

ANNUAL COMPLIANCE REPORT

Makakilo Quarry, Kapolei, Oahu, Hawaii

2022

Appendix L

Lighting Assessment Report, July 2022
(CUP Condition #4)

Lighting Assessment Report

for the

Makakilo Quarry

Kapolei, Hawaii

July 2022



Prepared For:

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Executive Summary

The current operations in Makakilo Quarry are restricted to day-time only. This lighting assessment is being done to identify the impacts of added illumination that will be necessary to support nighttime operations at the quarry. The results of this lighting assessment will be included in the entitlements for the quarry's application for expanded night time / 24-hour operations.

This assessment performed several illumination calculations and found that there will be no appreciable direct illumination or light being reflected off the exposed quarry walls. The calculations were based on the existing lighting and additional lighting being proposed at the Asphalt Batching Plant, Concrete Ready-Mix Plant, trailers, scales, and at the maintenance sheds.

The lighting from within the quarry will all be mounted below the perimeter berms which prevent any direct illumination from escaping the quarry. In addition, the distance from the light sources to the quarry walls, coupled with the dark color of the quarry walls, eliminate any appreciable light being reflected off the face of the quarry walls.

However, the following situations will have visual impacts to the surrounding areas due to nighttime operations.

1. Light Reflecting Off Rain (Remote Visible Impact)

Due to the quarry's elevation over the Kapolei area, light reflecting off light misting to moderate rain fall will cause a noticeable illumination over the quarry. The City & County of Honolulu recently converted 55,000 street lights to full cutoff LED lights which lessened the uplighting caused by their street lights. Therefore, the night sky is considerably darker than before, thereby making any light reflected off rain more noticeable. However, Makakilo experiences very low rain fall and the asphalt batching plant will cease operations during heavy rains so the visual impact of light reflecting off falling rain is remote.

2. Portable Generator Mounted Floodlights at the Asphalt Batching Plant (High Impact)

It was noted that the Asphalt Batching Plant had three portable generator lighting systems, of which one was being utilized during our site visit. There are four (4) unshielded white HID floodlights on each generator lighting system. Each light is aimable along the horizontal and vertical axis.

Based on the above mentioned findings, we provide the following recommends to minimize any impacts to the surrounding areas.

1. 3000K Light Sources (Recommendation – High)

The color of the light is very important in minimizing any perceived lighting impacts to the surrounding areas. Most people notice or object to very white lights at night when in

the context of light pollution. The color of white light and bluish white light is 5000 Kelvin (K) and above. The color of warmer yellower light is 3000 Kelvin and below. Since the major cause of any visible light emanating from the quarry will only be observed during a light misting to moderate rain fall, the contrast between the dark night sky and the light reflecting off the rain needs to be minimized. Although there will be no uplighting that will project light straight up into the night sky, the concrete batching plant has highly reflective concrete pavement that will reflect the area lighting upwards. The Asphalt Batching Plant may also have concrete pavement around that site when the ABP is relocated to the quarry from Kalaeloa. Hence, it is important to select light fixtures with color temperatures of 3000K to minimize the contrast of any light reflected upwards from the concrete pavements.

2. Full Cutoff Light Fixtures (Recommendation – High)

As mentioned previously, it is important to minimize any light that may be reflected off falling rain. To do this, all light fixtures should be of the full cutoff type which do not allow light to be distributed above the light fixture's horizontal plane. Hence, it is recommended that all existing light fixtures be replaced with full cutoff 3000K lights. It is especially important to replace any white colored floodlights.

3. Portable Generator Lighting Systems (Recommendation – High)

To minimize stray light from being directed upwards, each floodlight should be provided with add-on shielding and should be directed at a slightly downward angle. The color of the HID lamps should also be changed from the current 5,000K to 3,000K. Lastly, the generators should be located on the southern side of each work area so the floodlights will only be pointed in the north, east, and west direction, away from Kapolei.

Section 1 Introduction

1.1 Background

- a. Grace Pacific Corporation acquired Pacific Concrete and Rock in 1984 which included the Makakilo Quarry. Currently all work at the Makakilo Quarry is restricted to day-time hours only.
- b. External visual sight lines of the quarry's operations are blocked through the careful placement of berms which increase the elevations of the quarry's perimeter. The berms prevent visual observations of the quarry and the structures within the quarry. Natural vegetation usually covers any newly constructed berms within a year, which allow the berms to blend in with the surrounding hillside.
- c. Landscaping around office trailers also help to obscure the sight of some otherwise exposed trailers.

- d. The existing operations cause very little dust so dust clouds during any future nighttime operations is not expected to reflect any light coming from within the quarry.
- e. There are very limited existing lighting installations at the office trailers, maintenance sheds, and the concrete batching plant. All vehicles have headlights for driving between the illuminated areas and on roads without roadway illumination.

1.2 Purpose

- a. The purpose of this lighting assessment is to verify if the relocation of the Asphalt Batching Plant and the addition of any lighting, that is provided to support nighttime operations, will have any detrimental visual impacts to the surrounding properties.
- b. The results of this lighting assessment will be included in the entitlements submittal for the proposed nighttime operation request.

1.3 Scope of Work

- a. Review available record drawings.
- b. Conduct a non-intrusive field investigation to verify the types and locations of existing lighting installations.
- c. Meet with facility personnel to gain additional information on the anticipate nighttime operations.
- d. Perform an illumination calculation based on the existing lighting installations to create a baseline of how much light may be reflecting off the quarry walls and how much light may be escaping the quarry.
- e. Perform an illumination calculation based on the relocation and installation of the existing Asphalt Batching Plant that is currently located in Kalaeloa; adding full cutoff 3000K floodlights onto the existing Concrete Ready-Mix Plant; and adding full cutoff 3000K floodlights at the existing maintenance sheds.
- f. Provide a lighting assessment report with the findings of the calculations and recommendations to minimize any visual impacts of the added lighting.

Section 2 Existing Conditions

2.1 Quarry Observations

- a. The current operations in Makakilo Quarry are restricted to day-time only. Therefore, there are only very limited existing lighting installations at the office trailers, maintenance sheds, scales, and trailers at the Concrete Ready-Mix Plant.
- b. The existing lighting only provide localized illumination of key areas frequented by personnel during the early morning at the start of operations and the early evening at the end of operations.
- c. The existing lights mainly consist of non-cutoff wall packs at the office trailers and storage unit, small floodlights at the maintenance sheds and on a pole at the office trailers, and a medium sized post mounted HID floodlight at the end of one of the office trailers that is pointed towards the quarry.
- d. Lighting at the Concrete Ready-Mix Plant (CRMP) only consists of a single wall pack light fixture above the trailer office door. There are no floodlights that illuminate the area surrounding the CRMP. A storage container that is off on the Diamond Head side of the CRMP site also has a wall pack light fixture but the illumination from the light does not contribute to the lighting levels surrounding the CRMP.
- e. The highest part of the Concrete Ready-Mix Plant is well below the southern berm of the quarry so no part of the CRMP installation is visible for east Kapolei.
- f. The tallest structure/part of the Concrete Ready-Mix Plant includes a platform at the top which appears ideally suited for any new area lighting that may be required.
- g. The quarry has three wooden utility poles that are stored at the maintenance sheds for possible use for future area lighting at the maintenance sheds. Lights can be mounted onto the wooden poles provided that the proper mounting brackets are provided with the light fixtures.



Figure 1 – Concrete Ready-Mix Plant. The tallest part of the sturture appears ideally suited for the mounting of any additional area lighting.



Figure 2 – Quarry - Various light fixtues types. Clockwise from upper left: Office Trailer with wall pack lights; Office Trailer with large floodlight; trailer at Concrete Ready-Mix Plant; Storage Container at Concrete Ready-Mix Plant; Mini floodlights at Maintenance Sheds; and Wall Packs at Maintenance Sheds.

2.2 Asphalt Batching Plant Observations

- a. The Asphalt Batching Plant (ABP), which is currently located in Kalaeloa, is scheduled to be relocated to the Makakilo Quarry. The ABP has many exterior lights mounted on the various structures that provide localized illumination of specific areas. The existing illumination is not continuous within the ABP as there are many dark spots with very little or no illumination. The highest illumination level and greatest illumination coverage is provided by a portable generator lighting system which utilizes four (4) large HID floodlights. See figure 3.
- b. The light fixture types at the ABP are varied and consist of small to large floodlights; incandescent, fluorescent, fluorescent induction, high intensity discharge (HID), and LED lamps; warm colored (2500K) to white colored (5000K); and bare bulb, enclosed, and wraparound light fixtures. See Figure 4.
- c. There is a floodlight light on the tallest structure at the ABP which is at about the same height of the existing berm on the south side facing east Kapolei. Hence, this light may be visible from east Kapolei. The existing light is a non-shielded floodlight that is used to illuminate the upper work platform of the structure. See Figure 5.



Figure 3 – Asphalt Batching Plant - Portable generator lighting system (left); Area illuminated by the portable generator lighting system.



Figure 4 – Asphalt Batching Plant - Various light fixtures. Clockwise from upper left: Various floodlights on the operations building; bare bulb light fixtures; HID Floodlight (top) and fluroescent wraparound light fixtures at the QC lab; LED floodlights; LED floodlight; and fluroescent induction floodlights.

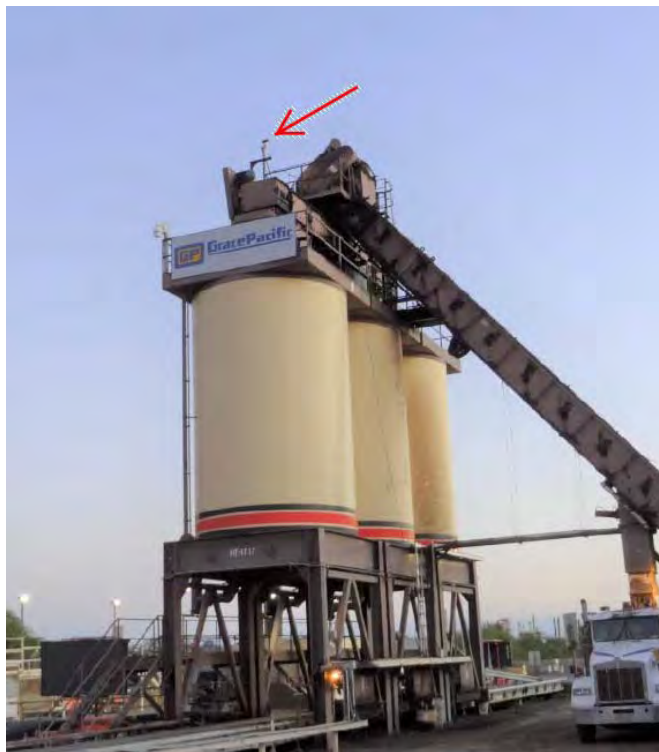


Figure 5 – Asphalt Batching Plant - Highest light on the highest structure may be visible from east Kapolei over the the quarry's southern berm.

Section 3 Analysis

3.1 Analysis

- a. Lighting calculations were performed by creating a lighting model that was based on the topographic survey of the entire quarry. See Figure 6. The existing light fixtures that are currently located at the quarry and at the Asphalt Batching Plant (ABP) in Kalaeloa were added to the model. Because information (manufacturer, model number, lumen output, distribution patterns, etc.) of the existing light fixtures were not available, a night time site visit was conducted to measure the lighting levels in order to estimate the performance of existing light fixtures. The initial lighting calculation was adjusted to match the measured lighting levels and serves as the baseline. See Figure 7.
- b. Once the lighting baseline was completed, the proposed additional lights were added to the calculation. See Figure 8. The additional lights included relocating the ABP to the quarry, adding four (4) full cutoff wide area lights at the Concrete Ready-Mix Plant (CRMP), and adding three (3) pole mounted full cutoff wide area lights at the maintenance sheds.
- c. The lighting calculations indicate that the areas surrounding the quarry would not be able to see any observable light being reflected off the quarry face.
- d. The layout of the ABP at the new quarry location does not include the QC lab building and the roof mounted floodlight or the ceiling mounted fluorescent wraparound light fixtures. The new ABP layout in the quarry does not include the QC lab so the QC lab was omitted.

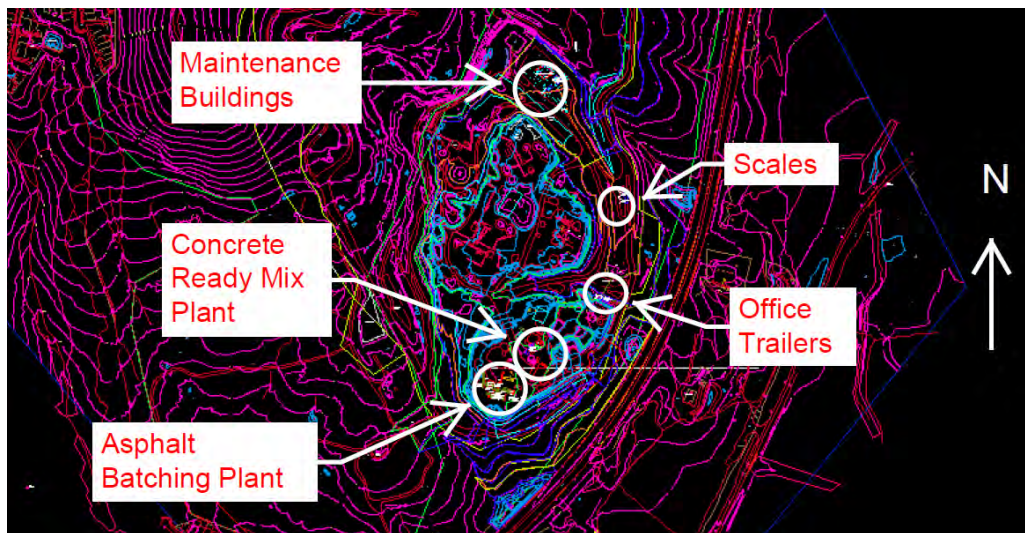


Figure 6 – Topographic survey used for the lighting calculations include the locations of the maintenance sheds; scales; office trailers; Concrete Ready-Mix Plant; and the Asphalt Batching Plant.



Figure 7 – Baseline Lighting Calculation (plan view) of the quarry. The illuminated areas include the maintenance sheds; scales; office trailers; and Concrete Ready-Mix Plant.

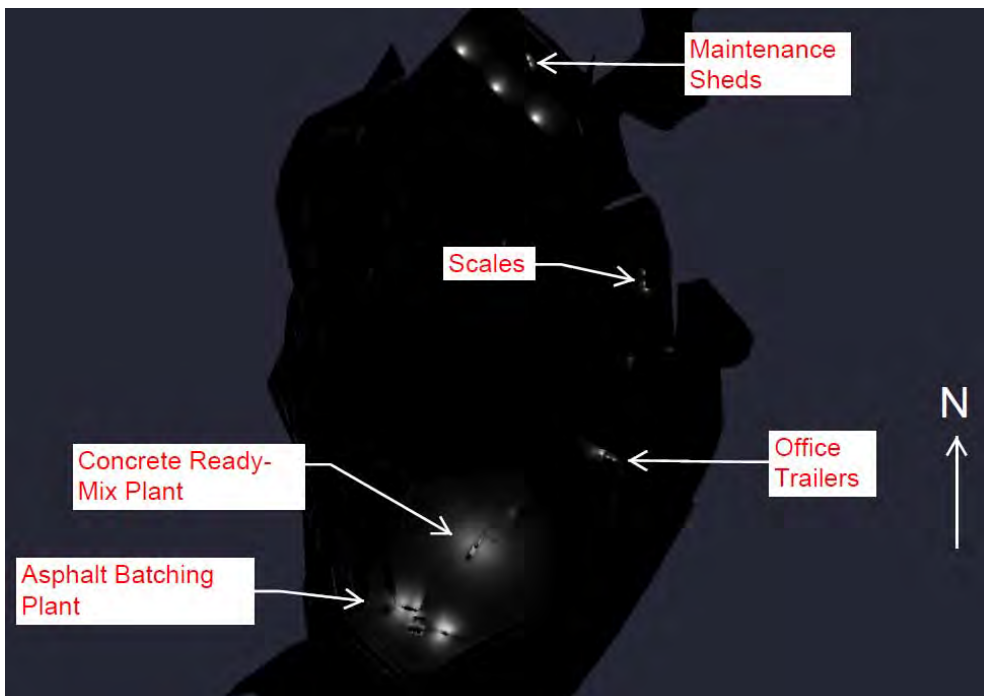


Figure 8 – Lighting calculation (plan view) of quarry with the additional lighting at the maintenance sheds; Concrete Ready-Mix Plant; and the relocated Asphalt Batching Plant.

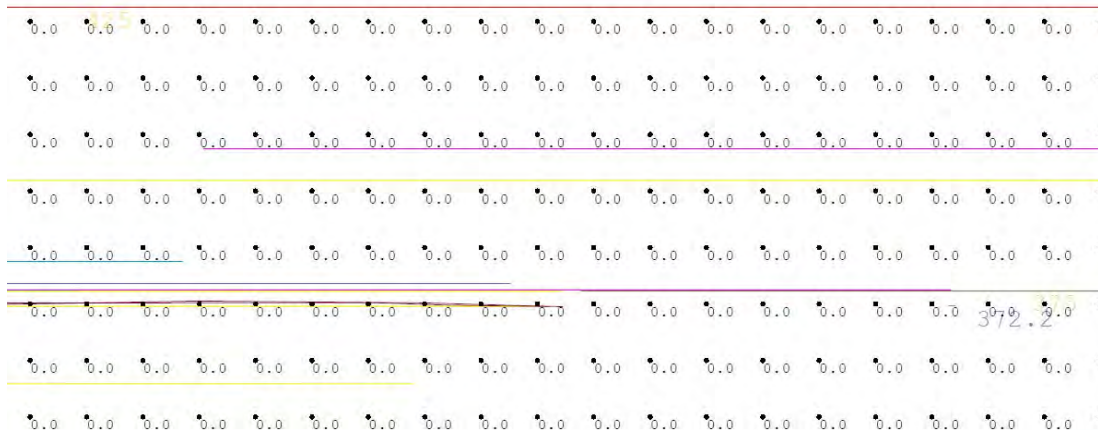


Figure 9 – Illumination calculation (Footcandles) of the north-western quarry face indicate there would be no observable light being reflected off the quarry face between an elevation of 350’ to 425’. Similar for higher elevations.

Section 4 Recommendations

4.1 Recommendations

The following recommendations are based on adding lights to illuminate key areas and to minimize visual impacts of the lighting system on the surrounding areas.

1. General Recommendations

Where possible, lights should be individually or group controlled to allow selective illumination of specific areas and to darken areas where lighting is not needed. The lighting controls should be located on the ground level to provide easy access to the controls. The lights should also be controlled with either a photocell or time switch to ensure the lights are only utilized during the night and are automatically turned off during the day.

Full cutoff LED type light fixtures should be provided for long life, energy efficiency, and instant “on” (whereas HID type light fixtures require several minutes to warm up). Full cutoff light fixtures do not allow light to be distributed above the light fixture’s horizontal plane, thereby minimizing light pollution.

The color of the lights should be selected to be no higher than 3000K. 3000K is a warmer color of light which will minimize the reflection off the exposed rock faces of the quarry’s north face and will allow any reflected light to blend in with the hill side.

3000K lights will also minimize the contrasts with the dark night sky when the light reflects off of light misting to moderate rain.

2. Concrete Ready-Mix Plant

The area surrounding the Concrete Ready-Mix Plant (CRMP) can be illuminated by adding four (4) full cutoff floodlights on the highest portion of the CRMP facility. Full cutoff light fixtures are defined as light fixtures that do not allow any direct illumination to be distributed above the horizontal plane (no up lighting).

In addition, all existing trailer mounted wall pack light fixtures should be replaced with full cutoff 3000K wall mounted light fixtures.

3. Asphalt Batching Plant

The ABP already has lighting in most of the required locations. However, portable generator lighting systems are used where additional lighting is required. The portable generator lighting systems utilize white floodlights which create a lot of light pollution. Therefore, it is recommended that new 3000K full cutoff light fixtures be provided on the ABP structures, where required, to allow the elimination of the portable generator lighting systems. If the portable generator lighting systems are to still be used, we recommend adding shields onto the existing light fixtures and replacing the existing 5000K HID lamps with 3000K HID lamps.

In addition, all existing structure mounted light fixtures should be replaced with full cutoff 3000K light fixtures.

4. Maintenance Sheds

Additional pole mounted full cutoff 3000K lighting can be added to cover selected high use areas and unloading areas.

In addition, all existing trailer mounted wall pack and floodlight fixtures should be replaced with full cutoff 3000K wall mounted light fixtures.

5. Office Trailers

The large pipe mounted floodlight and the two smaller flood lights, that are mounted on the utility pole, should be replaced with a full cutoff LED floodlights.

In addition, all existing trailer mounted wall pack and floodlight fixtures should be replaced with full cutoff 3000K wall mounted light fixtures.