Appendix A1: Lighting Study

Prepared by MD Acoustics

CEQ 220011

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January 21, 2022

Mr. Fred Nobles
Wintec Energy, LTD
2045 E.Tahquitz Canyon Way
Palm Springs, CA 92262

Subject: Nobles Solar Project – Lighting Study, County of Riverside, CA

Dear Mr. Nobles:

MD Acoustics, LLC (MD) has completed a lighting survey for the proposed Noble Solar Project located over the area encompassed by APNs 651-130-062 through -065, 651-140-039 through -042, and 651-140-017 through -025 in the County of Riverside, California. The Project proposes to develop the approximately 166-acre project site with a 400MW battery and 60-150MW solar facility connecting into SCE Mirage Substation. This letter report evaluates the projected light levels (foot-candles) and glare impact to the County's lighting general development standards (Title 8, Chapter 8.80). Appendix A contains lighting definitions.

1.0 Assessment Overview

MD conducted a site visit on 12/12/21 to evaluate the existing light conditions at the project site. MD utilized a LX1330B digital illuminance/light meter that can measure from 0 to 200,000 lux (0 to 18,580 foot-candles). The existing light conditions are compared to the requirements outlined by the County's Outdoor lighting code, Chapter 8.80.

Additionally, MD modeled the glaring impact using the ForgeSolar glare analysis tool based on the site configuration and project specifications available. The glare analysis is meant to estimate the project's influence over the nearby roadways and sensitive receptors.

Per the County of Riverside Western Coachella Valley Area Plan Land Use Plan the site has a current land use classification of Rural Residential. Land uses surrounding the site include vacant medium residential to the west, vacant rural residential to the north and east, and industrial to the south.

2.0 County of Riverside Lighting Requirements

Chapter 8.80 Outdoor Lighting outlines the following as it relates to minimum lighting requirements:

8.80.050 - Standard.

> All outdoor luminaries in shall be located, adequately shielded, and directed such that no direct light falls outside the parcel of origin, or onto the public right-of-way. Outdoor luminaries shall not blink, flash or rotate.

8.80.060 – Exemptions.

The following outdoor luminaries shall be exempt from the provisions of this chapter when properly installed and in compliance with all county ordinances.

A. Luminaries used or otherwise required by law enforcement or other emergency personnel.
B. Luminaries used to illuminate publicly-owned property, including but not limited to, parks, recreation areas, schools, street, street signs and sidewalks.
C. Luminaries used to illuminate authorized public and private monuments.
D. Luminaries authorized by a provision of state or federal law as long as that lighting conforms to the requirements of the state of federal law.
E. Luminaries used for holiday decorations.
F. Luminaries producing light directly by the combustion of fossil fuels (such as kerosene lanterns, and gas lamps).
G. Neon luminaries.
H. Luminaries used to illuminate agricultural activities, operations or facilities as defined in Section 5 of Riverside County Ordinance No. 625.

B. Security Lighting. Security lighting triggered by motion or noise shall be allowed subject to all the provisions this chapter.

Therefore, the project at minimum must provide sufficient lighting to suffice the exterior requirement while providing adequate shielding still.

3.0 Methodology and Approach

The glare analysis is modeled in the ForgeSolar tool. The software employs an interactive Google map where the photo-voltaic array coordinates are submitted, and it also includes the location of sensitive receptors or paths to be analyzed. All the positioning coordinates are used for sun position and vector calculations. Also, the information regarding the orientation and tilt of the PV panels, reflectance, environment, and ocular factors are entered by the user.

The ForgeSolar software provides an estimation of when and where glare will occur throughout the year, potential effects on the human eye, and annual energy production from the PV system. Calculations are based on Sandia National Laboratories photo-voltaic reflectance algorithm.

The PV panel modeled is the SF-7 bi-facial made by Soltec. The panels are estimated to be installed 8-foot above the ground, and they have a single-axis rotation to track the sunlight. In addition, the panel modules are modeled to be oriented facing south (heading 180 degrees)—finally, the panels were modeled without an anti-reflective coat to be conservative.

4.0 Evaluation and Findings

Some land uses are considered more sensitive to light than others, such as hotels, residential neighborhoods, and nursing homes. Although light may be observed by humans at 0.1 foot-candles, it would not make a substantial difference, especially if lighting is already present within the area of

introduction. For example, approximately 37.1 foot-candles would be generally acceptable for a reading area.

Thus, a significant impact would occur if sensitive land uses (such as residences) were exposed to a substantial increase in sources of light, if that level of light was not previously present. Similarly, mobile source lighting impacts would be significant if residential or other light sensitive uses are introduced to new light sources along roadways and driveways.

MD measured the lighting levels in foot-candles at spot locations along the perimeter of the project site (see Exhibit A), which considers the light from vehicles along Highway I-10, Ramon Road, and existing street lights at the residential area located at the western property line. The existing light levels measured between 0 to 0.3 foot-candles.

The preliminary lighting plan is not available at this time. Still, it is not expected to impact the existing lighting levels conditions since the project will utilize nighttime lighting for security purposes only.

At the corners of the project site, the level is 0.3 foot-candles. The level quickly drops to 0.1 foot-candles as going away from the property line. Currently, the land to the west is vacant and is zoned medium density residential. The property next to the adjacent vacant land is an existing medium residential development.

The nearest residences are located 230 feet to the project site's southwest corner (across Vista de Oro Road). The foot-candle readings at the closest residences would be 0.

The glare analysis showed no potential risk of glare to any roadways and sensitive receptors in the project site vicinity. As the glare analysis report shows, the project's photo-voltaic array would not contribute to substantial amounts of daytime glare. The glare model report is available in Appendix B.

5.0 Conclusions

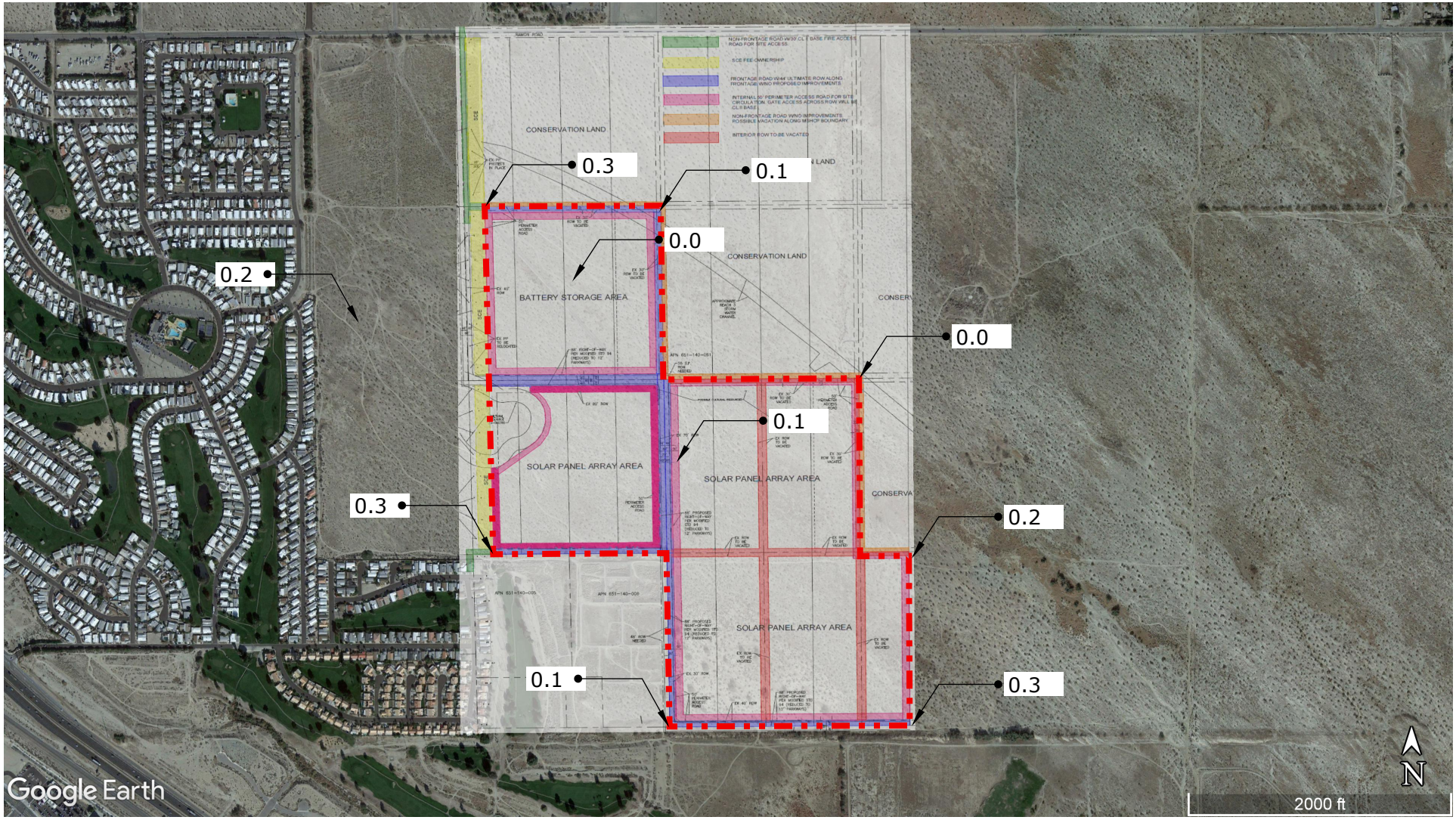
MD is pleased to provide this evaluation. If you have any questions regarding this analysis, please don't hesitate to call us at (805) 426-4477.

Sincerely,
MD Acoustics, LLC

Francisco Irarrazabal
Acoustical Consultant

Exhibit A

EXISTING LIGHTING LEVELS - NOBLES SOLAR LIGHTING
THOUSANDS PALMS RIVERSIDE COUNTY, CA.
(MEASUREMENT UNITS = FOOT CANDLE)
FOR ILLUSTRATIVE PURPOSES ONLY



Appendix A
Glossary of Lighting Terms

Glossary of Terms

Foot-Candle *is* a unit of illumination (now little used) equal to that given by a source of one candela at a distance of one foot (equivalent to one lumen per square foot or 10.764 lux).

Lumen *is* a measure of the total amount of visible light (to the human eye) from a lamp or light source. The higher the lumen rating the "brighter: the lamp will appear (Integral LED, 2015). This light, as low as 0.1 lumens is visible to the human eye, and the average household lightbulb (60 watts) emits approximately 800 lumens (at the source).

Lux *is* the SI unit of illuminance, equal to one lumen per square meter.

Appendix B
Glare Analysis Report

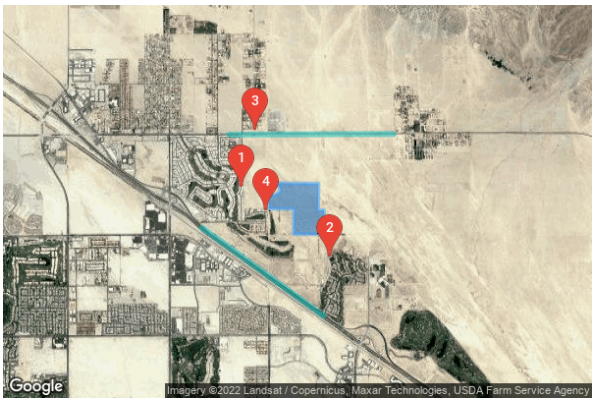
Nobles

Noble initial

Site description: Noble Solar Project

Created Jan. 17, 2022
Updated Jan. 21, 2022
Time-step 1 minute
Timezone offset UTC-8
Site ID 63800.11319

Project type Advanced
Project status: active
Category 500 kW to 1 MW



Misc. Analysis Settings

DNI: **varies (7,500.0 W/m^2 peak)**
Ocular transmission coefficient: **0.5**
Pupil diameter: **0.002 m**
Eye focal length: **0.017 m**
Sun subtended angle: **9.3 mrad**

Analysis Methodologies:
- Observation point: **Version 2**
- 2-Mile Flight Path: **Version 2**
- Route: **Version 2**

Summary of Results No glare predicted!

PV Name	Tilt	Orientation	"Green" Glare	"Yellow" Glare	Energy Produced
	deg	deg	min	min	kWh
PV array 1	SA tracking	SA tracking	0	0	455,300,000.0

Component Data

PV Array(s)

Total PV footprint area: 122.4 acres

Name: PV array 1
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 30.0 deg
Tracking axis panel offset: 4.0 deg
Maximum tracking angle: 60.0 deg
Resting angle: 60.0 deg
Footprint area: 122.4 acres
Rated power: 150000.0 kW
Panel material: Smooth glass without AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 6.55 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	33.802006	-116.366567	181.21	8.00	189.21
2	33.801997	-116.361256	176.28	8.00	184.28
3	33.805501	-116.361267	178.51	8.00	186.51
4	33.805510	-116.362297	177.05	8.00	185.05
5	33.809361	-116.362243	187.15	8.00	195.15
6	33.809397	-116.369871	182.63	8.00	190.63
7	33.808960	-116.369195	183.25	8.00	191.25
8	33.808559	-116.368884	182.10	8.00	190.10
9	33.808149	-116.368970	180.48	8.00	188.48
10	33.807801	-116.369657	182.12	8.00	190.12
11	33.807623	-116.370333	182.60	8.00	190.60
12	33.807382	-116.370901	183.20	8.00	191.20
13	33.805697	-116.370901	178.56	8.00	186.56
14	33.805670	-116.366513	177.30	8.00	185.30

Route Receptor(s)

Name: I-10
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	33.802921	-116.382583	198.48	8.00	206.48
2	33.790154	-116.361383	167.66	8.00	175.66

Name: Ramon Rd
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	33.816456	-116.377813	217.90	8.00	225.90
2	33.816563	-116.349103	208.95	8.00	216.95

Discrete Observation Receptors

Number	Latitude	Longitude	Ground elevation	Height above ground	Total Elevation
	deg	deg	ft	ft	ft
OP 1	33.808815	-116.375645	200.23	10.00	210.23
OP 2	33.798688	-116.360238	177.71	10.00	187.71
OP 3	33.817078	-116.373313	213.51	5.00	218.51
OP 4	33.805350	-116.371430	187.18	10.00	197.19

Summary of PV Glare Analysis

PV configuration and total predicted glare

PV Name	Tilt	Orientation	"Green" Glare	"Yellow" Glare	Energy Produced	Data File
	deg	deg	min	min	kWh	
PV array 1	SA tracking	SA tracking	0	0	455,300,000.0	

PV & Receptor Analysis Results

Results for each PV array and receptor

PV array 1 no glare found

Predicted energy output: 455,300,000.0 kWh (assuming sunny, clear skies)

Component	Green glare (min)	Yellow glare (min)
OP: OP 1	0	0
OP: OP 2	0	0
OP: OP 3	0	0
OP: OP 4	0	0
Route: I-10	0	0
Route: Ramon Rd	0	0

No glare found

Assumptions

- Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
- Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
- Detailed system geometry is not rigorously simulated.
- The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual values and results may vary.
- The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
- Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare.
- The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined ar of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
- Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
- Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
- Glare vector plots are simplified representations of analysis data. Actual glare emanations and results may differ.
- Refer to the **Help page** for detailed assumptions and limitations not listed here.