MONRAD ENGINEERING INC
CONSULTING ELECTRICAL ENGINEERS

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Principals:
Fernando Galvez, P.E., RCDD, CTM
Christian K. Monrad, P.E., FIES, LEED® AP

Lawrence E. Monrad, P.E., Emeritus

8 August 2023

Barbara Daoust
General Manager, First Service Residential
1171 E. Rancho Vistoso Blvd., #103
Oro Valley, AZ 85755

Re: Rancho Vistoso Street Lighting Repairs/Replacements – Board Memo

Barbara,
We present the following synopsis of our findings relative to the existing street lighting performance and recommendations for new LED street lighting luminaires to save energy, improve reliable light levels on the roadways and sidewalks, and to minimize stray light and glare into residential properties.

1. The existing induction lamp street lighting fixtures consume approximately 420 watts of power each and have very poor optical distribution, resulting in bright spots directly below the fixtures and dark spots in between the lights. The existing fixtures also have significant emissions to the rear of the poles away from the street, resulting in nuisance glare and light trespass into the residences. Aftermarket glare shields are in widespread use with limited success. Attachment A consists of a photometric model approximating existing conditions and graphically demonstrates these undesirable traits.
2. Attachments B, C, D, and E are representative photometric models of current LED street light offerings that utilize approximately 70% less energy than the existing induction fixtures while more evenly illuminating the roadway and greatly mitigating adverse effects upon the residences. The resulting light levels and uniformity ratios are consistent with nationally recognized recommendations for an intermediate collector roadway that I believe is applicable to Rancho Vistoso Boulevard in its present use. Attachment F consists of a table from the AASHTO Roadway Lighting Design Guide that outlines recommended lighting levels and uniformity ratios ('smoothness' of the lighting appearance). TEP incentive rebates are available for the LED conversion and are included in the cost estimates below.
3. A 'warm white' color temperature that is reminiscent of incandescent lamp quality is utilized in the demonstration project fixtures and is recommended for all of the new LED fixtures, as the 'stark white' color associated with the existing induction fixtures is known to have significant glare response and poor public acceptance.
4. Attachment G is a map of the roadway lighting throughout Rancho Vistoso indicating the four TEP metered electrical services, ownership of the roadway lighting segments, and known burnouts as documented by Mountain Power during their prior troubleshooting activities.
5. Attachment H consists of a Dimulator 'smart photocell' that may be installed on each fixture if there is a desire to dim the roadway lights after a certain time of night to reduce energy consumption and to moderate spill and trespass even further. This feature is currently being installed in the City of Riverside on 30,000 street lights. The City of Tucson uses this same strategy via a wireless networking system that is not warranted for your locale. We have assumed that these will be used and are included in the cost estimates below.
6. Mountain Power has confirmed that many pullboxes are filled with dirt and debris due to rodent activities. Rodents have also eaten away conductor insulation and have caused short circuits within several pullboxes. All pullboxes and cable splices warrant refurbishment.
7. All underground branch circuit wiring systems, pullbox splices, and TEP metered electrical services are nearly 40 years old, components are aged and in poor condition, and warrant replacement/refurbishment.

Conceptual present-day cost estimates for replacement of the lighting equipment, cabling, and refurbishment of electrical services and pullboxes are captured below:

Replace all wires within light poles and provide new LED street lights with Dimulator Smart Photocells	$ 225,000
Clean and refurbish all pullboxes	$ 25,000
Refurbish electrical services, four total	$ 30,000
Replace all branch circuit conductors and splices, utilizing No. 10 gauge cable	$ 320,000
Bidding Documents / Engineering Fees	$ 35,000
Total Conceptual Costs for holistic street lighting system modernization	$ 635,000

Annual TEP billing savings of $25,000 per year are estimated, based upon current billing rates.

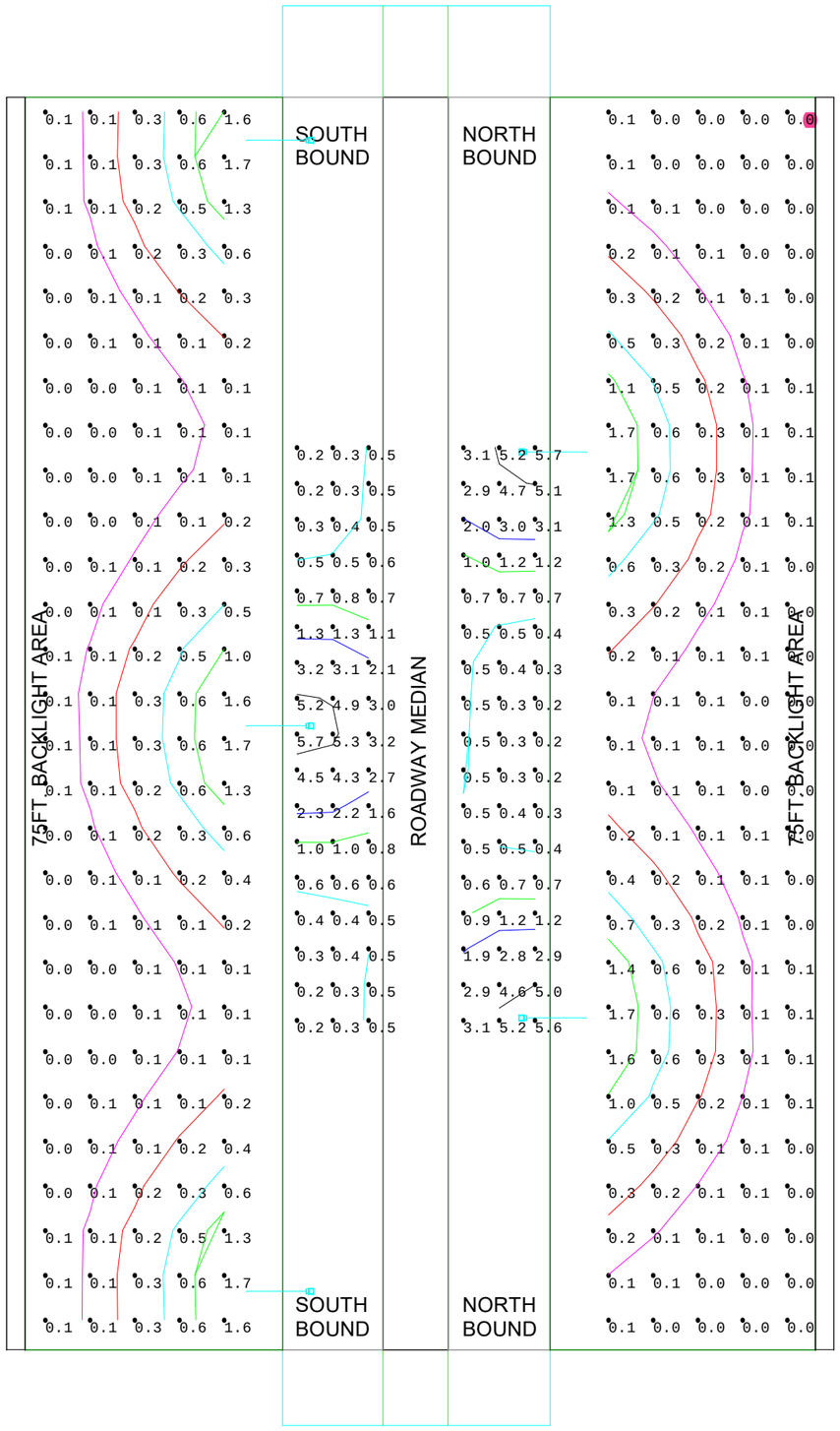
Alternatively, removal of all street lighting fixtures and poles may be considered with careful guidance by your Counsel. Abandonment of existing concrete foundations and pullboxes in place with a covering of crushed rock is recommended.

Estimated cost for removals and abandonment, per above $ 250,000

Please advise if additional information is required.

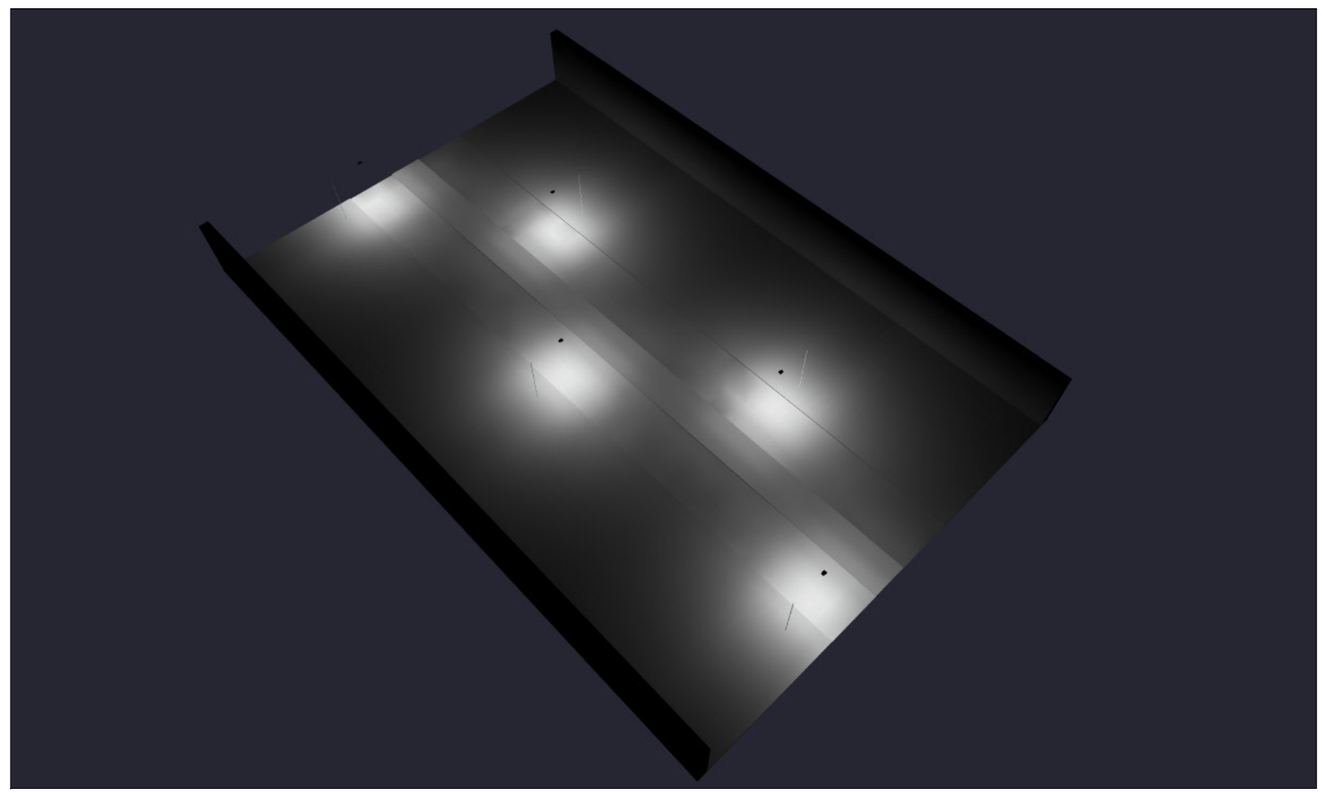
Very Truly Yours,

Christian K. Monrad P.E., LEED-AP, FIES



Calculation Summary							
Label	CalcType	Units	Avg	Max	Min	Avg/Min	Max/Min
North Bound Roadway	Illuminance	Fc	1.72	5.7	0.2	8.60	28.50
Northeast Backlight	Illuminance	Fc	0.22	1.7	0.0	N.A.	N.A.
South Bound Roadway	Illuminance	Fc	1.43	5.7	0.2	7.15	28.50
Southwest Backlight	Illuminance	Fc	0.26	1.7	0.0	N.A.	N.A.

ATTACHMENT A
EXISTING FIXTURE
POOR UNIFORMITY
EXCESSIVE SPILL



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07/07/2022

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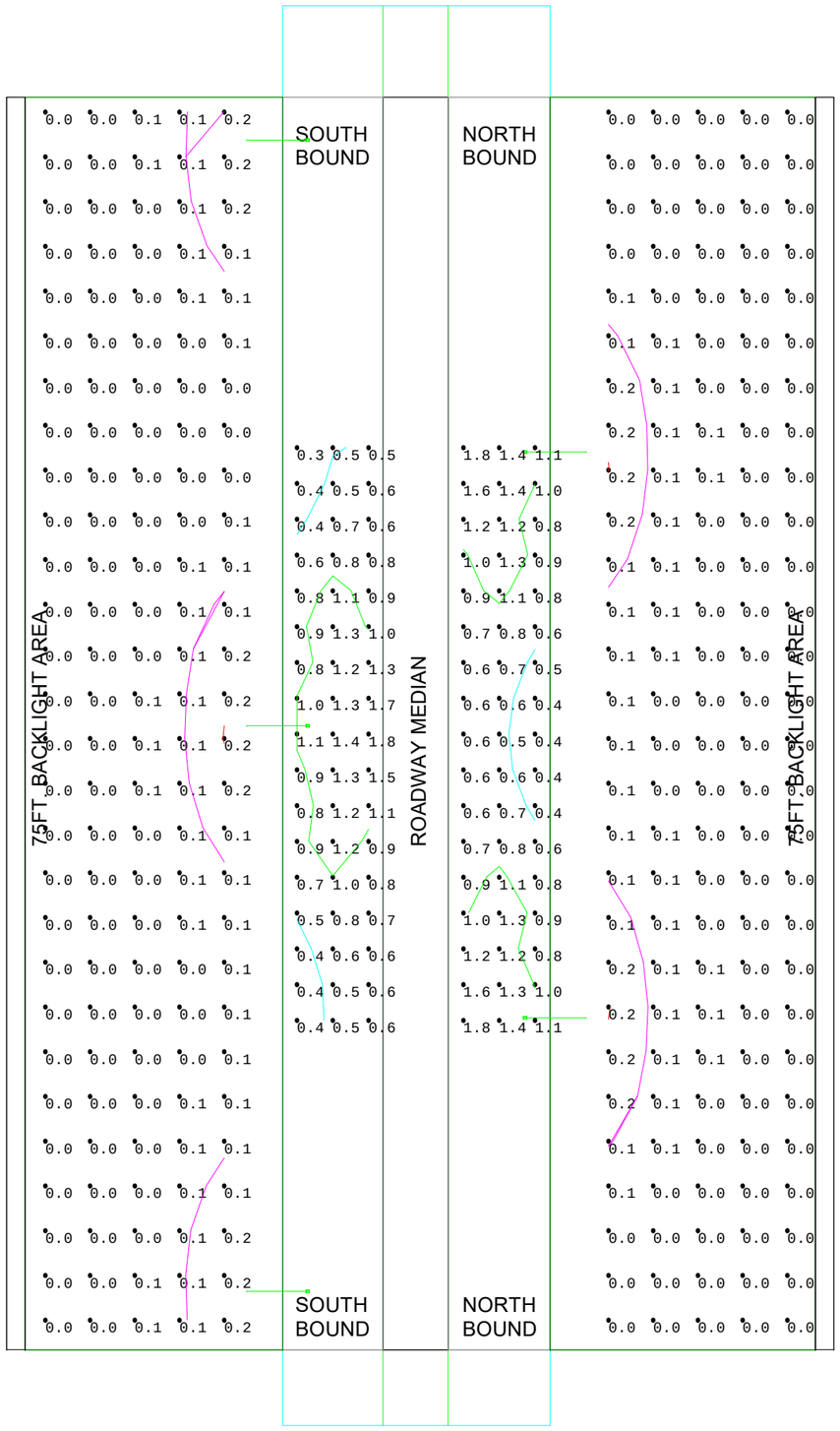
#	Date	Comments

Revisions

Drawn By: BB
Checked By: CM
Date:7/6/2022
Scale: AS NOTED

RANCHO VISTOSO STREET LIGHTING IMPROVEMENTS

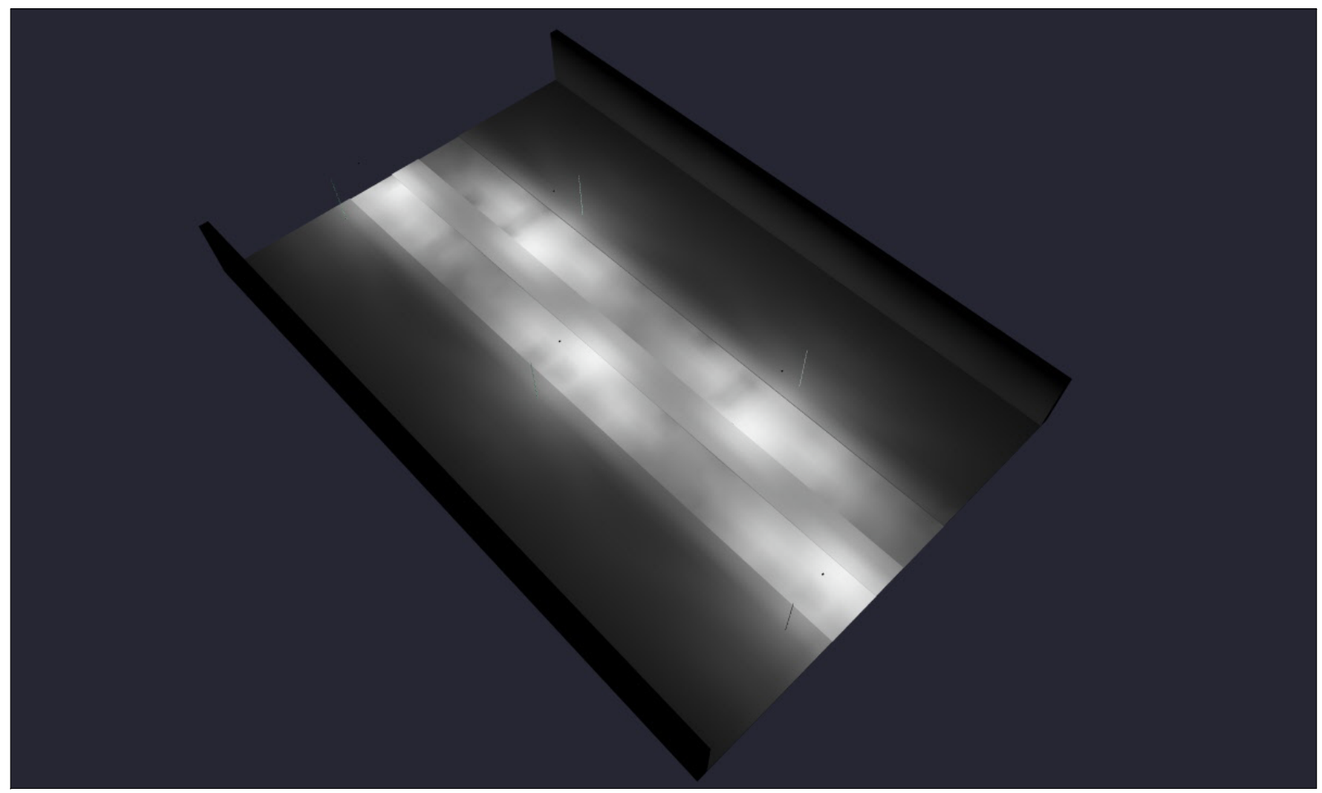
LIGHT FIXTURE: EXISTING



Calculation Summary							
Label	CalcType	Units	Avg	Max	Min	Avg/Min	Max/Min
North Bound Roadway	Illuminance	Fc	0.93	1.8	0.4	2.33	4.50
Northeast Backlight	Illuminance	Fc	0.04	0.2	0.0	N.A.	N.A.
South Bound Roadway	Illuminance	Fc	0.85	1.8	0.3	2.83	6.00
Southwest Backlight	Illuminance	Fc	0.04	0.2	0.0	N.A.	N.A.

ATTACHMENT B
ACUITY ATB0 FIXTURE

EXCELLENT UNIFORMITY
EXCELLENT SPILL CONTROL



ROADWAY RENDER - ATBO LIGHT FIXTURE

07/07/2022

MONRAD ENGINEERING INC
CONSULTING ELECTRICAL ENGINEERS

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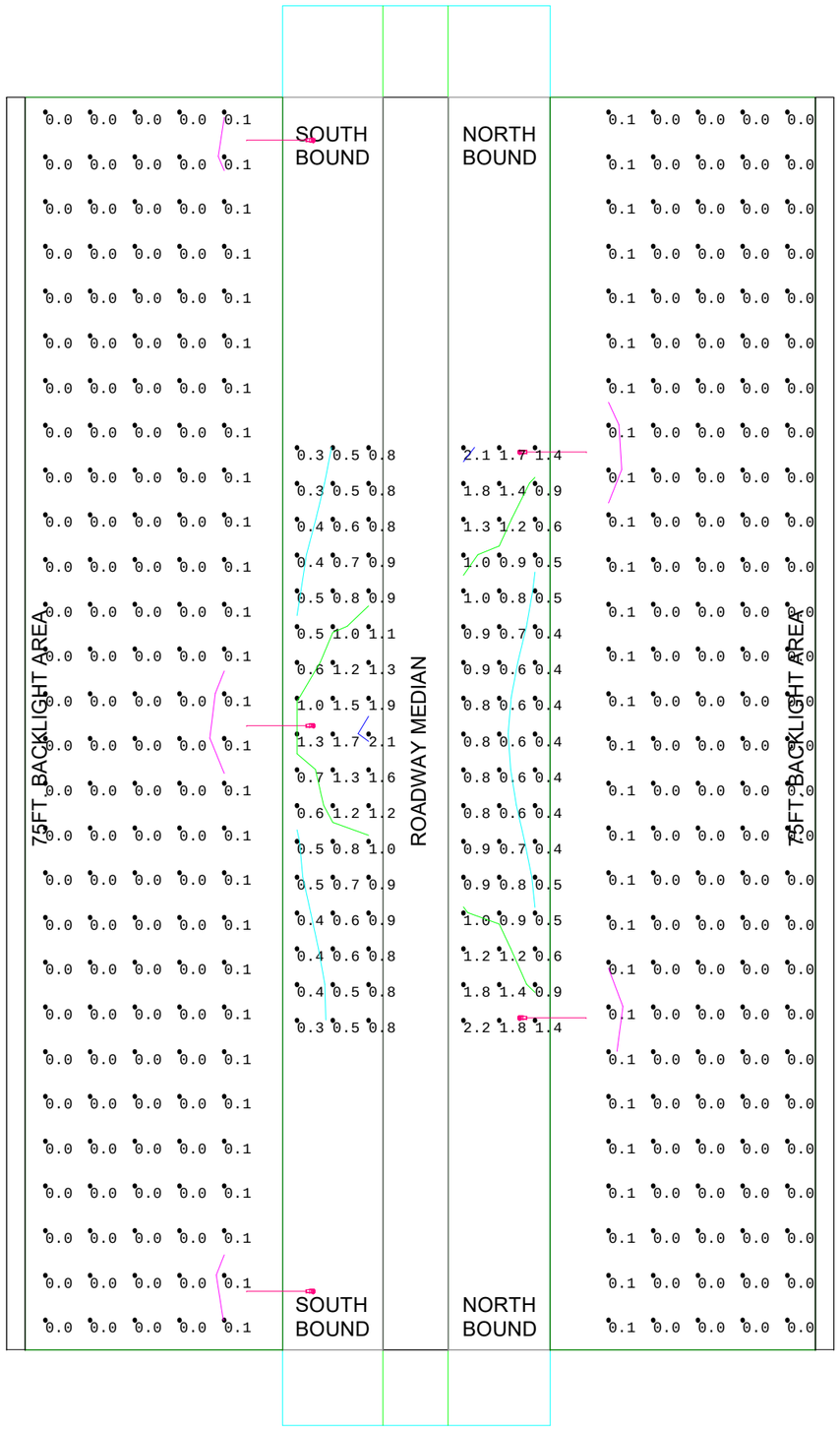
RANCHO VISTOSO STREET LIGHTING IMPROVEMENTS

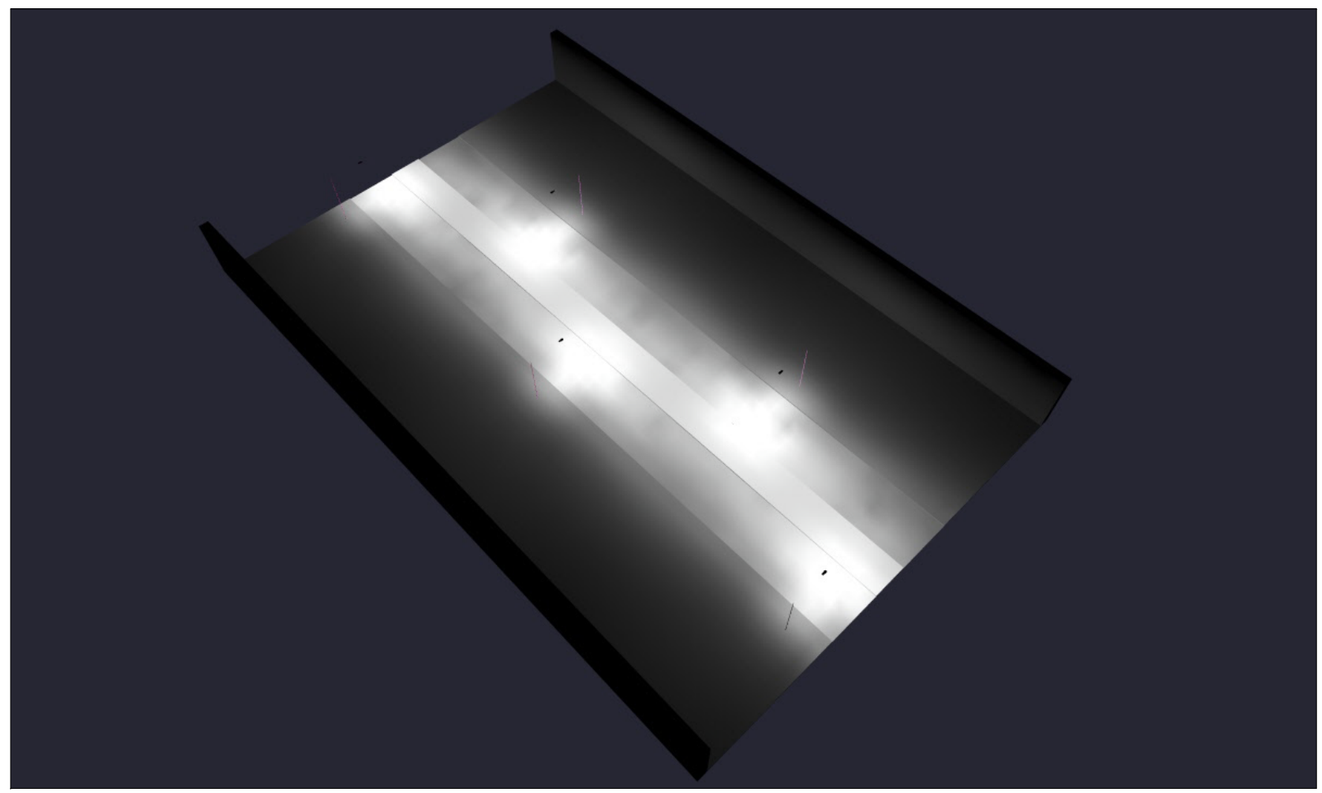
LIGHT FIXTURE: ATB0



Calculation Summary							
Label	CalcType	Units	Avg	Max	Min	Avg/Min	Max/Min
North Bound Roadway	Illuminance	Fc	0.93	2.2	0.4	2.33	5.50
Northeast Backlight	Illuminance	Fc	0.02	0.1	0.0	N.A.	N.A.
South Bound Roadway	Illuminance	Fc	0.83	2.1	0.3	2.77	7.00
Southwest Backlight	Illuminance	Fc	0.02	0.1	0.0	N.A.	N.A.

ATTACHMENT C
ACUITY ATBM FIXTURE

EXCELLENT UNIFORMITY
EXCELLENT SPILL CONTROL



ROADWAY RENDER - ATBM LIGHT FIXTURE

07/07/2022

MONRAD ENGINEERING INC
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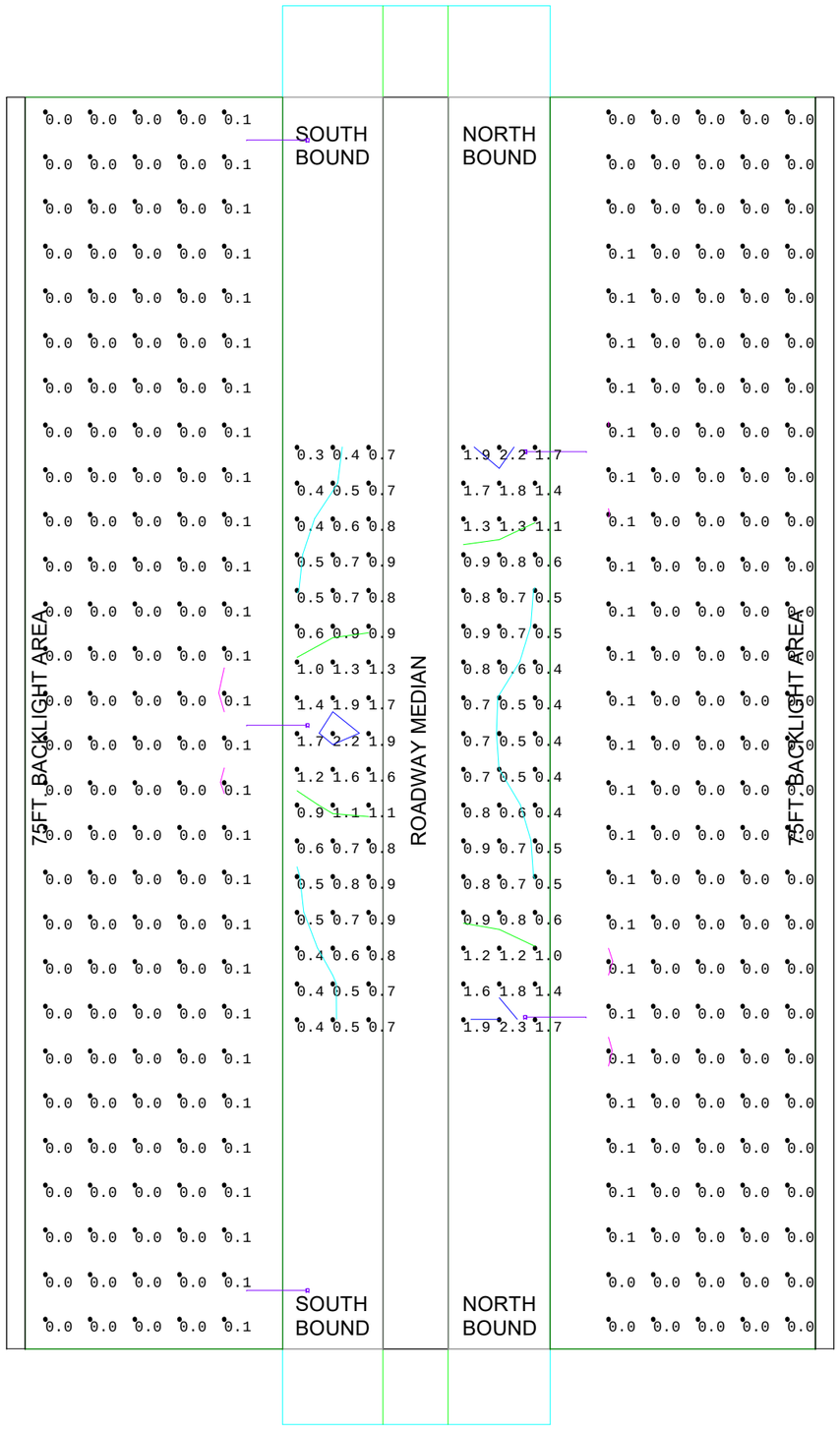
RANCHO VISTOSO STREET LIGHTING IMPROVEMENTS

LIGHT FIXTURE: ATBM



Calculation Summary							
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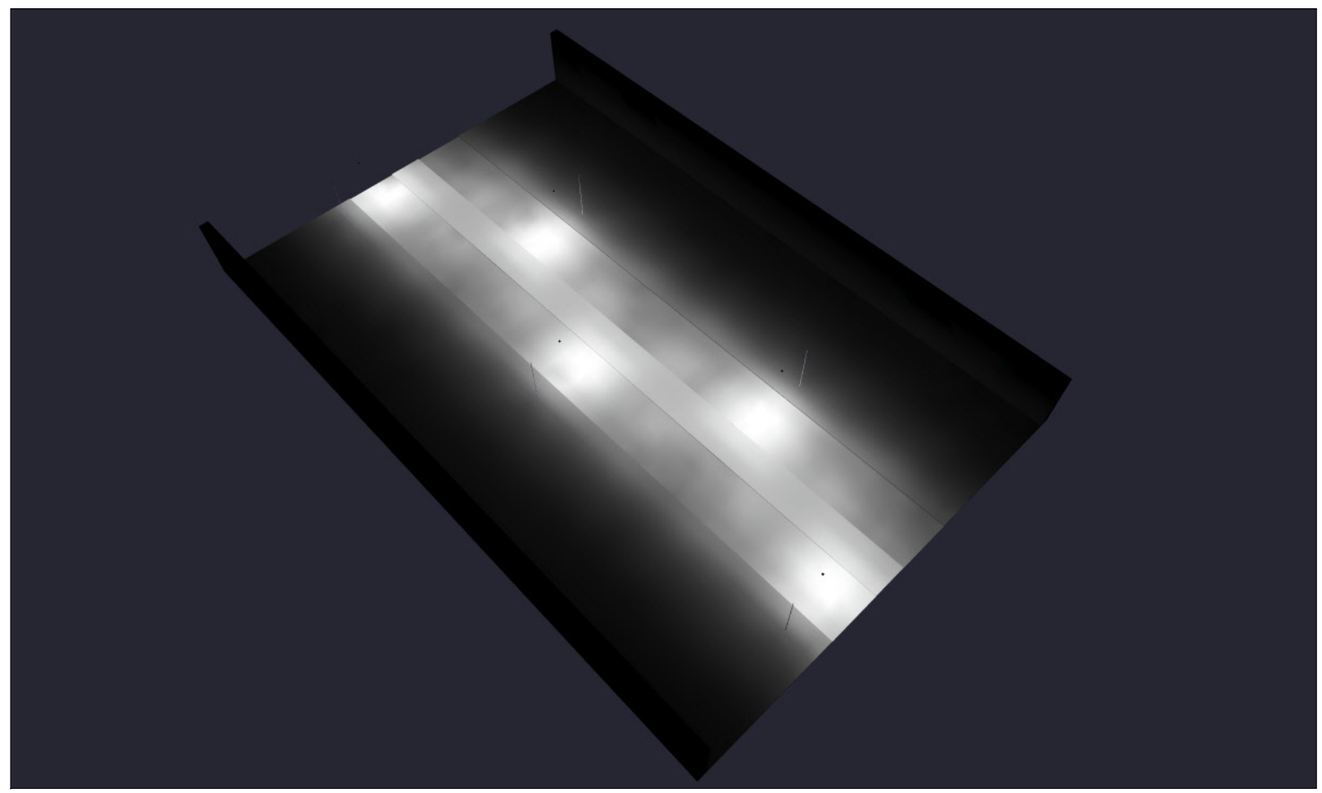
Northeast Backlight	Illuminance	Fc	0.02	0.1	0.0	N.A.	N.A.
South Bound Roadway	Illuminance	Fc	0.87	2.2	0.3	2.90	7.33
Southwest Backlight	Illuminance	Fc	0.02	0.1	0.0	N.A.	N.A.

ATTACHMENT D
GE CURRENT ERL2 FIXTURE

EXCELLENT UNIFORMITY
EXCELLENT SPILL CONTROL



ROADWAY RENDER - ERL2 LIGHT FIXTURE

07/07/2022

MONRAD ENGINEERING INC
CONSULTING ELECTRICAL ENGINEERS

#	Date	Comments

Revisions

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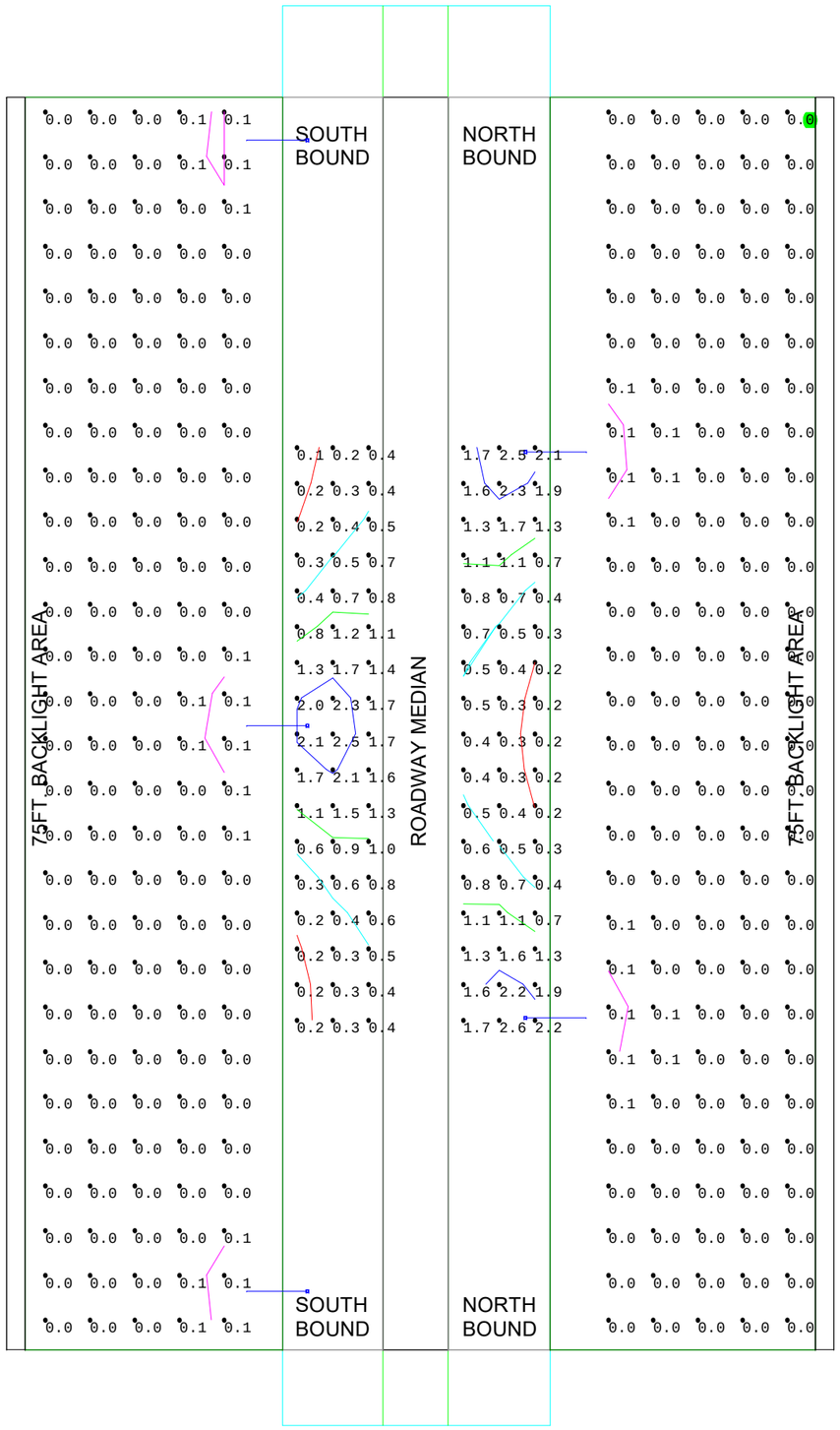
Scale: AS NOTED

RANCHO VISTOSO STREET LIGHTING IMPROVEMENTS

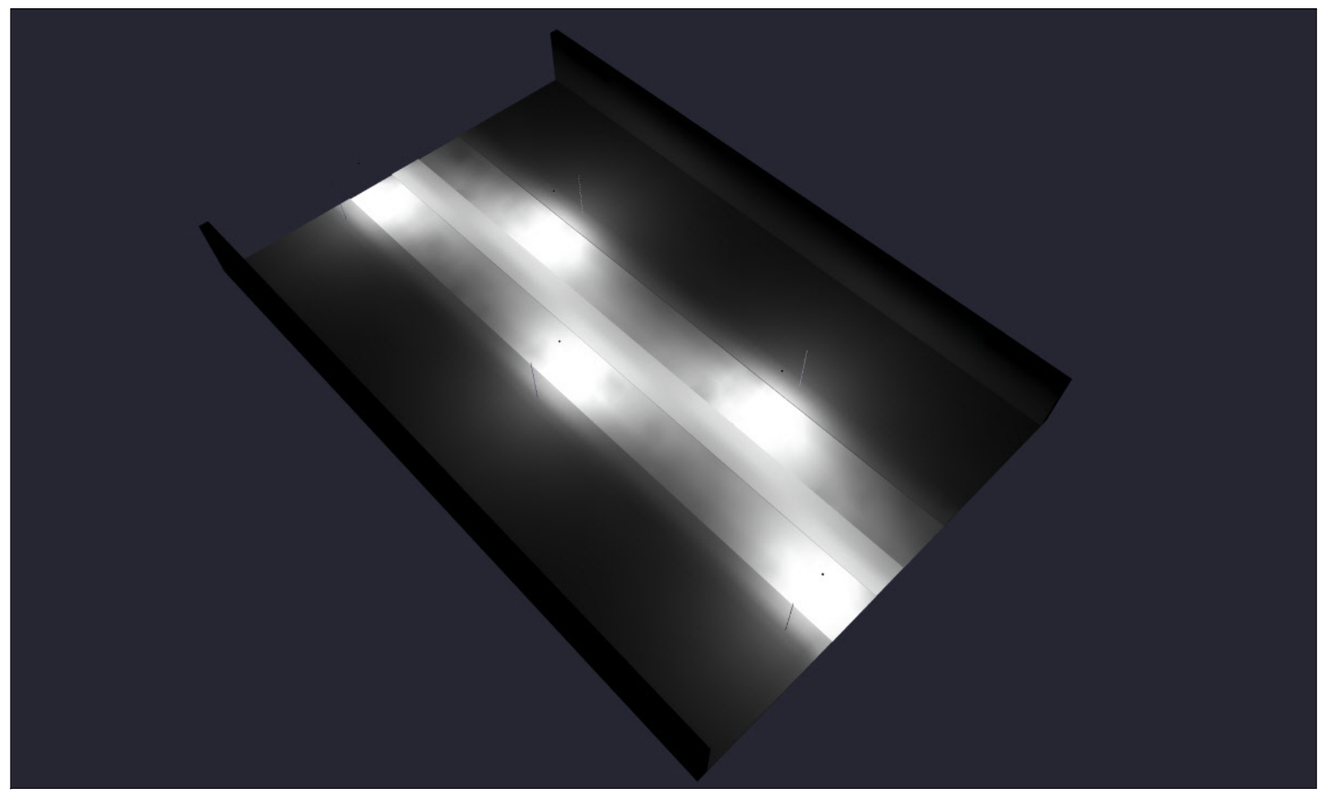
LIGHT FIXTURE: ERL2



Calculation Summary							
Label	CalcType	Units	Avg	Max	Min	Avg/Min	Max/Min
North Bound Roadway	Illuminance	Fc	0.99	2.6	0.2	4.95	13.00
Northeast Backlight	Illuminance	Fc	0.01	0.1	0.0	N.A.	N.A.
South Bound Roadway	Illuminance	Fc	0.85	2.5	0.1	8.50	25.00
Southwest Backlight	Illuminance	Fc	0.01	0.1	0.0	N.A.	N.A.

ATTACHMENT E
PHILIPS RFM FIXTURE

MARGINAL UNIFORMITY
EXCELLENT SPILL CONTROL



ROADWAY RENDER - RFM-7K-G2-R2S LIGHT FIXTURE

07/07/2022

MONRAD ENGINEERING INC
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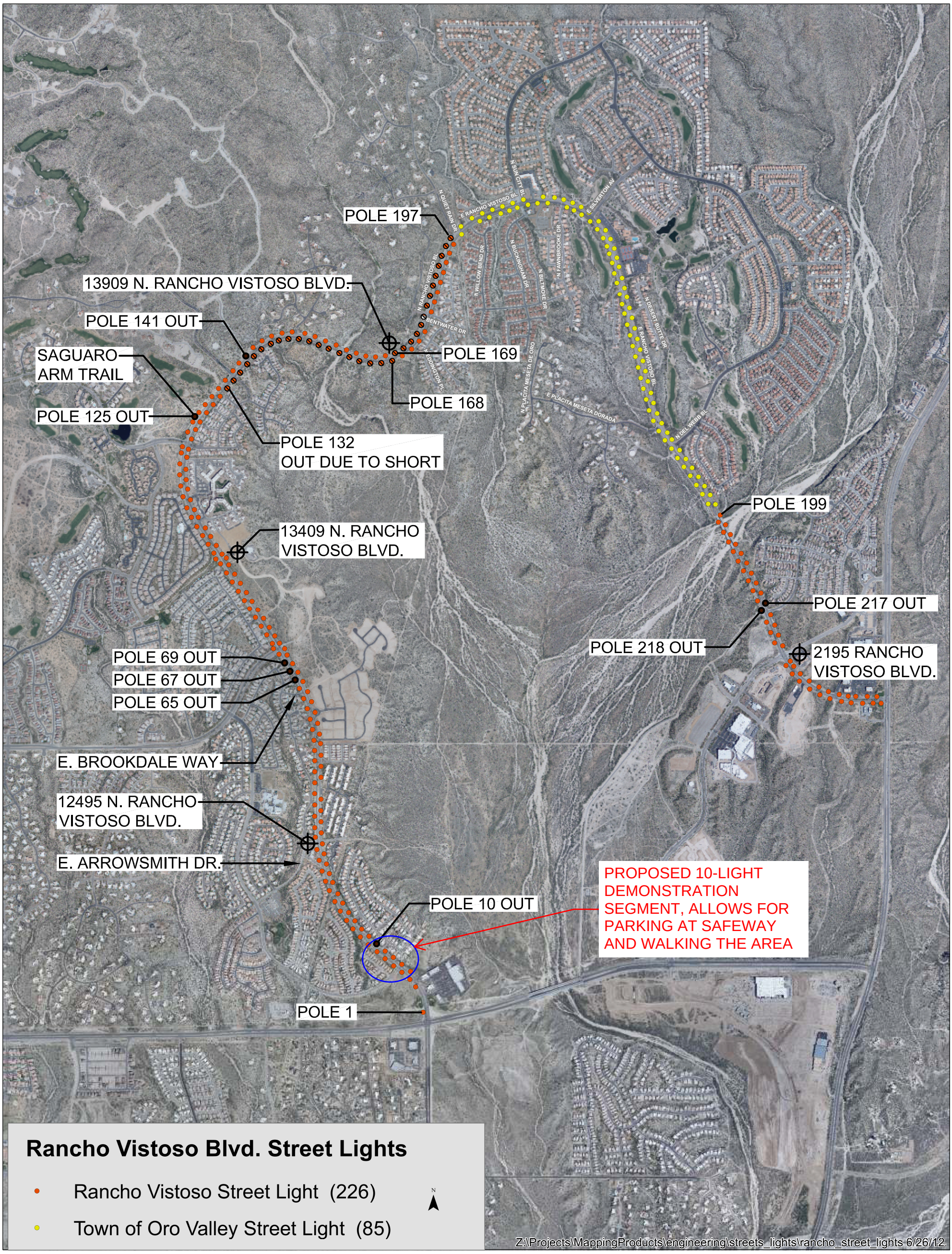
RANCHO VISTOSO STREET LIGHTING IMPROVEMENTS

LIGHT FIXTURE: RFM-7K-G2-R2S

ATTACHMENT F
AASHTO GL-7 TABLE

Roadway and Walkway Classification[a]	Area Classifications	Average Maintained Illuminance (E_{avg})				Minimum Illuminance E_{min}	Illuminance Uniformity Ratio E_{avg}/E_{min}	Average Maintained Luminance		
		R1	R2	R3	R4			L_{avg}	Uniformity	
	General Land Use	(footcandles) (min)	(footcandles) (min)	(footcandles) (min)	(footcandles) (min)	(footcandles)	Avg/min (max)[b]	cd/m² (min)	L_{avg}/L_{min} (min)	L_{max}/L_{min} (max)
Principal Arterials:										
Interstate and other freeways	All	0.6	0.6	0.6	0.6	0.2	4:1	0.4[d]	3.5:1	6:1
Other Principal Arterials (partial or no control of access)	Commercial	1.1	1.6	1.6	1.4	As uniformity rati	4:1	1.2	3:1	5:1
	Intermediate	0.8	1.2	1.2	1.0		4:1	0.9	3:1	5:1
	Residential	0.6	0.8	0.8	0.8		4:1	0.6	3.5:1	6:1
Minor Arterials	Commercial	0.9	1.4	1.4	1.0		4:1	1.2	3:1	5:1
	Intermediate	0.8	1.0	1.0	0.9		4:1	0.9	3:1	5:1
	Residential	0.5	0.7	0.7	0.7		4:1	0.6	3.5:1	6:1
Collectors	Commercial	0.8	1.1	1.1	0.9		4:1	0.8	3:1	5:1
	Intermediate	0.6	0.8	0.8	0.8		4:1	0.6	3.5:1	6:1
	Residential	0.4	0.6	0.6	0.5		4:1	0.4	4:1	8:1
Local	Commercial	0.6	0.8	0.8	0.8		6:1	0.6	6:1	10:1
	Intermediate	0.5	0.7	0.7	0.6		6:1	0.5	6:1	10:1

ATTACHMENT G



POLE IS OUT

POLE IS OUT DUE TO SHORT CIRCUIT IN UNDERGROUND CABLES

T.E.P. METER PEDESTAL / LIGHTING CONTROLLER

07/07/2022

FP Outdoor Lighting Controls
Quality Electrical Products

Sun - Tech
Sunrise Technologies, Inc.

Dimulator Stand-Alone Dimming Photocontrol

The Stand-Alone LED Dimming Solution

No Wireless Network Required

Simple, Easy to Deploy

- Saves power, saves money, quickly pays for itself
- Extends fixture life
- Advanced time/date algorithm auto-adjusts for daylight savings
- Just plug it in - will automatically synchronize to local time

Optional Features

- Factory preset dimming – no selector switch
- Constant all night dimming
- Adaptive lighting control with progressive intensities
- High voltage version for 312-530 VAC available

Bat Eye Technology

- Advanced light sensor, only reacts to sunlight
- Immune to LED and other artificial light
- No false activations (no cycling)
- May be oriented in any direction

ATTACHMENT H

Reduce Light Trespassing

with the Dimulator

ida DARK SKY APPROVED by the International Dark-Sky Association darksky.org

The information in this document is provided for informational use only and is subject to change without notice.

370 Paramount Drive, Raynham, MA 02767
Tel: 508-884-9732 • Fax: 508-802-6596
Email: info@fpolc.com

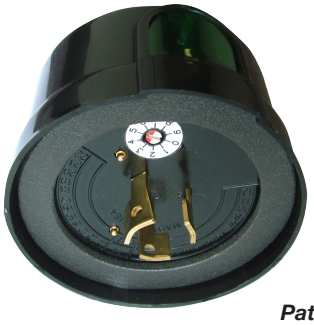
www.sun-tech.biz | www.fpolc.com

Doc: V082420.14

FP Outdoor Lighting Controls
Quality Electrical Products

Sun - Tech
Sunrise Technologies, Inc.

Dimulator Stand-Alone Dimming Photocontrol



Patent #9210746

Unsurpassed construction, electrical, process, and environmental protections make this **Dimming Control** the highest grade twistlock photocontrol on the market today.

The stand-alone unit is made to work with the **ANSI C136.41** receptacle and will provide dimming of LED fixtures.

ATTACHMENT H

Dimming Photocontrol Electrical Information

Load Rating	1,000W/1,800 VA	15 Amp relay tested to 15,000 operations on maximum available LED or Induction load
Operating Temperature	-40ºC to +70ºC	(-40ºF to +158Fº)
Surge Protection	40,000 Amps	1520 Joule MOV protection
Power Consumption	<0.5 Watts	@ 120 V
Dimming Circuit	0-10 VDC - Class 1	Must be used with Dimmable LED Fixture
Dielectric Strength	5,000 Volts	Between current carrying parts

Dimming Photocontrol Mechanical Data

Bat Eye Technology	Blind to artificial light	<0.5% Drift over 10 Years
Printed Circuit Board	Moisture Repellant Glass Epoxy	0.35 Maximum Moisture
Cover	Durable Polypropylene	Field Proven Optimal Solution for Ultra Long Life
Base	Polycarbonate 140ºC	UL94HB Flame Class Rating
Gasket	Neoprene	ASTM D 1056
Operating Light Levels	Turn-on: 1.5 FC, 1.5:1 Off/On Ration	+/- .25 FC, 3-5 Sec Turn-off Delay

Model Numbers

DIM4	105-305 VAC, 50/60 Hz with 10 position field adjustable selector switch
DIM4-HV	High Voltage 312-530 VAC, 50/60 Hz
DIM4-CD	Constant all-night Dimming
DIM4-CUL	120 VAC, 50/60 Hz, cUL certified version with grey cover
DIM4-ALC	Adaptive Lighting Control with 2% per year incremental increase to compensate for fixture aging
DIM3-XX	Factory set dimming schedule (10 position selector switch not available)

Note: All Dimulators (except for CD and DIM3 versions) have three selectable dimming levels (30%, 50%, 70%) with three different start times (10:00 pm, Midnight or 2:00 am) which are settable through the ten-position selector switch located on the bottom of the base. All dimming schedules will return to full brightness at 5:00 am.

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Email: info@fpolc.com

www.sun-tech.biz | www.fpolc.com

07/07/2022

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