Dewberry

LED Street Lighting

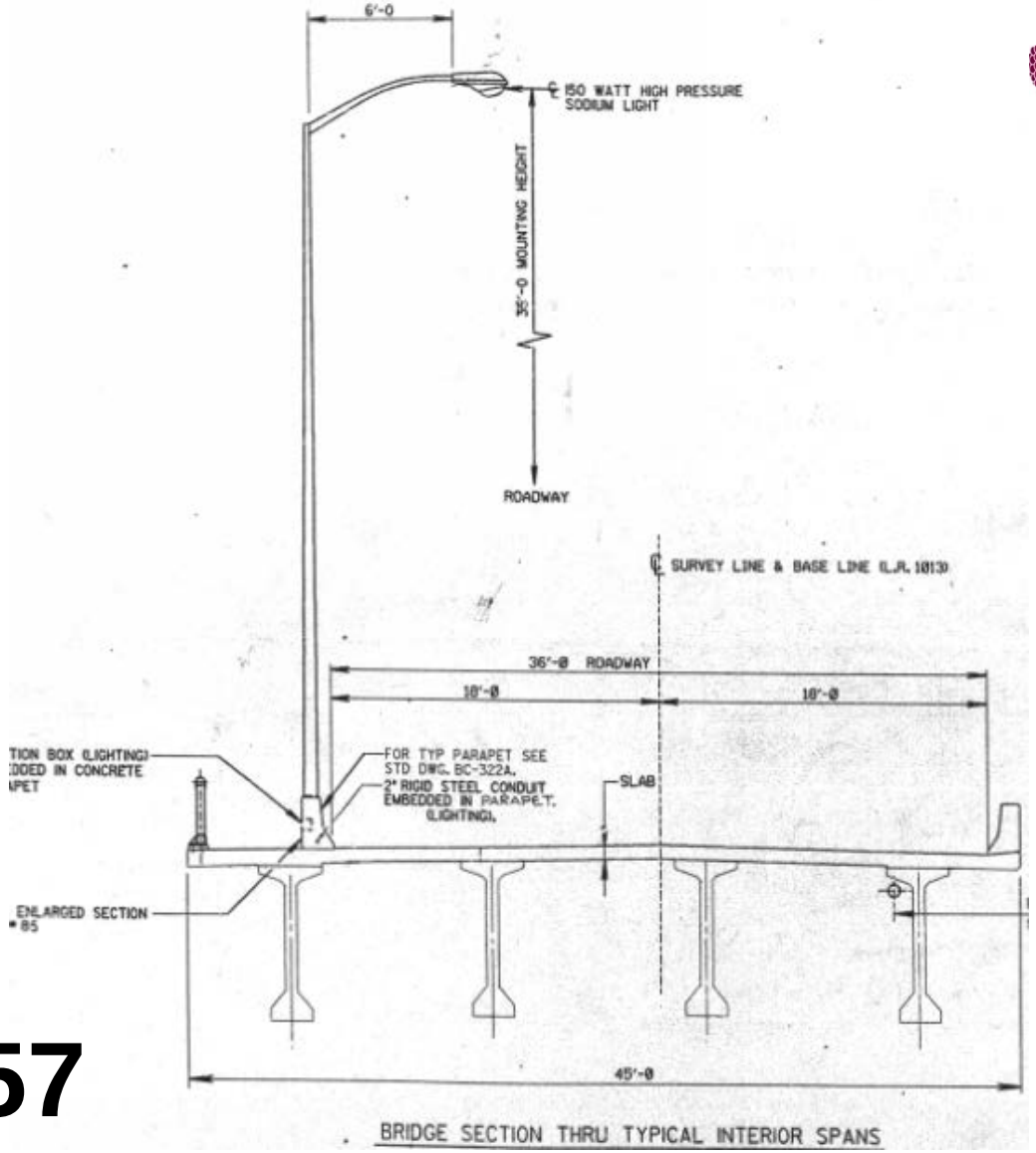
Why LED luminaire outperformed previous technology


SR-006
Old Route 6 Rd
2032
Merrill Pkwy
Main St
6

SR 6-057

Two-lane major arterial with lighting assemblies and sidewalk on one side

Dewberry



SR 6-057

Existing Lighting Assembly


Elizabeth St
Memorial Park Dr
2nd St
Olive St
Elliott St
Main St
Merrill Pkwy
6
1037
2034
3018
2032
2027
220
Rail Rd St
2024
1.1 mile
S Main St
T457
Bradford County Airport-N27

SR6-057

Photometric Design Criteria

PennDOT Ch. 5 (pub 13M 2015 Edition change #2) *Design lighting systems in accordance with the current AASHTO Roadway Lighting Design Guide to meet target light level requirements at ERL. Calculation summary must show average illuminance, minimum illuminance, average to minimum uniformity ratio, and veiling luminance ratio.*

DESIGN PARAMETERS

Bridge (Major/Local – Low Pedestrians)

Average maintained foot-candles at ERL – Bridge……. 0.60

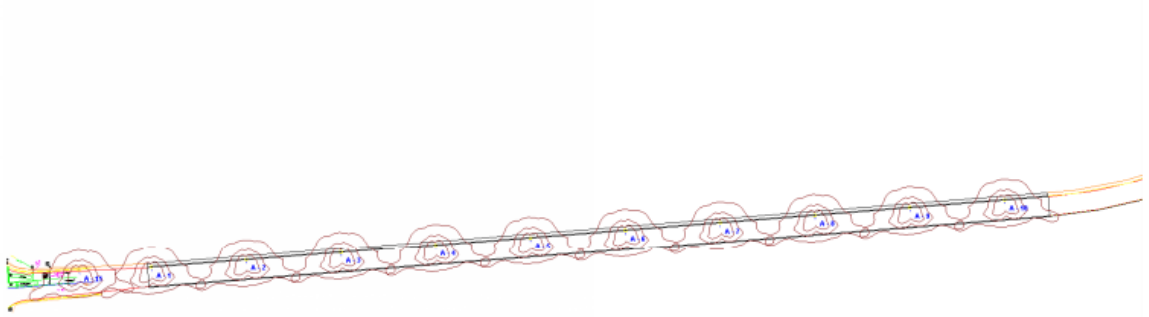
Dirt……0.80

Uniformity Ratio……3:1 maximum

Glare Ratio……0.3:1 maximum

Critical Outdoor Lighting Issues

- Illumination for Safety and Security
- Glare
- Light Trespass
- Urban Sky Glow
- Spectral Effects
- Initial System Cost
- Life Cycle System Cost



Luminaire Schedule

Quantity	Manufacturer	Catalog Number	Description	Filename	Lumens Per Lamp	Light Loss Factor
11	GE LIGHTING SOLUTIONS www.gelightingsolutions.com	M_CL15S____FMC2	M-150 HPS CUTOFF	ge450391_tcm201-62614.ies	16000	0.64

SR 0006-057 (150 WATT HIGH PRESSURE SODIUM FIXTURE AT EXISTING POLE LOCATIONS)

Statistics

Description	Symbol	Avg	Min	Avg/Min
Bridge with Sidewalk	+	0.60 fc	0.20 fc	3.0:1

LIGHTING ANALYSIS FOR SR006-057
TOWANDA BOROUGH, BRADFORD COUNTY, PA

Designer
ZK/AZ
Date
2/17/2017
Scale
Not to Scale
Drawing No.

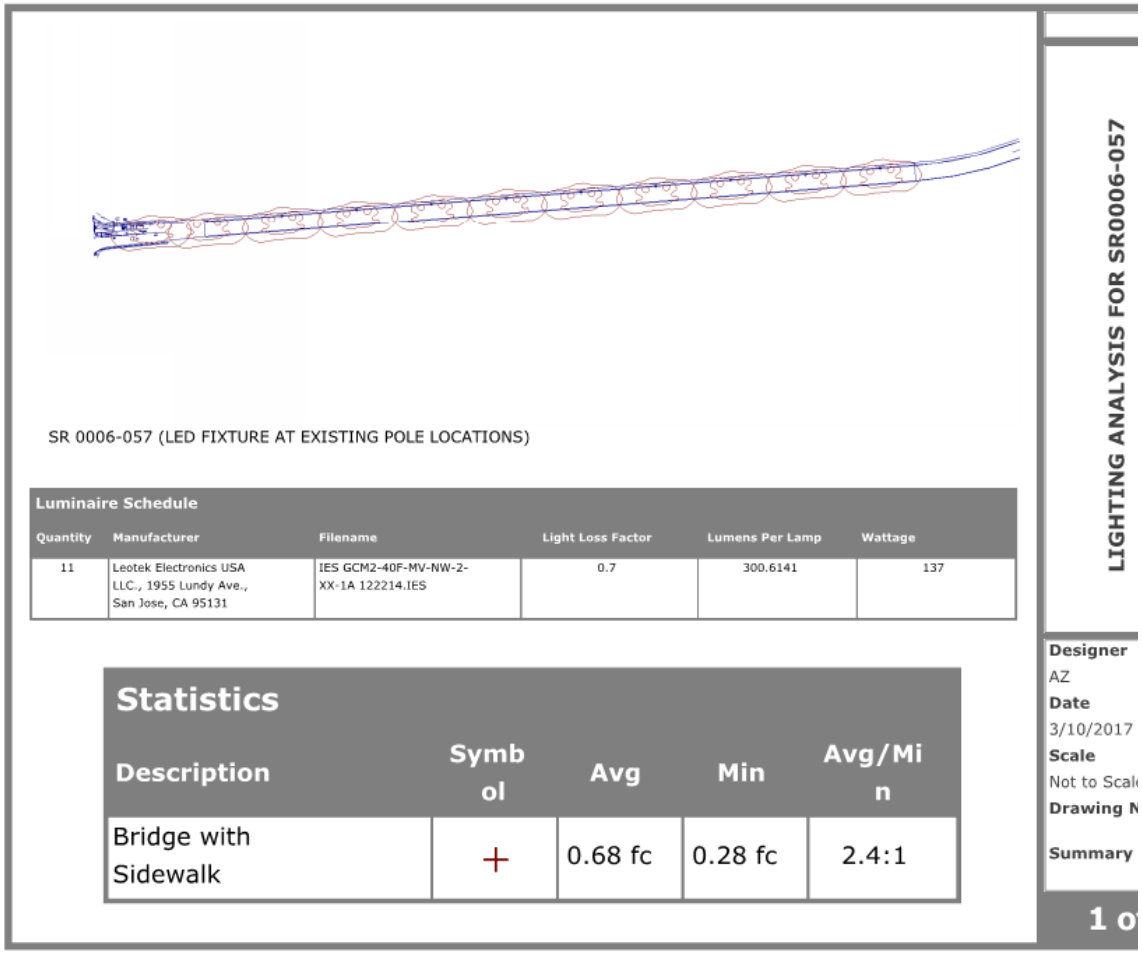
Summary

1 of 1

Dewberry

SR6-057

Photometric Statistics for HPS fixture



SR 0006-057 (LED FIXTURE AT EXISTING POLE LOCATIONS)

Luminaire Schedule

Quantity	Manufacturer	Filename	Light Loss Factor	Lumens Per Lamp	Wattage
11	Leotek Electronics USA LLC., 1955 Lundy Ave., San Jose, CA 95131	IES GCM2-40F-MV-NW-2-XX-1A 122214.IES	0.7	300.6141	137

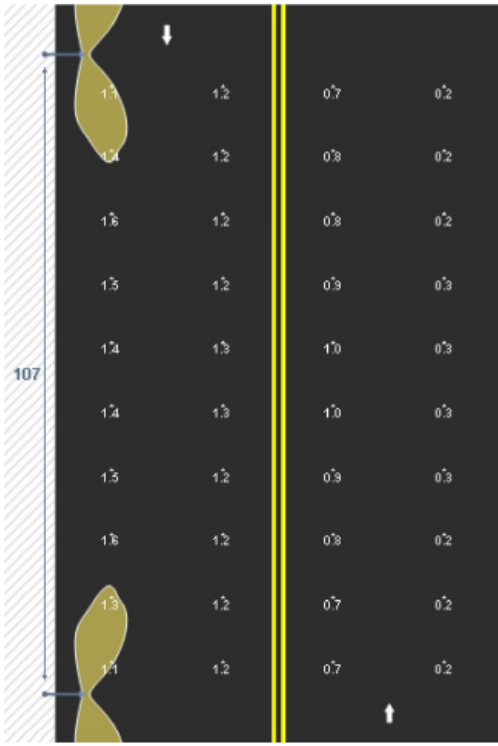
Statistics

Description	Symbol	Avg	Min	Avg/Min
Bridge with Sidewalk	+	0.68 fc	0.28 fc	2.4:1

LIGHTING ANALYSIS FOR SR0006-057

Designer
AZ
Date
3/10/2017
Scale
Not to Scale
Drawing No.
Summary

1 of



Luminance

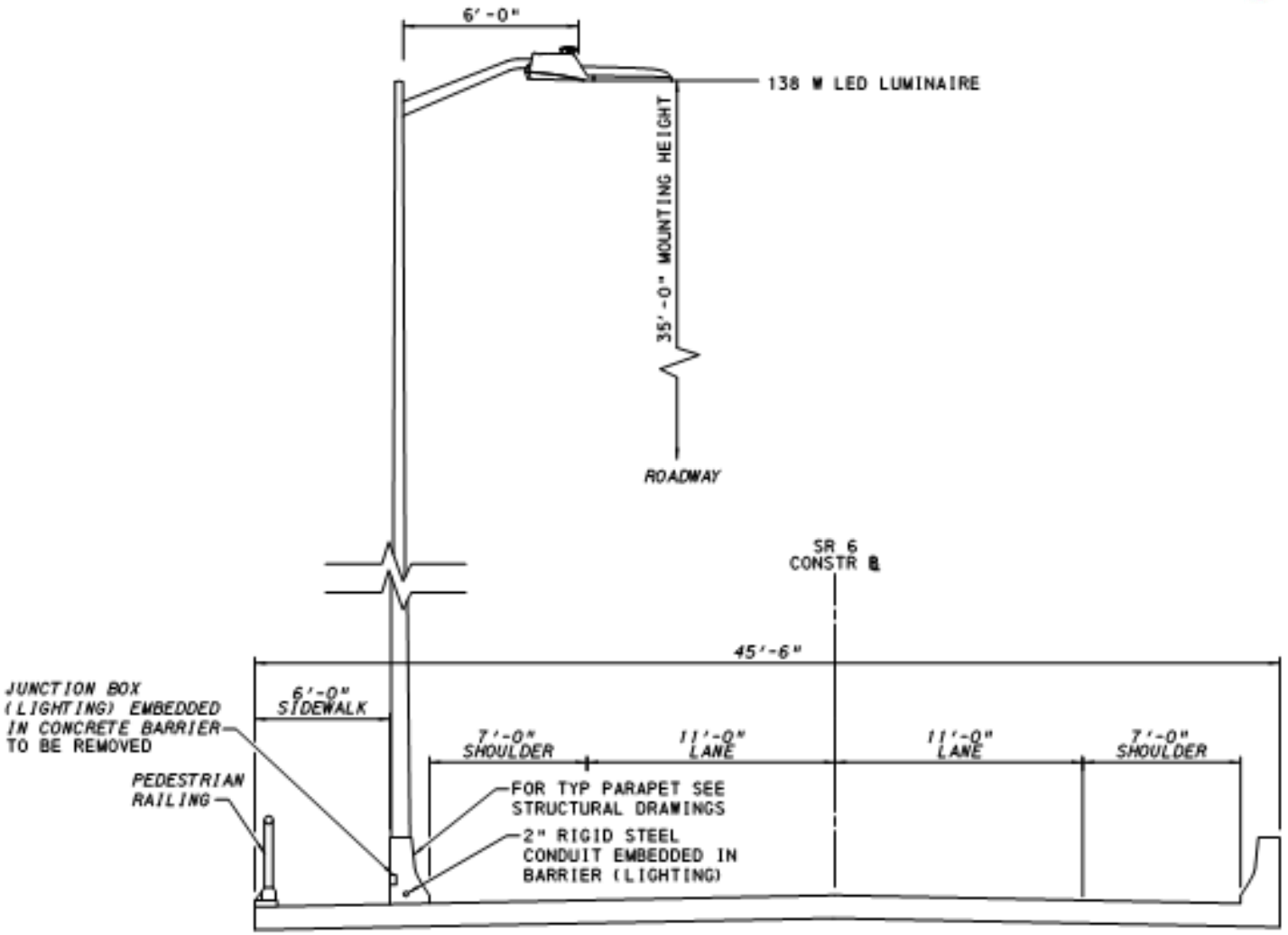
Calculation Results

Luminance	Left	Right		Illuminance	Left	Right		Sidewalk
Average:	1.3	0.6	cd/m²	Average:	1.2	0.5	fc	Average:
Max:	1.7	1	cd/m²	Max:	1.4	0.9	fc	Min
Min	1.1	0.2	cd/m²	Min	1	0.2	fc	Ave/Min:
Ave/Min:	1.2	2.5		Ave/Min:	1.2	2.7		Ev Min:
Max/Min:	1.5	4.6		Max/Min:	1.4	4.7		Bikelane
Lv Ratio:	0.1	0.1						Average:
STV:	1.2	0.9						Min
								Ave/Min:
								Ev Min:

glare ratio

SR6-057

Photometric Statistics for HPS fixture



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Proposed Lighting Assembly

SR 6-057

FHWA Life Cycle Cost Analysis (LCCA) Guidelines

- The FHWA Offices should not prescribe the forms of LCCA that a State Dept. must undertake.
- They should ensure LCCA are consistent with the established fundamental principles of good/best practice.
- LCCA best practice have sufficiently long analysis periods to reflect long term cost differences associated with investment alternatives.
- They should include evaluation of significance overall cost differences between competing alternatives, particularly when the difference are relatively small.
- This improves the credibility of the analysis by quantifying, to the maximum extent possible, the probability that the predicted life-cycle costs will actually occur.

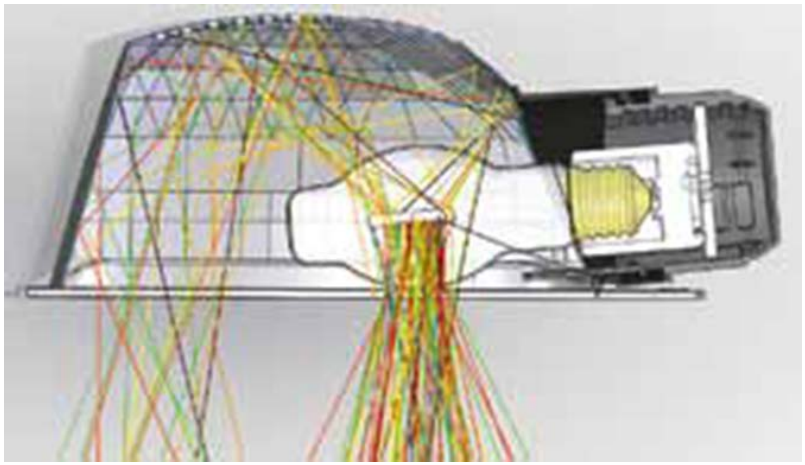
SR 6-057

Life Cycle Cost Analysis

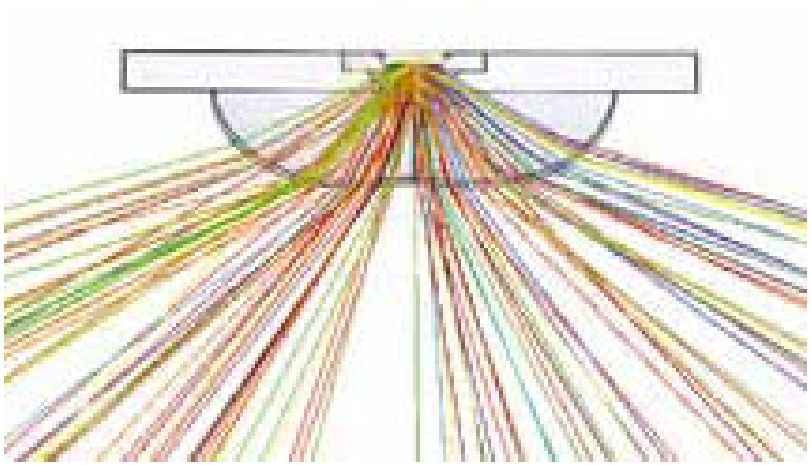
TOWANDA BRIDGE (SR-0006) LIGHTING LIFE CYCLE COST ANALYSIS, BRADFORD COUNTY PA			
	150 WATTS HIGH PRESSURE SODIUM (HPS) CUT OFF OPTICS	**138 WATTS LED COBRA MIDSIZE GCM F-SERIES**	**COMMENT**
RATING	150 WATTS/FIXTURE (LAMP+BALLAST)	138 WATTS/FIXTURE	
COST	$200	$190	
LAMP LIFE (HRS)	24,000	100,000	
REPLACEMENT COST ($)/LAMP LIFE OVER 60,000 HRS	700	270	Assume labor cost of $80/replacement. Assume LED replacement once.
ENERGY CONSUMPTION OVER 60,000 HOURS (kWH)	9000	8280	
ENERGY COST PER KWH	$0.084	$0.084	
COST OF ELECTRICITY NEEDED FOR 60,000 HOURS	$753.30	$693.04	
TOTAL LIFE CYCLE COST TO OWN AND OPERATE FOR 60,000 HOURS	**$1,653.30**	**$1,153.04**	

Note: Assume 60,000 hours for 20 years at 3000 hours per year

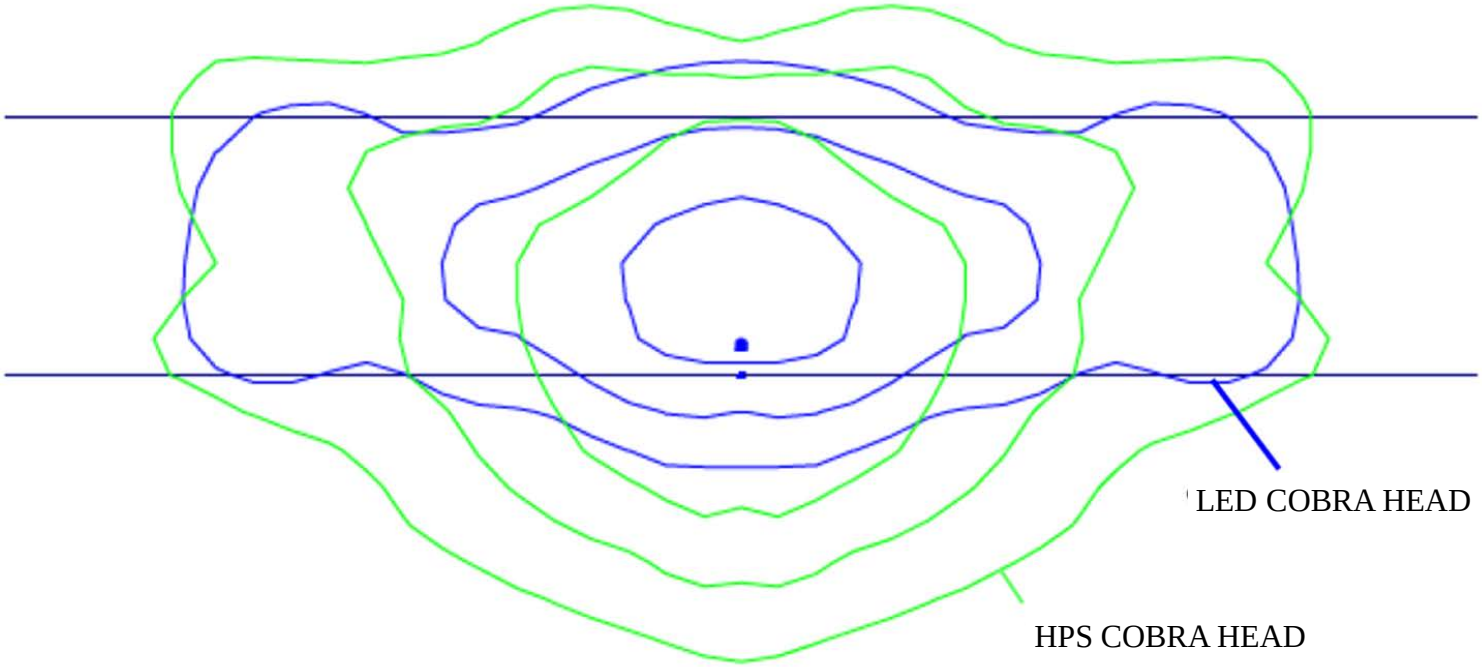
HID vs. LED Optics



HID Lamp

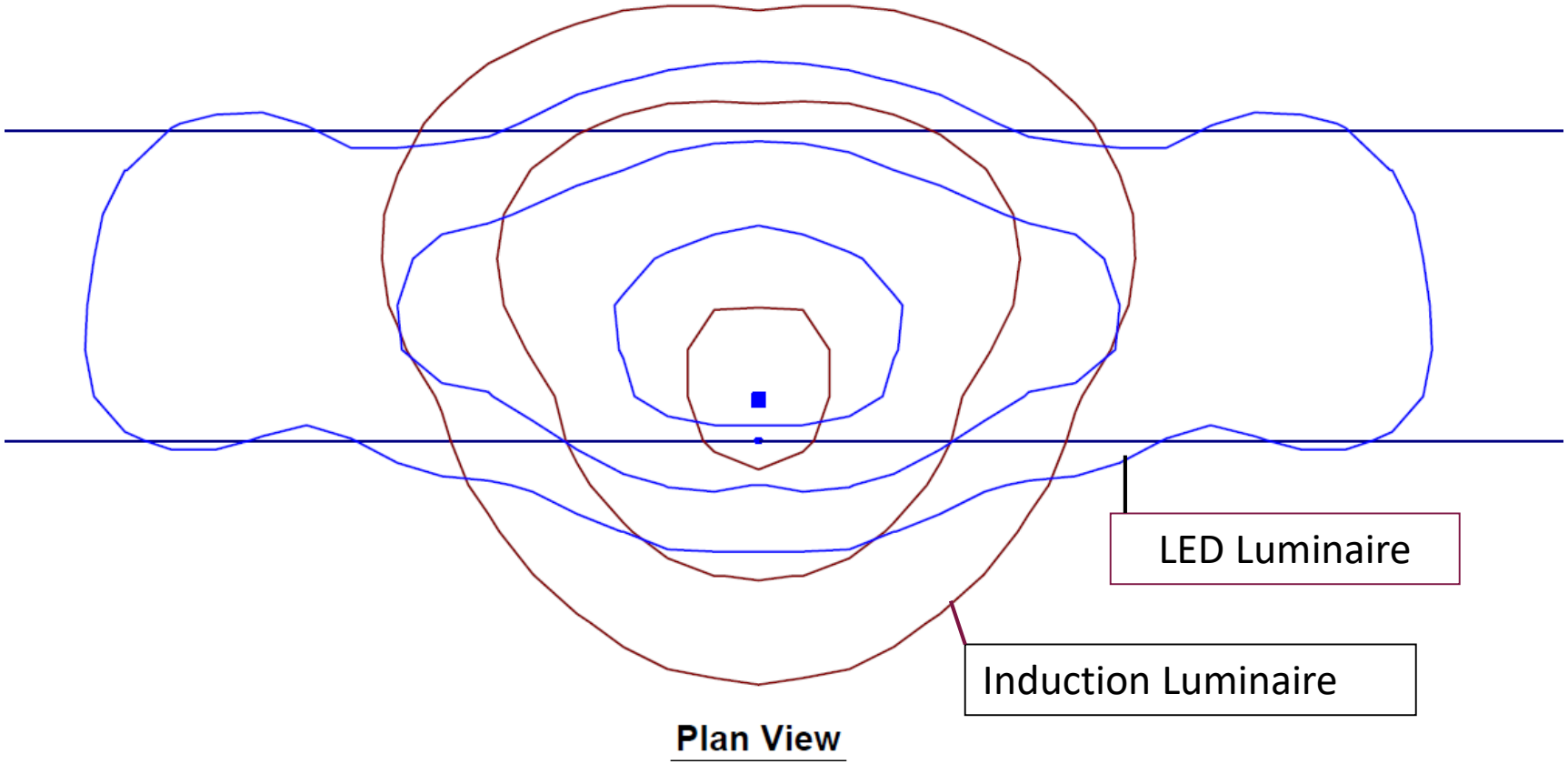


LED Lamp



HID vs. LED Optics

HPS v LED layout



HID vs. LED Optics

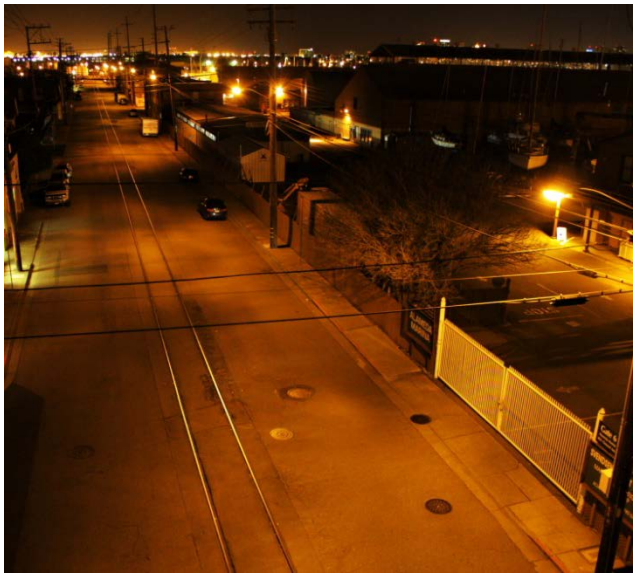
Induction vs. LED layout

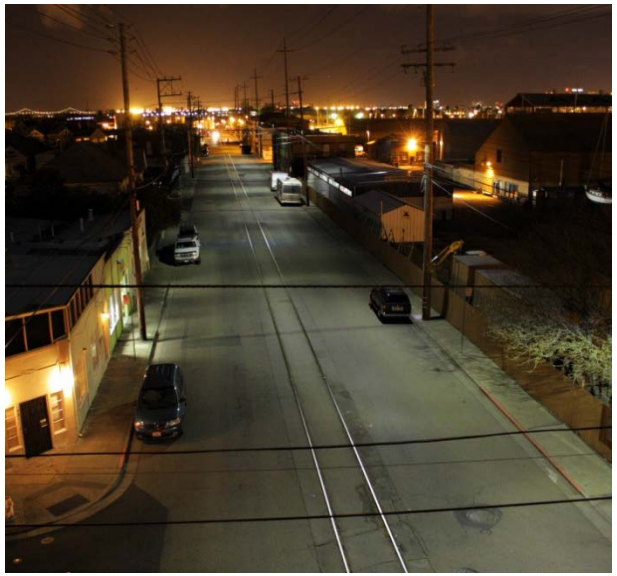
Street Lighting with LEDs

- Glare
- Better Optical Control and Sharp Cutoff Reduce High Angle Glare

Street Lighting with LEDs

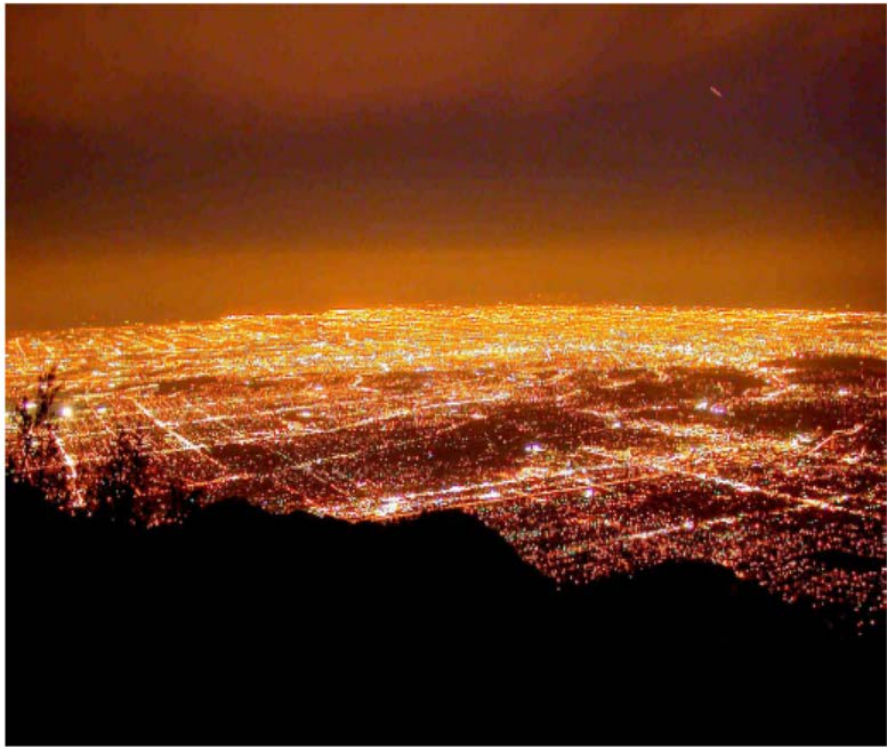
- Illumination for Safety and Security
- Substantially Improved Uniformity, even five years ago!

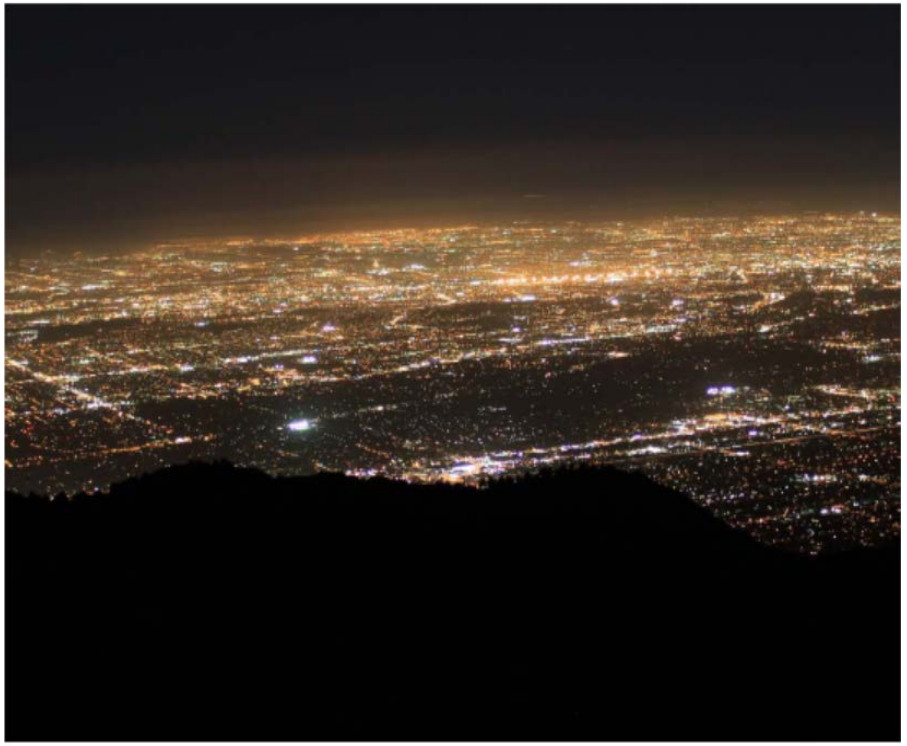




Urban Sky Glow

Zero direct uplight and reduced reflected uplight





Street Lighting with LEDs

- Spectral Effects
- Visibility is improved with white light over HPS especially at low light levels.

HPS 2800K 22 CRI

LED 4000K +70 CRI

Street Lighting with LEDs

Life Cycle System Cost - Energy

Light Source	Initial Lamp Efficacy (LPW)	Typical Luminaire Efficacy (System LPW)
Incandescent	10 - 25	5 - 15
Standard Fluorescent	55 - 90	50 - 80
Induction	60 - 80	40 - 60
Metal Halide	60 - 100	40 - 70
High Pressure Sodium	80 - 125	50 - 75
Low Pressure Sodium	100 - 140	60 - 90
Latest LED	120-140	80 - 105

Energy Efficiency in Street Lighting Systems

How efficiently does the Luminaire deliver quality illumination to the target area without casting light in unintended directions?

Comparing Efficiency of “Light on the Ground” (fc/kW)

Application

- 40ft wide roadway
- 28ft pole height
- 150ft pole spacing

	165W Induction	100W HPS	30 LEDs
Ave. Illuminance (fc)	0.57	0.53	0.68
Max. Illuminance (fc)	1.56	1.66	1.71
Min. Illuminance (fc)	0.11	.12	0.27
Ave/Min Uniformity	5.18	4.42	2.52
System Power (W)	180	120	**69**
Avg (fc/kW)	3.2	4.4	9.9
Min (fc/kW)	0.6	1.1	3.9

Conclusion

- It is important to recognize the environment where the lighting is to be provided.
- Provide a robust solution that would address the health and safety of the public.
- Provide an economical lighting design.
- Stay informed on the evolving technology in the lighting industry.