West Side Trail

Fall City Metropolitan Park District (FCMPD) *Otak # 32649*

Technical Memorandum #9

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Subject: Illumination Design Criteria and Analysis

By: Mark Cole, P.E. Date: June 28, 2017

This design memorandum presents criteria, recommendations, and other relevant information for project consideration on the above referenced subject.

Acknowledgement:

Significant discussion and agency comments during review are incorporated and reflected by date-revision, when shown. Information presented herein represents final concurrence and direction on referenced subject.	***Otak*** Mark Cole, PE, Proj.Mgr.	*initials*
	F.C.M.P.D. Kirk Harris, Commissioner	*initials*

Introduction

The purpose of this design memorandum is to presents illumination design criteria and trail illumination considerations for the proposed West Side Trail project. An attached memorandum, prepared by Transportation Engineering North West, titled "Illumination Design Criteria, Fall City West Side Trail", dated June 28, 2017 outlines design criteria, illumination standards, and provides preliminary calculations and costs for two illumination system alternatives, as follows:

- Alternative 1 - "Continuous Lighting System": This alternative provides illumination at locations where the trail crosses streets as well as continuous pedestrian-scale lighting along the entire trail.
- Alternative 2 - "Roadway Crosswalks Only": This alternative provides illumination only at the four locations where the trail crosses streets, i.e. 323rd Ave. SE; 324th Ave. SE, Chief Kanim Middle School entrance, and 332nd Ave. SE.

Conclusions and Recommendations

1. The use of Light Emitting Diode (LED) luminaires is recommended and preliminary lighting calculations are based on their use.

2. Alternative 2 – "Roadway Crosswalks Only", illumination option is recommended for preliminary design based on the following:
    a. It appears that for each of the 4 intersection crossing locations, existing utility poles can be used for installation of the new luminaire.
    b. Because the luminaries would also service the arterial roadway intersection, it is anticipated that future maintenance and energy usage would be the responsibility of King County.
    c. The added capital and maintenance cost associated with installation of the continuous illumination option.

3. Continue to seek community and property owner input for determining if continuous pedestrian scale illumination should be further consider during final design.

Exhibit ___

Significant Discussion Topics during Agency (Client) Memorandum Review

The below summary represent relevant discussion occurring during agency memorandum review in validating presented information and incorporating memorandum changes to reflect final agency direction.

[To be completed at time of final concurrence]

MEMORANDUM

DATE: May 8, 2017

TO: Touta Phengsavath, P.E.
OTAK

FROM: Chris Bicket, P.E.
TENW

SUBJECT: Illumination Design Criteria
PROJECT NAME: FALL CITY WEST SIDE TRAIL
TENW Project No. 5388

This memorandum summarizes illumination design criteria, alternatives analysis, and recommendations for the Fall City West Side Trail project.

Design Criteria

Below are recommended standards which we propose as the basis for illumination design criteria:

- Crosswalk/Roadway Crossings: Exhibit A – *King County Road Design and Construction Standards - 2016* – Systems Outside the Urban Growth Boundary/Trail Crossings – 1.0 Foot-Candle (FC) avg, 3:1 max uniformity (average-to-minimum)

- Trail System Lighting: Exhibit B - *ANSI/IESNA RP-8-00* – Table 7 – Walkway/Bikeway, Low ped conflict area, Low density residential – 0.3 FC avg, 6:1 max uniformity

Based on these standards and our experience on similar pedestrian facility projects for King County Parks and Snohomish County Parks, we recommend that the following criteria be established for the areas identified in Exhibits C and D for the Fall City West Side Trail project:

- 0.3 FC average, 6:1 maximum uniformity (main trail area)

- 1.5 FC average, 3:1 maximum uniformity (Roadway Crossings)

Pole/Fixture Type

For the roadway crossings, we recommend mounting lights on existing utility poles near the intersections. For the trail lights, we recommend also using existing utility poles to mount lights where possible and a pedestrian scale light in areas where utility poles are not available.

The illumination system and associated calculations are assumed to include Kim Warp9 LED fixtures or similar for the pedestrian scale lights and GE Evolve Cobra heads for the utility-pole mounted lights. The following pole/fixture combinations are proposed for the various design areas.

- Main Trail Pedestrian Scale Lights and Poles:16' sq., non-tapered aluminum pole, 60 – LED fixture
- Main Trail Utility Mounted Pole Lights: 40' pole height, existing utility poles, 90 – LED fixture
- Trail Crossing Luminaire Poles: 40' pole height., existing utility poles, 131 – LED fixture

Product materials specifications are included as **Exhibits E, F, and G**:

Design Layout

We have evaluated two trail illumination alternatives as follows:

Alt 1: Continuous Lighting System – Alternative 1 would include lighting of trail crossings at 323rd Ave SE, 324th Ave SE, Chief Kanim Middle School Entrance and 332nd Ave SE, as well as continuous lighting of the entire extent of the trail. **Exhibits C** reflect the resulting light levels and uniformity.

In summary, a total of 16 *Main Trail Pedestrian Scale Lights and Poles*, 7 *Main Trail Utility Mounted Pole Lights*, and 5 *Trail Crossing Luminaire Poles* are proposed. Total pole count would be approximately 28 poles. Preliminary Cost Opinion for the illumination system is estimated at $200,000.

Alt 2: Roadway Crosswalks Only – Alternative 2 would include lighting only at trail crossings, including the trail crossings 323rd Ave SE, 324th Ave SE, Chief Kanim Middle School Entrance and 332nd Ave SE. Additional spot-locations could also be provided at select locations along the trail. **Exhibits D** reflect the resulting light levels and uniformity.

In summary, a total of 4 *Trail Crossing Luminaire Poles* would be included. Additional *Main Trail Luminaire Poles* could be added at select locations such as midpoint between trail crossings as determined/desired by the Trail Association. For this analysis we have assumed up to 4 *Trail Crossing Luminaire Poles*. Preliminary Cost Opinion for the illumination system is estimated at $50,000.

Attachments:

Exhibit A – King County Guidelines
Exhibit B – ANSI/IESNA Guidelines
Exhibit C – Illumination Continuous
Exhibit D – Illumination Crossings Only
Exhibit E – Kim Warp9 Luminaire Specifications
Exhibit F – Kim lighting luminaire Arm Specification
Exhibit G – Kim Lighting Aluminum Poles

EXHIBIT A

King County Road Design and Construction Standards

All new street lights shall be Light Emitting Diode (LED) type. Contact the Traffic Engineer for the most current acceptable make, model and manufacturers of LED light fixtures.

Where existing illumination systems are modified, all fixtures within the project limits and turn channelization being extended shall be LED-type, unless otherwise approved. Light levels and average/minimum uniformity of light shall be based on the location of the system relative to the Urban Growth Boundary as identified on the most recent Comprehensive Plan Land Use map available on the county's website. The calculation area will include only the driving lanes, no shoulder areas.

Illumination systems within the urban growth boundary shall be designed to provide an average of 1.2 foot candles with an average-to-minimum uniformity ration of 3:1, except at intersections where the system shall be designed to provide a minimum of 1.5 foot candles with an average-to-minimum uniformity ratio of 3:1.

Illumination systems outside the urban growth boundary shall be designed to provide an average of 1.0 foot candles with an average-to-minimum uniformity ratio of 3:1, except at intersections where the system shall be designed to provide an average of 1.5 foot candles with an average-to-minimum uniformity ratio of 3:1. The intersection is the area bounded by the stop bars and/or the radius tangent points, whichever is closer to the center of the intersection. The road approach calculation area will include the turn lanes and tapers.

When illumination is required to satisfy a variance for a sag vertical curve the system shall be designed to provide a minimum of 0.4 foot candles within the limits of the sag curve with a maximum average foot-candle value of 1.0. If an intersection is adjacent to the sag vertical curve, the illumination area must include the intersection. If the adjacent intersection is an arterial, the design criteria (foot candle and uniformity values) above will apply. If the adjacent intersection does not have an arterial classification, then the 0.4 minimum foot candle value shall be met throughout the intersection as well as the sag curve area.

Steel poles shall be used for the street illumination system, unless otherwise approved. See Section 5.10, Roadside Obstacles for direction regarding placement of poles. Where poles are installed along roadways with posted speed limits of 40 mph or more, slip bases will be required, regardless of the presence of curb. Fixed based poles are permitted on roadways with posted speeds of less than 40 MPH as long as they are placed such that the face of pole is at least 10-feet from the edge of traveled way on shoulder-type roadways or behind sidewalk meeting the width requirements of Section 5.10.

Where street illumination is required by the DPER, the applicant shall bear all costs associated with installation. Where the street illumination serves the arterial roadway system, King County will pay for maintenance and energy usage of the system upon acceptance by DPER. Where the street illumination serves non-arterial roadways, the applicant shall bear all costs associated with maintenance and energy usage, or assign such costs to homeowners and/or homeowners associations.

EXHIBIT B

ANSI/IESA Guidelines

Table 7: Recommended Values for Low Pedestrian Conflict Areas

Maintained Illuminance Values for Walkways/Bikeways			
	E_H lux/fc	E_{Vmin} lux/fc	E_{avg}/E_{min} *
Rural/Semi-Rural Areas	2.0/0.2	0.6/0.06	10.0
Low Density Residential	3.0/0.3	0.8/0.08	6.0
Medium Density Residential	4.0/0.4	1.0/0.1	4.0

* Horizontal only

E_H = average horizontal illuminance at walkway/bikeway
E_{Vmin} = minimum vertical illuminance at 1.5 m (4.9 ft.) above walkway/bikeway measured in both directions parallel to the main pedestrian flow

crossing vehicular movements for each crosswalk (right turns and left turns from the cross street, and straight ahead from both directions on the street crossed by the walk).

Several studies have identified that the primary benefits produced by lighting of intersections along major streets is the reduction in night pedestrian, bicycle and fixed object accidents.[13,14]

3.6.3 Pedestrian Visibility. Night visibility of pedestrians typically involves observance by one of two methods–silhouette or reversed silhouette. Reversed silhouette is produced by vehicle headlights in possible combination with any fixed street lighting. The value of direct visibility by headlighting or lights at the intersection, is significantly affected by the reflectivity of the clothing worn by the pedestrian. For a major street with properly designed continuous lighting, the silhouette vision of the pedestrian may actually be enhanced by dark clothing–the darker object is seen against the lighter background.

To maximize visibility of a pedestrian at an intersection, it is preferable to have street lighting configurations as shown in **Annex D**, **Figure D3**. If a major street is intersecting a lesser classification, such as collector or local, these positions will typically provide for reasonable visibility. In **Annex D, Figure D3-b**, **D3-c**, and **D3-d** the far right side light is appropriately located just beyond the crosswalk. The light distribution across the width of pavement will serve to provide high illuminance in the crosswalk area as well as high luminance on the intersection pavement. It will also illuminate the pavement beyond the pedestrian thereby forming a background to the pedestrians silhouette. This far right position is also appropriate for the location of a traffic signal, whether it is bracket mount to a street light pole, is of combination mast arm/street light type, or utilizes ring-around span wire poles.

3.6.4 Recommended Illuminance for Intersections. **Table 9** shows the recommended illuminance values at intersections of continuously lighted streets, defined as the prolongation of the intersecting roadway edges. Other traffic conflict areas should be provided with illuminance values 50 percent higher than recommended for the street. It is based on the principle that the amount of light should be proportional to the classification of the intersecting routes and equal to the sum of the values used for each separate street. If an intersecting roadway is illuminated above

Table 8: Recommended Values for the Pedestrian Portion of Pedestrian Vehicular Underpasses and Exclusive Pedestrian Underpasses

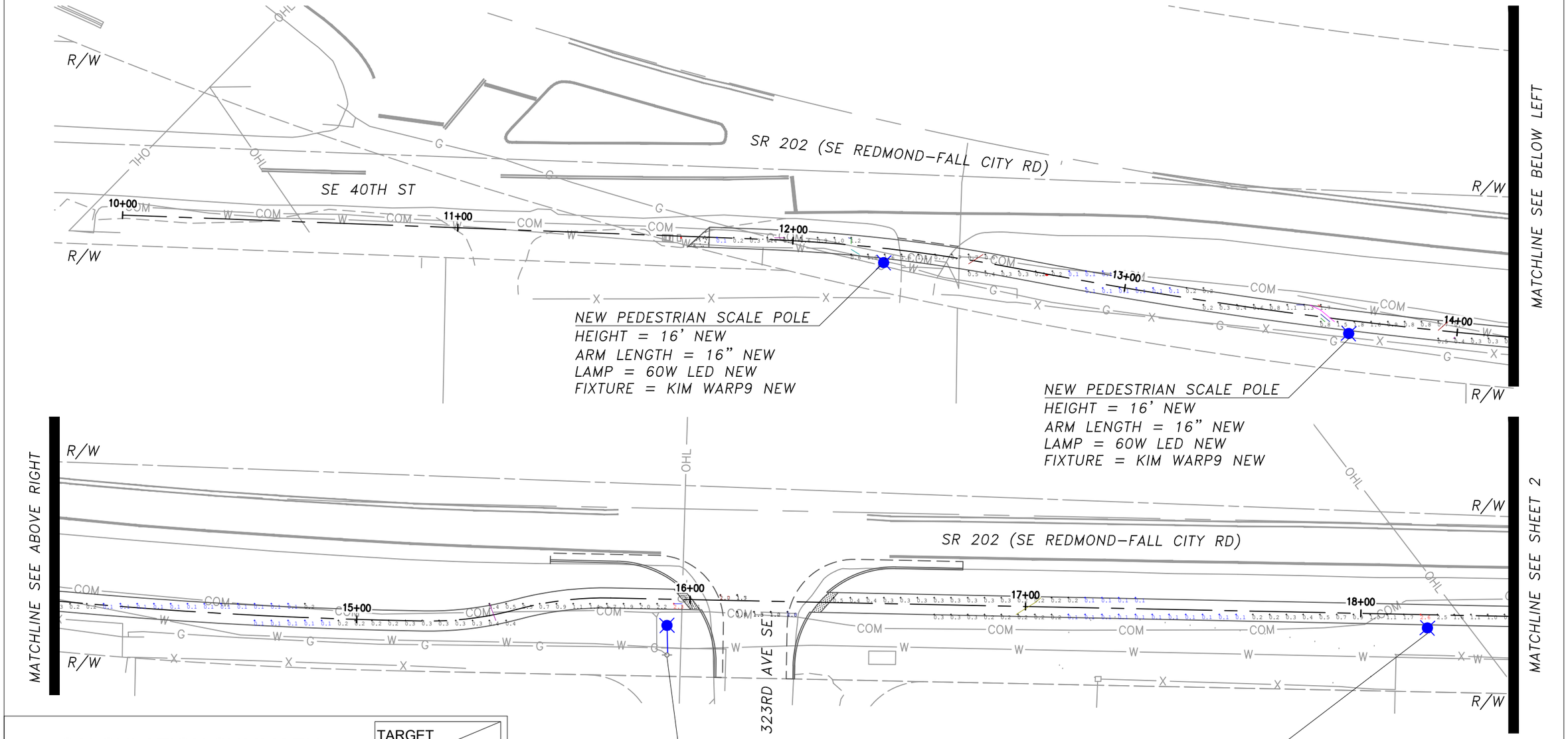
Maintained Illuminance Values for Walkways/Bikeways			
	E_H lux/fc	E_{Vmin} lux/fc	E_{avg}/E_{min} *
Day	100.0/10.0	50.0/5.0	3.0
Night	40.0/4.0	20.0/2.0	3.0

* Horizontal only

E_H = average horizontal illumination at walkway/bikeway
E_{Vmin} = minimum vertical illumination at 1.5 m (4.9 ft.) above walkway/bikeway measured in both directions parallel to the main pedestrian flow

EXHIBIT C

Illumination Calculation - Continuous



CALCULATION SUMMARY

CALCULATION AREA	DESIGN CRITERIA	
	AVG. MAINTAINED FOOT CANDLES (FC)	UNIFORMITY RATIO AVG. FC/ MIN. FC
	TARGET / ACTUAL	TARGET / ACTUAL
323RD AVE SE CROSSING	1.50 / 1.52	3.00:1 / 1.52:1
TRAIL LIGHTING	0.30 / 0.57	6.00:1 / 5:70:1

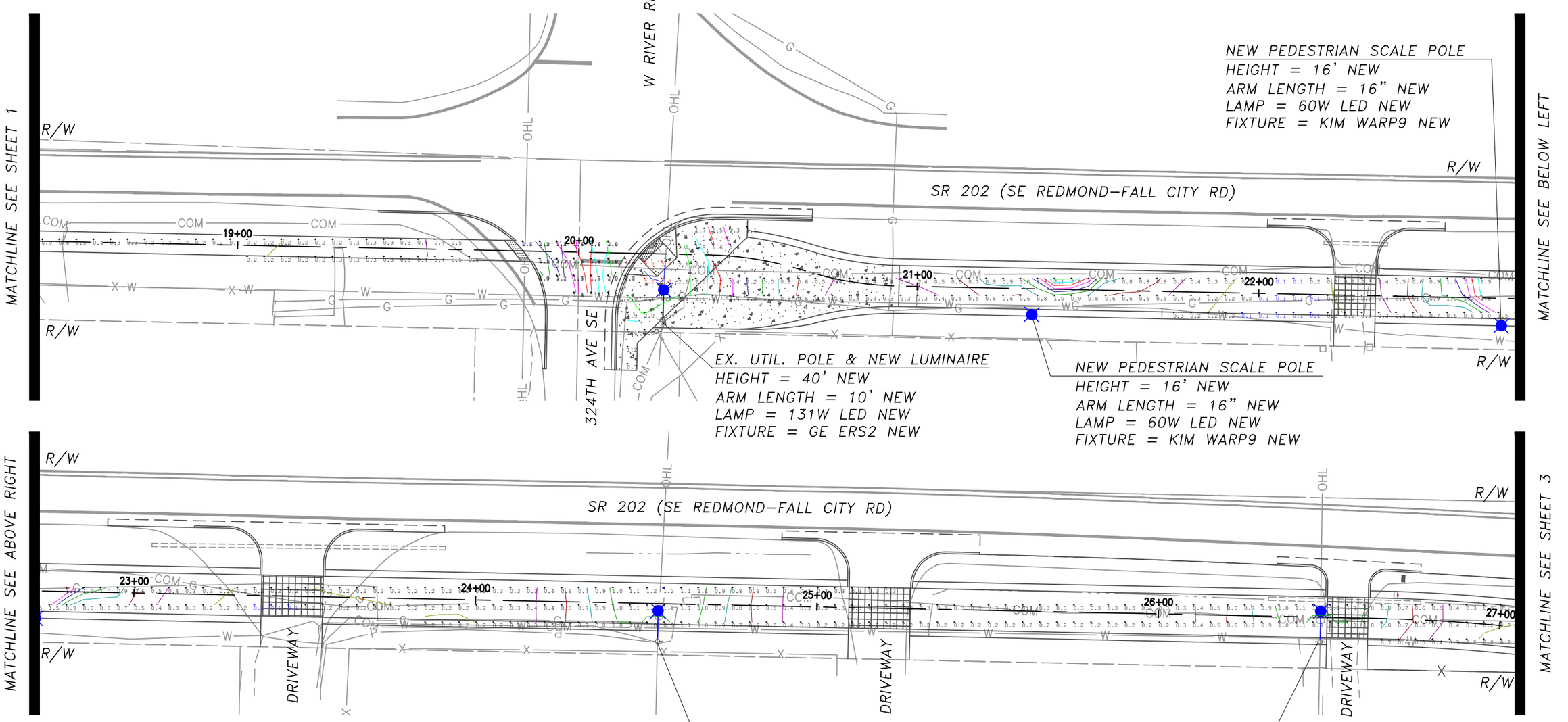
DATE: 05/05/2017

TENW
Transportation Engineering NorthWest
Transportation Planning | Design | Traffic Impact & Operations
11400 SE 8th Street, Suite 200, Bellevue, WA 98004 | Office (425) 889-6747
Project Contact: Chris Bicket, P.E.
Phone: 425-250-5002

FALL CITY WEST SIDE TRAIL
FALL CITY, WASHINGTON

SHEET 1 OF 7

ILLUMINATION CALCULATIONS
PROPOSED CONTINUOUS TRAIL LIGHTING



CALCULATION SUMMARY

CALCULATION AREA	DESIGN CRITERIA	
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	TARGET / ACTUAL	TARGET / ACTUAL
324TH AVE SE CROSSING	1.50 / 1.59	3.00:1 / 1.59:1
TRAIL LIGHTING	0.3 / 0.39	6.00:1 / 3.90:1

N

0 30

HORIZONTAL SCALE IN FEET

DATE: 05/05/2017

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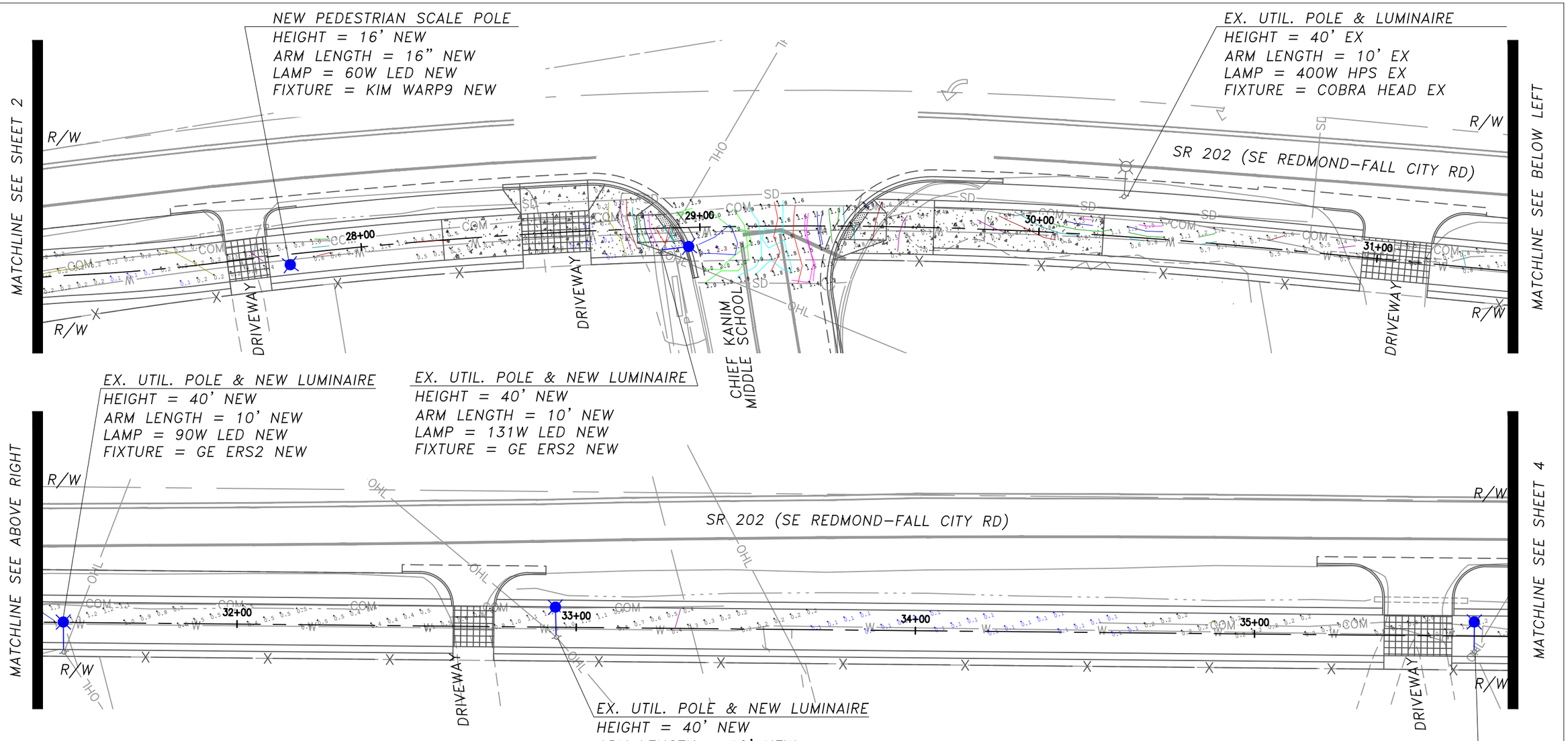
ILLUMINATION CALCULATIONS
PROPOSED CONTINUOUS TRAIL LIGHTING

SHEET 2 OF 7



CALCULATION SUMMARY

CALCULATION AREA	DESIGN CRITERIA: AVG. MAINTAINED FOOT CANDLES (FC) (TARGET / ACTUAL)	DESIGN CRITERIA: UNIFORMITY RATIO AVG. FC/ MIN. FC (TARGET / ACTUAL)
CHIEF KANIM MIDDLE SCHOOL CROSSING	1.50 / 1.71	3.00:1 / 2.05:1
TRAIL LIGHTING	0.3 / 0.9	6.00:1 / 9.00:1

N

0 30

HORIZONTAL SCALE IN FEET

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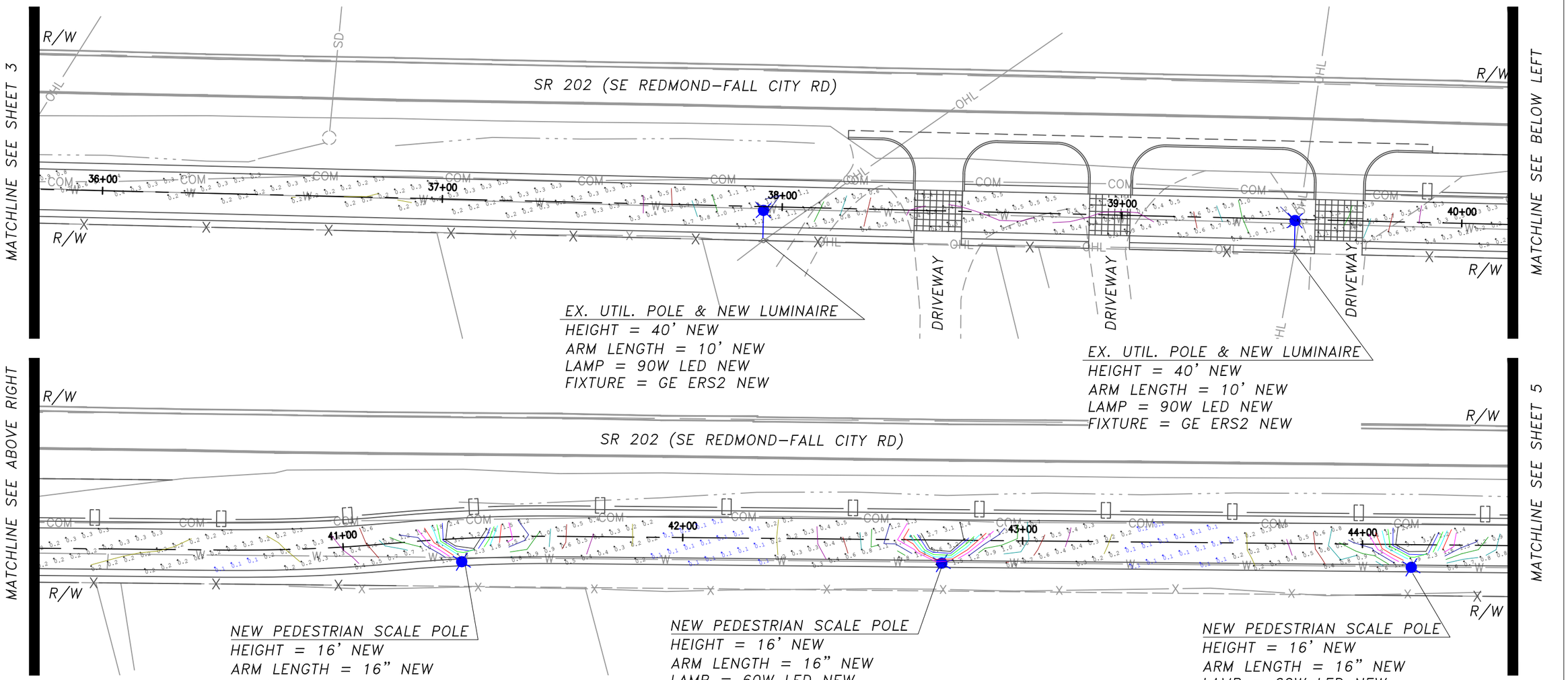
ILLUMINATION CALCULATIONS
PROPOSED CONTINUOUS TRAIL LIGHTING

SHEET 3 OF 7



CALCULATION SUMMARY

CALCULATION AREA	DESIGN CRITERIA	
	AVG. MAINTAINED FOOT CANDLES (FC)	UNIFORMITY RATIO AVG. FC/ MIN. FC
	TARGET / ACTUAL	TARGET / ACTUAL
TRAIL LIGHTING	0.30 / 0.30	6.00:1 / 6:00:1

N

0 30

HORIZONTAL SCALE IN FEET

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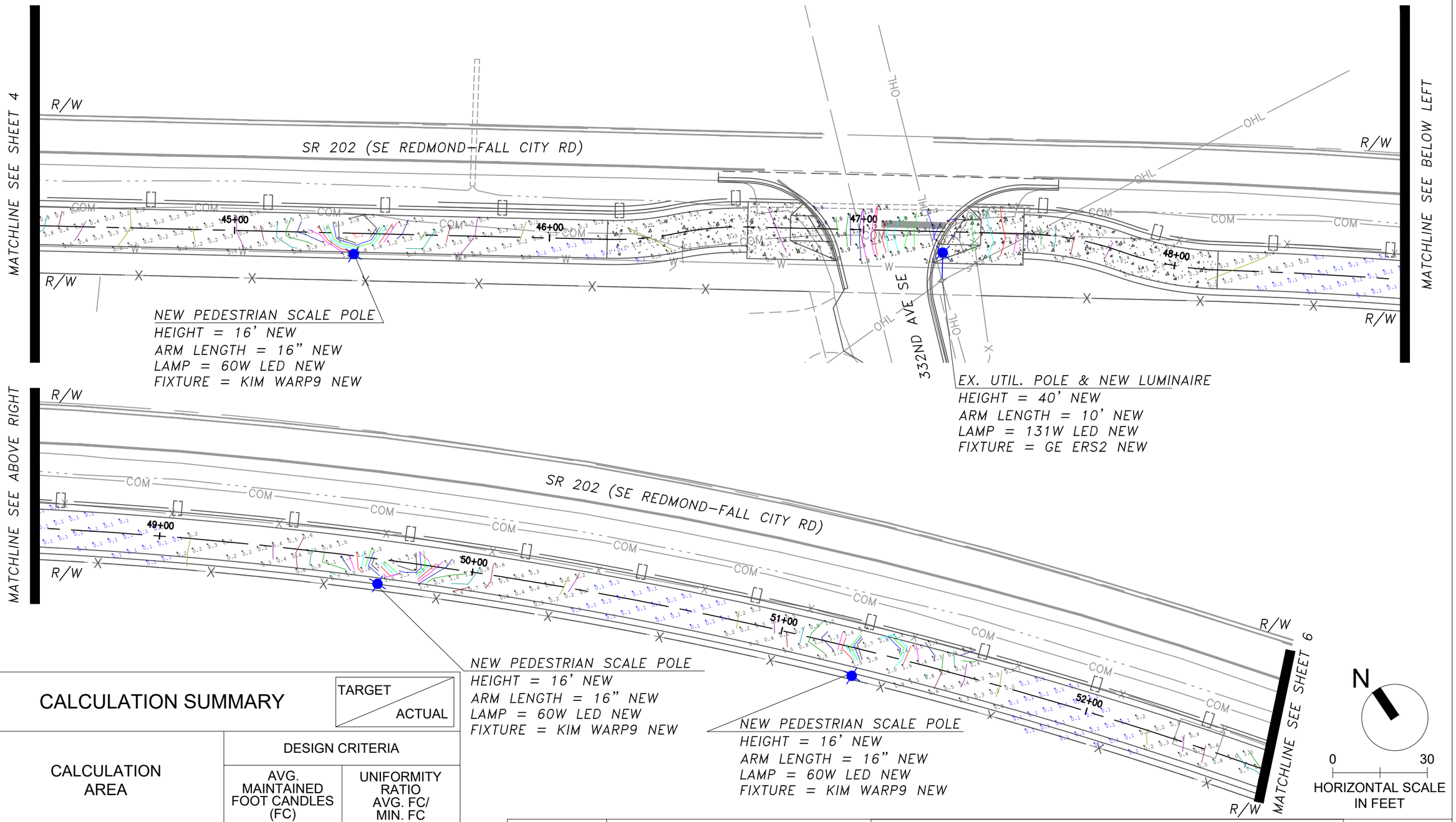
ILLUMINATION CALCULATIONS
PROPOSED CONTINUOUS TRAIL LIGHTING

SHEET 4 OF 7



CALCULATION SUMMARY

TARGET / ACTUAL

CALCULATION AREA	DESIGN CRITERIA	
	AVG. MAINTAINED FOOT CANDLES (FC)	UNIFORMITY RATIO AVG. FC/ MIN. FC
332ND AVE SE CROSSING	1.50 / 1.64	3.00:1 / 2.05:1
TRAIL LIGHTING	0.30 / 0.59	6.00:1 / 5.90:1

DATE: 05/05/2017

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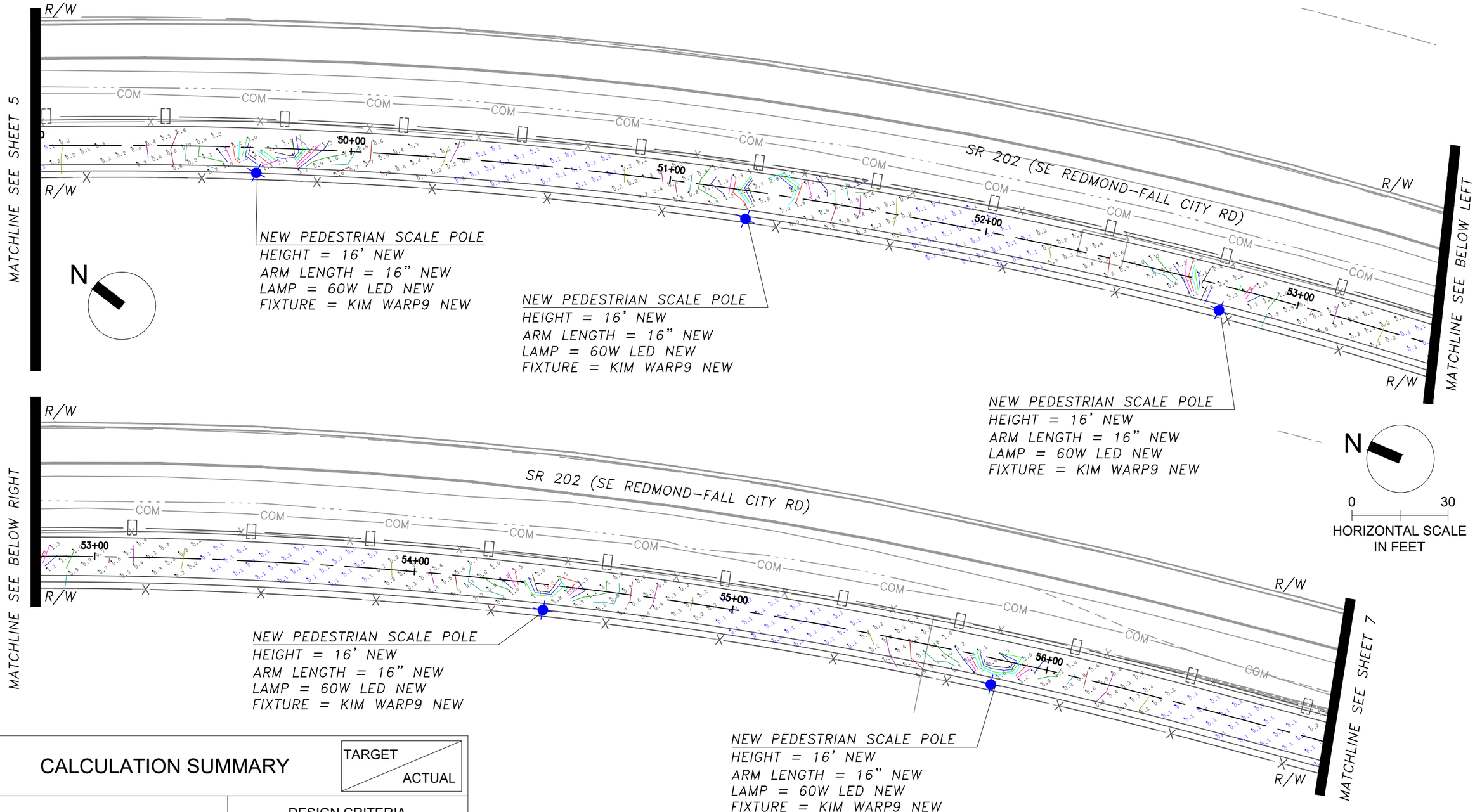
ILLUMINATION CALCULATIONS
PROPOSED CONTINUOUS TRAIL LIGHTING

SHEET 5 OF 7



CALCULATION SUMMARY

CALCULATION AREA	DESIGN CRITERIA	
	AVG. MAINTAINED FOOT CANDLES (FC)	UNIFORMITY RATIO AVG. FC/ MIN. FC
	TARGET / ACTUAL	TARGET / ACTUAL
TRAIL LIGHTING	0.3 / 0.6	6.00:1 / 6.00:1

DATE: 05/05/2017

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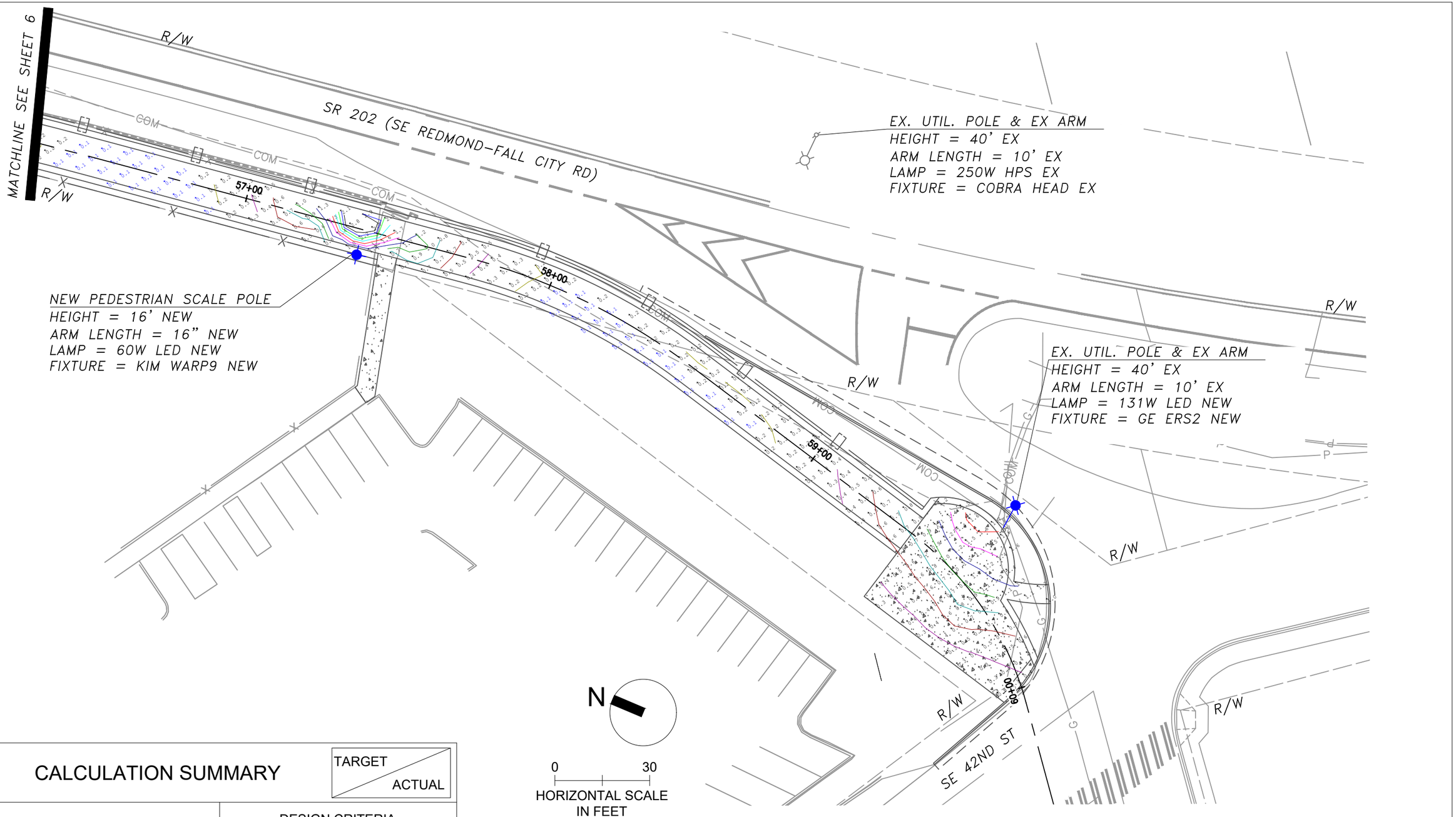
ILLUMINATION CALCULATIONS
PROPOSED CONTINUOUS TRAIL LIGHTING

SHEET 6 OF 7



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	AVG. MAINTAINED FOOT CANDLES (FC)	UNIFORMITY RATIO AVG. FC/ MIN. FC
	TARGET / ACTUAL	TARGET / ACTUAL
TRAIL LIGHTING	0.3 / 0.6	6.00:1 / 6.00:1

DATE: 05/05/2017

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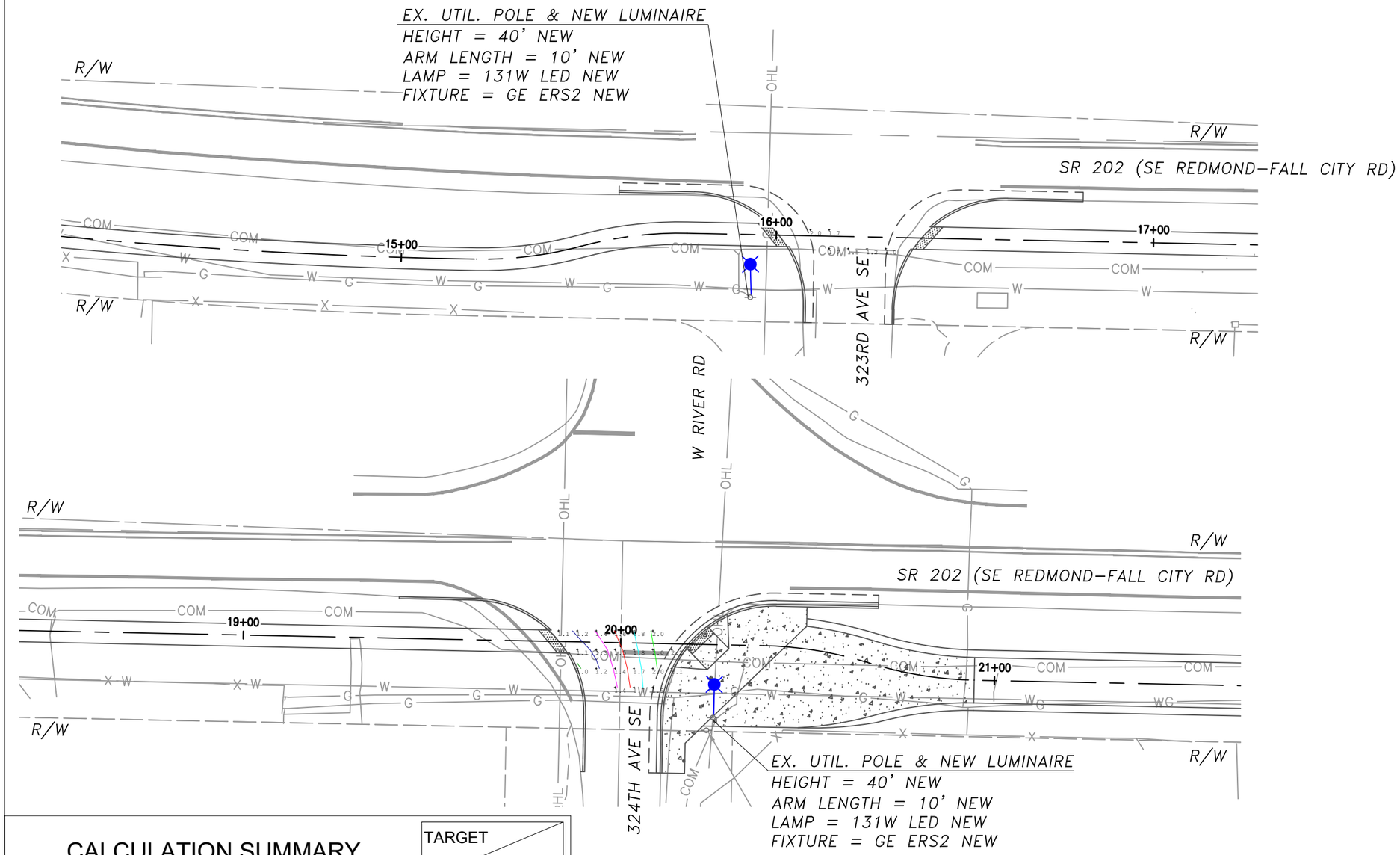
FALL CITY WEST SIDE TRAIL
FALL CITY, WASHINGTON

SHEET 7 OF 7

ILLUMINATION CALCULATIONS
PROPOSED CONTINUOUS TRAIL LIGHTING

EXHIBIT D

Illumination Calculation – Trail Crossing Only



CALCULATION SUMMARY

CALCULATION AREA	DESIGN CRITERIA: AVG. MAINTAINED FOOT CANDLES (FC) — TARGET	ACTUAL	DESIGN CRITERIA: UNIFORMITY RATIO AVG. FC/ MIN. FC — TARGET	ACTUAL
323RD AVE SE CROSSING	1.50	1.52	3.00:1	1.52:1
324TH AVE SE CROSSING	1.50	1.59	3.00:1	1.59:1

N

0 30
HORIZONTAL SCALE IN FEET

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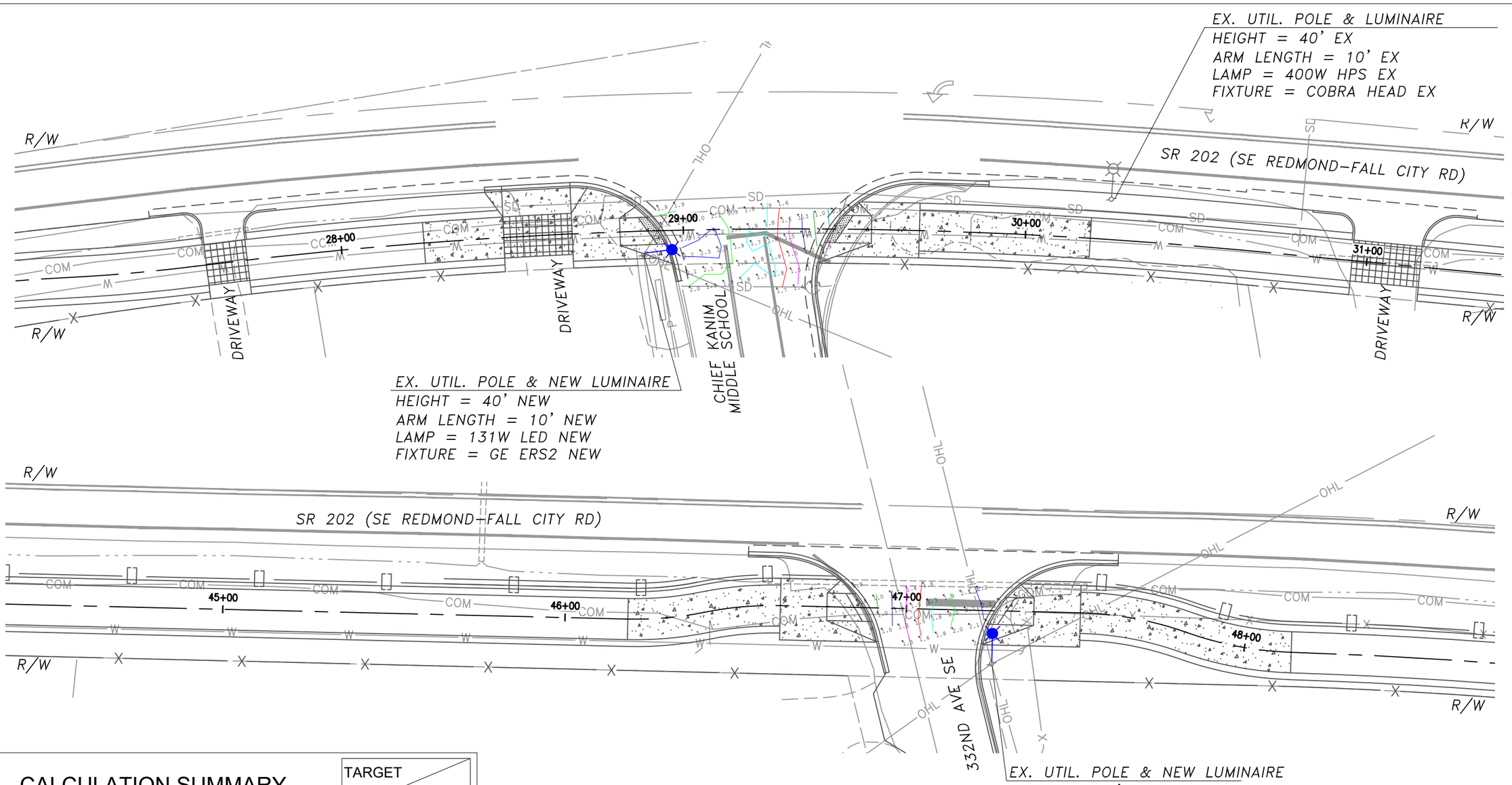
ILLUMINATION CALCULATIONS
PROPOSED TRAIL CROSSING LIGHTING

SHEET 1 OF 2



CALCULATION SUMMARY

CALCULATION AREA	DESIGN CRITERIA: AVG. MAINTAINED FOOT CANDLES (FC) — TARGET	AVG. MAINTAINED FOOT CANDLES (FC) — ACTUAL	UNIFORMITY RATIO AVG. FC/ MIN. FC — TARGET	UNIFORMITY RATIO AVG. FC/ MIN. FC — ACTUAL
CHIEF KANIM MIDDLE SCHOOL CROSSING	1.50	1.71	3.00:1	2.85:1
332ND AVE SE CROSSING	1.50	1.64	3.00:1	2.05:1

N

0 30

HORIZONTAL SCALE IN FEET

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FALL CITY WEST SIDE TRAIL
FALL CITY, WASHINGTON

ILLUMINATION CALCULATIONS
PROPOSED TRAIL CROSSING LIGHTING

SHEET 2 OF 2

EXHIBIT E

Kim Warp9 Luminaire Specifications

WARP9™ LED

Small Luminaire

FEATURES

- LED models incorporating patent pending LED MicroEmitter™ technology
- Patented design, incorporating visual stealth technology
- Easy-access, tool-less latches for lower maintenance
- Sealed optical chamber, IP-66 rated

Features exclusive wiHUBB technology

- Wireless system for 0-10VDC full range dimming control
- Programmable autonomous operation

wiHUBB ENABLED

ORDERING INFORMATION (Example)

1SA	WP9SE3	60L5K120	SG	SF/A-30	PRA12-5125SA/SG	—

MOUNTING

			EPA
	1SA	1 Arm Side Mt.	0.52
	2SB	2 Arm Side Mt.	1.04
	2SL	2 Arm Side Mt.	0.82
	3ST	3 Arm Side Mt.	1.3
	3SY*	3 Arm Side Mt.	1.3
	4SC	4 Arm Side Mt.	1.5
	1W	Single Wall Mt.	n/a

*Available on round poles only
NOTE: EPA is for Fixture only

FIXTURE

WARP9 Small LED

WP9SE1	Type I Full-Cutoff
WP9SE2	Type II Full-Cutoff
WP9SE3	Type III Full-Cutoff
WP9SE4	Type IV Forward Throw Full-Cutoff
WP9S4NB	Type IV - No Backlight
WP9SE5	Type V Square Full-Cutoff
WP9SER	Type R Right Full-Cutoff
WP9SEL	Type L Left Full-Cutoff

FIXTURE FINISH

SG	Stealth Gray™
BL	Black
DB	Dark Bronze
LG	Light Gray
PS	Platinum Silver
WH	White
CC	Custom Color*

*Consult representative

FIXTURE OPTIONS

1W	Wall Mounting
SF	120 Volt Single Fuse
DF	208 Volt Double Fuse
DF	240 Volt Double Fuse
SF	277 Volt Single Fuse
SF	347 Volt Single Fuse
DF	480 Volt Double Fuse
A-25	Photocell Receptacle
A-30	120 Volt Photocell Button
A-31	208 Volt Photocell Button
A-32	240 Volt Photocell Button
A-33	277 Volt Photocell Button
A-34	480 Volt Photocell Button
A-35	347 Volt Photocell Button
LS	Flat Lexan® Lens[3]
TL	Tamper Resistant Latch[4]
WIH-IM	In-Fixture wireless control module, PSG8 pg. 381.

POLE

See p. **768-770** for pole ordering no. and EPA.

SLIPFITTER MOUNTING OPTIONS

	HORIZONTAL
HSF	Horizontal Slipfitter Mount
	VERTICAL
	4" Round, Standard Fixtures
VSF-1SA	1 fixture side mt.
VSF-2SB	2 fixtures side mt. 180°
VSF-2SL	2 fixtures side mt. 90°
VSF-3ST	3 fixtures side mt. 90°
VSF-3SY	3 fixtures side mt. 120°[5]
VSF-4SC	4 fixtures side mt. 90°
	4" Square, Standard Fixtures
SVSF-1SA	1 fixture side mt.
SVSF-2SB	2 fixtures side mt. 180°
SVSF-2SL	2 fixtures side mt. 90°
SVSF-3ST	3 fixtures side mt. 90°
SVSF-4SC	4 fixtures side mt. 90°

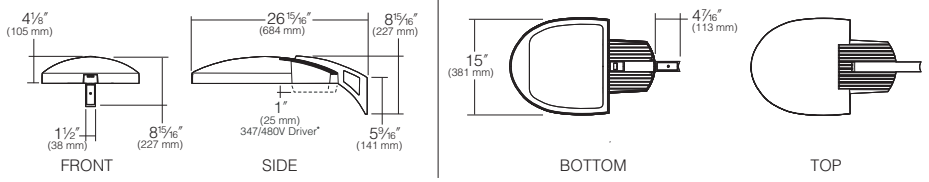
ELECTRICAL MODULE

WARP9 Small Electronic LED, 60 LEDs, 73W

Source	Color Temperature [1]	Voltages
60 60 LEDs	L3K 3500K	120 120V
	L5K 5100K	208 208V
	L2K Amber	240 240V
		277 277V
		347 347V[2]
		480 480V[2]

L3K = 3500 Kelvin LED
L5K = 5100 Kelvin LED
L2K = 580 nm Amber LED

[1] 4300K and 6500K are also available on an "Engineered to Order" basis.
[2] Due to current unavailability of 347V and 480V drivers, specification of these voltages may feature an integral step-down transformer. Driver compartment door extends down 1" on small housing.
[3] Use only when vandalism is anticipated to be high.
[4] Required only for vandal protection in locations where fixtures can be reached by unauthorized persons.
[5] 3Y only available on round slipfitter.



* Driver compartment door extends down 1" on small housing to accomodate integral step-down transformer on 347V and 480V models (only).

EXHIBIT F

Kim Luminaire Arm Specification

KIM LIGHTING

(Aluminum) AA09 / AA10
(Stainless Steel) AA11 / AA12
Uplift Adjustable Arm

revision 12/23/05 • aa09/aa10;aa11/aa/12.pdf

Type:
Job:
Ordering Example:

2B	/ STL3	/ 400PMH277	/ WH-P	/ **AA09**	/ .....
Mounting	Fixture	Electrical Module	Finish	Options	

Ordering Information

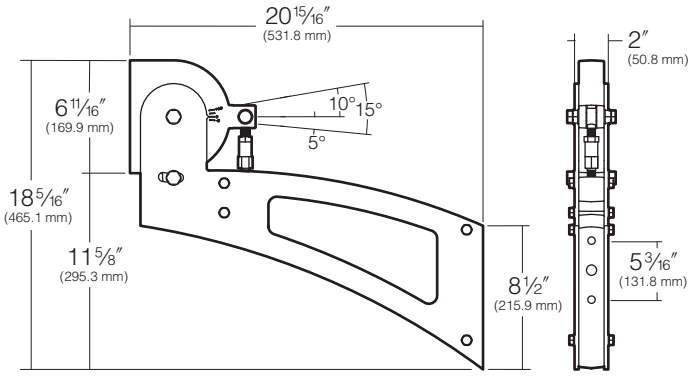
Always refer to the specific luminaire catalog, and the ordering information page within that catalog. Place the optional Architectural Arm catalog number as an **"Option"** following the Fixture catalog numbers.

Approvals:

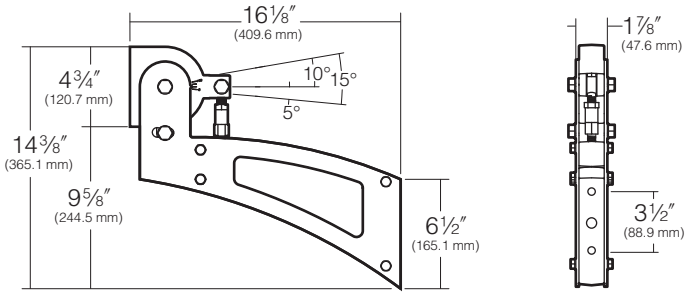
Date:

Specifications

AA09 Large
AA11 Large
(Stainless Steel)



AA10 Small
AA12 Small
(Stainless Steel)



Arm: (AA09/AA10) Constructed of cast aluminum spacer blocks sandwiched between stamped aluminum (stainless steel optional) side panels. Spacer blocks are cast of 356 alloy, low-copper (<0.6% Cu) aluminum. Side panels are stamped from 6061-T1 aluminum sheet, .188″ thick for small arm, and .250″ thick for large arm. **(AA11/AA12)** Optional stainless steel side panels are stamped from .125″ thick stainless sheet with a natural brushed finish. A stainless steel turnbuckle allows for upward fixture tilt from horizontal to +5°, -10° in unlimited smooth increments. Arm assembly is held together by ⅜″ stainless steel bolts with a black oxide finish. Wiring from the luminaire to the pole is braided stainless steel jacketed cable. Attachment to pole is by ⅜″ stainless steel hex head bolts threaded into a pole backing plate located inside the pole. Pole backing plate is heavy gauge zinc plated steel, and includes a wire strain relief and ground connection. For round poles, arm is circular cut for the specific pole diameter. Arm-to-luminaire attachment is by concealed ⅜″ galvanized rods threaded into the arm, projecting into the fixture where ⅜″ nuts and washers secure the mounting.

Finish: Kim's premium Super TGIC thermoset polyester powder coat, 2.5 mil nominal thickness, applied over a titanated zirconium conversion coating. Arm color is always provided to match the selected fixture, except for the stainless steel model that has natural brushed side panels.

HUBBELL®
Hubbell Lighting, Inc.

EXHIBIT G

Kim Lighting Aluminum Poles

KIM LIGHTING

PSA

Square Aluminum Non-Tapered Pole

revision 10/8/08 • psa.pdf

Type:
Job:
Catalog number:

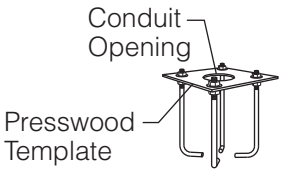
	/		/		/		/		/	
Pole Cat. No.		Mounting	Structural Luminaire Option		Finish		Optional Hinged Base		Optional Duplex Receptacle	

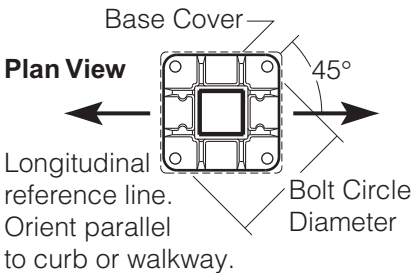
See page 2 | See page 3

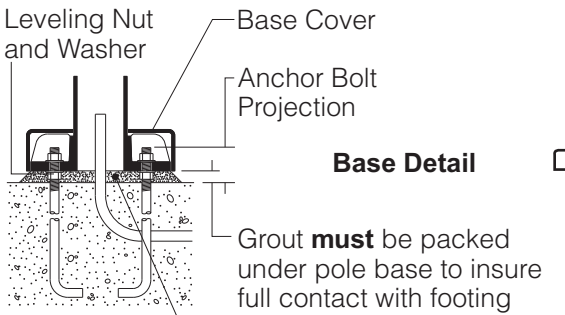
Approvals:

Date:

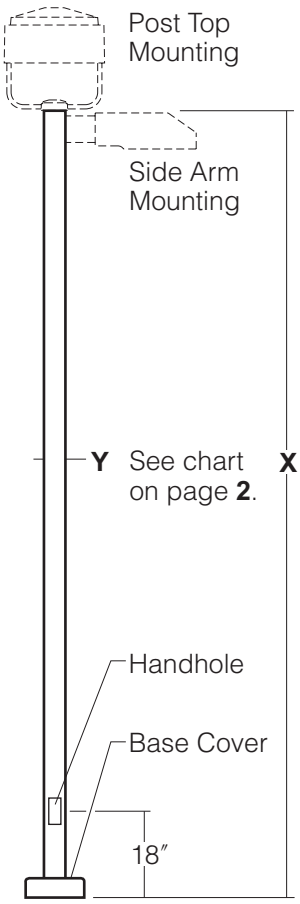
Specifications







Base Detail



Pole Construction: Seamless square extruded aluminum tube of alloy 6063-T6, welded to top and bottom of aluminum base casting of alloy 356.

Base Cover: Base has a two-piece cast aluminum full cover of 319 alloy, secured by stainless steel screws.

Pole Cap: A flush-sided cast aluminum pole cap is provided for side arm mounted luminaires.

Handhole: 18″ up from base, with a gasketed cover and ground lug.

Anchor Bolts: Four galvanized anchor bolts provided, complete with eight nuts, eight flat washers, and a presswood template.

Reinforcing Sleeve: All poles 25′ and above include an internal aluminum reinforcing sleeve, welded at the base.

Strength: Poles will withstand wind loads as listed in chart (see page **2**) when luminaires are mounted per fixture installation instructions.

Finish: Super TGIC thermoset polyester powder coat paint applied over a titinated zirconium conversion coating. Standard colors are Black, Dark Bronze, Light Gray, Stealth Gray™, Platinum Silver, and White. Custom colors are available.

CAUTION: Installation of poles without luminaire(s) will compromise pole strength. Any accessories attached to pole, or other modifications will compromise pole strength and may result in pole failure.

Maintenance: A regularly scheduled maintenance program must be established to insure the protective paint coating is intact, corrosion or structural damage has not occurred, and anchor bolt nuts are tight. Failure to do so could lead to pole collapse and serious personal injury.

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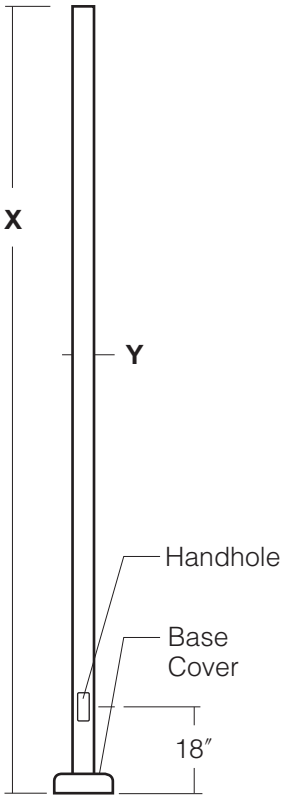
HUBBELL LIGHTING, INC.

 5604408282

Standard Features

NOTE: All allowable pole and fixture EPAs are derived from the AASHTO standard. Responsibility lies with the specifier for correct pole selection based on local codes and standards for the job location. (See page **4**).



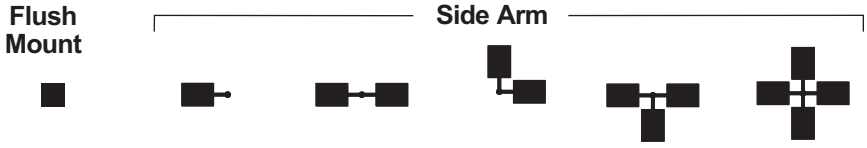
Pole Catalog Number	X	Y	Allowable Pole EPA 85	90	100	110	120	130	140	150
			Wind Map Steady Wind ↓							
☐ **PSA12-4125**	12′	4″ x .125	12.82	11.05	9.88	7.53	5.75	4.36	3.26	2.37
☐ **PSA14-4125**	14′	4″ x .125	9.87	8.34	7.34	5.33	3.80	2.61	1.67	---
☐ **PSA14-4188**	14′	4″ x .188	18.08	15.67	14.09	10.90	8.48	6.60	5.11	3.90
☐ **PSA16-4125**	16′	4″ x .125	7.50	6.16	5.29	3.53	2.19	1.15	---	---
☐ **PSA16-4188**	16′	4″ x .188	14.68	12.57	11.19	8.40	6.29	4.64	3.33	2.28
☐ **PSA20-4188**	19.5′	4″ x .188	9.70	8.07	7.00	4.85	3.22	1.94	0.93	---
☐ **PSA20-5188**	19.5′	5″ x .188	16.80	14.19	12.47	9.01	6.39	4.34	2.72	1.41
☐ **PSA25-5400**[1]	25′	5″ x .400	14.79	12.23	10.55	7.18	4.62	2.62	1.04	---
☐ **PSA30-6400**[2]	30′	6″ x .400	14.73	11.79	9.86	5.98	3.03	---	---	---
☐ **PSA30-66500**[3]	30′	6.6″ x .500	29.42	24.74	21.67	15.51	10.82	7.16	4.27	1.93

[1]Pole reinforced to 40″ above base, to 400″, remaining section is .188″
[2]Pole reinforced to 40″ above base, to 400″, remaining section is .250″
[3]Pole reinforced to 40″ above base, to 500″, remaining section is .250″

Anchor Base and Bolt Detail

Pole Height	Pole Size	Bolt Circle Dia.	Anchor Bolt Projection	Anchor Bolts Size	Base Cover Size	Conduit Opening
12′-16′	4″	11″	3⅛″	¾″ x 15″ + 3″	10½″ sq.	3″ dia.
19½′	4″	11″	3⅛″	¾″ x 30″ + 4″	10½″ sq.	3″ dia.
19½′-25′	5″	11″	3¼″	¾″ x 30″ + 4″	10½″ sq.	3″ dia.
30′	6″	12½″	3½″	1″ x 36″ + 4″	12″ sq.	5″ dia.
30′	6.6″	14½″	3⅞″	1″ x 36″ + 4″	14½″ sq.	5″ dia.

Mounting



Mounting[4]: ☐ **FM** ☐ **A** ☐ **SA** ☐ **B** ☐ **SB** ☐ **L** ☐ **SL** ☐ **T** ☐ **ST** ☐ **C** ☐ **SC**

NOTE: Allowable Pole EPA for jobsite wind conditions must be equal to or greater than fixture mount EPA. Please refer to Kim luminaire catalog for specific fixture.

[4]See luminaire drilling requirements in luminaire catalog.

Structural Luminaires *Only* - Examples

☐ **TS**:Single Tension for small and large Structural - PSA20-5188B-TS
☐ **TD**:Double Tension for small and large Structural - PSA20-5188B-TD
☐ **TR**:Truss for small and large Structural - PSA20-5188B-TR
☐ **XTS**:Single Tension for 1000W Structural - PSA20-5188B-XTS
☐ **XTD**:Double Tension for 1000W Structural - PSA20-5188B-XTD
☐ **XTR**:Truss for 1000W Structural - PSA20-5188B-XTR

