



**NOTE:** The information on these slides is informational. Always check current specifications and standards before using in projects.

# **Traffic Tech Talk #3**

## **Lighting & Electrical**

**Ahmet Demirbilek**

**WisDOT Bureau of Traffic Operations**

**Wednesday, January 18, 12:00pm-12:45pm**

# Overview

- Lighting Systems
- Lighting Design - Lighting Standard Detail Drawings and Standard Specifications
- Electrical Qualified Products List and Material Submittals
- State Furnished Equipment
- Underground/Above Ground Electrical Installations
- Lighting Structure Inspections



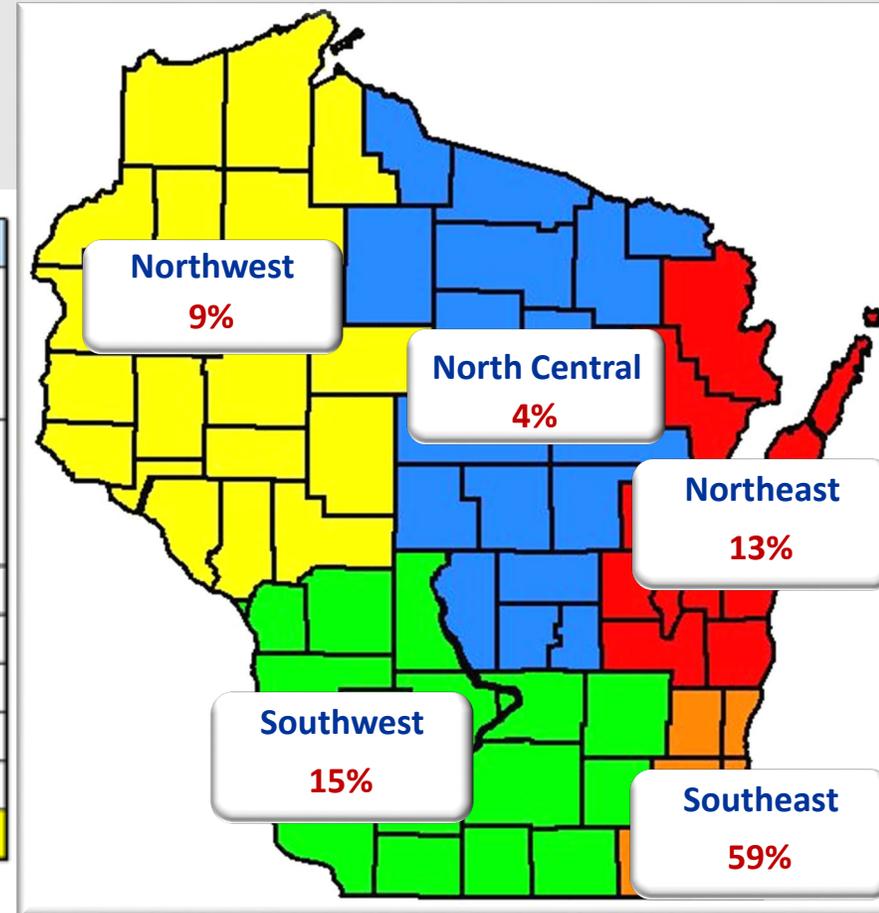
# WisDOT's Street Lighting Inventory Overview

Where are WisDOT's Street Lights?

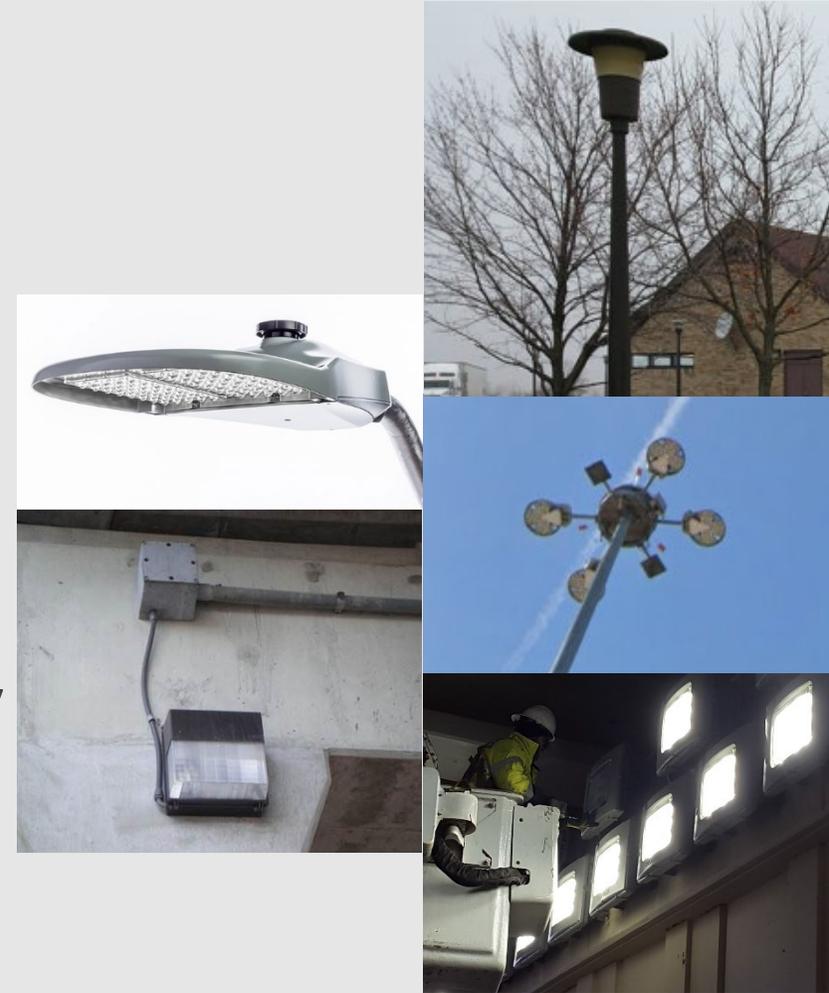
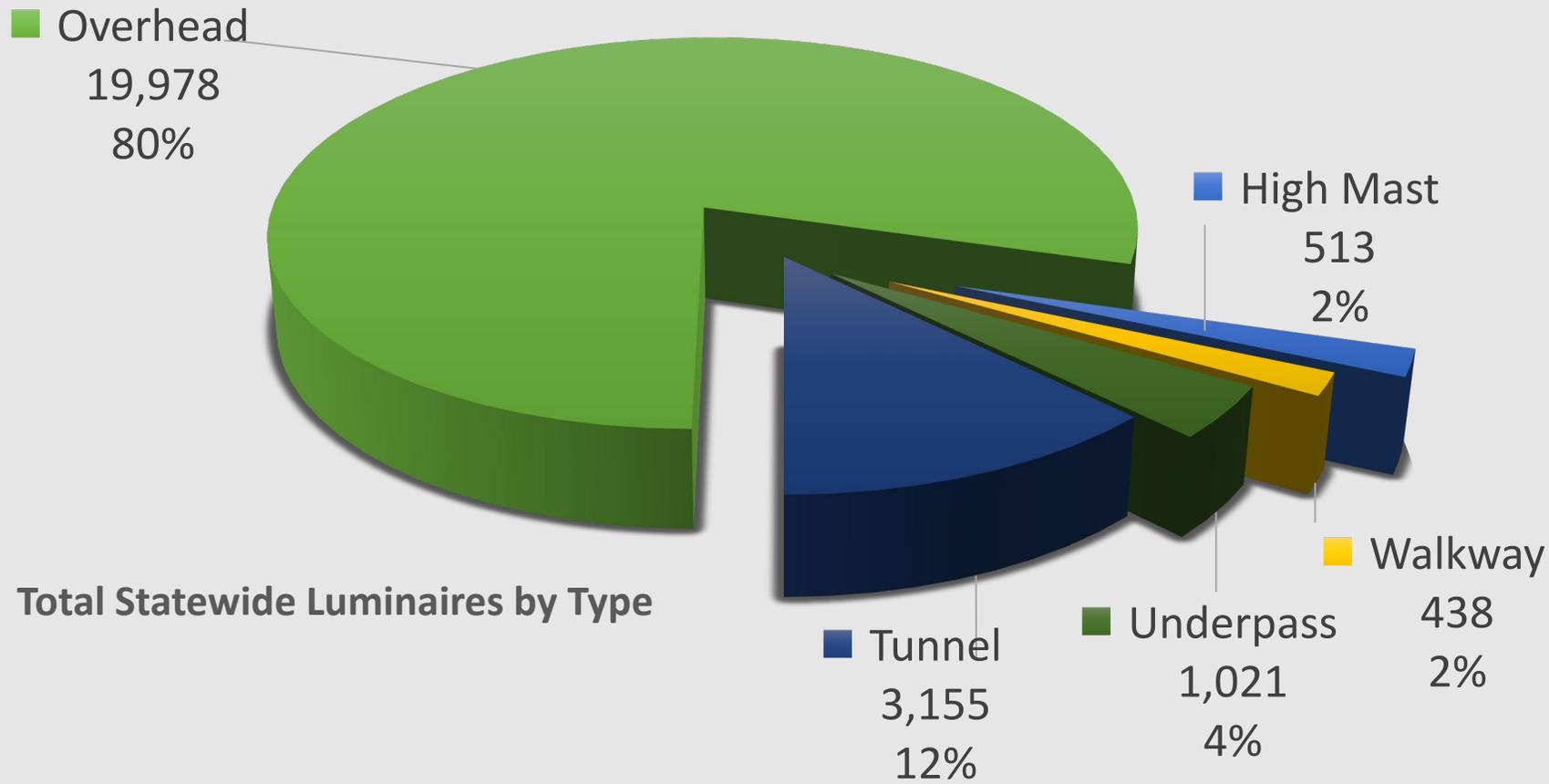
Luminaire Inventory Tracking by Region - w/ Improvement Projects

To-Date

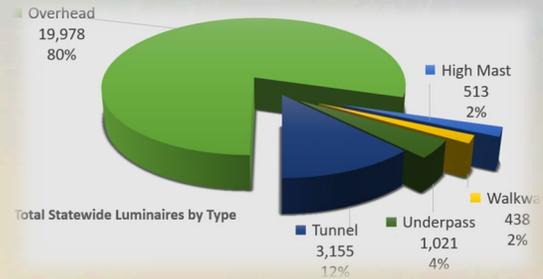
Region	HPS Standard	HPS Tunnel	LED Standard	LED Tunnel	Total	% LED
NC	41	0	908	0	949	96%
NE	0	0	3,288	0	3,288	100%
NW	11	0	2,426	70	2,507	100%
SE	1,172	869	10,423	1,216	13,680	85%
SW	181	0	3,746	0	3,927	95%
<b>Statewide</b>	<b>1,405</b>	<b>869</b>	<b>20,791</b>	<b>1,286</b>	<b>24,351</b>	<b>91%</b>



# 5 Primary Luminaire Types



# Overhead/Cobrahead Luminaires



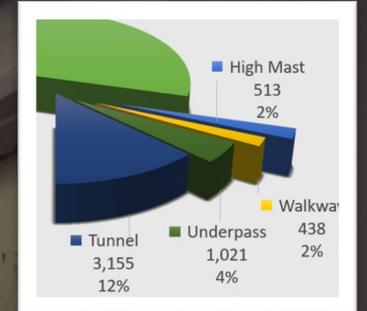
# High Mast Luminaires



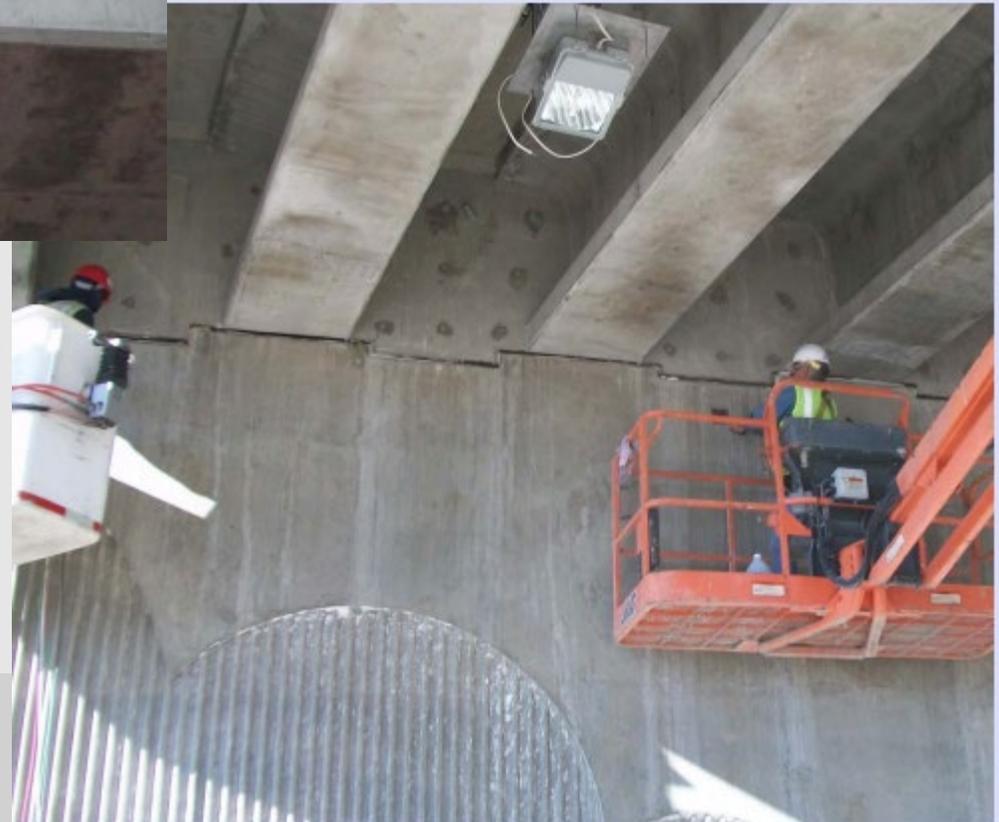
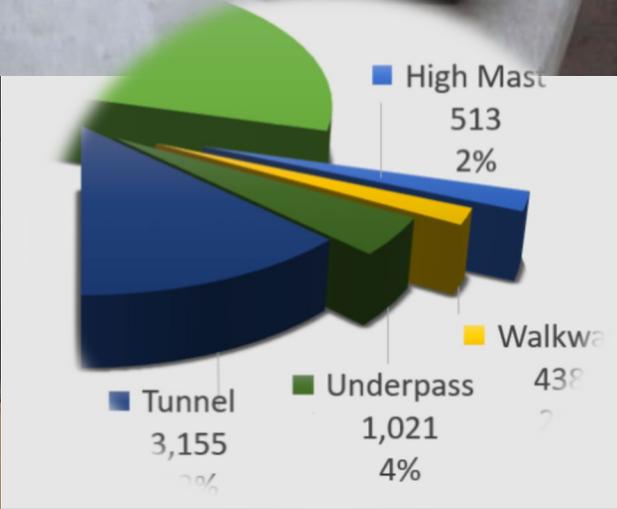
# Tunnels/Covered Roadways



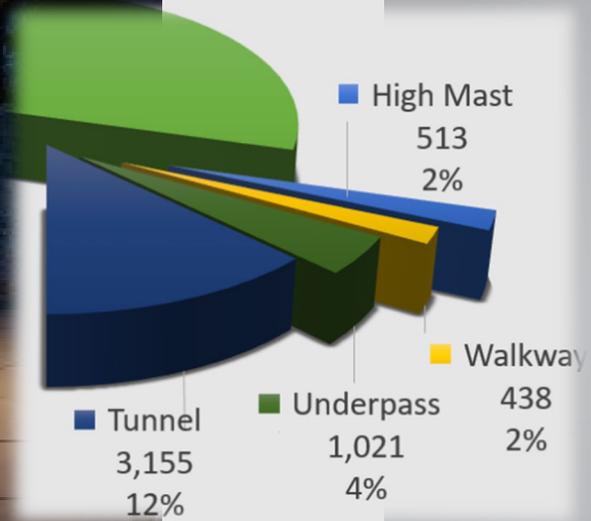
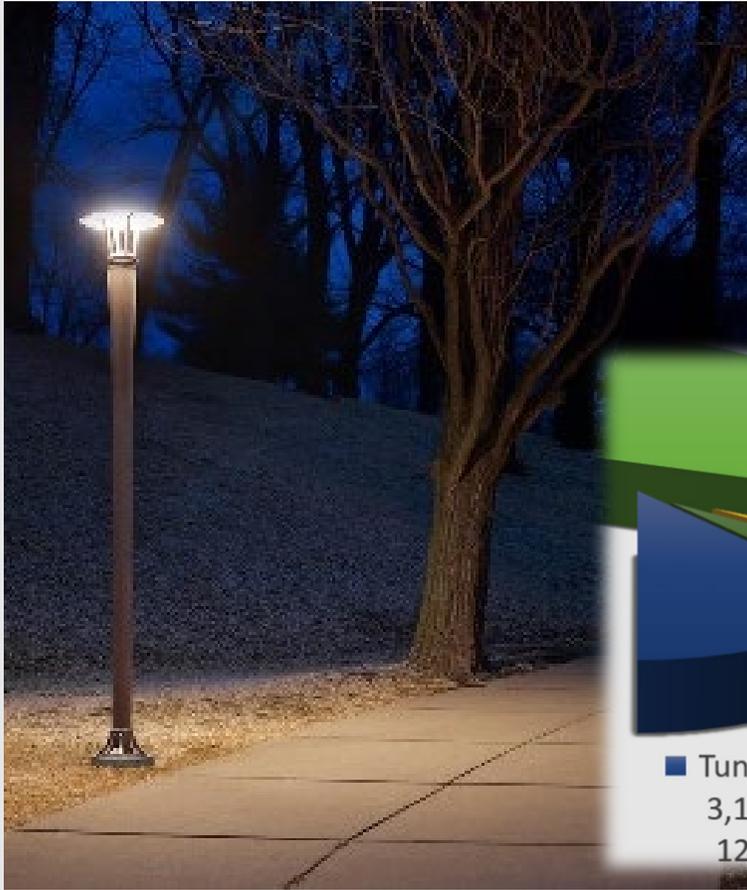
## Tunnel Lighting



# Underpass/Underdeck Luminaires



# Walkway Luminaires



# Temporary Lighting



# Sign Lighting



# Navigation and Aviation Lights



# Accent Lighting



# Lighting Control Cabinet



# Lighting Design

FDM 11-50-60 Lighting

September 19, 2013

## 60.1 General

WisDOT takes a conservative approach to the use of lighting, primarily because of the high cost of installation, coupled with the long-term maintenance and energy expenditures involved. There are several cases where safety concerns have been evaluated and lighting is always installed. These are:

- at signalized intersections
- at roundabouts
- the Milwaukee area freeways

Other than these, lighting is typically not installed unless it can be proven that the lack of illumination is the cause of the accidents/confusion at the site and the installation of lighting is the only remedy. [TEOpS 11-3-1](#) describes the policy and the approval process for lighting on State Highways.

Local units that are insistent upon WisDOT providing the lighting for various locations on the State Highway systems can be accommodated and the lighting included as part of the construction contract if the local unit will pay for the installation and all future maintenance and energy costs involved. This is accomplished with a permit. The permit policy and process are described the [TEOpS Chapter 11](#).

WisDOT also makes provisions for the lighting of major bridges in communities by installing necessary conduit, etc., during construction of the bridge. However, lighting of such bridges is the responsibility of the community, and all costs relating to installation, maintenance, and operation must be assumed by them.

A related topic concerns the use of breakaway supports for lighting installations as well as for signs and traffic signals. WisDOT has adopted the 1985 AASHTO Standard Specifications on the subject, which delineate requirements for the usage and design of such devices. The primary criterion of breakaway supports is that they allow the luminaire, sign, or signal to be safely displaced by a vehicle impact (from any possible direction or by any portion of the vehicle) without hazardous intrusion into the passenger compartment or causing a more serious accident (such as overturning the vehicle or directing it back into traffic, etc.).

Various release mechanisms have been developed, utilizing slip planes, plastic hinges, fracture elements, and combinations thereof. Since product costs vary considerably, contact BTO for more information. For installations within the clear zone (as well as for those beyond the clear zone, where the need exists), the designer should employ the least hazardous breakaway support that can be economically obtained.

- AASHTO Roadway Lighting Design Guide
- ANSI / IESNA Roadway Lighting RP-8-00

concerns have been evaluated and lighting is always installed. These are:

- at signalized intersections
- at roundabouts
- the Milwaukee area freeways





PURPOSE

This policy describes the requirements for approval of Lighting on the Wisconsin State Highway System.

POLICY

All lighting on the state trunk highway system shall require approval in accordance with this policy.

WisDOT Maintained Systems

The State Lighting Systems Engineer in the Bureau of Traffic Operations shall approve all proposed new lighting system installations on state trunk highways except as described below. When there is a possibility a project may include the installation of lighting, the DOT project manager for design shall work with the region lighting engineer in the traffic section to submit a DT1198 Roadway Lighting System Approval Request, supported by an investigation report, to the State Lighting Systems Engineer. These documents shall be submitted before any commitments are made concerning the installation of lighting systems.

The following lighting needs are required by the department and are exempt from the formal approval process. However, in these cases the project manager shall work with the region lighting engineer to accommodate coordination and oversight of the design:

- signalized intersections
- roundabouts
- metered ramps
- tunnels
- special facilities
  - Weigh stations
  - Park-rides
  - Crash investigation sites
  - Rest areas
  - Waysides

Improvement projects on roads where lighting presently exists are also exempt from the formal approval process.

The investigation report provides an objective description and analysis of the roadway/project for the State Lighting Systems Engineer to use in recommending installing and maintaining a lighting system.

The report shall include:

- DT1198 Roadway Lighting System Approval Request.
- Description/discussion of the project and plan drawing of the roadway project under consideration
- Data pertinent to determine the need for lighting that includes, but not limited to:
  - traffic volumes minimally broken down into day vs. night, but more specific time periods when pertinent to the investigation
  - crash history on the existing road including type of crash and if darkness was a pertinent factor
  - evaluation of other crash avoidance measures (geometric, signing, striping, etc.) being considered and/or implemented and how lighting relates to this overall safety evaluation
  - analysis based on the minimum warranting conditions as minimum thresholds for further consideration of lighting as described in the current AASHTO Roadway Lighting Design Guide
- Installation cost, maintenance cost, and what agency is funding/maintaining the system

# Lighting Design

- signalized intersections
- roundabouts
- metered ramps
- tunnels
- special facilities
  - Weigh stations
  - Park-rides
  - Crash investigation sites
  - Rest areas
  - Waysides



# Crash Investigation Site Lighting



# Clear Zone



**Breakaway/Transformer Base**





**Table 2. Minimum Lateral Offsets**

FACILITY TYPE	SPEED LIMIT (MPH)	TRAFFIC VOLUME (ADT**)	MINIMUM RIGID (FEET)	OFFSET BREAKAWAY (FEET)
<b>RURAL</b>	35 or less 40	ALL	12	SHOULDER width plus 2
		0 – 1,000	14	2
		1,500 – 6,000	16	2
		over 6,000	18	2
	45-50	0 – 1,500	20	2
		1,500-6,000	26	2
		over 6,000	28	2
	55	0 – 1,500	24	2
		1,500 – 6,000	30	2
over 6,000		30	2	
<b>URBAN</b>	40 or less	ALL	2 from face of curb	2 from face of curb
	45 and higher	ALL	Offsets same as rural section	(Measured from the edge of thru lane) the greater of 12 or 2 from face of curb



\$600,000 | Project ID 0072-40-54

\$2.5 Million | Project ID 0072-40-58

2018

All Regions – Inventory Procurement

Overhead, Walkway, Underdeck, High Mast

# LED Retrofit

6-Year

Improvement Plan

\$600,000 | Project ID 0072-40-54

\$2.5 Million | Project ID 0072-40-58

2019

&

2020

All Regions – Inventory Procurement

Overhead, Walkway, Underdeck,  
High Mast, Mitchel Tunnel #3

\$2.7 Million | Project ID 0072-40-54

2021

SE Region – Tunnel Conversions

Mitchel Tunnels #1, #2 & Tory Hill Tunnel

NW Region – Tunnel Conversion – STH 93

\$3 Million | Project ID 0072-40-54

2022

SE Region – Tunnel Conversions

Killbourne Tunnels & Howell Tunnel

SE Region – Inventory Procurement

Traffic Signal Lighting

&  
2023



# LED Retrofit Goals

**100%  
Conversion  
Target to  
LED**

**↓  
Energy  
Costs**

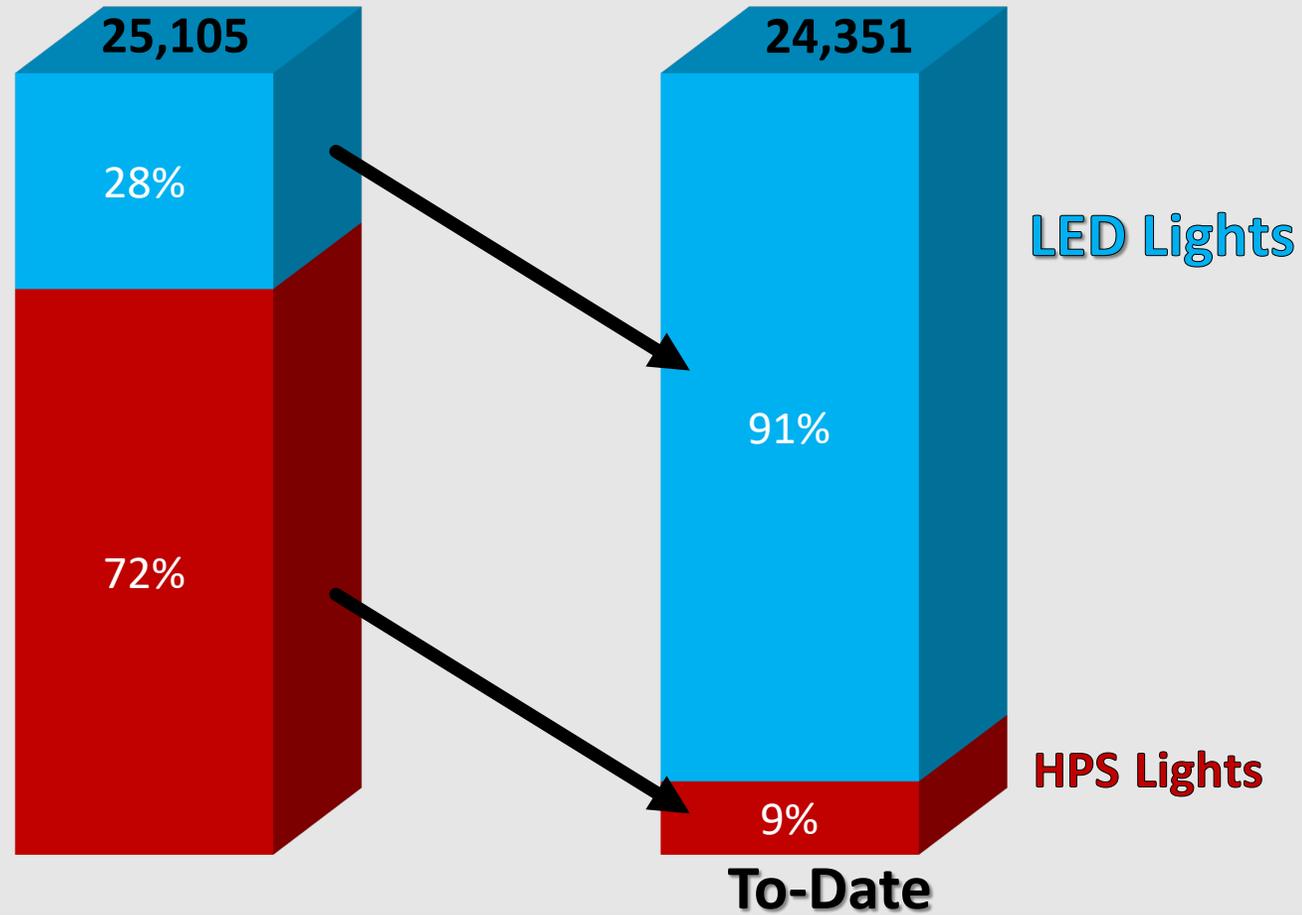
**↓  
Routine  
Maintenance  
Costs**

**↑  
WisDOT  
Lighting  
Efficiency**

**↑  
Control  
of Light**



# Project Results & Savings



# Project Results & Savings

**\$8.2 Million Investment (to-date) Pay-Back in Less Than 5 Years**

**\$1.61M Total Annual Savings**



**Annual Savings**

**Maintenance Savings**

**Energy Savings**



**One Time Savings**

**Focus on Energy Savings**

**Bid Reduction Savings**

**\$1.65M Total Initial Savings**



# The Future of Street Lighting



Smart Cities  
Initiatives & IOT

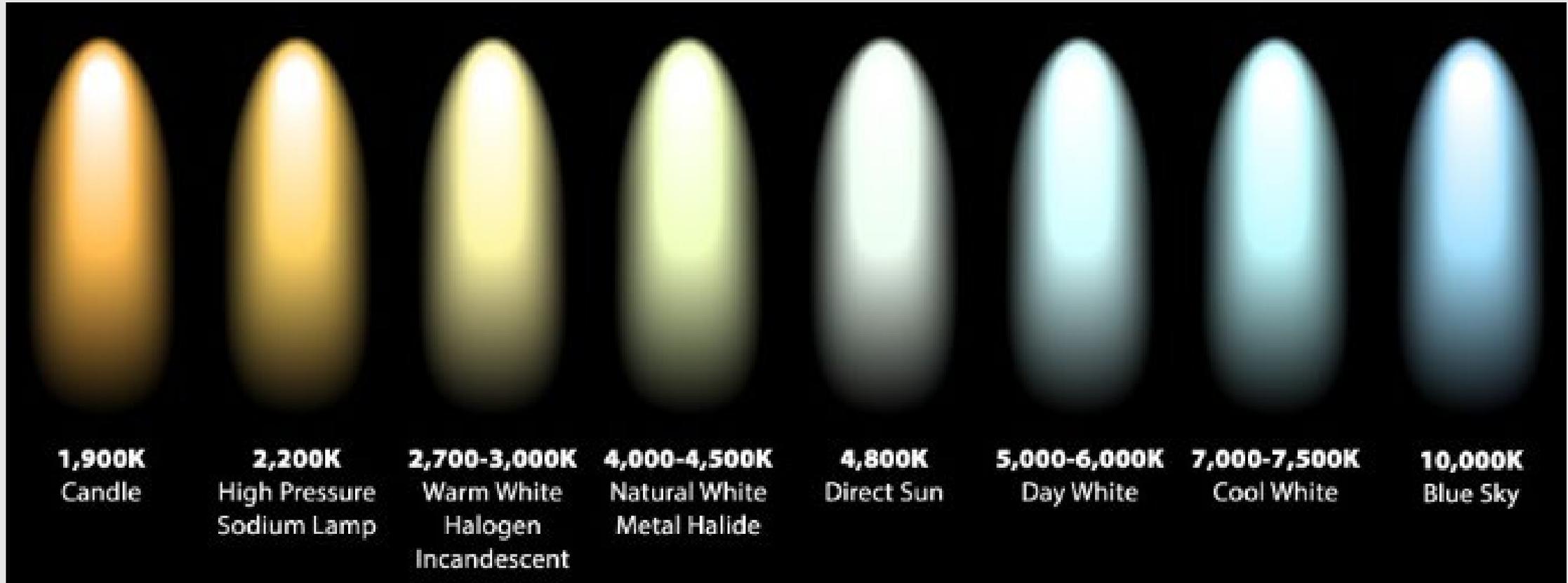
Remote Lighting Control  
System



# Combined Infrastructure

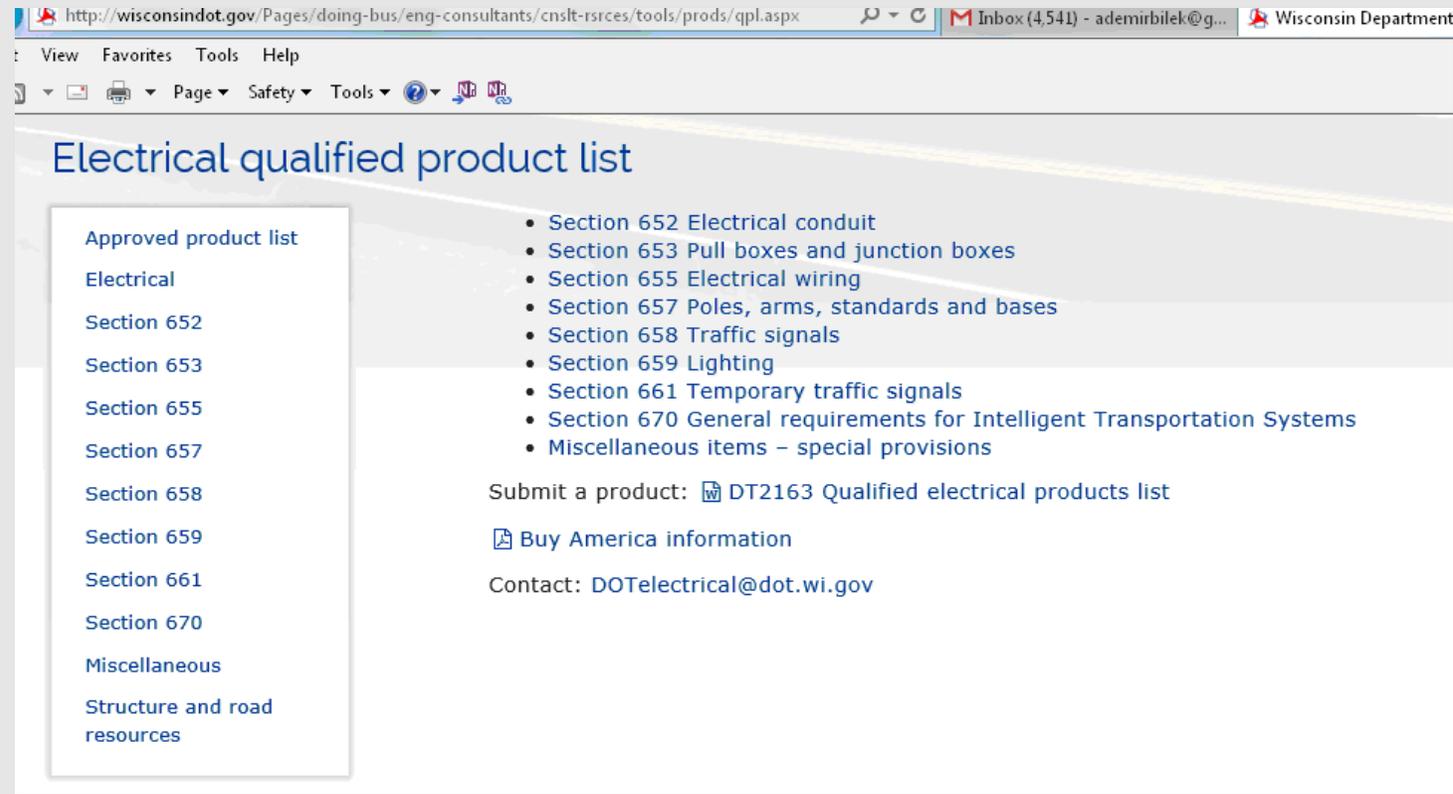


# Lighting Color Temperature Spectrum



# Electrical Qualified Product List QPL

- What is the Qualified Products List (QPL)
- What is the process to add/delete an item
- Feedback/Comments



The screenshot shows a web browser window with the URL <http://wisconsin.gov/Pages/doing-bus-eng-consultants/cnslt-rsrcs/tools/prods/qpl.aspx>. The page title is "Electrical qualified product list". On the left side, there is a navigation menu with the following items: "Approved product list", "Electrical", "Section 652", "Section 653", "Section 655", "Section 657", "Section 658", "Section 659", "Section 661", "Section 670", "Miscellaneous", and "Structure and road resources". The main content area on the right lists the following sections:

- Section 652 Electrical conduit
- Section 653 Pull boxes and junction boxes
- Section 655 Electrical wiring
- Section 657 Poles, arms, standards and bases
- Section 658 Traffic signals
- Section 659 Lighting
- Section 661 Temporary traffic signals
- Section 670 General requirements for Intelligent Transportation Systems
- Miscellaneous items – special provisions

Below the list, there is a link to "Submit a product: DT2163 Qualified electrical products list" and a link to "Buy America information". The contact information is "Contact: DOTelectrical@dot.wi.gov".



# Qualified Products List

- List was reformatted in 2012 and continues to be updated
- 2013 web based QPL launched
  - ✓ Able to links to product information sheets,
  - ✓ Specs, vendor websites

Section 658: Traffic signals

Approved product list	Item number	Description	Product name	Manufacturer/vendor	Date approved
Electrical					
Section 652	658.0101-0165	Traffic Signal Face (Section) (size)	McCain	McCain, Inc.	Dec. 2, 2013
Section 653			Eagle SIG (LFE Automatic)	Siemens	Feb. 23, 2016
Section 655			Peek	Peek Traffic Corp.	Dec. 2, 2013
Section 657					
Section 658			Chapel Hill	Traffic Parts Inc.	Dec. 2, 2013
Section 659					
Section 661					
Section 670	658.0205-0300	Backplates Signal Face (Section) (size)	McCain	McCain, Inc.	Dec. 2, 2013
Miscellaneous			Eagle SIG (LFE Automatic)	Siemens	Dec. 2, 2013
Structure and road resources			Peek	Peek Traffic Corp.	Dec. 2, 2013
			Chapel Hill		Dec. 2, 2013
	658.0412-0416	Pedestrian Signal Face (Inch)	McCain	McCain, Inc.	Dec. 2, 2013
			Eagle SIG (LFE Automatic)	Siemens	Dec. 2, 2013

## LOOP LEAD-IN CABLE

IMS Specification 50-2 Loop Lead-In Cable



Specifications		Color Code		Pair Types	
Conductor - Standard Three Copper	Shielding - Aluminum Jacket - Polyethylene	Clear/Black (1 Pair Types)	Standard Reels 1,000', 2,500', 5,000'	other sizes available, please contact your factory representative for availability.	
16 AWG - 0307 PE	Voltage Rating - 600V				
14 AWG - 0307 PE	Temp. Rating - 75°C				
12 AWG - 0307 PE					

PART NO.	AWG	NO. OF PAIRS	OUTER JKT THICKNESS		NORMAL O.D.		WEIGHT LBS. / 100'
			INCH	MM	INCH	MM	
<b>18 AWG</b>							
8741	18	1	.030	.762	.286	7.25	29
8742A	18	2	.030	.762	.322	8.19	54
8743A	18	3	.030	.762	.465	11.81	78
<b>16 AWG</b>							
8750	16	1	.030	.762	.292	7.42	38
<b>14 AWG</b>							
8780	14	1	.030	.762	.332	8.43	55
8782A	14	2	.030	.762	.400	10.16	102
8783A	14	3	.030	.762	.566	14.38	120
8784A	14	4	.030	.762	.584	14.83	171

**Cable Identification**  
 Indent print on jacket "ADVANCED DIGITAL CABLE YYY Y IMSA 50-2 600V"  
 \*replace YYY with year of manufacturer

ble.com

MONDAY, 06 JANUARY 2014

FOLLOW US: [Social Media Icons]

CALL US: 1.800.343.2579

## ADC

ADVANCED DIGITAL CABLE INC.

HOME PRODUCTS CORPORATE INFO TECHNICAL INFO CONTACT US

Introducing PowerPlex™

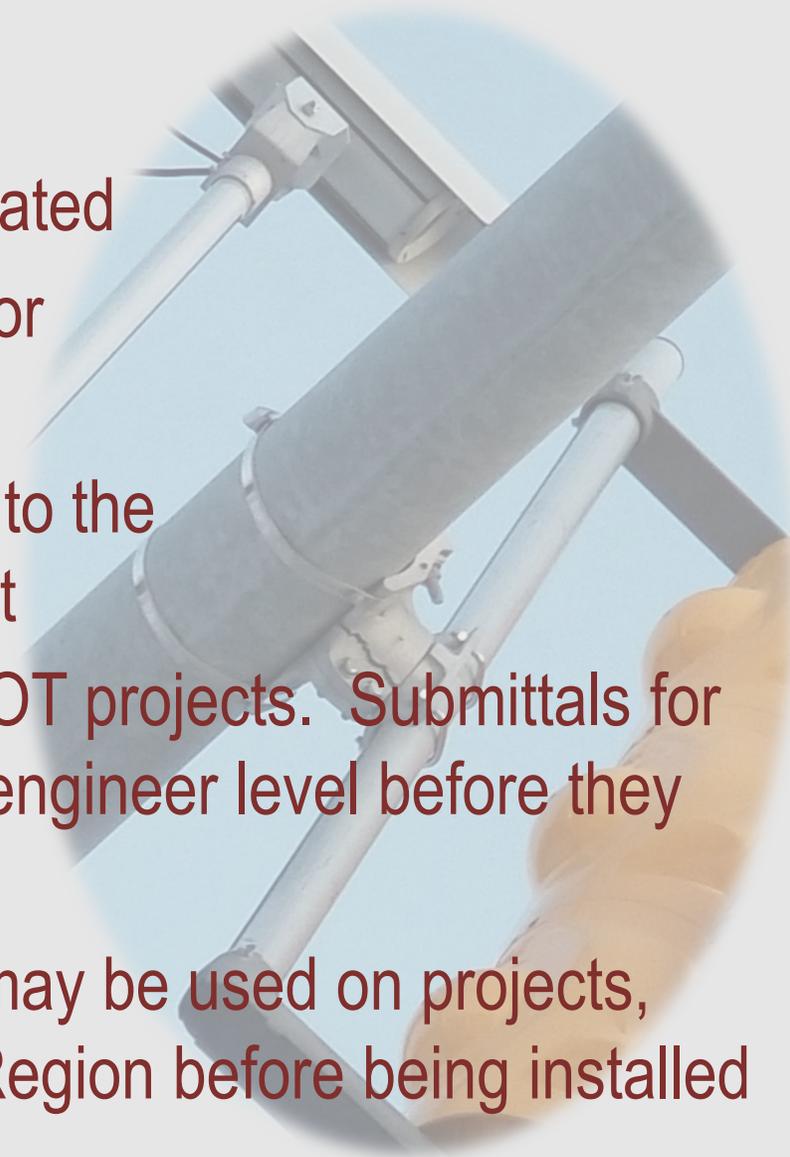
Avoid the costly set-up of multiple reels and the tangled mess of a paralleled reel. Make your next pull easier, faster with less tension and stress. Get PowerPlex™!

Download Brochure



# Updating the QPL

- DOT staff may request an item to be added, removed or updated
- Alternatively, vendors and contractors may request updates or additions
- The product is evaluated and/ or tested prior to being added to the list. We like to try the product out in the field before we add it
- Qualified means the items are pre-qualified for use on WisDOT projects. Submittals for items on the QPL are reviewed and approved at the project engineer level before they are installed
- Products that meet the specifications but are not on the list may be used on projects, however they require review and approval by BTO and the Region before being installed



# State Furnished Equipment-Procurement Contracts

## Monotube Pole Timeline

### State Supplied



### Contractor Supplied \*



\* Local Program Always Used this Process



# Monotube Poles and Arms

- If there are Department furnished monotube poles and arms on project, should be a SPV indicating this.

REGION	WHO WILL FURNISH
SE	All <b>Department</b> Furnished Monotube poles and arms
SW	All <b>Contractor</b> Furnished Monotube poles and arms
NW	All <b>Contractor</b> Furnished Monotube poles and arms
NC	All <b>Contractor</b> Furnished Monotube poles and arms
NE	All <b>Contractor</b> Furnished Monotube poles and arms



# Monotube Signal Poles

## Qualified Manufacturers

- ✓ Millerbernd
- ✓ Valmont
- ✓ Ameron

## Monotube Pole Arm & Length Combination

- **Small (Type 9 & 10 Pole ) Mast arm Length: 15, 20, 25,30 ft arm**
- **Medium (Type 9 & 10 Special Pole) Mast arm Length: 35, 40,45 ft special arm**
- **Big Pole ( Type 12 & 13 Pole) Mast arm Length: 35, 40, 50, 55 ft arm**



657.1345-1555	Monotube poles and arms	Steel	Valmont	Valmont Industries, Inc.
		Steel	Millerbernd	Millerbernd Manufacturing Co.
		Steel	Ameron	Ameron

# Stakeholder Involvement

- Traffic Signal Standing Committee (TSSC)
  - Quarterly meetings
- Electrical Standards Standing Committee (ESSC)
  - Quarterly meetings
- Roadway Lighting Standing Committee (RLSC)
  - Bimonthly meetings
- Trainings
  - Arc Flash Electrical Safety NFPA 70E
  - NEC Refreshment
  - Annual Roadshow



# Underground/Above Ground Electrical Installations

- Conduit
- Pull Box, Communication Vault
- Base (Foundation)
- Transformer (Breakaway Base)
- Pole, Arm, Luminaire Arm



# Conduit (UL or NRTL listed)

- **Rigid Metallic Conduit (Galvanized) IMC (intermediate metal conduit) is not approved to Install**
- **Rigid Non-Metallic PVC Conduit (Schedule 40–80) Methods of heating: Hot Boxes, Heat Blankets Fabricated elbow . Do not use torches to heat.**
- **Fiberglass Conduit -RTRC (Reinforced Thermosetting Resin Conduit)**
- **HDPE Conduit (High-density Polyethylene)**



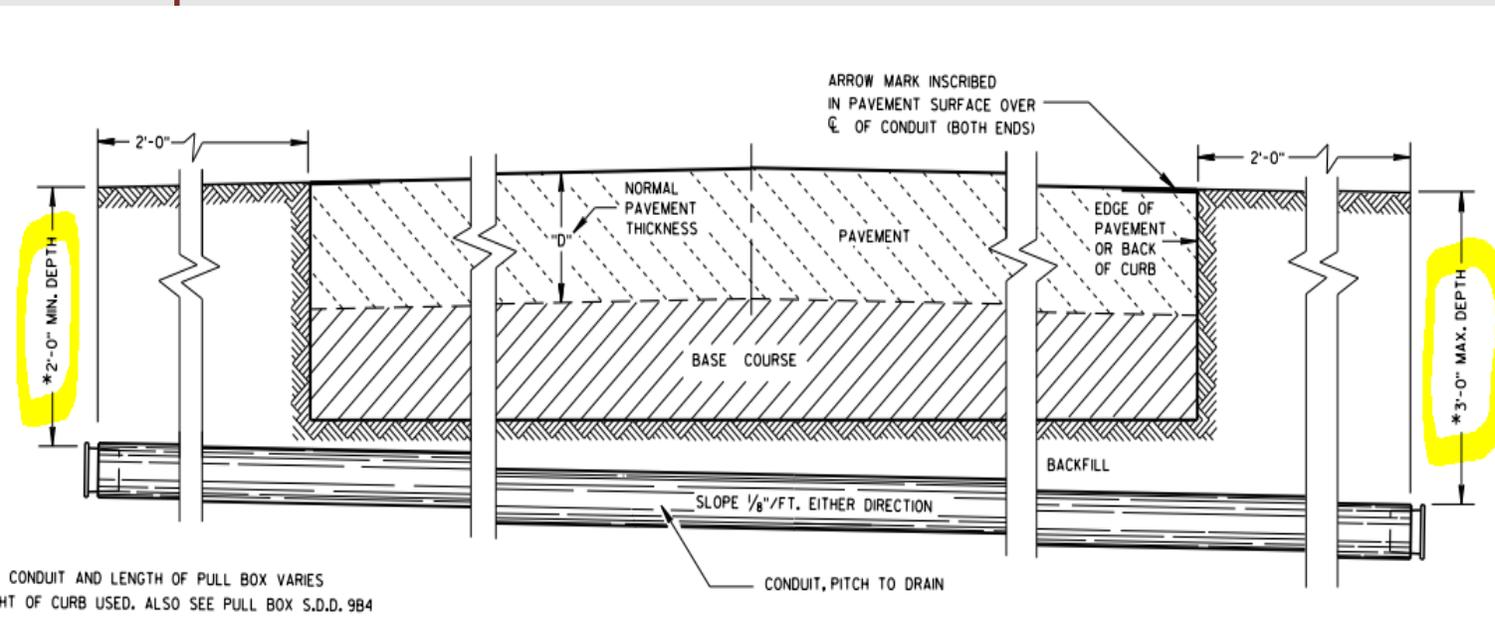
# Conduit Installation Methods

- Directional Boring
- Hydro Excavation
- Plowing
- Hand Digging
- Backhoe



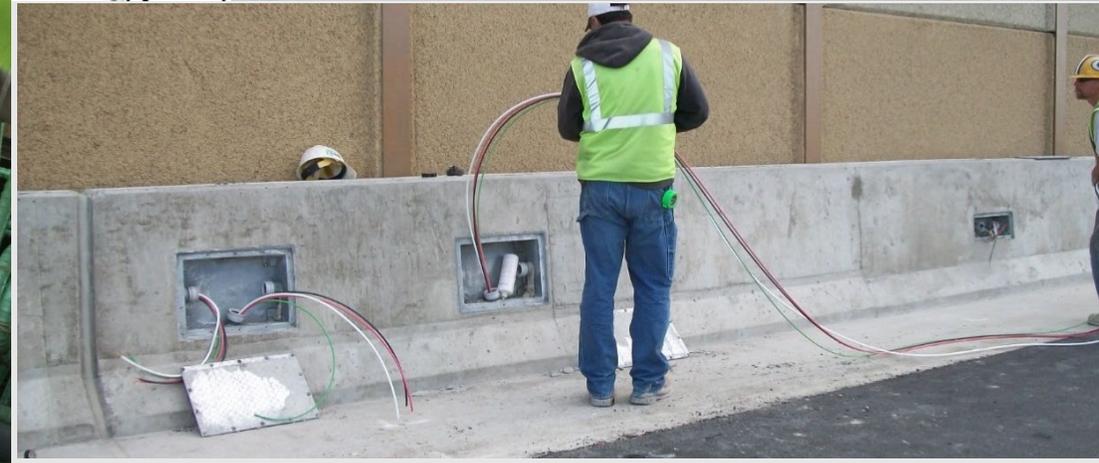
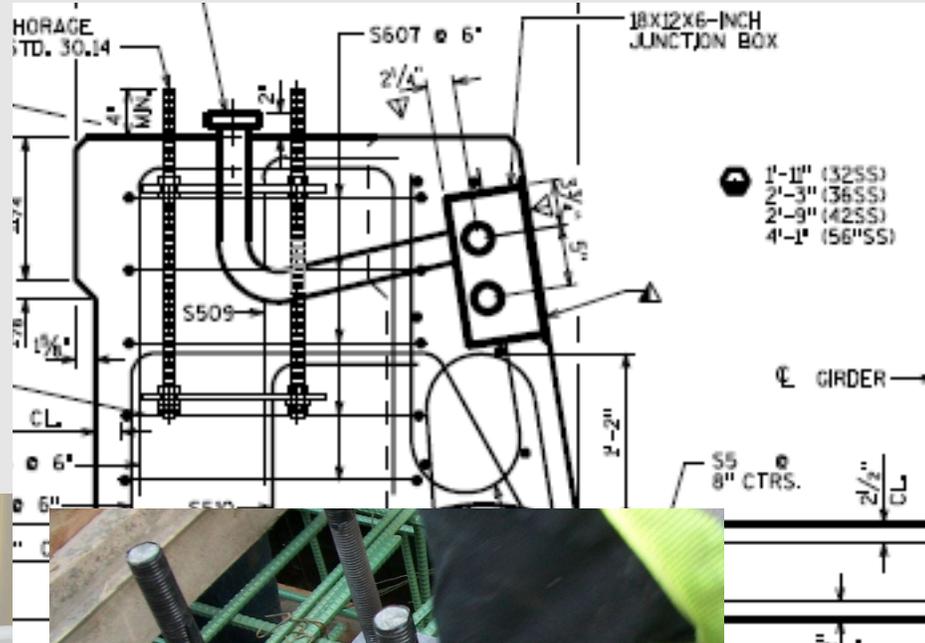
# Backfill and Conduit Dept

- Trench shall not be backfilled prior to inspection
- Backfill compacted in layers not exceeding 12 inches.
- Conduit depth max 36 Inches/min 24 Inches
- Maximum number of bends not exceed 360° between junction points

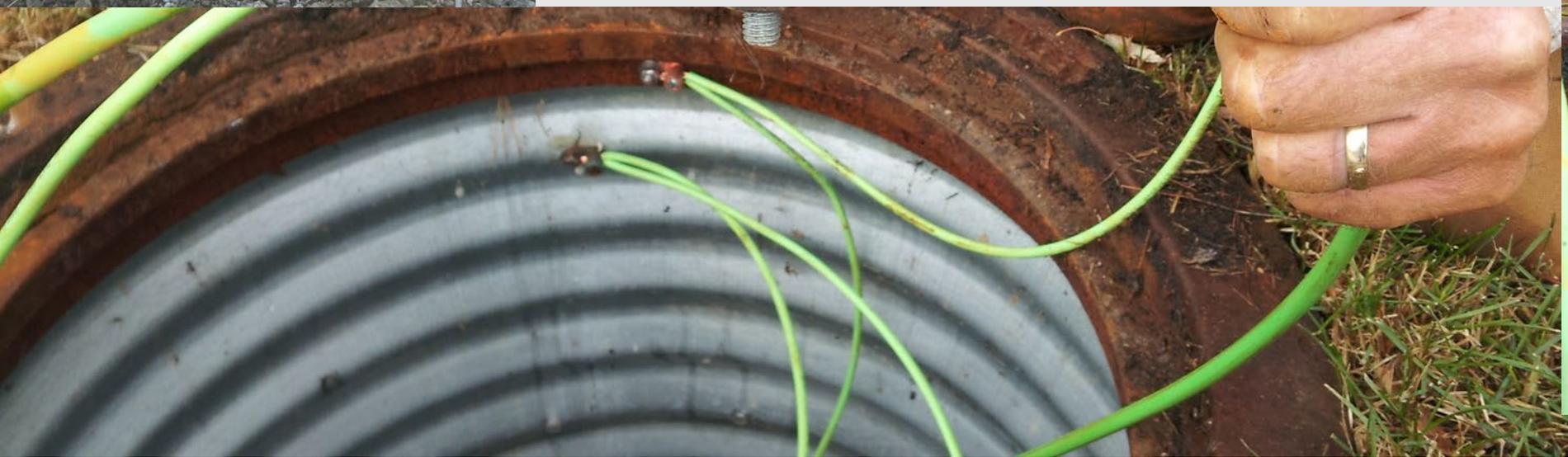


# Junction Boxes

- Max distance between junction box from 190 feet to 200 feet







# Pull & Junction Box, Vault Tier Rating

## General Installation Application Map ANSI/SCTE-77 2013 Specification

### APPLICATION

#### Light Duty

Pedestrian Traffic Only

### LOADING REQUIREMENTS

#### TIER 5

Sidewalk applications with a safety factor for occasional non-deliberate vehicular traffic.

<b>Vertical</b>	Test Load	13.3kN	3,000 pounds
<b>Vertical</b>	Design Load	22.2kN	5,000 pounds
	Test Load	33.3kN	7,500 pounds
<b>Lateral</b>	Design Load	28.7kPa	600 pounds/sq.ft.
	Test Load	43.1kPa	900 pounds/sq.ft. (1800/2700 lbs/ lateral load plate)

#### TIER 8

Sidewalk applications with a safety factor for non-deliberate vehicular traffic.

<b>Vertical</b>	Design Load	35.6kN	8,000 pounds
	Test Load	53.4kN	12,000 pounds
<b>Lateral</b>	Design Load	28.7kPa	600 pounds/sq.ft.
	Test Load	43.1kPa	900 pounds/sq.ft. (1800/2700 lbs/ lateral load plate)

#### TIER 15

Driveway, parking lot, and off-roadway applications subject to occasional non-deliberate heavy vehicular traffic

<b>Vertical</b>	Design Load	66.7kN	15,000 pounds
	Test Load	100.1kN	22,500 pounds
<b>Lateral</b>	Design Load	34.3kPa	800 pounds/sq.ft.
	Test Load	57.5kPa	1,200 pounds/sq.ft. (2400/3600 lbs/ lateral load plate)

#### TIER 22

Driveway, parking lot and off-roadway applications subject to occasional non-deliberate heavy vehicular traffic

<b>Vertical</b>	Design Load	100.1kN	22,500 pounds
	Test Load	150.1kN	33,750 pounds
<b>Lateral</b>	Design Load	38.3kPa	800 pounds/sq.ft.
	Test Load	57.5kPa	1,200 pounds/sq.ft. (2400/3600 lbs/ lateral load plate)

#### AASHTO H-20

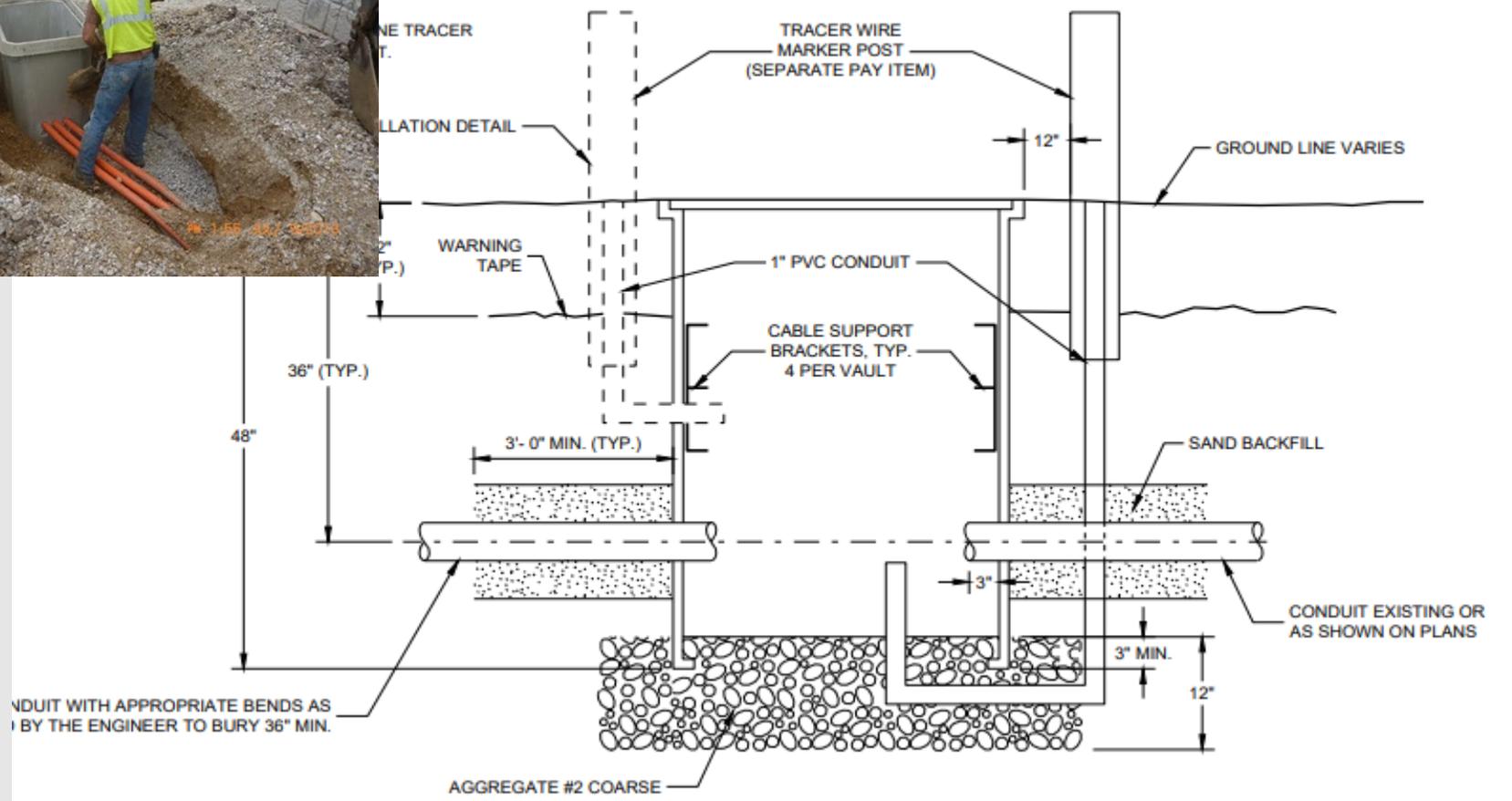
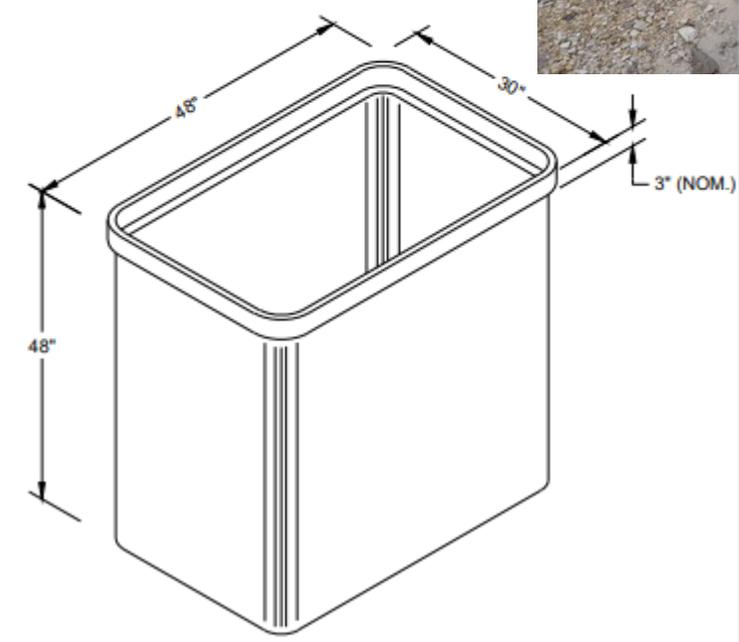
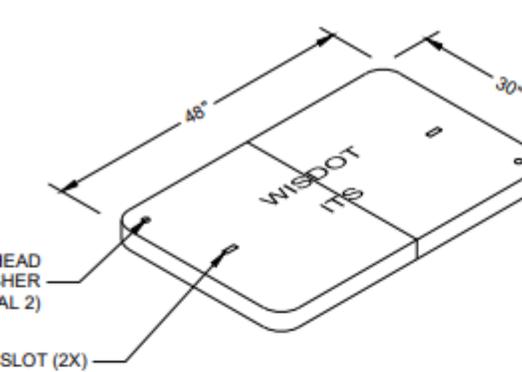
Deliberate vehicular traffic application.

Certified precast concrete, cast iron, or AASHTO-recognized materials.

**Martin Enterprises does not manufacture enclosures that**



# Communication Vault



# Concrete Bases

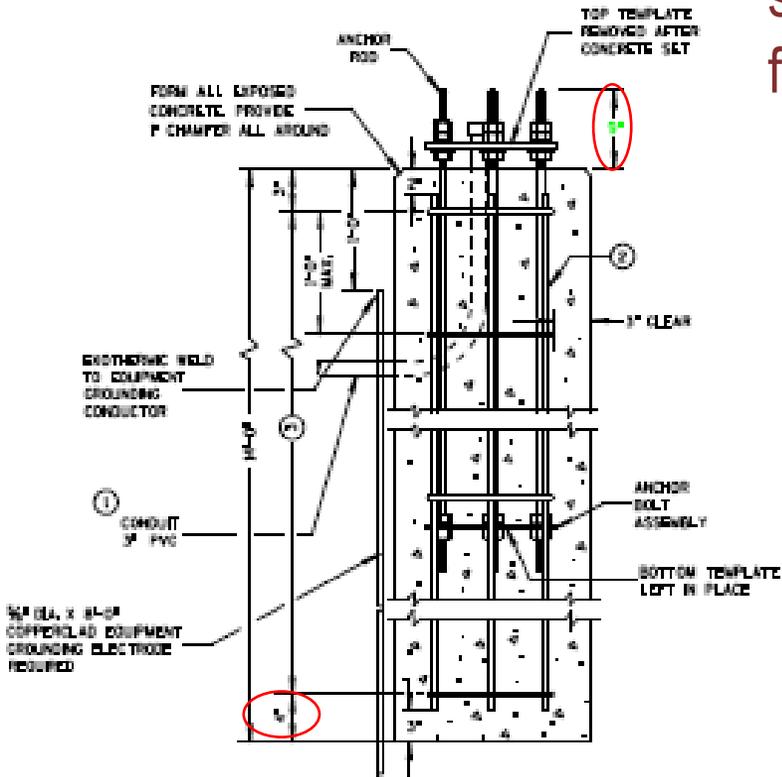
- Concrete Bases Type
- Concrete Control Cabinet Base
- Anchor rods



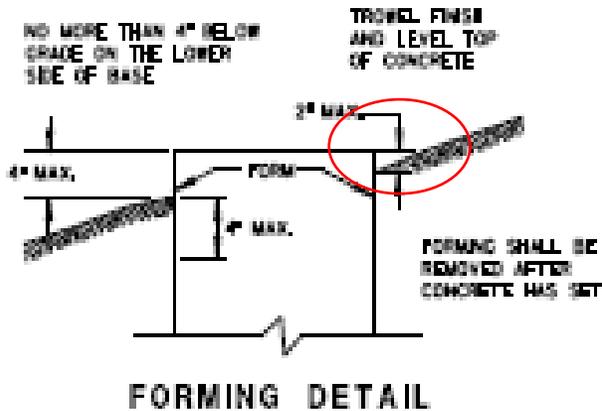
# Pole Base Detail Anchor Rod

Anchor bolts conforming to ASTM F1554 grade 105 for type 1 and 2 traffic signal bases; for type 5, 6, 7, and 8 street light bases; for type 10 control cabinet bases; and for type 11 walkway lighting unit bases.

	F1554 Grade 105
One End Red	



CONCRETE BASE TYPE 10  
(FOR TYPE 8 & 10 POLES)



FORMING DETAIL



Type 10, Type 10 Special and 13 bases for grade 55

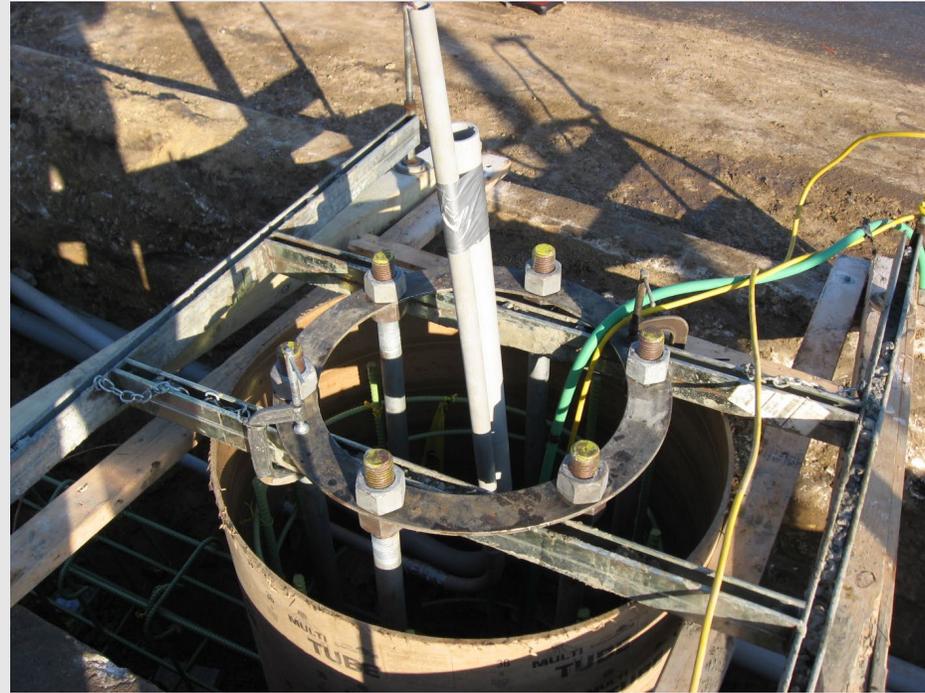
	F1554 Grade 55
One End Yellow	



- Make sure rodent screen installed



# Anchor bolt alignment is critical!!



- The access door of the base must be oriented away from traffic to allow maintenance personnel to see the intersection while servicing the base



**Concrete base location (staking) is crucial**

11-18-2013 12:04

11-11-2013 11:25



# Pole Base Location 10-Foot From Overhead



# Control Cabinet Bases



- Verify base location from the contract drawings all traffic operation elements can be seen from cabinet.
- Verify elevations to avoid flooding or snow accumulation.



# Plan Review

WKE Office 90% 10603381 ROADWAY PLAN SUBMITTAL - Message (HTML)

Message Adobe PDF

Reply Reply Forward Delete Move to Create Other Block Safe Lists Categorize Follow Mark as Find Related Select Find  
Respond to All Actions Junk E-mail Options Find

From: DOTDLCentralOfficePlanReview@dot.wi.gov Sent: Thu 1/15/2015 11:56 AM  
To: DOT DL Central Office Pre-PSE; bill.stoeck@CH2M.com; Bohlen, Jeff - DOT; Pobric, Silvana; Johnson, Chris - DOT (DTSD Consultant)  
Cc: DOT DL Electrical Plan Review; DOT DL Rails Plan Review; DOT DL Signing Plan Review; DOT DL Pavemark Plan Review; DOT DL Traffic Control Plan Review; DOT DL Traffic Signals Plan Review; DOTDLWaukeshaPlanReview@dot.wi.gov; DOTDLWaukeshaPlanReview@dot.wi.gov  
Subject: WKE Office 90% 10603381 ROADWAY PLAN SUBMITTAL

```
comments: Draft PSE Part 10 of 13
stars: *****
header: WKE Office 90% 10603381 ROADWAY PLAN SUBMITTAL
stars: *****

letting_parm: 09_2015_September
project_name: ZOO IC - ZOO INTERCHANGE PHASE 2
route_name: USH 45
structures: NA
additional_ids: 10602370
wdot_contact: Jeff Bohlen/414-750-2928
cons_contact: Bill Stoeck/414-550-1680
stars: *****
affects: A F F E C T S
affects1:
affects2: Rails
affects3:
affects4: Signing
affects5: Traffic_Control
affects6: Pavement_Marking
affects7: Traffic_Signals
affects8: Electrical
affects9: Office : WKE
stars: *****
exhibits: E X H I B I T S   S U B M I T T E D
folder: \\DotDtidN\N4Public\Bhc\PrePSE\wke
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**%90 Plan**

**AFFECTS**



# Plan Review

## 90% Plan (Pre-PS&E) Review

- Bureau Project Development
  - 90% biddability review
  - Constructability review
- Bureau of Traffic Operations
  - Plan quality review
  - Spec, detail drawing and constructability review
  - Permit process checking (if required)
- Provide comments/feedback to the project manager



# Questions?



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