

LOCAL TECHNICAL ASSISTANCE PROGRAM

DROP-IN

NIGHTTIME VISIBILITY FOR SAFETY

MAY 5, 2024



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INSTRUCTOR INFORMATION

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www.gis.penndot.pa.gov/ltap

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LTAP Nighttime Visibility for Safety

An EDC-7 Safety Initiative

Penn LTAP

Joe Cheung P.E. , FHWA Office of Safety



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Agenda

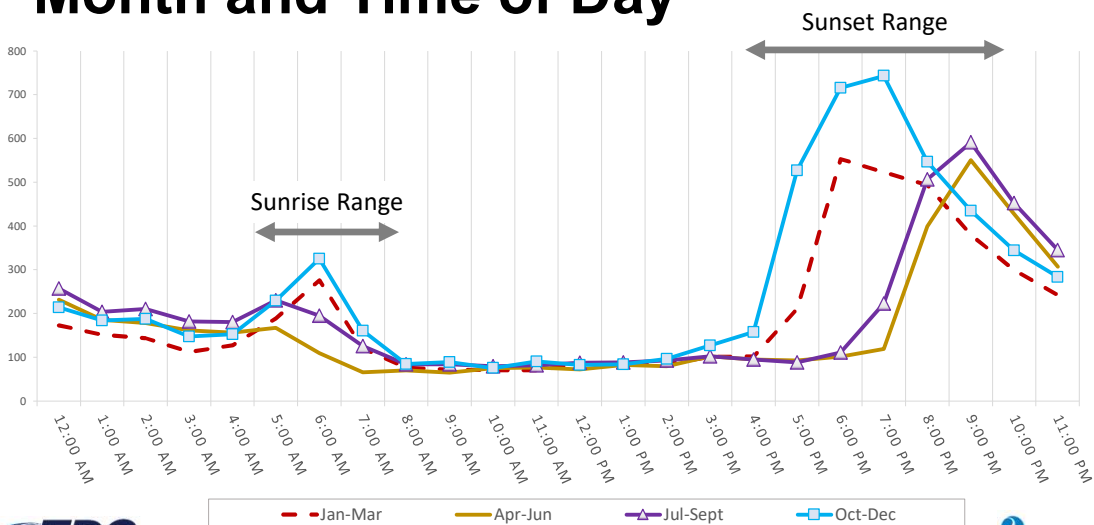
- Why is Nighttime Visibility Important?
- EDC-7 *Nighttime Visibility for Safety* Initiative
- Roadway Departure Benefits
- Intersection Benefits
- Pedestrian & Bicyclist Benefits
- Let's Talk about Lighting!
- Resources
- Wrap-up



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Pedestrians Killed in Fatal Crashes by Month and Time of Day



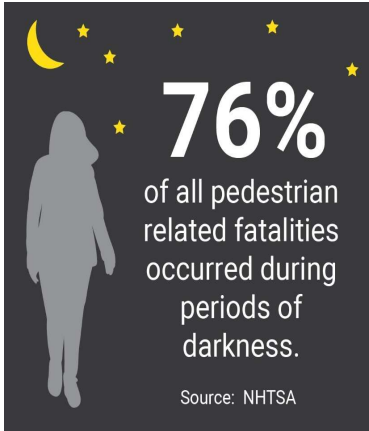
Source: NHTSA FARS 2012-2021 and <https://gml.noaa.gov/grad/solcalc/>



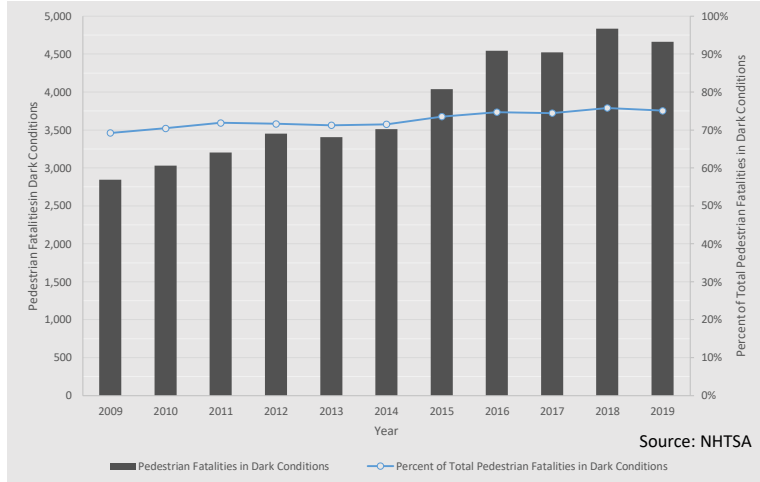
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Pedestrian Fatalities in Dark Conditions



Graphic. Infographic for nighttime pedestrian fatalities.



Dark condition pedestrian fatalities/year and dark condition pedestrian fatalities/year as a percentage of total pedestrian fatalities

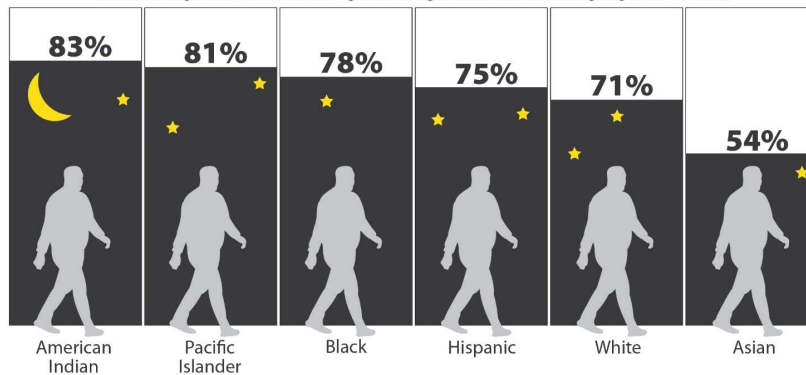
Figure 5 [Pedestrian Lighting Primer \(dot.gov\)](https://www.dot.gov/pedestrian-lighting-primer)



Lighting Impacts on Equity

10-Year Nighttime Pedestrian Fatalities Percentage by Race

for combined Light Conditions of Dark-Not Lighted, Dark-Lighted, and Dark-Unknown Lighting (FARS 2008-2018).



Source: NHTSA FARS (2008–2018)

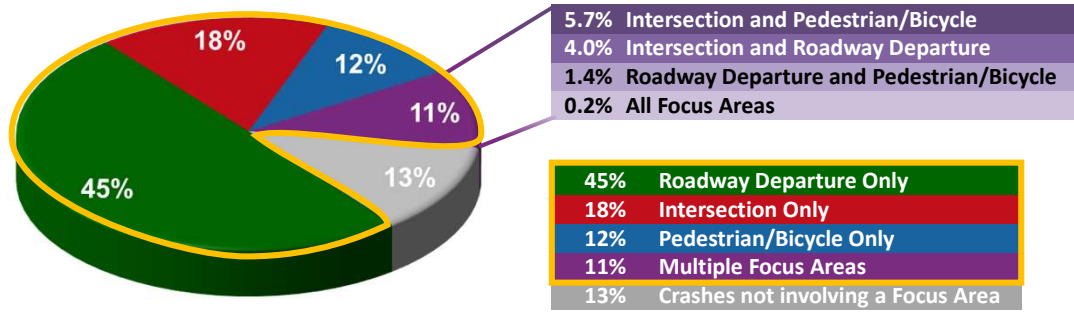


[Pedestrian Lighting Primer \(dot.gov\)](https://www.dot.gov/pedestrian-lighting-primer)



US Fatalities by FHWA Focus Area

Average National Traffic Fatalities: 37,338/Year



Source: NHTSA FARS 2018-2020



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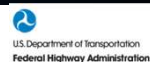
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A State-based model that identifies and deploys proven, yet underutilized innovations — saving time, money and resources that can be used to deliver more projects.

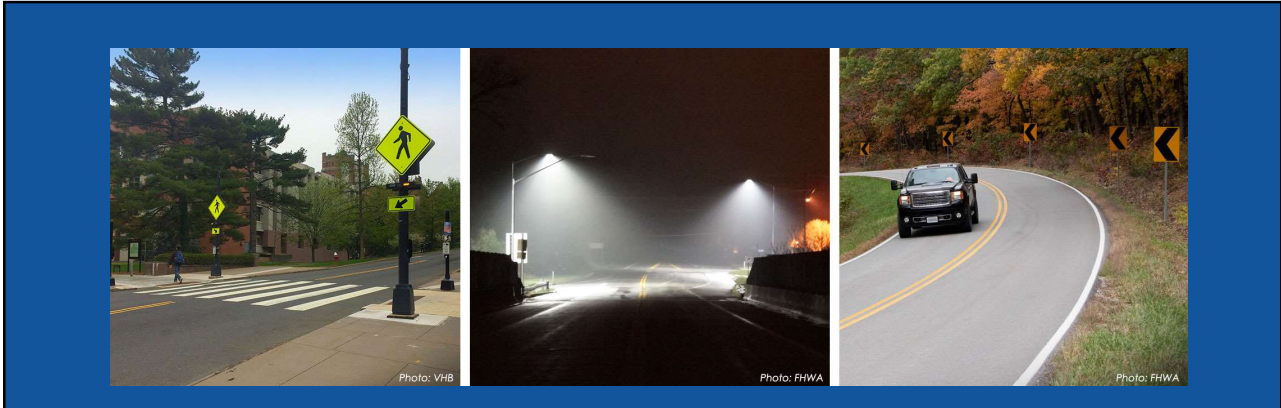


For over 10 years the Federal Highway Administration’s Every Day Counts program has rapidly deployed proven technologies and processes. EDC round 7 (2023-2024) highlights innovations to improve safety for all users, build a sustainable infrastructure for the future and grow an inclusive workforce



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EDC-7 Nighttime Visibility for Safety Initiative

Enhancing Nighttime visibility along corridors, intersections, and pedestrian crossings can help reduce fatalities. This initiative promotes traffic control devices and properly designed lighting to improve safety for all users



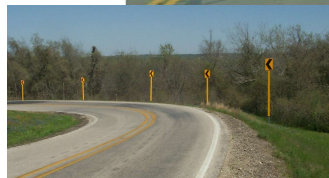
Roadway Departure Benefits



Roadway Departure Benefits



- Horizontal curve delineation enhancements through the use of chevrons (16- to 25-percent reduction)
- Edge and center line markings (24-percent reduction)
- Fluorescent sheeting for warning signs (18-percent reduction)
- Other enhancements like retroreflective raised pavement markers and delineators



Additional treatments that enhance conspicuity may be appropriate

- Bigger signs
- Doubling-up
- Fluorescent yellow prismatic sheeting
- Overhead placement
- Warning beacon
- Reflectorized posts
- Others in [MUTCD 2A.15](#)

Data Sources: <https://highways.dot.gov/safety/proven-safety-countermeasures/enhanced-delineation-horizontal-curves> and CMF Clearinghouse CMF ID 101



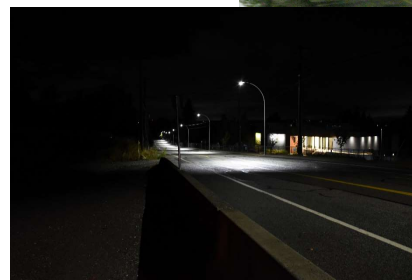
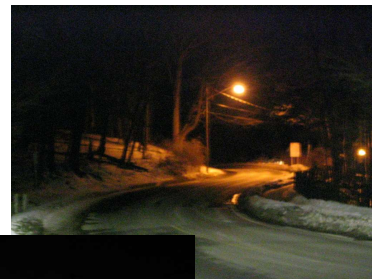
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Increase Nighttime Visibility for Safety: Roadway Departure

- Range of practice:
 - Focused improvements at locations with known crash history and/or travel ways for roadway departure benefits
 - Enhanced conspicuity of traffic control devices
 - Installation of lighting for curves
 - Maintain Minimum Retroreflectivity

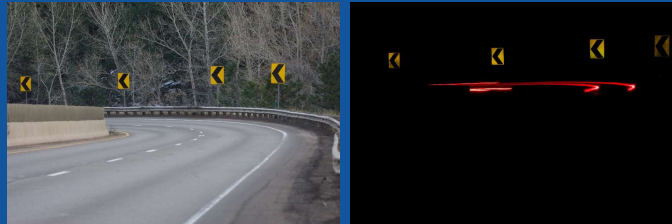
Source: WSP



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Don't Forget About Retroreflectivity Requirements!

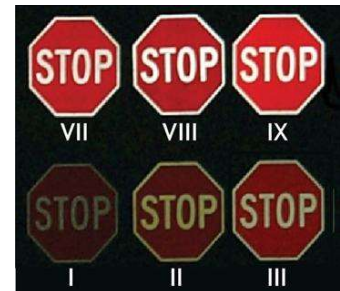


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Why is Traffic Sign Retroreflectivity Important?

Signs provide critical information to drivers but ...retroreflectivity degrades over time.



<https://mutcd.fhwa.dot.gov/htm/2009r1r2/part2/part2a.htm#section2A08>



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Why is Pavement Marking Retroreflectivity Important?

Visibility is critical for nighttime driving

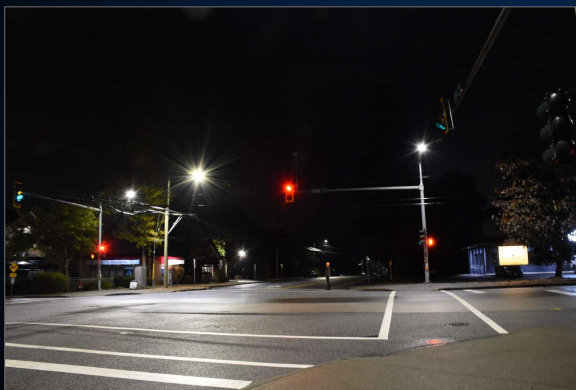
Daytime - many cues available



Nighttime - few cues remain



Intersection Benefits



Intersection Benefits

- Retroreflective backplates for signals can reduce crashes by 15-percent.
- Properly designed lighting at rural and urban intersections can reduce nighttime crashes by up to 38 percent.
- Adequate intersection lighting can help reduce pedestrian fatalities by 42-percent.
- Improved visibility with improved sight distance reduces crashes.

Traffic Signal Enhancements

- Use 12-inch signal indications
- Add supplemental signal heads
- Add retroreflective borders to backplates



Source: WSP

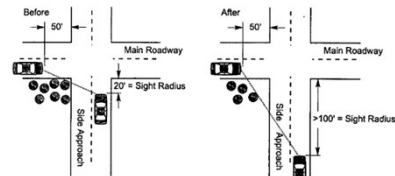


Increase Nighttime Visibility for Safety: Intersections

- Range of practice (examples):
 - Enhanced conspicuity of traffic control devices
 - Install luminaire at candidate rural intersections
 - Improve intersection sight distance with geometric improvement
 - Remove obstructions and maintain sight triangles in order to see traffic control and other road users
 - Restrict parking near intersections
 - Install well-designed lighting at intersections with a pattern of nighttime crashes (rear-end, right-angle and turning crashes)
 - Installation of signalized midblock crossings and other lighting/TCDs at locations with high benefit (near schools, parks, locations with higher activity during periods of darkness)



Source: WSP



Pedestrian & Bicyclist Benefits



Source: Screen capture of SWARCO "Cross Walk Street Lighting" YouTube Video (at 1:16)



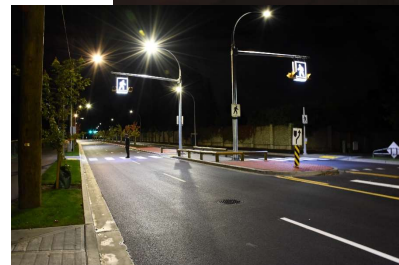
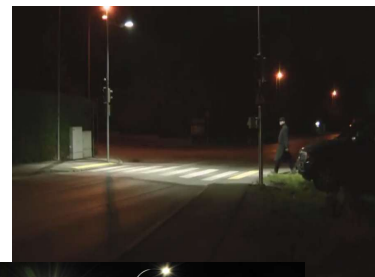
Source: Maricopa Association of Governments



Pedestrian & Bicyclist Benefits

- Crosswalk visibility enhancements for pedestrians, such as those in STEP, can reduce pedestrian crashes up to 47-percent!
- Advance markings and signs make it safer for people to cross a road.
- Improved pedestrian lighting design at intersections and mid-block crossings provide safer experiences at activity centers like schools, transit stops, and entertainment venues.








Source: WSP



Data source: [Rectangular Rapid Flashing Beacons \(RRFB\)](#)



Safe Transportation for Every Pedestrian (STEP) Countermeasures

-  **Crosswalk Visibility Enhancements**
-  *Raised Crosswalks*
-  *Pedestrian Refuge Island*
-  **Rectangular Rapid Flashing Beacon (RRFB)**
-  **Pedestrian Hybrid Beacon (PHB)**
-  *Road Diets*
-  **Leading Pedestrian Interval (LPI)**



Crosswalk Visibility Enhancements

This example combines curb extensions, high-visibility markings, overhead lighting, and in-street signs on a two-lane roadway.

Intersection Lighting
42% Reduction in
Nighttime Pedestrian
Crashes

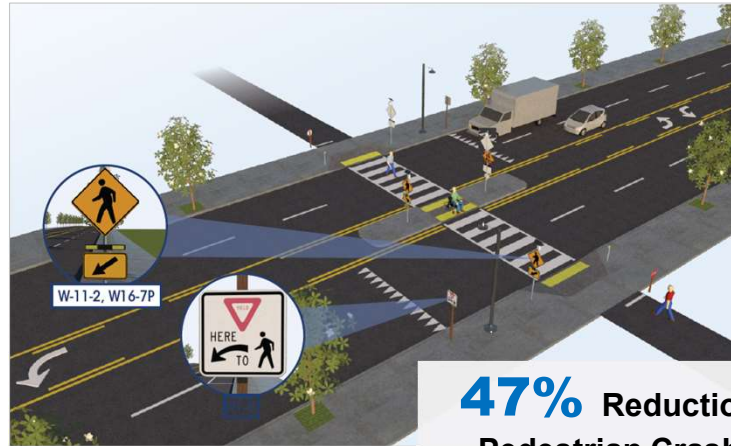


Data Source: <https://highways.dot.gov/safety/proven-safety-countermeasures/crosswalk-visibility-enhancements>

Rectangular Rapid Flashing Beacons (RRFB)



Source: FHWA



47% Reduction in Pedestrian Crashes



Data Source: <https://highways.dot.gov/safety/proven-safety-countermeasures/rectangular-rapid-flashing-beacons-rffb>



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Leading Pedestrian Interval (LPI)



13% Reduction in Pedestrian-Vehicle Crashes



Data Source: <https://highways.dot.gov/safety/proven-safety-countermeasures/leading-pedestrian-interval>

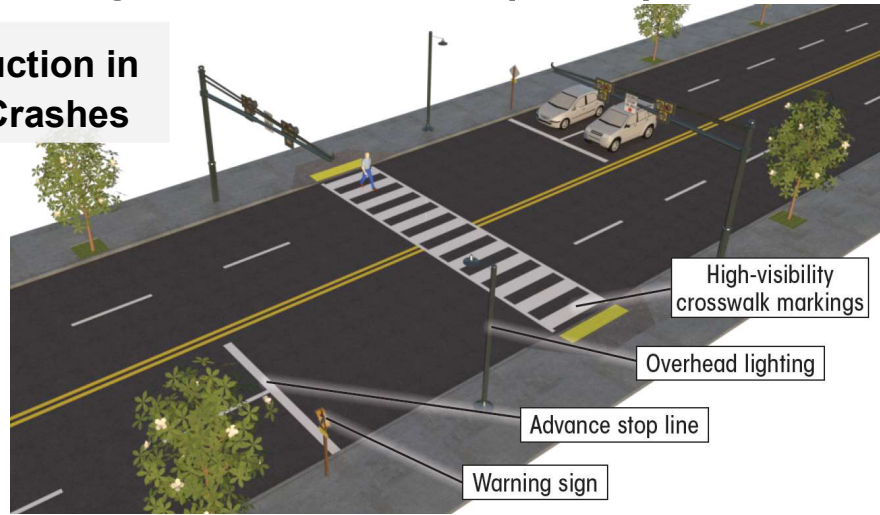


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Pedestrian Hybrid Beacon (PHB)

55% Reduction in Pedestrian Crashes



Data Source: <https://highways.dot.gov/safety/proven-safety-countermeasures/pedestrian-hybrid-beacons>



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Lighting Over Crosswalks - Positive Contrast

Negative Contrast

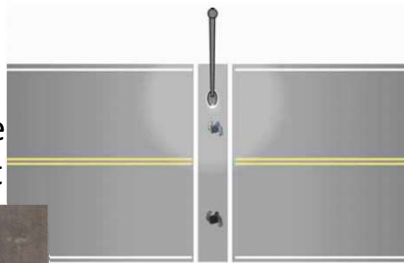


Fig 11. Traditional midblock crosswalk lighting layout

Figure 7 [FHWA Lighting Handbook \(2012\)](#)

Positive Contrast

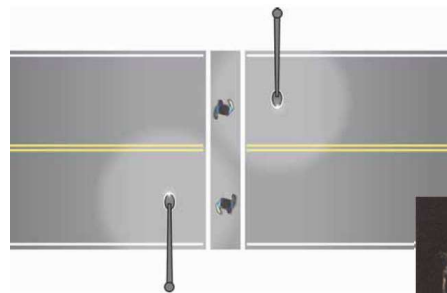


Fig 12. New design for midblock crosswalk lighting layout

Figure 7 [FHWA Lighting Handbook \(2012\)](#)



<https://www.fhwa.dot.gov/publications/research/safety/08053/>



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Increase Nighttime Visibility for Safety: Bicyclists and Pedestrians

- Range of practice:
 - Enhanced conspicuity of traffic control devices
 - Geometric enhancements to enhance visibility for pedestrians and other road users.
 - Install well-designed lighting to enhance safety and security for pedestrians.
 - Enhanced visibility at midblock crossings by incorporating those recommended under STEP



Source: WSP



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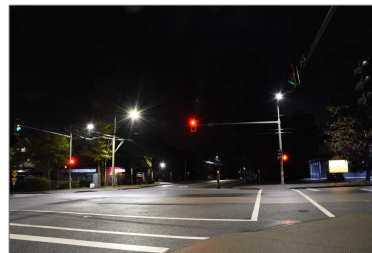
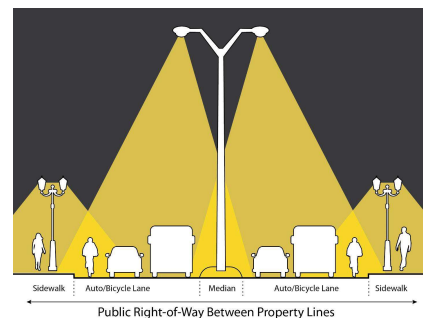
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Let's Talk About Lighting!

Safety Benefits

Lighting can reduce crashes up to:

- 42-percent for nighttime injury pedestrian crashes at intersections
- 33- to 38-percent for nighttime crashes at rural and urban intersections
- 28-percent for nighttime injury crashes on rural and urban highways



Source: WSP



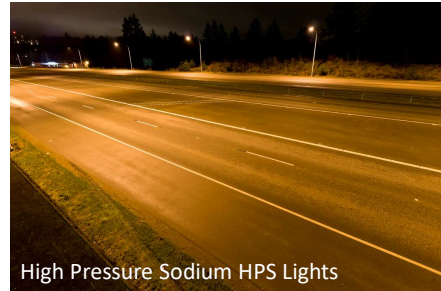
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New Lighting Technologies

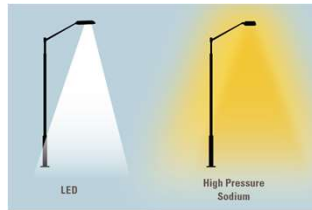
- Acutely dimmed to specific levels
- Can be turned on and off rapidly (no warm-up period needed)
- Can be fine-tuned for color output
- Energy efficiency
- Higher initial cost but longer life cycle



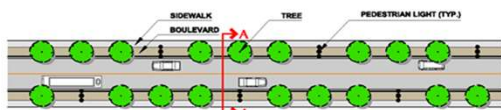
High Pressure Sodium HPS Lights



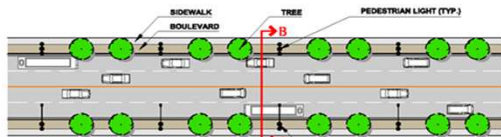
Light Emitting Diode Lights



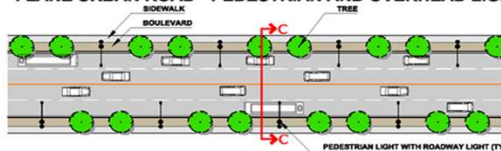
Urban Streetscape Design



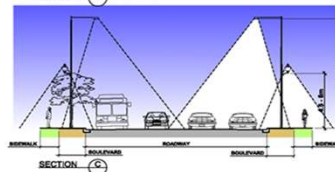
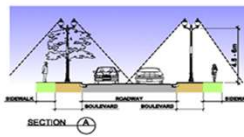
2 LANE URBAN ROAD - PEDESTRIAN LIGHT OPTION



4 LANE URBAN ROAD - PEDESTRIAN AND OVERHEAD LIGHT (TYP.)



4 LANE URBAN ROAD - PEDESTRIAN AND OVERHEAD LIGHTS, BOTH SIDES

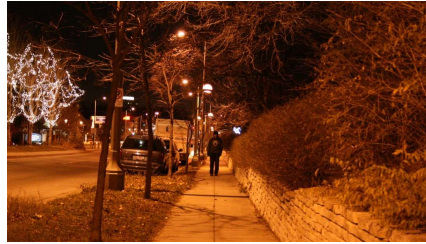
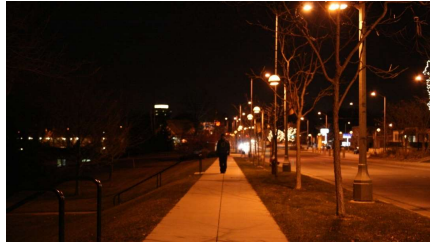


Source: [FHWA Lighting Handbook \(2023\)](#)

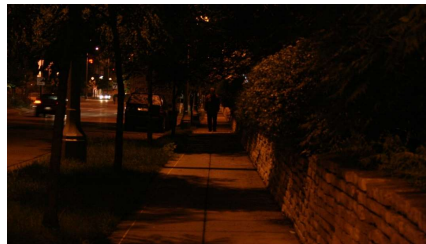


Lighting and Landscape Comparison Based on Time of Year

Winter



Summer



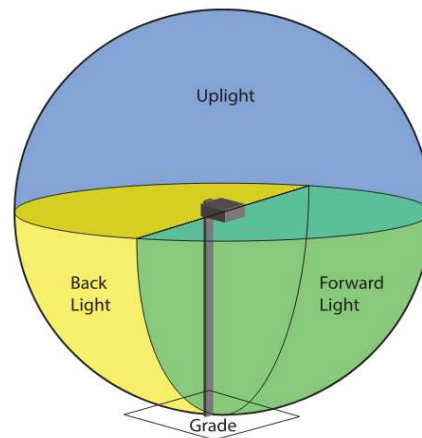
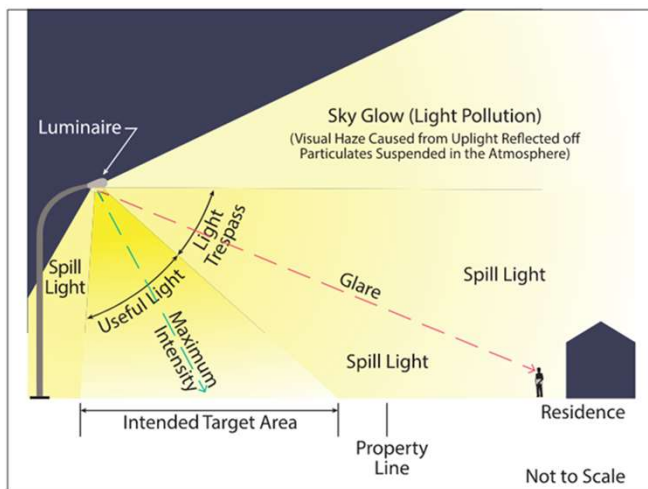
Source: WSP



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Skyglow



Source: FHWA Lighting Handbook 2012



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Dark Sky and LED Mitigation



LED lights with Full Cut-off and HPS light with no cut-off.



Shielding



Source – IES RP-33

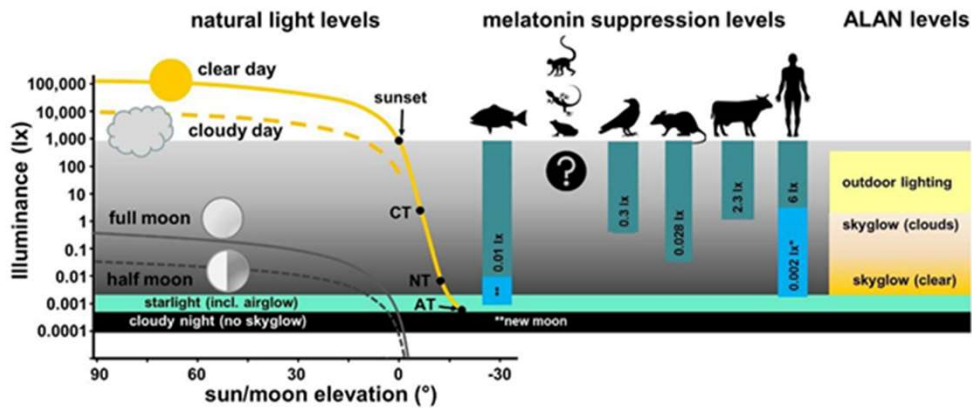
Example of how shielding only lights up targeted areas



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Wildlife Impacts



Source – FHWA Lighting Handbook 2023



[FHWA Lighting Handbook 2023 | FHWA \(dot.gov\)](https://www.fhwa.dot.gov/lighting/)



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Adaptive Lighting

Before



After



Source – FHWA Lighting Handbook 2023



The Safe Routes to School (SRTS)



One pedestrian population that may especially benefit from improved lighting is school-age children.

- May travel to or from school, during the early morning or evening hours especially for before or after school activities that may cause students to travel earlier or later.
- Vulnerable to vehicular traffic because of their size, are more difficult for motorists to see when crossing the streets
- Not as experienced at judging the direction of sounds, estimating the speed and distance of oncoming vehicles, or anticipating other road users' behavior.
- Studies have shown that the likelihood of child pedestrians being injured more than doubles during dark conditions.



Increase Nighttime Visibility for Safety: Lighting

- Range of practice:
 - Working with municipalities and/or energy providers to replace HPS systems and evolving toward modern lighting technology like LED
 - Install new or Retrofitting of existing luminaires with modern lighting technology and with well-designed lighting improvements
 - Evaluation of Lighting policies
 - Well-designed lighting can improve safety for all road users : Pedestrians, Bicyclists
 - Promote the use of adaptive lighting to reduce environmental impacts



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EDC 7 Nighttime Visibility for Safety Approach

- Apply cost-effective and proven lighting and traffic control device countermeasures with known safety benefits to reduce fatalities for all road users.
- Target visibility improvements in close proximities to **activity locations such as schools, parks, transit stops, sports complexes, and entertainment (urban core)**
- Use a focused approach to enhance visibility in three key areas: Intersections, Pedestrians and bicyclists and Roadway departures
- Influence State policy on improving nighttime traffic control devices and lighting in strategic locations.



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Tools & Resources

- Proven Safety Countermeasures [Proven Safety Countermeasures | FHWA\(dot.gov\)](#)
- Past EDC Initiatives
 - STEP (Safe Transportation for Every Pedestrian) [Safe Transportation for Every Pedestrian \(STEP\) | FHWA\(dot.gov\)](#)
 - FoRRRwD (Focus on Reducing Rural Roadway Departures) [Focus on Reducing Rural Roadway Departures | FHWA\(dot.gov\)](#)
- **Opportunities: Virtual and on-site technical support including workshops and training, webinars, peer exchanges, tools, guides, checklists, etc.**
- **Recommendations for lighting design and new tools for application of TCDs at strategic locations**
- Resources
 - FHWA Lighting Handbook 2023 [FHWA Lighting Handbook 2023 | FHWA\(dot.gov\)](#)
 - Pedestrian Lighting Primer [Pedestrian Lighting Primer \(dot.gov\)](#)
 - NCHRP - Report 940, Solid State Roadway Lighting Design Guide (design and research volumes) [NCHRP Research Report 940 – Solid-State Roadway Lighting Design, Volume 1: Guidance \(trb.org\)](#)
 - NCHRP REPORT 968 - LED Roadway Lighting: Impact on Driver Sleep Health and Alertness [LED Roadway Lighting: Impact on Driver Sleep Health and Alertness | Blurbs New | Blurbs | Publications \(trb.org\)](#)
 - NCHRP Synthesis Report Project 575 Lighting Practices for Isolated Rural Intersections [Lighting Practices for Isolated Rural Intersections | The National Academies Press](#)



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Outreach Products under Development

- **Recommendation Report for deployment of TCDs and Lighting at Strategic locations**
- **Recommendation Report for Lighting Design at Crosswalks**
- **Nighttime Road Safety Audits (RSA)**



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Recommendation Report for deployment of TCDs and Lighting at Strategic locations

- Chapter 1. Introduction
- Chapter 2. Fundamentals of Nighttime Visibility
- Chapter 3. Considerations for Nighttime Visibility at Activity-Based Locations
- Chapter 4. Nighttime Visibility for Pedestrians and Bicyclists
- Chapter 5. Nighttime Visibility at Intersections
- Chapter 6. Nighttime Visibility Along Road Segments
- Chapter 7. Opportunities For Future Studies



Recommendation Report for Lighting Design at Crosswalks

- **Chapter 1 Background and purpose**
 - Provide background on relevant national trends in pedestrian fatalities
- **Chapter 2 Visibility Concept**
 - Reviews foundational visibility concepts, including key definitions.
- **Chapter 3 Midblock Crosswalk Lighting Design Considerations**
 - Walk through considerations for midblock crosswalk lighting design.
- **Chapter 4 Intersection Crosswalk Lighting Design Considerations**
 - Provides information on lighting design for crosswalks at intersections.
- **Chapter 5 Design Example**
 - Provides a practical design example focused on an activity-based location.
- **Chapter 6 Summary and Recommendations**
 - Summary of the report and descriptions of key takeaways and future research needs.



Nighttime Road Safety Audits (RSA)

- Development of a Field Review Packet for Nighttime use
 - Observed Intersections and walk Route - Signalized/unsignalized, school zone, transit stops, bike paths, marked crosswalks
- Consideration of Nighttime/Low Light Condition RSA Prompts
 - Location with respect to Physical Environment/Infrastructure
 - Universal consideration, along the street, mid-block crossing, intersections, Bike facilities, Transit Stops, TCDs – Signs, Pavement Markings, Signals, Compliance
 - Presence/Placement, Quality/Conditions, Connectivity/Consistency, Visibility, Lighting
 - Operations/Interactions/Behaviors
 - Characteristics, mode Behavior, Interactions of Modes



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Find Additional Resources at:
 EDC-7: Nighttime Visibility for Safety
 (https://www.fhwa.dot.gov/innovation/everydaycounts/edc_7/nighttime_visibility.cfm)

Thank you!

Questions or Comments?



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