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TRB Asset Management Conference

**Sign Asset Management to Achieve Minimum
Retroreflectivity Compliance in the Las Vegas Region**

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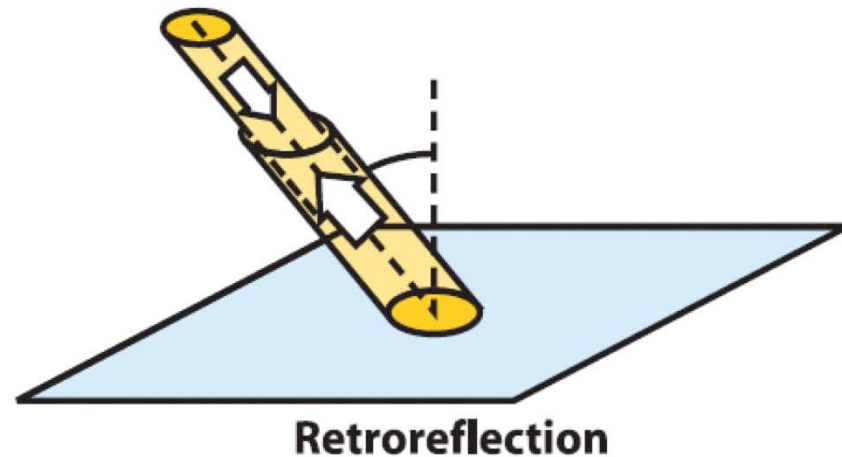
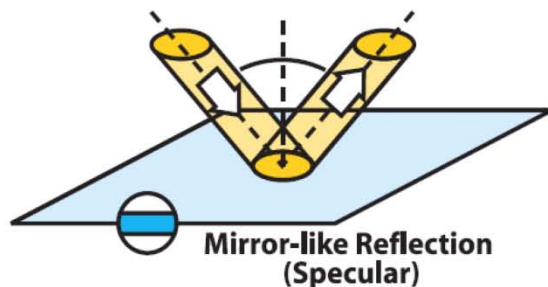
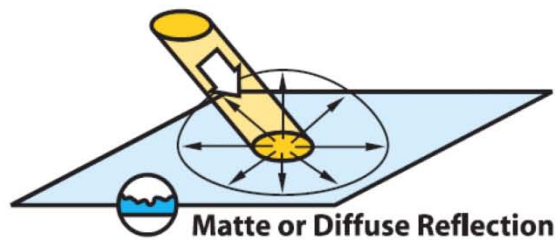
April 17, 2012

- **Background**
- **Federal Requirements**
- **Study Overview**
- **Key Findings**



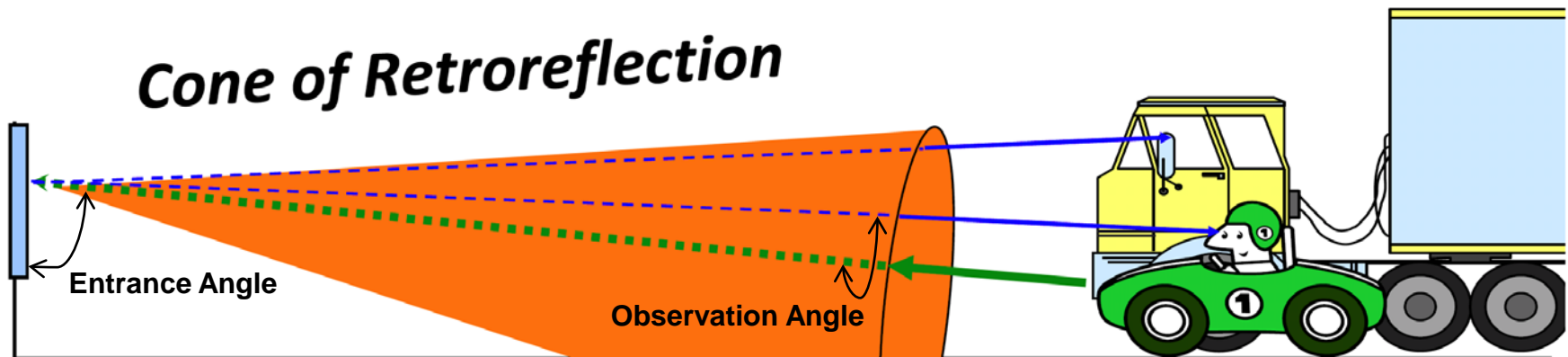
Background: What is Retroreflectivity?

- Retroreflectivity is a measure of reflective efficiency: the level of light reflected from the surface back to the point of luminance (the vehicle headlamps) and the driver
- It is a measure of nighttime visibility



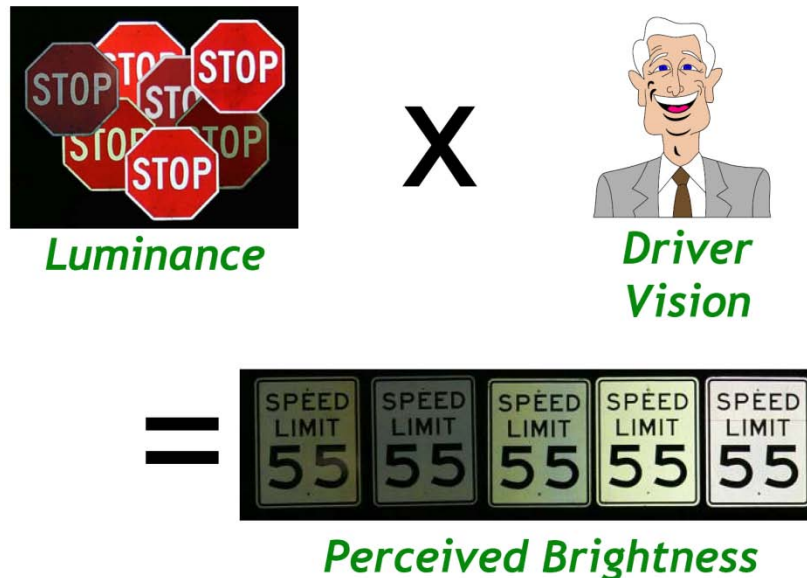
Background: Why is Retroreflectivity Important?

- Nighttime driving safety is a major issue of overall roadway safety. Rate of traffic fatalities per vehicle-mile during the night compared to daytime is more than double
- Sign retroreflectivity deteriorates with factors including age and sun exposure; nighttime visibility of signs declines faster than daytime visibility



Background: Retroreflectivity Standards

- Minimum retroreflectivity standards are particularly helpful to older drivers. As people age, their ability to read lower retroreflective signs at night deteriorates
- Most regions of the United States face an aging population



Federal Requirements: MUTCD Standards



- In order to improve nighttime driving safety, Congress passed legislation in 1993 requiring the FHWA to update the Manual on Uniform Traffic Control Devices (MUTCD) to include minimum retroreflectivity requirements
- In 2007, the FHWA adopted the final rules as an amendment to the 2003 MUTCD

Table 2A-3. Minimum Maintained Retroreflectivity Levels¹

Sign Color	Sheeting Type (ASTM D4956-04)				Additional Criteria
	Beaded Sheeting			Prismatic Sheeting	
	I	II	III	III, IV, VI, VII, VIII, IX, X	
White on Green	W*; G ≥ 7	W*; G ≥ 15	W*; G ≥ 25	W ≥ 250; G ≥ 25	Overhead
	W*; G ≥ 7	W ≥ 120; G ≥ 15			Post-mounted
Black on Yellow or Black on Orange	Y*; O*	Y ≥ 50; O ≥ 50			2
	Y*; O*	Y ≥ 75; O ≥ 75			3
White on Red	W ≥ 35; R ≥ 7				4
Black on White	W ≥ 50				—

¹ The minimum maintained retroreflectivity levels shown in this table are in units of cd/lx/m² measured at an observation angle of 0.2° and an entrance angle of -4.0°.

² For text and fine symbol signs measuring at least 48 inches and for all sizes of bold symbol signs

³ For text and fine symbol signs measuring less than 48 inches

⁴ Minimum sign contrast ratio ≥ 3:1 (white retroreflectivity ÷ red retroreflectivity)

* This sheeting type shall not be used for this color for this application.

Bold Symbol Signs		
<ul style="list-style-type: none"> • W1-1,2 – Turn and Curve • W1-3,4 – Reverse Turn and Curve • W1-5 – Winding Road • W1-6,7 – Large Arrow • W1-8 – Chevron • W1-10 – Intersection in Curve • W1-11 – Hairpin Curve • W1-15 – 270 Degree Loop • W2-1 – Cross Road • W2-2,3 – Side Road • W2-4,5 – T and Y Intersection • W2-6 – Circular Intersection • W2-7,8 – Double Side Roads 	<ul style="list-style-type: none"> • W3-1 – Stop Ahead • W3-2 – Yield Ahead • W3-3 – Signal Ahead • W4-1 – Merge • W4-2 – Lane Ends • W4-3 – Added Lane • W4-5 – Entering Roadway Merge • W4-6 – Entering Roadway Added Lane • W6-1,2 – Divided Highway Begins and Ends • W6-3 – Two-Way Traffic • W10-1,2,3,4,11,12 – Grade Crossing Advance Warning 	<ul style="list-style-type: none"> • W11-2 – Pedestrian Crossing • W11-3,4,16-22 – Large Animals • W11-5 – Farm Equipment • W11-6 – Snowmobile Crossing • W11-7 – Equestrian Crossing • W11-8 – Fire Station • W11-10 – Truck Crossing • W12-1 – Double Arrow • W16-5P,6P,7P – Pointing Arrow Plaques • W20-7 – Flagger • W21-1 – Worker

Fine Symbol Signs (symbol signs not listed as bold symbol signs)

Special Cases

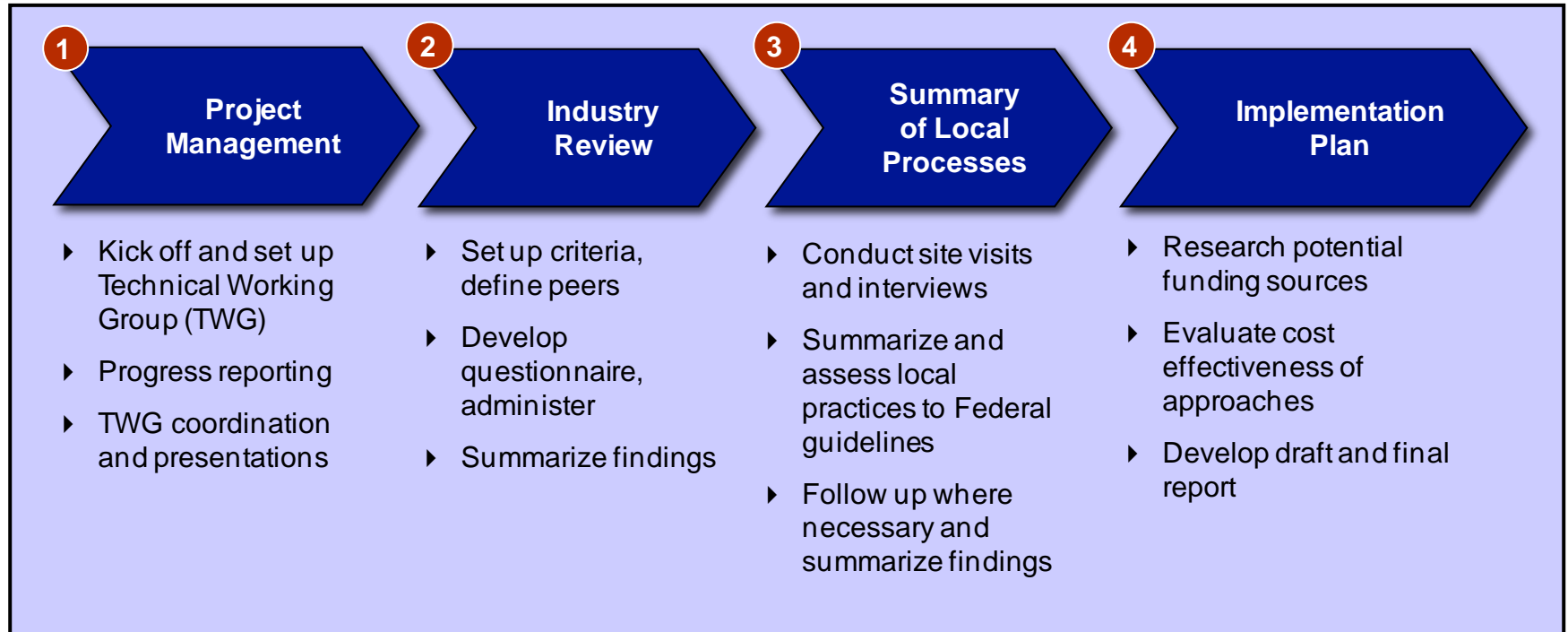
- W3-1 – Stop Ahead: Red retroreflectivity ≥ 7
- W3-2 – Yield Ahead: Red retroreflectivity ≥ 7; White retroreflectivity ≥ 35
- W3-3 – Signal Ahead: Red retroreflectivity ≥ 7; Green retroreflectivity ≥ 7
- W3-5 – Speed Reduction: White retroreflectivity ≥ 50
- For non-diamond shaped signs, such as W14-3 (No Passing Zone), W4-4P (Cross Traffic Does Not Stop), or W13-1P,2,3,6,7 (Speed Advisory Plaques), use the largest sign dimension to determine the proper minimum retroreflectivity level.

- To ensure signs comply with the standards, the MUTCD now also requires that agencies implement a management program to assess retroreflectivity. Options include:

Management Method	Description
a) Timed Replacement	Signs are replaced based on the manufacturer's expected sign useful life
b) Timed Replacement with Control Signs	Signs are replaced based on the observed useful life of control signs
c) Measured Retroreflectivity	Signs are replaced based on the inspection of each sign with a retroreflectometer
d) Nighttime Visual Inspections	Signs are replaced based on the visual inspection of each sign
e) Blanket Replacement	Signs are replaced all at once by sector regardless of age or condition
f) Other Methods	Based on engineering studies.

- Compliance schedule is based on the effective date of the final rule (January 22, 2008)
- Establish and implement a sign retroreflectivity management method in 4 years (January 2012)
- Replace regulatory, warning, and ground-mounted guide signs (except street name) identified as having substandard retroreflectivity in 7 years (January 2015)
- Replace identified substandard street name and overhead guide signs in 10 years (January 2018)

Study Overview: Four Main Tasks



Output

- Kick off
- Monthly progress reports
- TWG presentations

- Industry review technical memorandum

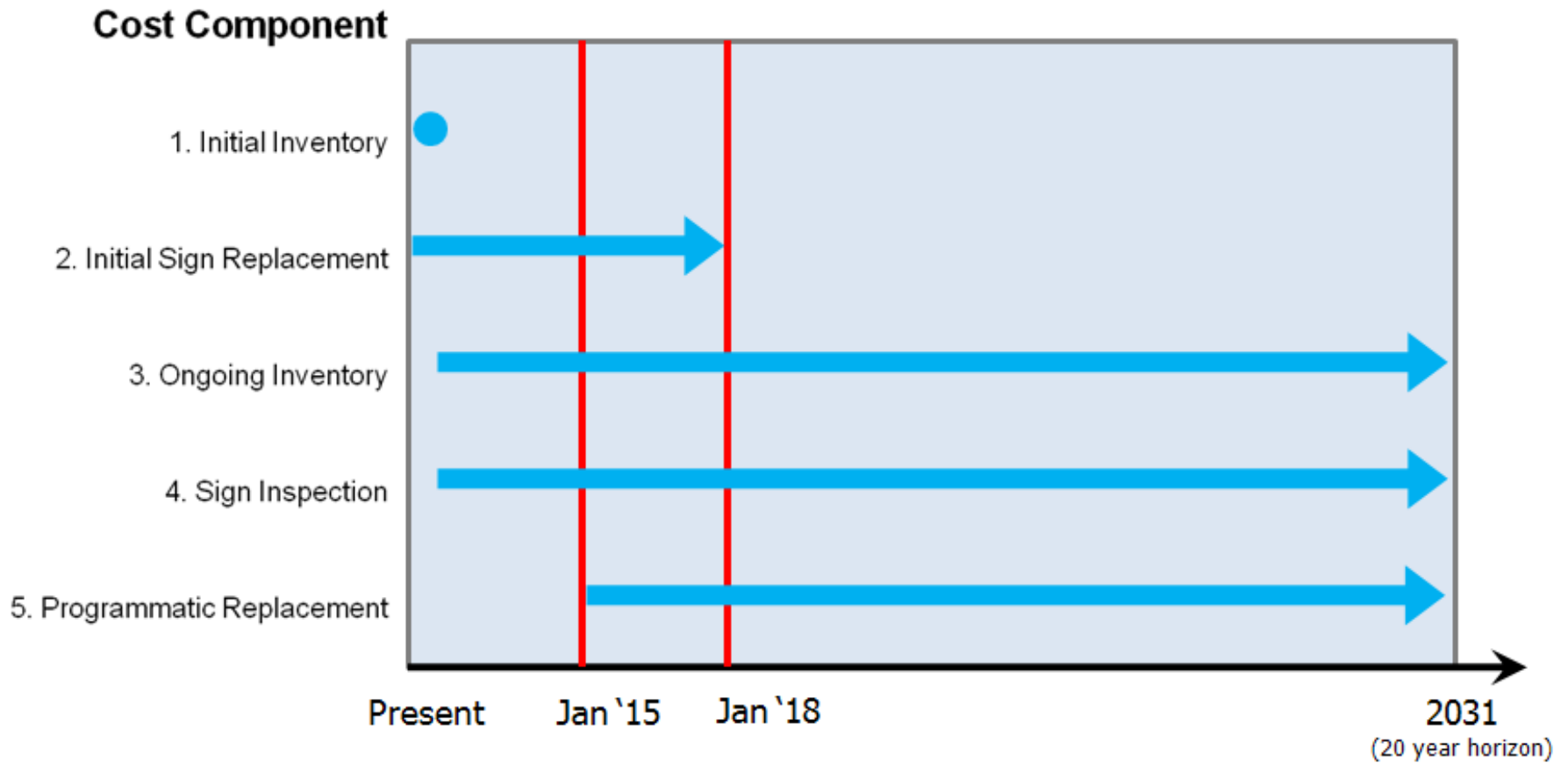
- Local practices technical memorandum

- Draft Report
- Final Report

- RTC Region: cities of Las Vegas, North Las Vegas, Mesquite, Boulder City, and Henderson; plus Clark County

- 20-Year Cost Model was developed which includes an initial compliance phase and an ongoing compliance phase
- Initial compliance costs include:
 - An inventory to identify and track noncompliant signs
 - Initial replacement of noncompliant signs
 - Beginning of programmatic sign replacement to maintain sign compliance
- Ongoing sign management costs include:
 - Ongoing inventory to track new signs and sign maintenance
 - Ongoing sign inspection, where applicable, to identify noncompliant signs
 - Programmatic sign replacement of targeted signs

Study Overview: Cost Model Components



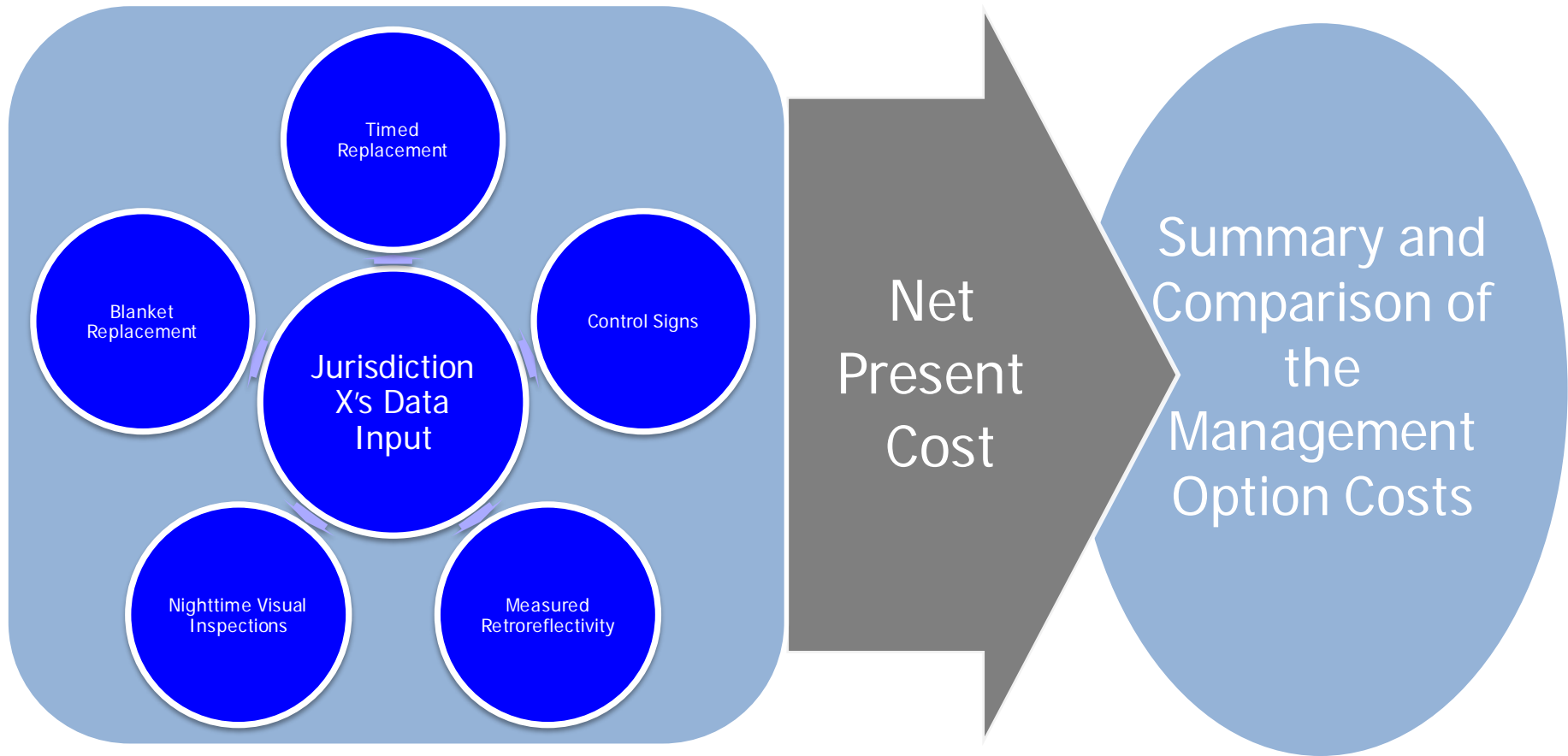
Study Overview: Review of Management Methods



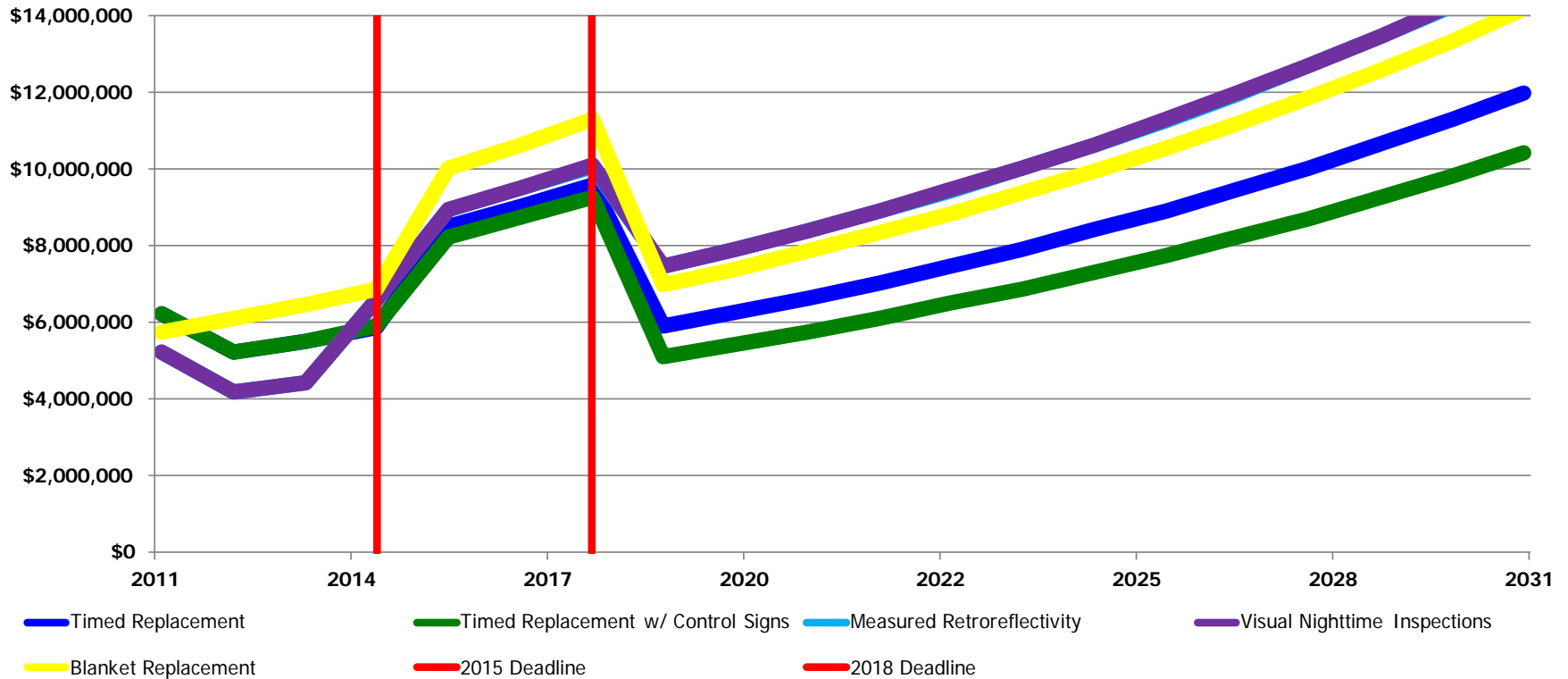
Management Method	1. Initial Inventory	2. Initial Sign Replacement	3. Ongoing Inventory	4. Sign Inspection	5. Programmatic Replacement
Timed Replacement	One-time capital	Capital cost annualized over 1st 7 years (2011 - 2017)	Annual operations cost	N/A	Annual capital cost
Timed Replacement w/ Control Signs	One-time capital	Capital cost annualized over 1st 7 years (2011 - 2017)	Annual operations cost	Annual operations cost	Annual capital cost
Measured Retroreflectivity	One-time capital	Capital cost annualized over 1st 7 years (2011 - 2017)	Annual operations cost	Annual operations cost	Annual capital cost
Visual Nighttime Inspections	One-time capital	Capital cost annualized over 1st 7 years (2011 - 2017)	Annual operations cost	Annual operations cost	Annual capital cost
Blanket Replacement	N/A	Capital cost annualized over 1st 7 years (2011 - 2017)	N/A	N/A	Annual capital cost

- The initial compliance phase is composed entirely of capital costs
- The ongoing compliance phase includes both capital and operations costs

Study Overview: Net Present Cost



Key Findings: Annual Program Costs



Key Findings: Cost Summary



Regional Totals Management Method	Average Annual Initial Cost (1st 7 years)	Comparison	Average Annual Program Cost (after Jan 2018)	Comparison	Net Present Cost (20 year horizon)	Comparison
Timed Replacement	\$5,874,655	1.03	\$3,898,803	1.15	\$72,238,527	1.08
Timed Replacement w/ Control Signs	\$5,784,074	1.02	\$3,386,143	1.00	\$67,127,244	1.00
Measured Retroreflectivity	\$5,687,443	1.00	\$4,927,926	1.46	\$79,987,520	1.19
Visual Nighttime Inspections	\$5,691,726	1.00	\$4,935,421	1.46	\$80,080,536	1.19
Blanket Replacement	\$6,672,622	1.17	\$4,610,940	1.36	\$83,534,695	1.25

- Timed Replacement with Control Signs ranks third in initial cost, but has the lowest ongoing compliance costs and the lowest overall net present cost for the region as a whole

- Cost model provides annual program cost estimates and allows comparison of management options
- Cost estimates can help jurisdictions plan more effectively to reach compliance:
 - Estimates allow an order-of-magnitude estimate of unmet needs
 - Estimates can support grant applications for additional funding, particularly for initial compliance costs
- For many jurisdictions, several options are close in cost:
 - Outlying options may be eliminated definitively
 - Some options may be preferable for their lower initial compliance costs
 - Timed replacement with control signs is a good option for a regional solution