Rural Interstate LED Lane Delineation for Low Visibility Conditions
(ITS Planning, Deployment, and Sustainability)

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A common issue faced by many transportation agencies in rural areas is the management of traffic during low visibility conditions. Indeed, due to elevation and environmental factors many areas are hotspots for congestion and accidents caused by low visibility. These conditions also result in a greater risk of dangerous chain reaction accidents. This paper focuses on the maintenance and upgrade of a legacy lane delineation system using in-road lighting and ancillary ITS assets. Other topics discussed include planning considerations for the lifecycle replacement of existing ITS assets, including the incorporation of sustainable design elements, in order to restore or enhance operational performance while lowering total cost of ownership.
Low Visibility Issues

- “It has been estimated that 23 percent of the non-recurrent delay on highways across the nation is due to snow, ice, and fog.”*
- Low Visibility causes 10% - 12% reduction in Freeway Average Speed and 12% reduction in Capacity*

*Source: www.fhwa.dot.gov
Low Visibility Issues
Low Visibility Issues

- “Twenty-four (24) percent of [crashes] — approximately 1,561,000—are weather-related.”*

- Weather-related crashes are defined as those crashes that occur in adverse weather (i.e., rain, sleet, snow, and/or fog) or on slick pavement.”*

*Source: [www.fhwa.dot.gov](http://www.fhwa.dot.gov)
Low Visibility Results
Increase Safety

Inform the traveler
- Better decision making
- Improve travel times
- Reduce the frequency and severity of crashes

Reliable, Timely, & Detailed Data
- Real-time
- Actionable

Low Visibility Warning & Lane Delineation System
I-64 Afton Mountain (VA)

- Original Components
  - Visibility Sensors (3 sites)
  - In-Pavement Lighting (841 fixtures)
  - Dynamic Message Signs (10 signs)

- Enhancements
  - Additional Visibility Sensors (total of 5 sites)
  - CCTV (5 sites)
  - Radar Traffic Sensors (5 sites)
Low Visibility Warning & Lane Delineation System

I-64 Afton Mountain, Virginia
Original Visibility Sensors

- Quantitative, Actionable Data
- 3 Sensor Sites
  - 2 added at later date
- Spaced ~1 per mile
Benefits
- Improve motorists’ visibility of edge line
- Reduce likelihood of initial, single car accident resulting from exiting travel lane, crossing median, etc.

Design
- 841 lights across ~24 Lane Miles / 6 Centerline
- High Voltage Power Distribution
  - Cover larger distance, less electrical service points
  - Afton system powers lights 6 miles from single power vault
Original Dynamic Message Signs

- 10 DMS total
- 1 on each Interstate and primary road approach
- Advance warning to motorists during low visibility conditions & other traffic events
- “Captive” communications method
Issues with Legacy System Components

- Up to 15+ Years old
  - In-Pavement Fixtures
  - DMS
  - Visibility Sensors

- Obsolescence, no manufacturer support

- High number of service calls

- High Cost of Ownership
The DTS Maintenance Approach

- Assumed Maintenance Responsibility in 2004
- Performance Based Contract – Incentive/Disincentive
  - Unlimited Service Calls
  - Repair Time Requirements – 8 hours (max)
  - Fixed Annual Fee
- Developed On-Going Maintenance Plan
  - Daily System Checks
  - Quarterly Preventive Maintenance Cycle
- Performed System-Wide Status Analysis
- Identified & Implemented Short-Term, Stop-Gap Solutions
- Evaluated & Installed Long-Term Alternative Solutions
Legacy In-Pavement Lighting Issues

- Incandescent
- 30% - 45% Failure Rate / Year
- Frequent costly & invasive in-road repairs
- EOL, Replacement Parts Unavailable
- High Energy Costs
New In-Pavement Lighting Solution

- LED fixtures
- Estimated runtime of LEDs – 10+ yrs
- Reduced impact to traveling public for maintenance
- Reused existing infrastructure
  - Transformers
  - Conduit
  - Wiring
  - Mounting Cans
- Reduced Power Consumption as much as 84% per circuit compared to incandescent fixtures
Legacy DMS

Sending a Clear Message?
8 out of 10 DMS non-operational at start of contract maintenance agreement

- Frequent Downtime & Pixel Errors
- False Status Polling
  - Reported posted when blank
  - Reported blank when posted
- No manufacturer support
New DMS Solution

- Full matrix
- NTCIP compliant
- Mounted onto existing structures
- Reliable Performance – 99% Reduction in Callouts!!
  - 2007 (Pre-Upgrade) – 79 Trouble Calls
  - 2008 (Mid-Upgrade) – 55 Trouble Calls
  - 2009 (Post-Upgrade) – 1 Trouble Call
- Other Potential Improvements – Under Evaluation
  - IP Comms (via CDMA)
  - Remote Reset Devices
Upgraded DMS
Legacy Visibility Sensors

- Issues with Current Hardware
  - Serial comms only
  - Visibility data only
  - No diagnostics
  - Obsolete - Not Serviceable

- Proposed Visibility Solution – *Under Evaluation*
  - IP comms
  - Visibility & Precipitation data
  - Support NTCIP 1204 protocol for integration
  - Diagnostics
  - Expandable
  - Serviceable
System Enhancements

CCTV

- DTS Added in 2006
- 5 Camera Sites
- Spaced ~1 per mile
- Visual Feedback & Qualitative Data for TOC personnel
System Enhancements

Radar Traffic Sensors

- DTS added in 2008
- 5 Traffic Sensors, spaced ~1 per mile
- Capture Volume, Speed, Headway, Gap…
- Provide quantitative data on motorist behavior for post-event analysis
Summary of System-Wide Improvements

- Upgrade of obsolete system components
  - In-Pavement Lighting - *Completed*
  - DMS - *Completed*
  - Visibility Sensors - *Planned*

- Enhanced System with
  - CCTV
  - Radar Traffic Sensors

- Maximized use of existing infrastructure

- Built with maintenance in mind

- Reduced total cost of ownership
Operational Results

- Improved Motorist Awareness
- Enhanced Monitoring & Response Capabilities
- Improved System Uptime
- Higher Reliability
- Reduced Maintenance Costs
- Energy Savings
System Enhancements + On-Going Preventative Maintenance = Operational Results, Safety and a Lower Total Cost of Ownership
Digital Traffic Systems, Inc.

Design

Install

Maintain