Weather and Speed Indicators to Support a Variable Speed Limit System in Southeastern Wyoming

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Introduction

- Wyoming weather
  - Unpredictable
  - Severe
- Safety problems
  - Speed variations
- Road closures
  - Inconvenient
  - Economic cumulative impact
    - $8-12 million in delay costs
- Without VSL, driver’s responsibility to pick a speed safe for conditions
Variable Speed Limits

- Variable speed limits (VSL)
  - Shown promise for improving safety on roadways subject to adverse conditions
- VSLs change advisory or enforceable speed limits
  - Weather
  - Traffic volumes
  - Incidents
  - Roadway construction
- Reduce speed variation
20 VSL signs in 10 locations
• 5 EB, 5 WB
Project corridor

- 52 miles from milepost 290.44 (Quealy Dome Interchange) to 238.15 (Peterson Interchange)
- 2005 AADT 10,800
- 60% of traffic on I-80 is heavy trucks
- Frequent adverse weather conditions
  - Blowing Snow
  - Heavy snow
  - High winds
  - Ice
- Seasonal Speed Limit from October 15-April 15
Existing ITS

Pre-trip
- Website
  - Cameras
  - Conditions
- 511
  - Driver chooses route of travel
  - Forecast for next 6 hours

Enroute
- Two Dynamic Message Signs (MP 234.6, 311.1)
- Road Weather Information System (RWIS) MP 272
Installed for VSL System

- Ten speed sensors
  - Six communicate with WYDOT
  - Four had to be manually downloaded
- Variable Speed Limit Signs
  - Installed in pairs
  - Speeds: 75, 65, 60, 55, 50, 45, 40, and 35
- Signs
- Portable DMS
- Speed Radar Signs
Road closures

- Problems
  - Wind Speeds
  - Weather Related
    - Snow, Ice, Limited Visibility, and Blowing Snow
- 29 Road Closures from September 2007 to May 2008
Road Closures

Reason for closures

Closure duration

- 8-hr closure has estimated impact of $8-12 million dollars
- Maximum duration
  - 22 hrs and 54 minutes
- Average duration
  - 8 hours and 24 minutes
- VSLs allow roads to remain open
Crash Data

- 2004 to June 2007
  - 1,787 crashes reported
  - 814 included heavy vehicles

Reported Crashes by Milepost
(2004-June 2007)
Current VSL Protocol

- Used until Decision Support System completed

- Wyoming Highway Patrol (WHP)
  - Initiate speed limit reduction based on visual inspection of conditions.

- Maintenance Foreman
  - May lower speed limit based on conditions if a WHP is not on duty.

- Traffic Management Center
  - May lower the speed limit if average vehicle speeds drop 15 mph and no one else on corridor to confirm conditions.
Data collected

- Speed Sensor data
  - 10 speed sensors
- Two sets of data
  - 75 mph data set- September 1-30, 2008
  - 65 mph data set- October 22-November 19, 2008
- Not all ten speed sensors worked properly during this phase
  - 6 during 75 mph data set worked
  - 7 during 65 mph data set worked
Data collected

- RWIS – collected every 5 minutes
  - SfStatus – status of the surface (dry, wet, ice warning, etc)
  - SfTemp – current surface temperature
  - AirTemp – current air temperature
  - RH – relative humidity – percent of moisture in air
  - Dewpoint – temperature at which air becomes saturated
  - AvgWindSpeed – average wind speed
  - GustWindSpeed – maximum wind speed
  - Wind Direction
  - Visibility (became available in October data set)
Baseline speeds

- Baseline speeds give insight into how drivers travel during favorable conditions.
- Used “Ideal Data” to find baseline speeds
  - No moisture on road
  - Gust Wind speeds < 45 mph
  - Visibility > 500 ft
- Two Data Sets
  - September 1-30, 2008, -12 days of ideal data
  - October 22-November 19, 2008-7 days of ideal data
- Analysis completed on:
  - Direction (Eastbound/Westbound)
  - Lane of travel
  - Time of Day
  - By Sensor
Baseline speeds

- **75 mph data set- Breakdown by direction**

<table>
<thead>
<tr>
<th>Direction</th>
<th>Ave, 50</th>
<th>Ave, 85</th>
<th>Med, 50</th>
<th>Med, 85</th>
<th>Stdev, 50</th>
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<td>EB</td>
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- **65 mph data- Breakdown by direction**

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<th>Med, 50</th>
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Comparison/Conclusion

- Speed variation reduced from 75 mph to 65 mph data sets.
  - Seasonal speed limit reduced the speed variation
- 65 mph data set- Average and 85th percentile speeds were much higher than the posted speed than 75 mph data set
  - Drivers were more disobedient of the seasonal speed limit when conditions were “ideal”
- Baseline speeds will likely become a modeling variable during Phase II
RWIS Variables and Speed Analysis

- Purpose of task to determine RWIS variables impacting driver’s speeds

- Storm events
  - Split data into four events
  - Had both “ideal” and “non-ideal” days
  - Two events for each data set
## Storms 1 and 2

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<th>Variable</th>
<th>Storm 1</th>
<th>Storm 2</th>
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Conclusions/Recommendations

- Each storm event similar but with slightly different results
  - Run analysis on larger data sets with multiple storm events to resolve discrepancies.

- Significant Variables
  - Day_Night
  - SfStatus
  - Wind Speed
  - Visibility

- Purpose of initial modeling allows some variables to be removed from larger datasets being compiled for Phase II.
VSL Use

VSL EB I-80 (Feb. 18-April 14)

Frequency

Speed (MPH)

35 40 45 50 55 60 65

- 256.17
- 262.40
- 267.71
- 273.85
- 280.36
VSL Use

VSL EB I-80 (Feb. 18-April 14)

Average Duration (Hours) vs. Speed (MPH)

- 256.17
- 262.40
- 267.71
- 273.85
- 280.36
VSL Use

VSL EB I-80 (Feb. 18-April 14)

Cumulative Duration (Hours)

Speed (MPH)

- 256.17
- 262.40
- 267.71
- 273.85
- 280.36
VSL Sign Significance

- **Task:** Determine whether VSL signs impact vehicle speeds
- **Data period**
  - VSL signs installed and operational Feb. 13, 2009
  - Preliminary analysis from Feb. 17, 2009 to March 17, 2009
- **Preliminary Results**
  - **0.47** to a **0.74** mph speed reduction observed for every mph of speed reduction posted in the VSL
Future work

- Analyses with larger more comprehensive data sets.
  - Precipitation Rate and Visibility for all data
  - Multiple storm events at a time

- New speed sensor software
  - Look at getting individual speeds to analyze truck and passenger car data
QUESTIONS

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