July 20, 2015
4A: Safety Analysis & Planning
3:30 – 5:00 p.m.

Grant G. Schultz, Ph.D., P.E., PTOE
Associate Professor & Associate Chair
Department of Civil & Environmental Engineering

Jacob S. Farnsworth, EIT
Transportation Analyst
Kimley-Horn and Associates, Inc.
Presentation Overview

• Objectives
• Safety framework and methodology
• Conclusions
• Questions
Objectives

• Purpose:
  – Advance the application of the framework for highway safety mitigation in Utah
  – Create methodology steps for the application of this framework
  – Describe the developed methodology and provide an example of how it functions
Safety Framework and Methodology

- HSM safety mitigation framework
- Utah hot spot identification and analysis methodology
HSM Safety Mitigation Framework

1. Identify Safety 'Hot Spots'
   - Network Screening

2. Implement Cost-Effective Countermeasures
   - Diagnosis
   - Countermeasure Selection
   - Economic Appraisal
   - Project Prioritization

3. Improve Future Decision Making and Policy
   - Effectiveness Evaluation
Hot Spot Identification/Analysis Methodology

• Step 1: Identify Problematic Segments
• Step 2: Identify Problem Spots
• Step 3: Micro Analysis of Segments/Spots
• Step 4: Defining the Segment/Spot
• Step 5: Defining the Problem
• Step 6: Evaluation of Possible Countermeasures
• Step 7: Selection and Recommendation of Countermeasures
Hot Spot Identification/Analysis Methodology

- Step 1: Identify Problematic Segments
- Step 2: Identify Problem Spots
  - Step 3: Micro Analysis of Segments/Spots
  - Step 4: Defining the Segment/Spot
  - Step 5: Defining the Problem
  - Step 6: Evaluation of Possible Countermeasures
  - Step 7: Selection and Recommendation of Countermeasures
Hot Spot Identification/Analysis Methodology

• Step 1: Identify Problematic Segments
• Step 2: Identify Problem Spots
• **Step 3: Micro Analysis of Segments/Spots**
• Step 4: Defining the Segment/Spot
• Step 5: Defining the Problem
• Step 6: Evaluation of Possible Countermeasures
• Step 7: Selection and Recommendation of Countermeasures
**Hot Spot Identification/Analysis Methodology**

- Step 1: Identify Problematic Segments
- Step 2: Identify Problem Spots
- Step 3: Micro Analysis of Segments/Spots
- Step 4: Defining the Segment/Spot
- Step 5: Defining the Problem
- **Step 6: Evaluation of Possible Countermeasures**
- **Step 7: Selection and Recommendation of Countermeasures**
Hot Spot Identification/Analysis Methodology

• Example site: Interstate 80, Parleys Canyon
  – Milepoints 139.43-141.84
Hot Spot Identification/Analysis Methodology

- **Step 1: Identify Problematic Segments**
- **Step 2: Identify Problem Spots**
- **Step 3: Micro Analysis of Segments/Spots**
- **Step 4: Defining the Segment/Spot**
- **Step 5: Defining the Problem**
- **Step 6: Evaluation of Possible Countermeasures**
- **Step 7: Selection and Recommendation of Countermeasures**
Step 1: Identify Problematic Segments

• Purpose:
  – To identify problematic segments or “hot spots” or “black spots” using a Hierarchical Bayesian statistical model
Step 1: Identify Problematic Segments

• Variable identification:
  – Roadway data: functional classification, AADT, percent trucks, speed limit, through lanes, urban code
  – Roadway segments: based on speed limit, # lanes, AADT, functional class, and urban code
  – Crash data: provided by UDOT with four levels of data: crash, vehicle, people, rollup files
Step 1: Identify Problematic Segments

• Statistical procedures:
  – *Statistical model*: hierarchical Bayesian model used to model the mean and variance of the crashes for each segment, route, and functional class using a Poisson Mixture Model (PMM) distribution of expected crash frequencies
Step 1: Identify Problematic Segments

- Statistical procedures:
  - Output: final output of the model produces a posterior predictive distribution for each parameter in the model for every segment
  - A percentile is assigned to the actual number of crashes (between 0 and 1) based on where it falls in the distribution
Step 1: Identify Problematic Segments

Posterior predictive distributions tell the analyst how probable the observed number of crashes are given the model

Percentile ~0.72
Step 1: Identify Problematic Segments

• Display and analysis:
  – Results of the statistical model are imported to ArcMap/ArcGIS to visually display results
  – GIS tools provide an opportunity to effectively evaluate and visualize safety model results
  – Visualization tools in GIS offer unique ways of viewing data and presenting it in a logical manner
Step 1: Identify Problematic Segments

• Display and analysis:
  – *Corridor analysis*: segments and corridors mapped using the State Linear Referencing System (LRS)
  – *Color and scale*: results displayed using a color scale that corresponds to the percentile (i.e., crash risk) – additionally the line weights were adjusted to show the difference between actual and expected to better represent scale of difference
Statewide model results displayed by percentile
Statewide model results displayed by percentile and crash difference
## Step 1: Identify Problematic Segments

<table>
<thead>
<tr>
<th>Route</th>
<th>Beg Milepoint</th>
<th>End Milepoint</th>
<th>Location Description</th>
<th>Crash Count</th>
<th>Post Med</th>
<th>Difference</th>
<th>Percentile</th>
</tr>
</thead>
<tbody>
<tr>
<td>89</td>
<td>334.855</td>
<td>335.59</td>
<td>SR 114 Center Street Provo via 500 West</td>
<td>19</td>
<td>4</td>
<td>15</td>
<td>1.00000</td>
</tr>
<tr>
<td>91</td>
<td>29.008</td>
<td>29.819</td>
<td>1400 North Logan</td>
<td>11</td>
<td>2</td>
<td>9</td>
<td>0.99984</td>
</tr>
<tr>
<td>154</td>
<td>15.72</td>
<td>15.93</td>
<td>6200 South</td>
<td>8</td>
<td>1</td>
<td>7</td>
<td>0.99886</td>
</tr>
<tr>
<td>71</td>
<td>8.843</td>
<td>9.212</td>
<td>10600 South</td>
<td>7</td>
<td>1</td>
<td>6</td>
<td>0.99831</td>
</tr>
<tr>
<td><strong>80</strong></td>
<td><strong>139.43</strong></td>
<td><strong>141.84</strong></td>
<td>Parleys Summit</td>
<td><strong>10</strong></td>
<td><strong>3</strong></td>
<td><strong>7</strong></td>
<td><strong>0.99802</strong></td>
</tr>
<tr>
<td>68</td>
<td>11.638</td>
<td>23.934</td>
<td>SR 6 Elberta</td>
<td>12</td>
<td>3</td>
<td>9</td>
<td>0.99771</td>
</tr>
<tr>
<td>65</td>
<td>8.441</td>
<td>14.158</td>
<td>Road to Great Western Trail</td>
<td>7</td>
<td>1</td>
<td>6</td>
<td>0.99702</td>
</tr>
<tr>
<td>209</td>
<td>6.947</td>
<td>7.154</td>
<td>700 West</td>
<td>9</td>
<td>2</td>
<td>7</td>
<td>0.99666</td>
</tr>
<tr>
<td>89</td>
<td>370.298</td>
<td>371.216</td>
<td>5900 South</td>
<td>24</td>
<td>12</td>
<td>12</td>
<td>0.99639</td>
</tr>
<tr>
<td>15</td>
<td>303.193</td>
<td>303.44</td>
<td>SR 266 4500 South Murray</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>0.99613</td>
</tr>
<tr>
<td>89</td>
<td>386.801</td>
<td>388.04</td>
<td>SR 93 (2600 South) Bountiful</td>
<td>14</td>
<td>5</td>
<td>9</td>
<td>0.99563</td>
</tr>
<tr>
<td>6</td>
<td>205.649</td>
<td>210.71</td>
<td>Sheep Creek Road Left</td>
<td>13</td>
<td>5</td>
<td>8</td>
<td>0.99500</td>
</tr>
<tr>
<td>15</td>
<td>58.85</td>
<td>62.5</td>
<td>SR 56 200 North Cedar City</td>
<td>9</td>
<td>3</td>
<td>6</td>
<td>0.99394</td>
</tr>
<tr>
<td>186</td>
<td>6.708</td>
<td>6.937</td>
<td>1300 South Foothill Village Shopping Center</td>
<td>5</td>
<td>0</td>
<td>5</td>
<td>0.99323</td>
</tr>
<tr>
<td>171</td>
<td>11.93</td>
<td>12.533</td>
<td>900 East</td>
<td>9</td>
<td>3</td>
<td>6</td>
<td>0.99319</td>
</tr>
<tr>
<td>12</td>
<td>92.77</td>
<td>106.644</td>
<td>Burr Trail road</td>
<td>8</td>
<td>2</td>
<td>6</td>
<td>0.99317</td>
</tr>
<tr>
<td>89</td>
<td>378.701</td>
<td>379.145</td>
<td>Main Street via 400 South</td>
<td>9</td>
<td>3</td>
<td>6</td>
<td>0.99224</td>
</tr>
<tr>
<td>191</td>
<td>253.09</td>
<td>258.999</td>
<td>Road to Power Plant</td>
<td>5</td>
<td>1</td>
<td>4</td>
<td>0.99163</td>
</tr>
<tr>
<td>15</td>
<td>295.999</td>
<td>297.703</td>
<td>SR 209 9000 South Sandy</td>
<td>11</td>
<td>4</td>
<td>7</td>
<td>0.99143</td>
</tr>
<tr>
<td><strong>172</strong></td>
<td><strong>0</strong></td>
<td><strong>0.993</strong></td>
<td>6200 South via 5600 West (SR 172)</td>
<td><strong>13</strong></td>
<td><strong>5</strong></td>
<td><strong>8</strong></td>
<td><strong>0.99112</strong></td>
</tr>
</tbody>
</table>
Hot Spot Identification/Analysis Methodology

• Step 1: Identify Problematic Segments
• **Step 2: Identify Problem Spots**
• Step 3: Micro Analysis of Segments/Spots
• Step 4: Defining the Segment/Spot
• Step 5: Defining the Problem
• Step 6: Evaluation of Possible Countermeasures
• Step 7: Selection and Recommendation of Countermeasures
Step 2: Identify Problem Spots

• Purpose:
  – Determine whether or not problem spots exist within the segment

• Process:
  – Utilize advanced GIS tools such as spot analysis, strip analysis, and sliding scale analysis to evaluate each segment identified as a ‘hot spot’ in order to pinpoint crash clusters
Step 2: Identify Problem Spots

- Strip and sliding scale analysis ArcMap tools used
- 1/20 of a mile
- Minimum of 6 KA crashes
Step 2: Identify Problem Spots

- Identified the problem spots within the top 20 hot spot segments

<table>
<thead>
<tr>
<th>Route</th>
<th>Segment Milepoint</th>
<th># of Crashes</th>
<th>Problem Spot</th>
<th># of Crashes</th>
<th># Severity 5</th>
<th># Severity 4</th>
<th>Segment Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>89</td>
<td>334.885-335.59</td>
<td>19</td>
<td>335.31-335.32</td>
<td>7</td>
<td>0</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>89</td>
<td>370.298-371.216</td>
<td>24</td>
<td>371.21</td>
<td>8</td>
<td>0</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>171</td>
<td>11.93-12.533</td>
<td>9</td>
<td>12.23-12.29</td>
<td>6</td>
<td>1</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>89</td>
<td>378.701-379.145</td>
<td>9</td>
<td>379.1-379.145</td>
<td>6</td>
<td>0</td>
<td>6</td>
<td>17</td>
</tr>
<tr>
<td>172</td>
<td>0.0-0.933</td>
<td>13</td>
<td>0.98-0.99</td>
<td>7</td>
<td>0</td>
<td>7</td>
<td>20</td>
</tr>
</tbody>
</table>
Hot Spot Identification/Analysis Methodology

- Step 1: Identify Problematic Segments
- Step 2: Identify Problem Spots
- **Step 3: Micro Analysis of Segments/Spots**
- Step 4: Defining the Segment/Spot
- Step 5: Defining the Problem
- Step 6: Evaluation of Possible Countermeasures
- Step 7: Selection and Recommendation of Countermeasures
Step 3: Micro Analysis of Segments/Spots

• Purpose:
  – Determine the cause, location, and contributing factors of the problem
Step 3: Micro Analysis of Segments/Spots

- Tools used in micro analysis:
  - Crash data
  - Internet
  - Site visits
  - Communicating with experts
Step 3: Micro Analysis of Segments/Spots

- Crash data from crash file (I-80 example):

<table>
<thead>
<tr>
<th>Crash ID</th>
<th>First Harmful Event</th>
<th>Manner of Collision</th>
</tr>
</thead>
<tbody>
<tr>
<td>10104093</td>
<td>Motor Vehicle</td>
<td>Front to Rear</td>
</tr>
<tr>
<td>10075463</td>
<td>Motor Vehicle</td>
<td>Front to Rear</td>
</tr>
<tr>
<td>10284229</td>
<td>Motor Vehicle</td>
<td>NA</td>
</tr>
<tr>
<td>10421947</td>
<td>Motor Vehicle</td>
<td>Front to Rear</td>
</tr>
<tr>
<td>10080777</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>10070796</td>
<td>Motor Vehicle</td>
<td>Head-On</td>
</tr>
<tr>
<td>10368724</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>10108839</td>
<td>Motor Vehicle</td>
<td>Parked Vehicle</td>
</tr>
<tr>
<td>10345683</td>
<td>Rollover</td>
<td>NA</td>
</tr>
<tr>
<td>10361258</td>
<td>Motor Vehicle</td>
<td>Sideswipe</td>
</tr>
<tr>
<td>10348565</td>
<td>Rollover</td>
<td>NA</td>
</tr>
<tr>
<td>10353894</td>
<td>Rollover</td>
<td>NA</td>
</tr>
<tr>
<td>10182559</td>
<td>Rollover</td>
<td>NA</td>
</tr>
<tr>
<td>10381755</td>
<td>Crash Cushion</td>
<td>Sideswipe</td>
</tr>
</tbody>
</table>
Step 3: Micro Analysis of Segments/Spots

- Crash data from vehicle file (I-80 example):

<table>
<thead>
<tr>
<th>Crash ID</th>
<th>Event Sequence(1-4)</th>
<th>Most Harmful Event</th>
<th>Vehicle Maneuver</th>
</tr>
</thead>
<tbody>
<tr>
<td>10104093</td>
<td>Motor Vehicle, ROR, Ditch</td>
<td>Motor Vehicle</td>
<td>Straight Ahead/Straight Ahead</td>
</tr>
<tr>
<td>10075463</td>
<td>Motor Vehicle</td>
<td>Motor Vehicle</td>
<td>Stopped in Lane/Straight Ahead</td>
</tr>
<tr>
<td>10284229</td>
<td>ROR, Embankment, Rollover</td>
<td>Rollover</td>
<td>Straight Ahead</td>
</tr>
<tr>
<td>10421947</td>
<td>Motor Vehicle, ROR, Embankment, Light Pole</td>
<td>Motor Vehicle/Utility Pole</td>
<td>Straight Ahead/Passing</td>
</tr>
<tr>
<td>10680777</td>
<td>ROR, Delineator Post, Culvert, Post</td>
<td>Delineator Post</td>
<td>Changing Lanes</td>
</tr>
<tr>
<td>10070796</td>
<td>Motor Vehicle, ROR</td>
<td>Motor Vehicle</td>
<td>Straight Ahead/Straight Ahead</td>
</tr>
<tr>
<td>10368724</td>
<td>Equipment Failure, ROR, Fence, Rollover</td>
<td>Rollover</td>
<td>Straight Ahead</td>
</tr>
<tr>
<td>10108839</td>
<td>ROR, Embankment/Equipment Failure, Downhill Runaway/Motor Vehicle</td>
<td>Embankment/Motor Vehicle</td>
<td>Straight Ahead/Parked/Straight Ahead</td>
</tr>
<tr>
<td>10345683</td>
<td>Motor Vehicle, ROR, Rollover</td>
<td>Rollover</td>
<td>Straight Ahead</td>
</tr>
<tr>
<td>10361258</td>
<td>Motor Vehicle, ROR, Fence, Rollover</td>
<td>Rollover</td>
<td>Straight Ahead/Crossed Median</td>
</tr>
<tr>
<td>10348565</td>
<td>ROR, Rollover</td>
<td>Rollover</td>
<td>Straight Ahead</td>
</tr>
<tr>
<td>10353894</td>
<td>Motor Vehicle, Rollover, Non-Fixed Object</td>
<td>Rollover</td>
<td>Straight Ahead</td>
</tr>
<tr>
<td>10182559</td>
<td>ROR, Rollover, Delineator Post</td>
<td>Rollover</td>
<td>Straight Ahead</td>
</tr>
<tr>
<td>10381755</td>
<td>ROR, Crash Cushion, Motor Vehicle</td>
<td>Motor Vehicle</td>
<td>Straight Ahead/Straight Ahead</td>
</tr>
</tbody>
</table>
Step 3: Micro Analysis of Segments/Spots

- Crash data from rollup file (I-80 example):

<table>
<thead>
<tr>
<th>Crash ID</th>
<th>DUI</th>
<th>Aggressive Driving</th>
<th>Speed Related</th>
<th>Intersection Related</th>
<th>Roadway Geometry</th>
<th>Teenage Driver</th>
</tr>
</thead>
<tbody>
<tr>
<td>10104093</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>10075463</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>10284229</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>10421947</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>10080777</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>10070796</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>10368724</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>10108839</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>10345683</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>10361258</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>10348565</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>10353894</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>10182559</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>10381755</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Total</td>
<td>1/14</td>
<td>0/14</td>
<td>7/14</td>
<td>0/14</td>
<td>14/14</td>
<td>3/14</td>
</tr>
</tbody>
</table>
Step 3: Micro Analysis of Segments/Spots

- Internet Tools (I-80 example):
  - Google Map/Google Earth
  - UDOT Roadview Explorer
  - Construction Projects History
Step 3: Micro Analysis of Segments/Spots

• Site Visit (I-80 example):
  – Measurements taken
  – Verified assumptions
  – Gained perspective
  – Noted: Median barriers mostly for eastbound traffic
Hot Spot Identification/Analysis Methodology

• Step 1: Identify Problematic Segments
• Step 2: Identify Problem Spots
• Step 3: Micro Analysis of Segments/Spots
• **Step 4: Defining the Segment/Spot**
• Step 5: Defining the Problem
• Step 6: Evaluation of Possible Countermeasures
• Step 7: Selection and Recommendation of Countermeasures
Step 4: Defining the Segment

• Purpose:
  – Provide a clear definition of the problem area and its characteristics
Step 4: Defining the Segment

• Highlights (I-80 example):
  – Parleys Canyon
  – Milepoints 139.43 to 141.84
  – 3 lanes of travel at 12 ft. wide
  – 65 MPH speed limit
  – 50 ft. sloped center median w/ no barrier
  – Ditch
  – 7 ft. shoulders
Hot Spot Identification/Analysis Methodology

- Step 1: Identify Problematic Segments
- Step 2: Identify Problem Spots
- Step 3: Micro Analysis of Segments/Spots
- Step 4: Defining the Segment/Spot
- **Step 5: Defining the Problem**
- Step 6: Evaluation of Possible Countermeasures
- Step 7: Selection and Recommendation of Countermeasures
Step 5: Defining the Problem

• Purpose:
  – Provide a clear definition of the safety problem to address along with any possible contributing factors
  – Segment vs. spot
Step 5: Defining the Problem

• I-80 example:
  – Problem occurs along entire segment
  – Excess of run-off-road (ROR) and rollover collisions
  – Contributing factors:
    • Speeding
    • Poor roadway geometry
Hot Spot Identification/Analysis Methodology

• Step 1: Identify Problematic Segments
• Step 2: Identify Problem Spots
• Step 3: Micro Analysis of Segments/Spots
• Step 4: Defining the Segment/Spot
• Step 5: Defining the Problem
• **Step 6: Evaluation of Possible Countermeasures**
• Step 7: Selection and Recommendation of Countermeasures
Step 6: Evaluation of Possible Countermeasures

• Purpose:
  – To make a comprehensive list of all possible known countermeasures related to the problem
  – Evaluate possible countermeasures for effectiveness and feasibility at the site

• Process:
  – Identify potential countermeasures (NCHRP 500)
Step 6: Evaluation of Possible Countermeasures

- I-80 Example:
  - Install midlane rumble strips
  - Eliminate shoulder drop off
  - Provide enhanced shoulder or in lane delineation and marking for sharp curve
  - Provide improved highway geometry for horizontal curves
  - Apply shoulder treatments such as eliminating shoulder drop off or widening shoulders
  - Design safer slopes and ditches to prevent rollovers
  - Install median and/or shoulder barriers
  - Enhance delineation along the curve
  - Add or improve roadside hardware
  - Widening of left shoulder
Step 6: Evaluation of Possible Countermeasures

- Countermeasure evaluation considerations:
  - Implementation time
  - Expense
  - Long term vs. short term effectiveness
  - Single vs. multiple countermeasures
  - Proven countermeasures - CMF
  - Alternatives comparisons - IHSDM
  - Site feasibility
**Hot Spot Identification/Analysis Methodology**

- Step 1: Identify Problematic Segments
- Step 2: Identify Problem Spots
- Step 3: Micro Analysis of Segments/Spots
- Step 4: Defining the Segment/Spot
- Step 5: Defining the Problem
- Step 6: Evaluation of Possible Countermeasures
- **Step 7: Selection and Recommendation of Countermeasures**

Network Screening

Diagnosis

Countermeasure Selection
Step 7: Selection and Recommendation of Countermeasures

• Purpose:
  – Select those countermeasures that will have the greatest impact for safety improvement at the site
  – Recommend those countermeasures feasible for implementation
Step 7: Selection and Recommendation of Countermeasures

• I-80 example:
  – Eliminate shoulder drop off
  – Design safer slopes and ditches – redesign center median
  – Install median barriers – focus on eastbound traffic
  – Install shoulder barriers
  – Widen the left shoulders
Conclusions

- **Hot Spot Identification and Analysis Methodology** was developed to:
  - Assist UDOT in the screening of Utah’s roadways
  - Determine hot spots
  - Diagnose hot spots
  - Select countermeasures to mitigate the safety issues
Questions and Discussion

• For more information, contact:

  Grant G. Schultz, Ph.D., P.E., PTOE
gschultz@byu.edu/(801) 422-6332

  Jacob Farnsworth, EIT
  jacob.farnsworth@kimley-horn.com/(702)862-3694

Awarded the Executive Director’s Excellence in Transportation Safety Award at the 2014 Zero Fatalities Safety Summit