The FHWA Geohazards Program

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Geohazard - geological or earth-material state and environmental conditions that may lead to widespread damage or risk

- Probability of occurrence
Risk – Exposure to the chance of loss or injury

- Future phenomenon; may or may not occur; has direct impact to project or system
- Probability*Impact = Risk
Geohazards and Performance Management

Performance Management

Highway System Performance
Establishes system performance requirements

State Highway Agencies to develop asset management plan toward achieving national highway performance goals

- Risk-based plan to improve and preserve assets and performance of the system
- Must include pavement and bridges
- Encourages inclusion of all assets within the corridor right-of-way
MAP-21 National Performance Goals

1. Safety
2. Infrastructure Conditions: State of Good Repair
3. Congestion Reduction
4. System Reliability- improve efficiency
5. Freight Movement and Economic Vitality
6. Environmental Sustainability
7. Reduced Project Delivery Delays
Rockslide on I-40 in NC

- 6-Month Closure
- 130-mile detour
- Frequent Back-ups in excess of 7-miles common in Asheville, NC

Table 1: Total Transportation Costs of I-40 and US-64 Rock Slides

<table>
<thead>
<tr>
<th></th>
<th>I-40 Rockslide</th>
<th>US-64 Rockslide</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Operating Costs</td>
<td>$56.9</td>
<td>$7.2</td>
<td>$64.1</td>
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<tr>
<td>Diversion Travel Time Costs</td>
<td>$65.2</td>
<td>$10.7</td>
<td>$75.9</td>
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<tr>
<td>Emissions Costs</td>
<td>$4.5</td>
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<td>$5.0</td>
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<tr>
<td>Congestion Travel Time Costs</td>
<td>$43.8</td>
<td>$3.5</td>
<td>$47.2</td>
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<tr>
<td>Pavement Maintenance Costs</td>
<td>$4.6</td>
<td>$0.3</td>
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<tr>
<td>TOTAL</td>
<td>$174.9</td>
<td>$22.1</td>
<td>$197.0</td>
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</tbody>
</table>

From HDR Report
# Examples of Geohazards in Transportation

<table>
<thead>
<tr>
<th>Geo-Environmental Hazards</th>
<th>System Geohazards</th>
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<tbody>
<tr>
<td>• Contaminated Sites/Landfills</td>
<td>• Seismic Hazards</td>
</tr>
<tr>
<td>• Waste Materials with Heavy Metals</td>
<td>• Scour</td>
</tr>
<tr>
<td>• Sulfate Soils</td>
<td>• Unstable Rock Slopes</td>
</tr>
<tr>
<td>• Acid (Hot) Rock</td>
<td>• Unstable Soil Slopes</td>
</tr>
<tr>
<td>• Acid Mine Tailings</td>
<td>• Talus and Colluvium</td>
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<tr>
<td></td>
<td>• Carbonate and Evaporite Karst</td>
</tr>
<tr>
<td></td>
<td>• Saline, Gypsiferous and Evaporitic Soils</td>
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<tr>
<td></td>
<td>• Underground Mines</td>
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<tr>
<td></td>
<td>• Expansive Soils</td>
</tr>
<tr>
<td></td>
<td>• Heaving Bedrock</td>
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<tr>
<td></td>
<td>• Collapsible Soils</td>
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<tr>
<td></td>
<td>• Organic Soils and Peat</td>
</tr>
<tr>
<td></td>
<td>• Sensitive Clays</td>
</tr>
<tr>
<td></td>
<td>• Permafrost</td>
</tr>
<tr>
<td></td>
<td>• Degradable Rock</td>
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<tr>
<td></td>
<td>• Volcanic Hazards</td>
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<td>• Coastal Hazards</td>
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</tbody>
</table>
Characterization of Geohazards

In Final Draft

Flow-chart guide based on causative and associative (e.g. environmental) conditions for investigation and characterization of geohazards
Transportation Asset Management Plans (TAMP)

3. Performance Gap Assessment
   - Define short-term and long-term asset management planning horizons.
   - Describe traffic growth and demand on the system.
   - Present an analysis of future funding versus condition scenarios.
   - Illustrate the performance gap between existing condition levels and future condition levels.

4. Lifecycle Cost Considerations
   - Define "lifecycle costs" and explain why they are important.
   - Describe the methodology used to address them in the TAMP.

5. Risk Management Analysis
   - Set the context for risk management.
   - Define key programmatic risks associated with implementation of the TAMP (e.g., cost escalations, budget cuts and environmental delays).
   - Define system risks that could adversely affect the NHS (e.g., asset failure and external events such as floods, earthquakes, and hurricanes).
   - Provide a map showing the NHS assets most at risk.
   - Include a risk register that provides the following for each programmatic risk – likelihood of occurrence, consequences of occurrence, and mitigation activities.
...Are Manageable.

• **Management Systems**
  – Number of states have slope or rockfall management systems

• **Corridor Management Concept**
Challenges as We Move Toward Performance Management

- Establish expectations for geotechnical performance
  - Implement methods for measuring and testing performance
  - Establish targets for performance (e.g. frequency of rockfall from a rock-cut, long-term settlement of bridge approach, movement of anchored wall, corrosion of steel MSE reinforcement or rock-bolt)
- Predicting change in performance over time
- Consistency in design & performance standards
Risk Standards

Risk = Probability * Impact

- Standards to which we design and mitigate based on risk and life-cycle costs
- Standard risk tolerances in relation to potential impact
Questions?