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Geotechnical Risks and Management Systems: An FHWA Perspective

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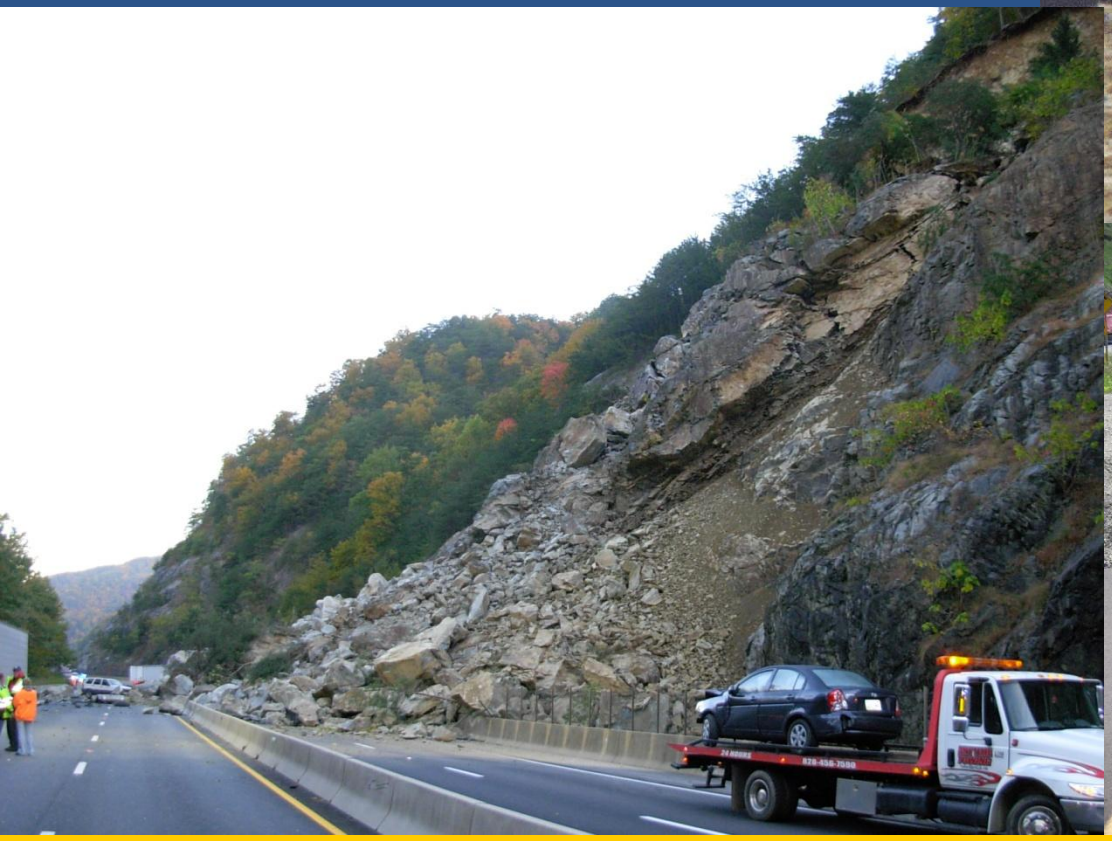
RESOURCE CENTER

Competing Demands…

Geotechnical Management

- Slope Management Systems
- Geohazard Management Systems
- Retaining Wall Inventories and Management
- Management of Geotechnical Systems & Appurtenances
  - Mechanically stabilized systems - Rock-bolts/anchors, dowels/soil-nails
  - Drainage systems
  - Rock-fall mitigation systems
  - Ground improvements
- Geotechnical Data Management Systems

Natural and Man-made Conditions affecting Slopes and Infrastructure



Hazard vs. Risk (Threat)

Hazards

Earthquake

Hurricane

Abandoned Underground Mines

Karst Geology

Landslides

Rockfall…

Risks

Earthquake occurs…

a) resulting in fatalities.

b) resulting in major injuries.

c) Resulting in disruption of lives.

d) damage to property…

Risk Management

- Limit Surprises
- Minimize Management by Crisis
  - Operate Proactively instead of Reactively
- Reduce Long-term Costs
- Increase Likelihood of Success
  - “Do It Right” the First Time
- Prevent or Minimize Bad Things from Happening
- Optimize Designed Solutions

Minimize Threats Maximize Opportunities

Slope Failure Impacts and Management

Threats

- Closure
- Impedance to Mobility
- Economic Impact to Region & Users
- Cost of Repair/Remediation
- Injury and damages
- Loss of Life

Obstacles

- Resources (time, money, people)
- Convincing Decision Makers
- Proactive Funding Mechanism
- Mitigating Off-ROW threats before failure

Slope Management Systems

Motivation - ECONOMICS

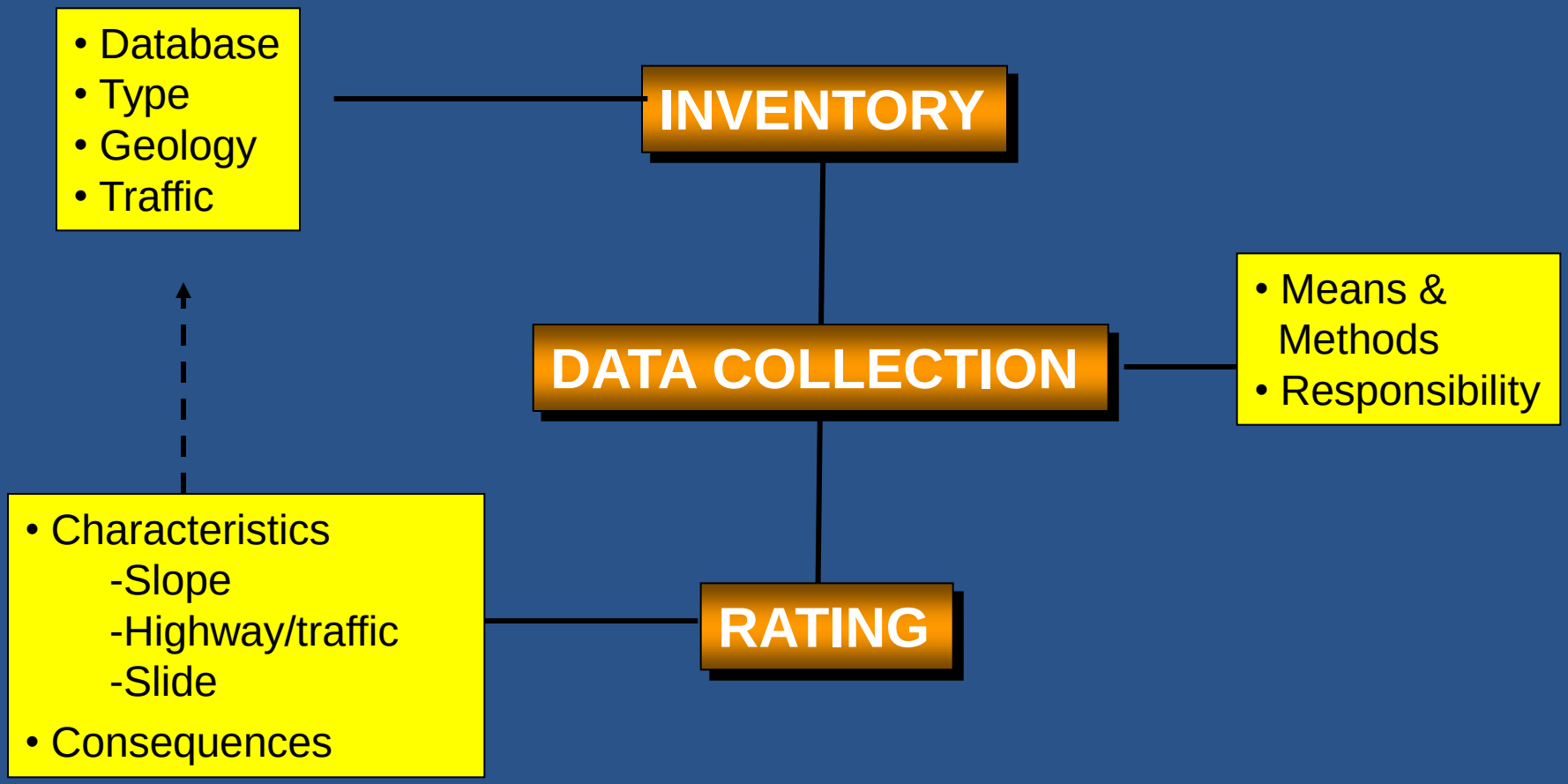
- Problem of frequency and severity
- Costs often poorly tracked, but known to be great
- Seldom have funding to address all problems
- No “one size fits all” strategy available

Slope Management Systems

Limitations

- Do not “solve problem” – rather provides information needed to address problem most effectively
- Do not establish optimum strategy – rather enables implementation of selected strategy
- Are not self-sustaining – require maintenance and upgrades (funding and manpower!)

Slope Management System



Slope Characteristics

Information	ODOT 1992	ODOT 2001	NYDOT 1992	WSDOT 1993	Ohio DOT 2006	NH DOT	TN DOT
Height	✓		✓			✓	✓
Geology	✓		✓			✓	✓
Ground-water	✓		✓	✓		✓	✓

Highway/Traffic Characteristics

Information	ODOT 1992	ODOT 2001	NYDOT 1992	WSDOT 1993	Ohio DOT 2006	NH DOT	TN DOT
ADT	✓	✓	✓	✓	✓	✓	✓
Classi-fication		✓		✓			
Speed	✓		✓	✓	✓	✓	✓
Detour time				✓			
Site distance	✓		✓	✓	✓	✓	✓
Travel distance			✓		✓		✓

Slide Characteristics

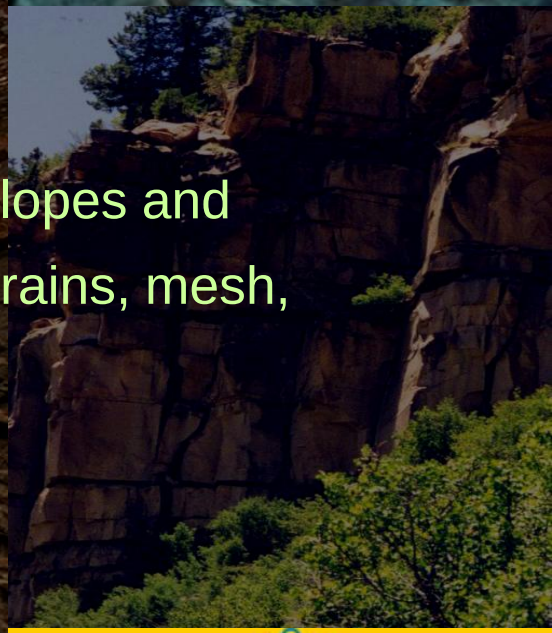
Information	ODOT 1992	ODOT 2001	NYDOT 1992	WSDOT 1993	Ohio DOT 2006	NH DOT	TN DOT
Volume	✓		✓				✓
Emergency					✓		
Frequency		✓	✓		✓	✓	✓
Deformation rate					✓		
Scarp dimensions		✓		✓	✓		

Consequences

Information	ODOT 1992	ODOT 2001	NYDOT 1992	WSDOT 1993	Ohio DOT 2006	NH DOT	TN DOT
Fatalities			✓	✓			
Vehicle risk	✓		✓	✓	✓	✓	✓
Damage			✓	✓	✓		
Road impact		✓		✓	✓		✓
Annual cost		✓		✓	✓		
History		✓		✓	✓		✓
Cost/benefit		✓		✓	✓		✓
Future impact			✓	✓	✓		

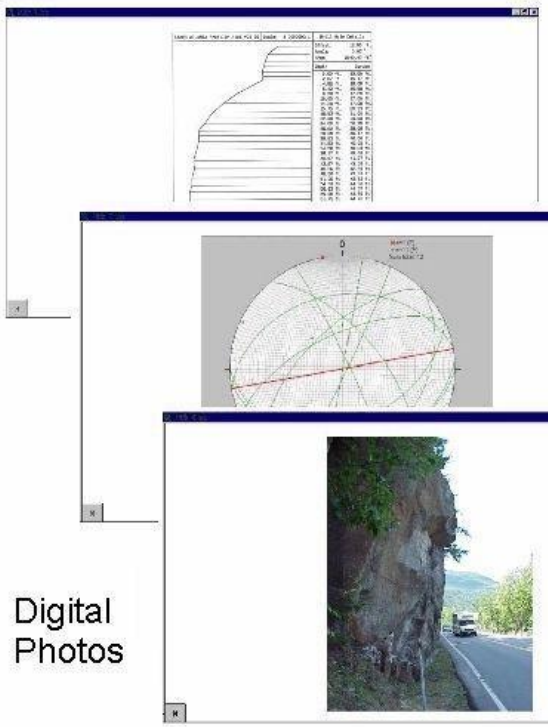
Other Features…

- Incorporate into GIS and integrated data layers (site info, photos, topographic, geologic maps, Google Earth Pro, etc.)
- Integrated Geologic Structure and Geotechnical Data
- Profiling Data
- Distinguish between modes of failure
- Condition assessments/performance monitoring of slopes and appurtenances (i.e. condition of rock-bolts/dowels, drains, mesh, fences, etc.)
- Effectiveness of Ditch (Catchment)
- Mitigation Cost



Example:

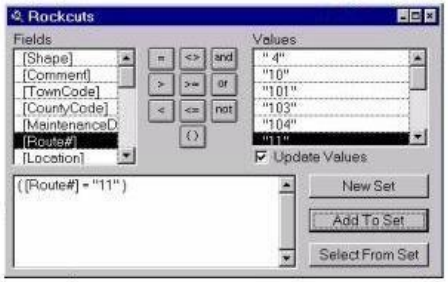
NH DOT Rock-cut Management System



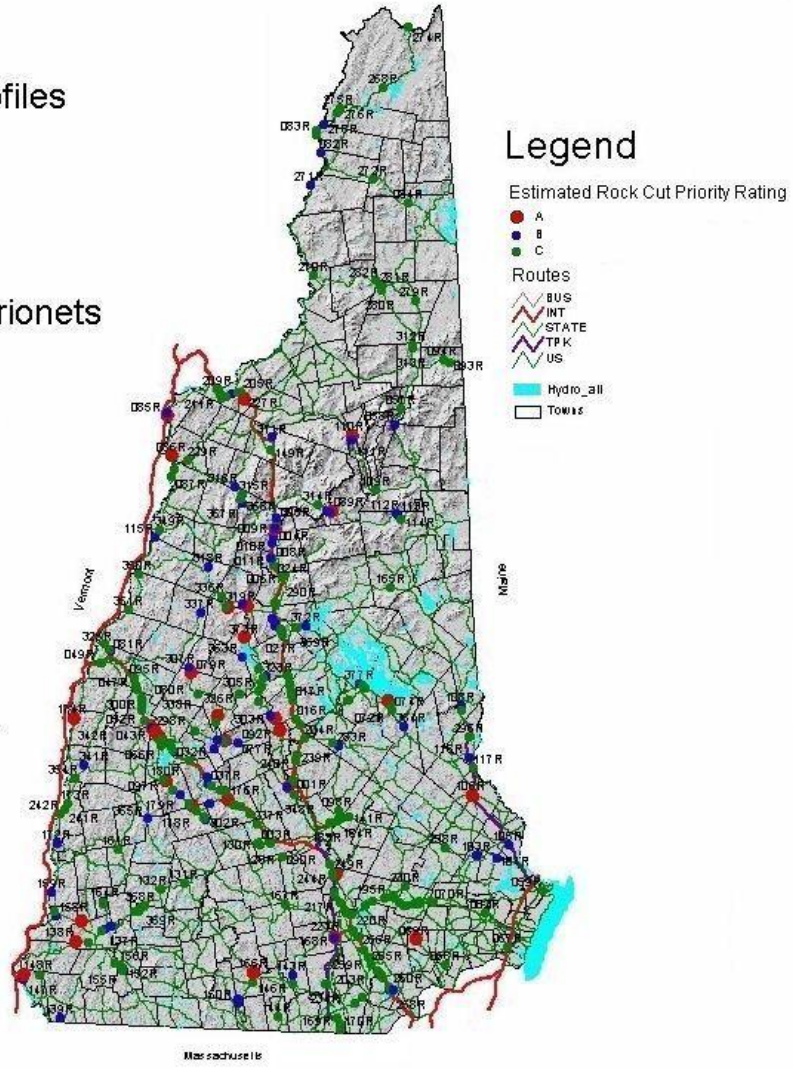
2D-Profiles

Sterionets

Digital Photos



Query Builder



Costs and Economic Strategies

Costs depend on…

- Size and severity of problem condition
- Maintenance/repair technique(s) used
- Site location
- Availability of equipment and materials
- Whether contracted or "in-house"
- Degree of improvement achieved

Economic Strategies

- Minimize costs
  - Immediate costs
  - Life-cycle costs
- Minimize risk
- Minimize "total cost"
- Maximize "value"

Take-Aways

Realistic Scope - Functional & Maintainable System

Support of Upper Management and Necessary Designated Resources

- Clearly convey risks and benefits
- Value-Added & Representation of Geotechnical Engineering

FHWA Initiatives

- Guidance framework for slope/geotechnical management systems
- Integration of Asset Management
  - Life-cycle considerations of geotechnical features and systems
  - Integration of Geotechnical Data Management
- Distinction between “Hazard” and “Risk”
  - Groundwork for Standard of Practice


Questions?