

## Implementation Report

### Rockfall Hazard Process Assessment

<http://www.mdt.mt.gov/research/projects/geotech/rockfall.shtml>



#### Introduction and Purpose

The Montana Department of Transportation (MDT) commissioned a new research program to improve assessment and management of its rock slope assets. The Department implemented a Rockfall Hazard Rating System (RHRS) program in 2005 and wished to add value to that existing program by adding new slopes and reassessing select ones, incorporating new rating approaches, and leveraging that data to generate a new prioritized list for consideration of mitigation projects. An ideal framework for a refreshed program would be consistent with modern transportation asset management (TAM) principles. These tools are useful across Departmental groups, from the core group of Geotechnical personnel, technical groups such as Roadway Design, to groups with more broad missions, such as Asset

Managers and Department Planners.

The resulting program, renamed the Rock Slope Asset Management Program (RAMP), is expected to reduce overall rockfall hazard to the public while helping MDT manage the cost of rock slope maintenance and mitigation work by offering decision support tools, risk assessments, and economic models suitable for incorporating network-level condition forecasting for various investment scenarios.

The project consisted of the following main tasks:

- Visit rock slopes throughout Montana which have changed significantly since 2004 and collect new or updated rating information
- Review the existing rockfall hazard rating criteria and develop Condition, Risk, and

other Performance Measures for use with the updated RAMP.

- Assess rockfall sites in Montana using the new rating criteria and new data collection tools.
- Using the new rock slope assessments and Performance Measures, demonstrate how this information can be used to select critical sites. Working with MDT, develop a final list of critical sites for conceptual mitigation designs.
- Develop cost/benefit scenarios that incorporate maintenance costs, highway user costs, safety risks, and construction cost estimates, and demonstrate the potential application to project selection.
- Evaluate the compatibility of the revised RAMP with

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**MORE INFO:**

*Principal Investigator*  
**Darren Beckstrand**  
[darrenb@landslide.technology.com](mailto:darrenb@landslide.technology.com)  
 503.452.1200

*MDT Technical Contact*

**Jeff Jackson**  
[jejjackson@mt.gov](mailto:jejjackson@mt.gov)  
 406.444.3371

*MDT Research Project Manager*

**Sue Sillick**  
[ssillick@mt.gov](mailto:ssillick@mt.gov)  
 406.444.7693

MDT's TAM plan, with additional consideration of how it can be integrated into MDT's existing IT and enterprise GIS environment.

- Presentation of research findings and recommendations to MDT via a report and meeting with relevant stakeholders and personnel.

## Implementation Summary

Using the existing RHRS program, new site rating data collected between 2015 and 2017, and additional maintenance activity and cost data provided by MDT, researchers developed a new Rock Slope Asset Management Program (RAMP) that will meet the Department's current and future needs. In order to continue benefiting from the RAMP in the future, the new program should be maintained by MDT and incorporated into high-level planning and budgeting activities to actively manage an asset that would cost approximately \$4 billion dollars to rebuild again today. This report summarizes the implementation recommendations made by the research team and the actions that will be taken by MDT based on these recommendations.

## Implementation Recommendations

### **Recommendation 1:**

*The RAMP is TAM compatible. Realize lower State budget*

*expenditures and unforeseen user costs due to slope deterioration by incorporating rock slopes into the State's TAM plan. Because current federal legislation does not require inclusion of geotechnical assets, MDT has significant flexibility in how it accomplishes this recommendation. At a minimum, implement RAMP principles in selecting sites to mitigate and/or reconstruct.*

### **MDT Response:**

Implementing and incorporating the RAMP Program as part of the formal TAM process will be reviewed by District Administrators and other management stakeholders. Implementation methods and how to incorporate them into the TAM plan using flexibility in federal CFRs will be investigated.

### **Recommendation 2:**

*Integrate the RAMP program into the Department's Planning workflow, addressing preservation and reconstruction measures for existing Fair and Poor condition rock slopes process early in the NEPA process.*

### **MDT Response:**

MDT will investigate methods to incorporate the RAMP data into the planning workflow, such as adding consultation with the RAMP into the Engineering Project Scheduler (EPS) and other milestone reports such as the Preliminary Field Review (PFR).

### **Recommendation 3:**

*Develop STIP and HSIP line items in state budgets for stand-*

*alone rock slope mitigation projects that accomplish both corridor risk reduction and safety improvements. Set aside of a percentage (for instance, 25 to 50%) of the forecast budget amount required to maintain current conditions (\$28 million annually) for rock slope preservation and reconstruction. Utilize the remaining forecast budget in existing corridor improvement projects for rock slope condition improvements and risk reduction. Set aside at least 18% for preservation projects.*

### **MDT Response:**

Developing budgetary line items to maintain the RAMP and to preserve rock slopes will be explored in consultation with District Administrators and upper management personnel.

### **Recommendation 4:**

*Utilize the Condition State approach in conjunction with percent retention for developing rock slope design goals. For instance, a design goal of all new slopes of Condition State 1 and percent retention of 95% would yield a rock slope that produces little rockfall and an effective ditch.*

### **MDT Response:**

The Condition State approach and percent retention will be utilized in the design process to develop rock slope design goals compatible with acceptable risk and budgetary constraints.

### **Recommendation 5:**

*Update rock slope site data after mitigation/repair work or construction of new slopes. As sites change over the coming years, either due to planned*

mitigation work or emergency responses to failure, this data should be reflected in the RAMP database so that MDT can use the most accurate data in their work.

**MDT Response:**

MDT Geotechnical personnel will update the RAMP data when changes to a rock slope occur, including known significant maintenance, mitigation or preservation activities, or construction of new slopes.

**Recommendation 6:**

*Track rockfall events (and other geotechnical-related traffic interruptions) and maintenance responses using the tracking tools developed as part of this project.*

**MDT Response:**

MDT Maintenance will be using rockfall-specific job codes in their new MMS system. The rockfall

event tracker and maintenance tracker tools will be used by geotechnical personnel for larger rather than routine maintenance events. Geotechnical personnel will also request that maintenance personnel utilize the maintenance tracker tools as often as practicable.

**Recommendation 7:**

*Maintain department licenses for the online programs used to host the current database. The ability to host the RAMP database online makes it easy for users throughout the Department to access this data, and to share it with the general public where relevant. Currently, the RAMP program is hosted through ESRI's ArcGIS Online (AGOL) program.*

**MDT Response:**

MDT will maintain ESRI licenses.

**Recommendation 8:**

*Conduct another large-scale assessment in five years, similar to annual or semiannual pavement and bridge condition assessments but at a wider timeframe. For example, the 2016 field work re-evaluated 27% of MDT's previously rated rock slopes. This new data was used to capture current conditions and improve deterioration and life cycle models. Future field work and associated data improvements will further improve the accuracy of the tools available to Department planners.*

**MDT Response:**

MDT will consider conducting a large scale assessment in five years to track network condition, deterioration, and improve fiscal models.

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