

May 5, 2008

TO: K. Littleton – Region Materials Engineer, ERO

FROM: *JA*  
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Geotechnical Services Division  
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SUBJECT: SR 21, vicinity MP 111.89 to 111.93, XL-3320 (Phase 3)  
State-Wide Risk Reduction Rock Slope Scaling Program  
Geotechnical Recommendations

### **INTRODUCTION**

A state-wide risk reduction scaling program was implemented by WSDOT in 2006. The program is meant to reduce rockfall until a permanent slope stabilization project under the P3 Unstable Slope Program can be programmed and constructed. This memorandum presents our findings and mitigation recommendations for the unstable rock slope located on SR 21 between MP 111.89 and 111.93, approximately 50 miles south of Republic, Washington (Figure 1).

### **GEOTECHNICAL ASSESSMENT**

Our geotechnical site assessment consisted of taking photographs of the slope, conducting Maintenance interviews, measuring slope heights, lengths, orientations, and detailing risk reduction work which includes tree/shrub removal, slope scaling, debris removal, and determining estimated quantities.

### **SITE CONDITIONS**

This unstable slope is approximately 200-feet long and ranges from 50- to 70-feet in height, with the existing cutslope angle near-vertical (Figure 2). The ditch is approximately 5-feet wide and 2-feet deep. Maintenance indicates the ditch is unable to contain the larger rockfall. Rockfall impacts both lanes of the highway at this location.

The slope is primarily composed of moderately- to highly-fractured, fresh- to slightly weathered, strong granodiorite. The bedrock is mapped as intrusive granodiorite of the Keller Creek Pluton. Block sizes range from 1- to 10-feet in dimension, and observed rockfall typically occurs as raveling and toppling-type failures.

No groundwater was observed on the slope during our site assessment on March 21, 2007.

## **MITIGATION RECOMMENDATIONS**

Mitigation measures that will reduce rockfall at this location consist of vegetation removal and slope scaling with debris removal.

### **Vegetation Removal**

Vegetation removal should include removal of trees or shrubs on steep, exposed bedrock slopes. We estimate that approximately three trees/shrubs will be removed during construction (Figure 4).

### **Slope Scaling with Debris Removal**

Slope scaling limits and areas of intensive scaling are shown in Figures 3 and 4. Within the slope scaling limits, typical rock scaling operations should be performed. The locations of intense scaling should consist of removing unstable blocks that we observed during our site visits.

We estimate that 80 crew hours will be required for slope scaling. Special Provisions for Slope Scaling are provided in Appendix B. Scaling will likely damage the highway surfacing, so provisions for its repair should be included in the contract.

We also estimate that approximately 250 cubic yards of debris will be generated during scaling operations. A Special Provision for Debris Removal Including Haul is provided in Appendix B.

## **CONSTRUCTION CONSIDERATIONS**

### **Traffic**

Full roadway closures will be required to perform scaling operations. We anticipate that these closures will be accomplished with short-duration work windows on the order of 20 to 30 minutes in length.

### **Geotechnical Inspection**

We request that a geotechnical specialist from our office be contacted to assess the slope prior to the completion of scaling to help the engineer determine whether or not additional scaling is required.

If you have questions regarding the information presented in this memorandum, then please contact Mike Mulhern at (360) 709-5583 or Doug Anderson at (360) 709-5427.

TMA:mpm

cc: M. Patterson, Eastern Region Materials, ERO

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May 5, 2008  
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K. English, Eastern Region Materials, ERO  
L. Chatterton, Assistant Region Administrator for Operations, ERO  
L. Moses, Geotechnical Division, MS 47365  
R. Carandang, Scheduling Engineer, MS 47365

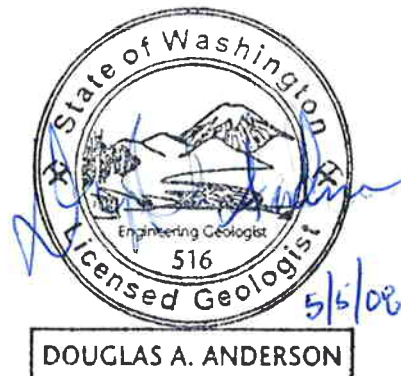
Prepared by:  
Michael P. Mulhern  
Geotechnical Specialist



Agency Approving Authority:  
TONY M. ALLEN, P.E.  
State Geotechnical Engineer



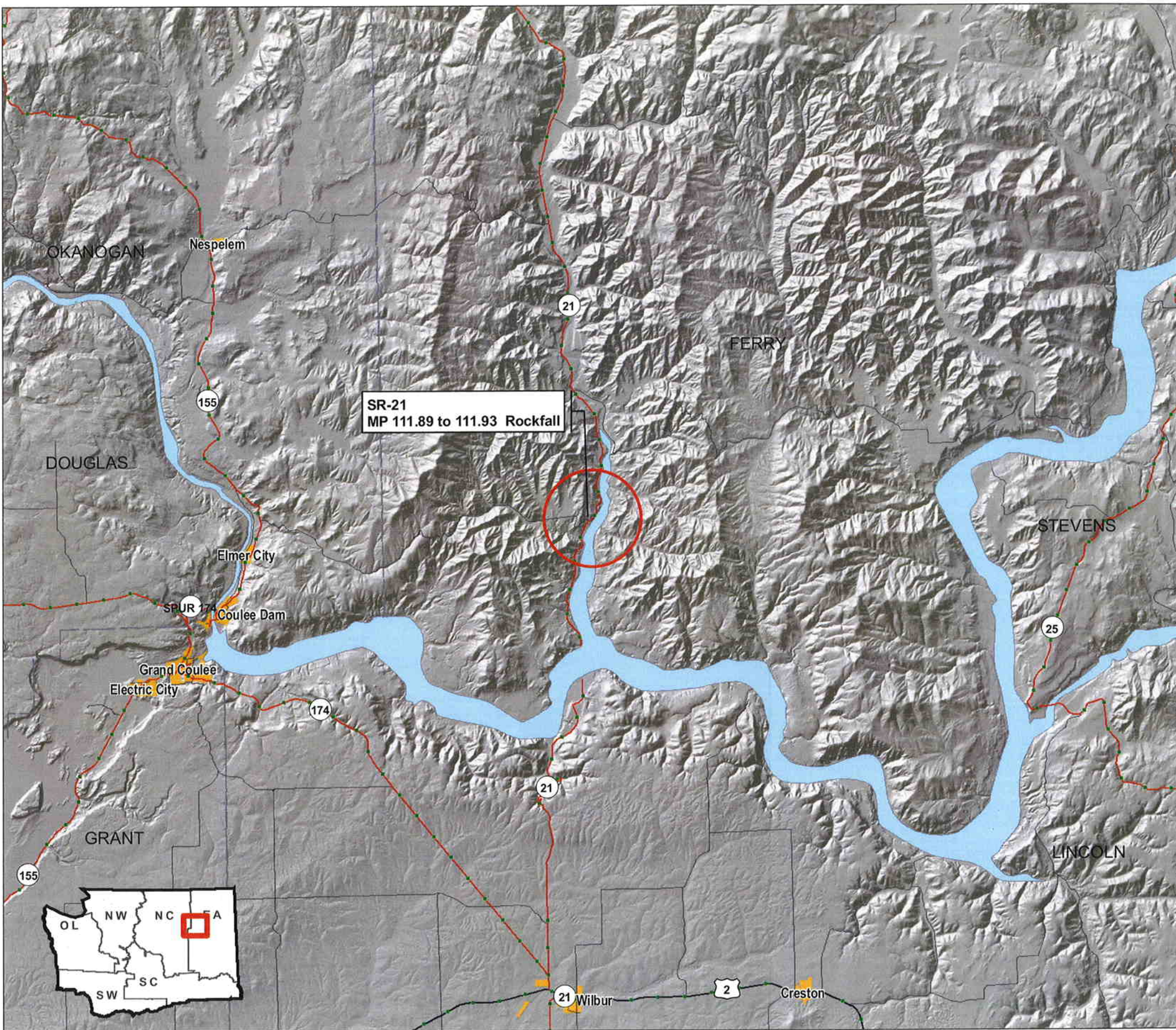
Technical Review By:  
Douglas A. Anderson, L.E.G.  
Assistant Chief Engineering Geologist



# **APPENDIX A**

## **Figures**

**FIGURE 1: SITE VICINITY**  
**SR-21 VICINITY MP 111.89 TO 111.93 ROCKFALL**



- LEGEND**
- Risk Reduction Scaling Program Slopes
  - Milepost Markers
- State Routes**
- Interstate
  - US Route
  - State Route
  - Ramps
  - Proposed Route
  - Local Road
  - County Boundary Lines
  - Incorporated Cities



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DATE	MARCH 17, 2008

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JOB XL-3320 S.R. 21

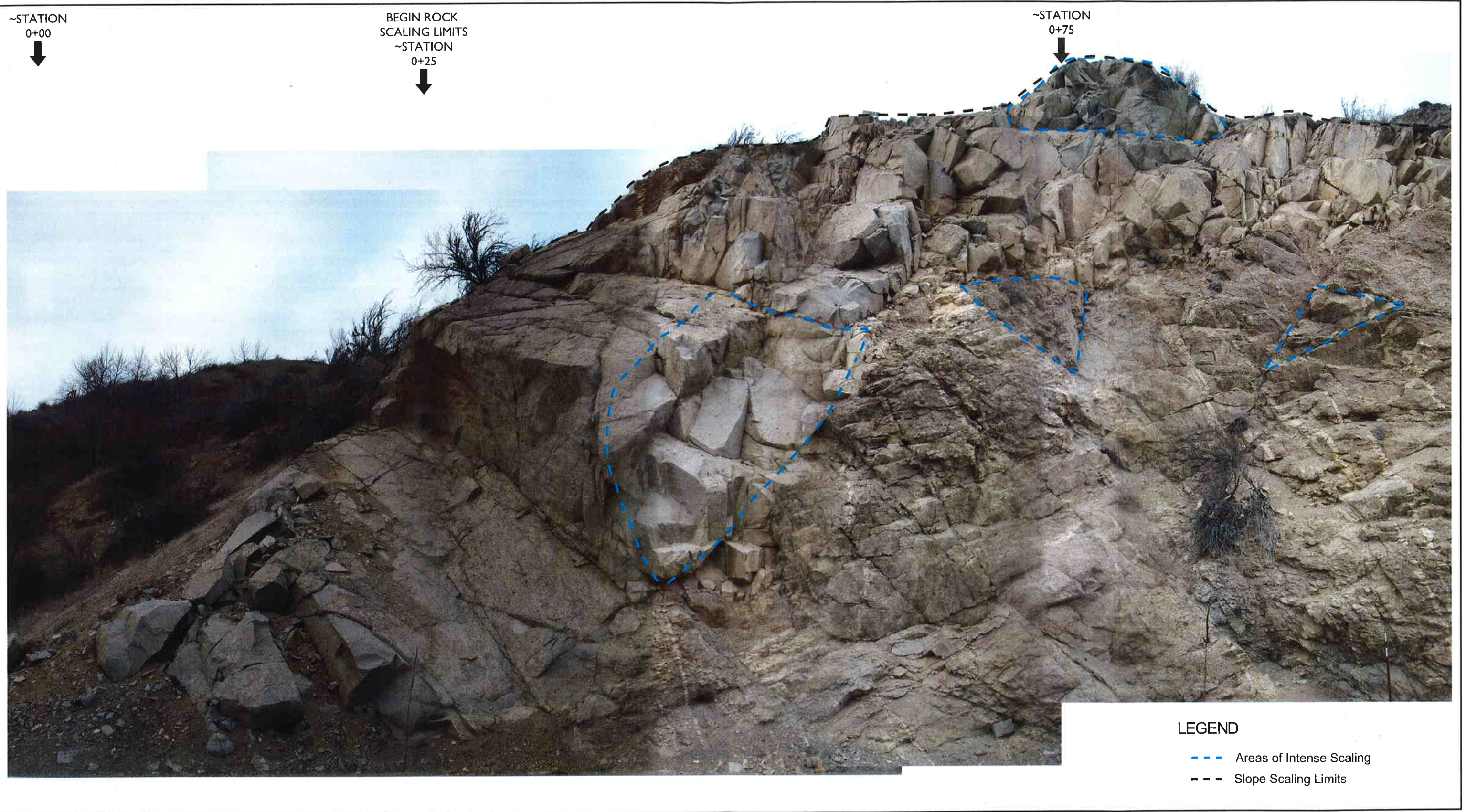
SR 21 vicinity MP 111.89 to 111.93 Rockfall

WASHINGTON STATE  
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GEOTECHNICAL DIVISION



DATE 4/2008  
SCALE N.T.S.  
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Figure 2. A photograph showing the unstable slope on SR 21 vicinity MP 111.89 to 111.93



**LEGEND**

- - - Areas of Intense Scaling
- - - Slope Scaling Limits



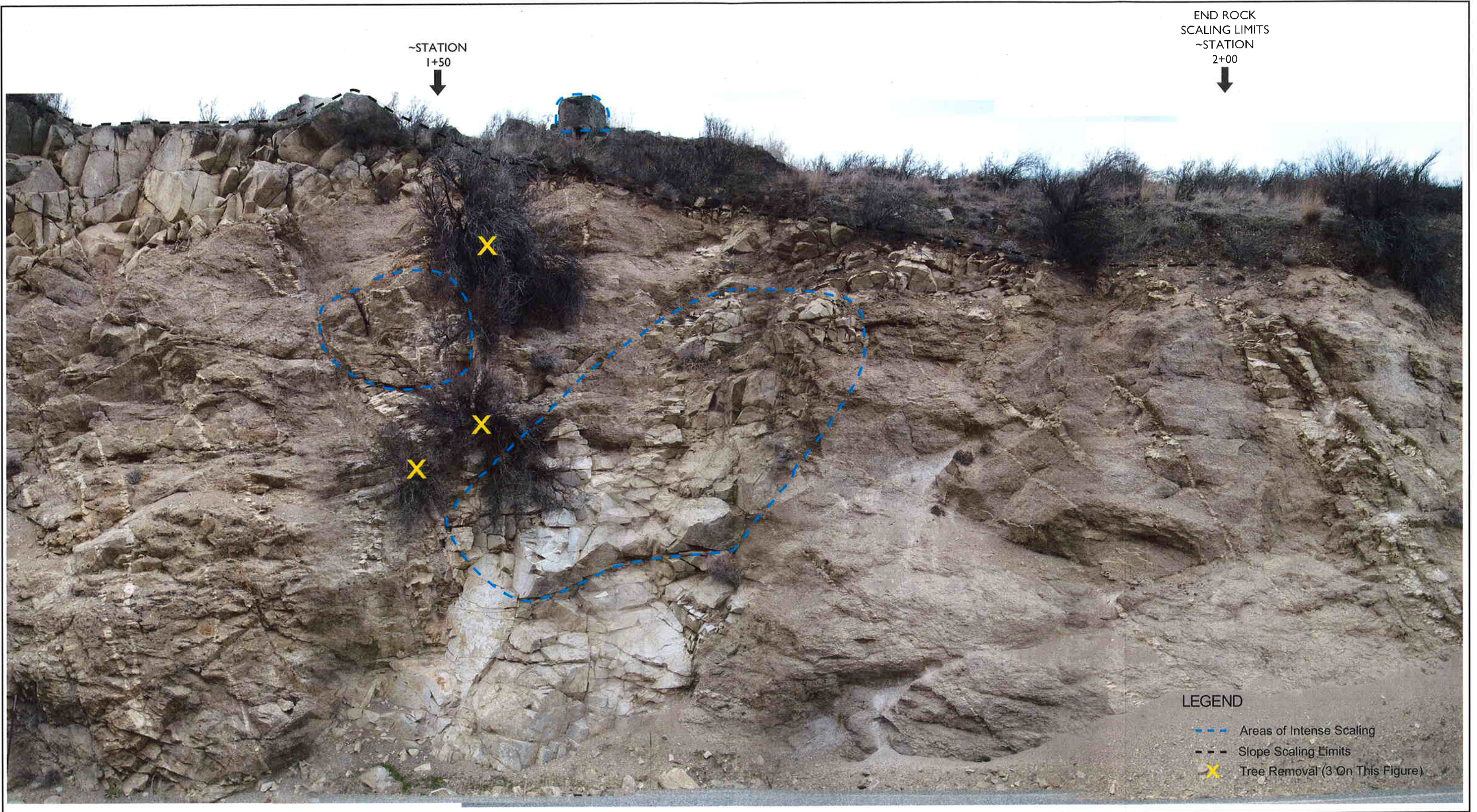
**FIGURE 3: RISK REDUCTION MITIGATION DESIGN**

SR 21 MITIGATION MEASURES

SR-21 SRMP 111.89 - 111.93 JOB # XL-3320

**NOT TO SCALE**

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GEOTECHNICAL DIVISION

**FIGURE 4: RISK REDUCTION MITIGATION DESIGN**

SR 21 MITIGATION MEASURES

SR-21 SRMP 111.89 - 111.93 JOB # XL-3320

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**APPENDIX B**

**Special Provisions**

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## **SLOPE SCALING**

### **Description**

This work shall consist of the manual removal of vegetation and loose rock and soil on the slope at the locations shown in the Plans or as directed by the Engineer. The Contractor shall provide all materials, equipment, and labor necessary to perform this work.

### **Submittals**

Not less than 2 weeks prior to commencing rock scaling, the Contractor shall provide to the Engineer:

- A. The Contractor shall provide written evidence that the rock slope scaling foreman and scalers have performed satisfactory work in similar capabilities for sufficient length of time to be fully qualified to perform their duties. The foreman shall have not less than 1500 hours of demonstrated experience as a scaler. The scalers shall have not less than 1000 hours of demonstrated experience on similar projects.
- B. The Contractor shall submit a detailed work plan for each rock slope to be scaled. The plan shall include:
  1. The proposed construction sequence and schedule.
  2. The type of equipment and tools to be used.
  3. The number of scaling crews to be employed on the project. (A scaling crew is defined as one qualified foreman and two qualified scalers.)
  4. Debris removal and disposal plan generated from the scaling work.
  5. Provisions to protect adjacent facilities.

Work shall not begin until the Engineer has approved the appropriate submittals in writing.

### **Materials**

Slope scaling will be done with the use of scaling bar, portable hydraulic wedges, air pillows, hand drills, splitters, Boulder Buster™ or other mechanical means. Other hand tools in addition to scaling bars may be used provided they have demonstrated effectiveness to perform the required work by approval of the Engineer.

### **Construction Requirements**

All trees and brush within 20 feet of the slope crest shall be flush cut and the root wad left intact.

Work shall proceed according to the work plan and schedule submitted by the Contractor prior to commencement of work. The size of the crew, defined as a foreman and two qualified scalers, shall be maintained at all times.

3/12/08

Slope scaling shall start at the top of the slope and work shall proceed down slope, removing loose rock and soil as the work progresses. Tree and brush removal shall be included as Slope Scaling. Unless otherwise directed by the Engineer, all trees within 20 feet of the slope crest shall be flush cut and the root wad left intact. Tree falling shall be completed prior to performing other scaling work.

The extent of the slope scaling will be determined by the Engineer and/or be specified in the Plans.

All rock, debris, and vegetive material produced by the scaling operation shall be removed by the Contractor and hauled to a site specified in the contract. See Special Provision **DEBRIS REMOVAL INCLUDING HAUL**.

### **Measurement**

Slope scaling will be measured by the crew hour.

Debris removal will be by the cubic yard in the hauling conveyance at the point of removal from the roadway. See Special Provision **DEBRIS REMOVAL INCLUDING HAUL**.

### **Payment**

Payment will be made in accordance with Section 1-04.1, for the following Bid item included in the proposal:

"Slope Scaling", per crew hour.

The unit contract price per crew hour for "Slope Scaling" shall be full pay for performing the work as specified.

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## **DEBRIS REMOVAL INCLUDING HAUL**

### **Description**

This work consists of removing existing debris from the roadway or material generated from slope scaling, mechanical scaling, and/or trim blasting operations.

### **Construction Requirements**

The Contractor shall remove all existing and slope scaling-, mechanical scaling -, and/or trim blasting-related debris within the project limits and as directed by the Engineer. The Contractor shall also haul and place debris at a specified location.

### **Measurement**

Debris removal will be measured by the cubic yard in the hauling conveyance at the point of removal from the roadway.

### **Payment**

Payment will be made in accordance with Section 1-04.1 for the following bid item that is included in the proposal:

“Debris Removal Including Haul”, per cubic yard.

The unit contract price per cubic yard for “Debris Removal Including Haul” shall be full pay for performing the work described including furnishing the equipment, materials, and labor required to load, haul, and place the debris at the specified location.