ROCK SCALING RECOMMENDATIONS

U.S. 95: MILEPOST 62.8 TO 64.10
MINERAL COUNTY, NEVADA

December 2004

NEVADA DOT
GEOTECHNICAL ENGINEERING

MATERIALS DIVISION

STATE OF NEVADA

DEPARTMENT OF TRANSPORTATION

MATERIALS DIVISION

GEOTECHNICAL SECTION

ROCK SCALING RECOMMENDATIONS
U.S. 95: MILEPOST 62.80 TO 64.10
MINERAL COUNTY, NEVADA
DECEMBER 2004

E. A. 72964-9

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INTRODUCTION

Presented herein are the results of our geotechnical investigation of potential rock fall hazards that have been identified on cut slopes along U.S. 95 at the western edge of Walker Lake from approximate milepost 62.8 to 64.1. The Materials Division previously investigated this area and provided recommendations for mitigation in September 1998 under E.A. No. 72419. In that investigation and during the 2004 PDFS for this project, rock fall from the cut slopes was identified by maintenance personnel. It has also been reported that rock fall is generated from the natural cliffs and steep slope above the roadway cuts.

FIELD SURVEY

An evaluation of potential slope instabilities was completed in November 2004 to identify and catalog potential rock fall hazards from the cut slopes. Photographs were taken of major areas of concern. Photographs have been included in this report for reference only. The photos are intended only to provide examples of the types of rock fall hazards that exist in the cut slopes. They are not intended to provide a complete catalog of areas that need to be scaled and cannot be relied upon for that purpose. Specific areas to be scaled need to be identified in the field by the Engineer and Contractor during the scaling operations.

Quantities of material that would be generated from slope scaling operations were estimated for each 1/10-mile section for use in developing bid items and costs for this project.

The cut slopes are between 65 and 100 feet in height and are roughly inclined at a 0.25:1 to 0.5:1 (horizontal:vertical) slope although the angle of the cut slopes vary throughout the project. Between approximate mileposts 63.5 and 63.6, the slope is roughly at a 1:1 with a near vertical head cut near the crest and a total vertical height of up to 185 feet from the road surface.

Four main categories of rock fall were identified at this site which include:

1. Failure of fractured bedrock
2. Collapse of overhanging cemented soils
3. Loose rock at the crest of the slope and perched on the slope face

4. Rockfall from natural erosion of the mountain cliffs located above the road

The slopes are comprised of granitic bedrock that is generally moderately to highly fractured and slightly to moderately weathered. The bedrock fracture spacing ranges from a few inches up to 10 feet or more with an average spacing of 1 to 4 feet in many locations. The fractures are relatively continuous in the vertical direction and discontinuous in the horizontal direction. This creates somewhat discontinuous columnar rock fractures and wedges. Numerous rock fragments fall as a result of failure of wedges; many of these fractures can be seen from the base of the cut, which have the potential to fail and reach the roadway.

Cemented alluvial soil deposits are present at the crest of the cuts in many areas. This soil deposit is cemented to varying degrees. Differential erosion of the softer cemented soil above the harder bedrock has created overhanging features in a number of areas. Some of these areas appear to be relatively stable; however many areas show some fracturing and deep differential weathering which present a potential rockfall hazard.

Perched rocks on top of the slope present further hazards as the soil erodes from around the rocks during rain, snow and wind events. A number of larger boulders are visible perched at the top of the slope as well as many smaller rocks along the entire section. Several other areas have loose rocks perched on benches and slope irregularities within the rock cut itself. The section between milepost 63.53 and 63.65 contains many of these loose rocks on the surface, which present a hazard.

The fourth category of rockfall that has been identified comes from the steep slopes and cliffs above the road cut through the entire section. Although natural slopes are generally more stable than cuts as is the case at this site, the sheer volume of steep slopes and cliffs exposing highly fractured rock presents an additional rockfall potential to those present on the cut slope faces.

RECOMMENDATIONS

The Geotechnical Section recommends that slope scaling be performed as part of this project. Scaling should be conducted from approximate milepost 62.8 to 63.0 and from milepost 63.2 to

64.1. The total estimated quantity of scaling is approximately 1,500 cubic yards estimated from scaling of rock fractures, perched surface rock and overhanging cemented soils on and directly above the cut slopes. Table 1 presents the estimated quantities of scaling for each 1/10 of a mile interval. Due to difficult access both on and above the cut slopes, quantities were roughly estimated using a laser optical measuring equipment as well as field judgment from the road surface; no direct measurements were made.

Table 1 – Estimated Rock Scaling Quantities	
Milepost	**Quantity (CY)**
62.8-62.9	180
62.9-63.0	25
63.2-63.3	30
63.3-63.4	225
63.4-63.5	95
63.5-63.6	200
63.6-63.7	390
63.7-63.8	185
63.8-63.9	80
63.9-64.0	55
64.0-64.1	35

Scaling operations will require negotiating difficult terrain and rappelling from steep to near vertical slopes. Only specialty contractors specifically trained and experienced in this type of work should be allowed on this project.

Scaling will require manpower using ropes and harnesses with pry-bars, handheld hydraulic splitters, jackhammers and other hand held equipment for much of the work. Some work could be accomplished using larger equipment; however the height of the cut slopes will limit their applicability unless cranes are used. Additionally, cemented overhangs and larger blocks of fractured rock may need to be drilled and blasted with small charges. Photographs of selected areas are included as Appendix A to show some of the major areas to be scaled. These photos delineate some of the major blocks of bedrock, overhangs and larger surface boulders to be

removed, but are by no means the only areas to be scaled. Specific areas for scaling will need to be delineated in the field by the Engineer during the operation. Full time inspection and coordination with the Contractor will be required.

Scaling will require a lane closure. During blasting and removal of large blocks of material, temporary road closures will likely be required. Temporary rock fall fencing will need to be placed to control rock fall during the scaling operation. Large blocks of material will need to be removed from the slope face that will likely fall onto the roadway. Damage to the pavement surface should be anticipated if the roadway is not protected.

Potential rock fall from natural cliffs and slopes above the cuts will require installation of rock fall protection. Rock fencing and/or a decelerator drapery could be constructed above the cut slopes to mitigate this rock fall potential. Due to poor access above the cut slopes, installation of any type of rock fall protection will be expensive. Additionally, right-of-way may need to be acquired. A detailed investigation will be needed to explore options for mitigating this rock fall potential, which is beyond the scope of this project.

APPENDIX A

SCALING PHOTOGRAPHS

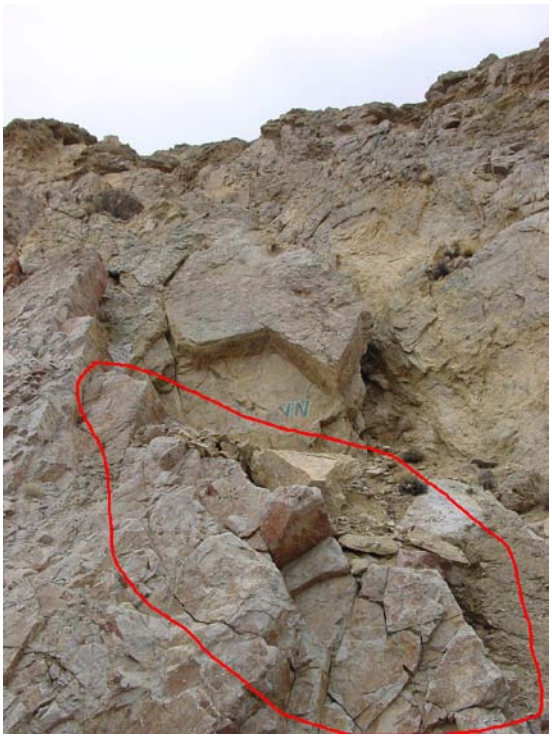

Fig 1. Milepost 62.8 showing loose rocks and fractured rock to be scaled.

Fig 2. Milepost 62.9 showing fractured rock and overhanging material.

Fig 3. Milepost 63.2 showing loose rock and alluvium overhang.

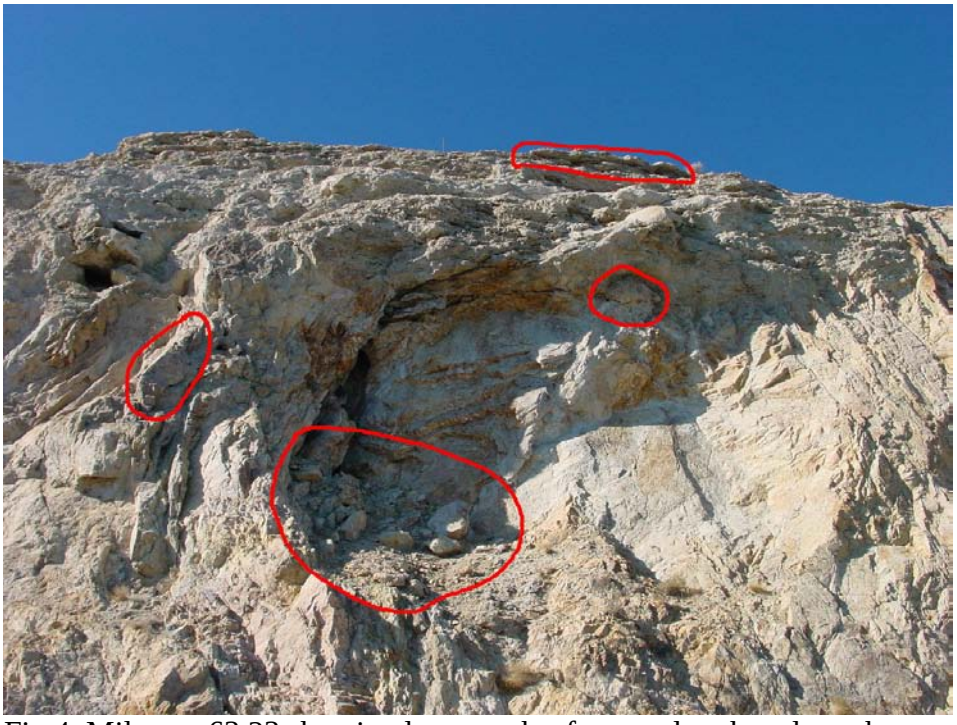

Fig 4. Milepost 63.23 showing loose rocks, fractured rock and overhangs.

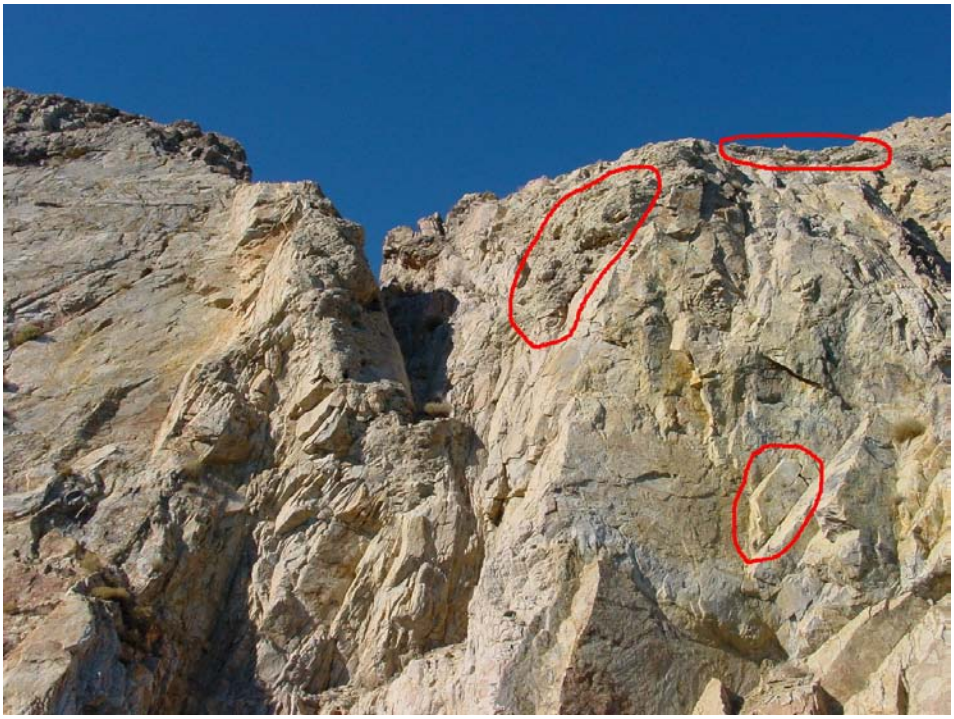

Fig 5. Milepost 63.29 showing cemented soil attached to bedrock, rock fracture and soil overhang.

Fig 6. Milepost 63.33 showing fractured rock wedges and soil overhang. Note rock debris in roadside ditch from recent rock fall.

Fig 7. Milepost 63.36 showing failed rock mass perched on rock face and overhang at top of cut slope.

Fig 8. Milepost 63.38 showing highly fractured rock and soil overhang. Note highly fractured bedrock in foreground with many loose wedges.

Fig 9. Milepost 63.48 showing poorly cemented soil mass at top of slope. Note many rock fractures across cut face.

Fig 10. Milepost 63.50 showing larger blocks of fractured rock.

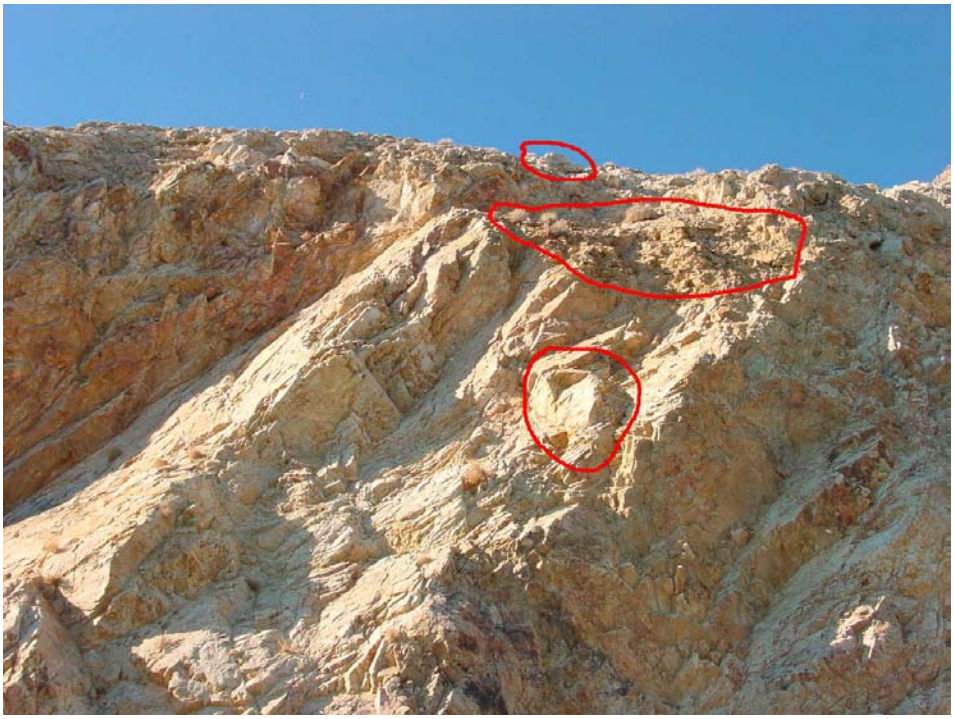

Fig 11. Milepost 63.53 showing large rock wedge, loose rocks perched on slope face and large rock at top of slope.

Fig 12. Milepost 63.55 showing fractured cemented soil on top of cut and large rock perched on slope.

Fig 13. Milepost 63.61 showing large volume of unstable rocks perched on slope.

Fig 14. Milepost 63.67 showing fractured rock wedge, over steepened degraded bedrock and cemented soil overhangs.

Fig 15. Milepost 63.70 showing perched rocks and soil mass at midslope bench and soil overhangs at crest.

Fig 16. Milepost 63.72 showing cemented soil overhangs. Note highly fractured bedrock across cut face.

Fig 17. Milepost 63.74 showing fractured soil overhangs. Note intense fracturing of bedrock across cut face.

Fig 18. Milepost 63.75 showing open fractures in rock creating unstable wedges of rock.

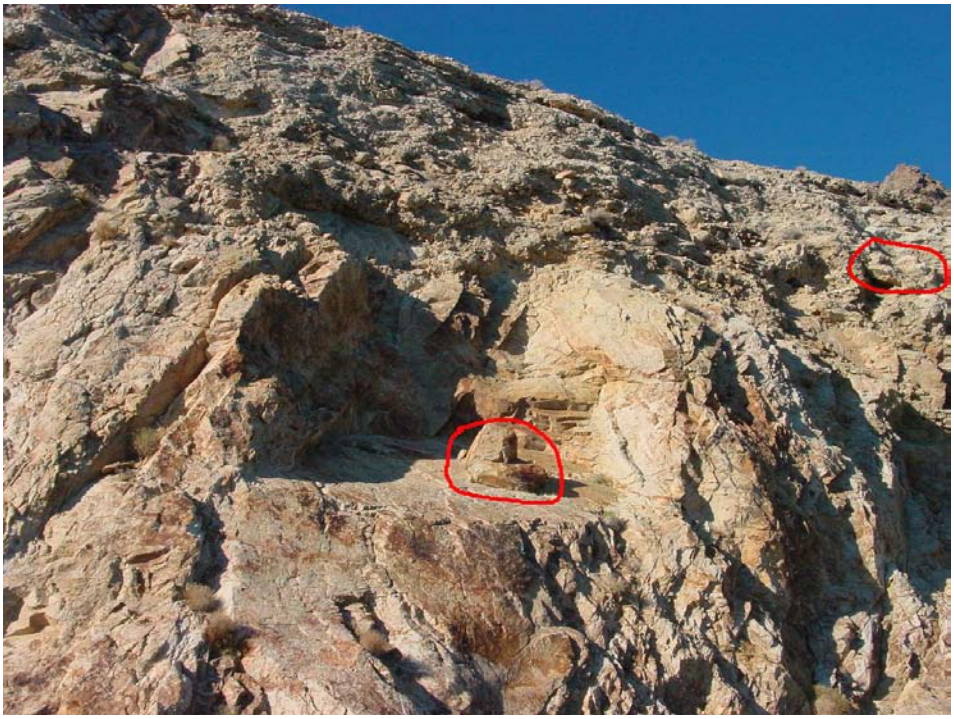

Fig 19. Milepost 63.76 showing perched loose rock and unstable wedge of cemented soil.

Fig 20. Milepost 63.83 showing large, overhanging, fractured bedrock.

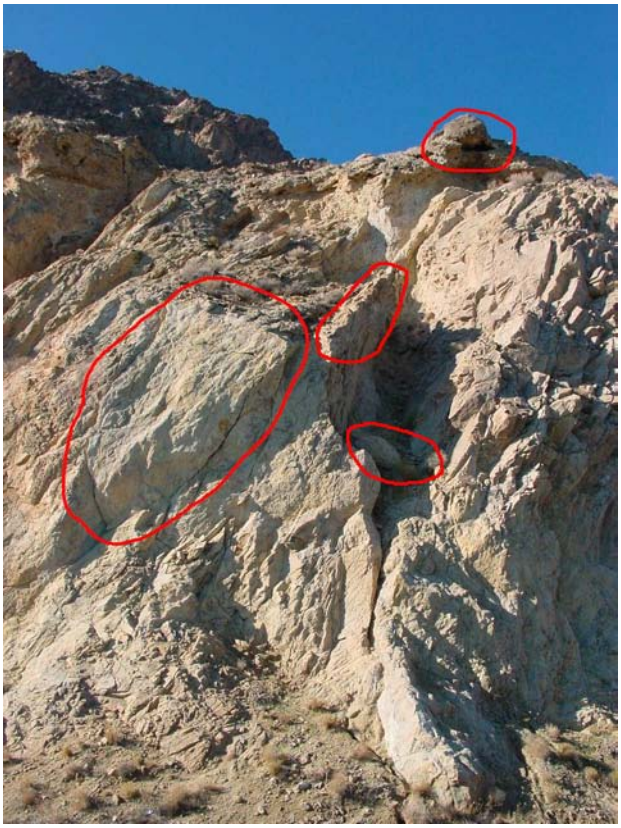

Fig 21. Milepost 63.85 showing large fractured bedrock wedge, overhanging bedrock, perched boulder and cemented soil overhang.

Fig 22. Milepost 63.89 showing fractured bedrock wedge and soil overhang. Note highly fractured bedrock across cut face.

Fig 23. Milepost 63.91 showing loose rocks perched at top of slope. Note highly fractured bedrock with many open fractures across cut face.

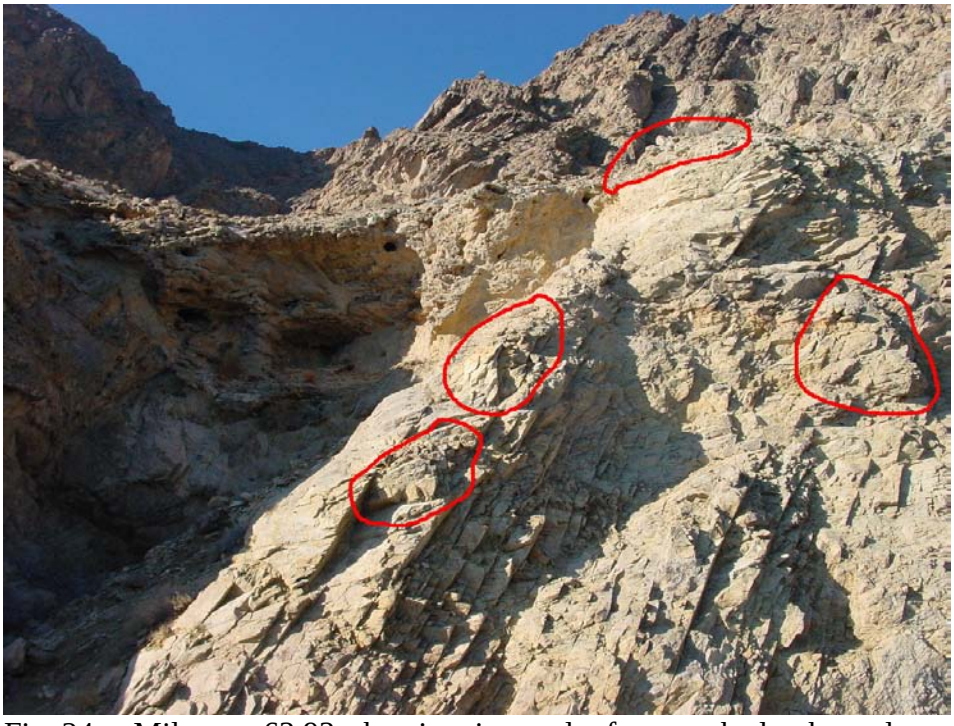

Fig 24. Milepost 63.93 showing intensely fracture bedrock wedges and soil overhang.

Fig 25. Milepost 63.96 showing large bedrock wedge and soil overhang.

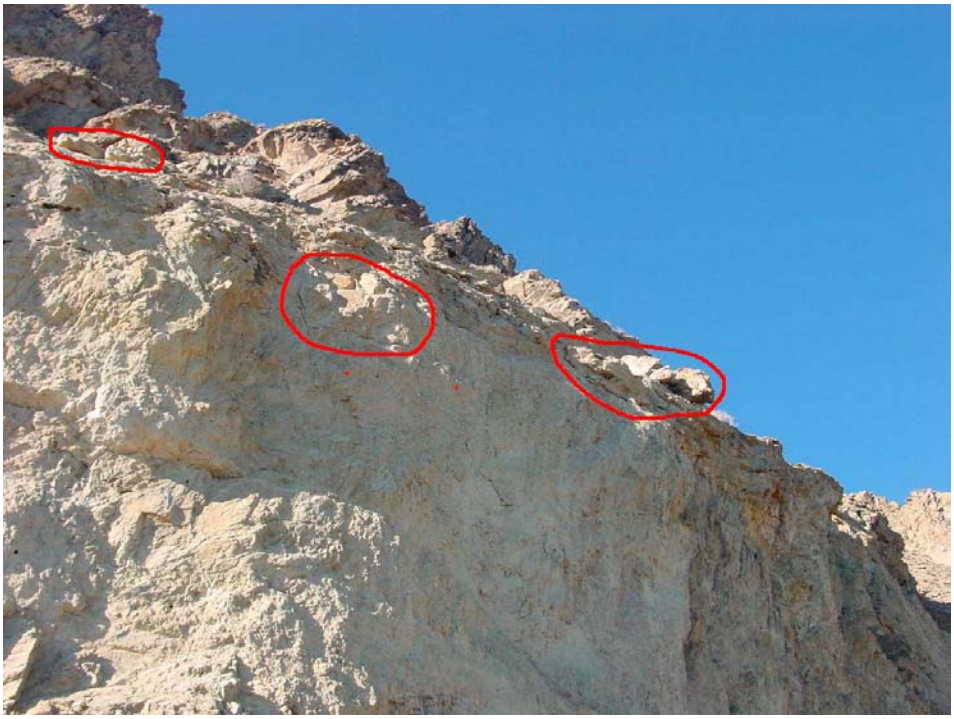

Fig 26. Milepost 64.07 showing fractured rock and large loose rocks on top of cut slope.