#### SR 77 Near Summit Slope Management









#### **Project Objectives**

- Reduce maintenance costs
- Improve safety
- Manage slope erosion
- Slope stability



#### **Design Challenges**

- 160 ft height of cut slope
- Maintenance of traffic during rock excavation
- Control scope to keep costs in check
- Blasting excavation required
- Steep slope below roadway 300 ft from top of slope to creek bottom
- Limited work zone two lane roadway with no shoulders and 5 ft cut ditch



#### About 300 ft from top to bottom





#### **Slope erosion undermining roadway**





#### **Embankment slope erosion**





#### Rockfall





## **Geologic History**

- Mescal Limestone Deposited 1.4 billion years ago in sea floor. Sedimentary, horizontally bedded at time of creation.
- Diabase Intrusive igneous rock. 1.05 billion years ago intruded, lifted and metamorphosed (Heated) limestone into marble when close.



## **Mescal Limestone and Diabase**





## **Diabase Intrusion/Heating Limestone**





#### **Construction Challenges**

- Safety of public
- Contractor safety
- Traffic disruption/delays
- Waste rock disposal



#### **Slope excavation in series of benches**





#### **Bench width safety**





## Drill hole collars – 130 ft above road





## Drilling and hardness of rock - \$\$\$\$





## **Blast sequencing and timing**





### **Explosive Products Utilized**

Detagel Presplit – Packaged 1.25 inch diameter





#### **Explosive Products**

Senatel Magnafrac – Packaged 2 inch diameter





### **Explosive Products**

ANFO – Ammonium Nitrate Fuel Oil





## Time of use explosive delivery















#### **Pre-split blasting operation**





#### **Clear the roadway each shift**





## Safety of travelling public





## **Completed small cut first to store future blast rock**





## **Contractor stacking waste blocks**





## **Mitigating erosion problem**





## **Culvert extension – Slope stability**





## **Slope plating – Long term stability**









# Fisher Industries proposed to line slopes with waste vs haul away





## **Rock fill compaction – Method Spec**





## Typical Section – 12 ft wide Ditch for maintenance access and containment





#### Modified SD 1.02





## **Rockfall containment ditch**









## **Completed slope**





# Pre-construction shoulders and sight distance





#### **Lessons Learned**









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![](_page_44_Figure_0.jpeg)

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#### **Rock Excavation Quantity Overrun**

- Contractor access benching required more width
- Unexpected vertical fractures in rock mass were encountered from Station 3314+00 to 3317+00

![](_page_57_Picture_3.jpeg)

#### **Measurement of rock quantity**

- Utilized LIDAR survey before and after construction to determine quantity
- LIDAR was effective and recommended for future slope excavation projects
- LIDAR should have been utilized in design phase

![](_page_58_Picture_4.jpeg)

#### Environmental

- Pre-construction clearance of additional areas outside project footprint to allow for contractor's innovation/partnering
- Kept project limits out of nearby BLM lands

![](_page_59_Picture_3.jpeg)

#### **Project Team**

- Contractor Fisher Industries
- Norm Bessler Sponsor, Brian Teskey Superintendant
- Construction Administration Globe District Mindy Teague Senior RE, TC Fish RE

![](_page_60_Picture_4.jpeg)

#### **International Partnering Institute Award**

2018 John L. Martin Partnered Project of the Year -

Sapphire

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## In Dedication to Nick Priznar 1952 to 2014

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