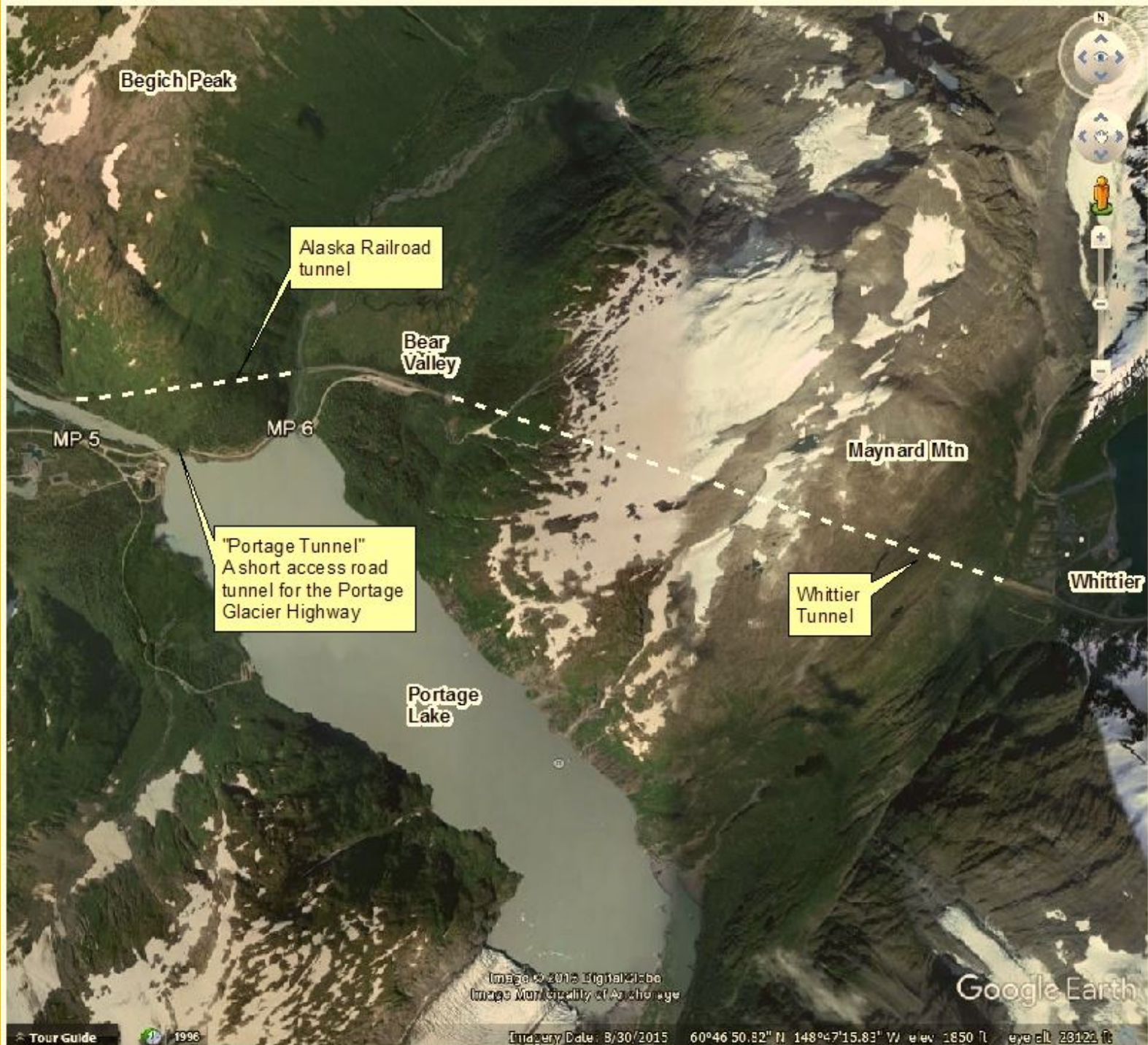


WHITTIER TUNNEL ROCK MITIGATION RESPONSE & USE OF GLOBAL MAPPER TO VIEW LIDAR

CRAIG BOECKMAN
REGIONAL GEOLOGIST
CENTRAL REGION MATERIALS

Overall Slide Presentation Outline

- ▶ Geology and Rock Fall History of the area
 - ❑ Whittier Tunnel
 - ❑ Portage Glacier Hwy Short Access Road Tunnel
 - ❑ Bear Valley
- ▶ Whittier Tunnel Configuration
 - ❑ Safe Houses
 - ❑ Typical Section
- ▶ Global Mapper use of Whittier Tunnel LIDAR
 - ❑ Ability to better view the overall tunnel
 - ❑ Evaluate rock structure
- ▶ Tunnel Wall Rock Stabilization



Begich Peak

Alaska Railroad
tunnel

Bear
Valley

MP 5

MP 6

"Portage Tunnel"
A short access road
tunnel for the Portage
Glacier Highway

Maynard Mtn

Whittier
Tunnel

Whittier

Portage
Lake

Image © 2015 DigitalGlobe
Image courtesy of Anchorage

Google Earth

Tour Guide

1996

Imagery Date: 8/30/2015 60°46'50.82" N 148°47'15.83" W elev 1850 ft eye alt 23121 ft

Geology and Rock Fall History of The Area

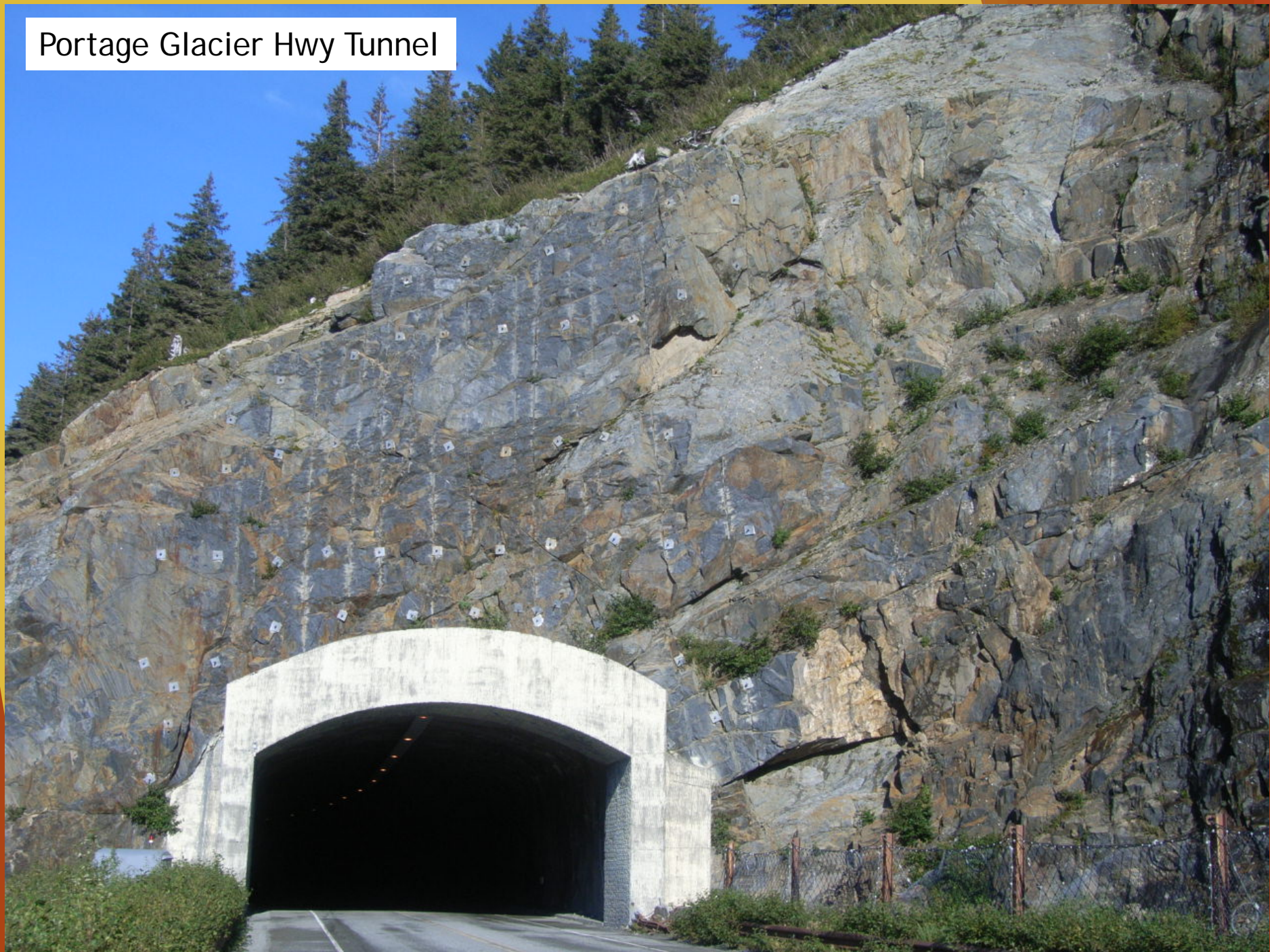
❑ Rock Types and Rock Fall at Whittier Tunnel:

- 1939 USGS Report indicated Graywacke, Slate and Argillite rock types.
 - This 1939 report was a recon for the railroad tunnels completed in 1943.
 - No geology report on Whittier Tunnel since it was built.
- A report of the 1964 earthquake indicated:
 - A 2.5 ton rock fell in one of the two tunnels.
- Pre 2000: Prior to making it a dual use tunnel a railroad worker would drive through it to inspect for rock fall before letting the train pass through.

Geology of The Area

- ❑ Portage Glacier Highway Tunnel (ADOT Reports):
 - Rock Types Similar to Whittier Tunnel
 - Greywacke, Argillite, and Slate rock types.
 - Short tunnel (~400 to 500 ft long).
- ❑ Bear Valley Landslide (ADOT 2009):
 - 2014 Petrographic analyses of the landslide material indicated the rock type as:
 - Carbonate-Rich Argillite.
 - Calcareous Sandy Siltstone.
 - Pyrite occurs in some fractures.
- ❑ Similar to Whittier Tunnel that has a lot of CaCO_3 seams and drainage

Portage Glacier Hwy Tunnel



East Portal of Access Road Tunnel - north of Portage Lake.

Undated Photo.

Shows blocks (yellow highlighted area) that have fallen since this image was taken. Based on comparison to an August 2014 Photo of the same area.

Rock fall since Construction



Portage Glacier Hwy Tunnel

Rock fall from behind a rock bolt

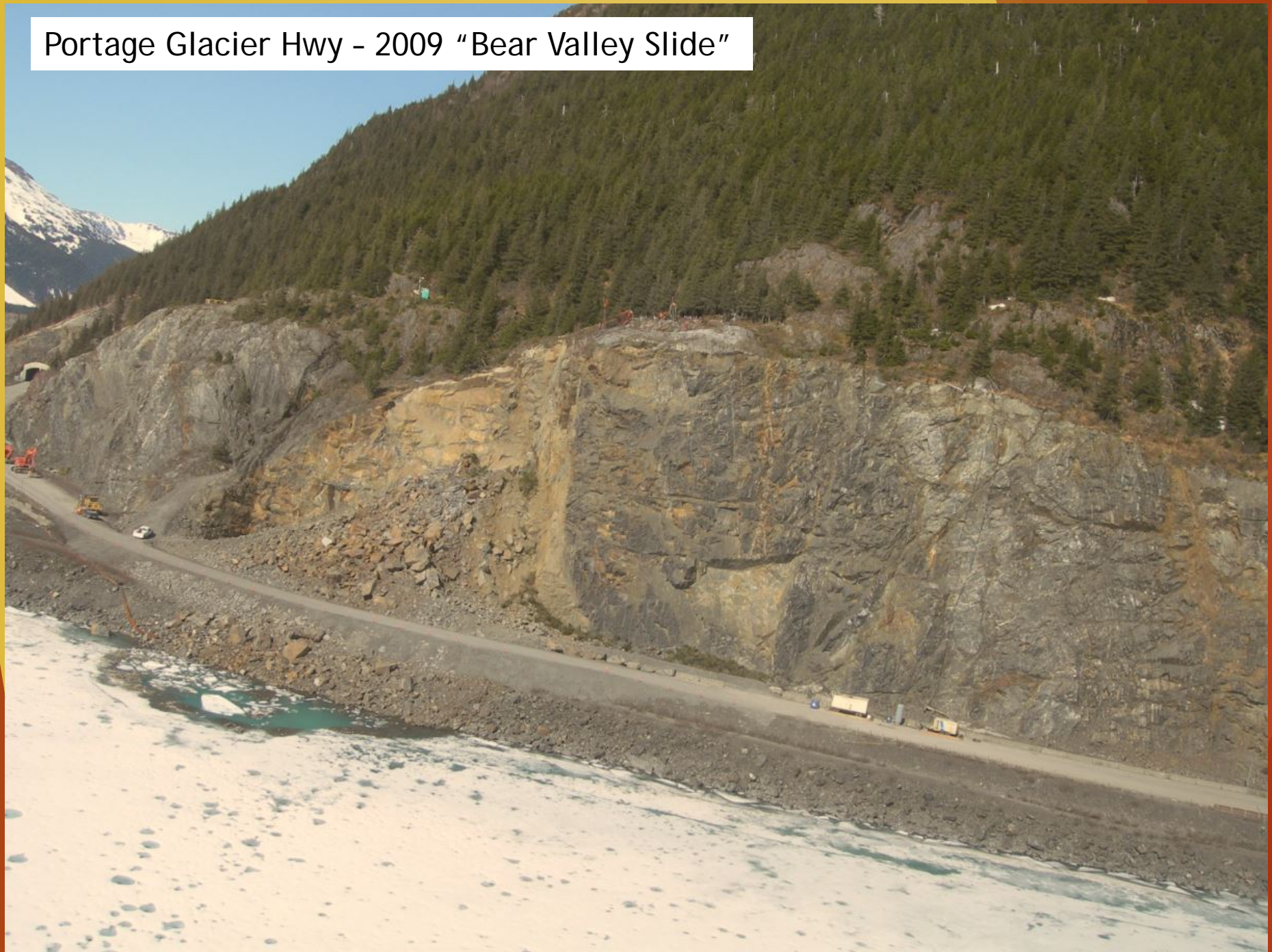


Portage Glacier Hwy - 2009 "Bear Valley Slide"



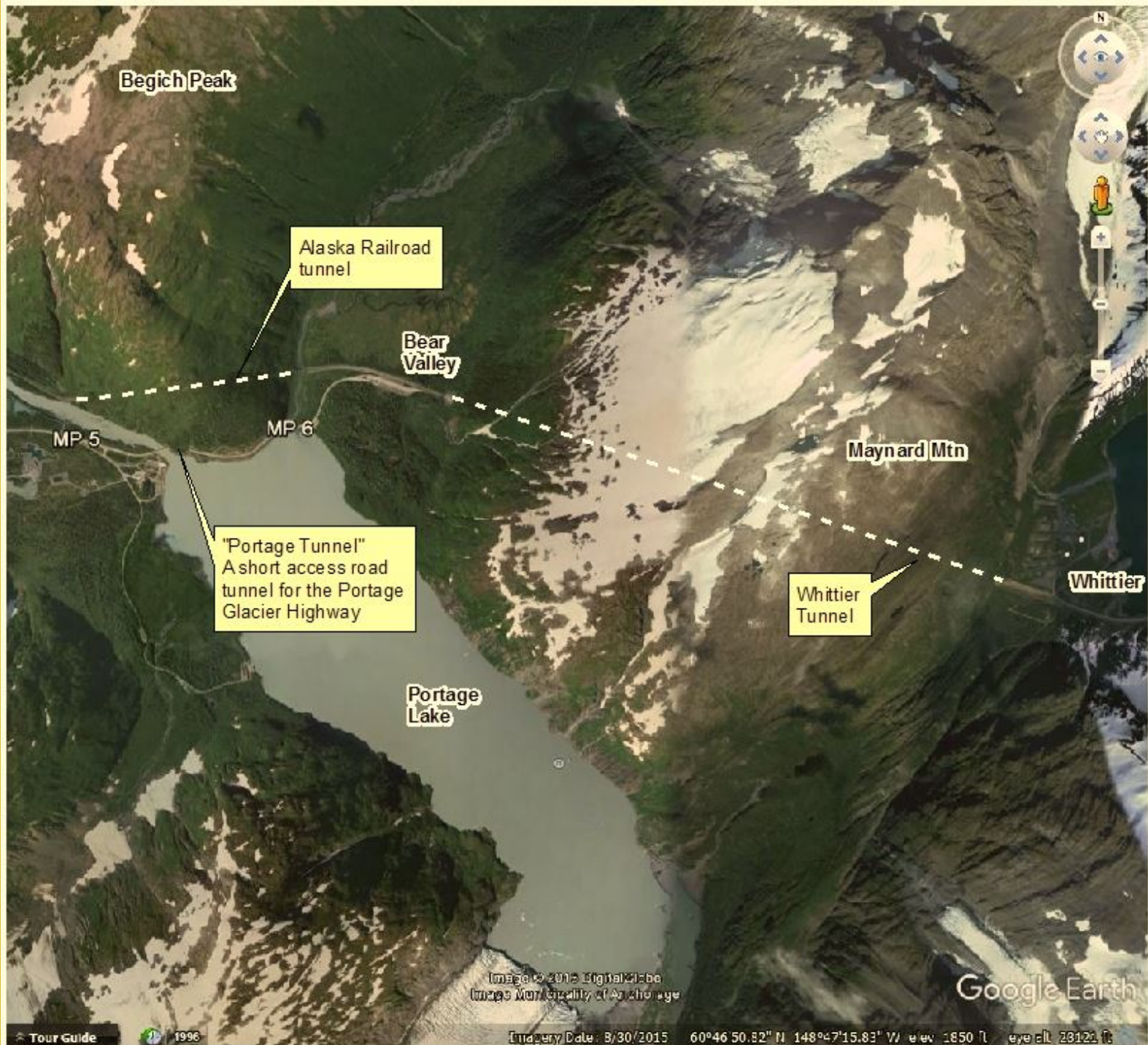
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Portage Glacier Hwy - 2009 "Bear Valley Slide"

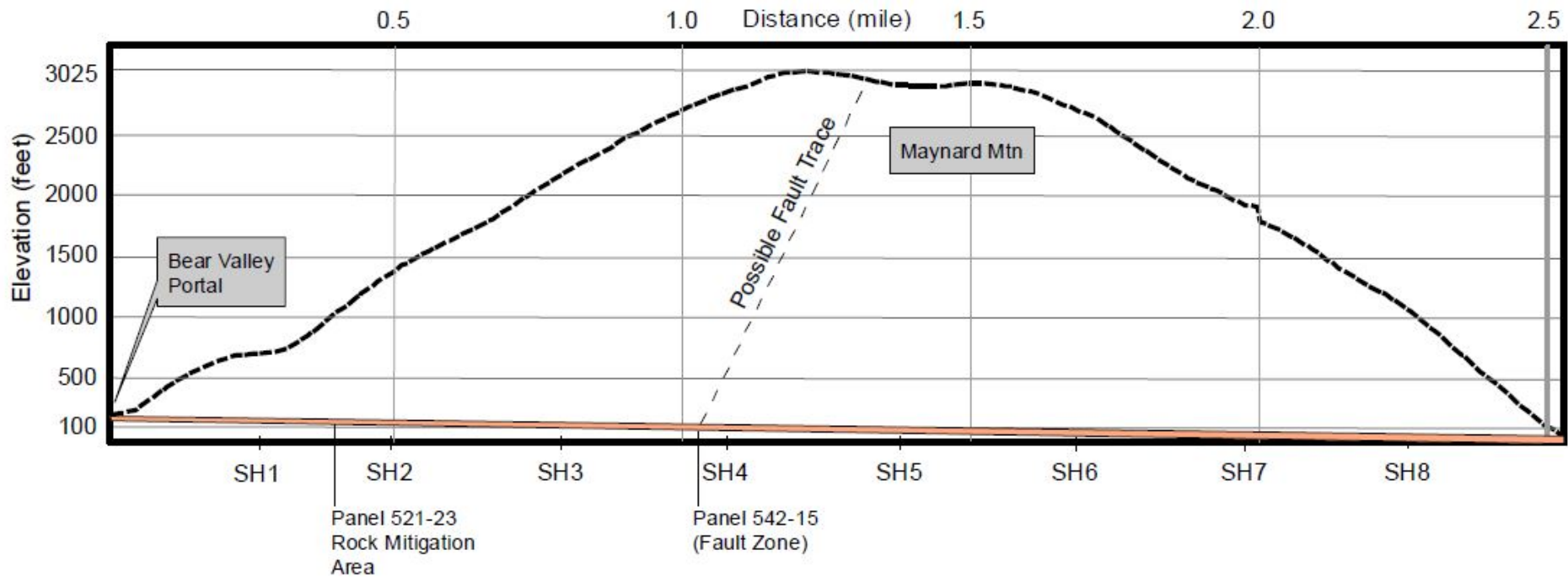


Whittier Tunnel Configuration

- Safe Houses
- Cross Sections

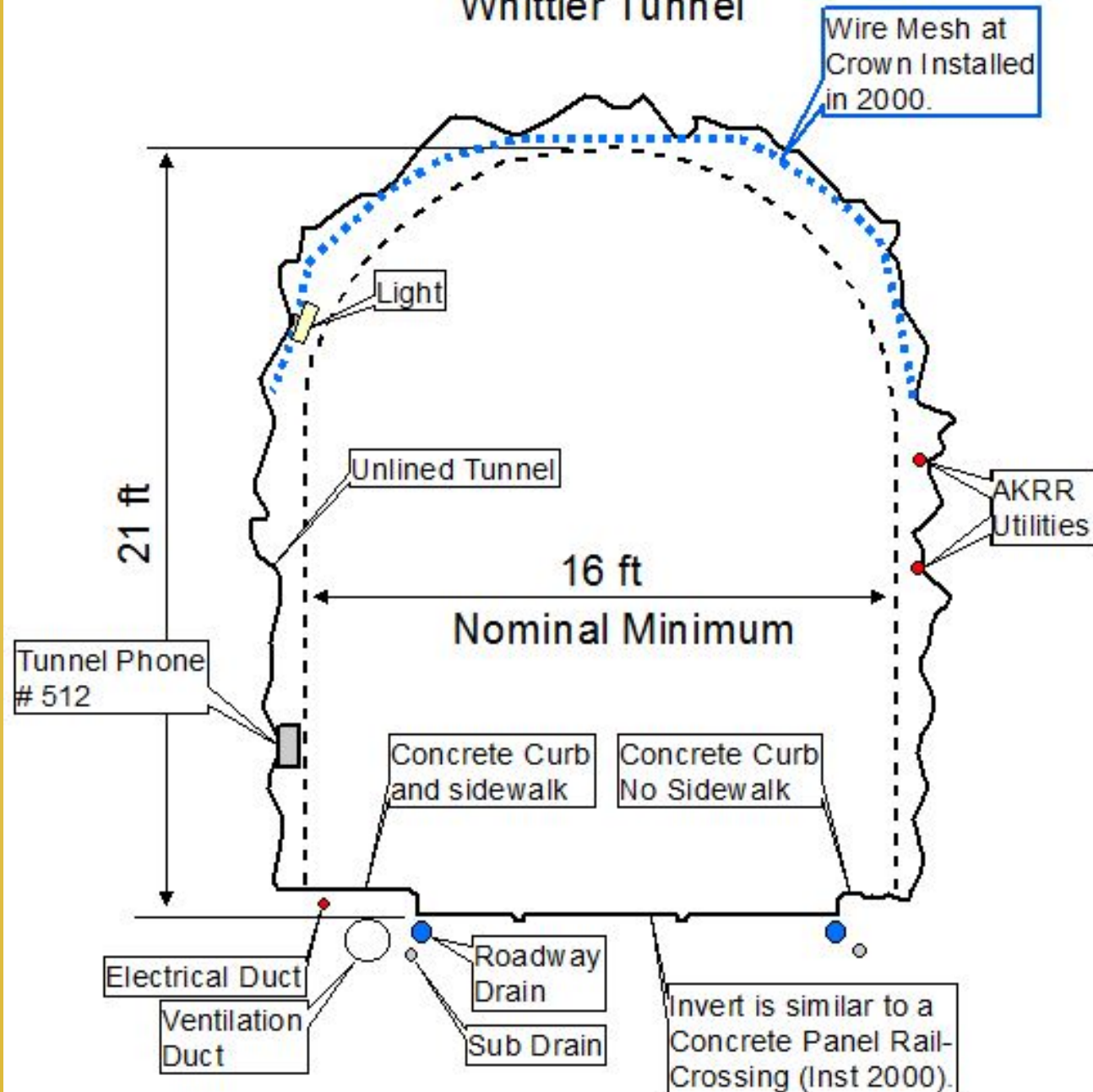


Generalized Whittier Tunnel Profile

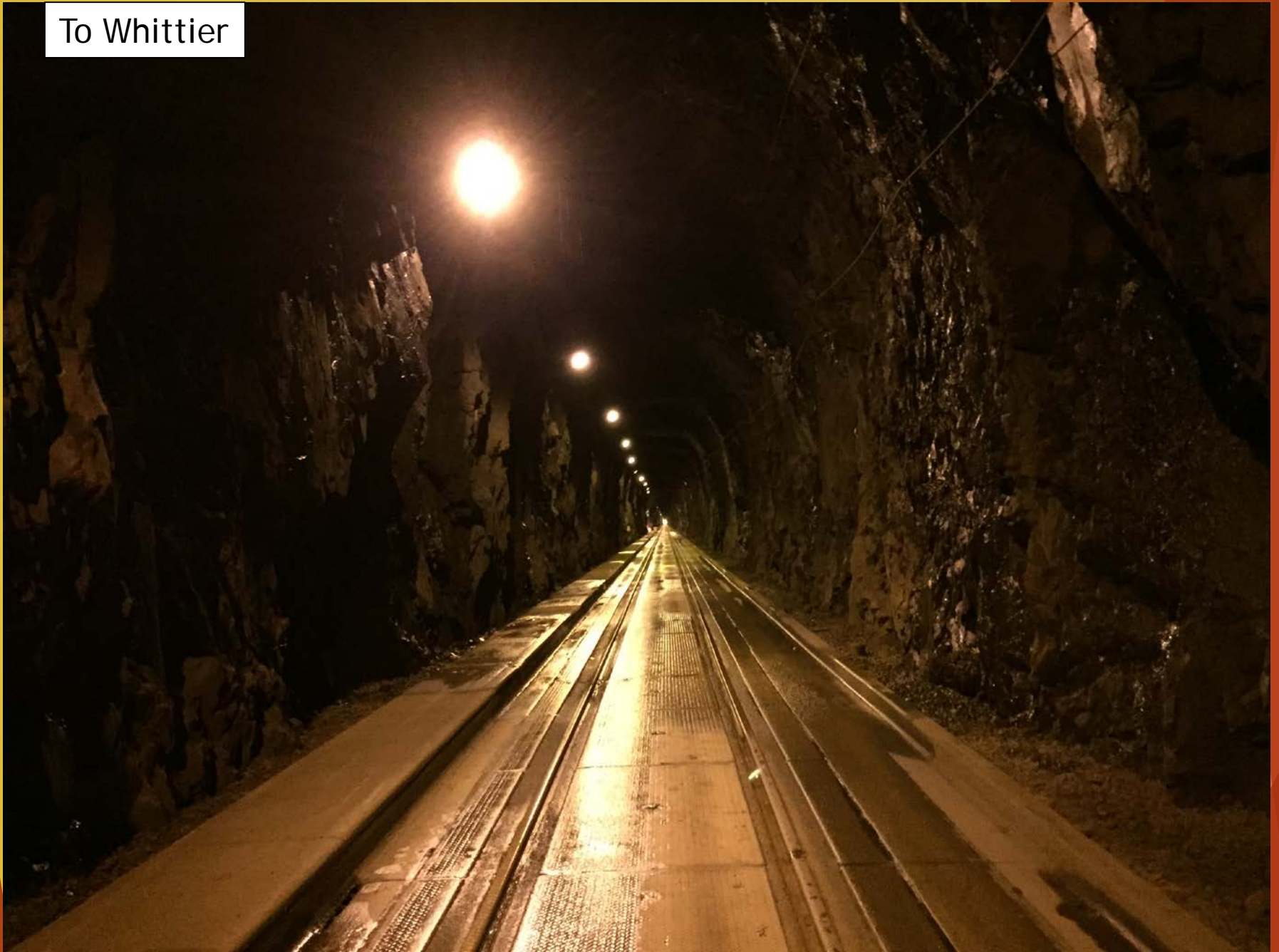


Start Location	End Location	Start Station	End Station	Distance (ft)
Face of Bear Valley Portal	SH #1	132+50	146+29	1379
Middle of SH#1	Middle of SH#2	146+29	158+78	1249
Middle of SH#2	Middle of SH#3	158+78	174+24	1546
Middle of SH#3	Middle of SH#4	174+24	189+94	1570
Middle of SH#4	Middle of SH#5	189+94	205+53	1559
Middle of SH#5	Middle of SH#6	205+53	221+45	1592
Middle of SH#6	Middle of SH#7	221+45	237+36	1591
Middle of SH#7	Middle of SH#8	237+36	252+11	1475
Middle of SH#8	Face of Whittier Portal	252+11	265+55	1344

Generalized Cross Section Whittier Tunnel



To Whittier



LIDAR and Global Mapper

- ❑ Ability to View Overall Tunnel
- ❑ Assistance in Rock Structure Review

▶ This repair was an M&O Emergency Repair

- ❑ FHWA required a report on materials used.
- ❑ No previous reports for Geology of the tunnel were available.
- ❑ For rock structure compass readings were collected, but unknown if they were off due to the steel in the tunnel.
- ❑ Use Split FX, a rock mapping software, to confirm readings. Need a point cloud for Split FX.

▶ Whittier Tunnel Drainage Project (Matt Tanaka's Design Project)

- ❑ This project already generated LIDAR for the tunnel (PND Engineers). Troy Gere provided LIDAR in 27 sections (each from 1,000 to 4,500 MB).

▶ Global Mapper use of Whittier Tunnel LIDAR

- ❑ Split FX and ArcMap had a hard time with these files. Only able to look at exterior 3D view of the tunnel.

► Global Mapper use of Whittier Tunnel LIDAR

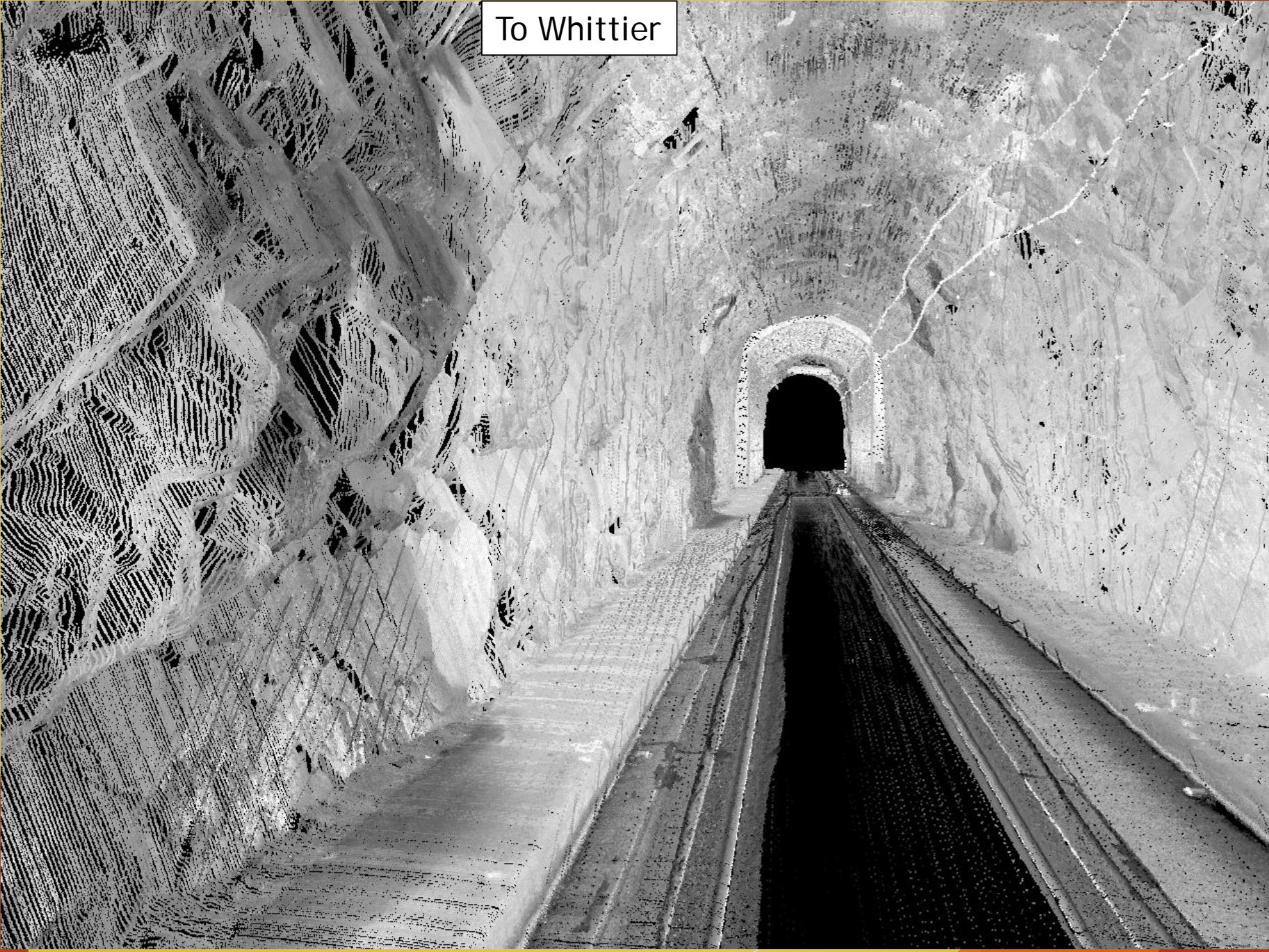
- ❑ Split FX couldn't handle the large LIDAR files.
- ❑ Global Mapper was able to open the LIDAR files in various formats such as .las, ascii, etc.
- ❑ Global Mapper was able to crop certain areas where I wanted to evaluate the rock structure and export it in a format (and file size) Split FX was able to handle (ascii).
- ❑ A few notes about Global Mapper:
 - If the file is too large the 3D function won't work or will lock up the program.
 - It won't measure dip/dip direction in the 3D function only 2D (Split FX is better in this aspect - Used together both programs give a good product).
 - LIDAR view is not restricted by poor lighting.
 - Able to add in ACAD Drawing Files.

To Whittier

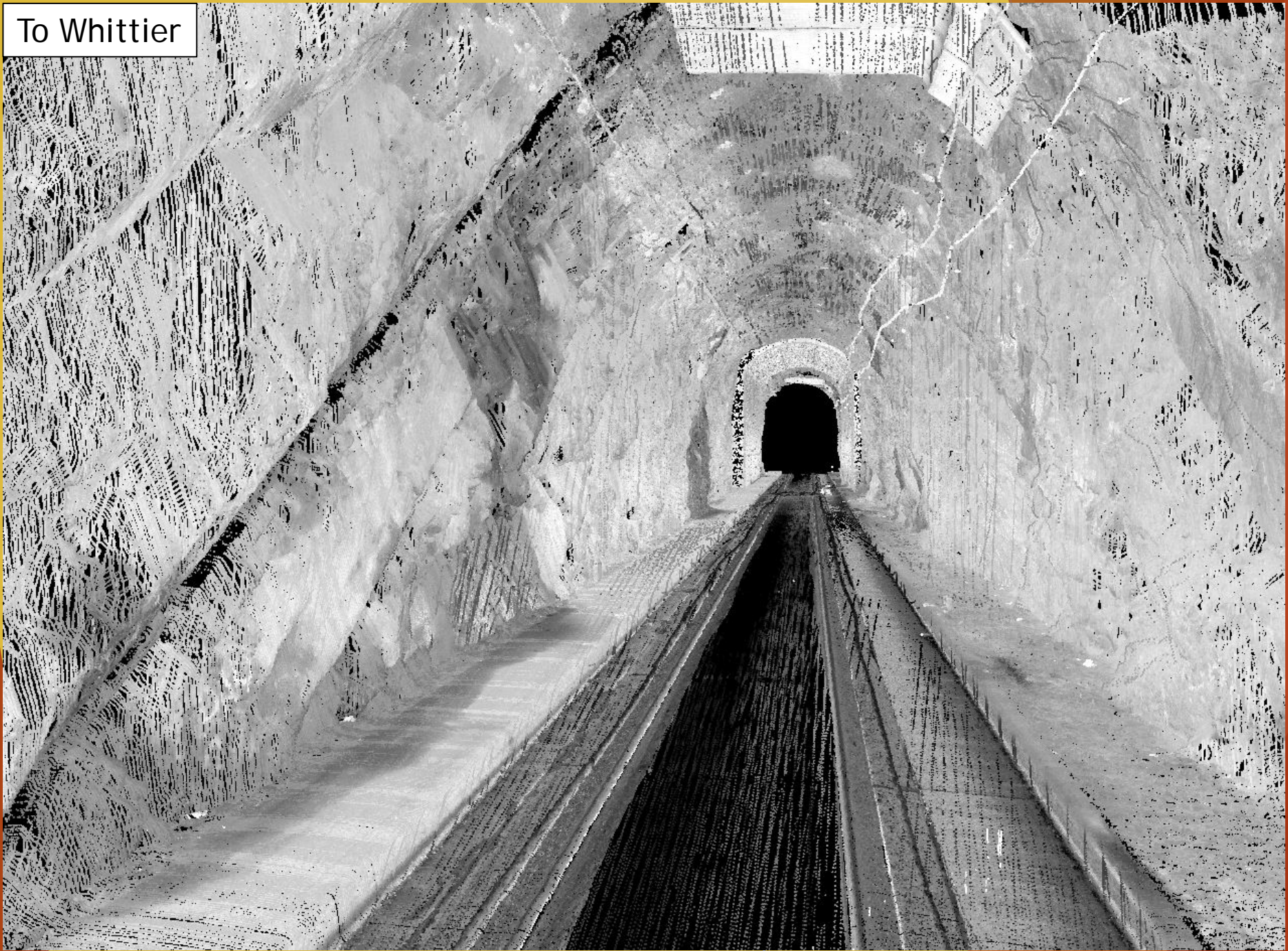
Panel 512-1 Area



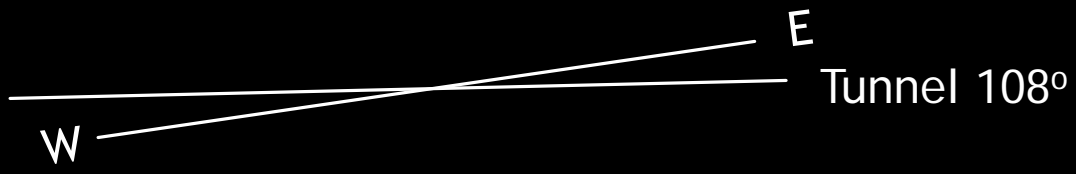
To Whittier



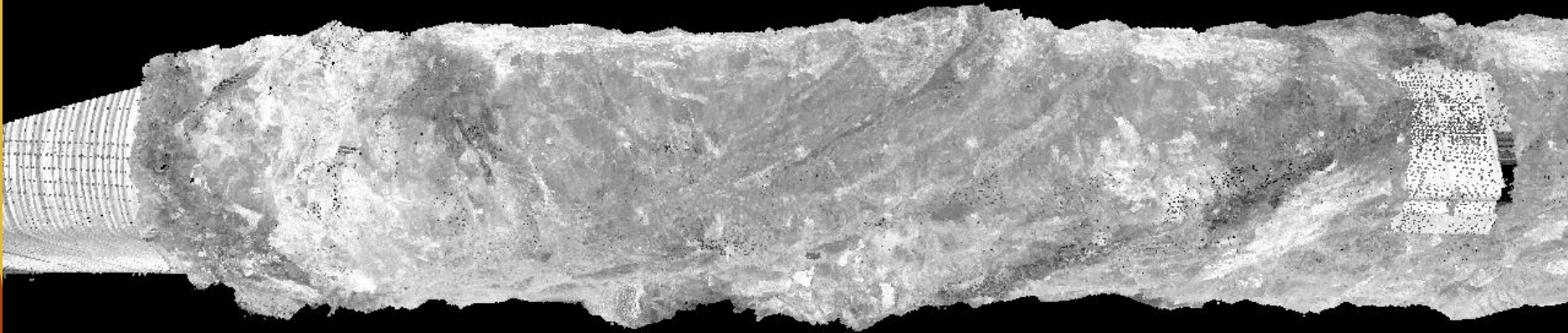
To Whittier



Oblique View



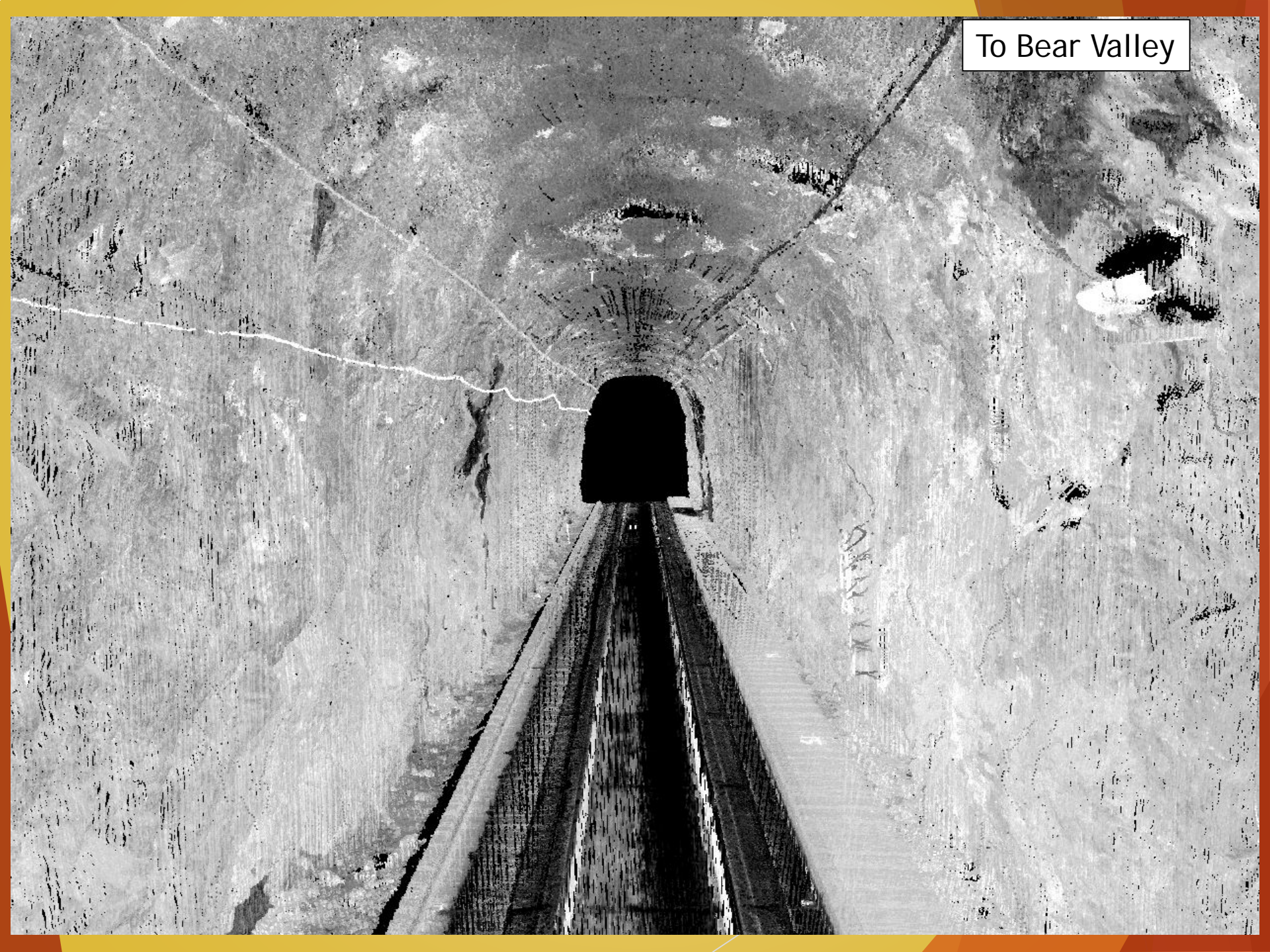
To Whittier



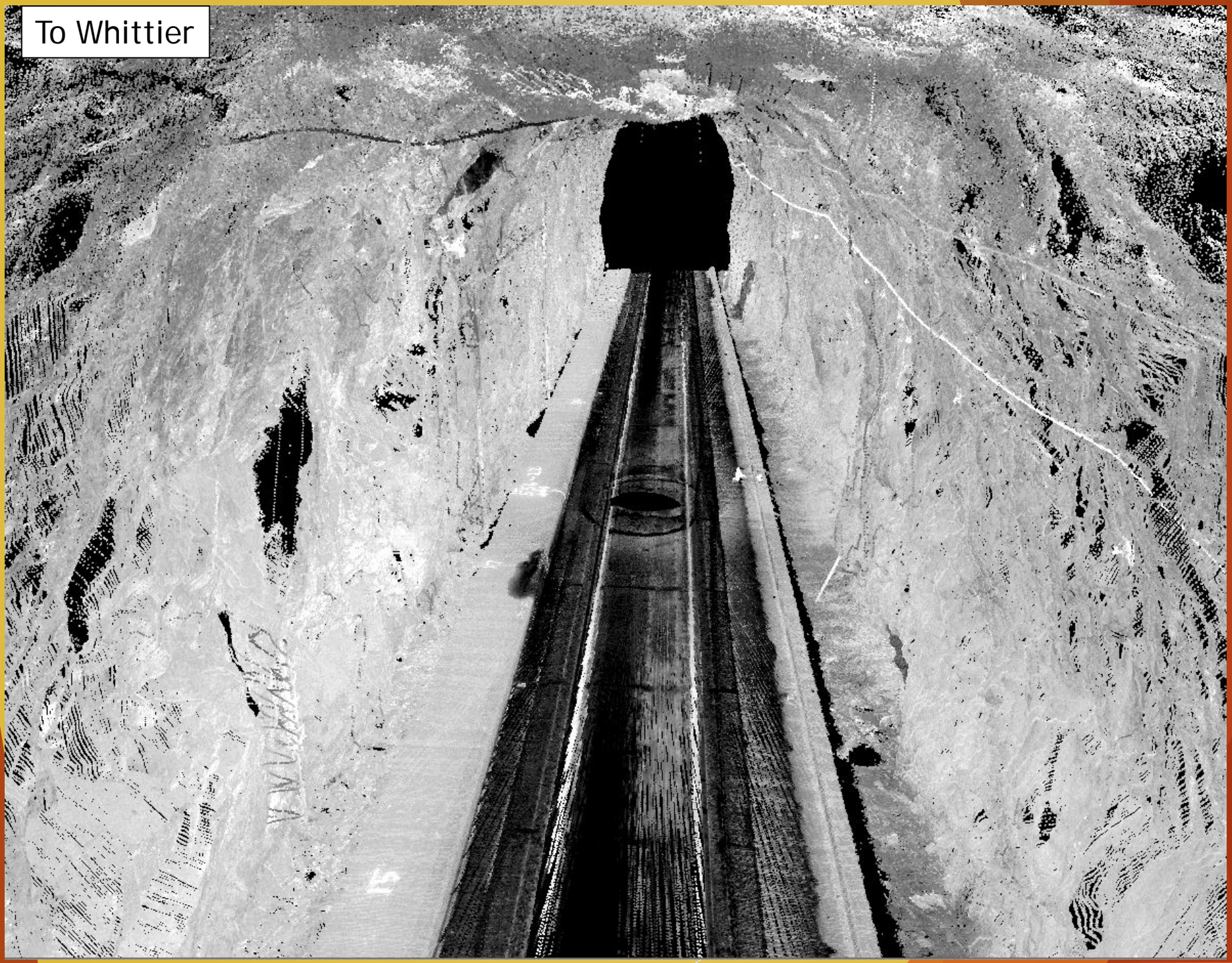


To Whittier

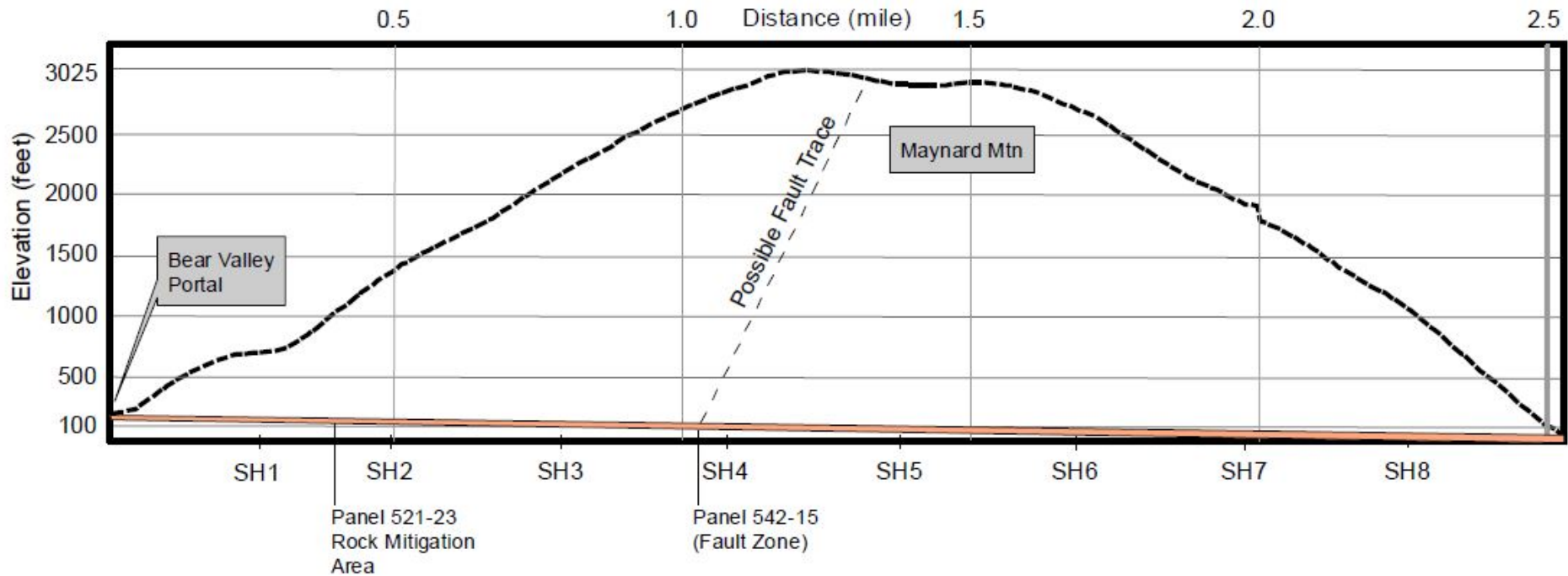
To Bear Valley



To Whittier



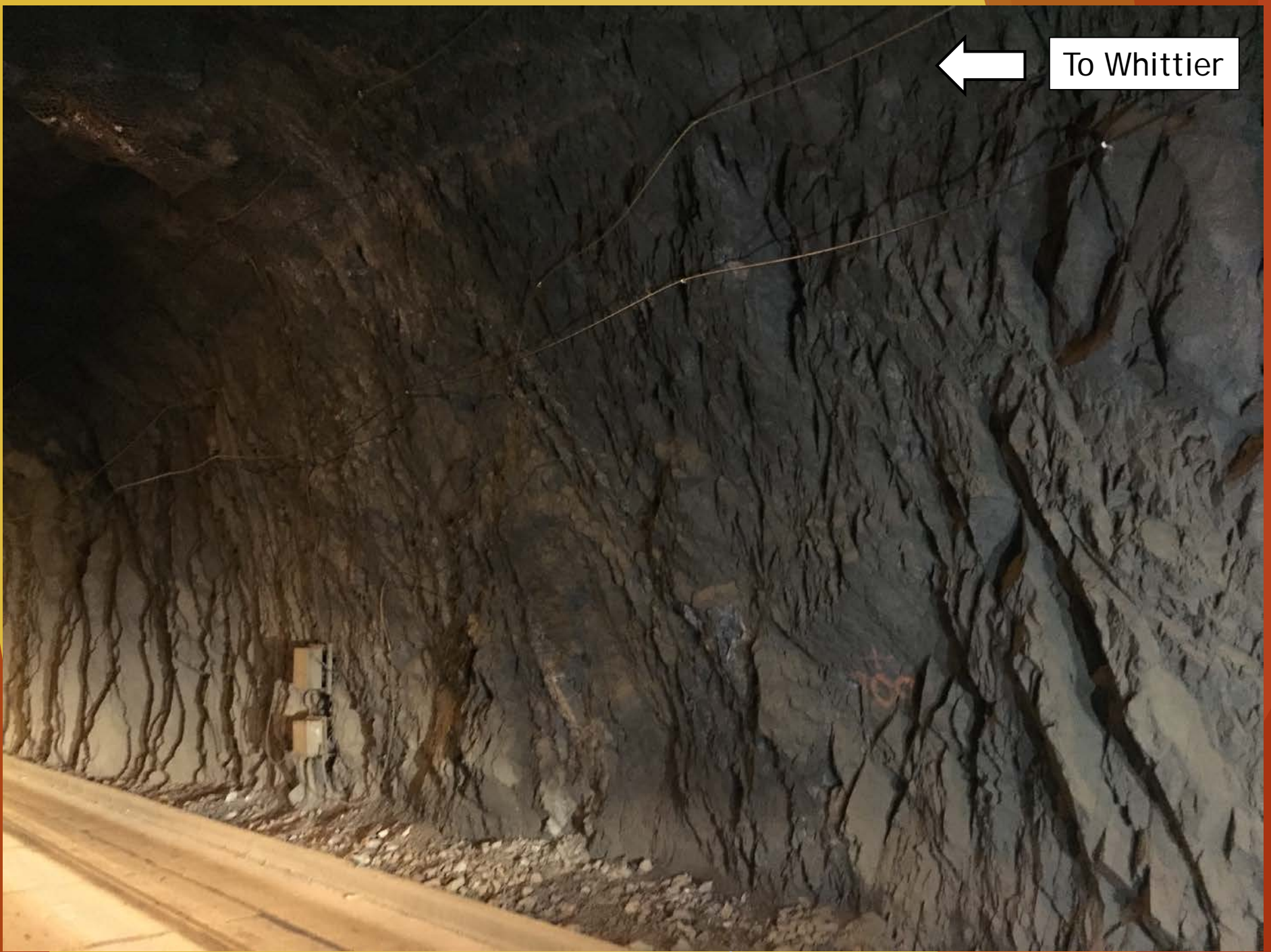
Generalized Whittier Tunnel Profile



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To Whittier

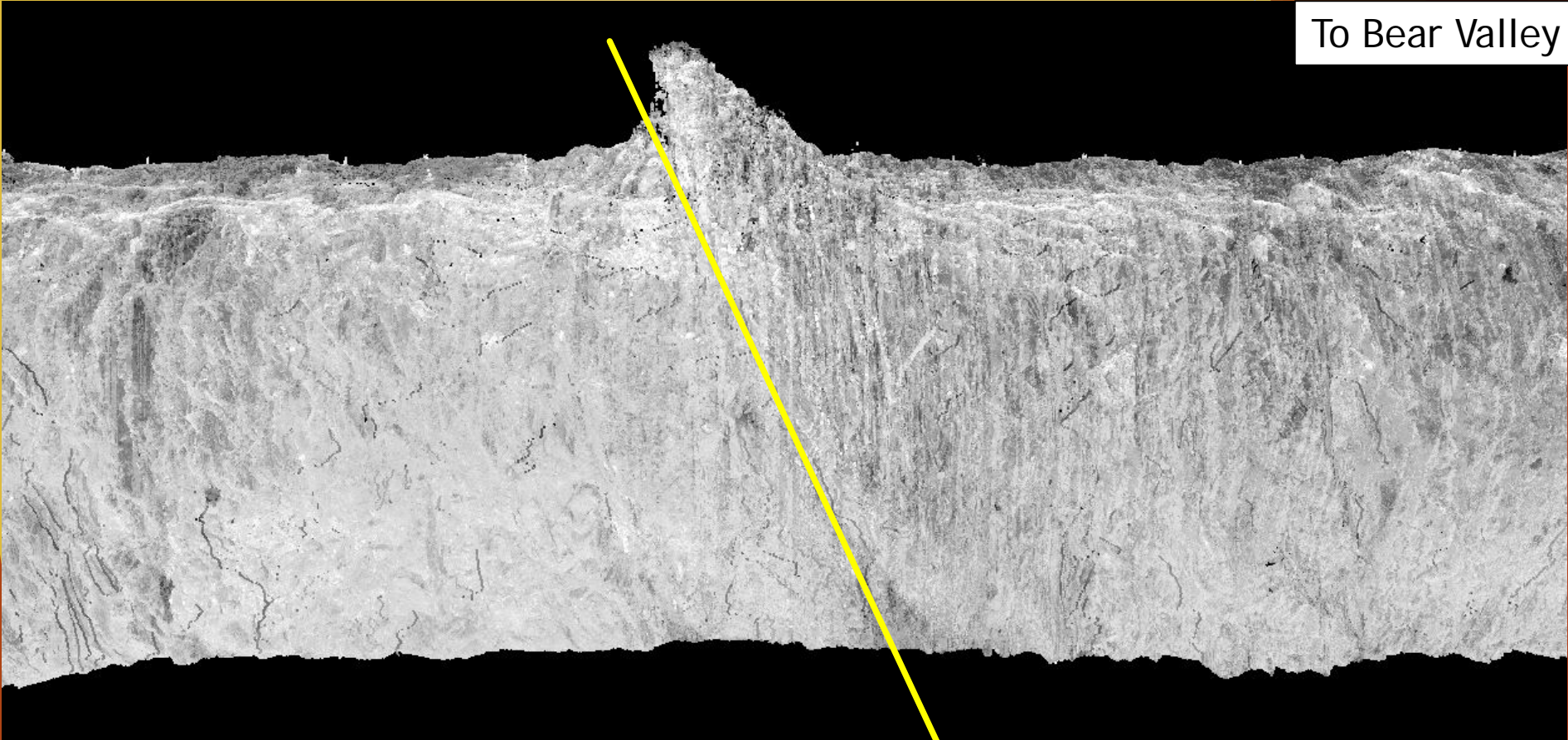


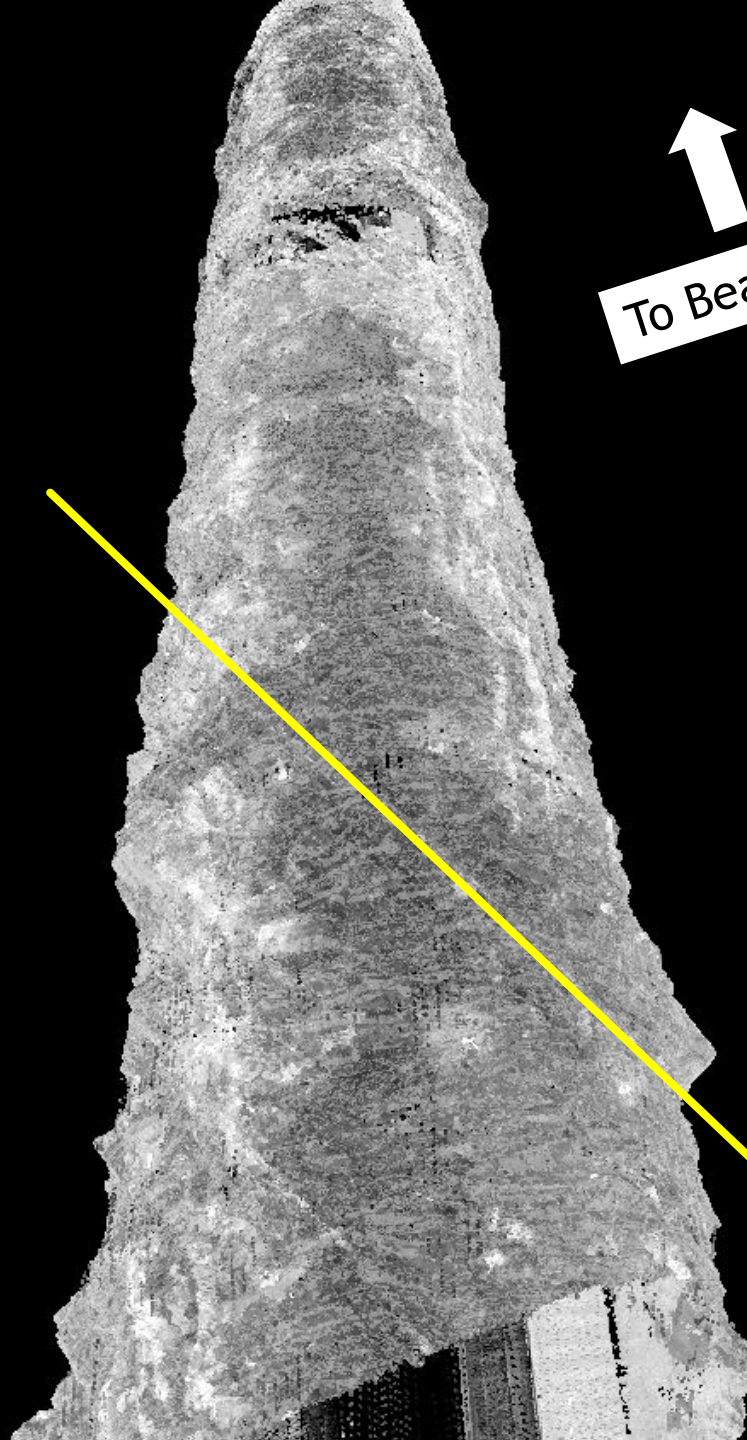
To Whittier





To Bear Valley





↑
To Bear Valley

N



► Tunnel Wall Rock Stabilization

► Tunnel Wall Assessment

- ❑ A “small rock fall” incident of about 500 pounds was being cleaned up by tunnel staff. During this work a large partially detached rock on the tunnel wall was noticed (Oct 25 2016).
- ❑ Whittier Tunnel Facilities Manager, Gordon Burton, placed all traffic (train and vehicle) on hold until an evaluation of the tunnel wall could be done.
- ❑ After an on-site evaluation by CR Materials, the Facilities Manager, and Tunnel Staff it was decided that the rock structure posed a significant risk to passing train traffic and vehicle traffic.
- ❑ Advanced Blasting was able to look at the site and provide a cost. Emergency Maintenance Repair Contract (10-26-16). Bolts/Mesh - Oct 26-28, 2016. Grouting - Nov 4-5, 2016.

► Options for Partially Detached Rock Stabilization

❑ Scaling:

- ❑ Tunnel staff did not have sufficient large equipment on-hand required to perform this work. Nor training for scaling large rock near the top of the wall (excavator with jack hammer).
- ❑ Risk that removing this rock might trigger overhanging blocks to slide (scaling crew safety) or leave overhanging blocks that might fall later.
- ❑ Risk that scaling the rock might damage the concrete panels or utilities.

❑ Anchored wire mesh:

- ❑ Anchored mesh could be used to stabilize rock above the partially detached rock.
- ❑ Then remove the partially detached rock.
- ❑ After removal extend the mesh down to above the curb.

► Anchored Mesh Rock Stabilization

- ❑ Advanced Blasting had experience with this type of work:

- ❑ They had sufficient materials in their yard to perform the installation of anchored wire mesh.

- ❑ Initial price of \$63,000:

- ❑ Temporary rock stabilization to allow a train to pass through the tunnel and also vehicle traffic.

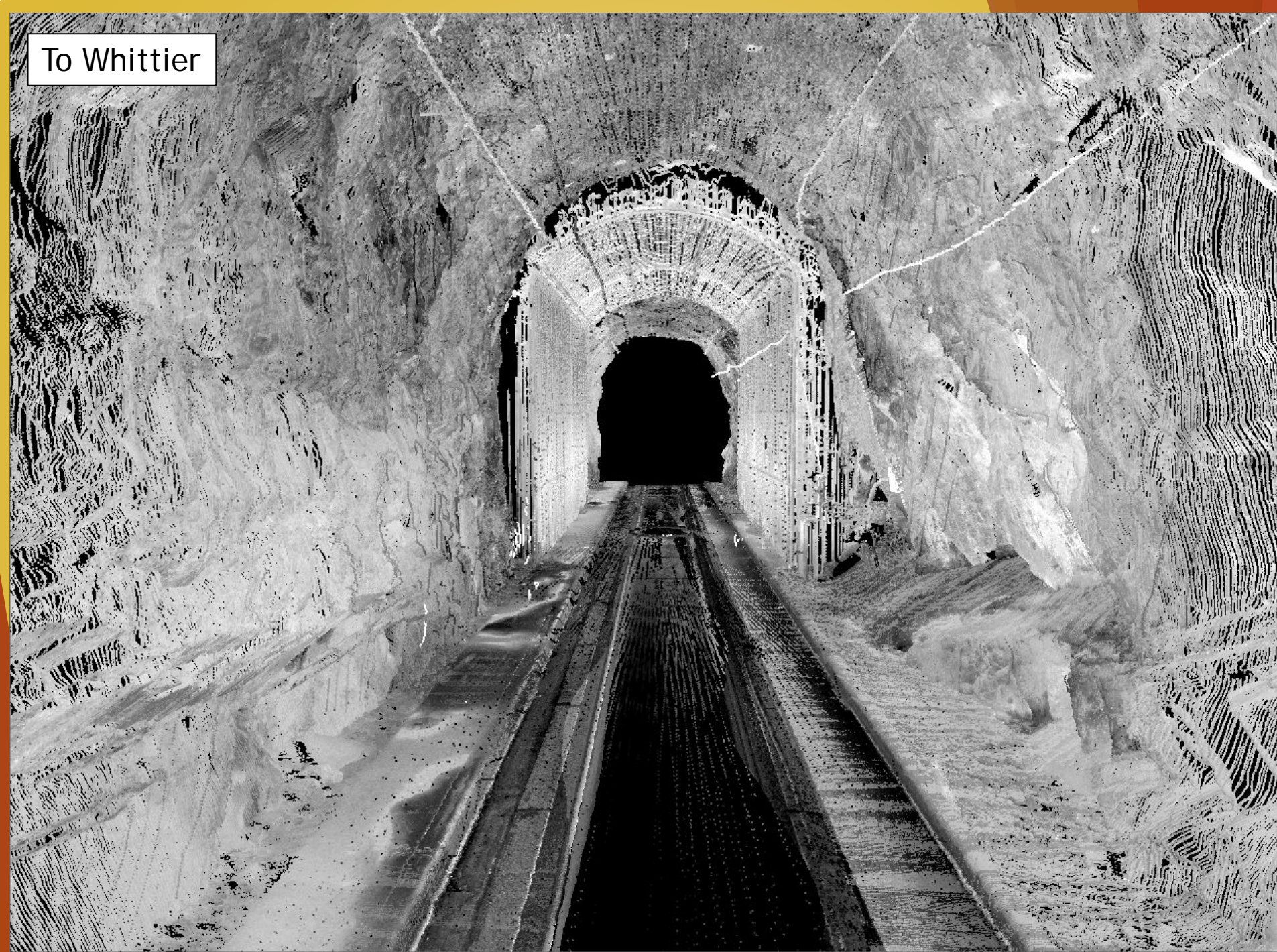
- ❑ Moving utilities.

- ❑ Installation of mechanical rock bolts (#8 hollow bar, torqued to 25 kips, and grouted), split-set bolts, and wire mesh (Geo-brugg mesh @ 3,100 lbs/ft²).

- ❑ Around the clock installation other than daily tunnel opening from 5:00 to 6:00 pm and one emergency opening.

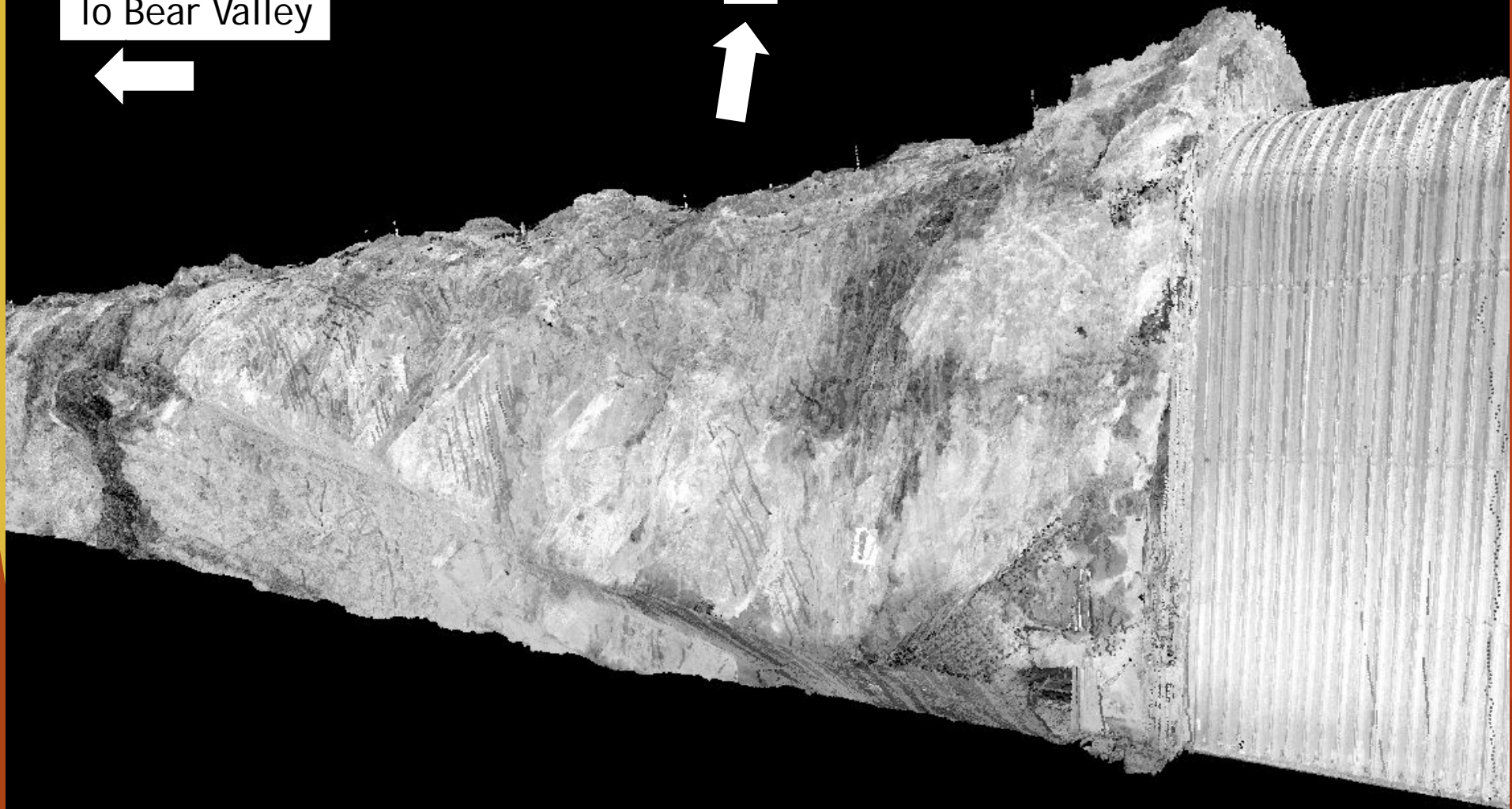
- ❑ Added cost of \$29,000 to remobilize a week later when there was less train traffic so the rock bolts could be grouted (72 hour concrete curing time).

To Whittier



N

To Bear Valley



Whittier Tunnel Rock Wall Stabilization October/November 2016

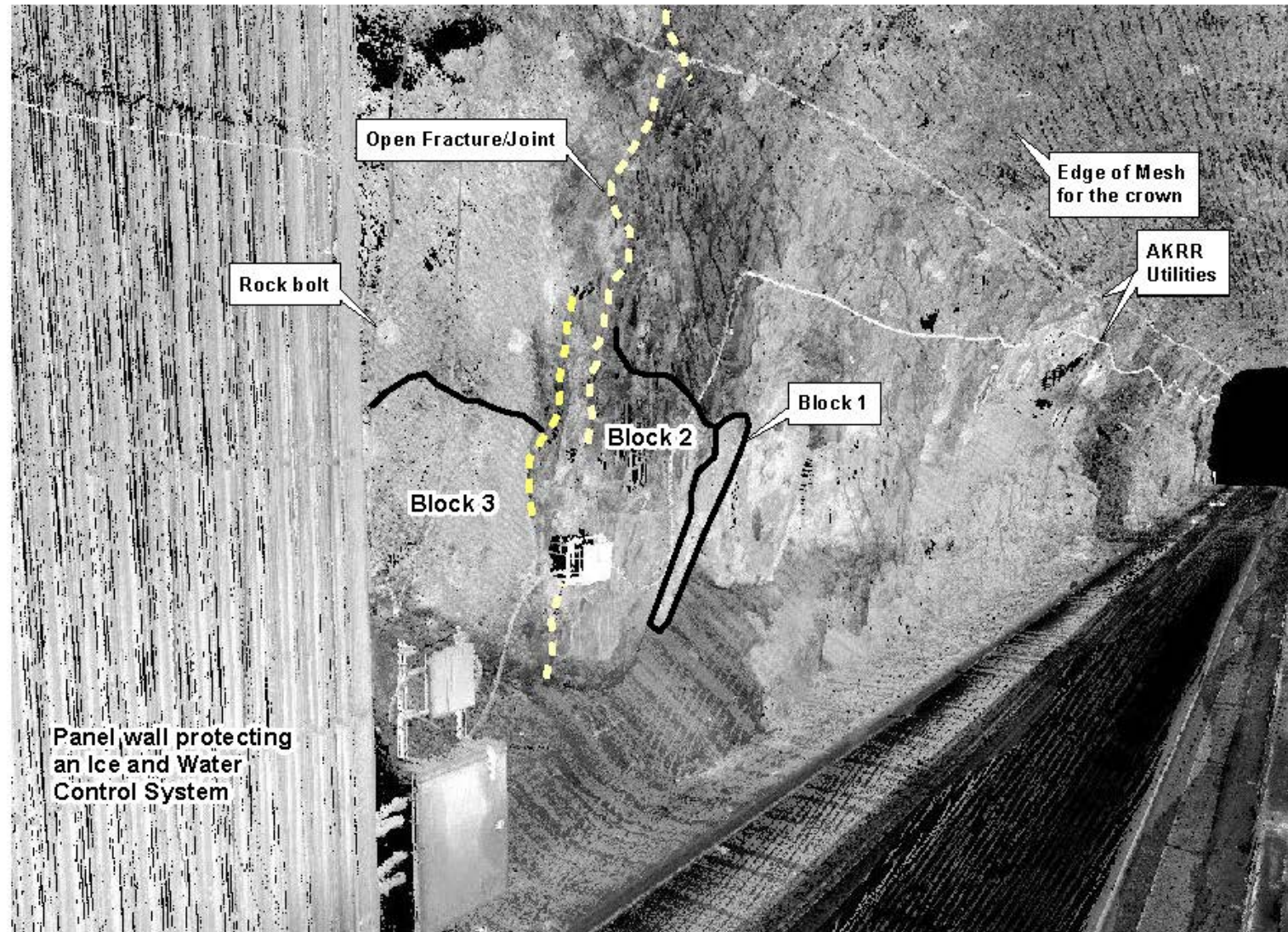
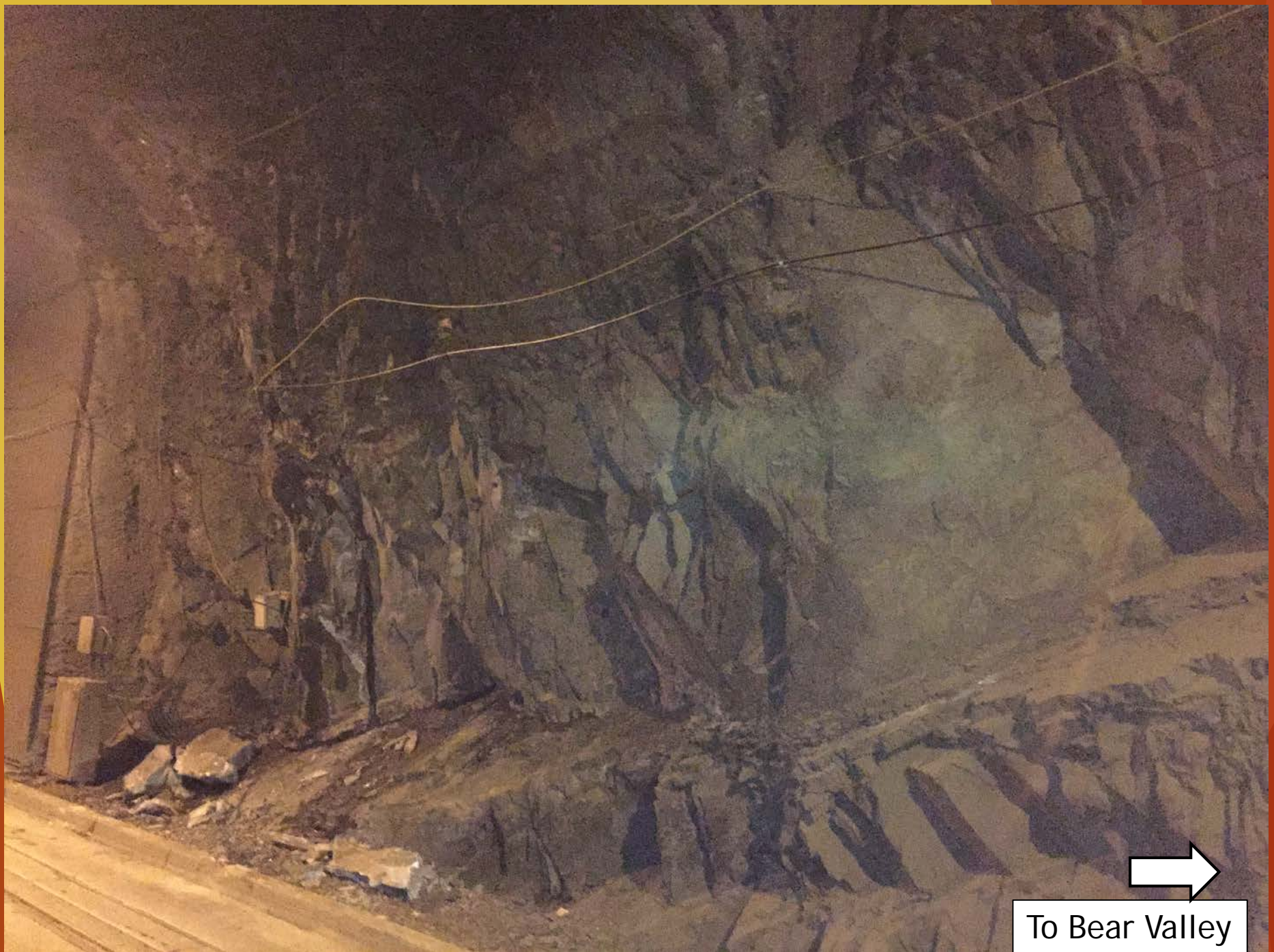
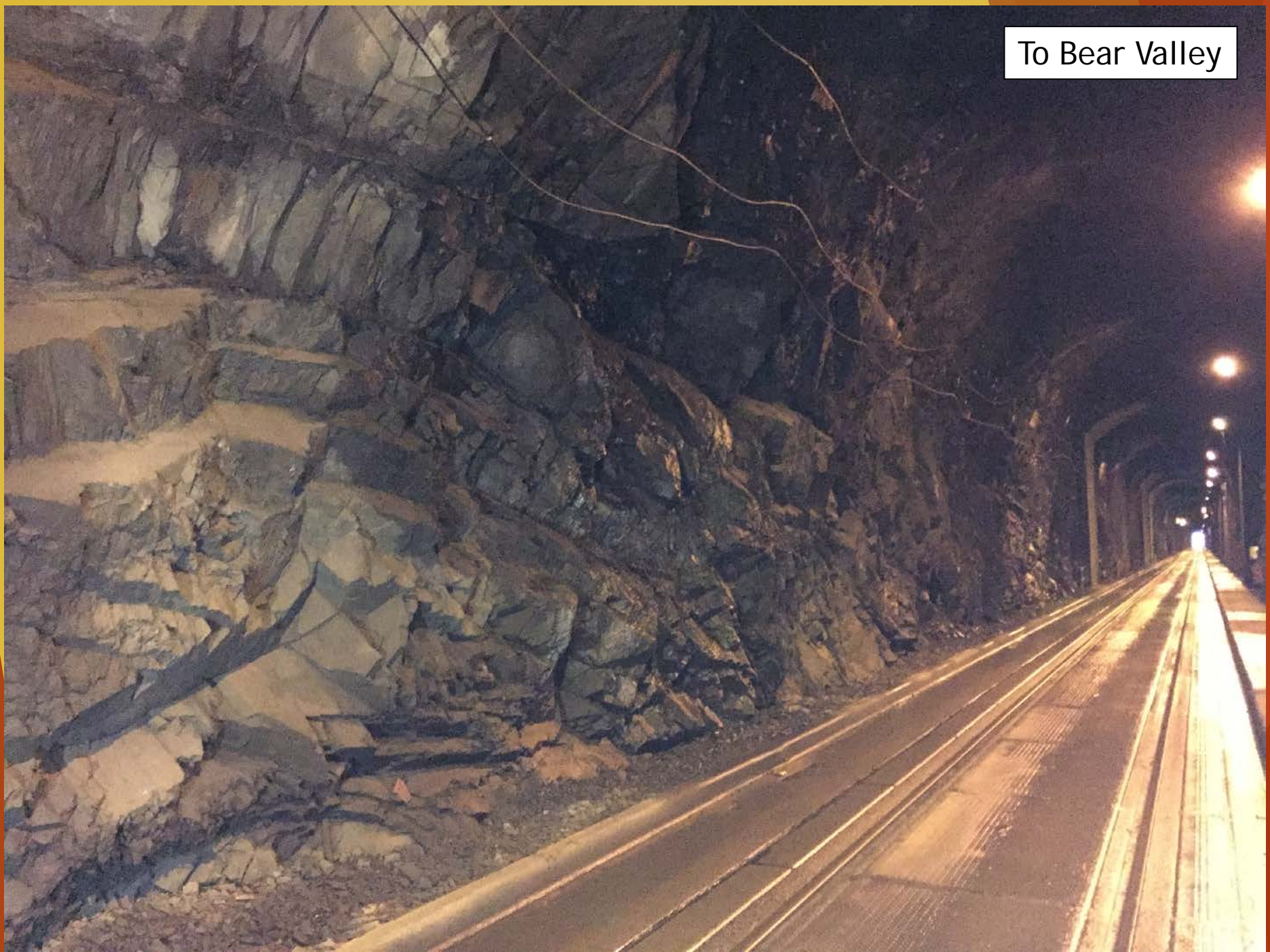


Photo 2: This photo shows the rock that fell or was removed. The tunnel staff was removing the initial rock fall (Block1) when they noticed the large partially detached block (Block2) that separated due to the open fracture. That block was removed once the area above was stabilized. It was about 3.4 tons of material. To the left of that was an area (Block3) that slid out during the rock mitigation work. That area amounted to about 3 tons of material. A total of 6.5 tons of material removed from the area.

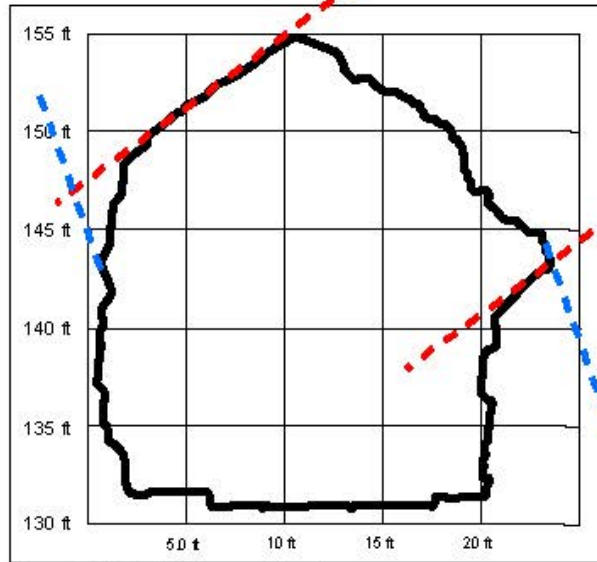


To Bear Valley

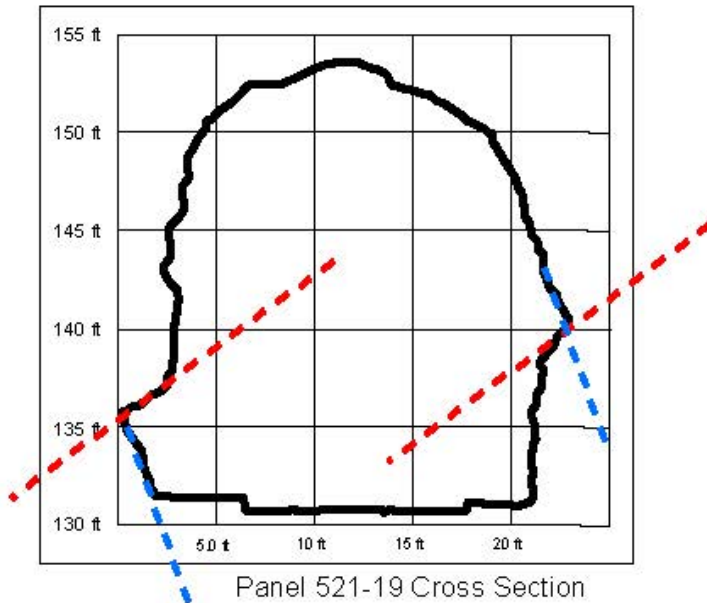
To Bear Valley



Whittier Tunnel Rock Structure Assessment



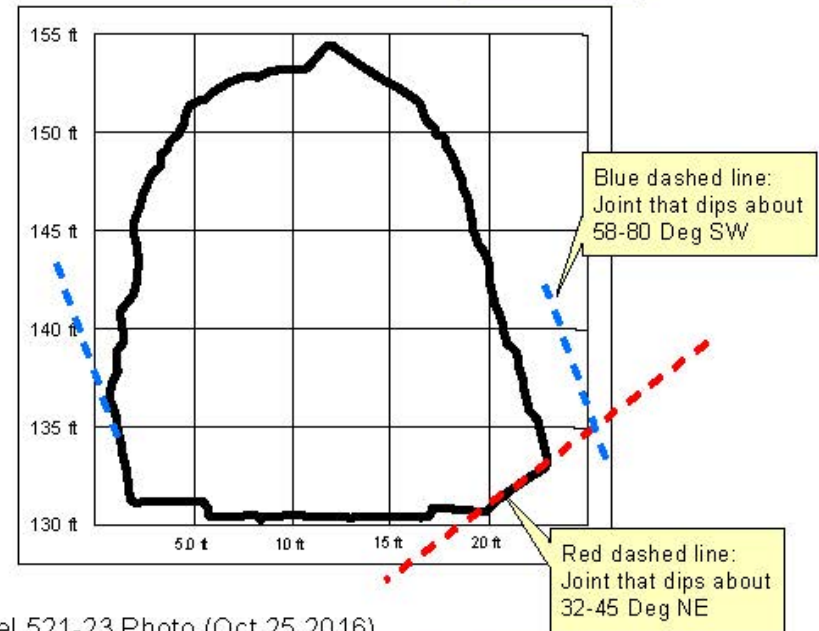
Panel 521-13 Cross Section



Panel 521-19 Cross Section

Panel 521-23 Cross Section

Rock fall site



Panel 521-23 Photo (Oct 25 2016)









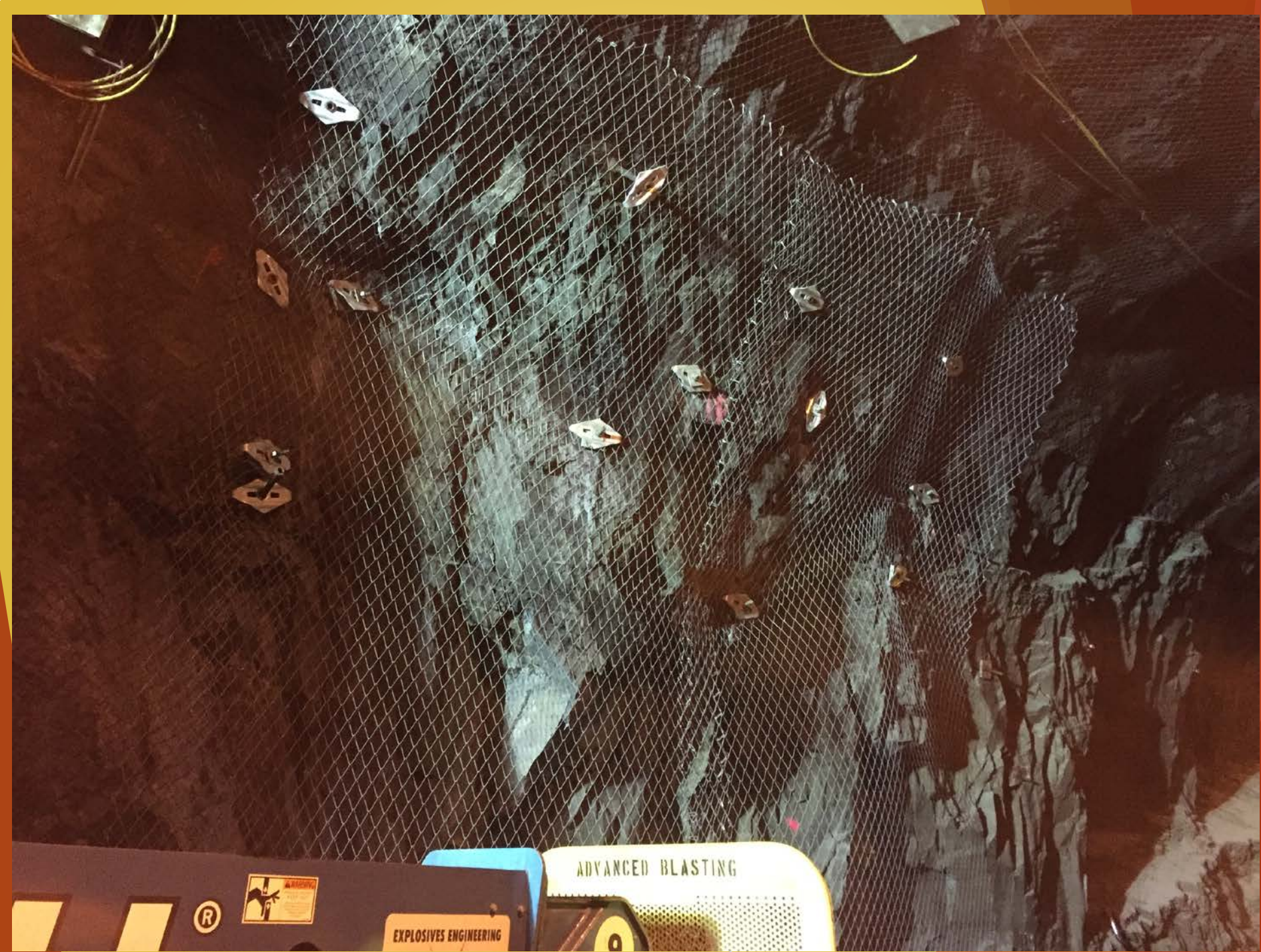




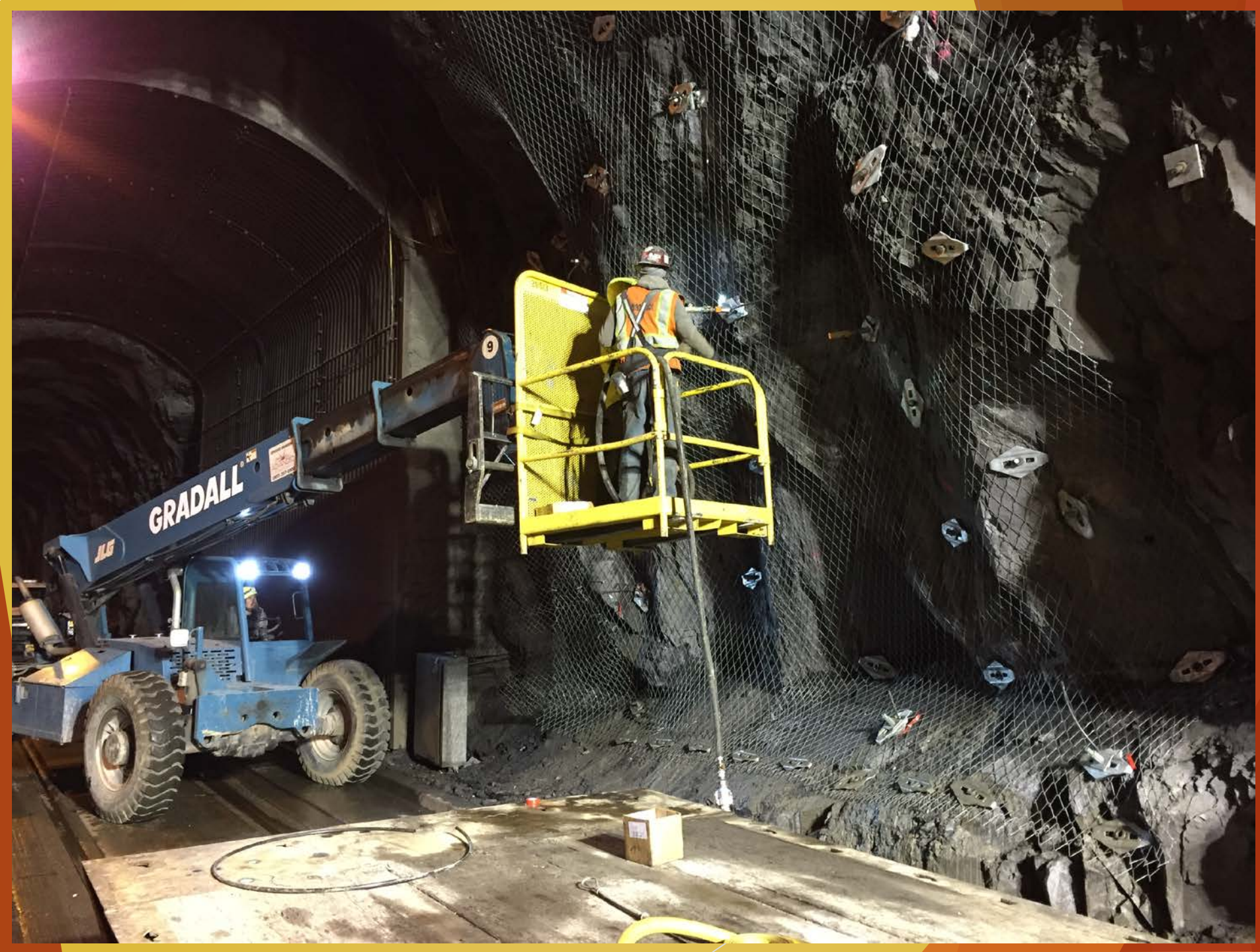


BLASTING











► Whittier Tunnel Follow-Up Procedures

❑ Record Rock Fall Events:

- ❑ Tunnel inspections by Tunnel Staff (Paul Spencer, Senior Superintendent with Broadspectrum a Contractor for ADOT&PF).
- ❑ Rock fall records include location, volume, size of material, water associated with rock fall area, etc.
- ❑ Tunnel Staff Report to the ADOT&PF Whittier Tunnel Facilities Manager (Gordon Burton).

❑ ADOT&PF Headquarters (Juneau):

- ❑ Biennial Tunnel Inspections were initiated this year.
- ❑ A team of personnel review all facets of the tunnel such as drainage, ventilation, geological, rock fall, etc.

❑ ADOT&PF Design (Matt Tanaka):

- ❑ Whittier Tunnel Drainage Improvements Project

QUESTIONS