

**STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION
MATERIALS DIVISION
GEOTECHNICAL SECTION**

**SEISMIC REFRACTION SURVEYS
US 93 PAVEMENT WIDENING AND SLOPE FLATTENING
LAGES TO CURRIE
MP WP 112.80 TO EL 11.79
*WHITE PINE AND ELKO COUNTIES, NEVADA***

MARCH 2013

EA 73710

Prepared by _____

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Approved by _____

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Introduction

This report presents the results of our geophysical surveys performed for the proposed pavement widening and slope flattening project on US 93 from Lages in White Pine County to Currie in Elko County (Mileposts WP 112.80 to EL 11.79). The project consists of modifying shoulder slopes to increase roadway safety along the roadway. This investigation was conducted to provide rippability characteristics for three rock cuts near Currie. Approximate locations of the rock cuts are Mileposts EL 8.4, 10.4 and 10.9 (Stations 680+00, 765+00 and 795+00).

Previous Studies

NDOT previously performed seismic refraction surveys in July of 2005 (Seismic Refraction Survey Rippability Studies, US 93, Milepost EL 0.00 to Milepost EL 12.0, Elko County, Nevada). Those surveys addressed the same cuts as the surveys reported herein, but were not as detailed. The results of the older surveys indicated seismic velocities less than 6,000 feet per second at all three cuts. This study, as reported below, indicates higher velocities at some locations.

Site Geology

The majority of the roadway alignment overlies Quaternary alluvium or fluvial deposits, as shown in Figure 1.

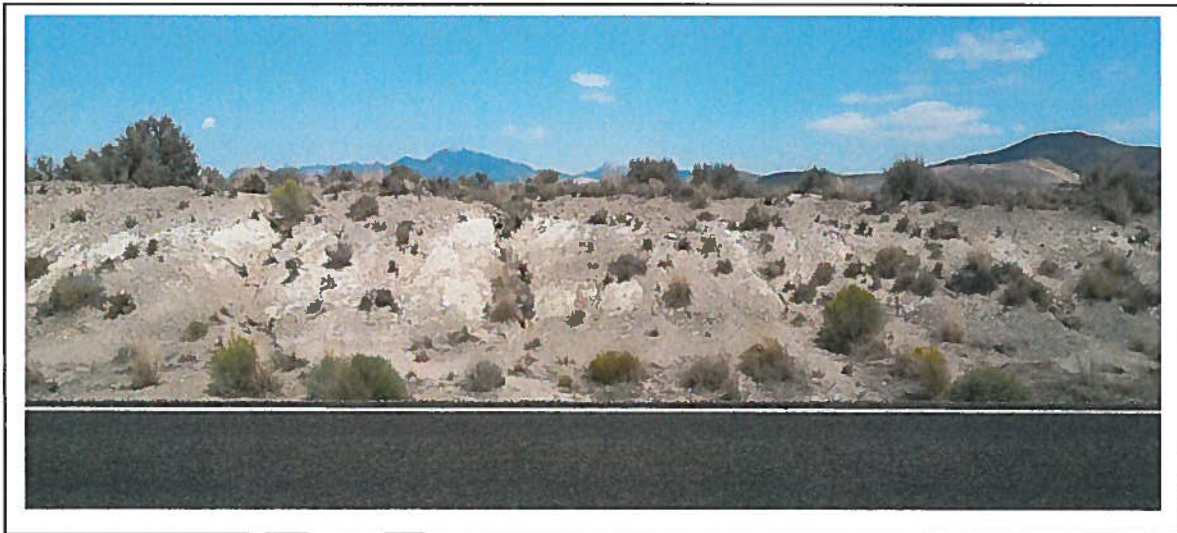


FIGURE 1
QUATERNARY DEPOSITS WITHIN CUTSLOPE NEAR STATION 625+00

However, the cut areas along the northern portion of the roadway alignment near Currie consist of Tertiary andesitic to latitic flows and pyroclastic rocks as well as sedimentary rocks.¹



**FIGURE 2
ROCK WITHIN CUTSLOPE NEAR STATION 765+00**

Field Exploration

Field exploration consisted of conducting geophysical refraction surveys at three locations within existing bedrock cut slopes at approximate Stations 680+00, 765+00 and 795+00. One refraction survey was conducted near the top of both the east and west cut slopes at Station 680. Two surveys were conducted along the east cut slope at Station 765 and one on the west slope. One survey was conducted along the top of the west slope near Station 795 and two were conducted near the top of the east slope. Locations of survey lines are shown on plan sheets included in Appendix A.

Refraction data was obtained used a 220-foot long cable with 12 geophones spaced 20 feet apart. A sledge-hammer and metal striking plate were used to generate an energy source for collection of seismic refraction data (ASTM D 5777). Strikes were conducted at 10 feet north of the first geophone, between the third and fourth geophones, between the sixth and seventh geophones, between the ninth and tenth geophones, and 10 feet south of the twelfth geophone. Where two surveys were conducted on a cut slope, the second survey overlapped the first

survey by placing the first geophone of the second survey at center of the first survey line, essentially shifting the second survey line 110 feet south of the first survey.

Refraction survey locations were obtained using resource grade Global Positioning System (GPS) equipment and should be considered accurate only to the degree implied by this method. Graphical results of the refraction surveys are included in Appendix B.

Rippability Characteristics of Proposed Cut Areas

The criterion for estimating rippability of the cut slopes was based on the Seismic Velocity vs. Rippability Chart developed by the California Department of Transportation (Caltrans):

<u>Seismic Velocity (feet/second)</u>	<u>Rippability</u>
< 3445	Easily Ripped
3445 – 4921	Moderately Difficult
4921 – 6562	Difficult Ripping / Light Blasting
> 6562	Blasting Required

At Station 795+00, the roadway profile is located approximately 10 to 13 feet below the top of the cut. Velocities near Station 795 range from 2,000 to 3,500 ft/s to depths of 40 to 70 feet. Using the chart developed by Caltrans, this cut area should likely be easily ripped; however, based on our field reconnaissance, weathering of the cut slope varies and excavation difficulties may be encountered within the southern portion of the east cut slope.

Refraction surveys near Station 765+00 indicate velocities of 2,000 to 3,500 ft/s within the upper 5 to 6 feet of the existing cut section increasing to around 5,000 to 6,000 ft/s to a depth of 40 feet. The refraction survey of the west slope indicates velocities of about 7,000 ft/s at an approximate depth of 8 feet below the surface near the south end of the slope. The roadway profile in this area is about 10 to 13 feet below the top of the existing cut. Therefore, the material of the cut section at the existing roadway elevation has high velocities that may cause difficulties during excavation and will likely require blasting.

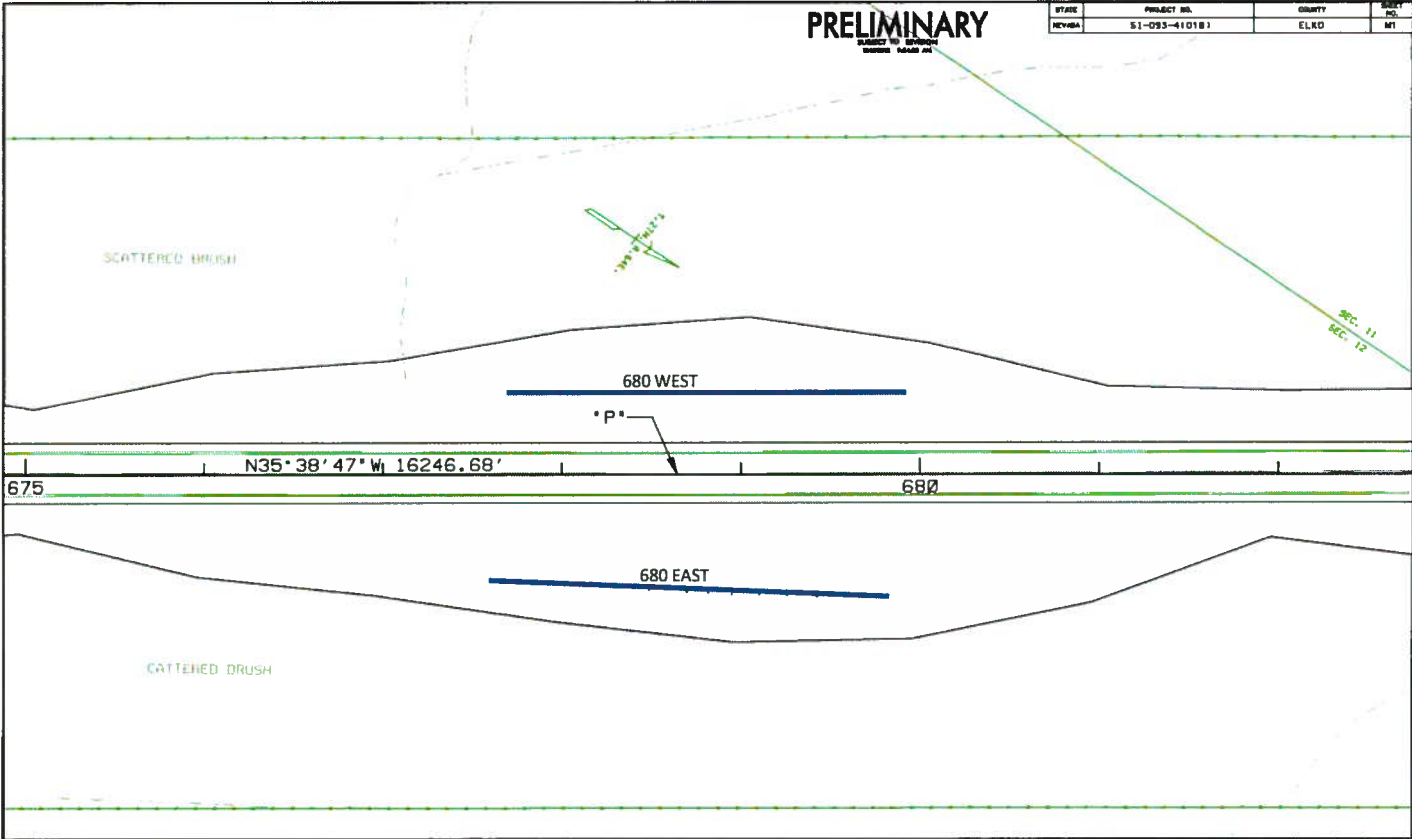
Velocities in the cut area near Station 680 are on the order of 2,000 to 3,500 ft/s within the upper five feet. At depths ranging from 5 feet to 15 feet, velocities of the bedrock exceed 5,000

ft/s and are as high as 8,000 ft/s. The roadway profile at Station 680 is located about 13 to 16 feet below the top of the existing cut; therefore, blasting will likely be required at this location.

Appendix A

PRELIMINARY

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	51-093-4101B	ELKO	MT



White Pine and Elko Counties, Nevada
EA#: 73710
DATE: November 2012

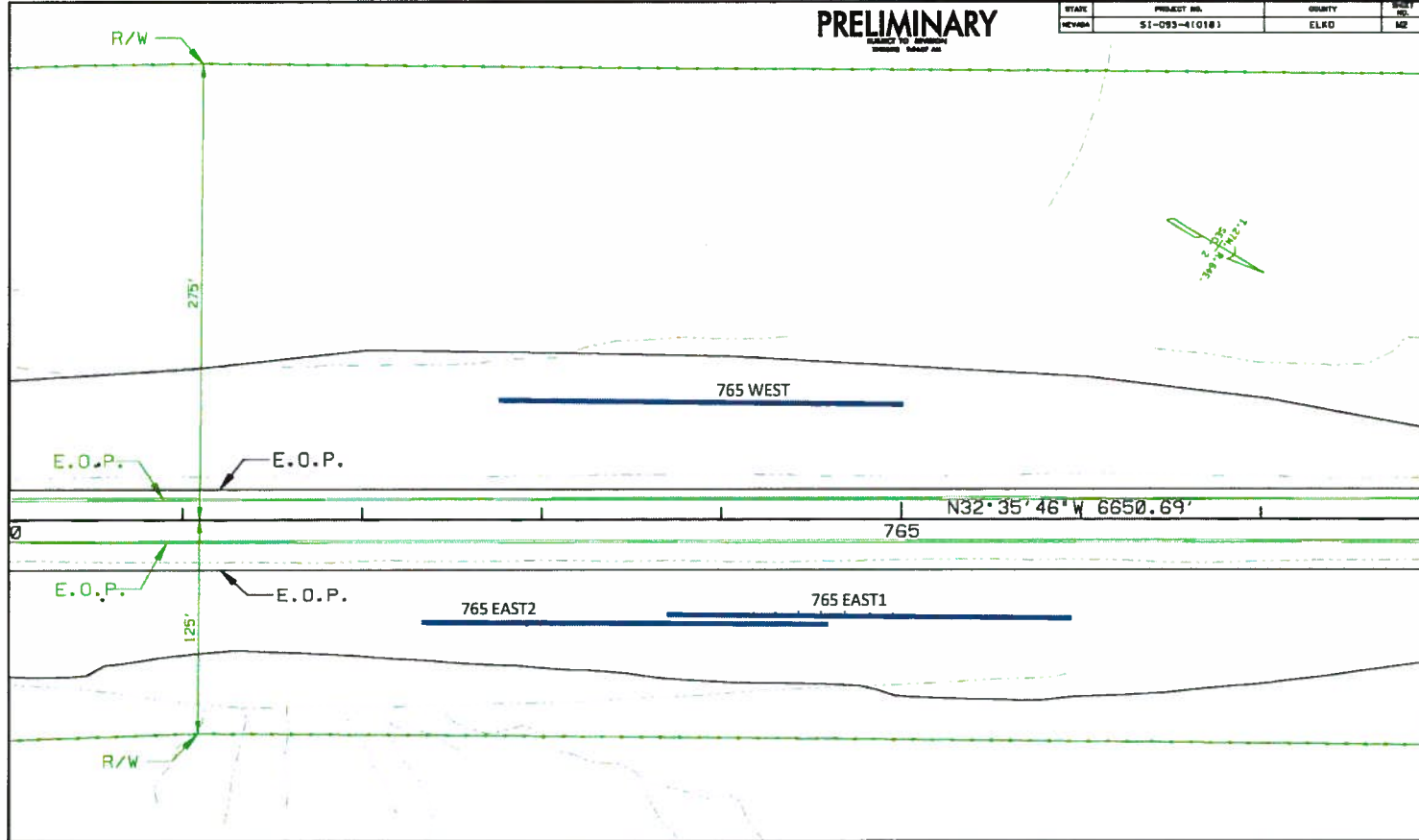
DRAWING NOT TO SCALE

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US 93 STATION 680
REFRACTION SURVEY LOCATION MAP
US 93 PAVEMENT WIDENING & SLOPE FLATTENING PROJECT
LAGES TO CURRIE

PRELIMINARY
DESIGN TO BE CONFIRMED
 BEFORE BIDDING

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	SI-093-4(1018)	ELKO	ME



White Pine and Elko Counties, Nevada
 EA#: 73710
 DATE: November 2012

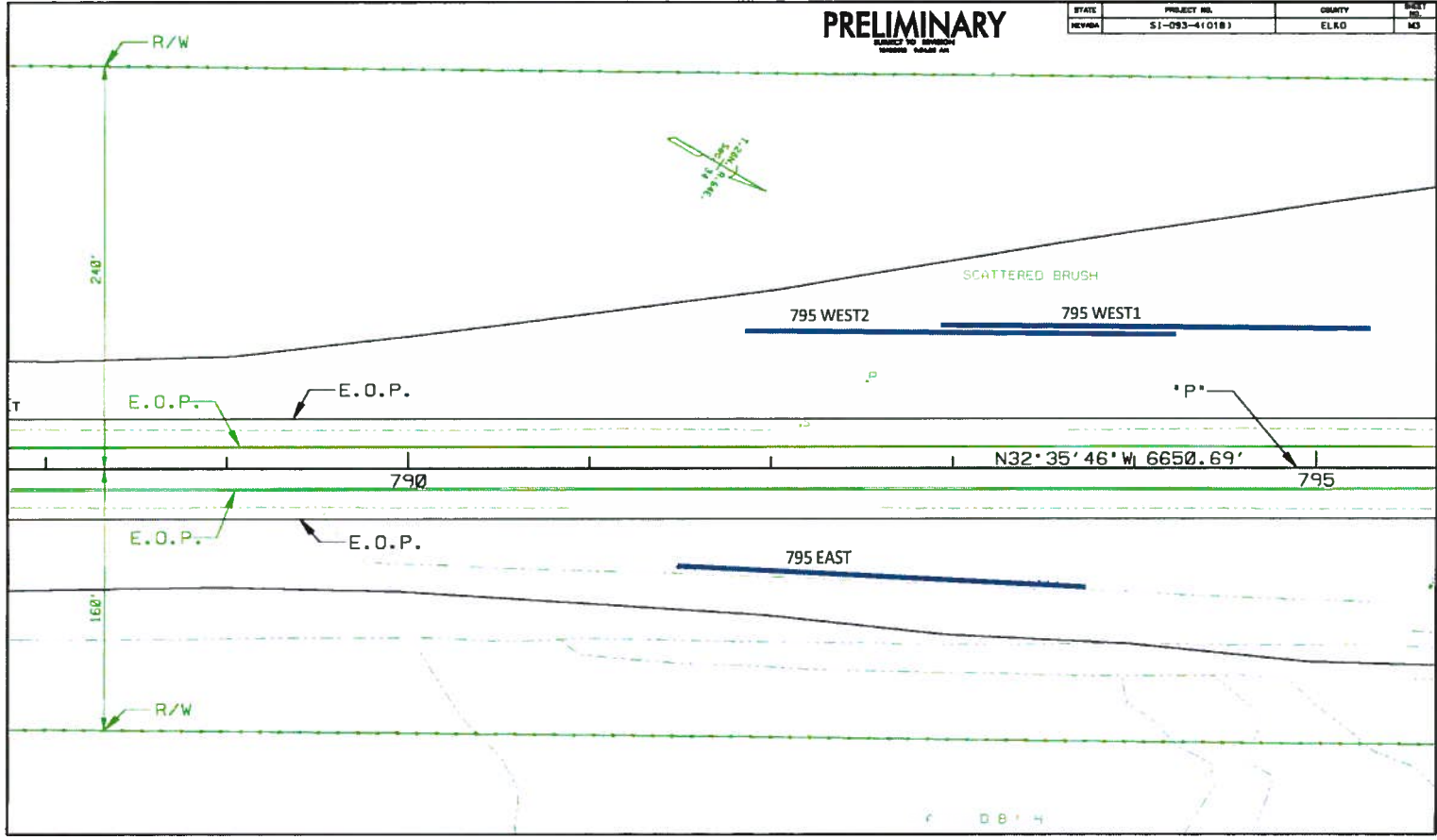
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US 93 STATION 765
REFRACTION SURVEY LOCATION MAP
US 93 PAVEMENT WIDENING & SLOPE FLATTENING PROJECT
LAGES TO CURRIE

PRELIMINARY
SUBJECT TO APPROVAL
ISSUED: 11/01/12

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	S1-093-410183	ELKO	MD



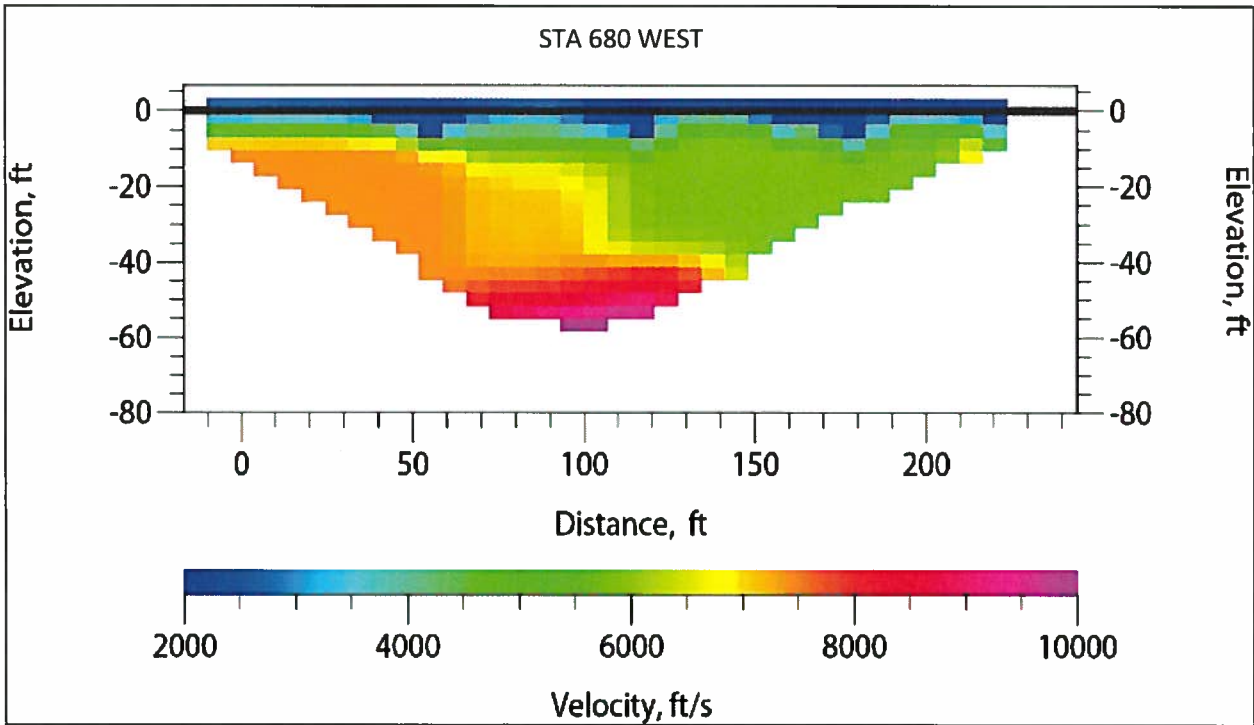
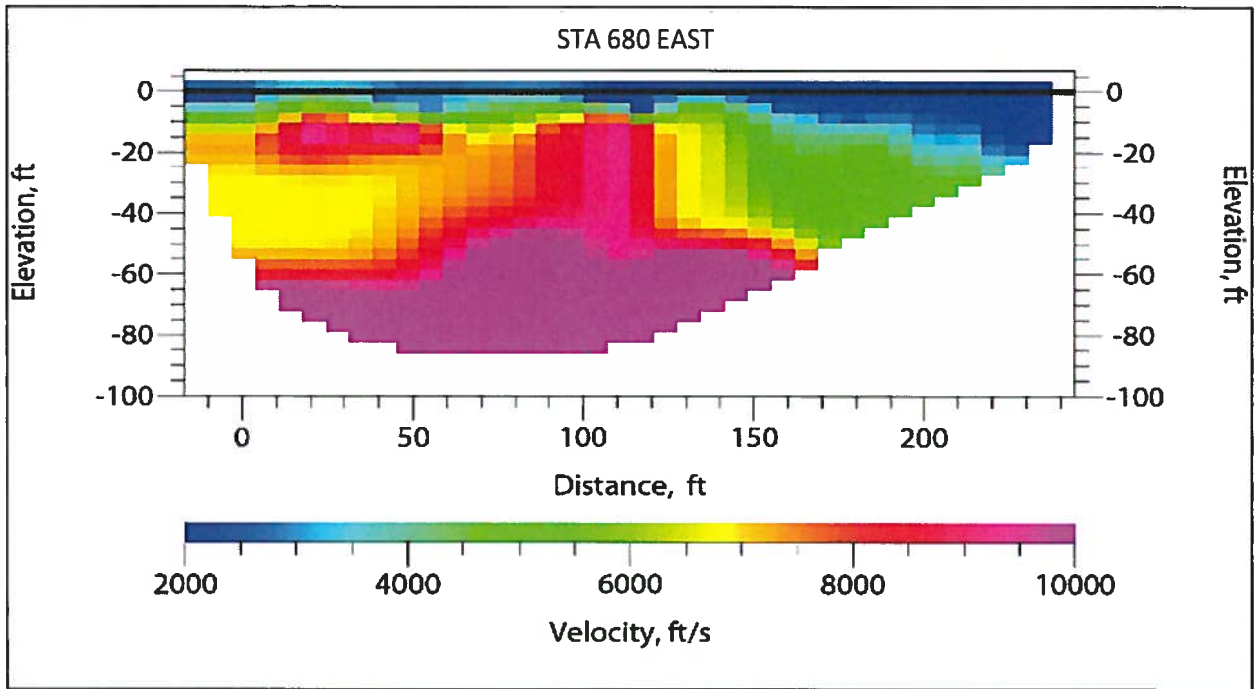
White Pine and Elko Counties, Nevada
EA#: 73710
DATE: November 2012

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US 93 STATION 795
REFRACTION SURVEY LOCATION MAP
US 93 PAVEMENT WIDENING & SLOPE FLATTENING PROJECT
LAGES TO CURRIE

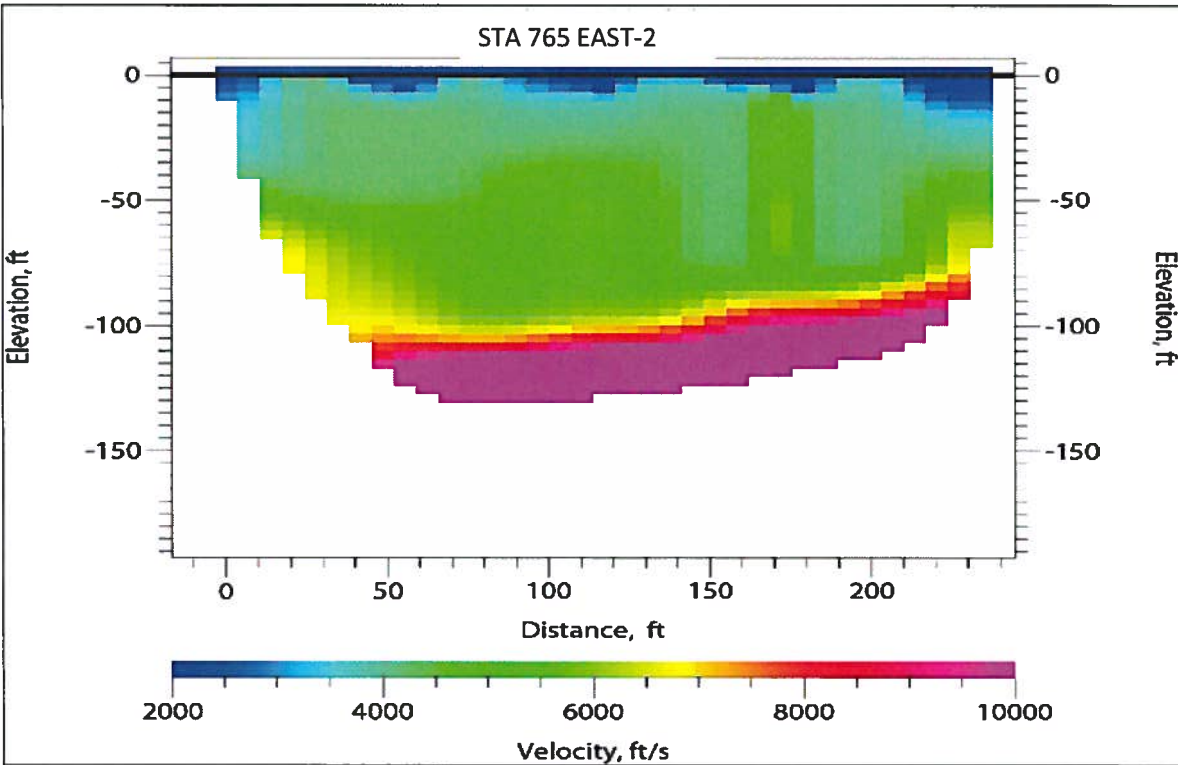
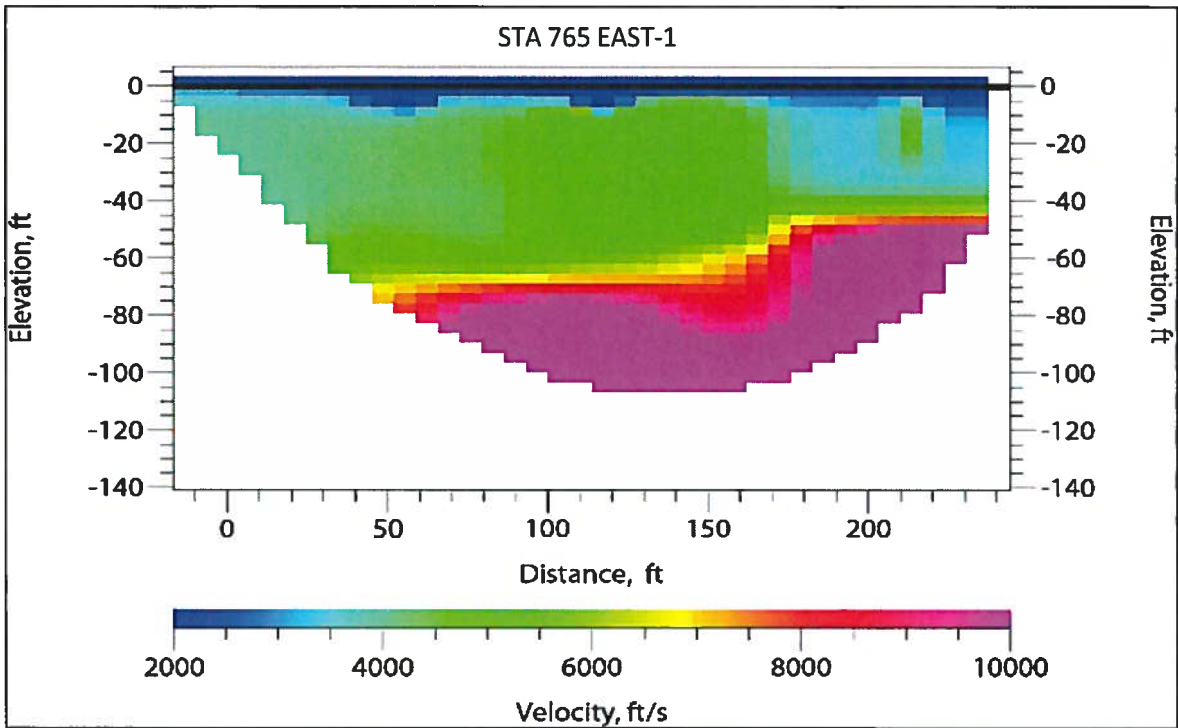
Appendix B



EA #73710
WHITE PINE & ELKO COUNTIES

**US 93 STATION 680 WEST
REFRACTION SURVEY RESULTS**

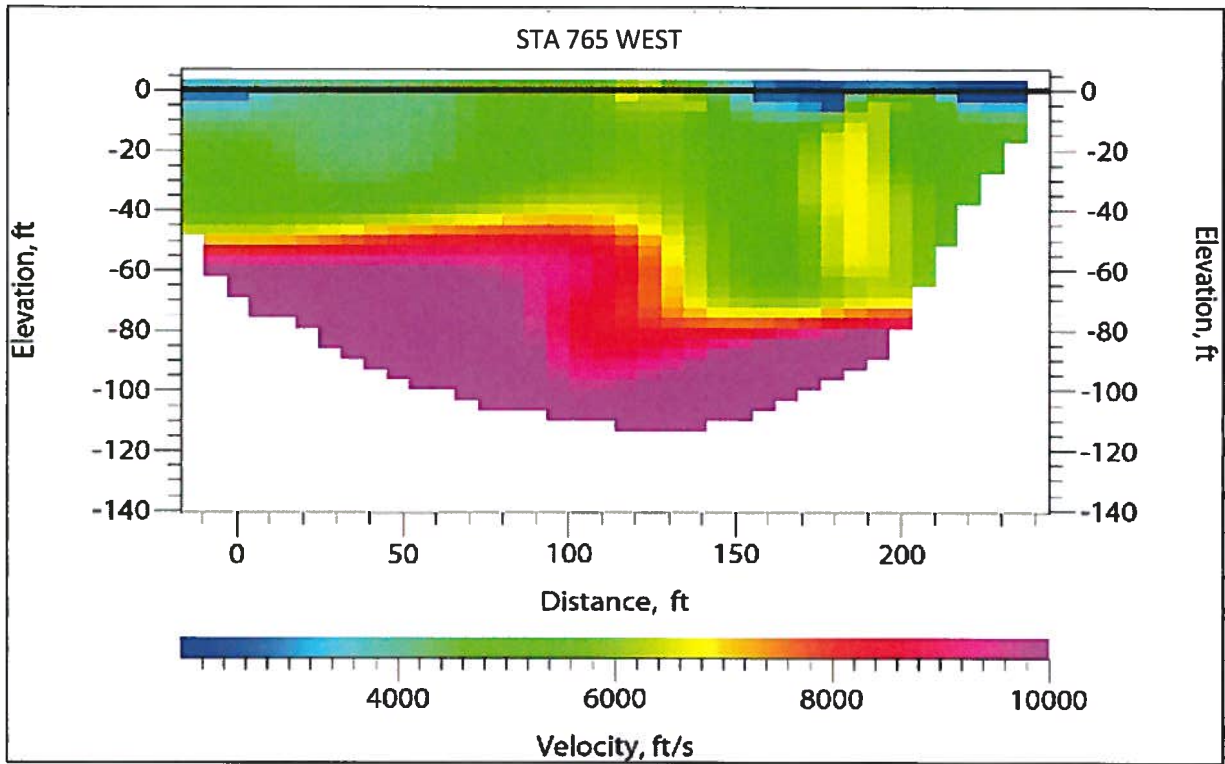
**US 93 SLOPE PROJECT
LAGES TO CURRIE**



EA #73710
WHITE PINE & ELKO COUNTIES

**US 93 STATION 680 EAST
REFRACTION SURVEY RESULTS**

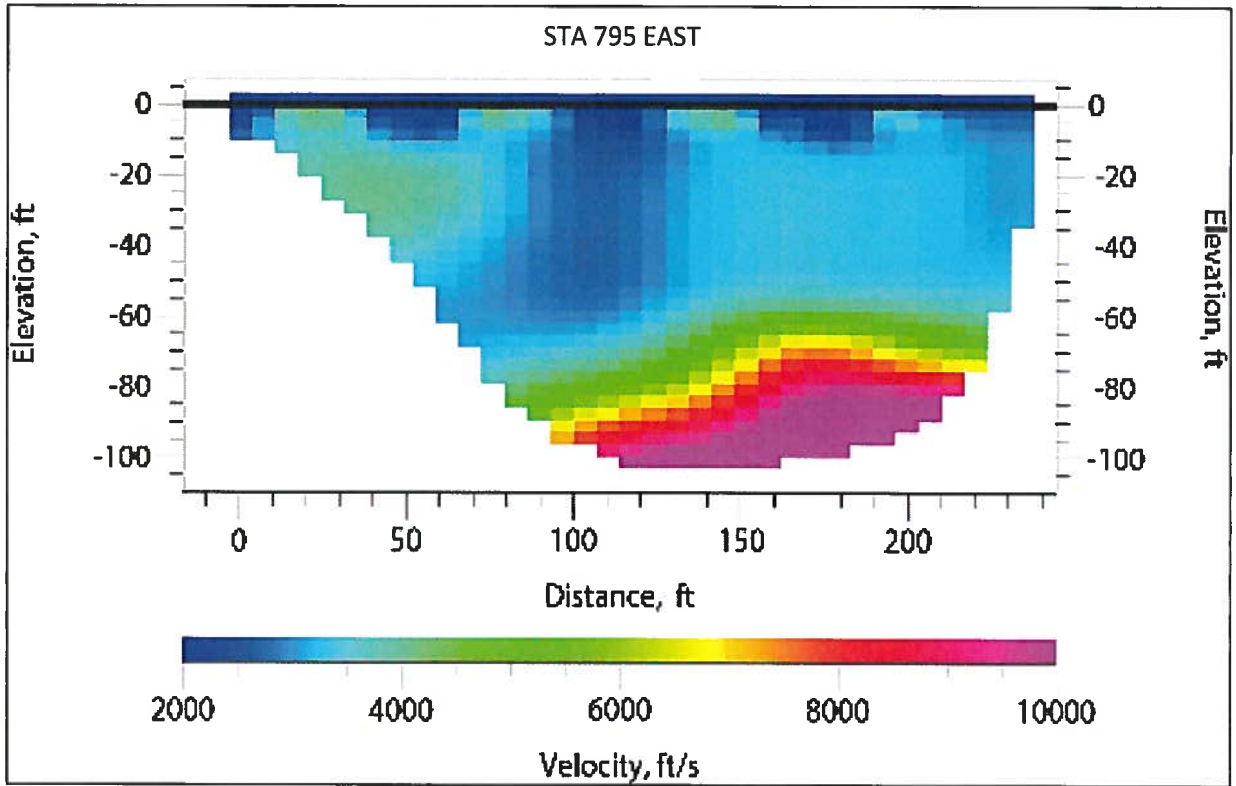
**US 93 SLOPE PROJECT
LAGES TO CURRIE**



EA #73710
WHITE PINE & ELKO COUNTIES

*US 93 STATION 680 WEST
REFRACTION SURVEY RESULTS*

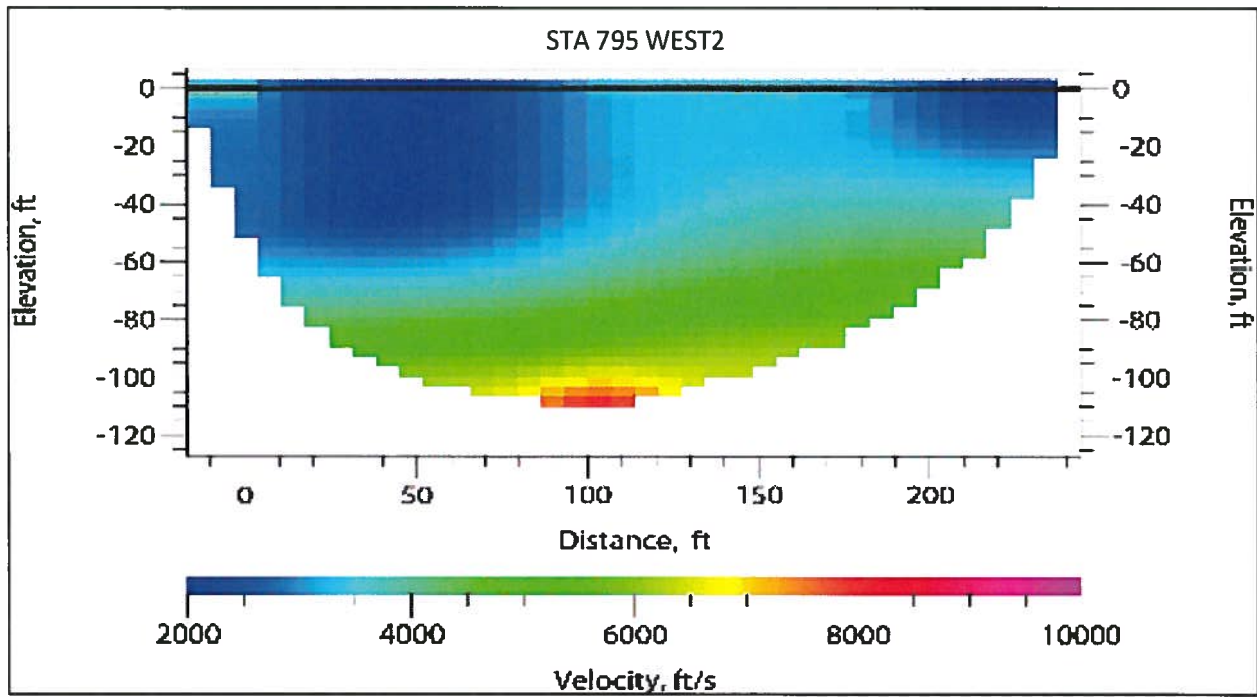
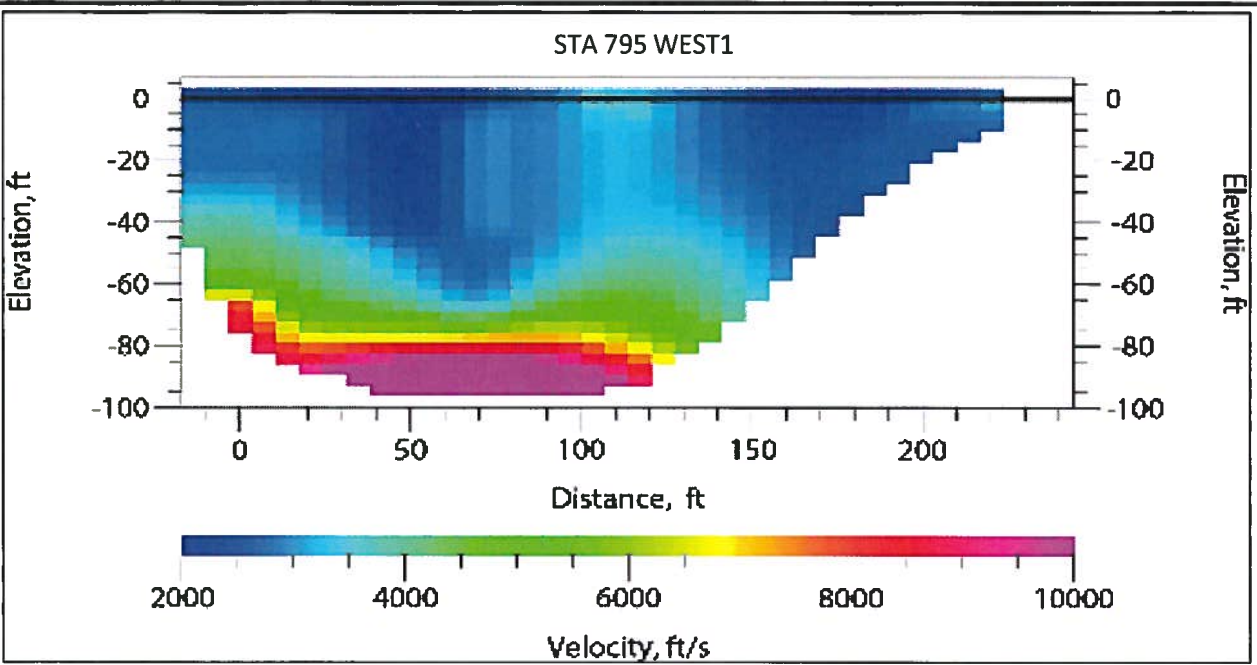
**US 93 SLOPE PROJECT
LAGES TO CURRIE**



EA #73710
WHITE PINE & ELKO COUNTIES

*US 93 STATION 680 WEST
REFRACTION SURVEY RESULTS*

**US 93 SLOPE PROJECT
LAGES TO CURRIE**



EA #73710
WHITE PINE & ELKO COUNTIES

*US 93 STATION 680 WEST
REFRACTION SURVEY RESULTS*

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