SR-87/Lake Fork River Gorge Geological Solutions and Realignment

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Introduction

This project involves realigning a section of road on SR-87 west of the city of Altamont, UT between mile markers 18.8-20.1 where the route traverses the Lake Fork River Gorge. Existing problems consist of. (1) the road has sloughed down the escarpment due to major sediment transfer underneath the road. (2) the road is fractured on the West Bank. These problems are exacerbated by sediment transfer, ultimately the result of poor drainage. Additionally, the climbing lanes require extension. Data gathered from the field and UDOT reports give us proposed solutions to existing barriers for the realignment of this portion of highway. Figure 1 below shows the overall project area

Figure1: Road Project Area.

Key Findings

- SR-87 is a Utah state road originally constructed in 1935 as a patchwork of smaller routes. In 1964, the route was expanded to its current alignment;
- The asphalt along the East Bank incline is sloping down the escarpment; see Figure 2 below
- The road is fracturing on the West Bank due to poor drainage of soil under the road; see Figure 3 below
- The South Bonita Canal flows through a culvert on the West Bank of SR-87 and is assumed to contribute to the excess ground moisture that has pushed through the surface in the asphalt; this culvert is inefficient and corroded due to age
- The sponsor of the project requested that the climbing lanes be extended and both side of the gorge

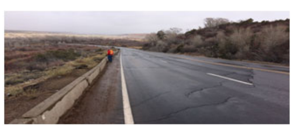

Figure 2: Road damage and asphalt sloping along East Bank

Figure 3: Fracturing of asphalt due to poor drainage on West Bank

Methods

East Bank Drainage Calculations:

- To account for 250 acres of inground water flow, a rate of 3 gal/sec is desired. a single 6-inch perforated pipe should sufficiently manage the drainage flow; however, locating the precise spot within the failure area could prove difficult so placing several pipes within the affected area would make the drainage of excess water more probable. Figure 4 a-b shows calculations for pipe flow, and Figure 5 shows the placement of pipes for horizontal drilling

$$250\ Acres * \frac{43560 ft^2}{1\ Acre} * \frac{1\ Yr.}{365\ days} * \frac{1 day}{24\ hours} * \frac{1\ hour}{60\ sec.} * \frac{1\ gal}{0.134\ ft^2} = \frac{2.57\ gal}{sec.}$$

Figure 4 a: Hydrologic flow calculation for the east bank soils

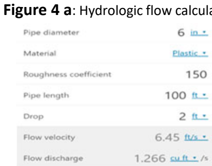

Figure 4 b: Pipe flow calculations for east bank drainage

Figure 5: Plan view showing locations for pipe placement following horizontal drilling

West Bank Culvert Calculations:

- A 3-foot width and 6-inch rectangular model was created to determined a flow rate between 5.03 cfs to 6.0 cfs. Proposed design is an 18-inch concrete culvert with a slope of 1.7%. This Allows a more efficient inlet control and transition. Figure 6 show the flow transition from super to sub critical flow within the culvert pipe.

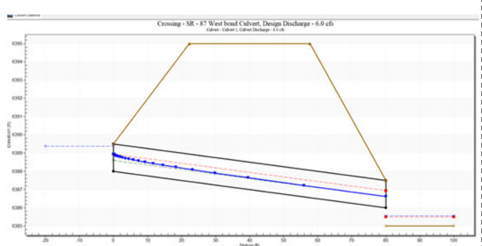

Figure 6: Profile of culvert showing the transition in the pipe

Horizontal Curve Calculations:

- The proposed curve was design with our project design criteria of 6%. Super elevation. Giving a new radius of 540 ft. this radius was can handle speeds of 41-42 mph the speed into the curve will be set at 35 mph for safety reasons Figure 7 show the equation used and the purposed design curve.

U.S. Customary	Metric	
$R_{min} = \frac{V^2}{15(0.01e_{max} + f_{max})}$	$R_{min} = \frac{V^2}{127(0.01e_{max} + f_{max})}$	(3-8)

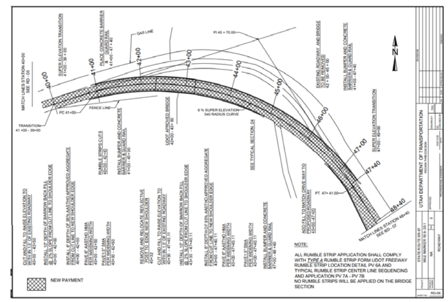

Figure 7: Purposed curve meets U-DOT standards and allows for a more comfortable ride, while using a 6% super elevation

Results

Proposed East Bank Drainage Solution

- There are three proposed concepts for the east bank drainage: excavating and trenching; horizontal drilling, and a grout dam; horizontal drilling is the most practical and financially feasible of these three concepts;
- A minimum of five pipes with a six-inch diameter, 100 feet in length spaced 20 feet apart will provide drainage to the saturated area;
- Figure 8 below is a cross section of the proposed position of the pipe

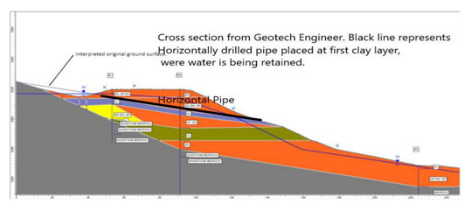

Figure 8: Each pipe shall be installed by a horizontal drilling method which minimizes traffic conflicts as the machinery is not needed to be in the roadway

Results, Continued

Proposed West Bank Drainage Solution:

- Adding a non-corrosive concrete pipe mitigates ponding, add strength, and will mitigate leaks that can cause road swelling.

Proposed cost to the whole project:

- The combined cost of the project can be seen in Table 14-16. in our report. The breakdown shows the estimated cost given feedback by our sponsor U-DOT.

Final Project Cost Estimates		
Pavement Marking Costs	$	17,357.40
Surfacing Material Costs	$	735,154.00
Signage	$	11,980.00
Excavation	$	1,914,363.80
West Bank Culvert	$	813,170.00
East Bank Drainage	$	137,400.00
Bridge Replacement	$	1,160,000.00
TOTAL	**$**	**4,789,425.20**

Conclusion

- Horizontal drilling and the addition of weep pipes will mitigate sediment transfer and improve drainage to the East Bank of the road
- A new concrete culvert would improve drainage on the West Bank and add strength to the culvert
- Extension of eastbound and westbound climbing lanes will increase safety and bring the road in to compliance with AASHTO standards
- These proposed solutions represent the most safe and economical ways to address the problems regarding road design and safety along this stretch of SR-87

Acknowledgements

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