

PROJECT MEMORANDUM

To: Mark McCune, P.E., Steve Cheney, P.E., UPRR
From: Carol Ravano, P.E.
Job No.: 4294.0
Date: 21 October 2013
Subject: Great Salt Lake Causeway East Culvert- Results of Diving Inspection, 11 October 2013

1 Introduction

As part of Jacobs Associates' on-going monitoring of the East Culvert on the Great Salt Lake Causeway, Blackwater Marine inspected the East Culvert on Friday 11 October 2013. The previous dive into the culvert was on Monday, 4 March 2013. The memorandum summarizing the observations of that dive was sent to UPRR on 20 March 2013.

Upon arriving at the site, a safety meeting was held by Cory Choate of UPRR. Present at the site were George Lulham, Bryan Cox (diver), and two helpers from Blackwater Marine, and Carol Ravano from Jacobs Associates. Mr. Lulham gave a briefing on the dive sequence, roles, and safety.

2 Results of East Culvert Dive Inspection

Bryan Cox entered the East Culvert from the north side at 10 a.m. and completed his dive at 1130 a.m. While in the culvert, the diver had a camera mounted on his dive helmet which transmitted to a screen inside the dive trailer; there was also voice communication between the diver and the dive trailer. The diver examined the sidewalls, bottom, and crown of the culvert visually and tactilely.

2.1 11 October 2013 Crack Observations

In the March 2013 memo to the UPRR reporting the results of the March inspection, we stated "...the diver did note that the cracks that are approximately 30 feet from the north entrance have increased in size since the last dive in July 2012. These cracks now continue over the crown and the floor of the culvert, connecting into a crack on the east wall. There also appeared to be one- to two-inch rounded gravel material coming out of the crack on the west wall; this is an indication that the original backfill material, which is rounded, is coming out of the crack."

2.1.1 East Sidewall

During the 11 October 2013 dive, the following observations were made regarding the crack in the east sidewall: There is an existing crack located in the east sidewall, approximately 30 feet in from the north culvert entrance that was first noted in July 2005. Over the years, the crack has increased in width and it is now 18-inches wide and greater than 12 inches deep; the concrete sidewall has continued to spall and there is exposed, corroding rebar present in the crack. As of March 2013, the crack on the east sidewall had split at the top (approx. 10 foot level) into 2 separate cracks. During this 11 October 2013 dive, the diver noted that there are now 4 separate cracks at the top of this crack and that the size and number of loose concrete blocks has increased. The diver described this crack as looking like a tree, with the large open crack as the trunk and then the branches at the top. The loose concrete blocks are located where the cracks diverge from the main trunk.

One of the loose blocks on the east sidewall, located where the cracks diverge, was described by the diver as approximately 6 feet high and 18 inches wide. Just below this block, there were several smaller blocks of loose concrete, less than one foot in diameter. The large block weighs approximately one ton, but because of the buoyant force of the super saline water, the diver was able to move the block around.

As the diver was attempting to scale the cracks in the east sidewall to reach the crown, smaller pieces of the concrete (less than 6 inches in size), broke off in his hand. The diver also noted that there are parallel cracks that continue from the above described crack, through the 45 degree chamfer that is located at the intersection of the sidewall and the crown, and across the culvert crown, connecting with the major crack on the west sidewall, which is described below. Because the water clarity was good during this dive, we were able to see the bubbles which formed at each of the crack lines, indicating that there is a slight offset between the cracks.

At the base of this crack in the east sidewall, there is a pile of rock material that is less than six inches in diameter, presumed to have come into the culvert through the open crack. The diver examined the rock and found that there was a mixture of angular and rounded rock. The angular rock is presumed to be ballast which has either migrated down the outside of the culvert and come through the crack or has fallen into the GSL and been carried into the culvert by the currents. The rounded rock is presumed to be backfill, which was placed around the culvert during the original construction in the 1950s. The diver took a sample of this rock out of the culvert; a photo of it is shown in Appendix A. This rounded rock indicates that the material surrounding the culvert is coming through the crack, resulting in a potential loss of material under the track section.

2.1.2 West Sidewall

Opposite the crack in the east sidewall, there is a crack in the west sidewall which appears to have widened since the March 2013 dive. The crack is approximately 2 feet wide at the base and greater than 12 inches deep. This crack divides into 3 smaller cracks, spaced approximately 2 to 3 feet apart, at about 10 feet up from the culvert bottom. Where the main crack divides into the smaller cracks, there are loose blocks of concrete, less than 1 foot in diameter.

Due to the amount of debris on the culvert bottom, the diver was not able to see or feel the crack, which is present on the bottom. This crack was present during previous dives and is presumed to still be present.

Similar to what we observed in March 2013, during this dive, we noted a pile of smaller rock, less than 6 inches in diameter, at the base of the crack in the west sidewall. The observations of the diver are similar to what was described above at the base of the crack on the east sidewall. This material is presumed to have come into the culvert through the open crack

During the dive, the diver also noted that the crack does continue through the 45 degree chamfers that are located at the intersections of the sidewalls and the crown and bottom of the culvert, making it a continuous crack around the entire perimeter of the culvert.

3 Conclusions and Recommendations

Based on the diver's observations inside the culvert during this dive, previous culvert inspections dating from January 2005, and our previous experience with the culverts, we make the following conclusions and recommendations:

1. The East Culvert has separated into two sections, with significant degradation at the interface, and has lost its original structural integrity.
2. It appears that the original culvert backfill material is coming into the culvert through the cracks in the east and west sidewalls.
3. This pattern of worsening crack formation, the formation of the loose concrete blocks, and the backfill material flow into the culvert is similar to the structural degradation process observed at the West Culvert prior to its closure in 2012.
4. The 2006 grouting program at the West culvert occurred when the culvert was still in adequate structural condition, with no loose blocks of concrete present. This is not the case with the East Culvert. The current condition of the East Culvert is more similar to the West Culvert just prior to its closure. Grouting the exterior of this culvert might prevent additional backfill material from entering the culvert, but it will not cause the culvert to regain its structural integrity.
5. Blackwater Marine divers, specifically Bryan Cox, have been diving in the West and East Culverts since 2005. Mr. Cox is the most knowledgeable about the conditions of the East Culvert. Due to the condition of the culvert, especially with the presence of the loose blocks of concrete, Blackwater Marine considers it unsafe to continue to dive in the culvert for inspection purposes.

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6. Based on the above points, we consider the culverts to be at risk of imminent failure and unable to be repaired; therefore, we do recommend completely filling in the culvert.

Please contact me if you have questions or would like to discuss.

Attachments:

Appendix A- Site Condition Photos and Sketches

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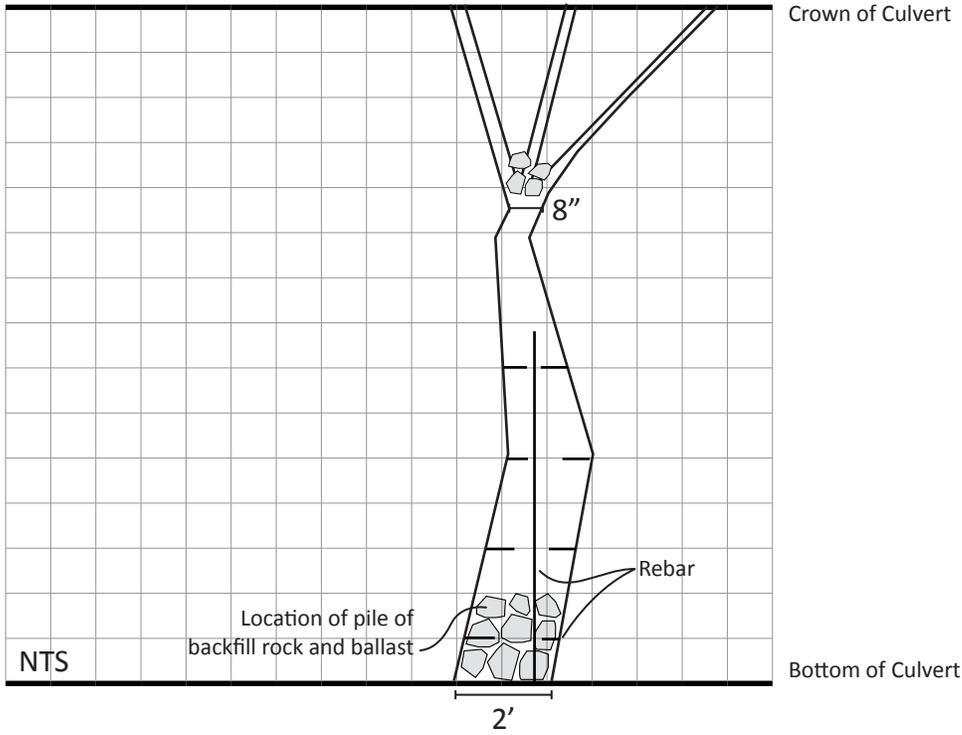


Photo 1- Sample of rounded rock taken from pile at base of crack in the west sidewall of the East Culvert. This is presumed to be original backfill material.



Photo 2-View of North Side of East Culvert. The water level is approximately 1.5 to 2 feet lower than in March 2013

WEST SIDEWALL



EAST SIDEWALL

