



FINDINGS and RECOMMENDATION REPORT

CITY OF GRANDVIEW – RAYTOWN ROAD

Twin 17'-2" x 11'-4" Structural Plate Arch Culverts



City of Grandview, Missouri
Raytown Road approximately 4,000 ft. north of High Grove Road
Roadway Station 52+00.00

INSPECTION DATE: Various dates from 8-1-17 thru 8-7-17

Executive Summary

Rain events on and before July 27, 2017 led to damage and closure of the shared-use trail above two structural plate arch culverts and brought to light potential issues with those culverts.

On August 1, 2017 a visual investigation was performed on both 211' long structural plate arch culverts to assess their general condition. On August 4, 2017 a second investigation was performed to obtain more specific information on the condition of the culverts. A third visual investigation was performed on August 7, 2017 after another rain event caused more damage to the shared-use trail and further concerns about the condition of the culverts.

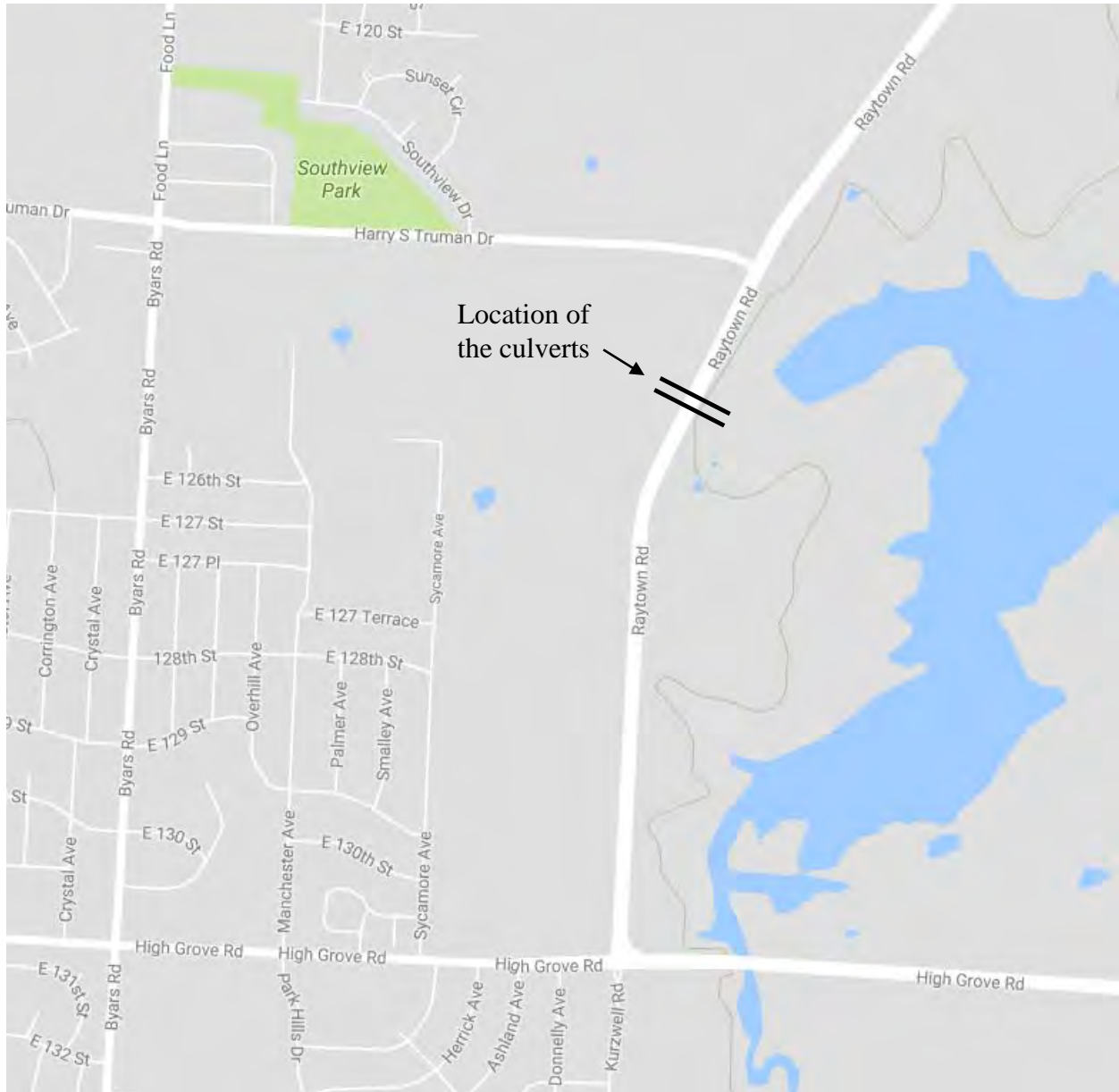
- Runoff from the roadway has eroded and undermined roughly 30' to 40' of the shared-use trail above the culverts. After encountering the trail, the runoff then appears to run under the concrete apron cast around the downstream end of the culverts and has been washing fill material out from under the apron and around the culverts.
- The north culvert is considered to be at the end of its useful life due to settlement, undermining and deterioration. At this time there is no apparent buckling or failure of the culvert but its condition should be monitored and checked after each significant rainfall event.
- The south culvert is in better condition but is partially undermined and has areas of deterioration. It's expected that within 2 – 5 years it will have also reached the end of its useful life assuming no significant undermining or loss of fill occurs within that time.
- Above the north culvert there is a noticeable depression in the northbound shoulder of Raytown Road which extends out into the right northbound lane. There is no apparent distress in the asphalt surface at this time nor is it known if the depression is directly related to the condition of the culvert or loss of fill material beneath it.
- It is recommended that both culverts be replaced with twin 105' long single span bridges and a separate pedestrian bridge for the shared-use trail.

More detailed descriptions of the findings and recommendations are enclosed on the following pages. Opinions of cost for the replacement structures are included at the end of this report.

The visual investigations were performed by and this report was prepared by:
Mark S. Huck, PE, and Jerry D. Stevenson, PE

SITE LOCATION

The structural plate arch culverts are located approximately 4,000 ft. north of High Grove Road and 1,100 ft. south of Harry S. Truman Drive.



FINDINGS:

Date of inspections: 8-1-17, 8-4-17 and 8-8-17

Location:

Latitude: N 38° 53' 49"

Longitude: W 94° 29' 33"

The existing structure is comprised of two corrugated structural plate arch culverts. Per plan dimensions each culvert is 17'-2" wide by 11'-4" tall and 211.2' long. Rain events on and before July 27, 2017 led to damage and closure of the shared-use trail above the pipes and brought to light potential issues with the culverts.

Shared-Use Trail and Culverts:

Runoff from Raytown Road has eroded and undermined roughly 30' to 40' of the trail above the culverts. After encountering the trail, the runoff then appears to run under the concrete apron cast around the downstream end of the culverts and has been washing fill material out from under the trail, the concrete apron and around the culverts. See photos 1- 4.

In addition, runoff from the road is seeping through the roadway embankment into the culverts near the interface with the concrete apron on both the upstream side and the downstream side. At these locations there is some deterioration of the culverts where the galvanized coating is no longer evident and the structural steel has begun rusting. See photos 5 and 6.

North Culvert:

In the north culvert a large percentage of the bottom corrugations are rusted out. Holes of various sizes and lengths exist in the trough of the corrugations beginning at a distance roughly 40' from the upstream end and extending to a point roughly 110' from the upstream end. In this area water was seen running down thru the corrugations and under the culvert before reemerging back up through the bottom corrugations. Probing indicated the depth of undermining and/or depth of soft material beneath the culvert to be 6" to 12" deep. Refer to photos 7 and 8 and Figure 1.

Roughly 70' or more of the downstream end of the culvert slopes / drops at a downward angle towards its outlet. The amount of drop was measured on 8-4-2017 to be 6" where the top of the culvert has separated from the concrete apron at its outlet. After the last major rainfall event the drop was measured on 8-7-2017 to be 8", an increase of 2". Refer to photos 9 and 10.

In our opinion the north culvert has reached the end of its useful life due to settlement, undermining and deterioration. At this time there is no apparent buckling or failure of the culvert but its condition should be monitored and checked after each significant rainfall event.

South Culvert:

In the south culvert a fair percentage of the bottom corrugations have holes of various sizes in the trough of the corrugations beginning at a distance roughly 40' from the upstream end and extending to a point roughly 120' from the upstream end. At the 120' point water was seen boiling up through various holes in the bottom of culvert. Refer to photo 11 and Figure 1.

Probing indicated the depth of undermining and/or depth of soft material beneath the culvert to be 6" to 12" deep in this stretch. In addition, probing / sounding of the culvert indicated the last 72' of the downstream end was undermined as shown in Figure 1.

At the time of the observations there was no apparent settlement of the culvert and no measurable separation from the upstream or downstream concrete aprons. A scour hole was noted at the upstream toe-wall near the north face of the culvert. The scour hole was roughly 2.5' deep and extended 6" or more back under the toe-wall.

In our opinion the south culvert is approaching the end of its useful life due to undermining and its deterioration. At this time there is no apparent buckling or failure of the culvert but its condition should be monitored and checked after each significant rainfall event

Raytown Road:

Above the north culvert there is a noticeable depression in the northbound shoulder of Raytown Road which extends out into the right northbound lane. This depression / settlement is also noticeable in the adjacent section of guardrail. There is no apparent distress in the asphalt surface at this time nor is it known if the depression is directly related to the condition of the culvert or loss of fill material beneath it. Refer to photo 12.

At this time, it is recommended to monitor the depression for any noticeable changes and for any correlation with changes noted in either culvert.

RECOMMENDATIONS:

Shared-Use Trail Repair:

To reopen the trail, we recommend that roughly a 50' long section over the culverts be removed down to the top of the culverts. The opening then backfilled with rock that has a predominant size in the 4" to 12" range up to a level at or slightly above the top of the concrete apron. Two layers of geotextile fabric would be placed over the rock and then the trail rebuilt over the fabric and having a thickness of 24". On the roadway (west) side of the trail a ditch would be graded to capture runoff from the roadway and drain the runoff either north and/or south away from the culverts. Refer to the sketch in Figure 2 included towards the end of this report.

Culvert Replacement:

It is recommended that both culverts be replaced with twin single span 105' long bridges. The proposed bridge length would place the abutments behind 2:1 front slopes and at or behind the top of the channel banks to avoid on-going scour issues, debris problems and maintenance costs. This would also improve the channel hydraulics, its alignment and allow Raytown Road to remain open to traffic during construction.

The shared-use trail can also be placed on a single span structure. That would allow the trail to maintain its current alignment and profile grade.

The recommendation to replace the culverts with bridges versus new culverts is based upon a number of factors.

- Construction for either metal culverts or concrete culverts would require the closure of Raytown Road or considerable and costly shoring operations to maintain traffic.
- The site is constantly impacted by varying water levels from Longview Lake. Thus a considerable amount of over excavation would be required to remove unsuitable wetted material that is now within the site. Additional cost would be incurred to backfill the over excavated area and for constructing new culverts within an area of varying water levels. Any major storm event or the anticipation of one is potentially disruptive to the construction process. This risk would be factored into higher unit prices and the overall cost of constructing for any type of culvert.
- Further costs would be incurred to construct culverts with angle breaks in them to better align them with the upstream and downstream sections of the channel.

Included at the end of this report is an opinion of probable cost and a detail (Figure 3) for the replacement of the existing culverts with new single span bridges.



Photo 1 – looking east at the failed portion of the shared-use trail from Raytown Rd, 8-6-2017.



Photo 2 – looking north along the shared-use trail, 7-31-2017.



Photo 3 – looking south towards the exposed outside face at the downstream end of the north culvert.



Photo 4 – downstream end of the north culvert showing 8" gap between the concrete apron and the top of the culvert.

Has settled / separated 8" from the concrete apron.



Photo 5 – north face of the north culvert roughly 30' from the upstream end.



Photo 6 – south face of the south culvert roughly 30' from the upstream end.



Photo 7 – water running thru the deteriorated corrugations of the north culvert at roughly 40' from the upstream end.



Photo 8 – general condition of the bottom corrugations in the north culvert.



Photo 9 – downstream end of the north culvert showing 8" gap between the concrete apron and the top of the culvert.

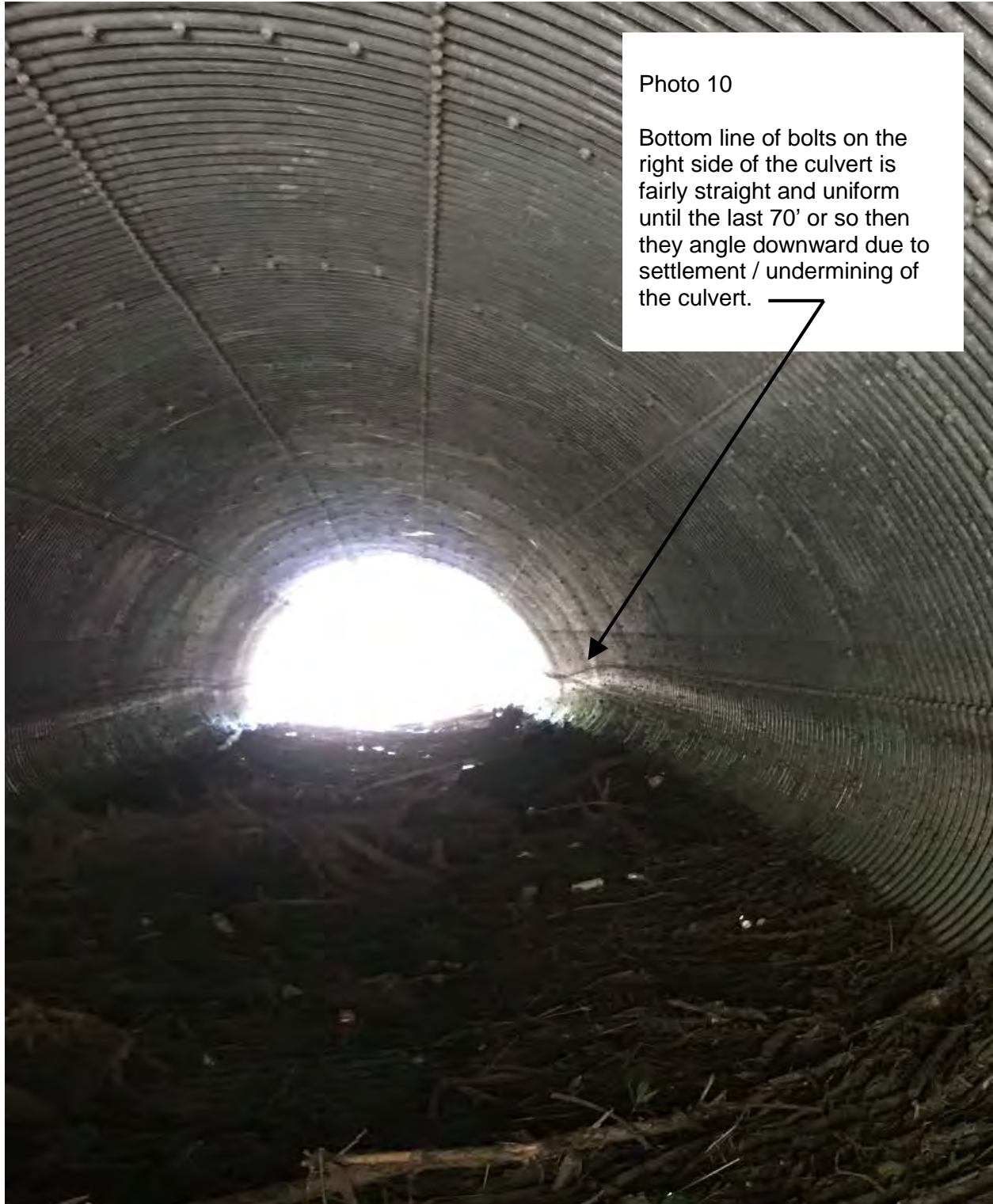


Photo 10

Bottom line of bolts on the right side of the culvert is fairly straight and uniform until the last 70' or so then they angle downward due to settlement / undermining of the culvert.

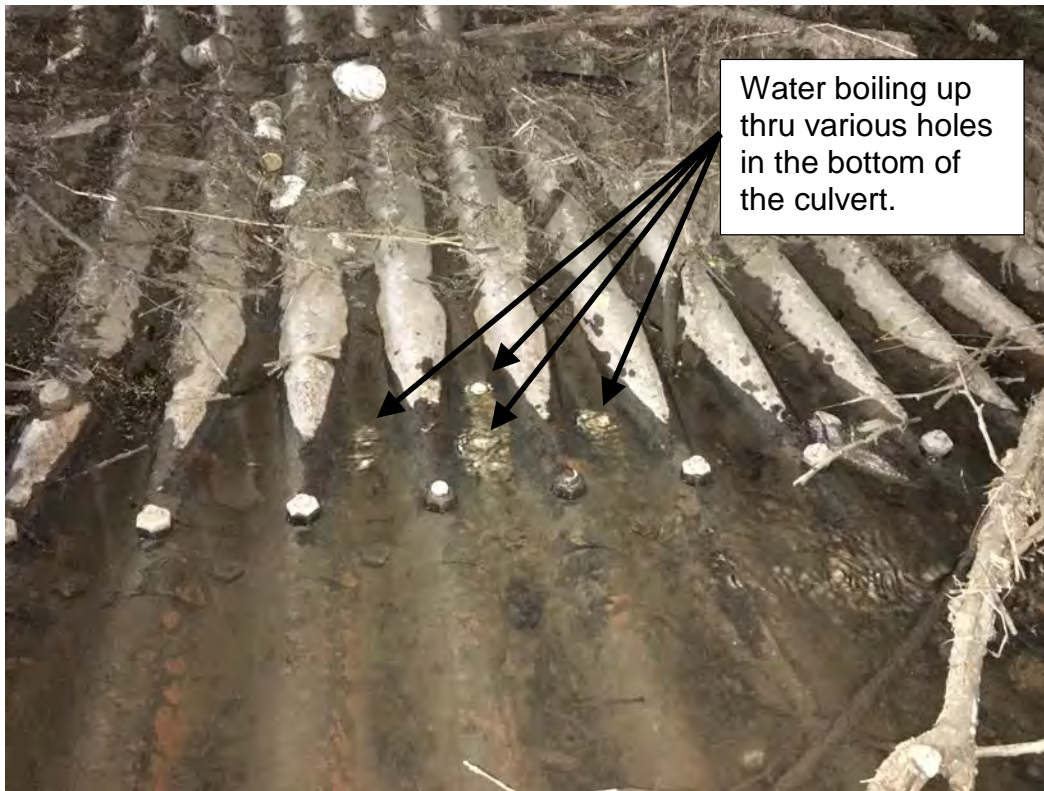


Photo 11



Photo 12 – depression in the northbound shoulder and right lane of Raytown Road.

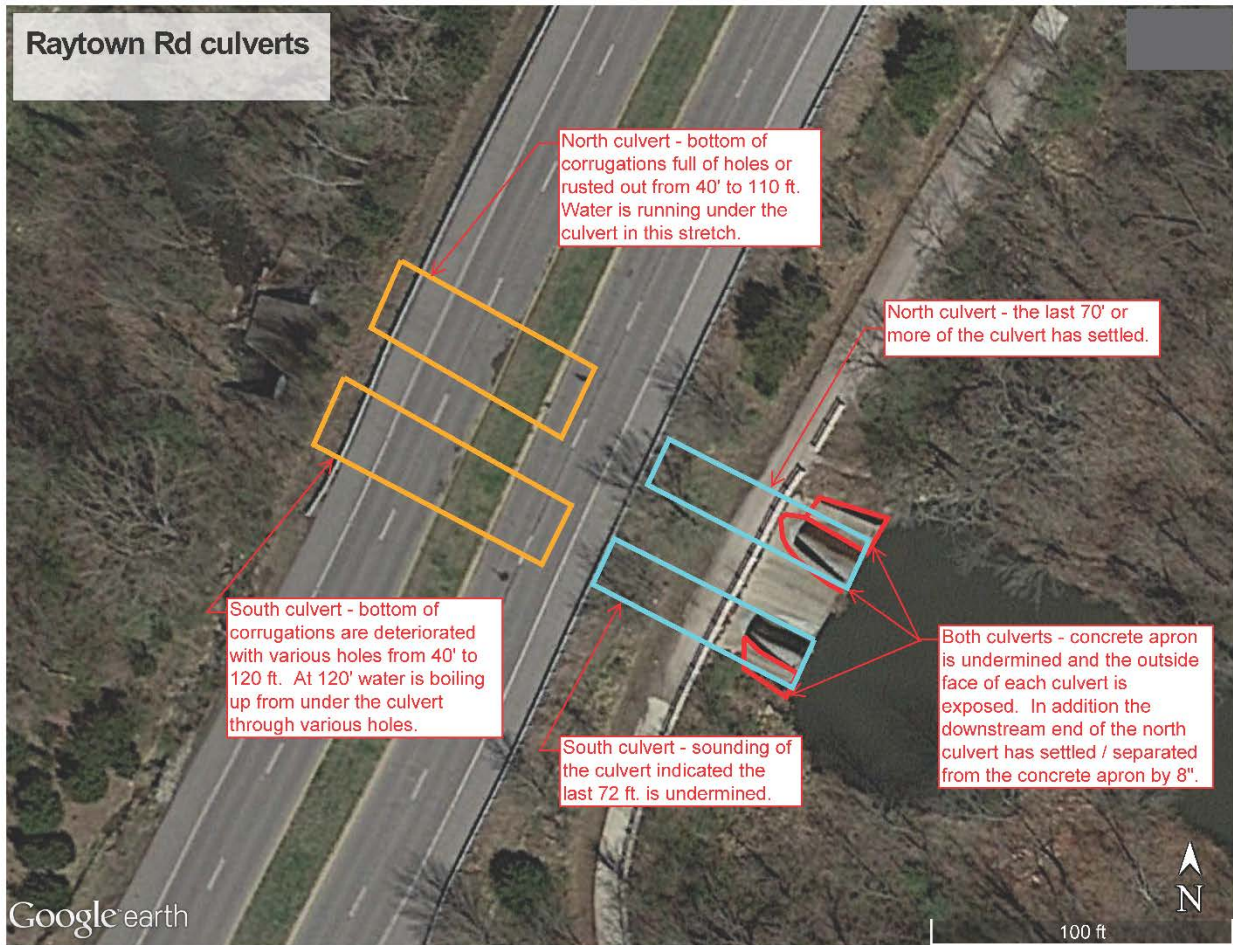


Figure 1

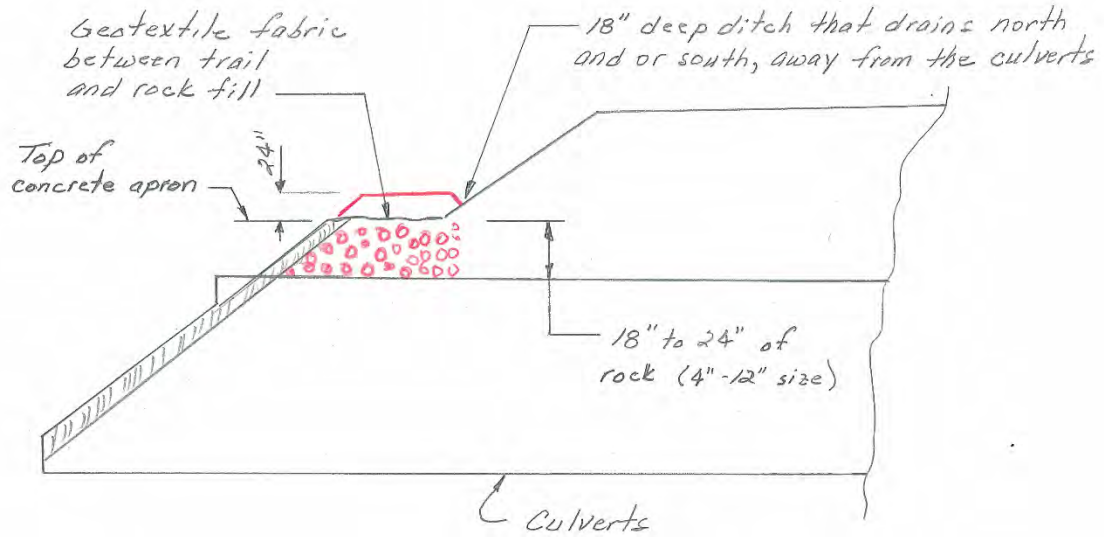


Figure 2



OPINION OF PROBABLE COST

Opinion of probable cost for the replacement of the existing structural plate arch culverts with new twin 105' long single span bridges on Raytown Road and a pedestrain bridge for the shared-use trail.

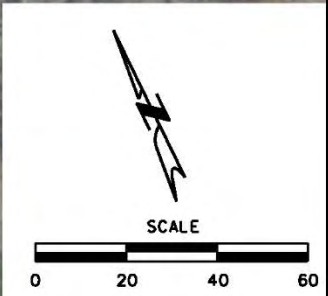
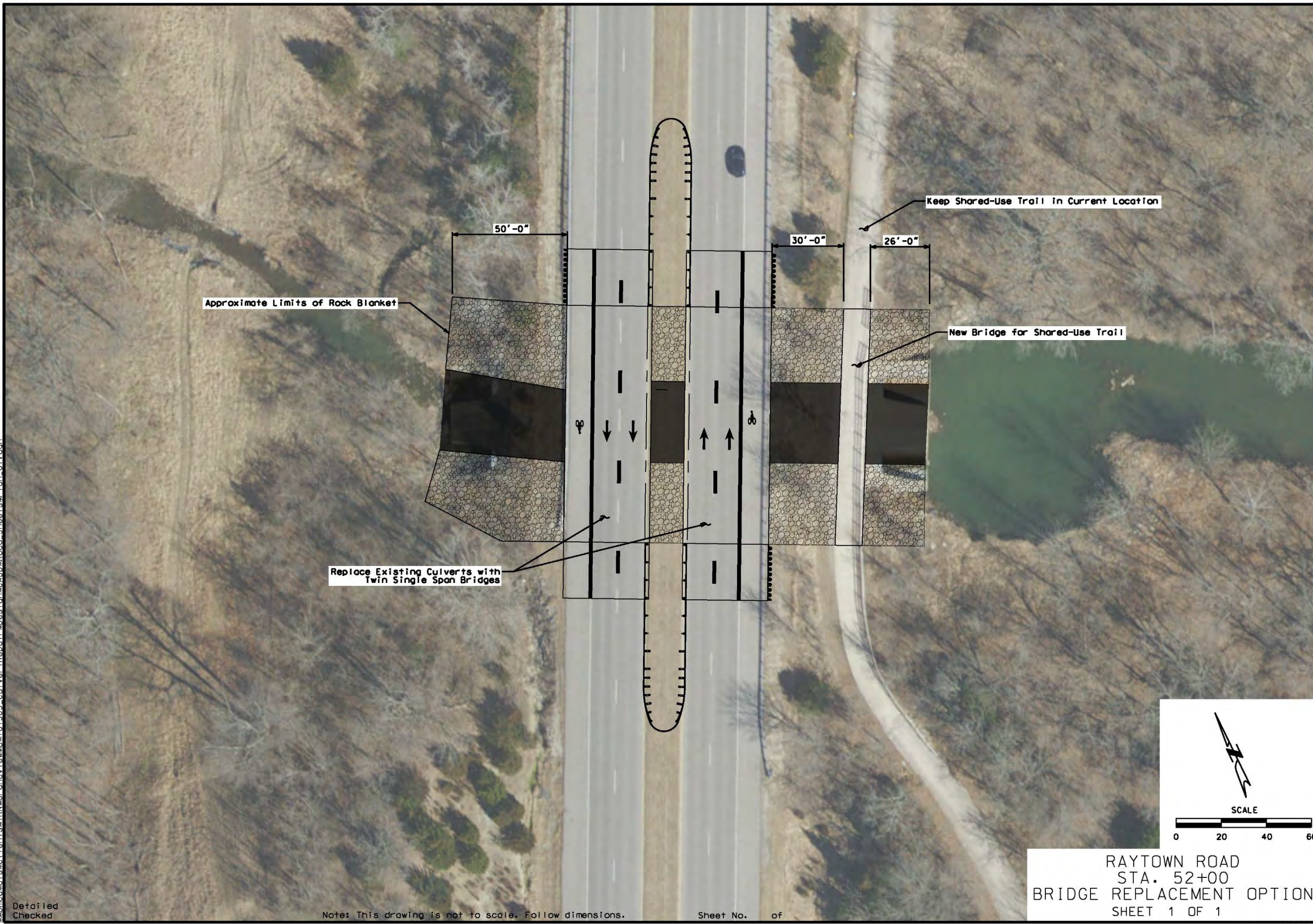
ITEM NO.	DESCRIPTION	UNIT	QTY.	UNIT PRICE	EXTENSION
<u>Base Bid</u>					
1	Demolition and Site Preparation	LS	1	\$75,000.00	\$75,000.00
2	Embankment (Compacted In Place)	CY	300	\$10.00	\$3,000.00
3	2" Asphaltic Concrete Surface (Type 3-01)	SY	422	\$10.00	\$4,220.00
4	9" Asphaltic Concrete Base (Type 1-01)	SY	422	\$30.00	\$12,660.00
5	Aggregate Base (MoDOT Type 5)	TONS	171	\$25.00	\$4,275.00
6	Rock Blanket (Culvert Outlets)(Type 2)(Thickness 24")	TONS	1600	\$40.00	\$64,000.00
7	Temporary Erosion Control	LS	1	\$7,000.00	\$7,000.00
8	Temporary Seeding and Mulching	LS	1	\$3,000.00	\$3,000.00
9	Permanent Seeding, Mulching and Fertilizer	LS	1	\$3,000.00	\$3,000.00
10	Guard Rail (Type A)	LF	421	\$30.00	\$12,630.00
11	Guard Rail Bridge Anchor Section	EA	4	\$1,500.00	\$6,000.00
12	Guard Rail Type A Crashworthy End Terminal	EA	2	\$1,900.00	\$3,800.00
13	Traffic Control	EA	1	\$5,000.00	\$5,000.00
<i>Subtotal Roadway</i>					\$203,585.00
14	Permanent Pavement Marking (White) (4")	LF	300	\$2.00	\$600.00
15	Permanent Pavement Marking (Dashed White) (4")	LF	75	\$2.00	\$150.00
16	Permanent Pavement Marking (Yellow) (4")	LF	300	\$2.00	\$600.00
<i>Subtotal Striping</i>					\$1,350.00
<u>NB Bridge</u>					
17	Single Span (105' by 38')	SF	3990	\$110.00	\$438,900.00
<u>SB Bridge</u>					
18	Single Span (105' by 38')	SF	3990	\$110.00	\$438,900.00
19	Pre-Fabricated Pedestrain Bridge (105' by 12')	SF	1260	\$160.00	\$201,600.00
<i>Subtotal Bridges</i>					1,079,400.00
<i>Sub-total</i>					1,284,335.00
<i>20% +/- Contingency</i>					257,000.00
<i>20% +/- Engineering/Const. Observation</i>					257,000.00
<i>Grand Total</i>					1,798,335.00
Budgetary Purposes use					\$1,800,000.00

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Detailed
Checked

Note: This drawing is not to scale. Follow dimensions.

Sheet No. of



RAYTOWN ROAD
 STA. 52+00
 BRIDGE REPLACEMENT OPTION
 SHEET 1 OF 1

FIGURE 3

RAYTOWN ROAD
 4,000' NORTH OF HIGH GROVE
 ROADWAY STA. 52+00

DATE	DESCRIPTION

CITY OF
GRANDVIEW
 1200 Main Street
 Grandview, MO 64030
 816-316-4800

**BURNS
 McDONNELL**
 Burns & McDonnell Engineering Co., Inc.
 9400 Ward Parkway
 Kansas City, Missouri 64114
 816-333-3400

REV. 1
 BMD Project No. 82855
 Certificate of Authority No. 000165