Appendix C

Miscellaneous Information

I-435/I-35/K-10 Interchange
### Preliminary Design Criteria Mainline and Ramps

**I-435/I-35/K-10**

**Johnson County Gateway**

#### Design Criteria

<table>
<thead>
<tr>
<th>Design Feature</th>
<th>Mainline</th>
<th>I-35</th>
<th>K-10</th>
<th>Regular Ramps</th>
<th>Departing/ Approaching Side Rd.</th>
<th>Loop Ramps</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Access Control</strong></td>
<td>Full</td>
<td>Full</td>
<td>Full</td>
<td>Full</td>
<td>Full</td>
<td>Full</td>
</tr>
<tr>
<td><strong>Design Speed (mph)</strong></td>
<td>75</td>
<td>70</td>
<td>75</td>
<td>70</td>
<td>50</td>
<td>45</td>
</tr>
<tr>
<td><strong>Design Vehicle</strong></td>
<td>WB-50 (Ck WB-67)</td>
<td>WB-50 (Ck WB-67)</td>
<td>WB-50 (Ck WB-67)</td>
<td>WB-50 (Ck WB-67)</td>
<td>WB-50 (Ck WB-67)</td>
<td>WB-50 (Ck WB-67)</td>
</tr>
<tr>
<td><strong>Typical Section</strong></td>
<td>Lane Width (ft)</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>16 (1 lane), 12 each (2 or more lanes)</td>
<td>16</td>
</tr>
<tr>
<td><strong>Shoulders (ft)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Inside (Rt.)</strong>*</td>
<td>12</td>
<td>12</td>
<td>10</td>
<td>10' without CSB, 12 with CSB</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td><strong>Median (Lt.)</strong>*</td>
<td>12</td>
<td>12</td>
<td>10</td>
<td>10' without CSB, 12 with CSB</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td><strong>Minimum Grade</strong></td>
<td>0.50%</td>
<td>0.30%</td>
<td>0.50%</td>
<td>0.30%</td>
<td>0.50%</td>
<td>0.50%</td>
</tr>
<tr>
<td><strong>Maximum</strong></td>
<td>3%</td>
<td>3%</td>
<td>3%</td>
<td>3%</td>
<td>5%</td>
<td>3%</td>
</tr>
<tr>
<td><strong>Min. Stopping Sight Dist. (ft)</strong></td>
<td>820</td>
<td>730</td>
<td>820</td>
<td>730</td>
<td>425</td>
<td>495</td>
</tr>
<tr>
<td><strong>Min. K Values</strong></td>
<td>6%</td>
<td>6%</td>
<td>6%</td>
<td>6%</td>
<td>8.0%</td>
<td>8.0%</td>
</tr>
<tr>
<td><strong>Horizontal Curvature</strong></td>
<td>3700</td>
<td>3200</td>
<td>3700</td>
<td>3200</td>
<td>800</td>
<td>590</td>
</tr>
<tr>
<td><strong>Des. Minimum Radius (ft)</strong></td>
<td>6% (7.2% max.)</td>
<td>6% (7.2% max.)</td>
<td>6% (7.2% max.)</td>
<td>8.0%</td>
<td>8.0%</td>
<td>8.0%</td>
</tr>
<tr>
<td><strong>Vertical Clearance</strong></td>
<td>16'-4&quot;</td>
<td>16'-4&quot;</td>
<td>16'-4&quot;</td>
<td>16'-4&quot;</td>
<td>16'-4&quot;</td>
<td>16'-4&quot;</td>
</tr>
<tr>
<td><strong>Curb Return Radii (ft)</strong></td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Clear Zone (ft)</strong></td>
<td>34</td>
<td>34</td>
<td>34</td>
<td>24 (20 min.)</td>
<td>24</td>
<td>24</td>
</tr>
</tbody>
</table>

### Notes:

- Design Criteria based on 2004 AASHTO Green Book
- * Rt. & Lt. Is referenced looking in the direction of traffic.
- ** Desired maximum superelevation is 6.0%
- *** Use $e_{max} = 8\%$ AASHTO table
- † Use Mainline Design Speed for exits with optional 2 lane exits.
I-435/I-35/K-10
Regional Study

EXHIBIT
C-2

Typical Sections

OVERLAND PARK
KANSAS

ABOVE AND BEYOND. BY DESIGN.

KDOT Project No. 435-46 KA-1002-01  Johnson County Gateway  Typical Sections  April 7, 2001
Single Lane CD Road / System Ramp
& Single Lane Service Ramp on Bridge

2 Lane CD Road / System Ramp

3+ Lane CD Road / System Ramp

Single Lane Service Ramp

2 Lane Service Ramp
## Preliminary List of Proposed Structures

<table>
<thead>
<tr>
<th>BR. NO.</th>
<th>PROJ</th>
<th>FEATURE CARRIED (upper roadway on TMR structure)</th>
<th>FEATURE CROSSED (lower roadway on TMR structure)</th>
<th>TOTAL SPANS (LONG SPAN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WO-1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MC-3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MC-4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R16</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R17</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RE-9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RE-10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RE-11</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RE-12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RE-13</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RE-14</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WI-18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WI-19</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WI-20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WI-21</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WI-22</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WI-22a</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WI-23</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WI-24</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Summary of Proposed Bridges

**Johnson County Gateway: I-435/I-35/K-10 Interchange**

#### Preliminary List of Proposed Structures

<table>
<thead>
<tr>
<th>BR. NO.</th>
<th>PROJ</th>
<th>FEATURE CARRIED (upper roadway on TMR structure)</th>
<th>FEATURE CROSSED (lower roadway on TMR structure)</th>
<th>TOTAL SPANS (LONG SPAN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LA-25</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LA-26</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LA-27</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LA-28</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-29</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-31</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-32</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-33</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-34</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-35</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-36</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-37</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-38</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-39</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-40</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-41</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-42</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-43</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-44</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-45</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-46</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Overland Park, Kansas

**WO-1**
- BR. NO.: WO-1
- PROJ: K-10
- FEATURE CARRIED: Woodland Road
- FEATURE CROSSED: BNSF Railway, Mill Creek, & Park Trail
- APPROX. LENGTH: 234 ft
- TOTAL SPANS: 3

**MC-3**
- BR. NO.: MC-3
- PROJ: K-10
- FEATURE CARRIED: Lackman Road
- FEATURE CROSSED: BNSF Railway, Mill Creek, & Park Trail
- APPROX. LENGTH: 234 ft
- TOTAL SPANS: 3

**MC-4**
- BR. NO.: MC-4
- PROJ: K-10
- FEATURE CARRIED: Lackman Road
- FEATURE CROSSED: BNSF Railway, Mill Creek, & Park Trail
- APPROX. LENGTH: 234 ft
- TOTAL SPANS: 3

**R15**
- BR. NO.: R15
- PROJ: K-10
- FEATURE CARRIED: Railroad Avenue
- FEATURE CROSSED: Woodland Road
- APPROX. LENGTH: 234 ft
- TOTAL SPANS: 3

**R16**
- BR. NO.: R16
- PROJ: K-10
- FEATURE CARRIED: Railroad Avenue
- FEATURE CROSSED: Woodland Road
- APPROX. LENGTH: 234 ft
- TOTAL SPANS: 3

**R17**
- BR. NO.: R17
- PROJ: K-10
- FEATURE CARRIED: Railroad Avenue
- FEATURE CROSSED: Woodland Road
- APPROX. LENGTH: 234 ft
- TOTAL SPANS: 3

**R18**
- BR. NO.: R18
- PROJ: K-10
- FEATURE CARRIED: Railroad Avenue
- FEATURE CROSSED: Woodland Road
- APPROX. LENGTH: 234 ft
- TOTAL SPANS: 3

**RE-9**
- BR. NO.: RE-9
- PROJ: K-10
- FEATURE CARRIED: Railroad Avenue
- FEATURE CROSSED: Woodland Road
- APPROX. LENGTH: 234 ft
- TOTAL SPANS: 3

**RE-10**
- BR. NO.: RE-10
- PROJ: K-10
- FEATURE CARRIED: Railroad Avenue
- FEATURE CROSSED: Woodland Road
- APPROX. LENGTH: 234 ft
- TOTAL SPANS: 3

**RE-11**
- BR. NO.: RE-11
- PROJ: K-10
- FEATURE CARRIED: Railroad Avenue
- FEATURE CROSSED: Woodland Road
- APPROX. LENGTH: 234 ft
- TOTAL SPANS: 3

**RE-12**
- BR. NO.: RE-12
- PROJ: K-10
- FEATURE CARRIED: Railroad Avenue
- FEATURE CROSSED: Woodland Road
- APPROX. LENGTH: 234 ft
- TOTAL SPANS: 3

**RE-13**
- BR. NO.: RE-13
- PROJ: K-10
- FEATURE CARRIED: Railroad Avenue
- FEATURE CROSSED: Woodland Road
- APPROX. LENGTH: 234 ft
- TOTAL SPANS: 3

**RE-14**
- BR. NO.: RE-14
- PROJ: K-10
- FEATURE CARRIED: Railroad Avenue
- FEATURE CROSSED: Woodland Road
- APPROX. LENGTH: 234 ft
- TOTAL SPANS: 3

**WI-18**
- BR. NO.: WI-18
- PROJ: K-10
- FEATURE CARRIED: Railroad Avenue
- FEATURE CROSSED: Woodland Road
- APPROX. LENGTH: 234 ft
- TOTAL SPANS: 3

**WI-19**
- BR. NO.: WI-19
- PROJ: K-10
- FEATURE CARRIED: Railroad Avenue
- FEATURE CROSSED: Woodland Road
- APPROX. LENGTH: 234 ft
- TOTAL SPANS: 3

**WI-20**
- BR. NO.: WI-20
- PROJ: K-10
- FEATURE CARRIED: Railroad Avenue
- FEATURE CROSSED: Woodland Road
- APPROX. LENGTH: 234 ft
- TOTAL SPANS: 3

**WI-21**
- BR. NO.: WI-21
- PROJ: K-10
- FEATURE CARRIED: Railroad Avenue
- FEATURE CROSSED: Woodland Road
- APPROX. LENGTH: 234 ft
- TOTAL SPANS: 3

**WI-22**
- BR. NO.: WI-22
- PROJ: K-10
- FEATURE CARRIED: Railroad Avenue
- FEATURE CROSSED: Woodland Road
- APPROX. LENGTH: 234 ft
- TOTAL SPANS: 3

**WI-22a**
- BR. NO.: WI-22a
- PROJ: K-10
- FEATURE CARRIED: Railroad Avenue
- FEATURE CROSSED: Woodland Road
- APPROX. LENGTH: 234 ft
- TOTAL SPANS: 3

**WI-23**
- BR. NO.: WI-23
- PROJ: K-10
- FEATURE CARRIED: Railroad Avenue
- FEATURE CROSSED: Woodland Road
- APPROX. LENGTH: 234 ft
- TOTAL SPANS: 3

**WI-24**
- BR. NO.: WI-24
- PROJ: K-10
- FEATURE CARRIED: Railroad Avenue
- FEATURE CROSSED: Woodland Road
- APPROX. LENGTH: 234 ft
- TOTAL SPANS: 3

**WI-25**
- BR. NO.: WI-25
- PROJ: K-10
- FEATURE CARRIED: Railroad Avenue
- FEATURE CROSSED: Woodland Road
- APPROX. LENGTH: 234 ft
- TOTAL SPANS: 3

**WI-26**
- BR. NO.: WI-26
- PROJ: K-10
- FEATURE CARRIED: Railroad Avenue
- FEATURE CROSSED: Woodland Road
- APPROX. LENGTH: 234 ft
- TOTAL SPANS: 3

<table>
<thead>
<tr>
<th>BR. NO.</th>
<th>PROJ</th>
<th>FEATURE CARRIED (upper roadway on TMR structure)</th>
<th>FEATURE CROSSED (lower roadway on TMR structure)</th>
<th>TOTAL SPANS (LONG SPAN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LA-25</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LA-26</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LA-27</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LA-28</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-29</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-31</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-32</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-33</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-34</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-35</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-36</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-37</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-38</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-39</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-40</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-41</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-42</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-43</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-44</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-45</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SF-46</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**45845 – Gateway Concept Drainage Study**

**Introduction**

As part of the Johnson County Gateway Project, a preliminary study of the primary drainage components of the project was completed. The preliminary analysis included an evaluation of the major stream crossings, detention basins, floodplain fills, and stream impacts. These primary design components are located in eight (8) general areas as illustrated in the exhibit below. Each area is described in the following write-ups. The write-ups include a summary of the existing conditions, engineering analysis, and proposed alternatives.

**Area 1: K-10 Crossing (East of Ridgeview)**

For conceptual design, the existing 12 ft. x 12ft RCB was extended to a total length of 965 ft. This proposed length was developed using an estimated elevation for the proposed CD roads, and approximately the same side slopes as the existing mainline. In the HEC-RAS model, “45845-concept”, 4 cross sections were removed to create the proposed model (0.809, 0.815, 0.922, and 0.928). The culvert centerline stations in the model were adjusted to the center of the upstream and downstream cross sections (0.953 and 0.748 respectively). This implies that the proposed culvert will require horizontal bends. The contraction/expansion coefficients were changed from 0.1/0.3 to 0.3/0.5 as necessary. Ineffective flow areas were also updated in the new cross sections. For the proposed model, a flow change location was moved upstream because of cross sections that were deleted. The deck of the roadway was set at 952.5 ft. This is a rough estimate because we do not yet have a preliminary surface or profile grade to determine an overtopping elevation. The existing structure carries the 500 year storm, so it is assumed the proposed structure is large enough to carry the design event.

This culvert has implications in relation to the detention basins near JC Penny (north and south of I-435/K-10). A conceptual solution for how these areas can be designed to work together is mentioned in the Area 8 write-up. When looked at independently, there are a couple issues to account for. A key issue for this crossing is the hydrologic storage accounted for in the FEMA FIS. By simply extending the culvert (raising the FL), meeting a no-rise condition for 100-yr backwater is not possible. Therefore, two options are identified and should be further studied with future phases of the project:

1. **Extending the culvert and improving the inlet condition.**
   - By improving the inlet condition of this culvert when extending the culvert, the headwater elevation will meet no-rise criteria. However, extending the culvert upstream will also decrease the amount of storage and will increase flows downstream of the culvert.

2. **Extending the culvert without improving the inlet condition and proposing a FEMA map revision.**
   - By extending the culvert without improving the inlet condition, it is possible to maintain the same flows downstream of the culvert as what is currently modeled in the FEMA model.
However, extending the culvert upstream without improving the inlet condition of the culvert will cause the headwater to rise in order to maintain the same amount of storage.

A field visit was conducted to this area on April 6, 2010. The channel is very low in comparison with K-10 and the surrounding buildings. There is ample available storage, and therefore it appears feasible to allow an increase in water surface elevations without significantly impacting adjacent properties, and no adverse impact to insurable structures (buildings). There are mines in the areas, so potential increases to water surface elevations will need checked versus mine openings in the area.

The FEMA map for this area (20091C0049G) shows that this area is Zone Af flood plain with a floodway mapped. This implies we would need to submit a CLOMR (1 year lead on construction).

Area 2: Renner Rd and CD Roads

There is a short stretch of stream between Renner and this culvert that will be impacted. Until a preliminary vertical alignment for the adjacent CD Road is set, it is difficult to estimate how much of this stream will be impacted. An early concept for the entrance road to the commercial area, located on the east side of Renner Rd and just north of K-10, was shifting the entrance location to the north. This has potential implications if it were to impact the detention area located to the north of the entrance road. However, for the revised concept the entrance road will not be shifted; instead only requiring minimal reconstruction. Therefore, it is assumed that there will be no encroachment/impacts on the detention basin in this area.

The culvert immediately upstream of the entrance just to the southeast is going to be extended on the upstream and downstream ends, primarily because of the proposed CD roads.

A site visit was conducted on April 6th, 2010 and it appears that it is very likely that a significant portion of the stream in this area will remain undisturbed with this project.

Area 3: I-435 Crossing (North of Interchange)

According to as-built plans, the crossing was originally an 8’x6’x480’ RCB open on both ends. However, upstream development has connected to, and enclosed, the upstream end of the RCB. From the as-buils, the drainage area flowing to this location was 210 Ac, and the Q50 was 445 cfs. According to our rough estimation, this value is low. It is practical to assume that there is about 4-5 cfs/acre of stormwater runoff for a 50 year storm for this developed area. This results in approximately 900 cfs flowing to this location. The headwater for the existing structure is 7.32’ from the FL of the culvert based on the 445 cfs described earlier.

This crossing is also in the HEC-RAS model for the Mill Creek watershed study. The crossing is located in River “MT-Trib20” Reach “RCR60” and at RS: 0.699. In the MT_Ultimate plan, the Q50 = 1077.0 cfs (which is much closer to our assumption than what was reported in the as-built plans), and the headwater is approximately 24 feet above the flow line of the culvert. The Q100 = 1225.1 cfs and the headwater elevation is at or around 990 feet. Looking at the AIMS contours, this is very close to the elevation of several buildings just to the north of where the culvert begins. Ultimately, this means a no-rise condition may have to be met if 1) structures are flooding in existing conditions or 2) required by city.

Downstream of this culvert, there is a wetland area that was constructed when the buildings and detention ponds were built for the downstream commercial development. More likely, wetland mitigation will be necessary.

In the proposed condition, the upstream end of this culvert, which is currently enclosed, will need to be modified. The configuration for two CD roads off of I-435 and 95th directly impacts the area inlets at the upstream end of the culvert. A new design for placement of area inlets will be needed to capture the stormwater runoff for a 50 year storm for this developed area. This results in approximately 900 cfs.
run-off to this area. Preliminarily it appears there will be room between the CD roads to fit an inlet, but this will need to be evaluated in more detail.

A site visit was conducted on April 6th, 2010, and the upstream end is enclosed and has a pretty large area inlet for picking up local surface runoff. Also, it looks as though there is some room for backup to accumulate.

**Area 4: CD Road Filling Stream between Lackman & Santa Fe Trail Rd.**

There is a stream running parallel to K-10/I-435 on the south side, which will be impacted by the proposed CD Roads. An initial concept solution was to relocate the stream south of the proposed construction, but after further investigation the proposed geometry of the CD road (it is going from level 2 to level 3 so it will be pretty high in the air), the grading between the road and the existing building and parking lot will not leave room for a channel. It is assumed that fill placement will be needed to the edge of the parking lot to the south of I-435. Therefore, the stream will have to be enclosed. Future services should include review of this area by an environmental scientist to determine the permitting requirements.

The drainage area to the downstream end of this section of stream is approximately 91 acres. For a 50-100 year event, assuming approximately 5-6cfs/acre, the design discharge to this location is approximately 450 cfs. If we assume a velocity of approximately 10 ft/sec, then the necessary cross-sectional area of the enclosed system will need to be about 45 ft². Therefore, a 9’x5’x900’ RCB is a reasonable preliminary estimate for this box.

A site visit was conducted on April 6th, 2010 to this location. The stream is approximately 3-6 ft deep and exhibits an ordinary high-water mark. With these characteristics the stream is likely jurisdictional, so mitigation requirements are anticipated if a stream enclosure is necessary.

**Areas 5: I-35 North of Interchange (Southern crossing)**

This culvert is a 5’x7’ RCB. A preliminary Culvert Master model was created to get a rough estimate of the headwater at the culvert in order to check for potential flooding of nearby buildings. The drainage area to this structure is about 52.0 acres and the rational C value is 0.78 (heavy industrial area). The flows used for the analysis were the 50 and 100 year storm event flows based on an assumed 10 minute time of concentration. This provided values of Q50 = 319 cfs and Q100 = 350 cfs.

Based on the preliminary Culvert Master calculation, the assumed Headwater Elevation is 1,021 ft. The lowest adjacent grade for the nearest building is at about 1,030 ft. Additionally, I-35 does not appear to overtop for either the 50 or 100 year storm event at this location.
In the proposed condition, this culvert will need to be extended upstream and possibly downstream because of the location of the proposed alignments of the CD Roads between I-435 and I-35. The upstream elevation appears low enough that an extension would not impact any structures at the upstream end. The upstream end may require a tapered inlet in order to meet a no-rise condition. The downstream end of this culvert may not need to be extended, but that cannot be determined without further analysis of the proposed alignment of the CD road which has not yet been set.

A site visit was conducted on April 6th, 2010, and for the south culvert, it looks as if the barrier on I-35 will be overtopped and water could travel north to the next RCB crossing for relief before the nearest building is flooded.

Area 6: I-35 North of Interchange (Middle crossing)

This culvert, according to as-built plans, is an 8’x6’ RCB (FL up = 977.52, FL down = 967.62). This culvert was originally designed to be open on both ends, but is now enclosed on the upstream end. There is an area inlet in a lawn area in front of a building with several manhole structures around it.

The area inlet has about a 4’x3’ grate with a 2’x2’ opening below the grade. A preliminary orifice equation calculation was performed to determine the approximate head above the inlet opening to check against surrounding buildings. The approximate drainage area to the structure was about 9.4 acres with a C value of 0.78 (heavy industrial area). The 100 year flow with a time of concentration of 10 min was approximately 63 cfs. In the orifice equation (Q = C*A*sqrt(2*g*h)), C is the orifice coefficient. A value of 0.9 was used for this coefficient assuming it is more efficient than a square edged opening (C=0.6). Solving for “h”, the approximate head around the inlet is 4.76’. The top of the inlet is at about 986 ft, so the WSE is at approximately 990.75 ft. The nearest building appears to be at about 992 ft according to the AIMS 2 foot contours, so we appear to be clear of the building by a little over a foot. A check not performed with this conceptual analysis is the inlet control headwater of the outflow pipe/RCB from this inlet. Also, getting a more accurate size and coefficient for analysis of the grate and opening could significantly impact these calculations. A more detailed analysis will be required at later phases of this project if any modifications to this system are proposed.

In the proposed condition, the downstream end of the culvert will need to be extended due to the widening of the roadway. The upstream end, which is currently enclosed, may need re-grading or protection because of the existing erosion. Some type of minor improvements to this area may need to be considered with the project.

Area 7: I-35 North of Interchange (Northern crossing)

The upstream end of this crossing is complex. The RCB crossing is located below grade with retaining walls on all four sides. There are two (2) 11’ diameter CMP’s dumping into this area and the crossing structure itself is a 12’x10’ RCB. In the HEC-RAS model, the 2-11’ diameter CMP’s are modeled as structures, and the 12’x10’ RCB is modeled using a user-defined rating curve.
Area 8: Detention Basins near JC Penny (North and South of I-435/K-10)

At the location of the proposed interchange of I-435 and K-10 there are two basins, one to the north and one to the south (See Figure 8.1 at the end of this section). The basin to the south is located between the JC Penny distribution center and I-435 and is approximately 40 feet deep. The basin to the north is located between I-435 and businesses to the north and is about 20 feet deep. These basins were modeled as part of the Mill Creek Watershed Study, specifically they are part of Mill Creek Tributary 1 models. Consistent with the study HEC-1 and HEC-RAS software was used for this analysis.

Existing Conditions

The analysis began with updating the watershed study existing conditions models to bring them up to date with today’s conditions in the field. The south basin (referred to as MT139S in the watershed study) used a rating curve that could not be verified. It appears that the watershed study may have used a 6x6 RCB as the outlet from this basin, when in reality there is a 4x4 RCB that becomes a 5x5 then a 6x6 as well as an overtopping path that leads parallel to the highway until it runs along Renner Rd under K-10. Therefore the stage-discharge curve was updated. The stage-storage information was also updated using the most current contours from AIMS. These corrections increased the water surface in the south basin by 2.5 feet. This basin currently has a flowage easement that was purchased by KDOT as part of the interchange project. This easement does not completely contain the flood pool as determined by the project existing conditions model (or by the watershed study).

The north basin (MT129S) has been physically modified since the completion of the watershed study. Therefore, the stage-storage curve was updated. The stage-discharge curve was also updated to include the increase in tail-water for the 5x5 RCB under I-435 draining to the south basin and the overtopping of a high spot located in the ditch to the west. The flow that leaves over the high point is then routed via ditches and small culverts around and through the existing interchange (likely using the infill areas to detain some of the flow) before making way back into the downstream end (the 6x6 RCB portion) of the outlet RCB from the south basin. For the purpose of this analysis (following the methodology of the watershed study), the flow from the north basin is assumed to entirely drain into the south basin and thus is detained accordingly. This is the conservative assumption for the purpose of determining allowable discharges downstream. The bypass flow is approximately 880cfs. If this flow is not contained, the amount of allowed discharge downstream of the south basin would be significantly increased in the proposed condition.

Downstream of these two basins the flow combines with the discharge from Area 1 before making its way down Trib 10 to the confluence of Tributary 1. This reach of Tributary 10 is located in an undeveloped area that has several mines near it. Several of the mine openings are underwater by many feet based on the 100-year storm as shown in the watershed study.
In conclusion for Area B, this study recommends the following actions to address the reduction in storage volume caused by the proposed interchange:
- Maximize the storage volume in the proposed south basin
- Replace the existing culvert from the south basin with a 9x9 RCB (or provide parallel conveyance system)
- Replace the existing culvert from the north basin to the south with an 8x8 RCB
- Decrease the conveyance of the K-10 basin to offset the increased discharges from the south basin

Additional tasks that should be completed as design progresses include the following:
- Model storm events besides the 100-year (10, 50, and 500-year)
- Confirm RCB sizes and alignments.
- Determine conflicts with Mines and Utilities
- Verify that ponds are not interconnected (PondPack or similar may be required if they are interconnected)

In conclusion for Area B, this study recommends the following actions to address the reduction in storage volume caused by the proposed interchange:
- Maximize the storage volume in the proposed south basin
- Replace the existing culvert from the south basin with a 9x9 RCB (or provide parallel conveyance system)
- Replace the existing culvert from the north basin to the south with an 8x8 RCB
- Decrease the conveyance of the K-10 basin to offset the increased discharges from the south basin

Additional tasks that should be completed as design progresses include the following:
- Model storm events besides the 100-year (10, 50, and 500-year)
- Confirm RCB sizes and alignments.
- Determine conflicts with Mines and Utilities
- Verify that ponds are not interconnected (PondPack or similar may be required if they are interconnected)
Detention Areas

Figure 8.1: Detention Basins

- CLOMR upstream of this point
- Upsize Box Culvert
- Downsize Box Culvert
- North Detention Basin
- South Detention Basin
- K-10 Detention Basin
Kansas Department of Transportation

MEMO TO: Jim Brewer, Engineering Manager
State Road Office

FROM: Scott P. Vogel, Chief Environmental Services Section

DATE: November 12, 2009

SUBJECT: 435-46 KA-1002-01 Preliminary Environmental Assessment
Johnson County

The KDOT Environmental Services Section (ESS) initiated a preliminary environmental assessment of the referenced project based on a Study Area map received June 17, 2008 (Study Corridor).

The following tasks have been evaluated using existing information and predictive modeling. Field investigations are not included at this stage of the study.

NOISE: The project concept may meet the criteria of a Type I project (addition of through traffic lanes or significant change in horizontal or vertical alignment) which would require traffic noise analysis if built. Design details are not available and the project is not funded for construction. At this time KDOT does not recommend any noise abatement features with this project. However, the eastern segment of the study area includes neighborhoods for which noise walls have been designed. Barrier designs have been completed both north and south of I-435, between I-35 and Quivira Road, under projects K-7451-02 and K-8251-01.

Appendix A discusses KDOT’s traffic noise policy and includes a preliminary evaluation of traffic noise. The distance of the 66 dBA noise level from the centerline of the nearest proposed traffic lane is reported. Any residential receptors falling within this distance may be impacted by traffic noise.

ARCHEOLOGY: The project corridor was submitted to the Highway Archeologist at the Kansas State Historical Society for review on June 18, 2009. The SHPO archeologist concluded that areas having the best potential for archeological sites have either been previously surveyed without locating any sites or have been destroyed by development. The SHPO has no objection to implementation of the project as defined by the project corridor.

HISTORIC: The project corridor was submitted to the SHPO for review on June 18, 2009. The SHPO noted that approximately 30 National Register-listed properties are in Johnson County, but none appear to be within the boundaries of the project corridor. This study is limited to known resources. The SHPO recommends an Activity I Survey be conducted to determine if any potentially eligible cultural resources are located within the project corridor.

Note: This document is intended to be an early analysis of typical environmental concerns. It is not intended to indicate an intention or need to perform an Environmental Assessment as understood in the context of NEPA documentation. See section 7.4.6 Environmental Issues.
Environment (KDHE) Surface Water Register classifies segment 39 of Mill Creek as an expected aquatic life use water (E). The unnamed tributaries to Mill Creek and Indian Creek are not classified in the Surface Water Register. Fill or excavation below the ordinary high water mark of COE jurisdictional streams or ponds requires Section 404 permits and mitigation. Corps of Engineers Nationwide Permit Regional Conditions for Kansas requires box culverts with three or more cells on E streams to have the opening of the center culvert lower than the adjacent cells to concentrate low flows for the passage of aquatic organisms. The Kansas Department of Agriculture, Division of Water Resources (DWR), regulates stream obstructions and channel changes. If bridges, culverts, or stream channels are constructed or modified DWR stream obstructions and channel changes permits may be needed.

FLOODPLAIN: The attached map (FEMA Q3 Flood Data) shows the location of 100-yr floodplains and floodways within the study corridor. In Johnson County, the DWR requires floodplain fills permits for fills averaging over 1 ft. in height placed within the 100-yr floodplain of streams having drainage area in excess of 240 acres. The DWR considers it unreasonable effect to increase the elevation of the design and base flood profiles within a floodway, or increase the elevation of the design and base flood profiles more than 1 ft. at any location outside a floodway. Johnson County Planning, Development, and Codes Department require Floodplain Development permits for structures, fills, or stream channel modifications within the 100-yr floodplain of streams.

HAZARDOUS WASTE: A search of the KDHE Landfills database indicated there are no active or closed landfills within the study corridor. Also, there are no Super Fund (CERCLIS) or National Priorities List (NPL) sites identified within the study corridor.

The KDHE Identified Sites database lists the following:

SW 1/4 NW 1/4 SE 1/4 Sec. 34-T12S-R24E, Lenexa Laundry, 13114 Santa Fe Trail. On active backlog for corrective action.

W 1/4 Sec. 10-T13-R24E, Olathe Naval Air Station Auxiliary Field #1. Listed as active with a “no further action” recommendation dated 07/12/2004.

Vehicle noise is a combination of noise produced by the engine, exhaust, and tires. Heavier traffic volumes, higher speeds, and greater numbers of trucks all increase the loudness of traffic noise. Traffic noise impacts occur when the predicted noise levels approach or exceed the noise abatement criteria (NAC) or when predicted noise levels substantially (greater than a 10 dB increase) exceed the existing noise level.

Sound pressure levels are used to measure the intensity of sound and are described in terms of decibels (dB). However, the human ear does not respond to all frequencies that compose sound. A-weighted sound levels (dBA) are used to measure sound pressure levels with a frequency-weighting network which best approximates sound as heard by the normal human ear and filters out frequencies the human ear cannot detect.

In addition to noise varying in frequency, noise intensity fluctuates with time. The equivalent sound level (Leq) is the equivalent steady-state sound level for a period of time and is measured in decibels on an A-weighted scale. If the time period is one hour, the descriptor is the hourly equivalent sound level dBA-Leq.

The FHWA has determined a Noise Abatement Criteria (NAC) for different land uses as shown in the Table below. For the purpose of traffic noise analysis, land usage of a property located adjacent to the transportation improvements is classified according to human activities that occur or are expected to occur within the property boundaries. KDOT’s “Policy Statement on Highway Noise Abatement” defines the “approached” value as 1 dBA less than the NAC.

<table>
<thead>
<tr>
<th>Land Use Criteria</th>
<th>Noise Abatement Criteria (Leq)</th>
<th>Description of Land Use Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>57 dBA (Exterior)</td>
<td>Land on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.</td>
</tr>
<tr>
<td>B</td>
<td>67 dBA (Exterior)</td>
<td>Parks, recreation areas, playgrounds, active sports areas, parks, recreation areas, hotels, schools, churches, libraries, and hospitals.</td>
</tr>
<tr>
<td>C</td>
<td>72 dBA (Exterior)</td>
<td>Developed lands, properties, or activities not included in Categories A or B.</td>
</tr>
<tr>
<td>D</td>
<td></td>
<td>Undeveloped lands.</td>
</tr>
<tr>
<td>E</td>
<td>52 dBA (Interior)</td>
<td>Residences, motels, hotels, public meeting rooms, sounds, churches, libraries, hospitals, and amusement parks.</td>
</tr>
</tbody>
</table>
The land usage along the Preferred Concept is classified as Category B, C and D. The noise sensitive receptors are scattered along the alignment.

Noise Results

The FHWA highway traffic noise prediction model known as TNM LookUp was used to predict estimated peak hour traffic noise levels in the year 2040 for the Study Corridor. TNM LookUp is a noise screening tool that assumes a flat and straight roadway. The preliminary noise analysis was subdivided into segments and utilized planning level estimates from traffic acquired from the Bureau of Transportation Planning.

Land Use Category B includes residential receivers. The approach value of the NAC is 66 dBA. The model predicted the approximate location of the 66 dBA noise level, for each of the segments, from the centerline of the nearest driving lane to potential receptors. The model predicted that in 2040, the 66 dBA noise level will be approximately 300 feet from the nearest centerline along both sides of K-10 and I-35. The 66 dBA noise level will be approximately 250 feet along both sides of I-435 in 2040. Any Category B receivers within this distance would be considered impacted by traffic noise and future analysis would be required when design details are available.

The segment predicted to show the largest increase in traffic noise over the existing levels is K-10 west of Ridgeview Road. This area would experience an estimated 5 dB increase over existing levels due to the approximate tripling in traffic volume. At the present time the area is undeveloped.

With one exception, the remainder of the project area experiences less than a doubling of traffic. Therefore, the traffic noise level increases would be less than 3 dB and not discernable over existing levels. The one area experiencing an approximate doubling in traffic is I-435 between K-10 and Lackman Road. The increase in the noise level (roughly 3 dB) would be barely discernable. At the present time this area is undeveloped.

Previously measured existing noise levels from the K-7451-02 noise study, for first row receivers, were taken in August of 2001. This study overlaps the current study area east of I-35 and adjacent to I-435. Noise levels for first row receivers were measured at 70 – 72 dBA with one location recorded at 77 dBA.

Modeled existing noise levels adjacent to I-35 north of the study area were computed in July of 2003. This model was based on existing traffic data provided for the K-7451-02 study. The first row receivers showed a modeled noise level from 71 to 74 dBA.
DATE: May 26, 2011

TO: Mr. James Brewer, P.E. Engineering Manager
State Road Office, Bureau of Design

FROM: Mr. Robert Henthorne, P.G., Chief Geologist
Topeka Regional Geology Office

RE: Mine Remediation Estimates
Johnson County Gateway to Kansas City Project
435-46-KA-1002-01
Johnson County

The proposed alignments along K-10 and Renner Road for the above referenced project cross an expanse of underground limestone mines. The limestone that was mined is the Argentine Member and the mine extraction rate was approximately 80 percent. The mine openings are 18 to 20 feet in height and the depth to the mines ranges from 40 to 110 feet below the ground surface. A portion of these mines are utilized as underground storage and are slated for future underground storage space. The existing mine passage beneath K-10 has been requested by the mine storage company to remain open. (Areas A and B) A larger portion of the mines are abandoned and are in various stages of collapse. These are labeled Areas C and D on the following diagram. The collapse mechanism for this section of the mines is “Pillar Punch Through”. The overburden force is greater than the resisting forces of the limestone mine floor and the pillars punch through the floor into the softer shale beneath. Collapsed features have propagated to the ground surface in several locations.

Remediation

To provide the traveling public with a satisfactory level of safety, we have investigated several remediation techniques. For this application, due to the height and width of the mines and leaving the mine tunnel beneath K-10 open, the Barrier Wall and In-fill methods are the best choice. We also reviewed 2 separate wall systems to allow the tunnel to remain open. The bunker block wall is considerably cheaper and easier to construct in a mine situation rather than a soldier pile wall system. This same type of remediation has recently been used by the Missouri Department of Transportation beneath I-435. The cost of grouting the mines for this project is a worst case scenario and is estimated at 14 million dollars.

Figure #1, Mine grouting areas and mine tunnel beneath K-10
If any additional information or an in-depth discussion of the grouting techniques is needed, please contact the Topeka Regional Geology Office.

**REK:AJG:RWH**

cc: Clay Adams, District I Engineer  
Jim Kowach, Bureau of Design  
Scott King, Road Squad Leader  
Regional Geology Offices  
Project File