

# **TECHNICAL ASSISTANCE REPORT**

## Highway Rail Crossing Prioritization

KTC-15-3/SPR57-4-15-1F

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Kentucky Transportation Cabinet

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**Technical Assistance Report  
KTC-15-03/SPR57-4-15-1F**

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## PROJECT SUMMARY

Research team members at the University of Kentucky in the Department of Civil Engineering and the Kentucky Transportation Center (KTC) worked with the Kentucky Transportation Cabinet (KYTC) to develop a high-level mechanism for ranking highway-rail crossings for reconstruction and/or rehabilitation. The Highway Rail Crossing Prioritization implementation study yielded the Rail Crossing Improvement Priority (RCIP), which combined qualitative measures of crossing conditions with quantitative measures including proposed project costs and a valuation of the crossing based on rail and truck traffic. This effort provides a template by which further development can yield prioritization procedures for road-rail grade separation projects.

The RCIP resulted in a toolkit for KYTC that consists of several components. Full documentation of the efforts including an evaluation questionnaire, instructions, background, and scoring workbook is available on the KTC website at: <http://www.ktc.uky.edu/research/public-transit-rail-water/rail/>. A brief summary of each of these documents including example figures is included.

The evaluation questionnaire asks proposers for basic information on the highway-rail crossing and the proposed project. The information is drawn from the individual proposer as well as the Web Based Accident Prevention System (WBAPS) and an attached qualitative assessment form. A snapshot of the two page questionnaire is shown in Figure 1. Questions are divided into categories including proposer information, crossing location basic information, highway information, rail information, crossing assessment (based on an additional evaluation form), and construction information.

**Figure 1: Highway Rail Crossing Evaluation Questionnaire**

| Highway Rail Crossing Evaluation Questionnaire   |     |   |  |
|--|-----|---|--|
| See the Instructions for more information.   |     |   |  |
| <b>Proposer Information</b>  |     |   |  |
| Proposing Agency:  |     | Date of Application:                      |  |
| Agency Contact Name:   |     | Email and Cell Phone:                     |  |
| Proposer Address:  |     | Proposer Nearest Location:                |  |
| Primary Application Reason (condition, safety, etc.):  |     |   |  |
| <b>Crossing Location Basic Information</b>   |     |   |  |
| FRA Crossing #:  |     | Pedestrian accommodation: (Yes/No)        |  |
| Route Number:  |     | Road Mile Point:                          |  |
| City and County:   |     | Latitude and Longitude:                   |  |
| Highway Classification:  |     | Number of Highway Lanes:                  |  |
| Rail Owner:  |     | Rail Division and Milepost:               |  |
| At grade or underpass: (if underpass, only fill out rail information section and construction information) |     | Rail Classification: (FRA class of track) |  |
| Number of tracks:  |     | Mainline, siding, or spur:                |  |
| <b>Highway Information</b>   |     |   |  |
| AADT:  |     | Commercial Vehicle %:                     |  |
| Accidents over Last 5 Years: (within 0.5 miles)  |     | Predicted Collision Probability (WBAPS):  |  |
| Highway speed limit:   |     |   |  |
| Specific Safety Concerns:  |     |   |  |
| Nearby Facilities Dependent Upon Crossing:   |     |   |  |
| Alternative Route Description (if necessary):  |     |   |  |
| <b>Rail Information</b>  |     |   |  |
| Average Monthly Tonnage:   |     | Number of trains per month:               |  |
| Crossing Issues from Rail:   |     |   |  |
| Specific Safety Concerns:  |     |   |  |
| Primary Commodities/Users: (top 3)   |     |   |  |
| <b>Crossing Assessment</b> (see Qualitative Evaluation Form)   |     |   |  |
| Perceived Crossing Roughness/Rideability:  | 1-4 |   |  |
| Perceived Condition of Pavement Approaches:  | 1-4 |   |  |
| Perceived Crossing Surface Condition:  | 1-4 |   |  |
| Any Other Issues:  |     |   |  |
| Type of Crossing: (timber, gravel, asphalt, concrete, composite)   |     |   |  |
| <b>Construction Information</b>  |     |   |  |
| Estimated repair cost:   |     | Estimated time for repair:                |  |
| Estimated annual maintenance cost:   |     | Any Other Issues:                         |  |
| Description of Problem:  |     |   |  |
| Description of Proposed Repair:  |     |   |  |

Part of the questionnaire is focused on the condition of the crossing in question. There are several categories that form a qualitative evaluation of the crossing. These are based on a report completed for KYTC by Rose, Malloy, and Purcell (2014). Evaluation is done on the roughness/rideability of the crossing, the surface material, and the pavement approaches, each on a scale of 1 to 4 from excellent to poor. Photos illustrating crossings in conditions corresponding to the ranking scale are included to guide the evaluation process. The information in

the questionnaire is then entered into the scoring workbook. A complete set of instructions is included to guide proposers in filling out the questionnaire and the associated crossing assessment and how to use the scoring workbook by populating data from the questionnaire. Figure 2 displays the instructions related to the questionnaire.

## Figure 2: Instructions for Highway Rail Crossing Evaluation Questionnaire

### Instructions for Highway Rail Crossing Evaluation Questionnaire

Fill out each section of the questionnaire. Crossing profiles that include some basic information that can assist in filling out the form are available via the Federal Rail Administration's (FRA) Web Based Accident Prediction System (WBAPS). They include pertinent information such as AADT, the number of trains, total number of tracks, predicted collision probability, etc. A snapshot of crossings from Anderson County pulled from WBAPS is shown below.

| RANK | PRED COLL. | CROSSING | RR | STATE | COUNTY   | CITY          | ROAD            | NUM OF COLLISIONS |    |    |    |    | DATE  | W  | TOT TRN | TOT TRK | TTBL SPD | HWY PVD | HWY LNS | AADT  |
|------|------------|----------|----|-------|----------|---------------|-----------------|-------------------|----|----|----|----|-------|----|---------|---------|----------|---------|---------|-------|
|      |            |          |    |       |          |               |                 | 13*               | 12 | 11 | 10 | 09 |       |    |         |         |          |         |         |       |
| 1    | 0.026866   | 735635K  | NS | KY    | ANDERSON | LAWRENCEBUR G | MAIN STREET     | 0                 | 0  | 0  | 0  | 0  | GT    | 22 | 1       | 45      | YES      | 2       | 9,979   |       |
| 2    | 0.026369   | 735636S  | NS | KY    | ANDERSON | LAWRENCEBUR G | WOODFORD STREET | 0                 | 0  | 0  | 0  | 0  | GT    | 22 | 1       | 45      | YES      | 2       | 9,143   |       |
| 3    | 0.023034   | 735638F  | NS | KY    | ANDERSON | LAWRENCEBUR G | BOND LILLARD R  | 0                 | 0  | 0  | 0  | 1  | FL    | 22 | 1       | 45      | YES      | 1       | 75      |       |
| 4    | 0.017463   | 735637Y  | NS | KY    | ANDERSON | LAWRENCEBUR G | COURT ST        | 0                 | 0  | 0  | 0  | 0  | 06/10 | GT | 22      | 2       | 45       | YES     | 2       | 3,360 |
| 5    | 0.014470   | 735646X  | NS | KY    | ANDERSON | LAWRENCEBUR G | MCBRAYER ROAD   | 0                 | 0  | 0  | 0  | 0  | FL    | 22 | 1       | 45      | YES      | 1       | 1,000   |       |
| 6    | 0.009488   | 735651U  | NS | KY    | ANDERSON | LAWRENCEBUR G | NEVIN ROAD      | 0                 | 0  | 0  | 0  | 0  | FL    | 22 | 1       | 45      | YES      | 2       | 180     |       |
| 7    | 0.009301   | 735640G  | NS | KY    | ANDERSON | LAWRENCEBUR G | SALT RIVER ROAD | 0                 | 0  | 0  | 0  | 0  | FL    | 22 | 1       | 45      | YES      | 2       | 170     |       |
| 8    | 0.001305   | 735643C  | NS | KY    | ANDERSON | LAWRENCEBUR G | PUMPHOUSE ROAD  | 0                 | 0  | 0  | 0  | 0  | FL    | 22 | 1       | 45      | YES      | 2       | 1       |       |
| 9    | 0.001305   | 735619B  | NS | KY    | ANDERSON | LAWRENCEBUR G | AVENSTOKE RD    | 0                 | 0  | 0  | 0  | 0  | FL    | 22 | 1       | 45      | YES      | 2       | 1       |       |
| 10   | 0.001268   | 719846R  | NS | KY    | ANDERSON | TYRONE        |                 | 0                 | 0  | 0  | 0  | 0  | SP    | 2  | 2       | 10      | YES      | 1       | 50      |       |
| 11   | 0.000806   | 735627T  | NS | KY    | ANDERSON | LAWRENCEBUR G | SR512 ALTON ST  | 0                 | 0  | 0  | 0  | 0  | 01/13 | GT | 22      | 1       | 45       | YES     | 2       | 1     |

In the Highway Information Section, nearby facilities that are dependent upon crossing would encompass industry/business/government entities that are within a 5 mile radius of the crossing and rely upon the crossing to conduct daily business. If the crossing were to be closed for repairs and alternative routes in place, then a description of that route would be included.

To complete the Crossing Assessment section, refer to the attached Qualitative Evaluation Form that contains a rating system for roughness/rideability, condition of pavement approaches, and crossing surface condition and visual depictions of various crossing states. To complete the Description of Proposed Repair in the Construction Information section, refer to the descriptions that are shown below for guidance. Once the Questionnaire and the Qualitative Evaluation Form are completed, attach photos of the crossing comprised of the following: left and right highway profiles, left and right rail profiles, aerial photo of crossing (if available), and any other photos that help illustrate the crossing condition.

Once the questionnaire is completed and submitted, then KYTC staff can cross-check the responses against their own databases and individual knowledge. The relevant information from the questionnaire is then used to populate the scoring workbook. While not all information in the questionnaire is needed for the scoring workbook, there are elements that can be used to guide professional judgments regarding project prioritization.

The scoring workbook is divided into three tabs titled: Index, Economic Valuation, and Total. The Index worksheet includes qualitative assessments of the crossing's roughness, the condition of the surface material, and the condition of the pavement approaches shown in Figure 3. Scores are normalized on a scale of 0-100. Safety is measured by the predicted collision probability, which is drawn from the WBAPS. All of these measures are inputted based on the responses to the questionnaire.

**Figure 3: Index Tab from Scoring Workbook**

|   | A               | B  | C  | D   | E                                      | F                  |
|---|-----------------|--|--|---|--|--------------------|
| 1 | <b>Crossing</b> | <b>Assessment of Roughness/Rideability</b> | <b>Assessment of Crossing Surface Material</b> | <b>Assessment of Crossing Pavement Approaches</b> | <b>Predicted Collision Probability</b> | <b>Index Score</b> |
| 2 | Line X          | 3  | 2  | 3   | 10.56%                                 | 185.56             |
| 3 | Line Y          | 2  | 4  | 4   | 15.23%                                 | 248.56             |
| 4 | Line Z          | 1  | 3  | 2   | 5.54%                                  | 147.21             |
| 5 |                 |  |  |   |  | 0.00               |
| 6 |                 |  |  |   |  | 0.00               |
| 7 |                 |  |  |   |  | 0.00               |
| 8 |                 |  |  |   |  | 0.00               |
| 9 |                 |  |  |   |  | 0.00               |

The Economic Valuation tab assigns monetary values to the truck and rail traffic at the crossing, and discounts the future maintenance costs to assess the net present value of the cost of the rehabilitation and maintenance thereafter. Truck value was derived by dividing the Bureau of Economic Analysis’s Truck Sector Gross Domestic Product in Kentucky by the total number of trucks that use the crossing each day. Train value is computed by determining the total daily tonnage that passes the crossing. An average value per ton is calculated by dividing Bureau of Economic Analysis Rail sector Gross Domestic Product in Kentucky by the total rail tonnage from the Bureau of Transportation Statistics. The total number of trains is then multiplied by average tonnage to yield a total tonnage. Total tonnage is multiplied by the value per ton to arrive at the train value. Costs are projected for 10 years and discounted at a five percent rate. The initial construction cost and nine years of maintenance are accounted for, which yields the net present value of the costs associated with the crossing rehabilitation. Inputs required for this tab include the AADT, percentage of trucks, monthly rail tonnage and number of trains per month, and the cost of the proposed crossing improvement along with annual maintenance estimates needed thereafter. Figure 4 shows a screenshot of some of the inputs needed for this tab.

**Figure 4: Economic Valuation Tab from Scoring Workbook**

|   | A               | B           | C               | D                   | E  | F  | G                      | H                                 |
|---|-----------------|-------------|-----------------|---------------------|--|--|------------------------|-----------------------------------|
| 1 | <b>Crossing</b> | <b>AADT</b> | <b>% Trucks</b> | <b>Total Trucks</b> | <b>Truck Value (Truck GDP/Registrations)</b> | <b>Current Daily Truck Economic Impact</b> | <b>Monthly Tonnage</b> | <b>Number of trains per month</b> |
| 2 | Line X          | 2354        | 10%             | 235 \$8,677         | \$2,042,566                                  |  | 750000                 | 150                               |
| 3 | Line Y          | 6520        | 25%             | 1630 \$8,677        | \$14,143,510                                 |  | 450000                 | 300                               |
| 4 | Line Z          | 1050        | 50%             | 525 \$8,677         | \$4,555,425                                  |  | 900000                 | 30                                |
| 5 | 0               |             |                 | 0 \$8,677           | \$0  |  |                        |                                   |
| 6 | 0               |             |                 | 0 \$8,677           | \$0  |  |                        |                                   |

The Total Worksheet ranks scores from the Index and Economic Valuation of Crossing Tabs (truck and rail), the Net Present Value of the costs, and a simple “Importance Ratio” which is the Economic Valuation minus the Costs. The scoring workbook takes factors into account that influence the allocation of funds for crossing rehabilitation and repair. Because of limited data availability, the values and rankings generated by the different worksheets represent inexact estimates and should be treated with caution. Sound professional judgment should be applied in conjunction with the scoring sheet results to determine final project rankings. Given the differences in value likely to emerge in urban versus rural crossing evaluations, it is recommended that these be treated as separate categories in order to ensure that rural crossings that merit funding are evaluated appropriately in context.

Figure 5 shows the entirety of the Total tab including the scores from the other tabs and the ranking based on each. Often, rankings from the various measures may result in different priorities, thus as we noted, it is incumbent upon policymakers to exercise additional judgment as needed.

**Figure 5: Total Tab from Scoring Workbook**

|   | A               | B                  | C                                  | D   | E  |
|---|-----------------|--------------------|------------------------------------|---|--|
| 1 | <b>Crossing</b> | <b>Index Score</b> | <b>Economic Impact of Crossing</b> | <b>NPV Cost of Crossing Rehab and Maintenance</b> | <b>Economic Impact-Cost (Importance)</b> |
| 2 | Line X          | 185.56             | \$2,199,300                        | \$238,554   | \$1,960,746                              |
| 3 | Line Y          | 248.56             | \$14,237,550                       | \$332,108   | \$13,905,443                             |
| 4 | Line Z          | 147.21             | \$4,743,506                        | \$410,662   | \$4,332,844                              |
| 5 |                 |                    |                                    |   |  |
| 6 |                 |                    |                                    |   |  |
| 7 |                 |                    |                                    |   |  |
| 8 |                 |                    |                                    |   |  |

| F                       | G                           | H                | I   |
|-------------------------|-----------------------------|------------------|---|
| <i>Index Score Rank</i> | <i>Economic Impact Rank</i> | <i>Cost Rank</i> | <i>Economic Impact-Cost (Importance) Rank</i> |
| 2                       | 3                           | 3                | 3   |
| 1                       | 1                           | 2                | 1   |
| 3                       | 2                           | 1                | 2   |