REPORT OF THE
VIRGINIA DEPARTMENT OF TRANSPORTATION ON

Railroad Grade Crossings

TO THE GOVERNOR AND
THE GENERAL ASSEMBLY OF VIRGINIA

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TABLE OF CONTENTS

List of Tables

PREFACE

The 1990 Session of the General Assembly of Virginia, through House Joint Resolution No. 39, directed the Virginia Department of Transportation to study replacement of railroad grade crossings with grade separations. The Department was further directed to include in its deliberations the identification of an appropriate mechanism to provide the necessary funds for replacement of railroad grade crossings.

Pursuant to this directive, staff of the Virginia Department of Transportation undertook such a study. A description of the study effort, its findings, and recommendations are contained in this report.

THE FEASIBILITY OF REPLACING AT-GRADE HIGHWAY/RAILROAD CROSSINGS WITH GRADE-SEPARATED CROSSINGS

EXECUTIVE SUMMARY

House Joint Resolution No. 39 requested that the Virginia Department of Transportation (Department) study the replacement of at-grade highway/railroad crossings in Virginia with grade-separated crossings, such study to include the identification of appropriate funding mechanisms. This report describes the analysis and findings thereof that were undertaken by Department staff to address this resolution.

There are 2,497 public, at-grade railroad crossings in Virginia and, as with any intersection, these crossings are locations where planning needs to be undertaken to reduce conflicts where possible. Due to the size and speed differential, collisions between a train and vehicle or pedestrian have the potential of resulting in fatalities and severe injuries. Further, there is a potential danger to others, if either the train or vehicle struck is carrying a hazardous material, and the material is released into the elements. Also, the wreckage at the crossing may block a needed evacuation route for persons in the affected neighborhood. Finally, emergency vehicles, such as fire trucks and ambulances, may be delayed at a crossing while waiting for the passage of the train.

Fortunately, however, the accident experience in Virginia has not borne out the potential danger of such accidents. While serious accidents have occurred, generally train collisions are relatively minimal in both number and severity especially when compared to other transportation statistics.

At-grade crossings are also an inconvenience to motorists. When particularly long, slow-moving, or stationary trains block the crossing, significant numbers of motorists can be delayed, especially in suburban or urban areas where traffic volumes are heavy. Not only is valuable time lost, but also additional fuel is consumed by idling vehicles.

All these potential dangers and inconveniences can be eliminated by grade-separating the crossing. However, grade-separated crossings are very costly, and it is not financially feasible to construct such a crossing at every one of the 2,497 public crossings in Virginia.

Since funds are not available to construct grade separations at all locations in Virginia, a method of prioritizing and selecting crossings on which to spend scarce resources was developed. Cost-effectiveness analysis was used as the basis for the methodology. The basic assumption is that a grade-separated crossing becomes economically justified when the cost to construct the grade separation is equal to or less than the costs associated with doing nothing, (i.e., retaining the at-grade crossing).

The major costs associated with an at-grade crossing include costs incurred by those involved in crossing accidents and those delayed by waiting for the passage of a train. The delay costs consist of two components--the cost of a person's time and the cost of excess fuel being burned by idling vehicles. Costs of the grade separation include that of the bridge or overpass structure, the roadway approaches to the structure, and the right-of-way. A grade separation is justified if the cost to construct is equal to or less than the costs of accidents and delay at the existing at-grade crossing.

General assumptions were made for some of the variables for an urban crossing and for a rural crossing. By substituting the assumed values and known values (expected accident rate, number of trains, traffic volume) into the formulas which were developed for this study, all crossings were evaluated to determine those that potentially satisfy the above fundamental relationship. A total of 56 crossings were identified.

Planning cost estimates of grade separating 52 (15 rural, 37 urban) of the 56 selected crossings were then developed. Subsequent to the initial selection, it was found that grade separations were already being constructed at three of the sites, and that the number of trains at one of the sites had been reduced. The cost estimate included the structure, roadway approaches, and right-of-way, and was based on similar structures and in-house cost data available to the Department. To assist in preparing the cost estimates, a conceptual layout for each location was prepared. A field review was made at most of the sites prior to the development of the layouts to determine possible concept designs.

Many of the locations involve complex engineering, geographic, and right-of-way problems because of their close proximity to major transportation facilities, waterways, and heavily developed areas. Also, some grade separations can only be accomplished by rebuilding bridges over rivers. Accordingly, grade separations at 19 of the crossings (4 rural, 15 urban) were not considered feasible. The total estimated cost to provide grade separation at the remaining 33 potentially feasible sites is $174,145,000.

It is important to emphasize that this cost estimate is for planning purposes only; it is an order of magnitude estimate at best. The crossings evaluated were selected based on sound economic theory; however, many assumptions were incorporated into the methodology. In many cases, average values of input variables were used rather than site-specific values. This was necessary because of the large number of crossings in Virginia and the significant amount of data needed for each one and time constraints. Accordingly, if each of the 2,497 public at-grade crossings were evaluated using site-specific data, a slightly different list of crossings at which grade separation is justified would likely be developed. This would result in a revised cost estimate. Finally, it is noted that detailed engineering cost estimates at each selected crossing would also likely change the total estimate. The estimated cost of $174,145,000 does provide the Department with a number on which to base financial discussions.

Funding for railway/highway grade separations has traditionally been provided from regular highway construction allocations. Separations within a town or city are funded from the urban system allocations, those on secondary routes are funded from the specific county's secondary construction allocation, and those on the primary system are funded from allocations to the appropriate district.

Individual projects typically follow two patterns. In the first case, a grade separation is identified as part of a larger improvement involving reconstructing or widening the existing roadway. In the second case, the specific intent is to provide the grade separation, with any roadway improvement incidental to the separation.

Regardless of the type of project initiated, funding is provided from transportation trust fund sources according to law. Funds entering the transportation trust fund may derive from state or federal sources, but are not distinguished as such in the allocation process. By law, allocations are based upon the total amount available, with the Department assigned the responsibility of ensuring that particular federal categorical requirements are met through the project programming process.

As the Department establishes a project for reconstruction or major widening, it may be identified for federal participation through the federal-aid programming process. In instances where the proposed project involves a grade separation 100 percent federal funding may be provided for the separation itself, however this is a programming function and does not mean additional funding is made available to the locality.

This is also true in the second case, where a grade separation project is proposed. The federal law provides Virginia approximately $2.8 million per year of which up to $1.4 million may be used for grade separation projects. This amount is included in the total available to the transportation trust fund and is aggregated with state and other federal categorical funds within the allocation process. Through the programming process, the Department ensures that sufficient projects are included to fully utilize this categorical amount.

There is no difficulty in programming the individual federal categorical amounts within the constraints of existing allocation. This is exhibited by the fact that none of the federal dollars available to Virginia have been allowed to lapse, and that Virginia continues to obligate all of the federal authority made available.

It is true that a very wide gap exists between identified improvement needs and available revenue. In the case of grade separation projects $1.4 million is available to address $174 million of needed improvements. A similar situation exists on the interstate system where approximately $7 billion of needs are being addressed with $70 million of annual revenues. In either case, a full century would be required to relieve the identified needs unless alternative funding methods can be identified.

Accordingly, there are no existing additional funds available to finance the estimated $174 million needed for grade separations. All current funds are being utilized to the maximum.

There are several additional funding alternatives that the General Assembly may wish to consider. Each has its own set of issues that must be addressed and resolved. They would, however, be effective at the specific locations of greatest need. These alternatives are described in the following.

The General Assembly may wish to amend the existing law to set aside a certain amount for grade separations prior to application of the distribution formulas. Without the provision of additional funding this would, however, diminish the amount allocated to the Districts, municipalities, and counties. In effect, places with no grade separation needs would be contributing a portion of their allocation to relieve the needs in another jurisdiction.

A special case exists where a grade crossing with protective devices in place is replaced with a structure. In these cases, the railroad is required to contribute a minimum of five percent of the cost of the construction of the structure and approaches. Since a grade separation reduces the liability exposure of the railroad company and certain benefits accrue to them, the General Assembly may wish to require a higher percentage contribution from the railroad. The contribution could depend on the party responsible for the maintenance after construction. Where the location is already grade separated and the bridge is owned by the railroad, the railroad should provide a commensurate contribution if it is to be replaced.

Under current law, municipalities must pay two percent of the cost of any urban system project. This requirement is not placed upon secondary system or primary projects. The General Assembly may wish to consider requiring the locality involved to provide a higher percentage of the project cost for any grade separation project on the secondary or urban systems.

Based on the findings of the study, it is recommended that:

1. the cost-effectiveness methodology developed in this report be included in the planning process, utilizing site-specific parameters, to evaluate the need for grade separations,

2. the results of applying the methodology be used in the selection and programming of all projects, and

3. the Department continue to use the present method of allocating funds for grade separation projects, and incorporate, as necessary, any additional funding that may be established by the General Assembly in response to this report. The alternatives listed would or could be directed to the areas of greatest need.

THE FEASIBILITY OF REPLACING AT-GRADE HIGHWAY/RAILROAD CROSSINGS WITH GRADE-SEPARATED CROSSINGS

INTRODUCTION

On February 27, 1990, the General Assembly passed House Joint Resolution No. 39 (HJR 39) (Appendix A). This resolution requests that the Virginia Department of Transportation (Department) study the replacement of at-grade highway/railroad crossings with grade-separated crossings. In its study, the Department should include the identification of an appropriate mechanism to provide the necessary funds for undertaking such replacements.

This report, prepared in response to HJR 39, presents the findings of analyses undertaken by the Department.

BACKGROUND

There are 2,497 locations in Virginia where public highways and railroads cross at-grade, i.e., the roadway and tracks are not physically separated by a bridge. At these crossings, planning needs to be undertaken to reduce the possibility of collisions between a train and a vehicle or pedestrian. Due to the size and speed differential between the train and vehicle or pedestrian, such collisions have the potential to result in fatalities and/or severe injuries. While serious accidents do occur, generally, train collisions are relatively minimal in both number and injuries. For example, in 1987 there were 5,627 accidents involving highway vehicles nationwide at 185,621 public rail crossings. Only 109 occurred in Virginia (1). In 1989 there were 143,155 recorded accidents on the highway systems in Virginia, 70 of which occurred at grade crossings. Thirty-seven of the crossings accidents which involved property damage only. The remainder involved injuries/ fatalities, with four fatalities attributed to crossing accidents (2).

There is also a danger to others not directly involved in the collision. If either the train or vehicle struck is carrying a hazardous material, there may be an immediate danger to the surrounding neighborhood from leaking substances. Further, the wreckage at the crossing may block a needed evacuation route for persons in the affected neighborhood. Again, however, the accident experience reflects only the potential for such accidents. In 1987 there were only 14 accidents nationwide between trains carrying hazardous materials and highway users at railroad crossings. Only three of these accidents, none of which were in Virginia, resulted in the release of hazardous materials, and all together required the evacuation of 500 people (1). During 1989, none of the railroad accidents in Virginia, including grade crossing, caused an evacuation due to the release of hazardous materials (3).

Finally, at-grade crossings are inconvenient to motorists. When particularly long, slow-moving, or stationary trains block the crossing, significant numbers of motorists can be delayed, especially in suburban or urban areas where traffic volumes are heavy. Not only is valuable time lost, but also additional fuel is consumed by idling vehicles. Emergency vehicles, such as fire trucks and ambulances, may also be delayed at a crossing while awaiting the passage of the train.

As suggested, grade-separated crossings, i.e., those at which the roadway and tracks are physically separated by a bridge, are desirable alternatives to at-grade crossings. All the aforementioned dangers and inconveniences are eliminated by separating the two modes. Unfortunately, grade-separated crossings are very costly, and it is not feasible to construct such a crossing at every one of the 2,497 public at-grade crossings in Virginia.

STUDY RATIONALE AND APPROACH

Since it is not feasible to grade-separate all locations in Virginia, a method of selecting and prioritizing crossings had to be developed. Cost-effectiveness analysis was chosen as the underlying methodology to utilize in developing such a procedure.

The basic assumption is that the grade-separated crossing becomes economically justified when the cost to construct the grade separation is equal to or less than the costs associated with doing nothing, i.e., retaining the at-grade crossing. In other words, it is not cost-effective to retain an at-grade crossing if it is less expensive to separate the modes.

Costs associated with the at-grade crossing include accident costs and societal costs. It is very hard to place any value on these costs. However, for the purposes of this study assumptions had to be made. In this case, accident costs (those associated with a train and vehicle/pedestrian collision) include:

- the costs to those involved, e.g., the cost of a fatality or injury, and property damage,
- the costs of a fatality or injury resulting from leakage of a hazardous material, and
- other costs associated with handling the leakage of hazardous material.

Societal costs include:

- the costs of delay to motorists,
- the costs of excess fuel consumed by idling vehicles, and
- the costs of a fatality, injury or property damage resulting from the delay to an emergency vehicle waiting for the passage of a train.

Costs associated with a grade-separated crossing include the costs of a bridge, roadway approaches, and necessary right-of-way.

For purposes of this study, estimates of the direct costs of accidents, delay, and excess fuel were compared with an average cost of the grade separation for both urban and rural locations. This analysis resulted in the selection of 39 urban crossings and 17 rural crossings (later reduced to 37 and 15, respectively) at which to develop site-specific cost estimates of constructing a grade separation. This provided a total planning cost estimate of replacing at-grade crossings at the selected locations in Virginia.

As a final task, appropriate mechanisms for providing the funds necessary for this replacement were reviewed and evaluated.

The remainder of the report provides details on the development of the cost-effectiveness procedure and the selection of at-grade crossings, the development of the planning cost estimates for 52 of the crossings examined, and a discussion of funding mechanisms.

COST-EFFECTIVENESS PROCEDURE

In order to justify the replacement of an at-grade railroad crossing with a grade-separated crossing, the costs associated with retaining the at-grade crossing must be equal to or greater than the costs of constructing the grade separation. Relating it more specifically, the costs of train/vehicle accidents and the costs of delay and excess fuel consumption to motorists awaiting the passage of trains must be equal to or greater than the costs of a new bridge or overpass.

This principle is sound in theory, and provides a valid tool for evaluating specific at-grade crossings. It was not practical, however, to evaluate all 2,497 crossings in Virginia. Therefore, a procedure based on rational assumptions and available data was developed which selected those crossings meeting this basic principle. This procedure is described in the remainder of this section.

Definitions of Costs

Costs associated with at-grade crossings include costs which are incurred by those involved in crossing accidents and those delayed by waiting for the passage of a train, both in time of delay and excess fuel consumption. Other costs include those associated with a possible leakage of hazardous materials resulting from a collision and those associated with the delay of an emergency vehicle waiting for a train to pass. Costs associated with a grade separation include that of the bridge or overpass structure, the roadway approaches to the structure, and the right-of-way.

Accident Costs

It is obviously impossible to predict the actual costs of future accidents that might occur at a crossing. Therefore, the standard practice is to use the average cost of railroad crossing accidents that have occurred previously, and multiply it by the expected number of accidents. Based on a total of 70 accidents (29 rural and 41 urban) at public crossings in Virginia in 1989, and on the accident costs recommended by the Federal Highway Administration (FHWA) (4), it was determined that a rural accident costs $141,126 and an urban accident costs $102,942. It is important to note that the FHWA costs are from nationwide data and reflect the average costs of fatal, injury, and property damage only accidents.

The expected number of accidents per year is determined by applying the Hazardous Index Formula. This New Hampshire model generates an expected accident rate (EAR) for a crossing based on certain characteristics of the crossing such as location, number of trains, existence of warning devices, etc.

Total accident costs are then obtained by multiplying together the average cost per accident and EAR. This is expressed as:

CA = $C(EAR), where   Eq. 1

CA = annual cost of accidents

$C = average cost per accident ($141,126 rural, $102,942 urban)

EAR = expected accident rate per year

Delay Costs

The cost of a person's time is often used in cost-effectiveness analysis when evaluating a proposed improvement. For purposes of this study, average wage rates in urban and rural areas were used. While this varies somewhat among areas, the Virginia Employment Commission reported an average wage in 1989 of $10.85/hour in a representative urban area and $7.80/hour in a representative rural county (5).

The amount of delay varies from crossing to crossing depending upon the length and speed of a train (6). Mathematically, the time a crossing is effectively blocked by the passage of a train is expressed as:

$$MT = [(L/S)(60)+0.6+0.05], \text{ where} \qquad \text{Eq. 2}$$

MT = minutes required for passage of a train

L = length of train in miles (a maximum length of 9,000 feet was assumed)

S = speed of train in mph (assumed as 45 mph rural, 25 mph urban)

60 = conversion to change mph to miles per minute

0.6 = average minutes for activation/deactivation of warning devices

0.05 = average minutes for motorists to react and start up after train has passed

By assuming all trains at the crossing are the same length and travel at the same speed, the number of minutes a crossing is blocked during an average day is expressed as:

$M = MT(T)$, where Eq. 3

M = minutes during an average day that a crossing is blocked

MT = minutes required for passage of a train (Eq. 2)

T = number of trains/day

The probability that a vehicle will be delayed is expressed as:

$P = M/1440$, where Eq. 4

P = probability of a vehicle being delayed during an average day

M = minutes during an average day that a crossing is blocked (Eq. 3)

1440 = number of minutes in a day

The number of vehicles delayed during an average day is expressed as:

$N = P(AADT)$, where Eq. 5

N = number of vehicles delayed during an average day

P = probability of a vehicle being delayed during an average day (Eq. 4)

AADT = average annual daily traffic volume using the crossing

These three equations can then be combined to calculate the total delay to vehicles during an average day:

$D = [P(AADT)][MT/2]$ Eq. 6

D = total minutes daily delay

P(AADT) = number of vehicles delayed (Eq. 5)

MT/2 = average minutes of delay per vehicle resulting from the passage of a train (An average is used to reflect the fact that some vehicles will arrive as the train is just coming and some as the train is just leaving.)

In addition to the cost of time, there is also excess fuel consumption resulting from vehicles idling during the passage of the train. For purposes of this study, it was assumed that gasoline cost $1.10/gallon.

An FHWA report indicated that idling vehicles burn 0.013 gallons of gasoline/minute (7). Total gasoline consumption due to delay during an average day is therefore estimated as:

$$G = 0.013D, \text{ where} \qquad \text{Eq. 7}$$

G = daily gallons of gasoline consumed by idling vehicles

0.013 = idling consumption in gallons/minute

D = total minutes of daily delay (Eq. 6)

In order to calculate the annual costs of delay, the equations and unit costs are combined and expressed as:

$$CD = 365D[(\$1.10)(0.013) + (\$W/60)], \text{ where} \qquad \text{Eq. 8}$$

CD = annual cost of delay

365 = number of days in a year

D = minutes of daily delay (Eq. 6)

$1.10 = cost of gasoline/gallon

0.013 = idling consumption in gallons/minute

$W = average hourly wage ($7.80 rural, $10.85 urban)

60 = conversion to change hourly wage to per minute wage

Hazardous Materials Costs

It is very difficult to quantify the costs associated with the leakage of a hazardous material. In fact, there is no known documentation of such costs. Based on the statistics presented earlier, however, grade-crossing accidents resulting in the leakage of hazardous materials are very rare. Accordingly, the validity of the cost-effectiveness analysis is not compromised by eliminating these costs from consideration.

Emergency Vehicle Delay Costs

There is no known documentation of costs resulting from the delay of emergency vehicles at the at-grade railroad crossings. Common sense indicates, however, that the probability of such an occurrence is very small. When the probabilities of an emergency occurring at a location that is completely isolated by railroad tracks and at a time when a train actually blocks the tracks are combined, there is very little total probability of such an event. Accordingly, the analysis is not compromised by eliminating these costs from consideration.

Grade Separation Costs

These costs were based on the Department's in-house information regarding the general construction costs of a highway bridge and required approaches, and the procurement of additional right-of-way. For the purpose of this study it was assumed that a grade-separated crossing costs \$1.2 million in a rural area and \$6.0 million in an urban area. Further, an average life of 50 years was assumed.

Development of Selection Criteria

As stated at the outset, a grade-separated crossing is economically justified if the costs associated with the existing at-grade crossing are equal or greater than the costs of constructing the grade separation. This is expressed as:

$$CA + CD \geq CB/50, \text{ where} \qquad \text{Eq. 9}$$

CA = annual cost of accidents (Eq. 1)

CD = annual cost of delay (Eq. 8)

CB = cost of bridge (\$1.2 million rural, \$6.0 million urban

50 = average life of a bridge in years

Accident Criteria

If costs due to delay are assumed to be zero, and Eq. 1 is substituted, Eq. 9 becomes:

$$\$141{,}126\ (EAR) \geq \$1{,}200{,}000/50 \text{ (rural), and}$$

$$\$102{,}942\ (EAR) \geq \$6{,}000{,}000/50 \text{ (urban)}$$

The sums \$141,126 and \$102,942 are weighted average costs for all grade crossing accident costs which occurred in 1989 (2).

The accident criteria are determined by solving the above equations for EAR. Thus, the minimum expected accident rate, or EAR, for which a grade-separated crossing is justified is 0.17 in rural areas and 1.17 in urban areas.

Delay Criteria

If costs due to accidents are assumed to be zero, and Eq. 8 is substituted, Eq. 9 becomes:

$$365\ D\ [(\$1.10)(0.013) + (\$7.80/60)] \geq \$1{,}200{,}000/50 \text{ (rural), and}$$

$$365\ D\ [(\$1.10)(0.013) + (\$10.85/60)] \geq \$6{,}000{,}000/50 \text{ (urban).}$$

The delay criteria are determined by solving the above equations for D. Thus, the minimum daily minutes of delays, or D, for which a grade-separated crossing is justified is 455.67 minutes in rural areas and 1,684.92 minutes in urban areas.

Combination Accident and Delay Criteria

If both accident and delay costs are considered, and Eq. 1 and Eq. 8 are substituted, Eq. 9 becomes:

$$2{,}679.44(EAR) + D \geq 455.67 \text{ (rural) and}$$

$$1{,}445.41(EAR) + D \geq 1{,}684.92 \text{ (urban).}$$

Selection of Crossings

The Department maintains a computerized inventory of at-grade public railroad crossings in Virginia. The Department of Transportation's (Federal) Hazardous Index Formula, or New Hampshire model can be run on this inventory to produce expected accident rates (EARs) for each crossing. Additionally, the Department developed a computer program which uses the criteria just described to select those crossings for which a grade separation is potentially justified. The following describes in general terms the Department developed program.

Urban Versus Rural

The inventory was reviewed to separate the urban crossings and rural crossings.

Application of Accident Criteria

The aforementioned Hazardous Index Formula program was run to produce EARs for each crossing. Rural crossings with an EAR $\geq$ 0.17 and urban crossings with an EAR $\geq$ 1.17 were selected and set aside.

Application of Delay Criteria

Daily delay is not a value that is maintained on the Department's inventory; accordingly, it has to be expressed in terms of inventory data items. This is done by starting with Eq. 6:

$$D = [P(AADT)][MT/2], \text{ and substituting Eq. 4 and Eq. 3}$$

$$D = [((MT)(T)/1440)AADT][MT/2]$$

$$D = (MT)^2(T)(AADT)/2880, \text{ and substituting Eq. 2}$$

$$D = [(L/S)(60) + 0.6 + 0.05]^2 \ (T)(AADT)/2880, \text{ thus}$$

For rural (s = 45 mph), $D = 0.003\ (T)(AADT)$

For urban (s = 25 mph), $D = 0.008\ (T)(AADT)$

The number of daily trains (T) and the daily traffic (AADT) included in the inventory for each crossing is substituted into these formulas to calculate the minutes of daily delay. Rural crossings having a delay $\geq$ 455.67 minutes and urban crossings having a delay $\geq$ 1684.92 minutes were selected and set aside.

Application of Combined Criteria

The expected accident rate (EAR) and delay (D) were then used for the combined criteria such that rural crossings with $2{,}679.44\ (EAR) + D \geq 455.67$ and urban crossings with $1{,}445.41\ (EAR) + D \geq 1{,}684.92$ were selected and set aside.

Check for Duplication

Finally, the crossings selected and set aside from the above procedures were checked for duplications. Duplicates were discarded, and a master list of at-grade crossings for which a grade separation is potentially justified was compiled. A total of 17 rural crossings and 39 urban crossings were identified.

PLANNING COST ESTIMATES

Planning cost estimates were developed for grade separating 52 (15 rural, 37 urban) of the 56 selected crossings. Subsequent to the initial selection, it was found that grade separations were already being constructed at three of the sites, and that the number of trains at one of the sites had been reduced. The cost estimate included the structure, roadway approaches, and right-of-way, and was based on similar structures and in-house cost data available to the Department.

To assist in preparing the cost estimates, a conceptual layout for each location was prepared on a USGS topography map. A field review was made at most of the sites prior to the development of the layouts to determine possible concept designs. Individual layout sheets, including the map, the conceptual design, the jurisdiction, the route or street, the crossing's railroad identification number, a project description, a typical section, the cost estimate, and comments, were prepared for each of the 52 crossings. The individual layout sheets have been retained by the Department and are available for review.

Relocations were suggested in at least four locations as substitutes for the existing crossings. Many of the locations involve complex engineering, geographic, and right-of-way problems because of their close proximity to major transportation facilities, waterways, and heavily developed areas. Some grade separations can only be accomplished by rebuilding bridges over rivers.

Additionally, the Department's 2010 State Highway Plan was reviewed to determine if any of the 52 locations were already recognized as needing improvement. Eighteen (8 rural, 10 urban) crossings are identified in the plan. Improvements to three crossings (two with increased protection only) are included in the Department's Six Year Improvement Program.

A summary of the individual selected grade crossing locations was prepared and is included as Table 1. All 56 originally selected crossings are listed. The four crossings which were deleted for the reasons explained earlier have "eliminated" or "under constr." in the column in which cost estimates are given.

As shown in the totals on Table 1, it is estimated that the cost to grade-separate the 52 crossings identified for evaluation is $407,255,000. Due to the problems described in the "Remarks" column, grade separations at 19 of the crossings (4 rural, 15 urban) are not considered feasible. If the cost for these crossings ($233,110,000) is subtracted, then the total estimated cost to provide grade separation at the 33 feasible sites is $174,145,000 (8).

It is important to emphasize that this cost estimate is for planning purposes only; it is an order of magnitude estimate at best. The crossings evaluated were selected based on sound economic theory; however, many assumptions were incorporated into the methodology. Generally, average values of input parameters were used rather than site-specific values. This was necessary, and acceptable from a planning perspective, because of the large number of crossings in Virginia and the significant amount of data needed for each one. Accordingly, if each of the 2,497 public at-grade crossings were evaluated using site-specific data, a slightly different list of crossings at which grade separation is justified would likely be developed. This would result in a revised cost estimate. Finally, it is noted that detailed engineering cost estimates at each selected crossing would also likely change the total estimate. The estimated cost of $174,145,000 does provide the Department with a number on which to base financial discussions and funding mechanisms.

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...ilroad Grade Crossing Study (Cost Summary)

August 29, 1990

Site No.	District	County/City	Route/Street Name	Railroad Number & Name	Estimate Cost	Grade Separation Not Recommended by TPD	Remarks
1	Bristol	Bristol	State Street	469842W - N. & W.	$5,000,000		
2	Bristol	Richlands	Virginia Avenue	468878B - N. & W.	$4,300,000	$4,300,000	Not feasible-structure would have to span Front St., Clinch River & R.R.
3	Bristol	Wise	Route 23	714991X - INT.	Eliminated		
	DISTRICT TOTAL				$9,300,000		
4	Culpeper	Orange	Bus. Route 20	714715V - SOU.	$5,700,000		
	DISTRICT TOTAL				$5,700,000		
5	Fredericksburg	West Point	Route 30/33	714289P - SOU.	$17,100,000	$17,100,000	Not feasible-structure R.R. would require new bridge over the Pamunkey River
	DISTRICT TOTAL				$17,100,000		
6	Lynchburg	Halifax	Route 501	470517W - N. & W.	$4,900,000		
	DISTRICT TOTAL				$4,900,000		
7	Northern Virginia	Fairfax	Route 2735	714326P - SOU.	$11,600,000	$11,600,000	Railroad appears to only be spur
8	Northern Virginia	Fairfax	Route 651	714337C - SOU.	$3,500,000		
9	Northern Virginia	Fairfax	Route 645	714341S - SOU.	$3,400,000	$3,400,000	Not feasible-geometrics & built up area - R/W problems
10	Northern Virginia	Fairfax	Route 611	905893K - DDD.	$3,600,000		
	SUBTOTAL				$22,100,000		
11	Northern Virginia	Manassas	Fairview Ave.	714345U - SOU.	$2,500,000		
	SUBTOTAL				$2,500,000		
12	Northern Virginia	Prince William	Route 636	860600A - RF&P	$3,000,000		
13	Northern Virginia	Prince William	Route 687	860598B - RF&P	$5,800,000		
	SUBTOTAL				$8,800,000		
	DISTRICT TOTAL				$33,400,000		

TABLE 1

Railroad
Grade Crossing Study
(Cost Summary)

August 29, 1990

Site No.	District	County/City	Route/Street Name	Railroad Number & Name	Estimate Cost	Grade Separation Not Recommended by TPD	Remarks
14	Richmond	Chesterfield	Route 36	623694C - CSX	Under Constr.		
15	Richmond	Chesterfield	Route 145	623681B - CSX	$5,000,000		
16	Richmond	Chesterfield	Route 147	715248N - SOU.	$28,500,000	$28,500,000	Not feasible-existing 4 lane roadway recently completed - previous studies taken into consideration
17	Richomond	Chesterfield	Route 620	623687S - CSX	$2,000,000		
	SUBTOTAL				$35,500,000		
18	Richmond	Henrico	Hungary Rd.	860437F - RF&P	$3,000,000		
	SUBTOTAL				$3,000,000		
19	Richmond	Prince Geofge	Route 629	467480F - N. & W.	$1,680,000		
	SUBTOTAL				$1,680,000		
20	Richmond	Hopewell	Main Street	467502D - N. & W.	$4,000,000	$4,000,000	Not feasible-Main St. dead end, very close to the recently constructed LaPrade Ave. structure
	SUBTOTAL				$4,000,000		
21	Richmond	Richmond	14th Street	714220U - SOU.	$50,000,000	$50,000,000	Not feasible-costly, geometric, R/W problems, require new
22	Richmond	Richmond	Hull Street	714071V - SOU.	$25,000,000	$25,000,000	bridge over the James River
23	Richmond	Richmond	Broad Rock Rd.	623668M - CSX	$7,000,000		
24	Richmond	Richmond	Jahnke Rd.	623663D - CSX	$7,000,000		
25	Richmond	Richmond	W. Bells Rd.	623640W - SOU	$4,000,000	$4,000,000	Not feasible-spur track, existing 4 lanes recently constructed
26	Richmond	Richmond	E. Bells Rd.	623548W - CSX	$5,500,000		
27	Richmond	Richmond	Walmsley Blvd.	623672C - CSX	$6,500,000		
28	Richmond	Richmond	Terminal Ave.	623637N - CSX	$3,250,000	$3,250,000	spur track only
29	Richmond	Richmond	Cofer Road	623636G - CSX	$4,200,000	$4,200,000	spur track only
30	Richmond	Richmond	Hopkins Rd.	623635A - CSX	$3,100,000	$3,100,000	spur track only, tracks been removed north of this point
	SUBTOTAL				$115,550,000		
	DISTRICT TOTAL				$159,730,000		

TABLE 1

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Grad ossing Study
(Co Summary)

Site No.	District	County/City	Route/Street Name	Railroad Number & Name	Estimate Cost	Grade Separation Not Recommended by TPD	Remarks
31	Salem	Roanoke	2nd Street	468572W - N. & W.	$10,000,000		
32	Salem	Roanoke	Campbell Ave.	468009G - N. & W.	$34,000,000	$34,000,000	Not feasible-costly, geometrics, R/W problems
	DISTRICT TOTAL				$44,000,000		
33	Suffolk	Chesapeake	Park Avenue	467378A - N. & W.	$3,800,000		
34	Suffolk	Chesapeake	Liberty Street	467376L - N. & W.	$6,500,000		
35	Suffolk	Chesapeake	Liberty Street	856069L - NPBL	$3,300,000		
36	Suffolk	Chesapeake	Geo. Washington Hwy.	463391N - N. & W.	Under Constr.		
37	Suffolk	Chesapeake	Campostella Rd.	467695E - N. & W.	$18,965,000		
	SUBTOTAL				$32,565,000		
38	Suffolk	Emporia	Altantic St.	623755R - CSX	$5,200,000	$5,200,000	Not feasible-geometrics, R/W problems, CBD area
	SUBTOTAL				$5,200,000		
39	Suffolk	Newport News	Warwick Blvd.	905875M - NNS	Eliminated		
	SUBTOTAL						
40	Suffolk	Norfolk	Bainbridge Blvd.	856067X - NPBL	$3,700,000		
41	Suffolk	Norfolk	Bessie Place	467368U - N. & W.	$3,300,000		
42	Suffolk	Norfolk	Hampton Blvd.	856004T - NPBL	$4,200,000		
43	Suffolk	Norfolk	Military Hwy.	735340T - SOU.	$9,500,000		
	SUBTOTAL				$20,700,000		
44	Suffolk	Portsmouth	Turnpike Rd.	856101C - NPBL	$4,000,000		
45	Suffolk	Portsmouth	Elm Avenue	856058Y - NPBL	$7,660,000	$7,660,000	Not feasible-costly, geometrics, Navy property
46	Suffolk	Portsmouth	Deep Creek Blvd.	856051B - NPBL	$7,000,000	$7,000,000	Not feasible-costly, geometrics, R/W problems
47	Suffolk	Portsmouth	Portsmouth Blvd.	856052H - NPBL	$9,000,000	$9,000,000	Not feasible-costly, geometrics, R/W problems
48	Suffolk	Portsmouth	Frederick Blvd.	623098M - CSX	$9,000,000	$9,000,000	Not feasible-major reconstruction of interchange, geometrics, R/W problems
49	Suffolk	Portsmouth	High Street	856100V - NPBL	$5,000,000		

TABLE 1

HJR 39
Railroad
Grade Crossing Study
(Cost Summary)

Site No.	District	County/City	Route/Street Name	Railroad Number & Name	Estimate Cost	Grade Separation Not Recommended by TPD	Remarks
50	Suffolk	Portsmouth	Geo. Wahington Hwy.	856053P - NPBL	$3,900,000		
	SUBTOTAL				$45,560,000		
51	Suffolk	Suffolk	W. Washington St.	467400K - N. & W.	$7,800,000		
52	Suffolk	Suffolk	W. Washington St.	464149V - N. & W.	$5,000,000		
53	Suffolk	Suffolk	W. Washington St.	626027R - CSX	$5,000,000		
54	Suffolk	Suffolk	Route 13	464154S - N. & W.	$3,500,000		
55	Suffolk	Suffolk	Main Street	464153K - N. & W.	$2,800,000	$2,800,000	Not feasible-dead end street at parking lot
	SUBTOTAL				$24,100,000		
56	Suffolk	Waverly	Route 40	457451V - N. & W.	$5,000,000		
	SUBTOTAL				$5,000,000		
	DISTRICT TOTAL				$133,125,000		
	Grandtotal				**$407,255,000**	$233,110,000	"Not Recommended" Total Trans. Plan. Div.

TABLE 1

FUNDING MECHANISMS

As a final task in this project, funding for grade separations was examined. The following sections describe the existing funding situation and then suggest several possible alternatives for consideration.

Current Funding For Grade Separations

Funding for railway/highway grade separations has traditionally been provided from regular highway construction allocations available to the locality. Grade separations within a town or city are funded from the urban system allocations specifically established in law for the urban place. Their funding is contingent upon their relative priority, compared to other needs within the municipality, as determined by the local jurisdiction.

Likewise, grade separations on secondary routes are funded from the specific county's secondary construction allocation which is established in law. Relative priorities are determined by the local Board of Supervisors in consultation with the Department.

Primary system grade separations are funded from allocations to the appropriate Department Construction District, again as set out in state law. Individual project selections are made by the Commonwealth Transportation Board following its preallocation and allocation public hearing process.

Individual projects typically follow two patterns. In the first case, a grade separation is identified as part of a larger improvement involving reconstructing or widening the existing roadway. In the second case, the specific intent is to provide the grade separation, with any roadway improvement incidental to the separation.

Regardless of the type of project initiated, funding is provided from transportation trust fund sources, which are allocated to specific Districts for primary improvements, specific localities for urban system improvements, and to specific counties for secondary road improvements. Funds entering the transportation trust fund may be derived from state or federal sources, but are not distinguished as such in the allocation process. By law, allocations are based upon the total amount available, with the Department assigned the responsibility of ensuring that particular federal categorical requirements are met through the project programming process.

In the first case above, when the Department establishes a project for reconstruction or major widening, it may be identified for federal participation through the federal-aid programming process. The decision process includes consideration of the total amount of federal funds included in the estimate of funds available for allocation, as well as individual federal categorical amounts available for programming. In instances where the proposed project involves a grade separation, 100 percent federal funding may be provided for the separation itself; however, this is a programming function and does not mean additional funding is made available to the locality. The total amount allocated to the District, county, or municipality is unchanged, but the "mix" of funds actually expended is dependent upon the individual project programming.

This is also true in the second case, where a specific grade separation project is proposed. The federal law provides Virginia with approximately $2.8 million per year which may be used for grade-crossing warning devices and grade separation projects. Up to 50 percent of the funds can be spent on grade separation projects. These funds are included in the total available to the transportation trust fund and are aggregated with state and other federal categorical funds within the allocation process. Through the programming process, the Department ensures that sufficient projects are included to fully utilize these categorical funds. Continued full use of the funds for warning devices will reduce the accident potential at various locations.

There is no difficulty in programming the individual federal categorical amounts within the constraints of existing allocation. This is exhibited by the fact that none of the federal dollars available to Virginia have been allowed to lapse, and that Virginia continues to obligate all of the federal authority made available.

A very wide gap exists between identified improvement needs and available revenue. In the case of grade separation projects, $1.4 million is available to address the aforementioned $174 million of needed improvements. A similar situation exists on the interstate system where approximately $7 billion of needs are being addressed with $70 million of annual revenues. In either case, a full century would be required to fund the needs unless alternative funding methods can be identified.

Additional Funding Alternatives

The General Assembly may wish to amend the existing law to set aside a certain amount for grade separations prior to application of the distribution formulae. Without the provision of additional funding, this would, however, diminish the amount allocated to the Districts, municipalities, and counties. In effect, places with no grade separation needs would be contributing a portion of their allocation to relieve the need in another jurisdiction.

A special case exists where a grade crossing with protection devices in place is replaced with a structure. In these cases, the railroad is required to contribute a minimum of five percent of the cost of the construction of the structure and approaches. Since a grade separation reduces the liability exposure of the railroad company and certain benefits accure to them, the General Assembly may wish to require a higher percentage contribution from the railroad. The contribution could depend on the party responsible for maintenance after construction. Where the location is already grade separated and the bridge is owned by the railroad, the railroad should provide a commensurate contribution if it is to be replaced.

Under current law, municipalities must pay two percent of the cost of any urban system project. This requirement is not placed upon secondary system or primary projects. The General Assembly may wish to consider requiring the locality involved to provide a higher percentage of the project cost for any grade separation project on the secondary or urban systems.

CONCLUSIONS AND RECOMMENDATIONS

Planning needs to be undertaken to resolve conflicts where possible at all intersections, including grade crossing. Accidents involving a train and a vehicle or person have the potential of resulting in severe injuries and fatalities. There is also the potential danger of leaking hazardous materials. Fortunately, however, the accident experience has not borne out the potential as such accidents in Virginia have been relatively minimal in both number and severity.

There is also a problem of inconvenience to motorists waiting for the passage of trains. Motorists are delayed plus excess fuel is being consumed while idling.

Both the potential danger and inconvenience of at-grade crossings can be eliminated by constructing a grade separation. Unfortunately, there are not enough financial resources available to grade-separate all 2,497 public at-grade crossings in the state. Thus, a method of prioritizing and selecting crossings on which to consider expending the scarce resources must be established.

Cost-effectiveness analysis can be used as the basis for a methodology. A grade separation is economically justified when its cost is equal to or less than the costs associated with retaining the existing at-grade crossing. It is not practical, however, to apply this principle to every one of the 2,497 existing crossings. Accordingly, a procedure based on rational assumptions and available data must be utilized to screen the crossings and select those that potentially meet this basic economic principle.

Based on such a screening, there are 52 existing at-grade crossings for which the construction of a grade separation is potentially justified based on the previously described economic principle.

An estimated total of $174,145,000 is required to construct grade separations at 33 of these selected sites. (Based on site inspections and construction knowledge, it is not considered feasible to construct separations at 19 of the locations.) It is important to note that this is a planning cost estimate only; it is an order of magnitude estimate. It provides, however, an estimated cost on which to base financial discussions.

Current funding for grade separations is utilized to its maximum, and there is no additional funding available. To provide funding for railroad crossing improvements, there are several alternatives (mechanisms) that the General Assembly may wish to consider. These are summarized as follows:

- o set aside a certain amount for grade separations prior to application of the distribution formulas,
- o require railroads to contribute more than the 5 percent currentlyrequired when a crossing with protection device is replaced with a grade separation, and

o require the locality involved to participate or increase their participation in the cost of a grade separation on the urban or secondary road systems (municipalities now pay 2 percent).

Each of these alternatives have associated issues connected with them that will have to be addressed. Some are enumerated in the previous section.

Based on the above conclusions, it is recommended that:

1. the cost-effectiveness methodology developed in this report be included in the planning process, utilizing site-specific parameters, to evaluate the need for grade separations,

2. the results of applying the methodology be used in the selection and programming of all projects, and

3. the Department continue to use the present methods of allocatingfunds for grade separation projects, and incorporate, any additional funding that may be established by the General Assembly in response to this report. The alternatives listed in the Funding Mechanisms section would or could be directed to the area of the greatest need.

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5. Virginia Employment Commission. May 1989. Labor Market Review. Richmond, Virginia.

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A P P E N D I X

HP4028466

1990 SESSION
ENGROSSED

HOUSE JOINT RESOLUTION NO. 39

House Amendments in [ ] - February 13, 1990

[*~~Establishing a joint subcommittee~~ Requesting the Virginia Department of Transportation*] *to study replacement of railroad grade crossings.*

Patrons—Glasscock; Senators: Earley and Joannou

Referred to the Committee on Rules

WHEREAS, in many places in Virginia, highways cross railroad tracks at grade; and

WHEREAS, railroad grade crossings have long been understood to be dangerous because of the possibility of collisions between trains and motor vehicles or pedestrians; and

WHEREAS, the danger of collisions between trains and motor vehicles is magnified by the possibility that either a train or a motor vehicle involved in such a collision may be carrying a dangerous cargo; and

WHEREAS, particularly for communities in which many railroad grade crossings are located, these crossings present not only a collision hazard, but additional hazards and inconveniences as well; and

WHEREAS, when railroad grade crossings are blocked either by the passage of particularly long or slow-moving trains or by stopped trains, motor vehicle traffic may be halted for long periods of time; and

WHEREAS, these blockages not only annoy motorists, but also obstruct the passage of emergency vehicles and may hamper or prevent evacuation of surrounding neighborhoods in the event of a grade crossing collision involving a dangerous cargo; and

WHEREAS, railroad grade crossings are especially numerous in areas surrounding river ports and seaports, where relatively flat topography makes construction of grade-separated crossings difficult and expensive; and

WHEREAS, because river ports and seaports are foci of transportation activities, railroad traffic across grade crossings in these areas is particularly heavy, compounding the danger and inconvenience to area residents and businesses; and

WHEREAS, it is highly desirable that wherever practicable, railroad grade crossings be replaced with grade-separated crossings; now, therefore, be it

RESOLVED by the House of Delegates, the Senate concurring, That [~~there is hereby established a joint subcommittee to study replacement of railroad grade crossings. The joint subcommittee shall be composed of five members as follows: one member of the House Committee on Appropriations, one member of the House Committee on Finance, one member of the House Committee on Roads and Internal Navigation, one member of the Senate Committee on Finance, and one member of the Senate Committee on Transportation. All House members shall be appointed by the Speaker, and all Senate members shall be appointed by the Senate Committee on Privileges and Elections.~~

~~The work of the joint subcommittee shall include, but shall not be limited to, identification of an appropriate mechanism or mechanisms to provide the necessary funds for replacement of railroad grade crossings.~~

~~The joint subcommittee shall complete its work in time to submit its findings and recommendations to the Governor and the 1991 Session of the General Assembly as provided in the procedures of the Division of Legislative Automated Systems for processing legislative documents.~~

~~The indirect costs of this study are estimated to be $13,675; the direct costs of this study shall not exceed $4,500.~~ the Virginia Department of Transportation is requested to study replacement of railroad grade crossings. The Department shall include in its deliberations the identification of an appropriate mechanism to provide the necessary funds for replacement of railroad grade crossings.

The Department shall complete its work in time to submit its findings and recommendations to the Governor and the 1991 Session of the General Assembly pursuant to procedures of the Division of Legislative Automated Systems for the processing of legislative documents.]

Official Use By Clerks	
Agreed to By The House of Delegates	**Agreed to By The Senate**
without amendment ☐	without amendment ☐
with amendment ☐	with amendment ☐
substitute ☐	substitute ☐
substitute w/amdt ☐	substitute w/amdt ☐
Date: ______________	Date: ______________
Clerk of the House of Delegates	Clerk of the Senate