Identification of Alternatives

IV

Previous chapters presented methodologies for selecting and analyzing potentially hazardous highway-rail grade crossings. In this chapter, existing laws, rules, regulations, and policies are presented and alternative safety and operational improvements are discussed. These alternatives are presented by type: crossing elimination; installation of passive traffic control devices; installation of active traffic control devices; site improvements; crossing surface improvements; and removal of grade separations. From information contained in this chapter, the highway engineer should select several alternative improvement proposals for any particular crossing being studied. The "do-nothing" alternative should also be considered a proposal. Procedures for selecting among the various alternatives are presented in Chapter V, Selection of Alternatives.

A. Existing Laws, Rules, Regulations, and Policies

Current Federal Highway Administration (FHWA) regulations specifically prohibit at-grade intersections on highways with full access control (23 CFR Section 625 (4)). Federal Railroad Administration (FRA) rail safety regulations require that crossings be separated or closed where trains operate at speeds above 125 miles per hour (mph) (49 CFR 213.347(a)). Additionally, if train operation is projected at FRA track class 7 (111–125 mph), an application must be made to FRA for approval of the type of warning/barrier system. The regulation does not specify the type of system but allows the petitioner to propose a suitable system for FRA review.

In 1998, FRA issued an Order of Particular Applicability for high-speed rail service on the Northeast Corridor. In the order, FRA set a maximum operating speed of 80 mph over any highway-rail crossing where only conventional warning systems are in place and a maximum operating speed of 95 mph where four-quadrant gates and presence detection are provided and tied into the signal system. Grade crossings are prohibited on the Northeast Corridor if maximum operating speeds exceed 95 mph. Current statutory, regulatory, and federal policy requirements are summarized in Table 33.

Table 33. Federal Laws, Rules, Regulations, and Policies

	Active	Warning/ barrier with FRA approval	Grade separate or close
Controlled access highways	Not allowed	Not allowed	Required
High-speed rail	> 79 mph	111–125 mph	> 125 mph

**Note: 1 mph = 1.61 kilometers per hour*

Source: Guidance on Traffic Control Devices at Highway-Rail Grade Crossings. *Washington, DC: Federal Highway Administration, Highway/Rail Grade Crossing Technical Working Group, November 2002.*

Not unlike the system specification that all highway-rail crossings on full control access highways be grade separated, it is only logical that certain rail systems should have similar status. In 1994, FRA defined a core railroad system of approximately 128,800 kilometers (80,000 miles) known as Principal Railroad Lines (PRLs). These lines have one or more of the following attributes: Amtrak service, defense essential, or annual freight volume exceeding 20 million gross tons. This core network was described in the U.S. Department of Transportation's (U.S. DOT) 1994 Action Plan to improve highway-rail grade crossing safety. The plan set forth a long-term goal of eliminating (grade separating or realigning) intersections of PRLs and highway routes on the National Highway System—defined as "an interconnected system of principal arterial routes to serve major population centers, intermodal transportation facilities and other major travel destinations; meet national defense requirements; and serve interstate and interregional travel."[72]

B. Elimination

The first alternative that should always be considered for a highway-rail at-grade crossing is elimination. Elimination can be accomplished by grade separating the crossing, closing the crossing to highway traffic, or closing the crossing to railroad traffic through the abandonment or relocation of the rail line. Elimination of a crossing provides the highest level of crossing safety because the point of intersection between highway and railroad is removed. However, the effects of elimination on highway and railroad operations may be beneficial or adverse. The benefits of the elimination alternative are primarily safety and, perhaps, operational—offset by construction and operational costs.

Decisions regarding whether the crossing should be eliminated or otherwise improved through the installation of traffic control devices or site or surface improvements depend upon safety, operational, and cost considerations. However, the Federal-Aid Policy Guide (FAPG) does specify that "all crossings of railroads and highways at grade shall be eliminated where there is full control of access on the highway (a freeway) regardless of the volume of railroad or highway traffic."[73]

The major benefits of crossing elimination include reductions in collisions, highway vehicle delay, rail traffic delay, and maintenance costs of crossing surfaces and traffic control devices.

Safety considerations include both train-involved collisions and non-train-involved collisions. Under the Federal Motor Carrier Safety regulations, all vehicles transporting passengers and trucks carrying many types of hazardous materials must stop prior to crossing tracks at a highway-rail grade crossing (49 CFR 392.10). In the event that following vehicles do not anticipate such stops and/or fail to maintain safe stopping distance, collisions may result. These conditions may be alleviated to some extent where the vehicles required to stop have a special lane at the crossing for such purpose. In addition, the presence of the crossing itself may cause non-train collisions. For example, when stopping suddenly to avoid a collision with an oncoming train, a driver may lose control of the vehicle and collide with a roadside object. Thus, these types of collisions would be avoided if an at-grade crossing were eliminated.

Four types of delay are imposed on highway traffic by crossings:

- Trains occupying crossings—Highway traffic should slow down to look for trains, particularly at crossings with passive traffic control devices. Vehicles must stop and wait for a train to clear a crossing. Furthermore, there may be some delay to vehicles that arrive at a crossing before vehicles that were delayed by a train have cleared the crossing.
- Special vehicles—Certain vehicles may be required to stop at all crossings. These include other commercial buses, passenger-carrying vehicles, and vehicles carrying hazardous materials. In addition to the delay incurred by these special vehicles, their stopping may also impose delay on following vehicles.
- Crossing surface—In other words, if the surface can be traversed at only 15 mph, the time needed for a vehicle to slow down and cross should be taken into account.
- Presence of crossing—This delay occurs regardless of whether a train is approaching or occupying the crossing. Motorists usually slow down in advance of crossings so that they can stop safely if a train is approaching. This is a required safe driving practice in conformance with the Uniform Vehicle Code, which states "...vehicles must stop within 15 to 50 feet from the crossing when a train is in such proximity so as to constitute an immediate hazard."[74] Therefore, the existence of a crossing may cause some delays to motorists who slow to look for a train.

Another benefit of crossing elimination is the alleviation of maintenance costs of surfaces and traffic control devices. As discussed in a later chapter on maintenance, these costs can be quite substantial for both highway agencies and railroads.

72 *Guidance on Traffic Control Devices at Highway-Rail Grade Crossings.* Washington, DC: Federal Highway Administration (FHWA), Highway/Rail Grade Crossing Technical Working Group, November 2002.

73 *Federal-Aid Policy Guide.* 646.214(c), Washington, DC: FHWA.

74 *Uniform Vehicle Code and Model Traffic Ordinance.* National Committee on Uniform Traffic Laws and Ordinances, Evanston, Illinois, 1961, and Supplement, 1984.

Costs of eliminating crossings depend on whether the crossing is merely closed to highway traffic, a grade separation is constructed, or the highway or railroad is relocated. These costs are discussed along with other considerations for each type of elimination alternative.

C. Grade Separation

The decision to grade separate a highway-rail crossing is primarily a matter of economics. Investment in a grade-separation structure is long-term and impacts many users. Such decisions should be based on long-term, fully allocated life-cycle costs, including both highway and railroad user costs, rather than on initial construction costs. Such analysis should consider the following:

- Eliminating train/vehicle collisions (including the resultant property damage and medical costs and liability).
- Savings in highway-rail grade crossing surface and crossing signal installation and maintenance costs.
- Driver delay cost savings.
- Costs associated with providing increased highway storage capacity (to accommodate traffic backed up by a train).
- Fuel and pollution mitigation cost savings (from idling queued vehicles).
- Effects of any "spillover" congestion on the rest of the roadway system.
- Benefits of improved emergency access.
- Potential for closing one or more additional adjacent crossings.
- Possible train derailment costs.

Specific recommendations for grade separation are contained in the FHWA Technical Working Group report in Chapter V.

A recently released report entitled *Grade Separations—When Do We Separate* provides a stepwise procedure for evaluating the grade-separation decision.[75] The report also contains a rough screening method based on train and roadway vehicular volumes. However, as pointed out in the report, the screening method should be used with caution and should be calibrated for values appropriate for the particular jurisdiction.

75 Nichelson, Jr., G. Rex and George L. Reed. *Grade Separations—When Do We Separate.* 1999 Highway-Rail Grade Crossing Conference. Texas Transportation Institute (TTI), College Station, Texas, October 17–19, 1999 (www.tti.edu or www.tamu.edu).

Recent publications include a methodology reflecting safety and economic factors applied in Israel;[76] a grade-separation policy for light-rail train crossings with specific highway operational, safety, and rail transit operational criteria adopted by the Los Angeles Metropolitan Transportation Authority;[77] a methodology applied in central Arkansas that considered use of seven quantitative factors: noise, community cohesion, delay, accessibility, connectivity, geographic distribution, and safety;[78] and a methodology by Nichelson and Reed presented at the 2001 National Highway-Rail Grade Crossing Safety Conference.[79]

D. Highway and Railroad Relocation

Other alternatives to highway-rail grade crossing problems are relocation of the highway or railroad or railroad consolidation. These alternatives provide a solution to other railroad impacts on communities; however, the costs associated with relocation or consolidation can be quite high.

Railroads provide advantages and disadvantages to communities. They generate employment opportunities for local citizens, provide transportation services to local industries and businesses, and are a source of tax revenue to government agencies. The presence of railroads in communities can impose some disadvantages, such as vehicular delay and safety concerns at highway-rail grade crossings. In addition, the presence of railroads may impose noise and other environmental concerns upon the community. Railroad relocation to the outer limits of the community may be a viable alternative for alleviating these concerns while retaining the advantages of having railroad service. Relocation generally involves the complete rebuilding of railroad facilities. This not only requires track construction but also acquisition of right of

76 Gitelman, Victoria, A. Shalom Hakkert, Etti Doveh, and Ayala Cohen. "Screening Tools for Considering Grade Separation at Rail-Highway Crossings." *Journal of Transportation Engineering* (January 2006).

77 Ogden, Brent D. "Los Angeles Metropolitan Transportation Authority Grade Crossing Policy: Reducing Uncertainty And Defining Scope And Cost For Light Rail Transit/Roadway Crossings." Proceedings, American Public Transportation Association Light Rail Conference, Miami, Florida, 2004.

78 Schrader, M.H. and J.R. Hoffpauer. "Methodology For Evaluating Highway-Railway Grade Separations." *Transportation Research Record*, No. 1754, Traffic Control Devices, Visibility, and Rail-Highway Grade Crossings, 2001.

79 TransTech Group, Inc., G. Rex Nichelson, and George Reed. "A Procedure for the Provision of Highway-Railroad Grade Separations." 2001 National Highway-Rail Grade Crossing Safety Conference sponsored by TTI, College Station, Texas, April 2001.

way and construction of drainage structures, signals, communications, crossings and separations, station facilities, and utilities.

In some cases, consolidation of railroad lines into common corridors or joint operations over the same trackage may allow for the removal of some trackage through a community. Railroad consolidation may provide benefits similar to those of railroad relocation and, possibly, at lower costs.

Benefits of railroad relocation in addition to those associated with crossing safety and operations include: improved environment resulting from decreased noise and air pollution; improved land use and appearance; and improved railroad efficiency. Railroad relocation and consolidation may also provide for the elimination of obstructions to emergency vehicles and the safer movement of hazardous materials. Collectively, the tangible and intangible benefits may justify the relocation or consolidation of railroad facilities; any one of the benefits alone might not provide sufficient justification for the expense.

Many factors must be considered in planning for railroad relocation. The new location should provide good alignment, minimum grades, and adequate drainage. Sufficient right of way should be available to provide the necessary horizontal clearances, additional rail facilities as service grows, and a buffer for abating noise and vibrations. The number of crossings should be minimized.

The railroad corridor can be further isolated from residential and commercial activity by zoning the property adjacent to the railroad as light and heavy industrial. Businesses and industry desiring rail service can locate in this area.

To accomplish a rail relocation or consolidation project, a partnership is required among the federal government (if federal funds are involved), state and local government agencies, the railroad, and the community. Although the purpose of the project may be only to eliminate physical conflicts between the highway user and the railroad, the partnership developed for this project provides an atmosphere of cooperative working relationships that continues into the future.

Highway relocations are sometimes accomplished to provide improved highway traffic flow around communities and other developed areas. Planning for highway relocations should consider routes that would eliminate at-grade crossings by avoiding the need for access over railroad trackage or by providing grade separations.

E. Closure

Closure of a highway-rail grade crossing to highway traffic should always be considered as an alternative. Numerous crossings were built when railroads first began operating. Safety was not a serious concern because horse-drawn carriages could easily stop and train speeds were low.

Closure of at-grade crossings is normally accomplished by closing the highway. The number of crossings needed to carry highway traffic over a railroad in a community is influenced by many characteristics of the community itself. A study of highway traffic flow should be conducted to determine origin and destination points and needed highway capacity. Thus, optimum routes over railroads can be determined. Highway operation over several crossings may be consolidated to move over a nearby crossing with flashing lights and gates or over a nearby grade separation. Alternative routes should be within a reasonable travel time and distance from a closed crossing. The alternate routes should have sufficient capacity to accommodate the diverted traffic safely and efficiently.

Eliminating redundant and unneeded crossings should be a high priority. Barring highway or railroad system requirements that require crossing elimination, the decision to close or consolidate crossings requires balancing public necessity, convenience, and safety. The crossing closure decision should be based on economics—comparing the cost of retaining the crossing (maintenance, collisions, and cost to improve the crossing to an acceptable level if it remains, etc.) against the cost (if any) of providing alternate access and any adverse travel costs incurred by users having to cross at some other location. Because this can be a local political and emotional issue, the economics of the situation cannot be ignored. This subject is addressed in a 1994 joint FRA/FHWA publication entitled *Highway-Railroad Grade Crossings: A Guide To Crossing Consolidation and Closure* and a March 1995 publication of the American Association of State Highway and Transportation Officials (AASHTO), *Highway-Rail Crossing Elimination and Consolidation.*

Whenever a crossing is closed, it is important to consider whether the diversion of highway traffic may be sufficient to change the type or level of traffic control needed at other crossings. The surrounding street system should be examined to assess the effects of diverted traffic. Often, coupling a closure with the installation of improved or upgraded traffic control devices at one or more adjacent crossings can be an effective means of mitigating local political resistance to the closure.[80]

There are several stumbling blocks to successful closure, such as negative community attitudes, funding problems, and the lack of forceful state laws authorizing closure or the reluctant utilization of state laws that permit closure.

Legislation that authorizes a state agency to close crossings greatly facilitates the implementation of closures. These state agencies should utilize their authority to close crossings whenever possible. Often, a state agency can accomplish closure where local efforts fail due to citizen biases and fear of losing access across the railroad. Local opposition sometimes may be overcome through emphasizing the benefits resulting from closure, such as improved traffic flow and safety as traffic is redirected to grade separations or crossings with active traffic control devices. Railroads often support closure not only because of safety concerns but also because maintenance costs associated with the crossing are eliminated. A list of who is responsible for closing public crossings in each state is shown in Table 34. Appendix H presents a more detailed state-by-state summary of the procedures for grade crossing elimination.

Achieving consensus among state transportation divisions, boards, review committees, railroads, municipalities, and the public is integral to the closure process. Closure criteria vary by locality but typically include train and roadway traffic volume, speed of trains, number of tracks, material being carried, crossing location, visibility, distance to traffic signals, and number of crashes. More than four crossings per mile with fewer than 2,000 vehicles per day and more than two trains per day are prime candidates for closure.[81]

To assist in the identification of crossings that may be closed, the systems approach might be utilized, as discussed in Chapter III. With this method, several crossings in a community or rail corridor are improved by the installation of traffic control devices; other crossings are closed. This is accomplished following a study of traffic flows in the area to assure continuing access across the railroad. Traffic flows are sometimes improved by the installation of more sophisticated traffic control systems at the remaining crossings and, perhaps, the construction of a grade separation at one of the remaining crossings.

Table 34. Responsibility for Closing Public Crossings

State agency	Regulatory commission	Local jurisdiction	No code or authority specifically mentioned
Alabama*	Arizona	Alabama*	Alaska
Delaware	Arkansas	Illinois	Hawaii
District of Columbia	California	Iowa*	New Jersey
Florida	Colorado	Louisiana*	New Mexico
Georgia	Connecticut	Nebraska	
Idaho	Kansas*	Ohio	
Indiana	Minnesota	Texas*	
Iowa*	Mississippi		
Kansas*	Montana		
Kentucky	Nevada		
Louisiana*	New Hampshire		
Maine	New York		
Maryland	North Dakota		
Massachusetts	Oklahoma		
Michigan	Pennsylvania		
Missouri	Rhode Island		
Nebraska	South Carolina		
North Carolina	Tennessee*		
Oregon	Texas*		
South Dakota	Vermont		
Tennessee*	Virginia		
Utah	Washington		
Wisconsin	West Virginia		
	Wyoming		

** Shares responsibility with other state organization.*

Source: From Transportation Research Board 82nd Annual Meeting Compendium of Papers CD-ROM, January 12-16, 2003, Transportation Research Board of the National Academies, Washington, DC. Reprinted with permission.

Another important matter to consider in connection with crossing closure is access over the railroad by emergency vehicles, ambulances, fire trucks, and police. Crossings frequently utilized by emergency vehicles should not be closed. On the contrary, these crossings should be candidates for grade separations or the installation of active traffic control devices. Specific criteria to identify crossings that should be closed are difficult to establish because of the numerous and various factors that should be considered. The *Traffic Control Devices Handbook* suggests criteria that may be used for crossing closure. It is important that these criteria not be used without professional, objective, engineering, and economic assessment of the positive and negative impacts of crossing closures.

80 *Guidance on Traffic Control Devices at Highway-Rail Grade Crossings.* Washington, DC: FHWA, Highway/Rail Grade Crossing Technical Working Group, November 2002.
81 Carroll, Anya A. and Judith D. Warren."Closure of U.S. Highway Grade Crossings: A Status Report." Washington, DC: Transportation Research Board 82nd Annual Meeting Compendium of Papers CD-ROM, January 12-16, 2003.

Criteria for crossings on branch lines include:

- Less than 2,000 average daily traffic (ADT).
- More than two trains per day.
- Alternate crossing within 0.25 mile that has less than 5,000 ADT if two lanes or less than 15,000 ADT if four lanes.

Criteria for crossings on spur tracks include:

- Less than 2,000 ADT.
- More than 15 trains per day.
- Alternate crossing within 0.25 mile that has less than 5,000 ADT if two lanes or less than 15,000 ADT if four lanes.

Criteria for crossing on mainline:

- Any mainline section with more than five crossings within a 1-mile segment.

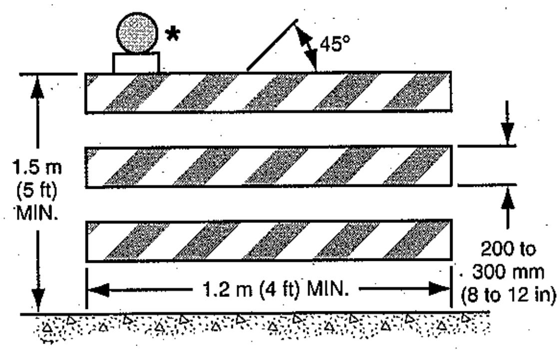
The guidance document developed by the U.S. DOT Technical Working Group provides specific criteria for screening of crossings for closure applicable to mainline trackage (see Chapter V). When a crossing is permanently closed to highway traffic, the existing crossing should be obliterated by removing the crossing surface pavement markings and all traffic control devices both at the crossing and approaching the crossing.

Generally, the railroad is responsible for removing the crossing surface and traffic control devices located at the crossing, such as the crossbuck sign, flashing light signals, and gates.

The highway authority is responsible for removing traffic control devices in advance of and approaching the crossing, such as the advance warning signs and pavement markings. Nearby highway traffic signals that are interconnected with crossing signals located at the closed crossing should have their phasing and timing readjusted.

The highway authority is also responsible to alert motorists that the crossing roadway is now closed. A Type III barricade, shown in Figure 10, may be erected. If used, this barricade shall meet the design criteria of Section 6F.63 of the *Manual on Uniform Traffic Control Devices* (MUTCD), except the colors of the stripes shall be reflectorized white and reflectorized red. Characteristics of a Type III barricade are provided in Figure 10.

Figure 10. Type III Barricade*



** Rail stripe widths shall be 150 millimeters (mm) (6 inches (in.)), except that 100-mm (4-in.) wide stripes may be used if rail lengths are less than 900 mm (36 in.). The sides of barricades facing traffic shall have retroreflective rail faces.*

Note: If barricades are used to channelize pedestrians, there shall be continuous detectable bottom and top rails with no gaps between individual barricades to be detectable to users of long canes. The bottom of the bottom rail shall be no higher than 150 mm (6 in.) above the ground surface. The top of the top rail shall be no lower than 900 mm (36 in.) above the ground surface.

Source: Manual on Uniform Traffic Control Devices, 2003 Edition. *Washington, DC: Federal Highway Administration, 2003.*

Warning and regulatory signing in accordance with MUTCD should be installed to alert motorists that the crossing roadway is now closed. These signs include the "Road Closed" sign (R11-2), "Local Traffic Only" sign (R11-3, R11-4), and appropriate advance warning signs as applicable to the specific crossing.

Consideration should also be given to advising motorists of alternate routes across the railroad. If trucks use the crossing being closed, they should be given advance information about the closure at points where they can conveniently alter their route.

1. Closure Programs

One grade crossing closure initiative was established by the Burlington Northern and Santa Fe Railway Company (BNSF) in 2000. This initiative is part of BNSF's grade crossing safety program, which has the goal of reducing grade crossing collisions, injuries, and fatalities. The grade crossing safety program also includes community education, enhanced crossing technology, crossing resurfacing, vegetation control, installation of warning devices, and track and signal inspection and maintenance. In March 2006, BNSF closed its 3,000th highway-rail grade crossing since the beginning of its grade crossing closure initiative. By eliminating unnecessary and redundant crossings, BNSF has made an important contribution to community safety while also improving the efficiency and safety of its rail operation. There are three key elements of BNSF's grade crossing closure initiative:

- A closure team was assembled, bringing together field safety and the public projects group in engineering.
- Closure candidates were identified by division engineering and transportation personnel.
- A closure database was developed to track progress.

Another example of a closure program is the effort begun by the North Carolina Department of Transportation (NCDOT) in 1993. North Carolina recorded its 100th crossing closure in 2004.[82] NCDOT criteria consider:

- Crossings within one-quarter-mile of one another that are part of the same highway or street network.
- Crossings where vehicular traffic can be safely and efficiently redirected to an adjacent crossing.
- Crossings where a high number of crashes have occurred.
- Crossings with reduced sight distance because of the angle of the intersection, curve of the track, trees, undergrowth, or man-made obstructions.
- Adjacent crossings where one is replaced with a bridge or upgraded with new signaling devices.
- Several adjacent crossings when a new one is being built.
- Complex crossings where it is difficult to provide adequate warning devices or that have severe operating problems, such as multiple tracks, extensive railroad-switching operations, or long periods of blocked crossings.
- Private crossings for which no responsible owner can be identified.
- Private crossings where the owner is unable or unwilling to fund improvements and where alternate access to the other side of the tracks is reasonably available.

82 *Consolidating Railroad Crossings: On Track for Safety in North Carolina.* Rail Division, Engineering and Safety Branch, North Carolina Department of Transportation, 2000 (www.dot.state.nc.us/).

NCDOT considers the following factors in deciding whether to close or improve a crossing:

- Collision history.
- Vehicle and train traffic (present and projected).
- Type of roadway (thoroughfare, collector, local access, truck route, school bus route, or designated emergency route).
- Economic impact of closing the crossing.
- Alternative roadway access.
- Type of property being served (residential, commercial, or industrial).
- Potential for bridging by overpass or underpass.
- Need for enhanced warning devices (four-quadrant gates, longer arm gates, or median barriers).
- Feasibility for roadway improvements.
- Crossing condition (geometry, sight distance, and crossing surface).
- Available federal, state, and/or local funding.

Closure implementation strategies used by NCDOT include:

- Constructing a connector road or improving roadways along alternate routes to direct traffic to an adjacent crossing.
- Dead-ending affected streets and rerouting traffic, creating cul-de-sacs.
- Constructing bridges.
- Relocating or consolidating railroad operations.

2. Crossing Consolidation and Safety Programs

A highly effective approach to improving safety involves the development of a program of treatments, including safety improvements, grade separations, and crossing closures, to eliminate significant numbers of crossings within a specified section of rail line while improving those that remain at grade. Both FRA and AASHTO have provided guidelines for crossing consolidation. State departments of transportation, road authorities, and local governments may choose to develop their own criteria for closures based on local conditions. Whatever the case, a specific criterion or approach should be used to avoid arbitrarily selecting crossings for closure. Examples include the previously noted NCDOT consolidation effort as well as the Alameda Corridor–East project in southern California, which was developed as a result of a grade crossing corridor study.[83]

83 *San Gabriel Valley Grade Crossings Study*, San Gabriel Valley Council of Governments, Korve Engineering, Inc., January 1997.

To improve crossing safety and provide a comprehensive approach to crossing consolidation, the traffic separation study approach is a worthwhile option. As part of a comprehensive evaluation of traffic patterns and road usage for an entire municipality or region, traffic separation studies determine the need for improvements and/or elimination of public highway-rail grade crossings based on specific criteria. Traffic separation studies progress in three phases: preliminary planning, study, and implementation.

Crossing information is collected at all public crossings in the municipality. Evaluation criteria include collision history; current and projected vehicular and train traffic; crossing condition; school bus and emergency routes; types of traffic control devices; feasibility for improvements; and economic impact of crossing closures. After discussions with the local road authority, railroad, state department of transportation, municipal staff, and local officials, these recommendations may be modified. Reaching a consensus is essential prior to scheduling presentations to governing bodies and citizens.

Recommendations resulting from a traffic separation study may include installation of flashing lights and gates; enhanced devices such as four-quadrant gates and longer gate arms; installation of concrete or rubber crossings; median barrier installation; pavement markings; roadway approach modifications; crossing or roadway realignments; crossing closures and/or relocation of existing crossings to safer locations; connector roads; and feasibility studies to evaluate potential grade-separation locations.

A key element of a traffic separation study is the inclusion of a public involvement element, including crossing safety workshops and public hearings. The goal of these forums is to exchange information and convey the community benefits of enhanced crossing safety, including the potential consequences to neighborhoods of train derailments containing hazardous materials resulting from crossing collisions. Equating rail crossings to highway interchanges, something the average citizen can relate to, greatly assists in reinforcing the need for eliminating low-volume and/or redundant crossings.[84]

84 *Guidance on Traffic Control Devices at Highway-Rail Grade Crossings.* Washington, DC: FHWA, Highway/Rail Grade Crossing Technical Working Group, November 2002.

F. Abandoned Crossings

Highway-rail grade crossings on abandoned railroad lines present a different kind of safety and operational problem. Motorists who consistently drive over crossings that are not maintained but have traffic control devices and at which they never see a train may develop a careless attitude and not take appropriate caution. Motorist may maintain this attitude and behavior at crossings that have not been abandoned, perhaps resulting in a collision with a train. Thus, credibility of crossing traffic control devices may be reduced, not only for the abandoned crossing but for other crossings as well.

Operational problems exist for abandoned crossings where existing traffic control devices and/or tracks for the crossing have not been removed. A careful motorist will slow down in advance of every crossing, especially those with passive traffic control devices. If the track has been abandoned, unnecessary delays result, particularly for special vehicles required by federal and state laws to stop in advance of every crossing. These special vehicles include school buses, vehicles carrying passengers for hire, and vehicles transporting hazardous materials. In addition, these vehicles may be involved in vehicle-vehicle collisions because other motorists might not expect drivers of these vehicles to stop.

The desirable action for abandoned crossings is to remove all traffic control devices related to the crossing and remove or pave over the tracks. The difficulty is in identifying abandoned railroad lines. For example, a railroad may discontinue service over a line or a track with the possibility that another railroad, particularly a short-line railroad, may later purchase or lease the line to resume that service. These railroad lines are called inactive lines and, obviously, removing or paving over the track will add substantial cost in reactivating the service.

Another type of inactive rail line is one with seasonal service. For example, rail lines that serve grain elevators may only have trains during harvest season. The lack of use during the rest of the year may cause the same safety and operational problems described earlier.

The first step in addressing the problem of crossings on abandoned rail lines is to obtain information from the Surface Transportation Board (STB) or a state regulatory commission. Railroads are required to apply to STB for permission to abandon a rail line. In addition, some state laws require railroads to also apply for permission or to notify a state agency of intentions to abandon the line. The state highway engineer responsible for crossing safety and operations