



U.S. Department
of Transportation
**Federal Railroad
Administration**

Rail-Highway Crossing Safety Report



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EXECUTIVE SUMMARY

MAGNITUDE OF THE PROBLEM

Over the years, the Federal Railroad Administration (FRA) has worked closely with the Federal Highway Administration (FHWA), the States, the railroad industry, rail labor, suppliers, the National Safety Council (NSC), and other parties to reduce the number of accidents and fatalities at rail-highway crossings. These efforts have produced dramatic results. Between 1978 and 1983, crossing accidents, fatalities, and injuries declined each year, with the cumulative decline for each category reaching nearly 50 percent.

Because of our commitment to continuing that improvement, and because 52 percent of the fatalities attributable to railroad operations had occurred at rail-highway crossings, in 1984 FRA initiated a series of inquiries into crossing safety. The purpose of the inquiries was twofold: to create a national forum for seeking out the best ideas on how the human resources of each agency and institution concerned with rail-highway crossing safety could be most effectively utilized and to examine issues relating to the reliability of crossing warning devices.

This report summarizes the conclusions drawn from the national forum, reviews the statistics on rail-highway safety, and chronicles both past and present efforts to improve safety at rail-highway crossings. It also includes FRA's recommendations on future actions to reduce the number of rail-highway crossing accidents and fatalities.

In 1983, there were 7,161 accidents at rail-highway crossings which led to 575 fatalities and 2,623 injuries. This represents the lowest absolute number of accidents and casualties since the Federal Government began compiling these statistics in 1920. These numbers represent about a 50-percent improvement from 1978.

Raw data for 1984 reflects an increase over 1983 in accidents, fatalities, and injuries when compared to the previous year. However, in 1984 the railroad industry also experienced a significant increase in train miles. When normalized to an accident rate per million train-miles, the number of accidents is down more than 4 percent (12.29 accidents per million train-miles).

There are over 370,000 public, private, grade-separated (bridges), and pedestrian crossings in the United States. Public at-grade crossings number approximately 200,000; 56,000 (28 percent) have a device to warn motorists, such as flashing lights and gates, that is activated by an approaching train. The remainder of the public crossings have signs to warn the public.

CURRENT EFFORTS TO ENHANCE RAIL-HIGHWAY SAFETY

Several education and engineering programs were initiated over the last 12 years to improve rail-highway crossing safety. The following is a description of these efforts, with comments provided by participants to the FRA hearings:

203 Funding: Under Section 203 of the 1973 Highway Safety Act, Congress dedicated a portion of the Highway Trust Fund for rail-highway crossing safety improvements. This program was subsequently renewed for each succeeding year. The FHWA administers the Section 203 Program. Through 1986, when the current categorical program expires, about \$2 billion will have been allocated to the States for crossing safety improvements. Approximately 20,000 public crossings have been equipped with train-activated warning devices. Other improvements include: new, smoother crossing surfaces, signs, realignments, clearances of visual obstructions, pavement markings, improvements in train-detection circuitry, illumination, elimination of little-used crossings, and standardization of signs, markings, and signals.

At the FRA safety inquiry hearings, most participants explicitly acknowledged the important contribution made by Federal highway funding in reducing hazards at crossings through installation of warning devices and other means. The railroad industry also urged expansion of eligibility to include upgrading of existing active-warning devices.

The Department of Transportation (DOT) has supported legislation which would continue to make rail-highway crossing safety improvements eligible for FHWA funding. While witnesses differed on whether a categorical or block grant would provide the most effective delivery system, all witnesses agreed that eligibility for Federal highway funding should be retained.

Operation Lifesaver: Operation Lifesaver is a public information and education program operated by the NSC to reduce accidents, fatalities, and injuries at rail-highway crossings. Through a program of educating motorists to the dangers at crossings, of encouraging enforcement of safety laws, and of improving crossing engineering, Operation Lifesaver has made a major contribution to the decrease in accidents. Forty-seven States have participated in the program.

The effectiveness of the program as a public education medium has been clearly demonstrated. All States with Operation Lifesaver programs have reported to the National Safety Council significant fatality reductions at crossings within one year after establishing the program. The fatality rate in Idaho dropped a resounding 39 percent at the end of the first year and Nebraska demonstrated even more impressive results after a one-year period--a 46 percent reduction in rail-highway crossing fatalities.

FRA has at least one Operation Lifesaver Coordinator in each of its eight regions. These offices encourage State and local participation in Operation Lifesaver and promote safety efforts. In 1984, FRA employees made over 1,000 contacts on behalf of Operation Lifesaver programs and directly reached nearly 100,000 people.

Participants at the FRA hearings praised the dedication of the people involved in Operation Lifesaver and the success of the program. The NSC and other participants advocated expansion of the program. Funding was recommended to educate drivers, especially schoolbus drivers, and future drivers. Witnesses urged additional efforts to enlist the assistance of law enforcement officials in more rigorously enforcing the law against those who fail to heed active warnings at crossings.

Crossing Inventory/Accident Reports: Since 1976, FRA has processed and analyzed crossing demographic and accident data provided by States and railroads. The National Rail-Highway Crossing Inventory contains site-survey data on all U.S. rail-highway crossings. FRA updates the file from information provided by States and railroads. In addition, railroads are required to report to FRA all crossing accidents. This information is essential to assess safety trends and to perform risk analyses to assist in prioritization of 203 funding.

At the FRA hearings, the American Trucking Association recommended that information on the type and size of trucks involved in crossing accidents/incidents be noted in an accident report.

Corridor System Approach: Recent efforts in Illinois, Florida, Minnesota, and South Dakota on a corridor approach to evaluate and improve crossing safety have proved effective. In the systems approach, all rail-highway crossings in a community or on a corridor are evaluated by a diagnostic team which considers the traffic flow patterns in the community, access to emergency services, bus routes, train traffic characteristics, train speeds, and other factors. Decisions are made from among alternative improvements for each crossing. The usual solution, if traffic flow and priorities dictate, is to decide on automated train-activated warning devices or nothing at all. When a corridor or systems approach is employed low-cost improvements, such as brush clearing, new signing, street lights, or pavement markings, are more often considered and applied. The corridor approach has demonstrated that implementation of lower cost strategies at all crossings along a rail line can significantly alleviate conflicts. All participants at the FRA hearings endorsed the continuation and expansion of the corridor approach.

Research: FHWA and FRA jointly sponsored a research program that has developed and made available to States and railroads a Resource Allocation Procedure and Accident Prediction Formulas. These computerized management tools can assist program managers in planning their crossing safety improvements. Some States and railroads have utilized the published User's Guide and have established their own internal procedures. Others continue to request resource allocation and accident prediction listings from the FRA. More recent research has produced Severity Prediction Formulas for rail-highway crossing accidents. Once completed, this work has the potential to provide an additional tool to help managers select projects and manage their programs.

The State of Texas has a program that encourages individuals to notify its State Department of Public Safety, via a toll-free telephone number, of malfunctioning train-activated signals. The information is then passed to the appropriate railroad. No assessment has been made yet on the accuracy of the information received from the calls or on the corrective action taken.

BUILDING ON PAST PROGRESS--RECOMMENDATIONS

FRA believes that crossing safety programs implemented over the last several years have proven effective and played a major role in the reduction of accidents and fatalities. If this progress is to continue, a renewed effort will be required by all parties. Current initiatives have proven effective and must be continued; in addition, new ideas, action plans, and research will be required.

The following initiatives, in our judgment, have the strongest chance of decreasing the number and severity of rail-highway crossing accidents. (The FRA recommendations are grouped according to education, enforcement, engineering and evaluation.)

Education: Rail-highway crossing accident data, and the history of Operation Lifesaver, provide a graphic example of how effectively public education can work if properly targeted. The propensity of motorists to run through or drive around even the most plainly marked crossings brings home the fact that for all our improvements in technology, an effective public education program will remain at the heart of future efforts to reduce accidents and fatalities. Implementation of the following recommendations would maximize the effectiveness:

- o Operation Lifesaver is the fulcrum program of the public education effort. It should be a fifty State program. And it is essential for everyone with a stake in rail-highway crossing safety -- railroads, organized labor in both the railroad and trucking industry, public agencies, automobile associations, trucking organizations, and educators, among others -- to intensify their commitments of time and human resources to the Operation Lifesaver program.

- o Under the leadership of NSC, a standard rail-highway crossing safety pamphlet should be developed for inclusion in all highway license manuals. A shortened form of the pamphlet should be designed for inclusion in all license renewal application packages sent to motor vehicle drivers.
- o Motorists' failure to appreciate the difference in stopping capability between a moving train and a truck or automobile appears to be a major, and possibly the major contributing factor in rail-highway accidents. A standard passage illustrating the difference in stopping capability between a rubber tire on pavement and a steel wheel on a steel rail should be incorporated in every driver training manual. A question on the point should be incorporated in every written driver examination.
- o Public education should not be delayed until an individual reaches the legal driving age. Educators at the primary and secondary school level should work to build awareness of the dangers through such devices as poster contests and safety campaigns.

Enforcement: In 1984, more than one-half of all rail-highway crossing accidents occurred at crossings with gates, bells, or flashing lights. In addition to educating motorists about the hazards of disregarding active warning devices, law enforcement officers, the courts, and State and local legislators must strengthen and consistently enforce safety laws. Strict law enforcement does have an impact on human behavior. It is a sad irony that drivers will slow to 25 mph in a low speed zone to avoid a traffic ticket, but will not stop at a marked crossing to protect their lives. Recommendations:

- o Local law enforcement officials must increase (and visibly increase) surveillance at heavily traveled crossings, and more strictly enforce crossing laws on those who violate them.
- o Law enforcement and railroad officials should initiate pilot programs in which railroad personnel identify those crossings which have repeated active warning device violators and then inform local police about train schedules so law enforcement officials can schedule surveillance at these "high exposure" points.
- o Operation Lifesaver officials should work with law enforcement and judicial organizations to develop special presentations emphasizing the importance of visible efforts to enforce crossing laws.

Engineering: The \$1.6 billion allocated to the States for crossing improvements has greatly reduced the physical and operational problems of the Nation's most hazardous crossings. Reality suggests, however, that many of the remaining crossings serve rail-highway traffic volumes too low to ever justify installation of automatic warning devices. We must develop low cost mechanisms to better safeguard these "low volume" crossings if we are to have any real expectation of further improvement in accident ratios. Recommendations:

- o Safety improvement at rail-highway crossings should remain eligible for funding through the Federal Highway Trust Fund. Eligibility should extend not only to the installation of automatic warning devices, but also to lower cost alternatives for crossings where rail-highway volumes cannot justify the installation of automatic devices.
- o To address problems arising at these "low volume" crossings, there is a pressing need for development and perfection of low cost alternatives to the automatic warning device. Such alternatives range from special pavement markings to grading and lighting improvements; from seasonal factors, such as winter snow removal, to brush control. Federal agencies like FRA are in a unique position to serve as focal points for gathering information on experiences and innovations throughout the 50 States, and ensuring that they are effectively communicated to State and local officials.
- o FHWA efforts to promote low cost alternatives on a corridor by corridor basis deserve support. FRA will make its field inspectors available upon request to evaluate risk exposure at existing crossings, and advise State and local officials on corridor resource allocation decisions.
- o It is essential to focus available resources on projects where the dollars spent will produce the greatest return in real safety improvement. Funds available for grade crossing safety enhancement are finite. Investing those dollars in projects with low cost benefit ratios can have a negative safety impact by drawing funds away from projects with a greater impact on human safety.

Evaluation: The NSC, FHWA, and FRA, individually and at times collectively, are conducting or sponsoring research on educational, engineering, operational, and analytical ways to improve crossing safety. These efforts should continue; expanded participation by the private sector and State officials could meaningfully enhance their success. Recommendations:

- o FRA should complete the development and refinement of its accident severity prediction formulas, and share their data with State and local planning officials. The data should be incorporated into resource allocation procedures, and used in the preparation of both FRA and individual carrier inspection plans.

- o FRA and NSC should evaluate the Texas "800 number" experiment, and on the basis of that evaluation, advise other States on the potential impact of a national expansion of the program.
- o FRA and the FHWA should expand their accident prediction formulas to develop corridor accident and severity prediction formulas, which identify a series of crossings that should receive priority evaluation for corridor solutions.
- o The National Inventory indicates that approximately 12,200 crossings do not have warning signs. There is a pressing need for States to accelerate the placement of signs at the crossings that lack signage. The lack of even the most rudimentary warning sign at these crossings constitutes a continuing public safety exposure.
- o Federal and State agencies should jointly study the impact of potential litigation exposure on State usage of data from the crossing inventory and accident prediction formulas.

MAGNITUDE OF THE PROBLEM

CROSSING STATISTICS

The National Rail-Highway Crossing Inventory, a database maintained by the Department of Transportation (DOT) and the Association of American Railroads (AAR), contains data for over 370,000 crossings, public, private, grade-separated (bridges), and pedestrian. Over 200,000 are public, at-grade motor vehicle crossings. Today, just over one-quarter (53,810) of the public at-grade crossings have automated train-activated warning devices, flashing lights or flashing lights with gates. (See Table 1.)

Table 1

Total Public-at-Grade Crossings with Active
Warning Devices, by Category and Year

Category	1981	1982	1983	1984
Gates	16,899	18,429	19,473	20,136
Flashing Lights	34,600	34,396	34,120	33,674
Signals, Wigways, Bells	<u>2,868</u>	<u>2,731</u>	<u>2,618</u>	<u>2,507</u>
TOTAL	54,367	55,556	56,211	56,317
<hr/>				
Total Crossings (Active and Passive)	213,907	209,541	205,339	200,730

Source: Federal Railroad Administration.

ACCIDENTS AND CASUALTIES

Of the 7,281 rail-highway crossing accidents that occurred in 1984, 649 fatalities resulted, which account for over half of all the fatalities stemming from rail operations. (See Figure 1.) Although absolute numbers in 1983 were lower, the crossing accident rate per million train-miles traveled decreased more than 4 percent in 1984. Even when normalized by train-miles, however, the fatality and injury rates increased in 1984. (See Table 2 and Figures 2 and 3.)

Table 2

Rail-Highway Crossing Accidents, 1980-84

<u>Category</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>
Accidents	10,611	9,295	7,748	7,161	7,281
Fatalities	833	728	608	575	649
Injuries	3,890	3,293	2,637	2,623	2,910
Accidents/Million Train-Miles	14.79	13.75	13.51	12.83	12.29
Fatalities/Million Train-Miles	1.16	1.08	1.06	1.03	1.10
Injuries/Million Train-Miles	5.42	4.87	4.60	4.70	4.91

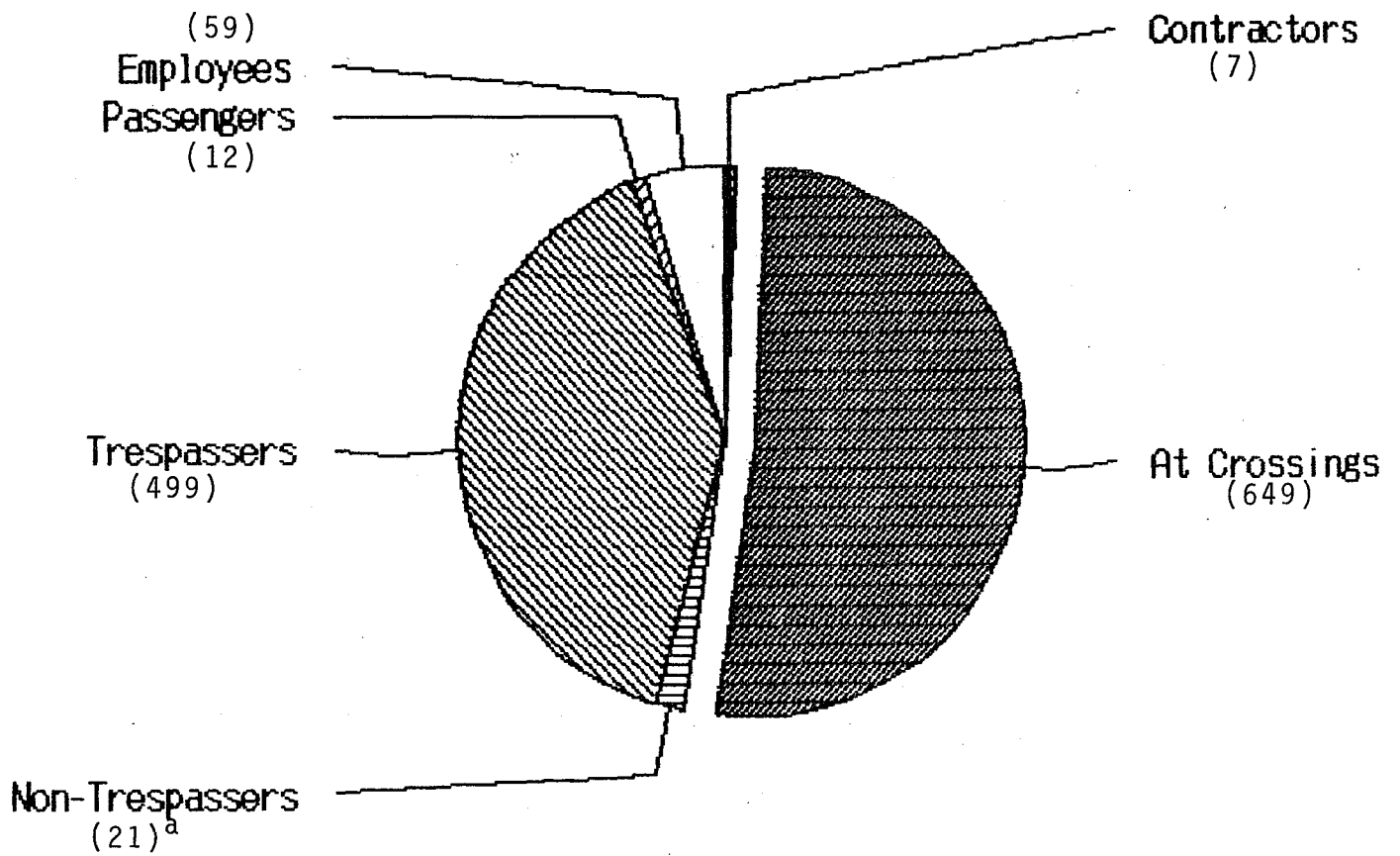
Source: Federal Railroad Administration.

ACCIDENT HISTORY

Rail-highway crossing accident and casualty records have been in existence since 1920.¹ In that year, 1,791 persons died in accidents at public rail-highway crossings. The number peaked in 1928 (2,568 died), fluctuated downward, and finally reached a low of 1,203 fatalities in 1959. The increase, which began again in 1960, drew national attention by the mid-1960's when it peaked at 1,780 fatalities in 1966. (See Figure 4.)

¹ Accident reporting by the railroads has been required by law since the Accident Reports Act of 1910. Current requirements stipulate that any accident involving "on track" equipment and a highway user at a crossing must be reported as a crossing accident. There is no dollar damage or casualty-reporting threshold--all crossing accidents must be reported. This has not always been the case, however; prior to 1975 either a \$750 threshold (damage to railroad equipment) had to be exceeded or a casualty had to result before the accident was reportable. Therefore, accident statistics prior to 1975 are not comparable to current figures.

Figure 1

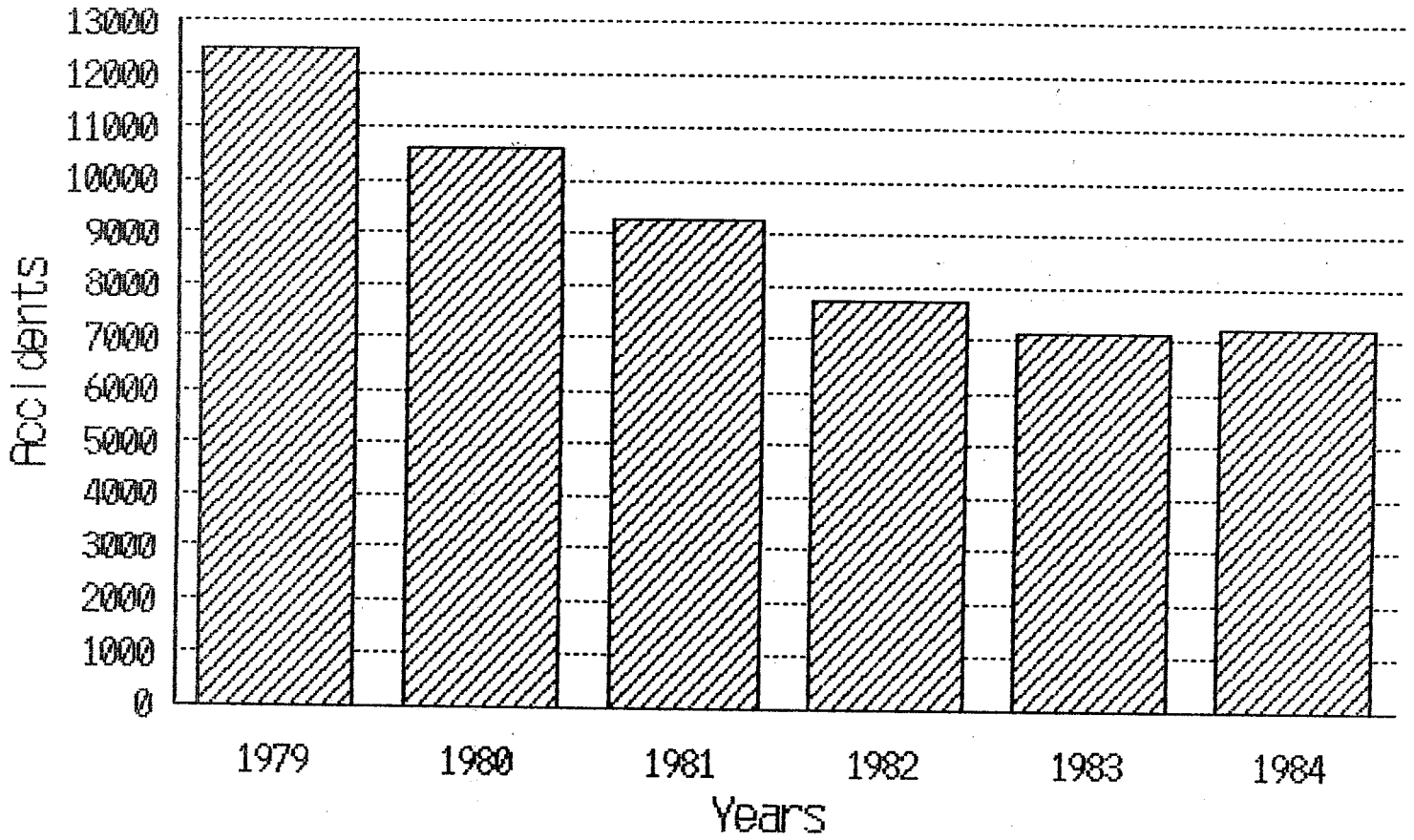


1984 Fatalities in US Rail Operations

^aLegally allowed on railroad property, but not an employee.

Source: Federal Railroad Administration.

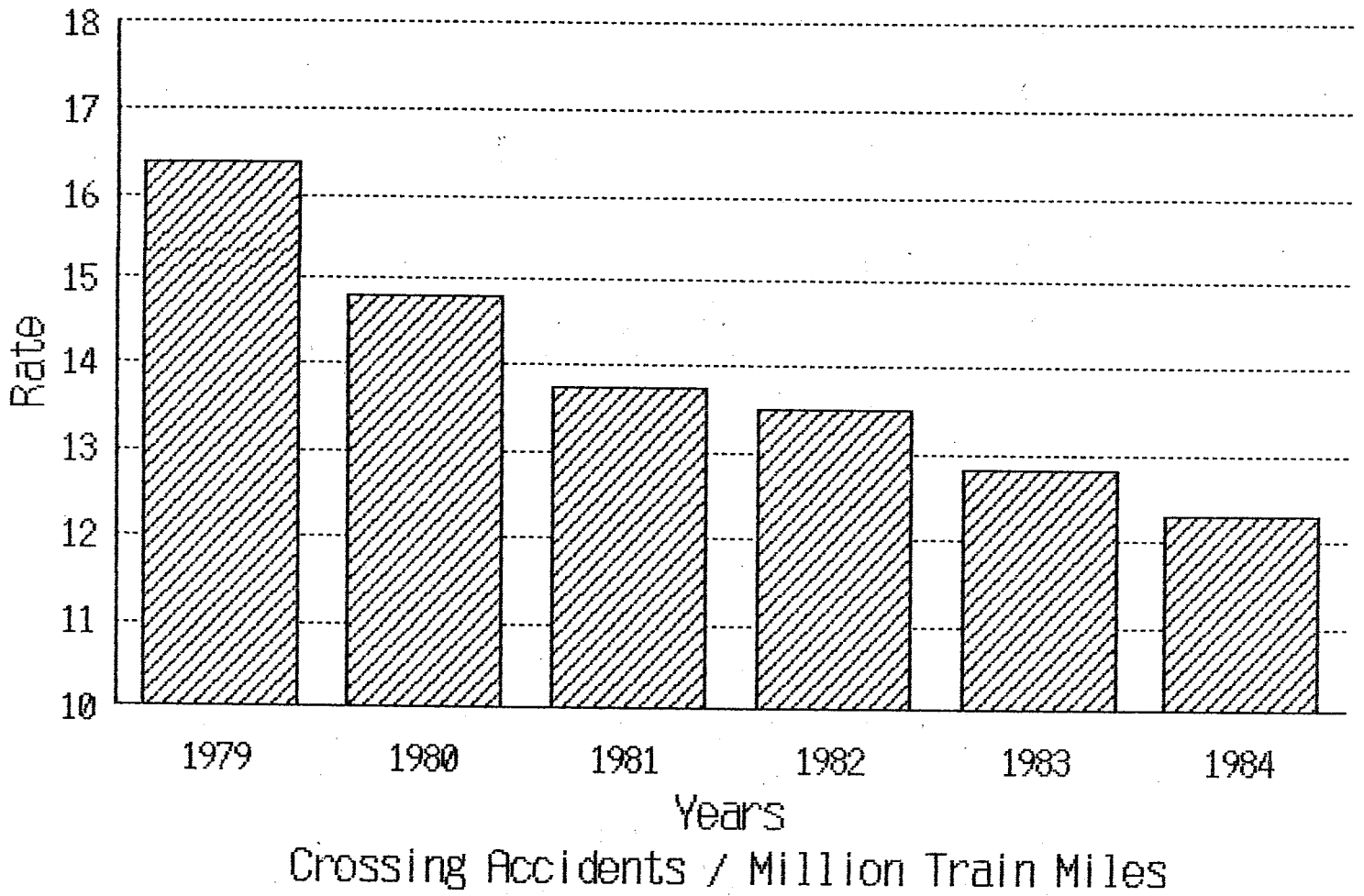
Figure 2



US Rail-Highway Crossing Accidents

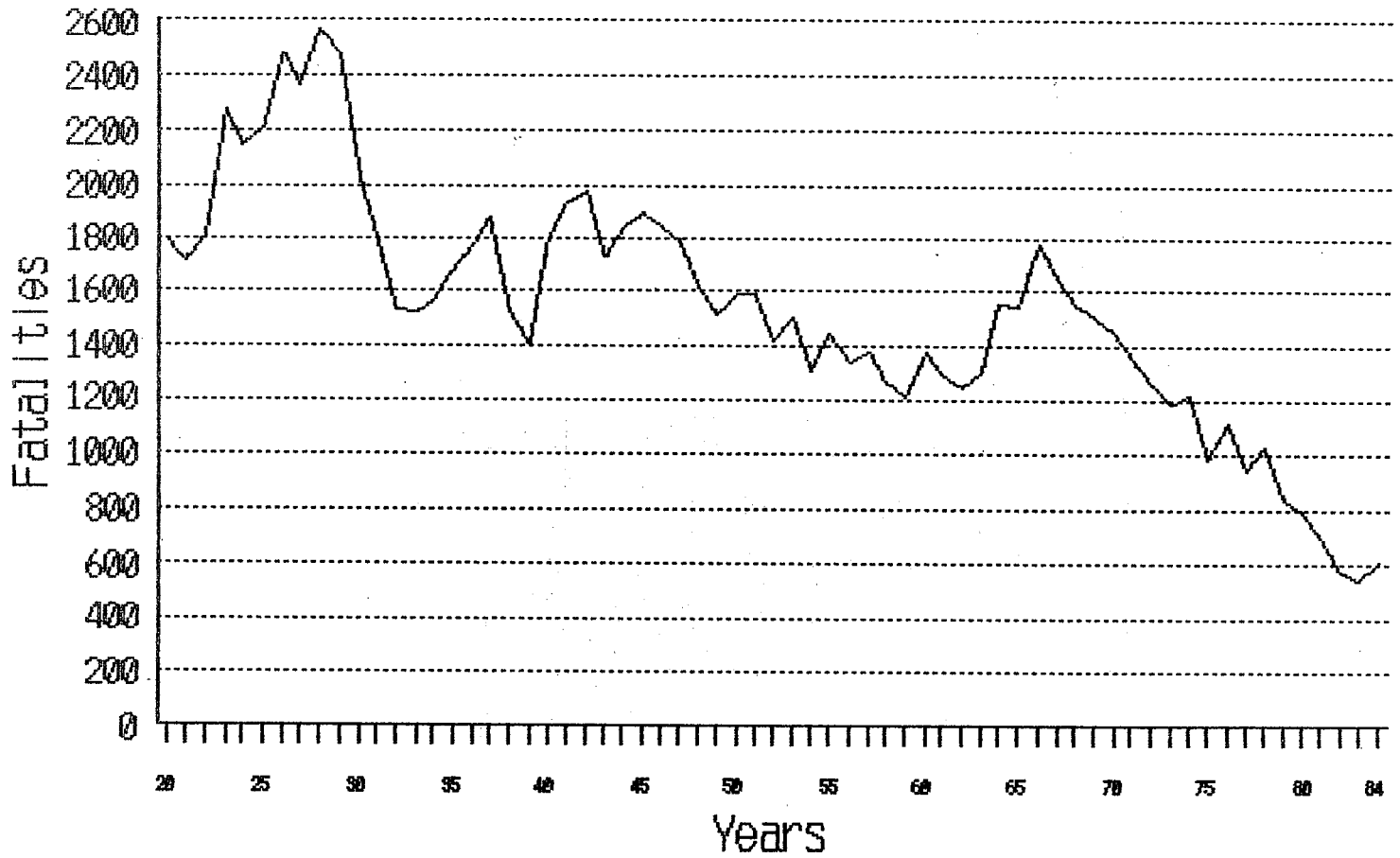
Source: Federal Railroad Administration

Figure 3



Source: Federal Railroad Administration

Figure 4



Fatalities at Public Crossings (1920-84)

Source: Federal Railroad Administration

EFFORTS TO ENHANCE RAIL-HIGHWAY SAFETY

INTERSTATE COMMERCE COMMISSION

In 1964, an Interstate Commerce Commission (ICC) report, Prevention of Rail-Highway Grade-Crossing Accidents Involving Railway Trains and Motor Vehicles, assessed the rail-highway crossing problem and the existing programs. The report contained two major points: Federal, State, and local authorities must work together, and existing safety regulations at rail-highway crossings must be strictly enforced. Other points included:

- o The need for uniform standards for selecting sites for the installation of warning devices or for the closing of crossings to certain heavily loaded vehicles or hazardous materials-carrying vehicles
- o Congress should consider providing public funds for installation and maintenance of warning devices
- o Public (driver) education programs hold considerable promise for improving safety
- o Construction and maintenance of rail-highway crossing separation structures and automatic warning devices are a public responsibility

FEDERAL RAILROAD ADMINISTRATION

When the Federal Railroad Administration (FRA) was established in 1967, and responsibility for railroad safety was transferred from the ICC, one of FRA's first activities was the sponsorship of a national conference on the crossing safety problem. The conference, held in December 1967 at the Texas Transportation Institute, sought to improve communication between principals (State and railroad officials) and to better define the problems. Seven additional national conferences have been held since 1967; another will be held in July 1985. The awareness and unity of purpose that were gained in the early meetings heightened the interest of the Congress.

CONGRESS

Responding to increased national awareness, in the Railroad and Highway Safety Acts of 1970, Congress directed the Secretary of Transportation to conduct a study of rail-highway crossings and to report its recommendations back to the Congress. Working together, the Federal Highway Administration (FHWA) and the FRA produced a two-part report. The first, published in 1971, was entitled A Comprehensive Statement of the Problem, and the second, published in 1972, was entitled, Recommendations for Resolving the Problem. The reports reiterated the need for a publicly funded solution--a goal of installing lights or gates at 30,000 crossings, nationwide, which it was estimated would reduce accidents and casualties by 50 percent. The establishment of a centralized database for crossing information was also stipulated.

203 FUNDING PROGRAM

In response to a Department of Transportation (DOT) recommendation for a publicly funded solution to reduce crossing accidents, in the Highway Safety Act of 1973, the Congress established a categorical highway safety program, to be subsidized from the Highway Trust Fund. Funds authorized for appropriation could be used by States for up to 90 percent of crossing project costs. In the 1973 legislation, only crossings on the Federal-aid highway system were eligible for funding. The 1976 Act provided some funding for off-system crossings; and the limitation was totally lifted when the Highway Safety Act of 1978 made rail-highway crossings on any public road eligible for money. This legislation also required that at least half the funds be spent on the installation of automatic warning devices.

As shown in Table 3, between 1974 and 1986, the Federal Government will have made available approximately \$2 billion² for 90 percent of the cost of rail-highway crossing safety improvement projects. The matching 10 percent must come from another source (State and local governments or the railroads).

Two additional provisions of the 1973 Act still in effect stipulate that: (1) each State shall conduct and systematically maintain a survey of all highways to identify those railroad crossings that may require separation, relocation, or warning devices, and establish and implement a schedule of projects for this purpose; and (2) at a minimum, such a schedule shall provide signs for all railroad-highway crossings.

Oversight responsibility for the 203 Program belongs to the FHWA, but project priorities are determined by the individual States in cooperation with local government representatives and railroad officials. The FHWA allocates funds to each State in accordance with a congressionally defined formula, and insures that project selection, progress, completion, and accounting follow Federal regulations and standards. Projects eligible for 203 Program funding include train-activated warning devices (traditional lights and gates), signs and pavement markings, illumination (street lights), crossing closure, improved track circuitry and highway surfaces, brush clearance, highway approach modifications, and other sight-distance improvements.

Fiscal Year 1984 was a record-setting year: \$243.9 million was obligated under the 203 Program. Also, \$146.4 million of other Federal-Aid Highway Funds was obligated by States for crossing projects.

² Of the \$2.1 billion authorized through FY 1986, \$190 million will not be available until FY 1986, \$88 million has been transferred out of the program for other highway safety needs, and \$32 million has been used by FHWA for administrative costs of the program.

Table 3

Federal Authorizations for Rail-Highway Crossing Safety

(Million \$)

Year	Crossings On-system	Crossings Off-system	All Crossings	Total
Highway Safety Act of 1973:				
74	25			25
75	75			75
76	75			75
Highway Safety Act of 1976:				
77 ^a	125	93.75		218.75
78	125	75		200
Highway Safety Act of 1978:				
79			190	190
80			190	190
81			190	190
82			190	190
Highway Safety Act of 1982:				
83			190	190
84			190	190
85			190	190
86			190	190
Total	425	168.75	1,520	2,113.75^b

^a Includes 3 additional months for the transition quarter which covered the period from July 1, 1977, to September 1, 1977, when Congress changed the Federal fiscal year to October 1-September 30.

^b Of the \$2.1 billion authorized through FY 1986, \$88 million has been transferred from the program for other highway safety needs, and \$32 million has been used by FHWA for administrative costs of the program.

Source: Federal Railroad Administration.

THE INVENTORY

The requirement that States maintain a survey of all crossings provided the impetus for creating the U.S. DOT/AAR National Rail-Highway Crossing Inventory. The Inventory took shape in the mid-1970's. Between 1973 and 1975, every rail-highway crossing in the Nation was visited and numbered, and relevant data were collected. These data included location information, environment³, type of rail and highway traffic signs, signals, and surfaces. An unprecedented tripartite effort, it involved the Federal Government, every State Government, and all the Nation's railroads. DOT provided \$2.1 million which was matched by the industry for a total cost of \$4.2 million.

In 1976, FRA assumed custodial responsibility for the inventory which then contained a total of 402,000 crossings. Since 1976, the FRA has received and processed file changes (updates) originated by either railroads or States. Last year, more than 80,000 changes were processed. Updating the National Inventory is voluntary, for although States are required to "maintain a survey," they are not required to submit it into the national file.

The file is used extensively by program managers at the Federal, State, and local levels, as well as by railroad officials. Use of the file by researchers, litigants, investigators, and consultants is also widespread. The Inventory is often combined with accident reports, thus providing a history and a profile of a crossing.

When the Inventory was originally established (1973-1975), between 5 and 10 percent of the database was expected to be updated and adjusted each year to keep the data functional. Although these estimates have been exceeded since 1977 and the numbers of adjustments are high, updates are not automatically received from all States and railroads. Generalized statements regarding the accuracy of the database and its usefulness are not pertinent since most applications are specific (to a single State, county, railroad, or crossing), not general. In 1978, a series of workshops was held by FRA and FHWA in various parts of the United States to provide a forum to discuss, evaluate, and enhance updating procedures. The workshop discussions, summarized in a report Regional Railroad-Highway Grade Crossing Workshops, contained a list of suggestions made by participating States and railroads.

³ Type of development: for public crossings--open space, residential, commercial, industrial; for private crossings--farm, residential, recreational, industrial.

By 1980, the original U.S. DOT/AAR National Rail-Highway Crossing Inventory and Numbering Project Advisory Committee (ADCOM) had reconvened and established a Task Force to consider the workshop suggestions. (ADCOM oversaw the development of the Inventory from its conception.) The Task Force was instructed to present to ADCOM a set of proposed changes to modify the National Inventory so that it would fulfill the needs of States and railroads in maintaining a current and accurate data base.

As the Task Force met 20 times between April 1980 to April 1982, six topical categories emerged: (1) short-term suggestions; (2) universal updating; (3) mass changes; (4) data elements; (5) reduction of lag time; and (6) feedback. Initially, the Task Force addressed only those issues that could be resolved in the short-term and would facilitate greater participation by States and railroads. In July 1980, the ADCOM confirmed the interim changes documented in A Supplement to the National Railroad-Highway Crossing Inventory Update Manual. Two procedures for making mass updates to the national file were endorsed: (1) A "fill-in-the-blanks" list and (2) magnetic tape in a prescribed format.

The Supplement also announced the availability of continuous-feed update forms, options available for obtaining feedback from the National Inventory, and conditions under which FRA would accept submissions of fresh data from either a State or a railroad--even if they were not reviewed by the other party (as established in the original update procedures). Such updates are now called "single party submissions."

In 1982, the Task Force gave the ADCOM a list of proposed changes which were organized into three categories: (1) changes to the data elements included in the National Inventory; (2) changes to the procedures for updating the National Inventory; and (3) instructional changes and needs. The FHWA distributed the proposed changes to its field offices, and the AAR distributed them to railroads attending its annual regional workshops.

Recognizing the potential impact on the National Inventory, if all the proposed changes were implemented, the FRA contracted in September 1983 for a study of the changes in terms of their impact on the FRA, the States, and the railroads. The contractor assessed how the effects of the proposed changes would improve State and railroad participation. The cost of each change was estimated, and the usefulness of each change was explored with FRA, FHWA, selected States, and railroads. A final report was sent to the members of ADCOM who will discuss it prior to the National Conference in July, 1985.

In 1986, FRA will implement filing and other procedural changes that were developed and coordinated by the State and industry Advisory Committee. The changes are to existing software and data handling procedures and will be reflected in the publication of a new Update Manual for Inventory users.

SELECTING A CROSSING PROJECT

Warning devices or circuitry systems were either installed or improved at more than 3,000 crossings in FY 1984. The State planner who must select which crossing merits improvement has an increasingly complex task. Those crossings in such obviously dire need in 1974 have been improved. Differences among crossings today are often subtle; the sheer number of potential projects can be staggering. (Seventeen States have more than 5,000 public at-grade crossings.) The average cost to install flashing lights with gates is \$65,000. The net present value of maintaining the flashing lights and gates over their useful lifetime is \$18,700. Flashing lights and gates have been shown to reduce accidents by 83 percent when a comparison is made to the same crossing without lights and gates.⁴ At the same time, it is generally recognized that the majority of the nation's crossings lack sufficient volume to justify the installment of flashing lights and gates.

The FHWA has established minimum planning considerations, some of which apply to all highway safety improvement programs, and some of which apply only to rail-highway crossing safety improvements. State highway planners must collect and maintain a record of accident, traffic, and highway data, including the types of highway and train traffic. Planners must have a process to identify hazardous locations and must conduct engineering studies to show whether safety will be improved. Priorities are based on the potential for reducing accidents and accident severity, costs, and resources. And, where rail-highway crossings are concerned, priorities are judged on a relative hazard-index formula, on-site inspection, and the exposure of large numbers of people on passenger trains, school buses or transit buses, pedestrians, and bicyclists, as well as on the basis of the numbers of trains and vehicles carrying hazardous materials. Individual State planners may add to these criteria.

A detailed annual assessment of each of these factors for all crossings as funds become available is an impossible manual task. Recognizing this, the FRA and the FHWA have jointly sponsored the development of a Resource Allocation Procedure which uses available national data (the U.S. DOT/AAR National Rail-Highway Crossing Inventory and the Railroad Accident/Incident Reporting System, for crossing accident reports). The procedure considers accident history, accident predictions, costs, available resources, option effectiveness values, rail and highway traffic data, and allows for the manual introduction of variables determined on-site during a field inspection by a State, railroad, and local diagnostic team.

⁴ Draft, Rail-Highway Crossing Resource Allocation Procedure User's Guide, Second Edition, not yet published.

Use of this procedure can reduce several thousand potential rail-highway crossing projects to a workable number that can then be subjected to rigorous analyses before final project decisions are made.

From the available databases, the FRA provides, on request, the initial computer listings to States and railroads. Several States and some railroads utilize all or parts of these automated procedures in their planning cycles. A User's Guide, published by the Transportation Systems Center (TSC) and available from FRA, documents the procedure. The widely distributed comprehensive guide allows a user to implement and operate the procedure without assistance from FRA or FHWA.

The current Resource Allocation Procedure uses accident predictions and accident history (per FHWA guidelines), but considers all past and predicted accidents equally. The procedure makes no distinction based on past or predicted accident severity. A July 1984 report entitled Accident Severity Prediction Formula for Rail-Highway Crossings provides the first analytic tool for making such a distinction. However, the severity prediction formula has not yet been incorporated into the Resource Allocation Procedure. A new User's Guide (second edition) incorporates the severity formula as a procedural option. (The new guide also updates cost and effectiveness figures that were originally published in the December 1982 guide. A draft version of the new guide is under review, and a final version should be available in late 1985.)

SIGNAGE

The Highway Safety Act of 1973 required the installation of standard crossbucks, as a minimum, at all crossings. Shortly after the legislation was enacted, according to the inventory data, 15,316 crossings were without any warning signs. Each State was asked to submit a schedule for meeting the minimum signing and marking standards for crossings on all streets and roads. Five States reported that the signs and markings at essentially all crossings complied with the minimum standards. Twelve States reported they had signing and marking schedules already in place; the remaining States had no schedules.

By 1984, 22 States had reported to FHWA that all crossings complied with the minimum standards. Schedules for the other States, when reported, extended through the year 2000. Those States either not reporting or not in compliance cited management and coordination problems, manpower limitations, financial constraints, and limited inventory data as reasons for not scheduling the installation of signs at crossings. Today there are 12,196 crossings, some in every State (except Hawaii), without either signs or signals according to the National Inventory. FHWA is continuing to work with the States to expedite the installation of signs at all crossings.

LOW-COST IMPROVEMENTS, THE CORRIDOR APPROACH

As the 203 Program matured, automated warning devices were installed at most of the crossings with generally acknowledged need, and the process of selecting crossings and installing automated warning devices continued. However, because of the expense of such installations and because of the nature of the project selection process which considers high accident-potential sites (statistically shown to be those with heavy rail and highway traffic volumes and a history of accidents), most crossings will never be selected for automated devices. It is probable that well over 100,000 crossings are precluded, and this is a real concern.

In a related development, program planners have begun to realize the merits of using a "corridor approach" in assessing crossing needs and selecting projects. Simply stated, State and railroad planners meet with community officials to form diagnostic teams and review all crossings along a given rail line. This approach, a concentrated effort, fosters the most economical use of the planners' time and, ultimately, of the railroad, State and local forces which will be required to complete the project. Initial emphasis is put on convincing communities to allow the closing of some crossings in exchange for improvements at other crossings. In theory, the approach could just as easily consider all crossings in a given community (potentially, a single community, multiple railroad project--a systems approach), as it does all crossings along a given line (single railroad, multiple communities--a corridor approach).

Many crossings that would be overlooked using conventional resource allocation procedures, accident predictions, and traffic volumes will now be reviewed. Crossings already equipped with automated warning devices will also be visited and evaluated. In these instances, diagnostic teams will frequently identify potential low-cost safety-related improvements. A myriad of low-cost options exist: new or upgraded signing and pavement markings; upgraded lights and gates; circuitry improvements; brush and tree cutting; street lights; road widening and surface improvements; approach alignments, both horizontal and vertical; improved drainage; restrictions on adjacent parking; use of mirrors; redirecting competing or confusing lighting; track removal; even changes in railroad operations and highway routings.

The FHWA, with FRA participation, planned and sponsored a demonstration rail-highway crossing corridor improvement project in 1981-82. The corridor selected, the Southern Railway Company's (SR) main line, ran east from the St. Louis area between Belleville and Fairfield, IL. Participants included: the Illinois Department of Transportation, the Illinois Commerce Commission, the SR, three cities, three counties, FHWA, and FRA. The project successfully demonstrated that a comprehensive

corridor approach that (1) analyzes all crossings along a railroad line, that (2) involves all interested parties from the beginning, and that (3) considers various sources of funding can be an effective means to achieve safer crossings. Significant improvements were made at a cost of \$5,000 per crossing or less, with Federal funds covering 90 percent of the costs. Through a review of the entire corridor, similar low-cost improvements were grouped together into a single project, resulting in shorter overall approval times and lower unit costs. In the urban portions of the corridor, some crossings were closed concurrent with the upgrading of warning devices at nearby crossings. There was strong overall community and railroad support for this kind of approach. The FHWA, again with FRA, is planning six additional demonstrations.

In FY 1986, FRA will sponsor a series of general seminars for interested railroads and States throughout various central locations to promote the corridor or systems approach concept and the FHWA demonstration programs. These seminars will stress the effectiveness of low-cost solutions and the need for local coordination.

In addition, FRA will prepare a pamphlet describing various types of crossings that could benefit from low-cost improvements. The pamphlet will include discussion of actual problems, site sketches, alternatives, solutions, planning cycle/schedules, cost data and funding sources, and before-and-after photographs. FRA will use the pamphlet to promote low-cost improvements to various States, local governments, concerned citizens, and railroads. The pamphlet will also increase the awareness of a large group of nontechnical rail safety activists (Operation Lifesaver proponents) to potential low-cost engineering solutions and will emphasize that even crossings already equipped with automated warning devices may benefit from low-cost improvements.

PRIORITY LIST LIABILITY

The fear that the computer generated priority listing of projects could be subpoenaed and the program manager found liable for not following it to the letter in his determinations of what crossing improvements should be made has resulted in some States (and railroads) trying to manage programs without the benefit of such a simple tool as a priority list. FRA and FHWA will investigate the need for evidentiary exclusion from entry in a legal proceeding of project priority listings used by States and railroads to manage and promote their safety programs.

OPERATION LIFESAVER

Operation Lifesaver, a cooperative effort between the States, railroads, and public service groups, is a public awareness program to reduce accidents at rail-highway crossings. The State of Idaho and Union Pacific Railroad initiated the program in the early 1970's. Operation Lifesaver emphasizes driver education, law enforcement, and engineering improvements targeted at crossings and crossing users. This program applies to all crossings, both public and private, with or without automated warning devices. It is the only program with such universal applicability. Operation Lifesaver is successful, popular, and has generated widespread interest since its inception. With support of the National Safety Council (NSC), and funding from AAR, and Amtrak, the program has been adopted in 47 States (excluding Hawaii, Delaware, and Pennsylvania). (See Figure 5.)

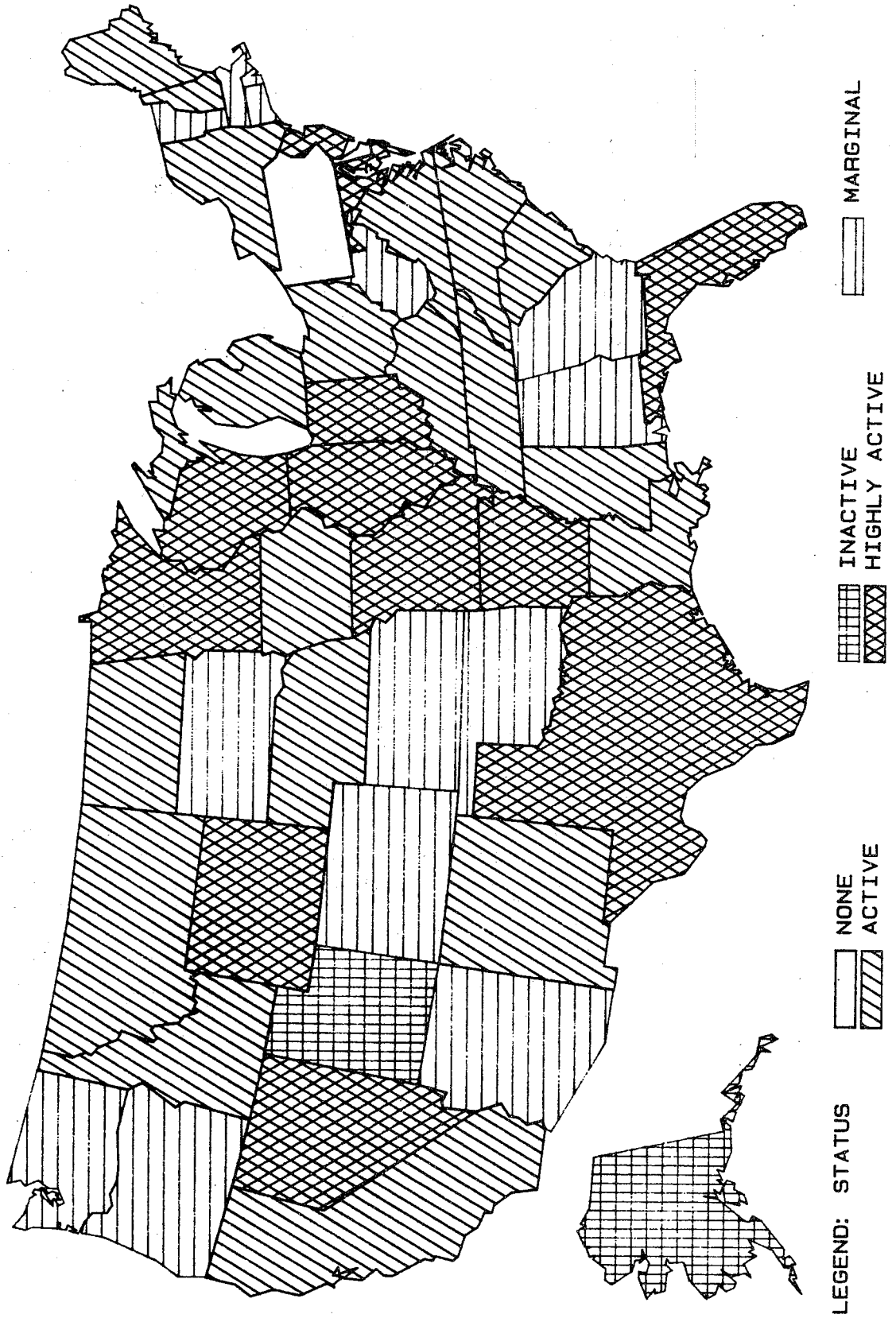
The program is structured to reach the motorist through the three E's -- Education, Engineering, and Enforcement. Education works through the media, using radio and television public service announcements, posters, bumper stickers, handouts, mailings, and speakers' bureaus to educate school children, drivers, and civic groups. Engineering deals with the improvement and standardization of signs, pavement markings, automated warning devices and sight-distance at or near crossings. Enforcement involves communicating with local law enforcement officers to elicit their cooperation in reemphasizing State and local ordinances and the need for compliance.

Since this State-local-industry program has been successful, Federal involvement has been limited to a support role. FRA involvement has continued to expand: FRA field personnel participate in local speakers' bureaus and set up and staff displays and arrange meetings between industry and local officials. In 1984, FRA personnel generated more than 1,000 contacts or presentations and directly reached nearly 100,000 people. The Department of Transportation, through FRA and FHWA joined in funding the 1984 Operation Lifesaver National Symposium and is involved in planning the 1986 symposium.

The education program continues to absorb the bulk of the Operation Lifesaver effort. Telling all motorists and pedestrians: "trains can't stop, you can" is a continual message. Adding to the challenge is the periodic need to reinforce that statement with new and innovative packaging of essentially the same message. And, although a growing group of drivers are the elderly, no materials have been prepared to address the specific education requirements and opportunities for this group.

Figure 5

OPERATION LIFESAVER AS OF MAY, 1985



Each State has a driver training manual for each prospective licensee. The NSC has standardized and is promoting the adoption of a special section dealing with rail-highway crossing safety. Also, the NSC has agreed, in principle, to seek the inclusion of a standard test question relating to crossing safety in each State's driver qualification test. This topic will be discussed at the August 1985 meeting of NSC's crossing committee.

Of the three major Operation Lifesaver areas (education, engineering, and enforcement), enforcement has received the least attention. Over the last year, there has been increasing awareness of the need and potential for increased law enforcement. The NSC and the AAR have recently published a pamphlet, Law Enforcement Guide for Rail/Highway Grade Crossings. FRA has distributed copies to each of its Regional Offices so that they may be redistributed to local law enforcement officers.

A comprehensive law enforcement program should reach not only police officers, but judges, legislators, and local administrators. FRA field personnel have made isolated attempts to do this, but can be assisted by suitable materials that address Operation Lifesaver to these specific groups. Enlisting the active support of professional associations representing judicial, law enforcement, and legislative personnel will be the key to future progress in this area.

FRA supports the development of presentational and promotional materials and training programs for drivers who transport hazardous materials in their trucks, law enforcement officers, traffic court judges, legislators, and administrators, and for elderly drivers. Slide or tape presentations, tailored to a particular group will be developed and used as a focal point. In addition, FRA will insure that at least 30 percent of the Operation Lifesaver contacts (the annual goal is 1,200 contacts) is directed towards State and local law enforcement personnel. At a minimum, FRA regional personnel will contact railroad police officials and encourage them, even offer to accompany them, to contact local police chiefs and sheriffs in order to promote Operation Lifesaver.

RESEARCH

Since the early 1970's, the FRA and FHWA have coordinated or jointly sponsored rail-highway crossing research. Topics include: program reviews, statistical analyses, computer modeling, hardware innovation, driver needs, accident causes, and legal considerations. Reports that have been especially useful and in demand include the following, which can be obtained from the National Technical Information Service.⁵

The Visibility and Audibility of Trains
Approaching Rail-Highway Grade Crossings,
Systems Consultants, Inc., May 1971.

Report to Congress; Railroad-Highway Safety;
Part I: A Comprehensive Statement of the Problem,
and Part II: Recommendations for Resolving the Problem,
FHWA and FRA, November 1971 and August 1972.

A Study of State Programs for Rail-Highway
Grade Crossing Improvement, TSC, June 1978.

Safety Features of Stop Signs at Rail-Highway Grade
Crossings, FHWA, August 1978.

The Effectiveness of Flashing Lights and Flashing Lights
with Gates in Reducing Accident Frequency at Public
Rail-Highway Crossings, 1975-1978, IOCS, Inc., April 1980.

Investigation of Anomalous Rail-Highway Crossings,
FRA, January 1981.

Rail-Highway Crossing Resource Allocation Procedure,
User's Guide, TSC December 1982.

Freight Car Reflectorization,
TSC, December 1982.

Compilation of State Laws and Regulations on Matters
Affecting Rail-Highway Crossings, Kansas State University,
April 1983.

⁵ Reports may be ordered from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The Anomalous Crossings Report, January 1981, is available directly from FRA, and the Compilation of State Laws, April 1983, is available from the Government Printing Office.

The FHWA is directly sponsoring research, or is monitoring either State programs or cooperatively sponsored research (with Federal funds) into the following projects.

- o Innovative active warning devices
- o Active advance warning signals
- o The second edition of the Resource Allocation Procedure User's Guide
- o Mandatory stops at crossings for certain vehicles
- o Updating the Railroad-Highway Grade Crossing Handbook
- o Use and effectiveness of constant warning time devices
- o Evaluating modified crossbucks and pavement markings
- o Improved signal visibility
- o Evaluating alternatives for existing grade-separated crossings (bridges)
- o Evaluating effectiveness of crossing surface materials

The FHWA recently convened a Railroad-Highway Grade Crossing Research Review Panel whose members included individuals from States, railroads, academe, consultants/contractors, suppliers, and Federal agencies (National Transportation Safety Board, FRA, TSC, and FHWA). The panel concluded in February 1985 with a presentation to interested parties. Forty-nine original ideas were distilled into 31 "need" statements of which 8 are classified "most important"; 8, "important"; 12, "beneficial"; and 3 were eliminated. The eight "most important" are:

- (1) Preparation of a crossing needs study
(update of 1971-72 reports to Congress)
- (2) Recalibration of the DOT accident prediction formulas
- (3) Impact of heavier and longer trucks on crossing safety
- (4) Evaluation of driver behavior at rail-highway crossings
- (5) Determination of geometric and traffic control design standards and criteria for addressing hump crossings that are hazardous to vehicles with low clearances
- (6) Design of distinctive advance warning signs for active and for passive crossings
- (7) Determination of the highway user's level of understanding of existing rail-highway crossing traffic control devices and the user's responses to these devices
- (8) Nighttime visibility issues/warrants for nighttime illumination

Some of the other 20 identified needs include: research regarding the safety effects of train speed restrictions; an effort to determine the benefits of establishing a Statewide system for taking telephone calls from the public about perceived malfunctions of train-activated warning devices (Texas has an 800-number call-in system); analyses of accident and litigation costs; development of criteria for removing automated warning devices; an assessment of Operation Lifesaver; and development of special programs for certain classes of drivers. FHWA will soon publish a report detailing all 31 "needs" statements.

THE CALL-IN SYSTEM

A program was established by the Texas Legislature whereby individuals can notify the State Department of Public Safety of malfunctioning train-activated signals. Texas law requires the placement of signs at crossings on the State highway system which are equipped with train-activated warning devices. A toll-free telephone number and the crossing inventory number are placed on the sign. The public is encouraged to report any malfunction of the device. The public safety department dispatcher receives the call and relays the information to the appropriate railroad company. During the first full year of operation, 2,548 calls were received by the department. For about 90 percent of the calls, the problem reported was that the signals were operating when there was no train on the approach. The Texas program has been in existence for 16 months and has not yet been evaluated. The program cost about \$1 million--for the installation of signs at about 3,000 crossings--and annual telephone costs were a few thousand dollars. State law prohibits the use of this information in crossing-related litigation.

In FY 1986, FRA will evaluate the Texas call-in program, including an assessment of the validity of the calls received and the corrective actions taken by the railroads. If the evaluation proves favorable, expansion to other States will be considered.

TRAIN BORNE DEVICES

Freight car reflectorization and locomotive alerting lights have been studied by FRA as possible methods of reducing the number of crossing accidents by enhancing train visibility, but the cost-to-benefit ratios failed to support Federal involvement.

Freight Car Relectorization

Tests conducted in 1981 and 1982 on the Canadian National Railroad System, where reflectorization has been underway since 1959, and on the Boston and Maine Railroad, provided quantitative data that shows a sharp decline in reflector quality soon after installation. The study documented that reflective intensity is reduced to 23, 14, and 5 percent after 6 months, 1 year, and 2 years, respectively, of installation. The report estimated the cost of equipping the 1.7 million unit freight car fleet at \$70 million annually. These costs include material acquisition, installation, and maintenance.

In addition to field testing reflective materials, the report documents an analysis of all rail-highway crossing accidents that occurred during the 6 year period from 1975 through 1980. After eliminating accidents that occurred in daylight hours, accidents where a vehicle was struck by a train, accidents that occurred at crossings with active warning devices, accidents where a vehicle struck a locomotive, and other accidents unlikely to be affected by reflectors--less than 3 percent of all crossing accidents remained for study. The report recognized that many of these accidents would continue to occur because of driver intoxication, fatigue, inattention, or incapacitation; vehicle speed; and geometry of the crossing. The conclusions are that very few accidents are likely to be affected by reflectorization, the cost far exceeds the benefits, and other approaches to the crossing safety problem are more effective.

Locomotive Alerting Lights

FRA prepared a study in 1982 that compared railroads with and without locomotive alerting lights and found no meaningful difference in accident rates between the two categories. This finding means no favorable cost-to-benefit ratio could be formulated to justify regulatory action. As a result, the NPRM issued in October of 1982 proposing the installation of an alerting light was terminated in May of 1983.

In addition, in response to Section 702(c)(j) of the Federal Railroad Safety Authorization Act of 1982 on April 1, 1983, FRA submitted to Congress the results of a study concerning the costs and benefits of equipping railroad locomotives with oscillating headlights⁶ to increase motorist awareness at rail-highway crossings. The analysis concluded that the use of oscillating headlights would result in costs which would exceed benefits by 130 percent, even if the headlights were assumed to be 100 percent effective. A Federal requirement for oscillating headlights would therefore reallocate resources from other safety programs which are more cost effective. On the basis of these conclusions, a Federal requirement that the railroads install oscillating headlights cannot be justified.

⁶ Oscillating light (MARS LIGHT) -- also called a "swept" headlight. It used one or more standard locomotive headlight lamps on a mounting plate that is moved by a small motor in either a figure eight, a circular, or an oval pattern. Other types of alerting lights include:

Strobe light -- A type of roof light powered by a flash tube and capable of producing very high intensity with a very fast flash rate.

Rotating beacon light -- An incandescent type roof light that functions by rotation--turning lenses around a lamp bulb, a wedge-shaped reflector, or an assembly of sealed beam lamps.

Sequentially flashing light -- An incandescent type of roof light that operates by regularly flashing bulbs.

BUILDING ON PAST PROGRESS--RECOMMENDATIONS

To continue to improve rail-highway crossing safety a renewed effort will be required from FRA, FHWA, the States, NSC, the rail industry, rail labor, suppliers and all other parties concerned with this problem. Current programs which have proven effective in reducing rail-highway crossing accidents and attendant casualties over the past several years must be continued. In addition, new ideas and additional research are needed.

FRA believes that the following initiatives have the best chance of reducing the number and severity of rail-highway crossing accidents.

Education: Public education is the broadest, most well-developed, and the most important program option for improving rail-highway crossing safety. Proof of the effectiveness of public education when properly targeted can easily be seen by reviewing the history of Operation Lifesaver. Since Operation Lifesaver's inception, by a cooperative effort by the State of Idaho and the Union Pacific Railroad in 1972, it has been sustained by the participation of State, local, and industry resources. Large, almost incredible, declines in rail-highway crossing fatality statistics were attributed to Operation Lifesaver following its introduction. Operation Lifesaver has been initiated into 47 States and should remain at the center of all efforts to reduce rail-highway crossing accidents and casualties. Recommendations:

- o Proponents of Operation Lifesaver are generally quick to admit that when the program is terminated, abandoned or interest lags, the gains are quickly lost. The program cannot be allowed to atrophy. Operation Lifesaver should be an active program in all fifty States. Everyone concerned with crossing safety, including railroads, organized labor in both the railroad and trucking industry, automobile associations, educators, and public agencies should increase their commitment in time and resources to support the Operation Lifesaver program.
- o A standard rail-highway crossing safety pamphlet should be made available to States for inclusion in highway license manuals. A standard insert should be included in all license renewal application packages sent to motor vehicle drivers.
- o A lack of understanding or appreciation of the train-automobile dynamics (comparative weights and stopping distances) appears to give rise to driver complacency. These differences should be stressed in public education messages to all ages.

Enforcement: Drivers are often more concerned about the possibility of a speeding or reckless driving citation from local authorities than they are about their own safety. Enforcement of crossing safety laws should be a companion of Operation Lifesaver's education effort. However, education of the legal community (police officers, judges, administrators--managers and mayors, and local legislators) must precede any expectation of enforcement at the crossing. Recommendations:

- o FRA will develop presentation materials addressing enforcement for use in communities along our Nation's rail lines.
- o In order to facilitate the presence of police officers at crossings at the appropriate times, FRA will work with the railroads to gather crossing specific information on near misses and supply this information along with train schedules to the local law enforcement officials.

Engineering: With the \$1.6 billion allocated to the States to date under the 203 program, automatic protective devices have been installed at approximately 20,000 of the Nation's most hazardous rail-highway crossings. Since many of the remaining crossings serve rail-highway traffic volumes too low to ever justify installation of automatic warning devices, the current challenge is to devise cost-effective solutions for these "low volume" crossings.

- o Safety improvement at rail-highway crossings should remain eligible for funding through the Federal Highway Trust Fund. Eligibility should extend not only to the installation of automatic warning devices, but also to lower cost alternatives for crossings where rail-highway volumes cannot justify the installation of automatic devices.
- o To address problems arising at these "low volume" crossings, there is a pressing need for development and perfection of low cost alternatives to the automatic warning device. Such alternatives range from special pavement markings to grading and lighting improvements; from seasonal factors, such as winter snow removal, to brush control. Federal agencies like FRA are in a unique position to serve as focal points for gathering information on experiences and innovations throughout the 50 States, and ensuring that they are effectively communicated to State and local officials.
- o FHWA efforts to promote low cost alternatives on a corridor by corridor basis deserve support. FRA will make its field inspectors available upon request to evaluate risk exposure at existing crossings, and advise State and local officials on corridor resource allocation decisions.

- o It is essential to focus available resources on projects where the dollars spent will produce the greatest return in real safety improvement. Funds available for grade crossing safety enhancement are finite. Investing those dollars in projects with low cost benefit ratios can have a negative safety impact by drawing funds away from projects with a greater impact on human safety.

Evaluation: The research efforts of NSC, FHWA, and FRA, on educational, engineering, operational, and analytical ways to improve crossing safety should be continued and enhanced through expanded participation by the private sector and State officials.
Recommendations:

- o FRA should complete the incorporation of the accident severity prediction formulas into resource allocation procedures. The new procedures should be made available to States and railroads.
- o FRA and NSC should evaluate the Texas "800 number" experiment. States should be advised on the potential impact of a national expansion of the program.
- o FRA and the FHWA should develop corridor accident and severity prediction formulas.
- o States should accelerate the placement of signs at the crossings that lack signage.
- o Federal and State agencies should study the possible need to ensure the confidentiality of surveys and reports compiled for the purpose of identifying and establishing priorities for crossing improvement projects.

