

Rail Crossing Priority Analysis

Draft

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CHAPTER 1- INTRODUCTION

In the last two decades, Riverside County has grown to over 1.7 million in population. One effect of the rapid growth has been the emergence of traffic congestion on roadways that previously operated at free flow, even during peak traffic hours. Long-distance commute patterns have created substantial peak hour congestion, particularly in corridors where topographic barriers limit the number of available roadways.

In addition, the movement of freight through Southern California is increasing at a rapid rate. From 1993 to 2000, freight tonnage shipped through the Ports of Los Angeles and Long Beach increased 60%, and is projected to increase another 165% in volume by the Year 2020. Greater flows of goods result in higher volumes of trains passing through the region.

To accommodate increasing freight rail traffic leaving the Ports of Los Angeles and Long Beach, the Alameda Corridor is being constructed. The Alameda Corridor is a 20-mile freight line that connects the ports of Long Beach and Los Angeles to intermodal facilities near downtown Los Angeles (see [Figure 1-1](#)) and generally parallels Alameda Street along most of its route. Throughout the corridor, the rail line is being separated from surface street traffic, so the high volume of freight trains will not delay street traffic. In the mid-corridor section, freight trains will travel through a 10-mile, 33-foot-deep trench between SR-91 and 25th Street.

After leaving the Alameda Corridor, the majority of trains turn east, destined to intermodal terminals in the Inland Empire or to other parts of the country. This area is known as the Alameda Corridor East (ACE). The rail lines of the Alameda Corridor East pass through the San Gabriel Valley (Los Angeles County), Orange County, San Bernardino County, and Riverside County.

In 1999-2000, as part of the Comprehensive Transportation Plan (CTP) process, the agencies of Western Riverside County studied freight movement problems and issues, including improvements to at-grade rail crossings and truck movement. That study identified long-term needs for grade separation at most of the grade crossings on the railroad mainlines passing through Riverside County.

In 2000, the State Legislature passed AB2928, the Governor's transportation improvement program. Included in the legislation was a provision for funding of improvements in the ACE area, contingent upon completion of a four-county strategy for improving the rail crossings (the Alameda Corridor East Trade Corridor Plan). Development of this four-county study required that each county identify its own improvement priorities.

This study was initiated to identify Riverside County's improvement priorities as input to the ACE Trade Corridor Plan.

The evaluation of rail crossings addresses the five mainline freight rail lines in Riverside County (see Figures [1-1A](#) (or [download](#) in pdf format) and [1-1 B](#) (or [download](#) in pdf format):

- Burlington Northern Santa Fe (San Bernardino Subdivision)

- Union Pacific (Los Angeles Subdivision)

- Burlington Northern Santa Fe & Union Pacific (Riverside)

- Burlington Northern Santa Fe & Union Pacific (San Bernardino Subdivision)

- Union Pacific (Yuma Main)

(Note: The San Jacinto Branch Line and the spur line off the Union Pacific line do not carry regional rail traffic, and are therefore were not included in the analysis.)

These rail lines accommodate line haul freight service as well as Metrolink commuter rail service and Amtrak passenger service. Currently 85 freight trains per day pass through Riverside County, and the number is projected to increase to 169 by 2020. The increase in train volume means that rail crossing gates will be down for longer periods of time, further delaying Riverside County motorists at the rail crossings. In 2020, with the projected growth of rail traffic and population, several arterials will be blocked by trains for over five hours per day, driver waiting time will more than quadruple, idling vehicles will generate 208 tons of extra pollutants annually, and more accidents will occur due to the combined increase in train traffic and automobile volumes. Therefore, safety and delay issues at rail crossings are becoming an increasingly important concern.

The location of at-grade crossings on the five Riverside County rail lines is shown in Figures 1-2 (download [1-2.pdf](#)) and [1-2A](#) (download [1-2A.pdf](#)). The remainder of this report presents the

methodology by which the rail crossing improvements were prioritized, and the results and recommendations of the prioritization analysis.

CHAPTER 2 - METHODOLOGY

The evaluation and recommendation of rail crossing improvement needs can be found in the “Western Riverside County Comprehensive Transportation Plan Goods Movement Analysis”. That study identified long-term (20 year) improvement needs (grade separation, roadway widening, or safety improvements) based on future delay, cost-effectiveness, and accident reduction potential. The purpose of this rail crossing priority analysis is to identify rail crossing locations with the greatest need for improvement in Riverside County. Seven factors were considered in determining the priority; they were identified in consultation with technical staff of the affected jurisdictions, and approved by elected officials on the Riverside County Transportation Commission (RCTC). The factors include:

- Safety-Accident Score Rating (combination of frequency and severity)

- Delay-1999 Daily Vehicle Delay

- Delay-2020 Daily Vehicle Delay

- Emissions

- Noise

- Adjacent grade separations

- Local priority ranking

Each rail crossing was evaluated in terms of each of the seven factors, and a score was assigned based on the potential for benefits from grade separation. For example, a location with a high accident rating was given a high score because of the potential to improve safety through grade separation. A location with a high delay was given a high score because of the potential to reduce delay through grade separation.

The scores for each factor were weighted to achieve the relative importance approved by the RCTC Commissioners. The weighted factor scores were combined to achieve an overall score for each location. The overall scores were used to assign each location a relative priority of 1-5, with priority #1 and #2 locations being the locations with greatest need.

The following discussion describes each factor used in the prioritization analysis, and how it was evaluated and scored.

Methodology for Safety Evaluation

Existing rail crossing accident data was obtained from the Federal Railroad Administration (FRA) and from local jurisdictions. The Federal Railroad Administration maintains a database of incidents involving rail equipment (both passenger and freight trains) at the crossings. Through these sources, accidents by location were obtained, representing the accident history for each crossing over a 10-year period.

An overall accident rate was developed for each rail crossing based on 10 years of accident history or recorded incidents. The accident rate took into account both frequency (number of accidents per million vehicles) and severity (property damage only, injury accident, fatality). The calculation produces an overall accident rating that is weighted according to the number of injury and fatality accidents. Each location was assigned a safety score of 0-5 based on its overall accident rating.

Methodology for Rail Crossing Delay

The principal measures of delay impacts at highway/rail grade crossing are characterized by the following two measures of effectiveness:

Total Gate Down Time in Minutes
Vehicle-Hours of Delay per Day

The grade crossing delay analysis used for this study followed the same methodology used in the Alameda Corridor Draft EIS (August 1992) and the San Gabriel Valley Grade Crossing Study (January 1997). This analytical methodology was employed to estimate existing and future levels of delay at each of the grade crossings being studied, including consideration of delays to vehicles on parallel roads close to the rail line. The calculation produces the total crossing-gate down-time and vehicle-hours of delay experienced by roadway traffic at each grade crossing location. In addition, it produces an estimate of the length of roadway traffic queue due to the gate down interval caused by trains passing through the crossing. The formulas are as follows:

Gate down time (for each train) = $0.603 + \{60 * [\text{train length} + 50 + 12 * \# \text{lanes}]\} / \{5280 * \text{train speed}\}$

Vehicle delay (for each train) = $\{[\text{gate down time}^2] * \text{vehicle queue per lane} / [2 * (1 - \text{vehicle queue per lane} / \text{vehicle departure rate})]\} / 60 * \# \text{lanes}$

Queue length (for each train) = gate down time * vehicle queue per lane * avg. vehicle length

Vehicle hours of delay at grade crossings were calculated for both 1999 and 2020 scenario conditions based on existing and future train volumes and traffic volumes. Existing average daily traffic data on roadways crossing the railroad tracks were obtained from the local jurisdictions. For 1999 and for 2020, each location was assigned a delay score of 0-5 based on its total daily traffic delay. Existing freight train traffic and time of day operations was obtained from staff of Union Pacific and BNSF, while passenger train frequencies and time of day operations was collected from Metrolink and Amtrak timetables.

In recent years, various estimates of growth in freight and passenger train traffic have been made by:

SCAG's Regional Railroad Consolidation Study (March, 1995)

San Gabriel Valley Council of Governments' Grade Crossing Study — Final Report (January, 1997)

SCAG's Regional Grade Crossing Improvement Program (July, 1998)

In addition to the consideration of these sources, discussions were held with railroad representatives to estimate train frequencies for future year 2020 planning purposes.

To forecast traffic volumes in 2020, the SCAG RIVSAN CTP model was used to determine how much the existing volume would increase by the year 2020. 2020 ADT estimates were developed using actual vehicle counts provided by the localities, which were then factored upwards based on the amount of growth projected by SCAG's regional traffic models for the Year 2020.

Methodology for Vehicle Emissions

Vehicle emissions resulting from grade crossing delays were calculated for both existing and future years by multiplying the estimated daily delay by the idling vehicle emissions established by the USEPA and published in the April 1998 EPA Emission Facts and summarized in Table 1. As different emission factors were provided for different vehicle classifications, total delay was broken down proportional to vehicle classification. In the absence of a specific estimated vehicle classification breakdown for each grade crossing, vehicle classification was considered proportional to the 2001 estimated total vehicles for the State of California as published in the Caltrans November 1997 Motor Vehicle Stock, Travel and Fuel Forecast and summarized in Table 2. The calculated value for vehicle emissions resulting from grade crossing delay was scaled for the purpose of matrix comparison. The formula used for calculating the vehicle emissions for each vehicle classification is as follows:

$$VC_{ie} = vhd \times ms \times vc \times ef$$

VC_{ie} is idle emissions for vehicle classification type

where vhd is total vehicle hours of delay at crossing

ms is vehicle type mode split at crossing

vc is vehicle type classification split by mode for State of California (from Table 3 below)

ef is emissions factor for vehicle and fuel type (from Table 1)

The total vehicle idle emissions resulting from grade crossing delay is obtained by summing the idle emissions for each vehicle classification type.

Table 1 – Emission Factors

Pollutant (g/hr)	Gasoline				Diesel		
	Autos	Light Trucks	Heavy Trucks	Motor-cycles	Autos	Light Trucks	Heavy Trucks
VOC	16.1	24.1	35.8	19.4	3.5	4.6	12.5
CO	229	339	738	435	10	11	94
NO _x	4.7	5.7	10.2	1.7	6.5	6.7	55.0
PM ₁₀	0	0	0	0	2.6	2.6	2.6

Source: Idling Vehicle Emissions, Summer Conditions, EPA, *Emission Facts*, April 1998

Table 2 – State of California 2001 Total Vehicles by Classification

Total (millions)	Gasoline				Diesel		
	Autos	Light Trucks	Heavy Trucks	Motor-cycles	Autos	Light Trucks	Heavy Trucks
23.86	20.96	1.78	0.13	0.44	0.13	0.15	0.28
100.00%	87.9%	7.5%	0.5%	1.8%	0.5%	0.6%	1.2%

Source: California Total Vehicles, Caltrans, *California Motor Vehicle Stock, Travel and Fuel Forecast*, November 1997

Table 3 – State of California 2001 Total Vehicles Classification by Mode

Total (millions)	Automobiles			Total (millions)	Trucks			
	Auto - Gas	Motor-cycles	Auto - Diesel		Light - Gas	Heavy - Gas	Light - Diesel	Heavy - Diesel
21.53	20.96	0.44	0.13	2.34	1.78	0.13	0.15	0.28
100.00%	97.5%	2.0%	0.5%	100.00%	76.6%	5.1%	6.1%	12.2%

Source: California Total Vehicles, Caltrans, *California Motor Vehicle Stock, Travel and Fuel Forecast*, November 1997

Each location was assigned an emissions score of 0-100 based on the total daily emissions generated by delayed traffic.

Methodology for Noise Impacts

Noise impacts resulting from mandatory whistle blowing at grade crossings were determined by plotting whistle noise profiles as concentric rings corresponding to estimated decibel level and judging intrusion into residential areas. Noise profiles were based on a whistle noise level of 100dB at 100 feet from the source, extending ¼ mile (1, 320 feet) either side of the subject crossing. This level is consistent with the option 1 median whistle level and the maximum warning distance prescribed in the January 13, 2000 FRA *Proposed Rule for Use of Locomotive Horns at Highway-Rail Grade Crossings*. Concentric rings corresponded to each 15dB reduction in noise level (noise levels typically reduce by 7.5dB with each doubling in distance from the source) until a level of 55dB was observed. A noise level of 55dB is considered to be below the ambient noise level of a typical residential neighborhood, and therefore the impact of a whistle at this level was considered insignificant. The model concentric rings corresponded to the distances indicated in Table 3, although obviously actual observed distances could vary based on topological and climatic conditions. Each location was assigned a noise score of 0-100 based on the percentage of existing residential development within the contours incurring noise levels in excess of 55 dB.

Table 4 – Noise Level from Source

Noise Level (dB)	100	85	70	55
Distance from Source (feet)	100	400	1,600	6,400

Source: FRA, *Use of Locomotive Horns at Highway-Rail Grade Crossings*

Methodology for distance to nearest grade separation

The distance to the nearest adjacent grade separations was measured using map and field information. Each grade crossing location was assigned a score of 0-5 for adjacent grade separations based on the distance to the nearest grade separation, as follows:

- >1.0 mile = 5
- .5 – 1.0 mile = 3
- .25 – .5 mile = 1
- < .25 mile = 0

Methodology for Local Agency Priority

Local agency priorities were determined through a survey of the affected local agencies, and the results were scaled so that the highest priority location in each jurisdiction received the highest score and the lowest priority location in each jurisdiction received the lowest score. Each crossing was assigned a score of 1-25 for local priority, with the local agency’s highest priority location receiving 25 points, with lower priority locations receiving points in a descending scale so that in each jurisdiction the lowest priority location received 25/x points (where x is the number of crossings in that jurisdiction).

Weighting Points

Each criterion was evaluated separately before the scores for each criterion were combined into an overall score for the crossing. In calculating the overall score, the individual criteria were weighted as follows:

- Existing delay: 20 percent of total score
- Future delay: 20 percent of total score
- Accident reduction: 20 percent of total score

Distance to nearest grade separation: 10 percent of total score

Local priority: 10 percent of total score

Emissions reduction: 10 percent of total score

Noise reduction: 10 percent of total score

The relative weighting applied to the various criteria were approved by elected officials representing Riverside County and the local agencies on the Riverside County Transportation Commission.

To achieve the desired weighting, each score was multiplied by a weighting factor which was applied in order to:(1) normalize all the scores relative to each other; and (2) apply the additional weighting to the delay and safety scores. The following table shows the scoring and weighting factors applied to each criterion:

Criterion	Maximum Score	Weighting Factor	Maximum Possible Weighted Score
Safety	5	200	1000
1999 Delay	5	200	1000
2020 Delay	5	200	1000
Emissions	100	5	500
Noise	100	5	500
Nearest Grade Separation	5	100	500
Local Priority	25	20	500

Priority Groupings

From the evaluation of these factors, the rail crossings were separated into five groups to indicate their relative priority for improvement, with the crossings grouped according to their overall score and Group #1 representing the highest priority locations. The priority groupings were reviewed with the RCTC Commissioners, and the final groupings shown in this report reflect the grouping adopted by the Commission.

CHAPTER 3 - RESULTS

The methodologies described in Chapter 2 were applied to each of the seven evaluation factors, and the individual scores for each factor are reported in the first seven columns of Table 3-1. The next seven columns show the weighting factors applied to each criterion. The overall weighted score represents the sum of the individual factor scores after being multiplied by their respective weighting factors.

Initial priority groupings were assigned as follows:

Overall weighted score ≥ 3100 , Group 1

Overall weighted score > 2500 and < 3100 , Group 2

Overall weighted score > 1800 and ≤ 2500 , Group 3

Overall weighted score > 1000 and < 1800 , Group 4

Overall weighted score ≤ 1000 , Group 5

The final groupings as adopted by RCTC (and reflected in Table 3-1) include a switch of two

crossings between Groups 1 and 2 (Streeter Avenue and Mary Street) to reflect the Commission's preferred priority plan.

A total of ten crossings are in the highest priority group (Group 1) and nine are in the second highest priority group. Seventeen crossings were grouped into priority group 3 and eighteen crossings were put in priority group 4. Only five crossings received the lowest priority in group 5.

Figure [3-1](#) (or download [3-1.pdf](#)) shows the priority of rail crossing improvements from Corona to Riverside. Figure [3-1A](#) (or download [3-1A.pdf](#)) shows the priority of rail crossing improvements from Moreno Valley to Banning and Figure 3-1B shows the priority of rail crossing improvements in the Coachella Valley.

Recommendations

While many of the rail crossings in Riverside County are projected to experience high levels of delay by the Year 2020, the prioritization of rail grade crossings in based on the factors selected by the stakeholders in Riverside County has identified 19 crossing locations with the highest priority for improvements. Table 3-2 provides a listing of the highest priority grade crossings and Figures [3-2](#) (or download [3-2.pdf](#)) and [3-2A](#) (or download [3-2A.pdf](#)) illustrate their location. These rail crossings in priority group 1 and 2 are all typically characterized by high train and vehicular traffic volumes, extensive vehicle delay and emissions, and a history of safety problems. These crossings have the highest priority for near-term improvement and it is recommended that these locations be programmed for improvements as funding becomes available.