El Paso Region Freight Rail Study

Phase II – Final Report

July 2013

Rail Division

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Acknowledgements

The *El Paso Region Freight Rail Study – Phase II* was a collective effort among the Texas Department of Transportation and many cooperative public, private, and governmental representatives from the region, which include:

BNSF Railway
Camino Real Regional Mobility Authority
City of El Paso
City of Sunland Park
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El Paso County Road & Bridge
El Paso Hispanic Chamber of Commerce
El Paso Metropolitan Planning Organization
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Greater El Paso Chamber of Commerce
New Mexico Department of Transportation
Union Pacific Railroad
US Department of Homeland Security, Customs and Border Protection

Executive Summary

This Phase II report for the El Paso Region Freight Rail Study is a supplement to the Phase I report previously completed in 2011, and begins with a reevaluation of the freight rail network previously developed for the six-county study area of the TxDOT El Paso District. The Phase I report is comprised of six chapters detailing information on the project background (Chapter 1), the purpose of the study (Chapter 2), an analysis of freight mobility (Chapter 3), an inventory of the freight rail network within the study area (Chapter 4), the development of the base case rail network model using Rail Traffic Controller software (Chapter 5), and the identification of freight rail and rail-roadway interface safety issues (Chapter 6). This Phase II report begins with revisions of Chapters 5 and 6, providing updated and additional information to what was presented in the Phase I report. The Phase I report can be found at http://ftp.dot.state.tx.us/pub/txdot-info/rail/freight/el_paso.pdf.

This Phase II report presents an updated model and analysis of the freight rail network within the study area, evaluates various traffic growth scenarios, over the next 20 years, on the rail network, determines subsequent impacts on both the rail and roadway networks from increased freight rail traffic, and identifies potential improvements to help mitigate those impacts. Safety statistics were updated and evaluated for the region and were also used in identifying additional roadway improvements. Lastly, construction costs and benefits were estimated for identified potential improvements.

Rail Modeling

An updated model of the freight rail network was developed to represent current conditions and operational performance within the study area (Base Case). The model was developed using Rail Traffic Controller (RTC), a modeling software tool in broad use by North American railroads to test rail operational plans and proposed infrastructure improvements or configurations (track and signal) by realistically simulating train operations and capturing operational performance metrics. The railroad network model represents the infrastructure of both Union Pacific Railroad (UP) and BNSF Railway (BNSF) in the study area and is comprised of over 550 track miles. The model simulates current operations of over 400 trains per week over this rail network. With the majority of the rail system within the study area owned and operated by UP, over 86% of the modeled trains are UP trains. BNSF trains represent approximately 13% of the modeled trains. Six passenger trains, representing Amtrak's Sunset Limited service operating through El Paso, accounted for the remaining 1% of the modeled trains.

With the opening of UP's Strauss Yard in Santa Theresa, NM scheduled for 2014, the Base Case model was revised to determine the operational impacts to the rail network. With the resulting shift in locomotive fuelling, servicing and crewing out of downtown El Paso to the Strauss Yard, rail operations throughout the El Paso region are expected to drastically improve throughout the El Paso region compared to current day conditions. Strauss Yard is expected to allow the UP to accommodate annual traffic increases of up to approximately 1.5% over a 20-year period without having to add infrastructure.

Various rail traffic growth scenarios, or planning cases, with annual growth rates at or greater than 1.5% over 20 years, were then evaluated to determine the operational impacts on the rail network and crossing occupancy times within the study area. The rail traffic volumes were evaluated with the proposed change in rail operations provided by UP's Strauss Yard. Generally, as the freight traffic volumes increased and operational efficiency decreased compared to those determined for current day conditions, additional rail infrastructure was added to the network model to return to current day operational fluidity, as defined by train delay ratios.

For annual freight rail traffic increases higher than about 1.5%, additional infrastructure along the UP is required to maintain rail operational metrics similar to current day conditions. This additional infrastructure consists primarily of constructing a second mainline track, or double tracking, along various sections of the UP Valentine and Toyah Subdivisions, which are located east of El Paso. Generally, more double track is required as the annual growth rate of rail traffic increases above 2% per year.

BNSF has significantly fewer trains operating in the study area compared to the UP. With the comparatively low number of trains, BNSF is more likely to accommodate the various increases in freight traffic by "fleeting" trains together across the route. "Fleeting" means operating two or more trains consecutively in the same direction of movement, thereby reducing the number of meet/pass events for every train. Any infrastructure improvements to improve their operations would likely occur outside of the study area.

Safety Issues

The increased volumes of freight and roadway traffic provide for increased public exposure and risk to safety at roadway-rail at-grade crossings. To assist in identifying roadway-rail at-grade crossing improvement projects that will mitigate impacts associated with increased roadway and rail traffic volumes, crossing safety statistics over the last five years were updated and reviewed. These statistics include roadway-rail incidents, trespasser incidents, and train accidents. Roadway-rail incidents include accidents at grade crossings. Trespasser incidents are not included in accidents associated with vehicular traffic at crossings. Train accidents include derailments and collisions, and do not include roadway-rail incidents.

The study area includes 304 public and private grade crossings, with each representing nearly 50% of the total number. A total of 33 grade crossing accidents, four fatalities and 15 injuries have occurred within the six-county area in the last five years. El Paso County had 29 of those 33 grade crossing accidents, and all four fatalities. There were 19 trespasser casualties, with 16 of them occurring with El Paso County.   There were 33 train accidents, with 28 occurring in El Paso County.

Within the study area, the majority of roadway-rail incidents, trespasser incidents, and train accidents occurred in El Paso County. This, coupled with the majority of the study area population, led to the identification of crossing improvements that minimize the public's exposure to trains and mitigate impacts associated with increased roadway and rail traffic focused on El Paso County.

Identified Improvements

Proposed crossing improvements and rail infrastructure improvements are both identified and described in this report. A cost-benefit analysis was conducted on each of the proposed improvements to estimate both public and private benefits. Public benefits are those which accrue to everyone in the study area, whereas private benefits are those which accrue to private enterprise, such as a privately owned railroad. The methodology and detailed results are presented in Appendix 5: Benefit –Cost Analysis Calculations & Methodology and Appendix 6: Benefit – Cost Analysis Results.

A total of 33 crossing improvements, with an estimated total cost of $314 million, were identified. These improvements include 19 grade separations and 14 crossing closures. Crossing closures were included with grade separations to comprise project groupings, based on their traffic volumes and proximity to the proposed grade separation. Undiscounted public benefits for the identified crossing improvement groupings total approximately $221 million. Undiscounted values are the costs and benefits not adjusted for time and inflation. Some of the groupings have Benefit-Cost Ratios (BCR) of less than one, primarily driven by the crossing closures associated with the proposed grade separations. When examined individually, 11 of the 19 grade separations have an undiscounted BCR of greater than one when considered without the crossing closures. This suggests the proposed new grade crossings have independent utility and may be worthwhile from a public expenditure perspective when considered on their own, but not when grouped with other crossing closures.

When considering annual growth rate of freight rail traffic of up to about 1.5%, no rail infrastructure improvements were required to maintain operational efficiency when compared to current day conditions due to the planned operations for the UP Strauss Yard. However, for planning cases with annual growth rates of freight rail traffic above 1.5%, various rail infrastructure improvements are required to maintain rail network operational performance at or better than current day conditions. Below is a summary of required rail infrastructure improvements for each planning case, and the estimated construction cost:

- Planning Case 1 (0.50% annual growth) – No additional rail infrastructure ($0)
- Planning Case 2 (1.55% annual growth) – Four sections of double track on UP Valentine Subdivision between El Paso and Sierra Blanca ($155M)
- Planning Case 3 (2.12% annual growth) – Four sections of double track on UP Valentine Subdivision between El Paso and Sierra Blanca ($155M); same rail infrastructure improvements as Planning Case 2
- Planning Case 4 (2.55% annual growth) – Double track entire UP Valentine Subdivision between El Paso and Sierra Blanca ($293M)
- Planning Case 5 (2.75% annual growth) – Double track entire UP Valentine Subdivision between El Paso and Sierra Blanca ($293M); same rail infrastructure improvements as Planning Case 4
- Planning Case 6 (4.02% annual growth) - Double track entire UP Valentine Subdivision between El Paso and Sierra Blanca and UP Toyah Subdivision between Sierra Blanca and Toyah ($689M)

Benefit-cost analyses were performed on Planning Cases 3 and 6 to estimate the public and private benefits for the proposed rail infrastructure improvements covering the spectrum of rail traffic growth scenarios. The total undiscounted benefits for Planning Cases 3 and 6 are $63 million and $200 million, respectively. The largest benefits in both planning cases are the private freight rail operating cost impacts due to reduced train delay. In Planning Case 3, the freight rail operating cost benefit represents 92% of the total benefits, while in Planning Case 6 it represents 99% of the total benefits. In Planning Case 6, there are also cost impacts due to increased train volumes in the Build Case (with infrastructure improvements) relative to the No-Build Case (business as-usual) due to increased capacity.

Section 5A: Rail Modeling

Section 5.1: Rail Traffic Controller

Rail Traffic Controller (RTC), developed by Berkeley Simulation Software, LLC, is a modeling software tool in broad use by North American railroads to test rail operational plans and proposed infrastructure arrangements (track and signal) by realistically simulating train operations and capturing the results.

The basis of the RTC model is comprised of two mathematical formula sets. The first set matches empirically derived characteristics of train performance, for the model user's selected train characteristics, to the track geometry. The model calculates the best possible acceleration, maximum speed, and deceleration characteristics of the modeled train as it travels over the modeled track. The second set of formulas uses railroad operating rules, user-selected Methods of Operation, and user-selected train-prioritization options to dispatch multiple trains over the modeled territory in a manner similar to the decision matrix used by a human train dispatcher. RTC modeled trains behave in a fashion similar to how trains would actually operate on an actual railroad, making meet/pass, overtake, and station-stop events. The model has the capability to preplan train movements and avoid dispatching errors such as advancing two trains toward a siding in which neither train will clear. RTC excels in handling trains entering and departing from a number of different networks.

By automating the application of these mathematical formula sets, the RTC model enables the user to more rapidly test the effects on single-train performance of proposed track geometry and methods of operation; and to more rapidly test the effects on multiple-train performance of proposed schedules, prioritization plans, and infrastructure arrangements as compared to the pencil-and-paper methods that the RTC model replaced.
The RTC model is not a black box tool that suggests, or optimizes, infrastructure, schedules, or train priorities on its own. Rather, the RTC model is a validation tool that measures the results of user-proposed infrastructure, schedules, and train priorities. The RTC model is best used as a "single variable" test, where the user controls for a single independent variable at one time in order to avoid confounding errors where multiple independent variables interact.

The RTC model is also not a perfect mimic of real-world results. The RTC model requires no significant time to create train dispatching plans or to execute dispatching instructions, there is no dwell time in the RTC model for train signaling and communications systems to react, and trains respond immediately to instructions and operate at best possible speed. On actual railroads, train dispatcher efficiency (compared to the model) can be seriously affected by other tasks such as issuance of track bulletins, responses to inquiries and unusual events, and human inability to make multiple contingent mathematical calculations to select among many possible dispatching plans for the best possible outcome. The model can be arranged to test for user-proposed irregular events such as maintenance-of-way windows, signal failures, and locomotive failures, but these are not necessarily mirror images of the multiple related or unrelated unusual failures that can occur on an actual railroad. The RTC model can execute train dispatching instructions instantaneously and can test thousands of possible outcomes and choose the best one. In complex terminals and stations with high train-movement density, the RTC model can smoothly execute train routing patterns and not fall behind, whereas the plan, point, and click workload can overwhelm a human train dispatcher.

The RTC model is used to compare infrastructure and train planning alternatives within its own set of rules and results, with the results viewed by rail operations experts who test for adequacy of the model against what is likely to happen within real railroads.
The RTC software is used by every North American Class I railroad, and is the only rail simulation software recognized by the Federal Railroad Administration (FRA) to validate and support rail infrastructure improvement projects funded in part by the federal government.

For the purposes of this study, the following train performance metrics were calculated to provide a measurable framework for comparing train operations between different model variations:

- *Average speed* – the average operating speed (in miles per hour) of the train across the model network.
- *Delay % (Ratio)* – The ratio of congestion-related delay to unimpeded running time, defined as the time it would take to operate all the trains in their normal manner with regular work stops, without any congestion-related delay. A higher delay ratio indicates poor performance. A lower delay ratio is an indication that the railroad is operating in a more sustainable manner with better overall train performance.
- *Delay Minutes/100 Train-miles* – the amount of minutes of delay a train experiences during 100 miles of travel. Generally, the higher the number of delay minutes, the more congested a railroad is and the higher the operating cost for the railroad. However, this normalized value is expected higher in terminals, as trains do not travel long distances.

RTC Input Files

The simulation model consists primarily of two kinds of files:

- *Network files* include track, signals, grades, curves, bridges, road crossings, and railroad junctions or interlockings. These files can be as detailed as required to obtain accurate results; distances can be specified to within six feet, though that level of precision is seldom required. The network files also allow the simulation to reflect the specific time that segments of track must be withdrawn from service for maintenance-of-way activity.
- *Train files* include all information related to individual trains, including their identity, type, weight, length, locomotives, time and day of operation, relative priority, origin and destination, route, railroad carrier, and intermediate work, if any. In all simulation cases run for this study, each train movement or instance is treated individually. Additionally,

no two days in the model are identical. Some freight trains operate on completely random schedules, according to traffic demands; or according to availability of resources, such as locomotives and crews. This variation in rail operations is fully captured in these RTC simulations.

RTC Dispatching Logic

As the RTC model routes trains across the railroad network, it resolves conflicts between trains in the same manner as an actual railroad dispatcher. The model resolves conflicts with full knowledge of all trains within the model network.

The RTC model and actual dispatchers both make decisions based on many factors involved in train performance:

- Priority
- Type of train
- Time available for the train and engine crew to work
- Train length and weight
- Locomotive power
- Scheduled work

Unless a train is significantly delayed, both actual railroad dispatchers and the simulation model will generally give operating priority to passenger trains over expedited freight trains, expedited freight trains over lower priority manifest freight trains, and manifest trains over local freight trains or yard engines. These priorities are determined by the railroads and are incorporated into the logic used to resolve train conflicts.

When there is a particularly complicated series of conflicts, the model, as well as an actual dispatcher, discards normal priorities and seeks alternate solutions that will keep the railroad as fluid as possible under the circumstances.

The model will generally minimize the total cost of delay for all trains involved in a conflict or a series of conflicts. These conflicts frequently arise around congested terminals or on high-density line segments. The decision to advance one train and delay another has impacts. RTC identifies these impacts and determines the best solution based on the defined dispatching logic.

The RTC model fails occasionally, and repeated failures are a good sign that what's being attempted is impossible or at the very least unsustainable; which means that the rail demand being placed on the available infrastructure network and the practical capacity of that network are incompatible.

Section 5.2: The RTC Base Case

Before railroad operations simulation models can be used to test alternative operating or investment plans, a base case model that represents current conditions must be generated. This Base Case model can be considered accurate after the model is iteratively refined to yield operating performance metrics that are similar to current conditions. Future or planning case performance, considering increases in rail traffic or changes in infrastructure or operations, will then have assumed credibility but should only be considered speculative based on assumed operating schemes that may be different than those actually implemented by the operating railroad.

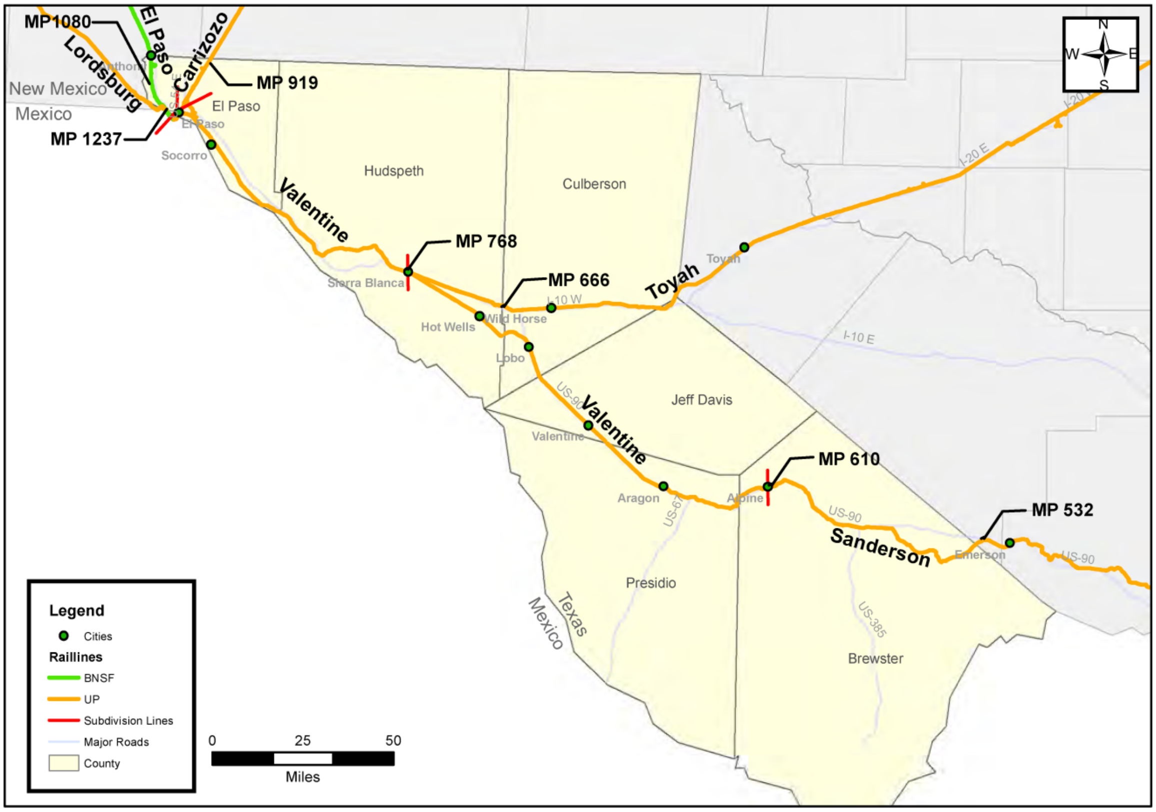
Section 5.3: Updating the Phase I RTC Base Case Model

The original Phase I RTC Base Case model was developed in 2010. This original model was developed using data provided by the UP and BNSF to create the RTC railroad infrastructure and populate it with train schedules created from railroad operating data. During Phase II, the network and train files that comprised the Phase I RTC Base Case were carefully analyzed and compared with current infrastructure and operating conditions. Based on this review, the Phase II model was modified, as noted below, to more accurately reflect current rail system conditions:

- The geographic area of the model was reduced to analyze train operations within the six-county study area only. The study area boundaries, defined by railroad subdivision and control point name, are seen in Figure 5-1, and are as follows:
    - UP Valentine/Sanderson Subdivisions (east to Houston): near Longfellow, Mile Post (MP) 532
    - UP Valentine/Toyah Subdivisions (east to Fort Worth): near Toyah, MP 666
    - UP Lordsburg Subdivision (west to Los Angeles): near Dona, MP 1237
    - UP Carrizozo Subdivision (north to Kansas City): near Oro Grande, MP 919
    - BNSF El Paso Subdivision (north to Belen): near Rincon, MP 1080
    - Ferromex (south to Juarez): None; Proxy to account for traffic to/from Mexico
- The number of daily UP trains was increased from 45 to 50 to reflect estimated 2012 daily traffic volumes.
- Train files were modified to reflect stopping locations for current UP practices for fuelling and crew changes in El Paso.

UP elected not to participate in verification of the RTC modeling for Phase II of the study, so assumptions on service and schedules were made based upon alternate information sources.

Figure 5-1: El Paso Region Freight Rail Study Boundaries by Milepost (MP)



Since actual 2012 freight train schedules were not provided by the railroads to TxDOT, Phase I train profiles (class, maximum speed, locomotives, length and tonnage) were utilized but the schedules were adjusted. UP trains entering the model area from all four points of entry into the study area boundaries were loaded onto the network (seeded) evenly throughout the day, which provided a more robust test of infrastructure compared to using (unavailable) schedules based upon daily UP operating practices.

Updated RTC Base Case

Using the train data previously described and the infrastructure files that represent current conditions, the Updated RTC Base Case model results are shown in Table 5-1.

Table 5-1: RTC Model Results- Updated Base Case with Base Infrastructure

Updated Base Case - Base Infrastructure				
Train Group	Weekly Train Count	Avg. Speed [mph]	Delay %	Delay Minutes/100 Train Miles
Passenger	6	49.34	0.00	0.00
UP Expedited	294	33.94	14.36	19.19
UP Freight	56	33.03	14.74	21.68
BNSF Expedited	25	32.69	N/A	N/A
BNSF Freight	28	31.20	N/A	N/A

It should be noted that the BNSF has fewer passing sidings on its rail network within the study limits, but also significantly fewer trains than the UP. For modeling purposes, it was assumed that the BNSF would "fleet" trains together across the route. "Fleeting" means operating two or more trains consecutively in the same direction of movement, reducing the number of meet/pass events for every train. Also, due to the small amount of the BNSF route in the study area, any infrastructure improvements would most likely occur outside of the study area, so no improvements were evaluated. As a result of using these assumptions, the RTC model results record no delay metrics for BNSF trains.

Amtrak currently operates the Sunset Limited (New Orleans – Los Angeles) three times a week, in both directions, on the existing UP rail network. Operating railroads typically give priority to Amtrak trains across their respective networks. As such, the RTC model gives absolute priority to passenger trains, resulting in no delay to Amtrak trains.

Section 5.4: Applied RTC Methodology

The major objectives for RTC modeling of the El Paso region were to best represent infrastructure and operating conditions, and to evaluate various train traffic growth scenarios over 20 years that would allow determination of impacts on the region.

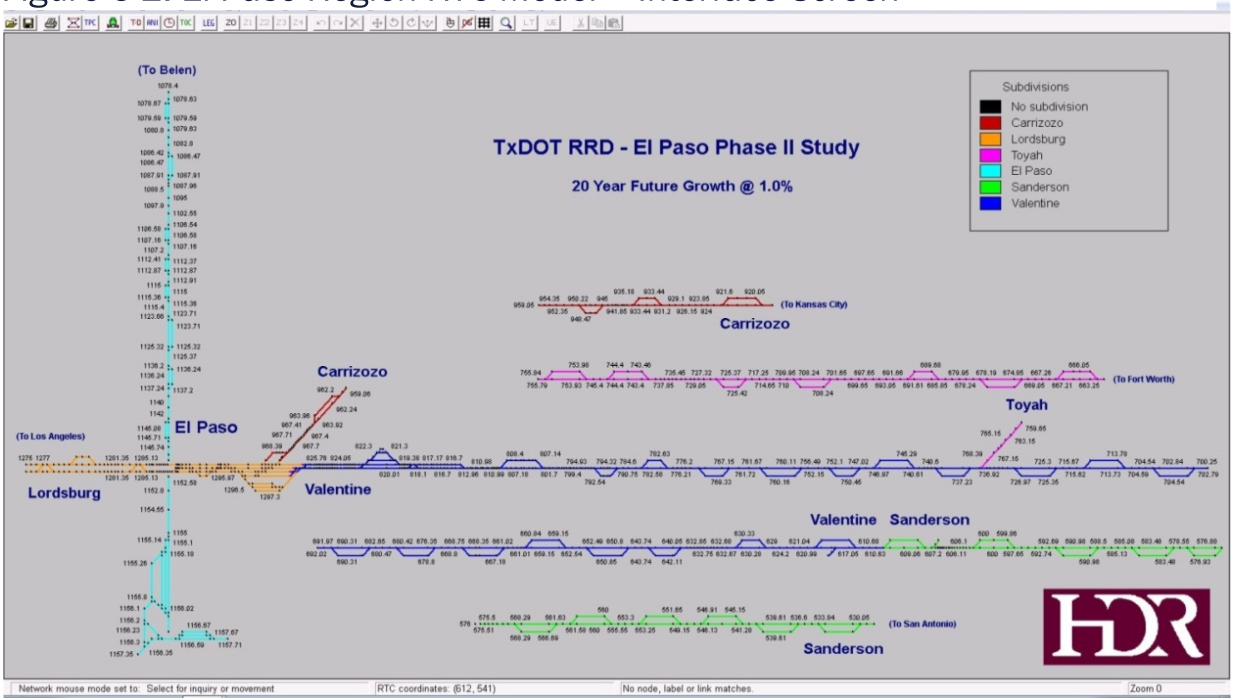
The applied steps for the RTC modeling in this study consisted of:

- Modification of the original Phase I RTC model, with infrastructure and train volumes adjusted to reflect current operating conditions
- RTC model runs to test and debug (if necessary) the initial infrastructure design
- RTC model runs at various levels of traffic growth
- Amtrak service remains at 6 trains per week in all growth models
- Multiple iterations of schedule and infrastructure refinements to develop a fluid model run

- Comparison of train performance metrics between the base case model and growth models
- Where train performance deviates significantly from the Base Case model, add infrastructure to allow the model to operate near the levels of performance of the Base Case Model
- Add infrastructure, where appropriate, to consecutive growth models to match Base Case performance up to the final 4.02% growth case
- Final assessment of the model results

The modified RTC model for the study area is graphically represented in Figure 5-2.

Figure 5-2: El Paso Region RTC Model – Interface Screen



Section 5.5: RTC Base Case Model Parameters

The following tables describe the UP and BNSF train consist data developed for the Phase I model and carried over into the Phase II Base Case model:

Table 5-2: RTC Model Parameters – UP Consist Data

UP Train Consist Information							
Train Type	Max Speed	Loco Type	Loco Count	Loads	Empties	Tons	Length (ft)
Autos/Parts	65	SD70M	3	92	0	5500	7500
Expedited IM	70	SD70M	4x1	74	0	6000	8000
Grain	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Intermodal (IM)	65	SD70M	3x1	74	0	6000	8000
Manifest	55	SD70M	4x1	68	67	11500	6670
Priority Manifest	55	SD70M	4x1	43	43	7350	5160

Table 5-3: RTC Model Parameters – BNSF Consist Data

BNSF Train Consist Information							
Train Type	Max Speed	Loco Type	Loco Count	Loads	Empties	Tons	Length (ft)
Autos/Parts	50	AC4400	3	55	12	3780	6000
Expedited IM	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grain	45	AC4400	3x1	110	0	15730	6900
Intermodal	55	AC4400	2	15	0	6000	6000
Manifest	50	AC4400	2	43	43	7439	6000
Priority Manifest	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Weekly UP, BNSF, and Amtrak train counts used in the revised Base Case model are shown in the following tables.

Table 5-4: RTC Model Parameters – Weekly UP Train Frequency

Weekly UP Train Frequency															
Train Type	Sun		Mon		Tue		Wed		Thu		Fri		Sat		Total
	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	
Autos/Parts	2	2	2	2	2	2	2	2	2	2	2	2	2	2	28
Expedited IM	4	4	4	4	4	4	4	4	4	4	4	4	4	4	56
Grain	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Intermodal	15	15	15	15	15	15	15	15	15	15	15	15	15	15	210
Manifest	3	3	3	3	3	3	3	3	3	3	3	3	3	3	42
Priority Manifest	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
Total	50		50		50		50		50		50		50		350

Table 5-5: RTC Model Parameters – Weekly BNSF Train Frequency

Weekly BNSF Train Frequency															
Train Type	Sun		Mon		Tue		Wed		Thu		Fri		Sat		Total
	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	
Autos/Parts	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
Expedited IM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grain	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
Intermodal	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
Manifest	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
Priority Manifest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	8		8		8		8		8		8		8		56

Table 5-6: RTC Model Parameters – Weekly Amtrak Train Frequency

Weekly Amtrak Train Frequency															
Train Type	Sun		Mon		Tue		Wed		Thu		Fri		Sat		Total
	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	EB	WB	
Passenger	0	1	1	0	0	1	0	0	1	1	0	0	1	0	6
Total	1		1		1		0		2		0		1		6

East of El Paso, the UP track system separates into three separate rail lines (subdivisions).

The following table shows the breakdown of daily traffic by train type and subdivision:

Table 5-7: RTC Model Parameters – Daily UP Train Routing

Daily UP Train Routing (east of El Paso) by Subdivision							
Train Type	Toyah		Sanderson		Carrizozo		Total
	EB	WB	EB	WB	EB	WB	
Autos/Parts	0	0	0	0	2	2	4
Expedited IM	2	2	1	1	1	1	8
Grain	0	0	0	0	0	0	0
Intermodal	7	7	2	2	6	6	30
Manifest	1	1	1	1	1	1	6
Priority Manifest	0	0	1	1	0	0	2
Total	20		10		20		50

Section 5.6: RTC Base Case Model Results

When processing RTC model results, train performance metrics were calculated to provide a measurable framework for comparing train operations between the Base Case model and the various rail traffic growth scenarios over 20 years. These metrics include train count, average train speed, delay % and delay minutes per 100 train-miles.

Results for each model run were grouped into five different train groups: Passenger (Amtrak), UP Expedited, UP Freight, BNSF Expedited and BNSF Freight.

Revised RTC Base Case with Strauss Yard

In 2011, UP began construction of Strauss Yard, a major infrastructure improvement project approximately 20 miles west of El Paso and within the RTC model study limits. Located west of Santa Teresa, New Mexico, the yard, when completed, will include a run-through fuelling facility, intermodal yard and block swap yard.

Construction is scheduled for completion in 2014. When the yard is fully functional, UP operations within the El Paso area will change drastically. All intermodal and most yard operations will move from Alfalfa Yard and Dallas Yard in El Paso to Strauss Yard. In addition, all train fuelling and crew changes, currently handled at various locations in El Paso, will move to Strauss Yard as well. The opening of this facility will significantly increase the velocity of nearly all UP trains through El Paso. In order to compare rail network performance between present day and future growth scenarios, the infrastructure elements modified in the updated Base Case model were again modified to include the Strauss Yard infrastructure and the resultant changes in train operations, servicing and crewing. This modified Updated Base Case model is referred to as the Revised Base Case model.

The metrics generated from the Revised Base Case model are the benchmark metrics upon which metrics from various future traffic growth scenarios are compared. If the metrics from the growth scenarios deviate significantly from those of the Revised Base Case, new rail infrastructure was added at strategic locations until those metrics were comparable.

Using the same train data previously described and the modified infrastructure files to include Strauss Yard, the Revised Base Case model RTC results are shown in Table 5-8.

Table 5-8: RTC Model Results – Revised Base Case with Strauss Yard

Revised Base Case – Base Infrastructure with Strauss Yard				
Train Group	Weekly Train Count	Avg. Speed [mph]	Delay %	Delay Minutes/100 Train Miles
Passenger	6	49.33	0.00	0.00
UP Expedited	294	42.23	11.93	15.14
UP Freight	56	37.59	8.91	12.86
BNSF Expedited	25	32.69	N/A	N/A
BNSF Freight	28	31.20	N/A	N/A
Total Trains	409			

With the Strauss Yard in operation, train performance metrics improve significantly in all categories. For the key delay percentage category, delay percentages for UP expedited trains went from 14.36 to 11.93 and UP general freight from 14.74 to 8.91, with average operating speeds increasing approximately 8 and 4 mph, respectively. These results indicate UP will realize significant immediate improvements in operational efficiency upon commissioning of Strauss Yard and the resulting relocation of fuelling, servicing and crewing.

Section 5.7: RTC Growth Models

In order to test the ability of the El Paso freight rail network to accommodate future rail traffic growth, additional models were constructed for various annual volume percentage increases measured over a 20-year period. When adding additional train volume to reach the desired growth rate, there are two possible methods used to model this increase in volume. One method is to increase the length and tonnage of trains; the other method is to add additional complete trains to the model.

Increasing the length and tonnage of each train was deemed impractical, as the railroads operate trains short enough to be accommodated in main line sidings to allow for meet and pass events with other trains. Building trains longer than the sidings would significantly impede meet and pass events and create a difficult, if not impossible, railroad to operate. For this reason, entire trains were added to the Revised Base Case model to reach, as close as possible, the desired growth levels to be evaluated. Adding whole numbers of trains may not result in an exact or even percentage growth, but was close to the desired percentage growth (e.g., 0.57% vs. 0.5%).

In general, a single track railroad experiencing over a 16% delay percentage is reaching the point of serious congestion. For the purposes of this study, infrastructure was added to any model experiencing 16% or more delay percentages. The infrastructure was added in incremental stages, and was generally installed by connecting adjacent sidings to create continuous sections of main line double track. To minimize construction costs, as well as follow UP's assumed infrastructure selection criteria, locations with fewer grade crossings, viaducts and bridges were selected first over segments with significant physical constraints.

Table 5-9 shows the annual UP rail traffic growth rates for the various scenarios, or planning cases, that were modeled and evaluated. The corresponding total per cent increase in traffic volumes over the evaluated 20-year period is also provided for each planning case. The number of BNSF trains for each planning case growth rate was rounded to the near whole number.

Table 5-9: RTC Model – Planning Case Annual Growth Rates

20-Year Growth Rate Statistics				
Model Name	Annual Rail Traffic Growth Rate	UP		
		Daily Train Count	Weekly Train Count	% Train Increase
Revised Base Case	0.00%	50	350	0%
Planning Case 1	0.57%	56	392	12%
Planning Case 2 & 2a	1.55%	68	476	36%
Planning Case 3	2.12%	76	532	52%
Planning Case 4 & 4a	2.55%	82	574	64%
Planning Case 5	2.75%	86	602	72%
Planning Case 6	4.02%	110	770	120%

Planning Case 1

Using the Revised Base Case, Table 5-10 summarizes the train performance metrics when applying at 0.57% annual growth rate for rail traffic to the study network over a 20-year period. The train counts represent the weekly number of trains of each specific train group. This growth rate scenario increases the number of weekly UP trains from 350 to 392. Note that the number of Amtrak trains remains constant through the evaluation of various growth case scenarios.

Table 5-10: RTC Model Results – Planning Case 1 with Base Infrastructure

Planning Case 1: 0.57% Annual Growth over 20 Years – Base Infrastructure with Strauss Yard				
Train Group	Weekly Train Count	Avg. Speed [mph]	Delay %	Delay Minutes/100 Train Miles
Passenger	6	49.33	0.00	0.00
UP Expedited	329	41.95	12.44	15.83
UP Freight	63	35.63	13.74	19.99
BNSF Expedited	29	32.70	N/A	N/A
BNSF Freight	32	31.20	N/A	N/A
Total Trains	459			

The delay percentages remain below the 16% threshold, which is a general indication that the existing rail infrastructure, with Strauss Yard, can support the 0.57% annual growth without any required new infrastructure.

Planning Case 2

Using the Revised Base Case, Table 5-11 summarizes the train performance metrics when applying a 1.55% annual growth of rail traffic to the study network over a 20-year period. This growth rate scenario increases the number of weekly UP trains from 350 to 476.

Table 5-11: RTC Model Results – Planning Case 2 with Base Infrastructure

Planning Case 2: 1.55% Annual Growth over 20 Years – Base Infrastructure with Strauss Yard				
Train Group	Weekly Train Count	Avg. Speed [mph]	Delay %	Delay Minutes/100 Train Miles
Passenger	6	49.33	0.00	0.00
UP Expedited	399	40.21	17.39	22.10
UP Freight	77	33.93	18.95	27.76
BNSF Expedited	36	32.70	N/A	N/A
BNSF Freight	40	31.20	N/A	N/A
Total Trains	558			

The delay percentages now exceed the 16% threshold, representing noticeable congestion with the rail network. These delay percentages are also higher than those calculated for Base Case without Strauss Yard – representing current operating conditions within the rail network. The ability to efficiently dispatch and operate trains now becomes more difficult. Therefore, it is likely that new infrastructure would be added to the rail network in order to more efficiently dispatch and operate trains (i.e., lower the delay %).

Physical track infrastructure was then identified and added to the model to improve operational efficiency. Additional track (double track) was added between existing sidings at four different locations on the UP Valentine Subdivision, between El Paso (MP 827) and Sierra Blanca (MP 737). The locations of the proposed double track sections are:

- MP 807.1 to MP 794.9
- MP 792.5 to MP 784.6
- MP 760.1 to MP 752.2
- MP 745.2 to MP 739.3

The length of each new double track section varies between approximately 4 and 14 miles. A double track connection between the Valentine and Toyah subdivisions at Sierra Blanca was also included. The improvements require approximately 40 total miles of track to be constructed, leaving about 29 miles of single track along the UP Valentine Subdivision between El Paso and Sierra Blanca.

Table 5-12 summarizes the train performance metrics after the new infrastructure was added to the Revised Base Case model.

Table 5-12: RTC Model Results – Planning Case 2a with Expanded Infrastructure

Planning Case 2a: 1.55% Annual Growth over 20 Years – Expanded Infrastructure with Strauss Yard				
Train Group	Weekly Train Count	Avg. Speed [mph]	Delay %	Delay Minutes/100 Train Miles
Passenger	6	49.33	0.00	0.00
UP Expedited	399	40.86	15.53	19.74
UP Freight	77	36.39	10.78	15.80
BNSF Expedited	36	32.70	N/A	N/A
BNSF Freight	40	31.20	N/A	N/A
Total Trains	558			

Planning Case 3

Using the Revised Base Case and the expanded infrastructure described in Planning Case 2, Table 5-13 summarizes the train performance metrics when applying a 2.12% annual growth of rail traffic to the study network over a 20-year period. Note that this annual growth rate is a typical value supported by the FRA when evaluating future rail network capacity. This growth rate scenario increases the number of weekly UP trains from 350 to 532.

Table 5-13: RTC Model Results – Planning Case 3 with Expanded Infrastructure

Planning Case 3: 2.12% Annual Growth over 20 Years – Expanded Infrastructure with Strauss Yard				
Train Group	Weekly Train Count	Avg. Speed [mph]	Delay %	Delay Minutes/100 Train Miles
Passenger	6	49.33	0.00	0.00
UP Expedited	434	40.53	16.32	20.77
UP Freight	98	35.98	13.85	19.97
BNSF Expedited	40	32.70	N/A	N/A
BNSF Freight	46	31.21	N/A	N/A
Total Trains	624			

Note that the delay percentages remained close to the 16% threshold, a reasonable level of operating efficiency for the rail network. Therefore, no new infrastructure was added to the RTC model beyond those described for Planning Case 2.

Planning Case 4

Using the Revised Base Case and the expanded infrastructures described in Planning Case 2, Table 5-14 summarizes the train performance metrics when applying a 2.55% annual growth of rail traffic to the study network over a 20-year period. This growth rate scenario increases the number of weekly UP trains from 350 to 574.

Table 5-14: RTC Model Results – Planning Case 4 with Expanded Infrastructure

Planning Case 4: 2.55% Annual Growth over 20 Years – Expanded Infrastructure with Strauss Yard				
Train Group	Weekly Train Count	Avg. Speed [mph]	Delay %	Delay Minutes/100 Train Miles
Passenger	6	48.92	1.00	1.02
UP Expedited	476	37.92	24.64	31.28
UP Freight	98	34.04	22.65	32.20
BNSF Expedited	43	32.70	N/A	N/A
BNSF Freight	49	31.21	N/A	N/A
Total Freight Trains	672			

The delay percentages now again exceed the 16% threshold, representing noticeable congestion within the rail network. Therefore, additional rail infrastructure elements are required to more efficiently dispatch and operate trains (i.e., lower the delay %).

Additional track infrastructure elements were again identified and added to the model to improve operational efficiency. The remaining 29 miles of single track on the UP Valentine Subdivision between El Paso and Sierra Blanca was double tracked.

Table 5-15 summarizes the train performance metrics after the additional infrastructure was added to the model infrastructure described for Planning Case 2.

Table 5-15: RTC Model Results – Planning Case 4a with Additional Infrastructure

Planning Case 4a: 2.55% Annual Growth over 20 Years – Additional Infrastructure with Strauss Yard				
Train Group	Weekly Train Count	Avg. Speed [mph]	Delay %	Delay Minutes/100 Train Miles
Passenger	6	49.33	0.00	0.00
UP Expedited	476	41.14	14.74	18.73
UP Freight	98	37.02	12.61	17.93
BNSF Expedited	43	32.70	N/A	N/A
BNSF Freight	49	31.21	N/A	N/A
Total Trains	672			

Planning Case 5

In an effort to determine the growth level where, without improvements, the railroad becomes non-operable (i.e., so congested that normal train operations are not achievable), various growth models were tried. At 2.75% annual growth, with no improvements beyond the opening of Strauss Yard, the RTC model is unable to dispatch trains, meaning that in all likelihood, the actual railroad system shuts down as well. Infrastructure was then added to the model, not only to get the railroad running again, but to have it operate with train performance metrics comparable to current operations.

Table 5-16 summarizes the train performance metrics using the additional infrastructure described for Planning Cases 2 and 4:

Table 5-16: RTC Model Results – Planning Case 5 with Additional Expanded Infrastructure

Planning Case 5: 2.75% Annual Growth over 20 Years – Additional Infrastructure with Strauss Yard				
Train Group	Weekly Train Count	Avg. Speed [mph]	Delay %	Delay Minutes/100 Train Miles
Passenger	6	49.11	0.48	0.53
UP Expedited	490	40.15	17.58	22.34
UP Freight	112	35.13	16.56	23.93
BNSF Expedited	46	32.70	N/A	N/A
BNSF Freight	51	31.21	N/A	N/A
Total Trains	705			

Even with the added infrastructure, the model results show delay percentages that exceed 16% and are greater than those calculated to represent current conditions. Therefore, additional infrastructure is required in order to more efficiently dispatch and operate trains (i.e., lower the delay percentage).

Planning Case 6

Finally, an RTC model was run with an annual freight growth of 4.02%. Similar to Planning Case 5, the railroad was not dispatchable with current infrastructure and Strauss Yard. Including the added rail infrastructure described in Planning Cases 2 and 4, additional infrastructure was identified and added to the model until the train performance metrics were close to present day operations. The additional infrastructure consisted of double tracking the entire UP Toyah Subdivision from Sierra Blanca to Toyah, a section that currently is single track with sidings. This additional infrastructure equates to approximately 104 miles of new track.

Table 5-17 summarizes the train performance metrics using the additional infrastructure described for Planning Cases 2 and 4, and the additional double track along the UP Toyah Subdivision.

Table 5-17: RTC Model Results – Planning Case 6 with Additional Expanded Infrastructure

Planning Case 6: 4.02% Annual Growth over 20 Years – Additional Infrastructure with Strauss Yard				
Train Group	Weekly Train Count	Avg. Speed [mph]	Delay %	Delay Minutes/100 Train Miles
Passenger	6	49.23	N/A	N/A
UP Expedited	644	41.66	13.14	16.73
UP Freight	126	34.32	17.87	26.29
BNSF Expedited	58	32.70	N/A	N/A
BNSF Freight	65	30.79	N/A	N/A
Total Trains	899			

Section 5.8: RTC Model Findings

The opening of the Strauss Yard will significantly improve rail operations throughout the El Paso region compared to current day. Strauss Yard will allow the UP to handle annual traffic increases of up to approximately 1.5% over a 20-year period without having to add more infrastructure. This study modeled future rail operations at varying levels of traffic growth, to suggest how much new rail infrastructure may be needed to keep railroad operations fluid, dependable, and close to current day conditions.

For annual rail traffic increases higher than approximately 1.5%, additional infrastructure is required. For 2.12% annual growth, new sections of double track are required on the UP Valentine Subdivision between El Paso and Sierra Blanca, as well as a double-track connection between the UP Valentine and Toyah Subdivisions. For 2.75% annual growth, the entire UP Valentine Subdivision between El Paso and Sierra Blanca needs to be double tracked, as well as a double track connection between the subdivisions. For the 4.02% annual growth, which is a significant level of rail traffic growth, the entire UP Valentine Subdivision between El Paso and Sierra Blanca and the UP Toyah Subdivision between Sierra Blanca and Toyah, need to be double tracked.

As noted previously, BNSF has significantly fewer trains operating in the study area compared to the UP. Due to the relatively small amount of BNSF trackage in the study area, any infrastructure improvements would most likely occur outside of the study area. Alternatively, BNSF may decide to "fleet" trains together across the route to reduce future infrastructure requirements. "Fleeting" means operating two or more trains consecutively in the same direction of movement, reducing the number of meet/pass events for every train. There are also on-going grade separation projects in Ciudad Juarez and the expected extension of the operating windows for trains entering the US further support the likelihood of capacity infrastructure improvements on the BNSF. However, these improvements, which may include new signaling systems and/or new or enlarged passing sidings, would likely occur outside of the study area.

The models evaluated how the railroads may operate 20 years into the future. Realistically, traffic growth does not increase in 20 year increments, and railroads will forecast infrastructure needs in the near-term (5 years or less) and build incremental improvements to help with that growth. Railroads, however, will build this new capacity with long-term growth in mind, so that all improvements done in the short-term will complement future potential improvements rather than conflict with them.

It is important to note that there are other factors, aside from train throughput, that railroads consider in determining where and when to add infrastructure, including, but not limited to:

1. *Increasing train speed.* Depending on the rail route segment, a railroad may want to increase train speed to reduce fuel or crew costs, or meet rising service delivery expectations from shippers. Train speed can be increased on certain segments by reducing the degree of curves, replacing turnouts with ones rated for a higher track speed, etc.
2. *New shipper/border interchange activity.* An existing or new online shipper may increase the amount of business provided to a railroad, creating new areas of congestion that may be alleviated by adding new infrastructure. This applies to increases in cross border traffic as well.

Incorporating these factors into RTC modeling would be highly speculative without the direct partnership and input of the operating railroad. These issues, however, could influence future railroad infrastructure plans as well as overall train performance.

It should be noted that in practice, UP and BNSF may dispatch trains in a more efficient manner than the model, due to dispatchers' inherent knowledge of the territory as well as the UP and BNSF networks' operations beyond the model area. The models are meant to illustrate how growth rates may impact future service and how selected infrastructure improvements may help alleviate future congestion. The individual railroads, with their vast institutional knowledge, may determine that other infrastructure and/or dispatch and signal improvements may be superior in practice than what the model results and recommendations are.

Section 6A: Freight Rail and Rail-Roadway Interface Safety Issues

Historically, many towns and cities established adjacent to the railroads and major truck routes have thrived and turned into large municipalities over time, and are now faced with the dilemma of having railroad and truck freight operations pass directly through their central business districts. Additionally, as the municipalities have grown and prospered, so has residential land use adjacent to the truck routes and rail lines. Truck and rail freight movement through populated areas brings with it a potential exposure to safety hazards.

Various data pertaining to train accidents/incidents including collisions, derailments, and other events causing reportable damage, injuries, or fatalities are reported to the Federal Railroad Administration (FRA) by the operating railroads across the country. Incidents, including those resulting in damage to rail cars transporting hazardous material or causing the release of the hazardous material, must be reported to the FRA if there is reportable damage resulting from the incident above a specified threshold ($9,500 in 2012) or if there are any injuries or evacuations ordered in response to the incident.[1]

Additionally, incidents that result in any fatalities, personal injuries, public evacuations, closure of a major transportation artery, and fire, breakage, or spillage of radioactive or infectious materials must be immediately reported to the National Response Center for both rail and truck transport.[2]

The trucking industry continues to remain the dominant mode of freight transport. Approximately 70 per cent of the nation's domestic freight tonnage is carried by trucks, far more than by any other transportation mode.[3] The annual reported number of accidents is also consistently larger for trucks as opposed to rail.[4]

Section 6.1: Safety Data and Statistics

Safety hazards involving freight rail operations include rail-roadway crossing accidents, trespasser casualties, train accidents and derailments, and hazardous material spills. The following sections provide reported annual safety statistics, such as the number of

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[1] Code of Federal Regulations, Title 49, Part 225: Railroad Accidents/Incidents: Reports, Classification, and Investigations

[2] Code of Federal Regulations, Title 49, Part 171.15: Railroad Accidents/Incidents: Immediate Notice of Certain Hazardous Materials Incidents.

[3] US Department of Transportation, Federal Highway Administration, Freight Management and Operations, 2012.

[4] US Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, 2013.

incidents, the resulting injuries and fatalities, and, in some cases, estimated damages as reported by the railroads from January 2008 through December 2012. All safety data and statistics presented in this section were obtained from the FRA Office of Safety Analysis unless referenced otherwise.

Roadway-Rail At-Grade Crossing Accidents

Approximately 145 public at-grade roadway-rail crossings are located in the TxDOT - El Paso District. Table 6-1 depicts the number of public at-grade crossings for Texas and the El Paso District study area sorted by the type of warning device. The crossings listed for the El Paso District only include crossings with mainline tracks and exclude crossings at industry tracks and sidings. Table 6-2 shows the number of public and private crossings in the study limits, sorted by county.

Table 6-1: Public At-Grade Crossings for Texas and the El Paso District

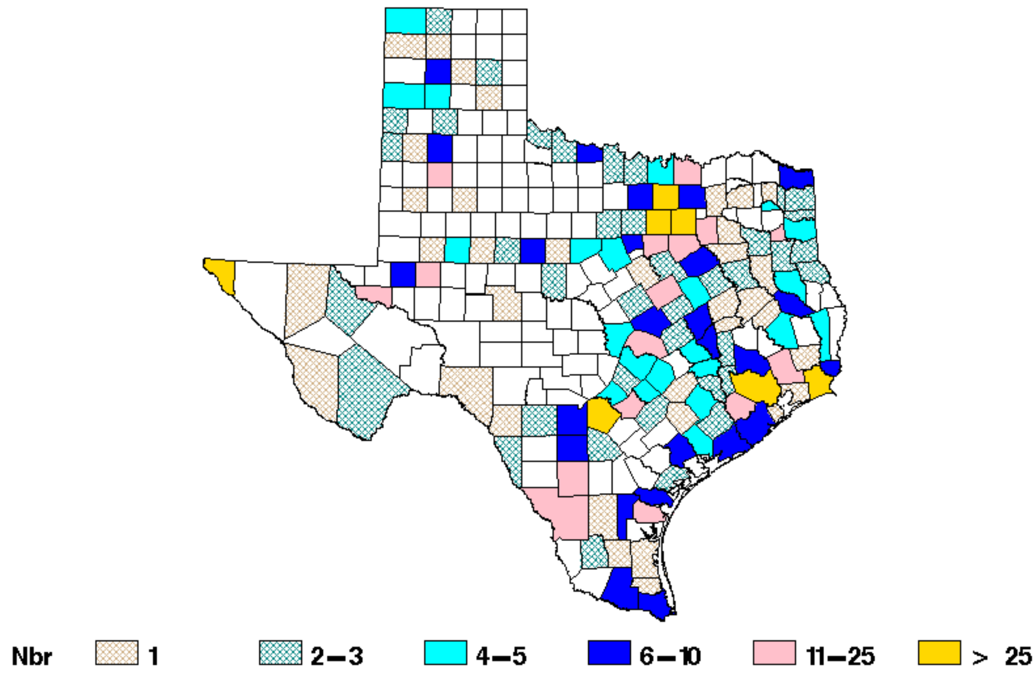
Public Crossing Warning Device Inventory		
Type of Warning Device	Texas	El Paso District
Crossbucks (passive)	2,977	20
Lights only (active)	806	10
Gates (active)	4,271	87
Stop Signs	236	13
Special Warning	40	3
Highway Traffic Signal	437	8
Other (passive & active)	11	1
Unknown / None	148	3
Total Warning Devices	8926	145

Table 6-2: Total At-Grade Roadway-Rail Crossings for the El Paso District

Crossing Inventory by County				
County	Total		Public	Private
	Number	%		
Brewster	33	10.8	11	22
Culberson	12	4.0	6	6
El Paso	179	58.9	102	77
Jeff Davis	12	4.0	2	10
Hudspeth	18	5.9	11	7
Presidio	50	16.4	13	37
Total	304	100	145	159

Figure 6-1 depicts the number of roadway-rail incidents in the State of Texas for the five-year time period from January 2008 through December 2012. The largest concentration of incidents within the study area over the five-year period occurred in El Paso County, which is the highest and most densely populated county in the study region.

Figure 6-1: Roadway-Rail Incidents for Texas, January 2008 through December 2012



The study area experienced 33 roadway-rail at-grade crossing accidents from January 2008 through December 2012, including 4 fatalities and 15 injuries, as shown in Table 6-3.

The roadway-rail incidents that occurred in El Paso County in the five-year timeframe accounted for nearly 90 per cent of the total roadway-rail incidents within the six-county study area.

Table 6-3: Roadway-Rail Incidents for the TxDOT - El Paso District by County (2008-2012)

Summary Statistics of Roadway-Rail Incidents															
County	Total			At Public Crossings						At Private Crossings					
				Motor Vehicle			Other			Motor Vehicle			Other		
	Cnt	Kld	Inj	Cnt	Kld	Inj	Cnt	Kld	Inj	Cnt	Kld	Inj	Cnt	Kld	Inj
Brewster	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Culberson	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
El Paso	29	4	14	23	2	11	1	1	0	5	1	3	0	0	0
Hudspeth	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jeff Davis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Presidio	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0
Total	33	4	15	26	2	12	2	1	0	5	1	3	0	0	0
Cnt = Incident Count; Kld = Fatalities; Inj = Injuries; Other = Railroad Employees or Passengers															

Trespasser Incidents

Trespasser incidents include fatalities and injuries caused by trespassing onto railroad property and are not included in accidents associated with vehicular traffic at crossings. The majority of trespasser incidents consist of being struck by on-track equipment or slipping, tripping or falling. A total of 19 trespasser incidents occurred in the study area from 2008 through 2012, of which 16 occurred in El Paso County. The number of trespasser incidents by county and year from 2008 through 2012 in the study area is listed in Table 6-4.

Table 6-4: TxDOT - El Paso District Trespasser Incidents (2008 through 2012) by County

Trespasser Casualties (Fatalities and Injuries)							
County	Total		Yearly Count				
	Number	% of Total	2008	2009	2010	2011	2012
Brewster	1	5.3%	0	0	1	0	0
Culberson	1	5.3%	0	0	1	0	0
El Paso	16	84.2%	2	1	1	5	7
Hudspeth	0	0.0%	0	0	0	0	0
Jeff Davis	0	0.0%	0	0	0	0	0
Presidio	1	5.3%	0	1	0	0	0
Total	19	100%	2	2	3	5	7

Train Accidents

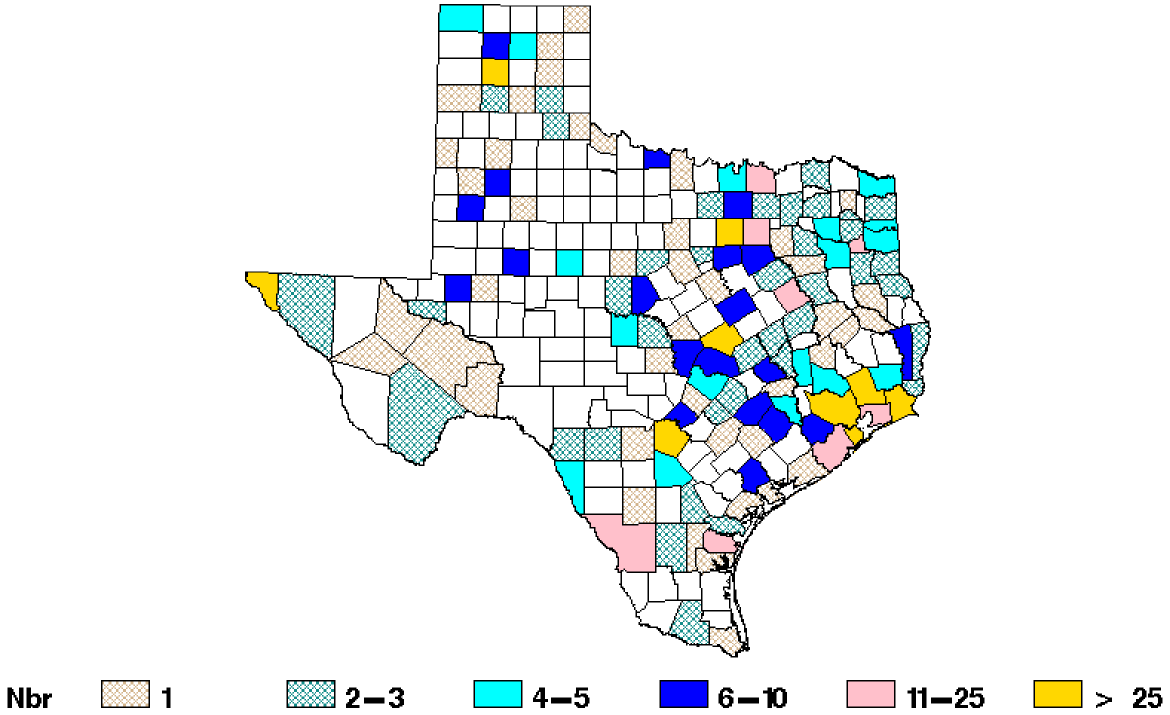
There were 33 reported train accidents, which include derailments and train collisions, within the El Paso study area from 2008 through 2012. Data provided by the railroads to the FRA shows the total cost of equipment and infrastructure damage was nearly $3 million within the study area over the five years. Table 6-5 provides a summary of the train accident damage statistics within the study area.

Table 6-5: Train Accidents in the TxDOT - El Paso District by County (2008 through 2012)

Train Accidents							
County	Totals				Accident Type		
	Accidents	Fatalities	Injuries	Reportable Damage	Collisions	Derailments	Other
Brewster	2	0	0	$733,626	0	2	0
Culberson	0	0	0	$0	0	0	0
El Paso	28	0	1	$1,428,536	0	22	6
Hudspeth	2	0	0	$591,955	0	2	0
Jeff Davis	1	0	0	$63,547	0	1	0
Presidio	0	0	0	$0	0	0	0
Total	33	0	1	$2,817,664	0	27	6

Figure 6-2 depicts the number of train accidents, excluding roadway-rail incidents, in the State of Texas for the time period from January 2008 through December 2012.

Figure 6-2: Train Accidents for Texas, January 2008 through December 2012



The FRA reports that the majority of serious events involving train derailments or train collisions have been associated with track conditions and human factors.[5] For the study area, between 2008 and 2012, Figure 6-3 shows how track condition and human factors together make up almost 64 per cent of these high-risk train accidents, while signal and equipment failures together comprise 9 per cent, and miscellaneous factors cause the remaining 27 per cent of rail incidents.

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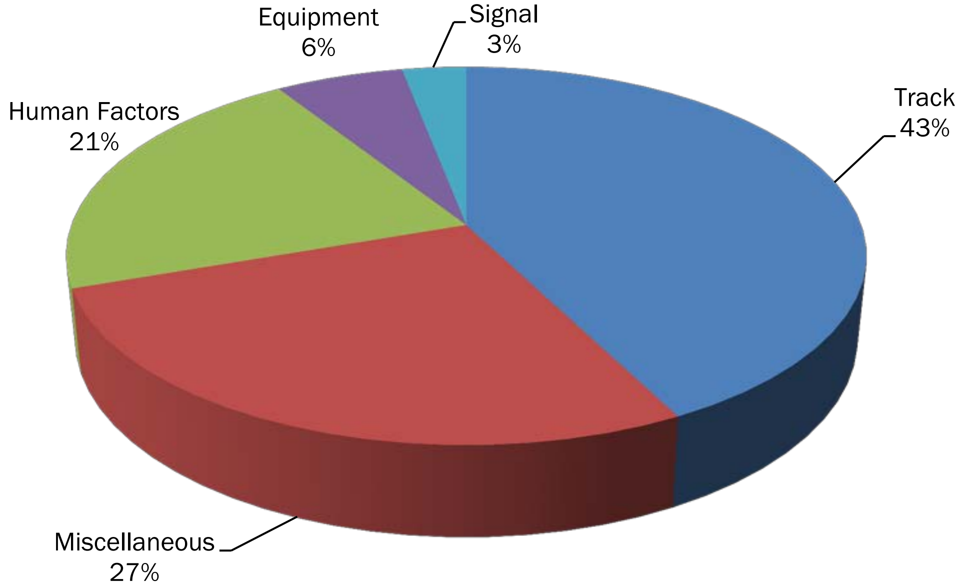
[5] National Rail Safety Action Plan Progress Report 2005-2007, Federal Railroad Administration, U.S. Department of Transportation, May 2007.

Figure 6-3: Causes of Non-Grade Crossing Train Accidents in the TxDOT - El Paso District



Incidents within the study area caused by human factors may be the result of errors on the part of the railroad locomotive crew or other employees, including, but not limited to, failure to properly secure equipment, exceeding train speed limitations, improper train make-up, failure to apply or secure brakes, and other similar incidents. Miscellaneous factors for incidents within the study area include extreme environmental incidents, such as flooding, among other causes not attributable to human error or deficiencies in equipment or infrastructure. Incidents within the study area caused by track condition include wide gage of track (rail spaced too far apart), defective or missing rail ties, defects or damage at switches, and damaged rails. All but one of these track related incidents occurred on non-mainline track, such as yards and industry lead tracks. This suggests that mainline tracks are adequately maintained for the operating conditions.

Maximum allowable train speeds for freight and passenger rail are prescribed according to track classification in 49 CFR 213 – Track Safety Standards.[6] Since the FRA bases track class on specific track standards (e.g., number of good rail ties per defined length, consistency of track gage, deviations in track profile and alignment, etc.) that relate to maximum allowable train speeds, records of maximum train speeds on each rail corridor can be used to infer track conditions without conducting an extensive and costly field

[6] Code of Federal Regulations, Title 49, Transportation, Part 213 (49 CFR 213), Subpart A – Classes of Track: Operating Speed Limits.

inventory. Figure 6-4 diagrams the locations of track classes for the study area rail network according to railroad operating timetables, which correlate to maximum allowable freight train speeds listed in Table 6-6. The portions of major rail lines in the study area are all designated as FRA Class 3 or higher. The portion of the South Orient Railroad, a rail line owned by TxDOT and operated and maintained by Texas Pacifico Transportation, Ltd, within the study area, is designated as Excepted Track. [7]

Table 6-6 lists the FRA-compiled accident rates for each track class in terms of cars derailed per billion freight car miles travelled.[8] One billion freight car miles is equivalent to a 100-car train traveling 100,000 times over a corridor distance of 100 miles. These statistics exclude incidents involving roadway-rail grade crossing accidents and, thus, reflect the potential for track and operating conditions at each FRA track class (which may involve human factors) to cause a derailment. Derailments per billion freight car miles traveled during the 1992-2001 period are listed in Table 6-6 according to FRA track class and associated maximum track speed. Table 6-6 represents statistics collected nationwide and provides no indication of when or where an accident involving a derailment will actually occur.

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[7] A railroad is allowed to operate sections of track designated as Excepted Track in certain cases where track quality (crossties, track gage, rail condition, etc.) does not meet Class I standards. For example, Excepted Track must be identified in the timetable under special instructions and restrictions and cannot be located within 30 feet of an adjacent track that can be subjected to simultaneous use in excess of 10 mph. The track must not be on bridges or public roadways and must limit the number of cars placarded by Hazardous Material Regulations (49 CFR 172) to five cars per train. Train speeds on Excepted Track must not be in excess of 10 mph and passenger service is prohibited.

[8] Anderson, R.T. and Barkan, C.P.L., Railroad Accident Rates for Use in Transportation Risk Analysis, Transportation Research Record, No. 1863, National Research Council, Washington, D.C., 2004, pp. 88-98.

Figure 6-4: FRA Freight Class of Track in the El Paso Region

Table 6-6: Relationship of Track Speed and Derailment Rate to FRA Track Class

Derailment Rate by Track Class					
Description	FRA Track Class (Freight)				
	1	2	3	4	5
Maximum Allowable Speed [mph] for Freight Trains	10	25	40	60	80
Freight Cars Derailed per Billion Freight Car Miles	3979	726	300	77	42

Hazardous Materials and Truck vs. Rail Freight

In 2007, trucks were reported to account for nearly 54 per cent of all hazardous material tonnage shipped in the U.S., while rail accounted for approximately 6 per cent of hazardous material tonnage shipments. Pipelines, water, and air transport accounted for the remaining 40 per cent of hazardous material tonnage.[9] Table 6-7 lists shipment data for all modes of hazardous material transport in the U.S. for the year 2007. Table 6-8 compares the hazardous material shipment data for the U.S. to the State of Texas.

Table 6-7: Hazardous Material Shipment Characteristics by Mode of Transportation for the United States

[Estimates are based on data from the 2007 Commodity Flow Survey. Because of rounding, estimates may not be additive]

Mode of transportation	Value		Tons		Ton-miles[1]		Average miles per shipment
	2007 (million $)	%	2007 (thousands)	%	2007 (millions)	%	
Total	1,448,218	100	2,231,133	100	323,457	100	96
Single modes	1,370,615	94.6	2,111,622	94.6	279,105	86.3	65
Truck[2]	837,074	57.8	1,202,825	53.9	103,997	32.2	59
For-hire truck	358,792	24.8	495,077	22.2	63,288	19.6	214
Private truck	478,282	33	707,748	31.7	40,709	12.6	32
Rail	69,213	4.8	129,743	5.8	92,169	28.5	578
Water	69,186	4.8	149,794	6.7	37,064	11.5	383
Air (includes truck and air)	1,735	0.1	(S)	(S)	(S)	(S)	1,095
Pipeline[3]	393,408	27.2	628,905	28.2	(S)	(S)	(S)
Multiple modes	71,069	4.9	111,022	5	42,886	13.3	834
Other and unknown modes	6,534	0.5	8,489	0.4	1,466	0.5	58

(S) Estimate did not meet publication standards.

[1] Ton-miles estimates are based on estimated distances traveled along a modeled transportation network.

[2] "Truck" includes shipments made by only private truck, only for-hire truck, or a combination of private and for-hire truck.

[3] Estimates for pipeline exclude shipments of crude petroleum (SCTG 16).

[9] 2007 Commodity Flow Survey, Bureau of Transportation Statistics and U.S. Census Bureau, 2007 Economic Census, Issued July 2010.

Table 6-8: Hazardous Material Shipment Characteristics US - Texas Comparison:2007

[Estimates are based on data from the 2007 Commodity Flow Survey. Because of rounding, estimates may not be additive]

Mode of transportation	Value		Tons		Ton-miles[1]		Average miles per shipment
	2007 (million $)	%	2007 thousands)	%	2007 (millions)	%	
US Total	1,448,218	100	2,231,133	100	323,457	100	96
Texas	658,465	45.5	987,026	44.2	128,786	39.8	94
Origin	340,144	23.5	499,592	22.4	76,530	23.7	95
Destination	318,321	22	487,434	21.8	52,256	16.2	93

[1] Ton-miles estimates are based on estimated distances travelled along a modeled transportation network.

In 2013, the Association of American Railroads reported that in 2010 hazmat shipments equal roughly 6 per cent of all U.S. rail traffic, and train accidents with a hazmat release have declined 26% since 2000, and 78% since 1980 (through 2012), while hazmat train accident rates have declined 38% since 2000, and 91% since 1980 (through 2010) [10]

Table 6-9 summarizes the roadway and rail incidents involving hazardous material transported by truck and rail from 2008 through 2012. Also shown in Table 6-9, the number of incidents and damages reported involving hazardous materials transported on roadways is significantly larger than those reported for hazardous materials transported via rail. This may be partly because of the presence of personal vehicles on the same roadways as heavy trucks, as well as the tendency for truck shipments to include more intermediate and transfer movements between the origin and destination than rail shipments. Additionally, the number of incidents per tonnage shipped is far lower for rail than roadway shipments of freight. Average truck weights as determined from FHWA data were found to be approximately 30 tons (including the weight of the empty truck) as opposed to a typical loaded rail car weight of up to 143 tons.

Over the last five years, 16 of the 33 train incidents or accidents in the study region involved train consists with cars carrying hazardous materials. None of these incidents or accidents released hazardous materials.

[10] "Just the Facts – Railroads Safely Move Hazardous Materials, Including Crude Oil", Association of American Railroads, May 2013.

Table 6-9: 2008 through 2012 Truck and Rail Hazardous Material Incident Data

Hazardous Material Incident Data					
	2008	**2009**	**2010**	**2011**	**2012**
Trucks					
Number of Truck Incidents in the U.S. Involving Hazmat	14,805	12,730	12,651	12,809	13,186
Injuries	153	153	152	130	144
Fatalities	6	12	8	12	11
Property Damage ($ million)	$42.89	$50.63	$63.84	$112.52	$57.47
Number of Truck Incidents in Texas Involving Hazmat	1,312	985	1,024	1,302	1,217
Injuries	4	30	11	16	24
Fatalities	1	1	1	1	2
Property Damage ($ million)	$3.91	$6.36	$5.18	$5.55	$6.62
Rail					
Number of Rail Incidents in the U.S. Involving Hazmat	748	642	749	745	660
Injuries	63	38	13	20	18
Fatalities	0	1	0	1	0
Property Damage ($ million)	$7.94	$17.56	$7.35	$12.31	$17.57
Number of Rail Incidents in Texas Involving Hazmat	80	104	99	112	112
Injuries	6	9	1	7	1
Fatalities	0	0	0	0	0
Property Damage ($ million)	$0.25	$1.34	$0.38	$1.38	$1.68

The expected frequency of hazardous material releases, based on nationwide rail derailment data, is shown in Table 6-10 as expected releases per billion railcar miles travelled. For example, based on FRA statistics, hazardous materials transported by rail on Class 2 track could be expected to experience four releases per billion freight car miles travelled. Note the decrease in release frequency as the track class increases. The most frequent causes of hazardous materials incidents for rail transportation were defective components and loose closure of components or devices.[11]

[11] U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration, Office of Hazardous Materials Safety: Hazardous Materials Incident Data, Yearly Incident Summary Reports.

Table 6-10: Hazardous Material Release Frequency per FRA Track Class

Frequency Rate of Hazardous Material Release by Track Class					
Description	FRA Track Class (Freight)				
	1	2	3	4	5
Maximum Allowable Speed [mph] for Freight Trains	10	25	40	60	80
Hazardous Material Releases per Billion Freight Car Miles*	8	4	2	1	0

*Release rates are rounded to nearest whole number (Class 5 = 0.4)

Section 6.2: Emergency Response Operations

The U.S. Department of Transportation has developed federal regulations governing the transport of hazardous materials to avoid emergency situations that may pose dangers to those transporting the materials and to the public.

> The Hazardous Materials Regulations (HMR; 49 CFR Parts 171-180) specify requirements for the safe transportation of hazardous materials in commerce by rail car, aircraft, vessel, and motor vehicle. These comprehensive regulations govern transportation-related activities by offerors (e.g., shippers, brokers, forwarding agents, freight forwarders, and warehousers); carriers (i.e., common, contract, and private); packaging manufacturers, reconditioners, testers, and retesters; and independent inspection agencies. The HMR apply to each person who performs, or causes to be performed, functions related to the transportation of hazardous materials such as determination of, and compliance with, basic conditions for offering; filling packages; marking and labelling packages; preparing shipping papers; handling, loading, securing and segregating packages within a transport vehicle, freight container or cargo hold; and transporting hazardous materials.[12]

Currently, the City of El Paso has an Office of Emergency Management (OEM) to prepare and mitigate the effects of emergencies and disasters in the region. The OEM is responsible for developing and implementing plans to protect the community in the event of a disaster. The OEM directs local emergency response activities and coordinates with the City and the County. The OEM is also responsible for providing emergency notification to provide individuals with vital information during a citywide emergency.

The operating railroads also have emergency response guidebooks that include instructions on how to handle accidents, collisions, derailments, and specific hazardous material accidents and exposures. BNSF and UP have sponsored a national outreach program,

[12] Overview of the Hazardous Materials Regulations, Pipeline and Hazardous Materials Safety Administration, U.S. Department of Transportation.

Transportation Community Awareness and Emergency Response (TRANSCAER) at multiple locations in the midwestern U.S. in recent years. The program aims to help communities prepare to respond to transportation incidents involving hazardous materials and includes training for proper tank-car loading and securement techniques.

Section 6.3: Safety Improvements

A combination of population increases, the number of people traveling on the roadway network, and an increase in the number of freight trains traveling through densely-populated locales has increased the exposure rate of the roadway-rail interface, stressing the importance of a more proactive approach to minimizing incidents and hazards associated with the movement of freight.

One method of increasing safety is to eliminate or minimize the number of potential incident locations within a particular area. Safety is increased by eliminating roadway-rail crossings through the use of grade separations or crossing closures that would reroute traffic to grade separations. Another method of improving safety is to upgrade warning protection to devices such as flashing lights with gates. One last method is by utilizing alternate rail routes from urban or suburban areas into more rural areas, thereby reducing the number of vehicles at grade crossings.

Grade separation and crossing closures, along with safety enhancements at existing crossings, also create the potential for establishing quiet zones. A quiet zone is a segment of a rail line, within which is situated one or more consecutive public roadway-rail crossings, on which locomotive horns are not routinely sounded. In locations where quiet zones are established, locomotives cannot sound horns except for emergency situations. As noted in 49 CFR Parts 222 and 229, implementing specific safety enhancements, such as channelization devices, at existing grade crossings would facilitate the establishment of a quiet zone. The establishment of a quiet zone often provides a quality of life benefit, resulting from the general absence of a train horn, to those that work or live near the railroad. However, vehicle exposure will remain unchanged when compared to grade separations.

There are currently no established quiet zones within the study area. However, the City of El Paso is currently developing two quiet zones. One is located within the downtown University Medical Center District and the other is located in the Five Points neighborhood in northeast El Paso. Each of the planned quiet zones will close some existing crossings and enhance other crossings with medians, channelization devices, four quadrant gates or roadway approach improvements.

Section 7: Improvements Analysis

This section of the report is intended to provide the El Paso region an examination of the infrastructure constraints within the region and a list of potential solutions from which the local governing agencies or partners may choose to analyze in greater detail or move forward towards implementation of infrastructure improvement projects. This section describes identified potential improvements, including roadway-rail grade separations and crossing closures, as well as improvements to existing railroad infrastructure described in Section 5a. The identified rail infrastructure improvements are intended to have an operational benefit to the operating railroads, as well as public benefits in the form of improved safety and reduced vehicular delay associated with moving trains more efficiently through the study area.

Grade separation and crossing closure projects were identified based on the current roadway and rail traffic volumes and speeds, roadway characteristics, recent safety statistics, and projected impacts from increased roadway and rail traffic. These identified improvements were analyzed to determine the public benefits associated with travel time, accident reduction, operating costs and emissions.

Rail infrastructure improvements were identified based on the results of the RTC modeling of freight rail traffic within the study area. The identified improvements were analyzed to determine the effects on efficiency and safety for rail operations, as well as for vehicular traffic in the region. This analysis included the identification of existing conditions, estimating the implementation cost and schedule, and estimating the public and private benefits associated with the respective improvements.

The estimated implementation costs for each improvement are order-of-magnitude costs based on preliminary planning. The costs included in this study represent an estimate of probable costs prepared in good faith and with reasonable care based on available information. The costs of construction labor, materials, and equipment may vary substantially from those presented in this report due to conditions such as competitive bidding and negotiation methods not controlled by the study team. These costs are also subject to inflation. All cost estimates include acquisition of right-of-way. Right-of-way costs may be adjusted based on current county appraisal district values for right-of-way acquisition, which may vary significantly from the eventual cost of acquiring property.

Section 7.1: Benefit-Cost Analysis (BCA)

This section of the report quantifies and presents the public and private benefits of possible rail improvements in the El Paso study area. Improvement benefits are presented in two project categories: at-grade rail crossing improvements and railroad infrastructure improvements. The at-grade rail crossing improvements include roadway-rail crossing closures and grade separations, and benefit vehicular traffic due to reduced impedance and risk of accidents. The railroad infrastructure improvements in general consist of additional mainline track and signals. These infrastructure improvements benefit railroads in terms of improved operating conditions and vehicular traffic due to reduced impedance at grade crossings and reduced emissions due to train dwell time.

Methodological Framework

Benefit-Cost Analysis (BCA) is a conceptual framework that quantifies in monetary terms as many of the costs and benefits of a project as possible. Benefits are monetized using a willingness-to-pay principle which represents the amount a person would be willing to pay in order to avoid something undesirable, such as traffic congestion or pollution. Central to BCA is the idea that people are best able to judge what improves their well-being or welfare. Benefits represent the extent to which people impacted by the project are made better off. For instance, reduced wait times at grade crossings will make drivers better off since they will reduce travel delay.

BCA also adopts the view that a net increase in welfare is beneficial for society as a whole, even if some groups within society are made worse off. A project would be rated positively if the benefits to some are large enough to compensate the losses of others.
Finally, BCA is typically a forward-looking exercise, seeking to anticipate the benefits of a project or proposal over its entire life-cycle. Future benefits are weighted against today's changes through discounting, which is meant to reflect society's general preference for the present, as well as broader inter-generational concerns.

The specific methodology developed for this study was developed using the above BCA principles. In particular, the methodology involves:

- Establishing existing and future conditions under the Base Case (No Build) and Alternative Case (Build) scenarios;
- Measuring benefits in dollar terms, whenever possible, and expressing benefits and costs in a common unit of measurement;
- Using US DOT guidance for the valuation of travel time savings, safety benefits and reductions in air emissions, while relying on industry best practice for the valuation of other effects; and,
- Discounting future benefits and costs with a 7 per cent real discount rate recommended by the US DOT. Discounted benefits and costs for the identified improvements are provided in Appendix 6: Benefit – Cost Analysis Results.

The BCA measures benefits against costs throughout a period of analysis beginning at the start of construction and including 20 years of operations. The monetized benefits and costs are estimated in 2012 dollars.

Section 7.2: Grade Crossings

As the number of people using the roadway network increases due to population growth and the number of trains increases on the rail network due to the demand for goods, it is expected that the impedance at grade crossings will increase as will the risk of roadway-rail accidents. Increased delay or impedance at roadway-rail crossings leads to increased vehicular travel time, out-of-pocket expenses, and emissions. All of these impacts are considered external costs due to increased road and rail usage growth. Eliminating at-grade crossings through the use of crossing closures or grade separations will reduce the impedance impacts and increase safety at the rail-roadway crossings. Grade separations consist of roadway overpasses or underpasses, which separate vehicular traffic from rail traffic. Crossing closures consist of removing the roadway-rail at-grade crossing entirely such that vehicles are prevented from crossing the railroad at that particular location, thus requiring an alternate route for vehicular through-traffic.

Table 7-1 lists the potential at-grade improvements, by improvement type, for the roadway-rail grade crossings in the El Paso study area. The list of grade crossings are based on annual average daily traffic (AADT) volumes and speeds of vehicular and train traffic at the crossings, as well as roadway characteristics, such as number of lanes, existing grade crossing warning devices and accident history. Most of these crossings were identified in the Phase I report. Most crossings identified for grade separation are located on high traffic rail lines, and had a daily traffic volume greater than 5,000 vehicles and/or numerous reported accidents. Additional crossings were added based on stakeholder input. As a result, these crossings are more likely to have a higher benefit-cost ratio for implementing a grade separation. Additional grade crossings within relatively close distance to the proposed grade separation may be identified and included in the presentation of benefits and costs.

The identified grade crossing improvements are numbered by their crossing grouping, which indicates any additional crossings that will be closed in conjunction with a specific grade separation project. The crossing closures associated with specific grade separations were selected as closures which could re-route vehicular volumes to the grade separation rather than to other nearby at-grade crossings.

Table 7-1: Potential Grade Crossing Improvements within Study Region

Potential Grade Crossing Improvements							
Crossing Grouping #	DOT Crossing ID	Subdivision	Grade Crossing Street Name	City	Improvement Type	AADT[13]	Accident History (2008-2012)[14]
1	741231D	UP Valentine	Zaragoza Road	El Paso	Grade Separation	14,350	3
2	741204G	UP Valentine	Copia Street	El Paso	Grade Separation	17,600	0
	741200E	UP Valentine	San Marcial	El Paso	Crossing Closure	375	0
	741201L	UP Valentine	Estrella Street	El Paso	Crossing Closure	375	0
	741202T	UP Valentine	Cebada Street	El Paso	Crossing Closure	375	0
	741203A	UP Valentine	Grama Street	El Paso	Crossing Closure	375	0
3	764227D	UP Valentine	Buford Street	Clint	Grade Separation	11,880	1
4	764089S	UP Valentine	Fabens Street	Fabens	Grade Separation	9,600	0
	764090L	UP Valentine	3rd Street	Fabens	Crossing Closure	50	0
	742914X	UP Valentine	4th Street	Fabens	Crossing Closure	1,930	0
5	741229C	UP Valentine	Pendale Road	El Paso	Grade Separation	7,820	2
6	741159P	UP Carrizozo	Montana Avenue	El Paso	Grade Separation	19,700	0
	741158H	UP Carrizozo	Yandell Drive	El Paso	Crossing Closure	2,080	0
7	764083B	UP Valentine	FM 1110	Clint	Grade Separation	7,900	0
8	741212Y	UP Valentine	Chelsea Street	El Paso	Grade Separation	6,670	0
	741209R	UP Valentine	Concepcion Street	El Paso	Crossing Closure	375	0
9	741614F	UP Carrizozo	Missouri Avenue	El Paso	Grade Separation	16,570	0
10	019780K	BNSF El Paso	Country Club Road	El Paso	Grade Separation	18,360	1
11	741216B	UP Valentine	FM 1505/Clark Road	El Paso	Grade Separation	7,600	2
12	741165T	UP Carrizozo	Piedras Street	El Paso	Grade Separation	5,790	0
	741160J	UP Carrizozo	Rosewood Street	El Paso	Crossing Closure	375	0
	741161R	UP Carrizozo	Maple Street	El Paso	Crossing Closure	375	0
	741162X	UP Carrizozo	Birch Street	El Paso	Crossing Closure	375	1
	741163E	UP Carrizozo	Cedar Street	El Paso	Crossing Closure	375	0
	741164L	UP Carrizozo	Elm Street	El Paso	Crossing Closure	375	0
13	019776V	BNSF El Paso	Redd Road	El Paso	Grade Separation	7,590	0
	019620W	BNSF El Paso	W. Green Avenue	El Paso	Crossing Closure	2,000	1
14	019753N	BNSF El Paso	FM 1905/ Washington Street	Anthony	Grade Separation	9,500	2
15	019786B	BNSF El Paso	Sunland Park Drive	El Paso	Grade Separation	9,250	0
16	019769K	BNSF El Paso	FM 259	El Paso	Grade Separation	9,000	0
17	019781S	BNSF El Paso	Sunset Road	El Paso	Grade Separation	7,790	0
18	019797N	BNSF El Paso	Executive Center	El Paso	Grade Separation	5,060	0
19	741056P	UP International	Delta Drive	El Paso	Grade Separation	375	3

[13] TxDOT, Texas Railroad Information Management System (TRIMS), 2013.

[14] US Department of Transportation, Federal Railroad Administration, Office of Safety Analysis, 2013.

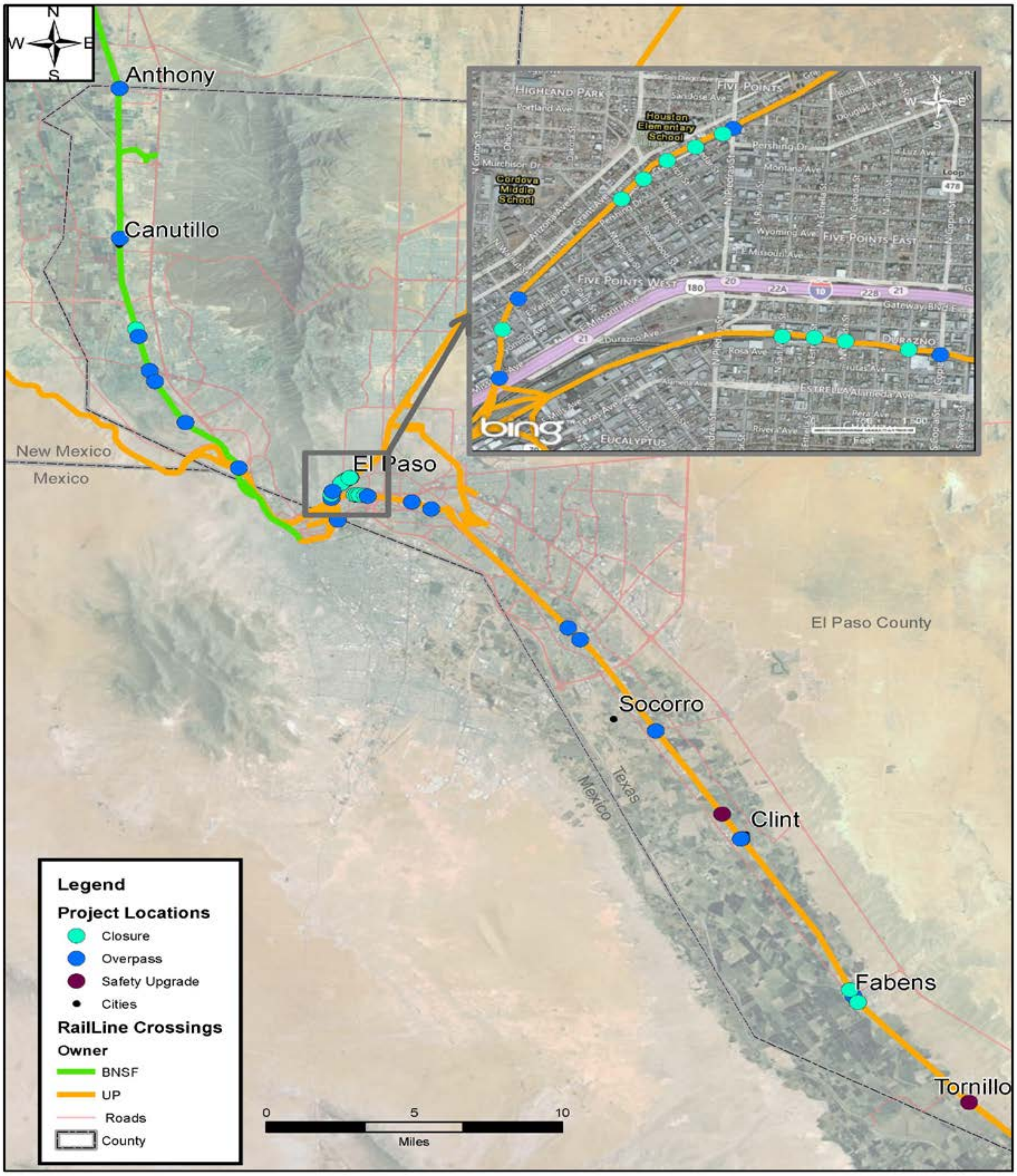
Table 7-2 lists additional crossings where grade separations or closures are not recommended, but additional roadway enhancements are suggested based on accident history. The locations of these crossings are generally in rural areas where populations are relatively small. The projects, when funded, should begin with a field diagnostic review with relevant public, agency and railroad stakeholders to document the field conditions and collectively determine the optimal safety enhancements at each crossing. These enhancements could include additional crossing warning devices (additional gates), signage or illumination, and roadway approaches.

Table 7-2: Other Potential Improvement Projects within Study Region

Potential Grade Crossing Upgrades or Enhancements							
Crossing Grouping #	DOT Crossing ID	Subdivision	Grade Crossing Street Name	City	Improvement Type	AADT	Accident History (2008-2012)
20	764232A	UP Valentine	Burbridge Road	Clint	Signage, Pavement Markings, Add'n Gates	110	3
21	742906F	UP Valentine	OT Smith Street	Tornillo	Signage, Pavement Markings, Add'n Gates	50	2
22	742907M	UP Valentine	Oil Mill Road	Tornillo	Signage, Pavement Markings	50	1

Figure 7-1 shows the location of the identified potential grade crossing improvements listed in Table 7-1 and Table 7-2. As shown in the figure, all of the grade crossing improvements identified are located within El Paso County.

Figure 7-1: Potential Grade Crossing Improvements within Study Region



Base Case (No Build) and (Build) Alternatives

The Base Case (No-Build) scenario assumed no grade separations will be built and no crossing closures occur. This case is otherwise known as the business-as-usual case. In the No-Build scenario, the impedance at grade crossings and risk of roadway-rail accidents remains at current levels and increases in future years due to assumed growth in vehicular and rail traffic. In the No-Build scenario, there are no additional vehicle miles travelled (VMT) due to crossing closures, which reroute vehicles from one grade crossing to another.

The Alternative Case (Build) scenario assumes the proposed grade crossings are built and associated crossings are closed as a means of consolidating route choice to the grade separated crossing. Under the Alternative Case, the impedance at roadway-rail crossings is eliminated at the grade-separated intersections. In addition, there is a combined crash reduction factor of 80 per cent at grade separations, which reduces the risk of roadway-rail accidents.[15] In the Alternative Case, there will be an increase in VMT due to crossing closures and vehicles rerouting to the associated grade separation. The increased VMT will lead to increased vehicle travel time impacts and increased accident risk.

Demand Assumptions

The rail and vehicle demand growth assumptions used as input to the grade crossing improvements BCA are the same under the Base Case and the Alternative Case scenarios. There are no limiting or constraining factors assumed in either case. The number of freight trains, average freight train speed, and AADT counts for each grade crossing was obtained from the TxDOT Texas Railroad Information Management System (TRIMS) or the FRA Office of Safety Analysis grade crossing database.

An estimate of historical grade crossing accidents was generated for each of the grade crossings using the FRA database. These historical accidents along with other crossing characteristics were used to predict the expected annual accident rate at each crossing using the USDOT Accident Prediction Model (APM).

Project Costs and Schedule Assumptions[16]

Cost estimates were developed for each of the grade separation projects based on published unit cost information for TxDOT projects, knowledge of locally-let projects and historical data from railroad construction projects, and are shown as undiscounted values in Table 7-3. Crossing closure costs were all assumed to a nominal value of $100,000. Closure costs do not typically exceed this value when considering pavement removal, additional signage or signaling, minor roadway improvement and utility adjustments. Grade separation and crossing closure projects were assumed to be designed and constructed over an 18-month period, with all projects being completed by the end of 2015 for all grade crossing improvement projects. All project construction costs are assumed to be incurred in 2015. Grade separations would be scheduled to open at the beginning of 2016, which will be the first year benefits would begin to accrue due to the improvements.

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[15] TxDOT crash reduction factor for grade separations. Evaluation of Hazard Elimination Safety Program Crash Reduction Factors. 2003.

[16] All cost estimates in this section are in undiscounted 2012 dollars.

Table 7-3: Grade Crossing Improvements Undiscounted Cost Estimates

Cost Estimates for Potential Grade Crossing Improvements				
Crossing Grouping #	DOT Crossing ID	Grade Crossing Street Name	Improvement Type	Project Cost Undiscounted
1	741231D	Zaragoza Road	Grade Separation	$11,410,000
2	741204G	Copia Street	Grade Separation	$13,600,000
	741200E	San Marcial	Crossing Closure	$100,000
	741201L	Estrella Street	Crossing Closure	$100,000
	741202T	Cebada Street	Crossing Closure	$100,000
	741203A	Grama Street	Crossing Closure	$100,000
3	764227D	Buford Street	Grade Separation	$8,520,000
4	764089S	Fabens Street	Grade Separation	$12,070,000
	764090L	3rd Street	Crossing Closure	$100,000
	742914X	4th Street	Crossing Closure	$100,000
5	741229C	Pendale Road	Grade Separation	$18,770,000
6	741159P	Montana Avenue	Grade Separation	$16,210,000
	741158H	Yandell Drive	Crossing Closure	$100,000
7	764083B	FM 1110	Grade Separation	$9,490,000
8	741212Y	Chelsea Street	Grade Separation	$8,580,977
	741209R	Concepcion Street	Crossing Closure	$100,000
9	741614F	Missouri Avenue	Grade Separation	$12,170,000
10	019780K	Country Club Road	Grade Separation	$7,220,000
11	741216B	FM 1505/Clark Road	Grade Separation	$13,280,343
12	741165T	Piedras Street	Grade Separation	$9,052,707
	741160J	Rosewood Street	Crossing Closure	$100,000
	741161R	Maple Street	Crossing Closure	$100,000
	741162X	Birch Street	Crossing Closure	$100,000
	741163E	Cedar Street	Crossing Closure	$100,000
	741164L	Elm Street	Crossing Closure	$100,000
13	019776V	Redd Road	Grade Separation	$36,349,526
	019620W	W. Green Avenue	Crossing Closure	$100,000
14	019753N	FM 1905/ Washington	Grade Separation	$8,310,000
15	019786B	Sunland Park Drive	Grade Separation	$19,510,000
16	019769K	FM 259	Grade Separation	$8,830,000
17	019781S	Sunset Road	Grade Separation	$33,929,294
18	019797N	Executive Center	Grade Separation	$45,509,238
19	741056P	Delta Drive	Grade Separation	$7,496,000

Benefit Categories

Table 7-4 provides descriptions of all categories related to vehicle impedance, accident exposure risk at roadway-rail crossings, and additional VMT impacts due to crossing closures. The identified potential grade separations and crossing closures may provide a benefit to the operating railroad by reducing vehicular exposure and mitigating potential operating impacts or disruptions. This is supported by the fact that railroads often provide financial contributions to local agencies for crossing closure projects. However, this risk mitigation benefit is often difficult to quantify and relatively small when compared to other public benefits, and thus is not included in this report.

Table 7-4: Grade Crossing Improvements Impact Categories

Impact Categories for Grade Crossing Improvements				
Impact Category	#	Impact Name	Description - Grade Separation	Description - Crossing Closure
Impacts of Grade Separation at Crossing; Crossing Closure	1	Travel Time Savings due to Grade Separation; Crossing Closure	Grade separation eliminates vehicle delays at grade crossing	Crossing closure eliminates vehicle delays at grade crossing, but increases travel time to grade separation due to additional vehicle-miles travelled
	2	Reduced Accident Costs due to Grade Separation; Crossing Closure	Grade separation reduces the possibility of accidents causing fatalities, injuries and property damage	Crossing closure reduces the possibility of accidents at crossing, but increases the possibility of accidents due to additional vehicle-miles travelled to grade separation
	3	Reduced Vehicle Operating Costs due to Grade Separation; Crossing Closure	Eliminated vehicle wait time at crossing results in vehicle operating cost savings	Crossing closure eliminates vehicle operating costs at grade separation, but increases vehicle operating costs due to vehicle-miles travelled to grade separation
	4	Environmental Savings due to Grade Separation; Crossing Closure	Eliminated vehicle wait time at crossing mitigates emissions and improves air quality	Crossing closure eliminates emissions costs at grade separation, but increases emissions due to vehicle-miles travelled to grade separation

Travel Time Savings due to Grade Separation; Crossing Closure

Grade separation eliminates vehicle delays at level crossings. Each grade separation will eliminate traffic congestion and allow free flow traffic conditions for vehicles using the crossing. Time delays are a function of gate blockage time by the train, number of trains per day, and the AADT at each crossing. Gate blockage time was assumed to be a function of the train speed, length of train, and a standard lead and lag time for grade crossing gates or warning devices. Train counts and AADT values were obtained for each crossing from the FRA database. AADT counts were adjusted from the year in which they were collected to current values using an assumed 2 per cent annual growth rate in vehicular traffic. This growth rate was also applied to AADT over the study period duration. It was assumed there would be no growth in train volumes.

For the associated crossing consolidations, there were increases in travel time due to additional VMT requirements to reach the new grade separation. Travel time increases were quantified as a function of distance from grade crossing closures to new grade separations, AADT, and the average vehicle speed.

Travel time impacts were monetized based on value of time (VOT) and average occupancy assumptions. The recommended US DOT value of time for drivers and passengers by vehicle type was used in the analysis.[17] The average number of drivers and passengers per vehicle-by-vehicle type was sourced from the National Highway Traffic Safety Administration (NHTSA).

Reduced Accident Costs due to Grade Separation; Crossing Closure

Grade separation reduces the risk of accidents causing fatalities, injuries and property damage. Crossing closure eliminates the possibility of accidents at each specific crossing, but increases the possibility of accidents due to additional vehicle-miles travelled to the new grade separation.

Each grade separation improvement project will improve safety by removing a conflict point between trains and vehicles at roadway-rail intersections. The reduction in expected accidents is a function of the combined crash reduction factor and the expected annual accident rate. The crash reduction factor (CRF) is a constant, which represents the proportion of crashes reduced as a result of a safety improvement at a specific location.[18] For grade separations, TxDOT recommends a CRF value of 0.8, suggesting a grade crossing will reduce crashes by 80 per cent.[19] The expected annual accident rate value was calculated using the principles consistent with the U.S. DOT Accident Prediction Model[20]. In particular, the methodology involves two independent calculations to produce a collision prediction value:

- The basic formula provides an initial hazard ranking based on a crossing's characteristics. Crossing characteristics were taken from the TxDOT TRIMS and/or FRA Accident/Incident Reports; and,
- The second calculation utilizes the actual collision history at a crossing over a determined number of years to produce a collision prediction value, taken from the FRA Accident/Incident Reports. This procedure assumes that future collisions per year at a crossing will be the same as the average historical collision rate over the time period used in the calculation.

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[17] US DOT. TIGER Benefit-Cost Analysis (BCA) Resource Guide. May 2013.

[18] Texas Transportation Institute (TTI) at Texas A&M University. Calibration Factors Handbook: Safety Prediction Models Calibrated With Texas Highway System Data. October 2008.

[19] Evaluation of Hazard Elimination Safety Program Crash Reduction Factors. 2003.

[20] US DOT. Accident Prediction Model. http://safety.fhwa.dot.gov/xings/com_roaduser/07010/sec03.htm

Grade crossing accidents are further delineated by the numbers of fatalities and injuries. The share of fatalities and injuries was determined based on Bureau of Transportation Statistics (BTS) grade crossing data. For crossing closures, the total increase in accidents due to increased VMT was calculated using BTS fatality and injury rates per VMT. Accident and injury costs were monetized using US DOT recommended values for the statistical value of a life and average injury cost.[21]

Reduced Vehicle Operating Costs due to Grade Separation; Crossing Closure

Under the Alternative Case where there is free flow traffic, vehicles will spend no time idling at a grade crossing. This translates into lower out-of-pocket expenses due to lower vehicle operating costs. Vehicle operating cost savings are a function of reduced idle time at grade crossings resulting in lower fuel and motor oil consumption. Fuel and oil consumption per hour of idle time by vehicle type and by AADT at grade crossings were used to determine total consumption.[22] Forecasted gasoline, diesel, and motor oil prices were used to quantify total expenses due to idling time.[23]

Crossing closures reduce vehicle operating costs at grade separation, but also increase vehicle operating costs due to additional VMT to get to the new grade separation. Average fuel economy and oil consumption rates by vehicle type were used to determine the total additional amount consumed due to the crossing closure. Consumption was quantified based on forecasted gasoline, diesel, and motor oil prices.

Environmental (Air Quality) Savings due to Grade Separation; Crossing Closure

The change in vehicle delay time at roadway-rail crossings due to grade separation was used to estimate the total fuel consumption reduction at idle by vehicle type. For every gallon consumed at idle, there are several hazardous air pollutants released into the atmosphere. These air pollutants include nitrogen oxides (NOx), carbon dioxide (CO_2), volatile organic compounds (VOC), and particulate matter (PM). Emission factors in units of grams/gallon consumed are known for NOx, CO2, VOC and PM emissions. These emission factors were used to quantify the emission reduction impact over the study period of reduced vehicle delay time due to grade separation. Emissions were monetized using US DOT recommended values for NOx, CO2, VOC and PM.[24]

Crossing closures reduce emissions costs due to vehicle delay at roadway-rail crossings, but increase emission costs due to additional VMT to get to the new grade separation. Total fuel

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[21] US DOT. TIGER Benefit-Cost Analysis (BCA) Resource Guide. May 2013.

[22] Consumption rates from California Air Resources Board. Emission Factor (EMFAC) Model.

[23] Energy Information Administration (EIA). Energy Outlook 2013., and Federal Highway Administration (FHWA). Highway Economic Requirements System (HERS). 1997.

[24] US DOT. TIGER Benefit-Cost Analysis (BCA) Resource Guide. May 2013.

consumption due to additional vehicle travel from the crossing closure to the new grade separation was calculated for the vehicle operating cost benefit. The additional fuel consumed was quantified using known emission factors and monetized using US DOT recommended values for NOx, CO2, VOC and PM.

Grade Separation BCA Results

The tables below summarize the grade separation BCA findings. Table 7-5 provides the undiscounted monetary value of benefits for each grade separation and crossing closure by category. Discounted benefits and costs are provided in Appendix 6: Benefit – Cost Analysis Results. Negative values in Table 7-5 represent negative benefits, or costs, where certain elements of the project actually have a negative outcome. This is the case for many crossing closures where the increased VMT costs to the grade separation from the closure site outweigh some of the benefits of grade separation. However, for grouped grade separations and crossing closures, the sum of all grouped components should be considered the full project benefit, not the individual components.

Table 7-6 provides a summary of the BCA output metrics for the grouped grade crossing improvement projects. Annual costs and benefits are computed over the life cycle of the project, which includes one year of construction and 20 years of operation.[25] As stated earlier, construction is expected to be completed by the end of 2015. Benefits accrue during the full operation of the project. The Net Present Value (NPV) represents the sum of all project capital costs and project benefits over the construction period and 20 years of operation. The Benefit-Cost Ratio is the ratio of total project benefits over total project capital costs.

[25] US DOT. TIGER Benefit-Cost Analysis (BCA) Resource Guide. May 2013. Recommends 20-year study period.

Table 7-5: Undiscounted Benefits, by Category

Undiscounted Benefits for Potential Grade Crossing Improvements						
Crossing Grouping #	DOT Crossing ID	Grade Crossing Street Name	Travel Time Savings	Accident Costs	Vehicle Operating Costs	Environmental Savings
1	741231D	Zaragoza Road	$11,459,708	$9,792,270	$685,666	$247,713
2	741204G	Copia Street	$22,887,511	$9,269,628	$1,369,423	$494,736
2	741200E	San Marcial	-$4,004,512	$1,567,869	-$818,848	-$242,319
2	741201L	Estrella Street	-$3,446,469	$1,773,696	-$708,226	-$209,488
2	741202T	Cebada Street	-$3,175,001	$1,667,375	-$653,366	-$193,236
2	741203A	Grama Street	-$4,466,992	$1,619,943	-$885,136	-$262,699
3	764227D	Buford Street	$7,657,086	$5,759,659	$458,145	$165,515
4	764089S	Fabens Street	$4,935,704	$4,813,403	$295,317	$106,690
4	764090L	3rd Street	-$424,693	$1,034,743	-$67,221	-$20,004
4	742914X	4th Street	-$20,296,362	-$590,651	-$3,186,909	-$949,389
5	741229C	Pendale Road	$6,018,941	$7,138,935	$360,130	$130,105
6	741159P	Montana Avenue	$44,930,363	$5,981,937	$2,688,307	$971,213
6	741158H	Yandell Drive	-$1,231,874	$2,310,146	-$1,071,136	-$300,846
7	764083B	FM 1110	$5,319,766	$4,478,286	$318,296	$114,992
8	741212Y	Chelsea Street	$8,430,398	$6,099,572	$504,414	$182,231
8	741209R	Concepcion Street	-$2,634,278	$1,539,977	-$543,781	-$160,781
9	741614F	Missouri Avenue	$57,001,417	$3,673,995	$3,410,552	$1,232,140
10	019780K	Country Club Road	$8,801,290	$3,777,419	$526,605	$190,248
11	741216B	FM 1505/Clark Road	$4,249,963	$7,717,319	$254,287	$91,867
12	741165T	Piedras Street	$12,888,816	$5,153,608	$771,173	$278,604
12	741160J	Rosewood Street	-$3,582,673	$867,011	-$632,465	-$185,685
12	741161R	Maple Street	-$3,085,181	$928,065	-$550,436	-$161,401
12	741162X	Birch Street	-$3,046,351	$870,870	-$548,113	-$160,562
12	741163E	Cedar Street	-$2,984,200	$1,020,117	-$544,394	-$159,219
12	741164L	Elm Street	-$299,677	$1,773,123	-$168,535	-$46,975
13	019776V	Redd Road	$2,036,576	$3,212,826	$121,854	$44,023
13	019620W	W. Green Avenue	-$19,294,056	-$1,574,715	-$2,997,655	-$894,253
14	019753N	FM 1905/ Washington Street	$2,175,834	$3,991,583	$130,186	$47,033
15	019786B	Sunland Park Drive	$8,692,682	$7,316,713	$520,107	$187,901
16	019769K	FM 259	$2,038,715	$2,824,684	$121,982	$44,069
17	019781S	Sunset Road	$2,401,030	$3,413,527	$143,660	$51,901
18	019797N	Executive Center	$5,322,763	$3,695,290	$318,476	$115,057
19	741056P	Delta Drive	$1,675,729	$1,597,052	$100,263	$36,222

Table 7-6: Grouped Grade Crossing Improvement BCA Summary Metrics Rank Ordered by BCR, Undiscounted

Summary of Benefit-Cost Analysis Results for Potential Grade Crossing Improvements					
Rank #	Grouping #	Total Undiscounted Benefits	Total Undiscounted Costs	Net Present Value (NPV)	Benefit/Cost Ratio (BCR)
1	9	$65,318,105	$12,170,000	$53,148,105	5.37
2	6	$54,278,111	$16,310,000	$37,968,111	3.33
3	1	$22,185,357	$11,410,000	$10,775,357	1.94
4	10	$13,295,562	$7,220,000	$6,075,562	1.84
5	3	$14,040,404	$8,520,000	$5,520,404	1.65
6	8	$13,417,753	$8,680,977	$4,736,776	1.55
7	2	$21,583,888	$14,000,000	$7,583,888	1.54
8	7	$10,231,340	$9,490,000	$741,340	1.08
9	11	$12,313,436	$13,280,343	-$966,907	0.93
10	12	$8,395,522	$9,552,707	-$1,157,185	0.88
11	15	$16,717,403	$19,510,000	-$2,792,597	0.86
12	14	$6,344,636	$8,310,000	-$1,965,364	0.76
13	5	$13,648,111	$18,770,000	-$5,121,889	0.73
14	16	$5,029,451	$8,830,000	-$3,800,549	0.57
15	19	$3,409,267	$7,496,000	-$4,086,733	0.45
16	18	$9,451,585	$45,509,238	-$36,057,653	0.21
17	17	$6,010,117	$33,929,294	-$27,919,177	0.18
18	13	-$19,345,402	$36,449,526	-$55,794,928	-0.53
19	4	-$14,349,373	$12,270,000	-$26,619,373	-1.17

Many of the results for the grade separation projects have Benefit-Cost Ratios (BCR) of less than one. The low or negative benefit cost ratios are primarily driven by the crossing closures associated with the new grade separations, which impose additional VMT external costs. When examined individually, 9 of the 19 grade separations have a BCR of greater than one when considered without the crossing closures. This suggests the proposed new grade crossings have independent utility and may be worthwhile from a public expenditure perspective when considered on their own, but not when grouped with other crossing closures.

Section 7.3: Railroad Infrastructure Improvements

Railroad infrastructure improvements are meant to provide capacity along rail corridors to relieve congestion and allow trains to pass through the region more quickly. The improvements will allow freight rail to operate more efficiently, which in turn will lead to increased economic growth in the region. The railroad infrastructure improvements typically include additional mainline track. These improvements benefit railroads in terms of improved operating conditions and benefit vehicular traffic due to reduced impedance at grade crossings and reduced emissions due to train dwell time.

As detailed in Section 5A: Rail Modeling, the Revised Base Case RTC model was developed to determine the ability of the regional rail network to accommodate increased rail traffic over a 20 year period. Two of the six planning cases were further evaluated using BCA and improvements were identified that would provide operational efficiency similar to current conditions. These two planning cases are Planning Case 3 and Planning Case 6, with an approximate 2 per cent and 4 per cent per annum growth rate, respectively, in rail traffic volume. In both growth cases, railroad infrastructure improvements were modeled to determine train performance metrics which could be compared to a do-nothing infrastructure case. The infrastructure improvements considered for each planning case are:

Planning Case 3, 2.12% Annual Growth:

- Double-track UP Valentine Subdivision from MP 807.1 to MP 794.9
- Double-track UP Valentine Subdivision from MP 792.5 to MP 784.0
- Double-track UP Valentine Subdivision from MP 760.1 to MP 752.2
- Double-track UP Valentine Subdivision from MP 745.2 to MP 739.3
- Double-track connection between UP Valentine and Toyah Subdivisions at Sierra Blanca

Planning Case 6, 4.02% Annual Growth:

- Double-track entire UP Valentine Subdivision from El Paso to Sierra Blanca
- Double-track entire UP Toyah Subdivision from Sierra Blanca to Toyah from about MP 664 to MP 768

Base (No-Build) Case and Alternatives (Build) Scenarios

The Base Case (No-Build) scenario is defined for both planning cases as the do-nothing infrastructure option. In the Base Case, it is assumed no rail infrastructure improvements are made in the El Paso study area to alleviate rail congestion. The UP Strauss Yard is included in the Base Case as it is currently under construction and scheduled to be completed in 2014. In the Base Case, the impedance at grade crossings and risk of roadway-rail accidents remains at current levels and increases in future years due to assumed natural growth in rail traffic in the corridor and an increase in vehicular traffic on the road network.

The Alternative Case (Build) scenarios assume the railroad infrastructure improvements listed above are built for the Planning Case 3 and Planning Case 6 scenarios. The UP Strauss Yard is also included in the Alternative Case scenario. In the Alternative Cases, the impedance at grade crossings decreases due to higher train speeds which reduce crossing blockage time. However, in the Planning Case 6 Alternative there are more trains on the network in later years compared to the Base Case due to capacity constraints. These additional trains will lead to greater impedance. The risk of accidents also increases in Planning Case 6 due to additional train movements, but otherwise remains the same as the Base Case since accidents are a function of total train movements rather than train speed.

Demand Assumptions

Demand for the rail network identified in the El Paso study area was determined using RTC software. The RTC models were run to simulate current and future demand for both planning cases under the No-Build and Build scenarios. The simulations assume a 20 year analysis period from 2012 to 2031. Key RTC output metrics used in the BCA model are: number of trains, average train speed, train delay hours, and delay ratio. These metrics were interpolated using linear interpolation over the 20 year analysis period to obtain values for each analysis year. Beyond the 20 year analysis period, it is assumed that rail volumes remain unchanged. Under Planning Case 2, the 4 per cent growth case, the No-Build rail network reaches capacity after 11 years. It is assumed once rail volumes reach the capacity constraint, they remain unchanged from that point forward.

Vehicle demand at grade crossings is assumed to be the same under the Base Case and Alternative Case scenarios. There are no limiting or constraining factors assumed in vehicle demand. The AADT counts for each grade crossing were obtained from the TxDOT Texas Railroad Information Management System (TRIMS). AADT counts were adjusted from the year in which they were collected to current values using an assumed 2 per cent annual growth rate in vehicular traffic. This growth rate was also applied to AADT over the study period duration.

Historical grade crossing accident records were generated for each of the grade crossings using the FRA Office of Safety Analysis database. These historical accidents along with other crossing characteristics were used to predict the expected annual accident rate at each crossing using the US DOT Accident Prediction Model (APM).

Project Costs and Schedule

Preliminary cost estimates for all planning case component sections were developed for each railroad infrastructure improvement project. All cost estimates are in 2012 dollars. For the purposes of the BCA, it is assumed design and construction of infrastructure improvements would occur over a four-year period. The design and construction schedule was based on when the railroad is forecasted to reach a delay ratio of 16 per cent, which is the point of serious congestion. Design and construction was assumed to begin four years before the railroad reached this point. Planning Case 3 was assumed to begin in 2016 and end in 2019 and Planning Case 6 was assumed to begin in 2013 and end in 2017.

Table 7-7: Planning Case 3 Capital Cost Estimate

Planning Case 3 – Capital Cost Estimate	
Proposed Improvement	Cost Estimate
Double track UP Valentine Subdivision, MP 807.1 TO MP 794.9	$47,343,698
Double track UP Valentine Subdivision, MP 792.5 TO MP 784.6	$30,031,657
Double track UP Valentine Subdivision, MP 760.1 TO MP 752.2	$38,203,493
Double track UP Valentine Subdivision, MP 745.2 TO MP 739.3	$30,347,931
Double track connection between UP Valentine and Toyah Subdivisions (MP 767 TO 768.55)	$9,297,418
TOTAL	**$155,224,197**

Table 7-8: Planning Case 6 Capital Cost Estimate

Planning Case 6 – Capital Cost Estimate	
Proposed Improvement	Cost Estimate
Double track UP Valentine Subdivision, MP 815 TO MP 737	$286,197,394
Double track UP Toyah Subdivision, MP 767 TO MP 663, including UP Valentine connection	$402,719,450
TOTAL	$688,916,845

Benefit Categories

This section presents the public and private benefit categories evaluated for the railroad infrastructure improvement planning cases. All impact categories are shown in Table 7-9. The public benefits are related to vehicle impedance, accident exposure risk at roadway-rail crossings, and reduced train emissions. The private benefits accrue to the rail operators and consist of network efficiency improvements, which allow for increased train speeds and reduced delay time.

Table 7-9: Rail Infrastructure Improvements Impact Categories

Impact Categories for Rail Infrastructure Improvements			
Impact Category	Impact #	Name	Description
Travel Time	1	Travel Time Cost Impact due to Vehicle Delay Time	Travel time costs are a function of vehicle wait times at grade crossings. Wait times will be affected by a change in train volumes and train operating speeds.
Operating	2	Freight Rail Operating Cost Impact due to Reduced Train Delay	Improvements in travel speed will reduce operating delay costs. Operating cost includes: train car cost, locomotive cost, crew cost and fuel cost.
	3	Vehicle Operating Cost due to Vehicle Delay Time	Vehicle operating costs are a function of vehicle wait times at grade crossings. Wait times will be affected by a change in train volumes and train operating speeds.
Accident	4	Accident Cost Impact at Grade Crossings	Accident costs at grade crossings are a function of train volumes on the network.
Emission	5	Emission Cost Impact due to Network Improvements	Reduction in train delay, congestion, and idling time will reduce train emissions.
	6	Emission Cost Impact due to Vehicle Delay Time	Emission costs are a function of vehicle wait times at grade crossings. Wait times will be affected by a change in train volumes and train operating speeds.

Travel Time Cost Impact due to Vehicle Delay Time

The rail infrastructure improvements will allow for greater efficiency in the movement of trains through the El Paso region and will reduce travel time costs that vehicles encounter. Travel time costs caused by vehicle wait times at grade crossings are a function of gate blockage time by the train, number of trains per day, and the AADT at each crossing. Gate blockage time was assumed to be a function of the train speed, length of train, and a standard lead and lag time for grade crossing gates or warning devices. Train counts were obtained from the RTC model and AADT values were obtained for each affected crossing on the improvement corridor from the FRA database.

Travel time impacts were monetized based on VOT and average occupancy assumptions. The recommended US DOT value of time for drivers and passengers by vehicle type was used in the analysis.[26] The average number of drivers and passengers per vehicle-by-vehicle type was sourced from the NHTSA.

[26] US DOT. TIGER Benefit-Cost Analysis (BCA) Resource Guide. May 2013.

Freight Rail Operating Cost Impact due to Reduced Train Delay

Infrastructure improvements identified in both Planning Cases will allow for more efficient operations on the rail network. These efficiencies will lead to reduced train delays and allow for increased train travel speeds. Reduced delays and increased speeds will lead to lower overall railroad operating costs. Operating costs typically include: train car cost, locomotive cost, crew cost and fuel cost. Rail delays and train speeds used to quantify this impact were taken directly from the RTC modeling output. An operating cost per hour of freight train delay of $671.93/hour was used to monetize this impact.[27]

Vehicle Operating Cost due to Vehicle Delay Time

Vehicle operating costs are a function of vehicle wait times at grade crossings. Wait times will be affected by a change in train volumes and train operating speeds in the Alternative Cases. Out-of-pocket transportation cost savings will accrue due to a decrease in vehicle wait times as a result of improved rail efficiency and movements in the Alternative Cases. Vehicle operating cost savings are a function of reduced idle time at grade crossings resulting in lower fuel and motor oil consumption. Fuel and oil consumption per hour of idle time by vehicle type and AADT at grade crossings were used to determine total consumption.[28] Forecasted gasoline, diesel, and motor oil prices were used to quantify total consumption due to idling time.[29]

In some instances, the total train volumes in the Alternative Cases will be greater than the Base Case due to capacity constraints under the No Build scenario. When this occurs, there can potentially be a cost due to increased vehicle wait times.

Accident Cost Impact at Grade Crossings

Accident costs at grade crossings are a function of train volumes on the network. Greater train volumes at grade crossings will increase the risk of accidents. Under Planning Case 3, the total train volumes are the same in the Base and Alternative Case and as a result there are no accident cost impacts. Under Planning Case 6, there are greater rail volumes in the Alternative Case since there is a capacity constraint in the Base Case. The greater volumes of trains in Planning Case 6 will lead to an accident cost impact.

The expected annual accident rate was calculated using the principles consistent with DOT APM[30]. Grade crossing accidents are further delineated by the numbers of fatalities and injuries. The share of fatalities and injuries were determined based on BTS grade crossing

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[27] Lower Rio Grande Valley and Laredo Region Freight Study. TxDOT Rail Division. July 2011, adjusted to 2012 dollars.

[28] Consumption rates from California Air Resources Board. Emission Factor (EMFAC) Model.

[29] Energy Information Administration (EIA). Energy Outlook 2013, and Federal Highway Administration (FHWA). Highway Economic Requirements System (HERS). 1997.

[30] US DOT. Accident Prediction Model. http://safety.fhwa.dot.gov/xings/com_roaduser/07010/sec03.htm

data. Accident and injury costs were monetized using US DOT recommended values for the statistical value of a life and average injury cost.[31]

Emission Cost Impact due to Network Improvements

A reduction in train delay, congestion, and idling time due to rail infrastructure improvements will reduce train emissions. For every gallon of fuel consumed due to train delay, there are several hazardous air pollutants released into the atmosphere. Emission factors in units of grams/gallon consumed are known for NOx, CO2, VOC and PM emissions. These emission factors were used to quantify the emission reduction impact over the study period of reduced train delay time due to network improvements. Emissions were monetized using US DOT recommended values for NOx, CO2, VOC and PM.[32]

Emission Cost Impact due to Vehicle Delay Time

Emission costs are a function of vehicle wait times at grade crossings. Wait times will be affected by a change in train volumes and train operating speeds. The change in vehicle delay time at roadway-rail crossings due to network improvements was used to estimate the total fuel consumption reduction at idle by vehicle type. The same emission factors that were used in the previous benefit category were used to quantify the emission reduction impact over the 20 year study period of reduced vehicle delay time due to network improvements. Emissions were monetized using US DOT recommended values for NOx, CO2, VOC and PM.[33]

Railroad Infrastructure Improvements BCA Results

The tables below summarize the railroad infrastructure improvement BCA findings. Table 7-10 and Table 7-11 provide the undiscounted monetary value of benefits and costs for each Planning Case. Discounted benefits and costs are provided in Appendix 6: Benefit – Cost Analysis Results. Annual costs and benefits are computed over the lifecycle of the project, which includes 4 years of construction and 20 years of operation. As stated earlier, construction is expected to be completed by the end of 2019 for Planning Case 3 and 2017 for Planning Case 6. Benefits accrue during the full operation of the project. Table 7-12 and Table 7-13 provide a summary of the BCA output metrics for the Planning Case 3 and Planning Case 6 improvement projects, respectively.

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[31] US DOT. TIGER Benefit-Cost Analysis (BCA) Resource Guide. May 2013.
[32] US DOT. TIGER Benefit-Cost Analysis (BCA) Resource Guide. May 2013.
[33] US DOT. TIGER Benefit-Cost Analysis (BCA) Resource Guide. May 2013.

Table 7-10: Planning Case 3, 2% Growth – Undiscounted Benefits and Costs

Undiscounted Benefits for Rail Infrastructure Improvements – Planning Case 3		
Benefit Category	Benefit #	NPV Undiscounted
Travel Time Cost Impact due to Vehicle Delay Time	1	$2,136,183
Freight Rail Operating Cost Impact due to Reduced Train Delay	2	$57,858,826
Vehicle Operating Cost due to Vehicle Delay Time	3	$124,844
Accident Cost Impact at Grade Crossings	4	$0
Emission Cost Impact due to Network Improvements	5	$2,768,334
Emission Cost Impact due to Vehicle Delay Time	6	$38,972
Capital Cost of Construction and Operating and Maintenance	X	-$155,224,197
NPV		**-$92,297,038**

Table 7-11: Planning Case 6, 4% Growth – Undiscounted Benefits and Costs

Undiscounted Benefits for Rail Infrastructure Improvements – Planning Case 6		
Benefit Category	Benefit #	NPV Undiscounted
Travel Time Cost Impact due to Vehicle Delay Time	1	-$3,125,543
Freight Rail Operating Cost Impact due to Reduced Train Delay	2	$198,987,397
Vehicle Operating Cost due to Vehicle Delay Time	3	-$123,247
Accident Cost Impact at Grade Crossings	4	-$6,543,881
Emission Cost Impact due to Network Improvements	5	$11,266,053
Emission Cost Impact due to Vehicle Delay Time	6	-$14,235
Capital Cost of Construction and Operating and Maintenance	X	-$688,916,845
NPV		**-$488,470,301**

Table 7-12: Planning Case 3, 2% Growth – BCA Summary Metrics

Summary of Benefit-Cost Analysis Results for Rail Infrastructure Improvements – Planning Case 3	
Financial Indicators	Undiscounted Values
Total Costs	$155,224,197
Total Benefits	$62,927,159
NPV	-$92,297,038
Return on Investment	-59%
B/C Ratio	0.41

Table 7-13: Planning Case 6, 4% Growth – BCA Summary Metrics

Summary of Benefit-Cost Analysis Results for Rail Infrastructure Improvements – Planning Case 6	
Financial Indicators	Undiscounted Values
Total Costs	$688,916,845
Total Benefits	$200,446,544
NPV	-$488,470,301
Return on Investment	-71%
B/C Ratio	0.29

The NPV for Planning Case 3 and 6 are -$92 million and -$488 million respectively, suggesting these projects lack adequate benefits to be considered worthwhile from a public spending perspective. In both Planning Cases, the largest benefits are the private freight rail operating cost impacts due to reduced train delay. In Planning Case 3, the freight rail operating cost benefit represents 92% of the total benefits, while in Planning Case 6, it represents 99% of the total benefits. In Planning Case 6 there are also cost impacts due to increased train volumes in the Build Case relative to the No-Build Case due to increased capacity.

Section 8: Descriptions of Improvements

The following section lists the roadway crossing and rail infrastructure improvements identified in this study. Descriptions of the potential improvements are provided by grouping, the proposed grade separation with any associated crossing closures, along with estimated costs and benefits for each group. The cost and benefits for each group are presented as undiscounted values; both undiscounted and discounted values can be found in Appendix 6: Benefit – Cost Analysis Results. Average daily traffic volumes used for the analysis were based on the TxDOT Texas Railroad Information Management System (TRIMS). Photographs of existing conditions at each proposed crossing improvement location can be found in Appendix 2: Inventory of Rail Crossings. Conceptual layouts with adjacent land uses or zoning designations for the proposed grade separations, as well as alternate route and associated distances for proposed crossing closures are included in Appendix 3: Conceptual Exhibits. Estimated undiscounted costs for each proposed grade separation and rail infrastructure improvement are provided in Appendix 4: Construction Cost Estimates.

Note that the conceptual layouts are feasible alternatives chosen to determine preliminary costs and benefits, and not to be construed as final designs. The determination of actual improvements will have to follow the documented National Environmental Policy Act (NEPA) process and evaluate several alternatives.

Section 8.1: Safety Improvement Descriptions

Group 1: Zaragoza Road

Zaragoza Road - Grade Separation

Zaragoza Road is a four-lane road that crosses the UP Valentine Subdivision at-grade in El Paso. This existing at-grade crossing is situated with residential properties to the west and industrial/commercial land use to the east. The roadway has an annual average daily traffic (AADT) of 14,350 with a posted speed limit of 35 miles per hour (MPH). The railroad has 30 trains a day through this crossing, with an average speed of 52 MPH. Between 2008 and 2012 there were 3 accidents at this crossing. Given the roadway and railroad statistics, and the crossing accident history, a grade separation is proposed at this location. Both a roadway overpass and underpass were examined at this crossing due to possible limitations of both options.

The roadway grade separation's geometry was designed at 30 MPH in lieu of the 35 MPH posted speed limit due to constraints from the park to the south of the crossing; it was decided that impacts to the park were not acceptable since additional environmental efforts would be associated with park impacts. The roadway overpass includes an access roadway on the northern side of the crossing, while the southern side loses connection to Otyokwa Way and Roseway Drive; however, Roseway Drive remains a through street, and a connection to Otyokwa Way would remain via Roseway Drive. Access to a couple of properties east of the overpass and south of Roseway Drive would be eliminated, and those businesses would likely require acquisition.

Railroad overpass and underpass alternatives were also considered. However, they were not selected due to constructability concerns of a required shoofly (temporary railroad bypass) within a constrained and limited right-of-way, possible railroad operational restrictions associated with a single track shoofly, and significantly higher costs.
The estimated cost of the roadway overpass is $11,410,000, with an expected public benefit of $22,185,357.

Group 2: Copia Street, San Marcial Street, Estrella Street, Cebada Street, and Grama Street

Copia Street - Grade Separation

Copia Street is a four-lane road that crosses the UP Valentine Subdivision at-grade in El Paso. This existing at-grade crossing is located in a densely commercialized area and is to the south of I-10. The roadway has an AADT of 17,600 with a posted speed limit of 40 MPH. The railroad has 30 trains a day through this crossing, with an average speed of 34 MPH. Between 2008 and 2012 there have been no accidents at this crossing. Given the roadway and railroad statistics, a grade separation is proposed at this location in conjunction with a number of crossing closures at nearby streets. It was determined that a roadway overpass was not a viable option due to impacts to both I-10 and Alameda Avenue.

The geometry of the roadway underpass meets a posted 30 MPH speed limit. Roadway closures that would be required due to the underpass include Frutas Avenue, Rosa Avenue, and Durazno Avenue. Businesses with frontage on Copia Street, from Alameda Avenue to the I-10 eastbound frontage road, would likely need to be acquired as part of the underpass construction due to the elimination of access.

The estimated cost of the underpass, with accompanying crossing closures, is $14,000,000, with an expected public benefit of $21,583,888.

San Marcial Street - Crossing Closure

San Marcial Street is a two-lane road that crosses the UP Valentine Subdivision at-grade in El Paso. San Marcial connects Gateway Boulevard with Alameda Avenue on either side of the two UP tracks. The roadway has an AADT of 375 with a posted speed limit of 30 MPH. The railroad has 30 trains a day through this crossing, with an average speed of 29 MPH. Between 2008 and 2012 there have been no accidents at this crossing. Given the roadway and railroad statistics, it is proposed to close the crossing at this location in conjunction with a number of other crossing closures and the construction of the proposed grade separation at Copia Street five blocks to the east. Traffic detoured from this crossing closure would take Gateway Boulevard East to Copia Street, turning south onto the proposed grade separation. The detour then leads west on Alameda Avenue to San Marcial Street, a total detour length of approximately 1.5 miles.

Estrella Street - Crossing Closure

Estrella Street is a two-lane road that crosses the UP Valentine Subdivision at-grade in El Paso. Estrella Street connects Gateway Boulevard East with Alameda Avenue on either side of the two UP tracks. The roadway has an AADT of 375 with a posted speed limit of 30 MPH. The railroad has 30 trains a day through this crossing, with an average speed of 31 MPH. Between 2008 and 2012 there have been no accidents at this crossing. Given the roadway and railroad statistics, it is proposed to close the crossing at this location in conjunction with a number of other crossing closures and the construction of the proposed grade separation at Copia Street four blocks to the east. Traffic detoured from this crossing closure would take Gateway Boulevard East to Copia Street, turning south onto the proposed grade separation. The detour then leads west on Alameda Avenue to Estrella Street, a total detour length of approximately 1.3 miles.

Cebada Street - Crossing Closure

Cebada Street is a two-lane road crosses the UP Valentine Subdivision at-grade in El Paso. Cebada Street connects Gateway Boulevard East with Alameda Avenue on either side of the two UP tracks. The roadway has an AADT of 375 with a posted speed limit of 30 MPH. The railroad has 30 trains a day through this crossing, with an average speed of 33 MPH. Between 2008 and 2012 there have been no accidents at this crossing. Given the roadway and railroad statistics, it is proposed to close the crossing at this location in conjunction with a number of other crossing closures and the construction of the proposed grade separation at Copia Street three blocks to the east. Traffic detoured from this crossing closure would take Alameda Avenue west to the existing grade separation at Piedras Street, turning north onto the new grade separation. The detour then leads east on Gateway Boulevard East to Cebada Street, a total detour length of approximately 1.2 miles.

Grama Street - Crossing Closure

Grama Street is a two-lane road that crosses the UP Valentine Subdivision at-grade in El Paso. Grama Street connects Gateway Boulevard with Alameda Avenue on either side of the two UP tracks. The roadway has an AADT of 375 with a posted speed limit of 30 MPH. The railroad has 30 trains a day through this crossing, with an average speed of 34 MPH. Between 2008 and 2012 there have been no accidents at this crossing. Given the roadway and railroad statistics, it is proposed to close the crossing at this location in conjunction with a number of other crossing closures and the construction of a new grade separation at Copia Street one block to the east. Traffic detoured from this crossing closure would take Alameda Avenue west to Piedras Street, turning north onto the existing grade separation. The detour then leads east on Gateway Boulevard to Grama Street, a total detour length of approximately 1.6 miles.

Group 3: Buford Street

FM 1281/Horizon/Buford - Grade Separation

FM 1281/Horizon Street is a two-lane road that crosses the UP Valentine Subdivision at-grade in Clint. This existing at-grade crossing is located in a generally residential area with a couple of businesses to the west of the crossing. The roadway has an AADT of 11,880 with a posted speed limit of 25 MPH. The railroad has 30 trains a day through this crossing, with an average speed of 60 MPH. Between 2008 and 2012 there has been one accident at this crossing. Given the roadway and railroad statistics, it is proposed to grade separate the crossing at this location. A roadway overpass is proposed at this location since the area is not heavily developed and costs for a roadway overpass are generally lower than for a roadway underpass.

The proposed roadway overpass has been designed for a 30 MPH speed limit. The overpass geometry includes an alignment shift to the north to utilize open land in lieu of acquisition of residential properties and businesses. Both sides of the crossing include access roadways to provide connections to adjacent roadways and properties; however, westbound traffic cannot directly access the access roadway on the west side of the crossing and vice versa.

There is also the potential for a railroad overpass grade separation. The existing railroad right-of-way can accommodate a single shoofly, which could be constructed to the east of the existing UP Valentine Subdivision. An existing at-grade crossing at Rio Vista Road, located approximately 3,300 feet north of the FM 1281/ Horizon Street crossing, would be impacted by the potential railroad overpass and would require modification to the existing warning devices and roadway. Note that this alternative will likely have significantly greater costs and operational impacts compared to the roadway overpass alternative.
The estimated cost of the roadway overpass is $8,520,000, with an expected public benefit of $14,040,404.

Group 4: Fabens Street, 3rd Street, and 4th Street

FM 76/Fabens Street - Grade Separation

FM 76/Fabens Street is a two-lane road that crosses the UP Valentine Subdivision at-grade in Fabens. This existing at-grade crossing is located in downtown Fabens just northeast of Alameda Avenue/Main Street, surrounded by commercial, industrial, and residential areas. The roadway has an AADT of 9,600 with a posted speed limit of 30 MPH. The railroad has 30 trains a day through this crossing, with an average speed of 64 MPH. Between 2008 and 2012 there have been no accidents at this crossing. Given the roadway and railroad statistics, it is proposed to grade separate Fabens Street over Alameda Avenue/Main Street and the UP line in conjunction with two other crossing closures.

The geometry of the proposed roadway overpass meets a posted 35 MPH speed limit. This grade separation would begin southwest of Camp Street. The northeast side of the grade separation would require Bryan Street to be closed. The bridge portion of the grade separation would continue from the UP track past Alameda Avenue/Main Street. Due to the grade separation over Alameda Avenue/Main Street, a portion of East River Street will need to be elevated to meet the grade separation elevation to allow traffic to access the grade separation. An existing bridge over the waterway, southwest of Fabens Street, will need to be rebuilt as part of the new grade separation.

The estimated cost of the overpass, with accompanying crossing closures, is $12,270,000, with an expected public benefit of -$14,349,373.

3rd Street Northwest- Crossing Closure

3rd Street Northwest is a two-lane road that crosses the UP Valentine Subdivision at-grade in Fabens. This existing at-grade crossing is just northeast of Alameda Avenue/Main Street. The roadway has an AADT of 50 with a posted speed limit of 25 MPH. The railroad has 30 trains a day through this crossing, with an average speed of 64 MPH. Between 2008 and 2012 there have been no accidents at this crossing. Given the roadway and railroad statistics, it is proposed to close this crossing in conjunction with another crossing closure at 4th Street Northeast and the proposed grade separation at Fabens Street three blocks to the southeast. Traffic detoured from this crossing closure would take Camp Street northeast to Fabens Street, turning southeast onto the proposed grade separation on Fabens Street. The detour then leads northwest on East River Street and Alameda Avenue/Main Street to 3rd Street Northwest, a total detour length of approximately 0.9 miles.

4th Street Northeast- Crossing Closure

4th Street Northeast is a two-lane road that crosses the UP Valentine Subdivision at-grade in Fabens. This existing at-grade crossing is just northeast of Alameda Avenue/Main Street. The roadway has an AADT of 1,930 with a posted speed limit of 25 MPH. The railroad has 30 trains a day through this crossing, with an average speed of 64 MPH. Between 2008 and 2012 there have been no accidents at this crossing. Given the roadway and railroad statistics, it is proposed to close this crossing in conjunction with another crossing closure at 3rd Street Northwest and the proposed grade separation at Fabens Street three blocks to the northwest. Traffic detoured from this crossing closure would take Camp Street northwest to Fabens Street, turning southwest onto the proposed grade separation on Fabens Street. The detour then leads southeast on East River Street and Alameda Avenue/Main Street to 4th Street Northeast, a total detour length of approximately 1.1 miles.

Group 5: Pendale Road

Pendale Road - Grade Separation

Pendale Road is a four-lane road that crosses the UP Valentine Subdivision at-grade in El Paso. This existing at-grade crossing intersects Roseway Drive south of the railroad right-of-way and is surrounded by residential properties and Pueblo Viejo Park. The roadway has an AADT of 7,820 with a posted speed limit of 30 MPH. The railroad has 30 trains a day through this crossing, with an average speed of 53 MPH. Between 2008 and 2012 there have been 2 accidents at this crossing. Given the roadway and railroad statistics, it is proposed to grade separate the crossing at this location. It was decided that a roadway underpass was more appropriate than a roadway overpass in this area due to the additional impacts an overpass would have on the adjacent park and residential properties, and the potential of eliminated access north of the crossing.

The geometry of the proposed roadway underpass meets a 30 MPH speed limit. The underpass design at the crossing would require roadway adjustments to Roseway Drive; closures would include Fay Road, Wells Road, and Plains Drive, all of which have alternate access. Impacts to property access appear to be minimal with the grade separation, but connectivity to the park by way of an existing sidewalk (east and west on the southern leg of Pendale Road) would be removed.

A railroad overpass alternative was also considered. However, this was not selected due to constructability concerns of a required shoofly (temporary railroad bypass) within a constrained and limited right-of-way, possible railroad operational restrictions associated with a single track shoofly, and significantly higher costs.

The estimated cost of the roadway underpass is $18,770,000, with an expected public benefit of $13,648,111.

Group 6: Montana Avenue and East Yandell Drive

Montana Avenue - Grade Separation

Montana Avenue is a four-lane road that crosses the UP Carrizozo Subdivision at-grade in El Paso. This existing at-grade crossing is in the midst of a large commercial area. The roadway has an AADT of 19,700 with a posted speed limit of 40 MPH. The railroad has 20 trains a day through this crossing, with an average speed of 20 MPH. Between 2008 and 2012 there have been no accidents at this crossing. Given the roadway and railroad statistics, it is proposed to grade separate the crossing at this location in conjunction with the crossing closure at East Yandell Drive. A roadway underpass at this location was selected due to the proximity of North Cotton Street as well as the potential limitation or elimination of access to any additional grade-separated length of roadway.

The proposed roadway underpass has been designed for a 30 MPH speed limit. The proposed grade separation would begin west of Palm Street and end east of North

Cotton Street. The roadways currently crossing the portion of Montana Avenue being grade separated will be closed. The roadway closures include North Eucalyptus Street and Willow Street to the west of the current crossing with the UP; and Willow Street and North Walnut Street to the east of the crossing. Traffic on these streets would be detoured to North Cotton Street on the west and Palm Street on the east to pass the proposed grade separation on Montana Avenue. The impacted properties within the proposed grade separation limits will continue to have access by using the existing alleyway between Montana Avenue and East Yandell Drive and sidewalks along Montana Avenue.

The estimated cost of the roadway underpass, with the accompanying crossing closure at East Yandell Drive, is $16,310,000, with an expected public benefit of $54,278,111.

East Yandell Drive - Crossing Closure

East Yandell Drive is a three-lane, one-way road that crosses the UP Carrizozo Subdivision at-grade in El Paso. This existing at-grade crossing is located in a large commercial/retail area that provides access to North Cotton Street. The roadway has an AADT of 2,080 with a posted speed limit of 35 MPH. The railroad has 20 trains a day through this crossing, with an average speed of 18 MPH. Between 2008 and 2012 there have been no accidents at this crossing. Given the roadway and railroad statistics, it is proposed that this crossing be closed in conjunction with the construction of the proposed grade separation at Montana Avenue. The part of East Yandell Drive between the crossing closure and Missouri Avenue and between the crossing closure and North Cotton Street would need to become a bi-directional roadway. The traffic at the crossing closure would be detoured around onto the existing grade separation on Wyoming Avenue, with a detour length of approximately 0.5 miles. Given the proposed detour uses the existing grade separation at Wyoming Avenue, this crossing could be considered as a stand-alone project, or coupled with the proposed grade separation at Montana Avenue, which is an alternate detour route.

Group 7: FM 1110

FM 1110 - Grade Separation

FM 1110 is a two-lane road that crosses the UP Valentine Subdivision at-grade in Clint. This existing at-grade crossing includes an additional crossing west (764084H) of the double-track mainline crossing and impacts a mainly residential area. The roadway has an AADT of 7,900 with a posted speed limit of 30 MPH. The railroad has 30 trains a day through this crossing, with an average speed of 53 MPH. Between 2008 and 2012 there have been no accidents at this crossing. Given the roadway and railroad statistics, it is proposed to grade separate the crossing at this location. A roadway overpass was determined to be the best option to keep Richfield Street and Robert Alvarez Street as through roadways.

The estimated cost of the roadway overpass is $9,490,000, with an expected public benefit of $10,231,340.

Group 8: Chelsea Street and Concepcion Street

Chelsea Street - Grade Separation

Chelsea Street is a two-lane road that crosses the UP Valentine Subdivision at-grade in El Paso. This existing at-grade crossing is located in a densely commercialized/ industrialized area and is to the south of I-10 near the intersection of El Paso Drive and East Paisano Drive. The roadway has an AADT of 6,670 with a posted speed limit of 30 MPH. The railroad has 30 trains a day through this crossing, with an average speed of 38 MPH. Between 2008 and 2012 there have been no accidents at this crossing. Given the roadway and railroad statistics, it is proposed to grade separate the crossing at this location with an overpass in conjunction with the crossing closure at Concepcion Street.

The geometry of the proposed roadway overpass meets a 30 MPH speed limit. The grade separation would begin south of Dailey Avenue and north of the UP track, and would end well before the intersection of El Paso Drive and East Paisano Drive. Beacon Avenue would retain access to Chelsea Street through the use of an access road along the east side of the grade separation. Frontage roads are proposed on the south side of the grade separation, which would require right-of-way acquisition.

The estimated cost of the roadway overpass with the accompanying crossing closure at Concepcion Street is $8,680,977, with an expected public benefit of $13,417,753.

North Concepcion Street - Crossing Closure

North Concepcion Street is a two-lane road that crosses the UP Valentine Subdivision at-grade in El Paso, beginning at the intersection of Alameda Avenue and El Paso Drive near the Texas Tech Medical Center/Thomason General Hospital. The roadway has an AADT of 375 with a posted speed limit of 30 MPH. The railroad has 30 trains a day through this crossing, over two tracks with an average speed of 36 MPH. Between 2008 and 2012 there have been no accidents at this crossing. Given the roadway and railroad statistics, it is proposed to close this crossing in conjunction with the construction of the proposed grade separation at Chelsea Street, three blocks to the east. Traffic detoured from this crossing closure would take Alameda Avenue west to Raynolds Street, turning north onto the existing grade separation. The detour would then lead east on Rosa Avenue to Concepcion Street, a total detour length of approximately 1.0 miles. Given the detour will use the existing grade separation at Raynolds Street, this crossing could be considered as a stand-alone project, or coupled with the proposed grade separation at Chelsea Street, which is an alternate detour route.

Group 9: Missouri Avenue

East Missouri Avenue - Grade Separation

East Missouri Avenue is a three-lane I-10 Frontage Road that crosses the UP Carrizozo Subdivision at-grade in El Paso. This existing at-grade crossing is adjacent to I-10 and is one block from an existing roadway underpass (Wyoming Avenue) for the same set of tracks. The roadway has an AADT of 16,570 with a posted speed limit of 45 MPH. The railroad has 20 trains a day through this crossing, with an average speed of 16 MPH. Between 2008 and 2012 there have been no accidents at this crossing. Given the roadway and railroad statistics, it is proposed to grade separate the crossing at this location. Initially, a roadway overpass and underpass at the location were examined. However, the roadway overpass was eliminated due to the proximity of Cotton Street and the need to have continued access to that connection.

The proposed roadway underpass's geometry was designed at 30 MPH in lieu of the 45 MPH posted speed limit, to reduce required sight distance requirements and length of the grade separation, thereby avoiding impacts to Cotton Street. The underpass would eliminate access to parcels adjacent to Missouri Avenue from Willow Street to Cotton Street, and it is possible these parcels would need to be acquired to construct the underpass due to the elimination of access. Also, there is not enough information to determine the constructability of the roadway underpass adjacent to the I-10 retaining walls and overpass structure; there may be structural conflicts and increased costs. This would need to be analyzed in greater detail in subsequent preliminary engineering activities. A roadway closure at this location was also examined, but it was determined to not be a reasonable alternative since it would eliminate connectivity from the I-10 exit onto Missouri Avenue and Cotton Street.

The estimated cost of the roadway underpass is $12,170,000, with an expected public benefit of $65,318,105.

Group 10: Country Club Road

Country Club Road - Grade Separation

Country Club Road is a five-lane road that crosses the BNSF El Paso Subdivision at-grade in El Paso. This existing at-grade crossing intersects with Doniphan Drive/SH 20 just outside of the railroad right-of-way and is close to commercial and residential areas. The roadway has an AADT of 18,360 with a posted speed limit of 40 MPH. The railroad has 8 trains a day through this crossing, with an average speed of 28 MPH. Between 2008 and 2012 there have been no accidents at this crossing. Given the roadway and railroad statistics, it is proposed to grade separate the crossing at this location. It was determined that a roadway overpass was a more suitable solution for grade separating this crossing than an underpass. An underpass was not a viable option due to the nearby drainage features, such as a detention facility and large culverts, which cross the roadway to drain into the detention facility.

The proposed roadway overpass's geometry was designed at 30 MPH in lieu of the 40 MPH speed limit, to reduce required sight distance requirements and length of the grade separation, due to the constraints posed by the neighborhood's access to the west of the crossing as well as the access to businesses to the east of the crossing. The overpass would provide direct access to Doniphan Drive/SH 20 from the westbound direction and continued access to businesses adjacent to the overpass. An existing connection at Crossroads Drive would provide a connection for eastbound overpass traffic. A connector road on the south side of the crossing allows access to Vista Grande Circle and Charl Ann Street.

The estimated cost of the roadway overpass is $7,220,000, with an expected public benefit of $13,295,562.

Group 11: FM 1505/North Clark Drive

FM 1505/North Clark Drive - Grade Separation

North Clark Drive is a two-lane road that crosses the UP Valentine Subdivision and El Paso Drive at-grade in El Paso. North Clark Drive connects a residential area with an industrial area. The roadway has an AADT of 7,600 with a posted speed limit of 30 MPH. The railroad has 30 trains a day through this crossing, with an average speed of 40 MPH. Between 2008 and 2012 there has been one accident at this crossing. Given the roadway and railroad statistics, it is proposed to grade separate North Clark Drive over both the UP tracks and El Paso Drive at this location.

The proposed grade separation would begin south of Welch Avenue on the north side of the UP tracks. An access road on each side of the proposed grade separation would provide continued access to Dulany Avenue. The grade separation would cross both the UP tracks and El Paso Drive, meeting grade south of El Paso Drive after Griems Court. An access road on each side of the south side of the grade separation provides continued access to Griems Court and El Paso Drive. Due to the grade separation, traffic on El Paso Drive will no longer be able to turn north onto Clark Drive and must be detoured west to Glenwood Street and Welch Avenue, taking Welch Avenue east to Clark Drive. The length of this detour is approximately 1.0 mile.

The estimated cost of the roadway overpass is $13,280,343 with an expected public benefit of $12,313,436.

Group 12: Piedras Street, Rosewood Street, Maple Street, Birch Street, Cedar Street, and Elm Street

Piedras Street - Grade Separation

Piedras Street is a four-lane road that crosses the UP Carrizozo Subdivision at-grade in El Paso. Piedras Street connects residential areas north of the UP track with the commercial/retail areas to the south. The roadway has an AADT of 5,790 with a posted speed limit of 30 MPH. The railroad has 20 trains a day through this crossing, with an average speed of 21 MPH. Between 2008 and 2012 there have been two accidents at this crossing. Given the roadway and railroad statistics, it is proposed to grade separate Piedras Street over the UP at this location in conjunction with a number of other crossing closures at Rosewood Street, Maple Street, Birch Street, Cedar Street, and Elm Street.

North of the UP tracks, the proposed grade separation would begin just south of San Jose Avenue, with access roads on each side to provide continued access to Grant Avenue. On the south side, the proposed grade separation will end just south of Pershing Drive, with an access road provided on the east side of Piedras Street.

The estimated cost of the roadway overpass, with accompanying crossing closures, is $9,552,707 with an expected public benefit of $8,395,522.

Rosewood Street - Crossing Closure

Rosewood Street is a two-lane residential and commercial road that crosses the UP Carrizozo Subdivision at-grade in El Paso. Rosewood Street connects Grant Avenue and Pershing Drive on either side of the UP track. The roadway has an AADT of 375 with a posted speed limit of 25 MPH. The railroad has 20 trains a day through this crossing, with an average speed of 20 MPH. Between 2008 and 2012 there have been no accidents at this crossing. Given the roadway and railroad statistics, it is proposed to close the crossing at this location in conjunction with a number of other crossing closures at nearby streets, and utilize the proposed grade separation at Piedras Street four blocks to the east. Traffic detoured from this crossing closure would take Grant Avenue to Elm Street and around, turning south onto the proposed grade separation on Piedras Street. The detour then heads west on Montana Avenue and Pershing Drive to Rosewood Street, a total detour length of approximately 1.2 miles.

Maple Street - Crossing Closure

Maple Street is a two-lane residential and commercial road that crosses the UP Carrizozo Subdivision at-grade in El Paso. Maple Street connects Grant Avenue and Pershing Drive on either side of the UP track. The roadway has an AADT of 375 with a posted speed limit of 25 MPH. The railroad has 20 trains a day through this crossing, with an average speed of 21 MPH. Between 2008 and 2012 there have been no accidents at this crossing. Given the roadway and railroad statistics, it is proposed to close the crossing at this location in conjunction with a number of other crossing closures at nearby streets and utilize the proposed grade separation at Piedras Street three blocks to the east. Traffic detoured from this crossing closure would take Grant Avenue to Elm Street and around, turning south onto the proposed grade separation on Piedras Street. The detour then heads west on Montana Avenue and Pershing Drive to Maple Street, a total detour length of approximately one mile.

Birch Street - Crossing Closure

Birch Street is a two-lane residential and commercial road that crosses the UP Carrizozo Subdivision at-grade in El Paso. Birch Street connects Grant Avenue and Pershing Drive on either side of the UP track. The roadway has an AADT of 375 with a posted speed limit of 25 MPH. The railroad has 20 trains a day through this crossing, with an average speed of 20 MPH. Between 2008 and 2012 there have been no accidents at this crossing. Given the roadway and railroad statistics, it is proposed to close the crossing at this location in conjunction with a number of other crossing closures at nearby streets and utilize the proposed grade separation at Piedras Street two blocks to the east. Traffic detoured from this crossing closure would take Grant Avenue to Elm Street and around, turning south onto the proposed grade separation on Piedras Street. The detour then heads west on Montana Avenue to Birch Street, a total detour length of approximately 0.85 miles.

Cedar Street - Crossing Closure

Cedar Street is a two-lane residential and commercial road that crosses the UP Carrizozo Subdivision at-grade in El Paso. Cedar Street connects Grant Avenue and Pershing Drive on either side of the UP track. The roadway has an AADT of 375 with a posted speed limit of 25 MPH. The railroad has 20 trains a day through this crossing, with an average speed of 19 MPH. Between 2008 and 2012 there has been one accident at this crossing. Given the roadway and railroad statistics, it is proposed to close the crossing at this location in conjunction with a number of other crossing closures at nearby streets and utilize the proposed grade separation at Piedras Street one block to the east. Traffic detoured from this crossing closure would take Grant Avenue to Elm Street and around, turning south onto the proposed grade separation on Piedras Street. The detour then heads west on Montana Avenue to Cedar Street, a total detour length of approximately 0.65 miles.

Elm Street - Crossing Closure

Elm Street is a two-lane residential and commercial road that crosses the UP Carrizozo Subdivision at-grade in El Paso. Elm Street connects Grant Avenue and Pershing Drive on either side of the UP track. The roadway has an AADT of 375 with a posted speed limit of 25 MPH. The railroad has 20 trains a day through this crossing, with an average speed of 20 MPH. Between 2008 and 2012 there have been no accidents at this crossing.

Given the roadway and railroad statistics, it is proposed to close the crossing at this location in conjunction with a number of other crossing closures at nearby streets and utilize the proposed grade separation at Piedras Street one block to the east. Traffic detoured from this crossing closure would take Elm Street north and around, turning south onto the proposed grade separation on Piedras Street. The detour then heads east on Montana Avenue to Raynor Street, then north to Pershing Drive, turning west on Pershing Drive to the proposed access road, and around to Elm Street a total detour length of approximately 0.5 miles.

Group 13: Redd Road and Green Avenue

Redd Road - Grade Separation

Redd Road is a divided four-lane road that provides access from residential developments to the commercial areas along Doniphan Drive/SH 20, into downtown El Paso, and crosses the BNSF El Paso Subdivision at-grade in El Paso. At this location, the BNSF single track runs parallel to Doniphan Drive/SH 20, and Redd Road currently intersects the BNSF at-grade shortly before its intersection with Doniphan Drive/SH 20. The roadway has an AADT of 7,590 with a posted speed limit of 30 MPH. The railroad has eight trains a day through this crossing, with an average speed of 40 MPH. Between 2008 and 2012 there have been no accidents at this crossing. Given the roadway and railroad statistics, it is proposed to grade separate Redd Road over the BNSF track at this location in conjunction with a crossing closure at West Green Avenue.

The proposed overpass was designed for a 30 MPH speed limit. This grade separation would handle Redd Road's current traffic as well as the traffic detoured from the West Green Avenue crossing closure. On the east side of Doniphan Drive/SH 20, the Redd Road overpass would begin in the median of the existing road; allowing for continued access to Doniphan Drive/SH 20 and McCutcheon Lane on either side of the track. The proposed overpass would return to existing grade of Redd Road just east of Saplinas Road, which is the detour street for the closure of West Green Avenue. From the west approach, the proposed Redd Road overpass will have flyovers to provide access to Doniphan Drive/SH 20 over the BNSF line. Due to the flyover configuration, right-of-way would need to be acquired on the west side of Doniphan Drive/SH 20.

The estimated cost of the roadway overpass, and accompanying crossing closure, is $36,449,526 with an expected public benefit of -$19,345,402.

W. Green Avenue - Crossing Closure

West Green Avenue is a two-lane road that provides access from a residential development to the commercial areas along Doniphan Drive/SH 20, into downtown El Paso, and crosses the BNSF El Paso Subdivision at-grade in El Paso. BNSF track runs parallel to Doniphan Drive/SH 20 in the area where West Green Avenue crosses the track. There is a short distance between the rail crossing and the intersection with Doniphan Drive/SH 20. The roadway has an AADT of 2,000 with a posted speed limit of 25 MPH. The railroad has eight trains a day through this crossing, with an average speed of 41 MPH. Between 2008 and 2012 there have been no accidents at this crossing. Given the roadway and railroad statistics, it is proposed to close the crossing at this location and utilize the proposed grade separation at Redd Road. There is another road, Saplinas Road, through the residential community, which connects West Green Avenue to Redd Road, providing alternative access to Doniphan Drive/SH 20. Drivers who use the grade crossing at West Green Avenue with have a detour length of 0.38 miles to use the proposed grade separation at Redd Road.

Group 14: FM 1905/Washington Street

FM 1905/ Washington St - Grade Separation

Washington Street is a two-lane road that crosses the BNSF El Paso Subdivision at-grade providing access to downtown Anthony, TX. This existing at-grade crossing intersections with SH 20/Main Street just east of the crossing and is near commercial and residential properties on both sides of the tracks. The roadway has an AADT of 9,500 with a posted speed limit of 30 MPH. The railroad has eight trains a day through this crossing, with an average speed of 45 MPH. Between 2008 and 2012 there has been one accident at this crossing. Given the roadway and railroad statistics, it is proposed to grade separate Washington Street over the BNSF tracks at this location. A roadway overpass is proposed at this location because the area is not heavily developed and costs for a roadway overpass are generally lower than for a roadway underpass.

The geometry of the proposed roadway overpass meets the posted 30 MPH speed limit. On the west side of the overpass, the alignment was shifted to the south so that acquisition of right-of-way and adjacent parcels would only occur on one side. An access road will provide for connections to existing roadways and to promote the development of those areas. On the east side of the proposed overpass, connections to adjacent parcels along FM 1905 from SH 20/Main Street to 2nd Street would be removed and acquisition of these parcels would likely be required to construct the overpass. There is also not a direct connection to SH 20/Main Street in the design.

The estimated cost of the roadway overpass is $8,310,000 with an expected public benefit of $6,344,636.

Group 15: Sunland Park Drive

Sunland Park Drive - Grade Separation

Sunland Park Drive is a four-lane road that crosses the BNSF El Paso Subdivision at-grade in El Paso. The BNSF track runs parallel to Doniphan Drive/SH 20 in the area where Sunland

Park Drive crosses the track. There is a short distance between the rail crossing and the intersection with Doniphan Drive/SH 20. Sunland Park Drive currently provides access to commercial properties to the east and residential properties to the west of the crossing. The roadway has an AADT of 9,250 with a posted speed limit of 30 MPH. The railroad has eight trains a day through this crossing, with an average speed of 21 MPH. Between 2008 and 2012 there have been two accidents at this crossing. Given the roadway and railroad statistics, it is proposed to grade separate Sunland Park Drive under the BNSF track at this location. A roadway underpass was chosen in this location to limit impacts to Doniphan Park Circle to the east of the track and additional properties in the area.

The proposed roadway underpass has been designed for a 40 MPH speed limit. Both sides of the crossing include access roadways to provide connections to adjacent roadways and properties. While traffic eastbound on the underpass cannot access Doniphan Drive/SH 20 directly, a roadway connection is shown in the design off of Doniphan Park Circle to access Doniphan Drive/SH 20.

The estimated cost of the roadway underpass is $19,510,000 with an expected public benefit of $16,717,403.

Group 16: FM 259

FM 259 - Grade Separation

FM 259 is a two-lane road that crosses the BNSF El Paso Subdivision at-grade in El Paso. The BNSF track runs parallel to Doniphan Drive/SH 20 in the area where FM 259 crosses the track. There is a short distance between the rail crossing and the intersection with Doniphan Drive/SH 20. This existing at-grade crossing is near some commercial and residential areas. The roadway has an AADT of 9,000 with a posted speed limit of 30 MPH. The railroad has eight trains a day through this crossing, with an average speed of 45 MPH. Between 2008 and 2012 there have been no accidents at this crossing. Given the roadway and railroad statistics, it is proposed to grade separate FM 259 over the BNSF track at this location. A roadway overpass was selected because the nearby Rio Grande eliminated the potential for a roadway underpass.

The proposed roadway overpass has been designed for a 40 MPH speed limit. The eastern side of the overpass eliminates access along the overpass from Doniphan Drive/SH 20 to Second Avenue, and acquisition of these parcels would likely be required to construct the overpass. Also, there is not a direct connection to Doniphan Drive/SH 20 from the overpass. On the western side, separate roadway connections are shown to provide access to La Junta Drive and properties to the north and south of the overpass. Levee Road is shown to be grade-separated at the overpass, but access from FM 259 has been removed.

The estimated cost of the roadway overpass is $8,830,000 with an expected public benefit of $5,029,451.

Group 17: West Sunset Road

West Sunset Road Grade Separation

West Sunset Road is a two-lane road that crosses the BNSF El Paso Subdivision at-grade in El Paso. The BNSF track runs parallel to Doniphan Drive/SH 20 in the area where West Sunset Road crosses the track. There is a short distance between the rail crossing and the intersection with Doniphan Drive/SH 20. West Sunset Road connects commercial areas on both sides of the railroad. The roadway has an AADT of 7,790 with a posted speed limit of 30 MPH. The railroad has eight trains a day through this crossing, with an average speed of 40 MPH. Between 2008 and 2012 there have been no accidents at this crossing. Given the roadway and railroad statistics, it is proposed to grade separate West Sunset Road over the BNSF track at this location.

The proposed overpass was designed for a 30 MPH speed limit. On the east side of Doniphan Drive/SH 20, the Sunset Road overpass will begin on the south side of West Sunset Road, allowing for continued access to Doniphan Drive/US 20, but Ripley Drive will be closed at West Sunset Road. The overpass will return to existing grade just east of Emory Road. From the west approach the West Sunset Road proposed overpass will have flyovers to provide access to Doniphan Drive/SH 20 over the BNSF track. Due to the flyover configuration, right-of-way would need to be acquired on the west side of Doniphan Drive/SH 20.

The estimated cost of the roadway overpass is $33,929,294 with an expected public benefit of $6,010,117.

Group 18: Executive Center Boulevard

Executive Center Boulevard - Grade Separation

Executive Center Boulevard is a four-lane road that crosses the BNSF El Paso Subdivision at-grade in El Paso near its intersection with West Paisano Drive. West Paisano Drive passes under two large under-truss railroad bridges for the UP Lordsburg Subdivision at this intersection. Also at this crossing with the BNSF tracks are a road turn-off to an industrial facility, and a small rail bridge and a turnout to a spur track. The roadway has an AADT of 5,060 with a posted speed limit of 30 MPH. The railroad has eight trains a day through this crossing, with an average speed of 19 MPH. Between 2008 and 2012 there have been no accidents at this crossing. Given the roadway and railroad statistics, it is proposed to grade separate Executive Center Boulevard over the BNSF and UP truss bridges at this location.

The proposed grade separation has been designed for a maximum 60 MPH speed limit for connection with West Paisano Drive. The proposed grade separation will consist of a series of flyovers that will connect West Paisano Drive to Executive Center Boulevard. The existing at-grade crossing with BNSF tracks will be closed and all traffic will use the proposed flyovers. To construct the flyovers, right-of-way would need to be acquired on both sides of West Paisano Drive and Executive Center Boulevard.

The estimated cost of the roadway overpass is $45,509,238 with an expected public benefit of $9,451,585.

Group 19: Delta Drive

Delta Drive - Grade Separation

Delta Drive is a four-lane road that crosses the UP Valentine Subdivision at-grade in El Paso. This grade crossing is located at the east entrance to the UP International Yard. Railroad operations associated with this yard often causes slow moving trains across Delta Drive. Bowie High School and Salazar Park Memorial Apartments are both located near this crossing and have direct access onto Delta Drive. The roadway has an AADT of 375 with a posted speed limit of 40 MPH. The railroad has 36 trains a day through this crossing, with an average speed of 10 MPH. Between 2008 and 2012 there have been no accidents at this crossing. Given the roadway and railroad statistics, it is proposed to grade separate Delta Drive over the UP at this location.

The proposed grade separation would begin just west of the entrance to the school's sports facilities, and would occupy the full width of Delta Drive. A one-lane access road with a U-turn under the overpass bridge would provide access to the apartment complex near the grade crossing. On the west side of the crossing with the UP, Delta Drive will return to existing grade with no impact to properties outside of the existing road footprint.
The estimated cost of the roadway overpass is $7,496,000 with an expected public benefit of $3,409,267.

Other Crossings

Burbridge Road - Safety Upgrade

Burbridge Road is a two-lane road that crosses the UP Valentine Subdivision at-grade in Clint just before an intersection with Trent Road, which runs parallel to the UP tracks. This roadway configuration provides limited visibility of train traffic for road traffic traveling down Trent Road turning onto Burbridge Road. The roadway has an AADT of 110 with a posted speed limit of 30 MPH. The railroad has 30 trains a day through this crossing, with an average speed of 52 MPH. Even with the existing gates and flashers, between 2008 and 2012 there have been three accidents at this crossing. Given the roadway and railroad statistics, safety improvements are recommended. However, the lack of nearby alternate access prohibits closing the crossing and at the same time does not justify a grade separation itself. Therefore, at a minimum, improved advance warning signs and improvements to the roadway surface with pavement markings along the crossing approaches are recommended.

OT Smith Road (FM 3380) - Safety Upgrade

OT Smith Road is a two-lane road that crosses the UP Valentine Subdivision at-grade in Tornillo, just before it intersects with Alameda Avenue. The roadway has an AADT of 50 with a posted speed limit of 40 MPH. The railroad has 30 trains a day through this crossing, with an average speed of 70 MPH. Even with the existing gates and flashers, between 2008 and 2012 there have been two accidents at this crossing. Given the roadway and railroad statistics, safety improvements are recommended at this crossing. However, the lack of nearby alternate access prohibits closing the crossing and at the same time does not justify a grade separation itself. Therefore, at a minimum, improved signage and pavement markings along the crossing approaches are recommended.

Oil Mill Road - Safety Upgrade

Oil Mill Road is a two-lane road that crosses the UP Valentine Subdivision at-grade in Tornillo, just before it intersects with Alameda Avenue. The roadway has an AADT of 50 with a posted speed limit of 30 MPH. The railroad has 30 trains a day through this crossing, with an average speed of 70 MPH. Even with the existing gates and flashers, between 2008 and 2012 there has been one accident at this crossing. Given the roadway and railroad statistics, improved signage and pavement markings along the crossing approaches are recommended.

Section 8.2: Capacity Improvement Descriptions

Based on the RTC modeling described in Section 5.7, three of the six growth scenarios required increases in infrastructure to accommodate the increased volume of rail traffic: Planning Case 3, Planning Case 4, and Planning Case 6. In this section, the infrastructure improvements are described in more detail, while the corresponding exhibits are found in Appendix 3: Conceptual Exhibits. The undiscounted costs associated with Planning Case 3 and Planning Case 6 and corresponding benefit are presented in each section. Detailed cost estimates and discounted costs and benefits can be found for these planning cases in Appendix 4: Construction Cost Estimates, and Appendix 6: Benefit – Cost Analysis Results respectively.

Planning Case 3: 2.12% Growth

The physical track infrastructure changes recommended to reduce delay to acceptable levels for a 2.12% growth scenario were additional track (double track) between existing sidings at four different locations on the UP Valentine Subdivision, between El Paso (MP 827) and Sierra Blanca (MP 737). Referencing Figure 5-1 for milepost limits of the study, the location of the proposed double track sections are:

- MP 807.1 to MP 794.9
- MP 792.5 to MP 784.6

- MP 760.1 to MP 752.2
- MP 745.2 to MP 739.3

The length of each new double track section varies between approximately 4 and 14 miles. A double track connection between the Valentine and Toyah Subdivisions at Sierra Blanca was also included. The improvements require approximately 40 total miles of track to be constructed, leaving about 29 miles of single track along the UP Valentine Subdivision between El Paso and Sierra Blanca.

The total estimated cost for this scenario is $155,224,000 with estimated benefits of $62,927,000. It is important to note that the cost estimate does not include environmental mitigation costs, right-of-way acquisition costs, or utility relocation costs.

Double Track from MP 807.1 to MP 794.9

For this double track segment, the west end of the existing siding at MP 808.83 would have the No. 14 turnout replaced with a powered No. 15 turnout and the east end of the existing siding at MP 807.1 would have two new powered No. 15 turnouts installed. This will allow the new double track portion to be accessed on the opposite side of the mainline from the existing siding by trains on the mainline while trains on the siding simultaneously move onto the existing mainline. There are nine public and seven private at-grade crossings on this new double track section. There are twelve culverts which require extension. There are two industrial leads with No. 10 turnouts that will be replaced with No. 11 turnouts. There are no new bridges to construct along this segment. The double track segment ends at the existing siding at MP 794.88 with a new No. 15 powered turnout and the existing ends of this siding and its No. 14 turnouts are to be removed and replaced with new No. 15 powered turnouts. The total new track construction is 10.44 miles and 1.73 miles of existing sidings are to be brought up to mainline standards.

Double Track from MP 792.49 to MP 784.60

For this double track segment, the west end of the existing siding at MP 794.88 would be replaced with either the new double track segment from MP 807.1 to MP 794.9, or it would have its existing No. 14 turnout replace with a new No. 15 powered turnout if it is being constructed without the previous segment. On the east end of the siding, the existing No. 14 turnout and connection to the main track would be removed. A new No. 15 powered turnout will be installed in the mainline before the existing siding connection at MP 792.49 for the new double track segment, and the siding will be reconnected farther to the east to allow for double track operation. There are no public and one private at-grade crossing on this new double track section. There are ten culverts that require extension. There are no industrial leads. There are 13 new bridges to construct along this segment for a total of approximately 600 track feet of new bridge. The double track segment ends at the existing siding at MP 784.57, the existing end of this siding and its No. 14 turnout are to be removed and the new double track connected to the remaining portion of the siding, and the existing No 14 turnout on the opposite end of the siding will be replaced with a new No. 15 power turnout. The total new track construction is 7.89 miles and 2.39 miles of existing sidings are to be brought up to mainline standards if this double track segment is built prior to the double track segment from MP 807.1 to MP 794.9.

Double Track from MP 760.1 to MP 752.2

For this double track segment, the end of the existing siding at MP 761.69 would have its existing No. 14 turnout replaced with a new No. 15 powered turnout. On the east end of the siding, the existing No. 14 turnout and connection to the main track would be removed and the new double track segment would be connected to the remaining segment of the existing siding. There are two public and no private at-grade crossings on this new double track section. There are two culverts that require extension. There are two industrial leads, one of which would have its No. 10 turnout replaced with a No. 11 turnout. There are 13 new bridges to construct along this segment for a total of approximately 675 track feet of new bridge. The double track segment ends at the existing siding at MP 752.15, the existing end of this siding and its No. 14 turnout are to be removed and the new double track connected to the remaining portion of the siding, and the existing No 14 turnout on the opposite end of the siding will be replaced with a new No. 15 power turnout. The total new track construction is 7.96 miles and 3.29 miles of existing sidings are to be brought up to mainline standards.

Double Track from MP 745.2 to MP 739.3

For this double track segment, the west end of the existing siding at MP 747.00 would have the No. 14 turnout replaced with a powered No. 15 turnout, and the east end of the existing siding at MP 745.27 would have a new No. 15 powered turnout installed and the siding extended before connecting to the existing mainline. The existing No.14 turnout at MP 745.27 would also be replaced by a powered No. 15 turnout. The new double track segment would have its powered No. 15 turnout installed between these other two No. 15 turnouts on the mainline. This will allow the new double track portion to be accessed on the opposite side of the mainline from the existing siding by trains on the mainline while trains on the siding simultaneously move onto the existing mainline. There are one public and two private at-grade crossings on this new double track section. There are 13 culverts which require extension. There are two industrial leads which would have their No. 10 turnouts replaced with No. 11 turnouts. There are four new bridges to construct along this segment for a total of approximately 230 track feet of new bridge. The double track segment ends at the existing siding at MP 739.27 with a new No. 15 turnout being installed to connect to the existing siding. The existing No. 14 turnouts on each end of the siding are to be replaced with new No. 15 powered turnouts. The total new track construction is 5.97 miles and 3.82 miles of existing sidings are to be brought up to mainline standards.

Double Track from Valentine MP 737.2 to Toyah MP 767.2

For this double track segment, the west end of the existing siding at MP 739.27 would be replaced with either the new double track segment from MP 745.2 to MP 739.3 or it would have its existing No. 14 turnout replaced with a new No. 15 powered turnout if it is being constructed without the previous segment. The east end of the existing siding at MP 737.18 would have the siding extended before connecting to the existing mainline with a new No. 15 powered turnout. A new No. 15 turnout will be installed in the mainline before the extended turnout connects to the mainline to provide double track operation. The existing No.30 turnout at MP 737.00 would remain in place. There is one public and no private at-grade crossings on this new double track connection. There are no culverts which require extension. There is one industrial lead which would have its No. 10 turnout replaced with a No. 11 turnout if the previous segment was not already constructed. There are no new bridges to construct along this connector. The double track segment ends at MP 767.15 on the Toyah Subdivision with a new No. 15 turnout being installed to connect to the existing mainline. The total new track construction is 1.73 miles and 1.99 miles of existing sidings are to be brought up to mainline standards if this segment is constructed independent of the previous segment.

Planning Case 4: 2.55% Growth

The physical track infrastructure changes recommended to reduce delay to acceptable levels for a 2.55% growth scenario were to double track the remaining 40 miles (after Planning Case 3 infrastructure additions) of single track on the UP Valentine Subdivision between El Paso and Sierra Blanca.

Double Track from MP 815 to MP 737

For this double track scenario, the intermittent gaps left after Planning Case 2 is constructed will be double tracked. However, for simplicity in presentation, the quantities and costs in this section, and the appendix, are presented as a complete double track scenario, meaning all, if any, of the previous planning cases infrastructure improvements that may have been constructed are not considered.

The double track begins at the east end of the existing double track at MP 815.21 with a new No. 15 powered turnout connecting to the existing mainline. The new double track remains on the north side of the existing mainline until the end of the siding at MP 807.10, where it shifts south of the existing mainline. The double track then runs on the south side of the existing mainline until the end of the siding at MP 792.49, where it shifts back to the north side of the mainline. It then remains on the north side of the mainline until the end of the siding at MP 782.59, when it shifts back to the south side. It remains on the south side past the overhead I-10 bridge until the end of the siding at MP 750.44, when it shifts back to the north side of the mainline. The double track then runs on the north side of the existing mainline until the end of the siding at MP 745.27, where it shifts back to the south side of the mainline. The double track remains on the south side of the mainline until the new double track connection with the Toyah Subdivision at MP 737.00. The purpose of the shift from the north side to the south side of the existing mainline is to avoid rebuilding as many industrial leads as possible while utilizing as much existing siding track for the new double track as possible. There are 22 public and 11 private at-grade crossings on this new double track section. There are 73 culverts that require extension. There are seven industrial leads with No. 10 turnouts that will be replaced with No. 11 turnouts. There are 64 new bridges to construct for this double track totaling approximately 3835 track feet of railroad bridge. The double track segment ends after the connection with the Toyah Subdivision at Toyah Sub MP 767.15 with a new No. 15 powered turnout connecting to the mainline. There are a total of 28 new powered No. 15 turnouts along this double track section. The total new track construction is 75.81 miles and 15.3 miles of existing sidings being brought up to mainline standards.

The total estimated cost for this scenario is $293,214,000 for the Valentine Subdivision double track and the Toyah Subdivision. It is important to note that the cost estimate does not include environmental mitigation costs, right-of-way acquisition costs, or utility relocation costs.

Planning Case 6: 4.02% Growth

The physical track infrastructure changes recommended to reduce delay to acceptable levels for a 4.02% growth scenario were to double track the entire UP Toyah Subdivision from Sierra Blanca to Toyah, a section that currently is single track with sidings.

Double Track Valentine Subdivision from MP 815 to MP 737 and the Toyah Subdivision from MP 767 to MP 663, with a Connection from Valentine MP 737 to Toyah MP 767

For this double track scenario, for simplicity in presentation, the quantities and costs in this section, and the appendix, are presented as a complete double track scenario, meaning all, if any, of the previous planning cases infrastructure improvements that may have been constructed are not considered. However, given that the double track of the Valentine Subdivision is the same as in Planning Case 4, the description will not be repeated here.

The double track begins at the east end of the Valentine Subdivision to Toyah Subdivision Connection track at MP 767.15 with a new No. 15 powered turnout connecting to the new connection track. The new double track remains on the north side of the existing mainline until the beginning of the siding at MP 746.94, where it shifts south of the existing mainline to connect the short sidings together, and then shifts back to the north side of the existing mainline at the end of the siding at MP 743.21. The double track continues on the north side of the existing mainline until the beginning of the siding at MP 727.26, where it shifts to the south side of the mainline. It then remains on the south side of the mainline until MP 699, after it crosses a box culvert. At this point, it shifts to the north side of the mainline, in part to avoid an existing industrial lead, and remains on the north side until the beginning of the siding at MP 678.24, when it shifts back to the south side to connect with an existing siding and then shifts back to the north side of the existing mainline. It remains on the north side, until the end of the double track section at MP 663.00 with a new No. 15 powered turnout connection to the existing mainline. The purpose of shift from the north side to the south side of the existing mainline is to avoid rebuilding as many industrial leads as possible, while utilizing as much existing siding track for the new double track as possible. There are six public and 12 private at-grade crossings on this new double track section. There are 33 culverts that require extension. There are five industrial leads with No. 10 turnouts that will be replaced with No. 11 turnouts. There are 64 new bridges to construct for this double track totaling approximately 4675 track feet of railroad bridge. There are a total of 32 new powered No. 15 turnouts along this double track section. The total new track construction is 104 miles and 15.5 miles of existing sidings being brought up to mainline standards.

The total estimated cost for the Toyah Double Track scenario is $395,702,000. It is important to note that the cost estimate does not include environmental mitigation costs, right-of-way acquisition costs, or utility relocation costs.

The total quantities for Planning Case 6 are a combination of the Valentine Double Track, the Toyah Double Track, and the Subdivision Connection. There are a total of 28 public and 23 private at-grade crossings on this new double track section. There are 106 culverts that require extension. There are 11 industrial leads with No. 10 turnouts that will be replaced with No. 11 turnouts. There are 128 new bridges to construct for this double track totaling approximately 8500 track feet of railroad bridge. There are a total of 60 new powered No. 15 turnouts along this double track section. The total new track construction is 180 miles and 31 miles of existing sidings being brought up to mainline standards.

The total estimated cost for Planning Case 6 is $688,916,000 and an estimated public benefit of $200,447,000. It is important to note that the cost estimate does not include environmental mitigation costs, right-of-way acquisition costs, or utility relocation costs.

Appendices:

Appendix 1: Terms & Definitions

Appendix 2: Inventory of Rail Crossings

Appendix 3: Conceptual Exhibits

Appendix 4: Construction Cost Estimates

Appendix 5: Benefit –Cost Analysis Calculations & Methodology

Appendix 6: Benefit – Cost Analysis Results

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