East Texas Infrastructure Analysis

Final Report

January 2012
# TABLE OF CONTENTS

ACKNOWLEDGMENTS

EXECUTIVE SUMMARY ........................................................................................................... 1

PROJECT BACKGROUND ......................................................................................................... 1

BACKGROUND REVIEW ......................................................................................................... 3

EXISTING INFRASTRUCTURE .................................................................................................. 4

INFRASTRUCTURE IMPROVEMENTS ....................................................................................... 12

  CURVE MODIFICATIONS ..................................................................................................... 12
  SIGNAL IMPROVEMENTS .................................................................................................... 15
  SIDING IMPROVEMENTS ...................................................................................................... 16
  SUMMARY OF ESTIMATED COSTS OF IDENTIFIED IMPROVEMENTS .................................. 18
  TRIP TIME ANALYSIS ......................................................................................................... 18

APPENDIX A - INVENTORY

APPENDIX B – EXHIBITS

APPENDIX C – COST ESTIMATES

APPENDIX D – TRIP TIMES
ACKNOWLEDGMENTS

The *Texas Eagle Infrastructure Assessment Study* could not be undertaken without the cooperative participation of public, private, and governmental representatives from the region, the State of Texas, and Amtrak.

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EXECUTIVE SUMMARY

The Amtrak Texas Eagle route runs between Los Angeles and Chicago and connects with three other Amtrak routes (Heartland Flyer, Missouri River Runner, and Sunset Limited) and four thruway bus routes, providing direct service to 41 cities and connection service to an additional 32 cities. The Amtrak Texas Eagle route provides daily service in each direction between with 17 station stops in Texas, 6 of which are within the limits of this study between Fort Worth and Texarkana, Texas.

The East Texas Infrastructure Assessment was completed to identify and provide conceptual engineering for improvements to increase allowable speeds and decrease trip times for the Amtrak Texas Eagle route between Fort Worth and Texarkana. The study included a background review and infrastructure inventory of the route to identify existing conditions. The study also included the identification of improvements to increase allowable operating speeds for passenger trains to 79 mph and to 110 mph, as well as estimated costs and reductions in theoretical trip times associated with those potential improvements. This study did not include an analysis of capacity or operational impacts to train speeds and actual trip times along the route, although such an analysis will be conducted by the Union Pacific Railroad.

The Texas Rail Plan (TRP) published by TxDOT in 2010 provided a description of the existing ridership, schedules, on-time performance and causes of delay for the Texas Eagle route. The TRP reported that the Texas Eagle ridership consisted of more than 200,000 boardings and alightings in 2009 with 75 percent on-time performance. The TRP reported that nearly 80% of total minutes of delay for the Texas Eagle route were the responsibility of the host railroad, primarily caused by delays from freight trains and temporary slow orders.

The portion of the Texas Eagle route within the study limits consists of nearly 250 route miles owned by Union Pacific Railroad with an average of 60 trains per day between Fort Worth and Texarkana. The corridor between Fort Worth and Texarkana is essential to UP operations due to the significant intermodal and premium, truck competitive operations on the line and is considered by UP as one of their most significant corridors in the southern U.S. since it provides access to the Little Rock gateway and the Meridian Speedway. Most of the study route is single track mainline with passing sidings typically spaced 5 to 10 miles apart. Approximately 36 miles of the route is double track between Fort Worth and Dallas in addition to an 8 mile double track segment near Longview. Amtrak stations are located in Fort Worth, Dallas, Mineola, Longview, Marshall, and Texarkana.

The Texas Eagle route runs on class 4 track between Fort Worth and Dallas, which has a maximum allowable speed for passenger trains of 80 mph, and class 5 track, which has a maximum allowable speed for passenger trains of 90 mph, for the remainder of the route. However, there are several speed restrictions along the
route that limit allowable speeds to less than the class of track designated maximums.

The majority (64%) of the route has allowable speeds of at least 70 mph, while 21% of the route has allowable passenger speeds of 60 to 70 mph and only 15% of the route has allowable speeds of less than 60 mph. The permanent speed restrictions along the route are due primarily to the track geometry at curve locations. The route has 207 existing curves, of which 86 (42%) meet design requirements for 79 mph operating speeds for passenger rail. Additionally, 29% of the existing curves have design speeds of 60 to 70 mph and 29% of the curves have design speeds of less than 60 mph for passenger operations.

Infrastructure improvements identified to increase maximum allowable speeds, thereby decreasing trip times, include geometry modifications to reduce the degree of curvature or increase superelevation of existing track and signal improvements to reduce signal block lengths. Although a capacity analysis was not performed, extensions to sidings were identified as improvements that may reduce trip times by reducing delays associated with train meets.

The improvements identified in this report would require analysis and approval from UP and may require provisions for increased maintenance costs that may be incurred resulting from the improvements. Additionally, UP has not agreed to allow 110 mph passenger rail operations within their existing corridor.

### Summary of Curve Improvements

<table>
<thead>
<tr>
<th></th>
<th>79 mph</th>
<th>110 mph*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing curves that meet speed requirements</td>
<td>86</td>
<td>51</td>
</tr>
<tr>
<td>Identified potential curve realignments</td>
<td>73</td>
<td>123</td>
</tr>
<tr>
<td>Superelevation only modifications</td>
<td>40</td>
<td>10</td>
</tr>
<tr>
<td>Curves not feasible for speed upgrades</td>
<td>9</td>
<td>23</td>
</tr>
<tr>
<td>New track required (miles)</td>
<td>25.4</td>
<td>228.9</td>
</tr>
<tr>
<td>Total length of improvements, including new track, shifted track and superelevation increases (miles)</td>
<td>62.5</td>
<td>240</td>
</tr>
<tr>
<td>ROW (acres)</td>
<td>260</td>
<td>2580</td>
</tr>
<tr>
<td>Estimated Cost – w/o ROW</td>
<td>$248 million</td>
<td>1.64 billion</td>
</tr>
</tbody>
</table>

*110 mph improvements include new mainline track with 50’ separation from existing freight tracks as required by UPRR passenger rail operating principles for passenger rail speeds greater than 90 mph.
The estimated costs and right-of-way acquisition quantities for the 110 mph curve improvements include the additional mainline track and right of way which may be required for a 50-foot separation between the passenger and freight tracks as designated in Union Pacific Railroad’s principles for higher-speed (greater than 90 mph) passenger rail corridors. To comply with UP’s 110mph passenger rail guidelines, a complete fatal flaw analysis, which would identify more detailed right-of-way acquisition requirements, new railroad structures, and additional at-grade crossing closures or separations, will need to be conducted, and is not a part of the scope of this report. For the purposes of this study, however, in order to estimate costs for 110mph maximum operating speeds, a $7 million cost per mile of new track, excluding the cost of right-of-way, was assumed for an alignment that parallels the existing UP track.

The curve improvements identified in this report to upgrade maximum allowable speeds were analyzed to determine the reduction in trip time that may be associated with the improvements. Since this study did not include a capacity analysis that takes into account the impact of other train movements, train meets, and train delays, only theoretical trip times were analyzed. The theoretical trip times estimated are the amount of time it would take a single train to travel the route from Fort Worth to Texarkana, including station stops, without encountering delays due to other trains on the line. Based on the analysis of theoretical trip times compared with the route schedule published by Amtrak, operating conditions including freight congestion and temporary slow orders may account for over an hour out of the Amtrak schedule. The Amtrak scheduled and theoretical trip times are listed below for the existing conditions as well as the two scenarios for increased speeds.

- Existing (Amtrak): Approx. 7.5 hours
- Existing (theoretical): Approximately 6 hours 20 minutes
- With 79 mph curve improvements: nearly 5 hours 15 minutes (approximate time savings of 1 hour 10 minutes)
- Assuming a new 110 mph alignment: approximately 4 hours 40 minutes (approximate time savings of 1 hour 45 minutes)

Improvements were also identified to reduce signal block lengths to a maximum of 2-mile-long blocks, which will improve trip times by reducing delays associated with train meets. Reducing signal block lengths, however, would require analysis and approval by UP. Additionally, existing sidings along the route were analyzed to determine potential improvements that could improve trip time by removing constraints for train meets along the line. Improvements identified at the existing sidings that did not provide 8,000 feet of unobstructed storage include siding extensions, grade separations at public grade crossings, and crossing closures.

The estimated costs of the improvements identified in this report are summarized in the table below.
### Table 4: Summary of Cost Estimates (Excluding Right of Way)

<table>
<thead>
<tr>
<th>Improvement Type</th>
<th>79 mph design speed</th>
<th>110 mph design speed*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curves</td>
<td>$248,210,000</td>
<td>$1,635,300,000</td>
</tr>
<tr>
<td>Signals</td>
<td>$16,200,000</td>
<td>$16,200,000</td>
</tr>
<tr>
<td>Sidings</td>
<td>$40,096,000</td>
<td>$40,096,000</td>
</tr>
<tr>
<td>Total Cost (w/o ROW)</td>
<td>$304,506,000</td>
<td>$1,691,596,000</td>
</tr>
</tbody>
</table>

*110 mph improvements include new mainline track with 50’ separation from existing freight tracks as required by UPRR passenger rail operating principles for passenger rail speeds greater than 90 mph.

The cost estimates summarized in the table above do not include right-of-way acquisition that may be required.

### Conclusions

The analysis of theoretical trip times as compared to the estimated costs of improvements associated with the trip time reductions indicates that the substantial increase in cost required for 110 mph passenger operations is not justified by the additional time savings of only 35 minutes. The significant increase in cost for 110 mph improvements is due to the requirement of UP for a fully separated rail line for passenger rail operations at speeds above 90 mph.
Project Background

The Amtrak Texas Eagle route runs between Los Angeles and Chicago and connects with three other Amtrak routes (Heartland Flyer, Missouri River Runner, and Sunset Limited) and four thruway bus routes. The Amtrak Texas Eagle route provides daily service in each direction between Chicago and Los Angeles, with 17 station stops in Texas. The cities with direct service along the Texas Eagle Route, as well as the other connecting routes, are shown in Figure 1.

Figure 1: Amtrak Texas Eagle Route Map
Source: http://www.texaseagle.com/

This study was conducted to analyze the existing infrastructure along the Texas Eagle route between Fort Worth and Texarkana and identify potential improvements, which if implemented would increase allowable train speeds along the route. This study did not include an analysis of capacity or operational impacts to train speeds and actual trip times along the route, although such an analysis is currently underway by the Union Pacific Railroad. The portion of the Texas Eagle route included in this study is shown in Figure 2.
Figure 2: Study Limits
The analysis completed in this study consisted of the following tasks:

- **Data collection and inventory for the existing infrastructure network within the study limits**
  - Coordination with Amtrak and Union Pacific Railroad (UP), the owning railroad of the route used by the Texas Eagle
  - Review previous analyses conducted for the study corridor
  - Inventory database of the locations of mainline tracks, siding tracks, and industry spurs off of the mainlines; class of track and maximum allowable train speeds according to railroad timetables; type of signal system; and the locations and degrees of curves

- **Conceptual engineering for potential improvements**
  - Identify improvements to the existing infrastructure between Fort Worth and Texarkana necessary to increase maximum allowable train speeds to 79 mph and a conceptual alignment assumed to parallel the existing alignment to 110 mph, where possible
  - Analyze the impact of identified improvements on theoretical trip times
  - Provide estimated order-of-magnitude costs for the identified infrastructure improvements

### Background Review

The Texas Rail Plan (TRP) published by TxDOT in 2010 provided a description of the existing ridership, schedules, on-time performance and causes of delay for the Texas Eagle route. The TRP reported that the Texas Eagle ridership has grown steadily from approximately 100,000 annual boardings and alightings in 1998 to more than 200,000 in 2009. The Texas Eagle train consists of one locomotive, one transition sleeper car, one sleeper car, one diner car, one lounge car, and three coaches) with a total of 210 passenger seats.

The TRP included figures for on-time performance as reported by Amtrak Government Affairs in 2010 to range from less than 20 percent in 2008 to approximately 75 percent in 2009. The significant improvement in on-time performance in 2009 was reportedly due to a reduction in delays caused by the host railroad.

The TRP also included the percentage of delays and associated causes attributable to Amtrak, a third party, and the host railroad as reported by Amtrak Government Affairs. The TRP showed that nearly 80% of total minutes of delay for the Texas Eagle route were the responsibility of the host railroad, primarily caused by delays from freight trains and temporary slow orders. The primary cause of delays with Amtrak responsibility was listed as passenger related, including baggage and large groups. The primary cause of third party delay responsibility was unused recovery time, which consists of waiting for a scheduled departure time at a station.

The delays experienced by the Amtrak Texas Eagle trains caused by freight train congestion are due to the existing capacity constraints along the route. Bottlenecks
include Tower 55 in Fort Worth, which causes severe congestion and delays at the
interlocking used by more than 100 trains per day, as well as mainline capacity
along the route. Although the route segment between Fort Worth and Dallas is
double track, it is at times effectively reduced to single track mainline capacity due to
trains unable to enter Centennial Yard just west of Fort Worth blocking one of the
mainline tracks. The remainder of the Texas Eagle Route between Dallas and
Texarkana has only a single track mainline with limited sidings, requiring both
Amtrak and freight trains to stop and hold in sidings for train meets. Amtrak Texas
Eagle train 21 (westbound) runs against the primary direction of freight traffic
between Big Sandy, Texas and Texarkana, which creates additional delays. Amtrak
also encounters congestion related delays in Dallas due to yard and local freight
operations as well as Mesquite due to freight operations at Mesquite Auto and
Intermodal Yard.

The other main source of delay is caused by temporary slow orders along the route,
such as work orders to repair damage caused by the summer heat and drought.
The locations of temporary slow orders are scattered along the route and change
frequently. There were no reported locations of recurring temporary slow orders.

Amtrak is currently performing an independent analysis to determine the
improvements necessary to add two daily Amtrak trains (one in each direction) to the
Texas Eagle route. The UP is performing operational modeling along the Texas
Eagle route between Fort Worth and Shreveport to analyze existing capacity.

Existing Infrastructure

The Texas Eagle route between Fort Worth and Texarkana consists of 248.4 route
miles along the Union Pacific (UP) Dallas, Mineola, and Little Rock Subdivisions.
The portion of the route on the Dallas Subdivision is made up of 35.5 miles between
Tower 55 in Fort Worth and the end of the subdivision in Dallas at SP Junction. The
route continues east from SP Junction in Dallas as the Mineola Subdivision for 123.3
miles to Longview. The route then continues east from Longview as the Little Rock
Subdivision to Marshall, where the line then turns north to Texarkana for a total
distance of 89.6 miles. Existing Amtrak stations along the route are located just
north of Tower 55 in Fort Worth, at Dallas Union Station, in Mineola, Longview,
Marshall, and Texarkana.

The Dallas and Mineola Subdivisions were originally constructed in 1873 by the
Texas and Pacific Railway, while the Little Rock Subdivision was constructed in
1869 by the Southern Pacific Railroad. The lines are now owned and operated by
UP with trackage rights granted to the BNSF Railway to operate between Longview
and Texarkana on the Little Rock Subdivision.

The corridor between Fort Worth and Texarkana is essential to UP operations due to
the significant intermodal and premium, truck competitive operations on the line.
The corridor is one of the most significant corridors owned by UP in the southern
U.S. since it provides access to the Little Rock gateway and the Meridian Speedway,
which are critical sources of business. Existing rail traffic is run in both directions along the route and consists of 50 to 60 trains per day, depending on location.

The Texas Eagle route includes interchanges with several other rail lines between Fort Worth and Texarkana. The Texas Eagle route along the Dallas, Mineola, and Little Rock Subdivisions interchanges with the rail lines listed below. In most instances operations are scheduled and dispatched to avoid conflict and delays associated with trains waiting at interchanges with other lines. However, Tower 55 is one of the busiest rail interchanges in the United States with more than 100 trains per day passing through the crossing. As a result, there is significant delay at Tower 55, although improvements for the interchange are currently under design.

- Tower 55, Fort Worth
  - BNSF Fort Worth Subdivision
  - UP Fort Worth Subdivision
  - UP Choctaw Subdivision
  - UP Duncan Subdivision
  - UP Midlothian Subdivision
  - BNSF Wichita Falls Subdivision
  - TRE

- Dallas
  - TRE
  - DART Red Line
  - BNSF DFW Subdivision
  - UP Ennis Subdivision

- Big Sandy
  - UP Corsicana Subdivision
  - UP Pine Bluff Subdivision

- Longview
  - UP Palestine Subdivision
  - BNSF Longview Subdivision

- Marshall
  - UP Reisor Subdivision

- Texarkana
  - UP Pine Bluff Subdivision
  - Texas and Northeastern Railroad
  - KCS Shreveport Subdivision

The route consists primarily of single mainline track with passing sidings located approximately 5 to 10 miles apart, except for the entire 35.5-mile portion of the route on the Dallas Subdivision between Fort Worth and Dallas as well as an approximately 8-mile portion of the Little Rock Subdivision at Longview that have double mainline track. Table 1 summarizes the track mileage by railroad subdivision and by county for the Texas Eagle route between Fort Worth and Texarkana.
There are some sidings along the Texas Eagle route that have at-grade roadway crossings located within the limits of the siding, which prevent the siding to be used to park trains since the grade crossings cannot be blocked. Such instances may impact average speeds and trip times along the route because trains may have to be held at sidings located further away from an actual conflict point with another train, which means that the stopped train would have to wait longer for the other train to pass.

The location of existing passing sidings, double mainline tracks, freight rail yards, and existing Amtrak stations are shown in Figure 3 and listed in the spreadsheet inventory included in Appendix A.

The Texas Eagle route between Fort Worth and Texarkana includes nearly 240 railroad bridges for a total length of approximately 6.4 miles. Approximately half of the structures are concrete, while the other half is nearly evenly split between timber and steel structures. Timber structures typically have more frequent maintenance requirements that could impact trip times along the route due to required temporary speed restrictions across the bridges. However, timber bridges are routinely replaced with concrete structures when maintenance requirements begin to impact trip times or capacity along a rail line.
Table 1: Summary of Existing Track Miles

<table>
<thead>
<tr>
<th>County:</th>
<th>Miles of Mainline Track:</th>
<th>Miles of Double Mainline Track:</th>
<th>Miles of Siding Track:</th>
<th>Total Miles:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dallas Subdivision</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tarrant</td>
<td>17.31</td>
<td>17.31</td>
<td>0.00</td>
<td>34.62</td>
</tr>
<tr>
<td>Dallas</td>
<td>20.88</td>
<td>17.79</td>
<td>0.00</td>
<td>38.67</td>
</tr>
<tr>
<td>Subtotal</td>
<td>38.19</td>
<td>35.10</td>
<td>0.00</td>
<td>73.29</td>
</tr>
<tr>
<td>Mineola Subdivision</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dallas</td>
<td>15.51</td>
<td>0.00</td>
<td>7.07</td>
<td>22.58</td>
</tr>
<tr>
<td>Kaufman</td>
<td>26.58</td>
<td>0.00</td>
<td>4.02</td>
<td>30.60</td>
</tr>
<tr>
<td>Van Zandt</td>
<td>28.28</td>
<td>0.00</td>
<td>4.66</td>
<td>32.94</td>
</tr>
<tr>
<td>Smith</td>
<td>1.63</td>
<td>0.00</td>
<td>0.00</td>
<td>1.63</td>
</tr>
<tr>
<td>Wood</td>
<td>25.34</td>
<td>0.00</td>
<td>4.51</td>
<td>29.85</td>
</tr>
<tr>
<td>Upshur</td>
<td>11.72</td>
<td>0.00</td>
<td>3.02</td>
<td>14.74</td>
</tr>
<tr>
<td>Gregg</td>
<td>14.20</td>
<td>0.17</td>
<td>2.71</td>
<td>17.08</td>
</tr>
<tr>
<td>Subtotal</td>
<td>123.26</td>
<td>0.17</td>
<td>25.99</td>
<td>149.42</td>
</tr>
<tr>
<td>Little Rock Subdivision</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gregg</td>
<td>1.64</td>
<td>1.64</td>
<td>0.00</td>
<td>3.28</td>
</tr>
<tr>
<td>Harrison</td>
<td>32.76</td>
<td>6.49</td>
<td>4.72</td>
<td>43.97</td>
</tr>
<tr>
<td>Marion</td>
<td>13.40</td>
<td>0.00</td>
<td>3.32</td>
<td>16.72</td>
</tr>
<tr>
<td>Cass</td>
<td>33.10</td>
<td>0.00</td>
<td>5.15</td>
<td>38.25</td>
</tr>
<tr>
<td>Bowie</td>
<td>8.70</td>
<td>1.79</td>
<td>1.92</td>
<td>12.41</td>
</tr>
<tr>
<td>Subtotal</td>
<td>89.60</td>
<td>9.92</td>
<td>15.11</td>
<td>114.63</td>
</tr>
<tr>
<td>Total:</td>
<td>251.05</td>
<td>45.19</td>
<td>41.10</td>
<td>337.34</td>
</tr>
</tbody>
</table>

Existing freight rail yards along the route are listed in Table 2.

Table 2: Existing Rail Yards

<table>
<thead>
<tr>
<th>Yard Name</th>
<th>Location (City)</th>
<th>Type of Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ginnie Yard</td>
<td>Fort Worth</td>
<td>Interchanges with Everman Industrial Lead and FWWR, local industry</td>
</tr>
<tr>
<td>Garrett Yard</td>
<td>Arlington</td>
<td>Switching, industry access</td>
</tr>
<tr>
<td>Browder, C.J. and Cadiz Yards</td>
<td>Dallas</td>
<td>Interchanges with DGNO, local industries, and car storage</td>
</tr>
<tr>
<td>Mesquite Auto and Intermodal Facility</td>
<td>Mesquite</td>
<td>Auto facility, intermodal</td>
</tr>
<tr>
<td>Mineola Yard</td>
<td>Mineola</td>
<td>Local industry, car storage</td>
</tr>
<tr>
<td>Longview Yard</td>
<td>Longview</td>
<td>Crew change, switching, local industry</td>
</tr>
<tr>
<td>Marshall Yard</td>
<td>Marshall</td>
<td>Industry service</td>
</tr>
<tr>
<td>Texarkana Yard</td>
<td>Texarkana</td>
<td>Switching, local industry</td>
</tr>
</tbody>
</table>
Figure 3: Location of Existing Passing Sidings and Additional Mainline Tracks
The Federal Railroad Administration has designated classes of track as part of their track safety standards that define the standards for track structure, geometry, and inspection frequency for each class. Each class of track has an associated maximum allowable operating speed for passenger and freight trains. As the class of track increases, so do the safety standards as well as the maximum allowable speed. The Texas Eagle route runs on class 4 track, which has a maximum allowable speed for passenger trains of 80 mph, on the Dallas Subdivision between Fort Worth and Dallas and class 5 track, which has a maximum allowable speed for passenger trains of 90 mph, for the remainder of the route. However, there are several speed restrictions along the route that limit allowable speeds to less than the class of track designated maximums.

Figure 4 shows the distribution of the route according to existing allowable speeds and Figure 5 shows the locations of permanent speed restrictions along the route and the class of track according to 2008 UP timetables\(^1\). As shown in the figures, the majority (64\%) of the route has allowable speeds of at least 70 mph, while only 15\% of the route has allowable speeds of less than 60 mph. The locations of the permanent speed restrictions by railroad milepost are listed in the spreadsheet inventory in Appendix A.

Figure 4: Existing Allowable Speeds Distribution Graph

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\(^1\) A timetable is a written document which establishes the authority for the movement of trains over a rail line, subject to the rules established for that track. Typically it describes maximum authorized train speeds and also include the names and locations of control points for the rail line.
Figure 5: Map of Existing Maximum Allowable Speeds
The causes of the permanent speed restrictions vary along the route and, although the causes are not reported by the railroad, may include geometric constraints such as curves, condition of the infrastructure including track and bridges, type of signalization, terminal and yard operations, and local agreements through towns and cities. Most of the permanent speed restrictions are due to horizontal geometry of the line at curves. The location, degree, and limit on allowable speeds based only on the geometry of the curve, are listed in the spreadsheet inventory in Appendix A. There are more than 200 curves along the line. Figure 6 shows the distribution of the curves by maximum allowable speed associated with the degree of curvature. Each degree of curvature has an associated design speed, depending on the geometry of the curve, based on Union Pacific and Amtrak design standards. Generally, as the degree of curvature increases the design speed decreases.

![Figure 6: Maximum Allowable Speed of Curves Distribution Graph](image)

The existing signal system along the Texas Eagle route between Fort Worth and Texarkana is Centralized Traffic Control (CTC). The locations of signals and the lengths of signals blocks, which vary widely along the route ranging from 0.1 to 11 miles apart, are listed in the spreadsheet inventory in Appendix A. The lengths of signal blocks are designed to allow trains to operate as frequently as necessary. A low-volume line might have blocks several miles long, while a high-volume
A commuter line might have blocks a few hundred feet long. Reducing the distance between signals can add capacity to the line as well as potentially increase average speeds and decrease trip times.

In addition to the permanent speed restrictions specified in the railroad operating timetables, temporary speed restrictions may exist along a route. Temporary speed restrictions are commonly associated with infrastructure defects such as mud-fouled ballast, timber tie condition, bridge member deficiency, etc., and normally are quickly rectified by railroad maintenance personnel so that the speed restriction does not remain in place for more than one to two days. The frequency, cause, and location of temporary speed restrictions are typically not reported publicly by the railroads, although the railroads maintain records of such occurrences. The railroads typically complete maintenance requirements to address any locations with recurring temporary speed restrictions with either maintenance or capital expenditures or may elect to make the speed restriction permanent as part of the operating timetable.

**Infrastructure Improvements**

Infrastructure improvements identified to increase maximum allowable speeds, thereby decreasing trip times, include geometry modifications to reduce the degree of curvature or increase superelevation of existing track and signal improvements to reduce signal block lengths. Although a capacity analysis was not performed, extensions to sidings were identified as improvements that may reduce trip times by reducing delays associated with train meets.

**Curve Modifications**

Modifications to the curves included reducing the degree of curvature (flattening out the curves) as well as adjusting the superelevation of the curves, which consists of raising the elevation of the outside rail on the curves. Adjusting the superelevation would not change the existing track alignment, though it would increase maintenance requirements and costs on the line over time. The increases in superelevation would require agreement from UP, including an agreement that the increased maintenance costs would be provided for by the passenger rail operator. Conceptual design exhibits for the curve modifications are included in Appendix B.

Of the existing 207 curves, 86 were determined to meet passenger rail requirements for 79 mph allowable speeds. Of the remaining 121 curves that did not meet requirements for 79 mph speeds, 113 were determined feasible to be upgraded for 79 mph. The 9 curves that were determined not feasible to be modified for 79 mph were located in the urban areas of downtown Dallas and between Dallas and Fort Worth due to the extensive right-of-way impacts that would be associated with the curve modifications. Nearly 40 of the 113 curve modifications for 79 mph speeds consisted only of adjustments to the superelevation and did not require any change to the curve alignment.

Of the existing 207 curves, 51 were determined to meet passenger rail requirements for 110 mph allowable speeds. Of the remaining 156 curves, 133 were determined
feasible to be upgraded for 110 mph. The 23 curves that were determined not feasible to be modified for 110 mph were located in the urban areas of downtown Dallas and between Dallas and Fort Worth due to the extensive right-of-way impacts that would be associated with the curve modifications, though 15 of those curves were determined feasible to be modified for 79 mph speeds. Only 10 of the 133 curve modifications for 110 mph speeds consisted only of adjustments to the superelevation and did not require any change to the curve alignment.

In addition to the curve modifications listed above, a new mainline track with 50 feet of separation from the existing freight tracks would be required to operate 110 mph passenger as specified in UP’s principles for “higher-speed” passenger rail corridors. Union Pacific Railroad has developed the following principles for “higher-speed” passenger rail corridors, defined as passenger trains that operate at speeds higher than 90 MPH but less than 110 MPH along their existing freight corridors.

- Existing freight service must be protected from higher-speed passenger rail service by at least 50 feet. It is also anticipated that the passenger rail operator would need to fund all safety requirements attributed to the project for grade crossings and grade separations as required.
- Additional passenger rail infrastructure must not affect the ability of UP to operate freight trains or the potential to increase freight rail capacity if needed. Freight service to UP’s customers must also not be compromised by the addition of passenger rail service.
- Additional liability cannot be placed on UP due to the higher-speed passenger rail service.

The requirement for 50 feet of separation would require that the passenger trains operate on a new mainline track separated from the existing track by 50 feet. During the assessment of a 110mph corridor, an assumption was made that the rail line would parallel the existing UP alignment. To comply with UP’s 110mph passenger rail guidelines, a complete fatal flaw analysis, which would identify estimated detailed right-of-way acquisition requirements, new railroad structures, and additional at-grade crossing closures or separations, will need to be conducted, and is not a part of the scope of this report. For the purpose of this study, a cost of $7 million per mile, excluding the cost of right-of-way, was assumed for the new mainline between Dallas and Texarkana. A new mainline was not analyzed for the portion of the route between Fort Worth and Dallas due to the level of development and the existing geometry of the alignment, since 110 mph speeds would not be feasible in that segment. Improvements to curves in that segment; however were included and would increase allowable speeds to up to 90 mph in some locations.

Figure 7 shows the distribution of the curves under existing conditions as well as for the 79 mph and 110 mph upgrade scenarios by degree of curvature. The identified geometric improvements are summarized in Table 3.
Figure 7: Distribution Graph for Speeds Associated with Curve Modifications for 79 mph and 110 mph Allowable Passenger Rail Speeds

Table 3: Summary of Curve Improvements

<table>
<thead>
<tr>
<th></th>
<th>79 mph</th>
<th>110 mph*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing curves that meet speed requirements</td>
<td>86</td>
<td>51</td>
</tr>
<tr>
<td>Identified potential curve realignments</td>
<td>73</td>
<td>123</td>
</tr>
<tr>
<td>Superelevation only modifications</td>
<td>40</td>
<td>10</td>
</tr>
<tr>
<td>Curves not feasible for speed upgrades</td>
<td>9</td>
<td>23</td>
</tr>
<tr>
<td>New track required (miles)</td>
<td>25.4</td>
<td>228.9</td>
</tr>
<tr>
<td>Total length of improvements, including new track, shifted track and superelevation increases (miles)</td>
<td>62.5</td>
<td>240</td>
</tr>
<tr>
<td>ROW (acres)</td>
<td>260</td>
<td>2580</td>
</tr>
<tr>
<td>Estimated Cost – w/o ROW</td>
<td>$248 million</td>
<td>1.64 billion</td>
</tr>
</tbody>
</table>

*110 mph improvements include new mainline track with 50' separation from existing freight tracks as required by UPRR passenger rail operating principles for passenger rail speeds greater than 90 mph.
The cost estimates for the curve modifications include the cost of new track that would be required for the new curve alignments as well as shifting existing track to a new alignment where possible. Shifting existing track to a new alignment, which is significantly less expensive than constructing new track, was assumed in locations where the proposed centerline of track is 10 feet or less from the existing centerline of track. Additionally, locations of superelevation adjustments without modifying the track alignment would not require any new track and were accounted for in the estimates with new ballast.

The cost for new track includes the track and trackbed (ballast and subballast), earthwork, new bridge and drainage structures, and modifications to existing grade crossings (crossing panels and warning devices), however did not include the costs of right of way. The trackbed and earthwork quantities estimated for areas of new track construction were based on the standard UP typical section, including ballast and subballast depths as well as ditch requirements on each side of the track. The earthwork quantities also included an assumed embankment height under the track of 2 feet over the project length to account for unknown terrain since vertical geometrics were not included as part of this study. The estimates include new bridge structures in areas where new track along the modified alignments would replace existing track with bridge structures. The new bridges were not designed and were included in the estimates as total linear feet of new bridge based on the lengths of existing bridges being replaced or estimates of required bridge length using aerial photos. Vertical profile data was not used to determine existing or proposed structure lengths. Signal modifications were included for grade crossing warning devices that would need to be moved or replaced from the existing track to the new alignments associated with the curve modifications.

The identified curve modifications are estimated to require a total of 25.4 miles of new track for the 79 mph allowable speeds and 228.9 miles of new track for the 110 mph allowable speeds, including the new additional mainline required for the 110 mph speeds, over the approximately 250-mile-long route from Fort Worth to Texarkana.

Signal Improvements

Improvements were identified to reduce signal block lengths to a maximum of 2-mile-long blocks, which will improve trip times by reducing delays associated with train meets. The signal improvements identified include the addition of 81 automatic signals to the existing CTC signal system along the route. Any modifications to the existing signal system would require analysis and approval by UP.

The reductions of signal block lengths to 2-mile-long segments are not required to increase allowable operating speeds, though the existing signal block lengths would prevent actual operating speeds from reaching maximum allowable speeds due to additional delays associated with train meets. The longer signal blocks require trains to stop further away and wait longer for passing trains. The cost estimates for the signal improvements include addition of new automatic signal locations including
signals, insulated joints, instrumentation components and interface with the existing CTC system.

Siding Improvements

Although capacity analysis and operational modeling were not performed, existing sidings along the route were analyzed to determine potential improvements that could improve trip time by removing constraints for train meets along the line. Siding improvements were identified for existing sidings with a length less than 8,000 feet available for storage or passing trains. While most of the existing sidings are at least 8,000 feet in length, many of the sidings contain public or private grade crossings that limit the storage capability of the existing sidings without blocking a point of access for vehicular traffic.

Improvements identified at the existing sidings that did not provide 8,000 feet of unobstructed storage include one or a combination of the following infrastructure improvements, which were determined based on the lowest cost alternatives for each siding.

- Extend the overall length of the siding
- Add a grade separation at public crossings located within the limits of the siding
- Close or provide alternative access for private crossings located within the limits of the siding

The UP rail lines utilized by the Texas Eagle route between Fort Worth and Texarkana contain 24 existing sidings. Improvements were identified for 16 of the 24 sidings, of which 13 included siding extensions and/or grade separations and 3 consisted of only crossing closures. The identified improvements include a total of approximately 9 miles of new track, 2 grade separations, 6 crossing closures and signal modifications to the existing sidings for a total estimated cost of nearly $40 million. The locations of the sidings identified for improvement are shown in Figure 8.

The siding improvements identified would not impact the maximum allowable speeds along the route, though they would likely improve trip times by reducing delays associated with train meets. A capacity analysis would be required to determine the optimum locations of the siding improvements to determine if the extension of some sidings would have a greater impact to trip times than other sidings.
Figure 8: Map of Potential Siding Improvements
Summary of Estimated Costs of Identified Improvements

The estimated costs of the improvements identified in this report are summarized below in Table 4 and shown in more detail in Appendix C.

Table 4: Summary of Cost Estimates (Excluding Right of Way)

<table>
<thead>
<tr>
<th>Improvement Type</th>
<th>79 mph design speed</th>
<th>110 mph design speed*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curves</td>
<td>$248,210,000</td>
<td>$1,635,300,000</td>
</tr>
<tr>
<td>Signals</td>
<td>$16,200,000</td>
<td>$16,200,000</td>
</tr>
<tr>
<td>Sidings</td>
<td>$40,096,000</td>
<td>$40,096,000</td>
</tr>
<tr>
<td>Total Cost (w/o ROW)</td>
<td>$304,506,000</td>
<td>$1,691,596,000</td>
</tr>
</tbody>
</table>

*110 mph improvements include new mainline track with 50’ separation from existing freight tracks as required by UPRR passenger rail operating principles for passenger rail speeds greater than 90 mph.

Although right-of-way acquisition was not included in the cost estimates, the approximate quantity of right-of-way acquisition that may be required for the identified curve modifications was estimated. The value of right-of-way may vary significantly along the corridor due to varying levels of development and land-use type and could not be accounted for with a single value per acre of acquisition. The right-of-way acquisition required by the improvements to attain allowable speeds of 79 and 110 MPH was determined by assuming a 100-foot existing and proposed right of way. The area for right-of-way acquisition was assumed to include the 100-foot corridor and any adjacent property between the existing and proposed right of way, where applicable. In some cases, a large area remained between the existing and proposed right-of-way corridors; in these cases, the property between the existing and proposed corridors was not assumed in the right-of-way acquisition. Approximately 260 acres was estimated to be required for the curve modifications for 79 mph and approximately 2,580 acres for the 110 mph curve modifications, which includes the right of way which may be required for a 50-foot separation between the passenger and freight tracks discussed previously.

Trip Time Analysis

The infrastructure improvements identified in this report to upgrade maximum allowable speeds to 79 mph and 110 mph were analyzed to determine the reduction in trip time that may be associated with the improvements. Since this study did not include a capacity analysis that takes into account the impact of other train movements, train meets, and train delays, only theoretical trip times were analyzed. The theoretical trip times estimated are the amount of time it would take a single train to travel the route from Fort Worth to Texarkana, including station stops, without encountering delays due to other trains on the line.
The theoretical trip times were calculated using the permanent speed restrictions included in the UP timetables for existing conditions, with theoretical average speeds modified to account for acceleration and deceleration requirements and adjusted to account for a service recovery percentage of 8% as is standard for Amtrak. The theoretical speeds were then adjusted based on the infrastructure improvements identified for the 79 mph and 110 mph upgrades.

Figures 9 and 10 show the distribution of the route according to speed limit with the identified curve modifications for 79 mph and 110 mph. As shown in the figures, the 79 mph curve modifications would provide for 96% of the route to have maximum allowable speeds of up to 79 mph, while only 4% of the route would have allowable speeds of 20 to 49 mph. The 110 mph curve modifications would provide for 90% of the route to have maximum allowable speeds of up to 110 mph, while only 4% of the route would have allowable speeds of 20 to 49 mph and 6% of the route would have allowable speeds of 70 to 79 mph.

The theoretical trip times do not account for actual operating conditions such as dwells and delays associated with train meets, which are not a function of the infrastructure itself, and are not reflected in the timetables. Based on the analysis of theoretical trip times compared with the route schedule published by Amtrak, unknown operating conditions such as those mentioned above, and as summarized from the TRP previously discussed, may account for over an hour out of the Amtrak schedule. The Amtrak scheduled and theoretical trip times are listed below for the existing conditions as well as the two scenarios for increased speeds.

- Existing (Amtrak): Approx. 7.5 hours
- Existing (theoretical): Approximately 6 hours 20 minutes
- With 79 mph infrastructure improvements: nearly 5 hours 15 minutes (approximate time savings of 1 hour 10 minutes)
- With 110 mph infrastructure improvements: approximately 4 hours 40 minutes (approximate time savings of 1 hour 45 minutes)

The analysis of theoretical trip times as compared to the estimated costs of improvements associated with the trip time reductions indicates that the substantial increase in cost required for 110 mph passenger operations is not justified by the additional time savings of only 35 minutes. The significant increase in cost for 110 mph improvements is due to the requirement of UP for a fully separated rail line for passenger rail operations at speeds above 90 mph. Additionally, UP has not agreed to allow 110 mph passenger rail operations within their existing corridor. It should be noted, however, that with the implementation of Positive Train Control (PTC) as mandated by the Rail Safety Improvement Act of 2008, the potential may exist to increase passenger train speeds from 79 to 90 mph with additional infrastructure improvements considerably less costly than those identified for 110 mph maximum operating speeds. Determining associated costs and further trip time reductions resulting from PTC implementation were not a part of this study.
The locations of the existing permanent speed restrictions from the UP timetables, theoretical average speeds for existing conditions as well as the 79 mph and 110 mph improvements, and estimated theoretical trip times are listed in the spreadsheet inventory in Appendix D.

Figure 9: 79 mph Maximum Allowable Speeds Distribution Graph
Figure 10: 110 mph Maximum Allowable Speeds Distribution Graph

- 100-110 mph: 90%
- 70-79 mph: 6%
- 30-39 mph: 2%
- 20-29 mph: 1%
- 40-49 mph: 1%