HOUSTON REGION
FREIGHT STUDY

Presented By
HNTB Corporation

HNTB

Texas Department of Transportation

EXECUTIVE SUMMARY

This report is the start of a conversation to address deficiencies in the Houston region's freight network (roads, ports, and railroads) and to develop ways to accommodate and capitalize on future freight movements. It identifies improvements that may provide relief to residents and the traveling public adversely affected by delays, interruptions, and noise attributed to the movement of freight within the region. It also identifies alternatives that may improve regional freight rail capacity by enhancing the efficiency and operations of the railroads.

This report identifies nearly **$3.4 billion** of improvements for the eight-county Houston region comprised of Harris, Fort Bend, Montgomery, Galveston, Waller, Brazoria, Liberty, and Chambers Counties, which are categorized as:

- Grade Separations (bridges to separate the railroad from streets) - **$808 million**
- Grade Crossing Closures (closing and rerouting the street at the intersection with the railroad) - **$5.2 million**
- Improvements to Existing Railroad Infrastructure (improving capacity and connectivity on existing rail lines) - **$1.4 billion**
- New Railroad Corridors - **$1.1 billion**

It is anticipated that the Houston region, through a cooperative effort of local governments, ports, and the newly-formed Gulf Coast Freight Rail District, will study this report – and add, subtract, modify, or use this information to develop a regional freight plan. The developed plan can then be incorporated into the region's long range transportation plan developed by the Houston-Galveston Area Council, the designated metropolitan planning organization (MPO) for the region.

This report is the result of a two year Houston regional freight analysis, contracted by the Texas Department of Transportation (TxDOT), under the guidance of a regional steering committee chaired by TxDOT Houston District Engineer Gary K. Trietsch, P.E. The steering committee was comprised of representatives from local governments, transportation and transit agencies, major railroad companies, ports, congressional staff, chambers of commerce, industry representatives, the MPO, and other interested parties.

The Houston Region Freight Study identifies existing and projected truck and freight rail transportation operations, bottlenecks, and constraints with the goal of establishing a slate of potential infrastructure improvements geared toward providing solutions that may resolve the problems associated with rising congestion levels and the expected growth of commodity movements in Houston.

Over the next twenty years, given growth rates for both vehicle and train traffic, the total public cost of delay at the roadway-rail crossings in the eight-county Houston region is estimated to be more than $2.6 billion. The cost of lost time is estimated at $2.3 billion; the cost of collisions is estimated at $146 million; and the combined cost of emissions and wasted fuel is $191 million. The estimated public benefit of the grade separations and crossing closures identified in this report is more than **$828 million**.

Houston's freight movement is forecasted to nearly double in volume by 2025, causing concerns of how this will impact regional mobility, and where future infrastructure investments should be made.

There are approximately 1,200 roadway-railroad crossings with a daily volume of almost five million vehicles within the Houston region. The Federal Railroad Administration (FRA) has reported for Harris County alone, more than 300 incidents between trains and vehicles at public and private railroad crossings occurring since January 2000, including more than 90 injuries and seven fatalities. The grade separations and crossing closures identified in this report play an instrumental role in improving public safety at roadway-rail crossings within the region.

An improved rail system can promote continued growth in the local economy as well as support the shifting of truck cargo to rail cars, potentially providing congestion relief on regional freeways. It can strengthen the region's global competitiveness in goods movement, and help citizens reap the benefits associated with economic growth and vitality. This report recognizes that improvements made to the region's transportation infrastructure must describe both public and private benefits, so that the costs for the improvements are apportioned in a fair and balanced manner to all parties involved.

Identified Improvements

At an estimated cost of **$808 million**, **55** identified **grade separations** would separate railroad lines from streets, thereby reducing safety hazards and delays. For the citizens in Houston's inner city neighborhoods, it means freedom from blocked intersections and backed-up vehicles on the streets. It also means improved safety by allowing emergency and law enforcement vehicles to respond without delay, while improving the quality of life for residents in the impacted neighborhoods. The estimated public benefit value of the identified grade separations totals nearly **$730 million**.

Also identified are **63** locations where **grade crossings** may be closed with an estimated cost of **$5.2 million**. These safety improvements minimize conflict points between trains and cars by closing crossings and encouraging motorists to use grade separated roadways, or alternate streets, which have better safety systems in place. The estimated public benefit value for the crossing closures totals more than **$98 million**.

Five of the crossing closures analyzed in this report include pedestrian bridges. For example, a pedestrian bridge is shown for the Runnels Street crossing located in downtown Houston where children cross the railroad tracks to travel between home and school. The photos below show before and after pictures of a potential pedestrian bridge at Runnels Street. These pedestrian bridges improve community safety by providing a safer route of travel between homes, commercial areas, and schools.

In addition to improvements addressing safety to the traveling public, the report also identifies **33 rail capacity improvements**, at an estimated cost of **$1.4 billion**. **Two** separate **rail relocation alternatives** at an estimated cost of nearly **$1.1 billion** were also investigated.

Rail capacity enhancements augment economic growth of the region by improving the efficiency of freight rail operations as well as minimizing disturbances to residents thus improving their quality of life. Improvements to the rail system relieve congestion along existing rail corridors, permitting the trains to pass through the region more quickly. The rail improvements analyzed can be categorized as follows:

- Adding a mainline track
- Adding track adjacent to existing mainlines at strategic locations to allow trains to pass one another or to idle without causing delays
- Constructing connections from one rail line to another to improve rail traffic mobility
- Expanding rail yard capacity
- Relocating rail yards and/or facilities that accommodate trailers and containers by ship, rail, and truck referred to as "intermodal facilities."

Existing Freight Rail Operations

Approximately 2,200 trains per week travel within the Houston regional rail network, which is comprised of tracks owned and operated by the Union Pacific Railroad (UPRR), the BNSF Railway Company (BNSF), and the Port Terminal Railroad Association (PTRA). The Kansas City Southern Railway Company (KCS) has the right to operate their trains over the UPRR and BNSF tracks as well. The region's infrastructure includes more than 800 miles of mainline tracks and 21 miles of railroad bridges.

The activity at the major rail yards located within the region is a contributing source of the congestion-related delay, and the key to delay relief. Almost half (48%) of all the trains in the network are local trains and rail yard engines. Of the trains in the Houston regional network simulation model, less than five percent operate completely through the region without having to stop in Houston to pick up or drop off rail cars.

The freight trains in the Houston region carry freight cars coming into, or leaving, the Houston, Dayton, Baytown, Bayport, and Beaumont industrial complexes. The freight carried on these trains is mostly for local business, and since it is shipped in carloads, must be sorted by destination (customer) at one or more of the major Houston yards. This traffic is predominantly local business, for local customers. Most of the trains carry chemicals, and/or heavy bulk commodities like coal, grain, rock/aggregate, and coke. This heavy industrial cargo accounts for about 84% of Houston's rail activity.

Within the Houston region, the railroads provide rail service to more than 900 customers. Although not a direct indication of the location of each and every customer within Houston's IH-610 loop, Figure 1 shows the general locations, excluding those that are along the ship channel or the Port areas, of existing tracks that extend out from the main tracks that could serve rail customers.

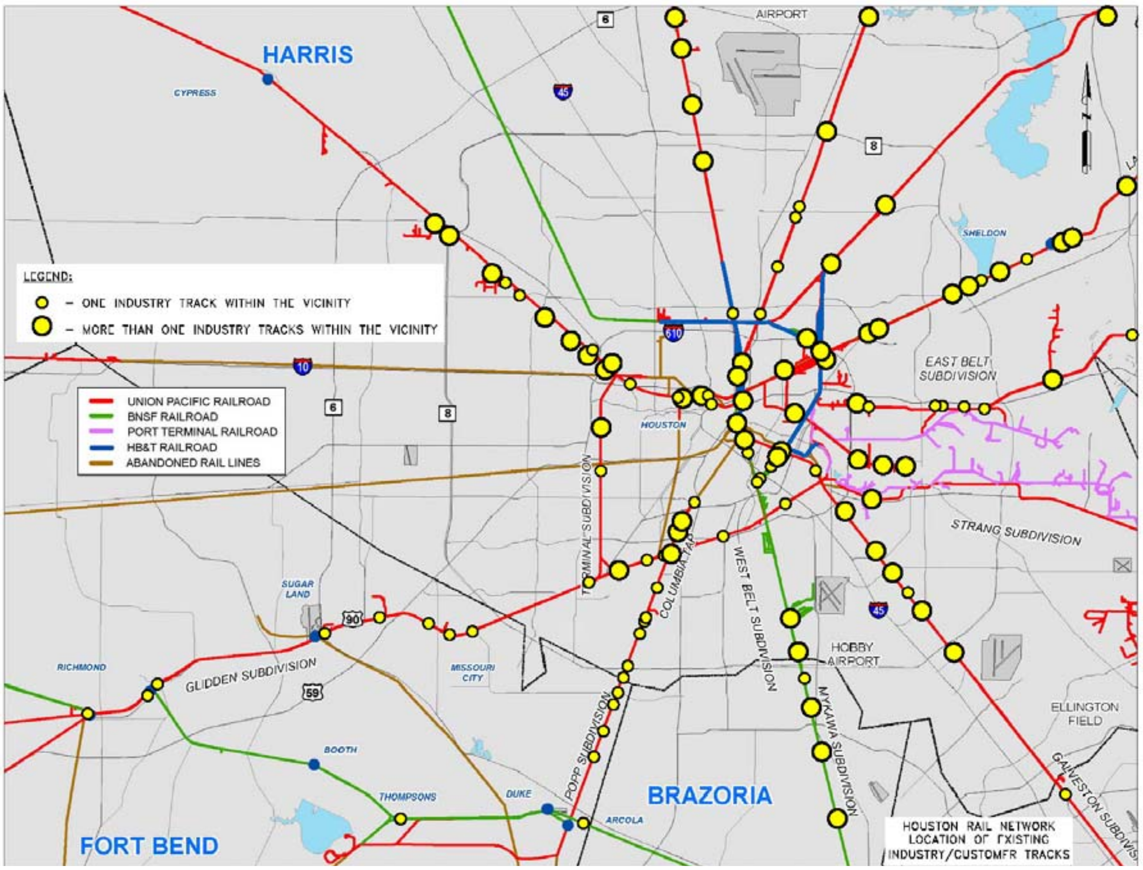

Figure 1: Approximate Industry/Customer and Spur Track locations

Rail improvements investigated to relieve rail congestion and test alternative routes were analyzed using Rail Traffic Controller (RTC), the same freight rail traffic modeling software used by the freight railroads. Four planning cases, representing a total of 12 improvements and/or relocations, were investigated with the ultimate goal of improving train mobility and efficiency, and addressing the areas of greatest congestion within the network.

As a result, the planning case improvements primarily address large terminals, such as Settegast and Englewood Yards, and bottlenecked locations such as single track bridges that connect double mainline tracks.

Public and Private Benefits

The public benefits estimated for the rail improvement planning cases were determined based on the change in the volume of train traffic at roadway-rail crossings in the region due to the improvements. The impact of potential commuter rail operations on existing rail infrastructure has not been included in the current public benefits calculations.

Anticipated public benefits of identified improvements include reduced vehicular delay times due to passing trains at roadway-rail crossings, reduced vehicle and locomotive fuel consumption, improved air quality, improved public safety, improved mobility for vehicular and freight traffic, reduced noise and vibration, and increased freight movement capacity.

The private benefit values were estimated based on calculated delay hours per day operated over the Houston rail network for each planning case. An average cost of $303 per train delay hour, based on estimated costs applicable to fuel consumption for idling locomotives, train crew labor costs, and the unavailability of locomotive power was used to determine an estimated private burden.

Planning Case Results and Comparisons

In general, the planning cases consisted of:

- Planning Case 1 – which tested improvements intended to unlock the congestion at the locations identified as most problematic;
- Planning Case 2 – which tested improvements that add capacity to existing mainline tracks, increasing train speeds and improving train performance;
- Planning Case 3 – which investigated creating a new rail corridor in Fort Bend County that bypasses the existing Rosenberg to Houston line; and
- Planning Case 4 – which investigated creating a new rail corridor that bypasses the east side of Houston.

More than **$1.4 billion** of the **$3.4 billion** in identified improvements were tested in the planning cases described above, which included establishing estimated public and private benefits for each planning case as shown below in Table 1.

	Planning Case 1	Planning Case 2	Planning Case 3	Planning Case 4
Total Estimated Cost*	$ 92,000,000	$ 331,000,000	$ 1,080,000,000	$ 542,000,000
Total Estimated NPV Private Benefit (over Base Case)**	$ 48,000,000	$ 73,000,000	$ (63,000,000)	$ 76,000,000
Total Estimated NPV Public Benefit (over Base Case)**	$ 73,000,000	$ 98,000,000	$ 634,000,000	$ 131,000,000
Benefit (Private + Public)/Cost Ratio	1.3	0.5	0.5	0.4
*Planning case costs are cumulative and rounded up to three significant figures. For example, Planning Case 3 costs include the costs of Planning Case 1 and 2 improvements as detailed on the following pages.				
**Estimated private and public benefits shown are based on a 20-year study period.				

Table 1: Planning Case Cost and Benefit Comparisons

As shown in Table 1, Planning Case 1 is the least expensive group of improvements, yet yields the highest benefit/cost ratio. This package of improvements significantly reduces the congestion-related delay on the railroad subdivisions that currently experience the worst problems.

The improvements included in Planning Case 2 build upon those identified in Planning Case 1. The additional main track from Dawes to Sheldon produced the best railroad results. An additional track from Rosenberg to West Junction in Houston, significantly reduced train delays along that line; however, adding capacity along this rail line may be opposed by the communities in the area.

The need for additional capacity, as described in Planning Case 2, serves as the foundation for testing a potential new rail corridor in Fort Bend County in Planning Case 3. Although the bypass alternative imposes a public cost burden by introducing train traffic along the new bypass route and increasing the number of trains on the existing Popp Subdivision and in East Houston, this burden is offset by a reduction in the public burden along the Glidden and Terminal Subdivisions, since the volume of train traffic on these subdivisions would be reduced. The additional train route miles associated with the Fort Bend bypass route in Planning Case 3 have shown to carry additional annual private burden to the operating railroads based on fuel consumption, train crew hours, and general transportation costs per track mile, and may therefore be opposed by the railroad companies.

The Dayton-Cleveland route included in Planning Case 4 was shown to benefit both the private and public sectors by reducing train traffic in the east end of Houston. The bypass alternative imposes a public cost burden due to the introduction of train traffic on the new Dayton to Cleveland route; however, this burden is offset by a reduction in the public burden along existing subdivisions such as the East Belt and Lafayette Subdivisions, since the number of freight trains along existing rail lines on the east side of Houston would be decreased.

The relocation of carload switching operations that currently take place at New South and Pearland (Mykawa) Yards may ultimately increase the benefits of this improvement. Initial analysis of hypothetical cases in which carload switching is relocated outside of Houston has shown that there may be a four to nine percent reduction in the number of trains operating on the East Belt Subdivision, and a 12 to 15 percent reduction in the number of trains operating on the West Belt Subdivision.

In summary, for an estimated cost of **$195 Million**, the relocation of carload switching operations at New South and Pearland Yards is estimated to produce a public benefit of approximately **$64 Million**. The estimated NPV private benefit to the railroads of the relocation is approximately **$5.8 Million**.

The planning cases are described in further detail in the following pages.

Planning Case 1

Planning Case 1 includes the following improvements as shown in Figure 2:

- Construct separate switching leads at Settegast Yard – will keep trains entering or leaving Settegast Yard off of the East Belt Subdivision main tracks. Estimated Cost: **$6.3 million**.
- Construct a separate switching lead between the north end of North Yard and Hunting Bayou – will keep trains entering or leaving PTRA North Yard off of the East Belt Subdivision main tracks. Estimated Cost: **$8.5 million**.
- Construct a second main track between Galena Junction and Manchester Junction – a new bridge and second track over Buffalo Bayou will relieve congestion on the PTRA Subdivision. Estimated Cost: **$39 million**.
- Construct a second main track between Sinco Junction and Deer Park Junction – will allow local service trains to operate on the PTRA while allowing additional trains to enter and leave the PTRA Subdivision. Estimated Cost: **$28 million**.
- Construct a second bridge across Buffalo Bayou on the East Belt - a new bridge and second main track over Buffalo Bayou will relieve congestion on the East Belt Subdivision. Estimated Cost: **$9.6 million**.

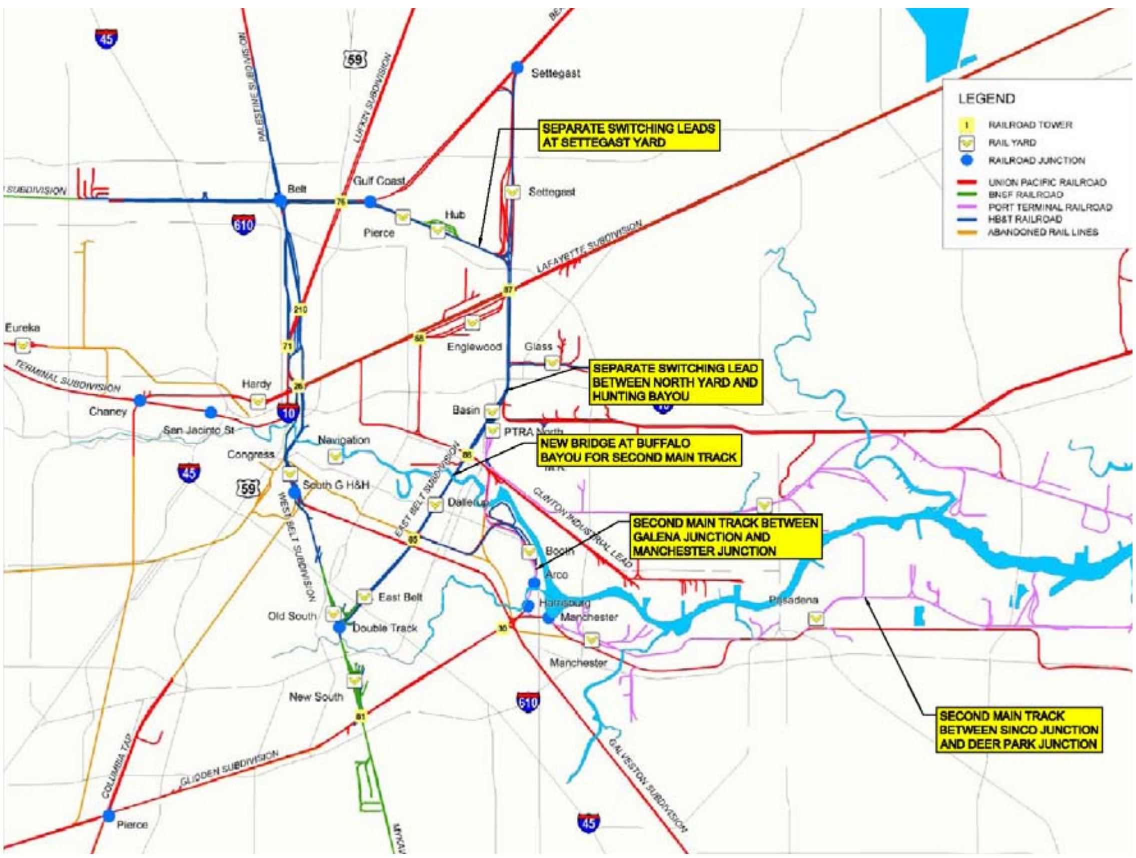

Figure 2: Planning Case 1 Improvements

Planning Case 2 (2a and 2b)

Planning Case 2 includes all of the improvements in Planning Case 1 in addition to the following improvements as shown Figure 3:

- **2a:** Expand Englewood East to Dawes – will increase the receiving and departure capacity of Englewood Yard. Estimated Cost: **$5 million**.
- **2a:** Extend the existing second main track east from Dawes to Fauna and upgrade the trackage connecting the East Belt with the Lafayette Subdivision at Dawes – permit movements between New South Yard or points on the East Belt Subdivision south of Englewood and Dayton to take place without trains having to stop. Estimated Cost: **$43 million**.
- **2a:** Extend the second track on the West Belt Subdivision north from Freight Junction through Belt Junction to connect with the Palestine Subdivision – will remove the single track bottleneck between the two double track segments at Belt Junction. Estimated Cost - **$4 million**.
- **2a:** Remove train stopping requirements on the West Belt from Cullen Boulevard north to Tower 26 – either grade separate or close all of the crossings along this segment to allow for trains to stop without causing delays or safety hazards to the public. Estimated Cost: **$50 million**.
- **2b:** Add a second main track between Rosenberg and West Junction on the Glidden Subdivision – will relieve congestion by allowing trains to pass one another along the highly trafficked Glidden Subdivision. Serves as a basis of comparison against the Fort Bend bypass route included in Planning Case 3. Estimated Cost: **$137 million**.

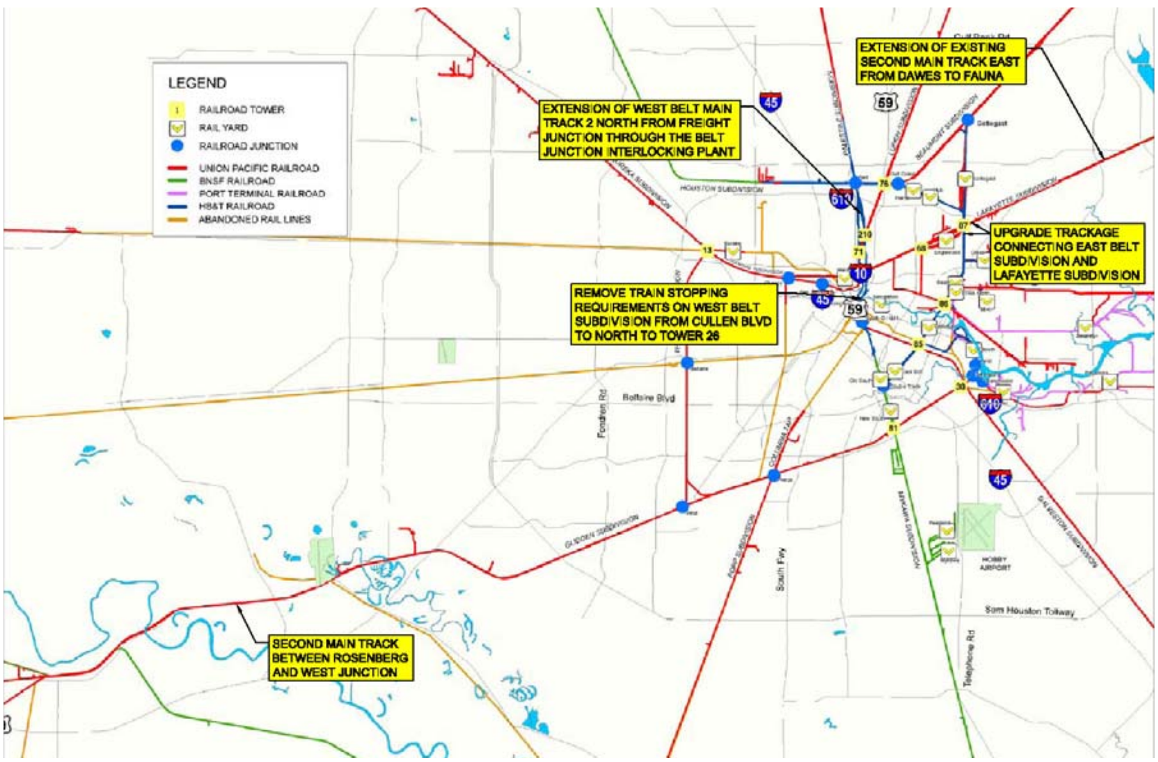

Figure 3: Planning Case 2 Improvements

Planning Case 3 – Ft. Bend County Bypass Alternative

Planning Case 3 includes all of the improvements from Planning Cases 1 and 2 (2a), with the second track on the Glidden Subdivision from Planning Case 2 (2b) replaced by the Fort Bend bypass as shown in Figure 4, which is estimated to cost **$880 million**.

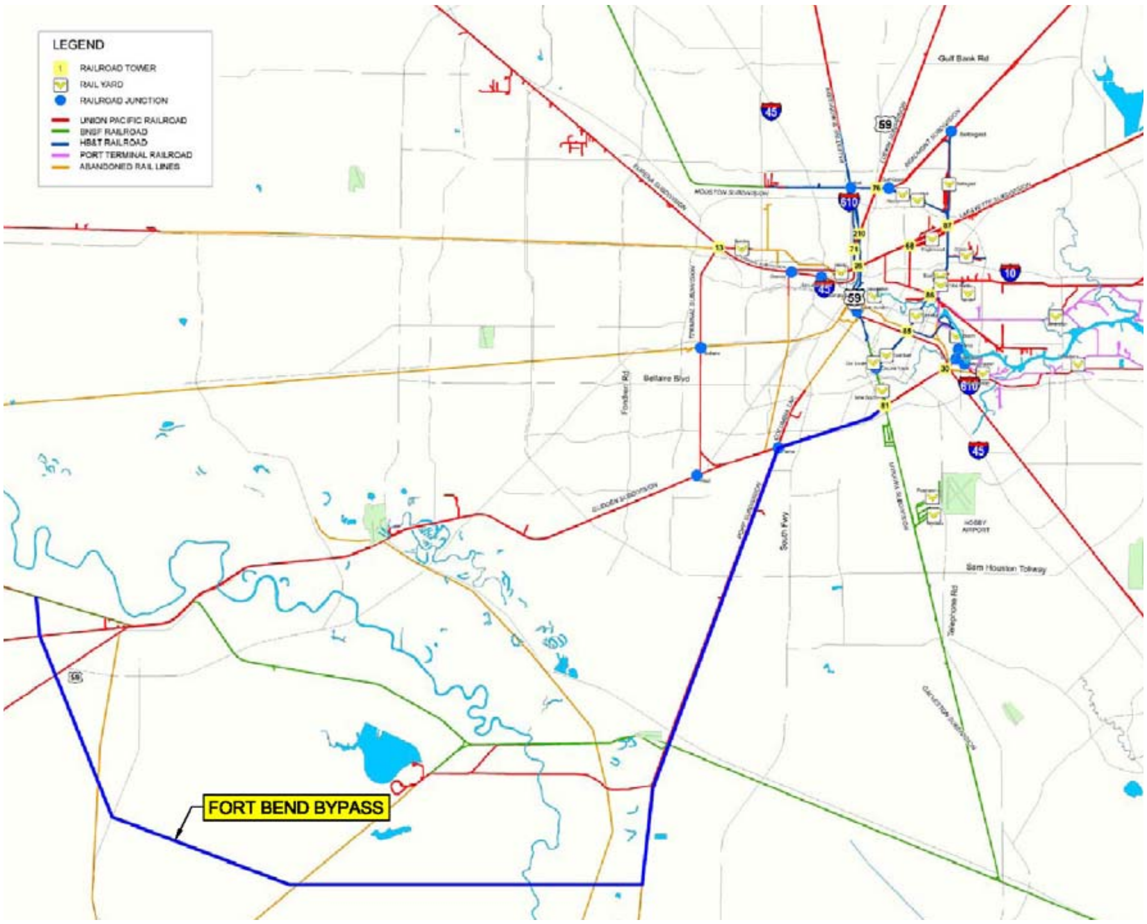

Figure 4: Planning Case 3 Fort Bend Bypass

The Fort Bend County bypass route would remove most through-freight trains from portions of the UPRR Glidden Subdivision between Rosenberg and West Junction, as well as UPRR's Terminal Subdivision between West Junction and Eureka.

There are approximately 2,400 additional train miles weekly required with the Fort Bend Bypass scenario, which equates to between 124,000 and 125,000 additional train miles annually. These added miles accrue because the bypass route is longer than the present, more direct route via the Terminal and Glidden Subdivisions.

Planning Case 4 – Dayton to Cleveland Rail Corridor

Planning Case 4 includes all of the improvements from Planning Cases 1 and 2 in addition to a new bypass around the east side of Houston as shown in Figure 5, which is estimated to cost **$212 million**. This 34-mile long bypass would run from a junction with the Baytown Subdivision, near Dayton, north and west to a connection with the Lufkin Subdivision near Cleveland.

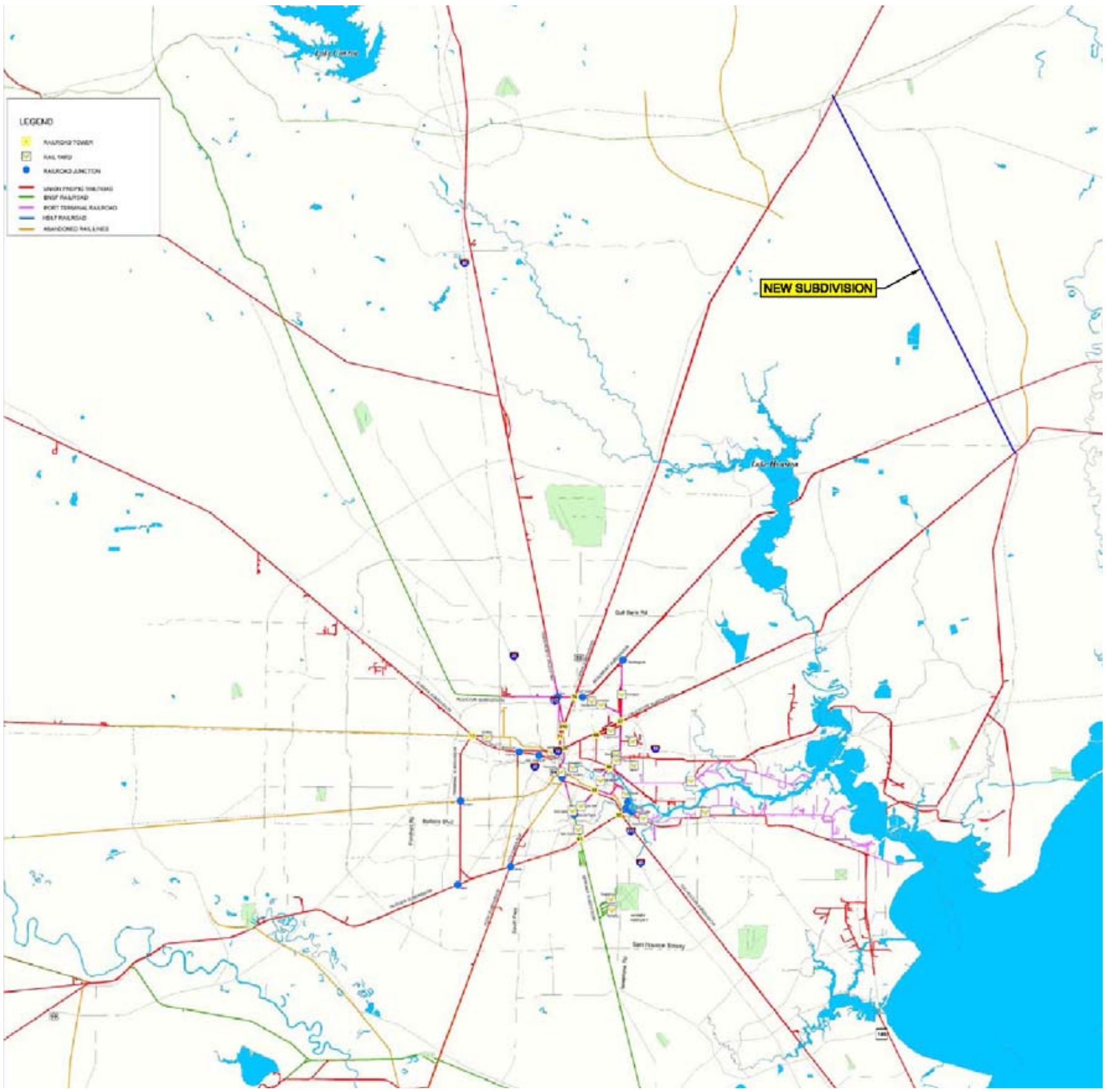

Figure 5: Planning Case 4 Dayton-Cleveland Corridor

Trains that could be rerouted to this alignment include BNSF through trains operating between Beaumont or points east, and points west/northwest of Houston such as Temple and/or Teague. Trains that originate or terminate at Dayton, conveying traffic to or from Dayton, and which would not have to work at any other point in the Houston terminal, also were directed to this alignment.

Next Steps

As part of the Texas statewide analysis of freight mobility, in particular understanding the movement of freight by rail and the inherent relationships that exist between rail, trucking, and maritime freight shipments, this study was conducted to establish a needs assessment report for the stakeholders in the Houston region that outlines potential infrastructure improvements, and their associated order of magnitude costs.

The improvements outlined in this report are intended to provide the foundation for a conversation on infrastructure and facility modifications that will benefit the quality of life in the local communities, reduce the public's exposure to freight movements, enhance economic growth and development, and improve passenger and freight mobility throughout the Houston region.

This needs assessment ultimately will assist the Texas Transportation Commission, and the State Legislature in understanding the magnitude and extent of the investment required to improve regional mobility, thus allowing them to adequately fund the Texas Rail Relocation and Improvement Fund (TRRIF).

Once the TRRIF has been funded, regional agencies such as the Gulf Coast Freight Rail District, in cooperation with the Texas Department of Transportation, the Ports of Houston, Galveston, Beaumont, and Freeport, the Houston-Galveston Area Council, as well as the freight railroads serving the Houston region, and other public and private partners will work together to determine which improvements will become prioritized projects. The chosen improvements will then undergo the rigorous project development schedule that includes environmental and public involvement processes.

Meeting this region's transportation needs, for both people and goods requires collaboration, cooperation, and an understanding that the region will continue to grow. The region requires a multi-modal solution that provides economic, efficient, and safe transportation infrastructure.

Further information on improvements identified in the Houston Region Freight Study can be viewed on the following web address:
http://www.houstonrailplan.com

PREFACE

The growth of freight movements in the nation and Texas have strained transportation networks and exacerbated conflicts between the traveling public and freight carriers. Steady growth in international trade is placing ever greater pressure on major gateways, ports, airports, and border crossings to handle this expanding volume of freight. While the Texas Department of Transportation (TxDOT) has a significant amount of information related to trucks using Texas roadways, a greater understanding of the state's private sector rail infrastructure and operations is needed.

In 2005, the 79th Texas Legislature made TxDOT the State's rail agency and granted it the authority to plan, acquire, finance, construct, and maintain rail facilities via House Bill 2702. However, the State is prohibited from spending dedicated funds derived by the gas tax on non-road related infrastructure. Recognizing the absence of a dedicated funding source for rail improvements, the same legislature passed House Bill 1546 creating the Texas Rail Relocation and Improvement Fund (TRRIF). This fund will provide a mechanism by which the State may issue obligations to finance the relocation, construction, reconstruction, acquisition, improvement, rehabilitation, and expansion of rail facilities. Texas voters approved the creation of the TRRIF in November 2005, but it currently is unfunded.

In accordance with TxDOT's goals to reduce congestion, enhance safety, expand economic opportunity, improve air quality, and increase the value of the State's transportation assets, the Department commissioned this freight study to help the legislature understand the extent of rail infrastructure needs, the associated public and private benefits, and the investment required to address those needs as well as to identify a possible timeframe for implementation. With this information, our legislators will be able to help Texans meet the growing transportation needs of tomorrow by capitalizing the rail fund today.

The Houston Region Freight Study encompasses an eight-county study area and is part of the overall statewide analysis of the rail network. The outcome of this study is a list of improvements to the network categorized as short-, medium-, and long-range in schedule. Since most, if not all, of the current rail lines in the Houston region are privately owned facilities, careful consideration has been given to quantify both the public and private benefits to ensure that costs are apportioned in a fair and balanced manner to all parties involved.

This report is the beginning of a new era of transportation at TxDOT. Future implementation of identified improvements will be local decisions made by local rail districts, local governments, and private partners, in cooperation with TxDOT and the Metropolitan Planning Organization. Improvements will be evaluated locally for inclusion in the transportation plan of the region. Once a project is in the plan the normal project development process would then be followed including detailed engineering and environmental studies that follow the National Environmental Policy Act and include an extensive public involvement process. In addition, further discussions would take place with the privately owned railroads as to their benefits from the project and what their actual cost participation may be.

This report is intended to be the foundation of a conversation on the future of rail transportation in Texas. It provides a broad perspective on the issues and possible solutions. It gives policy makers a better understanding of the need and associated cost to improve the rail system, and the effect that those improvements can have on enhancing Texans' quality of life and expanding economic opportunities by ensuring that Texas is adequately prepared to meet the growing demands of the future.

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Representatives of the
Houston Congressional Delegation

The Honorable Ed Emmett
County Judge, Harris County

The Honorable Robert Eckels
Former County Judge, Harris County

The Honorable Judge Alan Sadler
County Judge, Montgomery County

The Honorable Tom Stavinoha
Commissioner, Fort Bend County

The Honorable David Wallace
Mayor, City of Sugar Land

The Honorable Bill White
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GLOSSARY OF TERMS

Absolute Block – A length of track in which no train or engine is permitted to enter while it is occupied by another train or engine.

Automatic Block Signal System (ABS) – A series of consecutive blocks governed by block signals, cab signals or both, actuated by a train, engine or by certain conditions affecting the use of a block.

Bad Order – A piece of rolling stock that needs repair.

Block – A length of track between consecutive block signals or from a block signal to the end of block system limits, governed by block signals, cab signals or both.

Boxcar – An enclosed car used for general service and especially for lading, which must be protected from weather.

Bulk transfer – The transfer of bulk products, such as plastic pellets or liquid sweeteners, from one mode of transportation to another. Bulk transfer permits off-rail shippers and receivers of varied commodities to combine rail's long-haul efficiencies with truck's convenient door-to-door delivery.

Branch Line – A secondary line of a railroad, not the main line

Capacity – General Capacity: Rail demand or volume. Factors affecting capacity for a railroad are numerous, but include, for example, the availability of train crews, locomotives, equipment, and track.

Line or Track Capacity – Maximum number of trains that can operate safely and reliably in each direction over a given segment of track during a given period of time.

Carload – Shipment of not less than five tons of one commodity.

Centralized Traffic Control (CTC) – A traffic control system where train movements are directed through the remote control of switches and signals from a central control point. This system enables trains to pass each other at sidings or interlockings without the need for train crews to stop and manually throw switches. The train operates on the authority of signal indications instead of the authority via timetable or train orders.

Class 1 Railroad – A railroad with annual gross operating revenue of $319.3 million or more.

Class 2 Railroad – A railroad with average annual gross revenue between $20.5 and $319.3 million.

Class 3 Railroad – A railroad with average annual gross revenue under $20.5 million.

Classification – Grouping of railcars in a yard in accordance with train movement requirements, usually by destination.

Classification Yard – A rail yard in which rail cars are classified and grouped in accordance with their movement requirement such as kind, contents, and/or destination.

Container – A large, weatherproof box designed for shipping freight in bulk by rail, truck or steamship. Typically the box resembles a truck trailer, which is lifted onto a flatcar. Most containers are 20, 45, 48 or 53 feet in length.

Containers on Flat Cars (COFC) – Refers to Intermodal shipments where containers are moved on a railroad flat car. The movement is made without the container being mounted on a chassis.

Consist – The make-up of a freight train by types of cars and their contents.

Controlled Point (CP) – A location where switches and/or signals are remotely controlled by a control operator (dispatcher).

Cross-Over – Track that joins two main tracks. When a train moves from one main track to another, it "crosses over."

Cut, to – Separate car(s) from a train.

Diamond – The intersection of normally perpendicular tracks where only one track can be used at a time.

Division – A geographical unit of a railroad, the boundaries of which are designated by railroad timetables.

Double Track (DT) – Two main tracks, on one of which the current of traffic is typically in a specified direction, and on the other typically in the opposite direction.

Drill Track – A track connecting with the ladder track, over which locomotives and cars move back and forth in switching.

Flat Car – A freight car that has a floor without any housing or body above. Frequently used to carry containers and/or trailers, or oversized and odd-shaped commodities.

Grade Crossing – The crossing of highways, roadways, pedestrian walks or combinations of these, with railroad tracks at the same level.

Grade Separation – The separation of a grade crossing by either an underpass or overpass.

Haulage Rights – Rights obtained by one railroad to have its trains operated by another railroad over that railroad's tracks.

Hopper – A rail car with pockets, or hoppers, opening on the underside of the car for unloading bulk commodities.

House Track – A track entering, or along side a freight house. Cars are spotted here for loading or unloading.

Hump – The part of a gravity classification yard (hump yard) in which rail cars that have been pushed up a summit (hill) are cut off while in motion at the top of the hill. Gravity then pulls the rail cars down the hill switching it onto a predetermined track. The weight of the rail car, distance it must travel to the designated track, and it's location within the train that is being made-up, are all taken into consideration so the speed of the car can be adjusted through a series of retarders, or brakes, as the car moves down the hill toward the intended track.

Hump Yard – A yard in which rail cars are classified and forwarded to final destinations. The three components are a receiving yard, a classification yard in which railcars are pushed over a hump to various classification tracks, and a forwarding or departure yard.

Intermodal – Mode of rail transportation that covers the multi-modal transportation of trailers and/or containers by ship, rail, and truck.

Interchange – A track in which various cars are delivered or received from one railroad to another.

Interchange Point – The point at which two or more railroads join. Traffic is passed from one road to another at interchange points.

Interlocking – An arrangement of signal appliances so interconnected that their movements must succeed each other in proper sequence. It may be operated manually or automatically.

Junction – The convergence of two or more railroad lines. Typically a Junction is a Controlled Point as well.

Ladder Track – A diagonal track in a rail yard configuration that typically intersects all tracks, connecting each by means of switches.

Local Train – A train with an assigned crew that works between pre-designated points normally picking up or dropping off railcars to the railroad customer base within the area.

Locomotive – Locomotives are units propelled by any form of energy, or a combination of such units operated from a single control station, used in train or yard service.

Mainline – Primary rail line over which trains operate between terminals. It excludes sidings, and yard and industry tracks.

Manifest – Train made up of mixed railcars (box, tank, piggyback cars, etc.).

Mile Post – A post or sign on a pole each mile along the track that shows the distance from a predefined location such as a major rail terminal.

Multiple Main Tracks – Two or more main tracks, the use of which is designated in the timetable. Two main tracks are commonly referred to as double track. The tracks run parallel and may accommodate traffic in either direction. Typically, on one track the current of traffic is typically in a specified direction, and on the other track(s) typically in the opposite direction.

Piggyback – Slang term for the transportation of a highway trailer on a railroad flat car.

Ramp – Slang term for an intermodal terminal where trailers and containers are lifted onto or off of railcars.

Restricted Speed – The maximum operating speed of a train, not exceeding 20 MPH, which will permit the engineer to stop the train within one half the range of sight; short of other trains, engines, railroad cars, stop signals, derails or switches not properly lined, while concurrently being on the look-out for track infrastructure irregularities such as a broken rail. Train movement through rail yards are typically done at restricted speed.

Right-of-Way – The property owned by a railroad over which tracks have been laid.

Rip Track – A small car repair facility, often a single track in a small yard. Origination of name is derived from "Repair, Inspect, and Paint," however today “Repair in Place” is more applicable.

Running Track – A track, typically not a main track, designated in the timetable upon which movements may be made subject to prescribed signals and rules, or special instructions. Also the name given a track reserved for movement through a yard.

Secondary Track – Any designated track upon which trains or engines may be operated without timetable authority, train orders, or block signals. Also a common name given to tracks on railroad branch lines.

Siding – A track auxiliary to a main or secondary track for meeting or passing trains. The timetable will indicate stations at which sidings are located.

Single Track – A main track upon which trains are operated in both directions.

Spur Track – A track extending out from the main track that is usually used to serve rail customers.

Storage-in-Transit (SIT) – Bulk commodities, such as plastic pellets and polyvinylchloride powder, are made in vast quantities to minimize the expenses associated with their manufacture. These commodities are customarily loaded into empty railcars known as covered hoppers, and stored at a point (SIT Yard) located between the point of origin and the point of destination to be shipped at a later date.

Stub Track – A form of side track connected to a running track at one end only and protected at the other end by a bumping post or other obstruction.

Subdivision – A portion of a division designated by timetable. Normally the name given to a main track between two locations as specified in the timetable.

Surface Transportation Board (STB) – An independent governmental adjudicatory body administratively housed within the United States Department of Transportation responsible for the economic regulation of interstate surface transportation, primarily for the railroad industry, within the United States. The mission of the STB is to ensure competitive, efficient, and safe transportation services are provided to meet the needs of shippers, receivers, and consumers.

Switching – The movement of freight cars between two nearby locations or trains. This typically involves moving cars within a yard or from specific industry locations to a yard for placement of railcars in a train, or vice versa.

Through Freight Train – An express freight train between major terminals.

Timetable – A written document which establishes the authority for the movement of trains over designated lines of track, subject to the rules established for that track. Typically it describes maximum authorized train speeds for the entire rail line or a portion thereof. The timetable will also include the names and locations of control points for the rail line

Terminal – Railroad facilities established for the handling of passengers or freight, and for the breaking up, making up, forwarding and servicing of trains, and interchanging with other carriers.

Trailer on a Flat Car (TOFC) – Refers to intermodal shipments, commonly referred to as "piggy-back."

Tower – Prior to the centralization and computerization of switching operations, physical structures, called Towers, were erected in locations where the "Tower Operator" could observe and control the movement of trains within a localized area. The towers were complete with manual switching equipment where the operator would physically move levers back and forth controlling the direction of train travel, selection of track the train would occupy, and the signal indication. Today this function typically is done by a dispatcher at a remote location, although the tower designation of that control point, or junction, remains today even though the physical building may no longer exist.

Trackage Rights – An agreement between railroads where one railroad is authorized to operate its trains, between specific locations, over the tracks owned by another railroad. Typically there is a surcharge for this privilege, and the associated rights are filed with the Surface Transportation Board (STB).

Track Warrant – Track Warrant Control (TWC): A method of traffic control wherein trains are authorized for movement only between specified locations. The form giving a train crew the authority to operate between two locations is called a track warrant.

Train – An engine or more than one engine coupled, with or without cars, displaying a marker and authorized to operate on a main track.

Trim Lead – Track used to move cars from the sorting tracks (bowl) to the departure yard, where sorted cars are coupled into an outbound train.

Trains Spacing – The time spacing in which a terminal/subdivision can handle trains effectively. This could be predicated on the type of method of dispatching authorized for the particular line segment.

Trains Staging – Trains holding at a location awaiting authorization and/or release to move into a terminal.

Turnout – A section of track with movable rails to divert a train from one track to another. Also referred to as a "switch," although technically the switch is only the moving parts of a turnout. Turnouts are referred to by number. For example, a Number 6 turnout spreads one unit for each six units of travel measured from the point of the frog.

Unit Train – A train composed entirely of one commodity, usually coal or mineral, and usually composed of cars of a single owner and similar design, and usually destined for a single destination.

Universal Crossovers – A pair of crossovers, spaced at a predetermined distance, allowing for the movement of a train from one main track to another, and then return to the original track.

Wye – A track shaped like the letter "Y," but with a connector between the two arms of the "Y." A wye is used to reverse the direction of trains or cars. A train pulls completely through one leg of wye, the switch is thrown and reverses the direction, allowing the movement across the semi-loop track of the wye, and the train is then headed in the opposite direction.

Yard – A system of tracks, other than main tracks and sidings, branching out from a common track. Yards are used typically for switching, making up trains, and/or storing of railcars.

Yard Limits – The location on a main track in which the main track begins to enter a rail yard. This location is typically designated by a yard limit sign placed along the main track, and also is noted in the timetable.

SECTION 1: PROJECT BACKGROUND

Regional Setting

Houston, along with other great cities of the world, grew and prospered in part because of access to a major port. Beginning with the horse and wagon routes and vessel movements on the waterway, the basic framework for Houston's transportation network was developed many years ago. The railroad history for the area dates back to the middle nineteenth century where numerous railroad companies constructed several hundred miles of track. By the early twentieth century, the port city of Houston had constructed additional railroad around what is now the downtown area. The photo below shows the original Union Station train depot located in downtown Houston, which was later renovated to become the main entrance to the Minute Maid Field ballpark.

The development of the highway and rail transportation infrastructure in and around the Houston metropolitan area was influenced largely by the growth of the local ports and the geographical layout of Buffalo Bayou, the San Jacinto River, and Galveston Bay. The railroads and roadways were constructed along routes that lead to these areas and the City has grown and expanded out along these transportation arteries creating what is today the nation's fourth largest city.

Eleven railroad companies constructed 451 miles of railroad track prior to 1860, and by 1890, Houston was recognized as the railroad center of Texas.

Market Square was designated originally as the commercial hub of Houston. The majority of the existing rail network was constructed in the mid to late 1800's, with minor expansion completed in the mid 1960's to service the Port area while the city literally grew up around the rail lines. The train shown in the picture to the left was constructed in 1892 for the Houston and Texas Central Railroad.

Houston's growth potential was realized early on as the forefathers constructed in 1914 an outer rail loop around the downtown area known today as the Terminal Subdivision. Shortly after that, Houston railroads organized the Port Terminal Railroad Association (PTRA) in 1924, which services industrial facilities along Buffalo Bayou and the Houston Ship Channel.

In 1925, Texas began the construction of a coordinated highway system. It was during this era that the State Highway Department (predecessor to the Texas Department of Transportation) was given the responsibility of planning, constructing, and maintaining highways built through state and federal funding. Prior to that time, earlier roads were constructed by the counties with little or no consideration given to the coordination of connecting roads between counties or for any type of system of through highways. During the last half of the 1940's, Houston began seeing the "flight to the suburbs" as workers wanted to enjoy country living while having the advantage of employment within the city.

Local transportation has been a concern for Houston and the surrounding area. The Highway Committee of the Houston Chamber of Commerce (now the Greater Houston Partnership) had long been recognized as the advocate for freeway and thoroughfare planning and development. By the end of 1965, a 244-mile freeway system, with a cost of about $5 million, was roughly half-way completed with most of the right-of-way purchased. The metropolitan area of Houston had proposed a rail system from the areas southwest suburbs into downtown but voters rejected the plan in June 1983. By June 1988, the Hardy Toll Road from 610 North to Intercontinental Airport and I-45 North was completed and the Sam Houston Tollway between the Southwest Freeway and I-45 North was completed in June 1990.

Because portions of the original rail network were abandoned and removed over the years and there has not been a significant expansion of the original rail network, the growth of the region and the Port of Houston is forcing the railroads to operate on lines that are at or near capacity. In 1994 for example, the Houston rail network suffered a service meltdown, which impacted train performance nationally. Due to a 52 percent forecasted growth in rail tonnage by 2025, the freight railroads could become more protective of their operating rights on these tracks.

Decades of growth along freight routes have left limited right-of-way for expansion not only for the railroads, but also the highway infrastructure. As a result, the Houston Region Freight Study was contracted by TxDOT to identify existing and projected freight rail transportation operations, bottlenecks, and constraints, with the goal developing alternative solutions to resolve these transportation infrastructure problems before they become critical.

Previous Reports

One of the first tasks to be completed before proceeding with alternatives or concepts in this study was to locate and review any transportation studies previously performed within the last five years involving the Houston region. Seven studies that addressed transportation issues within the Houston region were identified and reviewed and are briefly summarized below:

The *Harris County Freight Rail Grade Crossing Study* (July 2004) was developed for the Harris County Public Infrastructure Department and the Port of Houston Authority and was performed by the team of DMJM Harris, TC&B, Knudson & Associates, and Woodharbor. This study presents an inventory database and priority list of railroad/roadway crossings within Harris County. This study includes an analysis of the Port of Houston Authority (PHA) rail traffic. The Port of Houston (POH) is the sixth largest seaport in the world, and ranks first in the United States in foreign tonnage. Rail service to POH facilities is provided by the Port Terminal Railroad Association (PTRA), UPRR, or both. This study acknowledged that while the interested parties agree that mobility is critical, the groups have different goals, needs, and concerns. No mobility plan exists that funds the recommendations outlined in this report.

The *H-GAC US90A Corridor Rail Feasibility Study* (April 2004) was created for the Houston-Galveston Area Council (H-GAC) and was performed by Edwards and Kelcey. The 25 mile corridor for this study extends from the vicinity of the METRO Rail Fannin South Park & Ride light rail station at Fannin and West Bellfort in the city of Houston, parallels Holmes Road and US 90A, to the SH 36 Bypass, located just west of the city of Rosenberg. The purpose of the study is to determine the need for high capacity transit and assess the technological and economic feasibility of establishing and operating efficient passenger rail service along the corridor. Five alternatives were developed that include exclusive commuter rail operation, shared commuter rail operation, exclusive diesel multiple unit (DMU) operation, shared DMU operation, and light rail transit. Based on the conceptual analysis, preliminary discussions have been conducted with UPRR. The UPRR has indicated that the most favorable service options are the exclusive operating scenarios.

The *Harris County Commuter Rail Analysis* (December 2003) was created for the Harris County Public Infrastructure Department and was performed by DMJM Harris/TC&B. This report explores potential for commuter rail operations on the existing US 290 and SH 249 corridors. According to the report, as of 2003 UPRR was interested in allowing commuter rail to operate on the Eureka and Terminal Subdivisions, and BNSF was interested in allowing commuter rail on the Houston Subdivision from Belt Junction to Tomball. As of 2006, the UPRR is no longer interested in allowing trains on the Terminal Subdivision, but will consider allowing a limited number of trains on the Eureka Subdivision if capital is provided to make the necessary infrastructures improvements along that line to support commuter operations. The report contains a track inventory for the US 290 and SH 249 corridors which includes the length, physical limits, areas of speed restriction, sidings, types of signalization, and other pertinent data for the corridors. The report also includes proposed improvements for the US 290 corridor and proposed improvements for the SH 249 corridor.

The *What We Know About Containerized Freight Movement in Texas* (June 2004) was developed for TxDOT by the Center for Transportation Research. This report summarizes available information and data on the container sector and on container movements in and through Texas. The objective of the report was to provide a better understanding of how containers move across the state, what commodities are shipped in these containers, to what degree container shippers utilize the Texas-Mexico ports of entry, and to examine the potential for diverting containers from key highway corridors to rail.

The *Inventory of Railroad Operating Conditions in the East End of Houston* (February 2003) was created for the Houston East End Rail Task Force Committee and was performed by TTI. This report overviews the history, previous ownership of track and rights-of-way, and current ownership of track and rights-of-way within Houston. The report lists the major shipping routes and the lines dedicated to directional traffic such as the Palestine, Lufkin, Beaumont, and Lafayette Subdivisions. The report also includes statistics for the daily train traffic volumes and number of roadway crossings for the rail network in the east end of Houston. The report concluded that trains moving through the east end are primarily through trains to other destinations because of the lack of connectivity between major lines outside of Houston, the proximity of major rail yards and industries to Houston, and the availability of an in-place network inherited by current operators.

The *Impact of Mexican Rail Privatization on the Texas Transportation System* (February 2001) report was created for TxDOT and was performed by TTI. This report estimated that 80-85 percent of US-Mexican trade is moved by truck through Texas, New Mexico, Arizona, or California by value and 75 percent by weight. A point of concern is that much of this material neither originates nor terminates in Texas. As a private industry, railroads are not subject to the same considerations as public transportation providers relative to serving the needs of the public. Railroads do not generally receive public money for infrastructure or operational needs, and seek business opportunities that maximize revenue and minimize cost. Research proposed four scenarios related to growth in trade-related transportation and truck-rail modal share: combined US/Mexican railroad traffic loads will I) grow to exceed,

II) grow to keep pace, or III) grow at a slower rate than NAFTA-related trade or IV) retain their current volume. Three factors: NAFTA, Mexican rail privatization, and more direct linkage to American networks have made rail transportation a viable transportation mode for international trade between Mexico, the United States, and Canada, and have contributed to the rail traffic growth over the last several years. Railroads are increasing their share of international trade and will attempt to add infrastructure and capacity at strategic locations where sustained commercial activity is likely. It is estimated that the railroad's United States-Mexican trade volume will grow at 10-12 percent per year.

The *Texas Rail System Plan* (October 2005) was prepared for TxDOT by TxDOT staff and TTI for the following purpose: to serve as the detailed rail planning document to implement State transportation elements of the annual operating budget, to serve as the State's "Rail Plan" document required by the Federal Railroad Administration if federal funds are to be used for eligible rail improvements, by providing updated information on the State's rail system plan and identifying lines eligible for, or in need of financial assistance, to identify and develop limited partnership opportunities between the public and private sectors, and to allow transportation planners to understand the role of the railroads in the movement of people and goods, and their impact upon the entire transportation system. Objectives of the state-wide rail planning program include: enhance mobility and safety through improvements to the Texas rail system, help maintain essential rail services, promote connectivity between different modes of transportation, and preserve facilities and corridors for other future transportation uses. To accomplish these objectives, TxDOT needs to be able to create a flexible program that quickly evaluates and determines endangered services and lines, identifies problems and suggests solutions, coordinates funding to acquire, rehabilitate, or promote new facility construction, and evaluates multimodal opportunities.

Pertinent information from the above listed reports has been incorporated into this study.

SECTION 2: PURPOSE OF STUDY

Purpose

The purpose of the Houston Region Freight Study was to identify a slate of potential infrastructure improvements for the Houston region's consideration, with evaluations for near-, mid-, and long-term improvements and/or activities that may reduce freight mobility impacts within the region. The overall purpose of this study evaluated freight movements and operations within the six counties of the TxDOT Houston District and two counties of the TxDOT Beaumont District. The six counties within the TxDOT Houston District consist of Harris, Waller, Brazoria, Galveston, Fort Bend, and Montgomery Counties, while the two counties of the TxDOT Beaumont District are Liberty and Chambers Counties. All together these eight counties comprised the study area. This study identifies opportunities to increase freight movement efficiency, determines the physical and financial viability of potential improvements, and includes an analysis of alternative freight corridors.

The study was conducted in three Phases. Phase I established an inventory of the existing freight rail system, conducting a regional freight rail operational study, and identified freight rail constraints. Phase II addressed the identification of freight rail and rail/roadway interface safety issues, alternatives and associated feasibility for rail system/roadway improvements within the study area, modeled rail system improvement recommendations to develop realistic cost/benefit analyses, and determined potential freight flows to and from potential future use corridors. Although not included in this report, the third phase, intended to determine the feasibility of utilizing existing freight rail lines for potential passenger rail operations, is being conducted jointly by TxDOT and the H-GAC.

Project Approach

Freight traffic throughout the Houston region represents a true multimodal transportation example where the movement of cars, trucks, trains, and ships, are all interrelated. If any one of these modes of transportation is disrupted the impact will be noticed in all the transportation modes. For this reason, it was imperative to include all the responsible government offices, agencies, and transportation companies throughout the Houston region to assure their information and concerns were incorporated into this study. To accomplish this goal, a stakeholders group was established. Throughout this study, periodic meetings were held with the stakeholders to receive input and to keep them informed on the study progress. During these meetings, the stakeholders were asked to assist the study team by providing transportation information from their respective areas and to express their concerns, plans, and expectations.

Realistic results of this analysis is critical, hence the data used throughout the study had to be as accurate as possible. Many of the stakeholders were asked to share their internal confidential plans and concerns regarding current and projected traffic patterns. Confidentiality agreements were used and all parties honored these arrangements generating a high level of trust and responsive input to the overall study. The following list represents the stakeholders that were involved in this study.

Government, Agency, and Private Company Stakeholders:

- BNSF Railway
- City of Houston
- City of Sugar Land
- Congressman John Culberson's Office
- Congressman Nick Lampson's Office
- Congressman Gene Green's Office
- East Harris County Manufacturing Association
- Fort Bend County Commissioner
- Greater Houston Partnership Commuter Rail Task Force
- Greater Houston Partnership (GHP)
- GHP - Gulf Coast Regional Mobility Partners
- Harris County
- Houston-Galveston Area Council (H-GAC)
- Houston Real Estate Council
- Kansas City Southern Railway
- Metropolitan Transit Authority of Harris County (METRO)
- Port of Houston Authority
- Port Terminal Railroad Association (PTRA)
- Texas City Terminal Railway
- Texas Department of Transportation
- Union Pacific Railroad

After establishing a task protocol to use throughout the study, including the stakeholders meetings, the work was broken down into the following tasks:

- Task 1 – Inventory the existing rail system,
- Task 2 – Conduct a regional freight rail operational study establishing the baseline data,
- Task 3 – Identify freight rail constraints based on the information developed in the first two tasks,
- Task 4 – Identify freight rail and rail/roadway interface safety issues,
- Task 5 – Develop alternatives and feasibilities for rail system/roadway improvements,
- Task 6 – Model existing system, improvements, and potential alternatives, and
- Task 7 – Potential future alternative alignments analysis.

Public Involvement

Community involvement and public input are critical components of any transportation study and TxDOT feels it is beneficial to engage members of the public to provide input on identified transportation improvements. The Houston Region Freight Study is a first time venture to develop a needs assessment report for the Texas Legislature's consideration, as it determines the statewide funding level needs for the Texas Rail Relocation and Improvement Fund.

In addition to forming a Steering Committee, composed of key area leaders, to assist the team in identifying current conditions and needs, a public workshop was held to present identified improvements to elected officials and a website was developed to post information on identified improvements and receive feedback. The workshop provided a forum for local, state, and federal elected officials, other policy makers, and the general public to preview identified future improvements. Stakeholders were invited to review study information listed on the website and provide feedback.

The public involvement process allowed the public to hold a vital role in the identified improvement details and preliminary planning. Two main concerns, which surfaced during the comment period included the following:

> *Concern*: Crossing Closures in Pecan Grove Area
> *TxDOT Response:* Closures were removed from identified improvements.
>
> *Concern:* Double Tracking of US 90A in Fort Bend County
> *TxDOT Response:* The railroads and regional planning entities have not yet come to a mutual agreement on what alternative should be chosen to improve this area.
> *UPRR Response:* This is an essential route into Houston for Union Pacific. UPRR has no intention to move freight operations off the Glidden Subdivision. A bypass would likely add significant operating costs for the railroad.

By effectively reaching out and educating stakeholders during the preliminary stage of the process, TxDOT was able to effectively address the major concerns. Further details about each component of the public involvement during this study are listed in the succeeding sections.

Task Force

The Houston Region Freight Rail Task Force was formed to take guidance and recommendations, and to update committee members on the progress of this study. Table 2-1 shows a list task force members.

PRIMARY MEMBERS	AGENCY/ ENTITY	TITLE	ALTERNATE
Gary Trietsch (Chairman)	TxDOT-Houston District	District Engineer	Delvin Dennis
Art Storey	Harris County	Executive Director- HCPID	Charles Dean
Jim Edmonds	Port of Houston	Chairman- Board	Tom Kornegay
Mike Marcotte	City of Houston	Director- PW&E	Jack Whaley
John Sedlak	METRO	Executive VP	Dave McSpadden
Joe Adams	Union Pacific	Chairman's Representative	Scott Moore
Rollin Bredenberg	BNSF	VP- Service Design	Ed Emmett
Paul Broussard	Kansas City Southern	Representative	
Marvin Wells	Port Terminal Rail	General Manager	Hugh McCulley
Bill Crow	Congressman Culberson	District Director	
Ben Jones	Congressman Lampson	District Director	
Armando Walle	Congressman Green	District Director	
Carol Lewis	City of Houston	Chair- Planning Commission	Maureen Crocker
Jeff Moseley	GHP	Executive Director	Brian Wolfe
Sam Lott	Transit Planning-GHP	Commuter rail task force	
George DeMontrond	Gulf Coast RMP	Chair- Rail task force	
Ed Emmett	Harris County	County Judge	
Alan Clark	H-GAC	MPO Director	Ashby Johnson
Tom Stavinoha	Fort Bend County	County Commissioner	D'Neal Krisch
Alan Sadler	Montgomery County	County Judge	Tommy Metcalf
Michael Wilson	Port of Freeport	Director of Trade Development	
Additional Members	**Affiliation**	**Others to Notify**	**Affiliation**
Steve Roop	TTI- Texas A&M	Mayor Bill White	City of Houston
Jennifer Moczygemba	TxDOT- Multimodal	Dick Schiefelbein	Port of Houston
Ann Travis	Mayor Bill White	Joe Lileikis	HNTB
Rakesh Tripathi, P.E	TxDOT Houston District Project Manager	Mayor David Wallace	City of Sugar Land
Robert Eckels	Former Harris County Judge	Edward Taravella	Real Estate Council

Table 2-1: Houston Region Freight Rail Task Force Members

Workshop

TxDOT organized a workshop on August 25, 2006 to introduce Houston-area federal, state, and local elected and public officials to the Houston Region Freight Study and to solicit feedback on the identified improvements.

The workshop, hosted at the Renaissance Hotel commenced with a welcome from TxDOT's District Engineer Gary Trietsch, who gave an introduction and discussed the purpose of the event. Joe Lileikis, HNTB project manager, gave a presentation on the Houston Region Freight Study covering project objectives and a summary of identified improvements. A copy of this video presentation is available for review at the TxDOT Houston office. After a comment period, then Harris County Judge Robert Eckels introduced the keynote speaker, John W. Johnson, Texas Transportation Commissioner, who gave a synopsis of the plan from a statewide perspective. Following his presentation, Houston Mayor Bill White gave a response on behalf of the City regarding the study. Alan Clark, MPO director for the Houston-Galveston region, gave final remarks and adjourned the meeting.

Publicity

Publicity materials used to announce the event included a save the date postcard, a media alert, invitation postcard, fax invitation flyer, and postings on H-GAC's website and the project website. Examples of the mailers and flyer are included at the end of this section along with a *Fort Bend Herald* article about the study.

Attendees

Approximately two hundred individuals attended the workshop. A conclusive list of attendees is located in Appendix A of this report.

Additional Presentations

TxDOT gave additional presentations to the following groups:

- Alliance of North Houston Chambers of Commerce
- Cy-Fair Houston Chamber of Commerce
- Greater East End Chamber of Commerce
- Greater East End Super Neighborhood
- Greater Houston Partnership – Transit Committee
- Houston Northwest Chamber of Commerce
- North Houston Association
- West Houston Association

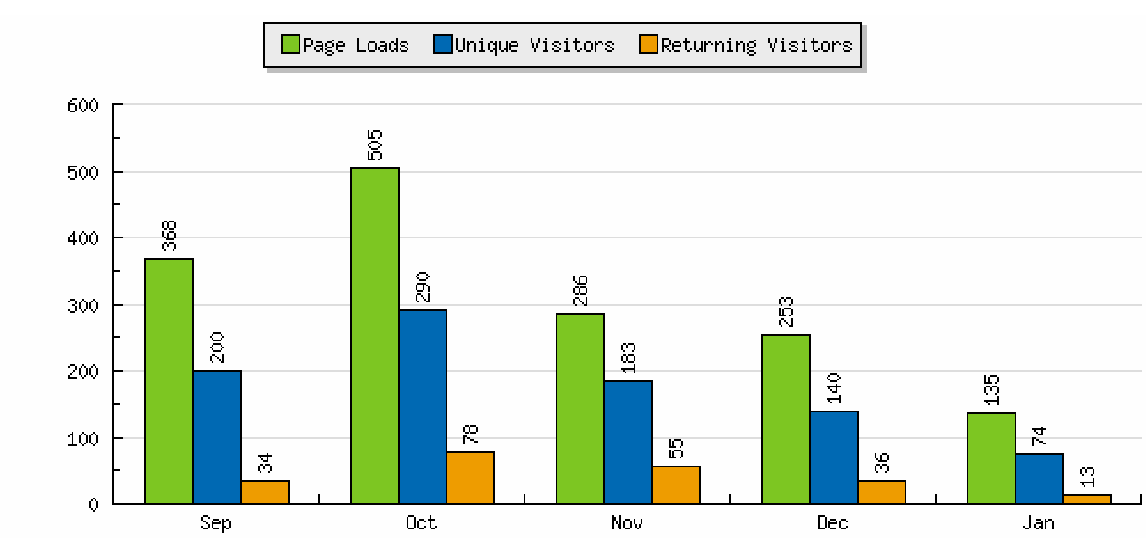
When requested, individual briefings were conducted with the following agencies' staff and elected leadership:

- City of Sugar Land
- City of Houston
- Fort Bend County
- Harris County
- H-GAC Technical Advisory Committee (TAC)
- H-GAC Transportation Policy Council (TPC)
- The Honorable Rick Noriega, State Representative
- Port of Freeport
- Port of Houston Authority
- TxDOT Beaumont District
- Westchase District

Website

A website (www.houstonrailplan.com) was developed to inform the public of the identified improvements included in this study and to obtain feedback. The website was initially launched in June to give advance notice of the August 25, 2006 workshop. The study description and participants were posted in mid-July, and information was provided on identified improvements. Throughout September and October, the information was updated.

As noted by the visitation statistics below, an average of 309 page loads were recorded per month (visitation monitoring began in September).



	Page Loads	Unique Visitors	First Time Visitors	Returning Visitors
Total	**1,547**	**887**	**671**	**216**
Average	309	177	134	43

Month	Page Loads	Unique Visitors	First Time Visitors	Returning Visitors
Jan 2007	135	74	61	13
Dec 2006	253	140	104	36
Nov 2006	286	183	128	55
Oct 2006	505	290	212	78
Sep 2006	368	200	166	34

Returning Visitors: Based purely on a cookie, if this person is returning to this website for another visit within an hour or later.	**First Time Visitors:** Based purely on a cookie, if this person has no cookie then this is considered their first time at this website.
Unique Visitors: Based purely on a cookie, this is the total of the returning visitors and first time visitors.	**Page Load:** The number of times this page has been visited.

Table 2-2: Visitation Statistics for Freight Study Website.

Comments

TxDOT received approximately 40 comments on the identified improvements via comment cards, the website, and mailed correspondence.

Comments afforded a meaningful way for local citizens and elected officials to provide the team with more detailed information about local conditions. Within the study’s eight-county area, most comments were received from individuals within Pecan Grove, Sugar Land, and Richmond/Rosenberg; and centered on concerns about the impact certain crossing closures would have on isolating certain properties. There also were several comments about the relocation of or double-tracking the railroad along the US 90A corridor.

In response to this valuable input on local conditions and needs, adjustments were made to identified grade crossing separations and closures that would still fulfill the study's goals to foster improved safety and reduced congestion, while maintaining property access.

SECTION 3: FREIGHT OPERATIONAL STUDY

Introduction

The Freight Operational Study is intended to supplement and provide guidance to the Houston region in determining the future situation for truck and rail freight activity. The process, to begin to explore the future freight outlook, requires that the best available tools are used to examine the current/base year (1998) and future year (2025) commodity flows within the Houston region. This section of the study describes the available tools as well as the freight modeling process and methods. Following the modeling methods section, technical information is provided on truck freight flows, rail freight movements to and from the Houston region, and finally a comparison of truck and rail movements. By understanding the movement of truck and rail freight, the region can begin to develop ways to accommodate and capitalize on future commodity movements.

Freight Model Methods

The primary tool used to determine future truck and rail freight activity is the Texas Statewide Analysis Model, referred to as "SAM". SAM is a travel demand simulation modeling package developed for and used by TxDOT to study and evaluate the movement of people and freight throughout the State. The SAM is a large group of interrelated models that generate passenger trip estimates and freight tonnage flows for highway, aviation, and railroad networks, as well as waterway facilities along the Texas gulf coast. The maps and data produced by the SAM are useful in planning transportation system improvements and addressing future state transportation system needs and priorities.

SAM was developed using base year (1998) transportation planning data to validate the adequacy of the model in estimating passenger flows by travel mode. In urban areas such as Houston, Dallas-Fort Worth, San Antonio, Austin, etc. transportation data from existing urban models was extracted. In the remaining rural areas, national and State travel survey and demographics data (population, employment, and other socioeconomic factors) was used to prepare travel estimates, which were then compared to traffic counts. SAM freight models were used to develop estimates of freight flow (tonnage) and heavy truck traffic.

Freight Model Calibration

Transportation and travel survey data necessary for freight modeling is less comprehensive than for passenger modeling. Therefore, SAM was developed using information from census employment data and H-GAC existing and future transportation networks to create a 1998 (base) and 2025 (forecast) models.

To calibrate the base year (1998) model three primary sources were used:

- **Reebie Transearch Database** – This 1998 survey data includes a sample of all Texas freight movements (within, to, from, and through the State), but does not include freight movements between Texas and Mexico.
- **Wharton Economic Forecasting Associates (WEFA)** – Similar to the Reebie data, the WEFA data included only intra-U.S. flows and did not include freight movements between Texas and Mexico.
- **Latin America Trade Transportation Study (LATTS)** – This study collected data from the DRI/Mercer World Sea Trade Service (WSTS), which integrates world trade databases and economic/trade models to produce historical data and forecasts of freight movements around the world.

Additionally, Surface Transportation Board (STB) Waybill Data from 2002, 2003, and 2004 was obtained and used as another level of calibration for freight rail movements throughout the State. The STB data, along with actual rail tonnage maps provided by the freight railroads, were compared as a process check to validate current rail freight volumes, thus establishing a valid prediction of rail freight movements throughout the State. For freight rail only, additional calibration was completed for a new base year (2004) and the forecast year (2025) using the following source:

- **Surface Transportation Board (STB)** – The STB collects freight flow information directly from freight management companies. The STB's data is considered to be an accurate sampling of freight flow.

After the development and calibration of the model, origin and destination information is extracted from the model and assigned to the base / forecast year transportation networks (autos, trucks, and rail). These assigned traffic volumes are then used in planning activities for the base and forecast years to take proactive measures to improve circulation and mobility.

The freight model produces freight flow tonnage estimates based on the 11 following commodity types:

- Agriculture
- Building materials
- Chemicals/petroleum
- Food
- Hazardous
- Wood
- Machinery
- Miscellaneous mixed
- Raw materials (i.e. coal)
- Secondary
- Textiles

Trip Generation

Trip generation is the process of converting people and jobs into trips. These trips become auto trips, truck trips, and in this case tons of commodities. All trip generation model estimates for the freight model were developed at the county level because Reebie and STB freight data was defined in terms of freight origins and destinations as counties. More specifically, the trip generation model applies equations relating variables for employment types and special freight handling facilities to the tonnages produced or attracted to individual counties. Freight transportation demand growth is affected by increases in both employment and worker productivity. The trip generation equations estimate freight tonnages based on employment and productivity increases; the resulting estimates were then compared to 1998 Reebie control total data and the equations iteratively adjusted to obtain reasonably accurate freight tonnage estimates by commodity and by movement type. *In short, freight movement was calculated using scientific equations; these calculations were compared to freight data from individual counties from 1998, and adjustments were made to develop accurate totals to use in the study.*

Finally, average daily trip tables were obtained by dividing the annual values by 365 (the number of days in a year). The freight model-estimated overall tonnage movements at county and region level are reasonable and accurate in replicating base and future freight movement. The freight flow estimates over the various highway network routes is also reasonably accurate.

2025 Roadway Network

The SAM model includes roadway improvements through the year 2025. These improvements represent anticipated roadway improvements based on future growth and mobility needs. For instance, IH 10 is widened in the 2025 network from four lanes to six lanes. Table 3-1 and Figure 3-1 depict the network improvements updated in the SAM to reflect projects cited in the Regional Transportation Plan (RTP).

Route	Improvement Type	Description
Barker Cypress	From 2 to 4 Lanes	From FM 529 to US 290
BS 146E	From 2 to 4 Lanes	From Brazos River to FM 1093
BS 288B	From 4 to 6 Lanes	From Harris-Brazoria C/L to SH 6
BU 90U	New 4-Lane	From Ft. Bend Toll to FM 521
Clay Road	From 2 to 4 Lanes	From Thompsons Ferry to Bethany
FM 149	From 2 to 4 Lanes	From FM 1791 to SH 249
FM 270	From 2 to 4 Lanes	From NASA 1 to FM 518
FM 359	From 2 to 4 Lanes	From FM 1093 to IH 10 W
FM 517	From 2 to 4 Lanes	From SH 35 to SH 146
FM 518	From 2 to 4 Lanes	From FM 270 to SH 146
FM 519	From 2 to 4 Lanes	From SH 6 to IH 45S
FM 521	From 2 to 4 Lanes	From SH 36 to SH 33
FM 528	From 4 to 6 Lanes	From FM 518 to IH 45S
FM 529	From 2 to 6 Lanes	From SH 99 to US 290
FM 646	From 4 to 6 Lanes	From FM 2090 to Community Dr.
FM 723	From 2 to 4 Lanes	From US 59 to FM 1093
FM 762	From 2 to 4 Lanes	From FM 1114 to FM 2759
FM 865	From 2 to 4 Lanes	From Airport Blvd. to FM 518
FM 1010	From 4 to 6 Lanes	From SH 249 to Memorial-Chase
FM 1093	From 2 to 4 Lanes	From SH 99 to FM 1489
FM 1097	From 2 to 4 Lanes	From FM 149 to Mont.-Waller C/L
FM 1098	From 2 to 4 Lanes	From FM 2920 to Spring-Cypress
FM 1314	From 2 to 4 Lanes	From SH 249 to Montgomery C/L
FM 1463	From 2 to 4 Lanes	From US 59 to IH 10W
FM 1464	From 2 to 4 Lanes	From FM 1093 to US 90
FM 1484	From 2 to 4 Lanes	From Clay Road to Barker Cypress
FM 1485	From 2 to 4 Lanes	From Langham Crk. to Bark. Cyp.
FM 1488	From 2 to 4 Lanes	From IH 45N to Mont.-Waller C/L
FM 1764	From 2 to 4 Lanes	From SH 6 to IH 45S
FM 1774	From 2 to 4 Lanes	From FM 2920 to SH 105
FM 1960	From 4 to 8 Lanes	From IH 45N to E. of Hardy Tollway
FM 2004	From 2 to 4 Lanes	From SH 36 to FM 1765
FM 2090	From 2 to 4 Lanes	From Kluge Road to Spring Cypress
FM 2100	From 2 to 4 Lanes	From SH 99 to FM 1960
FM 2100	From 2 to 4 Lanes	From FM 1960 to US 90
FM 2234	From 2 to 4 Lanes	From US 59 to SH 288
FM 2759	From 2 to 4 Lanes	From FM 762 to US 59
FM 2854	From 2 to 4 Lanes	From US 75N to Roman Forest Rd.

Table 3-1: Future Network Improvements (1998 to 2025)

Route	Improvement Type	Description
FM 2978	From 2 to 4 Lanes	From FM 2920 to FM 1488
FM 3005	From 2 to 4 Lanes	From SS 342 to Spring Creek
FM 3083	From 2 to 4 Lanes	From SH 105 to FM 1485
FS 1640	From 2 to 4 Lanes	From UA 90 to FM 2218
Ft. Bend Toll Rd.	New 6-Lane	From SH 99 to Ft. Bend-Harris C/L
Hardy	From 4 to 6 Lanes	From BW 8 to IH 45/SH 99
IH 10E	From 4 to 6 Lanes	From FM 2100 to SH 61
IH 45	From 4 to 6 Lanes	From SH 24 to Mont.-Waller C/L
IH 610	From 8 to 10 Lanes	From Westheimer to IH 10E
MLK	From 2 to 4 Lanes	From IH 610S to BW 8
SH 3	From 2 to 4 Lanes	From IH 10 to SH 99
SH 6	From 4 to 6 Lanes	From FM 1092 to SH 289
SH 35	From 6 to 8 Lanes	From IH 610S to Alvin
SH 36	From 2 to 4 Lanes	From SH 35 to US 59
SH 75	From 2 to 4 Lanes	From Galveston C/L to SH 288
SH 99	New 4-Lane	From FM 529 to Chambers C/L
SH 99	From 2 to 4 Lanes	From SH 146 to BUS 146
SH 105	From 2 to 4 Lanes	From Grimes C/L to E. of FM 149
SH 321	New 4-Lane	From FM 3083 to FM 1484
SH 146	From 2 to 6 Lanes	From US 90 to Liberty C/L
SH 242	From 2 to 4 Lanes	From E. of IH 45N to US 59
SH 249	From 4 to 6 Lanes	From Spring Cypress to FM 149
SH 249	From 2 to 4 Lanes	From FM 149 to FM 1774
SL 8	From 2 to 4 Lanes	From IH 610 to Sam Houston Toll
SL 197	From 2 to 4 Lanes	From SH 146 to FM 1764
SL 207	From 2 to 6 Lanes	From SH 146 to SH 146
SL 227	From 2 to 6 Lanes	From SH 146 to US 90
SL 336	From 2 to 4 Lanes	From IH 45N to FM 1484
SL 494	From 2 to 4 Lanes	From Mont. C/L to FM 1485
SP 10-SH 36 Bypass	From 2 to 4 Lanes	From SH 6 to Brazoria C/L
SS 55	From 2 to 4 Lanes	From Harris-Chamb. C/L to FM 1405
SS 330	From 4 to 6 Lanes	From IH 10E to SH 146
SS 548	From 4 to 6 Lanes	From SH 249 to US 59
US 59	From 4 to 10 Lanes	From BS 59 to Harris-FT.Bend C/L
UA 90	From 4 to 8 Lanes	From Fm 723 to Ft. Bend C/L
US 90	From 2 to 4 Lanes	From SH 146 to Liberty C/L
Westpark Toll Rd.	From 2 to 4 Lanes	From LP 573 to SH 105
Woodlands Pky.	From 2 to 4 Lanes	From Flintridge to Montgomery C/L

Table 3-1(continued): Future Network Improvements (1998 to 2025)

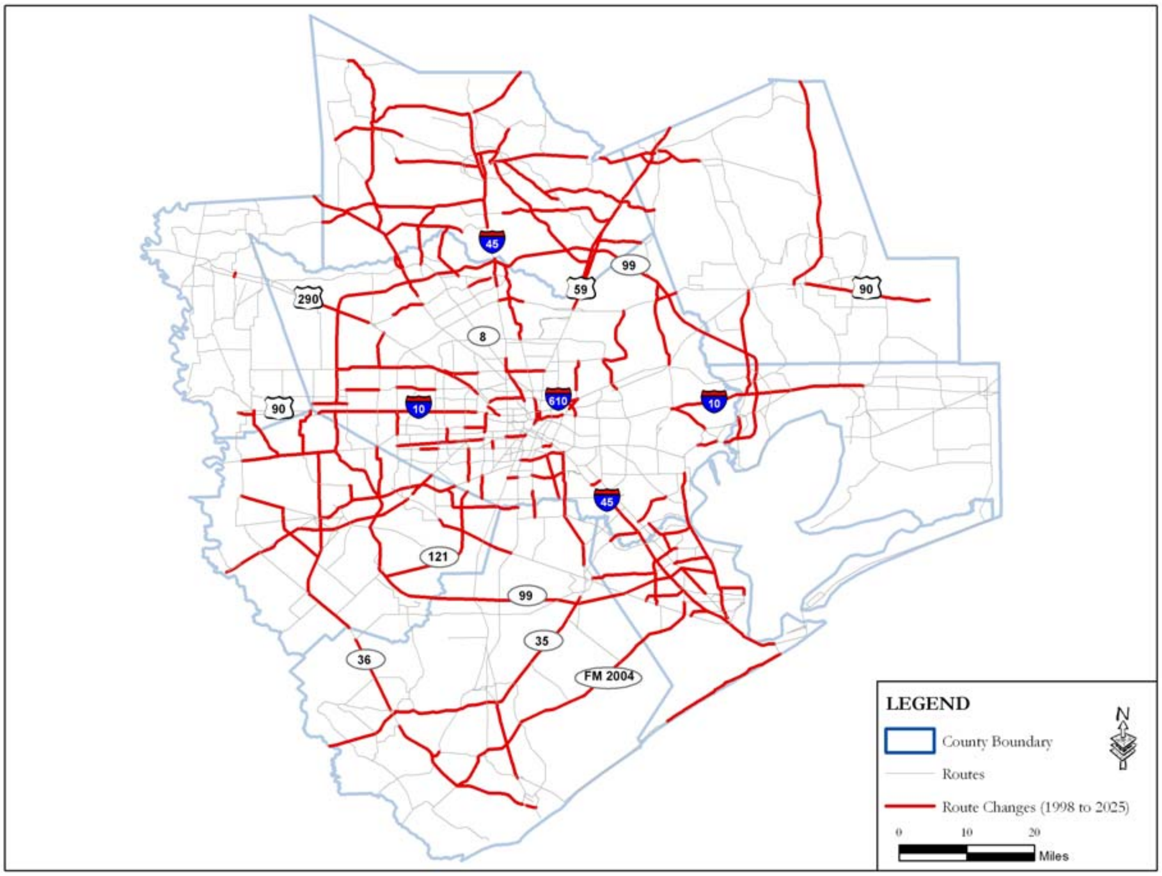


Figure 3-1: Future Roadway Network Improvements (1998 to 2025)

Mode Choice and Assignment

The statewide freight flow tonnage estimates (produced at the county level) are allocated to highway, rail, and waterway modes by a mode choice model. While rail and waterborne movements were assigned to their respective networks at the county level, the highway freight tonnage estimates were disaggregated to even smaller geographic areas (traffic analysis zones — TAZ) prior to being assigned to the road network. In addition, heavy truck flow estimates for the highway network were derived through factoring of the freight tonnage estimates (variables of vehicle load factor [by commodity group and related trip length] were applied to the freight tonnage values).

The following section discusses truck freight movements, percentages, and finally truck traffic and associated issues.

Truck Freight Movements and Commodities

The movement of truck freight within, into, and out of the Houston region is significant today and will continue to be a significant method of transport of goods and materials for the state of Texas and the country.

Truck Movements for the Houston Region, Texas, and the Country

The freight modeling efforts yielded truck tonnage movement within, into and out of the Houston region. Table 3-2 helps to illustrate the point that while the movement of truck tons staying within the Houston region will increase by more than 54 million tons, it pales in comparison to the increased movements coming into and out of the Houston region. These figures demonstrate that the Houston region truck freight activity has an important economic role for the state of Texas and the nation as a whole.

Annual Truck Tons – Houston Region				
Origin	**Termination**	**1998**	**2025**	**% Change**
Internal to Internal (Including the Ports of Houston and Freeport)				
Houston Region	Houston Region	28,091,158	82,356,496	193%
Internal to External				
Houston Region	Ports of Houston and Freeport	5,075,837	10,571,661	108%
Houston Region	Other Texas Counties	53,048,980	193,012,432	264%
Houston Region	Western US	899,352	2,530,571	181%
Houston Region	Northern US	5,396,111	15,183,427	181%
Houston Region	Eastern US	19,785,739	55,672,564	181%
Houston Region	Mexico	5,396,111	15,183,427	181%
	Total	**89,602,130**	**292,154,082**	**226%**
External to Internal				
Ports of Houston and Freeport	Houston Region	7,613,756	15,857,491	108%
Other Texas Counties	Houston Region	48,596,443	194,326,408	300%
Western US	Houston Region	819,597	3,426,565	318%
Northern US	Houston Region	4,917,585	20,559,393	318%
Eastern US	Houston Region	18,031,144	75,384,441	318%
Mexico	Houston Region	4,917,585	20,559,393	318%
	Total	**84,896,110**	**330,113,691**	**289%**
External to External				
Northern US	Mexico	7,270,658	29,584,897	307%
Mexico	Northern US	961,325	6,106,186	535%
Eastern US	Mexico	12,590,234	49,347,566	292%
Mexico	Eastern US	7,445,574	34,130,624	358%
	Total	**28,267,791**	**119,169,273**	**322%**

Table 3-2: Truck Freight Movements not including Ports of Houston and Freeport
(Source: Statewide Analysis Model based on 1998 Reebie Transearch Data, Wharton Economic Forecasting Associates and Latin American Trade Transportation Study)

Table 3-3 depicts the truck freight movements to and from the Port of Houston and Port of Freeport, which is not included in Table 3-2, unless noted otherwise in the table.

Annual Truck Tons – Ports of Houston and Freeport				
Origin	**Termination**	**1998**	**2025**	**% Change**
Internal to External				
Ports	Houston Region	7,613,756	15,857,491	108%
Ports	Other Texas Counties	43,707,892	91,210,384	109%
Ports	Western US	740,990	1,195,852	61%
Ports	Northern US	4,445,941	7,175,115	61%
Ports	Eastern US	16,301,783	26,308,754	61%
Ports	Mexico	4,445,941	7,175,115	61%
	Total	**77,256,303**	**148,922,711**	**93%**
External to Internal				
Houston Region	Ports	5,075,837	10,571,661	108%
Other Texas Counties	Ports	40,039,377	91,831,320	129%
Western US	Ports	675,279	1,619,265	140%
Northern US	Ports	4,051,676	9,715,589	140%
Eastern US	Ports	14,856,144	35,623,828	140%
Mexico	Ports	4,051,676	9,715,589	140%
	Total	**68,749,989**	**159,077,252**	**131%**

Table 3-3: Truck Freight Movements To/From the Port of Houston and Port of Freeport Only

(Source: Statewide Analysis Model based on 1998 Reebie Transearch Data, Wharton Economic Forecasting Associates and Latin American Trade Transportation Study)

Truck Movements within Texas

This section shows major origin and destinations for truck freight within Texas. Figure 3-2 illustrates that in 1998 large numbers of trucks were moving between Houston, Laredo, the Lower Rio Grade Valley, El Paso and the Dallas/Fort Worth Metroplex. Additionally, trucks were moving to other parts of the state; however, their final destination remained in the major growth markets mentioned above.

Figure 3-3 reflects many interesting trends emerging in the future. For instance, in addition to the major cities still playing a prominent role in producing and attracting truck activity, other areas along the I-35 and future I-69 corridors offer additional challenges and opportunities.

These trend maps begin to bring into focus the need to plan and accommodate for trucks along the major freeway corridors both inside and outside of the major urban centers. With already depleted capacity on most freeway facilities, new corridors, such as the Trans-Texas corridors will be needed to ensure mobility and economic opportunity.

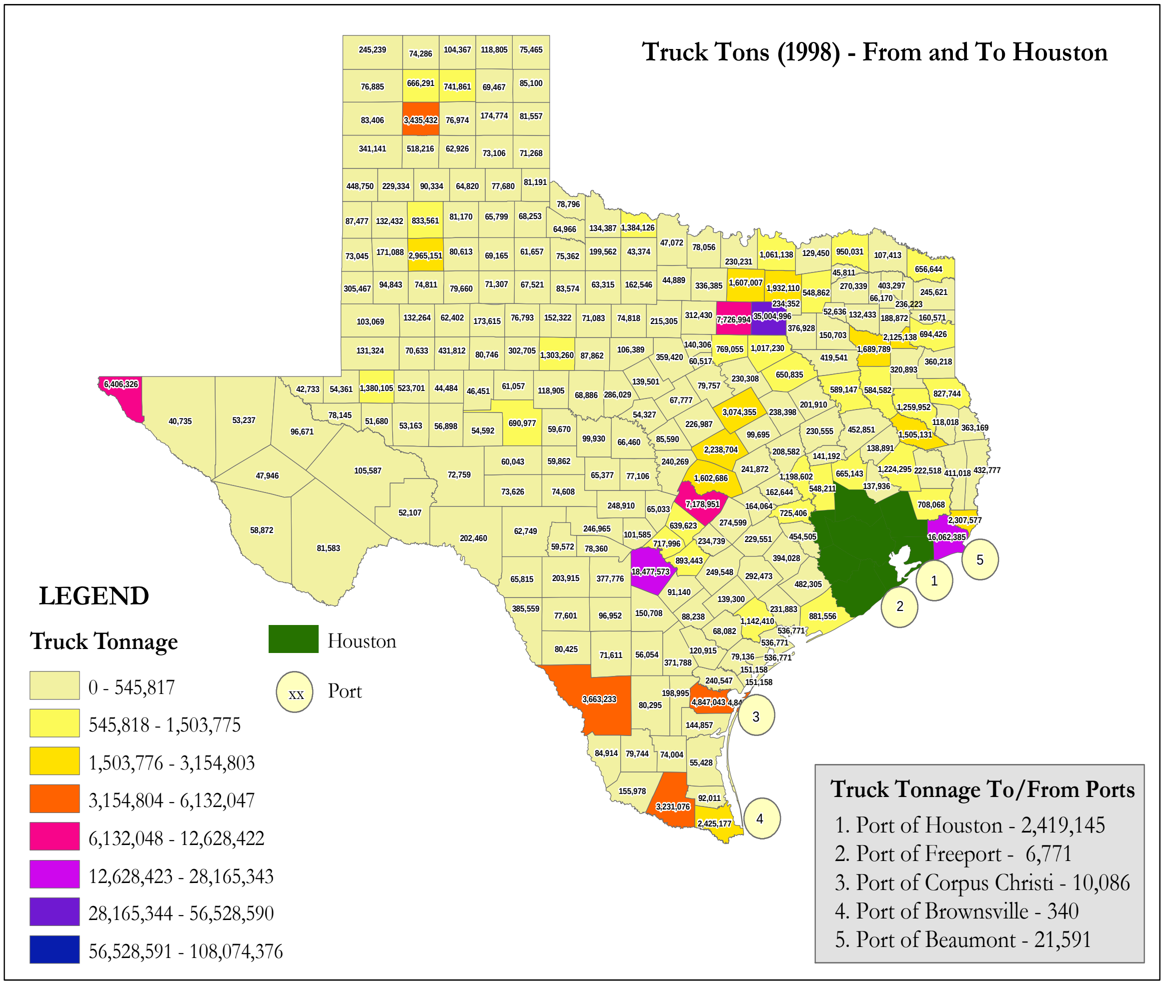


Figure 3-2: 1998 Truck Movements within Texas To and From Houston

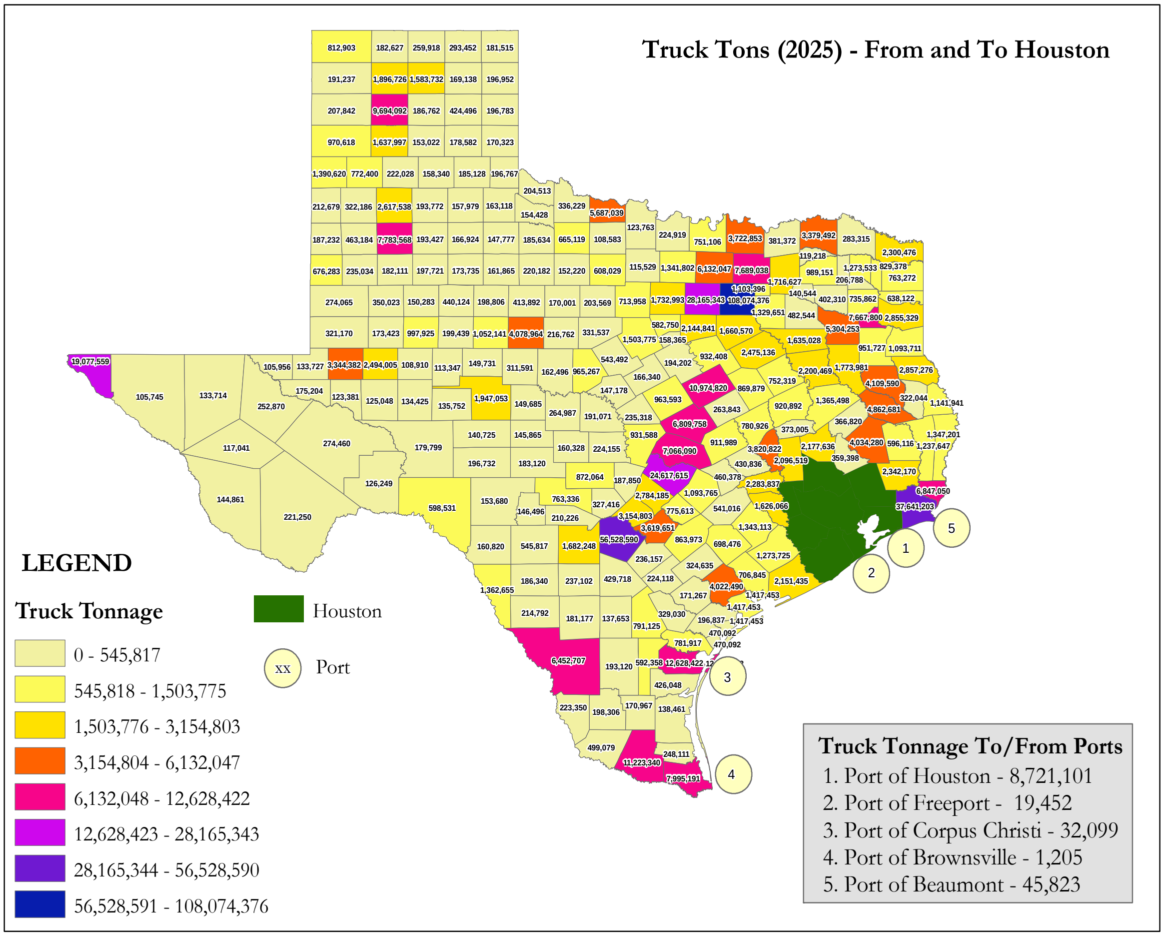


Figure 3-3: 2025 Truck Movements within Texas To and From Houston

Truck Movements Outside of Texas

Tables 3-2 and 3-3 shows a dramatic increase in truck freight activity to and from other parts of the country to the Houston region. These movements represent trucks that are relegated to long haul trips. Major movements in 1998 can be seen from Louisiana, Oklahoma, and Arkansas as shown in Figure 3-4. Similar patterns were found from Houston to destinations outside of the state. Looking again into the future of truck movements into and out of the State from the Houston region, it is clear that the trend is showing dramatic increases in truck activity. Figure 3-5 demonstrates increased movement from Louisiana, Arkansas, and Oklahoma to the Houston region in the future.

These movements outside of the state of Texas further illustrate the need for additional truck allowances on the freeway system. Some thought must be given to the use of exclusive truck lanes, and new freeway opportunities. Additionally, with the lack of available freeway capacity, these long haul movements can be better served by shifting truck cargo to rail cars. Notice the high tonnage levels moving from Houston to the northeast through the state of Texas along the proposed Trans-Texas corridor.

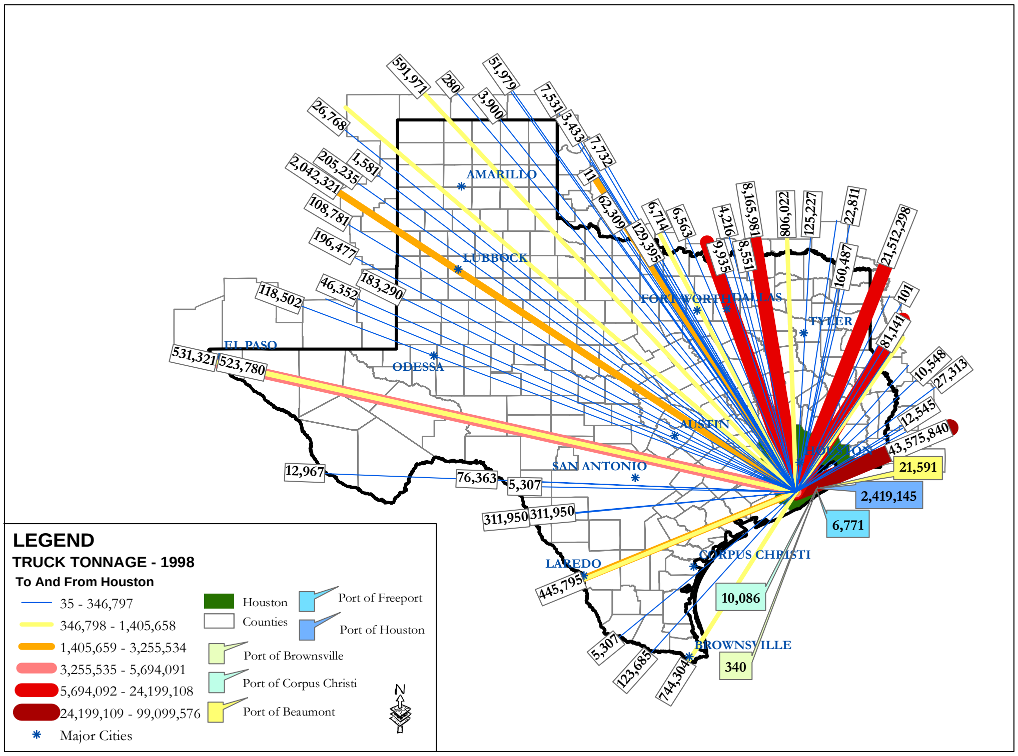


Figure 3-4: 1998 Truck Movements From Outside of Texas to Houston

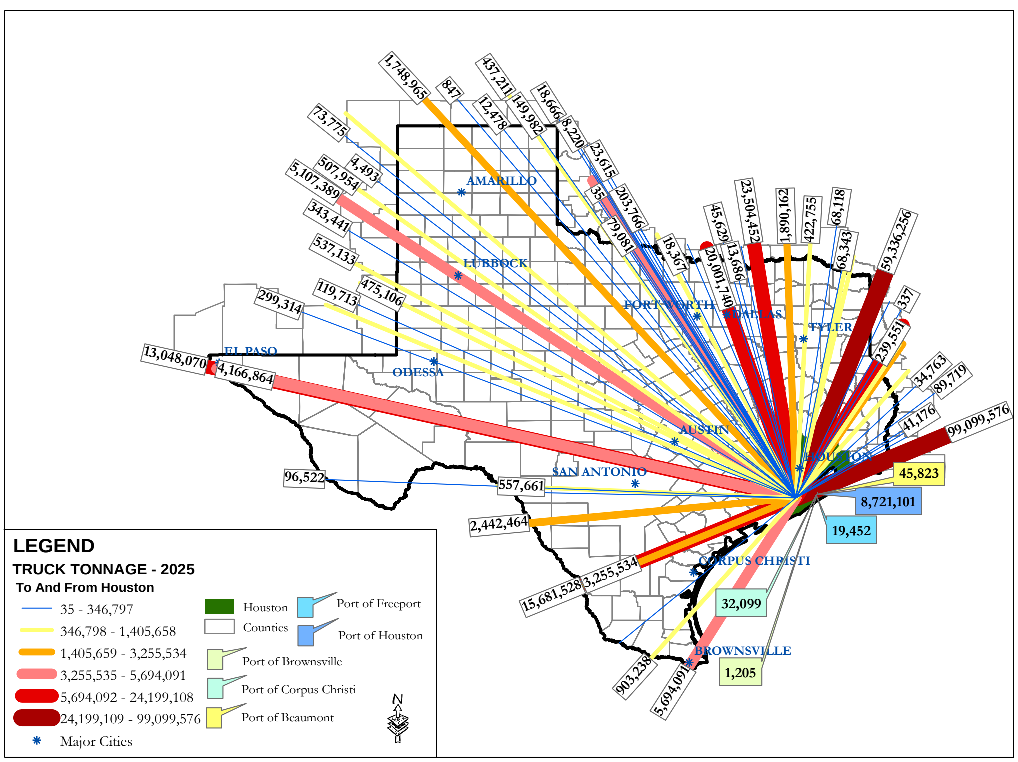


Figure 3-5: 2025 Movements From Outside of Texas to Houston

The overall truck tonnage movement from and to the Houston region was summarized by dividing the area within the state into specific areas of different distances from Houston as well as separate regions of Texas. The area inside of the state of Texas was broken into radii's of 50, 100, 300, and over 300 miles from the Houston region. The regions outside of the state were identified as Western US, Northern US, Eastern US, and Mexico. The modeling efforts allowed the study team to determine truck tonnage distribution for each area. Figure 3-6 shows the distribution of truck tonnage for each region projected in 2025.

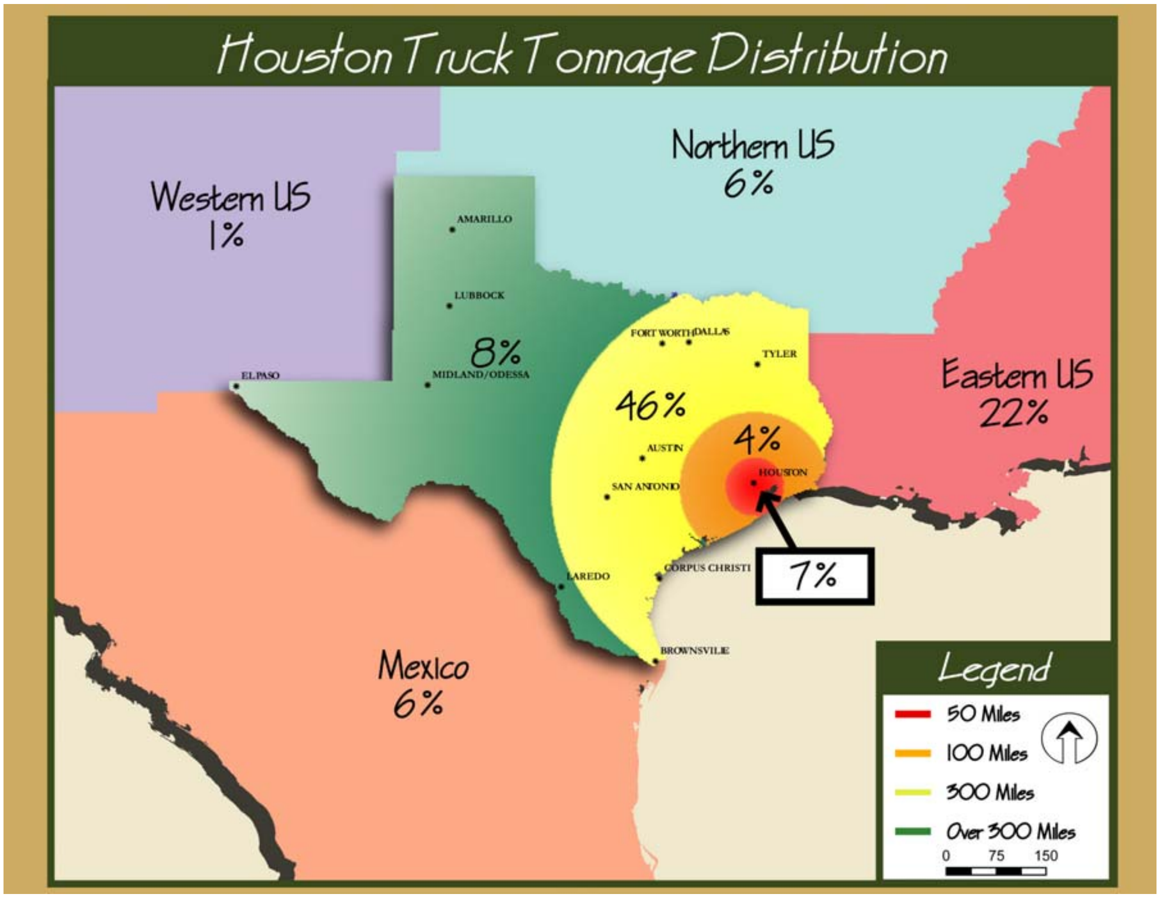


Figure 3-6: 2025 Truck Tonnage Distribution for Houston Region

The analysis showed that seven percent of truck tonnage is projected to stay within the Houston region while 46 percent is projected to travel between 100 miles and 300 miles from the area. Based on projections, nearly 60 percent of truck freight traffic could travel within 300 miles of the Houston region. Nine percent of the truck freight is distributed to an area within Texas outside of the 300 mile radius. The remaining percentages are split between Mexico (6 percent), Western US (1 percent), Northern US (6 percent), and Eastern US (22 percent).

In order to better understand these movements additional analysis was required. Specifically, the team needed to expand on the movement of freight throughout Texas through the use of commodities. The following section looks deeper into the movement of commodities in both 1998 and 2025. This section expands on how these commodities can be accommodated in the future.

Truck Commodity Trends

With the overall truck tonnage projected to more than double within the Houston region, it is important to know which commodities will have the highest rate of increase. Table 3-4 indicates that building materials will be the fastest growing commodity with approximately 6 percent yearly growth rate between 1998 and 2025. Other commodities observing similar growth are textiles (5.6 percent) and machinery (5.2 percent). All of the nine commodity groups show staggering increases and represent a very positive economic outlook for the entire Houston region. However with this amount of substantial growth, additional infrastructure will be needed.

Commodity	Truck Tons		
	1998	**2025**	**Yearly Growth Rate**
Building Materials	50,652,253	225,102,426	5.7%
Wood	24,265,243	81,856,720	4.6%
Agriculture	2,014,850	6,620,656	4.5%
Textiles	3,627,193	15,704,644	5.6%
Chemical/Petroleum	136,796,919	272,461,312	2.6%
Food	37,520,728	127,717,980	4.6%
Machinery	11,123,595	43,854,209	5.2%
Raw Materials	8,175,795	19,319,370	3.2%
Secondary	49,039,926	167,128,610	4.7%
Total	**323,216,502**	**959,765,928**	**4.1%**

Table 3-4: Truck Commodity Growth

By analyzing commodities we can further understand the makeup of freight tonnage. The greatest commodity volumes moving by truck are generally low value, bulk materials — consistent with traffic moving through bulk ports. The leading products moving by truck (in terms of tonnage percentage in the region) are chemical/petroleum products, building materials, food products, and wood products. Secondary materials are an exception to the low-value tendency among the top commodities (by weight). Secondary materials consist of re-handled freight from warehouse or distribution centers, and the truck drayage portions of truck/rail or truck/air intermodal trips. Figures 3-7, 3-8, and 3-9 further illustrate the commodity tonnage within the region for both 1998 and 2025.

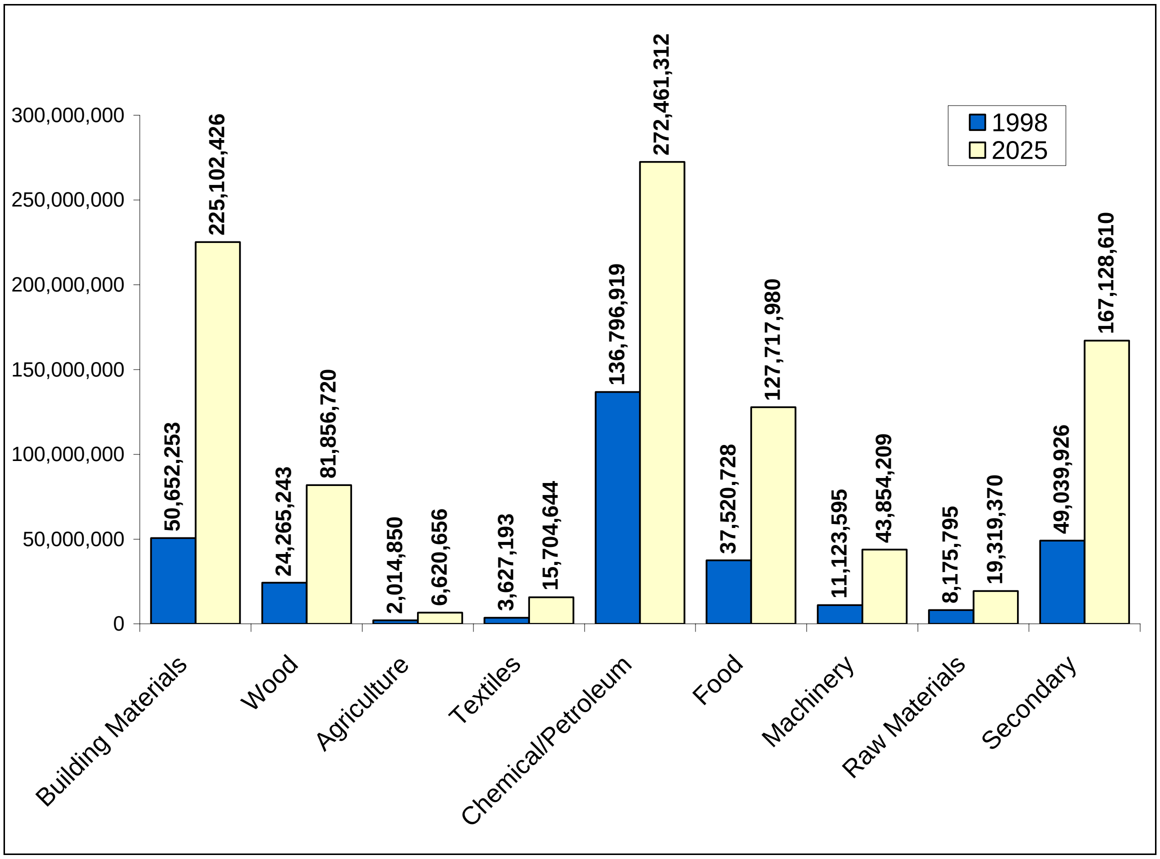


Figure 3-7: Total Truck Tons by Commodity

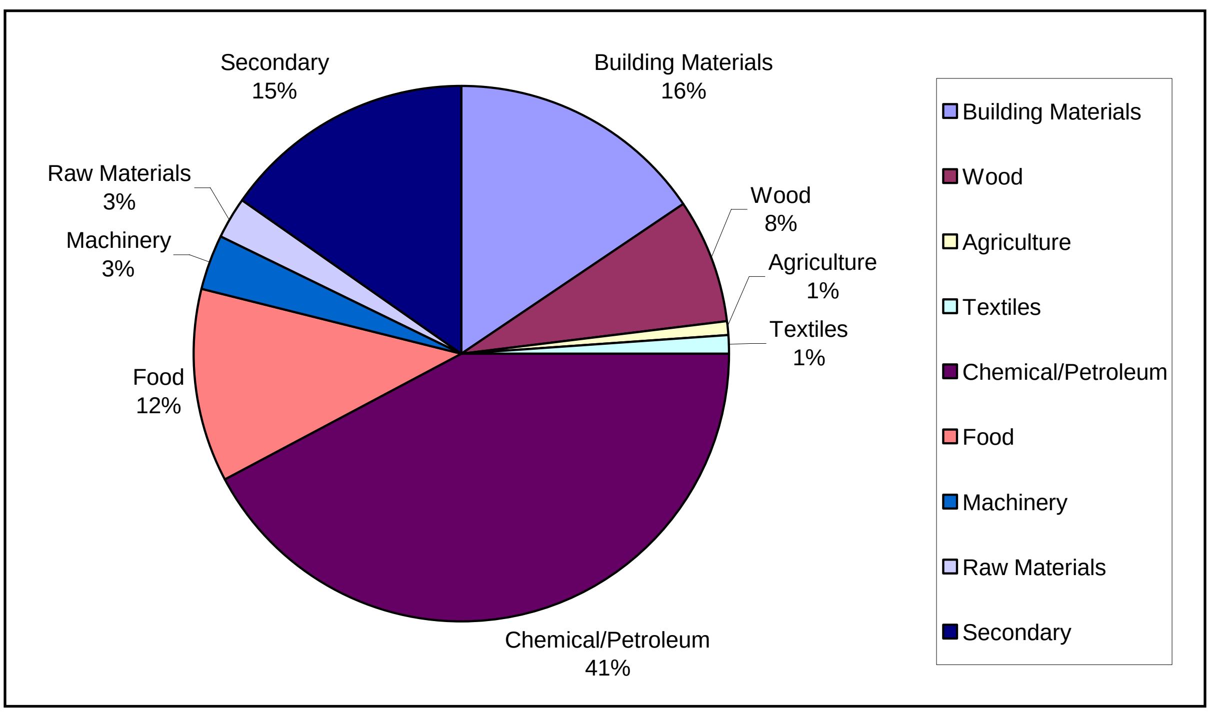


Figure 3-8: Total Truck Tons by Commodity - 1998

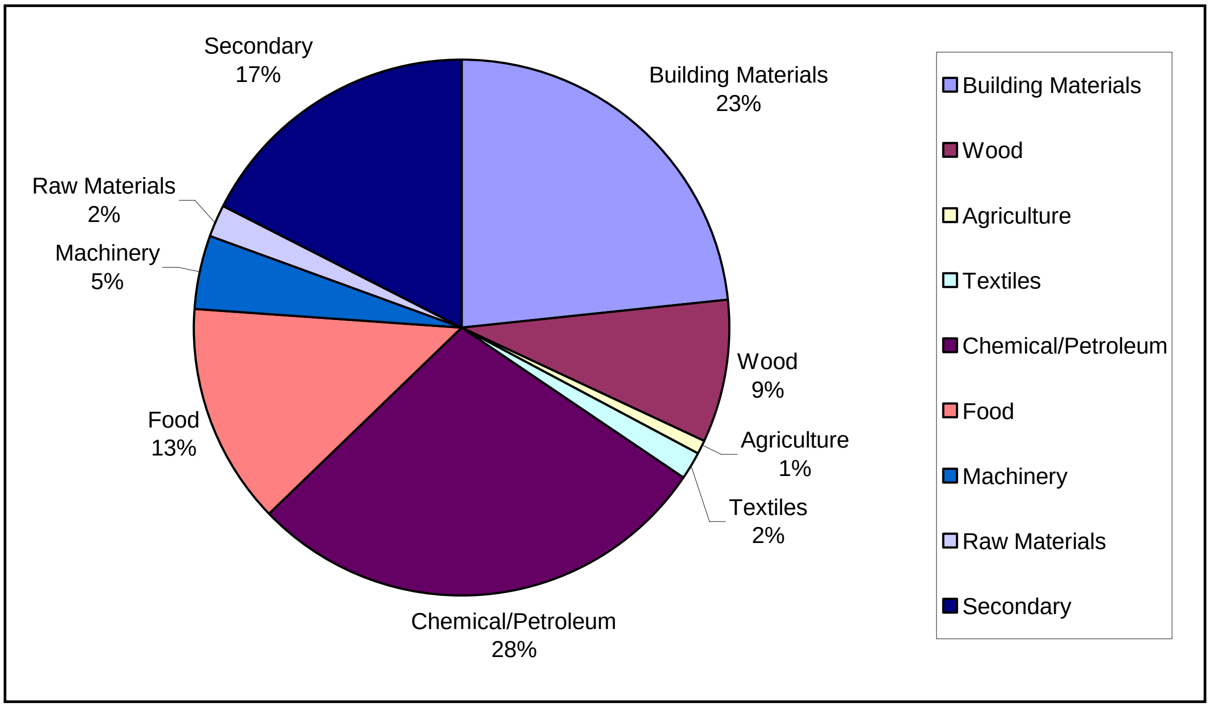


Figure 3-9: Total Truck Tons by Commodity - 2025

Once the truck freight movements were developed and the commodity types identified, the model can then assign all the tonnage to trucks and place them on the highway system. The following section illustrates the truck traffic volumes and begins to identify locations where truck traffic is the greatest.

Truck Traffic Volumes

In order to identify chokepoint areas within the Houston region that would hinder truck traffic movement, it was vital for the team to determine roadway segments that have the highest percentage of trucks both currently and in the future. Table 3-5 represents 2003 highway locations (Figure 3-10) within the Houston region where permanent count stations were located. These volumes were used to verify projected model volumes from the SAM. The SAM was used to predict future truck volumes, shown in Table 3-6**.** It is important to note that the 2025 model includes planned improvements for the roadways as outlined in Table 3-1 and Figure 3-1.

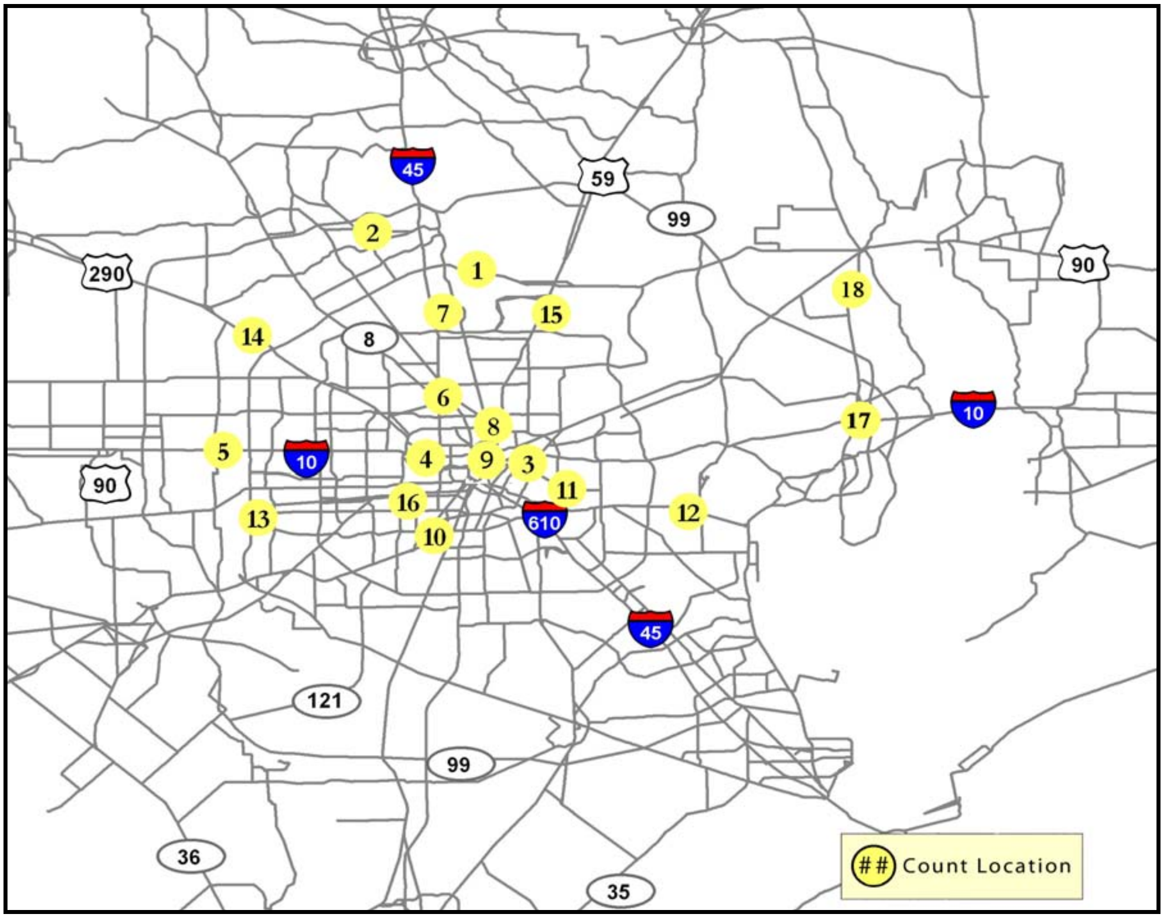


Figure 3-10: Truck Count Locations

Location	2003					
	Total Volume	% Trucks	Truck Volume	No. of Lanes	Capacity	V/C Ratio
FM 1960 E. of IH 45	46,000	3.2	1,472	8	40,000	1.15
FM 2920 W. of IH 45	39,000	6	2,262	4	40,000	0.98
IH 10 E. of US 59	163,510	9.8	15,533	8	138,000	1.18
IH 10 E. of Wirt St.	202,520	6.9	14,379	6	184,000	1.1
IH 10 W. of SH 6	145,500	9.3	12,513	6	138,000	1.05
IH 45 N. of IH 10	210,550	9	12,844	8	230,000	0.92
IH 45 N. of BW 8	263,920	8.2	14,252	8	184,000	1.43
IH 610 N. of IH 10	120,600	11.9	11,698	10	230,000	0.52
IH 610 At US 59	172,930	9.7	12,624	8	230,000	0.75
IH 610 W. of FM 521	190,150	3.2	6,275	8	230,000	0.83
IH 610 E. of IH 45	185,700	6.7	13,000	8	230,000	0.81
SH 225 E. of BW 8	22,410	11.6	2,936	6	72,000	0.31
SH 6 S. of FM 1093	49,000	6.2	2,989	6	72,000	0.68
US 290 W. of FM 1960	97,930	9.2	8,324	4	230,000	0.43
US 59 S. of FM 1960	115,930	9.8	8,695	4	230,000	0.5
US 59 W. of SH 288	197,760	8.4	14,634	6	138,000	1.43
IH 10: Chambers C/L	52,890	24.6	12,694	4	92,000	0.57
SH 146 S. of Dayton	11,100	11.3	1,077	4	20,000	0.56

Table 3-5: 2003 Truck Traffic Volumes

Location	2025					
	Total Volume	% Trucks	Truck Volume	No. of Lanes	Capacity	V/C Ratio
FM 1960 E. of IH 45	71,200	3.3	2,278	8	80,000	0.89
FM 2920 W. of IH 45	70,300	3.2	4,077	4	40,000	1.76
IH 10 E. of US 59	255,660	9.5	24,288	8	184,000	1.39
IH 10 E. of Wirt St.	289,910	7.1	20,584	6	184,000	1.58
IH 10 W. of SH 6	256,100	8.6	22,025	6	184,000	1.39
IH 45 N. of IH 10	308,870	6.1	18,841	8	230,000	1.34
IH 45 N. of BW 8	481,100	5.4	25,979	8	184,000	2.61
IH 610 N. of IH 10	191,120	9.7	18,539	10	230,000	0.83
IH 610 At US 59	269,390	7.3	19,665	8	230,000	1.17
IH 610 W. of FM 521	299,140	3.3	9,872	8	230,000	1.3
IH 610 E. of IH 45	227,260	7	15,908	8	230,000	0.99
SH 225 E. of BW 8	48,240	13.1	6,319	6	72,000	0.67
SH 6 S. of FM 1093	81,590	6.1	4,977	6	96,000	0.85
US 290 W. of FM 1960	176,670	8.5	15,016	4	230,000	0.77
US 59 S. of FM 1960	241,410	7.5	18,106	4	230,000	1.05
US 59 W. of SH 288	290,750	7.4	21,515	6	184,000	1.58
IH 10: Chambers C/L	81,770	24	19,625	4	138,000	0.59
SH 146 S. of Dayton	20,140	9.7	1,954	4	60,000	0.34

Table 3-6: 2025 Truck Traffic Volumes

Figures 3-11 and 3-12 show truck volumes within the Houston region. The volumes shown in previous tables were used to verify model volumes. As expected, the figures show an increase in truck volumes within the Houston region.

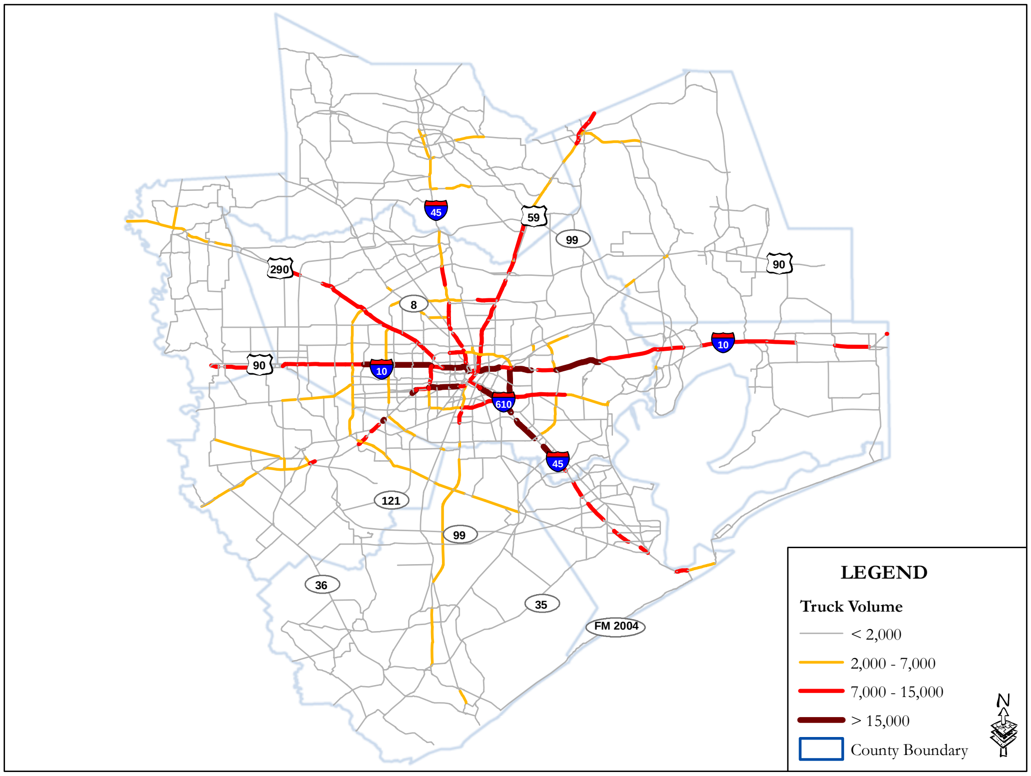


Figure 3-11: 1998 Truck Volume Flow

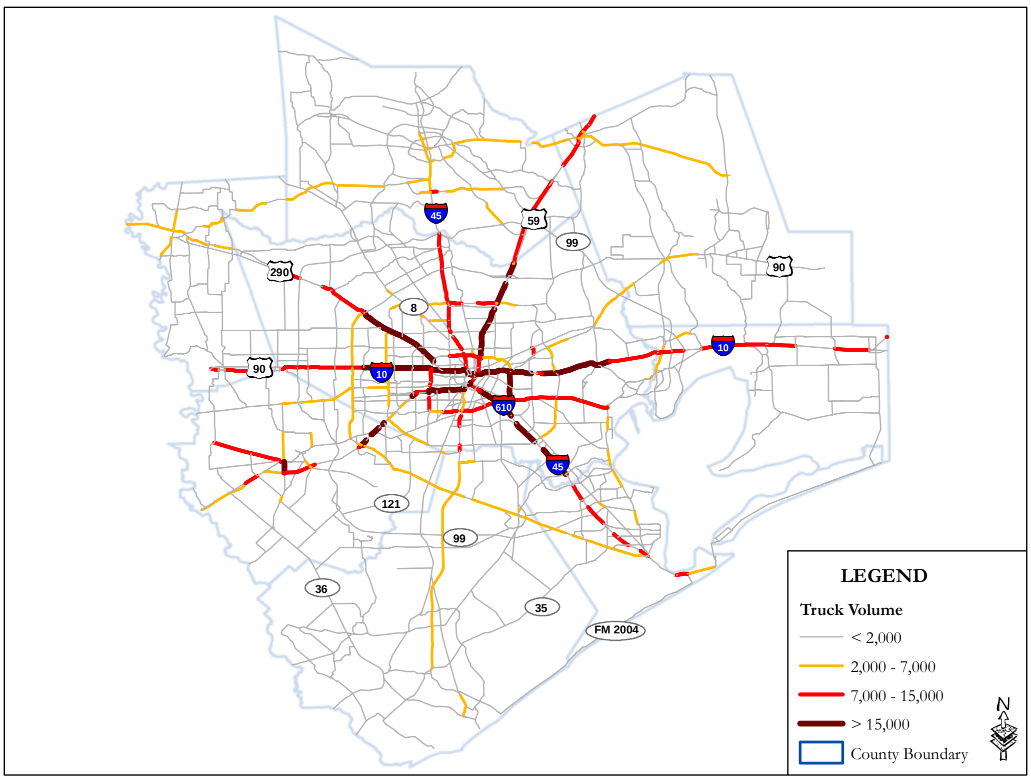


Figure 3-12: 2025 Truck Volume Flow

Truck Traffic Analysis

Once the truck volumes were established, vehicular traffic was added and congestion levels were calculated using a volume to capacity ratio (V/C). The V/C ratio is a measure of the volume of vehicles divided by the capacity of the roadway. V/C ratios are used to broadly define problem areas on major arterials and highways while allowing decision makers to make operational decisions at intersections and on-ramps. The V/C defines whether or not a roadway can fulfill the demand on the roadway. The higher a V/C, the more congested a roadway will become. The following descriptions are typically used for the various levels of V/C:

- V/C greater than 1.0 = Severe Congestion
- V/C of .90 to 1.0 = Heavy Congestion
- V/C of .65 to .90 = Moderate Congestion
- V/C of less than .65 = Low or No Congestion

Using the model, roadway segments that resulted in a V/C of over 0.90 were considered congested. While it would be desirable to improve all areas that have any congestion, it is not always feasible due to economic considerations. Therefore, identifying areas with a V/C over 0.90 seemed reasonable. Figures 3-13 and 3-14 show base year and projected levels of congestion at various locations. Even with the planned improvements, the congestion levels are projected to continue to grow significantly. As expected the highest areas of congestion are located inside Beltway 8 in Houston.

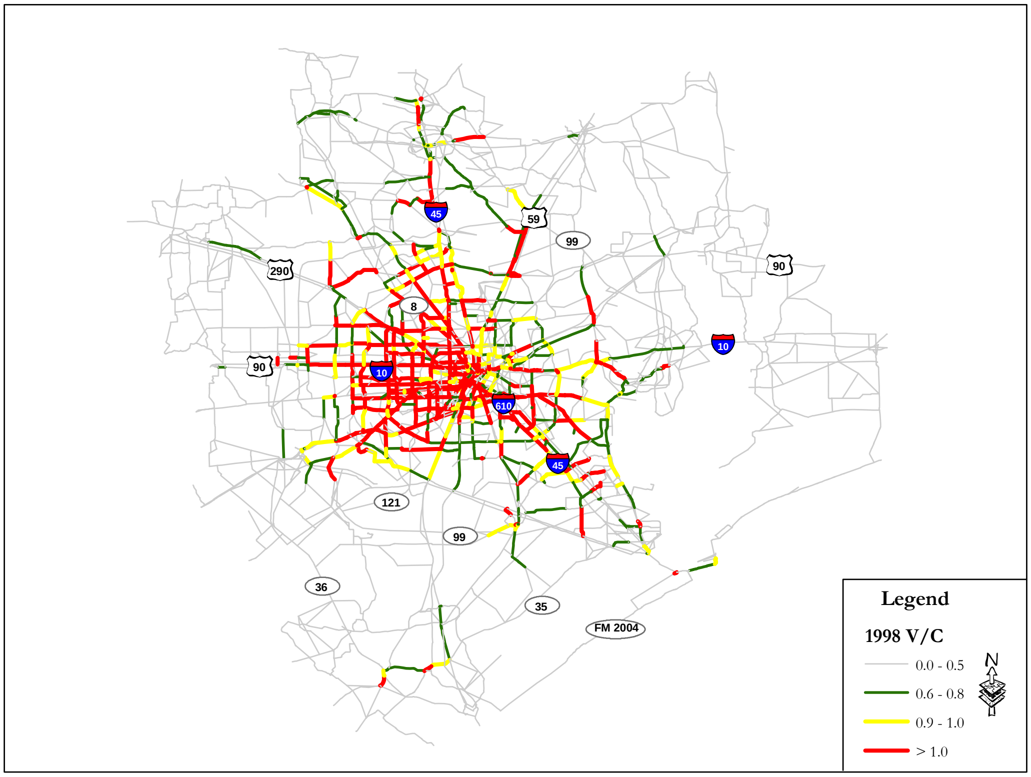


Figure 3-13: 1998 Volume to Capacity Ratio

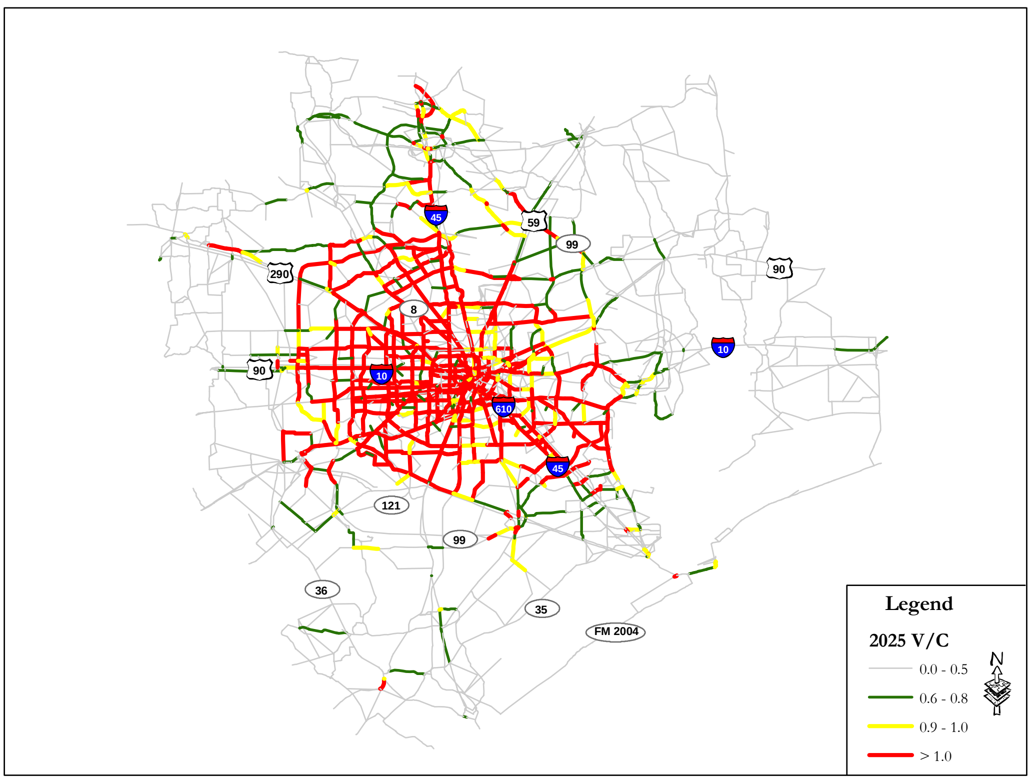


Figure 3-14: 2025 Volume to Capacity Ratio

The efficiency of truck and vehicle movement was evaluated by determining the travel distance within specific time periods from the Ports of Houston and Freeport. The following figures illustrate the benefit of the planned improvements, as described in Table 3-1, by showing the additional distance that vehicles and trucks can travel from the Ports of Houston and Freeport. Figure 3-15 shows the distance that vehicles are projected to travel from the Port of Houston if no capacity improvements were implemented in the Houston region, while Figure 3-16 illustrates the projected distance that could be traveled if the planned improvements were constructed.

The results show that the distance that a truck could travel would be much greater once the planned improvements are constructed. The planned improvements for the Houston region as well as those improvements planned in other regions were incorporated for this analysis. For instance, with planned improvements it is projected that trucks could travel from the Ports through the Dallas/Fort Worth Metroplex within the studied time frames. Without the planned improvements incorporated throughout the state, truck traffic would not be able to travel through the Dallas/Fort Worth Metroplex within the eight hour travel time.

Figures 3-17 and 3-18 show similar results for trips originating at the Port of Freeport. It was estimated that a truck traveling on a roadway network with the planned improvements would be approximately 60 miles or one hour ahead of a truck traveling on the No-build Network.

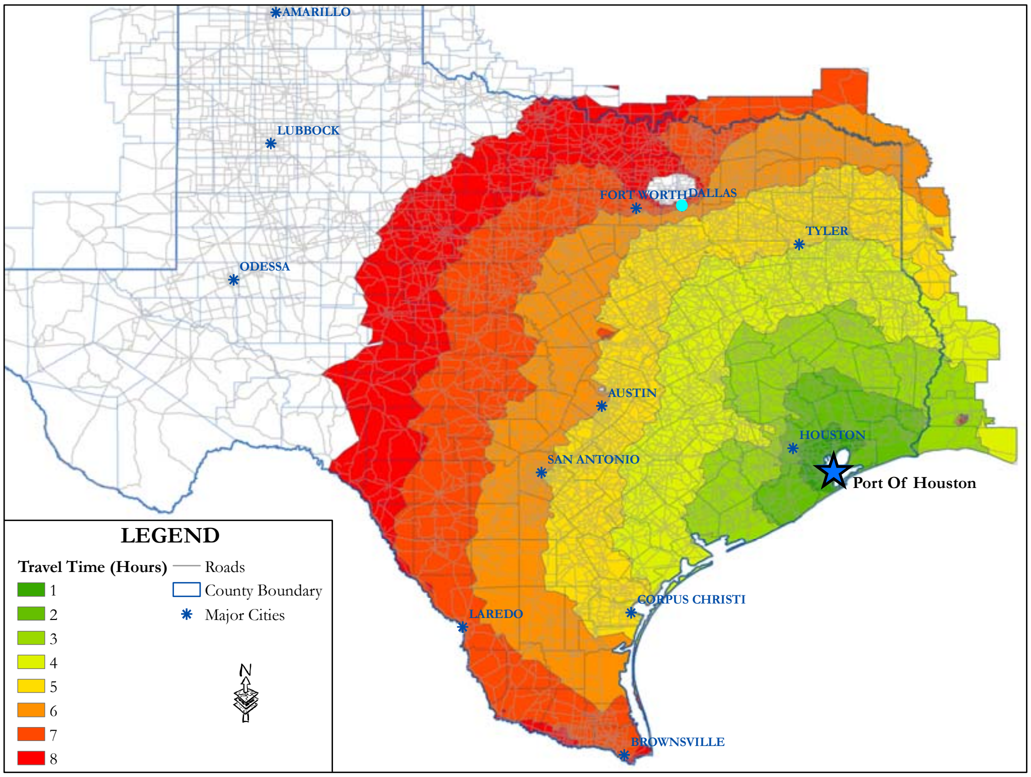


Figure 3-15: Port of Houston Travel Time Map with No-Build Network

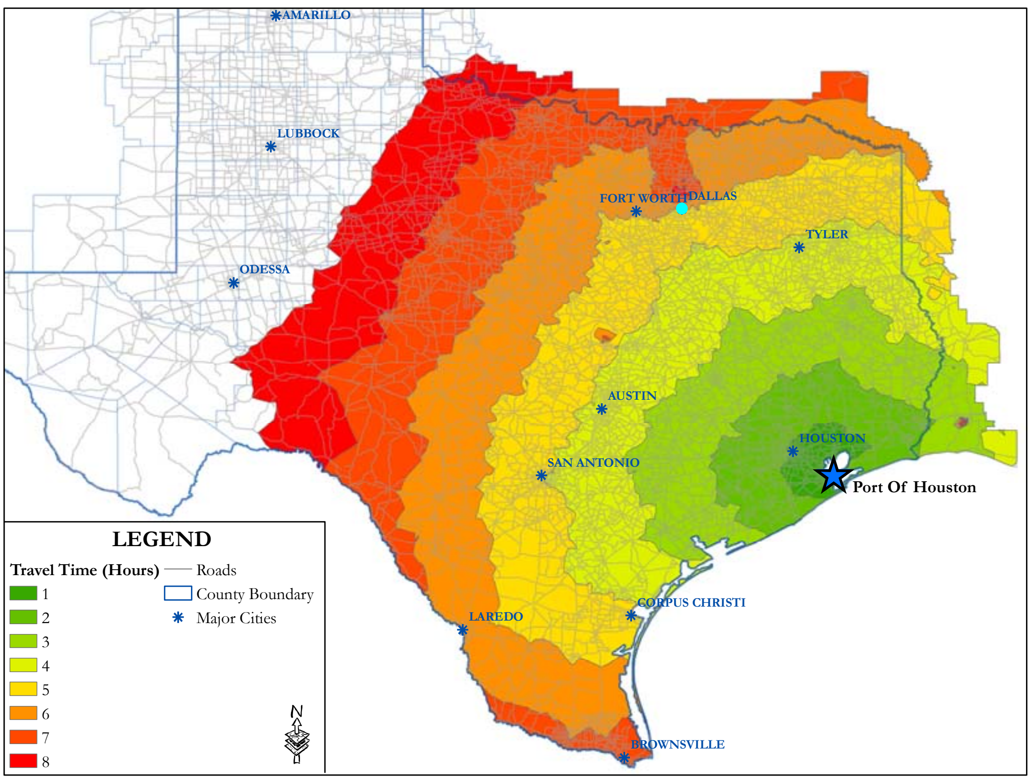


Figure 3-16: Port of Houston Travel Time Map with Planned Improvements

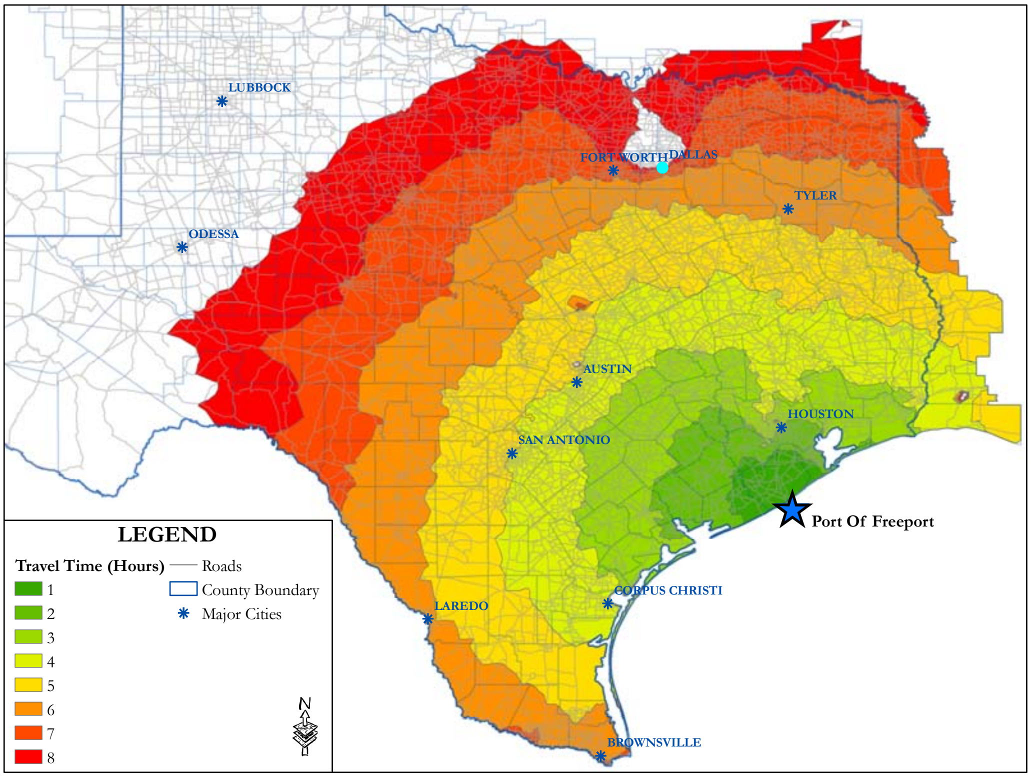


Figure 3-17: Port of Freeport Travel Time Map with No-Build Network

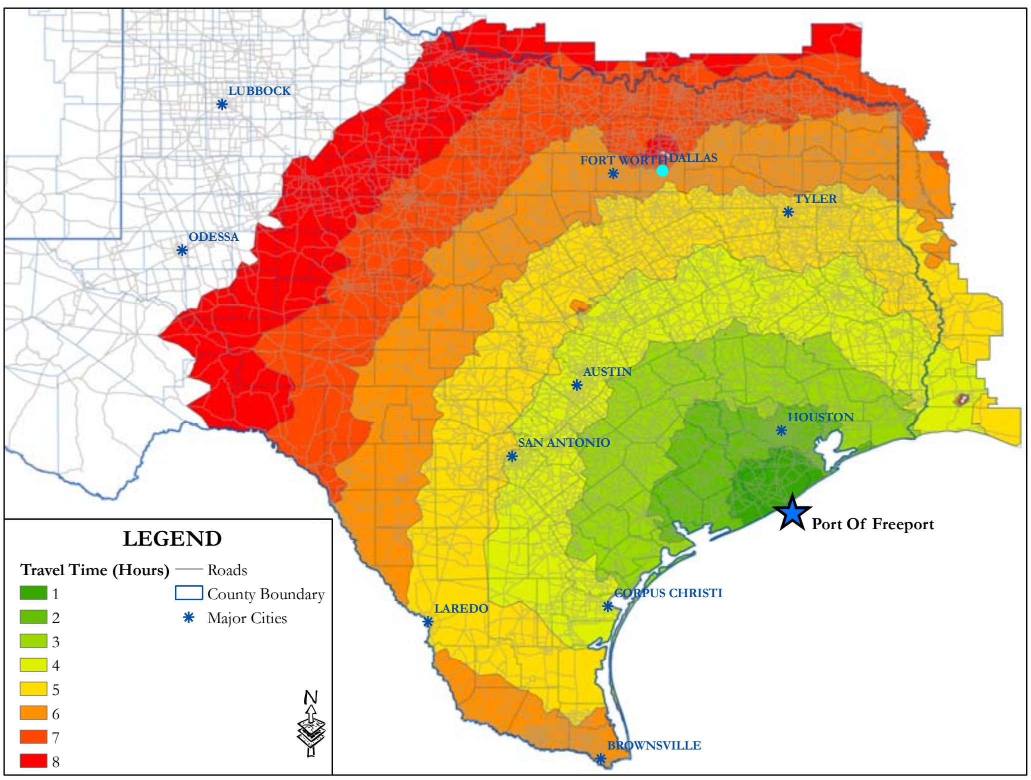


Figure 3-18: Port of Freeport Travel Time Map with Planned Improvements

Roadway Infrastructure Alternatives Analysis and Evaluation

The analysis shows that a large portion of the major roadways within the city of Houston would be impacted by severe congestion by future year 2025. With the expected congestion and the need to continue efficient movement of goods throughout the state, improvements to the city's transportation system are needed. The purpose of this section is to provide an analysis of recommendations to improve the movement of trucks within the region. The alternatives that were analyzed included the following:

- Roadway capacity improvements including new location roadways and dedicated truck lanes;
- Roadway-railroad grade separations and closures; and,
- Shifting cargo from trucks to freight rail.

Each of the alternatives were analyzed and compared through a number of effectiveness measures described in the Alternatives Analysis.

Roadway Capacity Improvements

Heavy trucks will continue to serve a much needed purpose for both local and regional service. A number of intermodal facilities located within the city of Houston use trucks to ship goods to local businesses and warehouses as well as regional locations. Therefore, it is important to attempt to make local roadway capacity improvements so that these trucks can move more efficiently. Roadway capacity improvements can come through operational or geometric means. Operational improvements can occur through more efficient signal timing, signing, striping or the use of intelligent transportation systems. Operational improvements typically are considered lower cost and do not require additional right-of-way.

Geometric improvements can include additional lanes for through or turning traffic as well as using channelization methods that will encourage increased traffic flow. The planned roadway capacity improvements and new location roadways for the Houston region were developed from the Houston-Galveston Area Councils 2025 Regional Transportation Plan (RTP). The roadway capacity upgrades described in Table 3-1 and Figure 3-1 were applied to the 2025 roadway network.

One way to encourage timely and efficient truck flows is through dedicated truck lanes. The interaction of trucks and passenger cars can often decrease the capacity of a roadway. By separating truck traffic from passenger cars, the roadways could operate more efficiently and result in safer driving conditions. Specifically, the Trans-Texas Corridor plan is an all-Texas transportation network of corridors up to 1,200 feet wide. The corridors will include separate toll-ways for passenger vehicles and trucks as well as for high-speed passenger rail, high-speed freight, commuter rail and a dedicated utility zone. Roadways that provide separate truck lanes would benefit both truck and passenger mobility.

A planning study and Tier One environmental impact statement analysis (consistent with the National Environmental Policy Act – NEPA) are currently underway for the Trans-Texas Corridor along I-69 (TTC-69) between the Rio Grande Valley and Texarkana. TTC-69 is a proposed multi-use, statewide network of transportation routes in Texas that will incorporate existing and new highways, railways and utility right-of-ways. Ultimately the proposed I-69 vehicular component of TTC-69 will connect to Mexico, the United States and Canada. This multi-state coordination effort is ongoing. The current plan for development of vehicular lanes could include the TTC-69 truck lanes as being constructed initially with passenger vehicles sharing the truck facility until such time as the separate passenger vehicles lanes are needed and constructed.

Specific routes for TTC-69 in the Houston-Galveston region have not been determined. The Tier One environmental impact statement study is under way and is scheduled to be completed in late 2007. The strategy for the TTC-69 near Houston is to consider additional passenger and freight capacity to serve trips intending to pass through the region and also to serve those whose origins and destinations include the region. Figure 3-12 demonstrates the high truck volumes that are projected to move through the city in 2025. Based on Figure 3-13, notice that the core of the city is highly congested. A regional route that allows a portion of passenger and freight traffic to bypass the city core will improve the congestion levels along Houston's transportation system. Any roadway or rail facilities proposed for TTC-69 must be consistent with all local, regional, and statewide planning. They will also need to go through final NEPA approvals including the appropriate additional NEPA analysis prior to any construction.

Grade Separation/Closures

Grade separations and closures at roadway-railroad crossings identified as improvements in this report were included in the analysis of freight movements. A grade separation allows increased capacity on a roadway as delay is eliminated. A combination of operational and geometric improvements along congested roadways can improve overall traffic flow, which would in turn benefit truck flow.

Shift of Cargo from Trucks to Rail

The final strategy that could be implemented to improve truck flow on Houston roadways is to reduce the number of trucks needed on the roadway by relying more on freight rail to move cargo. By using freight rail more to ship regional cargo, the number of trucks that need to be on local roadways will be reduced. As shown in Figure 3-6, nearly 60 percent of truck traffic is projected to originate within a 300 mile radius from the Houston region by 2025. A scenario was developed that shifted 15 percent of cargo that was normally shipped by truck a distance greater than 300 miles to a rail car.

The following section shows the results of the analysis of each of the discussed alternatives along with a comparison to a No-build scenario.

Alternatives Analysis

The analysis of alternatives was determined through an evaluation that included a comparison of mobility measures of effectiveness (MOE). The MOE's that were used in this evaluation were vehicle-miles of travel (VMT), delay, and vehicle hours of travel (VHT). The following alternatives were analyzed and compared:

- No-build;
- Planned roadway capacity improvements;
- Planned improvements with identified roadway-railroad grade separations and crossing closures; and,
- Planned improvements with identified roadway-railroad grade separations and shifting 15% of truck cargo to rail.

The base case for the analysis was assumed to be the existing roadway network with the projected 2025 traffic volumes. The planned improvements proposed in the 2025 RTP include a combination of roadway capacity upgrades and new location roadways. Figures 3-19, 3-20 and 3-21 show the comparison of results for the alternatives in each of the measures of effectiveness (vehicle-miles of travel, total delay, vehicle hours of travel) as compared to the No-build scenario. These results show a comparison for the entire Houston region.
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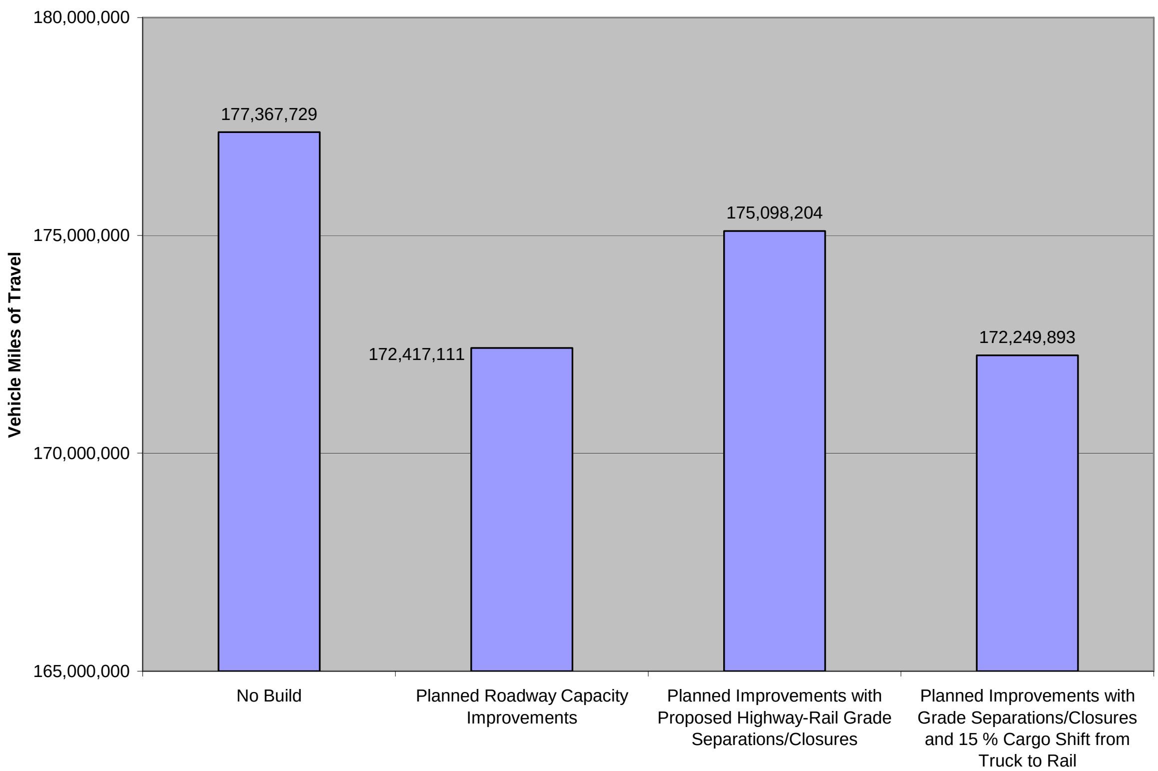


Figure 3-19: Comparison of Vehicle Miles Traveled

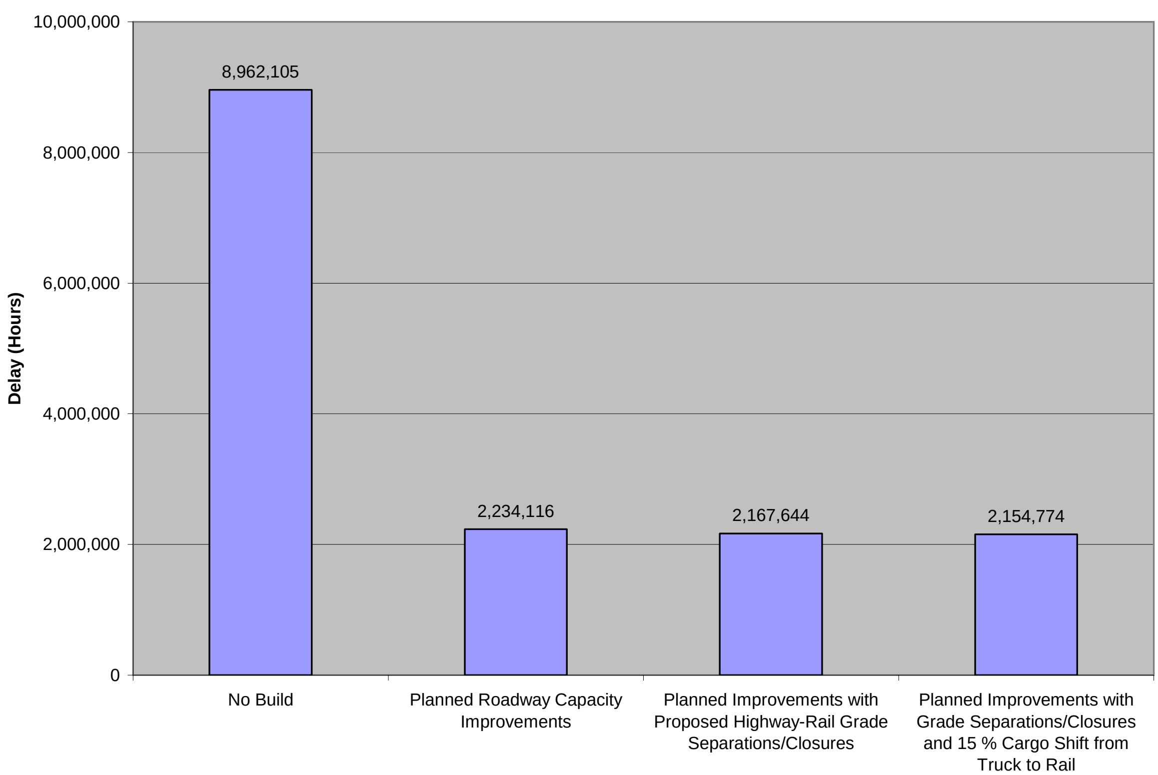


Figure 3-20: Comparison of Total Delay

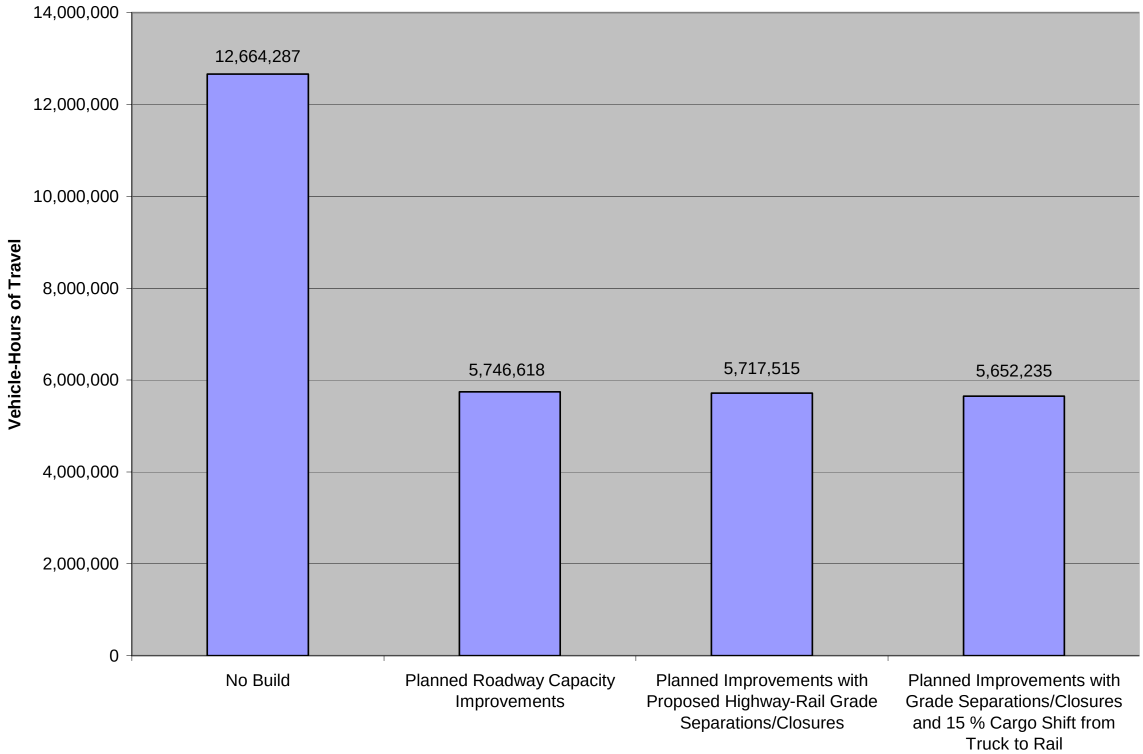


Figure 3-21: Comparison of Vehicle-Hours of Travel

As expected, implementing the planned roadways improvements for the Houston region identified in the 2025 Regional Transportation Plan prepared by the Houston-Galveston Area Council, resulted in the largest improvement. While the vehicle miles of travel reduced approximately three percent between the No-build scenario and Planned Improvements scenario, the total delay for the Houston region was projected to decrease by approximately 75 percent with this same comparison. Based on a standard hourly cost of time for the average driver, it was estimated that the planned roadway improvements for the Houston region would save the traveling public approximately $87 million. Assuming that 100 gallons of gas is spent for each 1,000 hours of delay and projecting that delay could be reduced by approximately 6.7 million hours, it was estimated that approximately 673,000 gallons of gas would be saved when the planned improvements are constructed. The comparison also revealed a reduction in vehicle hours of travel by nearly 55 percent.

The analysis revealed the regional benefit of identified grade separations and closures. Through a comparison of scenarios with and without the identified grade separations, it was projected that approximately 66,000 hours of delay would be eliminated. This translates into approximately $875,000 in time delay costs and 6,700 gallons of gas. The figures show that the vehicle-miles of travel are higher for the alternative including grade separations and closures than just implementing the planned roadway improvements. The comparison of these same two alternatives also shows a reduction in total delay and vehicle-hours of travel when implementing grade separations and closures. These results can be explained by the fact that while grade separations and closures might result in drivers traveling a longer distance to reach a grade separation or crossing, the improvements allow for faster speeds; therefore, the delay and travel time would be reduced.

As compared to the benefit of the planned roadway capacity improvements, the identified grade separations and closures as well as the 15 percent cargo shift from truck to rail result in an incremental change. Therefore, it was necessary to analyze the alternatives at both the regional level and the county level in order to gain a better understanding of the benefit. Figures 3-22, 3-23 and 3-24 show the comparison with and without the identified grade separations as well as the cargo shift for the various measures of effectiveness in each county. Since the majority of planned roadway improvements and identified grade separations are planned in Harris County, it was expected that the largest improvements, in terms of measures of effectiveness would occur in this county.

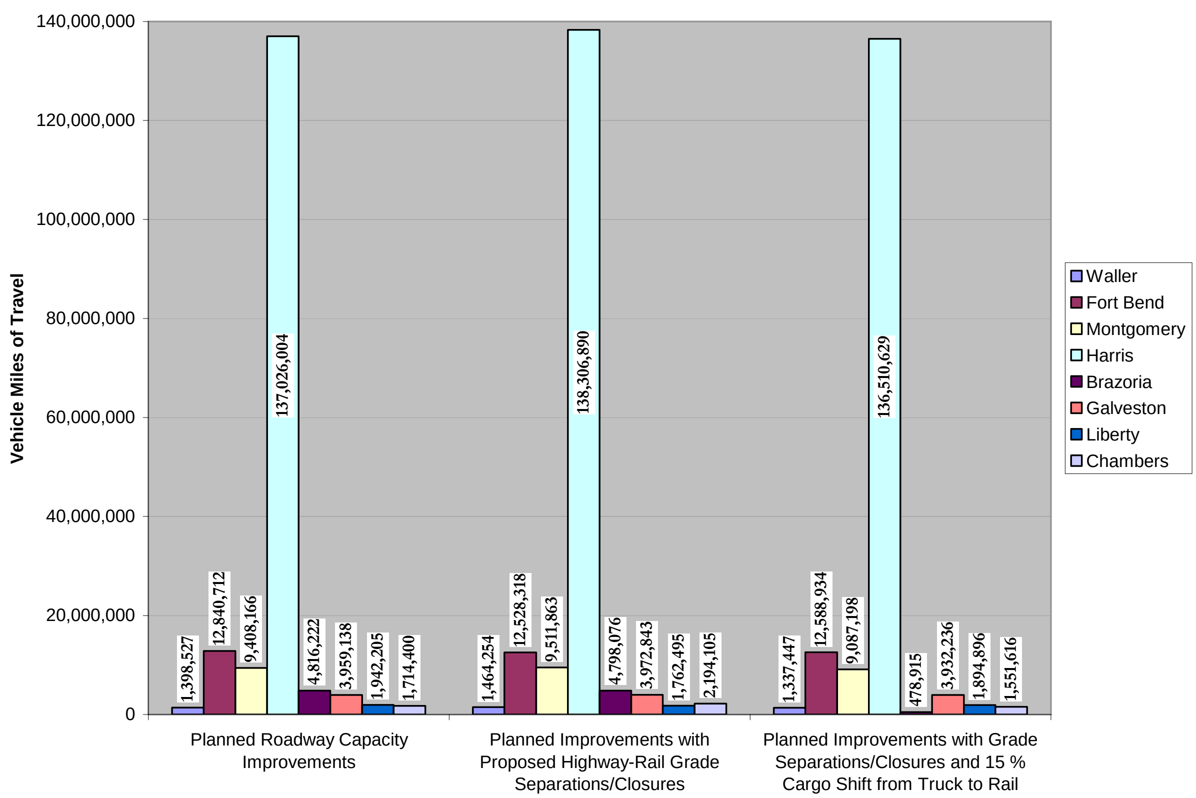


Figure 3-22: Comparison of Vehicle-Miles of Travel in each County

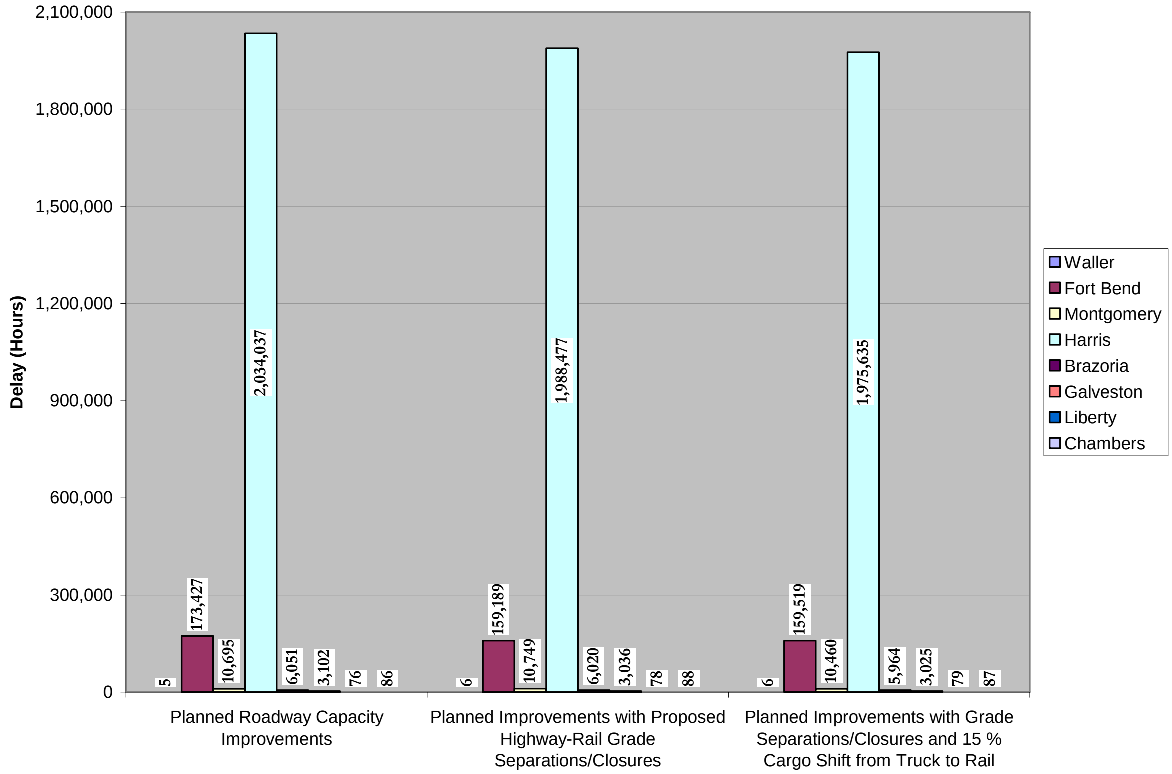


Figure 3-23: Comparison of Delay in each County

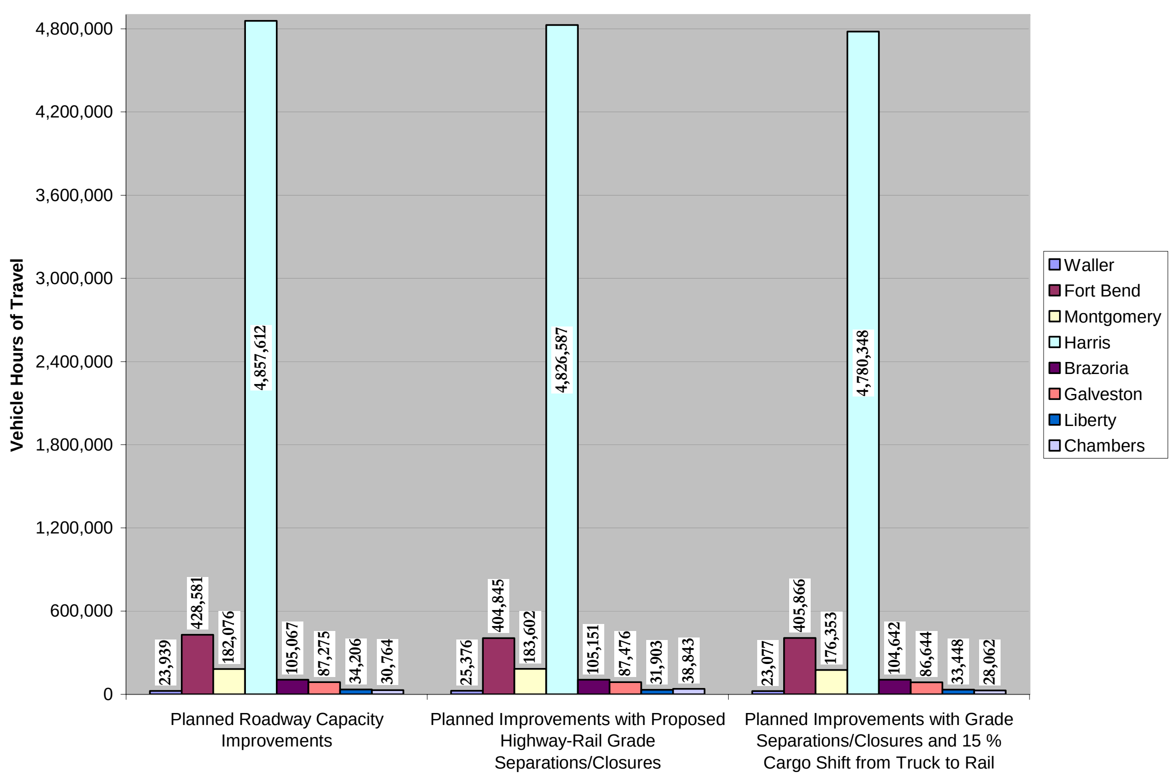


Figure 3-24: Comparison of Vehicle-Hours of Travel in each County

With the majority of grade separations identified in Harris County and Fort Bend County, drivers in these two counties will realize the largest benefit. It is projected that Harris County drivers will experience nearly $600,000 of delay savings and use 4,500 less gallons of gas while Fort Bend County is projected to have a reduction in delay costs of approximately $275,000 and a decrease in fuel of 2,200 gallons. While the overall regional reduction in delay and vehicle hours of travel was not as significant as the RTP planned improvements, an incremental benefit is shown. The reduction in overall vehicle hours of travel was projected as 65,000 vehicle hours.

A comparison was analyzed to determine the benefit of shifting 15 percent of truck cargo that travels more than 300 miles from the Houston region to the railroad. The results showed that the delay would reduce by approximately 13,000 hours while vehicle hours of travel would decrease by nearly 65,000. While these reductions seem insignificant from a regional perspective, the results represent an additional savings of approximately $170,000 in time and 1,300 gallons of gas. Harris County is projected to reap the majority of the benefit of the delay and gas savings within the Houston region. The vehicle hours of travel is projected to be reduced by 46,000 within Harris County as a result of shifting 15 percent of truck cargo to rail.

The total delay and gas savings when all of the alternatives are incorporated is projected to be approximately $90 million and 680,000 gallons of gas. It was shown that the majority of benefits resulted from the RTP planned improvements. However, grade separations/closures and shifting 15 percent of cargo from trucks to rail resulted in incremental changes that showed most of the benefits would be in Harris County.

Rail Freight Movements and Commodities

The following section discusses rail freight movements and commodities within the state of Texas and also those commodities destined for other locations such as other states and Mexico. It is important to note that products coming into the state of Texas also come via air and water.

Rail Freight Movements

Much like the truck movements described in Table 3-2**,** rail freight movements are growing. Table 3-7 illustrates that the Houston region will continue to import and export a great deal of commodities in the year 2025. Modest increases will occur via rail freight internal to the region, but overall, the increase of movement into Houston from other states and Mexico is substantial. More than 133 million additional tons will be imported to the Houston region from the Ports of Houston and Freeport, other Texas counties, other states, and Mexico by 2025, which equates to an increase of approximately 329 percent from 2004. Additionally, an increase of more than 65 million tons is projected to be exported from the

Houston region from 2004 to 2025, which equates to an increase of approximately 227 percent.

The challenge will be to efficiently transport additional tonnage and plan for the additional infrastructure to accommodate such needs. Furthermore, the state and national economies are dependent on the efficient transport of these goods. Therefore, it is in the best interest of both private and public sectors to improve the growing system.

Annual Rail Tons – Houston Region				
Origin	**Termination**	**2004**	**2025**	**% Change**
Internal to Internal (Including the Ports of Houston and Freeport)				
Houston Region	Houston Region	9,305,289	25,753,296	177%
Internal to External				
Houston Region	Ports of Houston and Freeport	1,718,439	2,908,323	69%
Houston Region	Other Texas Counties	7,055,022	33,312,244	372%
Houston Region	Western US	3,474,984	10,039,584	189%
Houston Region	Northern US	4,106,799	11,864,963	189%
Houston Region	Eastern US	8,213,598	23,729,926	189%
Houston Region	Mexico	4,106,799	11,864,963	189%
	Total	**28,675,641**	**93,720,003**	**227%**
External to Internal				
Ports of Houston and Freeport	Houston Region	2,577,658	5,401,172	110%
Other Texas Counties	Houston Region	15,927,874	61,865,596	288%
Western US	Houston Region	3,852,605	18,644,942	384%
Northern US	Houston Region	4,553,079	22,034,931	384%
Eastern US	Houston Region	9,106,158	44,069,862	384%
Mexico	Houston Region	4,553,079	22,034,931	384%
	Total	**40,570,453**	**174,051,434**	**329%**
External to External				
Northern US	Mexico	37,686,673	71,777,342	90%
Mexico	Northern US	16,870,586	35,645,148	111%
Eastern US	Mexico	6,979,665	13,399,341	92%
Mexico	Eastern US	2,249,175	5,057,994	125%
	Total	**63,786,099**	**125,879,825**	**97%**

Table 3-7: Rail Freight Movements for the Houston Region -
Not Including the Ports of Houston and Freeport, except as noted otherwise
(Source: Surface Transportation Board (STB) Waybill Data from 2002, 2003, and 2004)

As shown in Table 3-8, there is a large increase in the influx of rail tonnage to the Ports of Houston and Freeport, not only from other states and Mexico but also from Texas in 2025.

Annual Rail Tons – Ports of Houston and Freeport				
Origin	**Termination**	**2004**	**2025**	**% Change**
Internal to External				
Ports	Houston Region	2,577,658	5,401,172	110%
Ports	Other Texas Counties	6,050,690	15,880,064	162%
Ports	Western US	2,980,295	4,785,906	61%
Ports	Northern US	3,522,167	5,656,071	61%
Ports	Eastern US	7,044,334	11,312,142	61%
Ports	Mexico	3,522,167	5,656,071	61%
	Total	**25,697,311**	**48,691,426**	**89%**
External to Internal				
Houston Region	Ports	1,718,439	2,908,323	69%
Other Texas Counties	Ports	13,660,428	29,491,548	116%
Northern US	Ports	3,904,916	10,504,132	169%
Eastern US	Ports	7,809,831	21,008,263	169%
Western US	Ports	3,304,159	8,888,111	169%
Mexico	Ports	3,904,916	10,504,132	169%
	Total	**34,302,689**	**83,304,509**	**143%**

Table 3-8: Rail Freight Movements To/From Ports of Houston and Freeport Only
(Source: Surface Transportation Board (STB) Waybill Data from 2002, 2003, and 2004)

Rail Freight Movements within Texas

Unlike truck freight, rail movements are limited in their ability to deliver door–to-door service. Intermodal centers, rail yards, and ports of entry are the primary locations in which rail freight can be either sent or received. Figure 3-25 illustrates the origin and destinations for freight rail movements occurring in 2004. Austin, San Antonio, Dallas/Forth Worth, Laredo, and Brownsville appear to be handling the largest Houston region movements, while additional locations shown in Figure 3-26 such as part of east Texas and areas along the IH 35 corridor emerge as major origins or destinations for year 2025. Accommodating these and other locations with freight rail service will be critical to the future of Texas in terms of economic growth and providing options to shift truck cargo to rail cars.

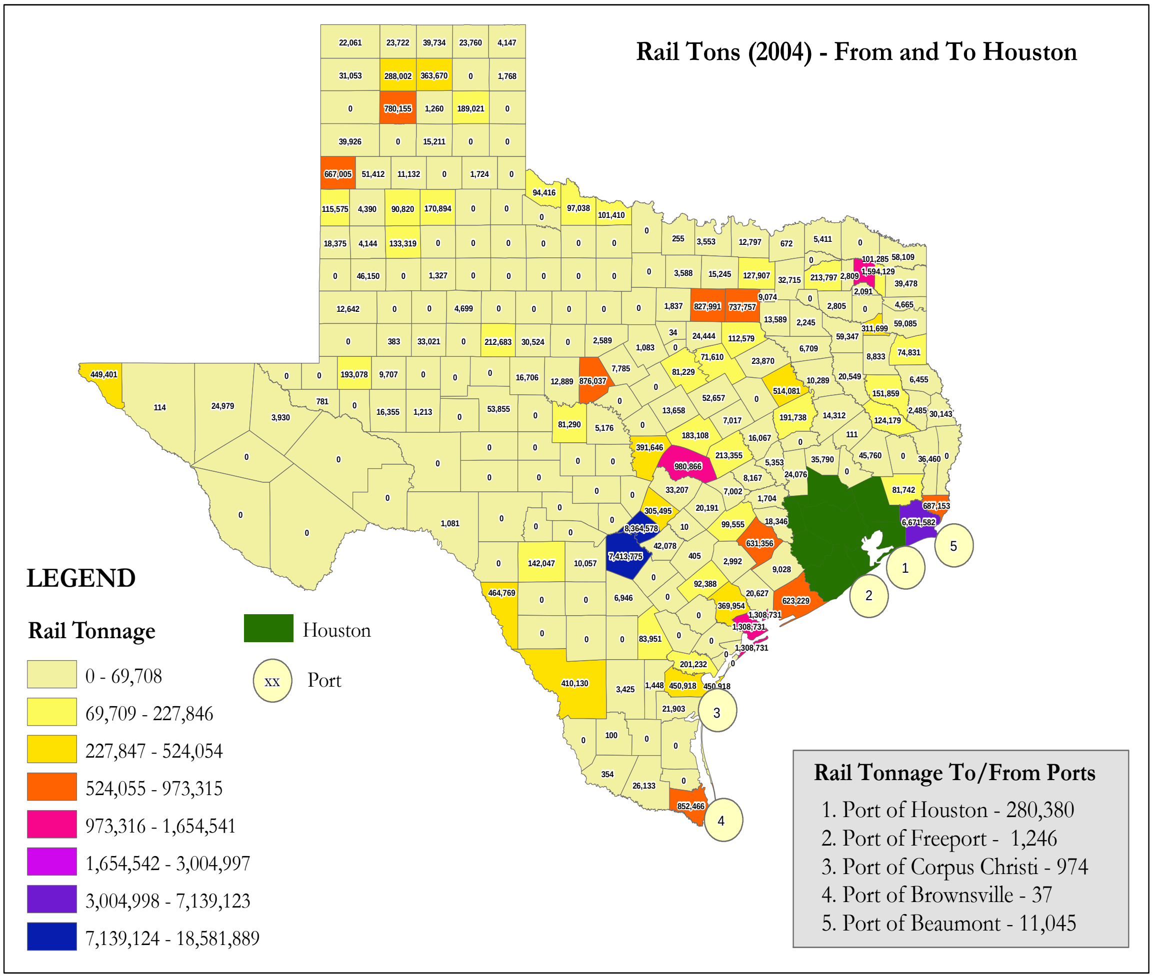


Figure 3-25: 2004 Rail Freight Movements

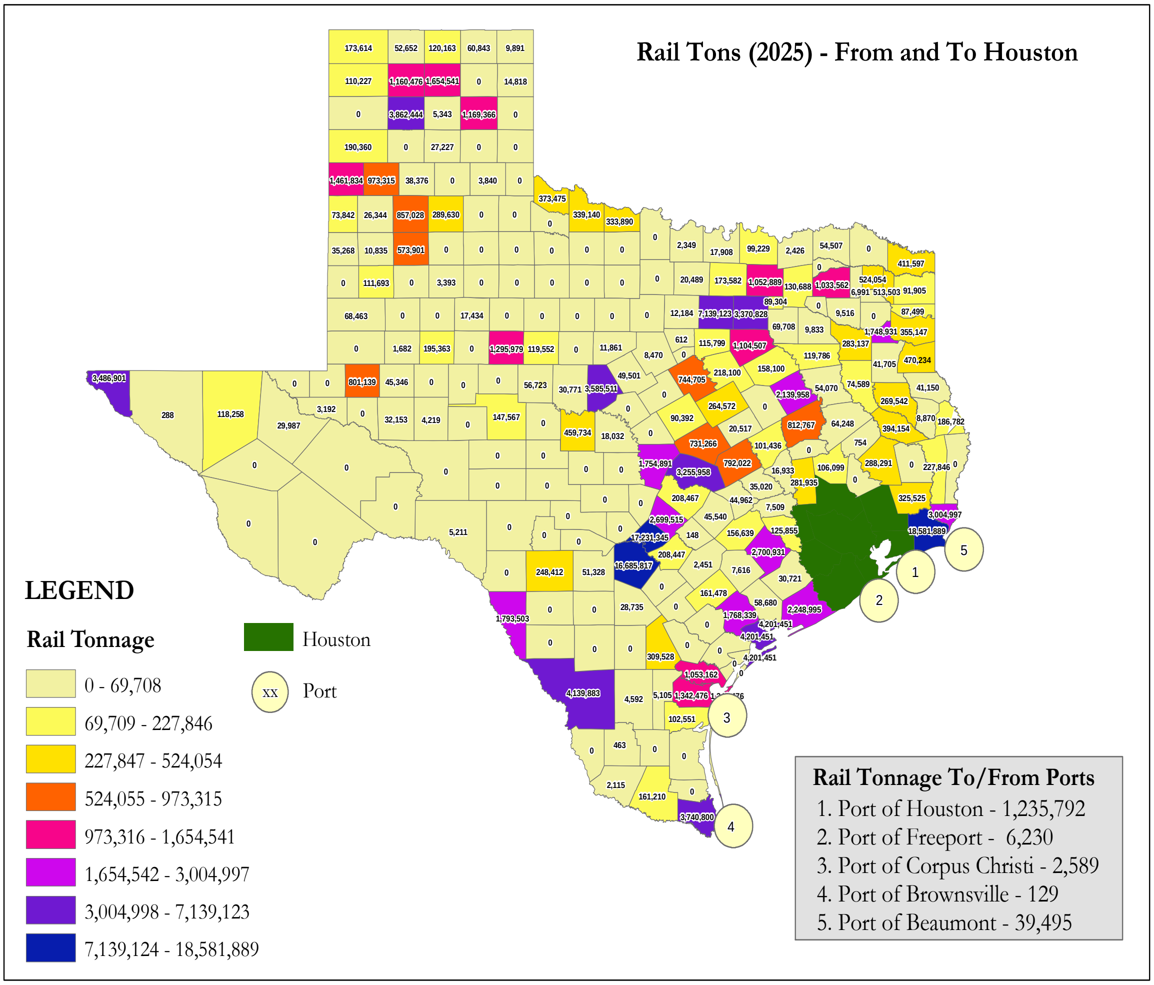


Figure 3-26: 2025 Rail Freight Movements

Rail Freight Movements Outside of Texas

Rail freight is most effective when carrying long haul cargo. Figure 3-27 illustrates that major Houston region rail freight movements in 2004 are occurring from Louisiana, Oklahoma, New Mexico, Colorado, and more moderately from Mexico. Figure 3-28 demonstrates that by the year 2025 these same major movements will continue to increase in rail tonnage. These new growth opportunities will need to be accommodated and strategic planning will need to occur to capitalize on these emerging markets.

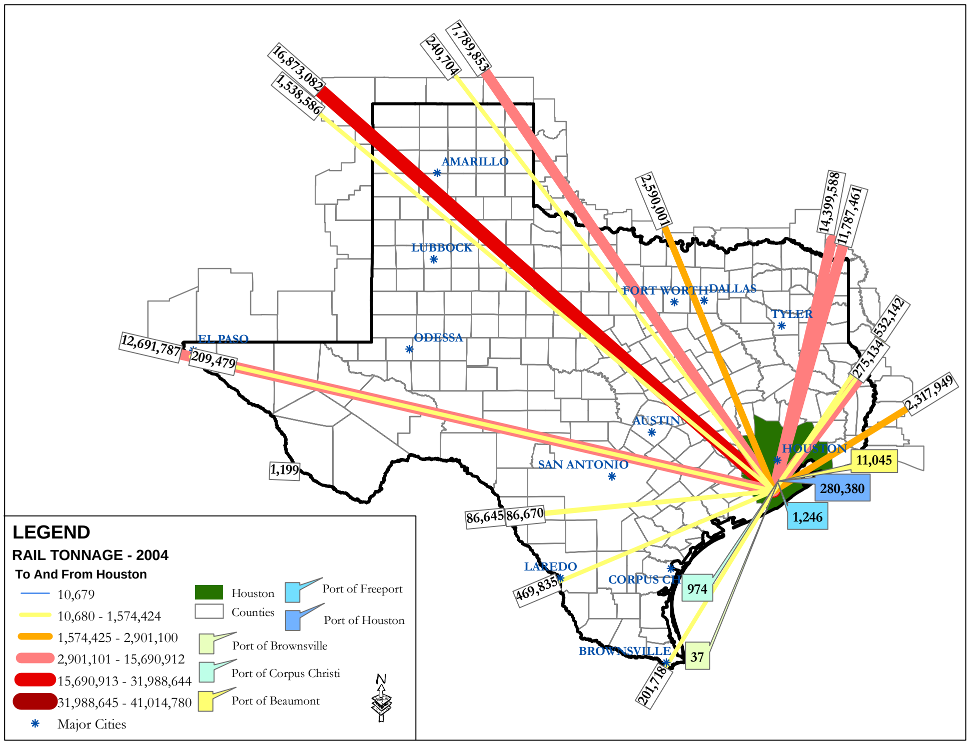


Figure 3-27: 2004 Freight Rail To/From Houston

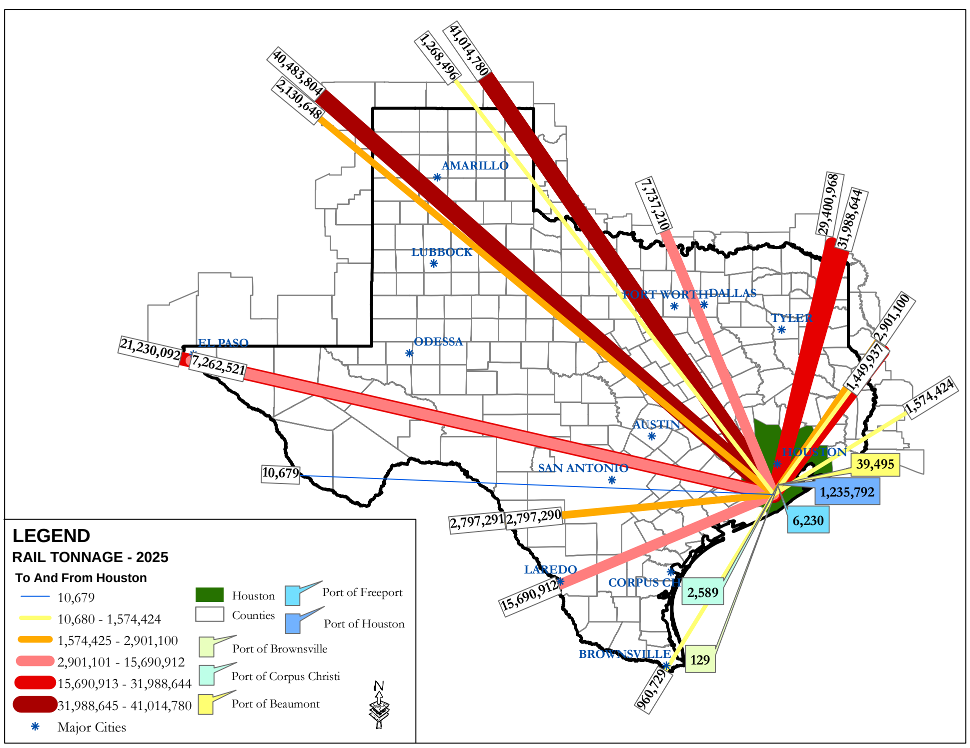


Figure 3-28: 2025 Freight Rail To/From Houston

The overall rail tonnage movement from and to the Houston region was summarized by dividing the area within the state into specific areas of different distances from Houston as well as separate regions of Texas. The area inside of the state of Texas was broken into radii's of 50, 100, 300, and over 300 miles from the Houston region. The regions outside of the state were identified as Western US, Northern US, Eastern US, and Mexico. The modeling efforts allowed the study team to determine truck tonnage distribution for each area. Figure 3-29 shows the distribution of rail tonnage for each region as projected in 2025.

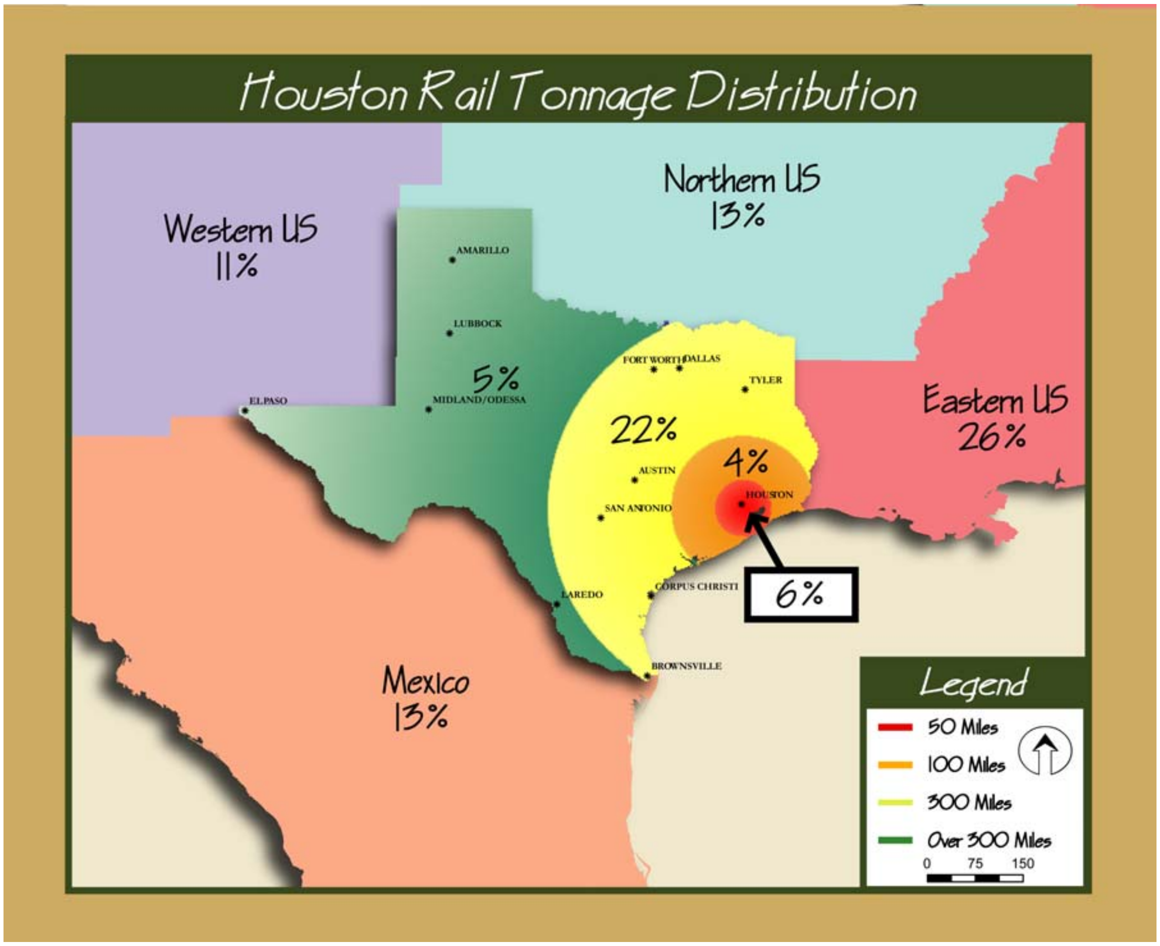


Figure 3-29: 2025 Rail Tonnage Distribution for Houston Region

The analysis showed that six percent of rail tonnage is projected to stay within the Houston Region while 22 percent is projected to travel between 100 and 300 miles from the area. Based on projections, approximately 32 percent of rail freight traffic travels within 300 miles of the Houston region. A projected five percent of the rail freight is distributed to an area within Texas outside of the 300 mile radius. The remaining percentages are split between Mexico (13 percent), Western US (11 percent), Northern US (13 percent), and Eastern US (26 percent).

The following section looks deeper into the movement of freight rail commodities for both 2004 and 2025 and begins to expand on how these commodities can be effectively accommodated in the future.

Freight Rail Commodity Trends

The overall annual growth rate in rail tonnage between 2004 and 2025 is projected to be 5.6 percent. Table 3-9 shown below, indicates that the amount of building materials shipped by freight will grow approximately eight percent per year between 2004 and 2025. Other commodities observing similar growth are food and machinery. All of the nine commodity groups show staggering increases and represent a very positive economic outlook for the entire Houston region. Figures 3-30, 3-31, and 3-32 display the commodities being moved by rail within the region for 2004 and 2025.

Commodity	Rail Tons		
	2004	2025	Yearly Growth Rate
Building Materials	9,030,692	45,346,122	7.99%
Wood	37,189,311	108,258,447	5.22%
Agriculture	3,455,156	8,328,604	4.28%
Textiles	1,774,423	5,934,229	5.92%
Chemical/Petroleum	55,235,767	163,928,137	5.32%
Food	1,778,072	8,035,598	7.45%
Machinery	2,192,286	10,760,184	7.87%
Raw Materials	19,303,484	58,310,356	5.41%
Secondary	0	0	0.00%
Total	**129,959,191**	**408,901,676**	**5.61%**

Table 3-9: Rail Freight Commodity Growth

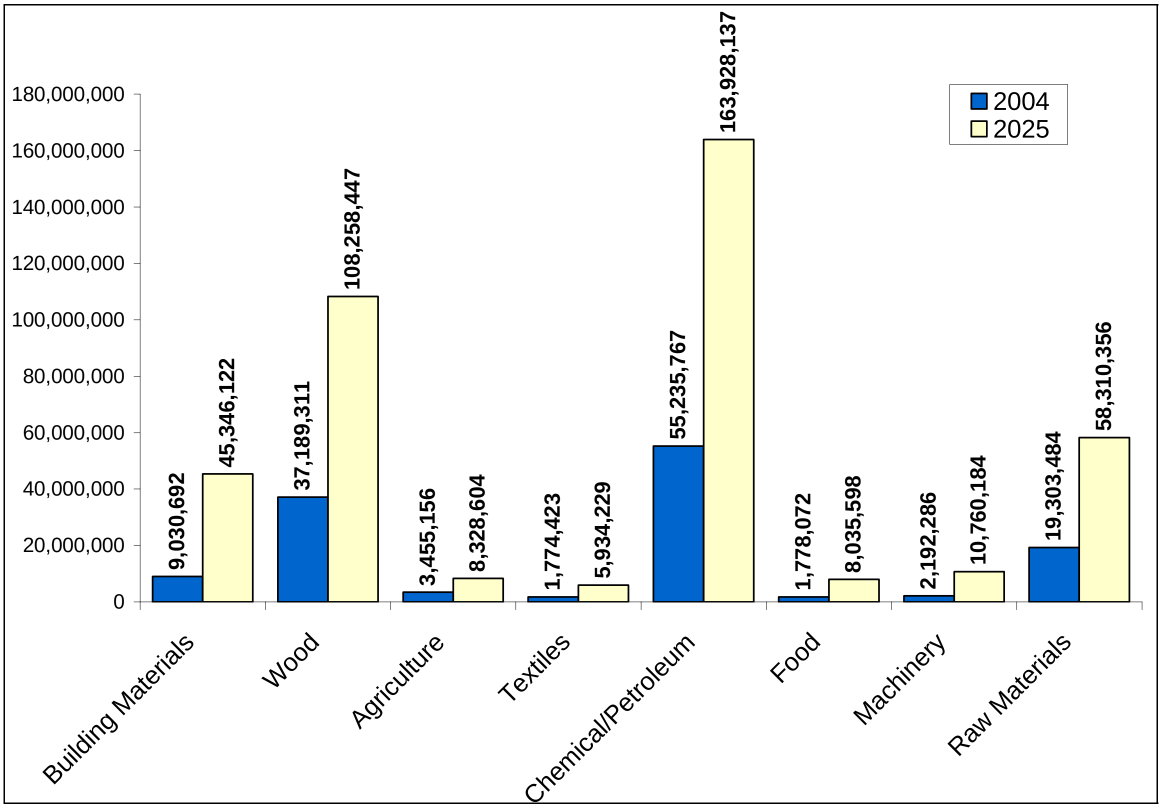


Figure 3-30: Total Freight Rail Tons by Commodity

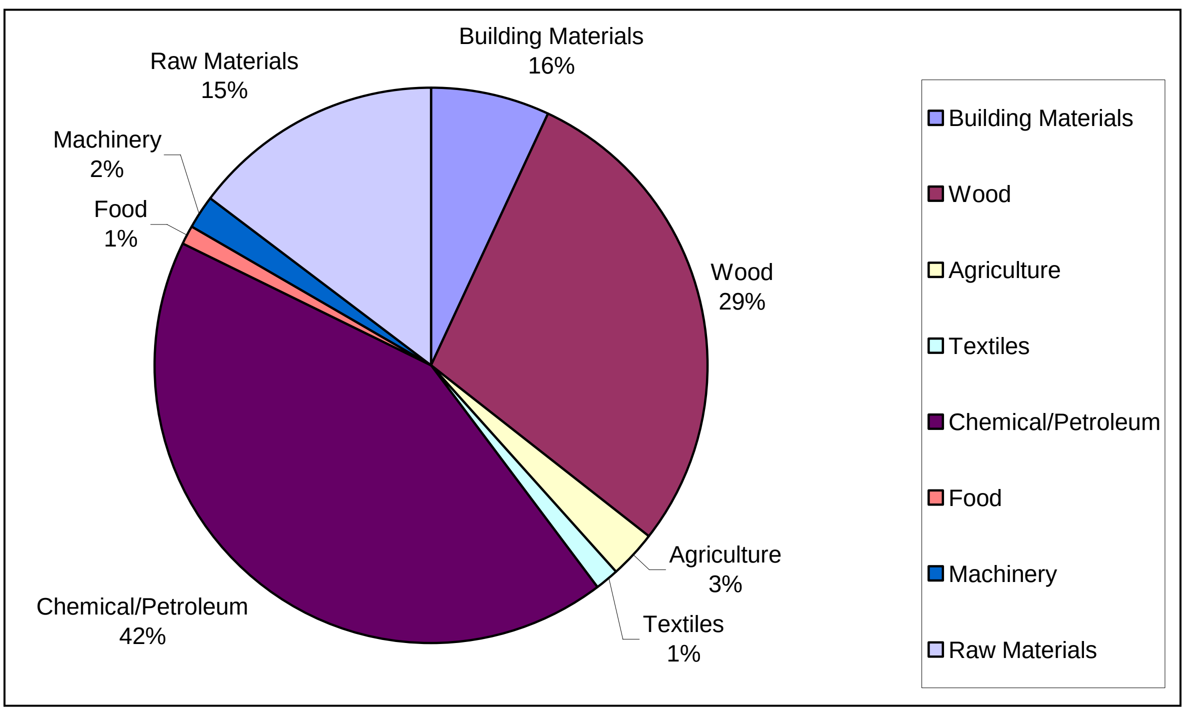


Figure 3-31: Total Freight Rail Tons by Commodity – 1998

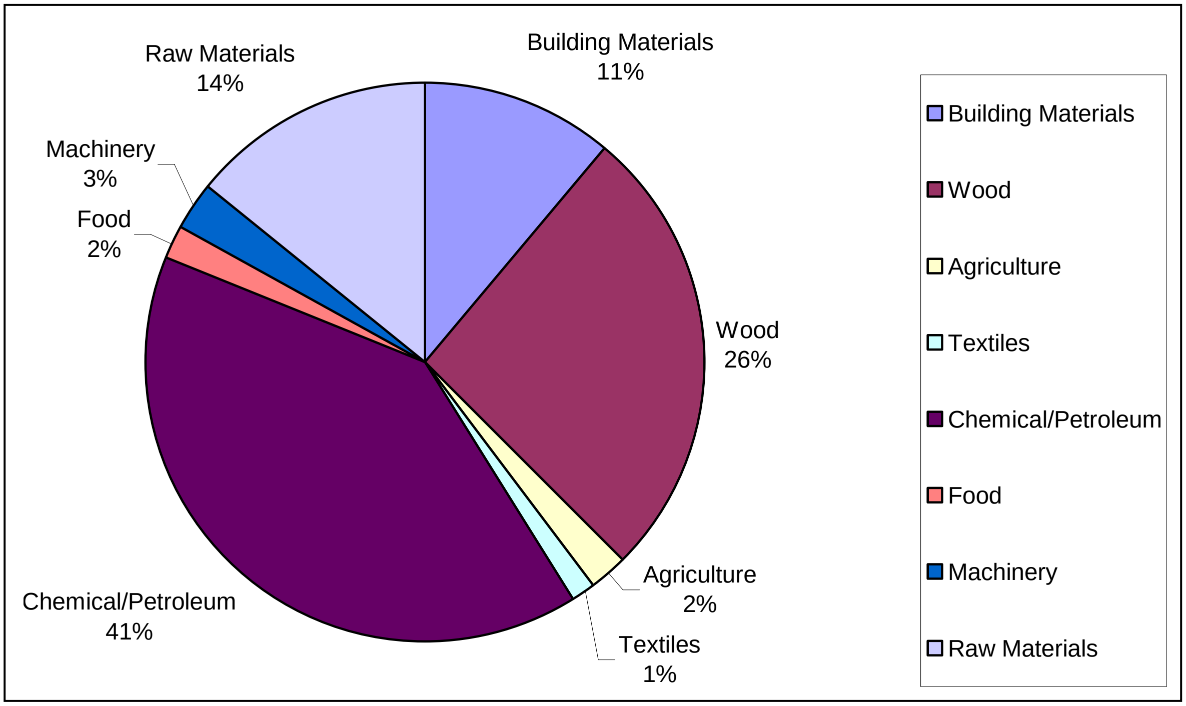


Figure 3-32: Total Freight Rail Tons by Commodity – 2025

The challenge will be in planning for new or expanded rail facilities that can capitalize on the growth markets. These new facilities must be planned in a way that allow for the ability to shift the truck cargo burden to rail cars. The percent growth is one way to present the data; however, looking into the percentage that each commodity has on the market is equally important.

While many of the growth sectors are important, it is critical to realize that wood and chemical/petroleum are the predominant commodities for the Houston region. As seen in Figure 3-33, the major movements for chemical/petroleum products are projected as to/from outside of Texas, i.e., through New Mexico and Oklahoma to the western region of the US. Within Texas, the figure projects that Beaumont, Corpus Christi, and Pharr districts would contribute to the rest of the heavy freight movement. Figure 3-34 projects major freight movements of wood to/from the Houston region that travels through New Mexico, Oklahoma and Arkansas on their way to all parts of the US and Mexico.

By analyzing the trends in commodity movement we can further understand the trip generation and distribution of rail freight movement. In general, railways are best suited to hauling large, heavy, low-value loads that are not overly time-sensitive over distances greater than 700 miles. The only products of any significance being moved by rail in the region (in terms of tonnage) are building materials, wood, chemical/petroleum, and raw materials.

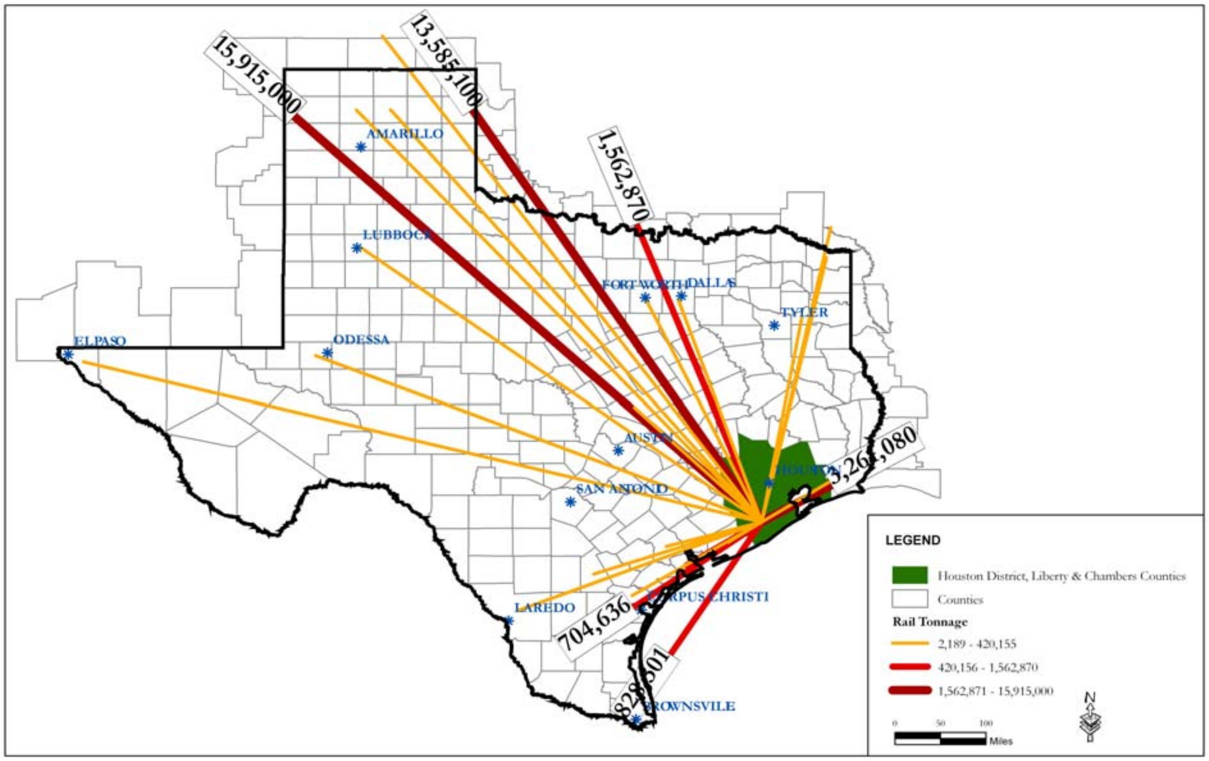


Figure 3-33: 2025 Rail Tonnage Distribution of Chemical/Petroleum Products

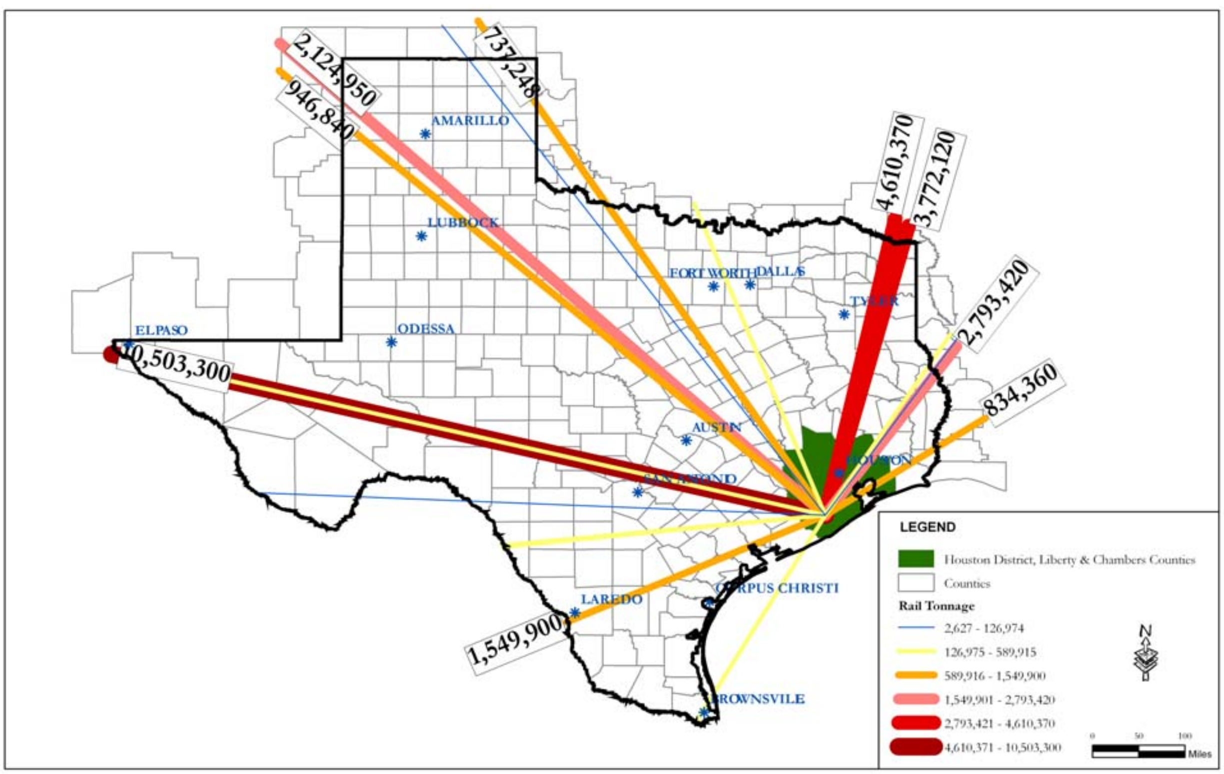


Figure 3-34: 2025 Rail Tonnage Distribution of Wood Products

To further evaluate the rail freight movements of wood and chemical/petroleum products, since they constitute the commodities with the two highest rail tonnage movements in the Houston region, their rail freight tonnage was assigned to the rail network to observe the resulting traffic pattern. According to Figure 3-35, heavy chemical petroleum freight movements are seen on rail lines parallel to IH-45 heading north outside of Houston in the future.

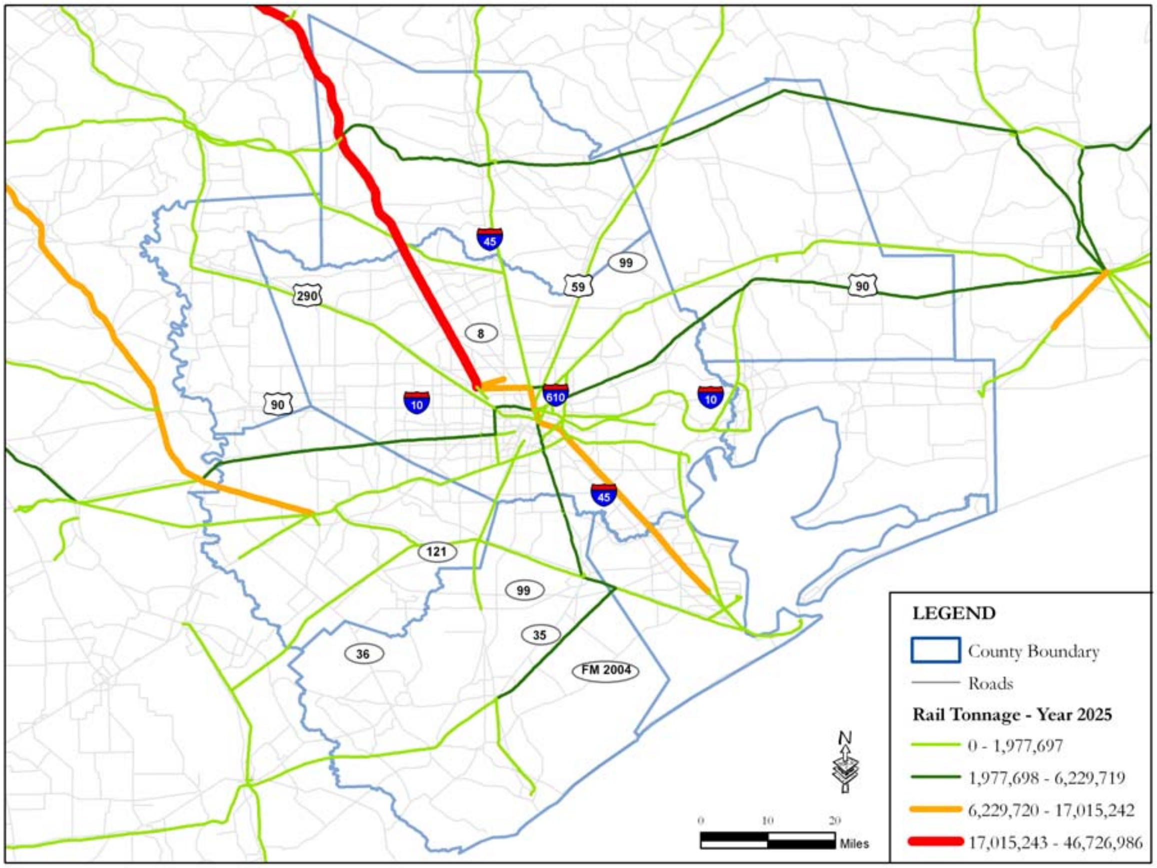


Figure 3-35: 2025 Freight Movement of Chemical/Petroleum Products

When wood rail freight was assigned to the transportation system, heavy traffic was observed on rail lines along I-45 North and US 59 North, as shown in Figure 3-36.

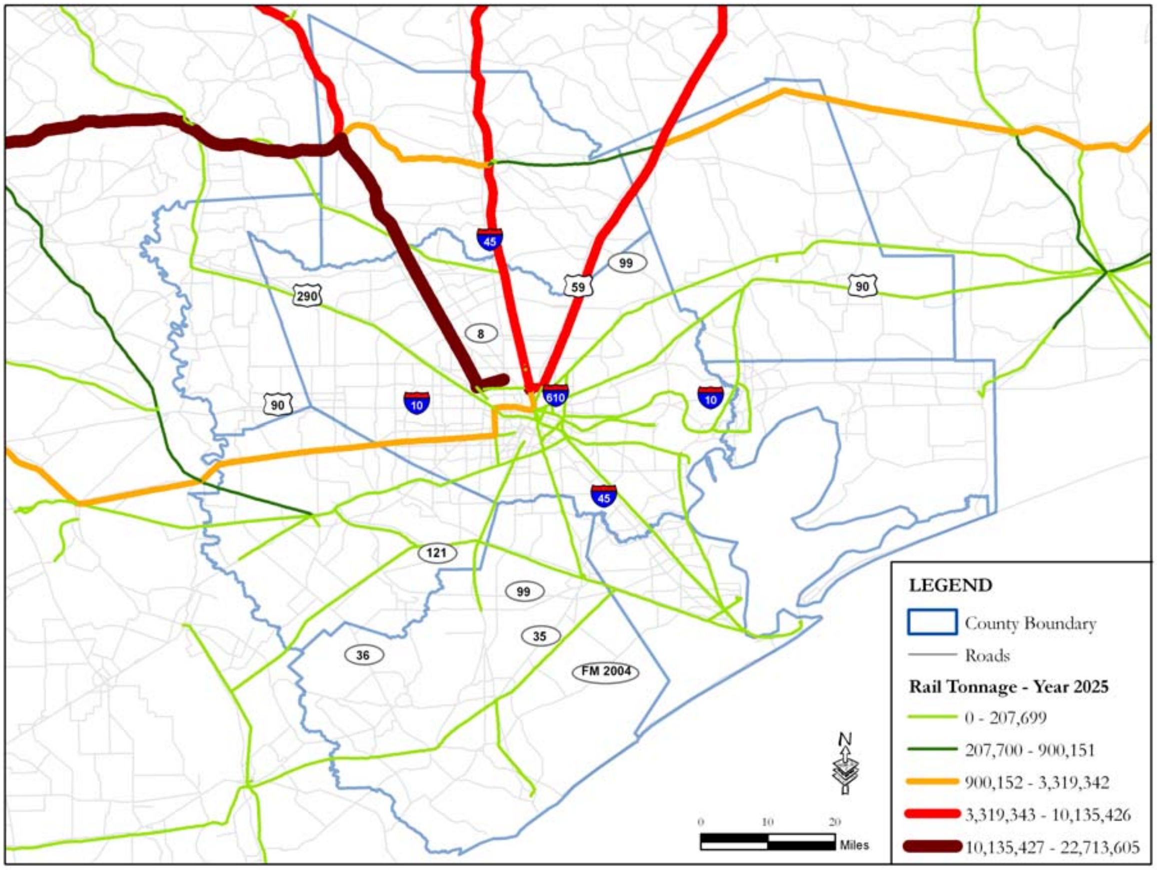


Figure 3-36: 2025 Freight movement of Wood products

Rail Freight Summary

- Freight tonnages moved by rail will more than triple by 2025
- Raw materials constitute a majority of the freight rail tonnage being shipped within the State, both in 2004 as well as 2025
- Building materials, machinery, and food are the commodities that show a high growth rate, i.e., more than seven percent annual growth rate
- Proportionally more rail shipments will have their destination in the Houston region in the future

Rail and Truck Freight Comparison

Figure 3-37 provides the total truck and rail tons in the Houston region, including internal movements as well as freight tonnage imported to and exported from the region. The increase between 1998 and 2025 for truck tons represents a 197 percent increase as opposed to a rail tonnage increase of 295 percent. This increase of both rail and truck tonnage is substantial and will need to be addressed through additional infrastructure.

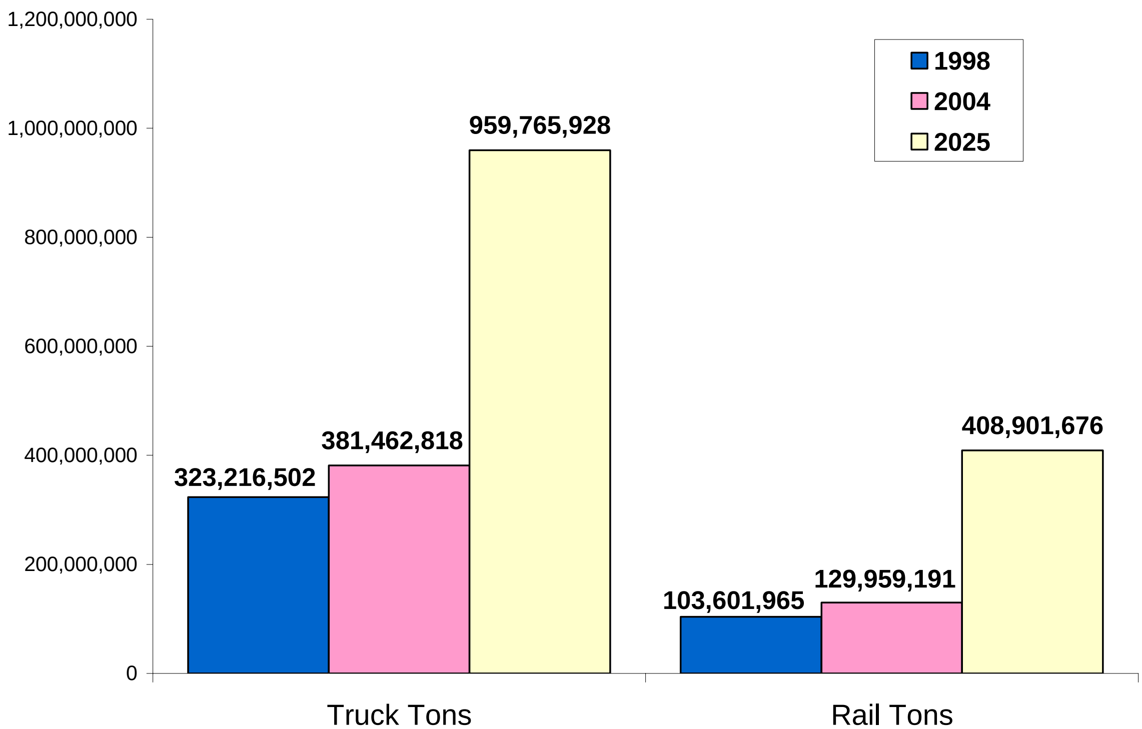


Figure 3-37: Total Rail / Truck Tons

Houston Region Summary

With congestion levels in Houston on the rise and the expected growth of commodity movements throughout the state, a comprehensive plan to accommodate such growth is needed. Not only must we look at the perceived congestion within the area, but create a vision that improves circulation though the use of alternative transportation modes and designs. To our benefit, a regional vision is already taking place. The Trans Texas Corridor (TTC) could provide some much needed relief for the Houston region. Through the creation of truck only lanes and a high speed rail corridor, not only will the corridor reduce congestion, but it will create an economic boom for many businesses through increased efficiency.

However, the TTC can not be the single infrastructure investment completed within the region. As mentioned, a vision is needed that not only addresses regional concerns, but also local needs. Furthermore, an alternative approach to the construction and alignment of rail corridors should be developed. The regional vision of planned roadway improvements has been developed through the 2025 Regional Thoroughfare Plan by the Houston-Galveston Area Council. Additional improvements that were analyzed included the regional benefit of roadway-railroad grade separations/closures. As discussed many commodities could be shifted from truck transport to rail. Yet, this can only happen through additional rail routes that follow a preferred alignment, as determined through a public involvement process including the major carriers.

The potential roadway capacity improvements and the resulting benefit both regionally and locally were determined. Each of the roadway capacity improvements were compared to the No-build scenario. The improvements that were analyzed included the following scenarios:

- No-build;
- Planned roadway capacity improvements based on the long-range plan determined in the 2025 Regional Thoroughfare Plan;
- Planned roadway capacity improvements with identified roadway-railroad grade separations; and,
- Planned improvements with identified roadway-railroad grade separations and shifting 15% of truck cargo to rail.

The total delay and gas savings when all of the alternatives are incorporated is projected to be approximately 7,000,000 hours and 680,000 gallons of gas per day for the Houston region when compared to a No-build scenario. It was shown that the greatest benefits resulted from the RTP planned improvements. However, grade separations/closures and shifting 15 percent of cargo from trucks to rail resulted in incremental changes that showed the majority of the benefit in Harris County.

SECTION 4: EXISTING RAIL SYSTEM INVENTORY

Existing Rail Infrastructure Overview

Eleven railroad companies constructed the system known today as the Houston Rail Network. Most of the original railroads that were constructed in the 1800's through 1950 have been bought, sold, and merged. Mergers that took place between the years of 1980 and 2000 have left three Class 1 railroads operating within the Houston region: the UPRR Railroad (UPRR), the Burlington, Northern, and Santa Fe Railway (BNSF), and the Kansas City Southern Railway (KCS). The KCS does not own any track within the Houston region, but, they do have trackage rights across other railroads.

The old Houston Belt & Terminal and the Port Terminal Railroad Association (PTRA) are terminal switching companies in Houston originally established to provide competing railroads equal service. Both of these switching companies have been merged and are now owned jointly by the UPRR and BNSF. Switching is the movement of freight cars between two nearby locations or trains. This typically involves moving cars within a yard or from specific industry locations to a yard for placement of railcars in a train, or vice versa.

The Houston region serves as one of the country's largest freight centers servicing trains, trucks, air, and ships. The volume of freight that is shipped into and out of the Houston region requires a number of major terminals that provide the capability to transfer freight to and from the railroads. Terminals are facilities established for the handling of passengers or freight, and for the breaking up, making up, forwarding, and servicing of trains, and interchanging with other carriers. The following is a list of the major terminals located within the Houston region:

- American Yard
- Basin Yard
- BNSF Intermodal Hub
- BNSF SIT Yard
- Booth Yard
- Congress Yard
- Dallerup Yard
- East Belt Yard
- Englewood Yard & Intermodal Facility
- Eureka Yard
- Glass Yard
- Hardy Yard
- Lloyd Yard
- Manchester Yard
- MK Yard
- Mykawa Yard
- Navigation Yard
- New South Yard
- Old South Yard
- Pasadena Yard
- Pearland Yard & Intermodal Facility
- Pierce Yard & Intermodal Facility
- PTRA North Yard
- Settegast Yard & Intermodal Facility

These terminals and junctions inside of Beltway 8 are shown in Figure 4-1.

Figure 4-1: Houston Rail Network Map (inside of Beltway 8)

The UPRR and BNSF have a total of 829.44 mainline track miles located throughout the eight county Houston region. Mainline track is the primary rail line over which trains operate between terminals and excludes sidings, yard, and industry track. Siding track is auxiliary to a main track and is used for meeting or passing trains. Yards consist of a system of tracks typically used for switching, making up trains, and/or storing of railcars. Table 4-1 summarizes the mileage data for main, siding, and yard track in the Houston region.

County:	**Miles of Main Track:**	**Miles of Siding Track:**	**Miles of Yard Track:**	**Total Miles of Track:**
Harris	371.64	53.88	31.64	457.16
Fort Bend	71.34	10.05	2.46	83.85
Montgomery	122.31	17.88	0	140.19
Galveston	46.26	4.66	4.00	54.92
Brazoria	73.06	16.99	2.91	92.96
Waller	21.11	3.35	0	24.46
Liberty	119.61	13.4	6.1	139.11
Chambers	4.11	2.41	0	6.52
Total:	**829.44**	**122.62**	**47.11**	**999.17**

Table 4-1: Houston Study Region Track Inventory

Union Pacific Railroad Infrastructure

The UPRR is the primary Class 1 railroad with the most track owned as well as trackage rights within the Houston region. Trackage rights is a term used for an agreement between railroads where one railroad is authorized to operate its trains, between specific locations, over the tracks owned by another railroad. Although the UPRR now owns most of the railroad tracks in this area, other railroads have been given trackage rights across their tracks. The following is a list of the major UPRR Subdivisions that are located within the Houston region:

- UPRR Angleton Subdivision
- UPRR Baytown Subdivision
- UPRR Beaumont Subdivision
- Houston East Belt Subdivision
- UPRR Eureka Subdivision
- UPRR Galveston Subdivision
- UPRR Glidden Subdivision
- UPRR Lafayette Subdivision
- UPRR Lufkin Subdivision
- UPRR Navasota Subdivision
- UPRR Palestine Subdivision
- UPRR Strang Subdivision
- UPRR Terminal Subdivision
- Houston West Belt Subdivision

UPRR Angleton Subdivision

The single track mainline of the Angleton Subdivision was originally constructed in 1907 by the St. Louis, Brownsville, and Mexico Railway and is owned and operated today by the UPRR. The BNSF has trackage rights across the Angleton Subdivision.

The Angleton Subdivision originates near Bloomington, Texas at its meeting point with the Brownsville Subdivision at milepost 221.00 and passes through Sweeny, Brazoria, Angleton, Danbury, and Liverpool before it ends at milepost 343.14 with the tracks continuing as the BNSF Galveston Subdivision.

The Angleton Subdivision crosses into Brazoria County (the limit of this Study) at milepost 295.83. In the city of Angleton, just east of the Angleton Yard tracks at milepost 320.24, access is gained to the Freeport Industrial Lead, 17.1 miles in length, which connects the Angleton Subdivision to the city of Freeport and the Port of Freeport. Access to the Monsanto Industrial Lead track is provided at the Monsanto Storage siding tracks at milepost 336.24.

At milepost 342.24, the Brazoria County/Galveston County line crosses the Angleton Subdivision just before it ties into the BNSF Galveston Subdivision at milepost 343.14 in the city of Algoa.

Table 4-2 displays the locations, lengths, and structure type of major bridges on the Angleton Subdivision, while Table 4-3 summarizes the track mileage data for the Angleton Subdivision. Figure 4-2 shows the location of the Angleton Subdivision. A complete listing of the Angleton Subdivision structures can be found in Appendix B.

Mile Post:	Waterway/Roadway Crossed:	Bridge Length (feet):	Bridge Type:
305.5	San Bernard River	598	Steel and timber
309.52	Brazos River	1516	Steel and timber
310.10	Brazos River Overflow	1069	Timber
311.40	waterway	322	Concrete
311.96	waterway	320	Concrete
312.89	Buffalo Camp Bayou	750	Timber
313.83	waterway	402	Timber
317.58	waterway	336	Concrete
328.8	Austin Bayou	416	Concrete
334.3	Chocolate Bayou	443	Concrete and steel

Table 4-2: Angleton Subdivision Major Bridge Inventory

County:	Miles of Main Track:	Miles of Siding Track:	Miles of Yard Track:	Total Miles of Track:
Brazoria	46.41	16.99	1.3	64.7
Galveston	.9	0	0	.9
Total:	**47.31**	**16.99**	**1.3**	**65.6**

Table 4-3: Angleton Subdivision Track Inventory

Houston Region - Angleton Subdivision

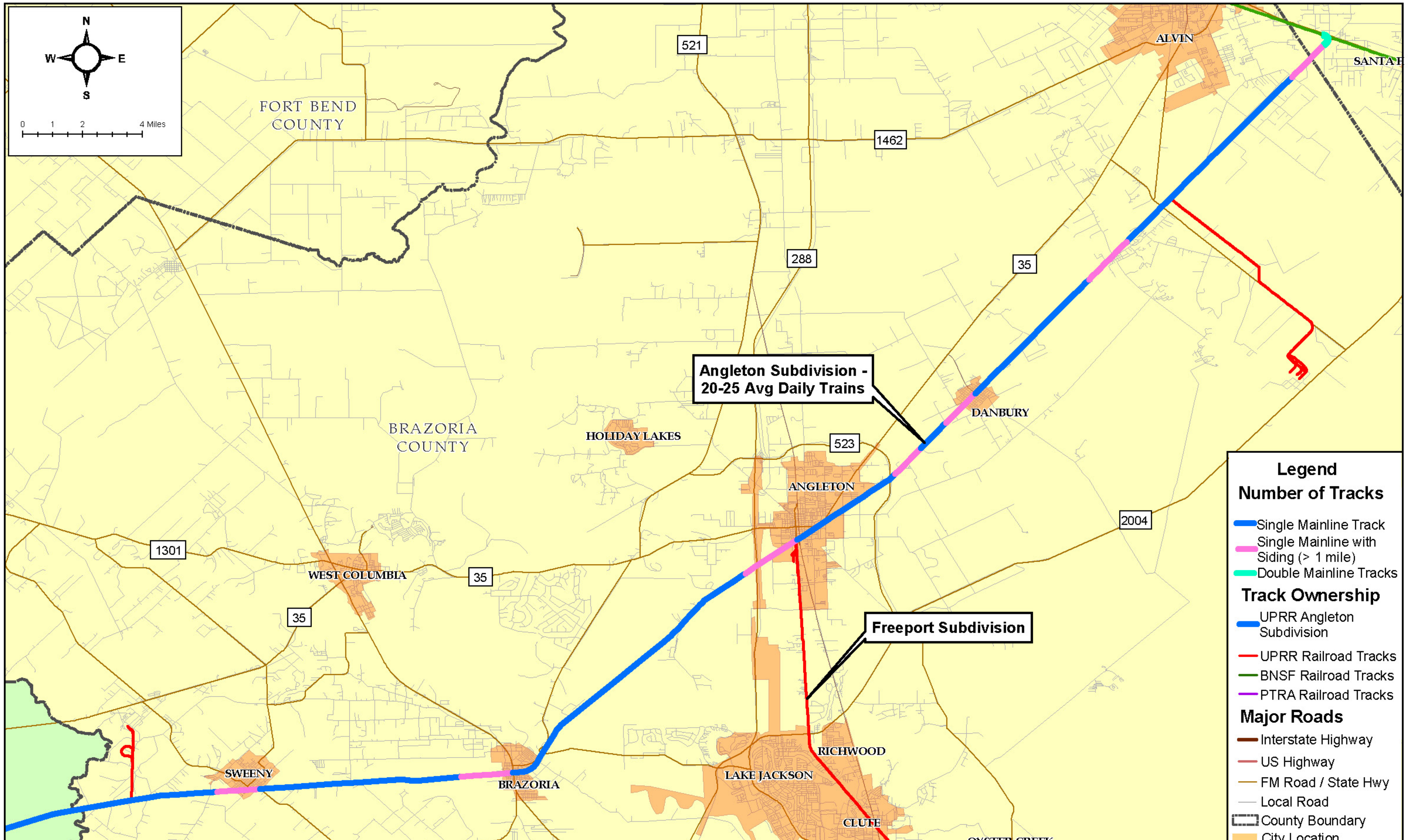


Figure 4-2: UPRR Angleton Subdivision Map

UPRR Baytown Subdivision

The Baytown Subdivision was constructed in the early 1900's and is owned and operated currently by the UPRR. The subdivision originates in Houston at North Shore Junction at milepost 0.00, which is just north of IH10 and west of Loop 610 on the east side of Houston. This line segment runs from Houston through Baytown and terminates at Dayton Junction at milepost 48.72, which is the point of connection between the Baytown Subdivision and the UPRR Lafayette Subdivision near Dayton, Texas. The Houston to Baytown segment of the Baytown Subdivision traverses along the northern shore of the Houston Ship Channel and the San Jacinto River. The Baytown to Dayton segment nearly parallels the SH 146 corridor. The Harris County/Chambers County line crosses the tracks near Eldon Junction at milepost 32.52. The Baytown Subdivision is approximately 49 miles in length, all of which is contained within the study area.

Rail traffic on the Baytown Subdivision is bidirectional with an average daily train count of 10-20 trains, most of which provide service to the local industries located on this line. The BNSF has authority to operate its trains on the Baytown Subdivision from Dayton to just west of Baytown, and has a rail yard just south of the city of Dayton and west of the Sjolander plastics storage facility. Typically, the BNSF traffic runs against the normal flow, however, the BNSF traffic runs at times during the day in which they do not pose a conflict to normal operations.

The Baytown Subdivision is predominantly a single track railroad with limited passing sidings; however, there are well over 20 industrial sidings or spur tracks allowing the railroads to serve the many petrochemical companies. The Jacinto Port Lead, which also connects to the PTRA North Shore Subdivision, connects to the Baytown Subdivision at milepost 7.96. The US Steel Industrial Lead, which is 4.63 miles long, connects to the Baytown Subdivision at milepost 27.75. The Cedar Bayou Industrial Lead, which is 6.50 miles long, connects to the Baytown Subdivision at milepost 32.52.

Table 4-4 displays the locations, lengths, and structure type of major bridges on the Baytown Subdivision, while Table 4-5 summarizes the track mileage data for the Baytown Subdivision. Figure 4-3 shows the location of the Baytown Subdivision. A complete listing of the Baytown Subdivision structures can be found in Appendix B.

Mile Post:	Waterway/Roadway Crossed:	Bridge Length (feet):	Bridge Type:
2.00	Loop 610	248	Concrete
6.59	Greens Bayou	706	Timber
13.13	San Jacinto River	4339	Timber, concrete and steel
14.23	San Jacinto River relief channel	476	Concrete
24.82	Goose Creek	522	Concrete and Timber
33.66	Cedar Bayou	329	Timber

Table 4-4: Baytown Subdivision Major Bridge Inventory

County:	Miles of Main Track:	Miles of Siding Track:	Miles of Yard Track:	Total Miles of Track:
Harris	33.46	7.13	2.41	43.00
Chambers	4.11	2.41	0	6.52
Liberty	10.95	.23	2.64	13.82
Total:	**48.52**	**9.77**	**5.05**	**63.34**

Table 4-5: Baytown Subdivision Track Inventory

Houston Region - Baytown Subdivision

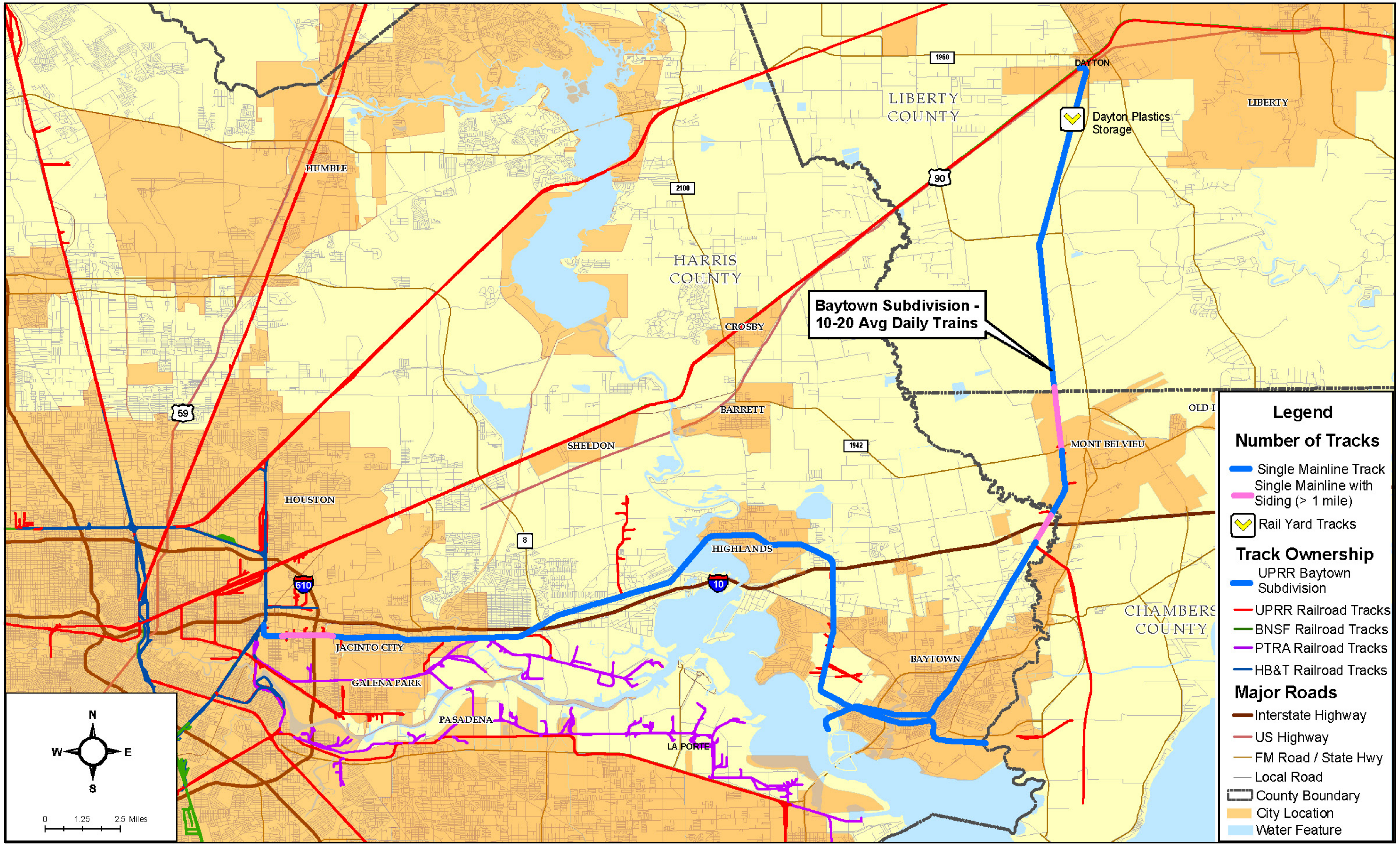


Figure 4-3: UPRR Baytown Subdivision Map

UPRR Beaumont Subdivision

The Beaumont Subdivision was constructed in 1907 by the Beaumont, Sour Lake, and Western Railway Company. Except for the segment of track outside of the study area from Beaumont to DeQuincy, which is owned by the KCS, the Beaumont Subdivision is owned by the UPRR. The subdivision originates in Houston with a connection to the East Belt Subdivision at Gulf Coast Junction located at railroad milepost 378.00 and terminates in Livonia, Louisiana at milepost 620.93. The BNSF and the KCS have trackage rights on the Beaumont Subdivision from Gulf Coast Junction to Beaumont. The UPRR has trackage rights on the KCS from Beaumont to DeQuincy, Louisiana. The Beaumont Subdivision is approximately 240 miles in overall length, of which approximately 48 miles are via the KCS. Approximately 55 miles of the subdivision are within the study area. Predominantly a single track railroad with limited sidings, the Beaumont Subdivision is normally utilized in a directional manner for eastbound traffic, averaging 60-70 trains daily near the downtown terminal and 15-20 trains daily in outlying areas.

Currently there is a single mainline track from Gulf Coast Junction located at milepost 378.00 to Settegast Junction at milepost 381.60, turning into a double mainline from Settegast Junction continuing for approximately 3 miles to Dyersdale, where the subdivision returns to a single mainline. The Beaumont Subdivision begins in Houston, runs northeasterly across Lake Houston, and then briefly parallels FM 1960 before heading towards the city of Beaumont. The Harris County/Liberty County line is located at milepost 401.27 and the Liberty County/Hardin County line crosses the track at milepost 429.39. The East Belt Subdivision connects to the Beaumont Subdivision at milepost 378.00 at Gulf Coast Junction as well as the northern side of Settegast Yard at milepost 380.90. HB&T Junction is located at milepost 381.53.

Table 4-6 displays the locations, lengths and structure type of major bridges on the subdivision, while Table 4-7 summarizes the track mileage data for the subdivision, and Figure 4-4 shows the location of the Beaumont Subdivision. A complete listing of the Beaumont Subdivision structures can be found in Appendix B.

Mile Post:	Waterway	Bridge Length (feet):	Bridge Type:
394.39	Lake Houston	3874	Concrete
415.75	Trinity River	1160	Timber
417.34	Trinity River ox bow	546	Concrete

Table 4-6: Beaumont Subdivision Major Bridge Inventory

County:	Miles of Main Track:	Miles of Siding Track:	Miles of Yard Track:	Total Miles of Track:
Harris	27.33	1.73	0	29.06
Liberty	.28.12	2.71	0	30.83
Total:	**55.45**	**4.44**	**0**	**59.89**

Table 4-7: Beaumont Subdivision Track Inventory

Houston Region - Beaumont Subdivision

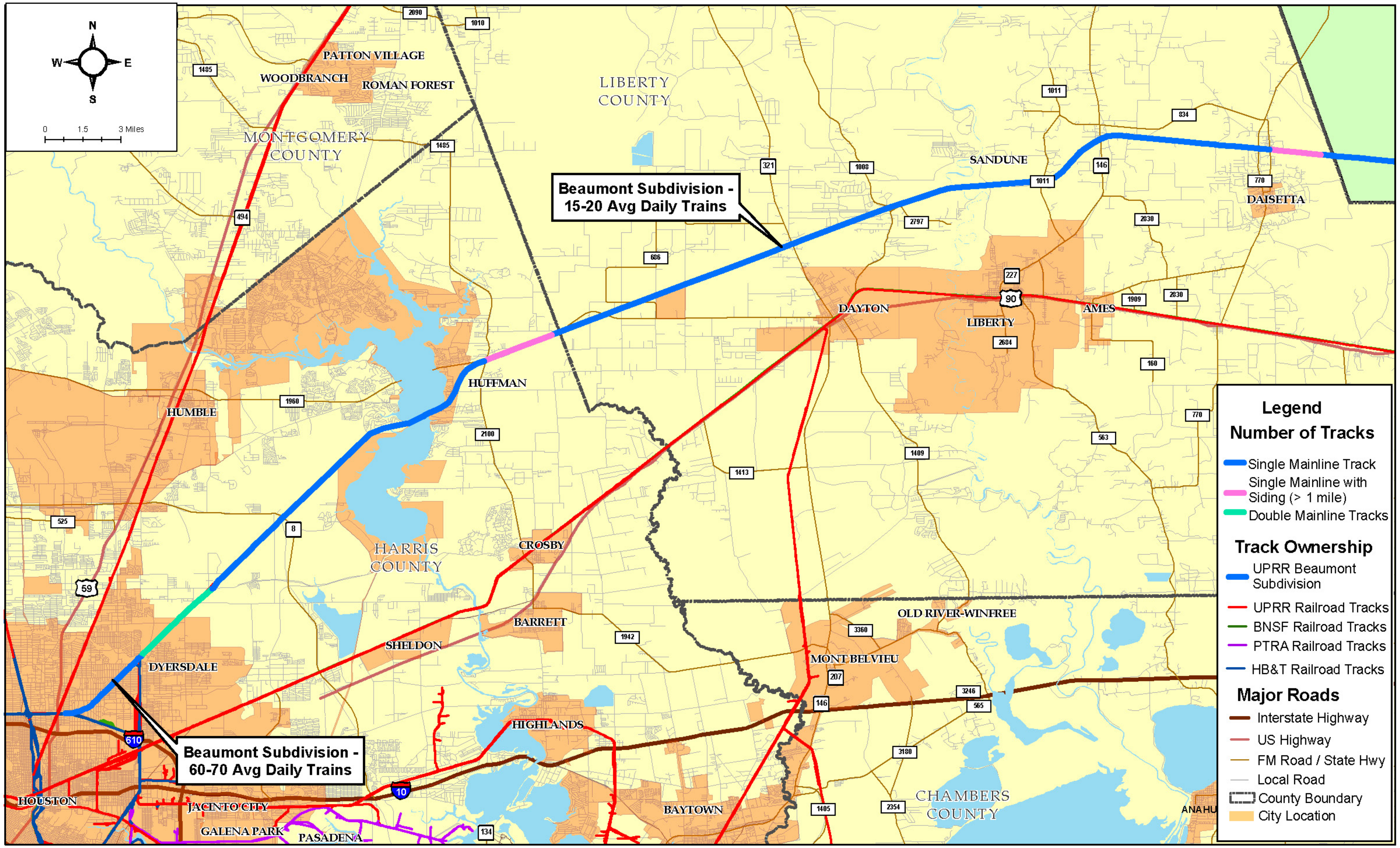


Figure 4-4: UPRR Beaumont Subdivision Map

Houston East Belt Subdivision

The East Belt Subdivision was constructed by the Houston Belt and Terminal Railway Company in 1908. The East Belt Subdivision is owned by the Houston Belt and Terminal Company (HB&T), which is now comprised of the UPRR and the BNSF. Currently, UPRR maintains the tracks while both the BNSF and KCS are granted the right to operate their trains over portions of the rail line. The Texas Mexican Railway has trackage rights from Tower 81 across the West Belt Subdivision onto the East Belt Subdivision at milepost 11.21 to the Strang Subdivision at milepost 7.50. The Texas Mexican Railway also has trackage rights between the Terminal Railway at milepost 4.70 and Gulf Coast Junction at milepost 1.70.

Beginning at Double Track Junction, which is located at railroad milepost 11.21 near Texas Spur 5 and University Drive near the University of Houston, the East Belt Subdivision crosses Buffalo Bayou near the intersection of North Wayside Drive and Clinton Drive, and then continues toward Settegast Yard and Belt Junction, which is located just north of Loop 610 between IH45 and US59 at railroad milepost 0.00.

The East Belt Subdivision makes an approximately 11 mile loop around the east side of Houston, all of which is contained within the study area. The East Belt Subdivision is a double track mainline railroad, with the exception of a single main track bridge over Buffalo Bayou at milepost 8.03. The double track mainline contains frequent locations where a train can cross over from one track to another. The railroad is utilized in a bi-directional manner, with trains dispatched to operate in both directions, averaging between 80 and 90 trains daily, depending upon location.

The East Belt Subdivision connects to multiple other subdivisions in the study region. The terminus of the East Belt Subdivision at Belt Junction is the intersection of the BNSF Houston Subdivision to the west, the East Belt Subdivision to the east, the UPRR Palestine Subdivision to the north and the West Belt Subdivision to the south. The crossing diamond, which is an intersection of crossing tracks where only one track can be used at a time, is located on the West Belt Subdivision. The Palestine Number 1 and Number 2 tracks make a transition to the East Belt Subdivision Number 1 and Number 2 tracks making a turn from the north-south tracks of the Palestine Subdivision to the east. The BNSF Houston Subdivision connects to the East Belt Number 1 track at milepost 0.30.

The UPRR Lufkin Subdivision crosses at milepost 1.23 without access to the East Belt Subdivision. The Beaumont Subdivision ties into the East Belt Subdivision Number 2 track at milepost 1.66. Access from the East Belt Subdivision to the Terminal Subdivision is provided off the Number 1 track to the west and off the Number 2 track to the east.

There are numerous sidings, industrial tracks, and yards along this subdivision. The East Belt Subdivision is the primary route for access to Settegast Yard from the south. Access to the North Settegast Yard is provided through multiple yard tracks that tie into the East Belt Number 2 track between mileposts 3.80 and 4.49. The East Belt tracks make a turn to the south at the North Settegast Yard crossing the UPRR Terminal Subdivision double tracks at milepost 4.70, known as Tower 87. A railroad tower is a physical structure where an operator could observe and control the movement of trains within the area. Towers were erected prior to the centralization and computerization of switching operations.

Pierce Yard is located on the south side of the tracks and the BNSF Hub Yard is located on the north side of the tracks between mileposts 1.66 and 3.00.

Basin Yard is located on the east side of track Number 2 between mileposts 6.26 and 7.60. The UPRR Baytown Subdivision ties into the Basin Yard tracks, which tie into the East Belt Number 2 track at milepost 6.25. Tower 86, at milepost 7.60, is the crossing of the double track Strang Subdivision and southern end of Basin Yard on the East Belt Subdivision. Although, the East Belt Subdivision crosses the Strang Subdivision, there are no connecting tracks between the subdivisions.

At milepost 7.99, the Number 2 track ends with a switch into the Number 1 track making a single track mainline across Bridge 8.03 over Buffalo Bayou. At milepost 8.13 the Number 2 track resumes and continues for the remainder of the subdivision. Two connecting tracks off of the Number 2 track at mileposts 9.11 and 9.25 provide access to Booth Yard.

Tower 85 serves as the access point to the Galveston Subdivision. The Galveston Subdivision crosses the East Belt Subdivision at milepost 9.40 with a connecting track off of the Number 2 track at milepost 9.29.

The East Belt Subdivision includes one major bridge structure, which consists of a 363-foot long bridge over Buffalo Bayou located at milepost 8.03.

Table 4-8 summarizes the track mileage data for the East Belt Subdivision, and Figure 4-5 shows the location of the East Belt Subdivision.

County:	Miles of Main Track:	Miles of Siding Track:	Miles of Yard Track:	Total Miles of Track:
Harris	22.28	.88	4.51	27.67
Total:	**22.28**	**.88**	**4.51**	**27.67**

Table 4-8: East Belt Subdivision Track Inventory

Houston Region - East Belt Subdivision

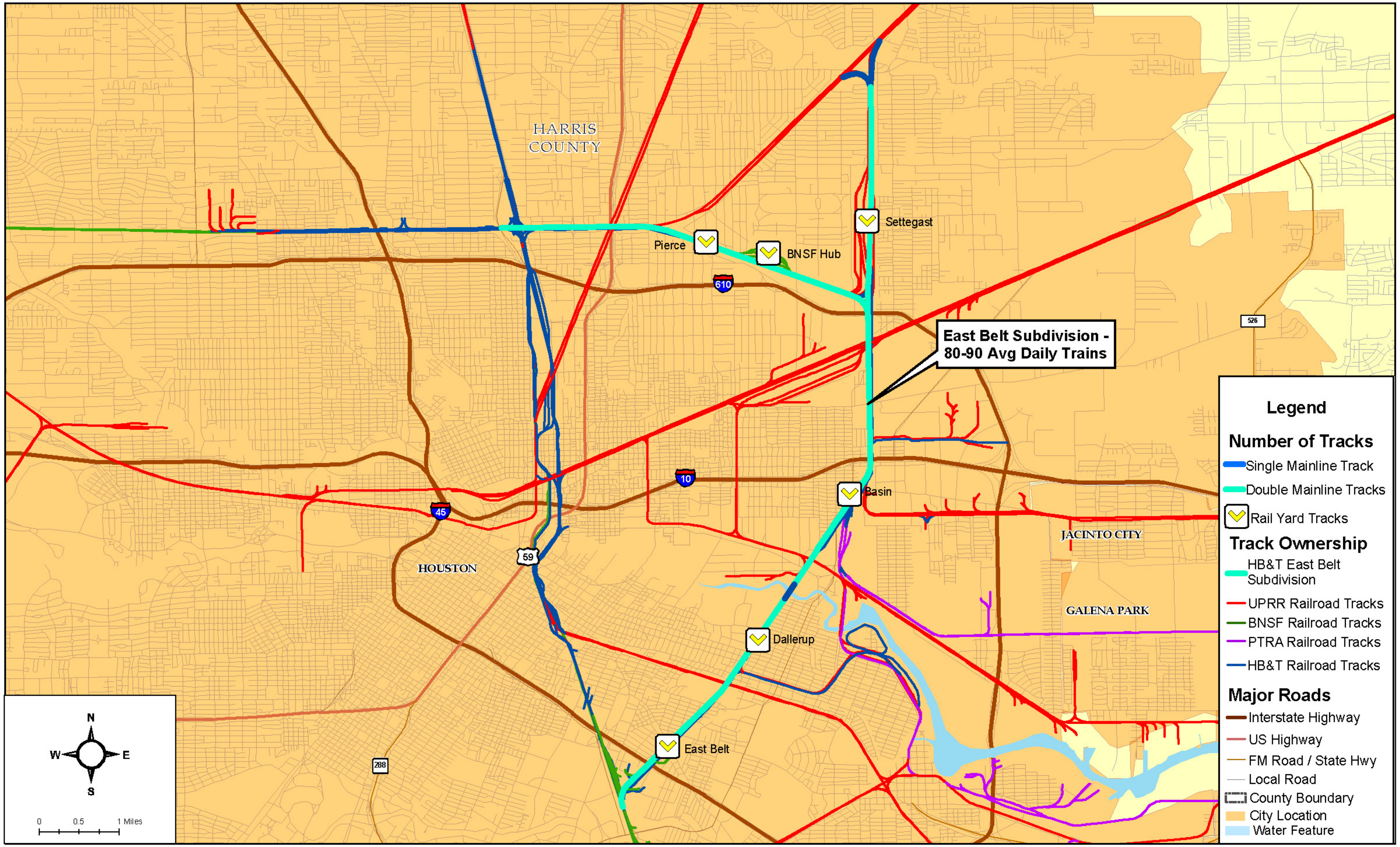


Figure 4-5: Houston East Belt Subdivision Map

UPRR Eureka Subdivision

The single mainline of the Eureka Subdivision was constructed in 1856 by the Galveston and Red River Railway. The Eureka Subdivision originates in the northwest Houston area near the intersection of IH 10 and IH 610 at milepost 0.00.

Eureka Junction is the intersection of the Terminal Subdivision on its Number 1 track milepost 366.28 with the Eureka Subdivision. The second leg of the Eureka Subdivision Wye connects to the Terminal Subdivision on its Number 1 track at milepost 366.55. The Eureka Subdivision generally follows US 290 to the northwest to Hempstead where it turns to the north along SR 6.

The single track mainline of the Eureka Subdivision traverses through the communities of Fairbanks, Jersey Village, Cypress, Waller, Prairie View, and Hempstead. The tracks cross the Harris County/Waller County line at milepost 34.99 and cross the Waller County/Grimes County line at milepost 54.32.

There are no major bridge structures on the Eureka Subdivision.

Table 4-9 summarizes the track mileage data for the Eureka Subdivision, and Figure 4-6 shows the location of the Eureka Subdivision.

County:	Miles of Main Track:	Miles of Siding Track:	Miles of Yard Track:	Total Miles of Track:
Harris	34.99	3.06	0	38.05
Waller	19.33	2.01	0	30.83
Total:	**54.32**	**5.07**	**0**	**59.39**

Table 4-9: Eureka Subdivision Track Inventory

Houston Region - Eureka Subdivision

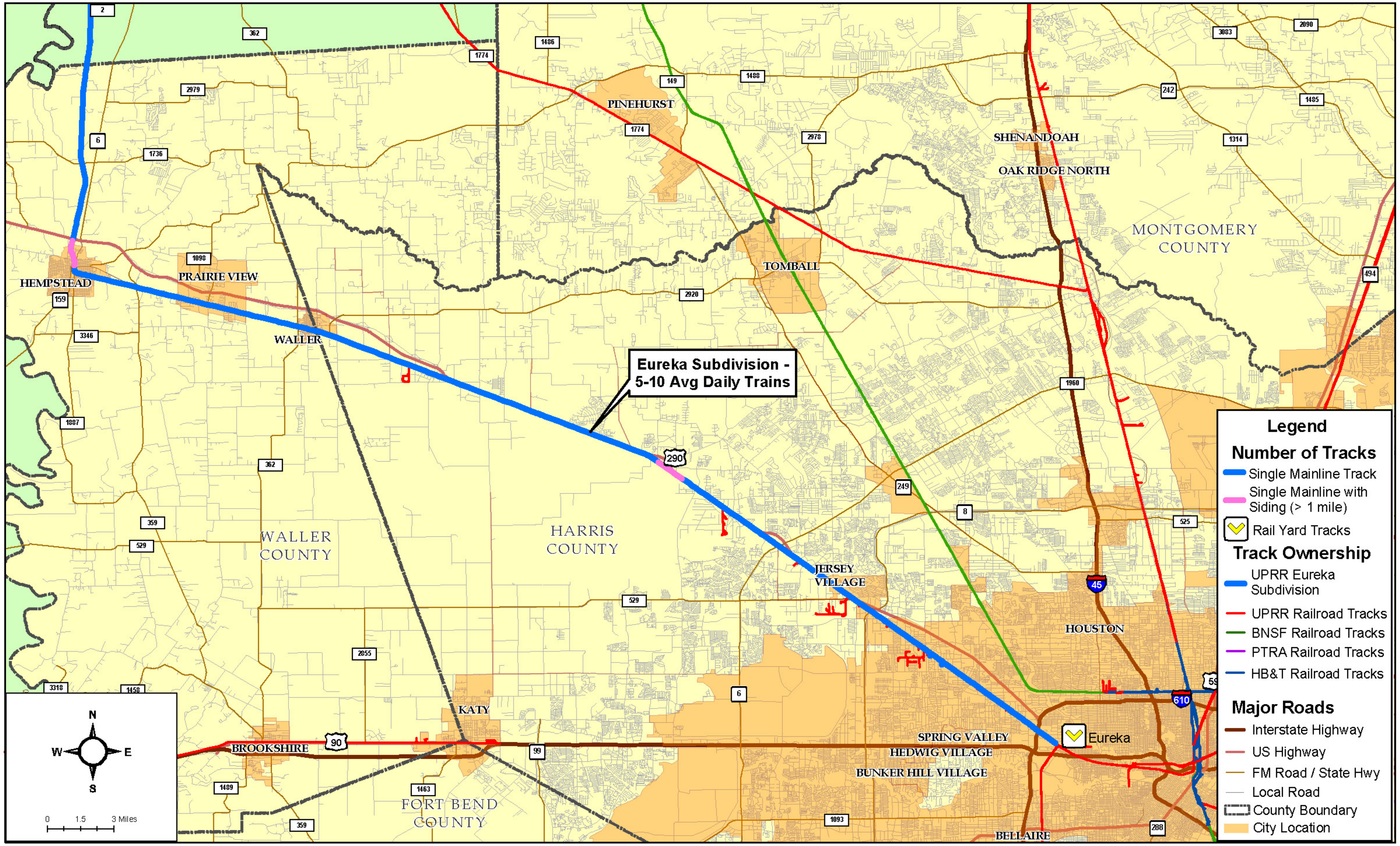


Figure 4-6: UPRR Eureka Subdivision Map

UPRR Galveston Subdivision

The Galveston Subdivision was constructed in 1857 by the Galveston Houston and Henderson Railroad Company and is owned and operated currently by the UPRR. The Galveston Subdivision begins at South GH&H Junction at milepost 0.00, located in south Houston just east and north of US Hwy 59 and IH 45 respectively and essentially parallels IH 45 and SH 3 to the city of Galveston. The West Belt Subdivision connects to the Galveston Subdivision at South GH&H Junction. The entire 47 miles of the UPRR Galveston Subdivision are contained within the study area.

Predominantly a single track line with limited passing sidings, the rail line is used in a bidirectional manner and averages between 15 to 25 trains daily, mainly between GH&H Junction and Tower 30, with approximately 5 to 10 trains daily in outlying areas. The UPRR Galveston Subdivision and the BNSF Galveston Subdivision jointly operate over a single track bridge spanning the Galveston Causeway accessing Galveston Island.

Along the rail line there are numerous industrial tracks to service the customer base, in particular an interchange with the Texas City Terminal Railway Company in Texas City.

The double track East Belt Subdivision crosses the Galveston Subdivision at milepost 2.14 with a connection track to the East Belt Number 2 track controlled by Tower 85 at milepost 2.10. Tower 30, referred to as the “Katy Neck”, is located at milepost 4.50. At this location, access is gained to the Glidden Subdivision, the Strang Subdivision, and the PTRA North Shore Subdivision.

The Galveston Subdivision mainline crosses the Harris County/Galveston County line at milepost 21.88 over Clear Creek. The single main passes through Webster, League City, Dickinson, La Marque, and Texas City. The Texas City Terminal Railway Company tracks cross the Galveston Subdivision at Texas City Junction, located at milepost 37.24, providing access to the Texas City Harbor. The Texas City Yard is located between mileposts 37.32 and 38.07.

The BNSF Galveston Subdivision joins the UPRR Galveston at Virginia Point, located at milepost 41.22 immediately before crossing Galveston Bay. Just past Galveston Bay, the BNSF departs from the UPRR Galveston Subdivision at milepost 43.28 at the Galveston East Yard where the tracks enter Galveston Island. The Galveston Subdivision ends in the city of Galveston at the Galveston West Yard, milepost 47.02.

Table 4-10 displays the locations, lengths, and structure type of major bridges on the Galveston Subdivision, while Table 4-11 summarizes the track mileage data for the Galveston Subdivision. Figure 4-7 shows the location of the Galveston Subdivision, and a complete listing of the Galveston Subdivision structures can be found in Appendix B.

Mile Post:	Waterway	Bridge Length (feet):	Bridge Type:
6.67	Simms Bayou	350	Concrete
27.59	Dickinson Bayou	393	Steel
41.3	Galveston Causeway	8045	Vertical Lift Span

Table 4-10: Galveston Subdivision Major Bridge Inventory

County:	Miles of Main Track:	Miles of Siding Track:	Miles of Yard Track:	Total Miles of Track:
Harris	21.88	12.22	.3	34.4
Galveston	24.55	2.47	4	31.02
Total:	**46.43**	**14.69**	**4.3**	**65.42**

Table 4-11: Galveston Subdivision Track Inventory

Houston Region - UPRR Galveston Subdivision

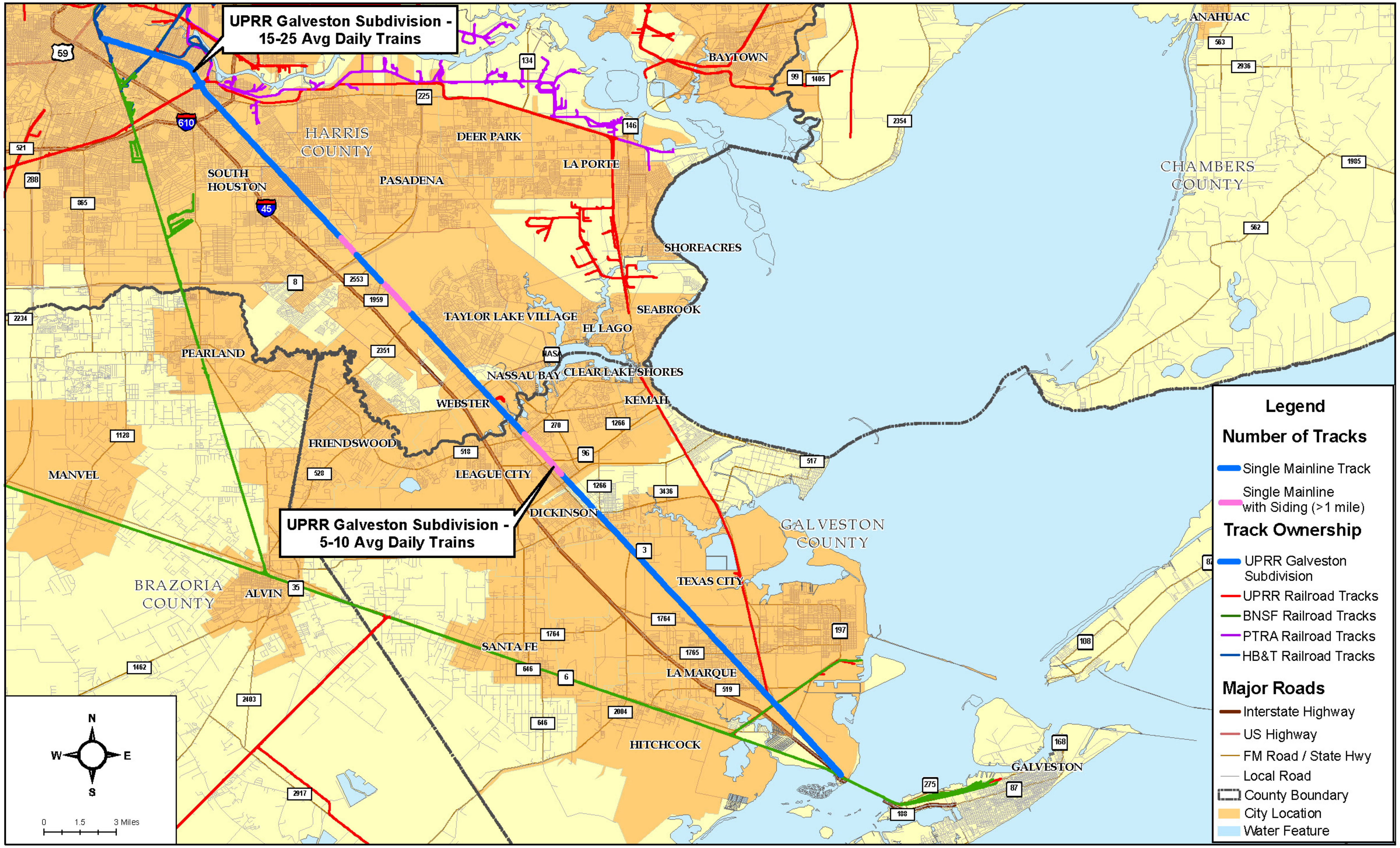


Figure 4-7: UPRR Galveston Subdivision Map

UPRR Glidden Subdivision

The Glidden Subdivision, constructed in 1860 by the Buffalo Bayou, Brazos and Colorado Railroad, is owned and operated currently by the UPRR. Beginning at Harrisburg Junction in Houston, which is just north of FM 225 and west of Loop 610, this line segment terminates at the east end of Kirby Yard, which is east of San Antonio near Randolph Air Force Base. The Glidden Subdivision is more than 210 miles in length; however, approximately 50 miles are contained within the study area.

Rail traffic on the Glidden Subdivision is bidirectional with an average daily train count of approximately 30 to 40 trains. The BNSF has authority to operate its trains on the Glidden Subdivision from Tower 17 in Rosenberg at milepost 36.30 to their Mykawa Subdivision connection at Tower 81 in Houston, while the KCS has authority to operate its trains from Flatonia to Houston. Amtrak's Sunset Limited, connecting Los Angeles to Orlando, operates along this route with three eastbound and three westbound trains weekly. The Glidden Subdivision is the main east-west route for the UPRR, connecting the Ports of Long Beach and Los Angeles to Houston, and Houston to New Orleans. The Texas Mexican Railway has trackage rights over the UPRR Glidden Subdivision between the T&NO Junction (Tower 81) at milepost 1.3 and West Junction at milepost 12.60 as well as between milepost 14.20 and milepost 224.20.

The Houston to Rosenberg segment of the Glidden Subdivision parallels US Highway 90A. Due to the large volume of train traffic combined with the increasing volume of vehicular traffic, vehicular delays typically are experienced in Rosenberg, Richmond, Sugarland, Stafford, and Missouri City.

The Glidden Subdivision crosses from Wharton County into Fort Bend County at milepost 50.93 over the San Bernard River generally following US 90A from San Antonio. The subdivision crosses the BNSF Gulf Coast Galveston Subdivision at Tower 17 located at milepost 36.34. The subdivision crosses the Fort Bend County/Harris County line at milepost 17.26.

A connection to the UPRR double track Terminal Subdivision is located at West Junction at the intersection of US 90, Holmes Road and Hiram Clarke Road in southwest Houston. The Terminal Subdivision's Number 1 and Number 2 tracks tie into the Glidden Subdivision on the northwest quadrant of the intersection at mileposts 12.93 and 12.61 respectively. The connection in the northeast quadrant accommodates access to the Terminal Subdivision from westbound trains off the Glidden Subdivision, or eastbound trains off the Terminal Subdivision. This northeast quadrant connection is called the Spence Cut-Off and ties into the Glidden Subdivision at milepost 11.33.

The Popp Subdivision crosses the Glidden Subdivision at milepost 9.16 as well as at milepost 9.11 with a connection track in the southeast quadrant of the intersection between the two subdivisions. The Glidden Subdivision crosses the BNSF Mykawa Subdivision at the TN&O Junction (Tower 81) located at milepost 4.61. TN&O Junction provides for a connection for east bound trains off the Glidden Subdivision to travel north on the Mykawa Subdivision with the connection track located at milepost 4.65.

The Glidden Subdivision single mainline track passes through Rosenberg, Sugarland, Stafford, and Missouri City. This subdivision continues along US 90A, Holmes Road, and Griggs Road before terminating at Tower 30 in southeast Houston northeast of Broadway Street and Lawndale Street. The Galveston Subdivision crosses the Glidden Subdivision at Tower 30 located at milepost 1.65 with a turnout located at milepost 1.51 for eastbound trains off the Galveston Subdivision. The Glidden Subdivision continues for a short distance to its eastern end at milepost 1.27 at Yard Track 13 providing access to Harrisburg Junction and Manchester Junction.

Table 4-12 displays the locations, lengths and structure type of major bridges on the Glidden Subdivision, while Table 4-13 summarizes the track mileage data for the Glidden Subdivision. Figure 4-8 shows the location of the Glidden Subdivision. A complete listing of the Glidden Subdivision structures can be found in Appendix B.

Mile Post:	**Waterway/Roadway Crossed:**	**Bridge Length (feet):**	**Bridge Type:**
27.82	US 59	432	Concrete
32.42	Brazos River	1133	Timber
50.93	San Bernard River at Wharton County Line	1051	Timber

Table 4-12: Glidden Subdivision Major Bridge Inventory

County:	**Miles of Main Track:**	**Miles of Siding Track:**	**Miles of Yard Track:**	**Total Miles of Track:**
Harris	16	1.52	0	17.52
Fort Bend	33.66	10.05	0	43.71
Total:	**49.66**	**11.57**	**0**	**61.23**

Table 4-13: Glidden Subdivision Track Inventory

Houston Region - Glidden Subdivision

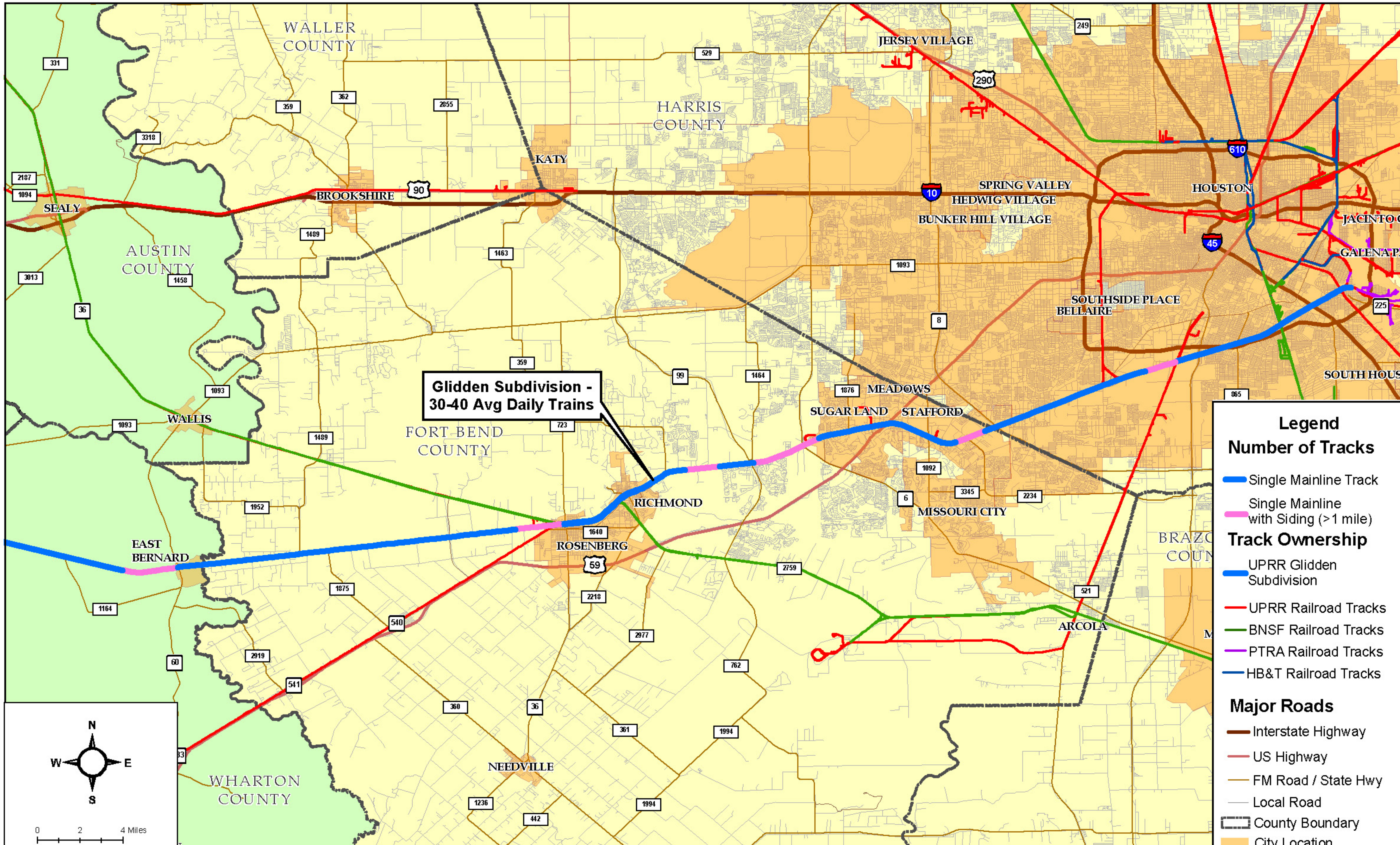


Figure 4-8: UPRR Glidden Subdivision Map

UPRR Lafayette Subdivision

Within the study area, the Lafayette Subdivision was constructed in 1861 by the Texas and New Orleans Railroad. The Lafayette Subdivision is owned and operated currently by the UPRR; however, the BNSF has acquired half interest in ownership from Dawes to Iowa Junction, Louisiana (near Lake Charles, Louisiana). The BNSF and the Kansas City Southern Railroad have trackage rights on the Lafayette Subdivision from Houston to Beaumont. The Lafayette Subdivision is approximately 205 miles in length, of which approximately 58 miles are via the BNSF Railway Company. Approximately 53 miles of the Lafayette Subdivision are within the study area. The Houston to Dayton segment of the Lafayette Subdivision parallels Business US Highway 90.

The Lafayette Subdivision is utilized in a directional manner for westbound traffic and averages 35 to 45 trains daily. Amtrak's Sunset Limited, connecting Los Angeles to Orlando, operates along this route with three eastbound and three westbound trains weekly. Predominantly a single track railroad within the study area, there are numerous sidings and industry tracks between Dawes and Dayton. The Lafayette Subdivision single main originates at milepost 353.00 at the connection with the double track Terminal Subdivision. The Lafayette Subdivision single main tracks become a double main at milepost 351.00 and return to single track at milepost 346.10. The tracks pass through the town of Crosby and cross the Harris County/Liberty County line at milepost 334.59. The tracks pass through Crosby, Dawes, Fauna, Sheldon, Dayton, Liberty, and Ames and cross the Liberty County/Jefferson County line at milepost 299.38.

Table 4-14 displays the locations, lengths, and structure type of major bridges on the Lafayette Subdivision, while Table 4-15 summarizes the track mileage data for the Lafayette Subdivision. Figure 4-9 shows the location of the Lafayette Subdivision. A complete listing of the Lafayette Subdivision structures can be found in Appendix B.

Mile Post:	Waterway	Bridge Length (feet):	Bridge Type:
321.98	Trinity River	1,558	Timber
322.65	Trinity River relief channel	435	Timber
324.65		495	Timber
343.77	San Jacinto River	2,029	Concrete

Table 4-14: Lafayette Subdivision Major Bridge Inventory

County:	Miles of Main Track:	Miles of Siding Track:	Miles of Yard Track:	Total Miles of Track:
Harris	18.39	6.69	.95	26.03
Liberty	35.21	5.26	3.46	43.93
Total:	**53.6**	**11.95**	**4.41**	**69.96**

Table 4-15: Lafayette Subdivision Track Inventory

Houston Region - Lafayette Subdivision

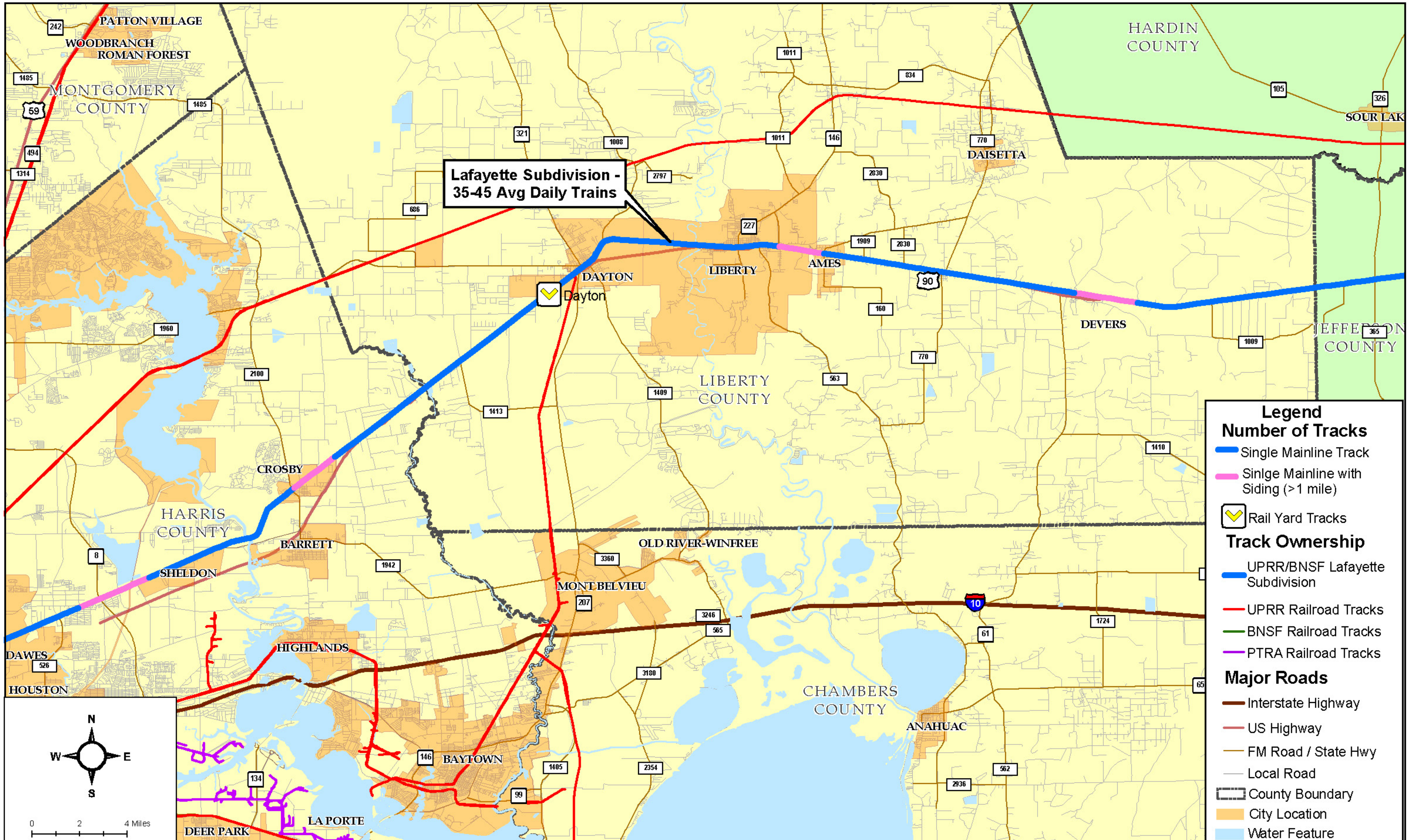


Figure 4-9: UPRR Lafayette Subdivision Map

UPRR Lufkin Subdivision

This single main track of the Lufkin Subdivision originally was constructed in 1876 by the Houston East and West Texas Railroad. The Lufkin Subdivision originates at Tower 26 located at milepost 0.74, and runs from the Terminal Subdivision Hardy Yard generally following US 59 north to Shreveport.

The Lufkin, Terminal, and West Belt Subdivisions meet at Tower 26 in Houston. Access to the Terminal Subdivision is achieved to the west via a single connection point while access to the east towards Englewood Yard is gained via a pair of crossovers and a single wye on the Houston West Belt Subdivision. Tower 71 is located at milepost 1.50 and serves as a connection point to the Number 1 track on the Houston West Belt Subdivision. Tower 210 is located at milepost 2.1 and serves as a connection point to the Number 2 track on the Houston West Belt Subdivision. Tower 76, located at milepost 4.1 crosses the double tracks on the northern reach of the Houston East Belt Subdivision. No connection exists between the Lufkin Subdivision and these East Belt Subdivision tracks.

The single main track traverses through the city of Humble, crosses the Harris County/Montgomery County line at milepost 20.34, passes through the town of Splendora, and then the Montgomery County/Liberty County line at milepost 37.28. At milepost 43.70, the single main crosses the BNSF Conroe Subdivision in Cleveland. The Liberty County/San Jacinto County line crosses the tracks at milepost 47.59.

Table 4-16 displays the locations, lengths, and structure type of major bridges on the Lufkin Subdivision, while Table 4-17 summarizes the track mileage data for the Lufkin Subdivision. Figure 4-10 shows the location of the Lufkin Subdivision. A complete listing of the Lufkin Subdivision structures can be found in Appendix B.

Mile Post:	Waterway	Bridge Length (feet):	Bridge Type:
19.06	San Jacinto River	950	Concrete/Timber
28.6	Caney Creek	1084	Timber
31.82	Peach Creek	1560	Concrete
39.38	San Jacinto River (east fork)	1560	Timber

Table 4-16: Lufkin Subdivision Major Bridge Inventory

County:	Miles of Main Track:	Miles of Siding Track:	Miles of Yard Track:	Total Miles of Track:
Harris	19.6	1.77	1.61	22.98
Liberty	16.94	1.87	0	18.81
Montgomery	10.31	.99	0	11.3
Total:	**46.85**	**4.63**	**1.61**	**53.09**

Table 4-17: Lufkin Subdivision Track Inventory

Houston Region - Lufkin Subdivision

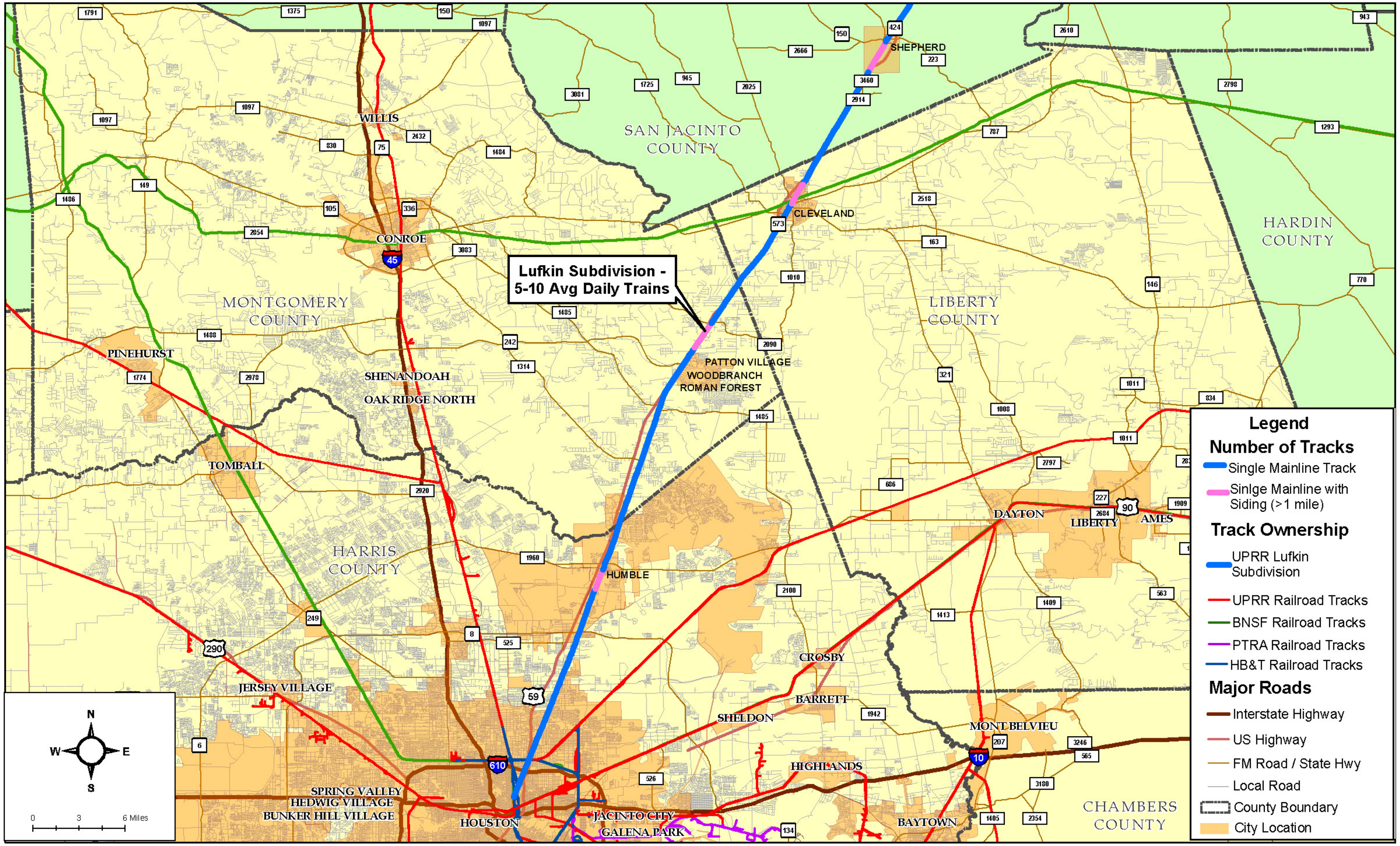


Figure 4-10: UPRR Lufkin Subdivision Map

UPRR Navasota Subdivision

Within the study area, the Navasota Subdivision, follows the general direction of FM 2920 from Spring to Tomball, and was constructed in 1902 by the International and Great Northern Railroad. The Navasota Subdivision is approximately 100 miles in length, with terminus points at Spring Junction and Valley Junction near Bryan/College Station. The track is owned and operated by UPRR with approximately 27 miles of this line segment contained within the study area. Only the tracks located within Harris, Montgomery, and Waller Counties will be considered for the purposes of this study. Predominantly a single track railroad with limited passing sidings, rail traffic is bidirectional with the majority of traffic inbound toward Houston. The Navasota Subdivision averages 15 to 25 trains daily.

Beginning at Spring Junction, the Navasota Subdivision proceeds to the northwest to Navasota. Spring Junction is located on the Palestine Subdivision north of Houston at milepost 0.00 on the Navasota Subdivision, which equals milepost 210.84 on the Palestine Subdivision. The Navasota Subdivision connects to the Palestine Subdivision with a wye track located at milepost 0.35 on the Navasota Subdivision, which is equal to Palestine Subdivision milepost 210.44.

The Navasota Subdivision passes through the communities of Spring, Huffsmith, and Magnolia. The subdivision tracks cross the Montgomery County line at milepost 13.05, the Waller County line at milepost 25.52, and the Grimes County line at milepost 27.30, providing the limits of this report. The BNSF Houston Subdivision crosses under the Navasota Subdivision at milepost 14.20 without any connections between the two railroads.

The only major bridge structure along the Navasota Subdivision is an 893-foot long concrete bridge over Spring Creek at milepost 12.80.

Table 4-18 summarizes the track mileage data for the Navasota Subdivision, and Figure 4-11 shows the location of the Navasota Subdivision.

County:	Miles of Main Track:	Miles of Siding Track:	Miles of Yard Track:	Total Miles of Track:
Harris	13.05	2.84	.89	16.78
Montgomery	12.47	1.21	0	13.68
Waller	1.78	1.34	0	3.12
Total:	**27.3**	**5.39**	**.89**	**33.58**

Table 4-18: Navasota Subdivision Track Inventory

Houston Region - Navasota Subdivision

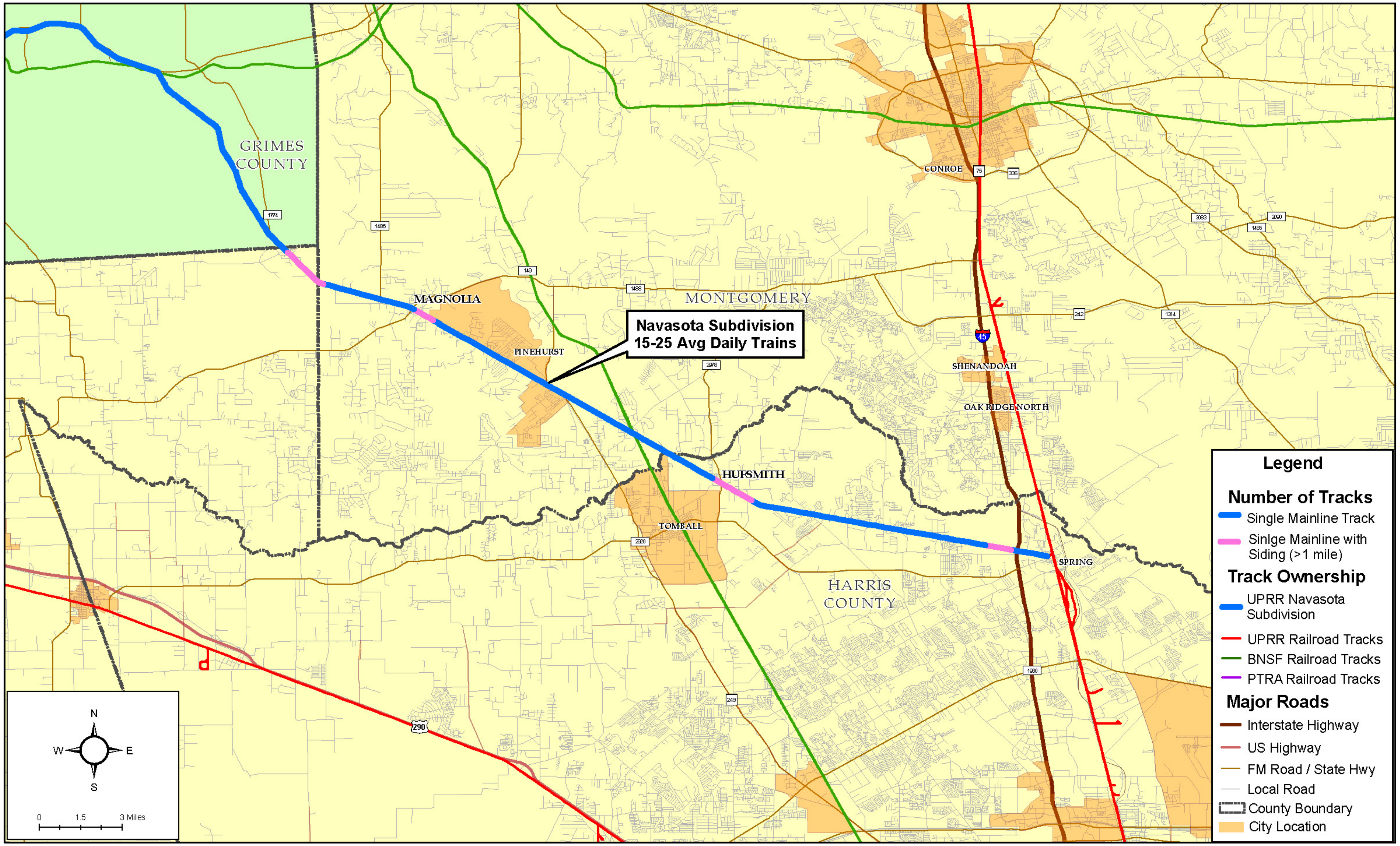


Figure 4-11: UPRR Navasota Subdivision Map

UPRR Palestine Subdivision

The Palestine Subdivision, which generally parallels the Hardy Toll Road, was constructed by three individual railroads during the 1870's with a second mainline added in 1992. The southern most segment of the Palestine Subdivision, between Belt Junction (located just north of Loop 610 between IH45 and US59) to a location approximately two miles north of Belt Junction at railroad milepost 226.76, was constructed by the HB&T. From this location to Palestine, Texas the line was constructed by the Houston and Great Northern Railroad, and the segment between Palestine and Longview, Texas was constructed by the International Railroad. In Longview, the Palestine Subdivision connects to UPRR's Little Rock Subdivision providing a rail route to Little Rock, Arkansas. The Palestine Subdivision is owned and operated currently by UPRR. The BNSF has the right to operate outbound trains on the Palestine Subdivision between railroad milepost 226.67 and Longview, Texas.

The Palestine Subdivision is approximately 229 miles in length, with more than 48 miles contained within the study area. Although the subdivision is predominantly a single track railroad with limited sidings, about 14 miles between Belt Junction and Spring, Texas (at milepost 210.69) has a second mainline that was constructed in 1992. Between Belt Junction and Spring Junction, where the UPRR Navasota Subdivision connects to the Palestine Subdivision, the railroad is utilized in a bi-directional manner, with trains operating in both a northbound and southbound manner, averaging around 30 to 40 trains daily in this segment of track. From Spring Junction to Palestine, the predominant flow of traffic is northbound toward Palestine with a daily average of eight to ten trains.

The Palestine Subdivision begins in Longview, Texas at milepost 0.00 passing through Palestine, Texas at milepost 82.20 then onto Houston ending at Belt Junction at milepost 228.90. Only the tracks located between Belt Junction and the Montgomery/Walker County line located at milepost 180.35 will be considered for the purposes of this study.

The BNSF Conroe Subdivision crosses the Palestine Subdivision at milepost 194.65 without any connecting tracks. The Montgomery/Harris County line is located at milepost 208.06, where Spring Creek crosses the tracks. The UPRR Navasota Subdivision connects to the Palestine Subdivision with one connector track at milepost 210.44 and the other connector track at milepost 210.84.

At milepost 222.25 the southbound lane of the Hardy Toll Road crosses over the Palestine Subdivision and from that location to milepost 228.36, the railroad is located between the northbound and southbound lanes of the toll road. At milepost 228.36, the Hardy Toll Road northbound lane crosses over the railroad. The Palestine Subdivision ends at Belt Junction, milepost 228.90 after it passes through Spring, The Woodlands, Conroe, and Willis.

Union Pacific has two rail facilities, Lloyd Yard located on the east side of the Palestine Subdivision between mileposts 211 and 214 and the Westfield Auto Facility located on the west side of the subdivision between mileposts 215 and 216 near Spring, Texas. Westfield is an auto facility for Gulf States Toyota, and Lloyd Yard is a “Storage in Transit” (SIT) Yard, a yard that typically stores covered hoppers and tank cars normally filled with bulk materials such as PVC powder, plastic pellets, or another commodity that typically is made in huge quantities so that manufacturing the product may be cost effective.

Major structures are located over Spring Creek, a 763 feet concrete bridge, and over the San Jacinto River and San Jacinto relief channel, 1,065 feet and 652 feet long respectively.

Table 4-19 displays the locations, lengths, and structure type of major bridges on the Palestine Subdivision, while Table 4-20 summarizes the track mileage data for the Palestine Subdivision. Figure 4-12 shows a map of the Palestine Subdivision. A complete listing of the Palestine Subdivision structures can be found in Appendix B.

Mile Post:	**Waterway**	**Bridge Length (feet):**	**Bridge Type:**
214.07	Cypress Creek	516	Concrete
208.15	Spring Creek	784	Concrete
199.06	San Jacinto River	1065	Timber & Concrete
198.68	San Jacinto River relief channel	652	Timber

Table 4-19: Palestine Subdivision Major Bridge Inventory

County:	**Miles of Main Track:**	**Miles of Siding Track:**	**Miles of Yard Track:**	**Total Miles of Track:**
Harris	39.05	1.57	3.97	44.59
Montgomery	27.71	4.65	0	32.36
Total:	**66.76**	**6.22**	**3.97**	**76.95**

Table 4-20: Palestine Subdivision Track Inventory

Houston Region - Palestine Subdivision

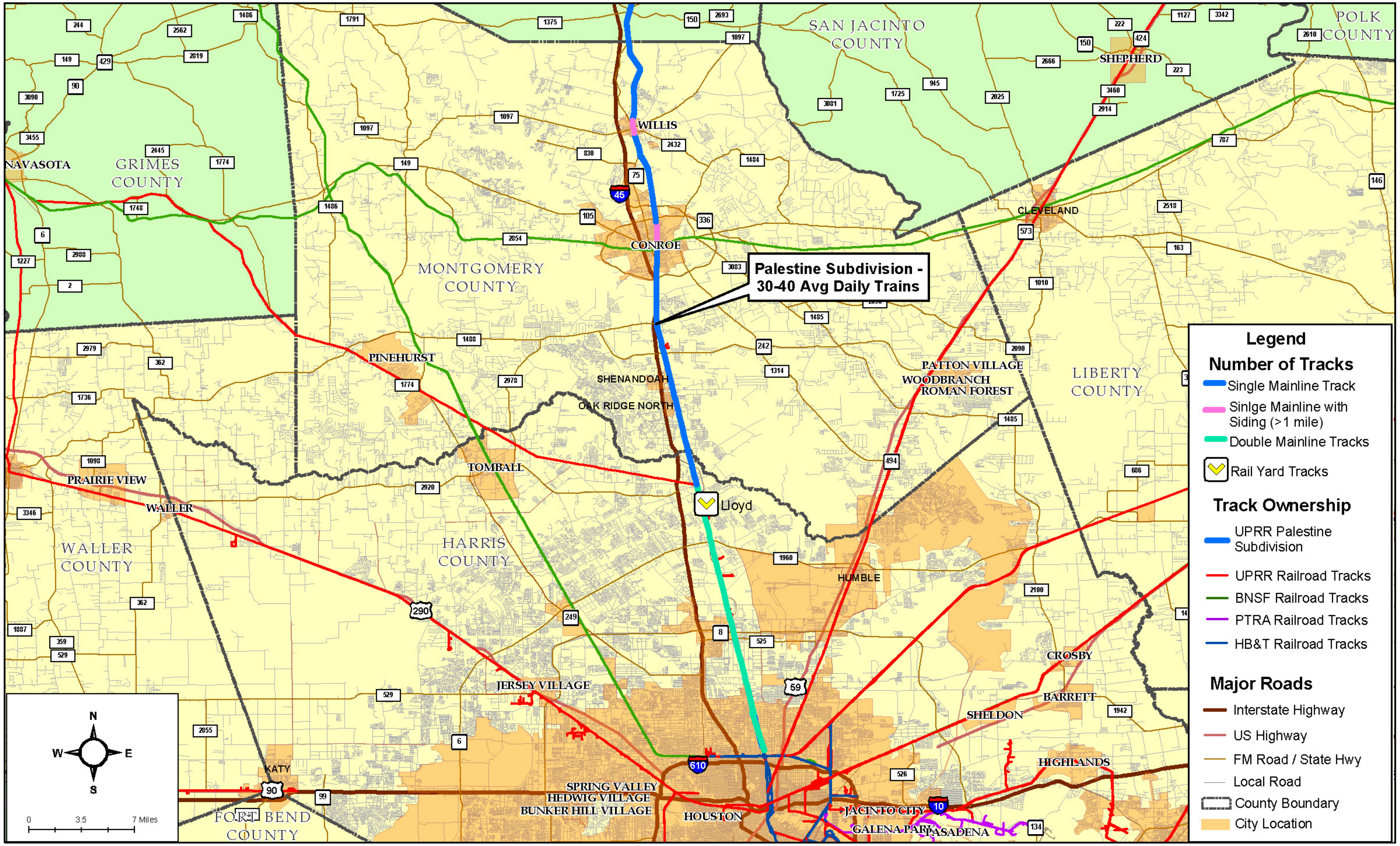


Figure 4-12: UPRR Palestine Subdivision Map

UPRR Strang Subdivision – Seabrook Industrial Lead

The portion of the Strang Subdivision between milepost 0.00 and Buffalo Bayou, located at milepost 3.55, was constructed originally in 1903 by the Galveston, Harrisburg and San Antonio Railroad. The PTRA constructed the tracks between Buffalo Bayou and the Katy Connection at milepost 6.00 and have trackage rights over this segment of the Strang Subdivision. The Galveston, La Porte and Houston Railroad constructed the tracks between the Katy Connection and milepost 8.80 in 1895 and 1903. In 1961, the Texas and New Orleans Railroad extended the tracks to milepost 9.50 and between mileposts 13.97 and 16.90. The PTRA constructed the railroad between mileposts 9.50 and 13.97. The Galveston, La Porte and Houston Railroad constructed the remaining section of the Strang Subdivision to milepost 21.42 and the Seabrook Industrial Lead.

The Strang Subdivision consists of approximately 21 miles of track beginning at Tower 68 near Englewood Yard to Strang. At Strang Yard, the Strang Subdivision becomes the Seabrook Industrial lead serving the Bayport Industrial District and the Port of Houston’s Bayport Terminal. The entire line segment is within the study area, and is owned and operated currently by the UPRR, with trackage rights granted to the PTRA for intermodal movements.

There are approximately 16 trains per day on the Strang Subdivision. The rail traffic along the Strang Subdivision is bidirectional, traveling to and from Englewood Yard and the Port of Houston. From Deer Park Junction to Strang, this line is operated as two main tracks, the second main track being the PTRA “New” main. Trains of both railroads can use either track, which is crucial in establishing the rail capacity of the Strang Subdivision. The Port of Houston’s Barbour's Cut facility, the principal water/rail Intermodal Container Transfer Facility (ICTF) in Houston, also is accessed from the Strang Subdivision.

The Strang Subdivision originates at a connection with the Terminal Subdivision, in the Englewood Yard South Tower 68 located at milepost 0.00. From the Englewood Yard, the Strang Subdivision goes south crossing Buffalo Bayou then following along the south side of Buffalo Bayou to Galveston Bay where it makes a transition into the Seabrook Industrial Lead at milepost 21.42. The Strang Subdivision passes through the cities of Pasadena and Deer Park. The Strang Subdivision is a double track mainline to Fidelity Yard where it transitions to a single track.

The Bell Main connects to the Strang Subdivision at milepost 1.65 going to the Englewood Intermodal Facility. The double track East Belt Subdivision crosses the Strang Subdivision double tracks at milepost 2.55 (Tower 86) without any connecting tracks. Access to the PTRA Yard is available at milepost 3.54, immediately north of Buffalo Bayou with the single track mainline crossing Buffalo Bayou at milepost 3.55. The Booth Yard and Siding are located just past Buffalo Bayou at milepost 4.50.

Connecting tracks between the East Belt Dallerup Yard and Booth Yard cross the Strang Subdivision at milepost 3.99.

At milepost 5.96 the Strang Subdivision passes the Katy Neck, which includes Tower 30, Harrisburg Junction, GH&H Junction, and Manchester Junction providing access to the UP Glidden and Galveston Subdivisions. At milepost 6.24, access is gained to the PTRA mainline that serves Manchester Yard, chemical plants, and facilities along Buffalo Bayou. At milepost 9.84, the PTRA main track connects back to the Strang Subdivision at Sinco Junction with an additional track parallel to the mainline to Pasadena Junction where the PTRA single main breaks off to the north at milepost 10.96. Access to the PTRA is again available at milepost 13.92 at Deer Park Junction where the PTRA turns toward Buffalo Bayou before returning to the Seabrook Industrial Lead and the Barbours Cut track at Strang.

The Strang Subdivision terminates at milepost 21.42 where it makes a transition to the Seabrook Industrial Lead milepost 0.00. The Seabrook Industrial Lead ends at milepost 7.68 immediately north of Clear Creek and Seabrook, Texas passing through the city of La Porte. From milepost 7.68 south along Highway 146 to Texas City and the Galveston Subdivision, the railroad track has been abandoned. The Barbours Cut Industrial Lead tracks join the Seabrook Industrial Lead mainline track at milepost 0.09. The Seabrook Industrial Lead serves Strang Yard, Bayport Intermodal Terminal, and Bayport Industrial Loop track industries at milepost 3.00.

Major structures along the Strang Subdivision consist of a 568-foot long bridge over Buffalo Bayou located at milepost 3.55, and a 325-foot long bridge over Shaver Street located at milepost 10.51.

Tables 4-21 and 4-22 summarize the track mileage data for the Strang Subdivision and Seabrook Industrial Lead, respectively, and Figure 4-13 shows the location of the Strang Subdivision.

County:	Miles of Main Track:	Miles of Siding Track:	Miles of Yard Track:	Total Miles of Track:
Harris	21.42	6.26	3.56	31.24
Total:	**21.42**	**6.26**	**3.56**	**31.24**

Table 4-21: Strang Subdivision Track Inventory

County:	Miles of Main Track:	Miles of Siding Track:	Miles of Yard Track:	Total Miles of Track:
Harris	7.68	.89	3.8	12.37
Total:	**7.68**	**.89**	**3.8**	**12.37**

Table 4-22: Seabrook Industrial Lead Track Inventory

Houston Region - Strang Subdivision

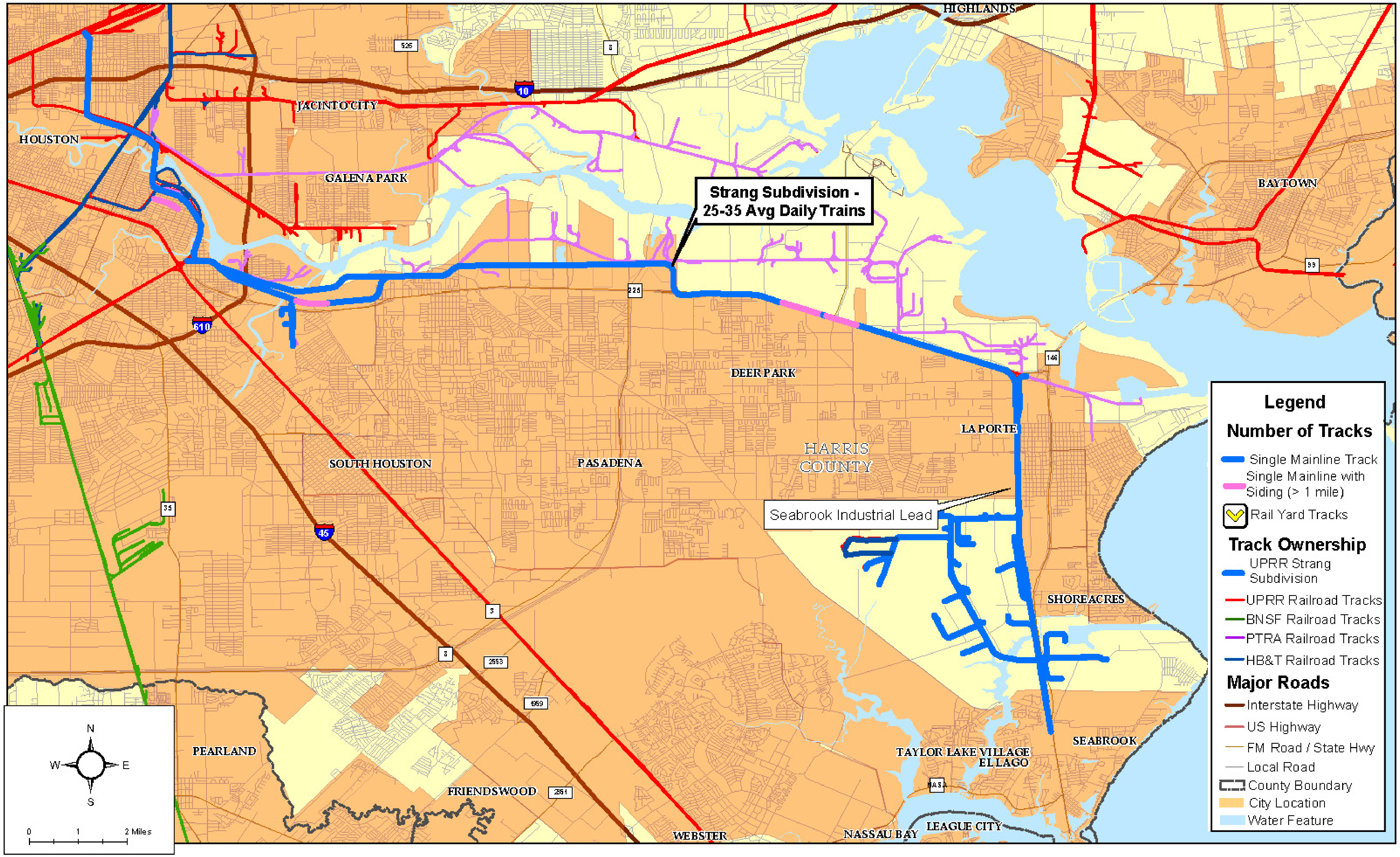


Figure 4-13: UPRR Strang Subdivision and Seabrook Industrial Lead Map

UPRR Terminal Subdivision

The initial mainline of the Terminal Subdivision was constructed in stages in the mid to late 1800's; however, a second main line track was added in the 1900's to have the Terminal Subdivision act as a by-pass route of downtown Houston. Between West Junction and milepost 370, the Number 2 track originally was constructed from 1853 to 1858 by the Galveston and Red River Railway. From milepost 360.00 to the Lafayette Subdivision at milepost 353.00, the tracks were constructed by the Texas and New Orleans Railway in 1861 as a wide gauge track and rehabilitated to standard gauge track in 1876. The Number 1 track was constructed by the Galveston, Harrisburg and San Antonio Railway in 1877 between mileposts 363.84 and about 363.30. Between mileposts 365.00 and 363.84, track Number 1 was constructed by the Houston and Texas Central Railroad in 1900, and track Number 2 was constructed between mileposts 363.84 and 361.20 by the Houston and Texas Central Railway in 1900. The Number 1 track was constructed in 1914 by the Houston and Texas Central Railway.

Approximately 22 miles in length, the Terminal Subdivision has terminus points at West Junction, located near the intersection of US 90 and Willowbend Blvd, and Dawes. The entire Terminal Subdivision is within the study area.

The track is owned and operated by the UPRR and runs 50 - 60 trains per day. The rail traffic along the Terminal Subdivision is primarily bidirectional, traveling to and from Englewood Yard. The BNSF has authority to operate its trains on the Terminal Subdivision from Tower 26 to Dawes, while the KCS Railway Company has the authority to operate trains nearly the entire length of the Terminal Subdivision. The Terminal Subdivision is the primary route used for connecting rail traffic from the west coast to Houston, and also is used by Amtrak's Sunset Limited, with three trains eastbound and westbound weekly.

Located in southwest Houston at West Junction, the Terminal Subdivision milepost 375.69 on the Number 1 track, and milepost 375.6 on the Number 2 track, ties into the UPRR Glidden Subdivision on the west side of the Terminal Subdivision near Holmes Road and Highway 90. From West Junction, the double track Terminal Subdivision main tracks go due north across west Houston to the Eureka Subdivision, near Tower 13, before turning east.

On the east side of the Terminal Subdivision, the Number 2 track is connected to the Glidden Subdivision across the Spence Cutoff. The Spence Cutoff extends from the Terminal Subdivision Number 2 track at milepost 374.37 to the east connecting to the Glidden Subdivision at Stella.

As the Terminal Subdivision crosses Buffalo Bayou at milepost 368.50, it enters into the Houston Arboretum and Botanical Garden Park until it crosses under IH-10 at milepost 366.81. As the railroad crosses under IH-10 it makes a sharp turn toward the east through a 6°–31' curve. The UPRR Eureka Subdivision enters the Terminal Subdivision's Number 2 track on each side of this curve at mileposts 366.55 and 366.28. Access to the UPRR Eureka Yard is provided off these connection tracks to the Eureka Subdivision. This intersection is known as Tower 13.

At Chaney Junction, which is located just north and east of the intersection of Washington Avenue and Studemont Street, the two main tracks separate from each other. The northernmost track is referred to as the Freight Main, and between Sawyer and Holly Streets, runs down the middle of Winter Street. The southernmost track is referred to as the Passenger Main and parallels Washington Avenue to the north passing by the Amtrak Station. The Freight Main and the Passenger Main reconnect just west of Tower 26. As the tracks extend east from Chaney Junction, the mainline Number 2 track departs toward the south from the Number 1 track between mileposts 363.43 and 360.75 located at Tower 26, near the intersection of IH 10 and IH 45. Tower 26 is located in this area, where the two mainlines return together, near the Lufkin Subdivision connection, and the West Belt track crossing. Through this area, the Number 1 track is known as the freight line and the Number 2 track is known as the passenger line.

The Freight Main (Number 1 track) traverses the narrow right-of-way of Winter Street before crossing over the IH 45 / IH 10 interchange. The Passenger Main (Number 2 track) passes through the Amtrak Station before traversing under the University of Houston-Downtown and IH 45. The UPRR Hardy Yard is located along the north side of the Number 1 track between mileposts 361.71 and 360.75. The UPRR Lufkin Subdivision connects to the Number 1 tack at milepost 360.69. The Amtrak passenger station is located directly under the IH-45 overpass structure at milepost 362.25 on the Number 2 track. Just east of the Lufkin Subdivision connection, the double track West Belt Subdivision crosses the Terminal Subdivision at milepost 360.65. The West Belt Subdivision connects to the Terminal Subdivision on the east side of the crossing at milepost 360.55 on mainline Number 1 and milepost 360.41 on track Number 2. This intersection is known as Carr Street Junction.

Between Tower 26 (milepost 360.69) and Tower 87 (milepost 356.8) the double track Terminal Subdivision turns to the east northeast where it will turn into the La Fayette Subdivision at milepost 353.00. The two mainline tracks are not operated via Central Traffic Control (CTC) and are not designated as tracks 1 and 2. The Englewood Intermodal Facility is located on the south side of the tracks between milepost 359.40, near Waco Street, and milepost 358.60 near Lockwood Drive. The Englewood Yard extends from milepost 358.90, at the east end of the Intermodal Facility, past Tower 87 at milepost 356.80 and beyond Settegast Junction where it comes back into the Number 2 track at milepost 355.29. At milepost 356.89, the East Belt Subdivision crosses the Terminal Subdivision with connections at milepost 356.92.

At milepost 356.91, CTC operations utilized making the double track designation track Number 1 and track Number 2 until the end of the Terminal Subdivision at milepost 353.00

Texas Mexican Railway has trackage rights between West Junction and Chaney Junction, from Chaney Junction to Tower 26 via the Hardy Street Yard, and from milepost 360.42 (Carr Street Junction) to the Lafayette Subdivision. The BNSF Railway has trackage rights from milepost 360.42 (Carr Street Junction) to the Lafayette Subdivision.

Table 4-23 displays the locations, lengths and structure type of major bridges on the Terminal Subdivision, while a complete listing of the Terminal Subdivision structures can be found in Appendix B. Table 4-24 summarizes the track mileage data for the Terminal Subdivision, and Figure 4-14 shows a map of the subdivision.

Mile Post:	**Waterway/Roadway Crossed:**	**Bridge Length (feet):**	**Bridge Type:**
361.81	I-45/I-10	1027	Single (No.1) track
365.48	I-10	553	Double track, Concrete
368.5	Buffalo Bayou	315	Double track, Concrete

Table 4-23: Terminal Subdivision Major Bridge Inventory

County:	**Miles of Main Track:**	**Miles of Siding Track:**	**Miles of Yard Track:**	**Total Miles of Track:**
Harris	45.29	.79	6.56	52.64
Total:	**45.29**	**.79**	**6.65**	**52.64**

Table 4-24: Terminal Subdivision Track Inventory

Houston Region - Terminal Subdivision

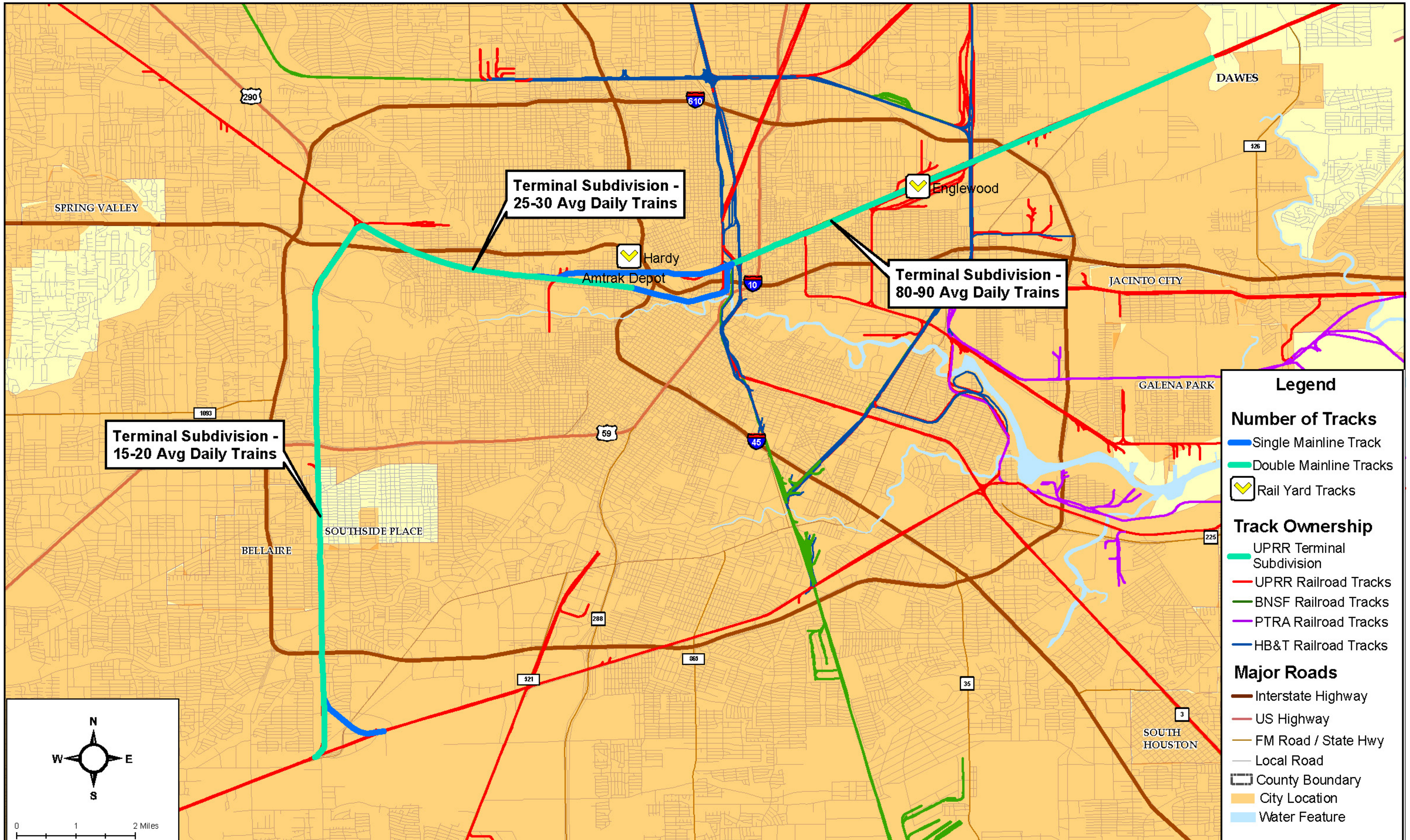


Figure 4-14: UPRR Terminal Subdivision Map

Houston West Belt Subdivision

The main tracks originally were constructed in 1883 by the Gulf Colorado and Santa Fe Railway. The West Belt Subdivision is made up of two parts that are leased from the owning roads to the Houston Belt and Terminal Railway. The north part of the West Belt, from Belt Junction south to Congress Yard, is owned by the Missouri Pacific, and from Congress Yard south to T&NO Junction (Tower 81) is owned by the ATSF Railway. The Houston Belt and Terminal Company (HB&T is now comprised of the UPRR and the BNSF. Currently, UPRR maintains the tracks while both the BNSF and KCS are granted the right to operate their trains over portions of the rail line. The Texas Mexican Railway also has trackage rights over the West Belt Subdivision at its northern end from Quitman Street north to access the East Belt Subdivision to Gulf Coast Junction.

Beginning at T&NO Junction (Tower 81), which is located north of the LP 610 and Mykawa Road intersection, the West Belt Subdivision crosses Brays Bayou near the intersection of North Wayside Drive and Clinton Drive, and then continues toward Belt Junction, which is located just north of Loop 610 between IH45 and US59.

The West Belt Subdivision is approximately 9 miles in length, all of which is contained within the study area. The West Belt Subdivision is a double track mainline railroad with frequent locations where a train can cross over from one track to another. The railroad is utilized in a bi-directional manner, with trains dispatched to operate in both directions, averaging between 65 and 75 trains daily, depending upon location. There are numerous sidings, industrial tracks, and yards along this rail line. The West Belt Subdivision is the primary route for access to New South Yard from the south.

The West Belt Subdivision cuts through downtown Houston in a north – south direction connecting the UPRR Palestine Subdivision, at the north end, to the BNSF Mykawa Subdivision, on the south end. Milepost increases from north to south starting with milepost 228.90 at Belt Junction located just north of IH 610 and just east of the Hardy Toll Road. The West Belt Subdivision is a double track line with the exception of a very short segment through Belt Junction where the Palestine Number 1 track turns into the West Belt Number 1 track at the Subdivision Limits at milepost 228.9. Belt Junction is the intersection of the BNSF Houston Subdivision to the west, the East Belt Subdivision to the east, the UPRR Palestine Subdivision to the north and the beginning of the UPRR West Belt Subdivision to the south. The crossing diamond is located on the West Belt side at milepost 229.04. The BNSF Houston Subdivision Wye track connects into the West Belt Number 1 track at milepost 229.21. The West Belt Number 2 track begins at milepost 229.53.

The Number 2 track ends at milepost 231.49 where it reconnects to the Number 1 track. At Tower 71, milepost 231.5, the Number 1 track designation ends at milepost 231.54 where the Lufkin Subdivision joins then crosses the West Belt Subdivision for

0.09 miles and departs at milepost 231.63 where the Number 1 track begins again. The Number 2 track begins again at milepost 231.49 at its intersection to the Lufkin Subdivision.

At Tower 26, milepost 232.20, the double tracked Terminal Subdivision crosses the double tracked West Belt at milepost 232.21. There are connections to the Terminal Subdivision off the West Belt Number 2 track at mileposts 232.14 and 232.50. The Galveston Subdivision begins off of the Number 2 track at milepost 234.06. The East Belt Subdivision Number 1 track ties into the West Belt's Number 2 track at milepost 236.58. The East Belt Number 2 track ties into a siding track.

The West Belt terminates at T&NO Junction at milepost 238.00. The West Belt Number 2 track ends at milepost 238.06 as it transitions to the BNSF Mykawa Subdivision and crosses the UPRR Glidden Subdivision. The West Belt Number 1 track wye's into the Glidden Subdivision. Between the T&NO Junction and the Galveston Subdivision, along the West Belt Subdivision for about four-miles, the BNSF has access to their New South Yard, Old South Yard, and the Milby Street Roundhouse.

Major structures along the West Belt Subdivision consist of a 438-foot long concrete and steel bridge over Buffalo Bayou located at milepost 233.05, and a 403-foot long concrete bridge over IH-10 located at milepost 232.63.

Table 4-25 summarizes the track mileage data for the West Belt Subdivision, and Figure 4-15 shows a map of the West Belt Subdivision.

County:	**Miles of Main Track:**	**Miles of Siding Track:**	**Miles of Yard Track:**	**Total Miles of Track:**
Harris	17.69	.32	3.08	21.09
Total:	**17.69**	**.32**	**3.08**	**21.09**

Table 4-25: West Belt Subdivision Track Inventory

Houston Region - West Belt Subdivision

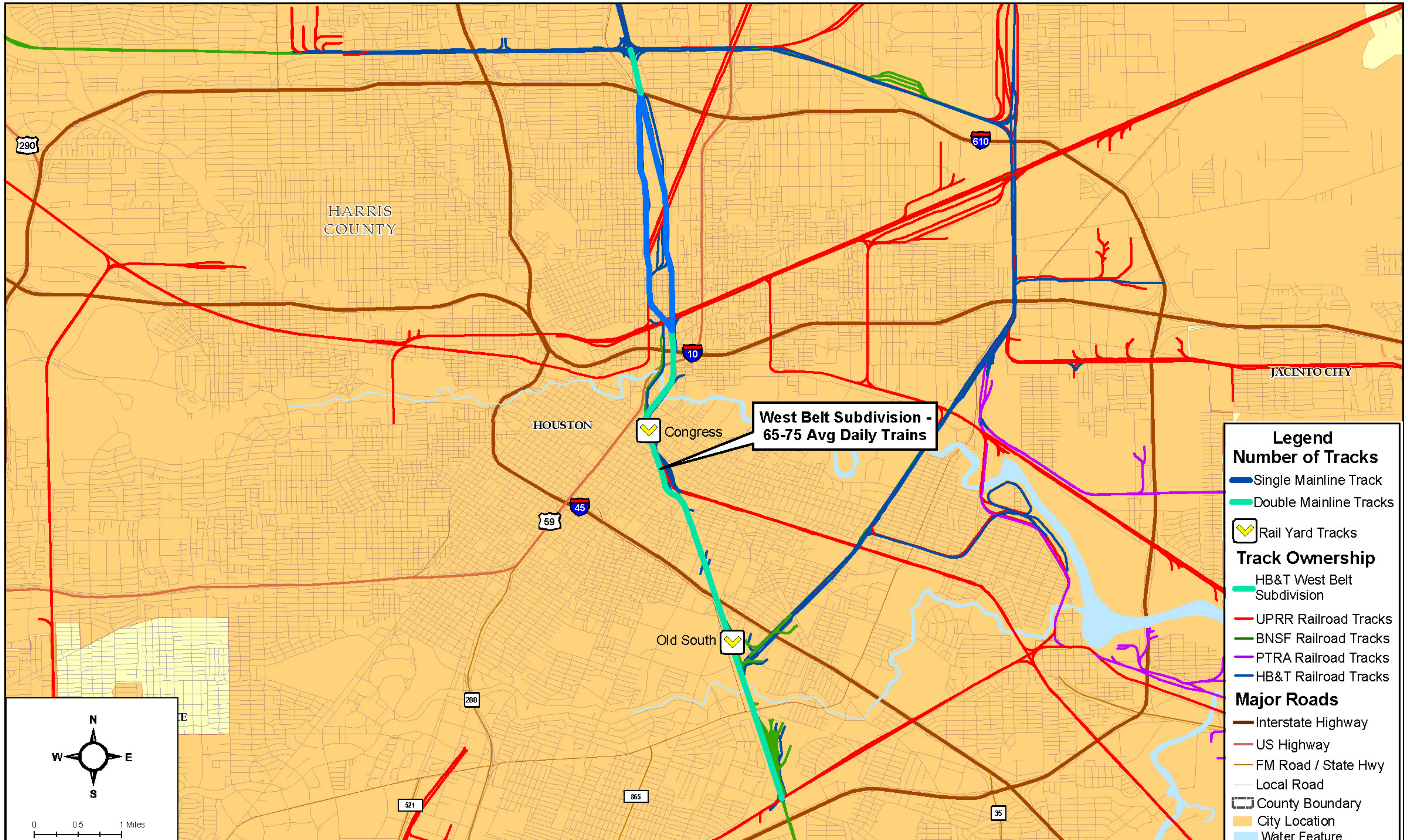


Figure 4-15: Houston West Belt Subdivision Map

BNSF Railroad Infrastructure

The BNSF Railroad is a Class I railroad that owns four major subdivisions throughout the Houston region. The BNSF is given trackage rights across other railroads within the Houston region just as other railroads have trackage rights across the BNSF tracks. The following is a list of the major BNSF Subdivisions that are located within the Houston region and are discussed in further detail in the following section:

- BNSF Conroe Subdivision
- BNSF Galveston Subdivision
- BNSF Houston Subdivision
- BNSF Mykawa Subdivision

BNSF Conroe Subdivision

Beginning at milepost 47.15 at the Grimes County/Montgomery County line, this single main track runs west to east across Montgomery and Liberty Counties. The tracks originally were constructed in 1878 by the Central and Montgomery Railroad.

The single main track crosses the BNSF Houston Subdivision at milepost 49.74 with a connecting track between the two subdivisions. The tracks traverse through the towns of Dobbin, Montgomery, Keenen, and Honea. At milepost 72.12, the tracks cross the UPRR Palestine Subdivision in Conroe, without a connection. At milepost 90.28, the Montgomery County/Liberty County line crosses the tracks. At milepost 94.97, the tracks cross the UPRR Lufkin Subdivision in the city of Cleveland with a connecting wye track between the two subdivisions. The Liberty County/Hardin County line crosses the tracks at milepost 118.67.

Major structures along the Conroe Subdivision consist of a 648-foot long timber bridge over the San Jacinto River located at milepost 68.66, and a 1,186-foot long bridge over the Trinity River located at milepost 110.40.

Table 4-26 summarizes the track mileage data for the Conroe Subdivision, and Figure 4-16 shows a map of the Conroe Subdivision.

County:	Miles of Main Track:	Miles of Siding Track:	Miles of Yard Track:	Total Miles of Track:
Liberty	28.39	3.33	0	31.72
Montgomery	43.13	7.82	0	50.95
Total:	**71.52**	**11.15**	**0**	**82.67**

Table 4-26: Conroe Subdivision Track Inventory

Houston Region - Conroe Subdivision

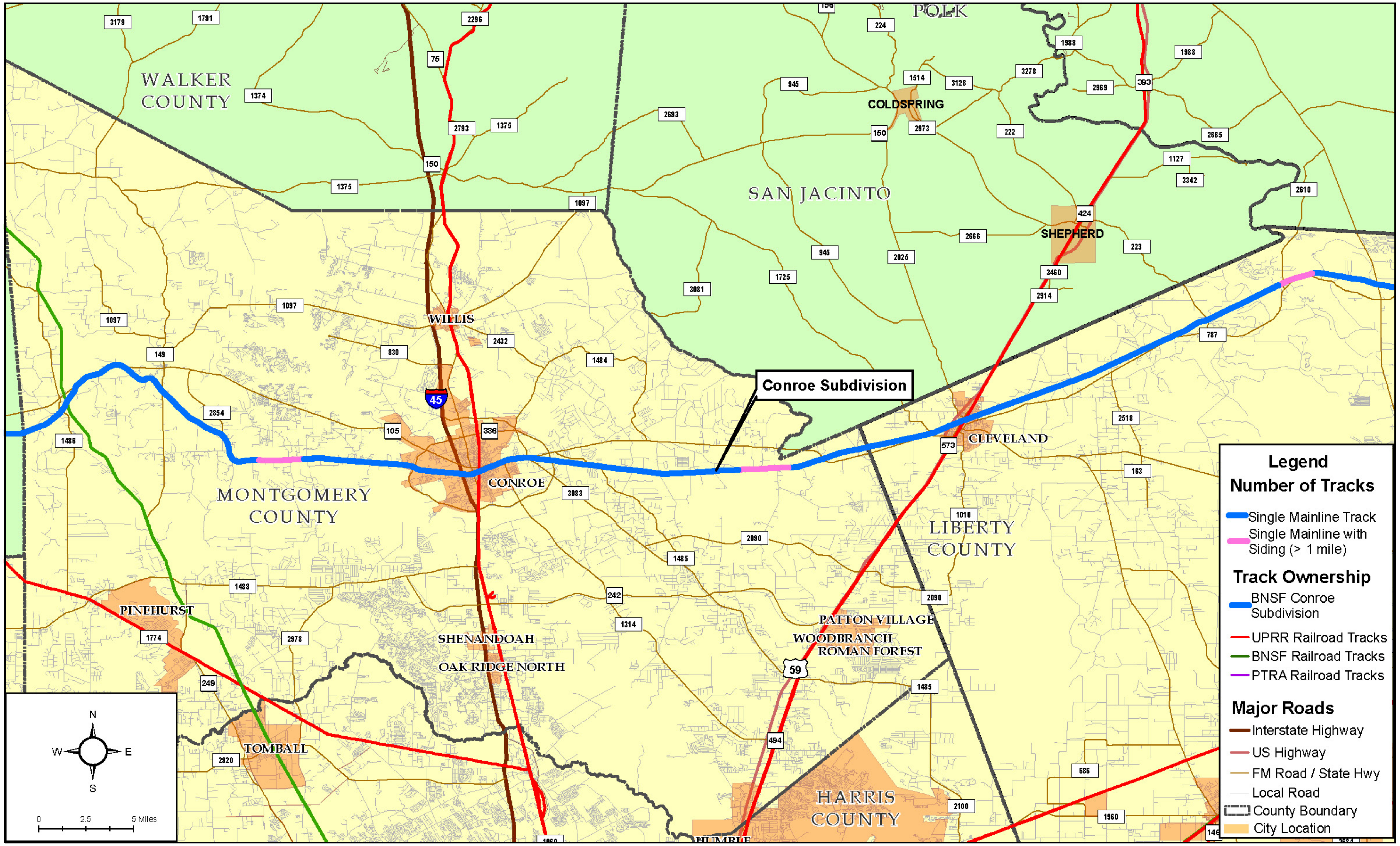


Figure 4-16: BNSF Conroe Subdivision Map

BNSF Galveston Subdivision

Crossing into Fort Bend County at milepost 79.54, the BNSF Galveston Subdivision single main track generally follows State Highway 36 towards the city of Rosenberg. The tracks originally were constructed in 1879 by the Gulf, Colorado, and Santa Fe Railway.

At milepost 66.20, access is gained to the UPRR Glidden Subdivision. The single main track traverses through the cities of Rosenberg, Thompsons, Arcola, Manvel, Alvin, and Algoa. A second mainline track runs between milepost 23.85 and milepost 28.50. At milepost 42.92, the BNSF tracks cross the Popp Subdivision tracks with no connection available. At mile post 41.83, the Fort Bend County/Brazoria County line crosses the tracks. Alvin, located at milepost 28.60, is where the BNSF Mykawa Subdivision is accessed. At milepost 25.51, the Brazoria County/Galveston County line crosses the tracks. At Algoa, milepost 23.85, there is a connection to the UPRR Angleton Subdivision, with UPRR having trackage rights over the Galveston Subdivision between Alvin and Algoa for access to the Angleton Subdivision. Texas City Terminal is accessed at milepost 10.80. The subdivision terminates at milepost 6.30, Virginia Point, where it connects to the UPRR Galveston Subdivision and crosses the Galveston Causeway bridge, over which UPRR and BNSF jointly operate, to Galveston Island.

Table 4-27 summarizes the track mileage data for the Galveston Subdivision, and Figure 4-17 shows a map of the BNSF Galveston Subdivision.

County:	Miles of Main Track:	Miles of Siding Track:	Miles of Yard Track:	Total Miles of Track:
Galveston	20.81	8.67	0	29.48
Brazoria	19.51	2.39	1.61	23.51
Fort Bend	37.68	7.68	2.46	47.82
Total:	**78**	**18.74**	**4.07**	**100.81**

Table 4-27: Galveston Subdivision Track Inventor

Houston Region - BNSF Galveston Subdivision

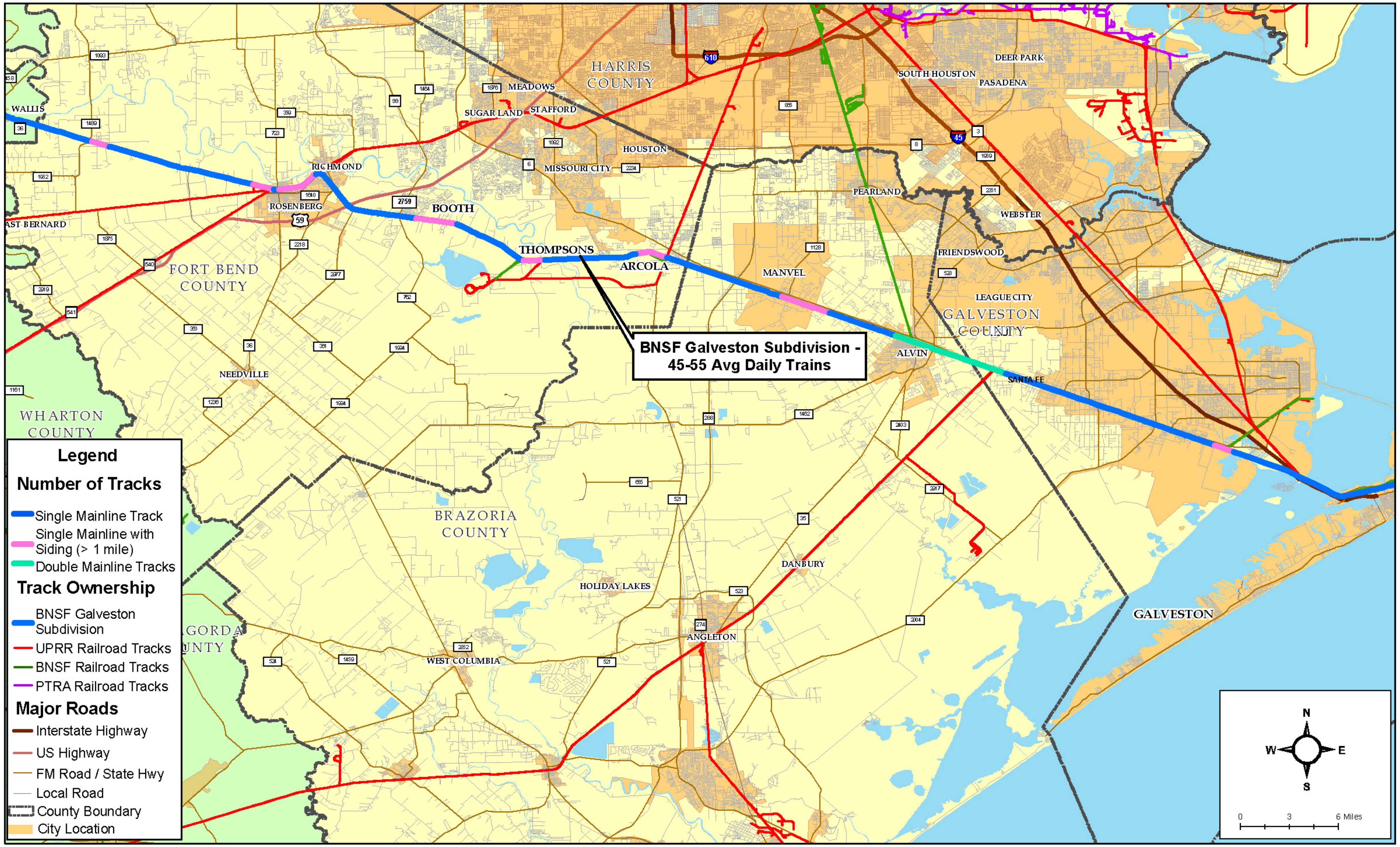


Figure 4-17: BNSF Galveston Subdivision

BNSF Houston Subdivision

The BNSF Houston Subdivision tracks originally were constructed in the late 1800's by the Trinity and Brazos Valley Railroad. The BNSF operates on a joint facility railroad between Belt Junction, just north of IH 610 and the Hardy Toll Road intersection, then west to Shepard Drive where the BNSF ownership begins on their Houston Subdivision at milepost 60.65. From Houston, the BNSF Houston Subdivision single main track runs to the northwest to Teague and crosses the Montgomery County/Grimes County Line at milepost 115.73.

The single main track traverses through the city of Tomball, and towns of Magnolia and Dobbin. The BNSF Houston Subdivision crosses the BNSF Conroe Subdivision at milepost 105.73 in the city of Dobbin, with a connecting track between the two subdivisions, and the UPRR Navasota Subdivision at milepost 88.30 without access to the crossing. The Harris County/Montgomery County line crosses the track at milepost 87.04.

Table 4-28 displays the locations, lengths, and structure type of major bridges on the Houston Subdivision, while a complete listing of the Houston Subdivision structures can be found in Appendix B. Table 4-29 summarizes the track mileage data for the Houston Subdivision, and Figure 4-18 shows a map of the subdivision.

Mile Post:	Waterway/Roadway Crossed:	Bridge Length (feet):	Bridge Type:
63.17	White Oak Bayou	240	Concrete
76.62	Cypress Creek	384	Steel
86.96	Spring Creek	296	Timber
91.17	Mill Creek	333	Timber trestle

Table 4-28: Houston Subdivision Major Bridge Inventory

County:	Miles of Main Track:	Miles of Siding Track:	Miles of Yard Track:	Total Miles of Track:
Harris	26.39	3	0	29.39
Montgomery	28.69	2.5	0	31.19
Total:	**55.08**	**5.5**	**0**	**60.58**

Table 4-29: Houston Subdivision Track Inventory

Houston Region - Houston Subdivision

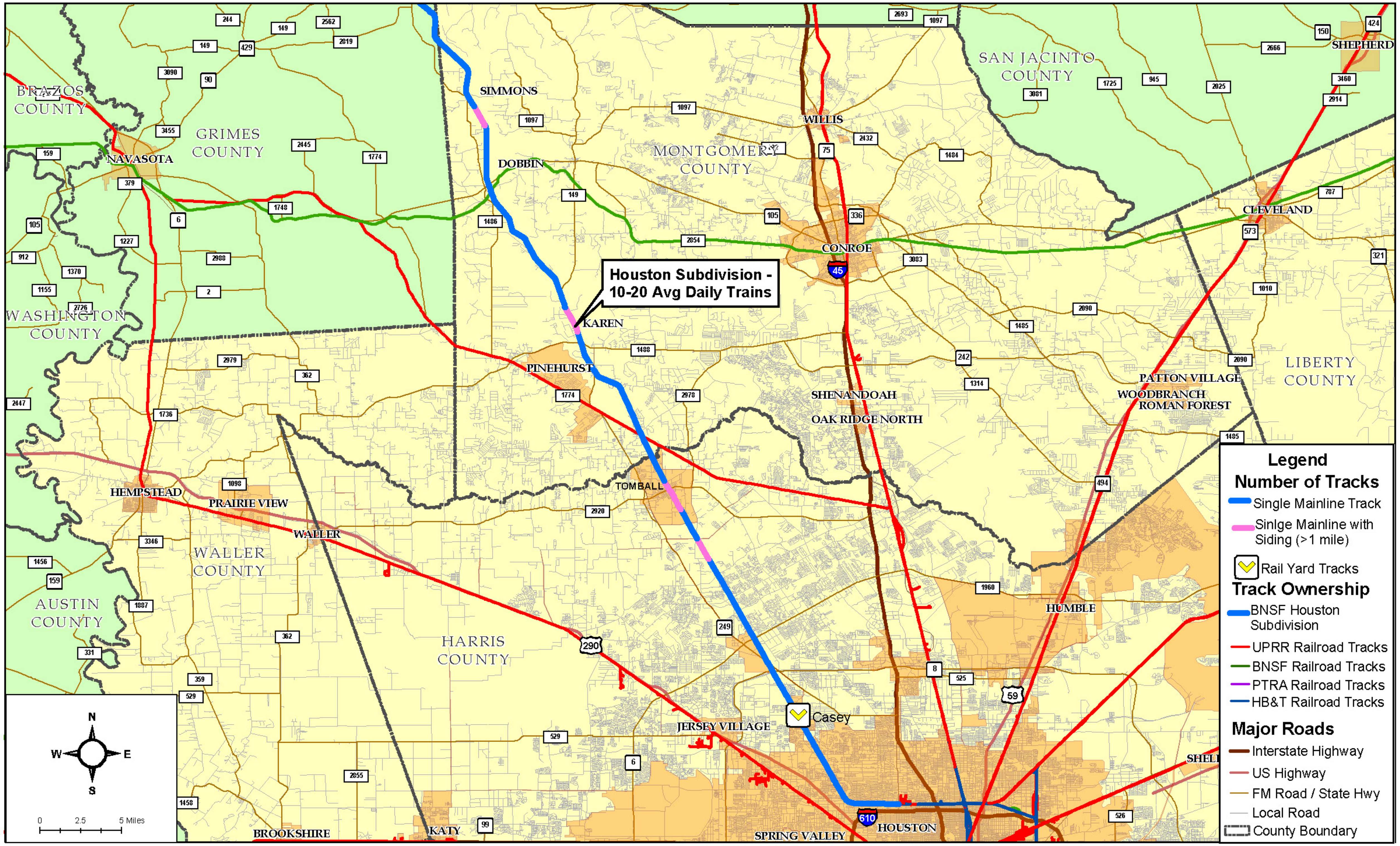


Figure 4-18: BNSF Houston Subdivision Map

BNSF Mykawa Subdivision

Located on the south side of Houston, the BNSF Mykawa Subdivision connects the BNSF Galveston Subdivision to the T&NO Junction at the intersection of the UPRR Glidden Subdivision and West Belt Subdivision. The main tracks originally were constructed in 1883 by the Gulf Colorado and Santa Fe Railway. The Mykawa Subdivision's mileposts increase to the north beginning at milepost 0.00 located at the BNSF Galveston Subdivision in Alvin. This subdivision is located in the counties of Brazoria and Harris with the county line located at milepost 12.34. The Mykawa Subdivision terminates at milepost 19.48 where it connects to the West Belt Subdivision at milepost 238.6.

Several sidings are located along 13-miles between milepost 3.00 and milepost 16.00. The main passes through the communities of Alvin, Pearland, Brookside Village, Mykawa, and Mayfair. The northern end of the BNSF Mykawa Subdivision, at the TN&O Junction off of the UPRR's West Belt Branch, provides access to the southern end of the BNSF New South Yard and the BNSF Old South Yard. The BNSF TOFC Facility is about 3.30 miles long located in Mykawa at milepost 14.50.

The only major bridge structure along the Mykawa Subdivision is a 306-foot long concrete trestle over Sims Bayou at milepost 16.5.

Table 4-30 summarizes the track mileage data for the Mykawa Subdivision, and Figure 4-19 shows a map of the subdivision.

County:	Miles of Main Track:	Miles of Siding Track:	Miles of Yard Track:	Total Miles of Track:
Harris	7.14	0	0	7.14
Galveston	12.34	5.48	0	17.82
Total:	**19.48**	**5.48**	**0**	**24.96**

Table 4-30: Mykawa Subdivision Track Inventory

Houston Region - Mykawa Subdivision

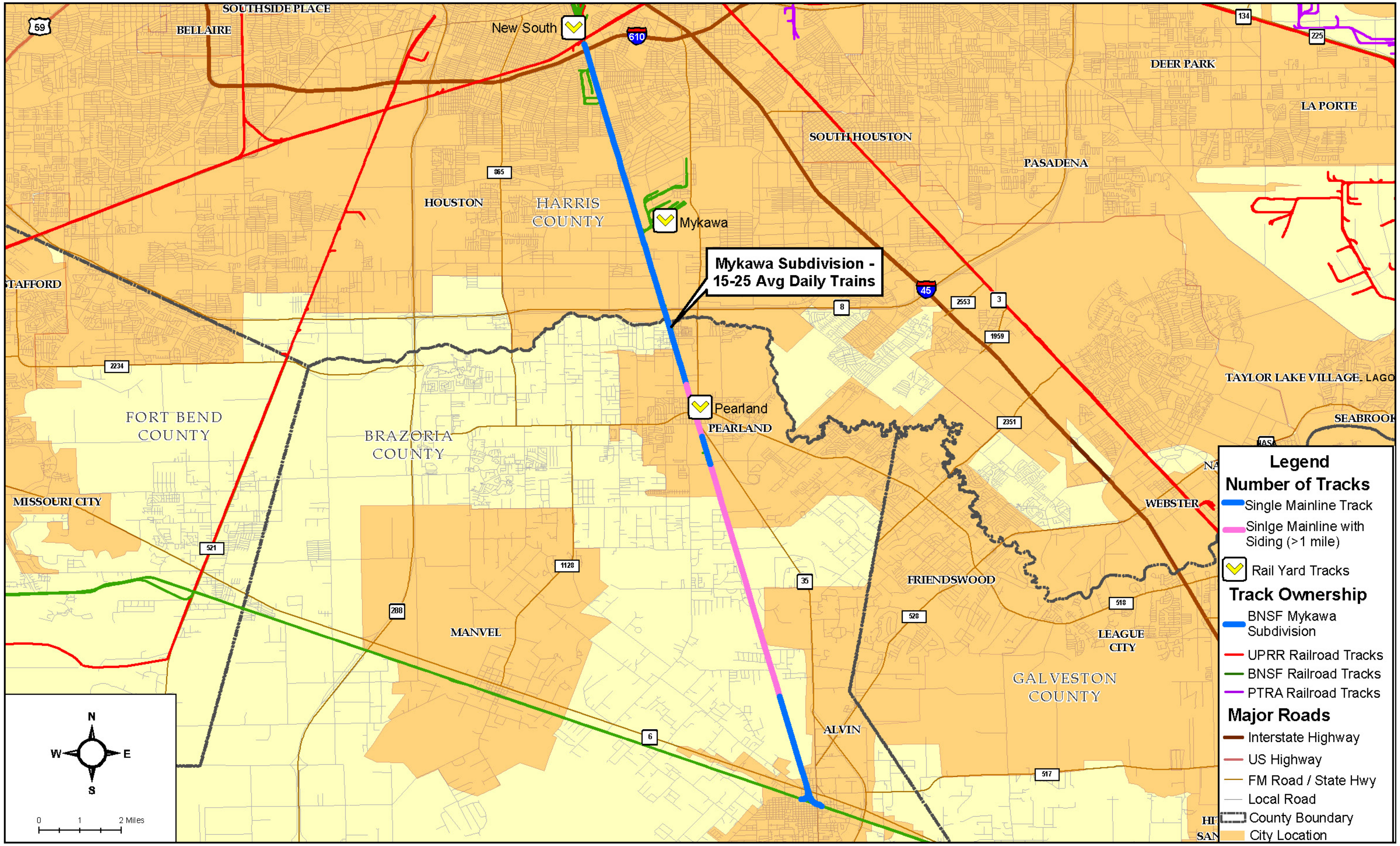


Figure 4-19: BNSF Mykawa Subdivision

Local Railroad Infrastructure

Throughout the Houston region, there are additional short industrial tracks and local railroads that provide rail service to multiple industries, especially in the vicinity of Galveston Bay and Buffalo Bayou.

PTRA (Port Terminal Railroad Association)

The PTRA trackage, which is operated by UPRR and BNSF, is located on land owned by the Port of Houston. The PTRA owns/operates trackage divided into the North, Carnegie, CTC, and Pasadena Districts, in addition to industrial spurs such as the HL&P Lead. The PTRA also operates across joint track with the UPRR. Formed in 1924, by the 18 railroads that had access to Houston, today's current members are the BNSF, the Texas Mexican Railroad Company and the UPRR. The PTRA maintains about 154 miles of track, including 46 miles of mainline. The major yards on the PTRA subdivisions include: the hub of the PTRA at North Yard with 52 tracks, Manchester Yard with 22 tracks, and Pasadena Yard with 14 tracks. The entire PTRA operation is contained in the study area.

North Yard is located north of the ship channel in the vicinity of Wayside Drive and Clinton Drive. Manchester Yard is located under the south approach to the 610 bridge over the ship channel, west of Central Avenue and south of Manchester Avenue. Pasadena Yard is east of the Washburn Tunnel and N. Witter Street and west of Davison Street.

The PTRA service area includes:

- the largest chemical complex in the world
- two of the South's export grain elevators
- numerous industrial tracks

Predominantly a single track line with limited passing sidings, the various rail lines in the PTRA Districts are generally used in both directions under yard rules. PTRA generally operates an average of 80 to 90 of its own trains and engines per day. Table 4-31 summarizes the track mileage data for the PTRA.

County:	Miles of Main Track:	Miles of Siding Track:	Miles of Yard Track:	Total Miles of Track:
Harris	46	51	57	154
Total:	**46**	**51**	**57**	**154**

Table 4-31: PTRA Subdivisions Track Inventory

The following list provides a sample of short industrial tracks and local railroads that provide rail service to multiple industries, including the PTRA lines:

- Barbours Cut Industrial Lead Track #1
- Barbours Cut Industrial Lead Track #2
- Bayport Loop Industrial Lead
- Baytown Branch – Cedar Bayou Industrial Lead
- Booth Industrial Lead
- Clinton Industrial Lead
- Columbia Tap Industrial Lead
- Houston Navigational Industrial Lead
- POPP – Industrial Lead (Smither's Lake)
- PTRA -- Brown Industrial Lead
- PTRA – Carnegie District
- PTRA -- Elevator Storage Yard
- PTRA – Manchester Zone Trackage
- PTRA – North District Zone Trackage
- PTRA – Pasadena Zone Trackage
- Seapack Saw Pipe
- Wharton Subdivision

Although the above examples, and the remaining short industrial lead tracks, are not described in detail, their impact and shipping tonnages are incorporated into the overall totals utilized in this report.

SECTION 5: ESTABLISHMENT OF A FREIGHT RAIL BASE CASE OPERATIONS MODEL

Rail Traffic Controller

Rail Traffic Controller (RTC) is a powerful computer program created by Berkeley Simulation Software, LLC, which simulates the operation of trains over a railroad network. Variations can be made in network track layouts, train consists (make-up of a train by types of cars and their contents) and schedules, and operating rules and constraints, which allows the testing of such changes before they are implemented. RTC is used by almost all North American Class I railroads to evaluate and plan their operations and capital expenditures. All carriers involved in this study (BNSF, KCS, PTRA, and UPRR) use the model, are familiar with the methodology, and accept the model's results when it is used to their standards.

Dispatching Simulation

RTC 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 6 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: 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 instance is treated individually. No two days in the real world are identical, and 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 simulation "dispatcher" sends trains across the railroad network, it resolves conflicts between trains in the same manner as an actual railroad dispatcher. However, the RTC dispatcher is resolving conflicts with the full knowledge of all trains on the territory, and with the look-ahead capability available to a powerful computer program. Unless a train is badly delayed, or the crew is nearing the federally mandated 12 hours-of-continuous-service limit, both actual railroad dispatchers and the simulation program "dispatcher" will generally give preference to passenger trains over expedited freight trains, to expedited freight trains over lower priority manifest freight trains, and to through manifest trains over local freight trains or yard engines. These priorities are determined by the freight railroads and are incorporated into the meet-pass logic used to resolve train conflicts.

RTC and human dispatchers make their 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

When there is a particularly vexing series of conflicts, the model, like its human counterparts, discards normal priorities, and seeks alternate solutions that will keep the railroad as fluid as possible under the circumstances. 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 plant, and the practical capacity of that plant, are incompatible.

All other factors being equal, the model will generally minimize the total cost of delay to the trains involved in a conflict. The model dispatcher will do this for all trains involved in any conflict or series of conflicts. Sometimes 25 or 30 trains may be involved in a related series of conflicts. These conflicts frequently arise around congested terminals, or on high-density line segments. The conflicts are endemic to all the Houston region cases, just as they are to the everyday railroad world in the Houston Terminal. Every decision to advance one train and delay another has its own set of effects; RTC sorts through the effects and settles on the solution that seems to work best. However, there are times when the RTC model makes an incorrect or poor decision, just as human dispatchers. The RTC decisions are analyzed, and if they are realistic, or have no significant impact, then they are left standing. Others are rejected in the case "resolution" process, which is the RTC user (or the Chief Dispatcher, in railroad terms) intervening to change an initial RTC decision for a better or more realistic one.

In the real world, the human dispatchers make decisions in real time, without the more perfect knowledge possessed by RTC. The RTC model has the luxury of revising its decisions until the delay cost is minimized; the human dispatcher cannot do the same. The difference between reality and the model does not invalidate the model, it simply means that RTC solutions may be more optimistic than can be expected in real life. In practice, RTC base cases (the ones that are designed to measure current performance under current conditions, in order to establish a starting point for subsequent comparisons) typically calibrate to within a small percentage of actual movement records. That process – validating the model –is an important part of ensuring that model outputs in planning cases are credible.

RTC Performance Measures:

RTC is designed to measure railroad performance in time. There are measures (such as fuel consumption), which are not specifically time-related, but for all practical purposes, the measures used are time-related. Some measures are "absolute" numbers, while some are ratios, or normalized measures of performance.

The measures used, and those shown in the following discussions of the simulation cases, are as follows:

- *Train Count* – the number of trains over a period (per day or per week) measured in the model. This number is always less than the number of trains in the case: trains that do not complete their entire run within the measured week are excluded from the statistics, lest they distort the results. ALL trains in the case are dispatched; however, not all trains are measured.

- *Average Speed* – the average operating speed, in miles per hour, of the measured trains operating across the entire network, or across a specific part of the network (i.e., a railroad subdivision or district).

- *Delay Ratio* – This is the ratio of congestion-related delay to "ideal" or "unimpeded" running time. Unimpeded time equals the time it would take to operate all the trains, including any en-route work they need to do or requirements they would have to meet (like federally mandated brake system tests), without any congestion-related delay. The numerator in the ratio is delay, and it varies. A higher number indicates worse conditions. The denominator doesn't change within a case, it's the irreducible minimum amount of time that it would take to run the railroad. The ratio is one measure of "normalized" delay. The ratio allows comparison of performance between simulation cases, or between segments of the railroad network, where the train counts are not the same. The lower the delay ratio, the better the expected, sustainable train performance will be.

- *Delay Hours/Day* – This is the absolute number of train-hours per calendar day lost to congestion related delay. Since a "train-hour" can take a value, it's a useful measure: reduce the delay hours, reduce the costs. A freight-train hour, however, is one train, either sitting still or running, for one hour. In reality, not all trains are equal, and the value of one hour lost by a train with 100 loaded cars of time-sensitive freight is different from the value of one hour lost by a local switching 20 cars a shift. However, the absolute values are needed. Generally, those solutions that eliminate the largest number of delay hours per day turn out to be the most cost-effective at generating private benefits.

- *Delay Minutes/100 Train-miles* – This is an alternate railroad industry measure of normalized delay. It functions much like the delay ratio (the numerator is actually the same, except reduced to minutes instead of hours); but the denominator is the distance trains travel over time, rather than just the time itself. These ratios often will be extremely high in terminals, because switch engines seldom go very far. By the same token, a significant reduction in delay minutes per 100 train miles will suggest a significant improvement in asset and labor productivity.

The RTC Base Case

Before the simulation model can be used to test alternative operating or investment plans, a "base" case in the model that represents the real world under current conditions must be built. Current performance can be validated; however, future or planning case performance can't be validated because it is hypothetical, and there is no sure real-world test that can be performed to ensure that planning case results are realistic.

As a result, a base case is used and is refined until it yields performance numbers that match those in the current operation. Once it is verified that the current world is described correctly by the model, the model results can be trusted. The subsequent planning cases then have credibility also and can be trusted to have measured the effect of identified changes well enough that those results can be used to make investment decisions, or to make changes to the operating plan.

The Houston region base case has 2,550 miles of railroad track and 2,200 trains per measured week. The network includes all principal rail lines and yards between Bloomington and Galveston on the south, Flatonia and Navasota on the west, Temple, Teague, Palestine, and Lufkin on the northwest and north, and DeQuincy and Connell on the east. All the major yards within the Houston Terminal are included, as are the principal industrial switching zones.

Inside the Houston Terminal, the model includes all of the PTRA, and all of the key trackage owned, operated, or used by trains of BNSF, KCS, PTRA, and

UPRR. Within the Houston Terminal area, there are 14 significant switching yards; outside the immediate Terminal, there are seven more included in the simulation. The railcar classification activity at these yards is a major part of the exercise; it is the source of most of the congestion-related delay, and the key to delay relief.

The base case simulation network was constructed largely from railroad “track charts” supplied by the railroads. These schematic maps show the physical plant in sections (often in sheets showing roughly five miles at a time). The detail on these charts allows the proper location of signals, switches, grade crossings, sidings, and yard tracks; and conveys the correct distances and grades between points. These charts, along with railroad timetables, also show the proper speed limits for trains on various parts of the network.

The base case train files were constructed from records and data received from the railroads. The railroads keep records of through train movements, which are taken from the dispatching system, and include the identity of the train, its consist, its route, and the day and clock time when it passed certain key recording points. The Houston study began with real data supplied by all the railroad carriers for a sample period in April 2006. The files created from this data were then updated twice: once in August 2006, and again in October 2006, to reflect ongoing changes to the local train operations.

Railroad dispatching systems capture only part of the total rail activity. Rail movements in and around yards and terminals seldom appear in the dispatching data with enough detail to be described to a simulation model. These trains and engines have to be described by local operating personnel who know the operation first hand. Consequently, personnel at all four railroads were interviewed to capture this detail, and railroad personnel were re-interviewed where train operations changed significantly between April and October.

The base case now includes the following trains by carrier:

- Amtrak - 7
- BNSF - 522
- KCS - 76
- Timber Rock - 6
- PTRA - 341
- UPRR – 1,248

Of these 2,200 trains, about 1,900 freight trains have complete, and therefore measured, runs in the simulation cases. In the base case, for example, the 1,895 measured freight trains in the simulation week break down as follows by type of train:

- Intermodal – 87
- Manifest – 571
- Grain – 64
- Coal – 40
- Other Unit (sulphur, potash, steel, coke, rock/aggregate) – 140
- Autos and Auto Parts – 47
- Locals – 396
- Yard Engines – 506
- Locomotives (“light engines”) – 44

This distribution by train type is the most important pattern in the study: almost half (48%) of all the trains in the study are locals and yard engines. Most of the remaining trains carry chemicals, and/or heavy bulk commodities like coal, grain, rock/aggregate, and Coke. This heavy industrial cargo accounts for about 84% of Houston’s rail activity. The heavy industrial cargo accounts for an even higher percentage of the freight trains in Harris County. The train counts include trains operating between places such as the Rio Grande Valley and Little Rock or between Galveston and Fort Worth or between Beaumont and Kansas City. Some of these trains do not have business in Houston and seldom see the heart of the city, since the railroads route them around the city to avoid adding trains to the East and West Belt Subdivisions.

The other important pattern to note is where trains originate and terminate. Of the 2,200 trains in the train file, only 77 operate completely through the Harris County part of the rail network without stopping in Houston. These 77 trains include, for example, all of KCS’ Mexico trains; all of the UPRR through intermodal trains between the southern California ports and points such as Atlanta and New Orleans; and the BNSF trains that run through from Teague to Lafayette and from Lafayette to Temple.

The freight trains using the Houston Terminal tracks are there because they carry freight cars coming into, or leaving, the Houston, Dayton, Baytown, Bayport, and Beaumont industrial complexes. The freight traffic on these trains is local business, usually in carloads, which means it must be switched and classified by destination at one or more of the major Houston yards (UPRR Settegast, UPRR Englewood, UPRR Strang, UPRR Basin, UPRR Dayton, UPRR Lloyd/Westfield; BNSF New South, BNSF Dayton; PTRA North, PTRA Manchester, PTRA Pasadena). This traffic is not capable of being re-directed to bypass routes around Houston, or to other railroad classification facilities - it is local business, for local customers.

Consequently, the base case, even before the simulation results are obtained, reveals two clear issues that have to be understood for any strategy to improve rail performance and/or make community life better:

- The rail congestion problem has to be addressed in and around the downtown classification yards.
- New belt lines or rail loops under the Houston Ship Channel will not address the congestion related delays in the region. Such lines could be built; however, few trains would use them.

Base Case Results

Table 5-1 below summarizes the base case train performance for the entire RTC network (all track, all trains, one week); and for 13 selected railroad subdivisions that are of particular interest to the study.

Subdivision	Trains	Average Speed	Delay Ratio	Delay Hours per Day	Delay Mins per 100 Train Miles
CTC District	292	6.1 mph	48.6%	4.1	237.9
North District	266	2.8 mph	65.7%	27.9	433.1
Pasadena District	223	2.7 mph	48.5%	19.9	367.4
Baytown	111	8.2 mph	15.3%	3.0	66.2
Beaumont	476	23.7 mph	23.9%	10.1	42.3
East Belt	586	4.6 mph	30.4%	8.3	144.7
Glidden	238	24.0 mph	51.6%	22.7	58.9
Lafayette	287	20.5 mph	17.8%	8.6	35.5
Strang	209	6.7 mph	27.3%	3.3	109.0
Terminal	610	8.1 mph	39.8%	16.4	154.7
West Belt	481	7.8 mph	31.1%	5.3	176.0
Mykawa	169	17.5 mph	10.3%	13.0	26.3
Network (total)	1,895	14.3 mph	36.4%	300.3	82.6

Table 5-1: Base Case Freight Train Performance

As a general rule, delay ratios higher than 30% on a terminal subdivision, and higher than 12% to 15% on a main-line subdivision, suggest that the railroad may be suffering high levels of congestion-related delay. Delays of more than 70 minutes per 100 train-miles on a main-line subdivision also cause concern. Inside terminals, delays per 100 train-miles are a bit misleading, because trains don't go very far under the best of circumstances, so the denominator is small.

However, even with some caveats about the measurements used, a clear pattern emerges in the model - all of the PTRA, the East Belt and West Belt Subdivisions, and the Terminal Subdivision, taken together, are the heart of the network delay. In fact, the localized areas where most delay takes place are so severe that they bring down the performance of the entire modeled network, even though there is quite a bit of open-country Texas trackage included in the results.

Of the longer, “mainline” subdivisions, the Glidden Subdivision performed the worst, due to congestion between Rosenberg and West Junction. Delay and congestion are caused by a lack of long sidings without interior road crossings, and the number of trains that must be re-crewed on this subdivision because the train and/or engine crews run short of work time.

The Beaumont Subdivision is a special case in the model. Between Dyersdale, just east of Settegast Yard, and Beaumont, this section of the rail plant performs quite well, because almost all the trains are eastbound. However, the Beaumont Subdivision performance numbers also include switching within Settegast Yard, and this switching is subject to major delay due to interference between switch engines and trains using that part of the East Belt Subdivision between Tower 87 and Gulf Coast Junction; and again to interference between yard engines on the east side of Settegast and trains entering or leaving the yard at Interstate Junction, just north of Tower 87. More than 60 percent of the entire delay registered in the model for the entire Beaumont Subdivision fell just on the Settegast Yard engines switching at the south end of the yard. These engines typically lost six to seven hours per day, or the equivalent of an entire engine shift. If the delay is shifted from the affected yard engines to trains using the adjacent tracks, the yard engine performance improves, and the performance of the other trains declines in equal measure.

The most delay-prone locations in the entire Houston Terminal are as follows:

- South Settegast/Pierce Junction – 365.5 hours per week (52 hours per day)
- Tower 87/North Shore Junction – 100.0 hours per week (14 hours per day)
- Sinco Junction/Deer Park Junction (PTRA/UPRR) – 92.5 hours per week (13 hours per day)
- Galena Junction/Manchester Junction (PTRA/UPRR) – 80 hours per week (11 ½ hours per day)

More than 30 percent of the total delay measured across the entire base case simulation takes place in the four sectors listed above. All of these locations are immediately adjacent to major classification yards: UPRR Settegast Yard in the first instance; UPRR Englewood and PTRA North Yard in the second instance; PTRA North Yard, UPRR Basin Yard, UPRR Booth Yard, and PTRA Manchester Yard in the third instance; and PTRA Pasadena Yard in the fourth instance.

Findings from the Base Case

The base case results clearly much of Houston's freight train congestion takes place between the south end of UPRR Settegast Yard, Tower 87, and PTRA North Shore Junction; again between the south side of PTRA's North Yard (Galena Junction), across Buffalo Bayou, south past Booth Yard, and through Harrisburg and GH&H Junctions to PTRA Manchester Junction; and again on the PTRA/UPRR joint track between Sinco Junction, Pasadena Junction, and Deer Park Junction. All of these line segments are characterized by very high train densities (50 or more movements per track per day), a great deal of switching, and a limited number of tracks, which means trains must compete for the same track in order to reach their destination, or to complete the switch move.

The heart of the problem is the inherent conflict between repetitive switching by yard engines and through movements by other trains. At the south end of Settegast Yard, the yard engines making up outbound trains conflict with trains entering or leaving the east and west receiving and departure yards. At North Shore Junction, PTRA yard engines classifying cars at the north end of North Yard conflict with other movements on the East Belt. At Buffalo Bayou, south of PTRA North Yard, yard engines, departing and arriving trains, and trains making initial terminal air brake tests, all compete for a single track across the Bayou ("Bridge 5a"). At the west end of PTRA Pasadena Yard, trains picking up and setting out blocks of cars, yard engines switching the yard, and through trains between Strang and downtown Houston all compete for time on the same tracks.

Furthermore, in today's railroads, most trains are much longer and heavier than they were when Houston's rail plant was built. Consequently, a departing train might be 120 cars long, weigh 12,000 tons, and stretch for 7,200 feet behind the locomotives. When these trains are coupled together, and readied for departure (a process that includes testing the brakes, which can take 45 minutes or more for a single train), that train may block an entire set of switches used by other trains trying to get around it. The consequence is four or five trains sitting while one other train prepares to move.

The effect where delays cascade through the system for hours on end can be seen in the simulation model. For example, 25 or 30 trains may be in a series of conflicts for several hours and result in all of the affected trains losing time.

In view of the base case model results, the first initiatives (improvements) tested in an effort to help unlock the congestion are aimed specifically at the bottlenecks described. The improvements have two purposes:

- Separate repetitive switching from through movements to the maximum practical extent.
- Create parallel trackage (i.e. a second track where there is now one) to relieve pressure on the current line capacity.

This first package of initiatives, tested in Planning Case 1, described and analyzed in further detail in Section 7 of this report, contains the following improvements:

- A separate switching lead at the south end of Settegast and Pierce Yards, dedicated just to the switch engines on the east side of Settegast. This additional "lead," in railroad terms, does not eliminate all conflicts. There is no practical way to do that with the available land. However, it keeps the Settegast "trim" engines off the two main tracks of the East Belt allowing many other trains and engines to make parallel and simultaneous moves.

- A separate switching lead north of PTRA North Yard to Hunting Bayou, dedicated to PTRA switch engines working the north end of North Yard. The lead would keep switching engines off of the East Belt Subdivision main tracks between North Shore Junction and Tower 87. In the model, this new lead crosses the track that connects the East Belt Subdivision to the Baytown Branch at North Shore Junction. The arrangement would be improved if the Baytown Branch connection track could be moved further north so as not to cross the new switching lead. To be conservative, the model includes the Baytown Branch connection track crossing the new lead. The benefits of removing switching operations from the East Belt Subdivision mainlines outweigh the drawbacks of the level crossing with the Baytown Branch.

- A second PTRA main track from Galena Junction, south across Buffalo Bayou on a new bridge (Bridge 5A), past Booth Yard, through both Harrisburg and GH&H Junctions, and on to Manchester Junction, where the new main track, like the existing one, connects to both the PTRA and UPRR tracks that continue east of Manchester Junction to Pasadena, Deer Park, and Strang. At the south end of PTRA North Yard, this second track doubles as another lead that can be used by departing trains making initial terminal brake tests, and by switch engines building trains: even if one train is working on the new track, another movement can use the existing track to get by.

- A second PTRA/UPRR joint track between Sinco Junction, Pasadena Junction, and Deer Park Junction, which would double the capacity of this segment, and allow switching moves at the west (north) end of PTRA's Pasadena Yard to operate entirely free of the main tracks. This area is already among the most congested in the terminal at today's traffic level, and will see more trains once the impending intermodal container transfer terminal at Bayport opens (at least two arriving and two departing expedited trains per day even in the early stages).

- Finally, the East Belt has its own single-track bottleneck at Buffalo Bayou: Bridge 16, between South Bridge Junction and North Bridge Junction. Capacity on this segment of the East Belt is further constrained because both main tracks in this area are cut by road crossings and therefore trains cannot hold between Double Track Junction and Tower 86 to meet or pass other trains. As a first try at improving performance, Planning Case 1 proposes to install a new bridge next to the existing one at Buffalo Bayou, thereby providing at least two main tracks on the East Belt between Double Track Junction and Belt Junction.

SECTION 6: FREIGHT RAIL AND RAIL/ROADWAY INTERFACE SAFETY ISSUES

The State of Texas traditionally has taken the lead regarding safety issues centering on the freight rail/roadway interface. The first toll-free call-in program for the public to notify of roadway-rail crossing incidents was establish by Texas in 1983 with the calls directed to the State's Emergency Management Center. Enacted by the Texas State Legislature in 1983, the Railroad Crossing Safety Information Act became part of the Texas Transportation Code in 1995, and established a State-wide toll-free telephone network intended to report malfunctions of the safety devices at roadway-rail grade crossings. Telephone numbers were mounted onto the sides of the railroads grade crossing equipment "huts" near the at-grade crossing that contained the name of the roadway, the railroad subdivision name, and the approximate milepost of the crossing. Upon receipt of a call, the EMC operator relays the information provided by the caller to the respective railroad company. Even though only at-grade crossings with active warning devices contained the contact information, the Texas system handles more than 1,200 calls monthly with information provided at public and private at-grade crossings.[1]

In 2001, after many system upgrades, the Texas call center operations were transferred to the Texas Department of Public Safety. This program, based on the success experienced in Texas, has been adopted by most Class I freight rail companies and other states throughout the United States. The number of fatalities has steadily declined from 615 in 1994 to 368 in 2004, with the incident rate per million train miles decreasing from 7.6 to 3.9 during the same time period.[2]

Table 6-1 depicts the number of public at-grade crossings, sorted by type of warning device, for the United States, the State of Texas, and the Houston region. The crossings listed for the Houston region only include crossings with the mainline tracks and exclude crossings at industry tracks and sidings. Table 6-2 shows the number of public and private roadway/rail at-grade crossings in the Houston region, sorted by county and includes crossings at mainline, industry, and siding tracks.

[1] Federal Railroad Administration – *Pilot Program for Emergency Notification Systems at Highway-Rail Grade Crossings,* May, 2006
[2] *ibid*

Number of Public At-Grade Crossings by Warning Device					
United States 2003		**Texas 2003**		**Houston Region* 2005**	
Crossbucks (passive)	68,834	Crossbucks (passive)	5,244	Crossbucks (passive)	145
Lights only (active)	25,656	Lights only (active)	1,362	Lights only (active)	31
Gates (active)	36,410	Gates (active)	3,728	Gates (active)	574
Stop Signs	9,905	Stop Signs	270	Stop Signs	145
Special Warning	3,209	Special Warning	93	Special Warning	0
Hwy. Traffic Signal	1,269	Hwy. Traffic Signal	74	Hwy. Traffic Signal	0
Other (passive & active)	618	Other (passive & active)	7	Other (passive & active)	308
Unknown	4,843	Unknown	458	Unknown	0
Source: Federal Railroad Administration				Source: TxDOT	
* Mainline tracks only					

Table 6-1: Number of Public At-Grade Crossings for the United States, Texas, and the Houston Region

Total At-Grade Roadway-Rail Crossings for Houston Region (2005)								
County	Total		Pedestrian		Private Vehicle		Public Vehicle	
	Count	%	Count	%	Count	%	Count	%
BRAZORIA	131	6.1	.	.	50	2.3%	81	3.8%
CHAMBERS	19	0.8	.	.	13	0.6%	6	0.3%
FORT BEND	145	6.7	.	.	51	2.4%	94	4.4%
GALVESTON	158	7.3	.	.	51	2.4%	107	5.0%
HARRIS	1,369	63.4	6	0.3	402	18.6%	961	44.5%
LIBERTY	129	6	.	.	47	2.2%	82	3.8%
MONTGOMERY	156	7.2	.	.	42	1.9%	114	5.3%
WALLER	52	2.4	.	.	15	0.7%	37	1.7%
TOTALS:	2,159	100	6	0.3	671	31.1%	1,482	68.6%

Table 6-2: Total At-Grade Roadway-Rail Crossings for Houston Region

Roadway/Rail At-grade Crossing Accidents

As shown in Table 6-3, during the January 2000 through December 2005 timeframe, the eight-county Houston region experienced 434 roadway/rail at-grade crossing accidents in which there were 27 fatalities and 136 injuries[3]. Table 6-4 lists, by county within the region, the number of incidents annually from 2000 to 2005. In comparison, the entire State of Texas experienced 1,974 incidents in which there were 213 fatalities and 775 reported injuries during the same period of time.[3]

Figure 6-1 depicts the number of roadway/rail incidents in the State of Texas for the January 2000 through December 2005 time period.

[3] Federal Railroad Administration, 2000 – 2005 highway-rail at-grade crossing safety statistics.

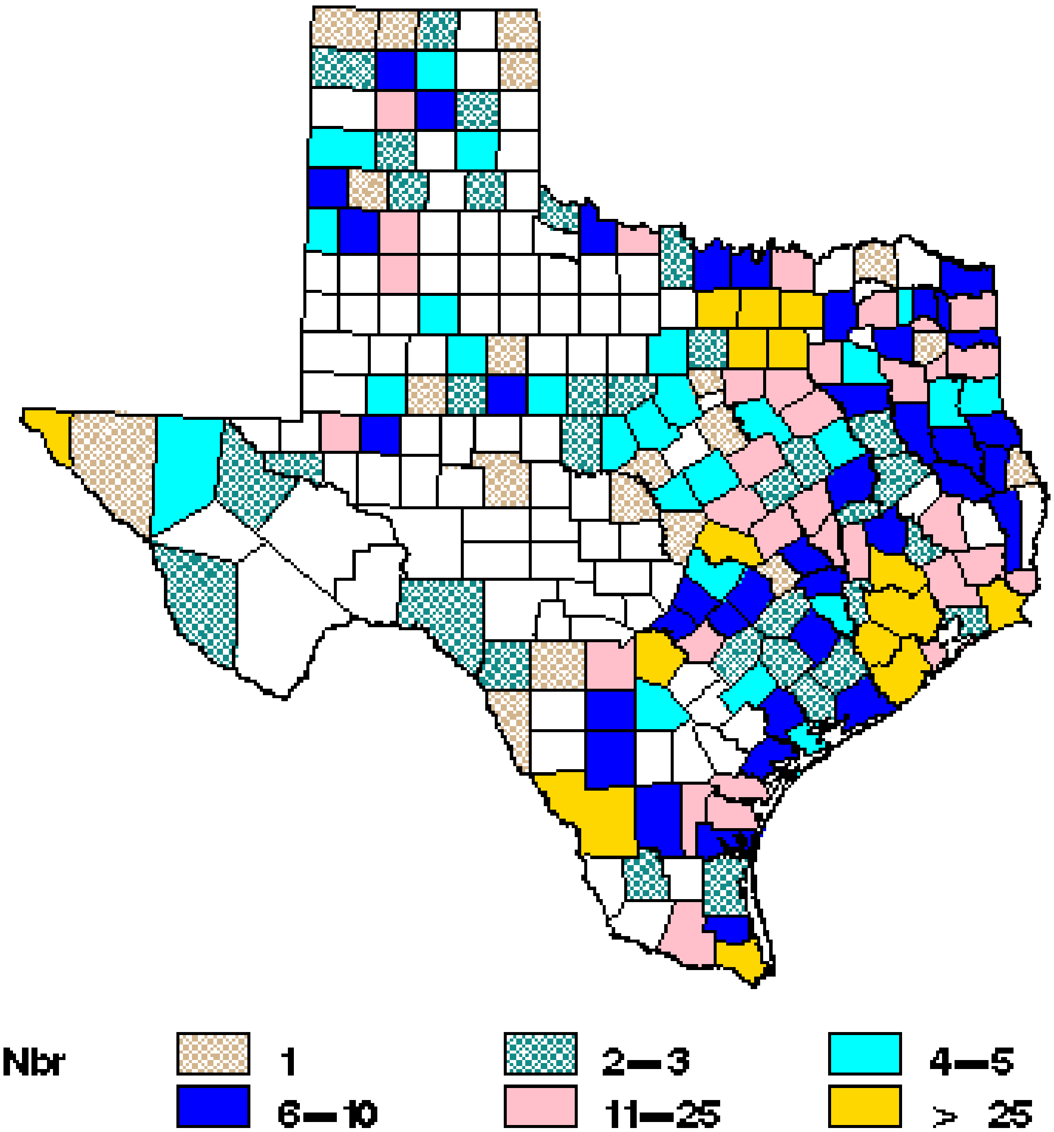


Figure 6-1: Roadway-Rail Incidents for Texas, January 2000 to December 2005

The roadway-rail incidents which occurred in Harris County in the 2000 to 20005 timeframe accounted for nearly 66 percent of the total roadway-rail incidents in the eight-county Houston region.

In reference to the following tables, the 'Cnt' value displays the number of accidents, while the 'Kld' and 'Inj' values display the number of people killed and injured in those accidents, respectively.

Roadway-Rail Incidents for Houston Region (2000-2005)															
County	Totals			At Public Crossing						At Private Crossing					
				Motor Vehicle			Other			Motor Vehicle			Other		
	Cnt*	Kld*	Inj*	Cnt*	Kld*	Inj*	Cnt*	Kld*	Inj*	Cnt*	Kld*	Inj*	Cnt*	Kld*	Inj*
BRAZORIA	35	2	9	22	2	9	0	0	0	13	0	0	0	0	0
CHAMBERS	2	0	2	2	0	2	0	0	0	0	0	0	0	0	0
FORT BEND	28	2	9	25	2	7	0	0	0	2	0	2	1	0	0
GALVESTON	15	1	3	13	0	3	1	1	0	1	0	0	0	0	0
HARRIS	293	10	94	230	4	76	6	3	1	57	3	17	0	0	0
LIBERTY	18	1	7	17	1	7	1	0	0	0	0	0	0	0	0
MONTGOMERY	41	11	11	38	10	11	0	0	0	3	1	0	0	0	0
WALLER	2	0	1	1	-	1	0	0	0	1	0	0	0	0	0
TOTALS:	434	27	136	348	19	116	8	4	1	77	4	19	1	0	0
* - Cnt = Incident Count, Kld = Fatalities, Inj = Injuries															

Table 6-3: Roadway-Rail Incidents for Houston Region, by County (2000-2005)

Annual Roadway-Rail Incidents for Houston Region (2000-2005)																					
County	2000 Totals			2001 Totals			2002 Totals			2003 Totals			2004 Totals			2005 Totals			2000 - 2005 Totals		
	Cnt	Kld	Inj	Cnt	Kld	Inj	Cnt	Kld	Inj	Cnt	Kld	Inj	Cnt	Kld	Inj	Cnt	Kld	Inj	Cnt	Kld	Inj
BRAZORIA	4	0	2	6	1	2	8	0	2	5	1	2	6	0	0	6	0	1	35	2	9
CHAMBERS	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	1	2	0	2
FORT BEND	5	0	0	6	0	2	6	2	2	5	0	2	4	0	2	2	0	1	28	2	9
GALVESTON	6	1	0	1	0	0	5	0	2	1	0	1	1	0	0	1	0	0	15	1	3
HARRIS	44	1	16	64	4	24	57	0	11	37	1	12	37	1	12	54	3	19	293	10	94
LIBERTY	5	0	0	3	0	3	3	0	2	4	1	1	1	0	0	2	0	1	18	1	7
MONTGOMERY	11	2	2	7	1	2	5	4	1	5	2	1	6	1	4	7	1	1	41	11	11
WALLER	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	2	0	1
TOTAL	**75**	**4**	**20**	**88**	**6**	**33**	**85**	**6**	**21**	**57**	**5**	**19**	**56**	**2**	**19**	**73**	**4**	**24**	**434**	**27**	**136**

Table 6-4: Annual Roadway-Rail Incidents for Houston Region (2000-2005)

Derailments

There were nearly 390 derailments within the Houston region from 2000 through 2005.[4] Data provided by the railroads to the Federal Railroad Administration (FRA) shows the accumulative cost of equipment and infrastructure damage was more than $23 million. Table 6-5 provides a summary of the derailment damage statistics in the Houston region from January 2000 through December 2005.

Derailments in Houston Region (2000 - 2005)				
County	# of Derailments	Reportable Damage ($)	Fatalities	Injuries
BRAZORIA	33	2,260,595	0	0
CHAMBERS	10	474,110	0	0
FORT BEND	7	1,079,313	0	0
GALVESTON	30	1,161,374	0	0
HARRIS	288	15,311,949	0	3
LIBERTY	12	1,027,826	0	1
MONTGOMERY	8	1,421,007	0	0
WALLER	1	1,134,771	0	3
TOTALS:	**389**	**23,870,945**	**0**	**7**

Table 6-5: Train Derailments in Houston Region, by County (2000 - 2005)

[4] Federal Railroad Administration safety statistics

Trespasser Incidents

Lastly, according to records obtained from the FRA, trespasser incidents within Harris County between 2000 and 2005, which incidentally experienced the highest number of incidents within the Houston region, are tabulated in Tables 6-6 through 6-8. A total of 108 trespasser incidents occurred in the Houston region between 2000 and 2005, 87 of which occurred in Harris County. Trespasser incidents consist of deaths and injuries caused by trespassing on to railroad property, and do not include accidents associated with traffic at roadway-rail interfaces.

Trespasser Casualties (deaths and injuries) in Harris County from (2000 through 2005)								
Railroad	Total		Total Year Counts					
	Cases	% of Total	2000	2001	2002	2003	2004	2005
Union Pacific RR Co. (UPRR)	70	80.5%	6	14	15	16	12	7
BNSF Rwy Co. (BNSF)	14	16.1%	2	4	1	3	3	1
Amtrak (ATK)	1	1.1%	0	0	0	0	0	1
Port Terminal Railroad (PTRA)	1	1.1%	1	0	0	0	0	0
Kansas City Southern Rwy Co. (KCS)	1	1.1%	0	0	0	1	0	0
TOTAL:	87	100.0%	9	18	16	20	15	9

Table 6-6: Harris County Trespasser Incidents (2000 – 2005) per Railroad

Trespasser Casualties (deaths and injuries) in Harris County (2000 through 2005)								
Age	Total		Total Year Counts					
	Cases	% of Total	2000	2001	2002	2003	2004	2005
1to 5	1	1.1%	0	0	0	0	1	0
6 to 10	3	3.4%	1	1	1	0	0	0
11 to 15	6	6.9%	1	0	1	2	0	2
16 to 20	4	4.6%	0	0	1	1	1	1
21 to 25	8	9.2%	0	3	2	2	1	0
26 to 30	14	16.1%	1	2	3	1	7	0
31 to 35	20	23.0%	2	6	3	7	1	1
36 to 40	6	6.9%	0	2	0	1	1	2
41 to 45	6	6.9%	1	2	2	1	0	0
46 to 50	4	4.6%	0	0	1	1	1	1
51 to 55	6	6.9%	2	1	1	0	1	1
56 to 60	4	4.6%	1	0	0	2	1	0
71 to 75	1	1.1%	0	0	1	0	0	0
Not Given	4	4.6%	0	1	0	2	0	1
TOTAL:	87	100.0%	9	18	16	20	15	9

Table 6-7: Harris County Trespasser Incidents (2000 – 2005) by Age

Trespasser Casualties (deaths and injuries) in Harris County (2000 through 2005)								
Event	Total		Incidents per Year					
	Cnt	% of Total	2000	2001	2002	2003	2004	2005
Struck by on-track equipment	69	79.3%	8	15	14	12	13	7
Climatic condition, exposure to env. heat	3	3.4%	0	0	0	3	0	0
Sudden/unexpected movement of on-track equipment	3	3.4%	0	0	0	2	0	1
Collision - between on track equipment	1	1.1%	0	0	0	1	0	0
Collision/impact - auto, truck, bus, van	1	1.1%	0	0	0	1	0	0
Horseplay, practical joke, etc.	2	2.3%	0	1	1	0	0	0
Lost balance	1	1.1%	0	0	1	0	0	0
Other impacts - on track equipment	1	1.1%	0	0	0	0	1	0
Ran into on-track equipment	3	3.4%	0	2	0	0	1	0
On track equipment, other incidents	1	1.1%	0	0	0	1	0	0
Slipped, fell, stumbled, other	2	2.3%	1	0	0	0	0	1
TOTAL:	87	100.0%	9	18	16	20	15	9

Table 6-8: Harris County Trespasser Incidents (2000 – 2005) by Event

Safety Mitigation

Operation Lifesaver was started by the State of Idaho in partnership with UPRR in 1972, when there were over 12,000 roadway/rail accidents nationally, as a one time, one state, six week “safety blitz” educating the traveling public of the hazards of roadway/rail interface. The reduction in grade crossing accidents in Idaho was so astonishing that the program was continued, and is now active in 49 states. The State of Texas became involved in this campaign in 1977.

The statistics shown in the previous tables, however, only show a moderate reduction in most categories between 2002 through 2005. 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 hazards associated with the movement of freight.

The partnerships developed between the State of Texas, the Texas Department of Transportation, and the eight-county Houston region, along with the City of Houston and the three Class I freight railroads and the PTRA are working for the collective good of the freight industry and the traveling public to continue striving for a safer community.

Section 7: Alternatives Analysis

This report is the start of a conversation to address deficiencies in the Houston region's freight network (roads, ports and railroads) and develop ways to accommodate and capitalize on future freight movements. It identifies improvements that may provide relief to residents and the traveling public adversely affected by delays, interruptions, and noise attributed to the movement of freight within the region. It also identifies alternatives that may improve regional freight rail capacity by enhancing the efficiency and operations of the railroads.

An improved rail system can promote continued growth in the local economy as well as support the shifting of truck cargo to rail cars, potentially providing congestion relief on regional freeways. It can also strengthen the region's global competitiveness in goods movement, and help citizens reap the benefits associated with economic growth and vitality. This report recognizes that improvements made to the region's transportation infrastructure must describe both public and private benefits, so that costs of the improvements are apportioned in a fair and balanced manner to all parties involved.

It is intended that the Houston region, through a cooperative effort of local governments, ports, and the newly-formed Gulf Coast Freight Rail District, will study this report and add, subtract, modify, or use this information to develop a regional freight plan. The plan can then be incorporated into the region's long range transportation plan developed by the Houston-Galveston Area Council, the designated metropolitan planning organization (MPO) for the region.

This report is the result of a nearly two year Houston regional freight analysis, contracted by the Texas Department of Transportation (TxDOT), under the guidance of a regional steering committee chaired by TxDOT Houston District Engineer, Mr. Gary K. Trietsch, P.E. The steering committee was comprised of representatives from local governments, transportation and transit agencies, major railroad companies, ports, congressional staff, chambers of commerce, industry representatives, the MPO, and other interested parties.

The Houston Region Freight Study identifies existing truck and freight rail transportation operations, bottlenecks, and constraints with the goal of establishing a slate of potential improvements geared toward providing solutions that may resolve the problems associated with rising congestion levels and the expected growth of commodity movements in Houston.

The improvements selected to be analyzed were compiled from information and or recommendations from the *Harris County Regional Freight Rail Improvement Plan*, the *BNSF - UPRR Houston Area Rail Infrastructure and Operating Plan*, the Houston-Galveston Area Council, meetings and independent discussions with the UPRR, the BNSF, and the PTRA, as well as research conducted by TTI, and lastly the results derived as recommendations to improve freight movement operations determined from the regional freight rail operations modeling (RTC) and the Statewide Analysis Model (SAM).

Improvements identified for the eight-county Houston region comprised of Harris, Fort Bend, Montgomery, Galveston, Waller, Brazoria, Liberty, and Chambers Counties are categorized as:

- Grade Separations (bridges to separate the railroad from streets)
- Grade Crossing Closures (closing and rerouting the street at the intersection with the railroad)
- Improvements to Existing Railroad Infrastructure (improving capacity and connectivity on existing rail lines)
- New Railroad Corridors

The improvements determined from the aforementioned sources have been analyzed to determine the effects on efficiency, mobility, and safety for both rail operations as well as vehicular and pedestrian traffic in the Houston region. This analysis began with the identification of the existing conditions and included estimates of the implementation cost, estimated implementation timeframe, and estimated public and private benefits for the identified improvements.

The identification of existing conditions for the locations of potential improvements incorporated a review of property land uses and estimated values based on county appraisal information, environmental constraints, traffic flow volumes for both vehicular and rail traffic, and traffic accident statistics.

The estimated implementation costs for each improvement are order of magnitude costs that were determined based on preliminary planning. The costs included in this study represent an estimate of probable costs prepared in good faith and with reasonable care. The study team has no control over the costs of construction labor, materials, or equipment, nor over competitive bidding or negotiating methods and does not make any commitment or assume any duty to assure that bids or negotiated prices will not vary from these estimates. The costs are subject to inflation, and in some cases are calculated using county appraisal district values for right-of-way acquisition, which may vary from the actual cost of property acquisition.

The implementation timeframe for each improvement was determined based on the additional analysis, engineering design, environmental mitigation, and funding that would be required prior to the implementation of an improvement.

Improvement classifications based on implementation timeframes were determined for each improvement and classified into the following categories:

1. Level 1 Improvement - Identified near-term railroad improvements
2. Level 2 Improvement - Identified mid-range railroad improvements
3. Level 3 Improvement - All grade crossing closures and separations
4. Level 4 Improvement - Identified long-range improvements such as double tracking of or adding infrastructure capacity to existing segments
5. Level 5 Improvement - Identified long-range improvements such as consolidations, alternative routes or corridors, and major yard operation relocations

Anticipated public benefits of the potential improvements include reduced vehicular delay times due to passing trains at existing at-grade crossings, reduced vehicle and locomotive fuel consumption, improved air quality, improved public safety, improved mobility for vehicular and freight traffic, reduced noise and vibration, and increased freight movement capacity.

The estimated public benefits of the potential improvements were determined by TTI using a Grade Crossing “Impedance” or delay model, which takes into account the volume and frequency of vehicular and train traffic at roadway-rail crossings to estimate the amount of time motorists are delayed by rail traffic.

The model measures the anticipated public costs associated with traffic delays and calculates the extra emissions and fuel usage experienced while delayed by a train at each of approximately 1,200 rail crossings within the region. The cost of collisions is added to time delay costs, emissions, and fuel usage to provide an annualized estimate of total public costs at each grade crossing in the study. Forecasting for growth in both rail and vehicular traffic provides an annualized estimate of public costs through the year 2016 for 10 year benefit calculations and through the year 2026 for 20 year benefit calculations.

The Net Present Value shown as the public benefit is the cumulative projected cost-burden over a 10 year or 20 year period, and is further detailed in a report to be submitted by the TTI. Net present value (NPV) is a standard method for financial evaluation of long-term projects. The NPV is the value of the improvement projected 10 years or 20 years into the future in terms of today’s dollars. This can be assessed as the savings associated with a grade separation or, as traffic levels change with changes to roadways and rail, the net savings to the public of each improvement being evaluated. An explanation of the public benefit calculations as completed by TTI can be found in Appendix D.

The public benefits were calculated for individual roadway grade separations and crossing closures, and were also calculated for rail improvements that were included in the RTC planning cases discussed in Section 7. The identified rail improvements which were not included in the planning cases should undergo further analysis to determine the extent of the improvement's impact on the region's rail network, and to quantify the benefits that may be attained. The impact of potential commuter rail operations on existing rail infrastructure has not been included in the current public benefits calculations.

Figure 7-1 illustrates the process used in the TTI Grade Crossing Impedance Model.

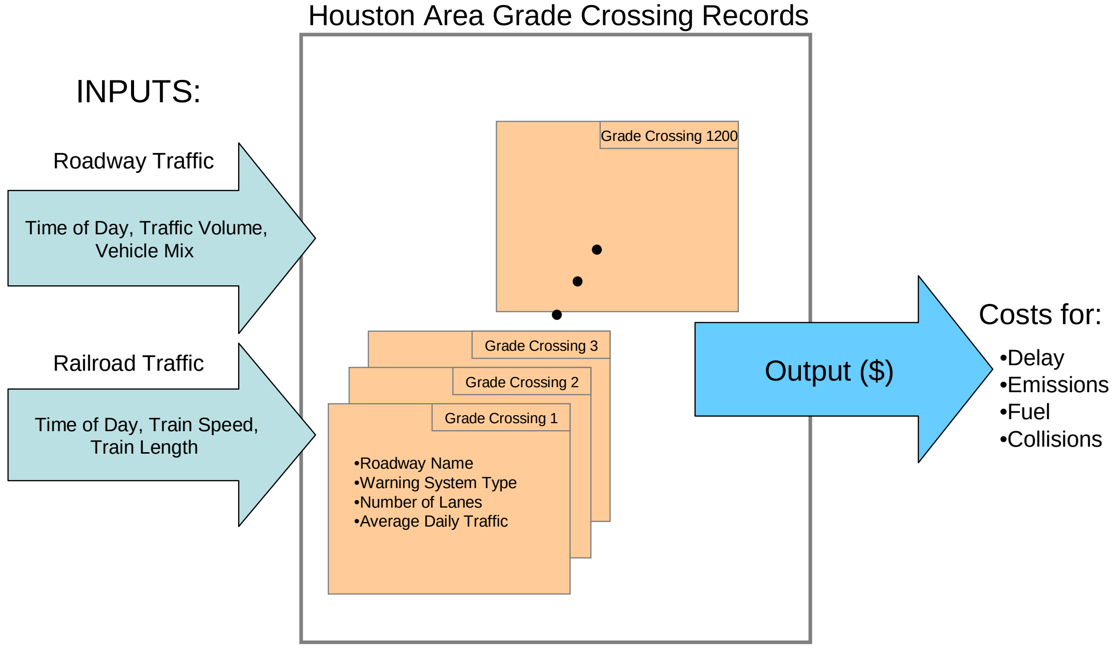


Figure 7-1: Texas Transportation Institute (TTI) Regional Impedance Model

Benefits that may be realized by the railroad companies (private benefits) were calculated for the grouped rail improvements in the RTC planning cases. Analysis of private benefits in addition to those shown with each planning case is beyond the scope of this study and should be examined in an independent benefit/cost analysis. The grade separations and crossing closures primarily provide benefit to the public in the form of reduced delays and improved safety, but also may provide a limited benefit to the railroads at certain locations.

A list of roadways identified as potential grade separations is provided in Table 7-1 along with the estimated costs, 10 and 20 year benefits, and average annual daily traffic (AADT) volumes associated with each roadway. All potential grade separations are classified as level 3 improvements, and may be ranked by the ratio of estimated public benefit to the estimated construction cost. Table 7-1 lists the potential grade separations in descending order of the 10-year public benefit to cost ratio.

Every grade crossing in the region has not been evaluated; rather the analysis of grade crossings and rail line capacity enhancements was limited to those locations contained in this report or deemed necessary for analysis from traffic data analysis conducted by TTI.

Those crossings with a public benefit shown as "NA" do not have associated public benefits identified because the streets do not currently cross the railroad.

Grade Separations							
Street Name	**Railroad Subdivision**	**AADT**	**Estimated Cost**	**Estimated 10-year Public Benefit**	**Ratio: Benefit/ Cost**	**Estimated 20-year Public Benefit**	**Ratio: Benefit/ Cost**
Quitman	West Belt	7,800	$ 7,400,000	$ 20,000,000	2.70	$ 54,000,000	7.30
Scott - York	West Belt	27,400	$ 11,000,000	$ 18,000,000	1.64	$ 52,000,000	4.73
Gessner	Glidden	21,100	$ 17,000,000	$ 26,000,000	1.53	$ 76,000,000	4.47
Shepherd/ Durham	Terminal	62,900	$ 29,000,000	$ 25,000,000	0.86	$ 72,000,000	2.48
Houston	Terminal	33,600	$ 13,000,000	$ 9,500,000	0.73	$ 27,000,000	2.08
Kirkwood	Glidden	39,900	$ 18,000,000	$ 12,000,000	0.67	$ 43,000,000	2.39
Leeland	West Belt	5,900	$ 7,000,000	$ 3,900,000	0.56	$ 11,000,000	1.57
FM 2978	Navasota	16,600	$ 11,000,000	$ 6,100,000	0.55	$ 13,300,000	1.21
Navigation/ Commerce	West Belt	9,300	$ 25,000,000	$ 13,000,000	0.52	$ 33,000,000	1.32
Fondren	Glidden	40,200	$ 20,000,000	$ 10,000,000	0.50	$ 37,500,000	1.88
Bay Area Blvd	Galveston (UPRR)	57,900	$ 20,000,000	$ 9,800,000	0.49	$ 26,000,000	1.30
Dairy Ashford	Glidden	20,800	$ 16,000,000	$ 6,300,000	0.39	$ 23,500,000	1.47
Kuykendahl	Navasota	18,800	$ 18,000,000	$ 6,400,000	0.36	$ 28,000,000	1.56
Wallisville	East Belt	2,600	$ 8,200,000	$ 2,900,000	0.35	$ 7,700,000	0.94
Federal	PTRA	26,300	$ 7,000,000	$ 2,300,000	0.33	$ 6,100,000	0.87
Bellaire	Terminal	50,700	$ 16,000,000	$ 5,200,000	0.33	$ 14,000,000	0.88
Collingsworth	West Belt	5,700	$ 9,000,000	$ 2,900,000	0.32	$ 7,000,000	0.78
FM 359	Glidden	15,600	$ 11,000,000	$ 3,500,000	0.32	$ 10,400,000	0.95
San Felipe	Terminal	44,300	$ 31,000,000	$ 8,400,000	0.27	$ 22,000,000	0.71
Richmond	Terminal	47,000	$ 28,000,000	$ 7,500,000	0.27	$ 19,000,000	0.68
Hirsch	East Belt	10,200	$ 6,100,000	$ 1,600,000	0.26	$ 4,500,000	0.74
TC Jester	Terminal	7,900	$ 8,400,000	$ 2,200,000	0.26	$ 5,900,000	0.70
Harrisburg	East Belt	14,900	$ 14,000,000	$ 3,500,000	0.25	$ 9,500,000	0.68
Hillcroft	Glidden	14,300	$ 17,000,000	$ 3,700,000	0.22	$ 8,700,000	0.51
Chimney Rock	Glidden	11,800	$ 17,000,000	$ 3,600,000	0.21	$ 8,100,000	0.48
Griggs/ Long/ Mykawa	Glidden	45,800	$ 23,000,000	$ 4,700,000	0.20	$ 14,800,000	0.64
Richey	Palestine	10,000	$ 17,000,000	$ 3,400,000	0.20	$ 9,100,000	0.54
Collins	Glidden	11,800	$ 13,000,000	$ 2,600,000	0.20	$ 7,400,000	0.57
Eldridge	Glidden	13,600	$ 21,000,000	$ 4,100,000	0.20	$ 11,900,000	0.57
Harlem	Glidden	12,600	$ 14,000,000	$ 2,600,000	0.19	$ 8,100,000	0.58
Lawndale	Galveston (UPRR)	24,100	$ 18,000,000	$ 3,300,000	0.18	$ 8,500,000	0.47
Canal	East Belt	10,500	$ 11,000,000	$ 1,900,000	0.17	$ 5,000,000	0.45
Lyons	East Belt	7,100	$ 6,700,000	$ 1,000,000	0.15	$ 2,800,000	0.42
Lockwood	Galveston (UPRR)	21,200	$ 7,600,000	$ 1,100,000	0.14	$ 2,900,000	0.38
Broadway	Galveston (UPRR)	14,700	$ 13,000,000	$ 1,800,000	0.14	$ 4,500,000	0.35
FM 1640	Galveston (BNSF)	5,400	$ 14,000,000	$ 1,900,000	0.14	$ 5,000,000	0.36
Market	Strang	4,900	$ 4,600,000	$ 570,000	0.12	$ 1,400,000	0.30
Westheimer	Terminal	44,900	$ 63,000,000	$ 7,000,000	0.11	$ 18,000,000	0.29
FM 521	Galveston (BNSF)	11,900	$ 6,400,000	$ 740,000	0.12	$ 1,900,000	0.30
FM 1960	Houston (BNSF)	87,800	$ 11,000,000	$ 870,000	0.08	$ 1,100,000	0.10

Table 7-1: Potential Grade Separations

Grade Separations							
Street Name	**Railroad Subdivision**	**AADT**	**Estimated Cost**	**Estimated 10-year Public Benefit**	**Ratio: Benefit/ Cost**	**Estimated 20-year Public Benefit**	**Ratio: Benefit/ Cost**
S Wayside	Glidden	16,500	$ 17,000,000	$ 900,000	0.05	$ 2,300,000	0.14
FM 2759/ Crabb River	Galveston (BNSF)	1,600	$ 13,000,000	$ 670,000	0.05	$ 1,600,000	0.12
Steubner/ Airline	Navasota	1,900	$ 5,100,000	$ 200,000	0.04	$ 630,000	0.12
Lyons	Strang	1,700	$ 5,000,000	$ 190,000	0.04	$ 480,000	0.10
Wallisville	Strang	3,700	$ 8,500,000	$ 300,000	0.04	$ 1,000,000	0.12
Telephone	Glidden	13,700	$ 18,000,000	$ 540,000	0.03	$ 1,200,000	0.07
Lyons	West Belt	4,600	$ 6,000,000	$ 130,000	0.02	$ 310,000	0.05
Kirby	Glidden	5,700	$ 14,000,000	$ 160,000	0.01	$ 380,000	0.03
Fannin	Glidden	2,100	$ 19,000,000	$ 73,000	0.00	$ 158,000	0.01
7th-8th	Glidden	NA	$ 5,000,000	NA	NA	NA	NA
Buffalo Speedway	Glidden	NA	$ 14,000,000	Proposed Road	NA	Proposed Road	NA
US 90A	New	13,800	$ 37,000,000	NA	NA	NA	NA
FM 1960	New	10,900	$ 6,800,000	NA	NA	NA	NA
SH 105	New	12,200	$ 6,000,000	NA	NA	NA	NA
FM 787	New	9,900	$ 5,600,000	NA	NA	NA	NA
US 90A	Ft. Bend bypass	7,600	$ 12,000,000	NA	NA	NA	NA
Spur 10	Ft. Bend bypass	2,300	$ 12,000,000	NA	NA	NA	NA
US 59	Ft. Bend bypass	19,600	$ 12,000,000	NA	NA	NA	NA
Cottonwood School	Ft. Bend bypass	1,540	$ 12,000,000	NA	NA	NA	NA
SH 36	Ft. Bend bypass	19,100	$ 12,000,000	NA	NA	NA	NA
FM 2977	Ft. Bend bypass	1,300	$ 12,000,000	NA	NA	NA	NA
FM 521	Ft. Bend bypass	5,500	$ 12,000,000	NA	NA	NA	NA

Table 7-1 (continued): Potential Grade Separations

The difference in values between the 10 year and 20 year estimated public benefits is due to the forecasted growth of both vehicular and train traffic volumes in the future. The public cost burden associated with the at-grade roadway-railroad crossings, which is equivalent to the estimated public benefit of grade separating the crossings, is projected to significantly increase after 10 years due to the compounding growth of traffic.

Crossing closures consist of the closure of a roadway at the point where the roadway crosses the railroad, requiring an alternate route for vehicular traffic. These safety improvements minimize conflict points between trains and cars by closing crossings and encouraging motorists to use grade separated roadways, or alternate streets, which have better safety systems in place.

Five of the crossing closures analyzed in this report include pedestrian bridges for an additional estimated cost of $400,000. For example, a pedestrian bridge is shown for the Runnels Street crossing located in downtown Houston where children cross the railroad tracks to travel between home and school. The photos below show a picture of existing conditions and a conceptual pedestrian bridge at Runnels Street. These pedestrian bridges improve community safety by providing a safer route of travel between homes, commercial areas, and schools.

All potential crossing closures were classified as level 3 improvements, and may be ranked by the ratio of estimated public benefit to the estimated cost of implementation. Only crossing closures that would redirect traffic to a grade separated crossing have identified public benefits; however, all closures provide a benefit to public safety. The cost estimated to implement a crossing closure was estimated to be $50,000, which only includes the placement of traffic barriers, minor street signage, and removal of the existing crossing material.

A list of crossings identified for potential closure is provided in Tables 7-2 and 7-2a along with associated costs, benefits, and AADT volumes. Table 7-2 lists identified crossing closures, in descending order of the benefit to cost ratio for those crossings that would reroute traffic to either an existing or future grade separated crossing. The remaining potential crossing closures, those that reroute traffic to at-grade crossings, are listed with a public benefit of “NA” and are ranked in Table 7-2a in descending order of daily traffic volumes (AADT). The potential reroutes of the crossing closures are discussed in further detail in Section 8.

Crossing Closures							
Street Name	**Railroad Subdivision**	**AADT**	**Estimated Cost**	**Estimated 10-year Public Benefit**	**Ratio: Benefit/ Cost**	**Estimated 20-year Public Benefit**	**Ratio: Benefit/ Cost**
Canal	West Belt	7,029	$ 50,000	$ 9,000,000	180.00	$ 24,000,000	480.00
Gregg	Terminal	5,341	$ 50,000	$ 6,700,000	134.00	$ 17,000,000	340.00
Milby	West Belt	4,868	$ 50,000	$ 3,100,000	62.00	$ 9,100,000	182.00
Lee	West Belt	851	$ 50,000	$ 2,500,000	50.00	$ 6,400,000	128.00
Old Underwood	Strang	13,023	$ 50,000	$ 2,000,000	40.00	$ 6,000,000	120.00
Cullen	West Belt	2,666	$ 50,000	$ 1,800,000	36.00	$ 5,100,000	102.00
FM 2977	Galveston (BNSF)	3,659	$ 50,000	$ 1,400,000	28.00	$ 3,600,000	72.00
Cravens	Glidden	2,595	$ 50,000	$ 660,000	13.20	$ 1,500,000	30.00
Nance	West Belt	675	$ 50,000	$ 630,000	12.60	$ 1,600,000	32.00
Runnels	West Belt	3,110	$ 450,000	$ 5,500,000	12.22	$ 13,000,000	28.89
Third	Glidden	2,470	$ 50,000	$ 530,000	10.60	$ 1,300,000	26.00
Caplin	West Belt	278	$ 50,000	$ 460,000	9.20	$ 1,200,000	24.00
Hailey	Terminal	278	$ 50,000	$ 370,000	7.40	$ 920,000	18.40
Hutchins	West Belt	1,013	$ 50,000	$ 360,000	7.20	$ 1,000,000	20.00
Bowie	Galveston (UPRR)	2,065	$ 50,000	$ 280,000	5.60	$ 670,000	13.40
Stanolind	Navasota	88	$ 50,000	$ 230,000	4.60	$ 420,000	8.40
Douglas/Morton	Glidden	326	$ 50,000	$ 190,000	3.80	$ 380,000	7.60
Colorado	Terminal	278	$ 50,000	$ 190,000	3.80	$ 380,000	7.60
Liberty	Terminal	278	$ 50,000	$ 190,000	3.80	$ 380,000	7.60
Sherwin	Terminal	278	$ 50,000	$ 170,000	3.40	$ 340,000	6.80
Benton	Galveston (BNSF)	326	$ 50,000	$ 130,000	2.60	$ 330,000	6.60
Haviland	Glidden	278	$ 50,000	$ 100,000	2.00	$ 210,000	4.20
Brady	East Belt	278	$ 50,000	$ 100,000	2.00	$ 210,000	4.20
Market	East Belt	5,855	$ 450,000	$ 830,000	1.84	$ 2,100,000	4.67
Johnson	Terminal	278	$ 50,000	$ 80,000	1.60	$ 170,000	3.40
Bringhurst	Terminal	278	$ 450,000	$ 380,000	0.84	$ 940,000	2.09
Sherman	East Belt	278	$ 450,000	$ 65,000	0.14	$ 150,000	0.33

Table 7-2: Potential Crossing Closures

Crossing Closures					
Street Name	**Railroad Subdivision**	**AADT**	**Estimated Cost**	**Estimated Public Benefit**	**Ratio: Benefit/ Cost**
E Noble	Palestine	7,428	$ 50,000	NA	NA
Lorraine	West Belt	6,874	$ 50,000	NA	NA
Bell	East Belt	4,878	$ 50,000	NA	NA
Main	Palestine	4,640	$ 50,000	NA	NA
W Hardy	Palestine	4,640	$ 50,000	NA	NA
Henderson	Terminal	3,114	$ 50,000	NA	NA
Caroline	Palestine	3539	$ 50,000	NA	NA
Lamar	Galveston (BNSF)	2,543	$ 50,000	NA	NA
Heather Row	Lafayette	1,432	$ 50,000	NA	NA
Kirkpatrick	East Belt	904	$ 50,000	NA	NA
Sixth	Glidden	872	$ 50,000	NA	NA
Medina	Strang	732	$ 50,000	NA	NA
Frio	Strang	560	$ 50,000	NA	NA
Fennell	Strang	332	$ 50,000	NA	NA
Fourth	Glidden	326	$ 50,000	NA	NA
Richwood	Glidden	326	$ 50,000	NA	NA
Fifth	Glidden	326	$ 50,000	NA	NA
Eighth	Glidden	326	$ 50,000	NA	NA
West	Terminal	322	$ 450,000	NA	NA
Pease	East Belt	278	$ 50,000	NA	NA
Leeland	East Belt	278	$ 50,000	NA	NA
Jefferson	East Belt	278	$ 50,000	NA	NA
Edgewood	Galveston (UPRR)	278	$ 50,000	NA	NA
Shabbona	Strang	278	$ 50,000	NA	NA
Ivy	Strang	278	$ 50,000	NA	NA
Sabine	Terminal	278	$ 50,000	NA	NA
Bonner	Terminal	278	$ 50,000	NA	NA
Parker	Terminal	278	$ 50,000	NA	NA
Roy	Terminal	278	$ 50,000	NA	NA
Thompson	Terminal	278	$ 50,000	NA	NA
Burnett	Terminal	278	$ 50,000	NA	NA
Semmes	West Belt	278	$ 50,000	NA	NA
Opelousas	West Belt	278	$ 50,000	NA	NA
Brooks	West Belt	278	$ 50,000	NA	NA
McKinney	West Belt	630	$ 50,000	NA	NA
Evergreen	Glidden	630	$ 50,000	NA	NA

Table 7-2a: Potential Crossing Closures

Rail capacity enhancements foster the economic growth of the region by improving the efficiency of freight rail operations as well as minimizing disturbance to residents of the region. Providing additional rail capacity relieves congestion along the rail corridors and allows trains to pass through the region more quickly. Examples of rail capacity enhancements are listed as follows:

- Adding a mainline track
- Adding switches and passing sidings at strategic locations to allow trains to pass one another or to idle without causing delays
- Expanding rail yard capacity
- Constructing connections from one rail line to another to improve rail traffic mobility
- Relocating rail lines, yard operations, and/or intermodal facilities

A list of potential rail capacity enhancements is provided in Table 7-3 along with the estimated costs of the improvements, improvement classifications, and average daily train counts.

The average daily train counts, however, do not express the delay incurred per train. In some cases, segments with lower raw train counts have higher indices than segments with more trains (train count x delay per train = train delay index). The same logic applies to the calculation of grade crossing and neighborhood impacts: it is an index where slower train speeds or frequent holds increase the relative impact (trains x time = impact). In general, improvements that are on segments with higher train counts will show higher railroad (private) benefits from reduced delay.

The numbers with asterisks in Table 7-3 are derived from the input files (i.e. trains scheduled to use the facility per day), not from output movement measurements. For example, the efficiency of a rail yard is not a dependent function of the train count, and therefore benefits can’t be estimated using only train counts. A symbol of “NA” signifies that the number isn't available from the simulation model, either because the cases to date don't provide it, or because the RTC model isn't a sufficiently reliable source for the number because the identified improvement is location specific, meaning it is one single point on a measured line.

Rail Capacity Enhancements				
Improvement	**Railroad Subdivision**	**Estimated Cost**	**Improvement Classification**	**Trains per Day**
Second Main, Baytown to Dayton	Baytown	$ 137,000,000	4	9
Second Main, Gulf Coast Jct to Settegast Jct	Beaumont	$ 20,000,000	2	10
Second Main, Bridge 16	East Belt	$ 9,600,000	1	26
SE Wye at Tower 76	East Belt	$ 2,800,000	1	NA
Expand Settegast Yard	East Belt	$ 6,300,000	1	NA
Lengthen tracks at Pierce Yard	East Belt	$ 15,000,000	2	2*
Fort Bend Bypass Route	Fort Bend (New)	$ 880,000,000	5	NA
Upgrade existing swingspan bridge	Freeport	$ 15,000,000	4	6
Add dedicated sidings for DOW Chemical	Freeport	$ 9,000,000	4	NA
Add passing siding (10,000' length)	Freeport	$ 8,600,000	4	6
Upgrade track GH&H Jct to Twr30 & Wye at Tower 85	Galveston (UPRR)	$ 5,000,000	4	14
Second Main, Rosenberg to Arcola	Galveston (BNSF)	$ 174,000,000	4	12
Second Main, Rosenberg to West Jct	Glidden	$ 137,000,000	4	25
Second Main, Dawes to Sheldon	Lafayette	$ 43,000,000	2	21
Second Main, Sheldon to Dayton Jct	Lafayette	$ 117,000,000	4	21
Second Main, Alvin to Tower 81	Mykawa	$ 100,000,000	4	21
Replace Automotive Operations - Pearland Yd	Mykawa	$ 20,000,000	5	2*
Replace Intermodal Operations - Pearland Yd	Mykawa	$ 75,000,000	5	4*
Replace Carload switching facility - New South Yard	Mykawa	$ 100,000,000	5	15*
Second Main, Spring Jct to MP 14.20	Navasota	$ 79,000,000	4	15
Single Main, Dayton to Cleveland	New	$ 212,000,000	5	NA
Siding Extensions at Lloyd Yard	Palestine	$ 4,000,000	1	NA
Third Main, Belt Jct to Spring Jct	Palestine	$ 104,000,000	1	25

Table 7-3: Potential Rail Capacity Enhancements

Rail Capacity Enhancements				
Improvement	**Railroad Subdivision**	**Estimated Cost**	**Improvement Classification**	**Trains per Day**
NE & NW Wyes at Arcola	Popp	$ 4,000,000	4	NA
Second Main, Arcola to Pierce Jct	Popp	$ 84,000,000	4	2
Second Main, Galena Jct to Manchester Jct	PTRA	$ 39,000,000	1	24
Second Main, Sinco Jct to Deer Park Jct	PTRA	$ 28,000,000	1	25
Extend Switching Lead through North Shore Jct	PTRA	$ 8,500,000	1	73
Expand Pasadena Yard	PTRA	$ 8,600,000	4	NA
Wye at Tower 86	Strang	$ 4,000,000	2	NA
Seabrook Industrial Lead, Second Main	Strang	$ 13,000,000	1	6
Second Main, Tower 30 to Sinco Jct	Strang	$ 25,000,000	2	30
Second Main, Chaney Jct to Tower 26	Terminal	$ 21,000,000	1	25
Replace intermodal operations at Settegast and Englewood	Terminal	$ 100,000,000	5	6*
Expand Englewood Yard	Terminal	$ 5,000,000	2	NA
Third Main, Tower 81 to MP 235.01	West Belt	$ 18,000,000	4	25
Extend two main tracks through Belt jct	West Belt	$ 4,000,000	2	36
Remove Hold Restrictions (Twr 26 to Cullen Blvd)	West Belt	$ 50,000,000	2	32

Table 7-3 (continued): Potential Rail Capacity Enhancements

It is difficult without a detailed economic analysis and benefit/cost study to establish the financial benefits resulting from infrastructure improvements, although the majority of improvements discussed in this section are anticipated to contain an associated, although not yet quantified, benefit for the railroads.

Even though there are tangible benefits that can be estimated using industry standard costing, there are also just as many intangible benefits, whose value can be assessed only by the respective railroads.

Potential benefits that may be realized by the railroads as a result of the modeled improvements may include:

- Reduced exposure to roadway-rail crossings
- Improved train operating efficiency
- Reduced train delays
- Improved train run-times
- Reduced public exposure in general

The measurement used to determine private benefit for this analysis centered on the calculated delay hours per day operated over the entire network as simulated in Rail Traffic Controller (RTC).

As the tables following each RTC planning case will show, a comparison of this performance measure is made between the base case and the potential improvements included in the planning cases.

An average cost of $303[1] per delay hour, based on estimated costs associated with fuel consumption for idling locomotives, train crew labor costs, and the unavailability of locomotive power was used to determine an estimated annual private burden.

This value was determined by analyzing each railroad's reported system-wide yard and switching hours and establishing a ratio of those hours with respect to their reported system-wide road train hours.

Since each railroad (UPRR, BNSF, KCS) had different calculated train delay hour costs, an apportionment based on the percentage of trains in the Houston network (UPRR – 67.6 percent, BNSF 28.3 percent, and KCS 4.1 percent) was used to derive the average cost of $303 per delay hour.

Projecting this annualized cost to 2016 and also to 2026 with an annual 3 percent rate of inflation, a Net Present Value (NPV) of this private burden was calculated, and used as an indicator of the private benefits that are associated with the results of the planning cases discussed. System performance degradation values for identified improvements were not incorporated in the analysis of private benefits, for, assuming no additional infrastructure improvements are implemented, the existing rail network may experience a degradation in performance measurements due to an increase in traffic volumes.

Potential additional costs to the railroads resulting from the implementation of alternative routes or rail corridor consolidations were based on those cumulative costs associated with additional route miles and fuel consumption, but did not take into account "institutional" factors such as crew costs, material handling burdens, or impacts on yard or terminal dwell.

A calculated Operating Expense value of $75.05 per track mile (for rail networks that have a high yard and/or terminal environment such as Houston's) was used to estimate the associated additional cost burden the respective railroads within the study area may encounter due to operating over rail lines that increase the overall route miles currently traveled.

[1] Detailed analysis is included in Appendix D

Since the statistical information obtained for this analysis did not include the PTRA, a similar value was not calculated; rather the averages of the three Class I Railroads were used throughout the economic analysis.

Replicating the tabular information contained in the 2005 Association of American Railroads (AAR) statistical report used for this analysis is a copyright infringement; hence the calculations used will not be reproduced in their entirety, rather only those portions pertaining to the calculation of delay costs and operating expense values will be shown. An explanation of private benefit calculations can be found in Appendix D.

The public benefits calculated for the planning cases were based on the change in train counts at roadway-rail crossings within the region. Decreased train counts at a crossing produced a public benefit, while increased train counts increased the public burden. The impact of potential commuter rail operations on existing rail infrastructure has not been included in the current public benefits calculations. The associated public benefit or burden at each crossing impacted by the planning case improvements was summed for each planning case to determine the total public benefit of the planning case.

RTC Planning Case Simulations

Rail improvements investigated to relieve rail congestion and test alternative routes were analyzed using Rail Traffic Controller (RTC), the same freight rail traffic modeling software used by the freight railroads. Four planning cases, representing a total of 12 improvements and/or relocations, were investigated with the ultimate goal of improving train mobility and efficiency, and addressing the areas of greatest congestion within the network.

As a result, the planning case improvements primarily address large terminals, such as Settegast and Englewood Yards, and bottlenecked locations such as single track bridges that connect double mainline tracks.

The RTC base case model quantified current rail performance, and identified the worst of the current bottlenecks. As indicated in Section 5, a set of railroad improvements were incorporated and intended to relieve congestion at these points. The initial package of improvements has been modeled as Planning Case 1.

A second planning case warranted analysis, which assumes that the improvements developed in the first case carry forward. Had any of the Planning Case 1 improvements failed, they would have been discarded, and conflicts with necessary alternatives would have been resolved.

Since, the improvements in Planning Case 1 were all effective, they have been retained and added to additional improvements in the subsequent planning cases, chosen to address other bottlenecks or alternative routes.

Planning Case 1

Planning Case 1 includes the following improvements as shown in Figure 7-2:

- Construct separate switching leads at Settegast Yard – will keep trains entering or leaving Settegast Yard off of the East Belt Subdivision main tracks. Estimated Cost: **$6.3 million**.
- Construct a separate switching lead between the north end of North Yard and Hunting Bayou – will keep trains entering or leaving PTRA North Yard off of the East Belt Subdivision main tracks. Estimated Cost: **$8.5 million**.
- Construct a second main track between Galena Junction and Manchester Junction – a new bridge and second track over Buffalo Bayou will relieve congestion on the PTRA Subdivision. Estimated Cost: **$39 million**.
- Construct a second main track between Sinco Junction and Deer Park Junction – will allow local service trains to operate on the PTRA while allowing additional trains to enter and leave the PTRA Subdivision. Estimated Cost: **$28 million**.
- Construct a second bridge across Buffalo Bayou on the East Belt - a new bridge and second main track over Buffalo Bayou will relieve congestion on the East Belt Subdivision. Estimated Cost: **$9.6 million**.

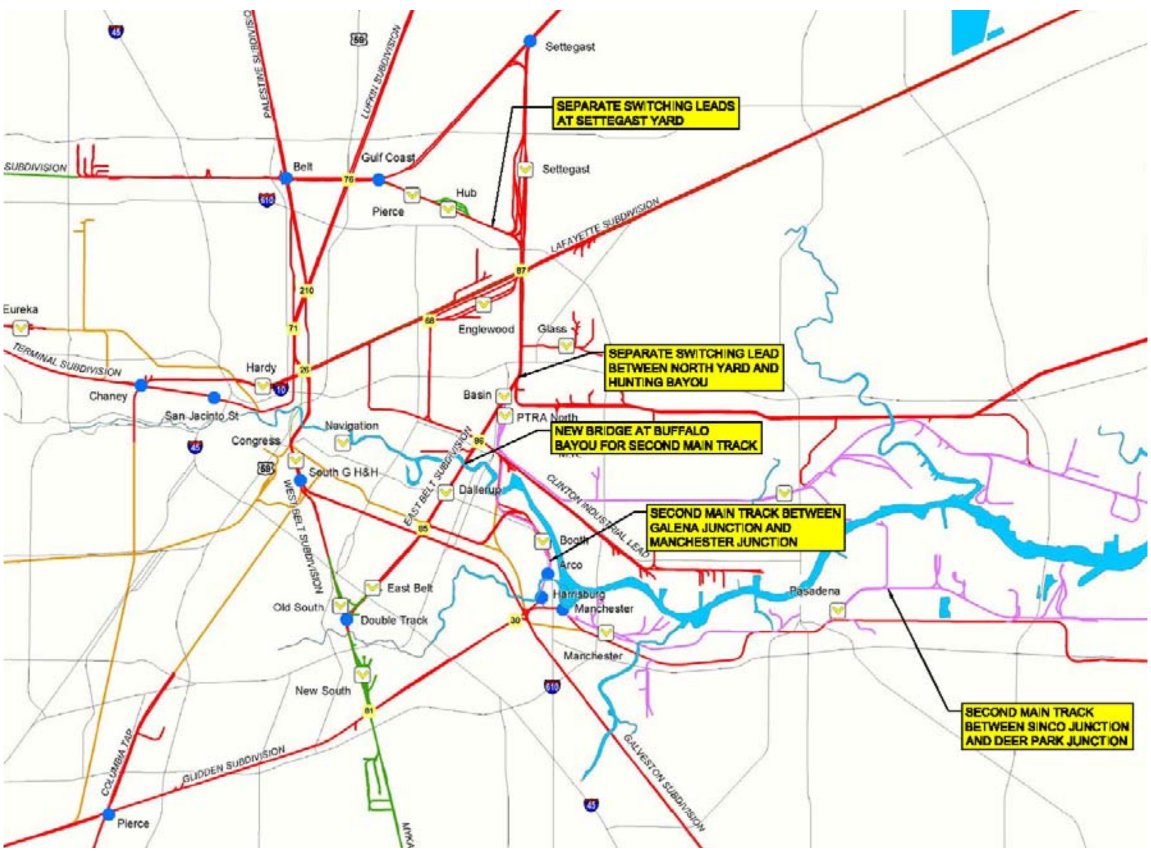


Figure 7-2: Planning Case 1 Improvements

Results from Planning Case 1

Table 7-4 displays the freight train performance over the entire simulated network and across each of the 13 key Railroad Districts/Subdivisions in Planning Case 1, and compares that performance to the results of the base case.

	Trains		Avg. Speed (mph)		Delay Ratio (percent)		Delay Hours/Day		Delay Mins/100 TM	
	Base	Plan1	Base	Plan1	Base	Plan1	Base	Plan1	Base	Plan1
Subdivision										
Network	1895	1897	14.3	14.6	36.4	32.5	300.3	267.0	82.6	73.5
CTC District	292	347	6.1	6.2	48.6	30.5	4.1	5.3	237.9	158.5
North District	266	264	2.8	2.8	65.7	54.1	27.9	24.9	433.1	383.4
Pasadena District	223	209	2.7	2.8	48.5	31.3	19.9	12.9	367.4	238.6
Baytown	111	111	8.2	8.1	15.3	17.3	3.0	3.3	66.2	73.5
Beaumont	476	479	23.7	24.3	23.9	16.0	10.1	7.8	42.3	31.7
East Belt	586	550	4.6	5.1	30.4	27.2	8.3	7.0	144.7	127.6
Glidden	238	239	24.0	23.7	51.6	54.8	22.7	24.1	58.9	62.6
Lafayette	287	286	20.5	20.9	17.8	14.3	8.6	6.9	35.5	28.7
Strang	209	177	6.7	7.4	27.3	18.1	3.3	1.9	109.0	64.2
Terminal	610	622	8.1	8.4	39.8	38.2	16.4	15.5	154.7	145.0
West Belt	481	477	7.8	7.3	31.1	42.2	5.3	7.2	176.0	176.0
Mykawa	169	169	17.5	17.5	10.3	10.3	2.2	2.2	26.3	30.7

Table 7-4: Freight Train Performance Planning Case 1 vs. Base Case

These results show that the identified package of improvements is effective in reducing congestion-related delay on those Districts and Subdivisions where the base case indicated the worst problems exist. In particular, the delay ratios (and delay minutes per 100 train-miles) on the PTRA, and on the UPRR Beaumont and Lafayette Subdivisions, show significant improvements in delays of 35 to 37 percent relative to the base case.

On the PTRA CTC District, the absolute hours of delay rise somewhat. However, there also are 20 percent more measured trains because the added trackage was assigned to the CTC District for RTC measurement purposes, and additional trains used the new track rather than the adjacent Strang Subdivision.

Reviewing the four most delay-prone locations, as identified in the base case, the modeling results show how this package of improvements makes the railroad performance better as shown in Table 7-5. Planning Case 1 improved train performance from 31 percent to almost 48 percent for the four worst bottlenecks.

Location	Base Case Delay Hours per Week	Planning Case Delay Hours per Week
South Settegast	365.5	252.0
North Shore Junction	100.0	61.3
Sinco – Deer Park	92.5	56.0
Galena Jct - Manchester	80.0	41.7

Table 7-5: Bottleneck Freight Train Delays Planning Case 1 vs. Base Case

This first package of improvements also helps performance on the East Belt and Terminal Subdivisions, although a slight worsening in performance was detected on the Glidden and West Belt Subdivisions. The performance decline is the effect of changing train performance on adjacent subdivisions: some of the delay doesn't disappear; just exported to new locations.

Improvement on the segments that showed positive results far outweighed the decay in performance elsewhere, and indicates that this group of improvements is warranted. The delay ratio for the entire 2,550 mile network improved by almost four percent, even though all the identified improvements are in a concentrated area in the heart of the Houston Terminal because the downtown congestion currently taking place has ripple effects far outside Harris County.

Benefits

The estimated private and public benefits associated with the improvements modeled in Planning Case 1 are summarized in Table 7-6.

Private Benefit Analysis - Train Delays		
Overall Network	**Delay Hours per Day**	
	Base	Case 1
	300.3	267
	Approx. annual train delay cost	
	$33,000,000	$29,000,000
	Approx. annual private benefit	
	$0	$4,000,000
Estimated Private Benefit (10 Year NPV)		$29,000,000
Estimated Private Benefit (20 Year NPV)		$48,000,000
Public Benefit Analysis		
Estimated Public Benefit (10 Year NPV)		$27,000,000
Estimated Public Benefit (20 Year NPV)		$73,000,000

Table 7-6: Private and Public Benefits from Planning Case 1

In summary, the identified Planning Case 1 improvements, with an estimated implementation cost of **$91.4 Million**, carry a rail network benefit of approximately **$29 Million** over a 10 year period and **$48 Million** over a 20 year period. The associated public benefits that accompany these improvements experienced a net present value (NPV) public benefit of approximately **$27 Million** over a 10 year period and **$73 Million** over a 20 year period.

Planning Case 2

Planning Case 2 includes all of the improvements in Planning Case 1 in addition to the following improvements as shown Figure 7-3:

- Expand Englewood East to Dawes – will increase the receiving and departure capacity of Englewood Yard. Estimated Cost: **$5 million**.
- Extend the existing second main track east from Dawes to Fauna and upgrade the trackage connecting the East Belt with the Lafayette Subdivision at Dawes – permit movements between New South Yard or points on the East Belt Subdivision south of Englewood and Dayton to take place without trains having to stop. Estimated Cost: **$43 million**.
- Extend the second track on the West Belt Subdivision north from Freight Junction through Belt Junction to connect with the Palestine Subdivision – will remove the single track bottleneck between the two double track segments at Belt Junction. Estimated Cost - **$4 million**.
- Remove train stopping requirements on the West Belt Subdivision from Cullen Boulevard north to Tower 26 – Either grade separate or close all of the crossings along this segment to allow for trains to stop without causing delays or safety hazards to the public. Estimated Cost: **$50 million**.
- Add a second main track between Rosenberg and West Junction on the Glidden Subdivision – will relieve congestion by allowing trains to pass one another along the highly trafficked Glidden Subdivision. Serves as a basis of comparison against the Fort Bend bypass route included in Planning Case 3. Estimated Cost: **$137 million**.

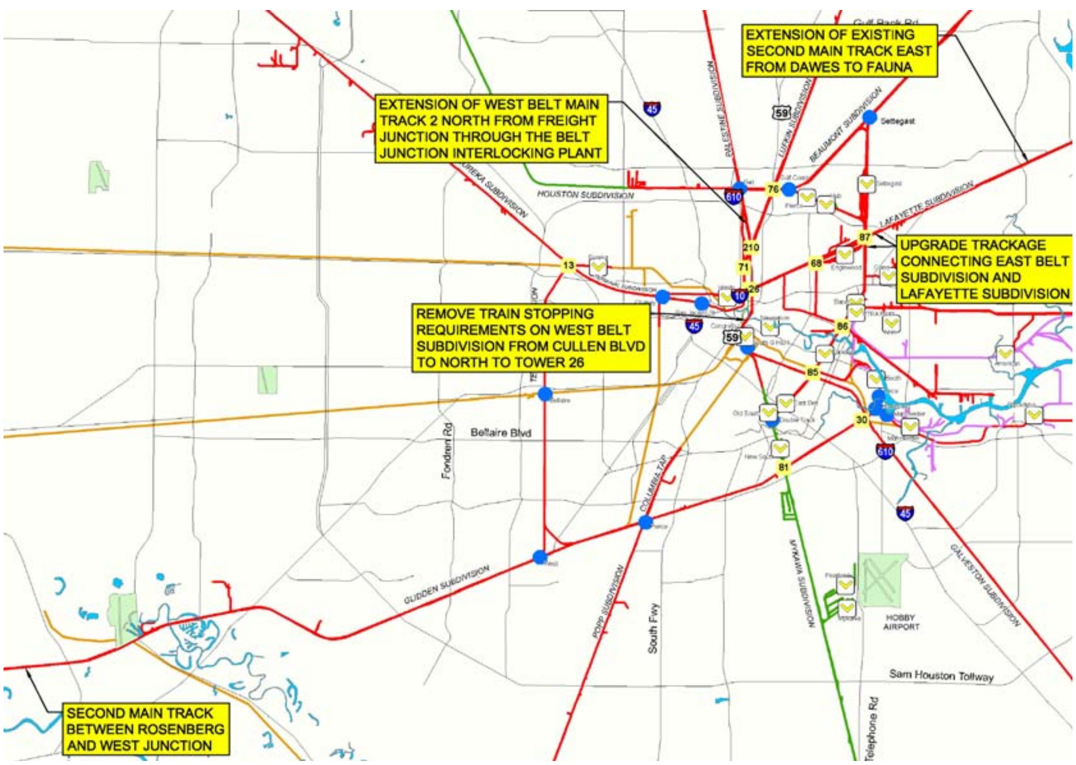


Figure 7-3: Planning Case 2 Improvements

In addition, this planning case created a change in the route taken by about 30 through trains per week. In the base case and Planning Case 1, the West Belt Subdivision is described to the model so that the simulation will not hold trains on the West Belt between South GH&H Junction and Tower 26. The model is directed to advance trains across this segment only when their route beyond these limits is clear, so that the train does not have to be stopped between these two points to meet another train or to let another train pass. The model is restricted in this way everywhere in the region that the railroads impose such restrictions on themselves, either to avoid blocking grade crossings with standing trains or to avoid the nuisance of standing trains in certain areas.

The existing restriction on the West Belt Subdivision between Cullen Boulevard and Tower 26 is due to the many grade crossings in this segment. One consequence of this restriction is that some UPRR through-trains requiring a crew change are forced to the East Belt Subdivision, where they can stop at Basin Yard for relief crews to take over without blocking street crossings. Other reasons these trains are routed via the East Belt include sending most eastward and northward trains via the East Belt; and most westward and southward trains via the West Belt, as is done under the current directional running.

In the base case and Planning Case 1, trains are operating on the East Belt Subdivision that do not have to go that way, such as trains operating from points in the Rio Grande Valley to points north of Houston such as Little Rock. The base case shows that the East Belt can be severely congested; by contrast, the West Belt has fewer trains under the current operation, and doesn't go directly past Basin, North, and Settegast Yards. With some enhancement of capacity on the West Belt, transferring some northward through-trains back to the West Belt may result in better performance than the current directional running.

However, for this route transfer to be practical, the transferred trains need to be able to change crews south of Tower 26 on the West Belt and not be forced to operate all the way north to the Toll Road crew change location on the Palestine Subdivision. The train and engine crews might not have sufficient time left before exceeding their allowable daily work hours to make it that far. Planning Case 2 includes the extension of the West Belt second main track through Belt Junction to the connection with the Palestine Subdivision and identifies the road crossings south of Tower 26 on the West Belt to be closed or grade separated so that trains can be held in this territory without blocking streets. The other potential improvements are intended to test whether additional main track capacity, and in the case of the East Englewood to Dawes “running track” upgrade, or increased train speeds would improve performance.

The addition of a second main track between Rosenberg and West Junction on the Glidden Subdivision was analyzed in Planning Case 2 in order to provide a basis for comparison with the modeling results of a possible Fort Bend bypass route around the Glidden Subdivision, as included in Planning Case 3.

Results from Planning Case 2

Table 7-7 displays the freight train performance in Planning Case 2 as compared with the base case. The Planning Case 2 measures represent the cumulative effect of the improvements from Planning Case 1 in addition to those conferred by Planning Case 2.

	Trains		Avg. Speed (mph)		Delay Ratio (percent)		Delay Hours/Day		Delay Mins/100 TM	
Subdivision	Base	Plan2	Base	Plan2	Base	Plan2	Base	Plan2	Base	Plan2
Network	1895	1898	14.3	14.7	36.4	30.2	300.3	249.4	82.6	68.6
CTC District	292	349	6.1	6.2	48.6	29.5	4.1	5.3	237.9	156.0
North District	266	267	2.8	3.0	65.7	45.6	27.9	20.4	433.1	309.8
Pasadena District	223	208	2.7	2.8	48.5	33.2	19.9	13.5	367.4	251.6
Baytown	111	110	8.2	7.2	15.3	18.0	3.0	4.1	66.2	92.8
Beaumont	476	479	23.7	24.8	23.9	14.9	10.1	4.7	42.3	29.2
East Belt	586	547	4.6	4.3	30.4	29.8	8.3	6.9	144.7	136.5
Glidden	238	239	24.0	25.0	51.6	46.6	22.7	20.3	58.9	53.3
Lafayette	287	288	20.5	21.8	17.8	11.6	8.6	5.4	35.5	22.7
Strang	209	179	6.7	7.1	27.3	19.6	3.3	2.1	109.0	74.6
Terminal	610	620	8.1	8.5	39.8	32.8	16.4	13.4	154.7	126.0
West Belt	481	494	7.8	7.4	31.1	45.3	5.3	8.1	176.0	183.9
Mykawa	169	169	17.5	17.6	10.3	11.3	2.2	2.0	26.3	28.4

Table 7-7: Freight Train Performance Planning Case 2 vs. Base Case

These results suggest that the additional mainline, and upgraded connecting track on the Terminal and Lafayette Subdivisions, along with the second track on the Glidden Subdivision, both complement the improvement gained from the potential improvements included in Planning Case 1. The results of the “West Belt Diversion” are not as clear: performance on the two Belt Subdivisions didn’t improve. Thirty-three trains in the measured week shifted from the East Belt to the West Belt in this test.

The additional capacity on the Lafayette Subdivision produced additional benefits in performance for trains using the Beaumont Subdivision (Settegast Yard is measured as part of the Beaumont Subdivision), and for PTRA trains and engines at North Yard, as well as the direct benefits to trains using the Lafayette and Terminal Subdivisions. Of the additional improvements tested in Planning Case 2, this one produced the best railroad results.

Added capacity on the Glidden Subdivision also is needed to improve railroad operating efficiency, and adding a second track between Rosenberg and West Junction significantly reduced delay. Additional main track capacity by itself, however, may not address the problem since this part of the network experiences a high re-crew rate resulting from activity associated with intermodal trains at Englewood Yard (for westbound trains) and delays to eastbound intermodal trains that have occurred west of Flatonia prior to entering the Houston network. The trains awaiting relief crews are parked on the available sidings, which in the base case resulted in congestion because opposing trains have to meet at some point other than the one at which they would have met most efficiently. The UPRR has plans to build a new intermodal facility in the future, which will eliminate the re-crew issues discussed above for westbound trains. Planning Case 3 analyzed the movement of trains via a new rail corridor in Fort Bend County, which may negate the need for upgrading the Glidden Subdivision as indicated.

The trains requiring relief crews in the base case still require relief crews in the two planning cases because of the activity mentioned above. The planning cases address infrastructure improvements and do not alter the railroad operating practices that may lead to train and engine crews running short on their legal time to work. In Planning Case 2, a significant overall improvement in performance can be seen despite the relatively high number of trains that have to be parked while awaiting fresh crews. The additional main track allows opposing trains to meet one another, while the delayed trains sit clear of the main track on a siding.

Benefits

The estimated private and public benefits associated with the improvements modeled in Planning Case 2 are summarized in Table 7-8.

Private Benefit Analysis - Train Delays		
Overall Network	**Delay Hours per Day**	
	Base	Case 2
	300.3	249.4
	Approx. annual train delay cost	
	$33,000,000	$28,000,000
	Approx. annual private benefit	
	$0	$6,000,000
Estimated Private Benefit (10 Year NPV)		$44,000,000
Estimated Private Benefit (20 Year NPV)		$73,000,000
Public Benefit Analysis		
Estimated Public Benefit (10 Year NPV)		$35,000,000
Estimated Public Benefit (20 Year NPV)		$98,000,000

Table 7-8: Private and Public Benefits from Planning Case 2

The identified Planning Case 2 improvements, with an estimated implementation cost of **$331 Million**, carry a private benefit of approximately **$44 Million** over a 10 year period and **$73 Million** over a 20 year period. The associated public benefits that accompany these improvements are approximately **$35 Million** over a 10 year period and **$98 Million** over a 20 year period.

Planning Case 3 – Ft. Bend County Bypass Alternative

Planning Case 3 includes all of the improvements from Planning Cases 1 and 2, except that the second main track on the Glidden Subdivision has been replaced by the Fort Bend bypass as shown in Figure 7-4, which is estimated to cost **$880 million**.

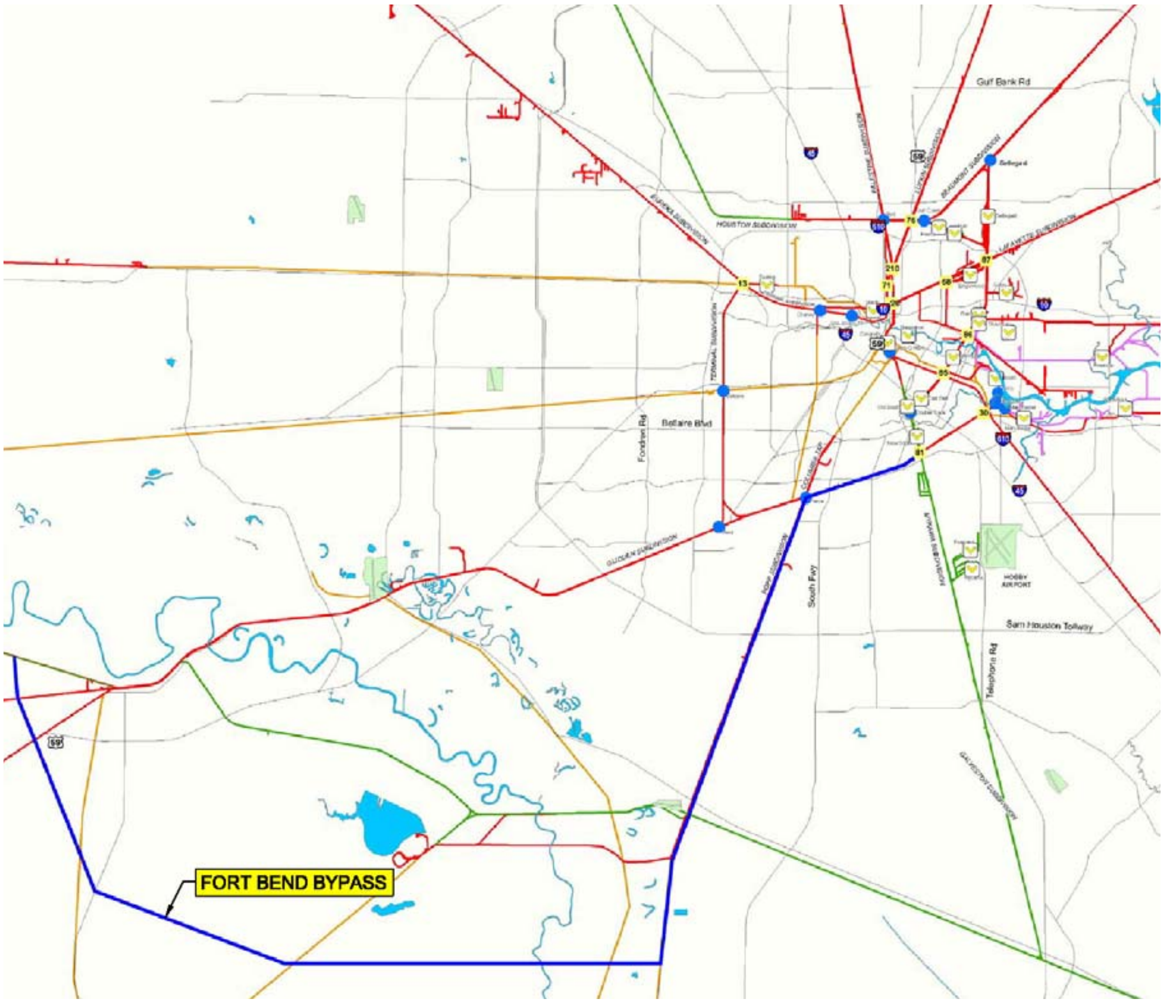


Figure 7-4: Planning Case 3 Fort Bend Bypass

The Fort Bend County bypass route would remove most through-freight trains from portions of the UPRR Glidden Subdivision between Rosenberg and West Junction, as well as UPRR's Terminal Subdivision between West Junction and Eureka.

As modeled, this bypass is approximately 36 miles long between its connection to the UPRR Glidden Subdivision west of Rosenberg, and its east end at the UPRR Popp Subdivision milepost 12.6, where the bypass would connect to the existing track leading to the Smithers Lake Power Plant. From that junction, the bypass route was modeled to continue northeast along the alignment of the existing Popp Subdivision, to Pierce Junction; then east along the alignment of the existing Glidden Subdivision, a total of about 17 miles, to Tower 81 (T&NO Junction). Trains using the bypass would enter or exit the bypass at this point, using either the West Belt or the East Belt north of Tower 81, or the eastward extension of the Glidden Subdivision east of that point to or from Tower 30.

In addition, there is an approximately three-mile long northward extension of the bypass at its western end, which provides a direct connection to the BNSF Galveston Subdivision northwest of Rosenberg. This connection enables BNSF trains that would otherwise use the Glidden Subdivision between Rosenberg and Towers 81 or 30 under trackage rights to use the bypass instead.

The bypass was modeled as a two-main track line, equipped with signals allowing trains to move in either direction on either track, and including universal crossovers at intervals of between eight and 10 miles to allow trains to occupy the opposite main track. Those portions of the Popp and Glidden Subdivisions incorporated into the bypass were upgraded in the model to the same standards as the new sections, although track speeds at and between Arcola, Pierce Junction, and Tower 81 are not as high in the simulation as they are for the sections west of the Smithers Lake connection.

Approximately 150 freight trains per week were routed across the Fort Bend bypass in the simulation. This count includes all UPRR and BNSF through freight trains that would otherwise have used the Glidden Subdivision between West Junction and Rosenberg. The count does not include UPRR local trains with work at points such as Sugarland or Missouri City, nor does the count include rock trains that originate, terminate, pick up, or set out either between Rosenberg and West Junction, or at Eureka, nor the passenger trains. BNSF trains with routes confined entirely to the Galveston and Mykawa Subdivisions also stayed on their base case routes.

Results from Planning Case 3

Table 7-9 displays the freight train performance in Planning Case 3, as compared with the base case. Planning Case 3 measures the cumulative effect of the improvements from Planning Cases 1 and 2, except that the second main track on the Glidden Subdivision between Rosenberg and West Junction, which was included in Planning Case 2, has been deleted in Planning Case 3, and replaced by the Fort Bend Bypass. The performance on two PTRA Districts not affected by the bypass is not shown; there were no significant changes as compared to Planning Case 2.

	Trains		**Avg. Speed (mph)**		**Delay Ratio (percent)**		**Delay Hours/Day**		**Delay Mins/100 TM**	
Subdivision	Base	Plan3	Base	Plan3	Base	Plan3	Base	Plan3	Base	Plan3
Network	1895	1898	14.3	14.9	36.4	30.7	300.3	255.0	82.6	69.0
Fort Bend		150		42.3		5.8		1.0		7.5
Popp	37	187	8.5	20.4	10.1	2.9	.3	5.4	40.8	100.4
Pasadena District	223	208	2.7	2.8	48.5	32.5	19.9	13.3	367.4	247.5
Baytown	111	110	8.2	7.1	15.3	14.7	3.0	3.6	66.2	79.3
Beaumont	476	479	23.7	20.8	23.9	14.0	10.1	6.7	42.3	27.5
East Belt	586	548	4.6	4.5	30.4	24.7	8.3	6.3	144.7	114.4
Glidden	238	240	24.0	23.5	51.6	25.6	22.7	17.4	58.9	58.5
Lafayette	287	288	20.5	21.1	17.8	15.2	8.6	7.1	35.5	30.0
Strang	209	181	6.7	7.4	27.3	20.5	3.3	2.3	109.0	74.6
Terminal	610	583	8.1	6.6	39.8	53.5	16.4	15.1	154.7	227.5
West Belt	481	568	7.8	8.2	31.1	33.8	5.3	7.3	176.0	134.7
Mykawa	169	179	17.5	17.1	10.3	11.8	2.2	2.2	26.3	30.8

Table 7-9: Freight Train Performance Planning Case 3 vs. Base Case

These results suggest that, relative to the base case, Planning Case 3 yields about the same improvement in performance as Planning Case 2. However, there are more train miles required under the Fort Bend bypass scenario: about 2400 additional train miles per week, or between 124,000 and 125,000 additional train miles annually. These added miles accrue because the bypass route is longer than the existing, more direct route via the Terminal and Glidden Subdivisions. For example, it is about 41 miles from the west end of Englewood Yard to Rosenberg via the Terminal and Glidden Subdivisions, while it is about 61 miles via the West Belt, Tower 81, Arcola, and the Fort Bend bypass.

Table 7-10 compares the freight train performance in Planning Cases 2 and 3. The only difference between these cases is the differential routing of trains off the Glidden and Terminal Subdivisions to the Fort Bend bypass.

The train counts shown in Table 7-10 are for the entire subdivision over a week's time period. These counts do not necessarily show the change in train counts on specific segments of the subdivisions due to the bypass. For example, the number of trains on the Glidden Subdivision from Rosenberg to West Junction would be reduced by 150 trains, which would be rerouted via the bypass. However, the overall subdivision train count does not significantly change since the bypass trains re-enter the Glidden Subdivision at Pierce Junction after leaving the Popp Subdivision. Additionally, most of the through-trains on the Terminal Subdivision between West Junction and Eureka would be rerouted via the bypass to the West Belt or East Belt Subdivisions. However, some of these trains would re-enter the Terminal Subdivision east of Tower 26 from either the West Belt or East Belt routes.

The eastbound trains entering the bypass route originate from the UPRR Glidden Subdivision (53 trains) or the BNSF Galveston Subdivision (6 trains) and travel on the West Belt Subdivision (32 trains), the East Belt Subdivision (21 trains), or on the Glidden Subdivision toward Tower 30 (6 trains) after leaving the bypass for a total of 59 eastbound trains. The westbound trains entering the bypass route originate from the West Belt Subdivision (69 trains), the East Belt Subdivision (12 trains), or on the Glidden Subdivision from Tower 30 (10 trains) and travel on the UPRR Glidden Subdivision (55 trains) or the BNSF Galveston Subdivision (36 trains) after leaving the bypass for a total of 91 westbound trains.

	Trains		**Avg. Speed (mph)**		**Delay Ratio (percent)**		**Delay Hours/Day**		**Delay Mins/100 TM**	
Subdivision	Plan2	Plan3	Plan2	Plan3	Plan2	Plan3	Plan2	Plan3	Plan2	Plan3
Network	1898	1898	14.7	14.9	30.2	30.7	249.4	255.0	68.6	69.0
Fort Bend		150		42.3		5.8		1.0		7.5
Popp	37	187	8.5	20.4	9.5	2.9	.3	5.4	38.2	100.4
Pasadena District	208	208	2.8	2.8	33.2	32.5	13.5	13.3	251.6	247.5
Baytown	110	110	7.2	7.1	18.0	14.7	4.1	3.6	92.8	79.3
Beaumont	479	479	24.8	20.8	14.9	14.0	4.7	6.7	29.2	27.5
East Belt	547	548	4.3	4.5	29.8	24.7	6.9	6.3	136.5	114.4
Glidden	239	240	25.0	23.5	46.6	25.6	20.3	17.4	53.3	58.5
Lafayette	288	288	21.8	21.1	11.6	15.2	5.4	7.1	22.7	30.0
Strang	179	181	7.1	7.4	19.6	20.5	2.1	2.3	74.6	74.6
Terminal	620	583	8.5	6.6	32.8	53.5	13.4	15.1	126.0	227.5
West Belt	494	568	7.4	8.2	45.3	33.8	8.1	7.3	183.9	134.7
Mykawa	169	179	17.6	17.1	11.3	11.8	2.2	2.2	28.4	30.8

Table 7-10: Freight Train Performance Planning Case 2 vs. Planning Case 3

Most of the case-to-case differences between those Subdivisions not directly affected by the Fort Bend bypass are not significant statistically, and represent the normal day-to-day variations captured in RTC. There is a slight tendency for the bypass alternative to transfer delay to places like the Lafayette Subdivision. However, performance on segments such as the West Belt Subdivision actually improves under the bypass alternative because it is necessary to enforce a more strictly directional use of both the East and West Belt Subdivisions in order to accommodate the extra volume of trains using those routes as an alternative to the Terminal Subdivision. The performance on the Terminal Subdivision itself declines significantly, but that is because it is stripped of its faster through trains, and left with the main line work in the immediate vicinity of Englewood Yard, and at Hardy Street.

Benefits

The estimated private and public benefits associated with the improvements modeled in Planning Case 3 are summarized in Table 7-11.

Private Benefit Analysis - Train Delays		
Overall Network	Delay Hours per Day	
	Base	Case 3
	300.3	255
	Approx. annual train delay cost	
	$33,000,000	$28,000,000
	Approx. annual private benefit	
	$0	$5,000,000
	Approx. annual private burden	
	$0	$9,000,000
Estimated Private Benefit (10 Year NPV)		($35,000,000)
Estimated Private Benefit (20 Year NPV)		($63,000,000)
Public Benefit Analysis		
Estimated Public Benefit (10 Year NPV)		$211,000,000
Estimated Public Benefit (20 Year NPV)		$634,000,000

Table 7-11: Private and Public Benefits from Planning Case 3

Since there are between 124,000 and 125,000 additional train miles annually due to the bypass, this additional mileage may carry an annual burden of approximately **$9 Million** to the operating railroads based on fuel consumption, train crew hours, and general transportation costs per track mile. As previously mentioned, these added miles accrue because the bypass route is roughly 20 miles longer than the present, more direct route.

Additional ancillary railroad facilities to accommodate this alternative may also be required to account for activities that currently take place along the existing rail lines. These facilities may include crew change points, maintenance-of-way and/or train and engine repairman facilities, and general services/office support facilities. An initial first year investment of approximately **$2 Million** to construct these facilities is forecast in the analysis of overall private benefits.

The construction of a new rail corridor does not have immediate requirements for annualized maintenance costs equal to that of an existing rail corridor, but there are maintenance and inspection requirements that are federally mandated, regardless of the age of an infrastructure. Since the existing rail corridors are intended to remain intact to serve the existing customer base, the Fort Bend County bypass corridor investigated in Planning Case 3 may require the railroads to add personnel in order to accomplish these mandated functions.

Nationally, an annual average of $46,000 per track mile must be spent to maintain a Class I Railroad to its current condition.[2] For a new rail corridor, however, table 7-12 provides a breakdown of annualized maintenance accruals per track mile that may be realized by the railroad that result from operating over a new track alignment. As noted, with year 11 and thereafter, there is no longer a reduction in the estimated annual maintenance cost.

Estimated Track Maintenance Expenses			
Year	**Estimated Maintenance Percentage**	**Estimated Cost/Mile**	**Estimated Annual Cost**
1	3%	$1,380	$49,680
2	7%	$3,220	$115,920
3	12%	$5,520	$198,720
4	19%	$8,740	$314,640
5	28%	$12,880	$463,680
6	39%	$17,940	$645,840
7	57%	$26,220	$943,920
8	65%	$29,900	$1,076,400
9	81%	$37,260	$1,341,360
10	98%	$45,080	$1,622,880
11	100%	$46,000	$1,656,000

Table 7-12: Annual Track Maintenance Costs for Fort Bend Bypass

Forecast over a 10 and 20 year period, the additional railroad burden costs due to fuel consumption, train crew hours, ancillary railroad facilities, and general transportation and maintenance costs per track mile along the bypass route may reduce the private benefit by an NPV of **$74 Million** and **$128 Million**, respectively.

Although the bypass alternative imposes a public cost burden due to the introduction of train traffic along the new bypass route as well as the existing Popp Subdivision, a reduction in the public burden along the Glidden Subdivision and the Terminal Subdivision offsets this increase, since there is a considerably lesser volume of train traffic on these subdivisions.

In summary, the identified Planning Case 3 improvements, with an estimated implementation cost of **$1.08 Billion**, carry with them a rail network benefit over a 10 and 20 year period of approximately $39 Million and $65 Million, respectively, which are subsequently reduced by $74 Million or $128 Million over the course of 10 and 20 years. The net burden to the railroads resulting from the Fort Bend bypass over a 10 and 20 year period, therefore, is **$35 Million** and **$63 Million**, respectively. The associated public benefits that accompany these improvements over a 10 and 20 year period are approximately **$211 Million** and **$634 Million**, respectively.

[2] Testimony of Dr. Allan M. Zarembski, President ZETA-TECH Association before the United States Senate Committee on Commerce, Science, and Transportation Subcommittee on Surface Transportation and Merchant Marine, May 9, 2001

Planning Case 4 – Dayton to Cleveland Rail Corridor

Planning Case 4 includes all of the improvements from Planning Cases 1 and 2 in addition to a new bypass around the east side of Houston as shown in Figure 7-5, which is estimated to cost **$212 million**. This 32-mile long bypass would run from a junction with the Baytown Subdivision, near Dayton, north and west to a connection with the Lufkin Subdivision near Cleveland.

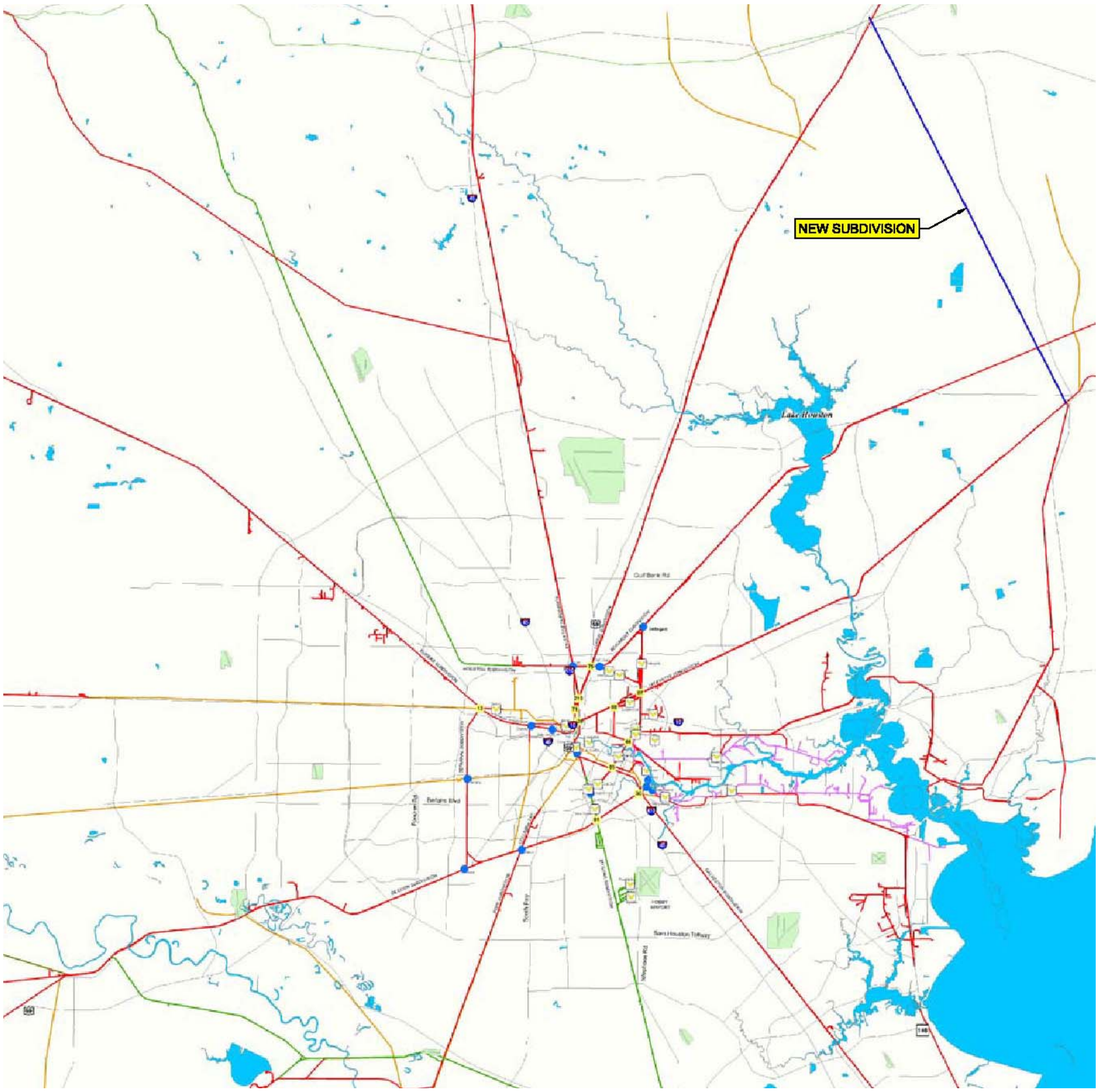


Figure 7-5: Planning Case 4 Dayton-Cleveland Corridor

The route was modeled as a single track line equipped with Centralized Traffic Control (i.e. power turnouts at control points remotely controlled by the train dispatcher). The junctions along the new route with the intersecting subdivisions also were described to the model as under dispatcher control, even where the adjoining subdivisions currently have no block signals. In the model, the line also is equipped with one intermediate, controlled siding about 10,300 feet long.

Trains in the train file that could logically be redirected to this cutoff were then rerouted to use all or part of the new line. For the most part, the candidates include BNSF through trains operating between Beaumont or points east thereof, and points west/northwest of Houston such as Temple and/or Teague. Trains that originate or terminate at Dayton, conveying traffic blocked to or from Dayton, and therefore would not have to work at any other point in the Houston Terminal, also were directed to the cutoff, provided that they had access.

To gain such access, other new connections would be required in the northeast quadrants at Conroe, between the BNSF Conroe Subdivision and the UPRR Palestine Subdivision; and at Dobbin, between the BNSF Houston Subdivision and the BNSF Conroe Subdivision. These connections were included in the case; and a limited number of BNSF trains used these routes.

The simulation case does not assume new grants of trackage rights beyond those that now exist; does not assume that any new yards are built, or existing facilities relocated; nor does it assume that the existing classification routines are significantly changed from those in the base case and preceding planning cases. Substantial changes to the existing operating patterns could change the utilization of the cutoff, and might make it more valuable.

Some re-routings were incorporated into train routes used in Planning Case 4: some BNSF through trains that now do work at Pearland or New South Yard were redirected to the Conroe Subdivision between Somerville, Dobbin, or Conroe and Cleveland; one UPRR train that originates at Pine Bluff and operated in the base case via Kinder, Beaumont, East Englewood, and then back out the Baytown branch to Baytown was redirected to arrive off the Lufkin Subdivision, via the cutoff to Baytown. The Beaumont traffic on this train was shifted to other trains. However, on the whole these changes were kept to a minimum.

Results from Planning Case 4

A total of 57 measured trains used the cutoff in the measured week, or between eight and 10 trains per day. Table 7-13 displays the freight train performance in Planning Case 4 as compared with the base case. Planning Case 4 includes all the improvements from Planning Case 2, plus the benefits of the Cleveland cutoff. Some subdivisions where performance is totally unaffected by the existence of the cutoff are not shown, while some new ones, where performance is affected, are shown.

	Trains		Avg. Speed (mph)		Delay Ratio (percent)		Delay Hours/Day		Delay Mins/100 TM	
Subdivision	Base	Plan4	Base	Plan4	Base	Plan4	Base	Plan4	Base	Plan4
Network	1895	1898	14.3	14.8	36.4	28.8	300.3	238.6	82.6	65.7
Galveston	360	360	22.9	23.1	13.4	12.6	17.4	16.0	25.2	23.5
Houston	107	98	18.0	19.1	15.0	10.4	6.4	3.6	36.6	24.4
Conroe	32	39	24.7	25.6	4.6	2.9	.4	7.6	10.6	6.6
Baytown	111	110	8.2	6.6	15.3	16.1	3.0	3.9	66.2	92.0
Beaumont	476	473	23.7	20.8	23.9	12.8	10.1	6.3	42.3	25.3
East Belt	586	502	4.6	4.2	30.4	21.1	8.3	4.7	144.7	99.6
Glidden	238	231	24.0	24.7	51.6	28.1	22.7	18.9	58.9	63.7
Lafayette	287	282	20.5	20.4	17.8	15.5	8.6	6.1	35.5	30.4
Cleveland		57		22.8		4.6		.4		11.6
Terminal	610	581	8.1	8.6	39.8	32.0	16.4	12.6	154.7	121.5
West Belt	481	476	7.8	8.4	31.1	27.8	5.3	4.9	176.0	112.0
Mykawa	169	169	17.5	18.0	10.3	6.6	2.2	1.2	26.3	16.8

Table 7-13: Freight Train Performance Planning Case 4 vs. Base Case

Despite the small number of trains diverted to the cutoff, this case shows a significant improvement in overall network performance. By all three standard measures, delays declined, and the performance ratios got better. The positive effect on performance is noticeable on the East Belt Subdivision, and the Terminal, Beaumont, and Houston Subdivisions, although it extends to the Lafayette, Mykawa, and Galveston Subdivisions as well.

This improvement results from removing a number of westward BNSF trains from that portion of the Lafayette Subdivision west of Dayton, from the East Belt Subdivision between East Englewood and Double Track Junction, from the West Belt Subdivision between Double Track Junction and Tower 81, from the Glidden Subdivision between Tower 81 and Rosenberg, and from the Galveston Subdivision between Rosenberg and Somerville. It also results from removing eastward BNSF trains from the Houston Subdivision between Dobbin and Belt Junction, from the East Belt Subdivision between Belt Junction and Gulf Coast Junction, and from the Beaumont Subdivision between Gulf Coast Junction and Hull. The one UPRR train rerouted in this exercise disappears entirely from the Lafayette Subdivision, as well as from East Englewood, North Shore Junction, and from the west end of the Baytown Subdivision.

These results are consistent with the findings from the earlier cases; namely, that the current physical plant is being taxed beyond its maximum practical capacity between Belt Junction and Basin Yard, and by the switching required at points such as North Shore Junction and adjacent to New South Yard. Thus, reducing train frequencies in these areas has a disproportionate benefit: taking away even a relatively small number of trains from these parts of the network, along with adding the switching leads and added staging trackage that emerge as recommendations from the first two planning cases, results in a significant improvement in overall capacity and performance. The UPRR, KCS, and PTRA all benefit from improved capacity around Tower 87; BNSF benefits by not having through trains delayed waiting to get across the East Belt.

Benefits

The estimated private and public benefits associated with the improvements modeled in Planning Case 4 are summarized in Table 7-14.

Private Benefit Analysis - Train Delays		
Overall Network	**Delay Hours per Day**	
	Base	Case 4
	300.3	238.6
	Approx. annual train delay cost	
	$33,000,000	$26,000,000
	Approx. annual private benefit	
	$0	$7,000,000
Estimated Private Benefit (10 Year NPV)		$48,000,000
Estimated Private Benefit (20 Year NPV)		$76,000,000
Public Benefit Analysis		
Estimated Public Benefit (10 Year NPV)		$47,000,000
Estimated Public Benefit (20 Year NPV)		$131,000,000

Table 7-14: Private and Public Benefits from Planning Case 4

The construction of a new rail corridor does not have immediate requirements for annualized maintenance costs equal to that of an existing rail corridor, but there are maintenance and inspection requirements that are federally mandated, regardless of the age of an infrastructure.

Nationally, an annual average of $46,000 per track mile must be spent to maintain a Class I Railroad to its current condition.3 For a new rail corridor, however, table 7-15 provides a breakdown of annualized maintenance accruals per track mile that may be realized by the railroad that result from operating over a new track alignment. As noted, with year 11 and thereafter, there is no longer a reduction in the estimated annual maintenance cost.

[3] Testimony of Dr. Allan M. Zarembski, President ZETA-TECH Association before the United States Senate Committee on Commerce, Science, and Transportation Subcommittee on Surface Transportation and Merchant Marine, May 9, 2001

Estimated Track Maintenance Expenses			
Year	Estimated Maintenance Percentage	Estimated Cost/Mile	Estimated Annual Cost
1	3%	$1,380	$44,160
2	7%	$3,220	$103,040
3	12%	$5,520	$176,640
4	19%	$8,740	$279,680
5	28%	$12,880	$412,160
6	39%	$17,940	$574,080
7	57%	$26,220	$839,040
8	65%	$29,900	$956,800
9	81%	$37,260	$1,192,320
10	98%	$45,080	$1,442,560
11	100%	$46,000	$1,472,000

Table 7-15: Annual Track Maintenance Costs for Fort Bend Bypass

Lastly, alterations to existing railroad labor agreements should be applied towards the calculation of additional anticipated railroad costs for operating on new rail corridors. Without having the benefit of scrutinizing the existing agreements the railroads have with the Brotherhood of Locomotive Engineers, Brotherhood of Maintenance of Way Employees, and Brotherhood of Railroad Signalmen agreements (to name a few), it is estimated the additional contractual burden that may be imposed to the operating railroad may total an aggregate of **$1 Million**.

Forecast over a 10 and 20 year period, the additional railroad operating and maintenance costs per track mile along the new corridor may reduce the private benefit by an NPV of **$5 Million** and **$13 Million**, respectively.

Although the bypass alternative imposes a public cost burden due to the introduction of train traffic on the new Dayton to Cleveland route, a reduction in the public burden along existing subdivisions offsets this increase, since the number of freight trains along existing rail lines on the east side of Houston should be decreased.

In summary, the identified Planning Case 4 improvements, with an estimated implementation cost of **$542 Million**, carry with them a rail network benefit over a 10 and 20 year period of approximately $53 Million and $89 Million, respectively, which are subsequently reduced by $5 Million or $13 Million over the course of 10 and 20 years. The net benefit to the railroads resulting from the Dayton-Cleveland corridor over a 10 and 20 year period is **$48 Million** and **$76 Million**, respectively. The associated public benefits that accompany these improvements over a 10 and 20 year period are approximately **$47 Million** and **$131 Million**, respectively.

The relocation of carload switching operations from existing rail yards such as New South Yard and Pearland Yard ultimately may increase the benefits of this improvement.

Planning Case Comparisons

The associated costs and benefits for each of the individual planning cases are shown below in Table 7-16.

	Planning Case 1	Planning Case 2	Planning Case 3	Planning Case 4
Total Estimated Cost*	$ 92,000,000	$ 331,000,000	$ 1,080,000,000	$ 542,000,000
10-Year Benefit/Cost Analysis				
Total Estimated NPV Private Benefit (over Base Case)	$ 29,000,000	$ 44,000,000	$ (35,000,000)	$ 48,000,000
Total Estimated NPV Public Benefit (over Base Case)	$ 27,000,000	$ 35,000,000	$ 211,000,000	$ 47,000,000
Benefit (Private + Public)/Cost Ratio	0.6	0.2	0.2	0.2
20-Year Benefit/Cost Analysis				
Total Estimated NPV Private Benefit (over Base Case)	$ 48,000,000	$ 73,000,000	$ (63,000,000)	$ 76,000,000
Total Estimated NPV Public Benefit (over Base Case)	$ 73,000,000	$ 98,000,000	$ 634,000,000	$ 131,000,000
Benefit (Private + Public)/Cost Ratio	1.3	0.5	0.5	0.4
*Planning case costs are cumulative and rounded up to three significant figures. For example, Planning Case 3 costs include the costs of Planning Case 1 and 2 improvements as detailed on the following pages.				

Table 7-16: Planning Case Cost and Benefit Comparisons

As shown in Table 7-16, Planning Case 1 is the least expensive group of improvements, yet yields the highest benefit/cost ratio. This package of improvements significantly reduces the congestion-related delay on the railroad subdivisions that currently experience the worst problems.

The improvements included in Planning Case 2 build upon those identified in Planning Case 1. The additional main track from Dawes to Sheldon produced the best railroad results. An additional track from Rosenberg to West Junction in Houston, significantly reduced train delays along that line; however, adding capacity along this rail line may be opposed by the communities in the area.

The need for additional capacity, as described in Planning Case 2, serves as the foundation for testing a potential new rail corridor in Fort Bend County in Planning Case 3. Although the bypass alternative imposes a public cost burden by introducing train traffic along the new bypass route and increasing the number of trains on the existing Popp Subdivision and in East Houston, this burden is offset by a reduction in the public burden along the Glidden and Terminal Subdivisions, since the volume of train traffic on these subdivisions would be reduced. The additional train route miles associated with the Fort Bend bypass route in Planning Case 3 may carry an additional annual private burden to the operating railroads based on fuel consumption, train crew hours, and general transportation costs per track mile, and may therefore be opposed by the railroad companies.

The Dayton-Cleveland route included in Planning Case 4 was shown to benefit both the private and public sectors by reducing train traffic in the east end of Houston. The bypass alternative imposes a public cost burden due to the introduction of train traffic on the new Dayton to Cleveland route; however, this burden is offset by a reduction in the public burden along existing subdivisions such as the East Belt and Lafayette Subdivisions, since the number of freight trains along existing rail lines on the east side of Houston would be decreased. The relocation of carload switching operations that currently take place at New South and Pearland (Mykawa) Yards may ultimately increase the benefits of this improvement. Initial analysis of hypothetical cases in which carload switching is relocated outside of Houston has shown that there may be a four to nine percent reduction in the number of trains operating on the East Belt Subdivision, and a 12 to 15 percent reduction in the number of trains operating on the West Belt Subdivision.

The reduction in mainline train counts corresponds to reductions in train-hours of 2 to 6 percent for the East Belt Subdivision and 9 to 26 percent for the West Belt Subdivision. As a result of the relocation, train-hours approximately equal to the number of train-hours run on either the East or West Belt Subdivisions today would be relocated outside of Houston.

In addition, nearly 500 hours per week of yard switching activity would no longer be conducted within Houston’s east side. As a result, locomotive emissions generated would be reduced and the interface between the trains within Houston's east side and the traveling public would be improved, inherently increasing the public benefits.

In summary, for an estimated cost of **$195 Million**, the relocation of carload switching operations at New South and Pearland Yards is estimated to produce a public benefit of approximately **$24 Million** over a 10 year period and **$65 Million** over a 20 year period, excluding the reduction in weekly yard switching hours. The estimated NPV private benefit to the railroads of the relocation is approximately **$3.5 Million** over a 10 year period and **$5.8 Million** over a 20 year period.

Additional Rail Improvements

With the completion of four separate planning cases as well as the modeling of the relocation of carload switching operations out of Houston, which tested the validity of 12 infrastructure improvements and/or impacts to the transportation network, there remain 25 rail network enhancements that have been developed and listed as potential improvements that were not included in planning cases to date. These potential improvements are founded on recommendations made from prior studies, the freight rail carriers themselves, or observations of train flows via the modeling simulation.

This slate of additional recommendations, however, has undergone a litmus test to determine if the improvement contained merit, and if it is feasible to implement from an engineering perspective. To determine the extent of an improvement's impact on the region's rail network, and to quantify the associated public and private benefits that may be attained, each improvement must undergo the scrutiny of testing via the Rail Traffic Controller simulation model as well as TTI's Grade Crossing Impedance Model. These improvements need to undergo an independent benefit analysis so that quantifiable measurements of public and private benefits can be ascertained utilizing traffic flow data that is representative of the time of the analysis.

Section 8: Identified Improvements

The potential improvements listed in the RTC planning cases as well as additional improvements as determined from the *Harris County Regional Freight Rail Improvement Plan*, the *BNSF - UPRR Houston Area Rail Infrastructure and Operating Plan*, and research conducted by the Texas Transportation Institute (TTI), have been organized by railroad subdivision and are described in the following section. Figures 8-1 and 8-2 show the location of each subdivision within the Houston region.

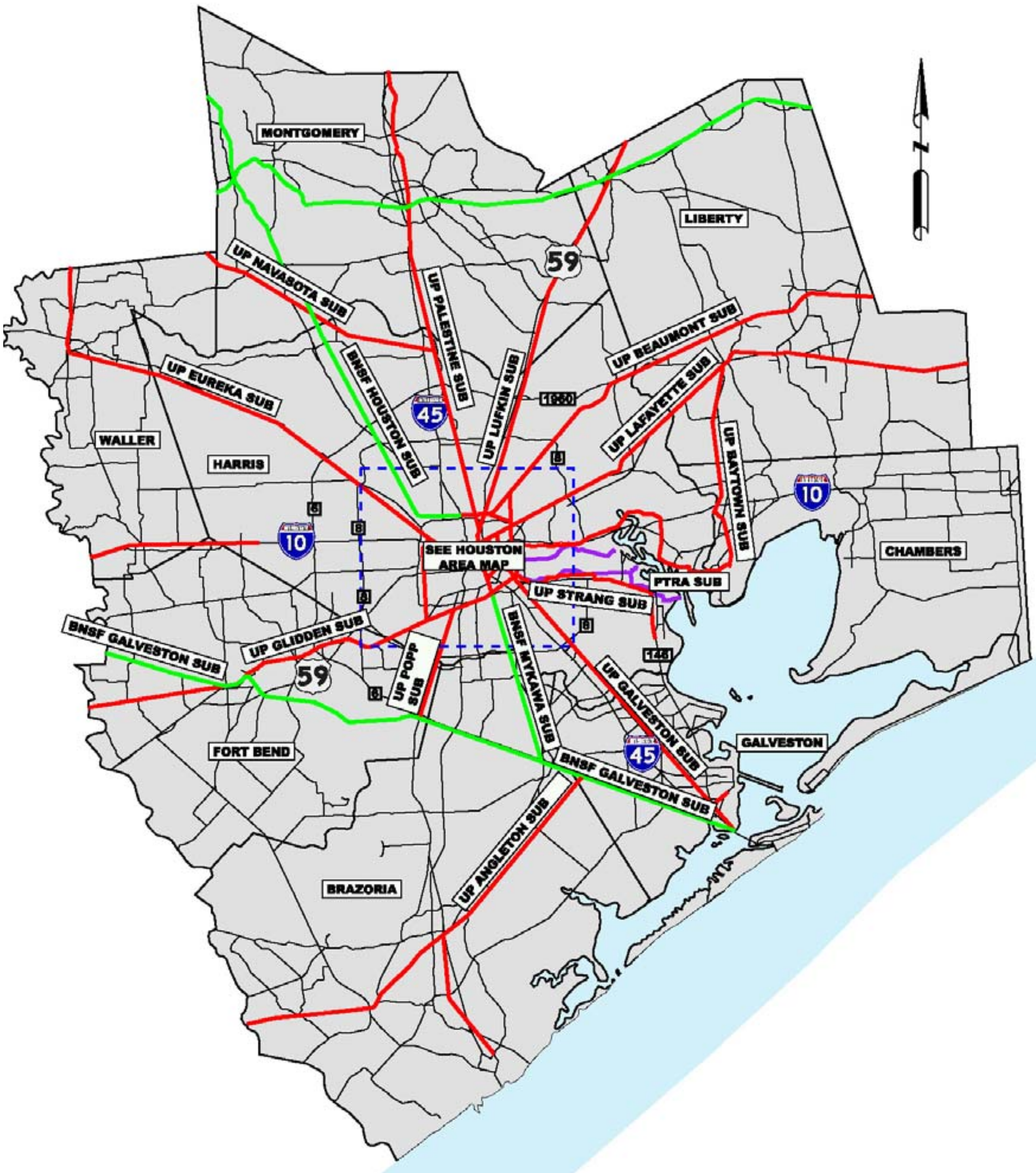


Figure 8-1: Overall Study Area Map

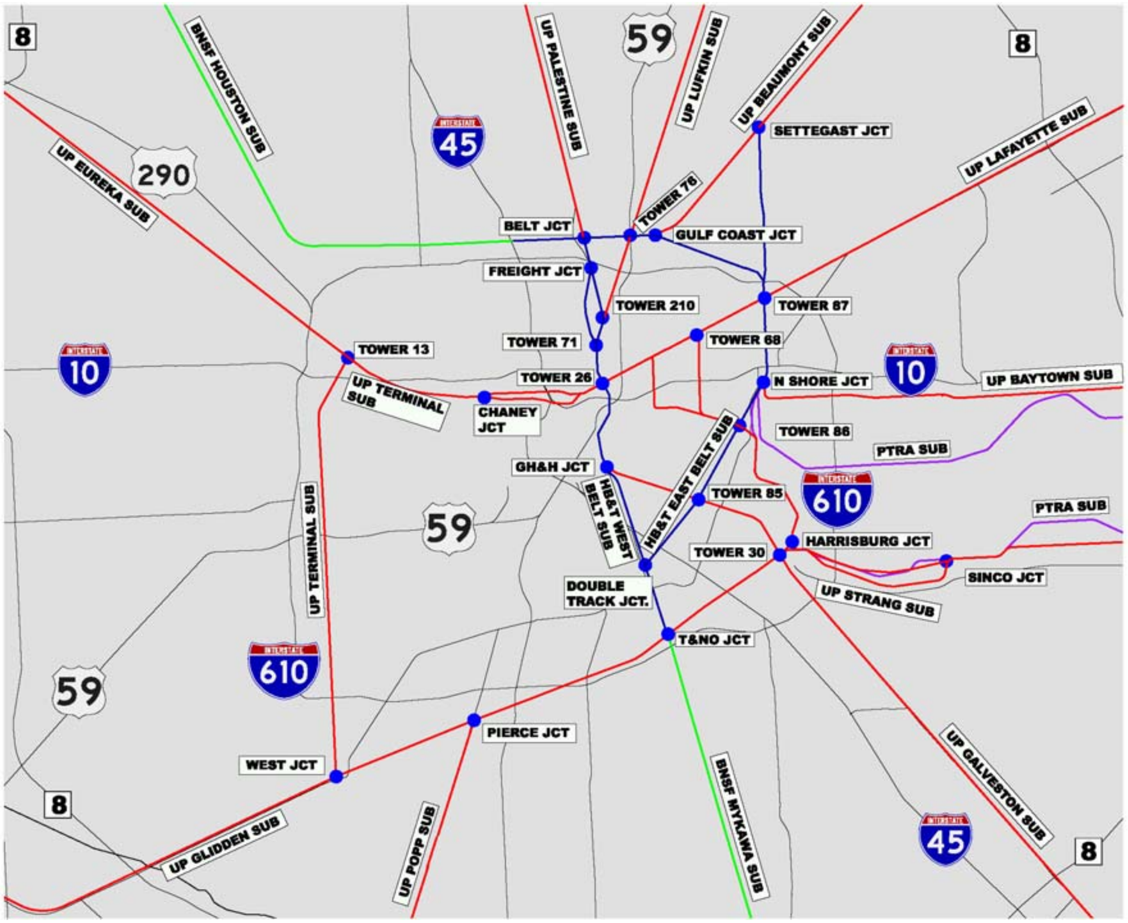


Figure 8-2: Houston Area Map

Figures 8-3 through 8-19 located throughout Section 8 show maps of the railroad subdivisions in the region. The improvements identified for each subdivision are listed in Tables 8-1 through 8-17 located throughout Section 8 along with their estimated costs, estimated public benefits, and improvement classification levels (near-, mid-, or long-range). A detailed discussion of each identified improvement is also included in the following section.

UPRR Baytown Subdivision

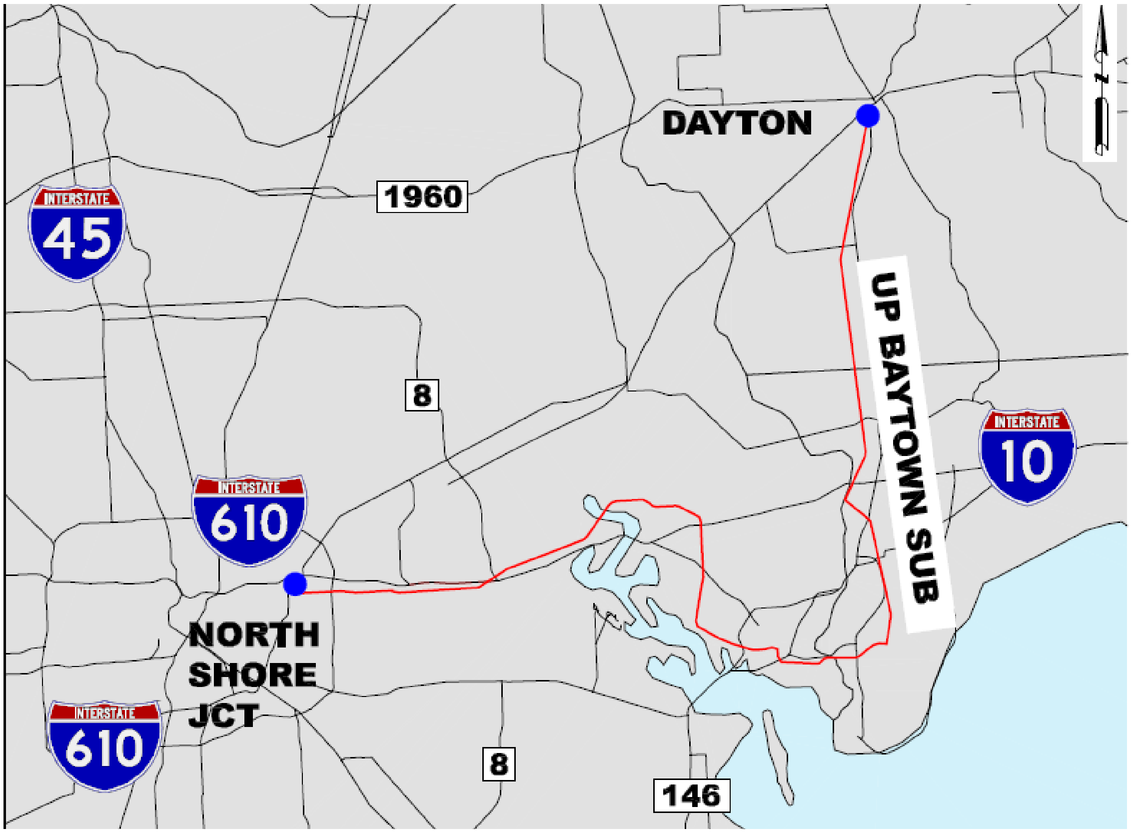


Figure 8-3: UPRR Baytown Subdivision Map

The UPRR Baytown Subdivision is a predominately single track railroad that runs between Baytown and Dayton, Texas. Rail traffic on the subdivision is bidirectional, with an average daily train count of 10 to 20 trains, most of which provide service to the local industries located on this line. The BNSF has authority to operate its trains on the Baytown Subdivision from Dayton to just west of Baytown and has a rail yard just south of Dayton and west of the Sjolander plastics storage facility. Typically, the BNSF traffic runs against the normal flow at times during the day in which they do not pose a conflict to normal operations.

The Baytown Subdivision contains more than 20 industrial sidings or spur tracks allowing the railroads to serve the many petrochemical companies such as Exxon, Chevron, and Amoco. Due to the large volume of train traffic serving the local industries, instances occur where non-industry serving train traffic is delayed during the performance of normal customer service work.

The only potential improvement identified for the Baytown Subdivision is the addition of a second mainline from Baytown to Dayton as shown in Table 8-1.

Baytown Subdivision				
Line Capacity Enhancements	**Improvement Classification Level**	**Estimated Cost**	**Estimated Public Benefit****	**Ratio: Benefit/Cost**
Second Main: Baytown to Dayton	4	$ 137,000,000	NA	NA
**No public benefits of individual rail improvements were identified.				
Class 4 Improvements (Rail Capacity Additions)		$ 137,000,000	NA	NA
Total Identified Improvements		$ 137,000,000	NA	NA

Table 8-1: Baytown Subdivision Improvements

Additional improvements along the Baytown Subdivision that have been identified by the *Harris County Regional Freight Rail Improvement Plan* include the construction of a new rail corridor containing dual tunnels beneath the Houston Ship Channel between Baytown and La Porte as well as grade separation of the following crossings: FM 1413, CR 479, FM 1942, Winfred Road, Needlepoint Road, FM 565, Spur 55 (Rice Farm Road), FM 1405 (Cedar Bayou – Bayshore Road), and FM 2354 (Tri-Cities Beach Road). The estimated cost of the tunnel route beneath the Ship Channel and the above listed grade separations as determined in the *Harris County Regional Freight Rail Improvement Plan* is approximately $1.4 billion. These improvements have not been included in the cost estimates for the Baytown Subdivision in this report, and may warrant further analysis.

Rail Capacity Enhancements

<u>Addition of a Second Mainline from Baytown to Dayton</u>

Adding tracks will allow the service of the customer base to continue without occupying the main track, staging tracks, or work leads on portions of the Baytown Subdivision. A second main track may reduce the interference on the first main track by providing bypass capability, and support the continued chemical traffic growth experienced along this segment. The addition of a second track along the Baytown Subdivision is illustrated in Figures A-1 through A-4 in Appendix F.

The second mainline is estimated to cost $137,000,000 and is classified as a level 4 long-range improvement, and should undergo further testing to determine the extent of the improvement's impact on the region's rail network, and to quantify the associated public and private benefits that may be attained.

UPRR Beaumont Subdivision

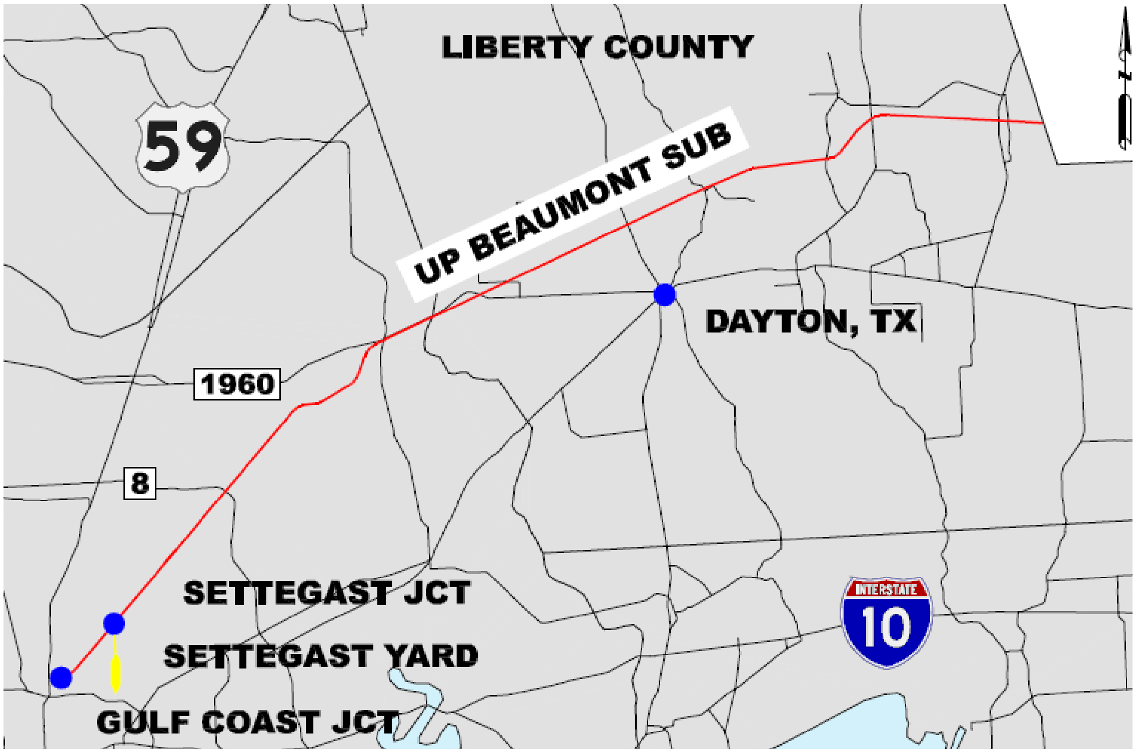


Figure 8-4: UPRR Beaumont Subdivision Map

The Beaumont Subdivision is owned by UPRR and runs from Houston, Texas to Livonia, Louisiana and is a predominately single track railroad with limited sidings, normally utilized in a directional manner for eastbound traffic, and averaging around 60 to 70 trains daily near downtown Houston and 15 to 20 trains daily in outlying areas.

Currently, there is a single mainline track from Gulf Coast Junction to Settegast Junction located in northeast Houston, turning into a double main line from Settegast Junction continuing north for approximately three miles to Dyersdale. Through traffic eastbound from Gulf Coast Junction gets caught into the mix with train traffic heading to/from Settegast Yard.

The existing single mainline of the Beaumont Subdivision is shown in Photos 8-1 and 8-2 at the crossing with Lockwood Drive.

Photo 8-1: Beaumont Subdivision at Lockwood Drive (looking east)

Photo 8-2: Beaumont Subdivision at Lockwood Drive (looking west)

The only potential improvement identified for the UPRR Beaumont Subdivision is the addition of a second mainline from Gulf Coast Junction to Settegast Junction as shown in Table 8-2.

Beaumont Subdivision				
Line Capacity Enhancements	**Improvement Classification Level**	**Estimated Cost**	**Estimated Public Benefit****	**Ratio: Benefit/Cost**
Second Main: Gulf Coast Jct. to Settegast Jct.	2	$ 20,000,000	NA	NA
**No public benefits of individual rail improvements were identified.				
Class 2 Improvements (Mid-range Improvements)		$ 20,000,000	NA	NA
Total Identified Improvements		$ 20,000,000	NA	NA

Table 8-2: Beaumont Subdivision Improvements

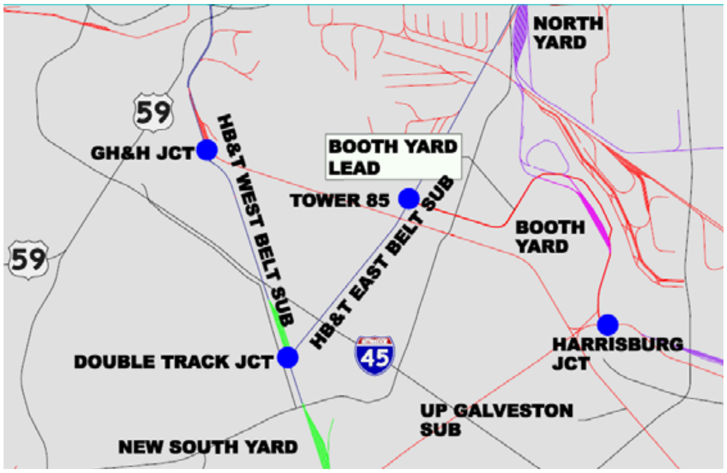
Rail Capacity Enhancements

<u>Addition of a Second Mainline from Gulf Coast Junction to Settegast Junction</u>

Constructing a second mainline track will allow for the separation of through-freight train and yard movements, and the reduction of train conflicts over the Gulf Coast Junction to Settegast Junction line segment.

The addition of a second mainline from Gulf Coast Junction to Settegast Junction, as shown in Figure B-1 in Appendix F, is estimated to cost $20,000,000 and is classified as a level 2 improvement, meaning that the improvement is a mid-range railroad improvement. However, the improvement should undergo further testing to determine the extent of the improvement's impact on the region's rail network, and to quantify the associated public and private benefits that may be attained.

Booth Yard Lead



The Booth Yard Lead is a nearly two mile line track segment southeast of downtown Houston that runs between Tower 85 on the East Belt Subdivision and Booth Yard on the Strang Subdivision.

The Booth Yard Lead is used by UPRR trains running between Basin Yard on the East Belt Subdivision and Booth Yard on the Strang Subdivision. The Booth Yard Lead is approximately two miles in length, and contains nearly 20 at-grade crossings. Closing or grade separating all of the crossings along this segment would not be warranted by the benefits.

Removing the Booth Yard Lead from service may be a potential improvement that would improve public safety in the area. Removing the lead would require relocating the operations at Booth Yard to an alternate location, possibly to Basin Yard. This improvement would require further analysis to determine the impacts to the UPRR and the cost to implement the improvement as well as any private and public benefits that would be seen resulting from the improvement.

Houston East Belt Subdivision

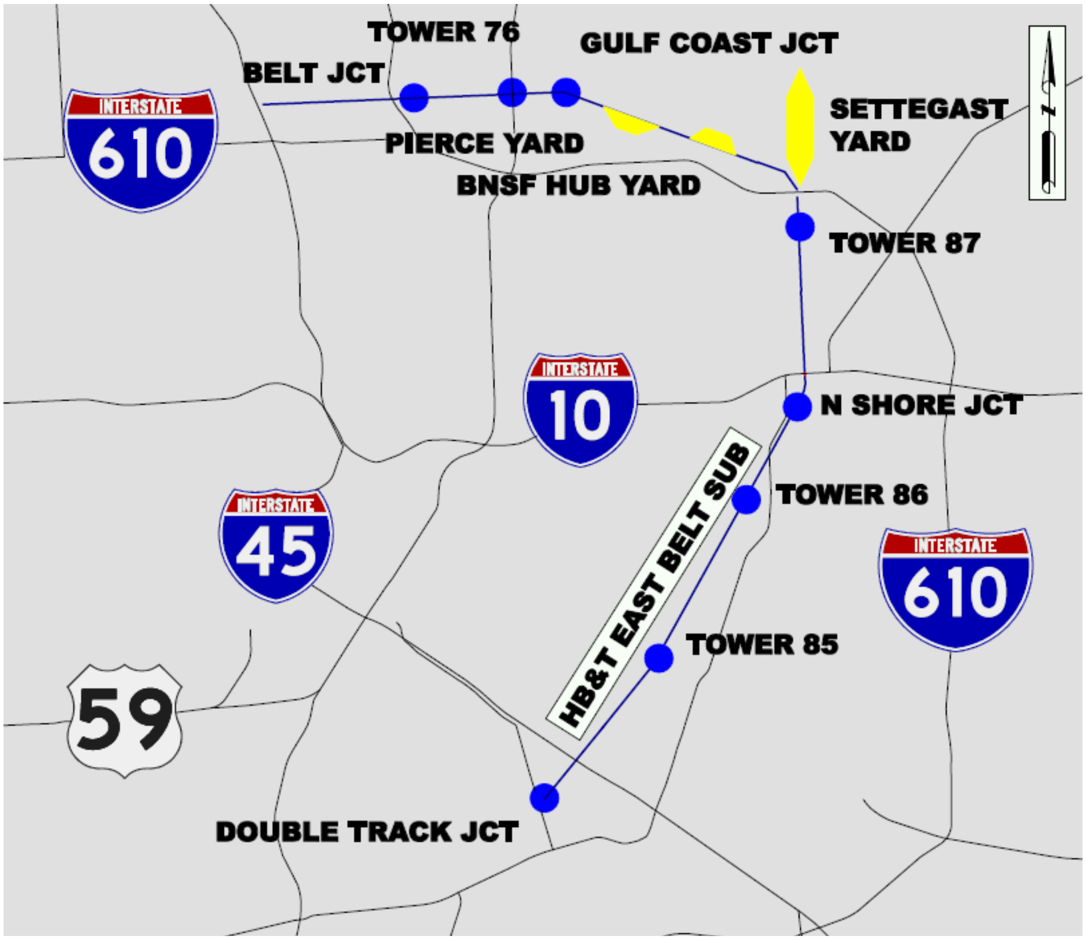


Figure 8-5: Houston East Belt Subdivision Map

The Houston East Belt Subdivision runs through central Houston and is a double track mainline railroad with frequent locations where a train can cross over from one track to another.

The railroad is utilized in a bidirectional manner, with trains dispatched to operate in both directions, averaging between 80 and 90 trains daily, depending upon location. There are numerous sidings, industrial tracks, and yards along this rail line, which is the primary route for access to Settegast Yard from the south.

Potential improvements along the East Belt Subdivision include five potential grade separations, eight potential crossing closures, two potential pedestrian bridge crossings, and four rail capacity enhancements. Table 8-3 identifies the crossings that have been analyzed for grade separation or closure, as well as the rail capacity enhancements and their associated costs.

Houston East Belt Subdivision

East Belt Subdivision						
Grade Separations	**Improvement Classification Level**	**Estimated Cost**	**Estimated 10-year Public Benefit**	**Ratio: Benefit/ Cost**	**Estimated 20-year Public Benefit**	**Ratio: Benefit/ Cost**
Canal	3	$ 11,000,000	$ 1,900,000	0.17	$ 5,000,000	0.45
Harrisburg	3	$ 14,000,000	$ 3,500,000	0.25	$ 9,500,000	0.68
Hirsch	3	$ 6,100,000	$ 1,600,000	0.26	$ 4,500,000	0.74
Lyons	3	$ 6,700,000	$ 1,000,000	0.15	$ 2,800,000	0.42
Wallisville	3	$ 8,200,000	$ 2,900,000	0.35	$ 7,700,000	0.94
Crossing Closures	**Improvement Classification Level**	**Estimated Cost**	**Estimated 10-year Public Benefit***	**Ratio: Benefit/ Cost**	**Estimated 20-year Public Benefit***	**Ratio: Benefit/ Cost**
Bell	3	$ 50,000	NA	NA	NA	NA
Brady	3	$ 50,000	$ 100,000	2	$ 210,000	4.20
Jefferson	3	$ 50,000	NA	NA	NA	NA
Kirkpatrick	3	$ 50,000	NA	NA	NA	NA
Leeland	3	$ 50,000	NA	NA	NA	NA
Market (Closure with Pedestrian Bridge)	3	$ 450,000	$ 830,000	1.84	$ 2,100,000	4.67
Pease	3	$ 50,000	NA	NA	NA	NA
Sherman (Closure with Pedestrian Bridge)	3	$ 450,000	$ 65,000	0.14	$ 150,000	0.33
Line Capacity Enhancements	**Improvement Classification Level**	**Estimated Cost**	**Estimated 10-year Public Benefit****	**Ratio: Benefit/ Cost**	**Estimated 20-year Public Benefit****	**Ratio: Benefit/ Cost**
Wye at Tower 76	1	$ 2,800,000	NA	NA	NA	NA
Second Mainline at Bridge 16	1	$ 9,600,000	NA	NA	NA	NA
Yard	1	$ 6,300,000	NA	NA	NA	NA
Lengthen tracks at Pierce Yard	2	$ 15,000,000	NA	NA	NA	NA
*Public benefit could only be estimated for crossing closures which would be rerouted to a grade separated crossing. However, all crossing closures produce a public benefit of improved safety.						
**No public benefits of individual rail improvements were identified.						
Class 1 Improvements (Near-term Improveme		$ 18,700,000	NA	NA	NA	NA
Class 2 Improvements (Mid-range Improveme		$ 15,000,000	NA	NA	NA	NA
Class 3 Improvements (Separations/Closures		$ 47,200,000	$ 11,895,000	0.25	$ 31,960,000	0.68
Total Identified Improvements		$ 80,900,000	$ 11,895,000	0.15	$ 31,960,000	0.40

Table 8-3: East Belt Subdivision Improvements

An additional improvement not included in Table 8-3 along the East Belt Subdivision that has been identified by the *Harris County Regional Freight Rail Improvement Plan* is the grade separation of Liberty Road (near Wayside Drive). Liberty Road crosses the East Belt Subdivision at the east end of Englewood Yard, south of Settegast Yard, and northeast of downtown Houston.

A grade separation of this crossing may also impact the existing Wayside Drive overpass located directly above Liberty Road, as well as the waterway crossed by Liberty Road just southwest of the railroad crossing.

Due to the two above mentioned constraints, the Liberty Road grade separation would need to be constructed as an overpass above the existing Wayside Drive overpass. At-grade access roads with a u-turn loop beneath the overpass would also be required to maintain access for adjacent properties. The expense of this high level overpass with at-grade access roads may not be warranted by the traffic volume experienced at the crossing. Approximately 4,000 daily vehicles cross the railroad at this location; however, many of these vehicles are freight trucks gaining access into and out of the existing intermodal facilities.

This crossing has not been included in the cost estimates for the East Belt Subdivision in this report, and would require further analysis on the traffic flows for the crossing to determine the validity of the grade separation.

Grade Separations

<u>Grade Separation of Canal St on the East Belt Subdivision</u>

Canal Street is currently a four-lane roadway that crosses the railroad at-grade in Harris County in the eastern portion of the city of Houston. Approximately 10,500 vehicles, including METRO buses, cross the railroad at this location daily. The identified four-lane roadway overpass would improve public safety by separating vehicular traffic from the East Belt Subdivision. According to collision data received from the H-GAC Traffic Safety Program and the FRA, one crash occurred at the Canal Street crossing between 1990 and 2003.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure C-1 of Appendix F, while the environmental constraints are identified in the Downtown Subdivisions Constraints Map on sheet 27 of 39 located in Appendix E. Some of the environmental constraints located in the vicinity of Canal Street are leaking petroleum storage tanks, schools, and cemeteries. A METRO bus route also runs along Canal Street at this location. Access to adjacent properties will be maintained via access roads alongside the main roadway along with at-grade u-turns located beneath the overpass on each side of the railroad. Right-of-way acquisition of the adjacent residential and industrial properties accounts for nearly 45 percent of the estimated construction cost of this grade separation.

The grade separation of Canal Street is estimated to cost $11,000,000 with an estimated public benefit of $1,900,000 over a 10 year period and $5,000,000 over a 20 year period, which account for approximately 17 percent and 45 percent of the estimated cost of construction, respectively.

Grade Separation of Harrisburg Blvd on the East Belt Subdivision

Harrisburg Boulevard is currently a four-lane roadway that crosses a double track segment of the railroad at-grade in Harris County in the eastern portion of the city of Houston. Approximately 14,900 vehicles including METRO buses cross the railroad at this location daily. The identified four-lane roadway overpass would separate vehicular traffic from the East Belt Subdivision. According to collision data received from the H-GAC Traffic Safety Program and the FRA, four crashes occurred at the Harrisburg Boulevard crossing between 1990 and 2003.

Photos 8-3 through 8-6 show the East Belt Subdivision at Harrisburg Boulevard under existing conditions. A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure C-2 in Appendix F, while the environmental constraints are identified in the Downtown Subdivisions Constraints Map on sheet 27 of 39 located in Appendix E. Some of the environmental constraints located in the vicinity of Harrisburg Boulevard are leaking petroleum storage tanks, schools, and cemeteries. A METRO bus route also runs along Harrisburg Boulevard at this location.

Access to adjacent properties will be maintained via access roads alongside the main roadway along with at-grade u-turns located beneath the overpass on each side of the railroad. Right-of-way acquisition of the adjacent residential and industrial properties accounts for nearly 50 percent of the estimated construction cost of this grade separation.

The grade separation of Harrisburg Boulevard is estimated to cost $14,000,000 with an estimated public benefit of $3,500,000 over a 10 year period and $9,500,000 over a 20 year period, which account for approximately 25 percent and 68 percent of the estimated cost of construction, respectively.

Photo 8-3: East Belt Subdivision at Harrisburg Boulevard (looking north)

Photo 8-4: East Belt Subdivision at Harrisburg Boulevard (looking south)

Photo 8-5: East Belt Subdivision at Harrisburg Boulevard (looking east)

Photo 8-6: East Belt Subdivision at Harrisburg Boulevard (looking west)

Grade Separation of Hirsch Rd on the East Belt Subdivision

Hirsch Road is currently a two-lane roadway that crosses the railroad at-grade near Gulf Coast Junction in Harris County in the city of Houston, located northeast of the US 59-Loop 610 intersection. Approximately 10,200 vehicles cross the railroad at this location daily. The identified two-lane roadway overpass would separate vehicular traffic from the East Belt Subdivision.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure C-3 in Appendix F, while the environmental constraints are identified in the Downtown Subdivisions Constraints Map on sheet 4 of 39 located in Appendix E. Some of the environmental constraints located in the vicinity of Hirsch Road are transmission lines and churches.

Access to adjacent properties will be maintained via access roads alongside the main roadway along with at-grade u-turns located beneath the overpass on each side of the railroad. Right-of-way acquisition of the adjacent residential and public and institutional properties accounts for approximately 18 percent of the estimated construction cost of this grade separation.

The grade separation of Hirsch Road is estimated to cost $6,100,000 with an estimated public benefit of $1,600,000 over a 10 year period and $4,500,000 over a 20 year period, which account for approximately 26 percent and 74 percent of the estimated cost of construction, respectively.

Grade Separation of Lyons Ave on the East Belt Subdivision

Lyons Avenue is currently a two-lane roadway that crosses the railroad at-grade in Harris County in the city of Houston, located east of the US-90 and I-10 (a.k.a. Wayside Drive) intersection. Approximately 7,100 vehicles cross the railroad at this location daily. The identified four-lane roadway overpass would separate vehicular traffic from the East Belt Subdivision. According to collision data received from the H-GAC Traffic Safety Program and the FRA, one crash occurred at the Lyons Avenue crossing between 1990 and 2003.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure C-4 in Appendix F, while the environmental constraints are identified in the Downtown Subdivisions Constraints Map on sheet 17 of 39 located in Appendix E.

Access to adjacent properties will be maintained via access roads alongside the main roadway along with at-grade u-turns located beneath the overpass on each side of the railroad. Right-of-way acquisition of the adjacent commercial and industrial properties accounts for approximately 15 percent of the estimated construction cost of this grade separation.

The grade separation of Lyons Avenue is estimated to cost $6,700,000 with an estimated public benefit of $1,000,000 over a 10 year period and $2,800,000 over a 20 year period, which account for approximately 15 percent and 42 percent of the estimated cost of construction, respectively.

Grade Separation of Wallisville Rd on the East Belt Subdivision

Wallisville Road is currently a two-lane roadway that crosses the railroad at-grade in Harris County in the city of Houston, located near the northeast corner of Loop 610. Approximately 2,600 vehicles cross the railroad at this location daily. The identified four-lane roadway overpass would separate vehicular traffic from the East Belt Subdivision.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure C-5 in Appendix F, while the environmental constraints are identified in the Downtown Subdivisions Constraints Map on sheet 12 of 39 located in Appendix E. Some of the environmental constraints located in the vicinity of Wallisville Road are a pipeline owned by Equilon Pipeline Company, LLC as well as the proximity of the floodplain. The preliminary layout of the overpass lies inside the 100 year flood zone.

Access to adjacent properties will be maintained via access roads alongside the main roadway along with at-grade u-turns located beneath the overpass on each side of the railroad. Right-of-way acquisition of the adjacent industrial and public/institutional properties accounts for approximately 11 percent of the estimated cost to implement this grade separation.

The grade separation of Wallisville Road is estimated to cost $8,200,000 with an estimated public benefit of $2,900,000 over a 10 year period and $7,700,000 over a 20 year period, which account for approximately 35 percent and 94 percent of the estimated cost of construction, respectively..

Crossing Closures

Crossing Closure/Pedestrian Bridge at Market St on the East Belt Subdivision

Market Street is currently a two-lane roadway that crosses the railroad at-grade in Harris County in Houston, located south of the US-90 and I-10 (a.k.a. Wayside Drive) intersection. Approximately 5,900 vehicles cross the railroad at this location daily. Market Street is identified to be closed and provided with a pedestrian bridge at the intersection with the East Belt Subdivision.

The proposed pedestrian bridge would be constructed over the railroad and separate pedestrian traffic from the East Belt Subdivision, reducing public safety hazards currently associated with the existing at-grade crossing. The pedestrian bridge would provide access for residents west of the tracks to the bus route stops and commercial/industrial complexes on the east side of the tracks.

The location of the potential crossing closure and pedestrian bridge as well as the alternative route and associated distance is identified in Figure C-6 in Appendix F, while the environmental constraints and adjacent property uses are identified in the Downtown Subdivisions Constraints Map on sheet 21 of 39 located in Appendix E. Some of the environmental constraints located in the vicinity of Market Street are a leaking petroleum storage tank and a fire station located a few blocks away.

A METRO bus route is located along Market Street at this location; however, the bus route does not currently cross the railroad and would not be affected by this crossing closure.

Access to adjacent properties will be maintained via the existing roadway network. Traffic may be rerouted to the adjacent roadway to the north on Lyons Avenue, which is included as a potential grade separation as part of this study. Right-of-way acquisition of the adjacent industrial and residential properties should be minimal, if required at all, since the pedestrian bridge should be able to be constructed within the existing right-of-way of Market Street.

The crossing closure at Market Street is estimated to cost $50,000, while the pedestrian bridge is estimated at $400,000. The estimated public benefit calculated for the closure of Market Street is $830,000 over a 10 year period and $2,100,000 over a 20 year period, which are nearly 85 percent greater and over four times greater than the estimated cost of implementing the crossing closure and pedestrian bridge, respectively.

Crossing Closure/Pedestrian Bridge at Sherman St on the East Belt Subdivision

Sherman Street is currently a two-lane roadway that crosses the railroad at-grade in Harris County in east Houston. Sherman Street is identified to be closed and provided with a pedestrian bridge at the intersection with the East Belt Subdivision.

The proposed pedestrian bridge would be constructed over the railroad and separate pedestrian traffic from the East Belt Subdivision, thereby reducing public safety hazards currently associated with the existing at-grade crossing. The pedestrian bridge will provide a safe access route to the school located on the east side of the railroad.

The location of the potential crossing closure and pedestrian bridge as well as the alternative route and associated distance is identified in Figure C-7 in Appendix F, while the environmental constraints and adjacent property uses are identified in the Downtown Subdivisions Constraints Map on sheet 27 of 39 located in Appendix E. Some of the environmental constraints located in the vicinity of Sherman Street consist of churches and a school.

Access to adjacent properties will be maintained via the existing roadway network. Traffic may be rerouted to adjacent roadways to the south on Harrisburg Boulevard, or to the north on Canal Street, both of which are included as potential grade separations as part of this study. Right-of-way acquisition of the adjacent residential properties should be minimal, if required at all, since the pedestrian bridge should be able to be constructed within the existing right-of-way of Sherman Street.

The crossing closure at Sherman Street is estimated to cost $50,000, while the pedestrian bridge is estimated at $400,000. The estimated public benefit calculated for the closure of Sherman Street is $65,000 over a 10 year period and $150,000 over a 20 year period, which are 14 percent greater and 33 percent greater than the estimated cost of implementing the crossing closure and pedestrian bridge, respectively.

Crossing Closures of Bell Street, Jefferson Street, Leeland Street, and Pease Street on the East Belt Subdivision

Bell, Jefferson, Leeland, and Pease Streets are currently two-lane roadways that cross the railroad at-grade in Harris County in southeast Houston. Approximately 4900 vehicles cross the double track railroad at Bell Street daily, while 280[4] vehicles cross at Jefferson Street, Leeland Street, and also at Pease Street daily. All four of these streets are identified to be closed at the intersection with the East Belt Subdivision in order to reduce public safety hazards currently associated with the existing at-grade crossings. According to collision data received from the H-GAC Traffic Safety Program and the FRA, two crashes occurred at the Bell Street crossing, and four crashes occurred at the Jefferson Street crossing between 1990 and 2003.

The locations of the potential crossing closures as well as the alternative routes and associated distances are identified in Figure C-8 in Appendix F, while the environmental constraints and adjacent property uses are identified in the Downtown Subdivisions Constraints Map on sheet 27 of 39 located in Appendix E. Environmental constraints located in the vicinity of these streets consist of leaking petroleum storage tanks located a few blocks to the north. Photos 8-7 and 8-8 show the East Belt Subdivision at Bell Street under existing conditions.

Access to adjacent properties will be maintained via the existing roadway network. Traffic may be rerouted to adjacent roadways to the south on Lawndale Street, or to the north on Polk Street. Right-of-way acquisition of the adjacent residential and industrial properties will not be required since no new construction is required.

The crossing closures are each estimated to cost $50,000. The estimated public benefit could not be calculated for these four closures since the traffic would be rerouted to other at-grade crossings; however, the closure would produce a safety benefit for the traveling public.

[4] Per TTI, this default value is used when AADT data is unavailable.

Photo 8-7: East Belt Subdivision at Bell Street (looking north)

Photo 8-8: East Belt Subdivision at Bell Street (looking south)

Crossing Closure of Brady Street on the East Belt Subdivision

Brady Street is currently a two-lane roadway that crosses the railroad at-grade in Harris County in northeast Houston. Brady Street is identified to be closed at the intersection with the East Belt Subdivision in order to reduce public safety hazards currently associated with the existing at-grade crossing. According to collision data received from H-GAC Traffic Safety Program and the FRA, one crash occurred at the Brady Street crossing between 1990 and 2003.

The location of the potential crossing closure as well as the alternative route and associated distance is identified in Figure C-7 in Appendix F, while the environmental constraints and adjacent property uses are identified in the Downtown Subdivisions Constraints Map on sheet 27 of 39 located in Appendix E. The environmental constraints located in the vicinity of this street consist of churches and a school.

Access to adjacent properties will be maintained via the existing roadway network. Traffic may be rerouted to adjacent roadways to the south on Harrisburg Boulevard, or to the north on Canal Street, both of which are included as potential grade separations as part of this study. Right-of-way acquisition of the adjacent properties will not be required since no new construction is required.

The crossing closure is estimated to cost $50,000. The estimated public benefit calculated for the closure of Brady Street is $100,000 over a 10 year period and $210,000 over a 20 year period, which are two times greater and over four times greater than the estimated cost of implementing the crossing closure, respectively..

Crossing Closure of Kirkpatrick Boulevard on the East Belt Subdivision

Kirkpatrick Boulevard is currently a two-lane roadway that crosses the railroad at-grade in Harris County in east Houston. Approximately 900 vehicles cross the railroad at this location daily. Kirkpatrick Boulevard is identified to be closed at the intersection with the East Belt Subdivision in order to reduce public safety hazards currently associated with the existing at-grade crossing. According to collision data received from the H-GAC Traffic Safety Program and the FRA, two crashes occurred at the Kirkpatrick Boulevard crossing between 1990 and 2003.

The location of the potential crossing closure as well as the alternative route and associated distance is identified in Figure C-9 in Appendix F, while the environmental constraints and adjacent property uses are identified in the Downtown Subdivisions Constraints Map on sheet 8 of 39 located in Appendix E. The environmental constraints located in the vicinity of this street consist of transmission lines, a pipeline, and the proximity of the 100 year floodplain.

Access to adjacent properties will be maintained via the existing roadway network. Traffic may be rerouted to adjacent roadways to the east on Wayside

Drive, or to the west on Homestead Road. Right-of-way acquisition of the adjacent properties will not be required since no new construction is required.

The crossing closure is estimated to cost $50,000. The estimated public benefit could not be calculated for this crossing closure since the traffic would be rerouted to other at-grade crossings; however, the closure would produce a safety benefit for the traveling public.

Rail Capacity Enhancements

Wye Connection Track between East Belt and Lufkin Subdivisions at Tower 76

Currently, there is no connection between the Lufkin Subdivision and the East Belt Subdivision at Tower 76, commonly called “the Rabbit Crossing”, which is located where the two rail lines intersect under US Hwy 59 just north of the Loop 610 interchange. The Lufkin Subdivision and the East Belt Subdivision mainlines intersect at-grade with a crossing diamond, which does not allow travel from one subdivision to the other at the intersection.

Trains destined for Englewood Yard from the west or the south at Tower 26 must travel either east to Tower 87 or north to Belt Junction to gain access into Settegast Yard. Constructing this wye track would provide an alternative route into Englewood yard, potentially reducing the congestion at other locations and improving the mobility of trains through the Houston terminal area.

The addition of a wye connection track at Tower 76, as shown in Figure C-10 in Appendix F, is estimated to cost $2,800,000 and is classified as a level 1 improvement, meaning that the improvement is a near-term railroad improvement. This improvement should undergo further testing to determine the extent of the improvement’s impact on the region’s rail network, and to quantify the associated public and private benefits that may be attained.

Addition of a Second Mainline over Buffalo Bayou (Bridge 16)

The existing single track bridge over Buffalo Bayou, as shown in Photo 8-9, is approximately 360 feet in overall length. The approaches at each end of the bridge consist of double track mainlines, making the single track bridge a chokepoint in the rail network on the East Belt Subdivision. Adding a second mainline would require the addition of a parallel railroad bridge over Buffalo Bayou to minimize the impact of this location on the movement of trains.

The addition of a bridge over Buffalo Bayou, as displayed in Figure C-11 in Appendix F, is estimated to cost $9,600,000 and is classified as a level 1 improvement, meaning that the improvement is a near-term railroad improvement. The addition of a second track at Bridge 16 was included in Planning Case 1 of the RTC freight operations modeling, which was discussed in further detail in Section 7.

Photo 8-9: East Belt Subdivision at Bridge 16 over Buffalo Bayou (looking south)

Expansion of Settegast Yard

Settegast Yard is a major railroad terminal in the Houston area where rail cars are classified (sorted) into trains that will serve the local industries, exchange with another railroad, or depart the Houston region for other parts of Texas or the country. Originally opened in June of 1950, the yard was built on 375 acres and was intended to act as a flat switching yard to fulfill the need for expanded facilities created by the fast-growing Texas Gulf Coast petrochemical industry. Since that time, the yard has grown in size and function, now incorporating service for intermodal traffic as well.

As a result of the large number of rail cars handled daily and the associated movements of trains through the yard, bypass tracks are frequently used for dispersing empty and loaded rail cars. At times, local freight trains with commodities for local delivery also occupy the bypass tracks, making the movement of non-stop trains through Settegast Yard difficult.

Constructing an approximate 9,000-foot passing siding track would permit trains destined for the Beaumont Subdivision via the East Belt Subdivision a dedicated route for movement, eliminating the need to keep a yard track clear for this activity. An extended trim lead from the south end of Settegast yard through Interstate Junction and east toward the Terminal Subdivision should also be constructed. These improvements could assist in the movement of 10 to 15 trains daily through Settegast Yard, while providing an alternative through route for trains that would normally pass through Tower 26 enroute to the Beaumont

Subdivision. This improvement may play an integral role in improving train mobility through the Houston Terminal.

In addition to the bypass track, a separate switching lead at South Settegast Yard toward Pierce Junction dedicated just to the switching trains on the east side of Settegast should be constructed. This additional lead doesn't entirely eliminate conflicts; there's no practical way to do that with the available land. However, it keeps the Settegast trains off the two main tracks of the East Belt; allowing many other trains and engines to make parallel and simultaneous moves.

The expansion of Settegast Yard, as illustrated in Figure C-12 in Appendix F, is estimated to cost $6,300,000 and is classified as a level 1 improvement, meaning that the improvement is a near-term railroad improvement. The expansion of Settegast Yard was included in Planning Case 1 of the RTC modeling, which was discussed in further detail in Section 7.

<u>Expansion of Pierce Yard</u>

Pierce Yard is located on the East Belt Subdivision near Settegast Yard and, along with the BNSF Hub Center, plays an important role in the location of rail cars and locomotives needed to properly work Settegast Yard. In the course of normal yard operations, trains are cut down to a certain length of rail cars, moved to a temporary location, switched onto the track to complete the make-up of a train, and then routed for delivery. In many instances, due to the length of the yard tracks approaching Pierce Yard, these trains occupy the mainline of the East Belt Subdivision and restrict the movement of mainline trains.

Extending the Pierce Yard tracks by approximately 2,500 feet toward the BNSF Hub Center Yard will essentially create a third mainline track in the area through Pierce Yard allowing for the continued bidirectional movement of trains on the East Belt Subdivision without having yard operations at Settegast Yard impact this movement. Homestead Road spans over the East Belt Subdivision in the area where this line expansion is identified, and, as a result, portions may require reconstruction if the alignment of the track extension cannot avoid the supporting structure of the Homestead Road overpass.

The expansion of Pierce Yard, as illustrated in Figure C-13 in Appendix F, is estimated to cost $15,000,000, and is classified as a level 2 improvement, meaning that the improvement is a mid-range railroad improvement. This improvement should undergo further testing to determine the extent of an improvement's impact on the region's rail network, and to quantify the associated public and private benefits that may be attained.

UPRR Freeport Subdivision

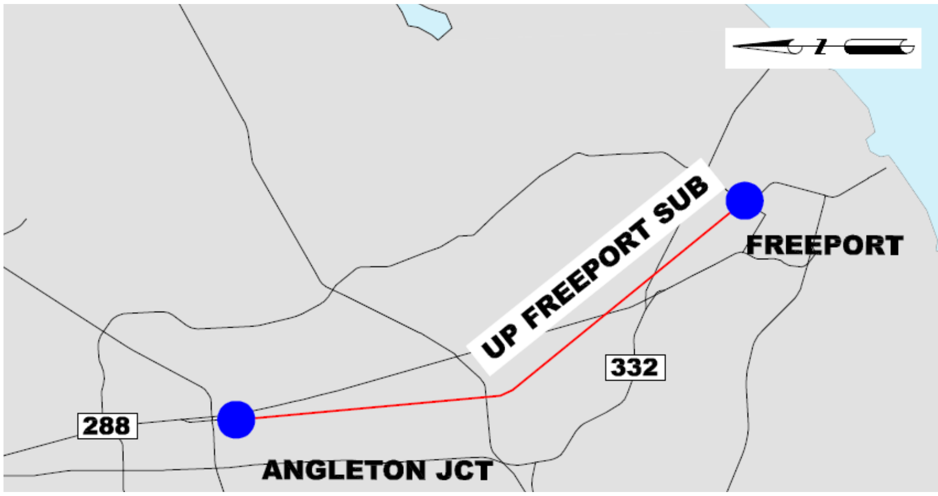


Figure 8-6: UPRR Freeport Subdivision Map

Consisting of approximately 17 miles of UPRR owned and operated track, the Freeport Subdivision and the Freeport Industrial Lead were constructed by the Velasco Terminal Railroad in the 1890's. The Freeport Subdivision parallels CR 288 with terminus points in Angleton and Lake Jackson where the Freeport Subdivision becomes the Freeport Industrial Lead and continues to the Port of Freeport. The train traffic on the subdivision consists primarily of petrochemical trains serving industries such as Dow Chemical. Trains are restricted to speeds between 10 and 20 miles per hour throughout the entire line segment. Since the Freeport Subdivision is primarily a bidirectional single track railroad with limited sidings, trains are not able to pass each other, and are customarily held in Angleton until the mainline is clear for additional train movement. Three potential rail capacity improvements have been identified for the Freeport Subdivision and are listed in Table 8-4 with associated costs.

Freeport Subdivision				
Line Capacity Enhancements	**Improvement Classification Level**	**Estimated Cost**	**Estimated Public Benefit****	**Ratio: Benefit/Cost**
Upgrade existing swingspan bridge	4	$ 15,000,000	NA	NA
Add dedicated sidings for DOW Chemical	4	$ 9,000,000	NA	NA
Add passing siding (10,000' length)	4	$ 8,600,000	NA	NA
**No public benefits of individual rail improvements were identified.				
Class 4 Improvements (Rail Capacity Additions)		$ 32,600,000	NA	NA
Total Identified Improvements		$ 32,600,000	NA	NA

Table 8-4: Freeport Subdivision Improvements

Rail Capacity Enhancements

Construction of a 10,000-foot Passing Siding

Constructing an approximate 10,000-foot siding between Angleton and the UPRR Hoskins Yard will create the ability for trains to meet and pass on the Freeport Subdivision, freeing up sidings or yard tracks in Angleton.

This improvement is estimated to cost $8,600,000 and is classified as a level 4 long range improvement and should undergo further testing to determine the extent of the improvement's impact on the region's rail network, and to quantify the associated public and private benefits that may be attained. A possible location for the 10,000-foot passing siding is shown in Figure D-1 in Appendix F.

Construction of Dedicated Sidings for DOW Chemical

Additionally, constructing dedicated siding tracks at the Dow Chemical Plant operations will allow Dow to perform their daily work duties without having railcars occupying the main track, which is currently the practice, allowing for the mainline to be kept open for movements to and from the Port of Freeport.

This improvement is estimated to cost $9,000,000 and is classified as a level 4 long-range improvement, and should undergo further testing to determine the extent of the improvement's impact on the region's rail network, and to quantify the associated public and private benefits that may be attained. The location of the DOW Chemical facility is shown in Figure D-2 in Appendix F.

Upgrade Existing Swing-Span Bridge

To better service the Port of Freeport, and to improve the operational reliability of the swing-span bridge crossing the navigable waterway (Brazos River), upgrading the structural and mechanical components of the bridge is essential.

This improvement is estimated to cost $15,000,000 and is classified as a level 4 long-range improvement, and should undergo further testing to determine the extent of the improvement's impact on the region's rail network, and to quantify the associated public and private benefits that may be attained. The location of the existing bridge to be upgraded is shown in Figure D-3 in Appendix F.

BNSF Galveston Subdivision

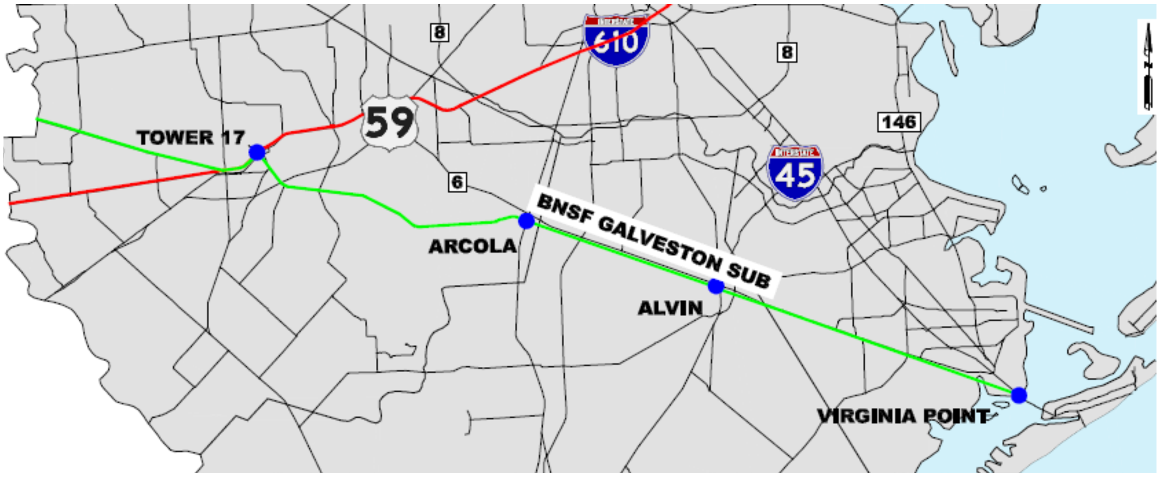


Figure 8-7: BNSF Galveston Subdivision Map

The BNSF Galveston Subdivision consists of approximately 216 miles of BNSF owned and operated track with terminus points at BNSF's West Yard in Galveston, Texas, and Temple, Texas. Approximately 80 miles of the Subdivision are located within the study area.

The BNSF Galveston Subdivision is predominantly a single-track railroad between Galveston and Tower 17 in Rosenberg. However, there are two main tracks between Algoa and Alvin, where the BNSF Mykawa Subdivision connects to the BNSF Galveston Subdivision. In addition to the second mainline, there are numerous sidings between Galveston and Rosenberg. The UPRR has the authority to operate trains over the BNSF Galveston Subdivision from Rosenberg to Algoa. The BNSF and UP operate 40 to 50 trains per day in a bidirectional manner, mainly between Rosenberg and Alvin.

Potential Improvements along the BNSF Galveston Subdivision include three potential grade separations, three potential crossing closures, and one rail capacity enhancement as listed in Table 8-5 with their associated costs.

BNSF Galveston Subdivision

Galveston (BNSF) Subdivision						
Grade Separations	**Improvement Classification Level**	**Estimated Cost**	**Estimated 10-year Public Benefit**	**Ratio: Benefit/ Cost**	**Estimated 20-year Public Benefit**	**Ratio: Benefit/ Cost**
FM 1640	3	$ 14,000,000	$ 1,900,000	0.14	$ 5,000,000	0.36
FM 2759/Crabb River	3	$ 13,000,000	$ 670,000	0.05	$ 1,600,000	0.12
FM 521	3	$ 6,400,000	$ 740,000	0.12	$ 1,900,000	0.30
Crossing Closures	**Improvement Classification Level**	**Estimated Cost**	**Estimated 10-year Public Benefit***	**Ratio: Benefit/ Cost**	**Estimated 20-year Public Benefit***	**Ratio: Benefit/ Cost**
Lamar	3	$ 50,000	NA	NA	NA	NA
FM 2977	3	$ 50,000	$ 1,400,000	28	$ 3,600,000	72
Benton	3	$ 50,000	$ 130,000	2.6	$ 330,000	7
Line Capacity Enhancements	**Improvement Classification Level**	**Estimated Cost**	**Estimated 10-year Public Benefit****	**Ratio: Benefit/ Cost**	**Estimated 20-year Public Benefit****	**Ratio: Benefit/ Cost**
Second Main: Rosenberg to Arcola	4	$ 174,000,000	NA	NA	NA	NA
*Public benefit could only be estimated for crossing closures which would be rerouted to a grade separated crossing. However, all crossing closures produce a public benefit of improved safety.						
**No public benefits of individual rail improvements were identified.						
Class 3 Improvements (Separations/Closures)		$ 33,550,000	$ 4,840,000	0.14	$ 12,430,000	0.37
Class 4 Improvements (Rail Capacity Additions)		$ 174,000,000	NA	NA	NA	NA
Total Identified Improvements		$ 207,550,000	$ 4,840,000	0.02	$ 12,430,000	0.06

Table 8-5: BNSF Galveston Subdivision Improvements

Grade Separations

Grade Separation of FM 1640 on the BNSF Galveston Subdivision

FM 1640 is currently a four-lane roadway that crosses the railroad at-grade in Fort Bend County near the city of Richmond. Approximately 5,400 daily vehicles cross the BNSF at this location. The identified four lane roadway overpass would intersect with Thompson Road and separate vehicular traffic from the BNSF Galveston Subdivision. In order to maintain grade separation of vehicular traffic from the railroad as well as connectivity between Thompson Road and FM 1640, Thompson Road is also identified as a four-lane roadway overpass. A preliminary layout of the overpass and the adjacent property land uses are identified in Figure E-1 in Appendix F.

Access to adjacent properties will be maintained via access roads alongside FM 1640 as well as Thompson Road along with at-grade u-turns located beneath the overpass on each side of the railroad. Right-of-way acquisition of the adjacent commercial properties accounts for approximately 16 percent of the estimated construction cost of this grade separation. Additional environmental constraints mapping may be required for further analysis.

The grade separation of FM 1640 is estimated to cost $14,000,000. The estimated public benefit calculated for the grade separation of FM 1640 is $1,900,000 over a 10 year period and $5,000,000 over a 20 year period, which account for approximately 14 percent and 36 percent of the estimated cost of construction, respectively..

Grade Separation of FM 2759 on the BNSF Galveston Subdivision

FM 2759 is currently a two lane roadway that crosses the railroad at-grade in Fort Bend County near the city of Booth. Approximately 1,600 daily vehicles cross the BNSF Railroad at this location. The identified two-lane roadway overpass would intersect with Thompson Road and separate vehicular traffic from the BNSF Galveston Subdivision.

In order to maintain grade separation of vehicular traffic from the railroad as well as connectivity between Thompson Road and FM 2759, Thompson Road is also identified as a two-lane roadway overpass. A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure E-2 in Appendix F. Additional environmental constraints mapping may be required for further analysis.

Access to adjacent properties will be maintained via access roads alongside FM 2759 as well as Thompson Road along with at-grade u-turns located beneath the overpass on each side of the railroad. Right-of-way acquisition of the adjacent residential properties accounts for approximately nine percent of the estimated construction cost of this grade separation.

The grade separation of FM 2759 is estimated to cost $13,000,000. The estimated public benefit calculated for the grade separation of FM 2759 is $670,000 over a 10 year period and $1,600,000 over a 20 year period, which account for approximately five percent and 12 percent of the estimated cost of construction, respectively.

Grade Separation of FM 521 on the BNSF Galveston Subdivision

FM 521 is currently a two-lane roadway that crosses the railroad at-grade in Fort Bend County near the city of Arcola. Approximately 11,900 daily vehicles cross the BNSF Railroad at this location. The identified two-lane roadway overpass would separate vehicular traffic from the BNSF Galveston Subdivision. The typical overpass bridge length was extended in order to maintain the grade separation and vertical clearance over the potential railroad connection in the NE quadrant of the FM 521/BNSF Galveston Subdivision intersection. A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure E-3 in Appendix F. Additional environmental constraints mapping may be required for further analysis.

Access to adjacent properties will be maintained via access roads alongside the main roadway along with at-grade u-turns beneath the overpass on each side of the railroad. Estimated right-of-way acquisition costs of the adjacent undeveloped properties are negligible when compared to the estimated construction cost of this grade separation.

The grade separation of FM 521 is estimated to cost $6,400,000. The estimated public benefit calculated for the grade separation of FM 521 is $740,000 over a 10 year period and $1,900,000 over a 20 year period, which account for approximately 12 percent and 30 percent of the estimated cost of construction, respectively..

Crossing Closures

Crossing Closure of Lamar Drive on the BNSF Galveston Subdivision

Lamar Drive is currently a two-lane roadway that crosses the railroad at-grade in Fort Bend County near the city of Rosenberg. Approximately 2,500 vehicles cross the BNSF at this location daily. Lamar Drive is identified to be closed at the intersection with the BNSF Galveston Subdivision in order to reduce public safety hazards currently associated with the existing at-grade crossing. The location of the potential crossing closure as well as the alternative route and associated distance is identified in Figure E-4 in Appendix F. Additional environmental constraints mapping may be required for further analysis.

Access to adjacent properties will be maintained via the existing roadway network and traffic may be rerouted to the east on US 90A or to the west to FM 1640 to cross the railroad. Right-of-way acquisition of the adjacent properties will not be required since no new construction is required.

The crossing closure is estimated to cost $50,000. The estimated public benefit could not be calculated for this crossing closure since the traffic would be rerouted to other at-grade crossings; however, the closure would produce a safety benefit for the traveling public.

Crossing Closure of FM 2977 on the BNSF Galveston Subdivision

FM 2977 is currently a two-lane roadway that crosses the railroad at-grade in Fort Bend County east of the city of Rosenberg. Approximately 3700 vehicles cross the BNSF at this location daily. FM 2977 is identified to be closed at the intersection with the BNSF Galveston Subdivision in order to reduce public safety hazards currently associated with the existing at-grade crossing. The location of the potential crossing closure as well as the alternative route and associated distance is identified in Figure E-5 in Appendix F.

Access to adjacent properties will be maintained via the existing roadway network. Traffic may be rerouted to the adjacent roadway to the east on US 59, which is a grade separated crossing. Right-of-way acquisition of the adjacent properties will not be required since no new construction is required. Additional environmental constraints mapping may be required for further analysis.

The crossing closure is estimated to cost $50,000. The estimated public benefit calculated for the crossing closure of FM 2977 is $1,400,000 over a 10 year period and $3,600,000 over a 20 year period, which are 28 times greater and 72 times greater than the estimated cost of implementing the crossing closure, respectively..

Crossing Closure of Benton Road on the BNSF Galveston Subdivision

Benton Road is currently a two-lane roadway that crosses the railroad at-grade in Fort Bend County east of the city of Rosenberg. Benton Road is identified to be closed at the intersection with the BNSF Galveston Subdivision in order to reduce public safety hazards currently associated with the existing at-grade crossing. The location of the potential crossing closure as well as the alternative route and associated distance is identified in Figure E-6 in Appendix F. Additional environmental constraints mapping may be required for further analysis.

Access to adjacent properties will be maintained via the existing roadway network. Traffic may be rerouted to the adjacent roadway to the east US 59, which is a grade separated crossing. Right-of-way acquisition of the adjacent properties will not be required since no new construction is required.

The crossing closure is estimated to cost $50,000. The estimated public benefit calculated for the crossing closure of Benton Road is $130,000 over a 10 year period and $330,000 over a 20 year period, which are more than two times greater and seven times greater than the estimated cost of implementing the crossing closure, respectively.

Rail Capacity Enhancements

Additional Mainline from Rosenberg to Arcola

Currently, the BNSF has the authority to operate trains on the UPRR Glidden Subdivision from Rosenberg to T&NO Junction (Tower 81), while the UPRR has the authority to operate trains on the BNSF Galveston Subdivision from Rosenberg to Algoa. Adding a second mainline track along the BNSF Galveston Subdivision between Rosenberg to Arcola would allow BNSF and UPRR trains to operate on either subdivision in a less congested manner and increase freight rail capacity.

A connection between the BNSF Galveston Subdivision and the Popp Subdivision would be required to facilitate this train movement and is included in the identified improvements for the Popp Subdivision.

In the event, that BNSF traffic would be relocated to alternative routes (see “New” Subdivision) and their existing carload switching operations at Pearland and New South Yard are relocated, upgrading the BNSF Galveston Subdivision as indicated may not warrant consideration.

Also, an alternative to upgrading both the BNSF Galveston Subdivision and the UPRR Glidden Subdivision would be to establish directional running on the Glidden and Galveston Subdivisions. Trains inbound to Houston would traverse the UPRR Glidden Subdivision, while trains outbound from Houston would traverse the BNSF Galveston Subdivision. With this alternative, upgrading the BNSF Galveston Subdivision as indicated also may not warrant consideration. These alternatives should undergo testing with the railroad operations simulation model that has been developed in RTC.

The estimate provided is for constructing an additional mainline for the BNSF Galveston Subdivision between Rosenberg and Arcola as shown in Figures E-7 through E-10 in Appendix F. The estimated cost of the addition of a second mainline along the BNSF Galveston Subdivision $174,000,000 and is classified as a level 4 long-range improvement. This improvement should undergo further testing to determine the extent of the improvement's impact on the region's rail network and to quantify the associated public and private benefits that may be attained.

UPRR Galveston Subdivision

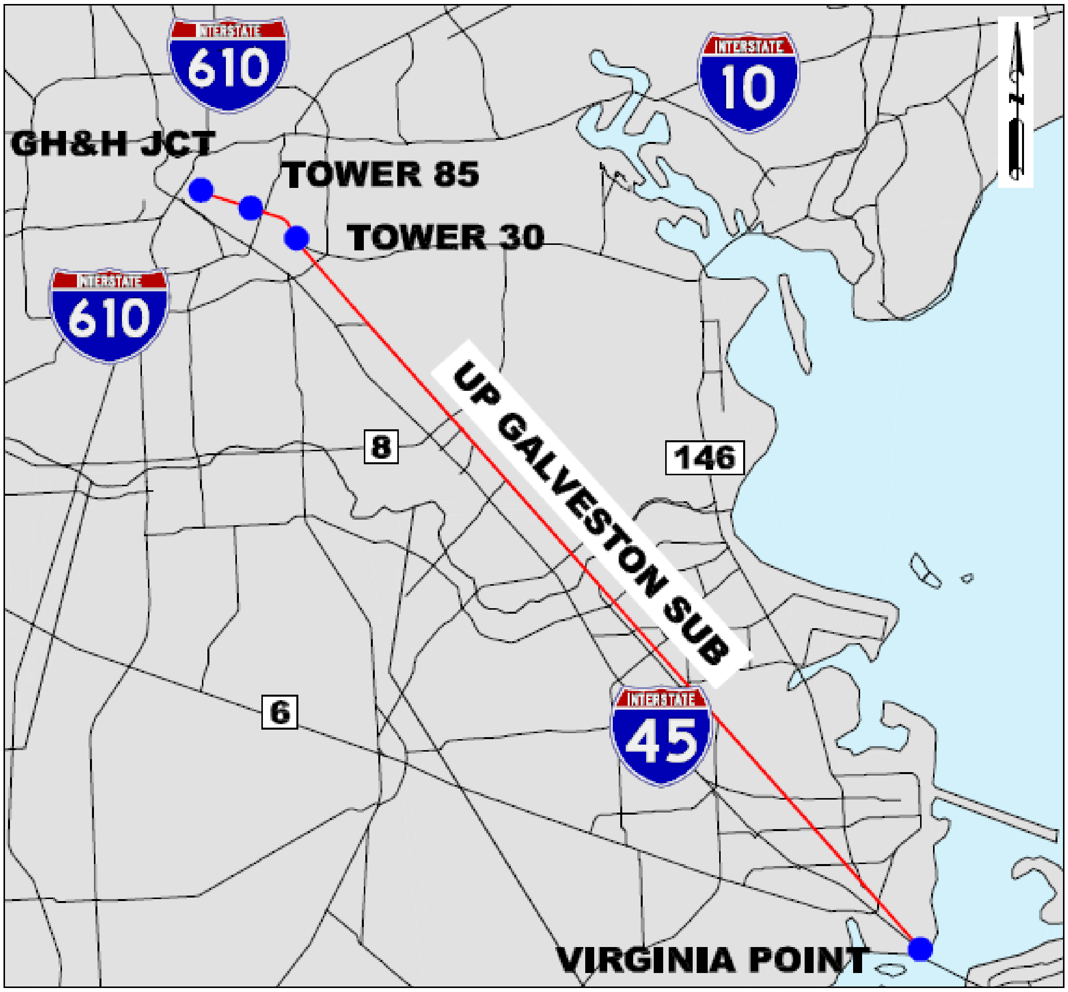


Figure 8-8: UPRR Galveston Subdivision Map

The UPRR Galveston Subdivision begins at South GH&H Junction, located in south Houston and essentially parallels IH 45 to Galveston. The UPRR Galveston Subdivision and the BNSF Galveston Subdivision jointly operate over a single track bridge spanning the Galveston Causeway accessing Galveston Island.

Predominantly a single track line with limited passing sidings, the rail line is used in a bidirectional manner and averages between 15 – 25 trains daily, mainly between GH&H Junction and Tower 30. Along the rail line there are numerous industrial tracks to service the customer base, in particular an interchange with the Texas City Terminal Railway Company in Texas City. Photos 8-10 and 8-11 show the UPRR Galveston Subdivision mainline at the crossing with Edgewood Street.

Photo 8-10: UPRR Galveston Subdivision at Edgewood Street (looking west)

Photo 8-11: UPRR Galveston Subdivision at Edgewood Street (looking east)

The potential improvements identified for the UPRR Galveston Subdivision include four grade separations, two crossing closures, and two rail capacity enhancements. The potential improvements and their associated costs are listed in Table 8-6.

Galveston (UPRR) Subdivision						
Grade Separations	**Improvement Classification Level**	**Estimated Cost**	**Estimated 10-year Public Benefit**	**Ratio: Benefit/ Cost**	**Estimated 20-year Public Benefit**	**Ratio: Benefit/ Cost**
Bay Area Blvd	3	$ 20,000,000	$ 9,800,000	0.49	$ 26,000,000	1.30
Broadway	3	$ 13,000,000	$ 1,800,000	0.14	$ 4,500,000	0.35
Lawndale	3	$ 18,000,000	$ 3,300,000	0.18	$ 8,500,000	0.47
Lockwood	3	$ 7,600,000	$ 1,100,000	0.14	$ 2,900,000	0.38
Crossing Closures	**Improvement Classification Level**	**Estimated Cost**	**Estimated 10-year Public Benefit***	**Ratio: Benefit/ Cost**	**Estimated 20-year Public Benefit***	**Ratio: Benefit/ Cost**
Bowie	3	$ 50,000	$ 280,000	5.60	$ 670,000	13.40
Edgewood	3	$ 50,000	NA	NA	NA	NA
Line Capacity Enhancements	**Improvement Classification Level**	**Estimated Cost**	**Estimated 10-year Public Benefit****	**Ratio: Benefit/ Cost**	**Estimated 20-year Public Benefit****	**Ratio: Benefit/ Cost**
Upgrade Track from GH&H Jct. to Tower 30 & Wye @ Twr 85	4	$ 5,000,000	NA	NA	NA	NA
*Public benefit could only be estimated for crossing closures which would be rerouted to a grade separated crossing. However, all crossing closures produce a public benefit of improved safety.						
**No public benefits of individual rail improvements were identified.						
Class 3 Improvements (Separations/Closures)		$ 58,700,000	$ 16,280,000	0.28	$ 42,570,000	0.73
Class 4 Improvements (Rail Capacity Additions)		$ 5,000,000	NA	NA	NA	NA
Total Identified Improvements		$ 63,700,000	$ 16,280,000	0.26	$ 42,570,000	0.67

Table 8-6: UPRR Galveston Subdivision Improvements

Grade Separations

Grade Separation of Bay Area Blvd on the UPRR Galveston Subdivision

Bay Area Boulevard is currently a six-lane roadway that crosses the railroad at-grade in southeast Harris County near the city of Webster. Approximately 57,900 daily vehicles cross the UPRR at this location. The identified six-lane roadway overpass would intersect with Galveston Road and separate vehicular traffic from the UPRR Galveston Subdivision. According to collision data received from the H-GAC Traffic Safety Program and the FRA, four crashes occurred at the Bay Area Boulevard crossing between 1990 and 2003.

In order to maintain grade separation of vehicular traffic from the railroad as well as connectivity between Galveston Road and Bay Area Boulevard, Galveston

Road is also identified as a four-lane roadway overpass. A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure F-1 in Appendix F. Additional environmental constraints mapping may be required for further analysis.

Access to adjacent properties will be maintained via access roads alongside Bay Area Boulevard as well as Galveston Road along with at-grade u-turns located beneath the overpass on each side of the railroad. Right-of-way acquisition of the adjacent commercial properties accounts for approximately 19 percent of the estimated cost to implement this grade separation.

The grade separation of Bay Area Boulevard is estimated to cost $20,000,000 with an estimated public benefit of $9,800,000 over a 10 year period and $26,000,000 over a 20 year period, which account for approximately 49 percent of the estimated cost of construction and 30 percent greater than the estimated cost of construction, respectively..

<u>Grade Separation of Broadway St on the UPRR Galveston Subdivision</u>

Broadway Street is currently a four-lane roadway that crosses the railroad at-grade in Harris County in the city of Houston, located just west of the 225-Loop 610 intersection. Approximately 14,700 daily vehicles cross the UPRR at this location. The identified four-lane roadway overpass would intersect with Galveston Road and separate vehicular traffic from the UPRR Galveston Subdivision. According to collision data received from the H-GAC Traffic Safety Program and the FRA, two crashes occurred at the Broadway Street crossing between 1990 and 2003.

In order to maintain grade separation of vehicular traffic from the railroad as well as connectivity between Galveston Road and Broadway Street, Galveston Road is also identified as a four lane roadway overpass. A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure F-2 in Appendix F. Additional environmental constraints mapping may be required for further analysis.

Access to adjacent properties will be maintained via access roads alongside Broadway Street as well as Galveston Road along with at-grade u-turns located beneath the overpass on each side of the railroad. Right-of-way acquisition of the adjacent commercial and school properties accounts for approximately 20 percent of the estimated cost to implement this grade separation.

The grade separation of Broadway Street is estimated to cost $13,000,000 with an estimated public benefit of $1,800,000 over a 10 year period and $4,500,000 over a 20 year period, which account for approximately 14 percent and 35 percent of the estimated cost of construction, respectively.

Grade Separation of Lawndale Street on the UPRR Galveston Subdivision

Lawndale Street is currently a four lane roadway that crosses the railroad at-grade in Harris County in the city of Houston. Approximately 24,100 daily vehicles cross the UPRR at this location. The identified four-lane roadway overpass would separate vehicular traffic from the UPRR Galveston Subdivision and the UPRR Glidden Subdivision. According to collision data received from the H-GAC Traffic Safety Program and the FRA, nine crashes occurred at the Lawndale Street crossing between 1990 and 2003.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure F-3 in Appendix F. Additional environmental constraints mapping may be required for further analysis. Right-of-way acquisition of the adjacent commercial, industrial, and residential properties accounts for approximately 14 percent of the estimated cost to implement this grade separation.

Access to adjacent properties west of the Glidden Subdivision will be maintained via access roads alongside Lawndale Street along with an at-grade u-turn located beneath the overpass on the west side of the railroad. The identified closure of the existing at-grade crossings of Lawndale and Evergreen Streets requires a reroute to 75th Street for traffic traveling in the north-south direction across the railroad. The Lawndale Street grade separation requires a new location to the north of the existing Lawndale Street. The new grade separation impacts commercial, industrial, and residential properties. Access to adjacent properties along Lawndale Street east of the Glidden Subdivision continues to be provided by the existing roadway network.

The grade separation of Lawndale Street is estimated to cost $18,000,000 with an estimated public benefit of $3,300,000 over a 10 year period and $8,500,000 over a 20 year period, which account for approximately 18 percent and 47 percent of the estimated cost of construction, respectively.

Grade Separation of Lockwood Dr on the UPRR Galveston Subdivision

Lockwood Drive is currently a four-lane roadway that crosses the railroad at-grade in Harris County in the city of Houston. Approximately 21,200 daily vehicles cross the UPRR at this location. The identified four lane roadway underpass would run beneath the railroad as well as Harrisburg Boulevard, separating vehicular traffic from the UPRR Galveston Subdivision. A preliminary layout of the underpass as well as the adjacent property land uses are identified in Figure F-4 in Appendix F. Additional environmental constraints mapping may be required for further analysis.

Access to adjacent properties will be maintained via at-grade access roads alongside Lockwood Drive along with an at-grade u-turn located above the underpass on the north side of the intersection of Lockwood Drive and

Harrisburg Boulevard. Harrisburg Boulevard would remain at-grade, meaning that traffic along Harrisburg Blvd would run above the traffic on Lockwood Drive.

Connectivity between Lockwood Drive and Harrisburg Boulevard would require traffic to reroute to other existing roadways. For example, traffic could reach Harrisburg Boulevard from Lockwood Drive by traveling east on Park Drive and north on Dumble Street to reach Harrisburg Boulevard. Another connection alternative would be to utilize Sherman Street, which intersects with Lockwood Drive, in conjunction with any of the north-south running roadways north of Harrisburg Boulevard.

Due to the identified closures of Walker Street, Rusk Street, Capitol Street, and Texas Avenue, adjacent properties south of Harrisburg Boulevard must acquire access to Lockwood Drive by means of either Park Drive or Harrisburg Boulevard.

The grade separation of Lockwood Drive is estimated to cost $7,600,000. Right-of-way acquisition of the adjacent commercial, industrial, and residential properties accounts for approximately 15 percent of the estimated cost to implement this grade separation. The estimated public benefit calculated for the grade separation of Lockwood Drive is $1,100,000 over a 10 year period and $2,900,000 over a 20 year period, which account for approximately 14 percent and 38 percent of the estimated cost of construction, respectively.

Crossing Closures

<u>Crossing Closure of Bowie St on the UPRR Galveston Subdivision</u>

Bowie Street is currently a two-lane roadway that crosses the railroad at-grade in Harris County in Houston. Approximately 2,100 vehicles cross the UPRR at this location daily. Bowie Street is identified to be closed at the intersection with the UPRR Galveston Subdivision in order to reduce public safety hazards currently associated with the existing at-grade crossing. The location of the potential crossing closure, the alternative route, and locations of nearby schools are identified in Figure F-5 in Appendix F.

Access to adjacent properties will be maintained via the existing roadway network and traffic may be rerouted to the north on Lawndale Street, which is included as a potential grade separation as part of this Study.

The crossing closure is estimated to cost $50,000. The estimated public benefit this crossing closure is $280,000 over a 10 year period, which is more than five times greater than the cost to implement the closure, and $670,000 over a 20 year period, which is more than 13 times greater than the implementation cost.

<u>Crossing Closure of Edgewood St on the UPRR Galveston Subdivision</u>

Edgewood Street is currently a two-lane roadway that crosses the railroad at-grade in Harris County in Houston. Edgewood Street is identified to be closed at the intersection with the UPRR Galveston Subdivision in order to reduce public safety hazards currently associated with the existing at-grade crossing. The location of the potential crossing closure as well as the alternative route and associated distance is identified in Figure F-6 in Appendix F.

Access to adjacent properties will be maintained via the existing roadway network and traffic may be rerouted to the east on Delmar or to the west to Dumble Street to cross the railroad. Right-of-way acquisition of the adjacent properties will not be required since no new construction is required.

The crossing closure is estimated to cost $50,000. The estimated public benefit could not be calculated for this crossing closure since the traffic would be rerouted to other at-grade crossings; however, the closure would produce a safety benefit for the traveling public.

Rail Capacity Enhancements

Upgrade Track and Signal from Tower 30 (Katy Neck) to GH&H Junction & Add Connection Track at SE Quadrant of Tower 85

Authorized track speeds on the UPRR Galveston Subdivision range from 20 to 35 miles per hour depending upon location. However, the segment from Tower 30 (Katy Neck) to GH&H Junction is limited to 20 mph. Upgrading the rail line between these two locations and installing a Centralized Traffic Control (CTC) signal system, along with implementing a connector from the UPRR Galveston Subdivision onto the East Belt Subdivision at Tower 85 will allow for the closer spacing of trains and establish the availability of alternative routes to Englewood and Settegast Yards for train movements from Galveston and the Strang Subdivision.

These improvements would coordinate with preliminary planning discussions in the region such as the possible use of the UPRR Galveston Subdivision for passenger rail service between Houston and Galveston. Additional regional discussions include a new agreement between the Ports of Houston and Galveston to join forces on expansion, which may mean more rail traffic from Galveston and/or Texas City on either the UPRR or BNSF Galveston Subdivisions. Photos 8-12 and 8-13 show the UPRR Galveston Subdivision at Tower 30 (the Katy Neck) under existing conditions.

The track and signal upgrades along the UPRR Galveston Subdivision, as shown in Figure F-7 in Appendix F, in addition to the construction of a connector track at Tower 85, as shown in Figure F-8 in Appendix F, are estimated to cost $5,000,000 and are classified as level 4 long-range improvements, and should undergo further testing to determine the extent of the improvement's impact on the region's rail network, and to quantify the associated public and private benefits that may be attained.

Photo 8-12: UPRR Galveston Subdivision at Katy Neck (Tower 30)

Photo 8-13: UPRR Galveston Subdivision at Katy Neck (Tower 30)

UPRR Glidden Subdivision

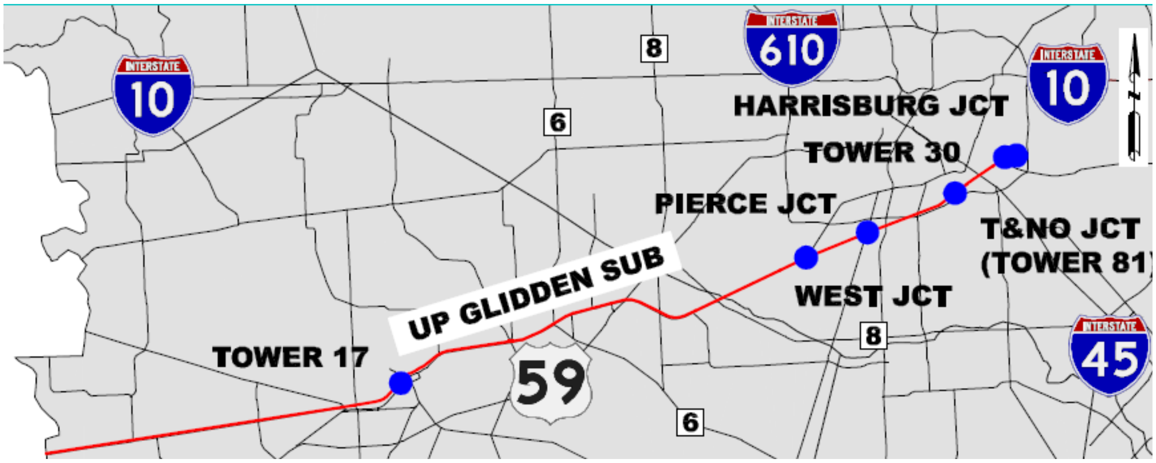


Figure 8-9: UPRR Glidden Subdivision Map

The UPRR Glidden Subdivision begins at Harrisburg Junction in Houston and terminates at the east end of Kirby Yard, which is east of San Antonio near Randolph Air Force Base. The Glidden Subdivision is over 210 miles in length; however, only approximately 50 miles are contained within the study area from Houston to Rosenberg. Within the study area, the subdivision is a single track railroad with passing sidings. A METRO test track runs parallel to the UPRR mainline from a location just east of Fannin Street toward the west for a distance of approximately 9,000 feet.

Rail traffic on the Glidden Subdivision is bidirectional with an average daily train count of approximately 30 - 40 trains. Amtrak's Sunset Limited, connecting Los Angeles to Orlando, operates along this route with three eastbound and three westbound trains weekly. The Glidden Subdivision is the main east-west route for the Union Pacific Railroad, connecting the Ports of Long Beach and Los Angeles to Houston, and Houston to New Orleans.

Due to the large volume of train traffic combined with the increasing volume of vehicular traffic, vehicular delays are typically experienced in Rosenberg, Richmond, Sugarland, Stafford, and Missouri City. The proximity of US 90A and the presence of numerous at-grade crossings increase the potential for hazards associated with the rail, vehicular, and pedestrian interface along this corridor.

UPRR Glidden Subdivision

The potential improvements identified for the UPRR Glidden Subdivision consist of 17 grade separations and 10 crossing closures which are listed with their associated costs in Table 8-7.

Glidden Subdivision						
Grade Separations	**Improvement Classification Level**	**Estimated Cost**	**Estimated 10-year Public Benefit**	**Ratio: Benefit/ Cost**	**Estimated 20-year Public Benefit**	**Ratio: Benefit/ Cost**
7th/8th Street	3	$ 5,000,000	Not existing x-ing	NA	Not existing x-ing	NA
Buffalo Speedway	3	$ 14,000,000	Proposed Rdwy.	NA	Proposed Rdwy.	NA
Chimney Rock	3	$ 17,000,000	$ 3,600,000	0.21	$ 8,100,000	0.48
Collins	3	$ 13,000,000	$ 2,600,000	0.20	$ 7,400,000	0.57
Dairy Ashford	3	$ 16,000,000	$ 6,300,000	0.39	$ 23,500,000	1.47
Eldridge	3	$ 21,000,000	$ 4,100,000	0.20	$ 11,900,000	0.57
Fannin	3	$ 19,000,000	$ 73,000	0.00	$ 158,000	0.01
FM 359	3	$ 11,000,000	$ 3,500,000	0.32	$ 10,400,000	0.95
Fondren	3	$ 20,000,000	$ 10,000,000	0.50	$ 37,500,000	1.88
Gessner	3	$ 17,000,000	$ 26,000,000	1.53	$ 76,000,000	4.47
Griggs/ Long/ Mykawa	3	$ 23,000,000	$ 4,700,000	0.20	$ 14,800,000	0.64
Harlem	3	$ 14,000,000	$ 2,600,000	0.19	$ 8,100,000	0.58
Hillcroft	3	$ 17,000,000	$ 3,700,000	0.22	$ 8,700,000	0.51
Kirby	3	$ 14,000,000	$ 160,000	0.01	$ 380,000	0.03
Kirkwood	3	$ 18,000,000	$ 12,000,000	0.67	$ 43,000,000	2.39
S Wayside	3	$ 17,000,000	$ 900,000	0.05	$ 2,300,000	0.14
Telephone	3	$ 18,000,000	$ 540,000	0.03	$ 1,200,000	0.07
Crossing Closures	**Improvement Classification Level**	**Estimated Cost**	**Estimated 10-year Public Benefit***	**Ratio: Benefit/ Cost**	**Estimated 20-year Public Benefit***	**Ratio: Benefit/ Cost**
Cravens	3	$ 50,000	$ 660,000	13.2	$ 1,500,000	30.0
Douglas/Morton	3	$ 50,000	$ 186,000	3.7	$ 380,000	7.6
Eighth	3	$ 50,000	NA	NA	NA	NA
Evergreen	3	$ 50,000	NA	NA	NA	NA
Fifth	3	$ 50,000	NA	NA	NA	NA
Fourth	3	$ 50,000	NA	NA	NA	NA
Haviland	3	$ 50,000	$ 97,000	2	$ 210,000	4
Richwood	3	$ 50,000	NA	NA	NA	NA
Sixth	3	$ 50,000	NA	NA	NA	NA
Third	3	$ 50,000	$ 532,000	10.6	$ 1,300,000	26.0
*Public benefit could only be estimated for crossing closures which would be rerouted to a grade separated crossing. However, all crossing closures produce a public benefit of improved safety.						
Class 3 Improvements (Separations/Closure		$ 274,500,000	$82,248,000	0.30	$256,828,000	0.94
Total Identified Improvements		$ 274,500,000	$ 82,248,000	0.30	$256,828,000	0.94

Table 8-7: Glidden Subdivision Improvements

Additional improvements for the Glidden Subdivision include a potential Fort Bend Bypass new corridor route or the addition of a second mainline along the

Glidden Subdivision from Rosenberg to West Junction. These improvements are not included in the cost estimates in Table 8-7, and are discussed in further detail in Section 9 of this report.

Other improvements along the Glidden Subdivision not included in the cost estimates included in this study were identified by the *Harris County Regional Freight Rail Improvement Plan,* including the grade separation of South 75th Street/Garland and the addition of a second mainline from Harrisburg Junction to Tower 81/T&NO Junction. Multiple crossings along the potential new rail corridor from Rosenberg to Arcola have also been identified as potential grade separations in the Harris County study. These improvements have not been included in the cost estimates for the Glidden Subdivision and may warrant further analysis.

Grade Separations

Grade Separation of 7th Street-8th Street on the Glidden Subdivision

7th Street and 8th Street are both currently two-lane roadways in the city of Rosenberg in Fort Bend County. The identified two-lane roadway overpass over the railroad would run from 7th to 8th Street and would separate vehicular traffic from the Glidden Subdivision mainline and the BNSF Galveston Subdivision mainline and passing siding. The overpass is being identified to provide an alternate route across the railroad, other than Houston Street, since 3rd Street is included as a potential crossing closure as part of this study.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure G-1 in Appendix F, while the environmental constraints are identified in the Glidden Subdivision Constraints Map on sheet 24 of 32 located in Appendix E. The environmental constraints located in the vicinity of these streets include multiple churches, a cemetery, a school, and a railroad museum.

Access to adjacent properties will be maintained via the existing roadway network. Access to 7th Street from Avenue E would be closed, and may be rerouted to the north on Avenue D. Access to 8th Street from Avenue F would also be closed, and may be rerouted to the south on Avenue G. Avenue F would also be reconfigured to cross beneath the overpass in order to maintain through traffic along the roadway. Right-of-way acquisition of the adjacent residential property and undeveloped properties accounts for approximately 20 percent of the estimated cost to implement this grade separation.

The grade separation of 7th Street and 8th Street is estimated to cost $5,000,000. The estimated public benefit could not be calculated for the grade separation of 7th Street and 8th Street since the roadways do not currently cross the railroad.

Grade Separation of Buffalo Speedway on the Glidden Subdivision

Buffalo Speedway is currently a four-lane roadway on the southwest side of Houston in Harris County that terminates at Bellfort Street and does not cross the Glidden Subdivision. However, a section of Buffalo Speedway that will cross the railroad has been proposed. The identified four-lane roadway overpass over the railroad would intersect with Holmes Road and separate vehicular traffic from the Glidden Subdivision mainline, passing siding, and METRO test track.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure G-2 in Appendix F, while the environmental constraints are identified in the Glidden Subdivision Constraints Map on sheet 24 of 32 located in Appendix E. The environmental constraints located in the vicinity of Buffalo Speedway include wetlands, oil and gas wells, a leaking petroleum storage tank, and industrial development.

Access to adjacent properties will be maintained via access roads alongside Holmes Road and Buffalo Speedway along with at-grade u-turns located beneath the overpass on each side of the crossing. Right-of-way acquisition of the adjacent industrial property and undeveloped properties accounts for approximately three percent of the estimated cost to implement this grade separation.

The grade separation of Buffalo Speedway is estimated to cost $14,000,000, not including the cost of extending the existing roadway to the railroad. The estimated public benefit could not be calculated for the grade separation of Buffalo Speedway as it is a proposed roadway and has no existing traffic crossing the railroad.

Grade Separation of Chimney Rock Rd on the Glidden Subdivision

Chimney Rock Road is currently a five-lane roadway that crosses the railroad at-grade in Harris County on the southwest side of Houston. Approximately 11,800 daily vehicles cross the UPRR at this location. The proposed four-lane roadway overpass would separate vehicular traffic from the UPRR Glidden Subdivision single mainline and would intersect with elevated ramps from US 90A. Chimney Rock Road currently terminates at US 90A, but is proposed to extend south as the Fort Bend Toll Road.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure G-3 in Appendix F, while the environmental constraints are identified in the Glidden Subdivision Constraints Map on sheet 20 of 32 located in Appendix E. The environmental constraints located in the vicinity of Chimney Rock Road include small wetlands areas, an oil and gas well, and a leaking petroleum storage tank.

Access to adjacent properties along Chimney Rock Road will be maintained via access roads alongside the main roadway along with at-grade u-turns located beneath the overpass on each side of the railroad. Access along US 90A remains the same, except for the entrance at Burdine Street, which must be relocated to the east to avoid the elevated ramps along US 90A and maintain an at-grade connection. Relocating the entrance of Burdine Street requires the construction of an access road at a location between the current entrance point and the relocated entrance. Right-of-way acquisition of the adjacent industrial property and undeveloped properties accounts for approximately six percent of the estimated cost to implement this grade separation.

The grade separation of Chimney Rock Road is estimated to cost $17,000,000 with an estimated public benefit of $3,600,000 over a 10 year period and $8,100,000 over a 20 year period, which account for approximately 21 percent and 48 percent of the estimated cost of construction, respectively.

<u>Grade Separation of Collins Road on the Glidden Subdivision</u>

Collins Road is currently a two-lane roadway that crosses the railroad at-grade in Fort Bend County in the city of Richmond. Approximately 11,800 daily vehicles cross the UPRR at this location. The identified four-lane roadway overpass would separate vehicular traffic from the UPRR Glidden Subdivision single mainline and would intersect with elevated ramps from US 90A.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure G-4 in Appendix F, while the environmental constraints are identified in the Glidden Subdivision Constraints Map on sheet 03 of 32 located in Appendix E. The environmental constraints located in the vicinity of Collins Road include commercial property and a hospital located just south of the railroad crossing.

Access to adjacent properties is maintained via an access road alongside Collins Road north of the railroad with an at-grade u-turn located beneath the overpass at the railroad, while access along US 90A will remain unchanged. Right-of-way acquisition of the adjacent properties accounts for approximately 13 percent of the estimated cost to implement the grade separation.

The grade separation of Collins Road is estimated to cost $13,000,000 with an estimated public benefit of $2,600,000 over a 10 year period and $7,400,000 over a 20 year period, which account for approximately 20 percent and 57 percent of the estimated cost of construction, respectively.

<u>Grade Separation of Dairy Ashford Road on the Glidden Subdivision</u>

Dairy Ashford Road is currently a four-lane roadway that crosses the railroad at-grade in Fort Bend County in the city of Sugarland. Approximately 20,800 daily vehicles cross the UPRR at this location. The identified four-lane roadway overpass would separate vehicular traffic from the UPRR Glidden Subdivision single mainline and would intersect with US 90A.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure G-5 in Appendix F, while the environmental constraints are identified in the Glidden Subdivision Constraints Map on sheet 13 of 32 located in Appendix E. The only constraints located in the vicinity of Dairy Ashford Road consist of adjacent commercial property.

Access to adjacent properties will be maintained via access roads alongside Dairy Ashford Road and US 90A along with at-grade u-turns located beneath the overpass on each side of the railroad. Right-of-way acquisition of the adjacent commercial properties accounts for approximately 14 percent of the estimated cost to implement this grade separation.

The grade separation of Dairy Ashford Road is estimated to cost $16,000,000 with an estimated public benefit of $6,300,000 over a 10 year period and $23,500,000 over a 20 year period, which account for approximately 39 percent of the estimated cost of construction and 47 percent greater than the construction cost, respectively.

<u>Grade Separation of Eldridge Road on the Glidden Subdivision</u>

Eldridge Road is currently a four-lane median divided roadway located in Sugarland in Fort Bend County. Approximately 13,600 daily vehicles cross the Glidden Subdivision at this location. The identified four-lane underpass under the railroad would connect with depressed ramps from US 90A, which will join with Eldridge Road under the westbound US 90A mainlanes, while the US 90A mainlanes continue at grade. According to collision data received from the H-GAC Traffic Safety Program and the FRA, five crashes occurred at the Eldridge Road crossing between 1990 and 2003. Photos 8-14 through 8-17 show the crossing of Eldridge Road with the UPRR mainline.

A preliminary layout of the underpass as well as the adjacent property land uses are identified in Figure G-6 in Appendix F, while the environmental constraints are identified in the Glidden Subdivision Constraints Map on sheet 12 of 32 located in Appendix E. The environmental constraints located in the vicinity of Eldridge Road include wetlands, residential properties, and a body of water located northwest and southeast of the crossing.

Access to adjacent properties will be maintained where access currently exists along Eldridge Road. Access along US 90A will remain the same as the main lanes will stay at-grade. Right-of-way acquisition of the adjacent commercial properties accounts for approximately 13 percent of the estimated cost to implement this grade separation.

The grade separation of Eldridge Road is estimated to cost $21,000,000 with an estimated public benefit of $4,100,000 over a 10 year period and $11,900,000 over a 20 year period, which account for approximately 20 percent and 57 percent of the estimated cost of construction, respectively.

Photo 8-14: Glidden Subdivision at Eldridge Road (looking north)

Photo 8-15: Glidden Subdivision at Eldridge Road (looking west)

Photo 8-16: Glidden Subdivision at Eldridge Road (looking east)

Photo 8-17: Glidden Subdivision at Eldridge Road (looking south at US90A)

Grade Separation of Fannin Street on the Glidden Subdivision

Fannin Street is currently a four-lane roadway on the southwest side of Houston in Harris County. Approximately 2,100 daily vehicles cross the Glidden Subdivision at this location. The identified four-lane overpass would separate vehicular traffic from the Glidden Subdivision mainline, passing siding, and METRO test track, and would intersect with elevated ramps from Holmes Road.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure G-7 in Appendix F, while the environmental constraints are identified in the Glidden Subdivision Constraints Map on sheet 25 of 32 located in Appendix E. The environmental constraints located in the vicinity of Fannin Street include small wetlands areas that should remain unaffected by the potential grade separation, oil and gas wells, and industrial development.

Access to adjacent properties will be maintained via access roads alongside Fannin Street along with at-grade u-turns located beneath the overpass on each side of the railroad. Access along Holmes Road will remain the same as the mainlanes and will stay at-grade. Right-of-way acquisition of the adjacent commercial properties accounts for approximately 16 percent of the estimated cost to implement this grade separation.

The grade separation of Fannin Street is estimated to cost $19,000,000 with an estimated public benefit of $73,000 over a 10 year period and $158,000 over a 20 year period, which account for less than one percent of the estimated cost of construction, respectively.. The public benefit is low when compared to other grade separations because of the low volume of trains that pass at this location daily. The low number of passing trains minimizes impact to vehicular delays and safety concerns at the crossing.

Grade Separation of FM 359 on the Glidden Subdivision

FM 359 is currently a two-lane roadway east of Richmond in Fort Bend County. Approximately 15,600 vehicles cross the Glidden Subdivision at this location daily. The identified two-lane overpass over the Glidden Subdivision single mainline would intersect with elevated ramps from US 90A.

Access to adjacent properties will be maintained via an access road alongside FM 359 on the north side of the railroad with an at-grade u-turn located beneath the overpass at the railroad, while access along US 90A will remain the same. Right-of-way acquisition of the adjacent residential properties accounts for less than two percent of the estimated cost to implement this grade separation since the majority of the potential construction is able to use existing right-of-way.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure G-8 in Appendix F, while the environmental constraints are identified in the Glidden Subdivision Constraints Map on sheet 5 of 32 located in Appendix E. The environmental constraints located in the vicinity of FM 359 include wetlands areas and adjacent residential properties.

The grade separation of FM 359 is estimated to cost $11,000,000 with an estimated public benefit of $3,500,000 over a 10 year period and $10,400,000 over a 20 year period, which account for approximately 32 percent and 95 percent of the estimated cost of construction, respectively.

Grade Separation of Fondren Road on the Glidden Subdivision

Fondren Road is currently a six-lane roadway on the southwest side of Houston in Harris County. Approximately 40,200 vehicles cross the railroad at this location daily. According to collision data received from H-GAC and the FRA, six crashes occurred at the Fondren Road crossing between 1990 and 2003.

The identified six-lane overpass over the Glidden Subdivision single mainline would intersect with elevated ramps from US 90A. The existing overpass for the mainlanes of US 90A, as shown in Photo 8-19, would be removed to allow the mainlanes to maintain through traffic at-grade without an intersection with Fondren Road. The mainlanes of US 90A would run beneath the identified Fondren Road overpass. The existing at-grade access roads, as shown in Photos 8-20 and 8-21, would be elevated to ramp up to the identified Fondren Road overpass.

Access along Fondren Road, as shown in Photos 8-18 and 8-19, to adjacent properties will be maintained via access roads alongside Fondren Road along with at-grade u-turns located beneath the overpass on each side of the railroad. Access along US 90A is currently provided by the at-grade access roads shown in Photos 8-20 and 8-21. This existing access along US 90A would be removed due to the proposed elevation of the access roads. The properties southwest of the intersection of Fondren Road and US 90A would maintain access via the existing roadway network south of US 90A. The properties southeast of the intersection would maintain access via an access road to be constructed south of the US 90A eastbound ramp. This access road would require the acquisition of right-of-way from the adjacent properties, which has been accounted for in the cost estimates.

Photo 8-18: Glidden Subdivision at Fondren Road (looking north)

Photo 8-19: Glidden Subdivision at Fondren Road (looking south)

Photo 8-20: Glidden Subdivision at Fondren Road (looking west)


Photo 8-21: Glidden Subdivision at Fondren Road (looking east)

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure G-9 in Appendix F, while the environmental constraints are identified in the Glidden Subdivision Constraints Map on sheet 19 of 32 located in Appendix E. The environmental constraints located in the vicinity of Fondren Road include residential, commercial, and industrial properties, a leaking petroleum storage tank, and churches located a couple of blocks away. Right-of-way acquisition of the adjacent residential, commercial, and industrial properties accounts for approximately 22 percent of the estimated cost to implement this grade separation.

The grade separation of Fondren Road is estimated to cost $20,000,000 with an estimated public benefit of $10,000,000 over a 10 year period and $37,500,000 over a 20 year period, which account for approximately 50 percent of the estimated cost of construction and 88 percent greater than the construction cost, respectively.

Grade Separation of Gessner Road on the Glidden Subdivision

Gessner Road is a four-lane roadway in Missouri City in Fort Bend County. Approximately 21,100 vehicles cross the Glidden Subdivision at this location daily. According to collision data received from the H-GAC and the FRA, two crashes occurred at the Gessner Road crossing between 1990 and 2003. The identified four-lane overpass over the Glidden Subdivision would intersect with elevated ramps from US 90A. Access to adjacent properties will be maintained via access roads alongside Gessner Road along with at-grade u-turns located beneath the overpass on each side of the railroad.

Access along US 90A is currently provided by the at-grade traffic lanes shown in Photo 8-25. Existing access to US 90A from School Street and Bull Lane would be retired due to the proposed elevation of US 90A to ramp up to the Gessner Road overpass. The properties east and west of the intersection of Gessner Road and US 90A would maintain access via the existing roadway network south of US 90A, including School Street and Bull Lane which maintain access to US 90A. Photos 8-22 through 8-26 show the crossing of Gessner Road with the UPRR mainline and passing siding.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure G-10 in Appendix F, while the environmental constraints are identified in the Glidden Subdivision Constraints Map on sheet 17 of 32 located in Appendix E. The environmental constraints located in the vicinity of Gessner Road include residential and commercial properties, schools, and churches located a couple of blocks away. Right-of-way acquisition of the adjacent residential and commercial properties accounts for approximately 22 percent of the estimated cost to implement this grade separation.

The grade separation of Gessner Road is estimated to cost $17,000,000 with an estimated public benefit of $26,000,000 over a 10 year period and $76,000,000 over a 20 year period, which are more than 50 percent greater and more than four times greater than the estimated cost of construction, respectively.

Photo 8-22: Glidden Subdivision at Gessner Road (looking northwest along Gessner north of the railroad crossing)

Photo 8-23: Glidden Subdivision at Gessner Road (looking southwest)

Photo 8-24: Glidden Subdivision at Gessner Road (looking northwest along Gessner)

Photo 8-25: Glidden Subdivision at Gessner Rd (looking northeast along US90A)

Photo 8-26: Glidden Subdivision at Gessner Road (looking southeast)

Grade Separation of Griggs/Long/Mykawa on the Glidden Subdivision

Griggs Road, Long Drive, and Mykawa Road are four-lane roadways that intersect in south Houston in Harris County. The three road intersection is located at railroad Tower 81, just south of the BNSF New South Yard. Approximately 45,800 vehicles cross the railroads at this location daily. Photos 8-27 through 8-38 show the existing crossing of Griggs, Long, and Mykawa Roads with the UPRR Glidden mainline and the BNSF Mykawa mainline.

The identified underpass intersection forms a four-way intersection under the railroads with Griggs Road from the east, Mykawa Road from the south, Griggs Road from the west, and Long Drive from the southeast. Access to adjacent properties will be maintained via access roads alongside Griggs, Long, and Mykawa along with at-grade u-turns located above the underpass.

A preliminary layout of the underpass is identified in Figure G-11 in Appendix F, while the environmental constraints are identified in the Glidden Subdivision Constraints Map on sheet 29 of 32 located in Appendix E. Constraints include a leaking petroleum storage tank, power lines, churches, a school (located a couple of blocks away), a rail yard, industrial and commercial properties, and Loop 610. The identified underpass would run beneath the existing Loop 610 bridge that crosses Mykawa Road. Right-of-way acquisition of the adjacent industrial and commercial properties accounts for approximately 15 percent of the estimated cost to implement this grade separation. The grade separation of Griggs, Long, and Mykawa Roads is estimated to cost $23,000,000 with an estimated public benefit of $4,700,000 over a 10 year period and $14,800,000 over a 20 year period, which account for approximately 20 percent and 64 percent of the estimated cost of construction, respectively.

Photo 8-27: Mykawa Subdivision at New South Yard (looking north)

Photo 8-28: Glidden and Mykawa Subdivisions (looking northeast)

Photo 8-29: Glidden and Mykawa Subdivisions (looking southwest)

Photo 8-30: Glidden Subdivision along Griggs Road (looking east)

Photo 8-31: Glidden Subdivision along Griggs Road (looking northeast)

Photo 8-32: Mykawa Subdivision along Mykawa Road (looking south)

Photo 8-33: Mykawa Subdivision along Mykawa Road (looking south)

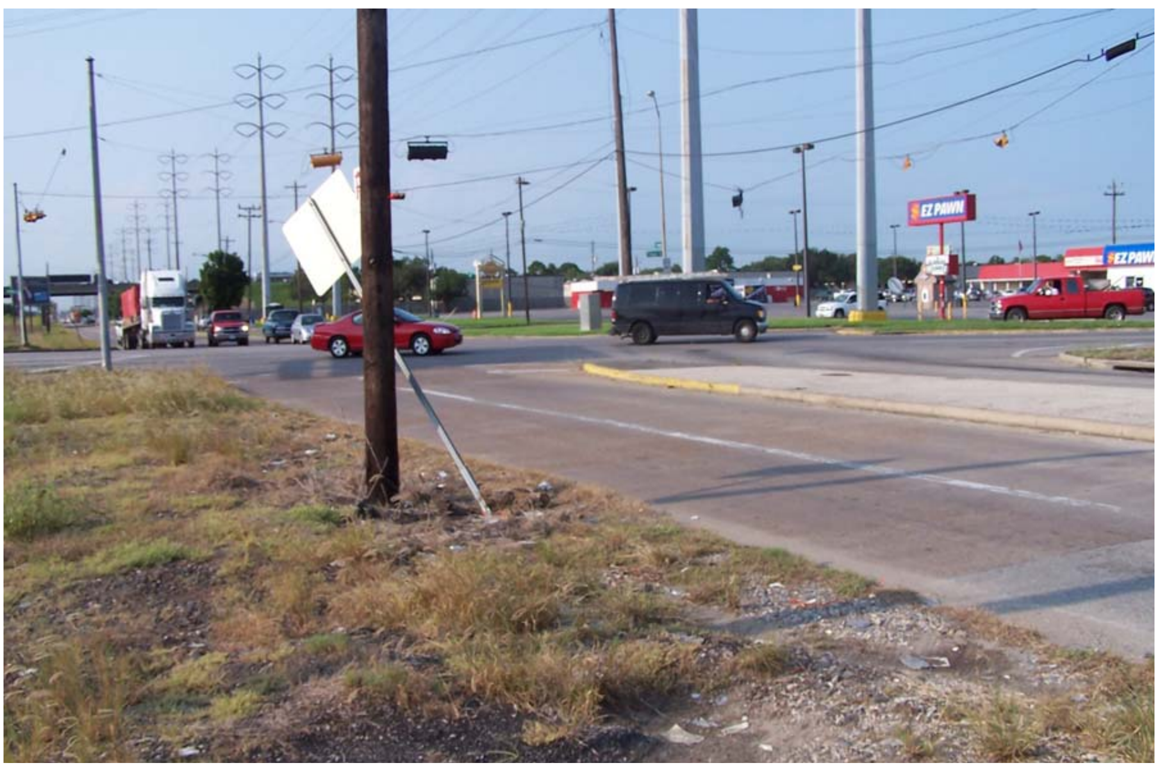


Photo 8-34: Mykawa Road (looking southwest)

UPRR Glidden Subdivision

Photo 8-35: Griggs Road (looking southwest)

Photo 8-36: Glidden Subdivision along Griggs Road (looking southwest)

Photo 8-37: Glidden Subdivision (looking west)

Photo 8-38: Glidden Subdivision along Griggs Road (looking southwest)

Grade Separation of Harlem Road on the Glidden Subdivision

Harlem Road is currently a two-lane roadway located west of Sugarland in Fort Bend County. Approximately 12,600 vehicles cross the UPRR Glidden Subdivision at this location daily. The identified two-lane overpass would separate vehicular traffic from the Glidden Subdivision mainline and passing siding, and would intersect with elevated ramps from US 90A.

Access to adjacent properties will be maintained via access roads alongside Harlem Road along with an at-grade u-turn located beneath the overpass. Access along US 90A will remain unchanged.

A new east-west access road is also identified to run between Harlem Road and FM 359 as an alternate route for Pitts Road, which is identified to remain as an at-grade crossing. Pitts Road, located just west of Harlem Road in Fort Bend County, is a two-lane roadway At which approximately 2,400 vehicles cross the UPRR Glidden Subdivision daily. Access to adjacent properties along Pitts Road will be maintained via the existing roadway network in addition to the identified east-west access road.

Preliminary layouts of the overpass and identified east-west connection road are identified in Figures G-12 and G-24 in Appendix F, while the environmental constraints are identified in the Glidden Subdivision Constraints Map on sheet 7 of 32. The constraints located in the vicinity of Harlem Road include the 500 year floodplain and adjacent residential property. Right-of-way acquisition of the adjacent residential property accounts for approximately two percent of the estimated cost to implement this grade separation and connection road, since the grade separation is able to remain in the existing right-of-way and the property utilized by the identified connection road is undeveloped.

The grade separation of Harlem Road and the connection road between FM 359 and Harlem Road is estimated to cost $14,000,000 with an estimated public benefit of $2,600,000 over a 10 year period and $8,100,000 over a 20 year period, which account for approximately 19 percent and 58 percent, respectively, of the estimated cost of construction of the grade separation and connection road.

Grade Separation of Hillcroft Avenue on the Glidden Subdivision

Hillcroft Avenue is currently a four-lane roadway on the southwest side of Houston in Harris County. Approximately 14,300 daily vehicles cross the Glidden Subdivision at this location. The identified four-lane overpass over the Glidden Subdivision single mainline would intersect with elevated ramps from US 90A.

Access to adjacent properties will be maintained via access roads alongside Hillcroft Avenue along with at-grade u-turns located beneath the overpass on each side of the railroad. Access along US 90A will be maintained for adjacent properties via the existing roadway network.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure G-13 in Appendix F, while the environmental constraints are identified in the Glidden Subdivision Constraints Map on sheet 20 of 32 located in Appendix E. The constraints located in the vicinity of Hillcroft Avenue include adjacent residential and commercial properties and a leaking petroleum storage tank. Right-of-way acquisition of the adjacent residential and commercial property accounts for approximately six percent of the estimated cost to implement this grade separation.

The grade separation of Hillcroft Avenue is estimated to cost $17,000,000 with an estimated public benefit of $3,700,000 over a 10 year period and $8,700,000 over a 20 year period, which account for approximately 22 percent and 51 percent of the estimated cost of construction, respectively.

Grade Separation of Kirby Drive on the Glidden Subdivision

Kirby Drive is currently a four-lane roadway on the southwest side of Houston in Harris County that terminates at Holmes Road. Approximately 5,700 daily vehicles cross the Glidden Subdivision at this location. According to collision data received from the H-GAC Traffic Safety Program and the FRA, one crash occurred at the Kirby Drive crossing between 1990 and 2003. The identified four-lane overpass over the Glidden Subdivision would intersect with elevated ramps from Holmes Road.

Access to adjacent properties will be maintained via an access road alongside Kirby Drive along with an at-grade u-turn located beneath the overpass on the north side of the railroad. Access along Holmes Road will also be maintained for the existing adjacent properties.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure G-14 in Appendix F, while the environmental constraints are identified in the Glidden Subdivision Constraints Map on sheet 24 of 32 located in Appendix E. The constraints located in the vicinity of Kirby Drive include adjacent industrial property and multiple oil and gas wells. Right-of-way acquisition of the adjacent industrial property accounts for only approximately five percent of the estimated cost to implement this grade separation.

The grade separation of Kirby Drive is estimated to cost $14,000,000 with an estimated public benefit of $160,000 over a 10 year period and $380,000 over a 20 year period, which account for approximately one percent and three percent of the estimated cost of construction, respectively. The public benefit is low when compared to other grade separations because of the low volume of trains that pass at this location daily. The low number of passing trains minimizes impact to vehicular delays and safety concerns at the crossing. Photos 8-39 and

8-40 show the crossing of Kirby Drive with the UPRR mainline, passing siding, and METRO test track under existing conditions.

Photo 8-39: Glidden Subdivision along Holmes Road at Kirby Drive intersection (looking west)

Photo 8-40: Glidden Subdivision at Kirby Drive intersection (looking east)

Grade Separation of Kirkwood Road on the Glidden Subdivision

Kirkwood Road is currently a four-lane roadway between Sugarland and Stafford in Fort Bend County. Approximately 39,900 daily vehicles cross the Glidden Subdivision at this location. The identified four-lane overpass over the Glidden Subdivision mainline would intersect with elevated ramps from US 90A.

Access to adjacent properties will be maintained via access roads alongside Kirkwood and Dulles Roads along with at-grade u-turns beneath the overpass on each side of the railroad. Access along US 90A will be removed for certain adjacent properties south of the elevated ramps (eastbound) of US 90A. The effected properties would require either the construction of an access road along US 90A (which would be constructed outside of the right-of-way) or the ability to use access routes from a neighboring property. The cost of the affected properties has been included in the estimate for this grade separation.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure G-15 in Appendix F, while the environmental constraints are identified in the Glidden Subdivision Constraints Map on sheet 14 of 32 located in Appendix E. The constraints located in the vicinity of Kirkwood Road include adjacent commercial and residential properties and schools. Right-of-way acquisition of adjacent property accounts for approximately 19 percent of the estimated cost to implement this grade separation.

The grade separation of Kirkwood Road is estimated to cost $18,000,000 with an estimated public benefit of $12,000,000 over a 10 year period and $43,000,000 over a 20 year period, which account for approximately 67 percent of the estimated cost of construction and more than two times greater than the estimated construction cost, respectively.

Grade Separation of South Wayside Drive on the Glidden Subdivision

South Wayside Drive is currently a four-lane roadway on the south side of Houston in Harris County. Approximately 16,500 vehicles cross the Glidden Subdivision at this location daily. The identified four-lane overpass over the Glidden Subdivision would intersect with elevated ramps from Griggs Road.

Access to adjacent properties will be maintained via access roads alongside South Wayside Drive along with at-grade u-turns beneath the overpass on each side of the railroad. Access along Griggs Road will be prevented for properties northwest of Griggs Road adjacent to the elevated ramps; however, alternative access routes are available for properties using the existing roadway network west of Griggs Road. Photos 8-41 through 8-44 show the crossing of South Wayside Drive and the UPRR Glidden Subdivision mainline.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure G-16 in Appendix F, while the environmental constraints are identified in the Glidden Subdivision Constraints Map on sheet 30 of 32 located in Appendix E. The constraints located in the vicinity of South Wayside Drive include adjacent industrial and residential properties. Right-of-way acquisition of these properties accounts for approximately 15 percent of the estimated cost to implement this grade separation.

The grade separation of South Wayside Drive is estimated to cost $17,000,000 with an estimated public benefit of $900,000 over a 10 year period and $2,300,000 over a 20 year period, which account for approximately five percent and 14 percent of the estimated cost of construction, respectively.

Photo 8-41: Glidden Subdivision along Wayside Drive (looking north)

Photo 8-42: Glidden Subdivision at Wayside Drive (looking west)

Photo 8-43: Glidden Subdivision at Wayside Dr (looking east along Griggs Rd)

Photo 8-44: Glidden Subdivision at Wayside Drive (looking south)

Grade Separation of Telephone Road on the Glidden Subdivision

Telephone Road is currently a six-lane roadway on the south side of Houston in Harris County. Approximately 13,700 daily vehicles cross the Glidden Subdivision at this location. According to collision data received from the H-GAC Traffic Safety Program and the FRA, six crashes occurred at the Telephone Road crossing between 1990 and 2003.

Photos 8-45 through 8-48 show the crossing of Telephone Road and the Glidden Subdivision under existing conditions. The identified six-lane overpass over the Glidden Subdivision would intersect with elevated ramps from Griggs Road.

Access to adjacent properties will be maintained via access roads alongside Telephone Road along with at-grade u-turns located beneath the overpass on each side of the railroad. The existing Griggs Road is a two-lane roadway, which is identified to be expanded by adding two ramps that would connect to the Telephone Road overpass.

The addition of two ramps to the Griggs Road traffic mainlanes requires the acquisition of additional right-of-way west of Griggs Road in order to avoid encroaching into railroad right-of-way to the east. Access along Griggs Road will be prevented for properties west of Griggs Road adjacent to the identified elevated ramps; however access may be maintained via the existing roadway network west of Griggs Road.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure G-17 in Appendix F, while the environmental constraints are identified in Glidden Subdivision Constraints Map sheet 30 of 32 located in Appendix E. The constraints located near Telephone Road include industrial, commercial and residential properties, leaking petroleum storage tanks, and churches. Right-of-way acquisition of adjacent properties accounts for roughly 12 percent of the estimated cost to implement this grade separation.

The grade separation of Telephone Road is estimated to cost $18,000,000 with an estimated public benefit of $540,000 over a 10 year period and $1,200,000 over a 20 year period, which account for approximately three percent and seven percent of the estimated cost of construction, respectively.

Photo 8-45: Glidden Subdivision along Griggs Rd at Telephone Rd (looking SW)

Photo 8-46: Glidden Subdivision along Griggs Rd at Telephone Rd (looking NE)

Photo 8-47: Glidden Subdivision at Telephone Road (looking southeast)

Photo 8-48: Glidden Subdivision at Telephone Road (looking northwest)

Crossing Closures

Crossing Closure of Cravens Road on the Glidden Subdivision

Cravens Road is currently a two-lane roadway that crosses the railroad at-grade, as shown in Photo 8-49, in Fort Bend County in Missouri City. Approximately 2,600 vehicles cross the UPRR at this location daily. Cravens Road is identified to be closed at the intersection with the UPRR Glidden Subdivision in order to reduce public safety hazards currently associated with the existing at-grade crossing. According to collision data received from the H-GAC and the FRA, five crashes occurred at the Cravens Road crossing between 1990 and 2003.

The location of the potential crossing closure and the alternative route and associated distance are identified in Figure G-18 in Appendix F, while the environmental constraints and adjacent property uses are identified in the Glidden Subdivision Constraints Map on sheet 18 of 32. The only environmental constraint identified is the presence of wetlands, which would not be affected by the crossing closure. Access to adjacent properties will be maintained via the existing roadway network and right-of-way acquisition of adjacent properties will not be required since no new construction is required.

The vehicular traffic along Cravens Road could be re-routed to Beltway 8, which is currently grade separated from the railroad, or Gessner Road, which is included as a potential grade separation in this study. The crossing closure is estimated to cost $50,000 with an estimated public benefit of $660,000 over a 10 year period and $1,500,000 over a 20 year period, which are more than 13 times greater and 30 times greater, respectively, than the estimated cost to implement the closure.

Photo 8-49: Glidden Subdivision at Cravens (looking northwest)

Crossing Closure of Douglas/Morton Street on the Glidden Subdivision

Douglas Street (as it is called north of the railroad) / Morton Street (as it is called south of the railroad) is currently a two-lane roadway at which approximately 330 vehicles cross the railroad at-grade in Fort Bend County in the city of Richmond. This crossing is identified to be closed at the intersection with the UPRR Glidden Subdivision.

The location of the potential crossing closure as well as the alternative route and associated distance is identified in Figure G-19 in Appendix F, while the environmental constraints and adjacent property uses are identified in the Glidden Subdivision Constraints Map on sheet 4 of 32 located in Appendix E.

The environmental constraints located in the vicinity of this street consist of leaking petroleum storage tanks, churches, a police station, a fire station, the 100-year floodplain, and historic sites. The environmental constraints would be minimally affected, if at all, by the crossing closure, since no new construction is required and alternate routes such as Collins Road, 10th Street, and 2nd Street are available to cross the railroad maintaining access to all existing properties. The vehicular traffic along Douglas/Morton Street could be rerouted to Collins Road, which is included as a potential grade separation as part of this study.

The crossing closure is estimated to cost $50,000 with an estimated public benefit of $186,000 over a 10 year period and $380,000 over a 20 year period, which are more than three times greater and more than seven times greater, respectively, than the estimated cost to implement the closure.

Crossing Closure of 4th, 5th, 6th, and 8th Streets on the Glidden Subdivision

4th, 5th, 6th, and 8th Streets are currently two-lane roadways that cross the railroad at-grade in Fort Bend County in the city of Richmond. These crossings are identified to be closed at the intersection with the UPRR Glidden Subdivision in order to reduce public safety hazards currently associated with the existing at-grade crossings.

The location of the potential crossing closures as well as the alternative routes and associated distances are identified in Figure G-20 in Appendix F, while the environmental constraints and adjacent property uses are identified in the Glidden Subdivision Constraints Map on sheet 4 of 32 located in Appendix E. The environmental constraints located in the vicinity of these streets consist of leaking petroleum storage tanks, churches, a police station, a fire station, the 100-year floodplain, and historic sites.

The environmental constraints would be minimally affected, if at all, by the crossing closure, since no new construction is required, and alternate routes such as Collins Road, 10th Street, and 2nd Street are available to cross the railroad maintaining access to all existing properties.

The crossing closures are each estimated to cost $50,000. The estimated public benefit could not be calculated for these crossing closures since the traffic would be rerouted to other at-grade crossings; however, the closures would produce a safety benefit to the traveling public.

Crossing Closure of Evergreen Street on the Glidden Subdivision

Evergreen Street is currently a two-lane roadway that crosses the railroad at-grade in Harris County in southeast Houston. This crossing is identified to be closed at the intersection with the UPRR Glidden Subdivision in order to reduce public safety hazards currently associated with the existing at-grade crossing. According to collision data received from the H-GAC and the FRA, one crash occurred at the Evergreen Street crossing between 1990 and 2003.

The location of the potential crossing closure as well as the alternative route and associated distance are identified in Figure G-21 in Appendix F, while the environmental constraints and adjacent property uses are identified in the Glidden Subdivision Constraints Map on sheet 32 of 32 located in Appendix E. The vehicular traffic along Evergreen Street could be rerouted to adjacent 75th Street. The environmental constraints located in the vicinity of this street consist of churches and a leaking petroleum storage tank.

Access to the churches would be maintained through alternate routes in the existing roadway network, and the petroleum tank would not be affected by a road closure. Right-of-way acquisition of the adjacent properties will not be required since no new construction is required.

The crossing closure is estimated to cost $50,000. The estimated public benefit could not be calculated for this crossing closure, since the traffic would be rerouted to other at-grade crossings; however, the closure would produce a safety benefit for the traveling public.

Crossing Closure of Haviland Street on the Glidden Subdivision

Haviland Street is currently a two-lane roadway that crosses the railroad at-grade, as shown in Photo 8-50, in Harris County in southwest Houston. According to collision data received from the H-GAC Traffic Safety Program and the FRA, two crashes occurred at the Evergreen Street crossing between 1990 and 2003.

This crossing is identified to be closed at the intersection with the UPRR Glidden Subdivision and rerouted to adjacent Hillcroft Street, which is included as a potential grade separation as part of this study in order to reduce public safety hazards currently associated with the existing at-grade crossing.

The location of the potential crossing closure as well as the alternative route and associated distance is identified in Figure G-22 in Appendix F, while the environmental constraints and adjacent property uses are identified in the Glidden Subdivision Constraints Map sheet on 19 of 32 located in Appendix E. The environmental constraints located in the vicinity of this street consist of schools, churches, and leaking petroleum storage tanks. The petroleum tanks would be unaffected by the crossing closure, and access to the schools and churches would be maintained with the alternate route along Hillcroft Street. Right-of-way acquisition of the adjacent properties will not be required for the crossing closure since no new construction is required.

The crossing closure is estimated to cost $50,000 with an estimated public benefit of $97,000 over a 10 year period and $210,000 over a 20 year period, which are two times greater and four times greater, respectively, than the estimated cost to implement the closure.

Photo 8-50: Glidden Subdivision at Haviland Street (looking north)

<u>Crossing Closure of Richwood Street on the Glidden Subdivision</u>
Richwood is currently a two-lane roadway that crosses the railroad at-grade in Fort Bend County in northeast Rosenberg. This crossing is identified to be closed at the intersection with the UPRR Glidden Subdivision and the BNSF Galveston Subdivision in order to reduce public safety hazards associated with the existing at-grade crossing.

The location of the potential crossing closure as well as the alternative route and associated distance is identified in Figure G-19 in Appendix F, while the environmental constraints and adjacent property uses are identified in the Glidden Subdivision Constraints Map on sheet 2 of 32 located in Appendix E. The environmental constraints located in the vicinity of this street consist of a church as well as commercial and residential properties. Right-of-way acquisition of the adjacent properties will not be required since no new construction is required.

Access to adjacent properties will be maintained via the existing roadway network. Traffic may be rerouted to adjacent roadways to the southwest to River Road, or to the northeast to Collins Road, which is included as a potential grade separation in this report.

The crossing closure is estimated to cost $50,000. The estimated public benefit could not be calculated for the closure of Richwood Street since traffic may be redirected to another at-grade crossing; however, the closure would produce a safety benefit for the traveling public.

Crossing Closure of Third Street on the Glidden Subdivision

Third Street is currently a two-lane roadway that crosses the railroad at-grade in Fort Bend County in the city of Rosenberg. Approximately 2,500 vehicles cross the UPRR and the BNSF at this location daily. This crossing is identified to be closed at the intersection with the UPRR Glidden Subdivision and the BNSF Galveston Subdivision in order to reduce public safety hazards currently associated with the existing at-grade crossing.

The location of the potential crossing closure, as well as the alternative route and associated distance is identified in Figure G-23 in Appendix F, while the environmental constraints and adjacent property uses are identified in the Glidden Subdivision Constraints Map on sheet 1 of 32 located in Appendix E. The environmental constraints located in the vicinity of this street include multiple churches, a cemetery, a school, and a railroad museum.

Access to adjacent properties will be maintained via the existing roadway network. Traffic may be rerouted west on Avenue D or Avenue I, and then south on Houston Street to cross the railroad. An additional route to cross the railroad may be provided by an overpass connecting 7^{th} Street and 8^{th} Street, shown in Figure G-1 in Appendix F, which is identified as a potential grade separation in this report.

The crossing closure is estimated to cost $50,000 with an estimated public benefit of $530,000 over a 10 year period and $1,300,000 over a 20 year period, which are more than ten times greater and 26 times greater, respectively, than the estimated cost to implement the closure.

BNSF Houston Subdivision

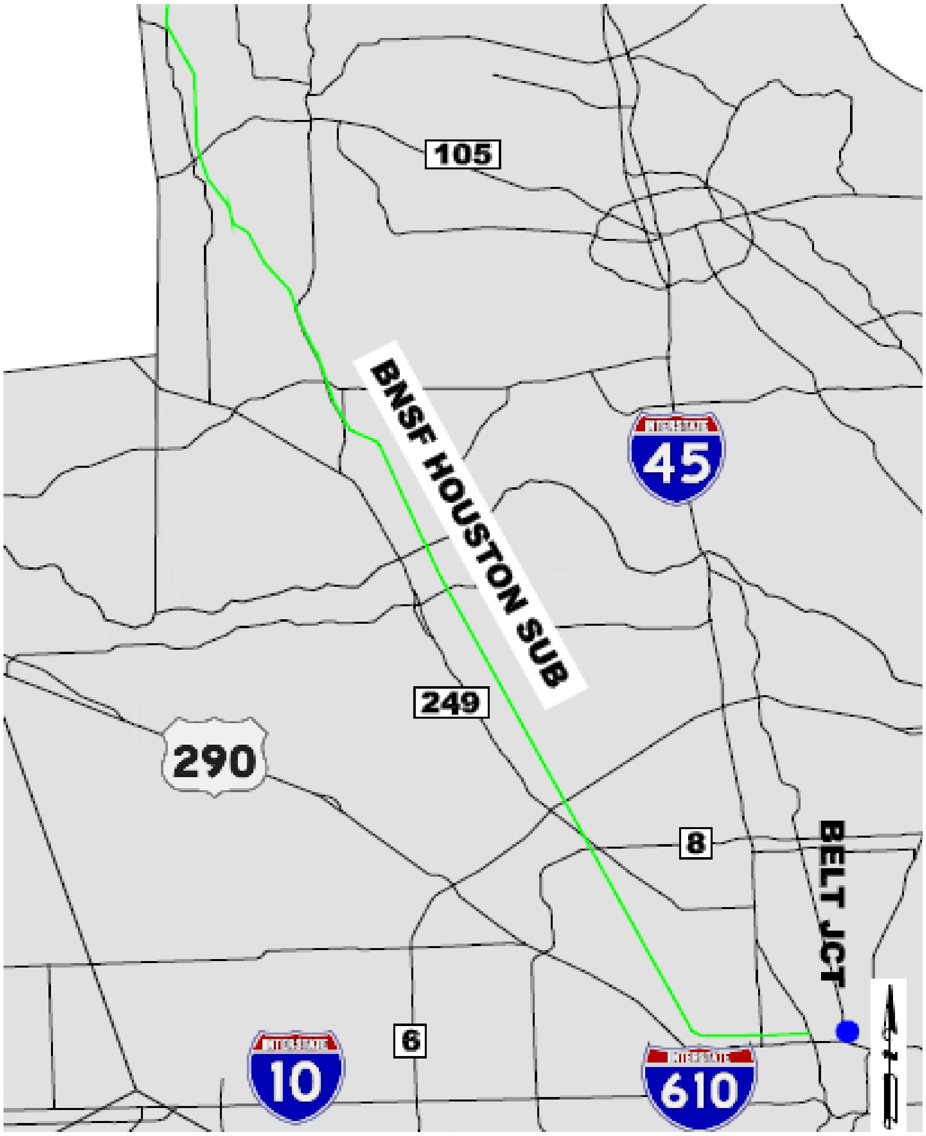


Figure 8-10: BNSF Houston Subdivision Map

The BNSF Houston Subdivision consists of approximately 144 miles of BNSF owned and operated track with terminus points at Teague, Texas and northwest Houston; however, only 55 miles of the subdivision is within the study area. Predominantly a single-track mainline with minimal sidings, the BNSF operates approximately 10-20 trains daily in a bidirectional manner on the Houston Subdivision.

The only potential improvement identified for the BNSF Houston Subdivision is the grade separation of FM 1960 as shown in Table 8-8.

BNSF Houston Subdivision						
Grade Separations	**Improvement Classification Level**	**Estimated Cost**	**Estimated 10-year Public Benefit**	**Ratio: Benefit/ Cost**	**Estimated 20-year Public Benefit**	**Ratio: Benefit/ Cost**
FM 1960	3	$ 11,000,000	$ 870,000	0.08	$ 1,100,000	0.10
Class 3 Improvements (Separations/Closures)		$ 11,000,000	$ 870,000	0.08	$ 1,100,000	0.10
Total Identified Improvements		$ 11,000,000	$ 870,000	0.08	$ 1,100,000	0.10

Table 8-8: Houston Subdivision Improvements

Grade Separations

Grade Separation of FM 1960 on the BNSF Houston Subdivision

FM 1960 is currently a six-lane roadway with a continuous left turn lane. The road crosses the railroad at-grade in northwestern Harris County and is adjacent to Willowbrook Mall. Approximately 87,800 vehicles cross the BNSF Railroad at this location daily. The identified six-lane overpass would separate vehicular traffic from the BNSF Houston Subdivision. A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure H-1 in Appendix F. Additional environmental constraints mapping may be required for further analysis.

Access to adjacent properties will be maintained via access roads alongside the main roadway along with at-grade u-turns located beneath the overpass on the east side of the railroad. On the west side of the railroad, the access roads will connect to the local roadway network that serves Willowbrook Mall. Right-of-way acquisition of the adjacent commercial and industrial properties accounts for approximately 14 percent of the estimated cost to implement this grade separation.

The grade separation of FM 1960 is estimated to cost $11,000,000 with an estimated public benefit of $870,000 over a 10 year period and $1,100,000 over a 20 year period, which account for approximately eight percent and ten percent of the estimated cost of construction, respectively.

UPRR Lafayette Subdivision

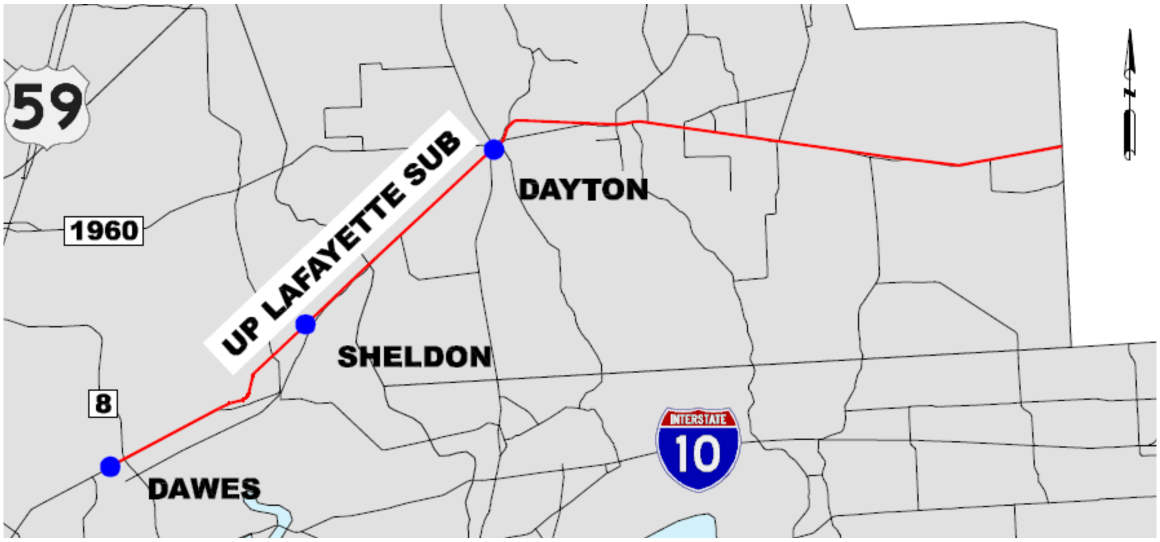


Figure 8-11: UPRR Lafayette Subdivision Map

The Lafayette Subdivision, owned and maintained by the UPRR with 50 percent ownership interest sold to the BNSF, is approximately 205 miles in overall length of which approximately 53 miles are within the study area. Predominantly a single track railroad within the study area, there are numerous sidings and industry tracks between Dawes and Dayton. The Lafayette Subdivision is utilized in a directional manner for westbound traffic and averages approximately 35 to 45 trains daily. Amtrak's Sunset Limited, connecting Los Angeles to Orlando, operates along this route with three eastbound and three westbound trains weekly.

Due to the large volume of train traffic combined with the numerous local industries served by the railroads, increasing the rail traffic capacity of the Lafayette Subdivision for current and anticipated growth is essential.

UPRR Lafayette Subdivision

The potential improvements identified for the Lafayette Subdivision consist of one crossing closure and a rail capacity enhancement that is divided into two segments, which are listed with their associated costs in Table 8-9.

Lafayette Subdivision				
Crossing Closures	**Improvement Classification Level**	**Estimated Cost**	**Estimated Public Benefit***	**Ratio: Benefit/Cost**
Heather Row	3	$ 50,000	NA	NA
Line Capacity Enhancements	**Improvement Classification Level**	**Estimated Cost**	**Estimated Public Benefit****	**Ratio: Benefit/Cost**
Second Main: Dawes to Sheldon	2	$ 43,000,000	NA	NA
Second Main: Sheldon to Dayton Jct.	4	$ 117,000,000	NA	NA
*Public benefit could only be estimated for crossing closures which would be rerouted to a grade separated crossing. However, all crossing closures produce a public benefit of improved safety.				
**No public benefits of individual rail improvements were identified.				
Class 2 Improvements (Mid-range Improvements)		$ 43,000,000	NA	NA
Class 3 Improvements (Separations/Closures)		$ 50,000	NA	NA
Class 4 Improvements (Rail Capacity Additions)		$ 117,000,000	NA	NA
Total Identified Improvements		$ 160,050,000	NA	NA

Table 8-9: Lafayette Subdivision Improvements

Additional improvements along the Lafayette Subdivision that have been identified by the *Harris County Regional Freight Rail Improvement Plan* include the grade separation of the following crossings: Liberty Road (near FM 527), John Ralston Road, C.E. King Parkway, Pineland Road, Sheldon Road, Miller Wilson Road, Crosby Eastgate Road, Plaza Circle Drive, CR 603 (Damek), US 90 (Wye Connection), CR 602 (Wolf Island), and Waco. These grade separations have not been included in the cost estimates for the Lafayette Subdivision and may warrant further analysis.

Crossing Closures

Crossing Closure of Heather Row Lane on the Lafayette Subdivision

Heather Row Lane is currently a two-lane roadway that crosses the railroad at-grade, as shown in Photo 8-51, in Harris County near the city of Dawes, Texas. Approximately 1,400 vehicles cross the UPRR at this location daily. This crossing is identified to be closed at the intersection with the UPRR Lafayette Subdivision in order to reduce public safety hazards associated with the existing at-grade crossing. According to collision data received from the H-GAC and the FRA, one crash occurred at the Heather Row crossing between 1990 and 2003.

The location of the potential crossing closure as well as the alternative route and associated distance are identified in Figure I-1 in Appendix F, while the environmental constraints and adjacent property uses are identified in the Lafayette Subdivision Constraints Map on sheet 4 of 25. The environmental constraints located in the vicinity of this street include residential and industrial properties as well as a church. Right-of-way acquisition of the adjacent properties will not be required since no new construction is required.

Access to adjacent properties will be maintained via the existing roadway network. Traffic may be rerouted to adjacent roadways to the east on CE King Parkway, or to the west on John Ralston Road.

The crossing closure is estimated to cost $50,000. The estimated public benefit could not be calculated for the crossing closure since the traffic must be rerouted to other at-grade crossings; however, the closure would produce a safety benefit for the traveling public.

Photo 8-51: Lafayette Subdivision at Heather Row Lane (looking south)

Rail Capacity Enhancements

The identified rail improvements represent what may be considered the ultimate build-out. It should be noted, however, that incrementally phasing in the rail improvements may also provide near to immediate private and public benefits. Railroad infrastructure improvements and at-grade crossing closure/separation could be phased in as follows:

- Phase I – Dawes to Sheldon, approximately 8 miles
- Phase II – Sheldon to Dayton, approximately 17 miles

<u>Addition of Second Mainline from Dawes to Dayton Junction</u>

A single mainline of track currently makes up the Lafayette Subdivision between Dayton and Dawes as shown in Photo 8-52. Limited passing sidings combined with a large local industry base along the corridor do not allow trains to pass one another, nor are there adequate locations for trains entering into the Houston rail network to sit and wait their turn to get into the queue for movement to one of the rail yards or outlying locations. The addition of a second mainline of track ultimately from Dayton to Dawes will improve the mobility of train traffic moving through this corridor, and may reduce westbound train re-crew requirements.

Mobility would essentially be improved because the local trains could perform their daily pick-up and delivery requirements, ultimately providing a more reliable level of service to the industries served, while allowing through trains to pass by on the new line. Currently, the predominant flow on this route is westbound; however, a second mainline may ultimately accommodate bidirectional traffic.

Photo 8-52: Lafayette Subdivision along Sheldon Road (looking north)

The first phase may include constructing approximately eight miles of a second mainline between Dawes and Sheldon to a point just west of the San Jacinto River crossing. An alignment shift may be necessary so that the second mainline can be constructed between the existing rail line and Business US Hwy 90. However, for this improvement to have merit, an additional mainline between East Settegast and Dawes may be required.

The addition of a second mainline along the subdivision from Dawes to Sheldon, as shown in Figure I-6 in Appendix F, is estimated to cost $43,000,000 and is classified as a level 2 mid-range railroad improvement. The addition of a second mainline from Dawes to Fauna (southwest of Sheldon) was included in Planning Case 2 as discussed in further detail in Section 7.

The second phase may include the addition of a second mainline along the subdivision from Sheldon to Dayton Junction as shown in Figures I-2 through I-5 in Appendix F, which is estimated to cost $117,000,000 and is classified as a level 4 long-range improvement. The addition of a second mainline should undergo further testing to determine the extent of the improvement's impact on the region's rail network, and to quantify the associated public and private benefits that may be attained.

BNSF Mykawa Subdivision

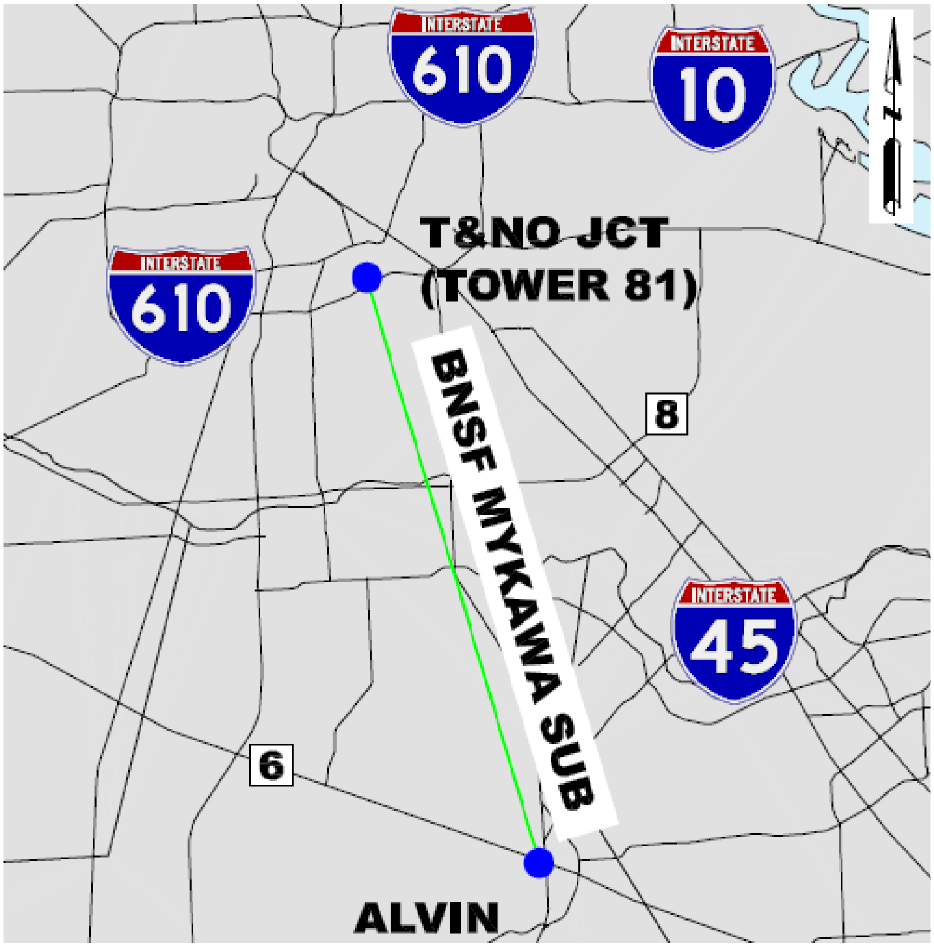


Figure 8-12: BNSF Mykawa Subdivision Map

The Mykawa Subdivision consists of approximately 20 miles of BNSF owned and operated track between Tower 81 (T&NO Junction) near the Mykawa/Griggs Road intersection in south Houston, to Alvin, Texas where the subdivision connects to the BNSF Galveston Subdivision. The Mykawa Subdivision, which parallels Mykawa Road, is predominantly a bidirectional single track railroad with numerous sidings that allow for trains to pass each other. The entire Subdivision is within the study area, with 25 - 35 BNSF and UPRR trains daily.

Bordered by Hobby Airport to the east, Mykawa Road to the west, and Airport Boulevard to the north, the BNSF has two major yard facilities that handle their intermodal and auto operations for the region: Pearland and New South Yards.

Mykawa Subdivision				
Line Capacity Enhancements	**Improvement Classification Level**	**Estimated Cost**	**Estimated Public Benefit****	**Ratio: Benefit/Cost**
Second Main: Alvin to Tower 81 (T&NO Jct)	4	$ 100,000,000	NA	NA
Relocate Automotive Operations - Pearland Yd	5	$ 20,000,000	NA	NA
Relocate Intermodal Operations - Pearland Yd	5	$ 75,000,000	NA	NA
Relocate Carload switching facility - N. South Yard	5	$ 100,000,000	NA	NA
**No public benefits of individual rail improvements were identified.				
Class 4 Improvements (Rail Capacity Additions)		$ 100,000,000	NA	NA
Class 5 Improvements (Rail Relocations)		$ 195,000,000	NA	NA
Total Identified Improvements		$ 295,000,000	NA	NA

Table 8-10: Mykawa Subdivision Improvements

The potential improvements identified for the BNSF Mykawa Subdivision consist of four line capacity enhancements, which are listed with their associated costs in Table 8-10. Future planning alternatives for the Mykawa Subdivision include the potential relocation of carload switching operations at Pearland and New South Yards, which is discussed in Section 9.

Rail Capacity Enhancements

<u>Addition of Second Mainline Track from Alvin to Tower 81</u>

The Mykawa Subdivision is the primary route used by BNSF Galveston Subdivision trains to gain access to their carload operations at New South Yard and the intermodal and auto operations located on the Mykawa Subdivision. The UPRR, on the other hand, relies heavily on the continued movement of trains over the Mykawa Subdivision to support their Gulf Coast Chemical operations.

The addition of a second mainline between Alvin and Tower 81 will reduce the conflict between UPRR and BNSF trains in the vicinity of BNSF's Pearland operations. In the event that BNSF operations at Pearland and New South Yard are relocated to alternative locations, upgrading the Mykawa Subdivision solely to support BNSF Galveston Subdivision or Gulf Coast Chemical operations may not warrant consideration.

The addition of a second mainline from Alvin to Tower 81, as illustrated in Photo 8-54 and shown in Figures J-4 through J-7 in Appendix F, is estimated to cost $100,000,000. The second mainline is a level 4 long-range improvement and should undergo further testing to determine the extent of the improvement's impact on the region's rail network, and to quantify the associated public and private benefits that may be attained. Photo 8-53 shows the Mykawa Subdivision under existing conditions, and Photo 8-54 shows the Mykawa Subdivision with the addition of a second mainline.

Photo 8-53: Before - Mykawa Subdivision under Existing Conditions (looking south at Tower 81)

Photo 8-54: After - Mykawa Subdivision with Identified Improvement (looking South at Tower 81)

UPRR Navasota Subdivision

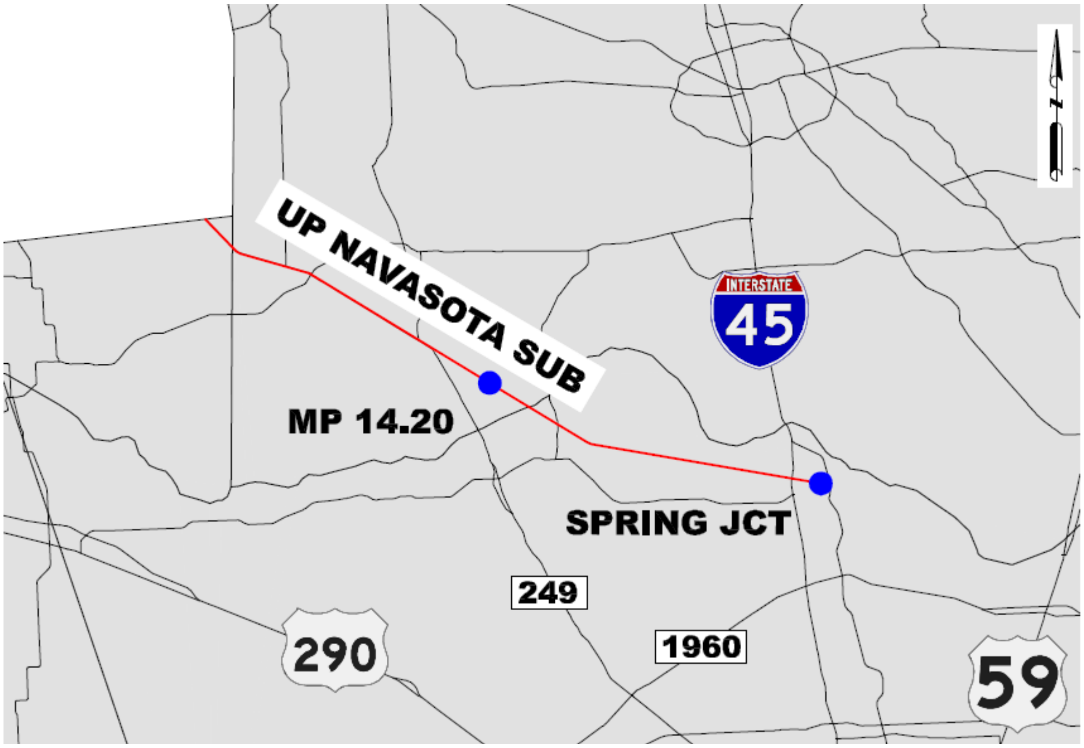


Figure 8-13: UPRR Navasota Subdivision Map

The Navasota Subdivision is approximately 100 miles in length, with terminus points at Spring Junction and Valley Junction near Bryan/College Station. The track is owned and operated by Union Pacific with approximately 27 miles of this line segment contained within the study area. Predominantly a single-track railroad with limited passing sidings, rail traffic is bidirectional with the majority of traffic inbound toward Houston and averages 15 to 25 trains daily.

Currently, vehicular traffic may be delayed along the Navasota Subdivision due to the frequency of trains. The pending southern expansion of residential areas such as The Woodlands will increase the overall vehicular travel on effected roadways such as Kuykendahl.

The potential improvements identified for the UPRR Navasota Subdivision consist of three grade separations, one crossing closure, and a rail capacity enhancement which are all listed with their associated costs in Table 8-11.

Navasota Subdivision						
Grade Separations	**Improvement Classification Level**	**Estimated Cost**	**Estimated 10-year Public Benefit**	**Ratio: Benefit/ Cost**	**Estimated 20-year Public Benefit**	**Ratio: Benefit/ Cost**
FM 2978	3	$ 11,000,000	$ 6,100,000	0.55	$ 13,300,000	1.21
Kuykendahl	3	$ 18,000,000	$ 6,400,000	0.36	$ 28,000,000	1.56
Steubner-Airline	3	$ 5,100,000	$ 200,000	0.04	$ 630,000	0.12
Crossing Closures	**Improvement Classification Level**	**Estimated Cost**	**Estimated 10-year Public Benefit***	**Ratio: Benefit/ Cost**	**Estimated 20-year Public Benefit***	**Ratio: Benefit/ Cost**
Stanolind	3	$ 50,000	$ 230,000	4.60	$ 420,000	8.40
Line Capacity Enhancements	**Improvement Classification Level**	**Estimated Cost**	**Estimated 10-year Public Benefit****	**Ratio: Benefit/ Cost**	**Estimated 20-year Public Benefit****	**Ratio: Benefit/ Cost**
Second Main: Spring Jct to MP 14.20 (BNSF Crossing)	4	$ 79,000,000	NA	NA	NA	NA
*Public benefit could only be estimated for crossing closures which would be rerouted to a grade separated crossing. However, all crossing closures produce a public benefit of improved safety.						
**No public benefits of individual rail improvements were identified.						
Class 3 Improvements (Separations/Closures)		$ 34,150,000	$ 12,930,000	0.38	$ 42,350,000	1.24
Class 4 Improvements (Rail Capacity Additions)		$ 79,000,000	NA	NA	NA	NA
Total Identified Improvements		$ 113,150,000	$ 12,930,000	0.11	$ 42,350,000	0.37

Table 8-11: Navasota Subdivision Improvements

Additional improvements along the Navasota Subdivision that have been identified by the *Harris County Regional Freight Rail Improvement Plan* include the grade separation of the following crossings: Hardin Store Road, Northcrest, Gosling, and Rothwood Drive. These grade separations have not been included in the cost estimates for the Navasota Subdivision, and may warrant further analysis.

Grade Separations

<u>Grade Separation of FM 2978 on the Navasota Subdivision</u>

FM 2978 is currently a two-lane roadway that crosses the railroad at-grade, as shown in Photos 8-55 through 8-58, in Harris County near the city of Tomball. Approximately 16,600 vehicles cross the railroad at this location daily. The identified two-lane roadway overpass would separate vehicular traffic from the UPRR Navasota Subdivision. According to collision data received from the H-GAC Traffic Safety Program and the FRA, one crash occurred at the FM 2978 crossing between 1990 and 2003.

Access to adjacent properties will be maintained via existing access roads alongside the main roadway along with at-grade u-turns located beneath the overpass on each side of the railroad.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure K-1 in Appendix F, while the environmental constraints are identified in the Navasota Subdivision Constraints Map on sheets 3 and 4 of 13 located in Appendix E. The environmental constraints located in the vicinity of FM 2978 consist of a pipeline and adjacent properties. Right-of-way acquisition of the adjacent properties would not contribute to the estimated cost to implement this grade separation since the grade separation may be constructed within the existing right-of-way.

The grade separation of FM 2978 is estimated to cost \$11,000,000 with an estimated public benefit of \$6,100,000 over a 10 year period and \$13,300,000 over a 20 year period, which account for approximately 55 percent of the estimated cost of construction and 21 percent greater than the cost of construction, respectively.

Photo 8-55: Navasota Subdivision at FM 2978 (looking west)

Photo 8-56: Navasota Subdivision at FM 2978 (looking east)

Photo 8-57: Navasota Subdivision at FM 2978 (looking south)

Photo 8-58: Navasota Subdivision at FM 2978 (looking north)

Grade Separation of Kuykendahl Rd. on the Navasota Subdivision

Kuykendahl Road is currently a two-lane roadway that crosses the railroad at-grade in Harris County near The Woodlands. Approximately 18,800 vehicles cross the railroad at this location daily. The identified four-lane roadway overpass would separate vehicular traffic from the UPRR Navasota Subdivision. Kuykendahl Road splits into Kuykendahl-Hufsmith Road, creating a three-way grade separated interchange.

The purpose of the planned expansion of Kuykendahl Road from a two-lane to a four-lane roadway is to accommodate the additional future traffic that will be associated with large planned developments of The Woodlands north of the Kuykendahl intersection. Access to adjacent properties will be maintained via at-grade access roads alongside the main roadway.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure K-2 in Appendix F, while the environmental constraints are identified in the Navasota Subdivision Constraints Map on sheet 6 of 13 located in Appendix E. The environmental constraints located in the vicinity of Kuykendahl Road consist of adjacent residential and commercial properties. Right-of-way acquisition of the adjacent properties accounts for approximately 23 percent of the estimated cost to implement this grade separation.

The grade separation of Kuykendahl Road is estimated to cost $18,000,000 with an estimated public benefit of $6,400,000 over a 10 year period and $28,000,000 over a 20 year period, which account for approximately 36 percent of the estimated cost of construction and 56 percent greater than the cost of construction, respectively.

Grade Separation of Stuebner Airline Rd. on the Navasota Subdivision

Stuebner-Airline Road is currently a two-lane roadway that crosses the railroad at-grade in Harris County near the city of Tomball. Approximately 1,900 vehicles cross the UPRR at this location daily. The identified two-lane roadway overpass would separate vehicular traffic from the UPRR Navasota Subdivision. Access to adjacent properties will be maintained along Kuykendahl-Hufsmith Road, which runs parallel to the Navasota Subdivision. An access roadway is identified to be constructed in order to provide connectivity between Kuykendahl-Hufsmith Road and Stuebner-Airline Road.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure K-3 in Appendix F, while the environmental constraints are identified in the Navasota Subdivision Constraints Map on sheets 4 and 5 of 13 located in Appendix E. The environmental constraints located in the vicinity of Stuebner-Airline Road consist of adjacent residential properties. Right-of-way acquisition of the adjacent properties accounts for less than one percent of the estimated cost to implement this grade separation.

The grade separation of Stuebner-Airline Road is estimated to cost $5,100,000 with an estimated public benefit of $200,000 over a 10 year period and $630,000 over a 20 year period, which account for approximately four percent and 12 percent of the estimated cost of construction, respectively.

Crossing Closures

Crossing Closure of Stanolind on the Navasota Subdivision

Stanolind Road is currently a two-lane roadway that crosses the railroad at-grade in northwest Harris County near the city of Tomball, Texas. Approximately 100 vehicles cross the UPRR at this location daily. According to collision data received from the H-GAC Traffic Safety Program and the FRA, one crash occurred at the Stanolind Road crossing between 1990 and 2003.

This crossing is identified to be closed at the intersection with the UPRR Navasota Subdivision in order to reduce public safety hazards currently associated with the existing at-grade crossing.

The location of the potential crossing closure as well as the alternative route and associated distance is identified in Figure K-4 in Appendix F, while the environmental constraints and adjacent property uses are identified in the Navasota Subdivision Constraints Map on sheet 3 of 13 located in Appendix E. The environmental constraints located in the vicinity of this street include residential properties as well as a pipeline.

Right-of-way acquisition of the adjacent properties will not be required since no new construction is required. Access to adjacent properties will be maintained via the existing roadway network. Traffic may be rerouted to the adjacent roadway to the east to FM 2978, which is included as a potential grade separation in this study.

The crossing closure is estimated to cost $50,000. The estimated public benefit calculated for the closure of Stanolind Road is $230,000 over a 10 year period, which is more than four times greater than the cost to implement the crossing closure, and $420,000 over a 20 year period, which is more than eight times greater than the implementation cost.

Rail Capacity Enhancements

Addition of Second Mainline from Spring Junction to BNSF Crossing

Currently, the UPRR Navasota Subdivision crosses the BNSF Houston Subdivision at railroad milepost 14.20, approximately one mile north of where the rail line crosses the Harris/Montgomery County line. Traffic on the BNSF Houston Subdivision from this location could enter the Houston rail network via a connection to the Navasota Subdivision, leaving the lower portion of the BNSF Houston Subdivision potentially available for alternative transportation uses, such as commuter rail.

A connector track would require construction between the Houston and Navasota Subdivisions, as would the construction of a second mainline to Spring Junction. Operating rights agreements would be required between the UPRR and the BNSF for this construction to materialize. Without the joint use of this rail corridor, double tracking this segment may not warrant consideration at this time.

The estimated cost of a second mainline from Spring Junction to the BNSF crossing on the Navasota Subdivision, as illustrated in Figures K-5 through K-7 in Appendix F, is $79,000,000. The second mainline is a level 4 long-range improvement, and should undergo further testing to determine the extent of the improvement's impact on the region's rail network, and to quantify the associated public and private benefits that may be attained.

Incidentally, should BNSF through-freight and yard operations (Pearland and New South Yards) be relocated to outlying areas, the same end result may be attainable without undertaking this improvement.

UPRR Palestine Subdivision

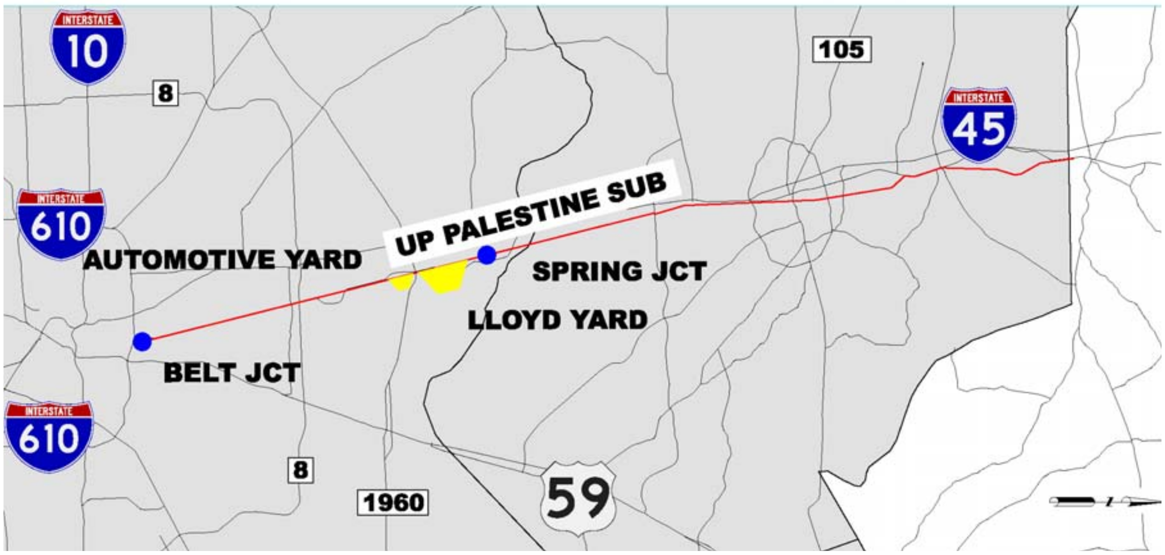


Figure 8-14: UPRR Palestine Subdivision Map

The UPRR Palestine Subdivision is approximately 229 miles in overall length, with over 48 miles contained within the study area. Predominantly a single track railroad with limited sidings, approximately 14 miles between Belt Junction and Spring, Texas has a second mainline. Between Belt Junction and Spring Junction, where the UPRR Navasota Subdivision connects to the Palestine Subdivision, the railroad is utilized in a bidirectional manner, with trains operating in both a northbound and southbound manner, averaging around 30-40 trains daily in this segment of track. From Spring Junction to Palestine, the predominant flow of traffic is outbound traveling north toward Palestine with a daily average of 8 to 10 trains.

UPRR has two rail facilities: Lloyd Yard and the Westfield Auto Facility near Spring, Texas. Westfield is an auto facility for Gulf States Toyota, and Lloyd Yard is a “Storage in Transit” (SIT) Yard, or simplistically a yard that typically stores covered hoppers and tank cars normally filled with bulk materials such as PVC powder, plastic pellets, or another commodity that is typically made in huge quantities so that manufacturing the product may be cost effective.

Vehicular traffic at times is delayed along the Palestine Subdivision, particularly in the vicinity of Spring Junction, where the Navasota Subdivision connects to the Palestine Subdivision.

The potential improvements identified for the UPRR Palestine Subdivision consist of one grade separation, four crossing closures, and two line capacity enhancements which are listed with their associated costs in Table 8-12.

Palestine Subdivision						
Grade Separations	**Improvement Classification Level**	**Estimated Cost**	**Estimated 10-year Public Benefit**	**Ratio: Benefit/ Cost**	**Estimated 20-year Public Benefit**	**Ratio: Benefit/ Cost**
Richey	3	$ 17,000,000	$ 3,400,000	0.20	$ 9,100,000	0.54
Crossing Closures	**Improvement Classification Level**	**Estimated Cost**	**Estimated 10-year Public Benefit***	**Ratio: Benefit/ Cost**	**Estimated 20-year Public Benefit***	**Ratio: Benefit/ Cost**
Caroline	3	$ 50,000	NA	NA	NA	NA
E Noble	3	$ 50,000	NA	NA	NA	NA
Main	3	$ 50,000	NA	NA	NA	NA
W Hardy	3	$ 50,000	NA	NA	NA	NA
Line Capacity Enhancements	**Improvement Classification Level**	**Estimated Cost**	**Estimated 10-year Public Benefit****	**Ratio: Benefit/ Cost**	**Estimated 20-year Public Benefit****	**Ratio: Benefit/ Cost**
Third Main: Belt Jct to Spring Jct	1	$ 104,000,000	NA	NA	NA	NA
Siding Extensions - Lloyd Yard	1	$ 4,000,000	NA	NA	NA	NA
*Public benefit could only be estimated for crossing closures which would be rerouted to a grade separated crossing. However, all crossing closures produce a public benefit of improved safety.						
**No public benefits of individual rail improvements were identified.						
Class 1 Improvements (Near-term Improvements)		$ 108,000,000	NA	NA	NA	NA
Class 3 Improvements (Separations/Closures)		$ 17,200,000	$ 3,400,000	0.20	$ 9,100,000	0.53
Total Identified Improvements		$ 125,200,000	$ 3,400,000	0.03	$ 9,100,000	0.07

Table 8-12: Palestine Subdivision Improvements

Grade Separations

Grade Separation of Richey Rd. on the Palestine Subdivision

Richey Road is currently a four-lane roadway that passes underneath the Hardy Toll Road and crosses the railroad at-grade. Approximately 10,100 daily vehicles cross the UPRR at this location. The identified four-lane overpass would separate vehicular traffic along Richey Road from the UPRR Palestine Subdivision as well as the Hardy Toll Road. In order to accomplish the identified grade separation as shown on Figure M-1 in Appendix F, the Hardy Toll Road would be reconstructed at the same elevation of the railroad track. Photos 8-59 through 8-62 show the UPRR Palestine Subdivision at Richey Road under existing conditions.

Photo 8-59: Palestine Subdivision at Richey Road (looking west)

Photo 8-60: Palestine Subdivision at Richey Road (looking south)

Photo 8-61: Palestine Subdivision at Richey Road (looking north)

Photo 8-62: Palestine Subdivision at Richey Road (looking east)

Access to the Hardy Toll Road will be achieved by constructing elevated ramps to the Richey Road overpass. Access to East Hardy Street from Richey Road will be achieved via a trumpet intersection configuration in the northeast quadrant which allows for the interchange of a two-way street to another multiple lane roadway with minimal traffic mix. Current access to adjacent properties will be maintained along Richey Road, East Hardy Street, and the Hardy Toll Road.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure M-1, while the environmental constraints are identified in the Palestine Subdivision Constraints Map on sheet 12 of 17 located in Appendix E. The environmental constraints located in the vicinity of Richey Road consist of adjacent industrial properties and wetlands. Right-of-way acquisition of the adjacent properties accounts for less than one percent of the estimated cost to implement this grade separation.

The grade separation of Richey Road is estimated to cost $17,000,000 with an estimated public benefit of $3,400,000 over a 10 year period and $9,100,000 over a 20 year period, which account for approximately 20 percent and 54 percent of the estimated cost of construction, respectively.

Crossing Closures

Crossing Closures of Caroline Street, Noble Street, Main Street, and Hardy Street on the Palestine Subdivision

Caroline, Noble, Main, and West Hardy Streets are each currently two lane roadways that cross the UPRR Palestine Subdivision east of Old Town Spring. Caroline Street provides access to and from Aldine-Westfield Road and Old Town Spring, of which the Palestine Subdivision crosses between. Closing the crossing would increase the travel distance between the two areas by less than one mile. Traffic would flow east on Caroline, south on Elm and Prairie Streets, and east on Main Street and Spring School Road to reach Aldine-Westfield Road.

East Noble Street, located at Spring Junction, provides access across the Palestine Subdivision between East Hardy Road and Old Town Spring. Closing the crossing would increase the travel distance between the two areas by about a quarter of a mile. Traffic would flow south on East Hardy Road, west on Spring School Road, and north on Main Street to reach Old Town Spring. Approximately 7,400 vehicles currently cross the UPRR at East Noble Street daily.

Main Street, located at Spring Junction, provides access across the Palestine Subdivision between East Hardy Road and Old Town Spring. Closing the crossing would increase the travel distance between the two areas by about a quarter of a mile. From Old Town Spring traffic would flow south to Spring School Road and east to East Hardy Road. Approximately 4600 vehicles currently cross the UPRR at Main Street daily.

West Hardy Road, as shown in Photo 8-63, provides a connection between Caroline and Main Streets of which the Palestine Subdivision crosses between, and is located near Spring Junction. Traffic would flow north to Caroline Street, south on Elm and Prairie Streets, and east on Main Street. Approximately 4600 vehicles currently cross the UPRR at Main Street daily.

The locations of the potential crossing closures as well as the alternative routes and associated distances are identified in Figure M-2 in Appendix F, while the environmental constraints and adjacent property uses are identified in the Palestine Subdivision Constraints Map on sheet 17 of 17 located in Appendix E. The environmental constraints located in the vicinity of these streets include residential and commercial properties, a fire station, oil and gas wells, and a church. Right-of-way acquisition of the adjacent properties will not be required since no new construction is required.

The crossing closures are each estimated to cost $50,000. The estimated public benefit could not be calculated for the closure of Caroline Street, Noble Street, Main Street, and Hardy Street because traffic would be required to reroute to other at-grade crossings; however, the closures would produce a safety benefit for the traveling public.

Photo 8-63: Palestine Subdivision at West Hardy Road (looking north)

Rail Capacity Enhancements

Addition of Third Mainline from Belt Junction to Spring Junction

In the event the BNSF would agree to operate their traffic to/from Temple, Texas on the UPRR Navasota Subdivision from Navasota on the BNSF Conroe Subdivision to Spring Junction, then on the Palestine Subdivision toward Houston, a third mainline would be required to facilitate this operation. With two current mainlines between Belt Junction and Spring Junction, without the BNSF train movements, an additional mainline may not prove to be a financially sound improvement.

The estimated cost of a third mainline from Belt Junction to Spring Junction on the UPRR Palestine Subdivision, as shown in Figures M-3 through M-6 in Appendix F, is $104,000,000 and is classified as a level 1 improvement, meaning that the improvement is a near-term rail improvement. This improvement should undergo further testing to determine the extent of the improvement's impact on the region's rail network, and to quantify the associated public and private benefits that may be attained.

Photo 8-64 shows the Palestine Subdivision at the crossing with Richey Road under existing conditions, and Photo 8-65 shows the Palestine Subdivision with the addition of a third mainline.

Photo 8-64: Before - Palestine Subdivision under Existing Conditions (looking North at Richey Road)

Photo 8-65: After - Palestine Subdivision with Identified Improvement (looking North at Richey Road)

<u>Siding Extensions – Lloyd Yard on the Palestine Subdivision</u>

Currently, there are two approximately 3,000-foot siding tracks located to the west of the Palestine Subdivision mainline tracks passing through Lloyd Yard. At their current length, they are not of sufficient length to be used as a staging area for trains inbound to Houston.

Extending the two sidings west of the mainline through Lloyd Yard to a clear length of approximately 9,000 feet; however, would provide Houston terminating trains off the Navasota Subdivision a landing slot prior to being queued into the flow of network traffic. Ultimately this would improve operations at Belt Junction while reducing mainline blockage.

The estimated cost of siding extensions for Lloyd Yard, as shown in Figure M-7 in Appendix F, is $4,000,000 and is classified as a level 1 improvement, meaning that the improvement is a near-term rail improvement. This improvement should undergo further testing to determine the extent of the improvement's impact on the region's rail network, and to quantify the associated public and private benefits that may be attained.

UPRR Popp Subdivision

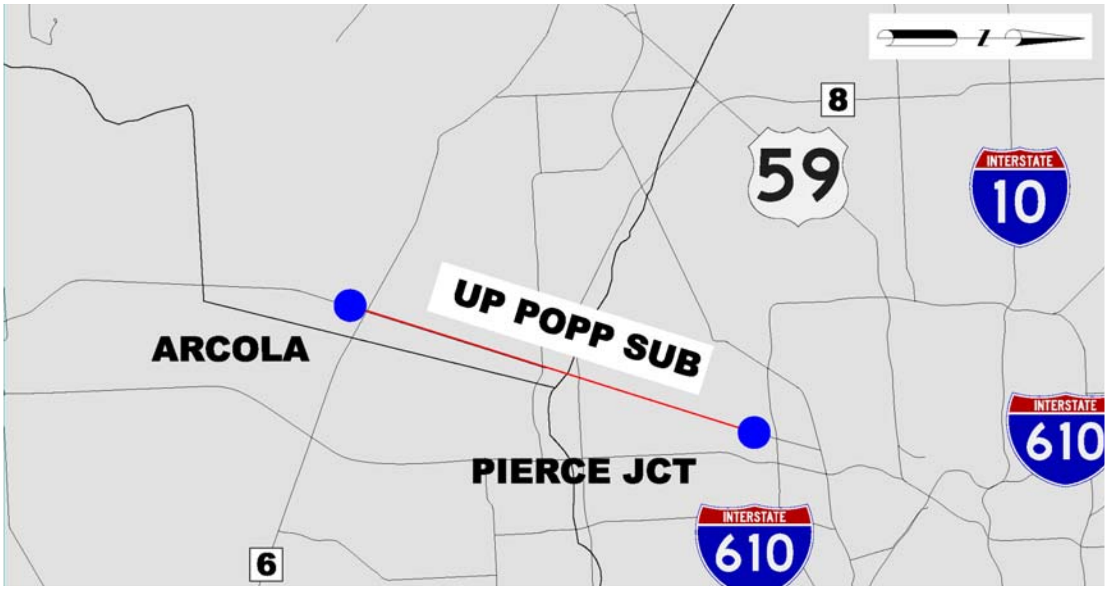


Figure 8-15: UPRR Popp Subdivision Map

Approximately 21 miles in length, all of which is within the study area, the Popp Subdivision has terminus points at Pierce Junction, (just south and west of Loop 610 and 288 respectively), and Arcola. The Subdivision is owned and operated by the Union Pacific Railroad and averages two trains daily, which typically consist of coal trains serving Houston Light and Power's (Reliant Energy) Smithers Lake Power Plant. BNSF also accesses the Smithers Lake facility near Thompson, Texas via a line from Arcola. Predominantly a single-track railroad operated with bidirectional traffic, there is an approximately 1.5-mile siding at Fresno, midway between Pierce Junction and Arcola, which permits most trains to pass each other. The potential improvements identified for the Popp Subdivision consist of two rail capacity enhancements as shown in Table 8-13.

Popp Subdivision				
Line Capacity Enhancements	**Improvement Classification Level**	**Estimated Cost**	**Estimated Public Benefit****	**Ratio: Benefit/Cost**
Second Main: Arcola to Pierce	4	$ 84,000,000	NA	NA
NE & NW Wye at Arcola	4	$ 4,000,000	NA	NA
**No public benefits of individual rail improvements were identified.				
Class 4 Improvements (Rail Capacity Additions)		$ 88,000,000	NA	NA
Total Identified Improvements		$ 88,000,000	NA	NA

Table 8-13: Popp Subdivision Improvements

Rail Capacity Enhancements

Addition of Second Mainline from Arcola to Pierce Junction

The Popp Subdivision would play a vital role in facilitating train movement in the event that the UPRR and BNSF would begin running directional traffic inbound on the Glidden Subdivision from Tower 17 (Rosenberg) to West Junction, and outbound on the BNSF Galveston Subdivision from Arcola to Tower 17.

The Popp Subdivision would require an upgrade to a double mainline facility complete with Centralized Traffic Control (CTC) signals. Ultimately, this could aid in relieving congestion on both the UPRR Glidden and BNSF Galveston Subdivisions, reducing train delays within the Houston Terminal.

The additional mainline along the Popp Subdivision, as shown in Figures N-1 through N-4 in Appendix F, is estimated to cost $84,000,000. The level 4 long-range improvement should undergo further testing to determine the extent of the improvement's impact on the region's rail network, and to quantify the associated public and private benefits that may be attained.

Construction of Connection Tracks to BNSF Galveston Subdivision at Arcola

The BNSF Galveston Subdivision crosses the UPRR Popp Subdivision at-grade with a crossing diamond, which does not allow travel between the two subdivisions. Connections from the Popp Subdivision onto the BNSF Galveston Subdivision in the Northeast and Northwest quadrants of the interchange in Arcola would facilitate movement between the subdivisions. Relocating existing BNSF operations to outlying areas may negate the need for an additional mainline between Arcola and Pierce Junction, however the construction of connecting tracks previously discussed may be required to facilitate the directional running of trains.

The estimated cost of connection tracks between the Popp Subdivision and the BNSF Galveston Subdivision, as shown in Figure N-2 in Appendix F, is $4,000,000. The level 4 long-range improvement should undergo further testing to determine the extent of the improvement's impact on the region's rail network, and to quantify the associated public and private benefits that may be attained.

PTRA Subdivisions

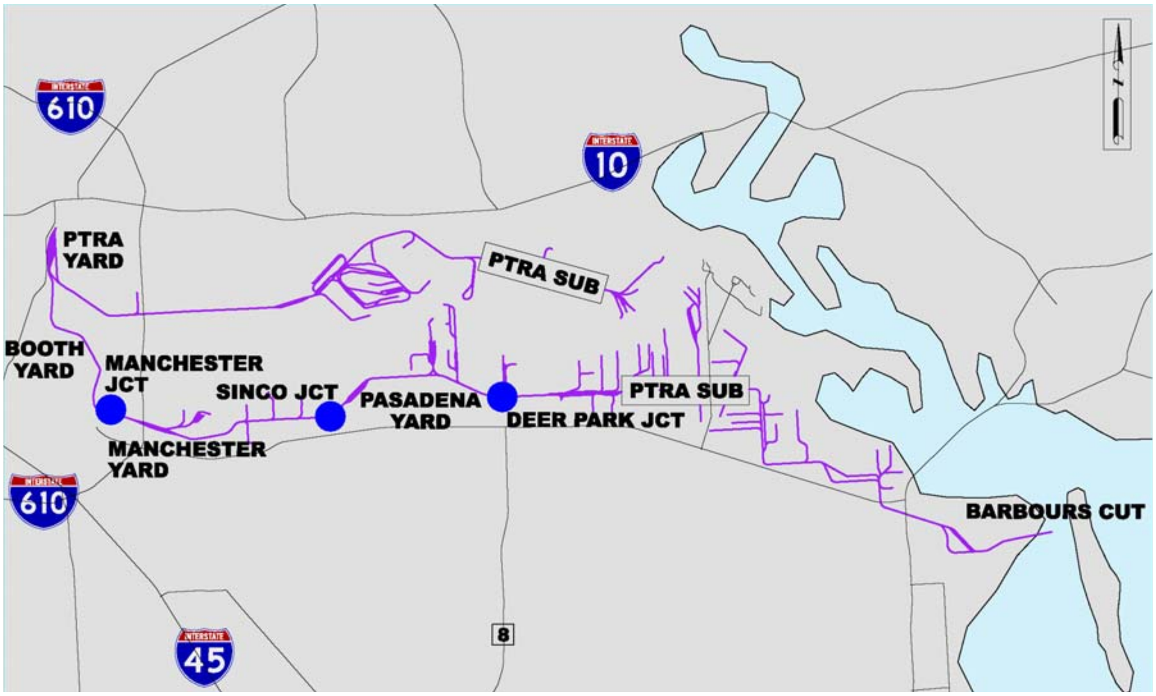


Figure 8-16: PTRA Subdivisions

The Port Terminal Railroad Association (PTRA) was formed in 1924 as an association of all railroads coming in to Houston. The PTRA provides switching service along both sides of the Houston Ship Channel. The PTRA maintains 153.9 miles of track including 46.4 miles of mainline, 22.8 on the south side, and 23.6 on the north side, all of which are included in the study area. The PTRA service area includes the world's largest chemical complex and the South's largest export grain elevators.

The PTRA splits into two separate subdivisions at the south end of North Yard. PTRA North Shore Subdivision runs east from North Yard following Clinton Drive, and PTRA Manchester Subdivision runs south parallel to the UPRR Strang mainline. The PTRA Manchester Subdivision mainline parallels the Strang Subdivision mainline from North Yard south to Bridge 5A, a single track bridge. PTRA maintains trackage rights from the UPRR across the bridge and continues to the east as a single mainline with sidings and multiple industrial tracks to terminate just past Barbour's Cut.

PTRA North Yard is the hub of the PTRA and is located in the area of the Houston Ship Channel Turning Basin adjacent to the intersection of Wayside Drive and Clinton Drive. The PTRA also includes two full service yards located on the south side of the Ship Channel: Pasadena Yard and Manchester Yard.

PTRA						
Grade Separations	**Improvement Classification Level**	**Estimated Cost**	**Estimated 10-year Public Benefit**	**Ratio: Benefit/ Cost**	**Estimated 20-year Public Benefit**	**Ratio: Benefit/ Cost**
Federal Road Blvd	3	$ 7,000,000	$ 2,300,000	0.33	$ 6,100,000	0.87
Line Capacity Enhancements	**Improvement Classification Level**	**Estimated Cost**	**Estimated 10-year Public Benefit****	**Ratio: Benefit/ Cost**	**Estimated 20-year Public Benefit****	**Ratio: Benefit/ Cost**
Second/Third Main: Galena Jct to Manchester Jct	1	$ 39,000,000	NA	NA	NA	NA
Second Main: Sinco Jct to Deer Park Jct	1	$ 28,000,000	NA	NA	NA	NA
Extend Switching Lead through North Shore Jct	1	$ 8,500,000	NA	NA	NA	NA
Expand Pasadena Yard	4	$ 8,600,000	NA	NA	NA	NA
**No public benefits of individual rail improvements were identified.						
Class 1 Improvements (Near-term Improvements)		$ 75,500,000	NA	NA	NA	NA
Class 3 Improvements (Separations/Closures)		$ 7,000,000	$ 2,300,000	0.33	$ 6,100,000	0.87
Class 4 Improvements (Rail Capacity Additions)		$ 8,600,000	NA	NA	NA	NA
Total Identified Improvements		$ 91,100,000	$ 2,300,000	0.03	$ 6,100,000	0.07

Table 8-14: PTRA Subdivision Improvements

The potential improvements identified for the PTRA Subdivisions consist of one grade separation and four rail capacity enhancements as listed in Table 8-14 with their associated costs.

Grade Separations

Grade Separation of Federal Rd on the PTRA North Shore Subdivision

Federal Road is currently a four-lane roadway that crosses the railroad at-grade in eastern Harris County. Approximately 26,300 vehicles cross the PTRA tracks just east of the American Rail Yard daily at Federal Road. The identified four-lane overpass would separate vehicular traffic along Federal Road from the PTRA North Shore Subdivision.

Access along Federal Road to and from adjacent properties will be achieved via at-grade access roads alongside the overpass as well as u-turn loops beneath the overpass on each side of the railroad.

A preliminary layout of the overpass and the adjacent property land uses are identified in Figure O-1 in Appendix F. Additional environmental constraints mapping may be required for further analysis. Some of the environmental constraints located in the vicinity of Federal Road consist of adjacent industrial properties, which consist of oil refineries and power plants. Right-of-way acquisition of the adjacent properties accounts for less than two percent of the estimated cost to implement this grade separation.

The grade separation of Federal Road is estimated to cost $7,000,000 with an estimated public benefit of $2,300,000 over a 10 year period and $6,100,000 over a 20 year period, which account for approximately 33 percent and 87 percent of the estimated cost of construction, respectively.

Rail Capacity Enhancements

Addition of Second Mainline from Galena Junction to Manchester Junction

Currently, a single track bridge (Bridge 5A) crossing Buffalo Bayou bottlenecks train traffic between Galena Junction and Manchester Junction. Constructing a new bridge over Buffalo Bayou, as shown in Figure O-2 in Appendix F, and adding a second mainline track, as shown in Figure O-3 in Appendix F, will permit the passage of trains through the area and reduce the conflict associated with trains serving the local customer base. Photos 8-66 through 8-68 show the PTRA Subdivision near Manchester Junction under existing conditions.

The estimated cost of a new bridge and a second mainline from Galena Junction to Manchester Junction on the PTRA Subdivision is $39,000,000 and is classified as a level 1 improvement, meaning that the improvement was determined to be a near-term railroad improvement. This improvement was included in Planning Case 1 of the RTC freight rail operations model, which was discussed in Section 7.

Addition of Second Mainline from Sinco Junction to Deer Park Junction

Currently, a single main track exists between Sinco Junction and Deer Park Junction, as shown in Photo 8-69. Work trains or locals providing service to the customer base typically occupy the main track, preventing trains from entering or leaving the Port area to operate on the PTRA Subdivision. The identified addition of a second mainline track will allow for the continuation of local service while allowing for the passage of additional trains, ultimately increasing rail capacity on the PTRA Subdivision and decreasing travel time.

The estimated cost of a second mainline from Sinco Junction to Deer Park Junction on the PTRA Subdivision, as shown in Figure O-4 in Appendix F, is $28,000,000 and is classified as a level 1 improvement, meaning that the improvement was determined to be a near-term railroad improvement. This improvement was included in Planning Case 1 of the RTC freight rail operations model, which was discussed in Section 7.

Photo 8-66: Tower 30 (looking west at Medina St)

Photo 8-67: Tower 30 (looking east on Medina St)

Photo 8-68: East Erath St (looking north on Medina St)

Photo 8-69 Sinco Jct to Deer Park South (looking east)

Switching Lead at the PTRA North Yard through North Shore Jct

A separate switching lead north of North Yard to Hunting Bayou should be constructed so that PTRA switch engines working the north end of North Yard can operate without requiring the use of the East Belt main tracks between North

Shore Junction and Tower 87. In the RTC model, this new lead crosses the track that connects the East Belt Subdivision to the UPRR Baytown Subdivision at North Shore Junction.

The extended switching lead, as shown in Figure O-5 in Appendix F, is estimated to cost $8,500,000 and is classified as a level 1 improvement, meaning that the improvement was determined to be a near-term railroad improvement. This improvement was included in Planning Case 1 of the RTC freight rail operations model, which was discussed in Section 7.

Expand Pasadena Yard

The PTRA Pasadena Yard, as shown in Figure O-6 in Appendix F, contains 14 tracks and is located east of the Washburn Tunnel and west of Davison Street. The expansion of Pasadena Yard would include three miles of additional yard track and a wye connection to the UPRR Strang Subdivision.

This improvement would allow trains destined for the West Coast or Mexico to be sorted and assembled from Pasadena Yard as opposed to PTRA North Yard, Settegast, or Englewood Yard, which would decrease train traffic through east Houston.

The expansion of Pasadena Yard is estimated to cost $8,600,000 and is classified as a long-range level 4 improvement. and the yard expansion should undergo further testing to determine the extent of the improvement's impact on the region's rail network, and to quantify the associated public and private benefits that may be attained.

UPRR Strang Subdivision

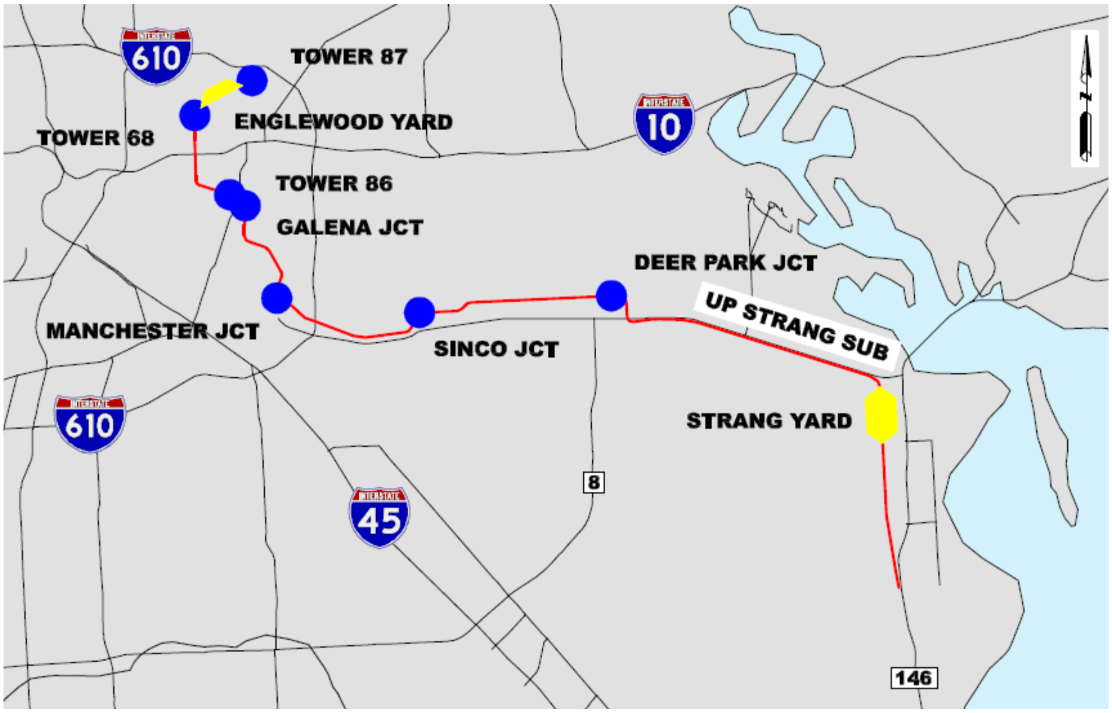


Figure 8-17: UPRR Strang Subdivision Map

The Strang Subdivision consists of approximately 21 miles of track beginning at Tower 68 near Englewood Yard to Strang. At Strang Yard, the Strang Subdivision becomes the Seabrook Industrial Lead, serving the Bayport Industrial District and the Port of Houston's Bayport Terminal. The entire line segment is within the study area, and is currently owned and operated by the Union Pacific, with trackage rights granted to the PTRA for intermodal movements.

The rail traffic along the Strang Subdivision consists of approximately 30 trains per day, is bidirectional, and travels to and from Englewood Yard and the Port of Houston. From Deer Park Junction to Strang, this line is operated as two main tracks, the second main track being the PTRA "New" main. Trains of both railroads can use either track, which is crucial in establishing the rail capacity of the Subdivision. The Port of Houston's Barbours Cut facility, the principal water/rail Intermodal Container Transfer Facility (ICTF) in Houston, is also accessed from the Strang Subdivision. Due to the large customer base served, local or industry trains often occupy the main track prohibiting the passage of additional trains. Photos 8-70 and 8-71 show the Strang Subdivision mainlines.

Photo 8-70: Strang Subdivision at North Richey (looking east)

Photo 8-71: Strang Subdivision at North Richey (looking west)

The potential improvements identified for the Strang Subdivision consist of three grade separations, six crossing closures and three line capacity enhancements which are listed with their associated costs in Table 8-15.

Strang Subdivision						
Grade Separations	**Improvement Classification Level**	**Estimated Cost**	**Estimated 10-year Public Benefit**	**Ratio: Benefit/ Cost**	**Estimated 20-year Public Benefit**	**Ratio: Benefit/ Cost**
Lyons	3	$ 5,000,000	$ 190,000	0.04	$ 480,000	0.10
Market	3	$ 4,600,000	$ 570,000	0.12	$ 1,400,000	0.30
Wallisville	3	$ 8,500,000	$ 300,000	0.04	$ 1,000,000	0.12
Crossing Closures	**Improvement Classification Level**	**Estimated Cost**	**Estimated 10-year Public Benefit***	**Ratio: Benefit/ Cost**	**Estimated 20-year Public Benefit***	**Ratio: Benefit/ Cost**
Fennell	3	$ 50,000	NA	NA	NA	NA
Frio	3	$ 50,000	NA	NA	NA	NA
Ivy	3	$ 50,000	NA	NA	NA	NA
Medina	3	$ 50,000	NA	NA	NA	NA
Old Underwood	3	$ 50,000	$ 2,000,000	40	$ 6,000,000	120
Shabbona	3	$ 50,000	NA	NA	NA	NA
Line Capacity Enhancements	**Improvement Classification Level**	**Estimated Cost**	**Estimated 10-year Public Benefit****	**Ratio: Benefit/ Cost**	**Estimated 20-year Public Benefit****	**Ratio: Benefit/ Cost**
Second Main: Tower 30 to Sinco Jct	2	$ 25,000,000	NA	NA	NA	NA
Second Main: Seabrook Industrial Lead	1	$ 13,000,000	NA	NA	NA	NA
Tower 86 Wye	2	$ 4,000,000	NA	NA	NA	NA
*Public benefit could only be estimated for crossing closures which would be rerouted to a grade separated crossing. However, all crossing closures produce a public benefit of improved safety.						
**No public benefits of individual rail improvements were identified.						
Class 1 Improvements (Near-term)		$ 13,000,000	NA	NA	NA	NA
Class 2 Improvements (Mid-range)		$ 29,000,000	NA	NA	NA	NA
Class 3 Improvements (Separations/Closures)		$ 18,400,000	$ 3,060,000	0.17	$ 8,880,000	0.48
Total Identified Improvements		$ 60,400,000	$ 3,060,000	0.05	$ 8,880,000	0.15

Table 8-15: UPRR Strang Subdivision Map

Additional improvements along the Strang Subdivision and Seabrook Industrial Lead that have been identified by the *Harris County Regional Freight Rail Improvement Plan* include the grade separation of the following crossings: 75th Street, Manchester, Light Company Road, Richey Street, South Street, Channel City Road, Shell Dock Road, Center Street, Sens Road, and Port Road. These crossings have not been included in the cost estimates for the Strang Subdivision, and may warrant further analysis.

Grade Separations

Grade Separation of Lyons Ave on the Strang Subdivision

Lyons Avenue is currently a two-lane roadway northeast of downtown Houston in Harris County. Approximately 1,700 daily vehicles cross the Strang Subdivision at this location. The identified two-lane underpass would separate vehicular traffic from the two Strang Subdivision mainlines.

A preliminary layout of the underpass as well as the adjacent property land uses are identified in Figure P-1 in Appendix F, while the environmental constraints are identified in the Downtown Subdivisions Constraints Map on sheet 16 of 39 located in Appendix E. The environmental constraints located near Lyons Avenue include commercial and industrial development as well as a church.

Access to adjacent properties along the underpass will be removed and Sam Wilson Street, Sakowitz Street, and Shotwell Street would need to be closed at the intersections with Lyons Avenue due to the construction of the grade separated ramps of the underpass. Access to adjacent properties would be maintained via the existing roadway network; however, driveways to adjacent roadways may need to be provided for certain properties. Due to the street closures, traffic may be rerouted to the north on Hershe Street, to the east on Lockwood Drive, to the west on Hoffman Street, and to the south on Farmer Street or East Freeway. Right-of-way acquisition of adjacent properties accounts for only one percent of the cost to implement this grade separation since the underpass would be constructed within existing right-of-way.

The grade separation of Lyons Avenue is estimated to cost $5,000,000 with an estimated public benefit of $190,000 over a 10 year period and $480,000 over a 20 year period, which are four percent and ten percent of the estimated cost of construction, respectively.

Grade Separation of Market Street on the Strang Subdivision

Market Street is currently a two-lane roadway northeast of downtown Houston in Harris County. Approximately 4,900 daily vehicles cross the Strang Subdivision at this location. The identified two-lane underpass would separate vehicular traffic from the two Strang Subdivision mainlines. A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure P-2 in Appendix F. Some of the constraints located near Market Street include adjacent commercial and residential properties. Additional environmental constraints mapping may be warranted for further analysis.

Access to adjacent properties along the underpass will be removed and Sakowitz Street and Shotwell Street would need to be closed at the intersections with Market Street due to the construction of the grade separated ramps of the underpass. Access to adjacent properties would be maintained via the existing roadway network, however, driveways to adjacent roadways or access roads may need to be provided for certain properties such as the residences southwest of the crossing.

Due to the street closures, traffic may be rerouted to the south on Arapahoe Street, to the east on Lockwood Drive, or to the west on Hoffman Street. Right-of-way acquisition of the adjacent commercial and industrial properties accounts for only three percent of the estimated cost to implement this grade separation, since the underpass would be constructed within existing roadway right-of-way.

The grade separation of Market Street is estimated to cost $4,600,000 with an estimated public benefit of $570,000 over a 10 year period and $1,400,000 over a 20 year period, which are 12 percent and 30 percent of the estimated cost of construction, respectively.

<u>Grade Separation of Wallisville Rd on the Strang Subdivision</u>

Wallisville Road is currently a two-lane roadway northeast of downtown Houston in Harris County. Approximately 3,700 daily vehicles cross the Strang Subdivision at this location. The identified two-lane underpass would separate vehicular traffic from the four railroad tracks which include Strang Subdivision mainlines and tracks entering Englewood Yard.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure P-3 in Appendix F, while the environmental constraints are identified in the Downtown Subdivisions Constraints Map on sheet 16 of 39 located in Appendix E. The environmental constraints located in the vicinity of Wallisville Road consist of adjacent commercial and residential properties as well as multiple railroad tracks at the south end of Englewood Yard located at Railroad Tower 68.

Access to adjacent properties along the underpass will be removed and Chew Street, Sam Wilson Street, Hoffman Street, and Hahlo Street would need to be closed at the intersections with Wallisville Road due to the construction of the grade separated ramps of the underpass. Access to adjacent properties would be maintained via the existing roadway network. Due to the street closures, traffic may be rerouted to the south on Downing Street, to the east on Lockwood Drive, or to the west on Woolworth Street. Right-of-way acquisition of adjacent commercial and industrial properties accounts for only one percent of the estimated cost to implement this grade separation, since the underpass would be constructed within existing roadway right-of-way.

The grade separation of Wallisville Road is estimated to cost $8,500,000 with an estimated public benefit of $300,000 over a 10 year period and $1,000,000 over a 20 year period, which are four percent and 12 percent of the estimated cost of construction, respectively.

Crossing Closures

Crossing Closures of Fennel Street, Frio Street, and Medina Street on the Strang Subdivision

Fennell Street, Frio Street, and Medina Street are each currently two lane roadways that cross the UPRR Strang Subdivision at-grade in the southeastern part of Houston near railroad Tower 30. These three streets provide access to and from Lawndale Street and SH 225 for the small residential area living north of the railroad. The three crossings are identified to be closed in order to reduce public safety hazards currently associated with the at-grade crossings. According to collision data received from the H-GAC and the FRA, one crash occurred at the Fennel Street crossing between 1990 and 2003.

Closing the crossings would increase the travel distance required to cross the railroad by less than one mile. Traffic would be rerouted east along Elm Street and south on Broadway Street to reach Lawndale Street and SH 225. Approximately 300 vehicles cross the railroad at Fennel Street daily, while 550 vehicles cross at Frio Street, and 5700 vehicles cross at Medina Street daily. Photo 8-72 shows Medina Street at the crossing with the Strang Subdivision.

Photo 8-72: Strang Subdivision (looking south on Medina St)

The location of the potential crossing closures as well as the alternative routes and associated distances are identified in Figure P-4 in Appendix F, while the environmental constraints and adjacent property uses are identified in the Downtown Subdivisions Constraints Map on sheet 32 of 39 located in Appendix E. The environmental constraints located in the vicinity of these streets include residential and industrial properties, churches, a school, a fire station, and two railroad junctions. Right-of-way acquisition of the adjacent properties will not be required since no new construction is required.

Access to adjacent properties will be maintained via the existing roadway network. Traffic may be rerouted to the adjacent roadway to the east to Broadway Street in order to cross the railroad.

The crossing closures are each estimated to cost $50,000. The estimated public benefit could not be calculated for the closures of Fennel Street, Frio Street, and Medina Street since traffic must be rerouted to another at-grade crossing; however, the closures would provide a safety benefit for the traveling pubic.

<u>Crossing Closure of Ivy Street and Shabbona Street on the Strang Subdivision</u>

Ivy Avenue and Shabbona Street currently cross the UPRR Strang Subdivision in the city of Deer Park in Harris County. Ivy Avenue, as shown in Photo 8-73, is a four lane roadway that provides access to and from SH 225 for the residential area living south of the railroad. Shabbona Street is currently a two lane roadway located just west of Ivy Avenue. Closing the crossings would increase the travel distance required to cross the railroad from Ivy Avenue by a little over one mile. Traffic would be rerouted south to 8th Street, west to Center Street, and north to reach SH 225. Approximately 300 vehicles cross the railroad at both Ivy Avenue and Shabbona Street daily.

The location of the potential crossing closures as well as the alternative routes and associated distances are identified in Figure P-5 in Appendix F. The primary constraint located in the vicinity of these streets is the presence of adjacent industrial properties. Additional environmental constraints mapping may be required for further analysis. Right-of-way acquisition of the adjacent properties will not be required since no new construction is required.

Access to adjacent properties will be maintained via the existing roadway network. Traffic may be rerouted to the adjacent roadway Center Street, which is located in between Shabbona Street and Ivy Avenue.

The crossing closures are each estimated to cost $50,000. The estimated public benefit could not be calculated for the closures of Ivy Avenue and Shabbona Street since traffic must be rerouted to another at-grade crossing; however, the closure would provide a safety benefit for the traveling pubic.

Photo 8-73: Strang Subdivision at Ivy Ave (looking north)

Crossing Closure of Old Underwood Road on the Strang Subdivision

Old Underwood Road is currently a two lane roadway that crosses the UPRR Strang Subdivision east of Deer Park and provides access to and from SH 225 for businesses directly south of the railroad. Closing the crossing would increase the travel distance between the points by less than one mile. Traffic would flow west on E 13th Street and north on Battleground Road to reach SH 225. Approximately 13,000 vehicles cross the railroad at Old Underwood Road daily.

The location of the potential crossing closure as well as the alternative route and associated distance is identified in Figure P-6 in Appendix F. The primary constraint located in the vicinity of this street is the presence of adjacent industrial properties. Additional environmental constraints mapping may be required for further analysis. Right-of-way acquisition of the adjacent properties will not be required since no new construction is required.

Access to adjacent properties will be maintained via the existing roadway network. Traffic may be rerouted to the adjacent roadway to the west on Battleground Road, which overpasses the railroad.

The crossing closure is estimated to cost $50,000. The estimated public benefit calculated for the closure of Old Underwood Road is $2,000,000 over a 10 year period, which is 40 times greater than the estimated cost to implement the closure, and $6,000,000 over a 20 year period, which is 120 times greater than the implementation cost.

Rail Capacity Enhancements

Addition of Second Mainline from Tower 30 to Sinco Junction

Currently, only a single main track exists between Tower 30 and Sinco Junction. Work trains or locals providing service to the customer base typically occupy the main track, preventing trains coming to or leaving the Port area to operate on the Strang Subdivision. The identified addition of a second mainline track will allow continuation of local service while allowing for passage of additional trains, ultimately increasing rail capacity within the Strang Subdivision and decreasing travel time.

The estimated cost of a second mainline from Tower 30 to Sinco Junction on the Strang Subdivision, as shown in Figure P-7 in Appendix F, is $25,000,000 and is classified as a level 2 mid-range railroad improvement. The improvements should undergo further testing to determine the extent of the improvement's impact on the region's rail network, and to quantify the associated public and private benefits that may be attained.

Strang Yard Expansion and the Addition of a Second Mainline along the Seabrook Industrial Lead

The Seabrook Industrial Lead is the main track that connects the Strang Subdivision to the Port of Houston facilities at Bayport and Barbours Cut. Constructing additional classification and receiving/departure tracks at Strang Yard will foster the operating plan that allows industry support or satellite terminals to directly serve the customer base and allow the train traffic to bypass the core yards/terminals running directly to the processing terminals outside of the Houston area.

Trains bound for Bayport with the current alignment would be required to approach the end of the line and then back up into the Bayport Intermodal Facility. With the planned expansion at Bayport, and the associated tracks internal to the terminal, this type of an operation may not be operationally effective. Adding a dedicated second mainline between Bayport and West Fairmont Parkway will facilitate this movement of traffic.

The estimated cost of a second mainline along the Seabrook Industrial Lead on the Strang Subdivision, as shown in Figure P-8 in Appendix F, is $13,000,000 and is classified as a level 1 improvement, meaning that the improvement was determined to be a near-term railroad improvement. This improvement should undergo further testing to determine the extent of the improvement's impact on the region's rail network, and to quantify the associated public and private benefits that may be attained.

Strang - East Belt Subdivision connection at the SW Quadrant (Tower 86)

Currently, the industrial lead track on the Strang Subdivision near Tower 86 does not permit northbound trains on the East Belt Subdivision to connect to the Strang Subdivision. Traffic destined for Englewood yard must currently operate to Tower 87, which is currently constrained during peak periods of train traffic.

Adding the connection track in the SW Quadrant at Tower 86 will provide an alternative route to Englewood Yard via the Strang Subdivision, allowing flexibility in the routing of train traffic which may potentially alleviate congestion not only at Tower 87, but perhaps Tower 26 as well.

The estimated cost of connection tracks between the Strang Subdivision and the East Belt Subdivision at Tower 86, as shown in Figure P-9 in Appendix F, is $4,000,000 and is classified as a level 2 improvement, meaning that the improvement was determined to be a mid-range railroad improvement. This improvement should undergo further testing to determine the extent of the improvement's impact on the region's rail network, and to quantify the associated public and private benefits that may be attained.

UPRR Terminal Subdivision

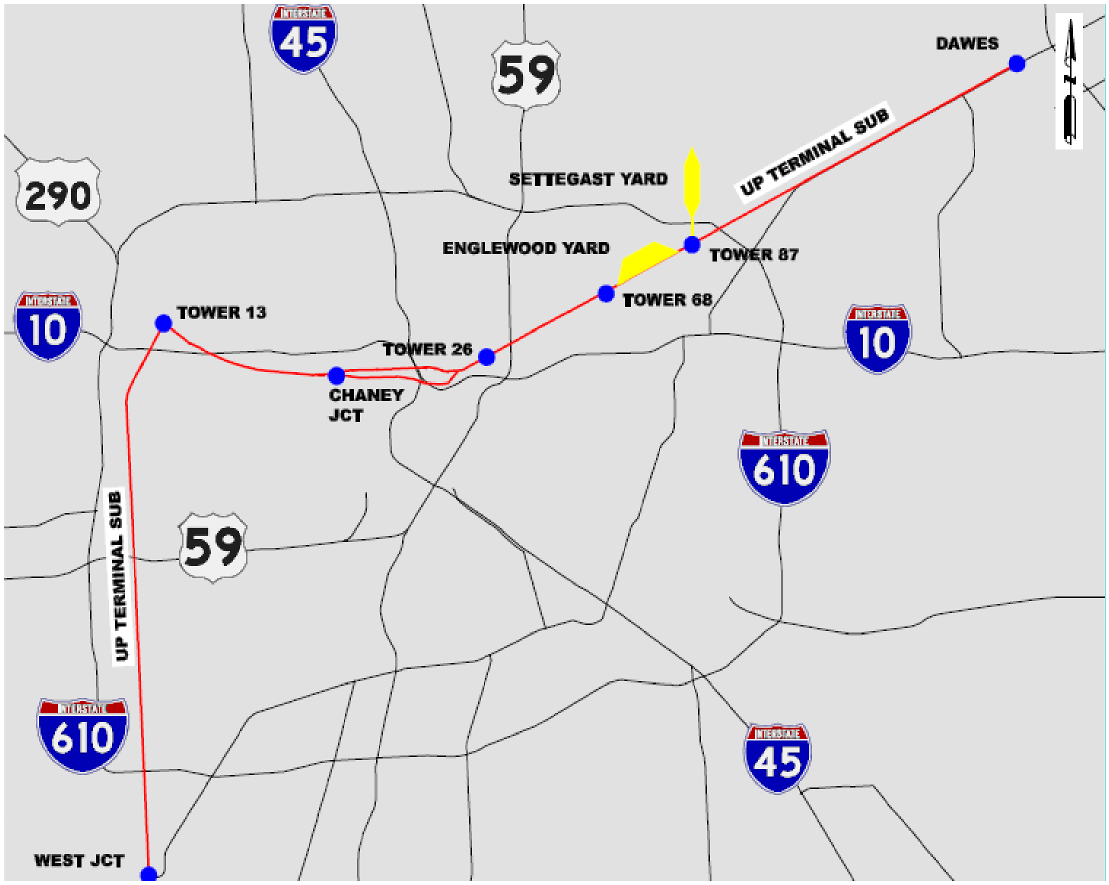


Figure 8-18: UPRR Terminal Subdivision Map

Approximately 22 miles in length, the Terminal Subdivision has terminus points at West Junction, located near the intersection of US 90 and Willowbend Boulevard, and Dawes. The entire Terminal Subdivision is within the study area. The track is owned and operated by the Union Pacific and runs 20 to 90 trains per day, depending on location. The rail traffic along the Terminal Subdivision is primarily bidirectional, traveling to and from Englewood Yard.

The Terminal Subdivision is the primary route used for connecting rail traffic from the West Coast to Houston, and is also used by Amtrak's Sunset Limited, with three trains eastbound and westbound weekly.

At Chaney Junction, which is located just north and east of the intersection of Washington Avenue and Studemont Street, the two main tracks separate from each other. The northernmost track is referred to as the Freight Main, and between Sawyer and Holly Streets, runs down the middle of Winter Street. The southernmost track is referred to as the Passenger Main and parallels Washington Avenue to the north passing by the Amtrak Station. The Freight Main and the Passenger Main reconnect just west of Tower 26.

UPRR Terminal Subdivision

Terminal Subdivision						
Grade Separations	**Improvement Classification Level**	**Estimated Cost**	**Estimated 10-year Public Benefit**	**Ratio: Benefit/ Cost**	**Estimated 20-year Public Benefit**	**Ratio: Benefit/ Cost**
Bellaire	3	$ 16,000,000	$ 5,200,000	0.33	$ 14,000,000	0.88
Houston	3	$ 13,000,000	$ 9,500,000	0.73	$ 27,000,000	2.08
Richmond	3	$ 28,000,000	$ 7,500,000	0.27	$ 19,000,000	0.68
San Felipe	3	$ 31,000,000	$ 8,400,000	0.27	$ 22,000,000	0.71
Shepherd - Durham	3	$ 29,000,000	$ 25,000,000	0.86	$ 72,000,000	2.48
TC Jester	3	$ 8,400,000	$ 2,200,000	0.26	$ 5,900,000	0.70
Westheimer	3	$ 63,000,000	$ 7,000,000	0.11	$ 18,000,000	0.29
Crossing Closures	**Improvement Classification Level**	**Estimated Cost**	**Estimated 10-year Public Benefit***	**Ratio: Benefit/ Cost**	**Estimated 20-year Public Benefit***	**Ratio: Benefit/ Cost**
Bonner	3	$ 50,000	NA	NA	NA	NA
Bringhurst (Crossing Closure with Pedestrian Bridge)	3	$ 450,000	$ 380,000	0.84	$ 940,000	2.09
Burnett	3	$ 50,000	NA	NA	NA	NA
Colorado	3	$ 50,000	$ 190,000	3.8	$ 380,000	7.6
Gregg	3	$ 50,000	$ 6,700,000	134	$ 17,000,000	340.0
Hailey	3	$ 50,000	$ 370,000	7.40	$ 920,000	18.4
Henderson	3	$ 50,000	NA	NA	NA	NA
Johnson	3	$ 50,000	$ 77,000	1.5	$ 170,000	3.4
Liberty	3	$ 50,000	$ 190,000	3.8	$ 380,000	7.6
Parker	3	$ 50,000	NA	NA	NA	NA
Roy	3	$ 50,000	NA	NA	NA	NA
Sabine	3	$ 50,000	NA	NA	NA	NA
Sherwin	3	$ 50,000	$ 170,000	3.4	$ 340,000	6.8
Thompson	3	$ 50,000	NA	NA	NA	NA
West (Crossing Closure with Pedestrian Bridge)	3	$ 450,000	NA	NA	NA	NA
Line Capacity Enhancements	**Improvement Classification Level**	**Estimated Cost**	**Estimated 10-year Public Benefit****	**Ratio: Benefit/ Cost**	**Estimated 20-year Public Benefit****	**Ratio: Benefit/ Cost**
Second Main: Chaney Jct to Tower 26	1	$ 21,000,000	NA	NA	NA	NA
Expand Englewood Yard	1	$ 5,000,000	NA	NA	NA	NA
Replace existing intermodal operations at Settegast and Englewood yards	5	$ 100,000,000	NA	NA	NA	NA
*Public benefit could only be estimated for crossing closures which would be rerouted to a grade separated crossing. However, all crossing closures produce a public benefit of improved safety.						
**No public benefits of individual rail improvements were identified.						
Class 1 Improvements (Near-term Improvements)		$ 26,000,000	NA	NA	NA	NA
Class 3 Improvements (Separations/Closures)		$ 189,950,000	$ 72,877,000	0.38	$ 198,030,000	1.04
Class 5 Improvements (Rail Relocations)		$ 100,000,000	NA	NA	NA	NA
Total Identified Improvements		$ 315,950,000	$ 72,877,000	0.23	$ 198,030,000	0.63

Table 8-16: Terminal Subdivision Improvements

The potential improvements identified for the Terminal Subdivision consist of seven grade separations, fifteen crossing closures including two pedestrian bridges, and three rail capacity enhancements which are listed with their associated costs in Table 8-16. The relocation of intermodal operations at Settegast and Englewood yards, as listed in Table 8-16, is a long-range planning alternative, which is discussed in Section 9.

Grade Separations

Grade Separation of Bellaire Boulevard on the Terminal Subdivision

Bellaire Boulevard is currently a six-lane roadway that crosses the railroad at-grade in Harris County within the City of Bellaire. Approximately 50,700 vehicles cross the UPRR Railroad at this location daily. According to collision data received from the H-GAC Traffic Safety Program and the FRA, one crash occurred at the Bellaire Boulevard crossing between 1990 and 2003. The identified six-lane overpass would separate vehicular traffic from the UPRR Terminal Subdivision. Photos 8-74 through 8-77 show the crossing of Bellaire Boulevard and the double track UPRR Terminal Subdivision.

Access to adjacent properties will be maintained via at-grade access roads alongside the main roadway along with at-grade u-turns located beneath the overpass on the east side of the railroad.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure Q-1 in Appendix F. The primary constraints located in the vicinity of Bellaire Boulevard include adjacent residential, industrial, and public and institutional properties and wetlands. Additional environmental constraints mapping may be required for further analysis. Right-of-way acquisition of the adjacent properties accounts for approximately 45 percent of the estimated cost to implement this grade separation.

The grade separation of Bellaire Boulevard is estimated to cost $16,000,000. The estimated public benefit calculated for the grade separation of Bellaire Boulevard is $5,200,000 over a 10 year period, which is approximately 33 percent of the estimated cost of construction, and $14,000,000 over a 20 year period, which is 88 percent of the construction cost.

Photo 8-74: Terminal Subdivision at Bellaire Blvd (looking east)

Photo 8-75: Terminal Subdivision at Bellaire Blvd (looking west)

Photo 8-76: Terminal Subdivision at Bellaire Blvd (looking north)

Photo 8-77: Terminal Subdivision at Bellaire Blvd (looking south)

Grade Separation of Houston Avenue on the Terminal Subdivision

Houston Avenue is currently a four-lane roadway that crosses the UPRR Terminal Subdivision freight mainline at-grade and underpasses the UPRR Terminal Subdivision passenger mainline in Harris County within Houston, located south of Interstate 10 and north of Memorial Drive. Approximately 33,600 vehicles and a METRO bus route cross the UPRR Railroad at Houston Avenue daily. According to collision data received from the H-GAC Traffic Safety Program and the FRA, two crashes occurred at the Houston Avenue crossing between 1990 and 2003. Photos 8-78 through 8-81 show the crossing of Houston Avenue and the UPRR Terminal Subdivision freight mainline.

Grade separating Houston Avenue underneath the Terminal Subdivision freight mainline would separate vehicular traffic from the UPRR Terminal Subdivision freight traffic. The existing underpass on the Terminal Subdivision Passenger Main would be removed and Houston Avenue would cross these tracks at-grade. The existing underpass would have to be removed due to the design requirements (the change in grade, or in other words the slope of the roadway) of the new grade separation. Leaving the existing underpass in place would require too steep of a slope of the roadway. It is anticipated that with the potential double tracking of the freight mainline that the passenger mainline would be used to service local customers only and would have less rail traffic than the freight mainlines.

The grade separation of Houston Avenue would conflict with the existing METRO bus route that runs along Crockett Street and crosses Houston Avenue. The bus route would either be required to follow the at-grade access road and loop underneath the Houston Avenue overpass, or reroute to the adjacent street to the north, Shearne Street to cross Houston Avenue.

Access to adjacent properties will be maintained via an at-grade access road alongside the main roadway along with an at-grade u-turn located above the underpass on the north side of the freight mainline. Adjacent properties on the south side of the freight mainline are able to access Houston Avenue via Edwards Street, or along Houston Avenue which will remain at-grade south of Edwards Street.

A preliminary layout of the underpass as well as the adjacent property land uses are identified in Figure Q-2 in Appendix F, while the environmental constraints are identified in the Downtown Subdivisions Constraints Map on sheet 19 of 39 located in Appendix E. The environmental constraints located in the vicinity of Houston Avenue consist of adjacent residential, commercial, and industrial properties, churches, a school, a fire station, and a leaking petroleum storage tank. Right-of-way acquisition of the adjacent properties accounts for approximately 31 percent of the estimated cost to implement this grade separation.

The grade separation of Houston Avenue is estimated to cost $13,000,000. The estimated public benefit calculated for the grade separation of Houston Avenue is $9,500,000 over a 10 year period, which is approximately 73 percent of the estimated cost of construction, and $14,000,000 over a 20 year period, which is more than two times greater than the construction cost.

Photo 8-78: Terminal Subdivision at Houston Ave (looking south)

Photo 8-79: Terminal Subdivision at Houston Ave (looking west)

Photo 8-80: Terminal Subdivision at Houston Ave (looking east)

Photo 8-81: Terminal Subdivision at Houston Ave (looking north)

Grade Separation of Richmond Avenue on the Terminal Subdivision

Richmond Avenue, a major east-west arterial that extends from downtown to west Houston, is currently a six-lane roadway that crosses the railroad at-grade in Harris County within Houston, inside Loop 610. Approximately 47,000 vehicles cross the UPRR at this location daily. The identified six-lane overpass would separate vehicular traffic from the UPRR Terminal Subdivision. Approximately 33,600 vehicles and a METRO bus route cross the UPRR Railroad at Houston Avenue daily. According to collision data received from the H-GAC Traffic Safety Program and the FRA, two crashes occurred at the Richmond Avenue crossing between 1990 and 2003. Photos 8-82 through 8-85 show the crossing of Richmond Avenue and the double track UPRR Terminal Subdivision.

A preliminary layout of the underpass as well as the adjacent property land uses are identified in Figure Q-3 in Appendix F. The environmental constraints located in the vicinity of Richmond Avenue include adjacent residential, commercial, and industrial properties. Additional environmental constraints mapping may be required for further analysis.

Access to adjacent properties will be maintained via access roads alongside the main roadway along with at-grade u-turns located beneath the overpass on each side of the railroad. Right-of-way acquisition of the adjacent properties accounts for approximately 68 percent of the estimated cost to implement this grade separation.

The grade separation of Richmond Avenue is estimated to cost $28,000,000. The estimated public benefit calculated for the grade separation of Richmond Avenue is $7,500,000 over a 10 year period, which is approximately 27 percent of the estimated cost of construction, and $19,000,000 over a 20 year period, which is 68 percent of the construction cost.

Photo 8-82: Terminal Subdivision at Richmond Ave (looking west)

Photo 8-83: Terminal Subdivision at Richmond Ave (looking north)

Photo 8-84: Terminal Subdivision at Richmond Ave (looking south)

Photo 8-85: Terminal Subdivision at Richmond Ave (looking east)

Grade Separation of San Felipe St on the Terminal Subdivision

San Felipe Street is currently a four-lane roadway that crosses the railroad at-grade in Harris County in the Uptown District of west Houston near Loop 610. Approximately 44,500 vehicles cross the UPRR at this location daily. The identified four-lane overpass would separate vehicular traffic from the UPRR Terminal Subdivision. According to collision data received from the H-GAC Traffic Safety Program and the FRA, one crash occurred at the San Felipe Street crossing between 1990 and 2003. Photos 8-86 through 8-89 show the crossing of San Felipe Street and the double track UPRR Terminal Subdivision.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure Q-4 in Appendix F. The environmental constraints located in the vicinity of San Felipe Street include adjacent residential (single and multi-family), commercial, and industrial properties. Additional environmental constraints mapping may be required for further analysis. Right-of-way acquisition of the adjacent properties accounts for approximately 77 percent of the estimated cost to implement this grade separation. Access to adjacent properties will be maintained via at-grade access roads alongside the main roadway along with at-grade u-turns located beneath the overpass on each side of the railroad.

The grade separation of San Felipe Street is estimated to cost $31,000,000. The estimated public benefit calculated for the grade separation of San Felipe Street is $8,400,000 over a 10 year period, which is approximately 27 percent of the estimated cost of construction, and $22,000,000 over a 20 year period, which is 71 percent of the construction cost.

Photo 8-86: Terminal Subdivision at San Felipe St (looking west)

Photo 8-87: Terminal Subdivision at San Felipe St (looking south)

Photo 8-88: Terminal Subdivision at San Felipe St (looking north)

Photo 8-89: Terminal Subdivision at San Felipe St (looking east)

Grade Separation of Shepherd Dr and Durham Dr on the Terminal Subdivision

Shepherd Drive and Durham Drive are currently four-lane roadways that cross the railroad at-grade in Harris County, located west of downtown, inside Loop 610 and south of Interstate 10. These two streets operate as one-way pairs, with northbound traffic including a METRO bus route traveling on Shepherd Drive, and southbound traffic including a METRO bus route on Durham Drive. A combined average of 62,900 vehicles cross the railroad at these locations daily. Photos 8-90 through 8-97 show the crossing of Shepherd Drive and Durham Drive and the double track UPRR Terminal Subdivision. These one way pairs are identified to be combined into a single overpass over the Terminal Subdivision, which would separate vehicular traffic from the railroad.

Access for properties east of Shepherd Drive will be maintained by an at-grade access road which would run alongside the overpass. Access for properties west of Durham Drive would remain unchanged. Access for many of the properties in between Shepherd Drive and Durham Drive would be eliminated, which has been accounted for in the costs of right-of-way acquisition.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure Q-5 in Appendix F. The environmental constraints located in the vicinity of Shepherd Drive and Durham Drive include adjacent residential, commercial, and industrial properties. Additional environmental constraints mapping may be required for further analysis. Right-of-way acquisition of the adjacent properties accounts for approximately 49 percent of the estimated cost to implement this grade separation.

The grade separation of Shepherd Drive and Durham Drive is estimated to cost $29,000,000. The estimated public benefit calculated for the grade separation of Shepherd Drive and Durham Drive is $25,000,000 over a 10 year period, which is approximately 86 percent of the estimated cost of construction, and $72,000,000 over a 20 year period, which is more than two times greater than the construction cost.

Photo 8-90: Terminal Subdivision at Durham Dr (looking south)


Photo 8-91: Terminal Subdivision at Durham Dr (looking west)

Photo 8-92: Terminal Subdivision at Durham Dr (looking east)

Photo 8-93: Terminal Subdivision at Durham Dr (looking north)

Photo 8-94: Terminal Subdivision at Shepherd Dr (looking north)

Photo 8-95: Terminal Subdivision at Shepherd Dr (looking west)

Photo 8-96: Terminal Subdivision at Shepherd Dr (looking east)

Photo 8-97: Terminal Subdivision at Shepherd Dr (looking south)

Grade Separation of TC Jester Blvd on the Terminal Subdivision

TC Jester Boulevard, a major north-south arterial located inside Loop 610, is currently a four-lane roadway that crosses the railroad at-grade in Harris County. The grade separation location is immediately south of Interstate 10. Approximately 8,000 vehicles and a METRO bus route cross the UPRR at this location daily. The identified four-lane overpass would separate vehicular traffic from the UPRR Terminal Subdivision. Photos 8-98 through 8-101 show the crossing of TC Jester Boulevard and the double track Terminal Subdivision.

Access to adjacent properties will be maintained via at-grade access roads alongside the main roadway along with at-grade u-turns located beneath the overpass on each side of the railroad.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure Q-6 in Appendix F. The environmental constraints located in the vicinity of TC Jester Blvd include adjacent residential, commercial, and industrial properties. Additional environmental constraints mapping may be required for further analysis. Right-of-way acquisition of the adjacent properties accounts for approximately 28 percent of the estimated cost to implement this grade separation.

The grade separation of TC Jester Blvd is estimated to cost $8,400,000. The estimated public benefit calculated for the grade separation of TC Jester Blvd is $2,200,000 over a 10 year period, which is approximately 26 percent of the cost of construction, and $5,900,000 over a 20 year period, which is 70 percent of the construction cost.

Photo 8-98: Terminal Subdivision at TC Jester Blvd (looking south)

Photo 8-99: Terminal Subdivision at TC Jester Blvd (looking west)

Photo 8-100: Terminal Subdivision at TC Jester Blvd (looking east)

Photo 8-101: Terminal Subdivision at TC Jester Blvd (looking north)

Grade Separation of Westheimer Road on the Terminal Subdivision

Westheimer Road is a six-lane roadway that crosses the railroad at-grade in Harris County within Houston, located inside of Loop 610. Westheimer Road is a major east-west arterial that traverses Houston from downtown to Houston's Uptown District. Approximately 44,900 vehicles cross the UPRR at this location daily. According to collision data received from the H-GAC and the FRA, one crash occurred at the Westheimer Road crossing between 1990 and 2003.

The identified six-lane overpass would separate vehicular traffic from the UPRR Terminal Subdivision. Photos 8-102 through 8-105 show the crossing of Westheimer Road and the double track UPRR Terminal Subdivision.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure Q-7 in Appendix F. The environmental constraints located in the vicinity of Westheimer Road include adjacent residential and commercial properties, many of which are very high in value. The properties include apartment homes, commercial offices, and retail shopping centers. Additional environmental constraints mapping may be required for further analysis.

Access to adjacent properties will be maintained via access roads alongside the main roadway along with at-grade u-turns located beneath the overpass on each side of the railroad. Right-of-way acquisition of the adjacent properties accounts for approximately 88 percent of the estimated implementation cost.

The grade separation of Westheimer Road is estimated to cost $63,000,000. The estimated public benefit calculated for the grade separation of Westheimer Road is $7,000,000 over a 10 year period, which is approximately 11 percent of the estimated cost of construction, and $18,000,000 over a 20 year period, which is 29 percent of the construction cost.

Photo 8-102: Terminal Subdivision at Westheimer Rd (looking west)

Photo 8-103: Terminal Subdivision at Westheimer Rd (looking north)

Photo 8-104: Terminal Subdivision at Westheimer Rd (looking south)

Photo 8-105: Terminal Subdivision at Westheimer Rd (looking east)

Crossing Closures

<u>Crossing Closure of Bonner Street, Parker Street, Roy Street, and Thompson Street on the Terminal Subdivision</u>

Bonner Street, Parker Street, Roy Street, and Thompson Street are each currently two lane roadways that cross the UPRR Terminal Subdivision south of I-10 in Houston. Approximately 300 vehicles cross the railroad daily at each of these locations. These four roadways provide access to and from Washington Avenue for the residential, commercial, and industrial areas to the north of the Terminal Subdivision. Photo 8-106 shows the at-grade crossing of Roy Street and the UPRR Terminal Subdivision. Closing these crossings would increase the travel distance to access Washington Avenue by less than one mile.

Due to the closures of Bonner Street and Thompson Street, traffic would be rerouted west on Schuler Street and south on Patterson Street to reach Washington Avenue. Due to the closure of Parker Street, traffic would be rerouted west on Schuler and south on Durham Drive to travel to Washington Avenue from Parker Street. Due to the closure of Roy Street, traffic would be rerouted east on Allen Street, south on Durham Drive, and west on Schuler Street to travel from I-10 to Washington Avenue via Roy Street.

Photo 8-106: Terminal Subdivision at Roy St (looking south)

The locations of the potential crossing closures as well as the alternative routes and associated distances are identified in Figure Q-8 in Appendix F. The environmental constraints located in the vicinity of these streets include residential and commercial properties and a fire station located north of I-10. Additional environmental constraints mapping may be required for further analysis. Right-of-way acquisition of the adjacent properties will not be required since no new construction is required.

The crossing closures are each estimated to cost $50,000. The estimated public benefit could not be calculated for the closure of Bonner, Parker, Roy, and Thompson Streets because traffic would be required to reroute to other at-grade crossings; however, the closures would produce a safety benefit for the traveling public.

<u>Crossing Closure/Pedestrian Bridge of Bringhurst Street on the Terminal Subdivision</u>

Bringhurst Street is currently a two lane roadway that crosses the UPRR Terminal Subdivision east of US 59 and north of I-10 in Houston. Approximately 300 vehicles cross the railroad at this location daily. According to collision data received from the H-GAC Traffic Safety Program and the FRA, one crash occurred at the Bringhurst Street crossing between 1990 and 2003. Bringhurst Street provides access for residents north of the railroad to and from schools south of the Terminal Subdivision. Photo 8-107 shows the at-grade crossing of Bringhurst Street and the UPRR Terminal Subdivision.

Bringhurst Street is identified to be closed and provided with a pedestrian bridge at the intersection with the UPRR Terminal Subdivision. The proposed pedestrian bridge would overpass the railroad and separate pedestrian traffic from the railroad, thereby reducing public safety hazards associated with the existing at-grade crossing.

The location of the potential crossing closure and pedestrian bridge as well as the alternative route and associated distance is identified in Figure Q-9 in Appendix F, while the environmental constraints and adjacent property uses are identified in the Downtown Subdivisions Constraints Map on sheet 15 of 39 located in Appendix E. Some of the environmental constraints located in the vicinity of Bringhurst Street are residential properties, churches, schools, and a fire station. Right-of-way acquisition of the adjacent residential properties should be minimal, if required at all, since the pedestrian bridge should be able to be constructed within the existing right-of-way of Bringhurst Street.

Access to adjacent properties will be maintained via the existing roadway network. Traffic may be rerouted to the west along either Lyons Avenue or Liberty Road toward US 59 which overpasses the railroad.

The crossing closure at Bringhurst Street is estimated to cost $50,000, while the pedestrian bridge is estimated at $400,000. The estimated public benefit calculated for the closure of Bringhurst Street is $380,000 over a 10 year period, which is 84 percent of the estimated cost to implement the closure and pedestrian bridge, and $940,000 over a 20 year period, which is more than two times greater than the implementation cost.

Photo 8-107: Terminal Subdivision at Bringhurst St (looking south)

<u>Crossing Closure of Burnett Street on the Terminal Subdivision</u>

Burnett Street is currently a two lane roadway that crosses the UPRR Terminal Subdivision north of I-10 and east of I-45 in Houston. Accommodating approximately 300 daily vehicles, Burnett Street provides access to and from residential and industrial areas to the north of the Terminal Subdivision. Photo 8-108 shows the at-grade crossing of Burnett Street and the UPRR Terminal Subdivision.

Closing the crossing would increase the travel distance to access these residences and businesses from Main Street by less than one-half mile. The vehicular traffic along Burnett Street could be rerouted to cross the railroad at Main Street.

The location of the potential crossing closure as well as the alternative route and associated distance is identified in Figure Q-10 in Appendix F, while the environmental constraints and adjacent property uses are identified in the Downtown Subdivisions Constraints Map on sheet 20 of 39 located in Appendix E. The environmental constraints identified in the vicinity of this street consist of transmission lines and adjacent industrial properties. Right-of-way acquisition of adjacent properties will not be required since no new construction is required.

The crossing closure is estimated to cost $50,000. The estimated public benefit could not be calculated for the closure of Burnett Street since traffic would be rerouted to another at-grade crossing; however, the closure would produce a safety benefit for the traveling public.

Photo 8-108: Terminal Subdivision at Burnett St (looking west)

<u>Crossing Closures of Colorado Street, Henderson Street, Johnson Street, and Sabine Street on the Terminal Subdivision</u>

Colorado, Henderson, Johnson, and Sabine Streets are each north-south running roadways that cross the Terminal Subdivision north of I-10 and west of I-45 in Houston. According to collision data received from the H-GAC and the FRA, one crash occurred at the Henderson Street, and two crashes have occurred at the Johnson Street crossing between 1990 and 2003.

Colorado Street and Johnson Street are each currently two-lane roadways north of the railroad and a four-lane roadways south of the railroad that provide access to and from residential and industrial areas. Closing the crossings would increase the travel distance to access these residences by less than one-half mile. Approximately 300 vehicles cross the railroad at both Colorado and Johnson Streets daily. Traffic could be redirected east on Shearne Street, south on Houston Street to overpass the railroad, and west on Edwards Street to access the other side of Colorado Street. Photo 8-110 shows the at-grade crossing of Johnson Street and the UPRR Terminal Subdivision.

Henderson Street is a two lane roadway that provides access to and from industrial areas along the roadway, at which approximately 3,100 vehicles per day cross the railroad. Closing the Henderson Street crossing would increase the travel distance to access these businesses by less than one-half mile, as traffic could be rerouted west on Summer Street and south on Sawyer Street. Photo 8-109 shows the at-grade crossing of Henderson Street and the UPRR Terminal Subdivision.

Photo 8-109: Terminal Subdivision at Henderson St (looking south)

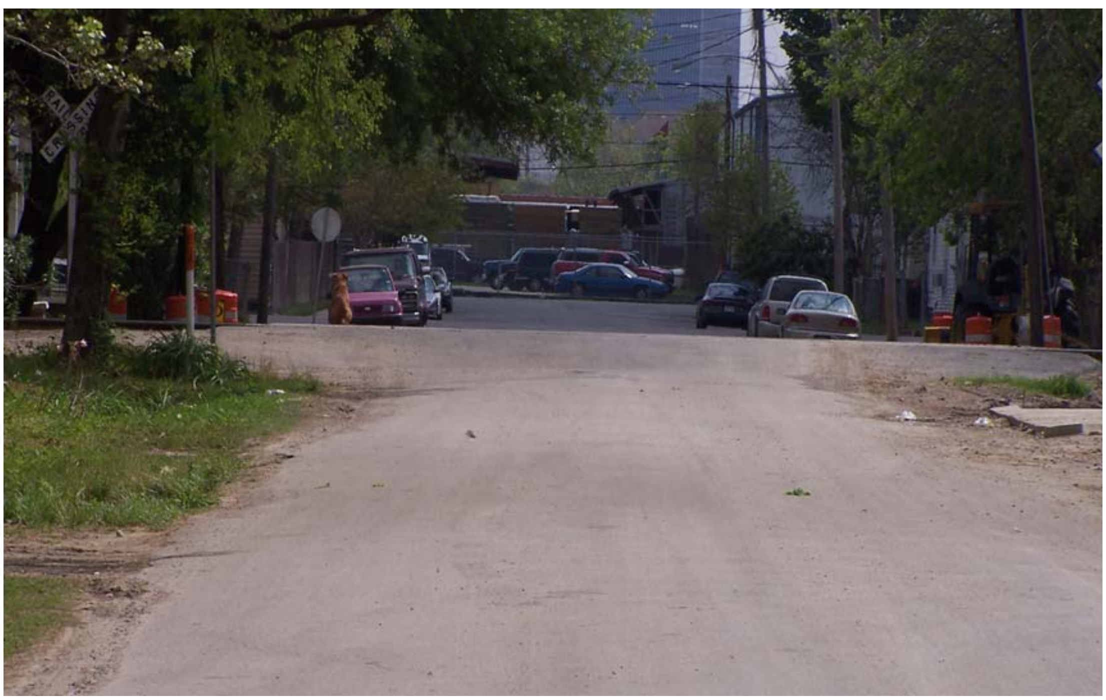


Photo 8-110: Terminal Subdivision at Johnson St (looking south)

Sabine Street is currently a two-lane roadway north of the railroad and a four-lane roadway south of the railroad that provides access to and from residential and industrial areas. Approximately 300 vehicles cross the railroad at Colorado Street daily. Closing the crossing would increase the travel distance to access these residences by less than one-half mile. Traffic could be redirected west on Summer Street, south on Silver Street, and east on Bingham Street to access the other side of Sabine Street. Photo 8-111 shows the at-grade crossing of Sabine Street and the UPRR Terminal Subdivision.

Photo 8-111: Terminal Subdivision at Sabine St (looking south)

The locations of the potential crossing closures as well as the alternative routes and associated distances are identified in Figure Q-11 in Appendix F, while the environmental constraints and adjacent property uses are identified in the Downtown Subdivisions Constraints Map on sheet 19 of 39 located in Appendix E. Some of the environmental constraints located in the vicinity of Colorado, Henderson, Johnson, and Sabine Streets are commercial and industrial properties, churches, schools, and fire stations. Right-of-way acquisition of the adjacent properties will not be required since no new construction is required.

The crossing closures are each estimated to cost $50,000. The estimated public benefit calculated for the closure of Colorado Street is $190,000 over a 10 year period, which is more than three times greater than the estimated cost to implement the crossing closure, and $380,000 over a 20 year period, which is more than seven times greater than the implementation cost.

The estimated public benefit calculated for the closure of Johnson Street is $80,000 over a 10 year period, which is 60 percent greater than the estimated cost to implement the crossing closure, and $170,000 over a 20 year period, which is more than three times greater than the implementation cost.

The estimated public benefit could not be calculated for the crossing closures of Henderson Street and Sabine Street since traffic would be rerouted to other at-grade crossings; however, the closures would produce a safety benefit for the traveling public.

Crossing Closures of Gregg Street and Hailey Street on the Terminal Subdivision

Gregg Street and Hailey Street are each currently two lane roadways that cross the UPRR Terminal Subdivision east of US 59 and north of I-10 in Houston. Approximately 5,300 vehicles per day cross the railroad at Gregg Street, which provides access for residents north of the railroad to and from schools south of the Terminal Subdivision. Approximately 280[5] vehicles cross the railroad at Hailey Street daily, which is directly adjacent to Gregg Street.

Closing the crossings would increase the travel distance to the schools by approximately two miles. However, pedestrian access across the railroad is maintained via a proposed pedestrian bridge located at Bringhurst Street, approximately 500 feet east of Gregg Street. Photos 8-112 and 8-113 show the at-grade crossings of Gregg Street and Hailey Street, respectively, at the Terminal Subdivision under existing conditions.

With the closures of Gregg Street and Hailey Street, traffic may be redirected west on Liberty Road or Lyons Avenue toward the US 59 overpass in order to cross the railroad. Delays to fire response from the station south of the Terminal Subdivision may occur for residents north of the tracks.

The locations of the potential crossing closures as well as the alternative routes and associated distances are identified in Figure Q-9 in Appendix F, while the environmental constraints and adjacent property uses are identified in Downtown Subdivisions Constraints Map sheet 15 of 39 located in Appendix E. Some of the environmental constraints located in the vicinity of Gregg Street and Hailey Street are residential properties, churches, schools, and a fire station.

[5] Per TTI, this default value is used when AADT data is not available.

Photo 8-112: Terminal Subdivision at Gregg St (looking south)

Photo 8-113: Terminal Subdivision at Hailey St (looking south)

The crossing closures are each estimated to cost $50,000. The estimated public benefit calculated for the closure of Gregg Street is $6,600,000 over a 10 year period, which is over 130 times greater than the estimated cost to implement the crossing closure, and $17,000,000 over a 20 year period, which is 340 times greater than the implementation cost. The estimated public benefit calculated for the closure of Hailey Street is $370,000, which is over seven times greater than the estimated cost to implement the crossing closure.

Alternatives to closing the Gregg Street crossing have also been analyzed, and consist of adding an estimated $700,000 four-quadrant crossing gate system if the crossing is determined to remain at-grade, or grade separating the crossing for an estimated cost of $6,600,000 as shown in Figure Q-21 in Appendix F.

The identified underpass would create a grade separated crossing for traffic between residential areas north of the railroad and the nearby schools, churches, and fire station south of the railroad. The estimated public benefit of grade separating Gregg Street is $6,600,000 over a 10 year period, which is equal to the construction cost, and $17,000,000 over a 20 year period, which is more than two times greater than the estimated construction cost. Grade separating the Gregg Street crossing may also negate the need to provide a pedestrian bridge at Bringhurst Street as identified in this study.

Crossing Closure of Liberty Road on the Terminal Subdivision

Liberty Road is currently a two lane roadway that crosses the UPRR Terminal Subdivision in northeast Houston and provides access to businesses east of the Terminal Subdivision from Loop 610. Closing the crossing would increase the travel distance to access these businesses from Liberty Road by approximately two miles. Approximately 300 vehicles cross the railroad at Liberty Road daily.

The location of the potential crossing closure as well as the alternative route and associated distance is identified in Figure Q-12 in Appendix F, while the environmental constraints and adjacent property uses are identified in Downtown Subdivisions Constraints Map sheet 09 of 39 located in Appendix E. The environmental constraints identified in the vicinity of this street consist of adjacent industrial properties and a leaking petroleum storage tank. Right-of-way acquisition of the adjacent properties will not be required since no new construction is required.

Access to adjacent properties will be maintained via the existing roadway network. Traffic could be rerouted from the Liberty Road crossing to Mesa Drive, which is the adjacent roadway to the east that underpasses the railroad.

The crossing closure is estimated to cost $50,000. The estimated public benefit calculated for the closure of Liberty Road is $190,000 over a 10 year period, which is over three times greater than the estimated cost to implement the crossing closure, and $380,000 over a 20 year period, which is more than seven times greater than the implementation cost. Photo 8-114 shows the at-grade crossing of Liberty Road at the Terminal Subdivision under existing conditions.

Photo 8-114: Terminal Subdivision at Liberty Rd (looking east on Fields)

<u>Crossing Closure of Sherwin Street on Terminal Subdivision</u>

Sherwin Street is currently a one-lane entrance ramp to the I-10 frontage road that crosses the UPRR Terminal Subdivision north of I-10 and east of Loop 610 West in Houston. Approximately 300 vehicles cross the railroad at Sherwin Street daily. According to collision data received from H-GAC Traffic Safety Program and the FRA, one crash has occurred at the Sherwin Street crossing between 1990 and 2003.

Closing the crossing would increase the travel distance from the residential properties north of the UPRR Terminal Subdivision to access I-10 by approximately one mile. Photos 8-115 and 8-116 show the at-grade crossing of Sherwin Street at the Terminal Subdivision under existing conditions.

The location of the potential crossing closure as well as the alternative route and associated distance is identified in Figure Q-13 in Appendix F. The environmental constraints identified in the vicinity of this street include adjacent industrial and residential properties. Additional environmental constraints mapping may be required for further analysis. Right-of-way acquisition of the adjacent properties will not be required since no new construction is required. Access to adjacent properties will be maintained via the existing roadway network. Traffic could be rerouted east on Larkin Street, south on TC Jester Boulevard, and west onto the I-10 westbound entrance ramp to reach the freeway.

The crossing closure is estimated to cost $50,000. The estimated public benefit calculated for the closure of Sherwin Street is $170,000 over a 10 year period, which is over three times greater than the estimated cost to implement the crossing closure, and $340,000 over a 20 year period, which is more than six times greater than the implementation cost.

Photo 8-115: Terminal Subdivision at Sherwin St (looking south)

Photo 8-116: Terminal Subdivision at Sherwin St (looking north)

Crossing Closure/Pedestrian Bridge of West Street on the Terminal Subdivision

West Street is currently a two lane roadway that crosses both the UPRR Terminal Subdivision and the Houston West Belt Subdivision north of I-10 and west of US 59 in Houston. West Street provides local access to and from residential and commercial areas around the railroads. Approximately 300 vehicles cross the railroad at this location daily. Photo 8-117 shows the at-grade crossing of West Street at the Terminal Subdivision under existing conditions.

Photo 8-117: Terminal Subdivision at West St (looking south)

According to collision data received from the H-GAC and the FRA, one crash occurred at the West Street crossing between 1990 and 2003. West Street is identified to be closed and provided with a pedestrian bridge at the intersection with the railroad. The proposed pedestrian bridge would overpass the railroad and separate pedestrian traffic from the UPRR Terminal Subdivision, thereby reducing public safety hazards associated with the existing at-grade crossing.

The location of the potential crossing closure and pedestrian bridge as well as the alternative route and associated distance is identified in Figure Q-14 in Appendix F, while the environmental constraints and adjacent property uses are identified in Downtown Subdivisions Constraints Map sheet 14, 15, and 20 of 39 located in Appendix E. Constraints located in the vicinity of West Street include residential and industrial properties, churches, schools, and fire stations.

Access to adjacent properties will be maintained via the existing roadway network. Traffic may be rerouted to the east along Mills Street, south on Jensen Drive, and west on Lyons Avenue to cross the UPRR Terminal Subdivision.

The crossing closure at West Street is estimated to cost $50,000, while the pedestrian bridge is estimated at $400,000. The estimated public benefit could not be calculated for the closure of West Street since traffic would be rerouted to other at-grade crossings; however, the closure would produce a safety benefit for the traveling public as well as pedestrians.

Rail Capacity Enhancements

Addition of a Second Mainline from Chaney Junction to Tower 26 (Freight Main)

Between Chaney Junction and Tower 26, the Freight Main track of the Terminal Subdivision is a single track rail line crossing White Oak Bayou and passing the Hardy Street Yard in the process. Between Sawyer and Holly Streets, the Freight Main runs down the middle of Winter Street, with single family residences no more that 50 feet from the rail line. Only a single mainline of track currently runs along the Terminal Subdivision's Freight Main.

The addition of a second track would move the freight service from the Passenger main onto the Freight main, making the Passenger Main available for alternative transportation use, such as commuter rail. With the property acquisition required for a second mainline, the proximity of the rail line to the residences along Winter Street would be addressed as well.

The current connection between the West Belt Subdivision and the Terminal Subdivision in the southeast quadrant of Tower 26 also serves as the connection track to industry tracks in the area. Reconfiguring the track in this quadrant will assist in avoiding train movement conflicts through Tower 26, while local service trains are working the industry tracks. This improvement would also allow for movements on both the Terminal Subdivision and the West Belt Subdivision to occur simultaneously, increasing the flexibility of movements to and from Englewood Yard.

The estimated cost of a second mainline along the Terminal Subdivision from Chaney Junction to Tower 26 and the reconfigured connection at Tower 26, as shown in Figures Q-15 and Q-16 in Appendix F, is $21,000,000. The estimated cost does not include the cost of additional right-of-way acquisition.

The improvements are classified as level 1 near-term railroad improvements. These improvements should undergo further testing to determine the extent of the improvements' impact on the region's rail network, and to quantify the associated public and private benefits that may be attained.

Expansion of Englewood Yard

Tower 87, located just east of Englewood Yard near Liberty Road and Wayside Drive, is a major crossroads for train traffic coming to and from Settegast Yard as well as Englewood Yard, and is by far the most congested rail interchange within the Houston Terminal.

The addition of an additional mainline track from the east end of Englewood Yard toward Dawes will allow for more flexibility in the positioning of trains in Settegast Yard which would play an integral role in increasing the overall speed of trains on the Terminal Subdivision. It would also improve the mobility of an estimated 40 to 50 daily train movement through the Tower 87 interchange by reducing conflicts and delays.

The estimated cost of expanding Englewood Yard, as shown in Figure Q-17 and Q-20 in Appendix F, is $5,000,000 and is classified as a level 2 improvement, meaning that it is a mid-range rail improvement. This improvement was included in Planning Case 2 of the RTC freight rail operations model, which is discussed in Section 7.

Houston West Belt Subdivision

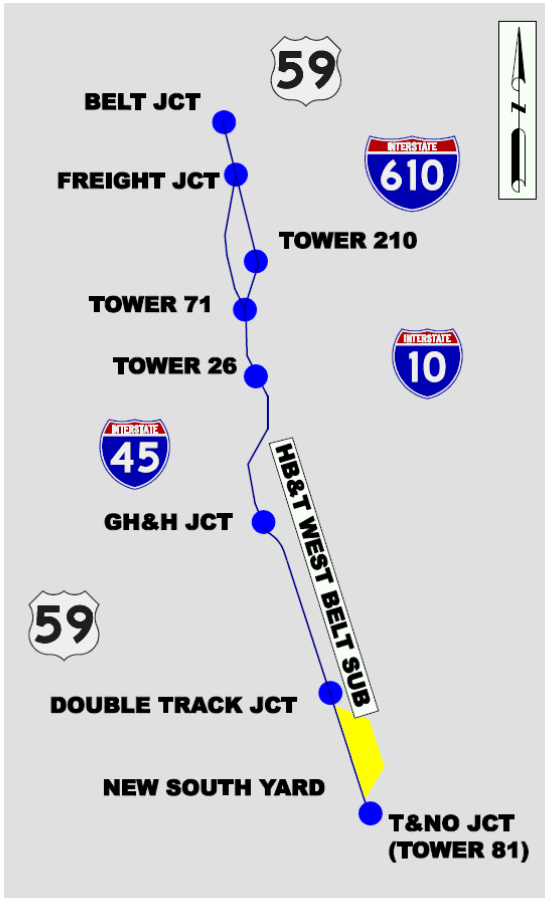


Figure 8-19: Houston West Belt Subdivision Map

Beginning at T&NO Junction (Tower 81), which is located north of the Loop 610 and Mykawa Road intersection, the West Belt Subdivision crosses Brays Bayou near the intersection of North Wayside Drive and Clinton Drive, and then continues toward Belt Junction, which is located just north of Loop 610 between IH 45 and US 59.

The West Belt Subdivision is approximately nine miles in overall length, all of which is contained within the study area. The West Belt Subdivision is a double track mainline railroad with frequent locations where a train can cross over from one track to another. The railroad is utilized in a bidirectional manner, with trains dispatched to operate in both directions, averaging between 65 and 75 trains daily, depending upon location. There are numerous sidings, industrial tracks, and yards along this rail line. The West Belt Subdivision is the primary route for access to New South Yard from the south.

Improvements identified for the West Belt Subdivision consist of six grade separations, 13 crossing closures, one pedestrian bridge, and three rail capacity enhancements which are listed with their associated costs in Table 8-17.

West Belt Subdivision						
Grade Separations	**Improvement Classification Level**	**Estimated Cost**	**Estimated 10-year Public Benefit**	**Ratio: Benefit/ Cost**	**Estimated 20-year Public Benefit**	**Ratio: Benefit/ Cost**
Collingsworth	3	$ 9,000,000	$ 2,900,000	0.32	$ 7,000,000	0.78
Leeland	3	$ 7,000,000	$ 3,900,000	0.56	$ 11,000,000	1.57
Lyons	3	$ 6,000,000	$ 130,000	0.02	$ 310,000	0.05
Navigation-Commerce	3	$ 25,000,000	$ 13,000,000	0.52	$ 33,000,000	1.32
Quitman	3	$ 7,400,000	$ 20,000,000	2.70	$ 54,000,000	7.30
Scott - York	3	$ 11,000,000	$ 18,000,000	1.64	$ 52,000,000	4.73
Crossing Closures	**Improvement Classification Level**	**Estimated Cost**	**Estimated 10-year Public Benefit***	**Ratio: Benefit/ Cost**	**Estimated 20-year Public Benefit***	**Ratio: Benefit/ Cost**
Brooks	3	$ 50,000	NA	NA	NA	NA
Caplin	3	$ 50,000	$ 460,000	9.2	$ 1,200,000	24
Cullen	3	$ 50,000	$ 1,800,000	36	$ 5,100,000	102
Canal	3	$ 50,000	$ 9,000,000	180	$ 24,000,000	480
Hutchins	3	$ 50,000	$ 360,000	7.2	$ 1,000,000	20
Lee	3	$ 50,000	$ 2,500,000	50	$ 6,400,000	128
Lorraine	3	$ 50,000	NA	NA	NA	NA
McKinney	3	$ 50,000	NA	NA	NA	NA
Milby	3	$ 50,000	$ 3,100,000	62	$ 9,100,000	182
Nance	3	$ 50,000	$ 630,000	12.6	$ 1,600,000	32
Opelousas	3	$ 50,000	NA	NA	NA	NA
Runnels (Crossing Closure with Pedestrian Bridge)	3	$ 450,000	$ 5,500,000	12	$ 13,000,000	29
Semmes	3	$ 50,000	NA	NA	NA	NA
Line Capacity Enhancements	**Improvement Classification Level**	**Estimated Cost**	**Estimated 10-year Public Benefit****	**Ratio: Benefit/ Cost**	**Estimated 20-year Public Benefit****	**Ratio: Benefit/ Cost**
Third Main: Tower 81 (T&NO) Jct) to MP 235.00	4	$ 18,000,000	NA	NA	NA	NA
Extend two main tracks through Belt jct	2	$ 4,000,000	NA	NA	NA	NA
Remove Hold Restrictions btwn Twr 26 and Cullen	2	Accounted for in the costs above.	NA	NA	NA	NA
*Public benefit could only be estimated for crossing closures which would be rerouted to a grade separated crossing. However, all crossing closures produce a public benefit of improved safety.						
**No public benefits of individual rail improvements were identified.						
Class 2 Improvements (Mid-range Improvements)		$ 4,000,000	NA	NA	NA	NA
Class 3 Improvements (Separations/Closures)		$ 66,450,000	$ 81,280,000	1.22	$ 218,710,000	3.29
Class 4 Improvements (Rail Capacity Additions)		$ 18,000,000	NA	NA	NA	NA
Total Identified Improvements		$ 88,450,000	$ 81,280,000	0.92	$ 218,710,000	2.47

Table 8-17: West Belt Subdivision Improvements

Grade Separations

Grade Separation of Collingsworth Street on the West Belt Subdivision

Collingsworth Street is currently a four-lane roadway that is a major east-west arterial inside Loop 610 and crosses the railroad at-grade in Harris County on the north side of Houston. Approximately 5,700 vehicles cross the railroad at this location daily. The identified four-lane roadway overpass would separate vehicular traffic from the West Belt Subdivision.

The existing double tracks are currently under design to become a triple track configuration as part of the Hardy Toll Road Extension improvement. The City of Houston, in cooperation with the Harris County Toll Road Authority, has consultants currently under contract to design the grade separation of Collingsworth Street.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure R-1 in Appendix F, while the environmental constraints are identified in the Downtown Subdivisions Constraints Map on sheet 10 of 39 located in Appendix E. The environmental constraints located in the vicinity of Collingsworth Street consist of adjacent industrial properties, a pipeline that runs perpendicular to the proposed overpass, a fire station and nearby churches. Right-of-way acquisition of the adjacent properties accounts for approximately 59 percent of the estimated cost to implement this grade separation.

The grade separation of Collingsworth Street is estimated to cost $9,000,000. The estimated public benefit calculated for the grade separation of Collingsworth Street is $2,900,000 over a 10 year period, which is approximately 32 percent of the estimated cost of construction, and $7,000,000 over a 20 year period, which is approximately 78 percent of the estimated cost of construction.

Grade Separation of Leeland Street on the West Belt Subdivision

Leeland Street is currently a four-lane roadway that crosses the railroad at-grade in Harris County in downtown Houston. Approximately 5,900 vehicles cross the railroad at this location daily. According to collision data received from the H-GAC Traffic Safety Program and the FRA, four crashes occurred at the Leeland Street crossing between 1990 and 2003.

The identified four-lane roadway underpass would separate vehicular traffic from the West Belt Subdivision. It would also result in the closure of Cullen Blvd due to significant grade differentials (vertical clearance requirements) with the Leeland underpass.

Access to adjacent properties will be achieved through the use of the current roadway network in the vicinity. Access to Leeland Street along the potential underpass ramps will be eliminated; however access to adjacent roadways is available for all affected properties. Traffic along Cullen Boulevard, which would be closed, may be rerouted to adjacent roadways as well.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure R-2 in Appendix F, while the environmental constraints are identified in the Downtown Subdivisions Constraints Map on sheet 26 of 39 located in Appendix E. The environmental constraints located in the vicinity of Leeland Street consist of adjacent commercial, residential, and industrial properties. Right-of-way acquisition of the adjacent properties accounts for approximately five percent of the estimated cost to implement this grade separation.

The grade separation of Leeland Street is estimated to cost $7,000,000. The estimated public benefit calculated for the grade separation of Leeland Street is $3,900,000 over a 10 year period, which is approximately 56 percent of the estimated cost of construction, and $11,000,000 over a 20 year period, which is approximately 57 percent greater than the estimated cost of construction.

<u>Grade Separation of Lyons Ave on the West Belt Subdivision</u>

Lyons Avenue is currently a two-lane roadway that crosses the railroad at-grade in Harris County in downtown Houston. Approximately 4,600 vehicles cross the railroad at this location daily. The identified two-lane roadway underpass would separate vehicular traffic from the West Belt Subdivision.

Access to adjacent properties will be achieved through the use of the current roadway network. Access to Lyons Avenue along the potential underpass ramps will be eliminated; however access to adjacent roadways such as Semmes, West, McCall, and Jensen Streets, is available for all affected properties except for the property directly northeast of the crossing.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure R-3 in Appendix F, while the environmental constraints are identified in the Downtown Subdivisions Constraints Map on sheet 20 of 39 located in Appendix E. The environmental constraints located in the vicinity of Lyons Avenue consist of adjacent commercial, residential, and industrial properties as well as transmission lines. Right-of-way acquisition of the adjacent properties accounts for approximately four percent of the estimated cost to implement this grade separation.

The grade separation of Lyons Avenue is estimated to cost $6,000,000. The estimated public benefit calculated for the grade separation of Lyons Avenue is $130,000 over a 10 year period, which is approximately two percent of the estimated cost of construction, and $310,000 over a 20 year period, which is approximately five percent of the estimated cost of construction.

Grade Separation of Navigation Boulevard/Commerce Street on the West Belt Subdivision

Navigation Boulevard is currently a four-lane roadway that, at the railroad crossing, underpasses the West Belt Subdivision. The roadway is located immediately east of downtown and US 59. However, this crossing has low vertical clearance and narrows at the underpass crossing with the railroad.

Commerce Street crosses the railroad at-grade above the existing Navigation Boulevard underpass. The existing underpass is identified to be improved in order to increase vertical clearance and widened to accommodate additional traffic volumes as well grade separate Commerce Street, at which approximately 9,300 cross the railroad. According to collision data received from the H-GAC and the FRA, two crashes occurred at the Commerce Street crossing between 1990 and 2003.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure R-4 in Appendix F, while the environmental constraints are identified in the Downtown Subdivisions Constraints Map on sheet 22 of 39 located in Appendix E. The constraints located near the underpass consist of adjacent industrial properties, a school, a fire station, and nearby churches. Right-of-way acquisition of the adjacent properties accounts for approximately three percent of the estimated cost to implement this improvement.

The grade separation of Navigation Boulevard is estimated to cost $25,000,000. The estimated public benefit calculated for the grade separation of Navigation Boulevard and Commerce Street is $13,000,000 over a 10 year period, which is 52 percent of the estimated cost of construction, and $33,000,000 over a 20 year period, which is approximately 32 percent greater than the estimated cost of construction.

Grade Separation of Quitman Street on the West Belt Subdivision

Quitman Street is currently a two-lane east-west arterial roadway that crosses the railroad at-grade in Harris County located inside Loop 610 in north Houston. Approximately 8,000 vehicles cross the railroad at this location daily. The identified four-lane roadway overpass would separate vehicular traffic from the West Belt Subdivision.

The existing double tracks of the West Belt Subdivision are currently under design to become a triple track configuration as part of the Hardy Toll Road Extension improvement. The Harris County Toll Road Authority has engineering consultants currently under contract to design this four-lane grade separation.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure R-5 in Appendix F, while the environmental constraints are identified in the Downtown Subdivisions Constraints Map on sheet 14 of 39 located in Appendix E. The constraints located near Quitman Street consist of

adjacent commercial, residential, and industrial properties as well as nearby schools and churches. Right-of-way acquisition of adjacent properties accounts for approximately 27 percent of the cost to implement this grade separation.
The grade separation of Quitman Street is estimated to cost $7,400,000. The estimated public benefit calculated for the grade separation of Quitman Street is $20,000,000 over a 10 year period, which is over 2 times greater than the estimated cost of construction, and $54,000,000 over a 20 year period, which is more than seven times greater than the estimated cost of construction.

Grade Separation of Scott Street and York Street on the West Belt Subdivision
Scott Street and York Street are two-lane roadways that operate as one-way pairs and cross the railroad at-grade in Harris County, east of downtown Houston. A combined 27,400 vehicles cross the railroad at these locations daily. These one way pairs are identified to be combined into a single overpass over the railroad, which would separate vehicular traffic from the West Belt Subdivision.

Access for adjacent properties west of Scott Street would be maintained via the existing roadways west of Scott Street. York Street is identified to be closed on the West Belt Subdivision and UPRR Galveston Subdivision.

A preliminary layout of the overpass as well as the adjacent property land uses are identified in Figure R-6 in Appendix F, while the environmental constraints are shown in the Downtown Subdivisions Constraints Map on sheet 26 of 39 located in Appendix E. The environmental constraints located in the vicinity of Scott Street and York Street consist of adjacent residential, commercial, and industrial properties. Right-of-way acquisition of the adjacent properties accounts for approximately 19 percent of the estimated cost to implement this grade separation.

The grade separation of Scott Street and York Street is estimated to cost $11,000,000. The estimated public benefit calculated for the grade separation of Scott Street and York Street is $18,000,000 over a 10 year period, which is over 60 percent greater than the estimated cost of construction, and $52,000,000 over a 20 year period, which is more than four times greater than the estimated cost of construction.

Crossing Closures

Crossing Closures of Brooks Street, Lee Street, Lorraine Street, Opelousas Street, and Semmes Street on the West Belt Subdivision
Brooks, Lee, Lorraine, Opelousas, and Semmes Streets are each currently two lane roadways that cross the West Belt Subdivision north of I-10 and west of US 59 in Houston. These streets provide local access to and from residential and industrial areas around the railroads with approximately 280[6] vehicles crossing

[6] Per TTI, this default value is used when AADT data is not available.

the railroad at Brooks Street, 850 vehicles at Lee Street, 6,900 vehicles at Lorraine Street, 280 vehicles at Opelousas Street, and 300 vehicles at Semmes Street. Access to adjacent properties will be maintained via the existing roadway network.

The location of the potential crossing closures as well as the alternative routes and associated distances are identified in Figure R-7 in Appendix F. The environmental constraints identified in the vicinity of these streets consist of adjacent industrial and residential properties, a police station, and a railroad tower. Additional environmental constraints mapping may be required for further analysis. Right-of-way acquisition of the adjacent properties will not be required since no new construction is required.

Due to the crossing closure of Brooks Street, traffic could be rerouted south on Elysian Street, east on Lyons Avenue, and north on Jensen Drive, west on Mills Street, and south on Mary Street to reach the east side of Brooks Street from the west side of the railroad. Closing the crossing would increase the travel distance to cross the railroad by less than two miles.

The crossing closure is estimated to cost $50,000. The estimated public benefit could not be calculated for the closure of Brooks Street since traffic would be redirected to other at-grade crossings; however, the closures would produce a safety benefit for the traveling public.

Due to the crossing closure of Lee Street, traffic could be redirected north on the adjacent streets of Elysian Street or Carr Street to cross the railroad along Quitman Street, which is included as a potential grade separation as part of this study. Closing the crossing would increase the travel distance to cross the railroad by less than two miles. Photo 8-118 shows the at-grade crossing of Lee Street at the West Belt Subdivision under existing conditions.

The crossing closure is estimated to cost $50,000. The estimated public benefit calculated for the closure of Lee Street is $2,500,000 over a 10 year period, which is 50 times greater than the cost to implement the crossing closure, and $6,400,000 over a 20 year period, which is 128 times greater than the cost to implement the crossing closure.

Due to the crossing closure of Lorraine Street, traffic could be either rerouted to the north along Elysian Street or Carr Street to cross the railroad along Quitman Street (included as a grade separation as part of this study), or traffic could be rerouted to the south along Elysian Street or Jensen Drive to cross the railroad along Lyons Avenue. Closing the crossing would increase the travel distance by less than two miles. Photo 8-119 shows the at-grade crossing of Lorraine Street at the West Belt Subdivision under existing conditions.

The crossing closure is estimated to cost $50,000. The estimated public benefit could not be calculated for the closure of Lorraine Street since traffic may be redirected to another at-grade crossing; however, the closure would produce a safety benefit for the traveling public.

Due to the closure of Opelousas Street, traffic could be redirected to the south to cross the railroad along Lyons Avenue. Closing the crossing would increase the travel distance by less than half of a mile. Photo 8-120 shows the at-grade crossing of Opelousas Street at the West Belt Subdivision under existing conditions.

The crossing closure is estimated to cost $50,000. The estimated public benefit could not be calculated for the closure of Opelousas Street since traffic would be redirected to another at-grade crossing; however, the closure would produce a safety benefit for the traveling public.

Due to the closure of Semmes Street, traffic could be rerouted south on Elysian Street, east on Lyons Avenue to cross the railroad, north on Jensen Drive, and west on Mills Street to reach the east side of Semmes Street. Closing the crossing would increase the travel distance by less than two miles.

The crossing closure is estimated to cost $50,000. The estimated public benefit could not be calculated for the closure of Semmes Street since traffic would be redirected to other at-grade crossings; however, the closure would produce a safety benefit for the traveling public.

Photo 8-118: West Belt Subdivision at Lee St (looking east)

Photo 8-119: West Belt Subdivision at Lorraine St (looking east)

Photo 8-120: West Belt Subdivision at Opelousas St (looking east)

Crossing Closure of Caplin Street on the West Belt Subdivision

Caplin Street is currently a two lane roadway that crosses the West Belt Subdivision north of Loop 610 and just east of the Hardy Toll Road in Harris County inside Houston. Caplin Street provides local access for residential and industrial areas across the railroad to and from Hardy Street. According to collision data received from the H-GAC Traffic Safety Program and the FRA, two crashes occurred at the Caplin Street crossing between 1990 and 2003.

Closing the crossing would increase the travel distance to cross the railroad by less than a mile. Photos 8-121 and 8-122 show the at-grade crossing of Caplin Street at the West Belt Subdivision under existing conditions.

The location of the potential crossing closure as well as the alternative route and associated distance is identified in Figure R-8 in Appendix F. The environmental constraints identified in the vicinity of this street consist of adjacent industrial and residential properties. Additional environmental constraints mapping may be required for further analysis. Right-of-way acquisition of the adjacent properties will not be required since no new construction is required.

Access to adjacent properties will be maintained via the existing roadway network. As a result of the closure of Caplin Street at the railroad crossing, traffic could be rerouted east on Caplin Street, south on Gold Street, west on Kelley Street to cross beneath the existing railroad bridge, and north on Hardy Street.

The crossing closure is estimated to cost $50,000. The estimated public benefit calculated for closing the Caplin Street crossing and rerouting to a grade separated crossing is $460,000 over a 10 year period, which is over nine times greater than the cost to implement the crossing closure, and $1,200,000 over a 20 year period, which is 24 times greater than the cost to implement the crossing closure.

Photo 8-121: West Belt Subdivision at Caplin St (looking east)

Photo 8-122: West Belt Subdivision at Caplin St (looking north)

Crossing Closure of Cullen Blvd on the West Belt Subdivision

Cullen Boulevard is currently a four-lane roadway that crosses the West Belt Subdivision southeast of downtown Houston in Harris County. Approximately 2,700 vehicles cross the railroad at this location daily. According to collision data received from the H-GAC Traffic Safety Program and the FRA, four crashes occurred at the Cullen Boulevard crossing between 1990 and 2003. Cullen Boulevard is identified to be closed at the crossing with the railroad as well as at the crossing with Leeland Street, since Leeland Street is identified to be grade separated as an overpass at that location.

Closing the crossing would increase the travel distance to cross the railroad by less than a mile, although the north side of the intersection of Cullen Boulevard and the railroad would no longer be accessible. Photos 8-123 through 8-126 show the at-grade crossing of Cullen Boulevard at the West Belt Subdivision under existing conditions.

Due to the closure of Cullen Boulevard, traffic would be rerouted to the adjacent roadways to the east or west, Hussion Street or Sidney Street, respectively, and then along Leeland Street to cross the railroad. At the intersection of Cullen and Leeland, traffic would no longer be able to travel between Cullen Boulevard and Leeland Street, and vice versa, due to the identified grade separation of Leeland Street.

The properties along Cullen Boulevard between the intersection with Leeland Street and the intersection with the railroad would lose the existing access routes to their properties. Access to other adjacent properties will be maintained via the existing roadway network.

The location of the potential crossing closure as well as the alternative route and associated distance is identified in Figure R-9 in Appendix F, while the environmental constraints are shown in the Downtown Subdivisions Constraints Map on sheet 26 of 39 located in Appendix E. The environmental constraints identified in the vicinity of this street consist of adjacent industrial and commercial properties as well as schools, churches, and a fire station located a few blocks away. Right-of-way acquisition of the adjacent properties may be required since access routes would be removed.

The crossing closure is estimated to cost $50,000. The estimated public benefit calculated for closing the Cullen Boulevard crossing and rerouting to a grade separated crossing is $1,800,000 over a 10 year period, which is over 36 times greater than the cost to implement the crossing closure, and $5,100,000 over a 20 year period, which is 102 times greater than the cost to implement the crossing closure.

Photo 8-123: West Belt Subdivision at Cullen Blvd (looking south)

Photo 8-124: West Belt Subdivision at Cullen Blvd (looking southeast)

Photo 8-125: West Belt Subdivision at Cullen Blvd (looking northwest)

Photo 8-126: West Belt Subdivision at Cullen Blvd (looking north)

Crossing Closure of Canal Street and Hutchins Street on the West Belt Subdivision

Canal Street is currently a two-lane roadway that crosses the West Belt Subdivision east of US 59 near downtown Houston in Harris County, and widens to a four-lane roadway east of the railroad. Canal Street provides local access to and from businesses, churches, schools and US 59, with approximately 7,000 vehicles crossing the railroad at this location daily. According to collision data received from H-GAC Traffic Safety Program and the FRA, one crash has occurred at the Cullen Boulevard crossing between 1990 and 2003.

Due to the closure of Canal Street, traffic could be redirected to the adjacent roadways to the south on Commerce Street, which is included as a potential grade separation as part of this study, in order to cross the railroad. Closing the crossing at Canal Street would increase the travel distance to cross the railroad by less than a mile.

Hutchins Street is currently a two-lane roadway that crosses the West Belt Subdivision east of US 59 near downtown Houston in Harris County. Hutchins Street provides local access to and from businesses, churches, schools and US 59, with approximately 1,000 vehicles crossing the railroad at this location daily.

Due to the closure of Hutchins Street, traffic could be redirected west to the US 59 frontage road and then east on Commerce Street (a potential grade separation) to cross the railroad, which would increase the travel distance by less than a mile.

The location of the potential crossing closures as well as the alternative routes and associated distances are identified in Figure R-10 in Appendix F, while the environmental constraints are shown in the Downtown Subdivisions Constraints Map on sheet 22 of 39 located in Appendix E. The environmental constraints identified in the vicinity of these streets consist of adjacent industrial and commercial properties as well as schools, churches, and a fire station. Right-of-way acquisition of the adjacent properties will not be required since no new construction is required. Access to adjacent properties will be maintained via the existing roadway network.

The crossing closures are each estimated to cost $50,000. The estimated public benefit calculated for closing the Canal Street crossing is estimated to be $9,000,000 over a 10 year period, which is 180 times greater than the estimated cost to implement the closure, and $24,000,000 over a 20 year period, which is 480 times greater than the cost to implement the crossing closure.

The estimated public benefit calculated for closing the Hutchins Street crossing is estimated to be $360,000 over a 10 year period, which is over seven times greater than the estimated cost to implement the closure, and $1,000,000 over a

20 year period, which is 20 times greater than the cost to implement the crossing closure.

Crossing Closure of Milby Street on the West Belt Subdivision

Milby Street is currently a two-lane roadway that crosses the West Belt Subdivision southeast of downtown Houston in Harris County. Approximately 4,900 vehicles cross the railroad at this location daily. Milby Street is identified to be closed at the crossing with the railroad, which would increase the travel distance to cross the railroad by less than a mile.

Access to adjacent properties will be maintained via the existing roadway network. Due to the closure of Milby Street, traffic would be rerouted to the adjacent roadway to the east, St. Joseph Street, and then west on Polk Street to cross the railroad.

The location of the potential crossing closure as well as the alternative route and associated distance is identified in Figure R-9 in Appendix F, while the environmental constraints are shown in the Downtown Subdivisions Constraints Map on sheet 26 of 39 located in Appendix E. The environmental constraints identified in the vicinity of this street consist of adjacent industrial and commercial properties. Right-of-way acquisition of the adjacent properties would not be required since access routes would be maintained and no new construction is required.

The crossing closure is estimated to cost $50,000. The estimated public benefit for closing the Milby Street crossing is $3,100,000 over a 10 year period, which is 62 times greater than the cost of implementing the closure, and $9,100,000 over a 20 year period, which is 182 times greater than the cost to implement the crossing closure.

Crossing Closure of McKinney Street on the West Belt Subdivision

McKinney Street is currently a four-lane roadway that crosses the West Belt Subdivision southeast of downtown Houston in Harris County. McKinney Street is identified to be closed at the crossing with the railroad, which would increase the travel distance to cross the railroad by less than a mile. The crossing closure is estimated to cost $50,000.

Access to adjacent properties will be maintained via the existing roadway network. Due to the closure of McKinney Street, traffic would be rerouted to the adjacent roadway to the east, St. Joseph Street, and then west on Polk Street to cross the railroad.

The location of the potential crossing closure as well as the alternative route and associated distance is identified in Figure R-11 in Appendix F, while the environmental constraints are shown in the Downtown Subdivisions Constraints Map on sheet 26 of 39 located in Appendix E. The environmental constraints identified in the vicinity of this street consist of adjacent industrial and commercial properties. Right-of-way acquisition of the adjacent properties would not be required since access routes would be maintained and no new construction is required.

The estimated public benefit could not be calculated for the closure of McKinney Street since traffic would be redirected to other at-grade crossings; however, the closure would produce a safety benefit for the traveling public.

Crossing Closure of Nance St on the West Belt Subdivision

Nance Street is currently a two-lane roadway that crosses the West Belt Subdivision west of US 59 in Houston in Harris County. Approximately 680 vehicles cross the railroad at this location daily. Nance Street is identified to be closed at the crossing with the railroad, which would increase the travel distance to cross the railroad by less than two miles.

Access to adjacent properties will be maintained via the existing roadway network. Due to the closure of Nance Street, traffic would be rerouted either north on Jenson Drive or north on Hardy Street to cross I-10, and then west on Lyons Avenue, which is included as a potential grade separation as part of this Study to cross the railroad.

The location of the potential crossing closure as well as the alternative route and associated distance is identified in Figure R-14 in Appendix F, while the environmental constraints are identified in the Downtown Subdivisions Constraints Map on sheet 20 of 39 located in Appendix E. Right-of-way acquisition of the adjacent properties would not be required since access routes would be maintained and no new construction is required.

The crossing closure is estimated to cost $50,000. The estimated public benefit for closing the Nance Street crossing is approximately $630,000 over a 10 year period, which over 12 times greater than the estimated cost to implement the closure, and $1,600,000 over a 20 year period, which is 32 times greater than the cost to implement the crossing closure.

Crossing Improvement/Pedestrian Bridge on Runnels Street on the West Belt Subdivision

Runnels Street is currently a four-lane roadway that crosses the West Belt Subdivision south of I-10 and west of US 59 in Houston. Runnels Street provides local access to and from educational and commercial areas around the railroads, with approximately 3,000 vehicles crossing the railroad at this location daily. Runnels Street is identified to be closed and provided with a pedestrian bridge at the intersection with the West Belt Subdivision. Photo 8-127 shows the at-grade crossing of Runnels Street at the West Belt Subdivision under existing conditions.

The proposed pedestrian bridge would overpass the railroad and separate pedestrian traffic from the West Belt Subdivision, thereby reducing public safety hazards associated with the existing at-grade crossing. Currently, many of the residents, including children, living in the nearby apartment buildings and homes walk across the railroad to reach the school on the other side. The pedestrian bridge will provide a safe access route to the school located on the east side of the railroad.

Access to adjacent properties will be maintained along Runnels Street, although the existing roadway will be closed at the railroad crossing. Traffic may be rerouted to the west on Navigation Boulevard to underpass the railroad, or to the east under US 59, then south on Jackson Street, and east on Commerce Street, which is included in this study as a potential grade separation, to cross the railroad.

The location of the proposed pedestrian bridge at Runnels Street is identified in Figure R-10 in Appendix F, while the environmental constraints and adjacent property uses are identified in the Downtown Subdivisions Constraints Map on sheet 22 of 39 located in Appendix E. Constraints located in the vicinity of Runnels Street include adjacent industrial and commercial properties as well as schools, churches, and a fire station. The schools, churches, and the emergency vehicles coming to or from the fire station would be able to safely and efficiently cross the railroad at Navigation Boulevard, or Commerce Street.

The crossing closure at Runnels Street is estimated to cost $50,000, while the pedestrian bridge is estimated at $400,000. The estimated public benefit calculated for the closure Runnels Street is $5,500,000 over a 10 year period, which is 12 times greater than the estimated cost to implement the closure and pedestrian bridge, and $13,000,000 over a 20 year period, which is 29 times greater than the cost to implement the crossing closure.

Photo 8-127: West Belt Subdivision at Runnels St (looking northwest)

Rail Capacity Enhancements

Addition of Third Mainline Track: T&NO Junction to MP 235.00

Although it is a double track railroad, train switching operations at New South Yard typically occupy the mainline track between New South Yard and Double Track Junction inhibiting the movement of trains to Tower 26 and/or Tower 87. The addition of a third track will allow trains destined for locations other than New South Yard to do so unobstructed by train movement in and around the yard, ultimately improving the mobility in the Houston Terminal.

The estimated cost to add a third mainline along the West Belt Subdivision from T&NO Junction to milepost 235.00, as shown in Figure R-16 in Appendix F, is $18,000,000 and is classified as a level 4 long-range improvement. The addition of a third mainline on the West Belt should undergo further testing to determine the extent of an improvement's impact on the region's rail network, and to quantify the associated public and private benefits that may be attained.

As with many other improvement alternatives discussed, should the relocation of carload switching operations at existing BNSF facilities (New South and Pearland Yards) to outlying areas take place, the addition of a third mainline track in this area may not be required to maintain fluidity on the rail network, however, it may be required to support the potential of commuter rail operations along this alignment.

Remove Hold Restrictions between Tower 26 and Cullen Blvd

Under existing conditions, the West Belt Subdivision does not allow operators to hold trains on the West Belt between South GH&H Junction and the at-grade crossing with the Terminal Subdivision at Tower 26. The railroads impose such restrictions on themselves, either to avoid blocking grade crossings with standing trains, or to avoid the nuisance of standing trains in certain areas.

In this case, the existing restriction on the West Belt between Cullen Boulevard and Tower 26 is due to the many grade crossings in this segment. One consequence of this restriction is that some UPRR through trains requiring a crew change within the terminal are forced to the East Belt, where they can stop long enough at Basin Yard for relief crews to take over, without blocking street crossings.

The RTC base case demonstrates that the East Belt can be severely congested; by contrast, the West Belt has fewer trains under current operations. As a result, all of the crossings between Tower 26 and Cullen Boulevard were analyzed and determined to either be potential closures or grade separations on the West Belt Subdivision, thereby allowing trains to stop on this line segment of the subdivision.

The estimated cost to allow trains to stop on the West Belt Subdivision between Tower 26 and Cullen Boulevard, as shown in Figure R-12, is the combination of the costs for grade separating or closing all of the crossing along that segment, which totals nearly $50,000,000. The improvement is classified as a level 2 improvement, meaning that it is a mid-range rail improvement and was included in the RTC freight operations model Planning Case 2, which is discussed in Section 7.

Extend two main tracks through Belt Junction

The West Belt Subdivision currently has a single track bottleneck point between two double track segments at Belt Junction. The continuation of two tracks through Belt Junction would improve mobility, and improve the capacity of the West Belt Subdivision to handle trains moving between the Palestine Subdivision to the north, and points on or off the West Belt Subdivision to the south. For example, trains coming from Navasota or Spring, Texas traveling to Englewood Yard must go through Belt Junction.

The estimated cost to provide two continuous tracks through Belt Junction, as shown in Figure R-13 in Appendix F, is $4,000,000, and is classified as a level 2 improvement, meaning that it is a mid-range rail improvement. This improvement was included in the RTC freight operations model Planning Case 2, which is discussed in Section 7.

Section 9: Future Planning Alternatives

As previously mentioned, this report is intended to serve as an assessment of infrastructure improvements that will enhance the movement of freight throughout the Houston region, and provide an estimate of the level of investment required to bring these improvements to fruition.

Previous sections of this report provided information on potential improvements that were deemed “doable” within the next 10 to 15 years. Long-range concepts and improvements, however, may warrant further investigation and consideration for implementation by regional planning agencies such as the Houston-Galveston Area Council and/or the newly formed Gulf Coast Freight Rail District in a beyond 2030 vision.

Descriptions of these identified improvements along with estimated costs follow for some of the future planning alternatives for the Houston region. These improvements do not include every long range improvement that may be addressed for the region, but rather improvements that were determined to need additional analysis resulting from freight rail operations modeling (RTC).

Rosenberg to Houston

Significant congestion, train delays, and public safety concerns exist on the Glidden Subdivision from Rosenberg to Houston. Modeling results show that freight rail improvements are needed in this area to improve freight movement capacity and efficiency; however, reducing public safety hazards and disturbances must be considered as well. Two alternatives for freight rail movement between Rosenberg and Houston have been evaluated in this study, and consist of:

- Fort Bend Bypass Route
- Existing Glidden Subdivision

The Fort Bend bypass route, which is described in further detail in the following section, would remove most through freight trains from the Glidden Subdivision between Rosenberg and Houston and also from the Terminal Subdivision between West Junction and Eureka, but would add traffic to the east end of Houston. This bypass would be a long-range improvement that would require agreements with the participating railroads, a public involvement process, and detailed engineering and environmental impact analysis prior to implementation.

Adding capacity to the existing Glidden Subdivision would be a near or mid-range improvement since the railroads already own the right-of-way, and is discussed in further detail in the following section.

<u>New Corridor route to Bypass the Glidden Subdivision in Fort Bend County</u>

The crossing of the UPRR Glidden Subdivision and the BNSF Galveston Subdivision in Rosenberg may experience more than 65 trains daily. Should growth forecasts become reality, this number could increase to nearly 100 trains daily.

A proposal contained in the *Harris County Regional Freight Rail Improvement Plan* recommended constructing an approximately 34 mile long new rail corridor between Rosenberg and Arcola and upgrading the existing Popp Subdivision from Arcola to Pierce Junction as shown in Figure 9-1.

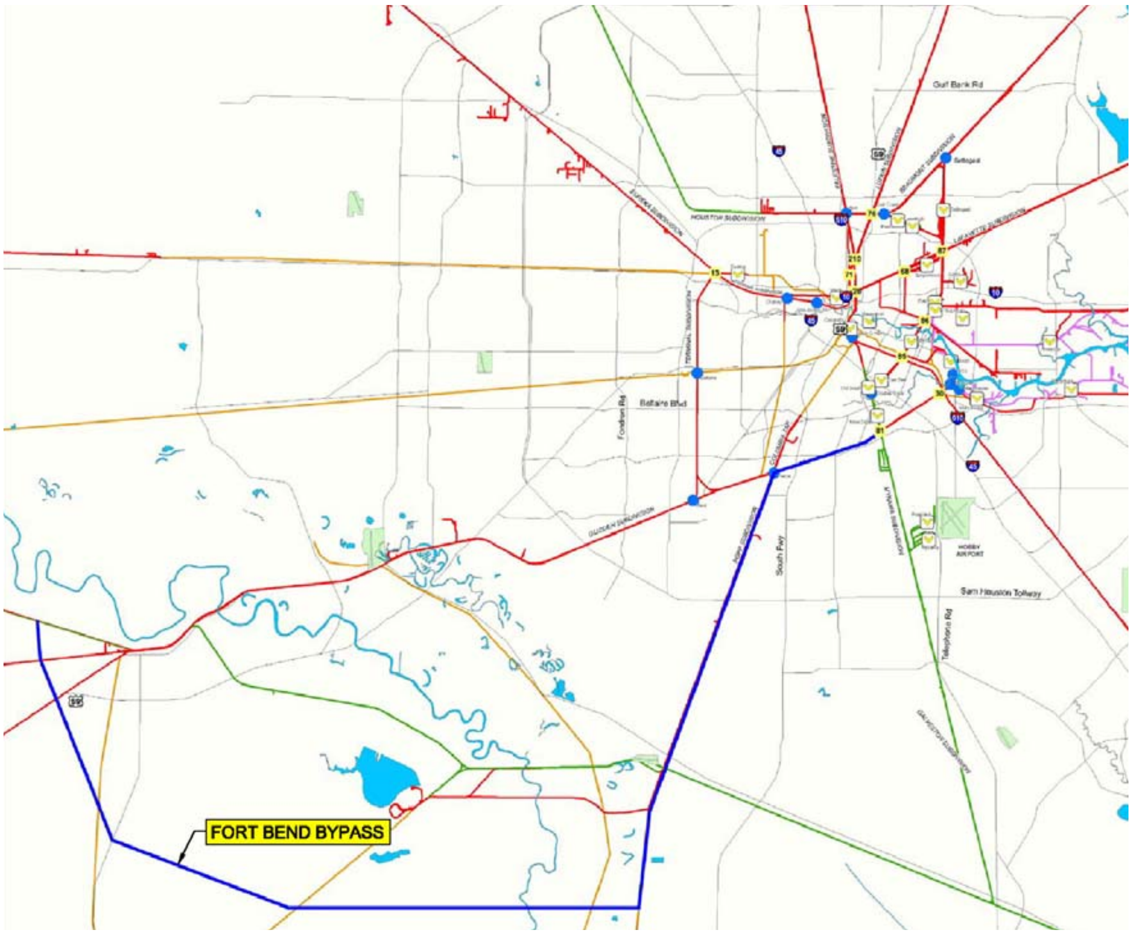


Figure 9-1: Fort Bend Bypass Route

Although the train travel distance from Rosenberg to Houston is approximately 20 miles longer in length, this proposal as written in the aforementioned *Plan* would permit faster train speeds and increase train capacity. The estimated cost of this improvement is **$880 million**.

The study team's evaluation of the Fort Bend Bypass was not one that questioned the merit of this alternative, rather established point of connection to the existing rail lines at the terminus of the bypass route for rail movement simulations modeling.

Planning Case 3, which was discussed in Section 7, tested the Fort Bend County bypass route as an alternative to upgrading or adding trackage to the existing rail line along the US 90A corridor. Establishment of the operating characteristics between the three alternatives posed for the Rosenberg to Houston rail line (No Build, Double Track, Bypass) allows for the determination and comparison of the public and private benefits associated with each alternative as discussed in Section 7.

While the communities along the Glidden Subdivision want a reduction of train volumes through the area, the option of adding capacity along the Glidden Subdivision is the UPRR's preference.

As part of the analysis of the Fort Bend bypass route, the roadways that would cross the potential new route were analyzed to determine the feasibility and benefits of grade separating or closing the roadways at the possible future crossings with the Fort Bend bypass rail line.

Seventeen roadways would cross the potential new rail line between Rosenberg and Arcola. The *Harris County Regional Freight Rail Improvement Plan* indicates that this bypass would be entirely grade separated. However, this study identified eight roadways as candidates for potential grade separations, while the remaining nine crossings were determined to remain at-grade based on the average daily traffic volumes along the roadways. The potential grade separations consist of the following roadways: US 90A, Spur 10, US 59, Cottonwood School Road, SH 36, Minontite Road (FM 2977), and FM 521 (north of CR 57 and also north of Sienna Parkway). Two of the potential grade separations, US 90A and Spur 10, are shown in Figures S-1 and S-2 in Appendix F.

<u>Addition of Second Mainline Track from Rosenberg to West Junction</u>

The Glidden Subdivision is a key east-west route for the UPRR, connecting the Ports of Long Beach and Los Angeles to Houston, and Houston to New Orleans. Approaching Houston from Rosenberg, the Glidden Subdivision parallels US Highway 90A. Due to the large volume of train traffic combined with the increasing volume of vehicular traffic, vehicular delays are typically experienced in Rosenberg, Richmond, Sugarland, Stafford, and Missouri City. The rail improvement would increase the rail traffic capacity of the Glidden Subdivision for current and anticipated growth.

A single mainline currently makes up the Glidden Subdivision between Rosenberg and West Junction. Limited sidings, in particular between West Junction and Missouri City, do not allow trains to pass one another, nor are there adequate locations for trains entering into the Houston rail network to sit and wait their turn to get into one of the rail yards or outlying locations. The addition of a second mainline between Rosenberg and West Junction, as shown in the modeling results of Planning Case 2, significantly reduced the delay ratios, increasing rail traffic capacity and decreasing travel times.

The anticipated cost of the rail improvement from Rosenberg to West Junction, as illustrated in Figure G-25 in Appendix F, is $137,000,000. The estimated cost for adding a second mainline from Rosenberg through West Junction to Tower 30 is approximately $200,000,000, but is not included in the cost estimates or RTC modeling in this study.

As also mentioned from the modeling analysis discussed in Section 7, more main track capacity by itself may not fully address the problem, which is that this part of the network experiences an especially high re-crew rate. The trains awaiting relief crews are parked on the available sidings, which, in the base case, predictably results in congestion because opposing trains have to meet at some point other than the one at which they would have met most efficiently. The construction of the Fort Bend bypass route may negate the need for adding capacity to the Glidden Subdivision.

The option of adding capacity along the Glidden Subdivision is UPRR's preference, while the communities along this line want a reduction of train volumes through the area.

BNSF Mykawa Subdivision

<u>Relocate Carload Switching Operations at BNSF Pearland Yard</u>

BNSF Pearland Intermodal Facility and Mykawa Yard, as shown in Figure J-1 in Appendix F, are located south of Tower 81 on the BNSF Mykawa Subdivision near the Houston Hobby Airport. The Pearland Intermodal Facility occupies over 80 acres of land, and handles receiving and distribution of automobiles. Mykawa Yard primarily handles the classification and storage of freight cars.

The BNSF Gulf Division, which includes the Mykawa Subdivision, is nearing capacity in terms of meeting merchandise operations demand. Relocating the facilities at Pearland and Mykawa to a location which could accommodate a larger facility would consolidate these operations.

The ancillary benefits to the relocation of carload switching operations at existing BNSF facilities to a location outside of the Houston metroplex may include:

- Using the BNSF Galveston Subdivision and the UPRR Glidden Subdivision for directional traffic in to and out of Houston, which may negate the perceived need to double track the Glidden Subdivision
- Reducing the volume of BNSF trains within the immediate region, which improves safety and air quality
- Allow for additional uses on the existing rail line, such as commuter rail

A relocation site has not yet been identified; however, an RTC modeling exercise is investigating locations south, north, and northeast of Houston. The relocation of the carload switching operations at Pearland is estimated to cost $95,000,000, and classified as a level 5 long-range improvement. This alternative should undergo further testing to determine the extent of the improvement's impact on the region's rail network, and quantify the associated public and private benefits that may be attained.

Relocate BNSF New South Yard Carload Switching Facility

BNSF New South Yard, as shown in Figure J-2, is located north of Tower 81 near the connection between the East Belt Subdivision and the West Belt Subdivision at Double Track Junction. The south end of the yard is located immediately north of the Griggs/Long/Mykawa intersection, which is frequently occupied by vehicular traffic traveling in all directions and crossing both the UPRR Glidden Subdivision and the BNSF Mykawa Subdivision. New South Yard is a major classification yard with a carload switching facility. The benefits of relocating the carload switching facility at New South Yard to a location outside the Houston metroplex are the same as those discussed in reference to relocating the Pearland and Mykawa facilities.

A relocation site has not yet been identified; however, an RTC modeling exercise is investigating locations south, north, and northeast of Houston. The relocation of carload switching operations at New South Yard is estimated to cost $100,000,000, and classified as a level 5 long-range improvement. This alternative should undergo further testing to determine the extent of the improvement's impact on the region's rail network and quantify the associated public and private benefits that may be attained. Photo 9-1 shows the south end of New South yard under existing conditions.

Photo 9-1: Mykawa Subdivision at New South Yard (looking north)

Terminal Subdivision

Relocation of Existing Intermodal Operations at Settegast and Englewood Yards

The UPRR Settegast Yard Intermodal Facility is located on the west side of Settegast Yard along the East Belt Subdivision adjacent to Kirkpatrick Boulevard. The intermodal facility consists of approximately nine tracks in addition to storage areas for truck and container staging. The Intermodal Facility is used to transfer freight from train cars to trucks and vice versa.

The UPRR Englewood Intermodal Facility is located on the UPRR Terminal Subdivision directly southwest of Settegast Yard. The approximately 100-acre intermodal facility consists of approximately eight tracks in addition to storage areas for truck and container staging. The Intermodal Facility is used to transfer freight from train cars to trucks and vice versa and classifies (sorts) 1,100 to 1,900 train cars per day.

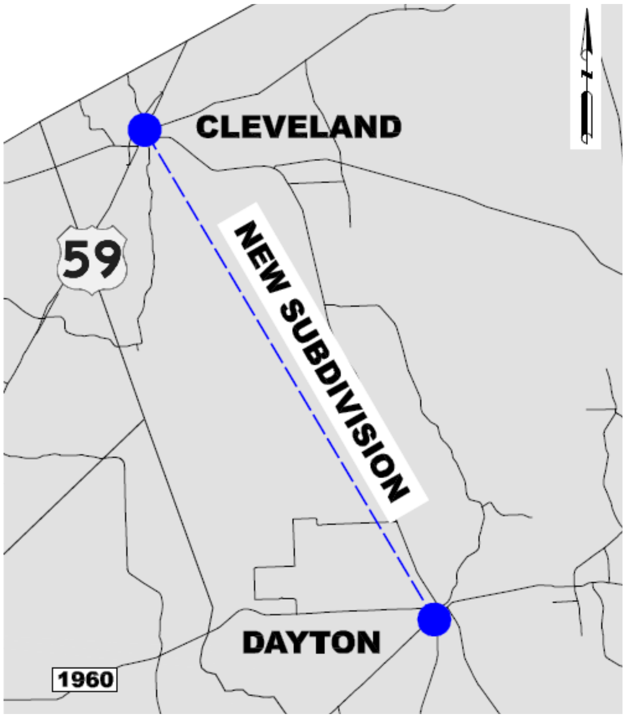
The ancillary benefits to the relocation of intermodal facilities may include:

- Reduction of delay on the Glidden Subdivision due to re-crew issues associated with westbound trains from Englewood Yard
- Reducing the volume of trains within the immediate downtown region, which improves safety and air quality

Although it is outside the scope of this study to determine the relocation site for the intermodal facilities, multiple locations on the Palestine and Navasota Subdivisions near Spring, Texas, as shown in Figure Q-18 in Appendix F, have been identified as possible relocation sites.

The estimated cost to relocate the existing intermodal operations at Settegast and Englewood Yards, as shown in Figure Q-19 in Appendix F, is $100,000,000 and classified as a level 5 long-range improvement that should undergo further testing to determine the improvements' impact on the region's rail network and quantify the associated public and private benefits that may be attained.

New Subdivision



The new Dayton to Cleveland single mainline rail corridor consists of approximately 40 miles of track connecting the UPRR Lufkin Subdivision and the BNSF Conroe Subdivision near Cleveland to the UPRR Baytown Subdivision south of Dayton. The new Dayton to Cleveland rail corridor and identified grade separations are listed in Table 9-1 with their associated costs.

The Dayton to Cleveland corridor was included in Planning Case 4, which was discussed in Section 7 in further detail.

Additional improvements along the New Subdivision that have been identified by the *Harris County Regional Freight Rail Improvement Plan* include the addition of a second mainline from Plantersville to Cleveland as well as an upgrade of the existing mainline to a centralized traffic control (CTC) operation system, and the construction of a double track corridor from Cleveland to Dayton. Multiple crossings (twenty-four) located between Plantersville and Dayton also have been identified as potential grade separations in the Harris County study. These improvements, with the exception of four grade separations, have not been included in the cost estimates for the New Subdivision and may warrant further analysis.

New Subdivision				
Grade Separations	**Improvement Classification Level**	**Estimated Cost**	**Estimated Public Benefit***	**Ratio: Benefit/Cost**
US 90A	3	$ 37,000,000	NA	NA
FM 1960	3	$ 6,800,000	NA	NA
SH105	3	$ 6,000,000	NA	NA
FM 787	3	$ 5,600,000	NA	NA
Line Capacity Enhancements	**Improvement Classification Level**	**Estimated Cost**	**Estimated Public Benefit****	**Ratio: Benefit/Cost**
Single Main: Dayton to Cleveland	5	$ 212,000,000	NA	NA
*No public benefits were identified since the streets do not currently cross the railroad.				
**No public benefits of individual rail improvements were identified.				
Class 3 Improvements (Separations/Closures)		$ 55,400,000	NA	NA
Class 5 Improvements (Rail Relocations)		$ 212,000,000	NA	NA
Total Identified Improvements		$ 267,400,000	NA	NA

Table 9-1: UPRR New Subdivision Potential Improvements

Rail Capacity Enhancements

<u>Add Single Mainline from Dayton to Cleveland</u>

Incorporating a CTC signal system with set-out tracks and passing sidings along the line from Dayton to Cleveland would permit bidirectional traffic flow.

Currently, the BNSF intermodal, auto and carload operations take place at either Pearland on the BNSF Mykawa Subdivision or New South Yard on the West Belt Subdivision. Trains inbound from Temple or Teague must take the long way around to get to either facility, while trains being prepared for departure often occupy the main track preventing the passage of additional trains.

The Cleveland to Dayton connection carries with it the relocation of current BNSF carload switching operations to a site not yet determined. Utilizing their existing network, a large number of BNSF trains will not need to enter into the heart of Houston area rail network, although the existing interchange with the PTRA will remain, as will trains serving their customer base such the Houston Light and Power facility at Thompson, Texas.

This relocation would free up capacity on existing rail lines and enhance movement capabilities on other existing rail corridors within the region.

Combined with the UPRR Glidden Subdivision, this relocation could make it feasible for the directional running of train traffic between Rosenberg and Houston, perhaps eliminating the need for either a double track rail facility along the US 90A corridor, or a new bypass alternative route through Ft. Bend County.

The estimated cost for the addition of a new rail corridor from Dayton to Cleveland, as shown in Figures L-1 through L-4 in Appendix F, is $197,000,000, and is classified as a level 5 long-range improvement. This alternative underwent simulations modeling in Planning Case 4 previously discussed in Section 7.

Planning Case 4, however, only tested the implementation of this cut-off route without relocating the existing BNSF rail yards. Determining this alternative on its merit alone was essential, so that the perceived added benefit of relocating the existing BNSF rail yards, at an estimated cost of $195,000,000, could be determined independently. A subsequent planning case is currently underway which investigates locations south, north, and northeast of Houston.

Grade Separations

<u>Grade Separation of SH 105 on the New Dayton to Cleveland Subdivision</u>

SH 105 is a two-lane roadway in Liberty County that would cross the potential new Dayton to Cleveland rail corridor near Cleveland, Texas. Approximately 12,200 daily vehicles currently use this roadway. The identified two-lane roadway overpass would separate vehicular traffic from the potential Dayton-Cleveland rail line.

A preliminary layout of the overpass is identified in Figure L-7 in Appendix F, while the environmental constraints are identified in the Lufkin Subdivision to Lafayette Subdivision Constraints Map on sheet 6 of 29.

Access to adjacent properties will be maintained via access roads alongside the main roadway along with an at-grade u-turn located beneath the overpass on the west side of the railroad.

The grade separation of SH 105 is estimated to cost $6,000,000. The estimated public benefit could not be calculated for the grade separation of SH 105 since the roadway currently does not cross the railroad.

<u>Grade Separation of FM 1960 on the New Dayton to Cleveland Subdivision</u>

FM 1960 is a two-lane roadway in Liberty County that would cross the potential new Dayton to Cleveland rail corridor near Dayton, Texas. Approximately 10,900 daily vehicles currently use this roadway. The identified two-lane roadway overpass would separate vehicular traffic from the potential Dayton-Cleveland rail line.

A preliminary layout of the overpass is identified in Figure L-5 in Appendix F, while the environmental constraints are identified in the Lufkin Subdivision to Lafayette Subdivision Constraints Map on sheet 24 of 29.

Access to adjacent properties will be maintained via access roads alongside the main roadway along with at-grade u-turns located beneath the overpass on each side of the railroad.

The grade separation of FM 1960 is estimated to cost $6,800,000. The estimated public benefit could not be calculated for the grade separation of FM 1960 since the roadway currently does not cross the railroad.

Grade Separation of FM 787 on the New Dayton to Cleveland Subdivision

FM 787 is a two-lane roadway in Liberty County that would cross the potential new Dayton to Cleveland rail corridor near Cleveland, Texas. Approximately 9,900 daily vehicles currently use this roadway. The identified two-lane roadway overpass would separate vehicular traffic from the potential Dayton-Cleveland rail mainline as well as the wye connections to the Lufkin Subdivision.

A preliminary layout of the overpass is identified in Figure L-6 in Appendix F, while the environmental constraints are identified in the Lufkin Subdivision to Lafayette Subdivision Constraints Map on sheet 4 of 29. No properties currently access FM 787 at the location of the grade separation, and are therefore not affected by the overpass.

The grade separation of FM 787 is estimated to cost $5,600,000. The estimated public benefit could not be calculated for the grade separation of FM 787 because the roadway currently does not cross the railroad.

Grade Separation of US 90A on the New Dayton to Cleveland Subdivision

US 90A is a four-lane median separated roadway in Liberty County that would cross the potential new Dayton to Cleveland rail corridor near Dayton, Texas. Approximately 13,800 daily vehicles currently use this roadway. In order to separate vehicular traffic from the potential Dayton-Cleveland rail line, the US 90A roadway would overpass the new wye connections between the New Subdivision and the existing Lafayette Subdivision. The New Subdivision mainline also would overpass the US 90A mainlines as well as the existing Lafayette Subdivision mainline. In summary, grade separating vehicular traffic from rail traffic on the new subdivision would require three separate overpass structures.

Preliminary layouts of the overpasses are identified in Figure L-8 in Appendix F, while the environmental constraints are identified in the Lufkin Subdivision to Lafayette Subdivision Constraints Map on sheet 25 of 29.

The grade separation of US 90A over the new wye connections between the new subdivision rail line and the existing Lafayette Subdivision is estimated to cost $18,000,000, and the grade separation of the new subdivision over the US 90A mainlanes is estimated to cost $19,000,000, for a total cost of $37,000,000.

Under existing conditions, the Baytown Subdivision mainline crosses US 90A at-grade, and connects and terminates at the Lafayette Subdivision at Dayton Junction in the city of Dayton. The at-grade crossing is in close proximity to the intersection of SH 146 and US 90A. The Baytown Subdivision has a very sharp curve just before the at-grade crossing requiring the train speed to be reduced to 10 mph, which results in closing US 90A for 20 minutes or longer when a train is passing. There are approximately eleven trains per day crossing US 90A.

The TxDOT Beaumont District has created preliminary and conceptual plans that relocate and grade separate the existing crossing west of Dayton. The identified location is approximately in the same location where the new subdivision crosses US 90A and the Lafayette Subdivision. Proper coordination between the conceptual layout of the US 90A/new subdivision crossing included in this study and the conceptual plans created by the TxDOT Beaumont District is imperative prior to final design of the grade separation of US 90A.

Section 10: Evaluation Criteria

The improvements selected to be analyzed were compiled from information and or recommendations contained in the *Harris County Regional Freight Rail Improvement Plan*, the *BNSF - UPRR Houston Area Rail Infrastructure and Operating Plan*, the Houston-Galveston Area Council, meetings and independent discussions with the UPRR, the BNSF, and the PTRA, as well as research conducted by TTI, and lastly the results derived as recommendations to improve freight movement fluidity determined from the regional freight rail operations modeling (RTC) and the Statewide Analysis Model.

The potential improvements determined from the sources listed above have been analyzed to determine the effects on efficiency, mobility, and safety for both rail operations as well as vehicular and pedestrian traffic in the Houston region. This analysis began with the identification of the existing conditions, and included estimates of the implementation cost, estimated implementation timeframe, and estimated public and private benefits for the identified improvements.

The existing conditions for the locations of potential improvements incorporated a review of property land uses and estimated values, environmental constraints, traffic flow volumes for both vehicular and rail traffic, and traffic accident statistics.

The estimated implementation costs for each improvement are order of magnitude costs that were determined based on preliminary planning. The costs included in this study represent an estimate of probable costs prepared in good faith and with reasonable care. The study team has no control over the costs of construction labor, materials, or equipment, nor over competitive bidding or negotiating methods and does not make any commitment or assume any duty to assure that bids or negotiated prices will not vary from these estimates. The costs are subject to inflation, and in some cases are calculated using county appraisal district values for right-of-way acquisition, which may vary from the actual cost of acquisition of property.

The implementation timeframe for each improvement was determined based on the additional analysis, engineering design, environmental mitigation, and funding that would be required prior to the implementation of the improvement.

Improvement classifications based on implementation timeframes were determined for the potential improvements and have been classified at this time into the following categories:

1. Level 1 Improvement - Identified near-term railroad improvements
2. Level 2 Improvement - Identified mid-range railroad improvements
3. Level 3 Improvement - All grade crossing closures and separations
4. Level 4 Improvement - Identified long-range improvements such as double tracking of or adding infrastructure capacity to existing line segments
5. Level 5 Improvement - Identified long-range improvements such as consolidations, alternative routes or corridors, and major yard relocations

Anticipated public benefits of the potential improvements include reduced vehicular delay times due to passing trains at existing at-grade crossings, reduced vehicle and locomotive fuel consumption, improved air quality, improved public safety, improved mobility for vehicular and freight traffic, reduced noise and vibration, and increased freight movement capacity.

The estimated public benefits of the potential improvements were determined by TTI using a Grade Crossing “Impedance” or delay model which takes into account the volume and frequency of vehicular and train traffic at highway-rail grade crossings, then estimates the amount of time motorists are delayed by rail traffic.

The model measures the anticipated public costs associated with traffic delays and calculates the extra emissions and fuel usage experienced while vehicles are delayed by a train at each of the approximate 1200 rail crossings within the region.

The cost of collisions is added to time costs, emissions, and fuel use to provide an annualized estimate of total public costs at each grade crossing in the study. Forecasting for growth in both rail and vehicular traffic provides an annualized estimate of public costs for a 10 year period through the year 2016 and for a 20 year period through the year 2026. The impact of potential commuter rail operations on existing rail infrastructure has not been included in the current public benefits calculations.

The Net Present Value shown as the public benefit is the cumulative projected cost-burden over a 10 year period or 20 year period, and is further detailed in an independent report to be submitted by the Texas Transportation Institute. Net present value (NPV) is a standard method for financial evaluation of long-term projects. The NPV is the value of the improvement projected 10 and 20 years into the future in terms of today’s dollars. This can be assessed as the savings associated with a grade separation or, as traffic levels change with changes to roadways and rail, the net savings to the public of each improvement being evaluated. An explanation of the public benefit calculations as completed by TTI can be found in Appendix D.

Establishing an associated dollar value to what may be considered the private benefit resulting from infrastructure improvements, upgrades, or operating changes is difficult in its own right, and is additionally complex without the availability of detailed economic analyses and benefit/cost studies. The majority of improvements discussed throughout this section, however, without a doubt will produce an associated benefit for the railroads. Rail improvements analyzed in this study centered on the following criteria:

- Adding a mainline track
- Adding switches and passing sidings at strategic locations to allow trains to pass one another or to idle without causing delays
- Expanding rail yard capacity
- Constructing connections between rail lines to improve rail traffic mobility
- Relocating rail yard and/or intermodal facilities

The private benefit values were estimated based on calculated delay hours per day operated over the Houston region rail network for each planning case. Additional benefits that may be realized by the railroads as a result of the modeled improvements, but not explicitly quantified, may include:

- Reduced exposure to roadway-rail crossings
- Improved train operating efficiency
- Reduced train delays
- Improved train run-times
- Reduced public exposure in general

A comparison of performance measures was then made between the perceived cost to the railroads due to network inefficiencies and that associated with each planning case result. An average cost of $303 per delay hour[1], based on estimated costs associated with fuel consumption for idling locomotives, train crew labor costs, and the unavailability of locomotive power was used to determine an estimated annual private burden.

Projecting this annualized cost to 2016 and also to 2026 with an annual 3 percent rate of inflation, the NPV of this private burden was then calculated, and used as an indicator of the private benefit that may be associated with the results of the planning cases discussed. Further explanation of the private benefit calculations can be found in Appendix D.

[1] Calculated based on 2005 statistics provided by the railroads to the Association of American Railroads (AAR).

Section 11: Next Steps

As part of the Texas statewide analysis of freight mobility, in particular understanding the movement of freight by rail and the inherent relationships that exist between rail, trucking, and maritime freight shipments, this study was conducted to establish a needs assessment report for the stakeholders in the Houston region that outlines potential infrastructure improvements, and their associated order of magnitude costs.

The improvements outlined in this report are intended to provide the foundation for a conversation on infrastructure and facility modifications that will benefit the quality of life in the local communities, reduce the public's exposure to freight movements, enhance economic growth and development, and improve passenger and freight mobility throughout the Houston region.

This needs assessment ultimately will assist the Texas Transportation Commission, and the State Legislature in understanding the magnitude and extent of the investment required to improve regional mobility, thus allowing them to adequately fund the Texas Rail Relocation and Improvement Fund (TRRIF).

Once the TRRIF has been funded, regional agencies such as the Gulf Coast Freight Rail District, in cooperation with the Texas Department of Transportation, the Ports of Houston, Galveston, Beaumont, and Freeport, the Houston-Galveston Area Council, as well as the freight railroads serving the Houston region, and other public and private partners will work together to determine which improvements will become prioritized projects. The chosen improvements will then undergo the rigorous project development schedule that includes environmental and public involvement processes.

The Houston region should take this report; add, subtract, modify it; and develop regional freight transportation improvement initiatives that will be made a part of the H-GAC's Regional Transportation Plan, allowing the continued economic growth of the region by meeting the needs associated with freight movement mobility.

Meeting this region's transportation needs, for both people and goods requires collaboration, cooperation, and an understanding that the region will continue to grow. The region requires a multi-modal solution that provides economic, efficient, and safe transportation infrastructure.

Section 12: Meet the Staff

Joe Lileikis
Project Manager, Houston Region Freight Study
HNTB Corporation
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512/691-2227

Mr. Lileikis brings 25 years of practical railroad experience to the Houston Region Freight Study. Prior to joining HNTB as Texas Rail Leader in 2004, he worked in the Engineering departments of Union Pacific Railroad and Amtrak. During that period, Mr. Lileikis played an instrumental role in the development and upgrading of mainline tracks in Los Angeles for the Metrolink Commuter Rail project, held direct responsibility for the maintenance and construction of railroad structures on UPRR's Western Region, assisted in the development of Amtrak's Structure Department Capital Improvement Program, with direct oversight of complex projects. He also established capital improvement plans for Cal-Trains Peninsula Commute Service, established the manual for dealing with infrastructure characteristics and Amtrak's State of Good Repair, and was instrumental in the planning of Amtrak's High Speed Rail Initiatives along the Michigan to Chicago Corridor, and the Northeast Corridor from Washington, DC to Boston, MA.

Since joining HNTB, Mr. Lileikis has served as the Project Manager on railroad relocation/improvement studies for the Central Texas Rail Network and the State Highway 130 transportation corridor, and provided the detailed analysis, scope, and methodology required to integrate freight, passenger, and high speed rail within the multimodal Trans-Texas 35 Corridor.

Mr. Lileikis is a graduate Engineer from the University of Nebraska and is actively involved in the American Railway Engineering and Maintenance of Way Association, having served as President of its predecessor organization, the American Railway Bridge and Building Association.

Willard Keeney
Railroad Operations Manager
Washington Group International

Mr. Keeney obtained extensive railroad operating experiences as an Assistant Terminal Superintendent, Terminal Superintendent, and Assistant Division Superintendent for the former Southern Pacific Railroad. His knowledge of railroad operations is essential in the development and analysis of railroad operations simulation modeling — in particular, he has invaluable experience with and understanding of large railroad terminal operations.

Mr. Keeney has been involved in simulation modeling since 1992. Since that time, he has performed the analysis of freight rail movements on such high-profile projects as Chicago's CREATE project and the Alameda Corridor. The large and complex Chicago Rail Improvement Study took three years (2000-2003) and numerous major simulation cases to help develop the capital plans that have become the CREATE Plan. Mr. Keeney managed the series of cases throughout the study, personally conducting the interpretive analysis and presentations, while coding and executing many of the iterations. Other hands-on simulation work conducted by Mr. Keeney includes:

- Analysis of capacity and railroad performance for the Alameda Corridor Transportation Authority
- Port of Tacoma rail network
- The Ogden/Salt Lake area rail system for the Utah Transit Authority (2004-2005)
- Union Pacific-plus-passenger-operators joint analysis of all UP's trackage in North-central California
- St. Louis High Speed Rail Project for the Wisconsin and Illinois Departments of Transportation
- The Pacific Northwest Rail Corridor for the Washington and Oregon Departments of Transportation
- Numerous studies for the BNSF Railway Company
- Numerous studies for the Association of American Railroads

Stephen S. Roop, Ph.D.
Assistant Agency Director
Texas Transportation Institute

Dr. Roop is an Assistant Agency Director for the Transportation Safety Center and the Multimodal Freight Transportation Programs, Rail, AAR Affiliated Lab, Center for Ports and Waterways, National Pipeline Safety Center, at the Texas Transportation Institute (TTI). He is responsible for guiding transportation safety research, rail, ports and waterways, intermodal trucking, and pipeline related activities at TTI with the goal of establishing these areas as a national focal point in Texas for innovative research.

Dr. Roop has served as the Director of Texas A&M's Association of American Railroads Affiliated Laboratory since its establishment in 1995, working closely with A&M's College of Engineering to identify research of interest to the railroad industry. He is a chairman of the bi-annual National Conference on Highway-Rail Grade Crossing Safety, sponsored by TTI.

Section 13: Legislation

Documents relating to legislation significant to this study are included in this section of the report and are listed as follows:

- A summary of House Bill 2702, which addresses transportation facilities and issues within Texas,
- A summary of The Texas Rail Relocation and Improvement Fund (House Bill 1546),
- A summary of House Bill 2958, which created a Gulf Coast Freight Rail District for the Houston region, and
- Copies of the Memoranda of Understanding (MOU's) between the State of Texas (acting through TxDOT) and the Union Pacific Railroad and the BNSF Railway Company.

House Bill 2702

79th Texas Legislature
House Author: Krusee
Senate Sponsor: Staples
Effective Date: 6-14-2005

House Bill 2702 is an omnibus bill addressing transportation facilities and other transportation issues in this state.

Article 1, Rail Facilities, amends the Transportation Code to transfer all powers and duties of the Railroad Commission of Texas that relate primarily to railroads and the regulation of railroads to the Texas Department of Transportation, effective October 1, 2005. It authorizes the department to enter into comprehensive development agreements for rail facilities and to combine a rail facility and a toll project in an agreement. It prohibits the department from spending money from the general revenue fund for rail facilities except pursuant to a line-item appropriation, rather than setting the limit on annual disbursements from the state highway fund for rail facilities at $12.5 million. It authorizes the department to enter into an agreement with a public or private entity that provides for the payment of certain fees to the entity as reimbursement for designing, building, and operating a passenger or freight rail facility.

Article 2, Highways, prohibits obligations from the Texas Mobility Fund if the Texas Transportation Commission or the department requires that toll roads be included in a regional mobility plan in order for a local transportation authority to receive an allocation from the fund. It authorizes the commission to acquire property necessary or convenient to a state highway to provide a location for an ancillary facility, including a gas station, garage, store, hotel, restaurant, or other commercial facility, that is anticipated to generate revenue for a toll project. It

requires the department, to pay the value of the property acquired and, if an acquisition of real property for a state highway severs an owner's real property, to pay the damages to the remainder of the owner's property, including damages caused by the inaccessibility of one tract from the other. It specifies that if the remaining property is agriculture or open space land outside the municipal limits or extraterritorial jurisdiction of a municipality with a population of 25,000 or more, the commission is required to consider the loss of reasonable access to or from the remaining property in determining the damage to the property owner. It requires a utility to relocate a utility facility at state expense if the relocation is required by improvement of a segment of the state highway system that was designated by the commission as a turnpike project or toll project before September 1, 2005, and it requires the department and the utility to share the relocation cost under certain circumstances. It provides that money granted by the department each year for constructing toll facilities may not exceed an amount that, together with the money granted for the preceding four fiscal years, results in an average annual expenditure of $2 billion, rather than $800 million. It authorizes the department to enter into a comprehensive development agreement with a private entity to design, build, operate, and expand a facility on the Trans-Texas Corridor (TTC) and certain other projects, and it establishes a process for entering into the agreements. It provides that if the department enters into a comprehensive development agreement with a private participant that includes the collection of tolls, the private participant must submit the methodology for setting and increasing the tolls to the department for approval, and it provides that such an agreement may not be for a term longer than 50 years. It provides that property within the TTC that is licensed or leased to a private entity for a commercial purpose is not exempt from ad valorem taxation and is subject to local zoning regulations and building standards. It requires the department to ensure that at each intersection of the TTC and an interstate, state, or United States highway, the corridor and the highway are directly accessible to each other, and it requires the department to make every reasonable effort to connect the TTC with significant farm-to-market roads and certain other roads. It prohibits the department from pumping or extracting groundwater from the right-of-way of the TTC unless the groundwater is needed for a state highway or other transportation facility, other than a public utility facility. The bill also provides that if a well drilled and operated on the TTC is located inside the boundaries of a groundwater conservation or subsidence district, the well is subject to the rules of the district. Regarding right-of-way acquisition for the TTC, the bill prohibits the commission from acquiring property for an ancillary facility that will be used for commercial purposes except to acquire property for a gas station, convenience store, or similar facility in a specified location. It prohibits the commission from condemning property contiguous to an existing or planned segment of the TTC for an ancillary facility.
It authorizes the department to lease property or rights on the TTC, unless the lease is under a comprehensive development agreement, only if each agreement has been approved by the local county commissioner’s court. It requires toll

revenue from a state highway toll project to be deposited in the state highway fund unless it is to be used to repay toll revenue bonds. It specifies when the department may operate a non-tolled state highway or a segment of a non-tolled state highway as a toll project and requires a local election to approve conversion of a state highway or a segment of a highway to a toll project. The bill provides for a regional mobility authority to construct, own, operate, maintain, and acquire a transit system. It amends the Government Code to authorize a county to issue bonds for a toll or non-toll project or facility on the state highway system located in the county or, as a continuation of the project or facility, in an adjacent county.

Article 3, Vehicles, authorizes the department to seek funding from public and private sources to establish and operate hydrogen-fueled vehicles and refueling stations and to establish the refueling stations on the TTC.

Article 4, Coordination of Public Transportation for Health and Human Services Programs, amends the Transportation Code, the Health and Safety Code, and the Human Resources Code to authorize the department to deliver public transportation services to clients of eligible programs.

Article 5, Regional Transit System Review Committee, creates the committee to study the implications of implementing regional transit service in a certain region of the state.

Article 6, Carriers Transporting Household Goods, prohibits a motor carrier from operating a vehicle, regardless of the vehicle's size, to transport household goods for compensation unless the carrier registers with the department.

Article 7, Texas Department of Transportation Motor Vehicle Division, amends the Occupations Code to provide that a reference in law to the motor vehicle board of the department means the director of the division unless the reference relates to the adoption of rules.

Article 8, Transition Provisions and Effective Date, abolishes the State Aircraft Pooling Board and transfers its powers and duties to the department.

For additional information regarding the legislation, visit the Texas Legislature Online website at http://www.legis.state.tx.us/home.aspx.

House Bill 1546

79th Texas Legislature
House Authors: McClendon, Krusee, Herrero, Hamric, Guillen
Senate Sponsor: Staples
Last Action: 6-18-2005 – Effective upon adoption of constitutional amendment

House Bill 1546 and subsequently an amendment to the State Constitution approved by voters in November 2005, created the Texas Rail Relocation and Improvement Fund. This fund was necessary because TxDOT does not have the authority to spend State gas tax dollars, which are constitutionally dedicated to roadways, on rail. In addition, the State gas tax monies can cover preventative maintenance only on the aging TxDOT system; hence it is inadequate for other uses. In conjunction with local, federal, and private rail road monies, this new Rail fund will help to implement rail improvement projects in the future.

Though the fund has been established by law, it is currently unfunded. Because of this, the Texas Transportation Commission, TxDOT's governing body, commissioned a Statewide Freight Rail Study to determine the amount of funding required to address the needs of the State's rail infrastructure. In addition, the study will identify a timeframe for implementation such as short-range (1-5 years); mid-range (5-15 years); and long-range (15+ years). The Commission is expected to send this report to the 80th Texas Legislature in order to facilitate the funding of the newly created rail fund.

For additional information regarding the legislation, visit the Texas Legislature Online website at http://www.legis.state.tx.us/home.aspx.

House Bill 2958

79th Texas Legislature
House Authors: Hamric
Senate Sponsor: Lindsay
Effective Date: 6-17-2005

House Bill 2958 created a Freight Rail District for the Houston region. The law provides for a local governing body where TxDOT will be an ad hoc member. In cooperation with the area's Metropolitan Planning Organization, which in Houston is the Houston-Galveston Area Council (H-GAC), and TxDOT, this local district will advance these, or any other projects deemed necessary, towards implementation. The Texas Transportation Commission's intent is to delegate authority and responsibility to local elected officials and policy makers to chart the region's transportation future.

For additional information regarding the legislation, visit the Texas Legislature Online website at http://www.legis.state.tx.us/home.aspx.

MEMORANDUM OF UNDERSTANDING
BETWEEN
THE STATE OF TEXAS
ACTING THROUGH
THE TEXAS DEPARTMENT OF TRANSPORTATION
AND
THE BNSF RAILWAY COMPANY
FOR A COOPERATIVE PARTNERSHIP TO ADDRESS FREIGHT RAILROAD TRANSPORTATION ISSUES IN THE STATE OF TEXAS

WHEREAS, the Governor of Texas has proposed the development of a multimodal transportation system throughout the state of Texas, designated as the "Trans-Texas Corridor"; and

WHEREAS, in accordance with House Bill Number 3588, 78th Texas Legislature, the Texas Department of Transportation (TxDOT) was authorized to proceed with the development of the Trans-Texas Corridor facilities; and

WHEREAS, in accordance with House Bill Number 3588, 78th Texas Legislature, TxDOT has been authorized to acquire, finance, construct, maintain, and lease operations on state owned rail facilities in order to improve the safety and efficiency of Texas transportation systems; and

WHEREAS, in certain areas of the state, the growth of freight movements in and through the state of Texas is projected to increase in volumes that will eventually exceed the capacity of existing transportation systems in the state; and

WHEREAS, the state recognizes the essential need to promote and improve the efficiency of the multiple modes of transportation within the state, in order to facilitate the efficient movement of freight goods in and through the state of Texas; and

WHEREAS, the BNSF Railway Company (BNSF) operates and performs freight rail transportation services within the state of Texas, and recognizes the important role played by TxDOT in rail transportation planning and will participate in studies to advance statewide transportation interests; and

WHEREAS, the BNSF in its cooperation with the state herein will be guided by its own internal principles as outlined in the policy document entitled "Public Private Partnerships," (Exhibit A, attached), which contains an overview as to how BNSF will consider and participate in projects such as the Trans-Texas Corridor, beneficial freight rail relocations or other rail infrastructure projects and the state of Texas is willing to work with BNSF under the guidelines in Exhibit A for projects of this nature; and

WHEREAS, the state of Texas has seen a need to improve the Texas transportation system, and the potential to include the possibility of relocating some portions of freight rail services to alternative alignments that would benefit multiple modes of transportation; and

WHEREAS, improvements in the statewide freight rail system will offer opportunities to maximize the safety of all Texans while providing increased capacity for freight; and

WHEREAS, the BNSF and the state of Texas have agreed that improvements to the Texas freight rail system will benefit the state by enabling increased freight rail efficiencies and improving services to freight customers, and encouraging additional economic development within the state;

WHEREAS, the State of Texas understands and appreciates that BNSF operates in a competitive business environment and BNSF understands and appreciates that the State of Texas intends to enter into similar Memorandums of Understanding with other transportation providers, including BNSF's competitors; and

WHEREAS, the State of Texas and BNSF agree that to the extent that any other Memoranda are executed by the State of Texas with any of BNSF's competitors, and to the extent that such Memoranda contain substantive terms that effect the competitive environment BNSF operates in, that the same or functionally similar terms will also be offered to BNSF.

NOW THEREFORE, we declare to direct our respective planning and development personnel to work in a cooperative manner to identify potential rail projects which will facilitate the safe and reliable movement of goods and people within the state of Texas, and which will benefit the transportation system of Texas and the people of the state.

By: RICK PERRY
Rick Perry
Governor of Texas

DATE: 3/19/05

Matthew Rose
Chairman, President and CEO
BNSF Railway Company

DATE: 3/19/05

Exhibit A

Public Private Partnerships Brochure

BNSF Railway Company (BNSF) will consider public-private partnerships in cases that benefit the public and ensure the interests of BNSF customers, investors and employees are protected. BNSF has successfully accomplished a number of public-private partnerships, including a partnership with several California state entities resulting in the Alameda Corridor and a partnership with various entities in Missouri and Kansas resulting in fly-over projects in Kansas City.

What are public-private partnerships?

Public-private partnerships combine the business interests of companies with the diverse goals of the local, state and federal entities who are working in the interest of the public. Cooperation between the private and public sectors may, in many cases, allow both sides to achieve their respective goals better, faster, and at lower costs.

How does BNSF approach public-private partnerships?

Public-private partnerships must be voluntary on both sides. Decisions on behalf of the public must protect the public interest and investment. BNSF's decision on whether to participate must protect our assets and the interests of our customers, shareholders and employees.

Coordinated state and federal transportation planning is necessary to ensure prudent public investments are made in the national rail network. BNSF works with local, state, federal agencies and public officials to provide whatever relevant information is needed to achieve public goals.

What factors does BNSF consider when evaluating a potential public-private partnership?

Public-private partnerships require a fact-based planning approach that:

- o Describes project scope;
- o Assesses impact on current freight traffic levels and future traffic growth;
- o Provides a cost-benefit analyses on an after-tax risk-adjusted basis; and
- o Identifies public funding sources, timing, processes and probability of obtaining funding to meet the public's timeliness objectives and achieve the public's goals.

BNSF's preliminary interest in exploring the possibilities of a public-private partnership should not be construed as a real or implied commitment by BNSF to support a project or participate either operationally or financially. BNSF's official support or concurrence of a project's benefit will follow the fact-based planning process outlined above, completion of a Memorandum of Understanding (MOU) between the parties, and BNSF's issuance of a formal statement of benefit and support.

What factors may lead BNSF to reject a potential public-private partnership?

Any public project cannot negatively affect BNSF's freight customers or BNSF's ability to provide them with consistent service, now or in the future.

Will BNSF consider participating financially in a potential public-private partnership?

BNSF recognizes public funding for rail projects should be commensurate with public benefits. BNSF's contributions to public-private partnerships will be commensurate with benefits derived by BNSF in comparison with other freight transportation projects competing for BNSF capital dollars.

Even though a project may produce some benefits for BNSF, it may not rank sufficiently high enough compared to other capital projects, or meet BNSF's internal capital investment or timeframe thresholds. When this occurs, BNSF would still support a project but would not provide financial participation.

MEMORANDUM OF UNDERSTANDING
BETWEEN
THE STATE OF TEXAS
ACTING THROUGH
THE TEXAS DEPARTMENT OF TRANSPORTATION
AND
THE UNION PACIFIC RAILROAD
FOR A COOPERATIVE PARTNERSHIP TO ADDRESS FREIGHT RAILROAD RELOCATION ISSUES IN THE STATE OF TEXAS

WHEREAS, the Governor of Texas, on behalf of the citizens of the State of Texas, acting through the Texas Department of Transportation (TxDOT), plays a key role in transportation planning and the impact such planning has on communities and citizens all across the state of Texas; and

WHEREAS, TxDOT is authorized to participate in the planning, design, and development of multiple modes of transportation within the state; and

WHEREAS, investments in the state's rail freight system can be leveraged to provide major public benefits and can play a significant role in addressing growing transportation demands and related public issues such-as-automobile-congestion, pollution, safety, and energy; and

WHEREAS, in many communities across the State of Texas development has occurred that has placed businesses and homeowners directly adjacent to pre-existing Railroad corridors that have often been in existence for well over 100 years; and

WHEREAS, in certain cases existing Freight Rail Corridors could be available for alternate uses, including service to local Freight Customers, if and when the existing Through Freight Rail operations could be relocated to new corridors where rail infrastructure has been put in place to accommodate Through Freight Operations, and

WHEREAS, Union Pacific Railroad (UP) owns and operates rail freight transportation services within the state of Texas; and

WHEREAS, UP believes that certain rail relocation projects may be achieved through public-private partnerships and offer important opportunities to improve the state and national freight rail system; and

WHEREAS, UP and the State of Texas believe that there are locations and communities in Texas where the relocation of existing Through Freight rail corridors could indeed create significant Public Benefits for Citizens in the State of Texas.

WHEREAS, UP and the State of Texas agree that feasible proposals to relocate existing rail operations planned or developed as a result of this Memorandum of Understanding (MOU) will adhere to five basic principles identified as:

1. Public-private rail relocation projects undertaken within the scope of this MOU must be voluntary for both parties and will be contingent upon the parties entering into definitive agreements; furthermore, it is understood that TxDOT is responsible for protecting the public interest and investments, while UP is responsible for protecting the interests of its customers, shareholders and employees; and
2. Investment by Texas to fund any rail relocation project considered under this MOU must be commensurate with the benefit the public derives from the project. The source of such public funds should be from existing funds or some other general revenue source, and will not be funded by a user charge, additional taxes, or new fees levied on the rail industry in the State; and
3. Any UP contribution toward any rail relocation project considered under this MOU must be commensurate with the private benefit, if any, it derives from the project; and
4. Planning for rail relocation projects considered under this MOU must be coordinated among stakeholders to insure appropriate investments result from the public-private partnership process. UP will continue to work with TxDOT on such efforts and will supply reasonable input to the process. Planning and project implementation must take place in a manner that preserves the existing rail industry regulatory regime as well as ownership rights; and
5. The State will not expend public funds for any rail relocation project that would alter the existing competitive relationships between and among the railroads.

NOW THEREFORE, we declare to work together in a cooperative manner and in accordance with the five principles enunciated herein, and direct our respective planning and development personnel to work in a cooperative partnership to identify potential rail relocation projects which will improve safety and facilitate mobility within the state of Texas, and which will benefit the transportation system of Texas and the people of the state.

By: Rick Perry
Rick Perry
Governor of Texas

DATE: 3/18/05

Richard Davidson
Richard Davidson
Chairman & Chief Executive Officer
Union Pacific Railroad

DATE: 3/18/05