Regional Commuter Rail Connectivity Study

Prepared for :

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In association with:
HNTB Corporation
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Fregonese Associates, Inc.

Report for

REGIONAL COMMUTER RAIL CONNECTIVITY STUDY

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GLOSSARY OF TERMS AND ACRONYMS

Alignment – The specific location of the tracks within a corridor on which the commuter and freight trains operate.

610 Loop – Interstate Highway 610 which forms a loop around the urban core of Houston.

Beltway 8 – The controlled access facility that forms a loop around the City along the edge of the Suburban areas of Houston.

BRT – Bus Rapid Transit; a special class of rubber tired buses which have the ability to operate within a dedicated operating lane/guideway allowing the buses to bypass much of the roadway congestion, or when necessary in mixed flow traffic with all other vehicles.

CBD – Central Business District – Downtown Houston.

Commuter Rail – A "heavy" class of passenger trains which travel over long distances with infrequent **station** stops; FRA compliant vehicles – either DMU vehicles or passenger couches pulled by locomotives.

Corridor – The broad area through which a large number of travelers move utilizing various transportation modes operating generally in parallel paths.

DMU – Diesel Multiple Unit –A configuration of trains in a rail system in which each vehicle has a diesel-electric propulsion system. This configuration is different from the classic FRA compliant locomotive pulling passenger coaches; however, there are a few suppliers of FRA compliant DMUs. DMU's are common in non-FRA compliant suburban commuter lines and urban light rail transit.

Exurban Region – The far outer region of the metropolitan area beyond the suburban ring and comprising rural communities, villages, towns and major master planned communities.

FRA – The Federal Railroad Administration

FRA Compliant – Passenger trains/rail vehicles that the Federal Railroad Administration has classified as permissible to operate on the same tracks and operate in mixed traffic with freight trains.

FTA – The Federal Transit Administration – an agency of the United States Department of Transportation

FHWA – The Federal Highway Administration – an agency of the United States Department of Transportation

GCFRD – The Gulf Coast Freight Rail District

H-GAC – Houston-Galveston Area Council, the entity recognized by the US Department of Transportation as the local Metropolitan Planning Organization.

Hub – The Operational Hub Terminal (Hub) is the main passenger intermodal terminal which serves as the main operational hub for the regional commuter rail system, being the location where trains are placed in passenger/revenue service and removed from service.

ISTEA – The Intermodal Surface Transportation Efficiency Act of 1991 **–** Federal transportation funding act that established many of the programs and measures of efficiency used today for multi-modal transportation analysis.

LOS – Level-of-Service – Oftentimes the measure of the effectiveness of a given mode of transportation and the impacts of recommended changes amongst modes.

LRT – Light Rail Transit **–** A form of Mass Transit that is often utilized in the urbanized area of a City. LRT can be powered by overhead electrification, like Houston's Main Street Line. LRT vehicles can also be self propelled, usually through the operation of DMU technology.

MIS – Major Investment Study – Required under previous transportation funding legislation, now more so a practice of TxDOT for Multi-Modal corridor analyses.

M&SF – Maintenance and Storage Facility – Necessary for daily maintenance of trains, also used during the middle of the day as a lay-over locations for trains that are not in use. Additional rolling stock capacity is also stored at this location.

NIT – North Intermodal Terminal – Currently under design by Houston METRO as a large multi-modal facility on the north side of Downtown Houston.

Non-FRA Compliant – Passenger trains/rail vehicles that the Federal Railroad Administration has classified as NOT permissible to operate on the same tracks and operate in mixed traffic with freight trains.

Principal Corridors – The designated corridors which were determined in this study to be good representatives of a typical revenue service line for long distance passenger trains, and when taken as a complete set are conceptually representative of a mature regional commuter rail system.

Regional Growth Scenario – One of several growth scenarios defined through the Envision Houston Region study process.

RTP – Regional Transportation Plan

Regional Model – Also identified as Travel Demand Model – The tool used by transportation planners to emulate future travel conditions based upon a set of assumptions regarding the supply of and demand on the multiple modes within the transportation system.

Right-of-Way (ROW) – The strip of land through which the railroad tracks pass; a contiguous strip of land owned by the railroad or a government agencies within which the commuter rail line could be placed.

SAFETEA-LU – The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users – Was established in August of 2005 and governs the Federal funding of transportation projects through 2010. This legislation followed ISTEA and TEA-21.

Suburban Commuter Line – A "light" class of passenger trains which travel over moderate distances with frequent station stops; Non-FRA compliant vehicles **–** either DMU vehicles or conventional light rail vehicles.

Railroad (RR) Subdivision – The particular segment of the heavy railroad network that distinguished it from the other segments owned by a given railroad company.

TEA-21 – The Transportation Equity Act for the 21st Century – Enacted in June of 1998, this Federal Transportation Legislation continued and expanded upon many of the policies established by ISTEA

TMA – Transportation Management Area **–** H-GAC is the federally recognized MPO for the region and as such is responsible for programming transportation projects within the TMA.

Transit Mode – The classification of transit vehicle technology and/or the specific functional application of a transit vehicle.

Transit Realms – urban, suburban, exurban; urban LRT, suburban commuter line, and exurban long distance commuter rail.

Train – The combination of a locomotive providing propulsion and the vehicles/cars in which passengers are carried; in the case of a DMU, the coupled set of vehicles operated by a single operator.

Tower – A location in the rail road network where a junction of lines converge into complex grade crossing trackwork, historically requiring a manned "tower" in which train traffic through junction was controlled.

TOD – Transit oriented development, typically in the form of denser urban multi-purpose land use immediately surrounding a transit station.

PREFACE

The Regional Commuter Rail Connectivity Study has taken a fresh approach from past considerations of commuter rail in Houston, Texas. The look has been long range in terms of both the scale of the system and the timeframe in which it would evolve. The work builds on various studies that have preceded it, and draws from many sources of information and advice. It is considered a visioning document that is not constrained by current operating conditions, funding commitments, or organizational structures. Rather, it looks beyond the present to see the potential future, given sufficient political will and community commitment to see a long distance regional commuter rail system come to fruition.

Further, this study has maintained a "systems-level" approach in that an entire operating system has been studied, as compared to a "corridor-level" approach. The results and conclusions of this study, therefore, offer a complete conceptual definition of a passenger rail system that carries commuters from the far reaches of our region into the urban core of Houston. When taken as a whole, this document provides a conceptual system plan through which strategic decisions by the governmental agencies and transportation entities can be evaluated over the course of time, particularly with respect to related development and Right-of-Way (ROW) use. Over the course of the next 50 years, the overall access to our urban core will be dramatically affected by decisions made today. Hopefully, through presentation of this conceptual system plan for a regional commuter rail system, this study will help guide these decisions.

A fundamental concept, maintained throughout this study, has been that the commuter rail system will work in concert with the existing and future freight rail system. This means that passenger trains will share track with freight trains in locations where it is possible to provide sufficient capacity and operational fluidity for both, while providing dedicated track and facilities for passenger trains in locations where maintaining capacity and fluidity of freight operations requires this complete separation.

There has been no attempt in this early stage of study to determine any more than conceptual corridor alignments, operating plans, or specific station locations. Nor has an operating organization been identified that would provide for long distance commuter rail service covering much of the region. These will be steps that follow this work, refining and improving on the concepts presented herein. In fact, the end result will certainly be different than the conceptual as further planning and engineering studies progress. However, this initial look is an important first step toward achieving a realistic and effective new mode of intermodal transportation for Houston's future.

The report begins with an introduction that describes the region's need for commuter rail, as well as an overview of our common regional vision of commuter rail in Houston's future. Then in Chapter 2, a definition is developed of the "Principal Corridors" and "Secondary Corridors" in which commuter rail could serve.

This characterization of "Principal Corridors" simply defines which portions of the total possible system were selected for a more detailed study. The principal corridor conceptual system is representative of a future regional commuter rail system and is not necessarily the "recommended" system for design and construction.

Chapters 3 and 4 address the detailed ridership analysis and the operating facilities, some of the key elements of which are an operational hub terminal with an associated maintenance and storage facility.

Chapter 5 concludes the work with a critical look at the principal corridor conceptual system. In light of input received from the freight railroads, government officials, and the public involvement process, a new Baseline System Plan is proposed as a preferred reconfiguration of the conceptual system.

The final Chapter 6 presents the study conclusions and recommendations.

The appendices cover a variety of material developed during the study, beginning with an overview of the study scope in Appendix A.

Appendix B contains the presentation of "Commuter Rail 101" material that evolved as the work progressed and numerous presentations were made to public groups. This Appendix begins with an introductory definition of the term "commuter rail". Comparisons are then given to other transit modes, and the complimentary roles of all modes are described in a truly integrated multimodal system. True to the title of the study, the key objective of connectivity to the major urban districts is specifically addressed, but at a conceptual level only.

Appendix C addresses the existing railroad network. Of utmost importance in a study of commuter rail is the definition of the existing freight rail network, and the operating constraints of this most essential element of our region's economy. For this reason, substantial amount of material has been drawn from, and many of the conclusions built upon, the TxDOT Houston Region Freight Rail Study that was completed in 2007.

One of the key concepts that was a byproduct of the study concerned the use of both active and inactive right-of-way on the north side of downtown to form a "circulation loop", a concept that would facilitate the movement of passenger trains through METRO's North Intermodal Terminal (NIT). Appendix D describes this concept in general terms.

Appendix E contains, in the form of a white paper, a summarization of the preliminary analysis of commuter trip demand potential. This document was used in the assessment of the Principal Corridor selection process.

Appendix F presents a conceptual operating plan for the Principal Corridor system. This conceptual level plan was used in determining the ridership estimates contained in

Chapter 5. These ridership results were used in the detailed discussions with several groups of stakeholders to ultimately derive the Baseline System Plan discussed in Chapter 5.

Appendix G examines in more detail the economic development and environmental justice impacts associated with the operational hub terminal (Hub) potential locations as well as the maintenance and storage facility (M&SF) locations that were addressed in Chapter 4.

Appendix H addresses the Funding Mechanisms that were used in Chapter 5 in much more detail. The mechanisms discussed are based upon information and funding patterns that are currently programmed at the federal, state, and local levels.

Finally, Appendix I documents the Public Involvement process that was followed throughout the study. The many significant public and stakeholder meetings are listed there, and a summary of public comments is given. Those comments were received in response to the release of the draft report and the final round of public and stakeholder meetings at which the study findings and recommendations were presented

CHAPTER 1 – INTRODUCTION

Houston is at a crossroads, and decisions made in the near term will greatly affect our long term future in terms of commuter rail – a mode of transit that does not yet exist in Houston. The purpose of this report is to provide a definition of a regional long-distance commuter rail system, and to envision how such a system could help serve the tremendous need for efficient transit service throughout the very large metropolitan area around the Houston-Galveston Region. Although the study area was limited to the 8-County area surrounding Houston and Galveston, the concepts developed in this study would allow commuter rail to extend well beyond the study area.

A second dimension of this study is to address connectivity between transit modes within the urban core which will be essential for commuter rail to be fully successful. A given factor that has been assumed is the completion of the urban light rail transit (LRT) system (part of the METRO Solutions Plan, Phase II), which will tie together the major urban districts within the urban core. The study's purpose is also to define on a conceptual basis the connectivity solutions needed within Urban Districts in general to serve commuter rail.

The additional 3.5 million residents projected to move into the Houston-Galveston Region by 2035 will severely congest our region's transportation infrastructure if the current trend of development continues and the region remains auto-dependent. Even with the 2035 Regional Transportation Plan funded and built, the Houston-Galveston Region will see a projected 10% increase in congestion compared to today's level. It is necessary that other modes of transportation be investigated and implemented with the purpose of reducing the strain that congestion has on the region's economy and its ability to grow.

In light of this coming growth, a number of local transportation agencies are discussing the reality that the freeway and tollway system is not keeping up with the growth of our region. Currently all major freeway corridors are in planning, design, construction or have recently initiated operation of new freeway/tollway capacity. If funding becomes available over the next ten to fifteen years, all of this new capacity could be coming online. However, most of the freeways will be reaching capacity constrained conditions again within a few years after the new capacity is in place. Other means and modes are needed to move people through the most constrained portions of our radial travel corridors.

Figure 1-1 was taken from the recently published 2035 Regional Transportation Plan for the Houston-Galveston Region. The figure illustrates, in red, the level of congestion forecasted for the region even with the implementation of the roadway and transit projects contained within the 2035 Regional Transportation Plan. The graphical image is clear – the Houston region must begin to aggressively build high capacity transit that will carry people over long-distances and provide adequate mobility within the urban core of the City.

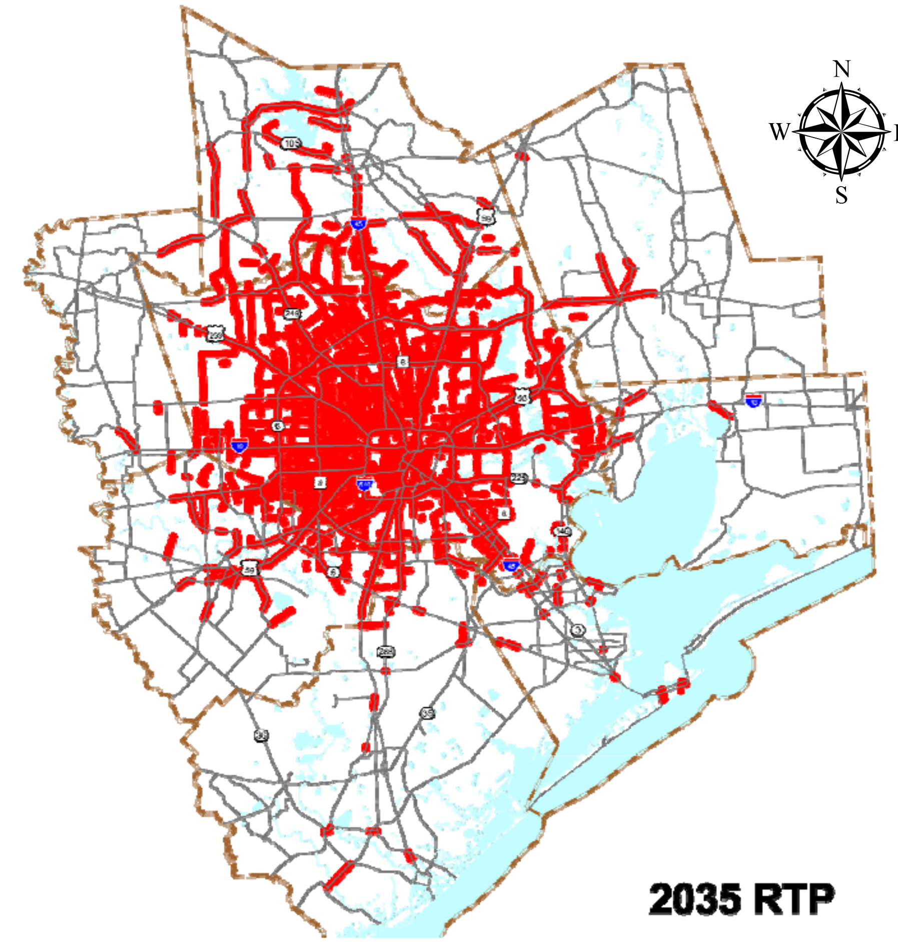


Figure 1-1: Congestion with Implementation of 2035 RTP

Figure 1-2, on the following page, illustrates the current conditions in the urban core where the interchanges are the greatest freeway system constraint. The capacity constraints of the interchanges that intercept the 610 Loop and the capacity of the 610 Loop itself, define the challenge of commuting to work across this barrier of congestion. A similar condition is developing at the interchanges around the outer Beltway 8 system, and a design reality is that even new interchanges are limited by capacity constraints. A strategic plan which adds capacity into the urban core along the radial corridors is critically important to our future mobility. It is this strategic purpose that drives the concepts proposed herein for a regional commuter rail system.

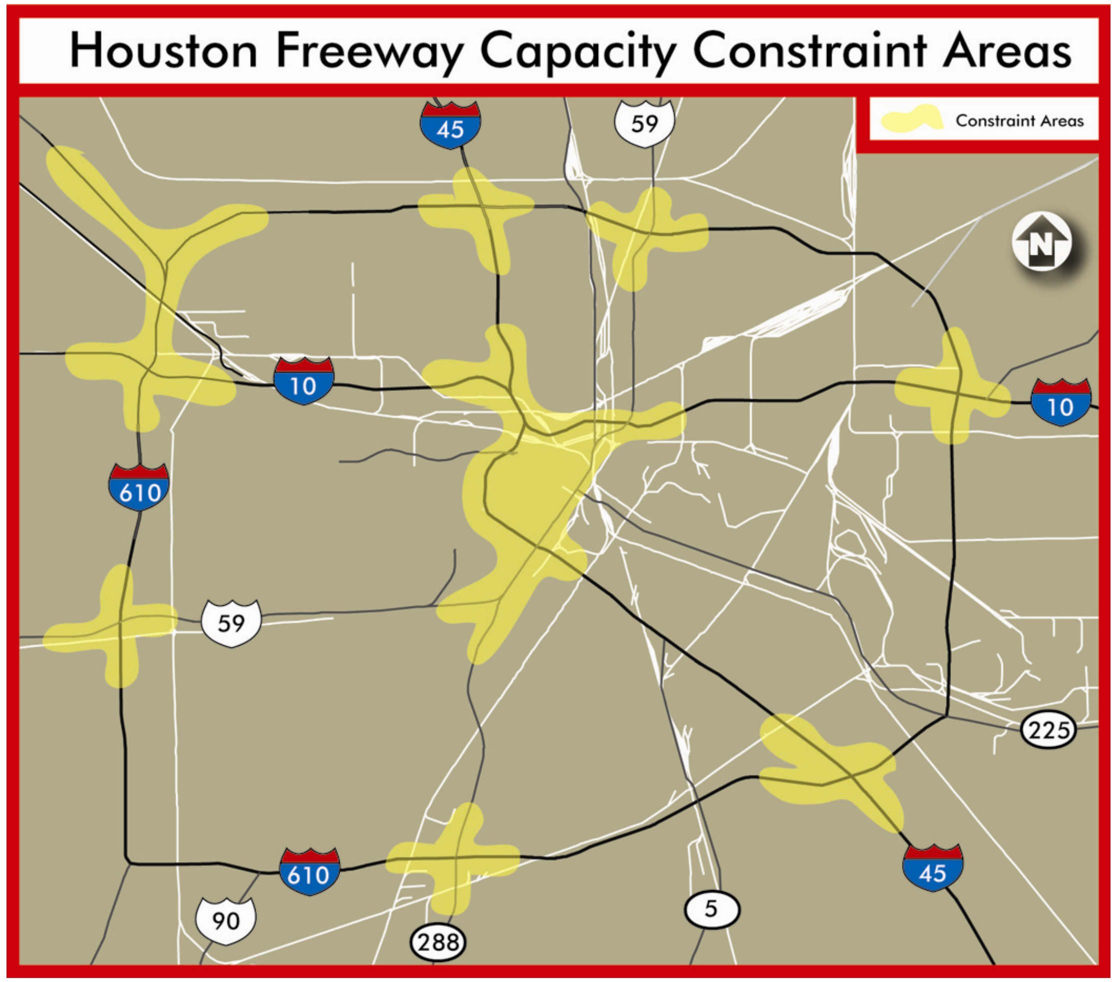


Figure 1-2: Houston's Freeway System's Most Critical Areas of Capacity Constraint

The figure also shows the railroad tracks and abandoned rights-of-way which are also configured in a similar radial pattern to that of the freeway system. This fact reveals a strategic source of potential new transportation infrastructure that could supplement our roadway system. A fundamental premise of this study is that a long-distance regional commuter rail system utilizing the railroad network of tracks could be a major part of the future intermodal transportation system that will be needed for filling the gap of the travel corridor capacity deficiencies.

In fact, TxDOT recently completed the US 290 Major Investment Study (MIS) and subsequent operational studies which have concluded that the combination of an improved freeway and arterial roadway system, combined with a new tollway and multiple passenger rail systems (i.e., commuter rail and light rail), will be needed through the corridor. Only the combined capacity of all the modes (i.e., freeway, tollway, arterial streets, suburban commuter lines, and long-distance commuter rail) will provide sufficient capacity to adequately serve all of the person-trip demands through the US 290/Hempstead Highway corridor over the medium term (i.e., the next twenty years of growth) and beyond. These challenges and proposed solutions that TxDOT has defined for the US 290 Corridor are representative of the challenges and solutions to be faced over the long term in every other radial corridor.

In addition to the benefits the benefits to capacity within a given corridor provided by commuter rail, the benefits of a regional long-distance commuter rail system within the Houston-Galveston Region include:

- **Reduction of Vehicle Miles Travelled** in single occupancy vehicles, as well as an associated reduction in gasoline consumption
- **Increase Economic Vitality** of the major urban districts and major activity centers served by the commuter rail system
- **New Economic Development** around the station sites
- **Increased Travel Mode Choices** for commuters throughout the corridors where commuter rail is implemented

1.1 Foundational Work For This Commuter Rail Study

A preceding study on which this work has been based is the TxDOT Houston Region Freight Rail Study, completed in 2007. This previous study compiled a tremendous wealth of information about the existing freight rail network. The Houston urban core has grown up around and integrated with the Houston Terminal, as our central railroad system is called by the freight railroads. The flow of freight to or from the Houston business, manufacturing, and industrial complex, as well as the Port of Houston, is an essential part of our economy and must be protected from any detrimental action that imposes significant capacity impacts. For this reason, the operational capacity constraints that are inherent to the Houston heavy rail network were of great importance to understand and accommodate in this regional commuter rail study. The TxDOT study provided this source of freight rail industry information, capacity restrictions, infrastructure improvement requirements, and general context.

1.2 Our Common Vision of Passenger Rail Service

The travel times for Houston region commute trips are continually increasing and the freeway congestion problems have been a growing concern within government and transportation agencies in recent years. There is evidence that many in the region already recognize that long distance passenger rail is a key missing piece of the transportation puzzle.

Specific to this study's focus, it is noteworthy that the concept of operating commuter rail along existing railroad ROWs has been embraced by a large number of governmental and transportation agencies in the Houston Metropolitan Area. In evidence of this interest, the various corridor specific studies are noted which address commuter rail within the region.

Major corridor studies that have been accomplished over recent years by different agencies, as follows:

- Harris County 90A Corridor Study
- Harris County FM 249 Corridor Study
- Galveston Commuter Rail Study

And building on the work of the various agencies concerned with regional transportation, other regional studies and plans have been found to include a strong and consistent vision for commuter rail on a regional scale, including the following studies:

- Harris County Comprehensive Transit Strategy
- Houston-Galveston Area Council 2035 Regional Transportation Plan
- Envision Houston Region Plan and Blueprint Houston
- Hempstead Multimodal Corridor Vision Statement; TxDOT US 290/ Hempstead Highway Schematic Design
- TxDOT Regional Freight Rail Study

The *Harris County Comprehensive Transit Strategy* contains a composite vision of commuter rail corridors reaching many parts of the region, some of which have also been studied by other entities. Of particular note, the SH 3 / IH 45 Corridor between Houston and Galveston, which continues to be studied by the City of Galveston. An additional corridor was that studied by TxDOT in 2005 within the FM 521 / Almeda Road rail corridor to the south as part of the SH 288 Corridor MIS. These two corridors, as well as others such as north to the Woodlands/Conroe area have been included within the Harris County strategy document. The document describes these corridors as strong prospective corridors for commuter rail operations along existing freight rail corridors.

In the current *Regional Transportation Plan for 2035*, the Houston-Galveston Area Council in Conjunction with Houston METRO has identified several planned commuter rail corridors, including US 90A, US 290, and IH 45 South. The commuter rail alignments are distinguished from the LRT network, which represents the full build-out of the current METRO Solutions Plan. The corridors of interest that are described by the 2035 RTP imply an application that fits into what this report defines as a either suburban commuter lines or long distance commuter rail.

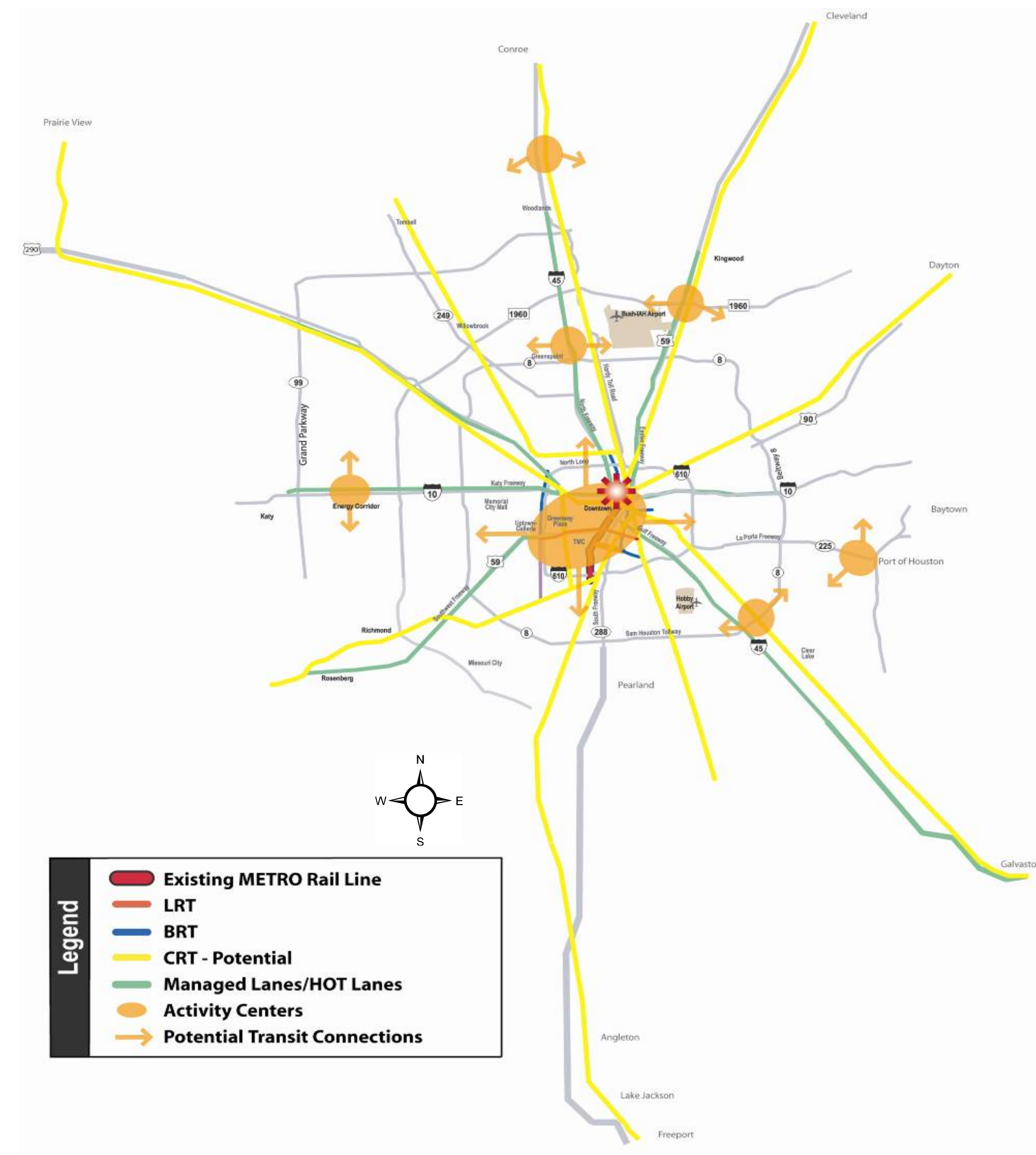


Figure 1-3: Envision Houston Regional Visioning Effort

The Metropolitan Transit Authority (identified generally as METRO) is a direct contributor to the H-GAC 2035 RTP, and as such the vision of METRO for the near to medium term is also reflected in the figure above.

Each of the four new rail lines are envisioned to be between 8 and 30 miles in length:

1. US 90A Sugar Land alignment,
2. SH 3 / IH 45 Galveston alignment,
3. US 290 / Hempstead Highway alignment, and
4. Westpark Toll Road alignment.

The previously listed commuter lines will directly interconnect with an expanded LRT system that is now in an active design/build process.

In 2005, H-GAC began the *Envision+Houston Region* (e+HR) project. The e+HR was a broad based public outreach initiative involving hundreds of stakeholders, elected officials, students, and citizens throughout the region who participated in a series of visioning workshops and forums. Participants contributed their ideas for the future through statements and spatial allocation of future jobs and housing. The outcomes from the e+HR process include common goals and values created by the citizens involved which have guided the development of the 2035 H-GAC RTP and added to the knowledge base of the Regional Commuter Rail Connectivity Study.

One outcome of e+HR was a compilation map of the combined participants' desires for high capacity transit service throughout the Region. The map that resulted, shown in **Figure 1-3**, is a transit vision map generated from e+HR input, METRO plans, and e+HR consultant expertise.

TxDOT has also conducted studies that have produced long range ideas about a regional commuter rail system. As a follow-up to the US 290 Corridor MIS, a concept for regional commuter rail was developed and presented under a report entitled the *Hempstead Multimodal Corridor Vision Statement,* addressing the potential development of the Hempstead Highway corridor that parallels US 290.

This Vision Statement special report focused on exploring the concepts of a major operational terminal for commuter rail that might be located at the base of the corridor where it joins Loop 610. The conceptual ideas for a regional commuter rail system included a system of routes that serve all quarters of the metropolitan area from the operational hub near the West Loop, as shown in **Figure 1-4**.

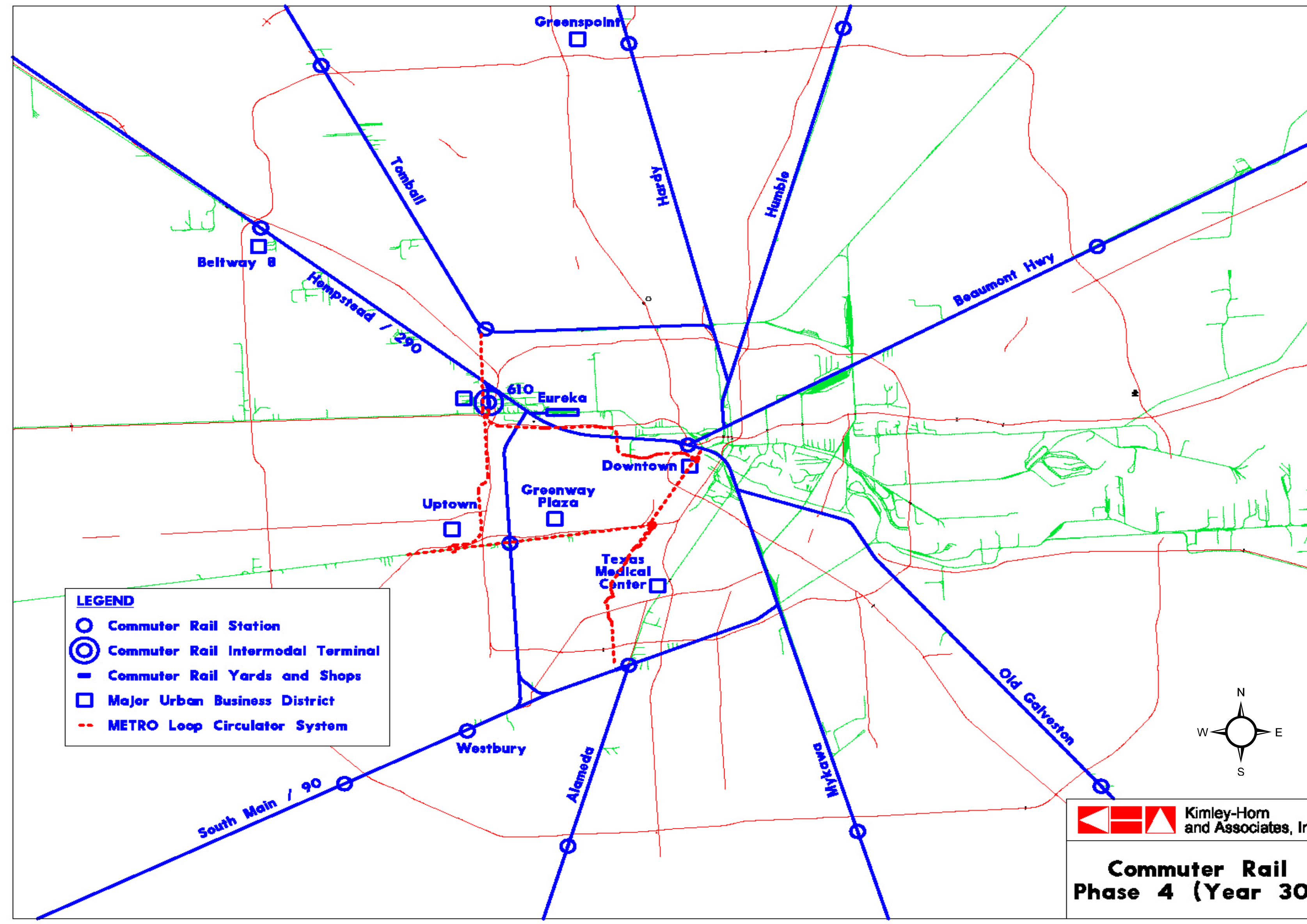


Figure 1-4: Hempstead Multi-Modal Corridor Vision Statement

When taken together, the collection of studies, plans and reports described above convey a strong and common vision for regional commuter rail among the governmental bodies and transportation agencies within the Houston metro area. Realizing that a unified understanding was vital, H-GAC commissioned this Regional Commuter Rail Connectivity Study to develop a Regional Base Case System Plan for long distance commuter rail that further defines our region's common vision.

The remainder of this report addresses long distance commuter rail, and describes the preliminary assessment and analysis that has been accomplished of a baseline system plan. The chapters that follow define a hypothetical system by which a basic understanding of the operations, the facilities, the track and right-of-way, and the associated cost for a well connected regional commuter rail system which is compatible with and builds upon the existing railroad network.

1.3 Definition of Commuter Rail

It is important to define our terms when discussing long distance commuter rail. This type of passenger rail system is distinguished in this study as equipment that is suited to operate along a rail line that is also serving freight train traffic somewhere along its length. This class of passenger rail rolling stock is referred to as he Federal Railroad Administration as "FRA compliant" equipment. The following characteristics are typical of Commuter Rail in comparison to Light Rail.

- Commuter rail characteristics:
- Larger trains = more passengers
- Stations are spaced further apart = faster average speeds
- Lower frequency of service, but with a well defined schedule of train departures from every station
- Mixed traffic operations of passenger trains and freight trains on an enhanced railroad network

Figure 1-5 shows an FRA compliant class of transit technology. In comparison, **Figures 1-6** and **1-7** show two other classes of non-FRA complaint transit technology, which cannot operate o the same tracks that the freight railroads actively use as well. These other rail technologies, which are sometimes confused with long distance commuter rail are called urban light rail, and suburban commuter lines.

While stations on an urban light rail system may be spaced at one-half mile to two-mile intervals, and stations along a suburban commuter line are located every three to five miles, long distance commuter rail stations are commonly placed at five to ten miles of separation. This longer station spacing is required for adequate high-speed operation that will provide travel times sufficient to serve the long distance regional commuter rail transit trip. The conceptual commuter rail system that is the focus of this study and the subject of this report is defined as a system suitable to move people who live long distances from the city into the urban core.

Refer to Appendix B for additional information on the differences between these three rail modes.

Figure 1-5: FRA-Compliant Commuter Rail in Fort Worth, TX

Figure 1-6: Houston's Main Street Line, an Urban LRT System

Figure 1-7: Suburban Commuter Line in Austin, TX

CHAPTER TWO - PRINCIPAL CORRIDOR SELECTION

An important task of the study scope of services required the determination of a set of "Principal Corridors" at the mid-point of the work program. This step was not necessarily intended to judge the highest priority corridors for commuter rail, nor was it intended to limit the consideration of other "secondary" corridors for near term implementation. Rather, it was a means to limit the number of representative corridors that would be carried into the tasks dealing with ridership analysis, operations planning, and capital cost estimating. The nature of the study overall is to establish a conceptual baseline for a regional long-distance commuter rail system. In developing the study toward this objective, the Principal Corridors selection phase defined a concept that was representative of a mature regional system. This Principal Corridor concept therefore served to provide a common understanding of what a regional commuter rail system would generically "look" like, and also provided an estimated cost for purposes of beginning the pursuit of federal, state and local funding sources necessary to begin the implementation of a regional system.

Most importantly, the definition of a set of Principal Corridors has allowed a dialogue to begin among the transportation agencies and with the Class 1 Railroads concerning specific corridors that could potentially be implemented in the near to medium term without detrimental impact on the freight rail movements within the region. This chapter provides an explanation of the process followed in determining the Principal Corridors that were studied further.

2.1 Determination of Candidate Corridors

Originally, there were eighteen railroad subdivisions/corridors that were considered as candidates for the implementation of FRA-compliant passenger trains. These corridors were first assessed as to their suitability for a regional commuter rail system in terms of whether they were part of a radial type of corridor pattern that could serve the movement of passengers into the urban core.

Some of the railroad subdivisions were found to be necessary connecting parts, in combination with other radial subdivisions, to route commuter rail to the major Urban Districts inside Loop 610. For example, the "Terminal Railroad Subdivision" which is contained entirely within Loop 610 was integral to several other radial alignments which would connect to the Terminal Subdivision in order for trains to reach Downtown Houston. Although corridors like this are not Principal Corridors themselves, the Terminal and West Belt Railroad Subdivisions were deemed "inherently" studied since they are components of other Principal Corridors.

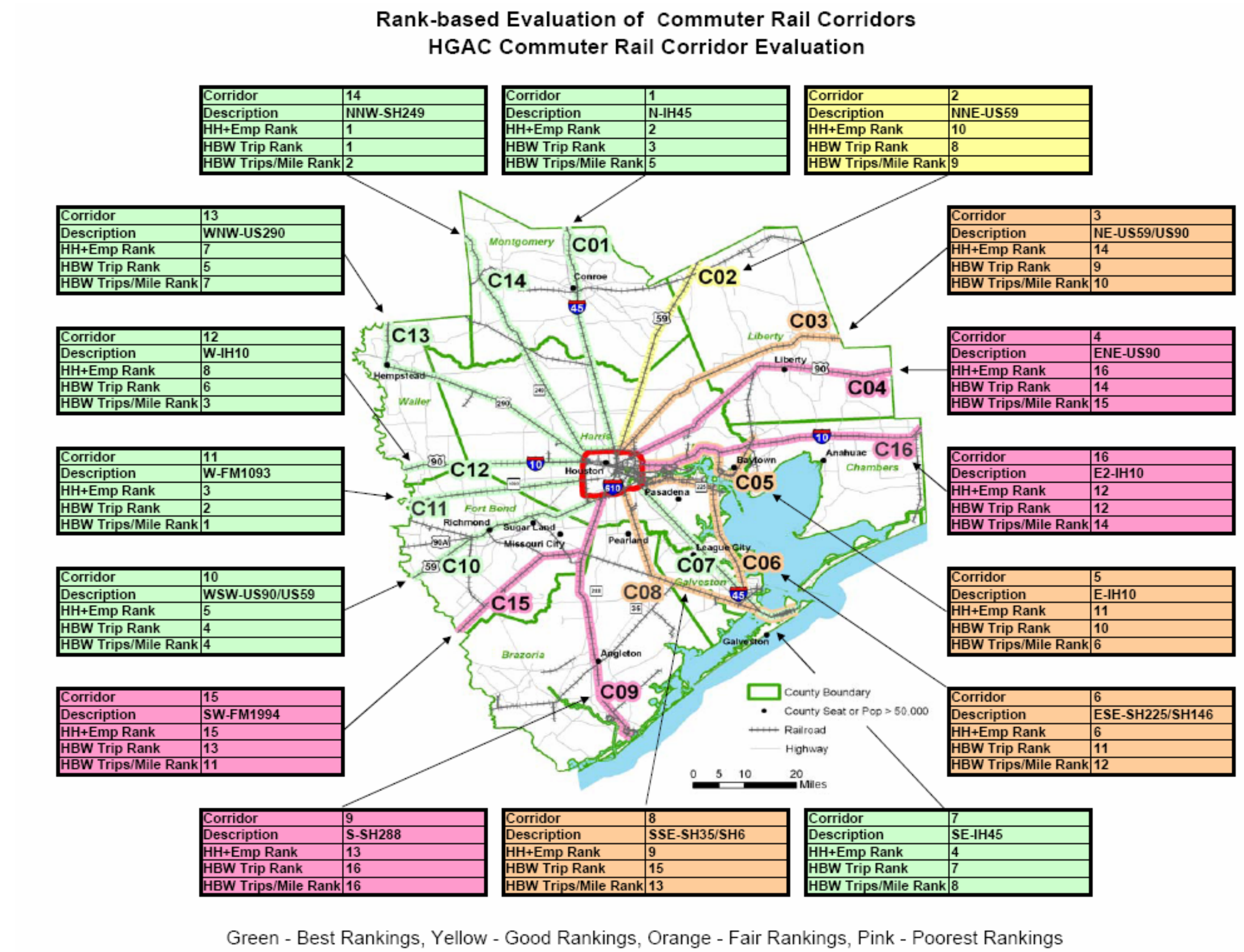


Figure 2-1: Relative Rank of Commuter Rail Corridors within the Region

Concurrently, the larger set of potential corridors was tested to see what a general "commuter trip demand potential" analysis would indicate about the commute trip patterns within the corridor. From this demand potential analysis, a judgment was made of the demand-side suitability for commuter rail service within the many corridor alternatives. This demand potential analysis is described fully in Appendix E, and was part of the basis for eliminating a number of corridors from further consideration as candidates for definition as a Principal Corridor.

This analysis evaluated a number of demographic and characteristic travel parameters, with the final set of comparative categories being described as follows:

- Demographics (Sum of Households and Employment)
- Work Trips (Sum of Corridor to Loop 610 Cordon Work Trips Generated)
- Work Trips per Mile (Intensity of Work Trip Generation per Mile)

The **Figure 2-1** shows the results of the demand potential screening analysis.

This first level assessment resulted in a reduction of the total corridors to be considered in the more detailed comparative evaluation. The "short list" of corridors taken into the comparative evaluation process is given in the table below. The graphic that follows indicates the corridors removed from consideration in subsequent assessment of Principal Corridors.

Table 2-1: Short List of Alternatives Considered for Principal Corridors

Travel Corridor Description	Railroad Subdivision Name
US 290	Eureka
Hardy Toll Road	Palestine
SH 249 / FM 1774	BNSF Houston
SH 3 / IH 45 South	UP Galveston
US 59 North	Lufkin
US 90A	Glidden
Westpark Toll Road	Bellaire
SH 35	Mykawa
Lake Houston / Huffman	Beaumont
FM 521	Popp

An important aspect of the selection of Principal Corridors was that all candidate corridors could be viable commuter rail corridors (assuming freight rail activity was somehow accommodated or redistributed within the network). With these assumptions and the assessments described above, the selected group of candidate corridors was reduced from 18 to 10 corridors, in part to provide reasonable bounds to the study scope. The rail segments that were removed from the initial screening are shown in **Figure 2-2** at right. Yellow areas indicate Railroad Subdivisions that were removed due to lack of connectivity to the urban core, or a very low potential for commuter rail demand. Blue areas indicate Railroad Subdivisions that were removed from the analysis as individual corridors because they were indicated as necessary components of other routes that were under analysis. However, the elimination of some corridors from the short list was not meant to indicate that these were "rejected" as candidate corridors for eventual commuter rail service.

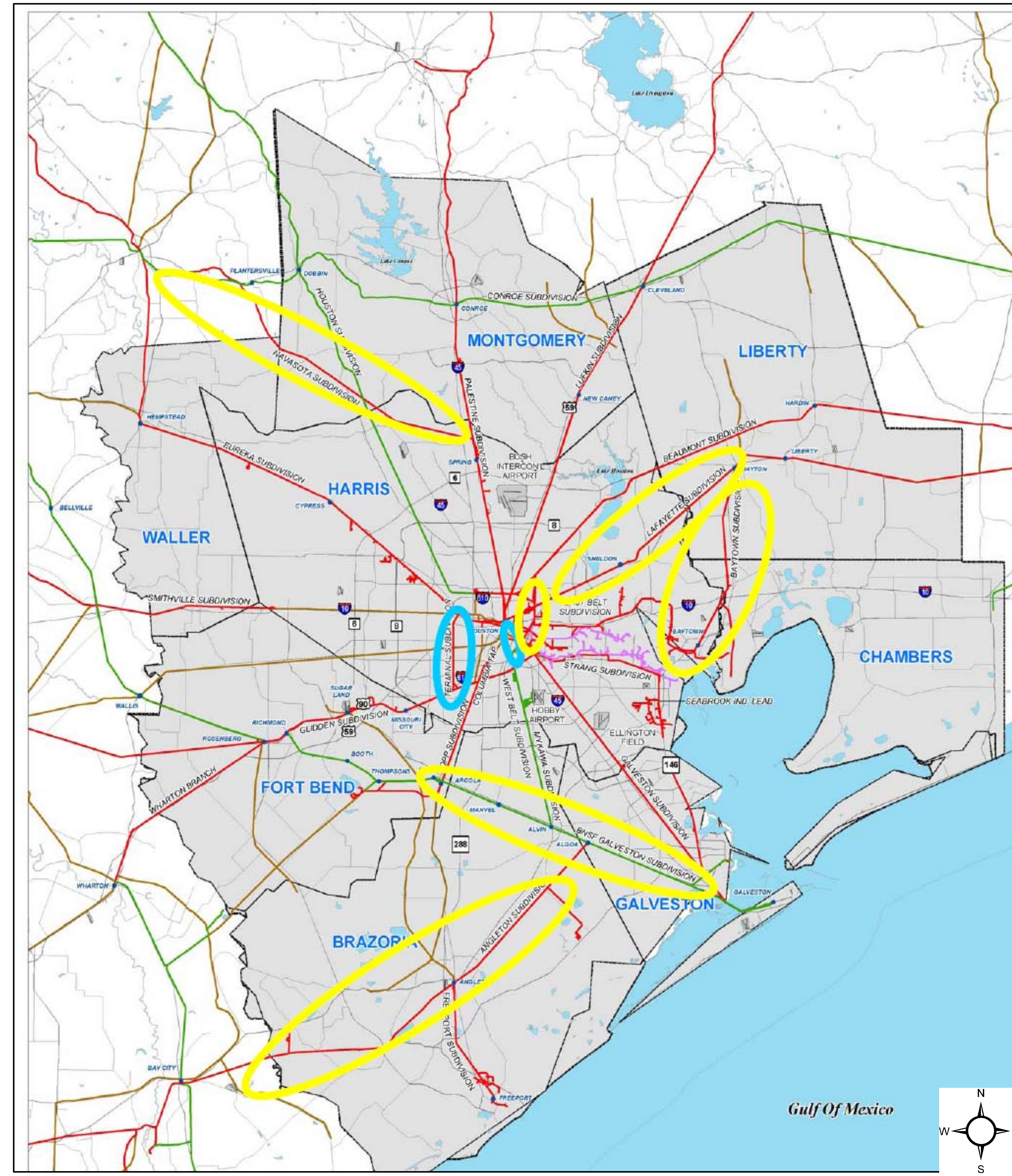


Figure 2-2: Railroad Corridors Removed from Consideration as Principal Corridors

2.2 Comparative Evaluation of Candidate Corridors

An initial set of twelve evaluation criteria categories was defined, and a process was undertaken to assess the suitability of these evaluation criteria in light of the fairly coarse level of corridor analysis possible under this study scope of work. Working with the project Oversight Task Force, the study team reduced the set of evaluation criteria to the following five categories.

- 2035 Demand Potential
- Capital Costs per Mile
- Implementability
- Urban Center Connectivity
- Economic Development Potential

The evaluation matrix was then established for each of the ten corridors, with numerical scores determined for each of these categories. For the scoring under the evaluation category called 2035 Ridership Demand Potential, each corridor was scored from 1-5 with 1 indicating the least demand potential while 5 indicated the highest demand potential. Refer to Appendix E for further information on the demand potential analysis.

For the Capital Cost category, general cost estimates were prepared for each corridor as a cost per mile value indicating preliminary start-up costs for commuter rail operations. The specific evaluation criteria was based on a scoring range where a score of 1 indicated the highest cost, over $20 million per mile; and a score of 5 demonstrated the lowest cost, less than $5 million per mile.

The evaluation criteria for Implementability, Urban Center Connectivity, and Economic Development Potential were also scored using the range of 1-5, with 1 representing the least favorable score. These categories are admittedly more subjective than the two criteria that were previously described, however, guidance for the scoring of these criteria was provided by the Study's Oversight Task Force. Implementability of commuter rail within each corridor was scored based upon the complexity of infrastructure needs, safety/social impacts, and political feasibility. Similarly, the Economic Development Potential within each corridor was scored by analyzing the current development trends as well as the future potential for economic growth within the corridor and around potential station locations. Urban Center Connectivity was scored more objectively based upon the number of Urban Centers that could be accessed by each corridor.

In an effort to further refine the Principal Corridor selection process, the scoring for each corridor was performed separately for the length of corridor inside Loop 610 and outside Loop 610, with the final scoring summed for each corridor. A weighting process was also used, based in part on the guidance of the Oversight Task Force, to establish the final scoring by which the Principal Corridors were defined.

2.3 Short List of Candidate Corridors

As a result of these considerations, the final scoring and ranking of the ten corridors that resulted is given below with the corresponding Railroad Subdivision name shown in parentheses and shown graphically in **Figure 2-3**.

1. US 290 (Eureka)
2. Westpark (former Bellaire RR Subdivision)
3. Hardy Toll Road (Palestine)
4. US 90A (Glidden)
5. SH 3 / IH 45 South (UP Galveston)
6. SH 249 / FM 1774 (BNSF Houston)
7. US 59 North (Lufkin)
8. SH 35 (Mykawa)
9. Lake Houston/Huffman (Beaumont)
10. FM 521 (Popp)

One additional consideration of the Oversight Task Force was that the commuter trip demand potential travel sheds for SH 249 and US 290 appear to overlap with each other, indicating that they would provide a certain redundancy in their service areas. The Oversight Task Force concluded that for purposes of the next phase of study, only one of these corridors should be selected, rather than both. Further, the Oversight Task Force also discussed the benefits of utilizing corridors with specific commuter rail ridership studies already performed or currently underway, which will serve to minimize the analysis effort and maximize the information obtained per dollar spent on the H-GAC study.

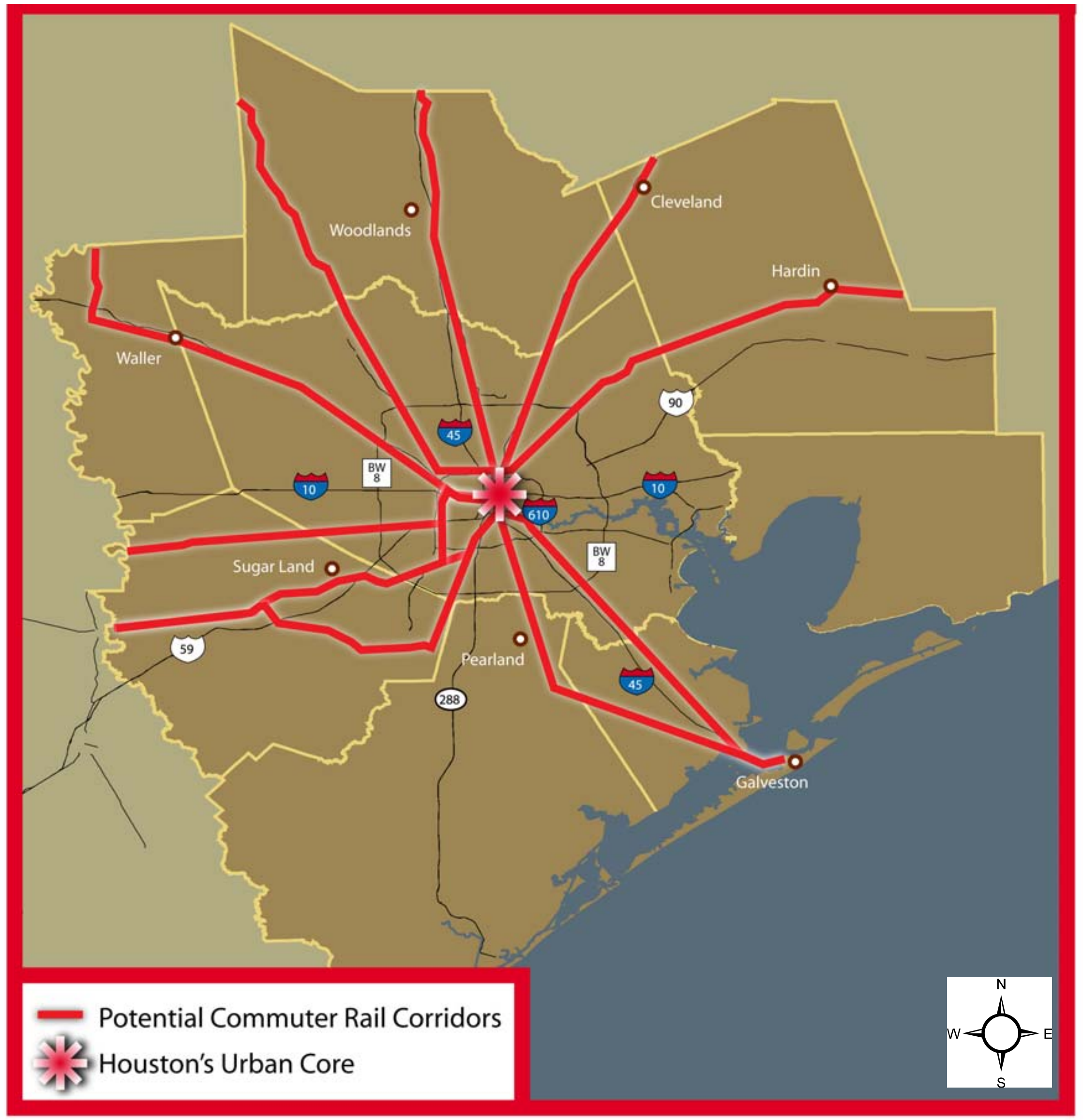


Figure 2-3: Potential Commuter Rail Corridors in the H-GAC TMA

As a result of the considerations and associated refinements to the scoring as described above, the five corridors selected as the study Principal Corridors are listed below, and shown in **Figure 2-4** at right:

1. US 290
2. Westpark
3. Hardy Toll Road
4. US 90A
5. SH 3 / IH 45 South

These five corridors defined a representative hypothetical commuter rail system that was used in the subsequent modeling tasks. Other corridors were, however, added to the Ridership and Operations analysis as additional optional corridors of interest, including SH 249 / FM 1774, US 59 North, and a combined corridor serving Fort Bend County as an alternative to US 90A, which utilized a part of the BNSF Galveston Railroad Subdivision and the Popp Railroad Subdivision as discussed in Chapter 3.

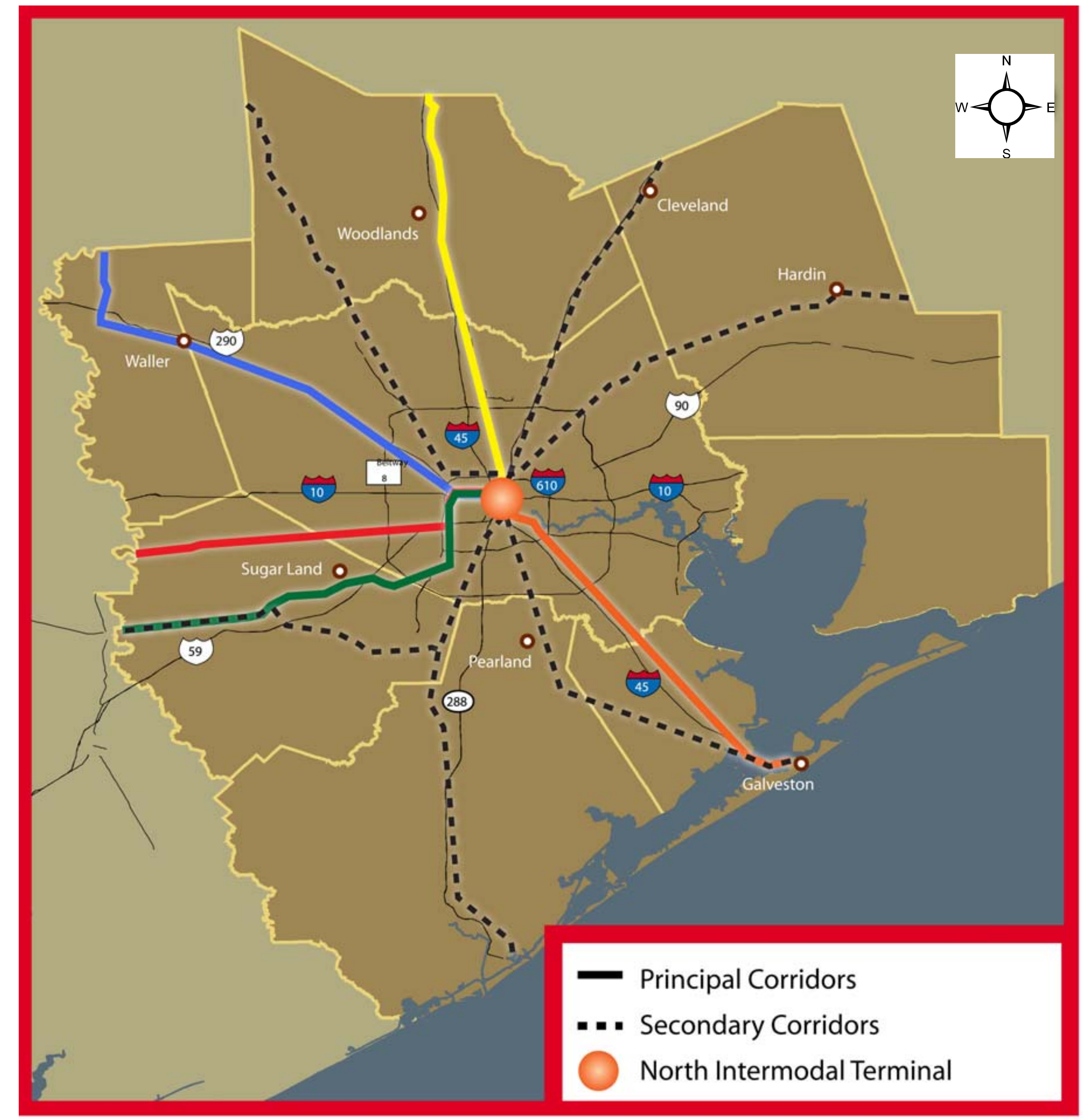


Figure 2-4: H-GAC Commuter Rail Principal Corridors

CHAPTER THREE - RIDERSHIP AND OPERATIONS ANALYSIS

Once the Principal Corridors were defined as a representative hypothetical system, the study efforts moved into a more detailed analysis of ridership potential. The assumptions described in the preceding chapters remained for this phase of analysis, in particular the assumption that a long distance commuter rail system would primarily serve home-to-work trips originating outside of Beltway 8 with destinations near or within the 610 Loop – the urban core.

This chapter discusses the results of this ridership forecast, as well as the corresponding preliminary operating plans assumed for a Houston area commuter rail service. The conceptual regional commuter rail system's service would be oriented toward the peak commute periods, heading in the peak commute directions on weekdays. In addition, limited bi-directional off-peak service was assumed as is typical for regional systems of this nature.

3.1 Ridership Forecast Methodology

The Houston-Galveston Area Council (H-GAC) regional travel demand model was the analytical tool utilized during this study to forecast commuter ridership on the rail corridors considered in this study.

The five Principal Corridors were assumed for the hypothetical regional commuter rail system analyzed in the Tier 1 ridership analysis performed for this study. These corridors are illustrated in **Figure 3-1**:

1. US 290 (Eureka RR Subdivision)
2. Westpark (former Bellaire RR Subdivision)
3. Hardy Toll Road (Palestine RR Subdivision)
4. US 90A (Glidden RR Subdivision)
5. SH 3 / IH 45 South (UP Galveston RR Subdivision)

Figure 3-1: Principal Corridors: Base Case for Tier 1 Ridership Forecasts

The Tier 1 modeling focused on forecasting ridership for the Principal Corridors to determine an order of magnitude ridership forecast for a mature and well connected regional commuter rail system.

A second set of ridership studies were also performed under the designation of Tier 2 studies. These studies tested a few selected alternative system configurations in which new corridors were added and some segments of the Principal Corridors were removed. The Tier 2 studies were designed to evaluate the sensitivity of the regional commuter rail ridership forecast when considering alternative corridor scenarios.

The travel demand modeling for the commuter rail ridership forecasting was based on the following basic assumptions and/or known constraints of the model:

- Average operating speed on the commuter rail are 45 to 50 mph;
- All suburban rail stations have drive access and walk access (depending on surrounding land use);
- With the potential commuter routes, the park and ride bus service outside Beltway 8 (in the corridors where there is commuter rail) is not available in the model;
- Initial waiting time is 20 percent of assumed headways;
- Sufficient capacity available on the rail lines;
- No changes were made to the light rail and bus transit routes or schedules;
- Transfers between commuter rail and other transit modes were allowed; and
- The METRO Solutions Plan, Phase II, was fully implemented.

The initial boarding station waiting time in the model is between 4 to 6 minutes. This assumes that most commuter rail patrons tend to arrive at the station just before the scheduled departure, and therefore do not have long initial wait times for the train.

The planning horizon year for the ridership forecast is Year 2035. The model network was based on H-GAC's 2035 Regional Transportation Plan (RTP). The bus system plan and other light rail lines; existing, planned, or in design by METRO; are included in the 2035 H-GAC networks. Additionally, the highway network (auto mode) included HOV lanes, but was modeled to represent a peak period level of congestion. It is standard practice to reflect peak period highway congestion when comparing to peak period transit travel times. Finally, Year 2035 population and employment forecasts were utilized as input to the travel forecasts.

3.2 Tier 1 Ridership Forecasts for the Principal Corridor System

The 2035 peak period travel demand forecast for the base case commuter rail ridership analysis with five Principal Corridors is summarized in **Table 3-1**.

Table 3-1: 2035 Forecast Weekday Peak Period Ridership

Principal Corridor Commuter Rail System

Commuter Rail Route Roadway (RR Subdivision)	Weekday Peak Ridership (Total Daily Boarding both directions)			
	HBW	HBNW	NHB	Total
US 290 (Eureka)	6,017	562	325	**6,904**
SH 3 / IH 45 South (UP Galveston)	9,537	1,017	323	**10,877**
Westpark	5,588	925	295	**6,808**
US 90A (Glidden)	6,033	1,078	344	**7,455**
Hardy Road (Palestine)	8,252	623	119	**8,994**
System Total	**35,427**	**4,205**	**1,406**	**41,038**

Source: H-GAC Regional Travel Demand Model, 2008

HBW – Home-based work; HBNW – Home-based non-work; NHB – non home-based

The estimated ridership for the base case commuter rail system is approximately 41,000 one-way trips per weekday day with a high of 10,900 trips per day on the SH 3/ IH 45 South route and a low of 6,800 riders per day on the Westpark route. As seen, home-based work trips constitute almost 90 percent of the total commuter trips. This is a strong indicator of traditional suburb to central city long-distance commuter rail ridership potential. For the purposes of the Principal Corridor selection screening analysis, the primary rationale of commuter rail is to connect work trips between outlying populations in the cities, towns, villages, and large master-planned communities (i.e., exurban areas) and the urban core employment centers. This measure is one direct indication of commuter rail market potential.

These estimates are deemed to be conservative (low) for a mature system in light of the following:

- Assumptions about complementary land-use development patterns near the stations were limited in this first analysis
- The relative price of travel by automobile, including fuel costs, inherent to the travel demand model were based upon observations contained within the most recent Benchmarking process, conducted in 2003
- Commuters with trips that originate from beyond the 8-County study area were not explicitly analyzed as potential commuter rail users, and it is likely that such long-distance trips will actually form a significant share of the ultimate ridership
- The full implementation of the improvements listed within the 2035 RTP were assumed for modeling purposes, however, recent funding short-falls and increased construction and ROW acquisition costs through many of the proposed corridors may lead to a smaller amount of projects being constructed

A detailed ridership breakdown by station in a boarding and alighting (exits from the trains) format is summarized in **Tables 3-2** through **3-6** for the five Principal Corridors commuter rail routes. A general representation of station locations was assumed along the rail routes for the ridership forecasting model. The inbound commuter trips are assumed to occur in the AM peak period from exurban areas to Major Activity Centers within the urban core and outbound trips are assumed to occur in the PM peak period from the urban core to the exurban areas of the region.

For example, there are a total 4,861 inbound trips on the US 290 route in the peak periods. Half of these trips (2,430) occur in the AM peak period as total boarding in inbound direction and the same riders (2,430) returning in the PM peak. Total boarding passengers of 594 shown at Hempstead station in the inbound direction can be interpreted as a round trip conducted by 297 passengers. The 297 passengers board at this station in the AM peak and alight (disembark) the train in the PM peak upon returning. The way the table is set up, Hempstead "creates" 594 total in-bound boardings on the commuter rail system: 297 in the AM and 297 in the PM.

The reverse commute trips, shown in the right-hand side tables, represent people who live in the urban core of the City that commute out to employment centers in the suburban/exurban areas. For instance, a total of 1,022 riders on US 290 route traveling outbound in the AM peak and return in the PM peak. The terms "inbound" and "outbound" generally refer to the central-city radial orientation of the base case commuter rail system that was assumed for the modeling. It is important to note that the numbers appearing below are unconstrained by such factors as train frequency, parking, and transit connections. This is to say, they represent total demand for commuter rail service inbound and outbound during the peak periods.

Table 3-2: 2035 Forecast Weekday Peak Ridership by Stations
US 290 Route (Eureka RR Subdivision)

Total Weekday Route Ridership – 6,904

AM Inbound - 2,430 **AM Outbound - 1,022**

PM Outbound - 2,430 **PM Inbound - 1,022**

Peak Commute Direction

Generalized Station Locations	Inbound (all trips)	
	Boarding	Exits
Hempstead	594	0
Waller	628	1
Fairfield Place Drive	827	1
Jarvis Road	636	3
N. Eldridge Parkway	1,114	15
Sam Houston Tollway	530	200
US 290 at Loop 610	532	1,295
Houston	0	3,346
Total	**4,861**	**4,861**

Reverse Commute Direction

Generalized Station Locations	Outbound (all trips)	
	Boarding	Exits
Houston	1,370	0
US 290 at Loop 610	640	1,167
Sam Houston Tollway	29	615
N. Eldridge Parkway	2	185
Jarvis Road	1	23
Fairfield Place Drive	1	32
Waller	0	18
Hempstead	0	3
Total	**2,043**	**2,043**

Table 3-3: 2035 Forecast Weekday Peak Ridership by Stations
SH 3 / IH 45 South Route (Galveston RR Subdivision)

Total Weekday Route Ridership – 10,877

AM Inbound - 4,102 **AM Outbound - 1,377**

PM Outbound - 4,102 **PM Inbound - 1,377**

Peak Commute Direction

Generalized Station Locations	Inbound (all trips)	
	Exits	Boarding
Galveston	0	406
La Marque	28	783
Dickenson	21	1,094
Webster	89	1,231
FM 1959	12	1,244
South Houston	126	1,957
Lawndale Street	818	1,489
Houston	7,110	0
Total	**8,204**	**8,204**

Reverse Commute Direction

Generalized Station Locations	Outbound (all trips)	
	Exits	Boarding
Houston	0	1,906
Lawndale Street	989	294
South Houston	451	75
FM 1959	41	53
Webster	357	55
Dickenson	55	71
La Marque	56	219
Galveston	724	0
Total	**2,673**	**2,673**

Table 3-4: 2035 Forecast Weekday Peak Ridership by Stations
Westpark Route

Total Weekday Route Ridership – 6,808

AM Inbound - 2,286 **AM Outbound - 1,118**

PM Outbound - 2,286 **PM Inbound - 1,118**

Peak Commute Direction

Generalized Station Locations	Inbound (all trips)	
	Exits	Boarding
Simonton (FM 1489)	0	373
Fulshear	0	435
Peek Road	0	684
Addicks Road/SH 6	29	1,324
Sam Houston Tollway	125	1,327
US 59 at Loop 610	1,572	429
Houston	2,846	0
	4,572	**4,572**

Reverse Commute Direction

Generalized Station Locations	Outbound (all trips)	
	Exits	Boarding
Houston	0	1,633
US 59 at Loop 610	1,144	502
Sam Houston Tollway	712	101
Addicks Road/SH 6	380	0
Peek Road	0	0
Fulshear	0	0
Simonton (FM 1489)	0	0
	2,236	**2,236**

Table 3-5: 2035 Forecast Weekday Peak Ridership by Stations
US 90A Route (Glidden RR Subdivision)

Total Weekday Route Ridership – 7,455

AM Inbound - 2,299 **AM Outbound - 1,429**

PM Outbound - 2,299 **PM Inbound - 1,429**

Peak Commute Direction

Generalized Station Locations	Inbound (all trips)	
	Exits	Boarding
Kendleton (FM 2919)	0	404
Beasley	0	348
Richmond	4	721
Sugar Land (US 59)	318	1,873
Missouri City (Bltwy 8)	152	804
US 59 at Loop 610	1,410	426
Houston	2,681	0
Total	**4,598**	**4,598**

Reverse Commute Direction

Generalized Station Locations	Outbound (all trips)	
	Exits	Boarding
Houston	0	1,578
US 59 at Loop 610	1,237	756
Missouri City (Bltwy 8)	308	522
Sugar Land (US 59)	1,271	1
Richmond	39	0
Beasley	1	0
Kendleton (FM 2919)	1	0
Total	**2,857**	**2,857**

Table 3-6: 2035 Forecast Weekday Peak Ridership by Stations
Hardy Toll Road Route (Palestine RR Subdivision)

Total Weekday Route Ridership – 8,994

AM Inbound - 4,107 **AM Outbound - 391**

PM Outbound - 4,107 **PM Inbound - 391**

Peak Commute Direction

Stations	Inbound (all trips)	
	Exits	Boarding
Willis (FM 1097)	0	513
Conroe	0	3,331
Rayford Road	13	726
Spring (FM 1960)	32	2,594
Greens Road	818	1,049
Houston	7,350	0
Total	**8,213**	**8,213**

Reverse Commute Direction

Stations	Outbound (all trips)	
	Exits	Boarding
Houston	0	648
Greens Road	504	125
Spring (FM 1960)	224	8
Rayford Road	53	0
Conroe	0	0
Willis (FM 1097)	0	0
Total	**781**	**781**

Table 7-7 presents the Tier 1 forecast of weekday passenger miles traveled on the Principal Corridor commuter rail system. The total system with 41,000 daily riders would generate approximately 757,800 passenger miles on their round trip commute.

Table 3-7: Forecast Weekday Peak Passenger Miles
(Baseline Commuter Rail System)

Commuter Rail Routes Roadway (RR Subdivision)	Weekday Boarding	Passenger Miles Traveled
US 290 (Eureka)	6,904	117,442
SH 3 / IH 45 South (UP Galveston)	10,877	197,701
Westpark	6,808	108,091
US 90A (Glidden)	7,455	116,081
Hardy Road (Palestine)	8,994	218,493
Total	**41,038**	**757,808**

3.3 Optional Configuration Tier 2 Ridership Forecast

In addition to the Principal Corridor commuter rail system, two other system configuration alternatives were analyzed for preliminary ridership. These alternatives are listed below and illustrated in **Figures 3-2** and **3-3**:

1. Base case Principal Corridor system with an alternative routing replacing the US 90A (Glidden RR Subdivision) Corridor Route with an Optional Route serving the exurban areas of Ft. Bend County and Rosenberg via the BNSF Galveston RR Subdivision and then connecting to the Popp Industrial Lead Freight Line along FM 521;
2. Base case system with SH 249 and US 59 North corridor commuter routes added.

The Fort Bend County / FM 521 / BNSF Houston RR Subdivision / Popp RR Subdivision alternative resulted in a lower overall system ridership of 37,000 passengers per day. The model is indicating that this alternative routing is more circuitous than the direct route along the US 90A corridor, and traverses different areas of the city with lower overall boardings in the H-GAC model. One reason for this could be that the overall travel time savings are not as great compared to making the trips by auto due to the more circuitous routing. However, the fact that the route also traverses past Sienna Plantation and the western edge of Pearland with a good connection to the Texas Medical Center could induce new trips that are not currently represented in the regional Travel Demand Model.

The addition of commuter routes along the SH 249 (BNSF Houston RR Subdivision) and the US 59 North (Lufkin RR Subdivision) Corridors had the effect of increasing overall system ridership to over 51,000. This indicates that these corridors also have a commuter trip market that could see some benefit from commuter rail. Perhaps more significantly, the addition of these two corridors did not decrease the overall ridership of other north/northwest commuter rail routes, the US 290 corridor and the Hardy corridor. Furthermore, the additional connectivity of routes appears to increase the reverse commute ridership; for example, the SH 3 / IH 45 Route ridership increased by approximately 5-percent.

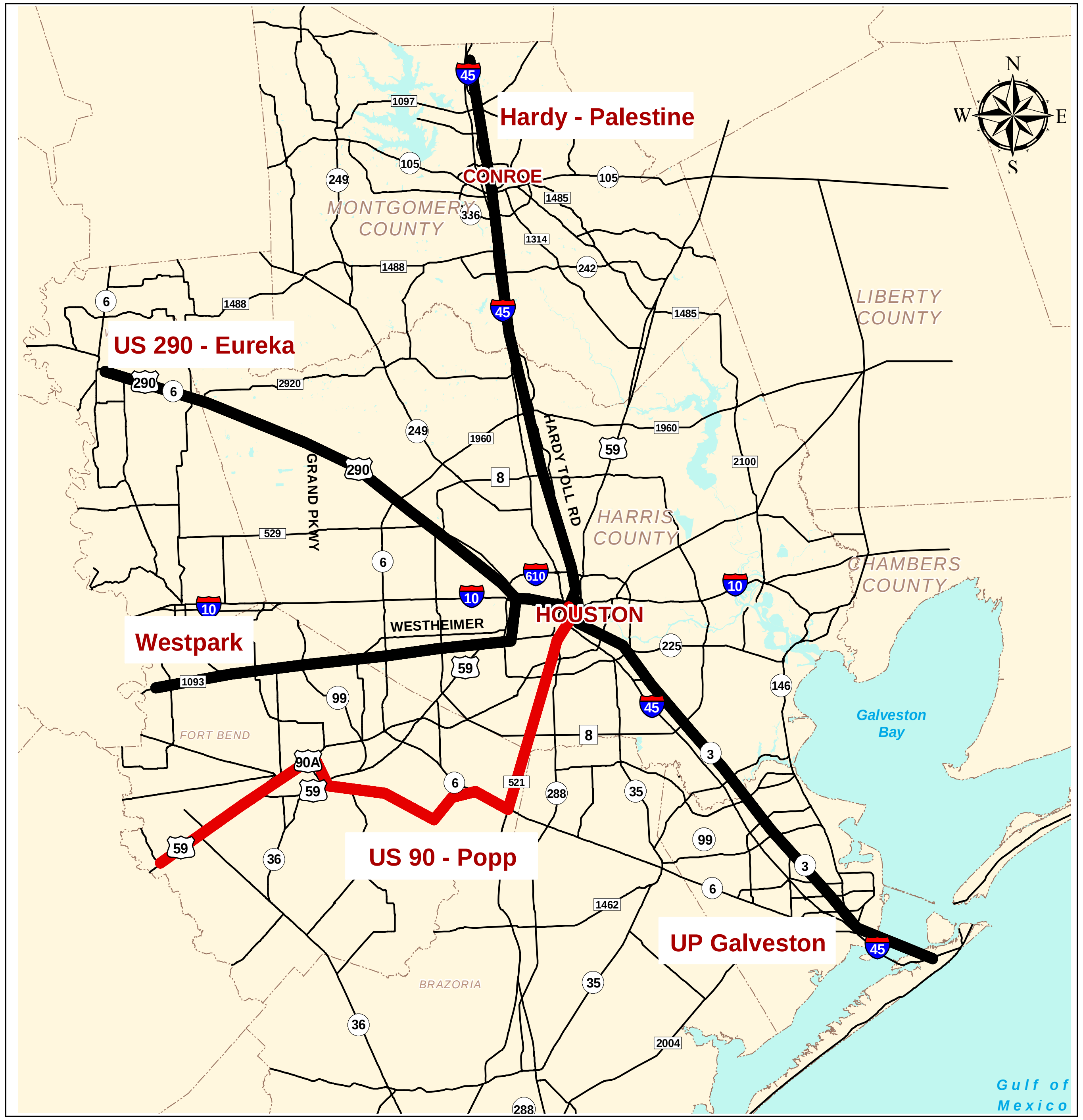


Figure 3-2: Tier 2 Modified Case No. 1: Base Case with Popp-Fort Bend Alternative

Table 3-8: 2035 Forecast Weekday Peak Ridership
Base Case with Popp-Fort Bend Alternative

Commuter Rail Routes Roadway (RR Subdivision)	Weekday Ridership (Total Weekday Boardings Both Directions)			
	HBW	HBNW	NHB	Total
US 290 (Eureka)	5,850	576	317	**6,743**
SH 3 / IH 45 South (UP Galveston)	9,461	994	316	**10,771**
Westpark	5,533	893	293	**6,719**
Fort Bend County / FM 521 (Popp/BNSF Galveston)	4,188	189	76	**4,453**
Hardy Road (Palestine)	7,676	614	116	**8,406**
System Total	**32,708**	**3,266**	**1,118**	**37,092**

Trip Purposes: HBW – Home-based work; HBNW – Home-based non-work; NHB – non home-based

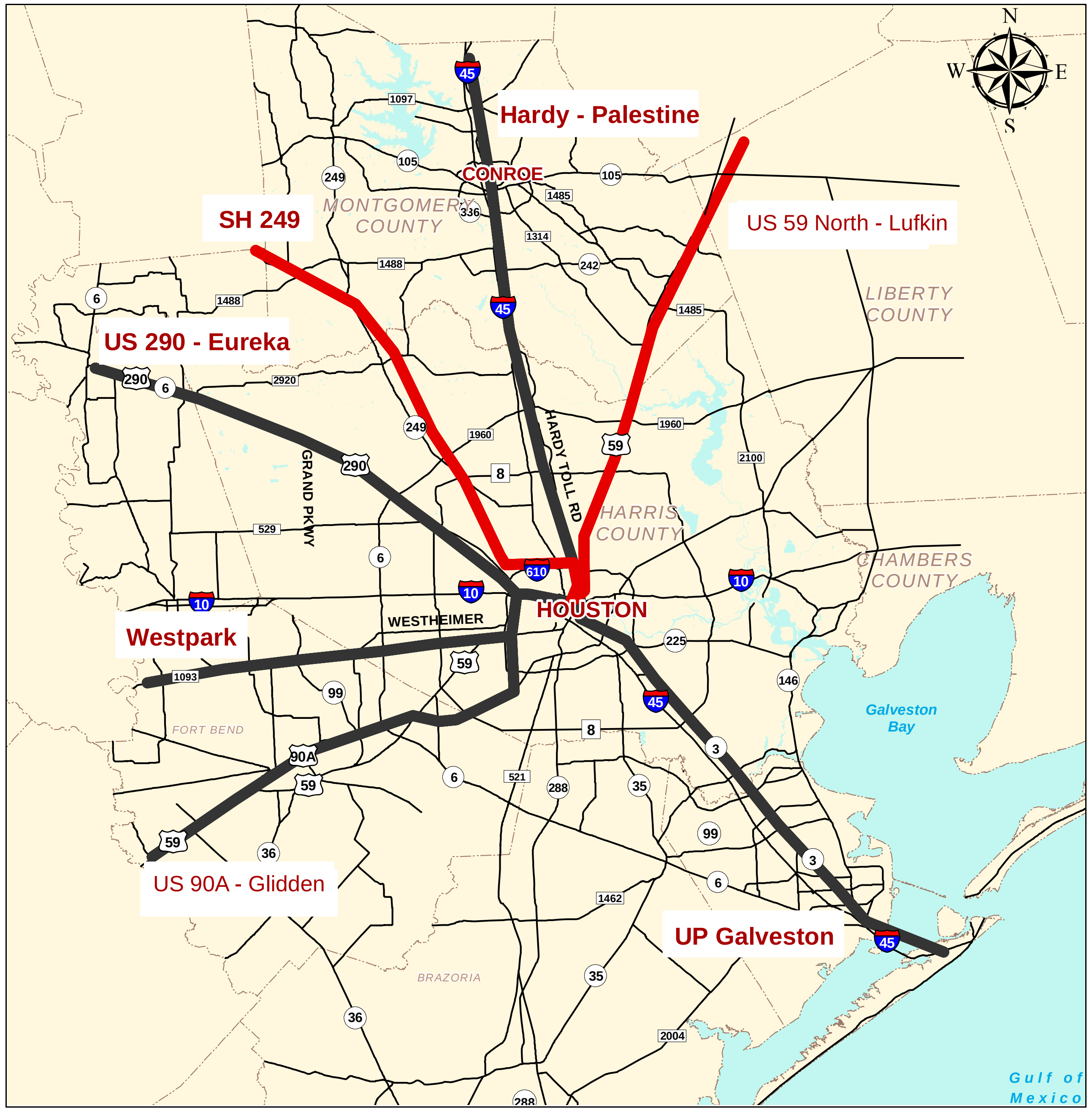


Figure 3-3: Tier 2 Modified Case No. 2: Base Case with SH 249 and US 59 North Alternatives

Table 3-9: 2035 Forecast Weekday Peak Ridership
Base Case with SH 249 and US 59 North Alternative

Commuter Rail Routes Roadway (RR Subdivision)	Weekday Ridership (Total Weekday Boardings Both Directions)			
	HBW	HBNW	NHB	Total
US 290 (Eureka)	5,821	749	380	**6,950**
SH 3 / IH 45 South (UP Galveston)	9,800	1,071	334	**11,205**
US 90A (Glidden)	5,999	1,109	354	**7,462**
Westpark	5,757	954	306	**7,017**
Hardy Road (Palestine)	7,942	678	124	**8,744**
US 59 North (Lufkin)	4,047	425	92	**4,564**
SH 249 /FM 1774 (BNSF Houston)	4,793	299	74	**5,166**
System Total	**44,159**	**5,285**	**1,664**	**51,108**

Trip Purposes: HBW – Home-based work; HBNW – Home-based non-work; NHB – non home-based

3.4 Impact of Limited Reverse Commute Service on Base Case

As noted above, the forecasts are unconstrained by numbers of trains. The forecasts indicate the total demand only. However, real world cost concerns typically dictate that commuter rail service operate primarily in the peak direction during the peak periods. That is, there are typically more inbound trains in the morning peak than there are outbound trains. Such is the case with the assumed operating plan. Accordingly, the ridership forecasts have to be rationalized per the preliminary operating plans. The rationalized numbers appear in **Table 3-10**. This estimate assumed that there would be 1/6 to 1/5 the number of outbound trains as there are inbound trains during the morning peak periods, and thus the outbound peak ridership is reduced accordingly. Furthermore, the table assumes that off-peak ridership is 10 percent of total weekday ridership, per recent findings of the Metrolink commuter rail service in Los Angeles. These factors would produce a total weekday ridership of 36,000 one-way passenger trips in 2035 for the Principal Corridor system configuration.

Table 3-10: Rationalized Total Weekday Ridership Forecast for Principal Corridors in 2035

Route Roadway (RR Subdivision)	Peak Period, Peak Direction Trips	Peak Period, Reverse Direction Trips	Total Peak Trips	Off-Peak Trips	Total Trips
US 290 (Eureka)	4,861	341	5,202	578	5,779
SH 3 / IH 45 South (Galveston)	8,204	446	8,650	961	9,611
Westpark	4,572	447	5,019	558	5,577
US 90A (Glidden)	4,598	571	5,169	574	5,744
Hardy Toll Road (Palestine)	8,213	156	8,369	930	9,299
Total	**30,448**	**1,961**	**32,409**	**3,601**	**36,010**

3.5 Benefits of External Trip Diversions and Transit Oriented Development

Overall, the ridership forecasts are considered to be conservative estimates of the number of people who would choose to commute to work using a regional commuter rail system. Generally, regional travel demand models tend to underestimate rail transit ridership for cities whose roadway system is highly congested. More specifically, two aspects of the ridership forecast analysis have had some additional considerations given as the ridership results have been evaluated: that certain additional riders could been witnessed due to trips that originate beyond the 8-county model area, and the effects on transit mode choice due to Transit Oriented Development (TOD). Both of these considerations are briefly discussed below.

The HGAC model extends over an area of 8 counties surrounding and including Harris County. Since commuter rail patronage is expected to consist of primarily long trips oriented towards jobs in the central urban core of the urbanized area, it is expected that additional ridership will certainly come from areas beyond the 8-county boundary. The number of autos is shown below that enter and exit in the various corridors at the 8-county boundary in 2035:

- US 290 – 78,900
- Westpark – 18,200
- US 90A/US 59 Southwest – 54,000
- Hardy/IH45 – 102,600
- SH 249 – 19,500
- US 59 North – 88,200

Using the assumption that a small percentage of these auto trips could improve their trip time and other trip characteristics by boarding a commuter train at the boundary station, additional ridership should be expected. For instance, a trip from College Station to downtown Houston would fall into this category. Even with a modest assumption of these trips, an increase of about 1,000 riders (one-day passenger trips) per weekday on some routes might result in the Principal Corridor base case configuration.

Similarly, the influence of Transit Oriented Development (TOD) is expected to significantly impact the walk access market for commuter rail in Houston. TOD is comparatively high density residential development, e.g. 20 units per acre, within a walking distance of a rail station. Currently, the HGAC model does not specifically account for TOD however the following segments of the ridership modeling could be positively affected by an increase in walk access patronage from TOD development:

- Trip generation could increase, since the availability of commuter rail increases accessibility to various employment, shopping, and educational opportunities. commuter rail provides a consistent travel time; therefore, a person may be more likely to choose an activity outside the home, creating a trip that did not exist prior to the increase in reliability.
- Trip destinations could change as various activities are more easily accessible through the use of commuter rail. Activities near commuter rail stations could include jobs, education, entertainment, and shopping. The satisfaction of this activity that may have occurred by automobile trip previously could now be satisfied by the use of a commuter train trip.
- Choice of mode is the modeling step that is focused upon in this analysis. Clearly, when commuter rail saves time versus an automobile, the choice to take the train becomes preferable. But, the characteristic that is not explicitly included in the ridership model in this analysis is the one of reliability. The train will run on very rigid schedules, and have very rigid commute times and arrival times. This may at first seem like a disadvantage, but given the congested highway system and high potential for congestion delay that is extraordinary (such as an accident along the highway route), the reliable mode is often preferred out of convenience to the patron.

H-GAC is in the early stages of its Livable Centers Initiative, and several TOD developments far from the urban core of the City are definitely anticipated within the exurban areas of the region. In fact, some developers who are now planning the next wave of suburban and exurban development outside of the currently developed suburban areas have expressed their interest developing TOD sections within their developments in association with the prospect of commuter rail service.

3.6 Preliminary Operating Plans

An essential part of the forecasting of ridership is the operational characteristics and mode of travel choice parameters assumed as inputs to the regional travel demand model. A preliminary operating plan was therefore conceived and key parameters were determined. The following described the overall operating conditions for a conceptual regional commuter rail System.

3.6.1 Routes and Trains

A system configuration consisting of the five Principal Corridor commuter rail routes was used to define the preliminary base case operating plans. The routes, their outlying termini and their frequency of operation (headways) during the peak commuting period appear in **Table 3-11**.

Table 3-11: Preliminary Operating Plans

Commuter Rail Routes (RR Subdivision)	Outlying Terminal	Peak Period Headway
US 290 (Eureka)	Hempstead	20 minutes (6 trains)
SH 3 / IH 45 South (UP Galveston)	Galveston	20 minutes (6 trains)
Westpark	Simonton	30 minutes (5 trains)
US 90A (Glidden)	Kendleton	30 minutes (5 trains)
Hardy Road (Palestine)	Willis	30 minutes (5 trains)

If peak period, peak direction trains were the only service provided, 27 trainsets would be required, all operating inbound during the morning peak, laying over during the day, and operating outbound during the evening peak. The study team's conceptual scheduling for these trains added mid-day and reverse peak service on a limited basis, utilizing the same number of trainsets. The team's experience on other commuter systems has shown that the availability of mid-day and reverse direction trains increases the opportunities for use and results in greater ridership on the peak trains as well as the off-peak service.

Thus, the operating plan provides for 4 additional round trips on the US 290 (Eureka RR Subdivision) and SH 3 / IH 45 (UP Galveston RR Subdivision) routes, and 3 additional trips on the Westpark, US 90A (Glidden RR Subdivision), and Hardy Toll Road (Palestine RR Subdivision) routes. A total of 44 round trips (88 trains in all) would operate into and out of Houston each weekday. Some of these would operate as a continuous run through Houston, while others would terminate or originate at Houston. Some would turn back at the end terminals to become another inbound train.

3.6.2 Rolling Stock

The type of rolling stock assumed is conventional locomotive-hauled equipment, consisting of a locomotive, trailing bi-level coaches and a bi-level cab car, allowing the operator to move from one end of the train to another and run the train from either end in a "push-pull" configuration. Push-pull's operational advantage is that it obviates the need to turn the locomotive (moving the locomotive from one end of the train to the other). Photographs of typical locomotive-hauled trainsets appear in **Figures 3-4 and 3-5**. The rolling stock type shown is in service on the Metrolink system in Los Angeles and the Trinity Railway Express in Dallas-Fort Worth.

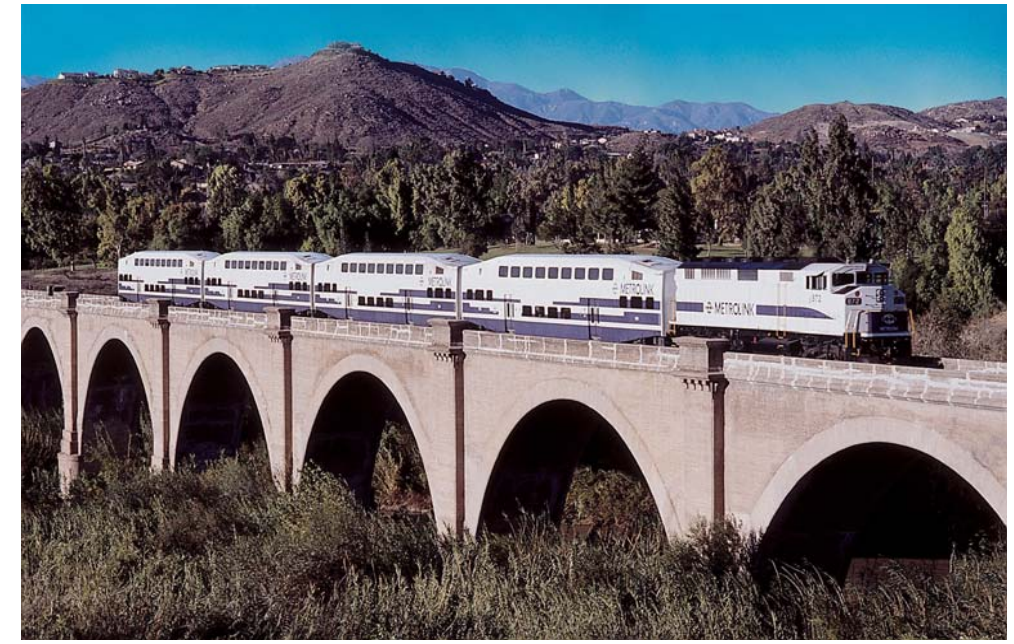


Figure 3-4: Typical Locomotive hauled Train

Figure 3-5: Station Boarding of a Locomotive-hauled Train

The average length of a train assumed for Houston would be five cars, or about 485 feet (depending on the length of the locomotive). Trainsets may be shorter or longer than five cars, depending on the ridership demand when it is set to run. Trains running at the peak of the peak commute period will be longer than those that operate on the shoulders of the peak. This variance is key, as peak of the peak trains will carry the higher numbers of riders.

3.6.3 Stations

Commuter rail station locations assumed for this conceptual ridership and operating plan analysis would be located as shown in **Table 3-12**. These stations are conceptual and no specific location has been assumed for this listing of station areas (although for modeling purposes a mile post was assumed).

Table 3-12: Commuter Rail Stations Assumed in Ridership Analysis

Route	Milepost Detail	Miles from NIT
US290/Eureka RR Subdivision		
Hempstead	MP 45.8	49.8
Waller	MP 35.0	39.0
Fairfield Place Drive	MP 25.0	29.0
Jarvis Road	MP 19.9	23.9
N. Eldridge Parkway	MP 13.2	17.2
Sam Houston Tollway	MP 9.6	13.6
290 at Loop 610	MP 1.8	5.8
Houston	MP 362.3	---
IH 45 South/Galveston RR Subdivision		
Galveston	MP 46.4	48.5
La Marque	MP 34.6	36.7
Dickenson	MP 26.4	28.5
Webster	MP 19.4	21.5
FM 1959	MP 14.8	16.9
South Houston	MP 9.2	11.3
Lawndale Street	MP 4.4	6.5
Houston	MP 362.3	---
Westpark		
Simonton (FM1489)	MP 38.2	40.1
Fulshear	MP 33.5	35.4
Peek Road	MP 25.0	26.9
Addicks Road/SH6	MP 18.0	19.9
Sam Houston Tollway	MP 12.8	14.7
US 59 at Loop 610	MP 370.4/6.2	8.1
Houston	MP 362.3	---
US 90A/Glidden RR Subdivision		
Kendalton (FM2919)	13.7 from Rosenberg[1]	50.4
Beasley	8.8 from Rosenberg[2]	45.5
Richmond	MP 31.6	33.5
Sugar Land (I-59)	MP 20.7	22.6
Missouri City (Hwy 8)	MP 15.2	17.1
US 59 at Loop 610	MP 370.4/6.2	8.1
Houston	MP 362.3	---
Hardy Toll Road/Palestine RR Subdivision		
Willis (FM1097)	MP 186.7	47.2
Conroe	MP 194.7	39.2
Rayford Road	MP 207.4	26.5
Spring (FM1960)	MP 214.7	19.2
Greens Road	MP 219.7	14.2
Houston	MP 362.3	---

Notes:
[1] Located on former UP line to Victoria; railroad milepost unknown.
[2] Located on former UP line to Victoria; railroad milepost unknown.

In concept, stations would have platforms 800 feet long – a length sufficient to accommodate longer trains deployed as ridership grows. The stations would have some shelter from the sun, rain, or cold but only limited protection from the heat. This limited shelter is to minimize station costs and is believed to be a reasonable assumption based on experiences throughout the country where commuter rail patrons learn the schedule and arrive at the station platform brief moments before the departure of their train. A station will also include public address systems, Internet-based real-time train information systems relaying train status for waiting passengers, automated Ticket Vending Machines (TVMs) with which passengers can buy tickets and passes, directional signage, sufficient parking, good access for connecting buses, and – in the case of the Houston North Intermodal Terminal (NIT), US 290 at Loop 610, and US 59 at Loop 610 stations – easy access to the Metro Urban LRT system.

These key intermodal stations would have the same amenities as outlying stations. Presumably they would have only a minor need for parking, as it would be where commuter rail riders transfer to other modes or walk directly to work centers. It would have a staffed ticket vending and general information booth available to commuters most of the day.

3.6.4 Ticketing and Transfers

As noted, train riders would buy tickets and/or passes using TVMs at their origin stations. They would also be able to buy their fare instruments through the Internet, through the mail, or at a ticket window at the key intermodal stations. A typical TVM is shown in **Figure 3-6** for the Caltrain terminal in San Francisco. A typical commuter rail fare of $6 one way was assumed for modeling and ridership purposes.

Figure 3-6: Typical Ticket Vending Machine

At the key intermodal stations, commuter rail riders would be able to transfer to METRO's Urban LRT system. To facilitate transfers, the connection from one mode to the other needs to be as seamless as possible. In other commuter rail systems, this seamless environment is accommodated in two important ways. First, free transfers between commuter trains and local area transit such as the LRT system. Second, station planners should design barrier-free access realized through such concepts as a cross-platform transfer. Examples of such a transfer can be seen in **Figure 3-7**, showing images of a connection between a Caltrain station platform and a Santa Clara Valley Transportation Authority (VTA) light rail train at Mountain View and showing the transfer connection between a Trinity River Express (TRE) commuter rail train and a Dallas Area Rapid Transit (DART) light rail train.

Figure 3-7: Cross Platform Transfer Station Examples

3.6.5 Maintenance and Storage Facility

A unique aspect of commuter rail service is that the trains are mostly out-of-service during the middle of the day. Further, the long distances that comprise the operating routes dictate that almost all trains travel inbound during the morning commute period, remain in the center of the system during the mid-day period, and then travel outbound during the evening commute period. This service pattern requires that the trains must be stored in the vicinity of the station where they are removed from service during the middle of the day. This also provides the best opportunity to maintain the vehicles at a centralized Maintenance and Storage Facility (M&SF).

Trains would therefore be cleaned and serviced at this M&SF during their mid-day layover, and only minor cleaning would be necessary at the outer terminals. The number of trains operating provides ample opportunity to cycle all the trainsets through the M&SF at least every other day. Refer to Chapter 4 for a discussion of the optional locations considered for the M&SF.

CHAPTER FOUR - OPERATING FACILITIES

Essential elements of a regional commuter rail system are the facilities where the trains are removed from revenue service; cleaned, maintained and stored; and then placed back into revenue service. These facilities include both large and small site requirements, as described below.

A few trains are often stored overnight at the outlying end-of-line storage facilities along each route. These outlying facilities serve the first train traveling inbound in the morning and the last train traveling outbound at night. The outlying operating facilities are usually relatively small and typically comprise siding track suitable to accommodate only two or possibly three trains at a time. These facilities are located in areas where land is more available and potential sites are therefore not a concern of this top level study.

A much larger set of operating facilities is required at the center of the rail network when serving a large regional system. The two functional types of facilities which are needed at the center of the system are an operational hub terminal (Hub) and an associated maintenance and storage facility (M&SF). The Hub facility is a true "terminal" station where routes begin and end – a place where trains are placed into revenue service and where they are removed from service. A much longer dwell time is typical for trains when they reach this Hub (as compared to the "on-line" stations along the mainline route). During this extended dwell, the train operators may exit the train or change ends to prepare the train to be moved to a storage facility. This chapter further describes these operational elements of the system which have been introduced above and in particular the chapter discusses the alternative locations considered for these very essential facilities.

4.1 Operational Hub and Maintenance and Storage Facilities

A comparable system that has been used throughout this study as an example of the set of operating facilities needed for a large regional commuter rail system is the Los Angeles Metrolink system. **Figure 4-1** illustrates the size of the long distance Metrolink System, and its connections to the Urban LRT and Rapid Transit System called Metro Rail. As with the conceptual commuter rail system described herein for the Houston region, the Metrolink System has radial routes that converge on the center of the rail network.

At the heart of the Metrolink System is its operational hub terminal (Hub), the classic old rail terminal called Union Passenger Terminal, popularly known as "Union Station". **Figure 4-2** is a photo showing Union Station in the foreground with its large train yard and boarding platforms suitable for serving a dozen large trains all at one time. From foreground to background in the photo can be seen the integral bus terminal and the entrance to the pedestrian tunnels by which the commuter rail platforms are accessed by passengers.

Figure 4-1: Los Angeles Metrolink System

Additionally, the terminal buildings are at the far side of the train yard where ticketing, baggage processing (for intercity trains) and other ground transportation and parking is available. Also integral to this large intermodal station are boarding platforms for transfer to the Red Line Rapid Transit Subway by which patrons reach Downtown and other parts of the urban core of LA, as well as several other LRT system lines by which travel to Pasadena, the Eastside, Long Beach and central parts of LA County can be accomplished.

Figure 4-2: Los Angeles Union Passenger Terminal

When trains are removed from revenue service at Union Station, they are shuttled in a "dead-head" mode to the nearby Metrolink M&SF. **Figure 4-3** illustrates the 5-mile River Corridor rail network, a corridor through which passenger trains travel to reach LA Union Station and freight trains travel to access the Alameda Corridor and the Port facilities. As shown in the figure, Union Station and the associated Metrolink M&SF are in close proximity, allowing an efficient handling of the critically important dead-head operations during the middle of the day.

As a reference values for comparison to the potential Operational Hub Terminal sites considered in Houston, the approximate size of the Union Station site is approximately 40 acres, including some high-rise development and parking integrated into the sits. Similarly, the Metrolink M&SF site is approximately 20 acres in area.

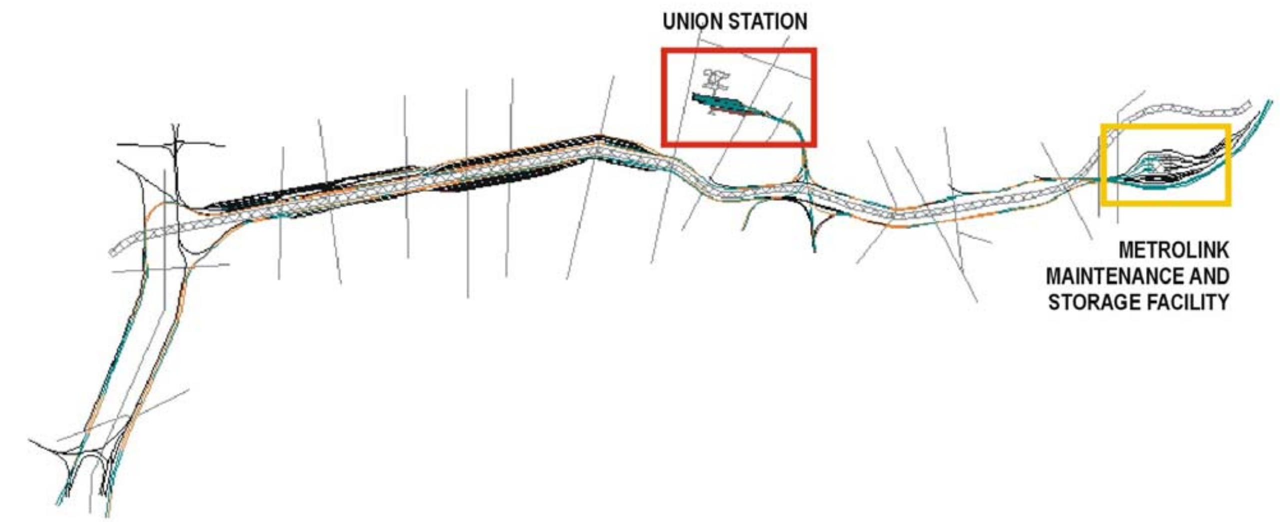


Figure 4-3: Los Angeles Union Station and M&SF Model Depiction

4.2 Potential Locations

The potential locations identified for a Hub or M&SF consist of the Northwest Mall, the area between Northwest Mall and the Northwest Transit Center, Eureka Yard, Hardy Yard, Congress Yard, Old South Yard – i.e., the area south of the junction of I-45 and Spur 5 (the future 35 Freeway), New South Yard, and Mykawa Yard. Each potential location was evaluated based on the site's location relative to and availability of railroad right-of-way and infrastructure, level of freight rail activity in the area, and the associated impacts on freight rail operations should the site be converted to commuter rail use.

The general locations evaluated for Hub and M&SF locations are shown in **Figures 4-4 and 4-5** and listed in **Table 4-1.** Each Hub and M&SF location was evaluated as to its proximity to existing railroad tracks. In particular, the assessment was made in consideration of the railroad subdivisions exhibiting the heaviest freight rail activity and the associated capacity (or lack of capacity) of these subdivisions to serve a focused commuter rail operation. The Hub sites were also considered in terms of their connectivity to the METRO Phase II LRT System (note that this LRT system is shown in **Figure 4-5. P**otential locations were also evaluated to initially assess the surrounding land use and environmental constraints. Subsequently, evaluations of selected sites were performed in terms of economic development potential and environmental justice implications.

Table 4-1: Potential Hub and M&SF Locations

Project Area	Location
Hub 1	Between Northwest Mall and the Northwest Transit Center
Hub 2	Northwest Mall
Hub 3	Eureka Yard
Hub 4	Hardy Yard
Hub 5	Old South Yard
M&SF 1	Eureka Yard
M&SF 2	Congress Yard
M&SF 3	New South Yard
M&SF 4	Mykawa Yard

In addition to the assessments described above, the operational efficiency of various combinations of Hub and M&SF combinations were also evaluated in order to assess the best configuration of a combined set of facilities. A scoring system similar to that used for selection of the Principal Corridors was then applied to obtain the final ranking of the preferred locations of these essential operating facilities, as further described in Section 4.6.

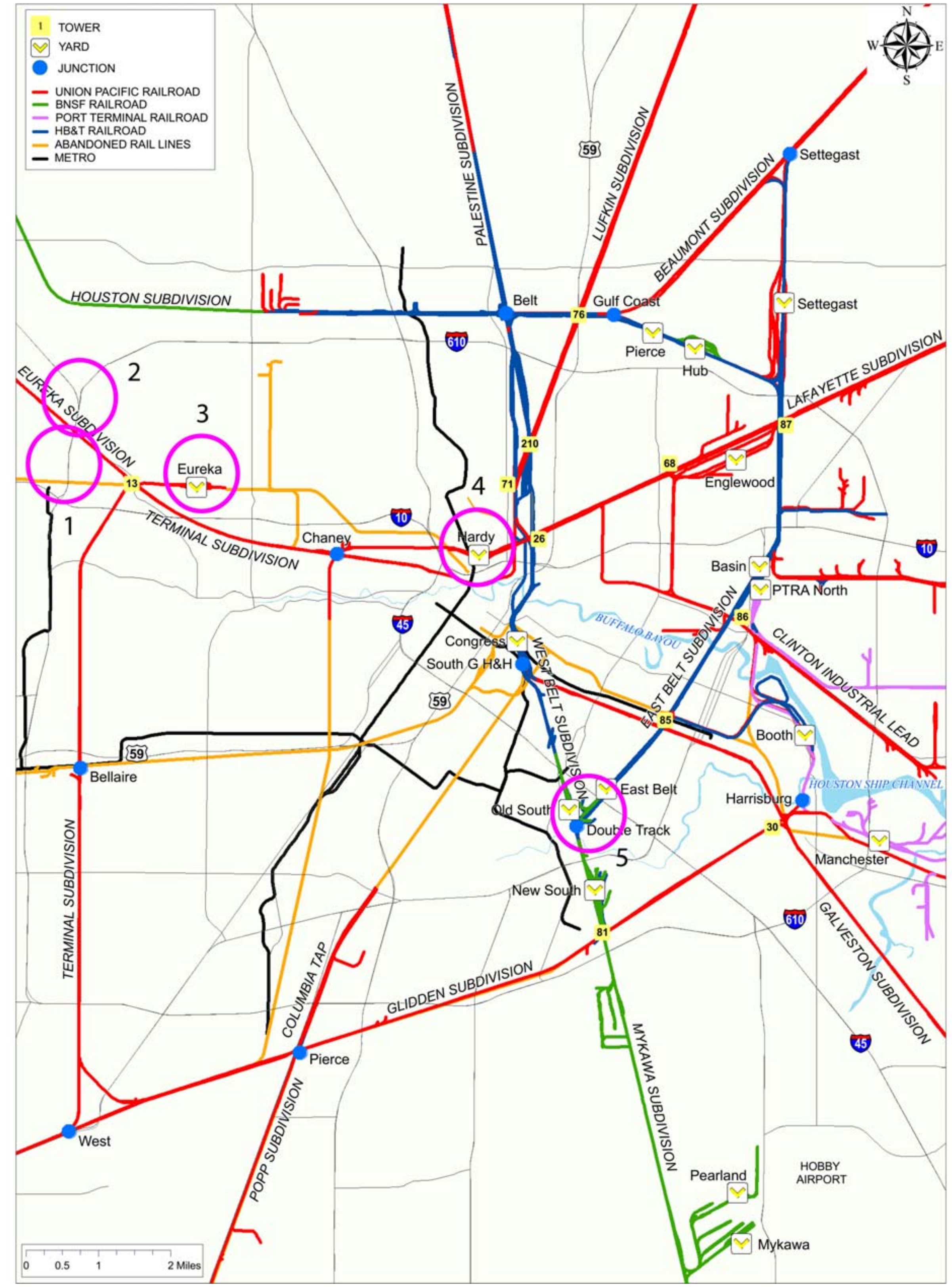


Figure 4-4: Potential Hub Locations

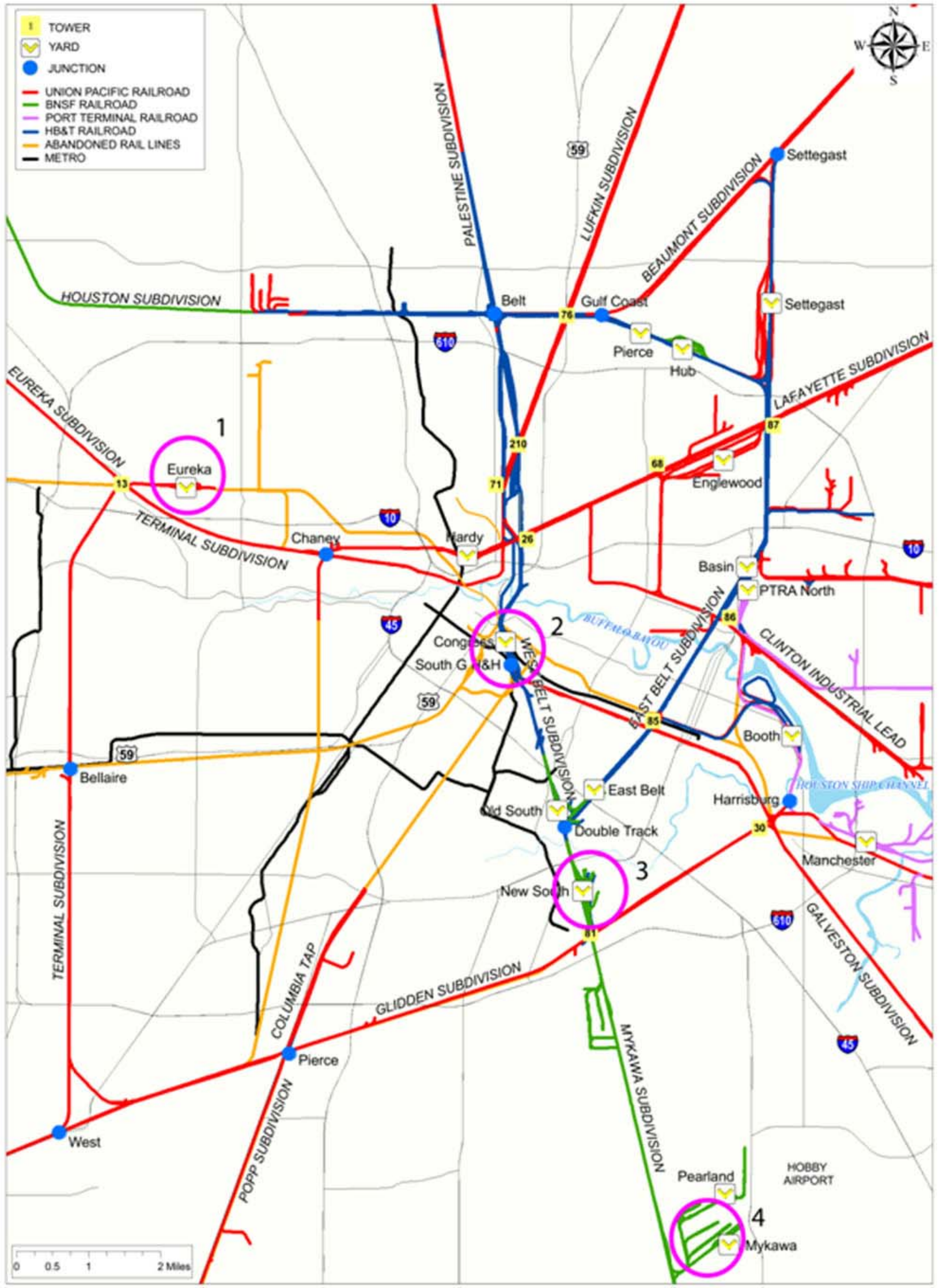


Figure 4-5: Potential M&SF Locations

The first potential site studied for a Hub is located at the intersection of IH 610 and Hempstead Road northwest of downtown Houston in the Northwest Mall area. This Hub 1 site is bordered by Old Katy Road, Post Oak Road, Hempstead Road, and IH 610. The site is bracketed between the Eureka Subdivision on the north and the METRO Northwest Transit Center on the south, and has an approximate area of approximately 161 acres.

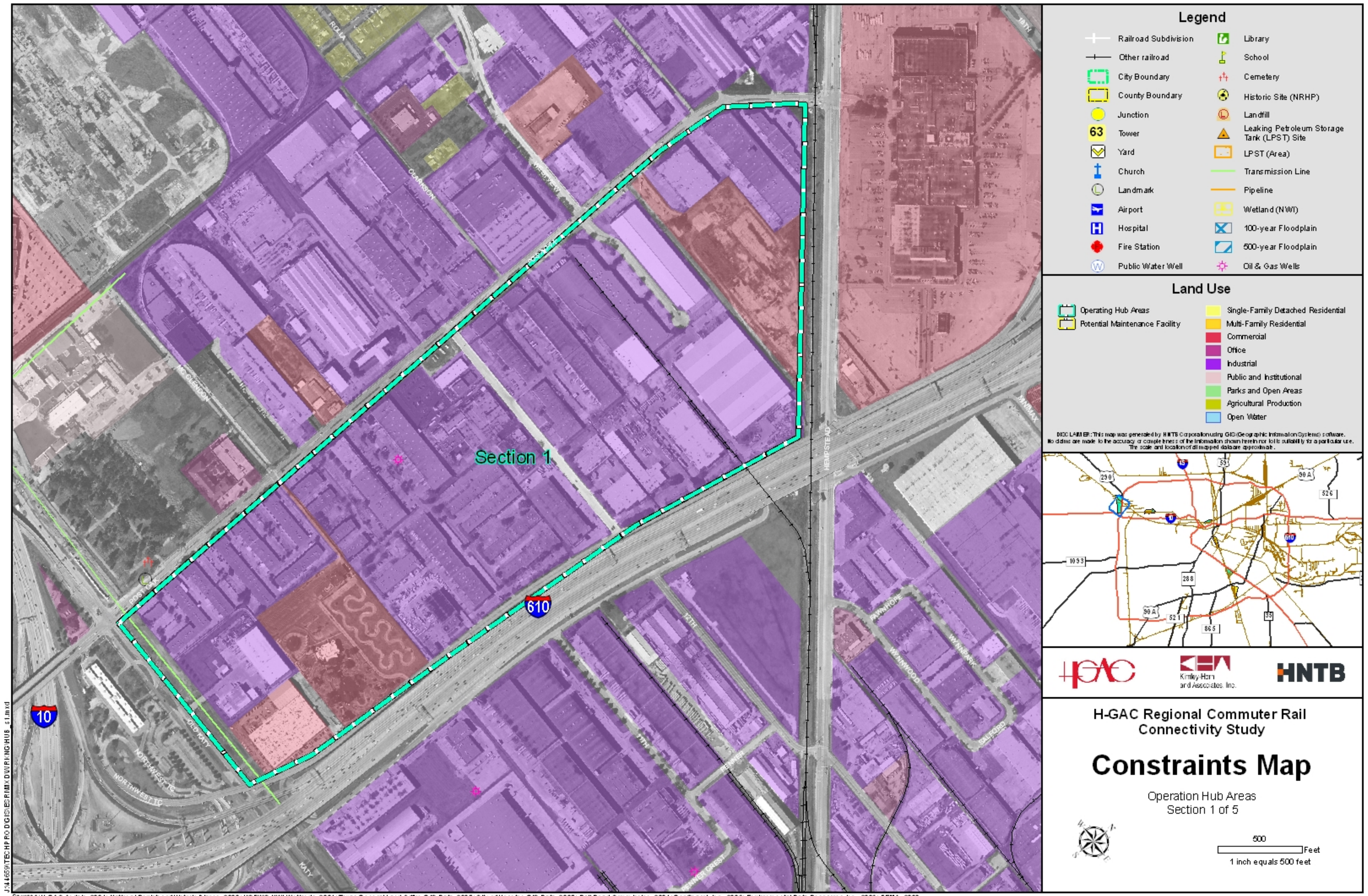


Figure 4-6: Constraints Map of Potential Hub 1 – Adjacent to the METRO Northwest Transit Center

The second potential site studied for a Hub is located adjacent to the IH 610 and US 290 interchange where the Northwest Mall is currently located. The Hub 2 site is bordered by US 290, IH 610, Hempstead Road, and Mangum Road, and is approximately 75 acres in area. Of this area, approximately 30% of the site will be needed for construction of the new interchange (currently in design), leaving about 50 acres of the site available for commuter rail operating facilities.

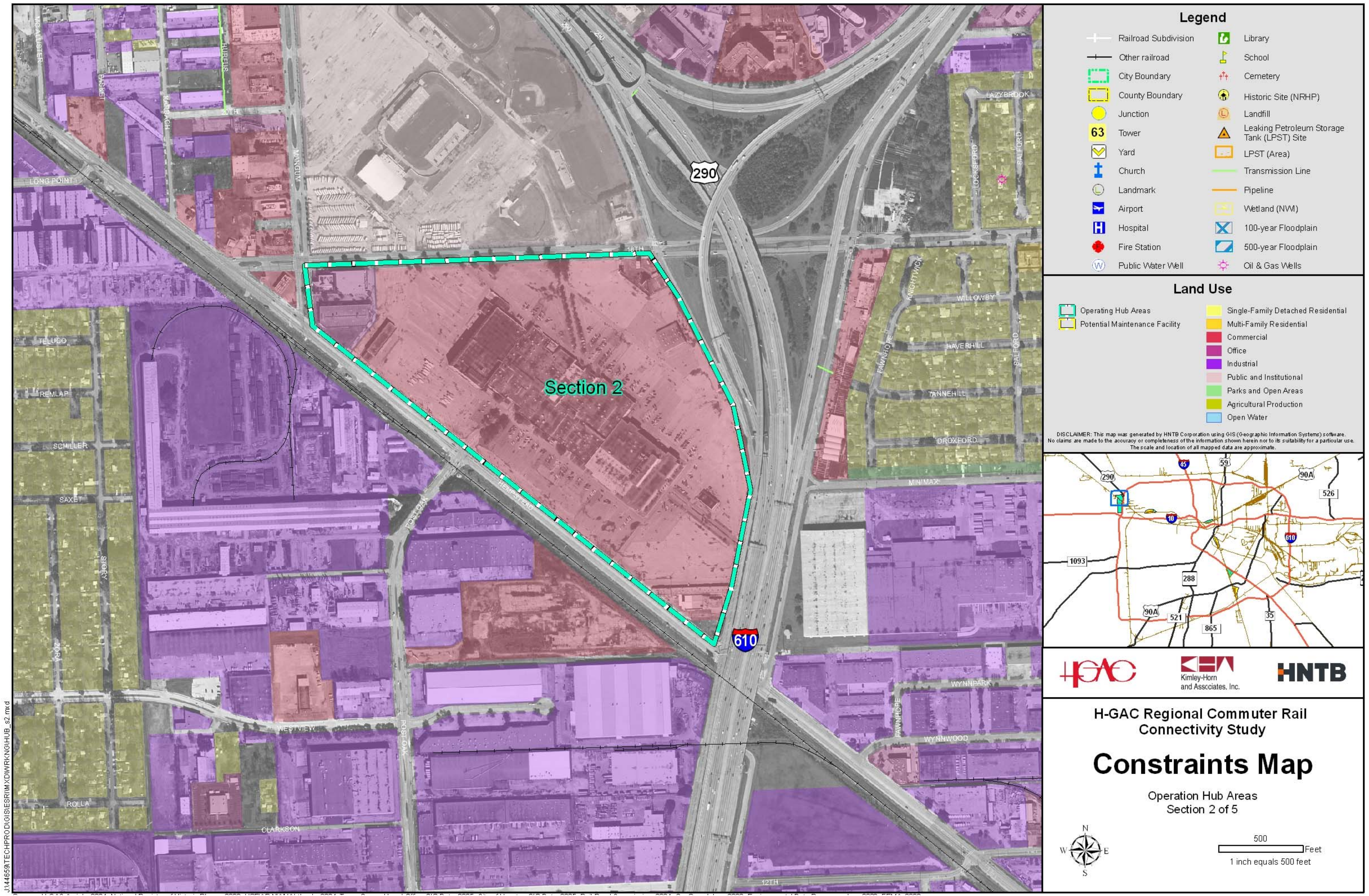


Figure 4-7: Constraints Map of Potential Hub 2 – the Northwest Mall Site

The third potential site studied for a Hub is located at the intersection of T.C. Jester Boulevard and the Eureka Rail Yard in the northwest end of downtown Houston. The Hub 3 site is bordered by White Oak Bayou, T.C. Jester Boulevard, and the Eureka Rail Yard, and encompasses an area of approximately 17 acres.

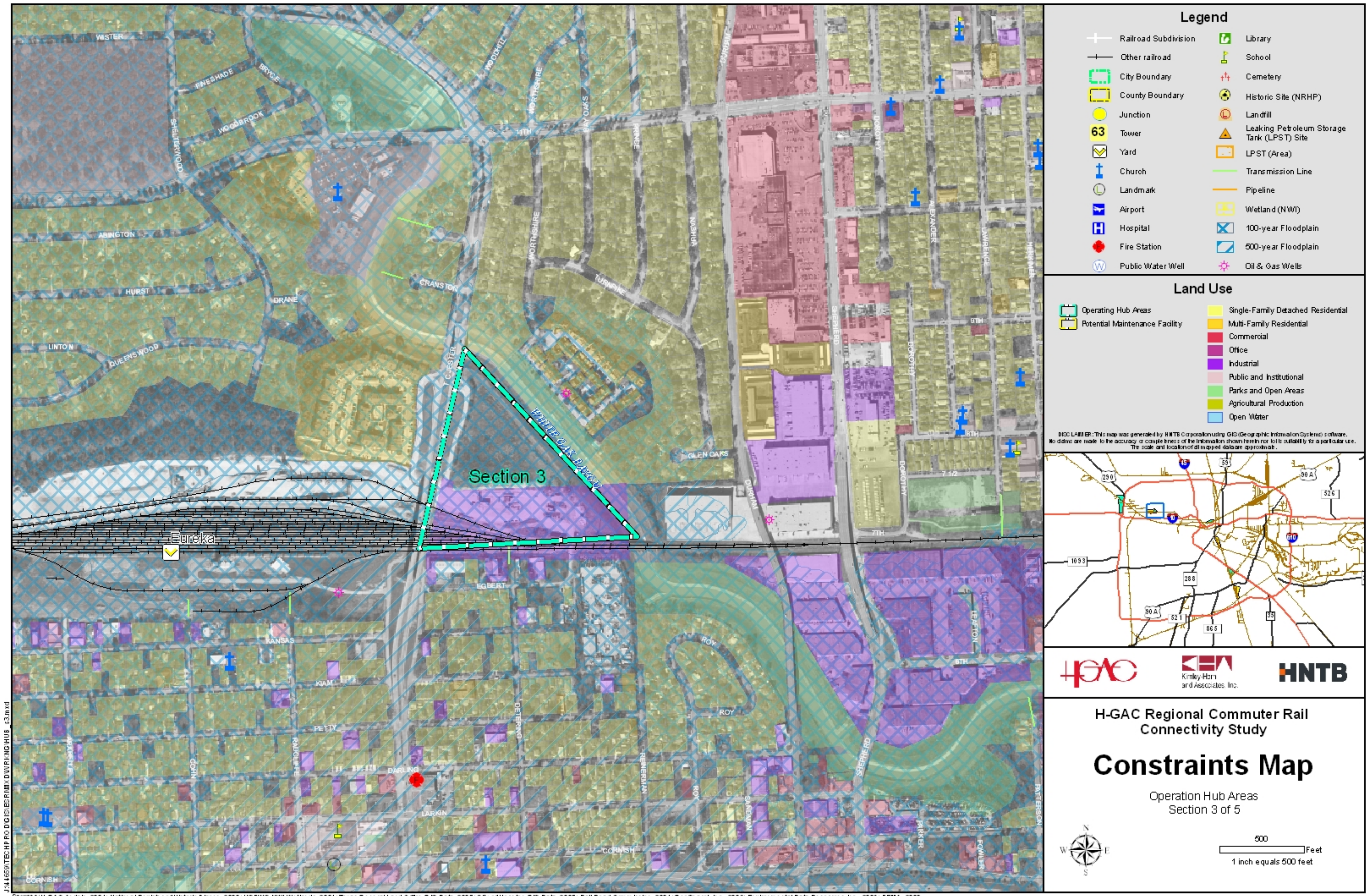
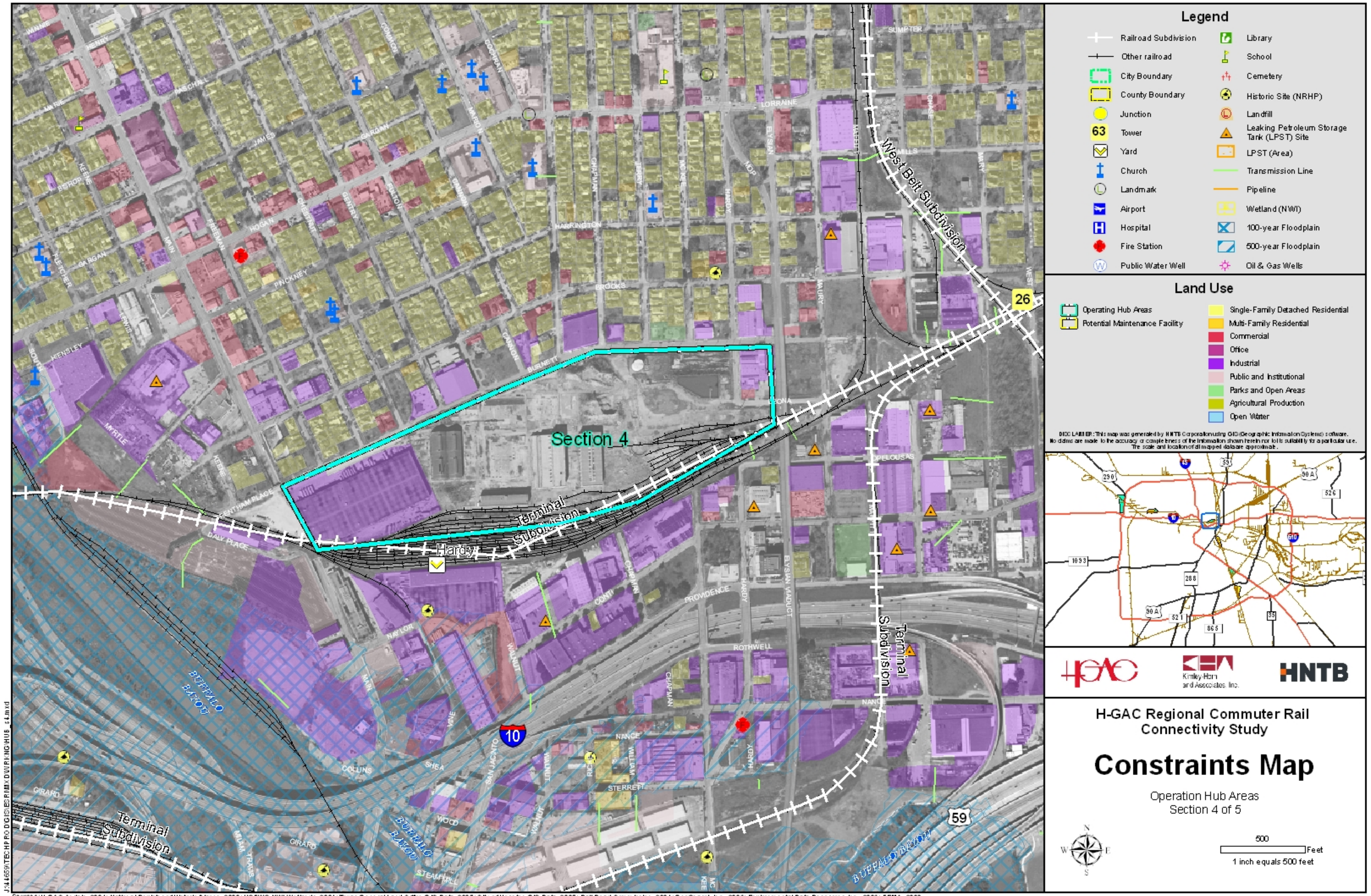


Figure 4-8: Constraints Map of Potential Hub 3 – Adjacent to Eureka Yard

The fourth potential location studied for a Hub is the Hardy Yard site bordered by the Elysian Viaduct, Burnett Street, North Main Street, and the Terminal Subdivision freight rail line. This Hub 4 site is adjacent to the METRO North Intermodal Terminal and has an approximate area of 46 acres.



Sources: H-GAC Aerials, 2004; National Register of Historic Places, 2000; USFWS NWI Wetlands, 2004; Texas General Land Office GIS Data, 2005; City of Houston GIS Data, 2005; Rail Road Commission, 2004; GeoSearch Inc., 2006; Environmental Data Resources Inc., 2006; FEMA, 2003.

Figure 4-9: Constraints Map of Potential Hub 4 – Hardy Yard Site Adjacent to the North Intermodal Terminal

The fifth potential site studied for a Hub is located at the intersection of IH 45, the East Belt Subdivision rail corridor, and the West Belt Subdivision rail corridor. This Hub 5 site is east of the University of Houston at the future junction of I-45 and the planned SH 35 Tollway (currently called Spur 5). The site area is approximately 94 acres, and is across the I-45 freeway from the Eastwood Transit Center.

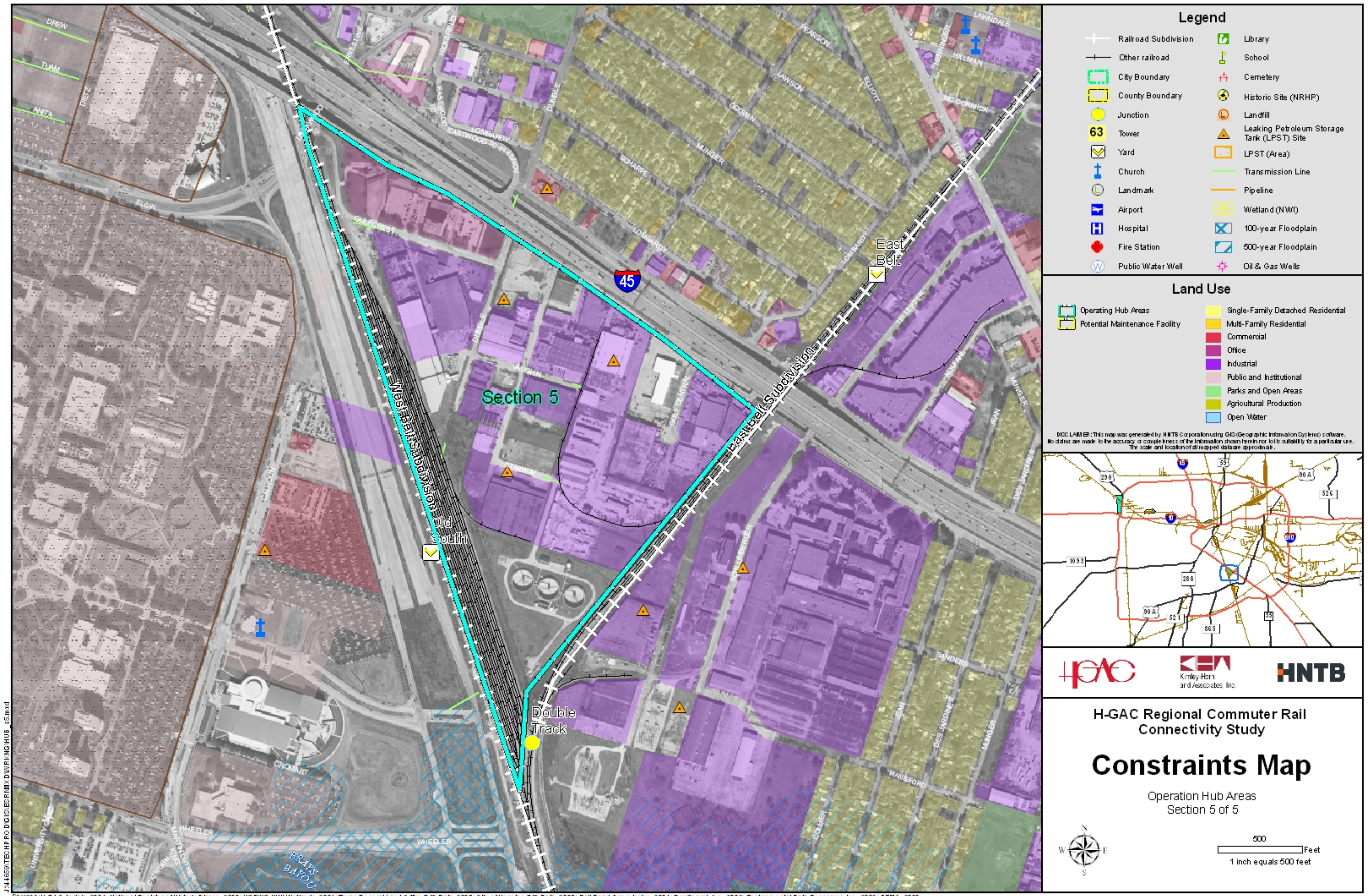


Figure 4-10: Constraints Map of Potential Hub 5 – Future Junction of I-45 and 35 Freeways

The first potential site studied for an M&SF is located at Eureka Yard, north of I-10 freeway and west of T.C. Jester Boulevard. The area encompassed by M&SF 1 is approximately 107 acres.

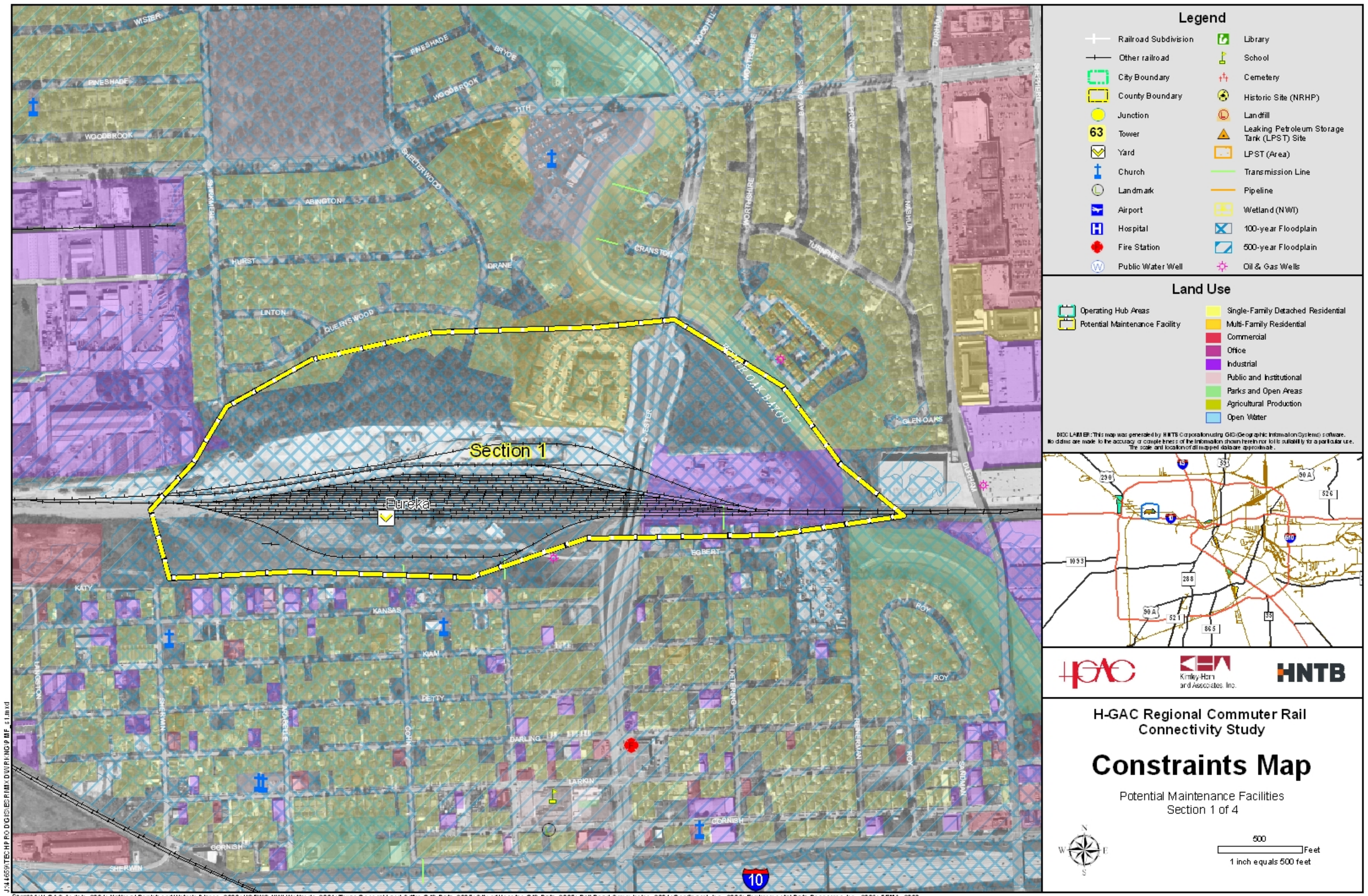


Figure 4-11: Constraints Map of Potential M&SF 1 – Eureka Rail Yard

The second potential site studied for an M&SF is located along the West Belt Subdivision rail corridor immediately east of downtown Houston. The area of M&SF 2, as depicted in the figure below, encompasses not only Congress Yard, but also the area north of the current rail yard along the West Belt Subdivision, and has an approximate area of 99 acres.

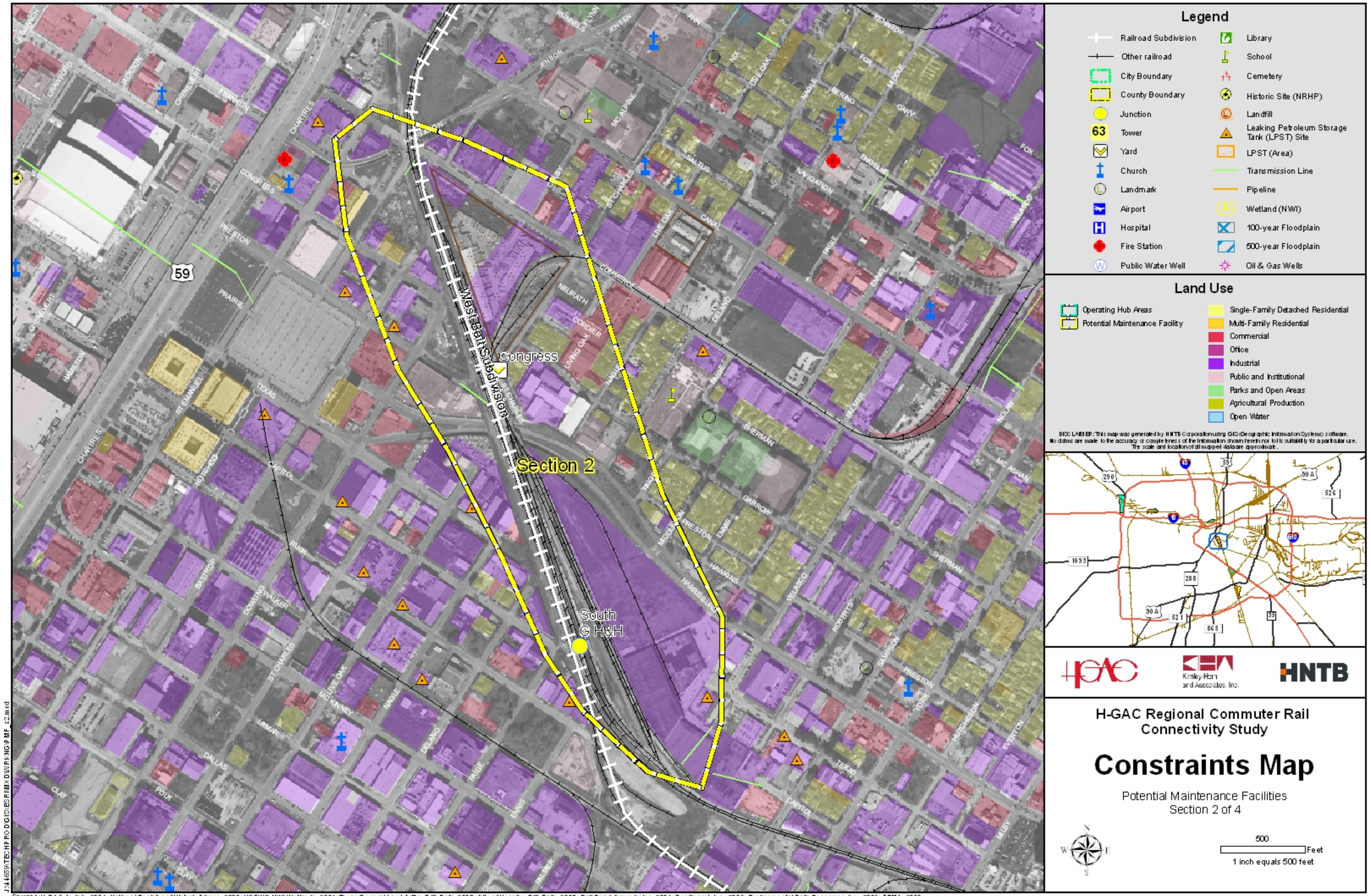


Figure 4-12: Constraints Map of Potential M&SF 2 – Congress Rail Yard and Adjacent Area

The third potential site studied for an M&SF is known as New South Yard, and is located along the Mykawa Subdivision rail corridor near the intersection of US 90 (Old Spanish Trail) and MLK Blvd. southeast of downtown Houston. The area of this M&SF 3 is approximately 130 acres.

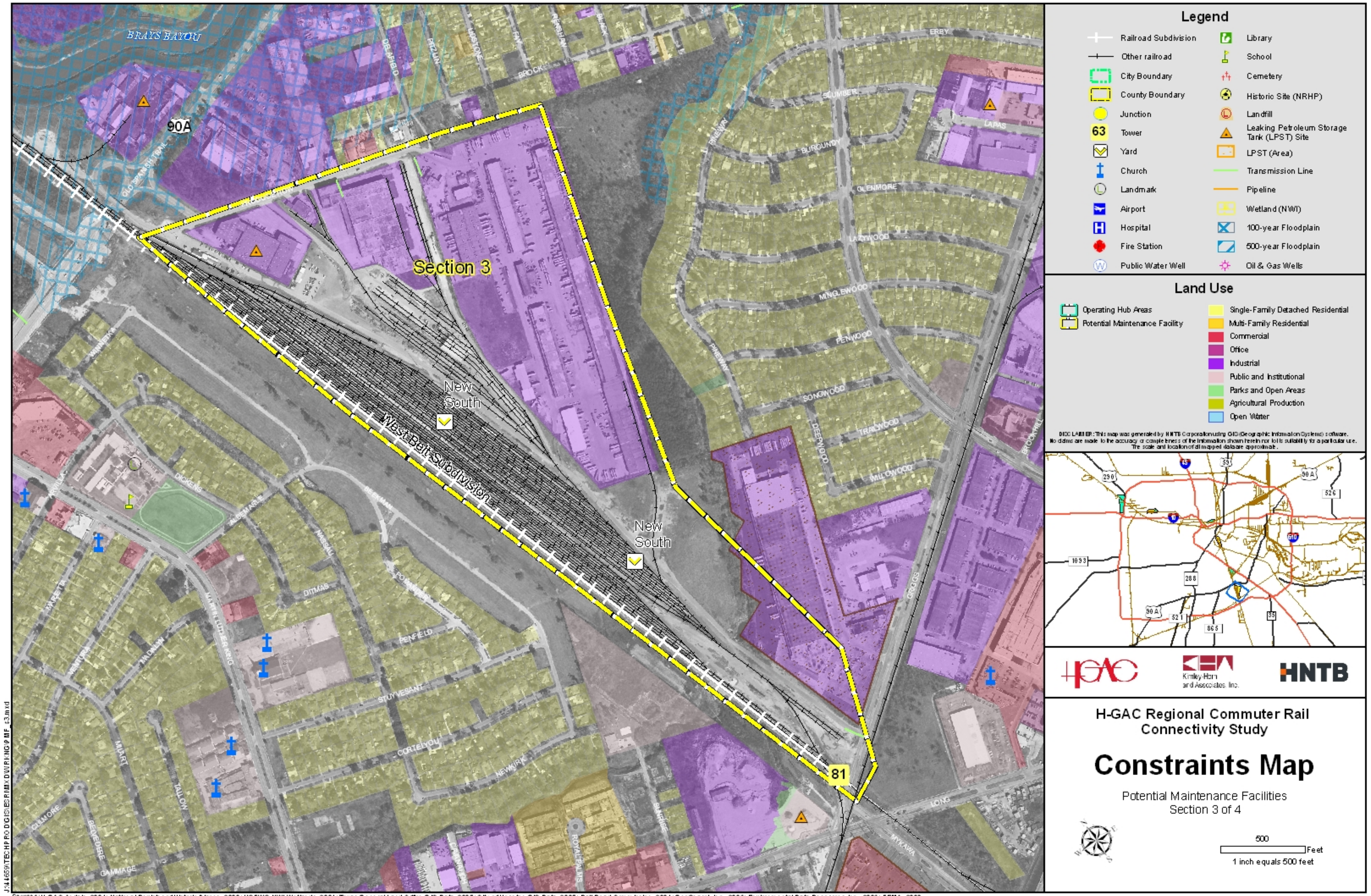


Figure 4-13: Constraints Map of Potential M&SF 3 – New South Rail Yard

The fourth potential site studied for an M&SF is located at the intersection of SH 35 and Brisbane at the Mykawa Rail Yard south of downtown Houston. The area of M&SF 4 is approximately 200 acres.

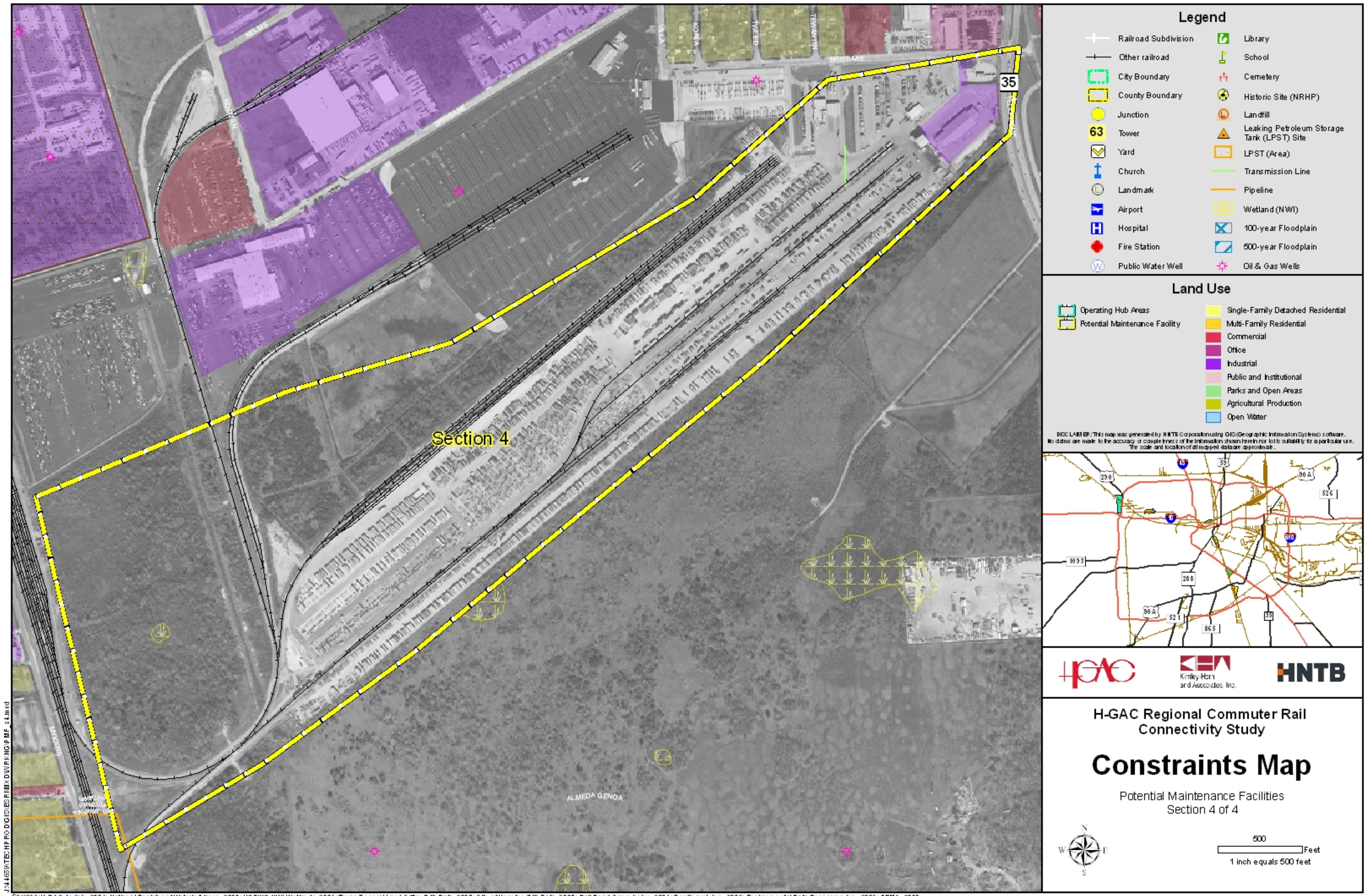


Figure 4-14: Constraints Map of Potential M&SF 4 – Mykawa Rail Yard

4.3 Environmental Considerations

The environmental analysis of each Hub and M&SF location included an evaluation of potential impacts to threatened and endangered species, historic structures, hazardous materials, and wetlands.

Tables 4-2 and 4-3 show the specific environmental assessments of each site, and the discussion below highlights the key findings.

4.3.1 Threatened and Endangered Species

Based on a review of the U.S. Fish and Wildlife Service (USFWS) County-by-County Listed/Candidate Species and Species of Concern Within Clear Lake Office Area of Responsibility (USFWS, 2002) and the Texas Parks and Wildlife Department (TPWD) Annotated County Lists of Rare Species (TPWD, 2004), the locations reviewed would have no effect on any federally listed species, its habitat, or designated critical habitat, nor will they adversely impact any state listed species. The TPWD's Natural Diversity Database (NDD) on endangered species was reviewed for the proposed locations; no known occurrences of threatened or endangered species were identified within the reviewed locations or surrounding areas. Available records show no evidence of suitable habitat for any of these species within the locations reviewed.

4.3.2 Historic Structures

A review of the National Registrar of Historic Places (NRHP), the list of State Archeological Landmarks (SAL), and the list of Recorded Texas Historic Landmarks (RTHL) indicated that no historically significant resources have been previously documented within the area of potential effects for any of the alternative locations.

4.3.3 Hazardous Materials

A list search was performed on all relevant state and federal databases to identify the presence of known hazardous materials contamination sites. Four mapped hazardous materials sites were identified at Potential Hub 5, located at the future junction of I-45 and the planned SH 35 Tollway. Three mapped hazardous materials sites were identified at Potential M&SF 2 – Congress Yard. Two mapped hazardous materials sites were identified at Potential M&SF 3 – New South Yard. No other potential sources of contamination were identified. If further investigation is required and hazardous materials are discovered, they would be required to be handled, removed, and disposed of in compliance with applicable local, state, and federal regulations.

Construction activities at the site could require the removal of existing structures which may contain lead-based paint and/or asbestos-containing materials. Surveys would be required prior to demolition of any structures within the project area.

4.3.4 Wetlands

A review of the National Wetlands Inventory (NWI) database was reviewed to detect the presence of wetlands within each studied location. The NWI database identified 0.21 ac of wetlands within Potential M&SF 4 – Mykawa Yard. Based on aerial imagery, a small undeveloped tract of Potential Hub 3 – adjacent to Eureka Yard – of approximately 8 acres could contain a potential wetland area. It is located on the east side of TC Jester between TC Jester and White Oak Bayou. Potential Hub 3 and Potential M&SF 1, both located at and adjacent to Eureka Yard, are within the 100-yr floodplain of White Oak Bayou and design considerations for operating facilities at those locations would need appropriate attention to mitigating any flood impacts. No other wetlands or waters of the U.S. were identified within the areas reviewed.

The project sites include five proposed operation hubs and four proposed maintenance facilities, and the environmental impact assessments are given below in **Tables 4-2** and **4-3**, respectively. A description of each hub and maintenance facility is provided below. Refer back to **Figure 4-6** through **Figure 4-14** for the locations of each site.

Table 4-2: Potential Operational Hub Terminal Environmental Issues

Project Area	Location	Size (ac)	Current Land Use	Wetlands	Historic Structures	Endangered Species	Hazardous Materials
Hub 1	Located at the intersection of IH 610 and Hempstead Road. The site is bordered by Old Katy Road, Post Oak Road, Hempstead Road, and IH 610.	161	The majority of the site is mapped as industrial. Industrial = 118.38 ac Commercial = 28.21 ac Undeveloped = 3.53 ac Transportation and Util. = 1.46 ac	The majority of the site is currently developed or has been previously disturbed. The site does not contain any mapped NWI areas, streams, or waterways and is not located within a 100-year floodplain. Review of aerials did not indicate the presence of wetlands or waters of the U.S. within the site.	The site does not contain any known National Register of Historic Places (NRHP) listed sites. There is a potential for unidentified historic structures to exist within the site. A detailed historic structures survey would be required to determine any potential historic sites.	The majority of the site is currently developed or has been previously disturbed. Approximately 3.53 ac of the site is undeveloped. The presence of endangered wildlife or vegetative species is unlikely within the site.	Mapped hazardous materials sites were not identified within the site. Construction activities at the site could require the removal of existing structures which may contain lead-based paint and/or asbestos-containing materials. Surveys would be required prior to demolition of any structures within the site.
Hub 2	Located at the intersection of US 290 and IH 610. The site is bordered by US 290, IH 610, Hempstead Road, and Mangum Road.	75	The majority of the site is characterized as commercial. Commercial = 67.97 ac Office = 3.39 ac Undeveloped = 0.21 ac	The majority of the site is currently developed or has been previously disturbed. The site does not contain any mapped NWI areas, streams, or waterways and is not located within a 100-year floodplain. Review of aerials did not indicate the presence of wetlands or waters of the U.S. within the site.	The site does not contain any known National Register of Historic Places (NRHP) listed sites. There is a potential for unidentified historic structures to exist within the site. A detailed historic structures survey would be required to determine any potential historic sites.	The majority of the site is currently developed or has been previously disturbed. Approximately 0.21 ac of the site is undeveloped. The presence of endangered wildlife or vegetative species is unlikely within the site.	Mapped hazardous materials sites were not identified within the site. Construction activities at the site could require the removal of existing structures which may contain lead-based paint and/or asbestos-containing materials. Surveys would be required prior to demolition of any structures within the site.
Hub 3	Located at the intersection of T.C. Jester Blvd. and the Eureka Rail Yard. The site is bordered by White Oak Bayou, T.C. Jester Boulevard, and a rail line.	17	The site is characterized as industrial and undeveloped land. Industrial = 7.99 ac Undeveloped = 8.29 ac	The site is located within the 100-yr floodplain of White Oak Bayou. The site does not contain any mapped NWI areas. Based on aerial imagery, a small undeveloped tract of approximately 8 ac could contain a potential wetland area. It is located on the east side of TC Jester between TC Jester and White Oak Bayou.	The site does not contain any known National Register of Historic Places (NRHP) listed sites. There is a potential for unidentified historic structures to exist within the site. A detailed historic structures survey would be required to determine any potential historic sites.	Approximately 48% of the site is undeveloped. Review of aerial photographs did not indicate the presence of endangered wildlife or vegetative species within the site. Awaiting information from TPWD regarding this site.	Mapped hazardous materials sites were not identified within the site. Construction activities at the site could require the removal of existing structures which may contain lead-based paint and/or asbestos-containing materials. Surveys would be required prior to demolition of any structures within the site.
Hub 4	The site is bordered by the Elysian Viaduct, Burnett St., N. Main St., and the Terminal Subdivision.	46	The majority of the site is characterized as industrial. Industrial = 45.72 ac Commercial = 0.09 ac	The majority of the site is currently developed or has been previously disturbed. The site does not contain any mapped NWI areas, streams, or waterways and is not located within a 100-year floodplain. Review of aerials did not indicate the presence of wetlands or waters of the U.S. within the site.	The site does not contain any known National Register of Historic Places (NRHP) listed sites. There is a potential for unidentified historic structures to exist within the site. A detailed historic structures survey would be required to determine any potential historic sites.	The majority of the site is currently developed or has been previously disturbed. The presence of endangered wildlife or vegetative species is unlikely within the site.	Mapped hazardous materials sites were not identified within the site. Construction activities at the site could require the removal of existing structures which may contain lead-based paint and/or asbestos-containing materials. Surveys would be required prior to demolition of any structures within the site.
Hub 5	Located at the intersection of IH 45, the East Belt Subdivision, and the West Belt Subdivision.	94	The majority of the site is characterized as industrial. Industrial = 41.93 ac Undeveloped = 33.09 ac Office = 6.34 ac Other = 3.24 ac Transportation and Util. = 1.38 ac	The majority of the site is currently developed or has been previously disturbed. The site does not contain any mapped NWI areas, streams, or waterways and is not located within a 100-year floodplain. Review of aerial photographs did not indicate the presence of wetlands or waters of the U.S. within the site.	The site does not contain any known National Register of Historic Places (NRHP) listed sites. There is a potential for unidentified historic structures to exist within the site. A detailed historic structures survey would be required to determine any potential historic sites.	The majority of the site is currently developed or has been previously disturbed. Approximately 33 ac of this site is undeveloped. The presence of endangered wildlife or vegetative species is unlikely within the site. Awaiting information from TPWD regarding this site.	Four mapped hazardous materials sites were identified within the site. These sites have been identified as leaking petroleum storage tanks (LPSTs). • REPRT Point LPST – Houston Armature Works, 2215 Dumble • REPRT Point LPST – R & R Wholesale Dist., 2306 Canada Dry • REPRT Point LPST – Lone Star Warehouse, 4724 Starway • REPRT Point LPST – Vaughan & Sons Inc Houston, 4802 S IH 45 Construction activities at the site could require the removal of existing structures which may contain lead-based paint and/or asbestos-containing materials. Surveys would be required prior to demolition of any structures within the site.

Table 4-3: Potential Maintenance and Storage Facility Environmental Issues

Project Area	Location	Size (ac)	Current Land Use	Wetlands	Historic Structures	Endangered Species	Hazardous Materials
M&SF 1	Located at the intersection of T.C. Jester Boulevard, the Eureka Subdivision, and White Oak Bayou.	107	The majority of the site is characterized as transportation and utilities. Transportation and Util. = 49.00 ac Undeveloped = 24.92 ac Industrial = 11.94 ac Multi-Family Residential = 9.69 ac Single-Family Detached Residential = 4.10 ac Parks and Open Areas = 1.18 ac	The site is located within the 100-yr floodplain of White Oak Bayou. The site does not contain any mapped NWI areas. Based on aerial imagery, a potential wetland area could exist on the east side of T.C. Jester Boulevard between White Oak Bayou.	The site does not contain any known National Register of Historic Places (NRHP) listed sites. There is a potential for unidentified historic structures to exist within the site. A detailed historic structures survey would be required to determine any potential historic sites.	The majority of the site is currently developed or has been previously disturbed. Approximately 25 ac of this site is undeveloped. The presence of endangered wildlife or vegetative species is unlikely within the site. Awaiting information from Texas Parks and Wildlife Department (TPWD) regarding this site.	Mapped hazardous materials sites were not identified within the site. Construction activities at the site could require the removal of existing structures which may contain lead-based paint and/or asbestos-containing materials. Surveys would be required prior to demolition of any structures within the site.
M&SF 2	Located along the West Belt Subdivision at the intersection of Commerce and Harrisburg.	99	The majority of the site is characterized as industrial. Industrial = 32.01 ac Undeveloped = 31.44 ac Commercial = 2.95 ac Single-Family Detached Residential = 2.84 ac Public and Institutional = 2.64 ac Other = 2.06 ac Multi-Family Residential = 0.75 ac Transportation and Util. = 0.60 ac	The majority of the site is currently developed or has been previously disturbed. The site does not contain any mapped NWI areas, streams, or waterways and is not located within a 100-year floodplain. Review of aerial photographs did not indicate the presence of wetlands or waters of the U.S. within the site.	The site does not contain any known National Register of Historic Places (NRHP) listed sites. There is a potential for unidentified historic structures to exist within the site. A detailed historic structures survey would be required to determine any potential historic sites.	The majority of the site is currently developed or has been previously disturbed. Approximately 31 ac of this site is undeveloped. The presence of endangered wildlife or vegetative species is unlikely within the site. Awaiting information from Texas Parks and Wildlife Department (TPWD) regarding this site.	Three mapped hazardous materials sites were identified within the site. These sites have been identified as leaking petroleum storage tanks (LPSTs). • LPST – R B Everett & Co 3118 Texas • LPST – RELCO Inc 2301 Preston, Houston, TX 77003 • LPST REPRT Region – UPRR Commerce Street Warehouse Property, 2410 Commerce St. Construction activities at the site could require the removal of existing structures which may contain lead-based paint and/or asbestos-containing materials. Surveys would be required prior to demolition of any structures within the site.
M&SF 3	Located along the West Belt Subdivision near the intersection of US 90.	130	The majority of the site is characterized as undeveloped land. Undeveloped = 72.12 ac Industrial = 54.22 ac Transportation and Util. = 1.02 ac	The majority of the site is currently developed or has been previously disturbed. The site does not contain any mapped NWI areas, streams, or waterways and is not located within a 100-year floodplain. Review of aerials did not indicate the presence of wetlands or waters of the U.S. within the site.	The site does not contain any known National Register of Historic Places (NRHP) listed sites. There is a potential for unidentified historic structures to exist within the site. A detailed historic structures survey would be required to determine any potential historic sites.	Approximately 50% of this site is undeveloped. Awaiting information from Texas Parks and Wildlife Department (TPWD) regarding this site.	Two mapped hazardous materials sites were identified within the site. These sites have been identified as leaking petroleum storage tanks (LPSTs). • REPRT Point LPST – The Rectorseal Corp., 2830 Produce Row • REPRT Region LPST – Sears Logistics Services, 5901 Griggs Rd. Construction activities at the site could require the removal of existing structures which may contain lead-based paint and/or asbestos-containing materials. Surveys would be required prior to demolition of any structures within the site.
M&SF 4	Located at the Intersection of SH 35 and Brisbane.	200	The majority of the site is characterized as undeveloped land. Undeveloped = 99.70 ac Transportation and Util. = 96.49 ac Industrial = 3.01 ac	A large portion of the site is occupied by a rail yard. The remaining area is currently undeveloped. One NWI (0.21 ac) is mapped within the undeveloped portion. The site does not contain any streams or waterways and is not located within a 100-year floodplain. Review of aerials indicates that an undeveloped tract 16 ac in size could contain potential wetland areas. The tract is located on the west side of the section, adjacent to Mykawa Rd.	The site does not contain any known National Register of Historic Places (NRHP) listed sites. There is a potential for unidentified historic structures to exist within the site. A detailed historic structures survey would be required to determine any potential historic sites.	Approximately 50% of this site is undeveloped. Awaiting information from Texas Parks and Wildlife Department (TPWD) regarding this site.	Mapped hazardous materials sites were not identified within the site. Construction activities at the site could require the removal of existing structures which may contain lead-based paint and/or asbestos-containing materials. Surveys would be required prior to demolition of any structures within the site.

4.4 Preliminary assessment of potential site locations

In order to eliminate unnecessary analysis, a preliminary assessment was made of the operational hub terminal locations. This step reduced the number of sites to be analyzed for economic development and environmental justice. The evaluation criteria used in this preliminary assessment were as follows:

Freight Railroad Operational Impacts – This assessment has been performed to assess the operational impacts on the freight rail – one of the principal objectives of the study. The information provided by the Class 1 Freight Railroads concerning their operations, and the associated analysis of the capacity constraints of the railroad subdivisions, were the primary aspects considered in this evaluation.

Multimodal Transportation Connectivity – The existing and planned transit, freeway/tollway and arterial street infrastructure around the potential Hub locations was evaluated, in accord with the principal goal of the study – to evaluate accessibility and connectivity of commuter rail facilities.

Environmental Considerations – The results of the environmental investigations, as documented in the previous section, were considered in a comparative assessment.

Based on this preliminary evaluation of potential environmental issues, railroad operations, and intermodal connectivity, the potential Hub locations were narrowed down to three alternative sites that were further analyzed based upon factors including environmental justice and economic development potential. The Northwest Transit Center area, the Northwest Mall, and Eureka Yard locations (Hub 1, 2, and 3) were determined to be the most feasible and practical sites. These three sites were determined to have the greatest benefits in terms of intermodal connectivity, with potential connections to METRO bus and light rail routes.

And further, as a result of this preliminary assessment of the Hub locations, and based on the necessary proximity of the M&SF location to the Operational Hub Terminal, the M&SF locations to be considered further were reduced to only M&SF 1. M&SF 2, 3 and 4 were not considered for further analysis since these sites are too far from the short listed Hub locations to be of practical use and were located directly on the heaviest freight rail routes.

To assist in the preliminary assessment, a conceptual layout for the track serving an operational hub terminal at Hub Site 1 is shown in **Figure 4-15.** This example is for the site between the Eureka Subdivision and the Northwest Transit Center. This train yard is sized to be generally equivalent to the train yard at Union Station in Los Angeles, with the added advantage of be a double ended configuration of the tracks.

In comparison, **Figure 4-16** shows an alternative conceptual track configuration that could serve terminal facilities in either Hub location that is constrained to only the north end of the potential Hub 1 site. Potential Hub 1 is located between North Post Oak Road and the US 290/I-610 interchange reconstruction zone (indicated by the yellow band in the figure) with connectivity with the Northwest Transit Center and the Eureka Subdivision.

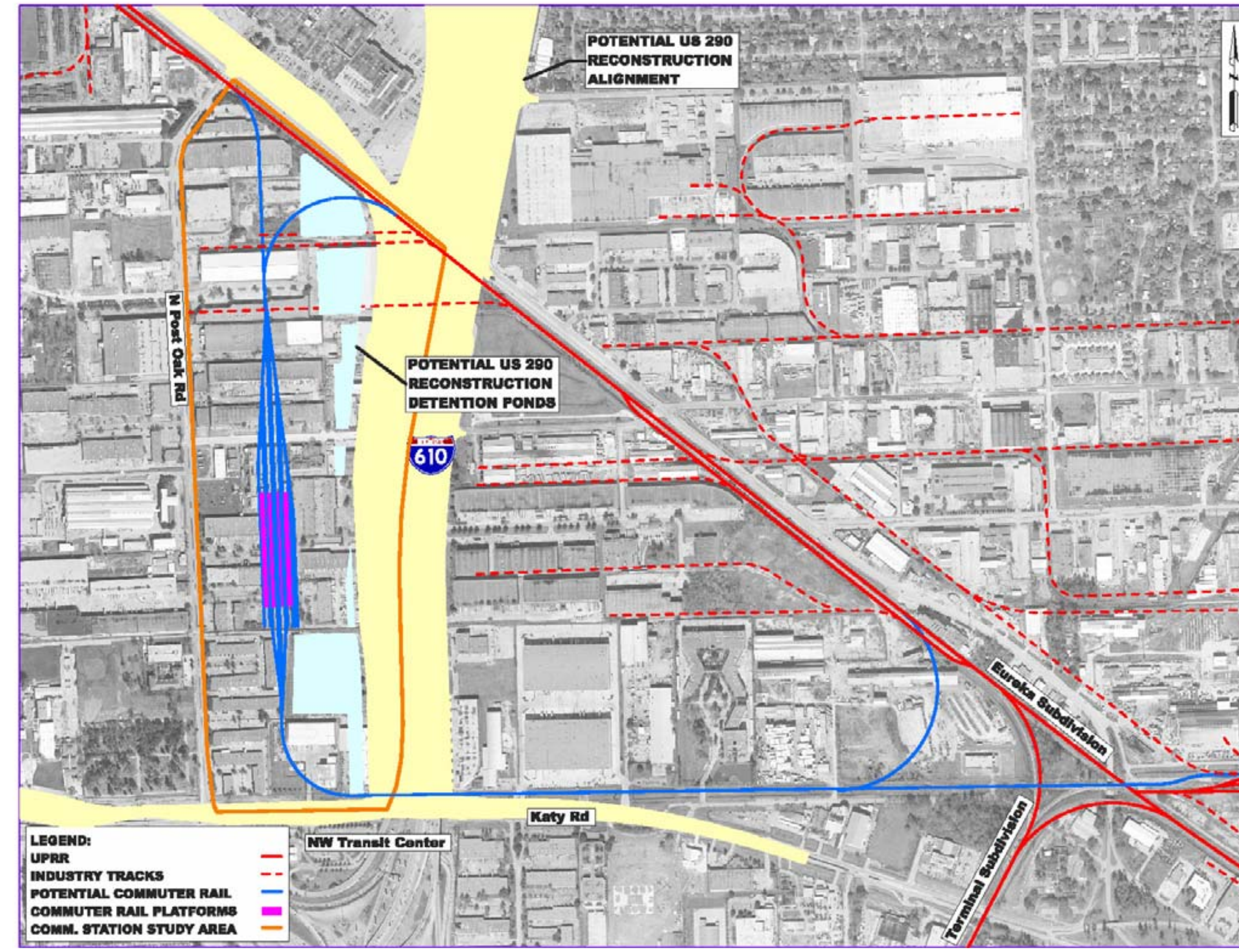


Figure 4-15: Potential Hub 1 Layout

Hub Site 2 is shown in **Figure 4-16**, and is located along the north side of the Eureka Subdivision. This site is also north of the alignment for the new the Hempstead Tollway/Managed Lanes to be constructed within the next few years. This wholly new toll facility will have direct connections to I-10 via the Northwest Transit Center HOV facilities and will have direct connections to the 610 Loop. The alignment of this new managed lane facility is parallel to the Eureka Subdivision and is also indicated by a yellow band in the figure. One complexity of placing the operational hub terminal at the Hub Site 2 location is the requirement for all access tracks to connect from the Eureka Subdivision on the south side of the future Hempstead Tollway/Managed Lanes across to the Northwest mall site on the north side. Design activities are beginning for both the US 290/I-610 interchange and the Hempstead Tollway/Managed Lane facilities. Accommodation of the track configuration for any Hub Site 2 facility is therefore an immediate issue affecting both design programs.

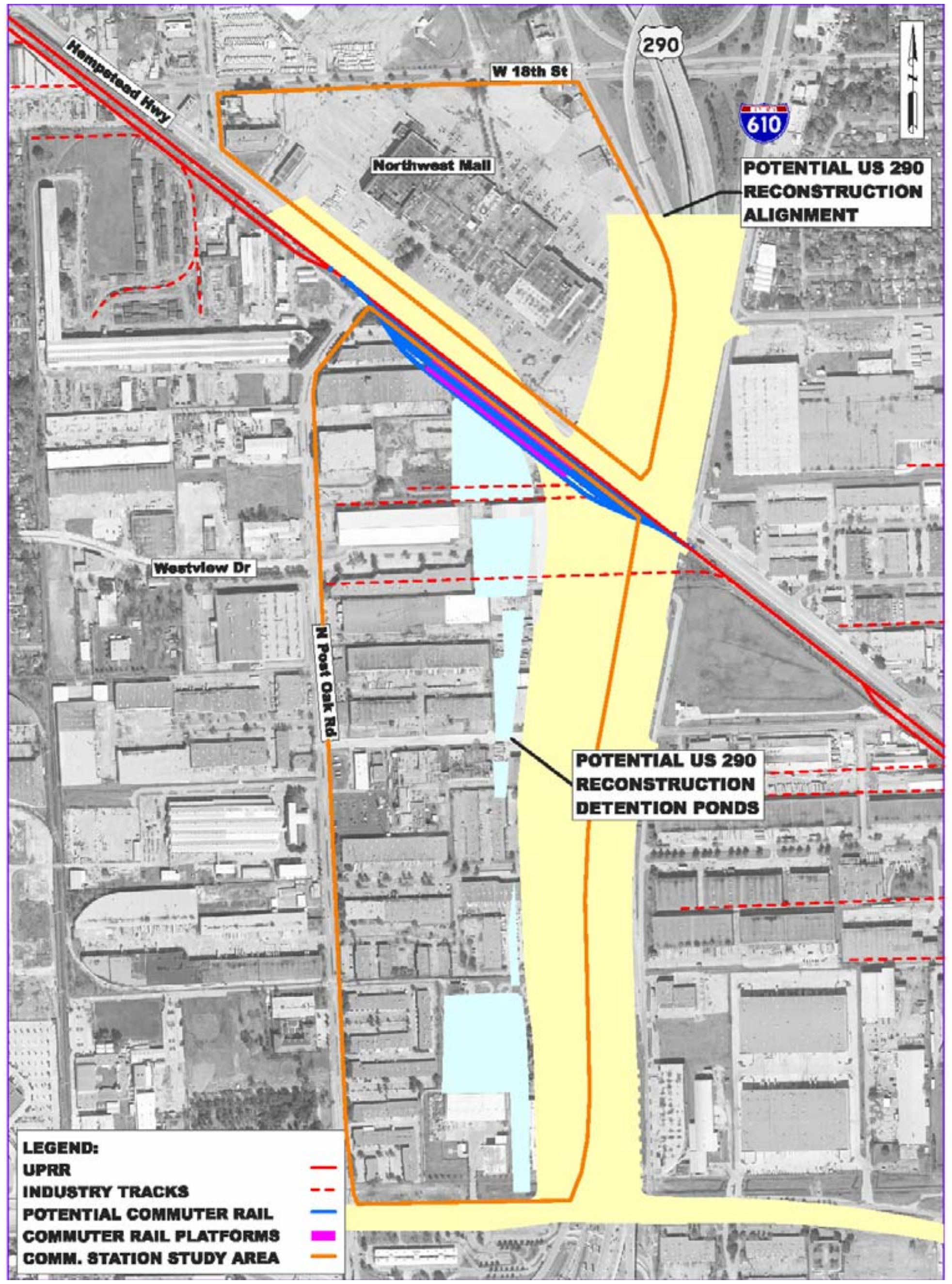


Figure 4-16: Potential Alternative Configuration for the Hub 1 Location

4.5 Economic Development Potential

4.5.1 Hub Sites 1 & 2 – Northwest Transit Center / Northwest Mall

An analysis of the area around Hub Site 1 and 2 sought to identify those parcels that may benefit from an increased intensity of use as a result of the activities surrounding the commuter rail operational hub terminal. This analysis began with creating a ½ mile buffer around the station, to represent a plausible pedestrian commute shed. Second, any existing residential neighborhoods, cemeteries, schools, and any proposed freeway rights-of-way or areas that would still be used for freight purposes were excluded as redevelopable areas. Contiguous areas made up of more than one parcel were prioritized, with the assumption that some parcel assemblage would have to take place.

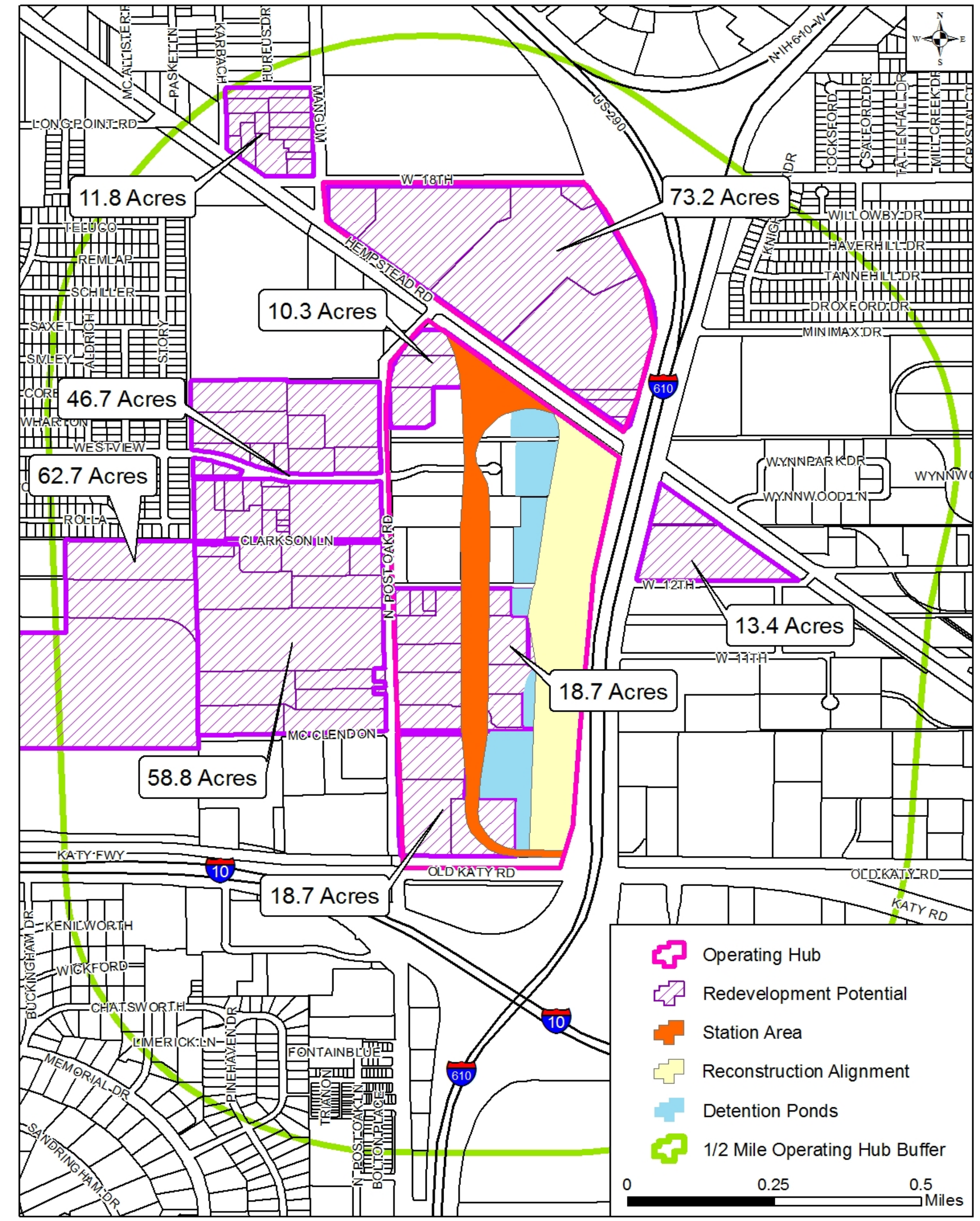


Figure 4-17: Potential Redevelopment Impact Area of Hub Sites 1 & 2

For the combined analysis of Hub Sites 1 and 2, a total of 346 acres were identified as potentially redevelopable. These consisted primarily of industrial and warehouse space within the immediate vicinity of Hub Site 1 and vacant parcels. Accounting for the approximate station area (Figure 4-16), freeway realignments, and potential detention ponds the net available acreage is approximately 303 acres (Figure 4-18). Land values in this area vary significantly, depending on existing uses and transportation access, however, they are significantly lower than the values of the Uptown/Galleria area located to the south. Based on this, a significant opportunity to intensify both use and values exists around Hub Site 1 & 2.

A basic pro-forma exercise was then conducted to evaluate the redevelopable lands identified in the parcel analysis. Assuming a basic land and remediation cost of $8 per square foot and prevailing rent and construction cost information, several prototypical building types were tested. These building prototypes are constructed on a per-acre basis, meaning they represent more of an approximation of the urban fabric, rather than a specific project. This analysis helps produce and snapshot view of what types of development might be suitable for the Hub Site area. This exercise does have some limitations; it does not account for phasing, but rather applies the prototypes across the site all at once. Second, while it uses pro-forma-like assumptions for construction cost, financing, and other market conditions, it is not meant to form the basis for any specific investment decision. A more detailed discussion of this process can be found in Appendix G. Overall, Hub Sites 1 & 2 appear to have significant economic development potential in the form of large parcels with relatively low intensity uses. The scarcity of large parcels inside Houston's already developed areas, particularly within the urban core, means this area may be especially suited for redevelopment.

4.5.2 Hub Site 3 -- Eureka Rail Yard

Hub Site 3 is located at the intersection of T.C. Jester Boulevard and the Eureka Rail Yard in the northwest quadrant of the urban core of Houston inside 610 Loop. Hub Site 3 is bordered by White Oak Bayou, T.C. Jester Boulevard, and the southern border of Eureka Rail Yard. The entire yard encompasses an area of approximately 107 acres, and the eastern parcel east of T.C. Jester (the Hub 3 Site) has an area of approximately 17 acres. Although more acreage could be taken from the rail yard acreage, the site would then need to span across T.C. Jester, a plausible prospect in that T.C. Jester crosses the rail yard on a bridge overpass structure.

As To the northwest of the Hub 3 Site is a single-family residential neighborhood. To the north and east of the site are also primarily residential areas. The site's eastern edge is the White Oak Bayou and channel. There is no direct street access from the site eastward across the White Oak Bayou.

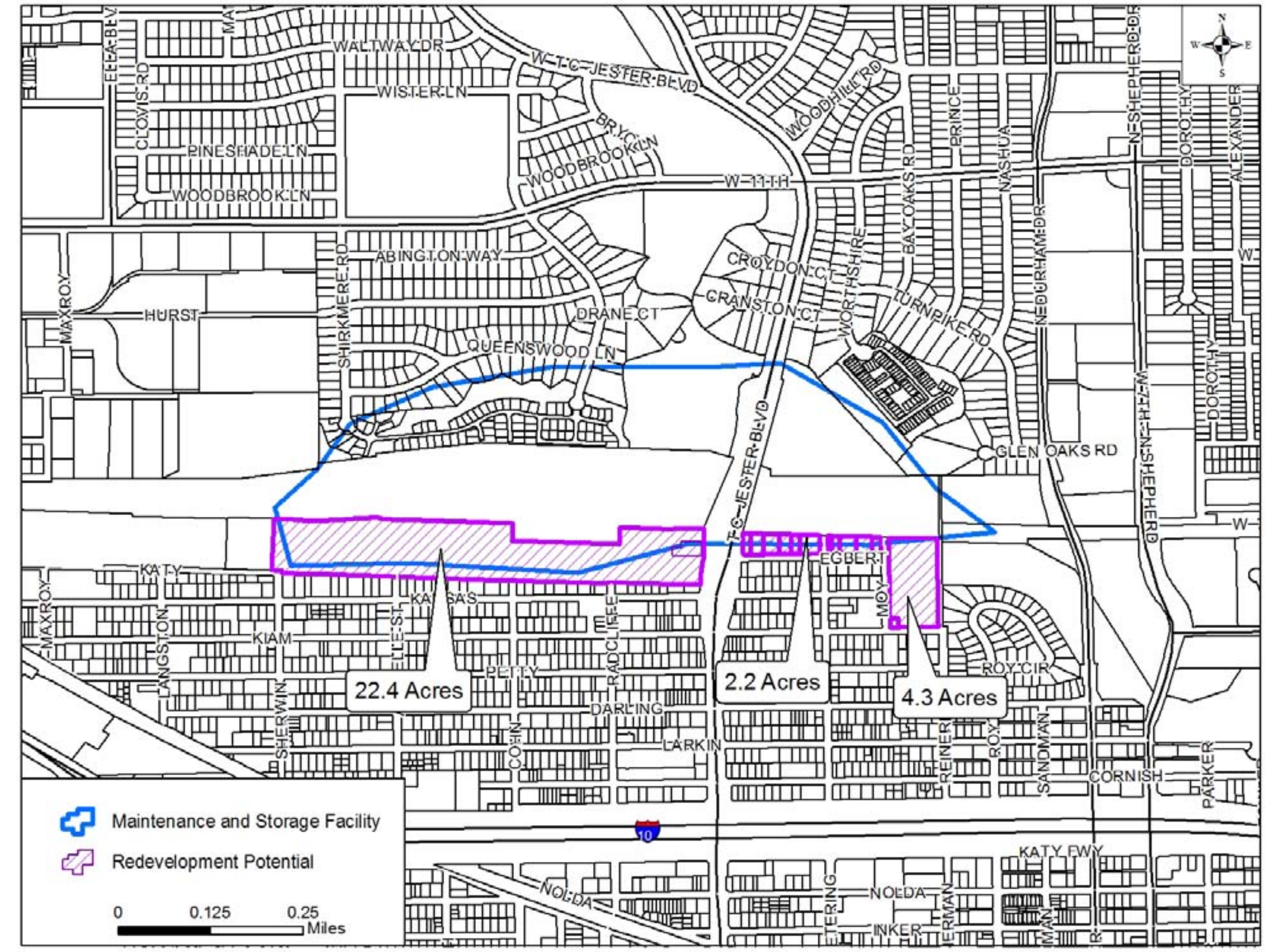


Figure 4-18: Hub 3 / M&SF 1 Redevelopment Potential

The main road access available to the site is a short frontage road off of T.C. Jester Blvd. that currently serves as access to an apartment complex adjacent to the overpass. To the south of the site, across the rail yard tracks, is a residential area interspersed with small scale retail and commercial land uses.

With the prospect of this site serving an operational hub terminal, the use of Eureka yard as the primary Maintenance and Storage Facility would also be likely, and as such the economic development strategy for most of the site should be limited to land uses that will not be in conflict with the operation of the train M&SF. Noting that the site is surrounded by both single family and multifamily residential housing, additional Housing development in this vicinity would be possible. With the very constrained size of the Hub site, the prospects for retail or office uses are low. Finally, the existing rail yard will continue to operate most probably as the M&SF for the commuter rail system, thus any intensification of land use should be designed to complement this use and minimize impacts to the surrounding neighborhood.

There are a few parcels adjacent to Hub Site 3 that could accommodate a somewhat more intense mix of uses. **Figure 4-18** highlights those parcels, which altogether represent 28.9 acres of non-contiguous land. The westernmost parcel has one rail spur connecting it to a silo facility. The collection of smaller parcels east of T.C. Jester Blvd that border the southern edge of the site currently house small warehouses. The easternmost parcel is a vehicle and materials storage yard. More information regarding the analysis of this site can also be found in Appendix G.

4.6 Environmental Justice

This section addresses this project's compliance with Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*. It identifies low-income and minority populations in the project corridor, and the number of building/parcel displacements that will occur under the proposed footprints of the Hub 1 and Hub 2 (Northwest Transit Center and Northwest Mall) operating area alternatives and the Hub 3 and M&SF 1 (Eureka Yard) sites. Executive Order 12898 applies only to projects that will use federal funds. It is anticipated that Section 5309 "New Starts" funds will be sought from the FTA to pay for a portion of the capital costs of this project.

For this analysis, the minority population in the block groups within a half-mile of Hub 1 Site, Hub 2 Site, and the Hub 3/M&SF 1 Site were compared to that of the populations for the whole of Harris County. The Council on Environmental Quality's (CEQ) guidance defines minorities as individuals who are members of the following population groups: American Indian or Alaskan native, Asian or Pacific Islander, Black or Hispanic. For this assessment, the following population categories were analyzed: White, Black, Latino, and Other. **Table 4-4** and **Table 4-5** show the percentage of non-white ("minority") residents and the income levels of all residents in the aggregate parcel groupings near Hub 1, Hub 2, and the M&SF 1.

Table 4-4: Racial Composition of Harris County and Hub 1, Hub 2 and M&SF 1 Sub Areas

	Harris County	Hub 1	Hub 2	Hub 3/ M&SF 1
White	42.1%	61.3%	51.3%	44.2%
Black	18.2%	2.6%	4.7%	6.0%
Hispanic	32.9%	34.8%	42.5%	48.3%
Other	6.8%	1.3%	1.5%	1.5%

Source: *2000 Census Report*, U.S. Census Bureau

Note: Hispanic persons are not considered a separate race, but may belong to any race.

The Executive Order and CEQ guidance state that public agencies are to consider whether human health effects, in terms of risks and rates, would be significant or above accepted norms if a proposed action were undertaken. **Table 4-6** summarizes the potential impacts that may occur with development of the Hub 1, Hub 2, and Hub/3M&SF Site 1.

Table 4-5: Population Characteristics in Hub 1, Hub 2 and Hub 3/M&SF 1 Sub Areas

	Harris County	Hub 1	Hub 2	Hub 3 / M&SF 1
Poverty Rate	14.97%	16.65%	21.48%	25.97%
Median HH Income	$42,598	$52,280	$35,533	$32,577
Median Age	31	40	34	31
HHs with no Vehicle	8.66%	5.90%	9.40%	22.0%

Source: *2000 Census Report*, U.S. Census Bureau

Table 4-6: Potential Adverse Impacts Associated with Development of Hub / M&SF Sites

	Disproportional adverse impact to populations with high poverty rates	Displacement of homes/businesses
Hub 1	X	X
Hub 2	X	X
Hub 3 / M&SF 1	X	

Overall, the operations hub terminal and maintenance and storage facility sites do have an impact upon the properties immediately surrounding them, however, a much more detailed analysis will need to be conducted as a part of either an Environmental Assessment (EA) or Environmental Impact Statement (EIS) associated with the pursuit of Federal funding for the construction of these sites.

Additional considerations to be examined during this future phase would include, but are not limited to, the following:

- Level of involvement with and from the communities in affected areas
- Change in level of transit access and service from NB
- Traffic, including changes in emergency response times, and impacts to pedestrians, bicyclist and other transit services
- Air, noise and vibration impacts that would be generated in affected areas
- Construction

Finally, it is noteworthy that the Hub 1 impacts on populations with high poverty rates and of minority population groups would be significantly lessened if the very large Hub 1 Site were divided into two different sites. If a reduced size Hub 1A was defined as the southern halve of the site, the tracks configured as shown in Figure 4-16 would serve that new site well. This modification would then localize the actual operational hub station facilities directly north of and adjacent to the Northwest Transit Center.

Similarly, a new Hub 1B would then be represented by the northern half of the original Hub 1 site, and the tracks would be configured as shown in Figure 4-17 with the operational hub terminal facilities clustered at the very north end of the site.

The reason that such a change would mitigate the environmental justice impacts for the southern site due to the fact that the high poverty and minority populations within the original impact area shown in Figure 4-18 are much more highly represented in the residential areas near the north end of the Hub 1 site than near the south end of the site. This would certainly lower the impacts described above in the Tables. This refinement of the Hub site definitions should be addressed in substantially more detail if an EA or EIS is pursued.

4.7 Ranking of operating facility sites

The ranking of the potential Hub and M&SF sites can therefore be made based on the two step process described previously. The preliminary assessment of potential site locations described above in Section 4.4 assessed the five hub sites for criteria associated with freight railroad operational impacts, multimodal transportation connectivity, and environmental considerations. This preliminary assessment was intended as an initial ranking of the Hub sites for the purpose of short-listing the locations to be addressed in the detailed economic development and environmental justice evaluations.

The number of sites that were considered in the further analyses was therefore reduced to three, specifically Hub 1, 2, and 3. This reduction in Hub sites resulted in the elimination of M&SF Sites 2, 3, and 4 due to the consideration of their longer distance from the remaining Hub sites being considered, as well as their locations along the most highly utilized freight rail subdivisions. M&SF Site 1 was therefore the only site considered further in the subsequent analyses.

In the final ranking of the remaining Hub Sites 1, 2, and 3, a similar scoring was performed that utilized the same criteria as in the preliminary assessment, but with the additional inclusion of the economic development and environmental justice criteria to the assessment. **Table 4-7** shows the scoring and resulting ranking of the three remaining Hub sites.

Based on the evaluation process discussed above, and the scoring and ranking process shown in the table, the preferred site for the operational hub terminal is Hub 1, the site north of the Northwest Transit Center and south of Northwest Mall. The associated maintenance and storage facility that is the preferred location is M&SF 1, the site located at Eureka Yard.

Table 4-7: Final Ranking of Operational Hub Terminal Sites

Operational Hub Terminal Location	Description	Freight Railroad Operational Impacts	Multimodal Transportation Connectivity	Environmental Considerations	Prelim. Rank	Economic Development Potential	Environmental Justice	Site Weighted Score	Final Rank
	Weighting Factor	**1.75**	**1.5**	**1**		**1**	**1**		
Hub 1	Adjacent to NW Transit	5	5	5	**1**	5	2	**29.5**	**1**
Hub 2	Northwest Mall	4	3	5	**2**	4	2	**23.5**	**2**
Hub 3	Adjacent to Eureka Yd	5	1	2	**3**	1	4	**18.5**	**3**
Hub 4	Hardy Yard	1	4	4	**4**	--	--	--	**4**
Hub 5	I-45/35 Junction	1	3	1	**5**	--	--	--	**5**

Scoring Key

1 - High Impacts	1 - Poor Conditions	1 - Poor Conditions	1 - Low Potential	1 - High Impacts
2 -	2 -	2 -	2 -	2 -
3 - Medium Impacts	3 - Medium Conditions	3 - Medium Conditions	3 - Medium Potential	3 - Medium Impacts
4 -	4 -	4 -	4 -	4 -
5 - Low Impacts	5 - Good Conditions	5 - Good Conditions	5 - High Potential	5 - Low Impacts

CHAPTER FIVE – BASELINE SYSTEM PLAN FOR LONG DISTANCE COMMUTER RAIL

The previous chapters have discussed a conceptual system which is representative of a mature, region-wide commuter rail system designed to carry people to and from work when they travel long distances to reach their place of employment. The development of these concepts has enabled a preliminary assessment of ridership for such a regional system, a preliminary assessment of operational impacts on the freight railroads, and an analysis of the prospects for connectivity with the multimodal transportation infrastructure of the region.

This chapter draws from the system concept to determine a representative cost of constructing a regional system, as well as a first estimate of ridership revenues and associated operating and maintenance costs. An overview of funding options is then discussed in the context of the order-of-magnitude costs to be covered.

Finally, a Baseline System Plan that would serve the Houston metropolitan area and surrounding Upper Gulf Coast has been defined, based on the implications and assessments given to the Principal Corridor system. These assessments have been drawn from reactions to the Principal Corridor conceptual system as it has been vetted among key stakeholders, transportation agencies, local counties and municipalities, and the general public. As a result of comments received and new information gained from this process, the key considerations for a Baseline System Plan have been derived. It is anticipated that a full System Plan will evolve from the information in this report as future studies build on the concepts presented.

Therefore, the Baseline System Plan described below provides a roadmap for decision makers, when combined with the representative service scope, defined operating facilities, and capital and operating costs derived from the conceptual Principal Corridor system. In particular, the financial program required to implement a regional commuter rail system is framed by these concepts, operational implications, and cost parameters.

5.1 Costs and Financial Performance Measures

Table 5-1, on the following page, summarizes the route operations and the associated financial performance of commuter rail routes serving each of the five Principal Corridors – a representative regional system. The financial indicators shown (2008 dollars) reflect a steady state of operations supporting the forecasted 2035 ridership for a system performing at a level of operations achieved by a mature system (as compared to a new start-up commuter rail system).

5.1.1 Trains

The trains appearing in **Table 5-1** reflect the preliminary operating plans for each route discussed in **Chapters 2 and 3** with both predominant peak period (peak direction) trains, as well as limited off-peak service. A total number of 88 weekday trains (i.e., revenue service train trips – half inbound and half outbound) is an operational scenario that provides the basis of the operating plan. A more detailed description of this operating plan is contained in Appendix F, Houston Principal Corridor commuter rail preliminary operating plan. A total of 27 five-car trains is the assumption of the rolling stock that would be utilized each day in revenue service.

5.1.2 Weekday Riders

The riders shown in **Table 5-1** are those forecasted for each route, as described in detail in **Chapter 3**. As is common for a commuter service, they are predominantly peak period riders. The ridership in the table is modified from the total peak period demand (unconstrained) shown previously in **Table 3-1** in that reverse peak ridership is rationalized to the number of reverse peak trans run, and off-peak period ridership is added. Overall, riders per train average about 410, which is comparable to the average riders per train achieved by several other commuter rail operations.[1]

5.1.3 Annual Revenue

This figure is the product of the number of riders multiplied by an average fare of $6 per one-way trip multiplied in turn by 255 weekdays per year. The fare assumption was based on a review of the recent and anticipated fare levels for the Metrolink commuter rail system in Los Angeles.[2]

5.1.4 Annual Operating Costs

The operating cost estimate for each route is the product of the total number of miles that line trains travel multiplied by $84 per train mile multiplied in turn by 255 weekdays per year. A train mile equals one train moving one mile. The $84 figure is based on the 2007 budget of the Altamont Commuter Express (ACE) in the San Francisco Bay Area (it includes total transportation and administrative costs)[3] and the number of revenue train miles generated by ACE trains on weekdays.

5.1.5 Annual Operating Subsidy

This dollar figure equals total operating costs less fare revenue. This is the portion of the operating cost to be covered by locally generated funding.

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[1] This analysis averaged total ridership of six commuter rail operations by the number of trains run. The systems were the Virginia Railway Express serving Washington DC, Metrolink serving Los Angeles, Sounder serving Seattle, The Coaster serving San Diego, Caltrain operating between San Jose and San Francisco, and Altamont Commuter Express operating between Stockton and San Jose. The average of these six systems totaled to 350 riders per train.

[2] Metrolink Commuter Rail Strategic Assessment, 2007, Southern California Regional Rail Authority.

[3] Appendix B of the Rail Commission/ACE Service Operating Budgets for 2006/2007, San Joaquin Regional Rail Commission.

Table 5-1: Principal Corridor Commuter Rail System Operating and Financial Summary

	US 290/ Eureka	IH 45 S/ Galveston	Westpark	US 90A/ Glidden	Hardy/ Palestine	Total
Trains	20	20	16	16	16	88
Annual Operating Costs	$21,334,320	$20,777,400	$13,743,072	$17,273,088	$16,176,384	$89,304,264
Capital Costs						
Outlying Stations Costs	$56,000,000	$56,000,000	$48,000,000	$48,000,000	$40,000,000	$248,000,000
Line Improvement Costs	$291,800,000	$144,980,000	$349,000,000	$423,290,000	$361,750,000	$1,570,820,000
Shared Line Costs						$531,940,000
Mantenance/Storage Facility						$140,000,000
Rolling Stock						$428,490,000
Total	$347,800,000	$200,980,000	$397,000,000	$471,290,000	$401,750,000	$2,919,250,000

NOTES:

1. The "Shared Line Costs" refers to the distributed costs between the multiple lines served by common segments inside 610 Loop.

2. A total of 236 miles of route service has been determined by the Principal Corridor conceptual system preliminary operating plans (ref. Section 3.6). This would equate to about 12 ½ million dollars for each route-mile of revenue service provided (including the shared costs described in 1. above).

5.1.6 Fare Box Recovery

Fare Box Recovery is the ratio of operating costs covered by the collection of fares. It is estimated by line and on a system-wide basis. System-wide, the Principal Corridors would generate an estimated 62 percent fare box recovery. This is higher than the average commuter rail fare box recovery for 2006 derived from the National Transit Database. The database, compiled by the Federal Transit Administration (FTA), revealed the average commuter rail fare box recovery to be around 50 percent. Though higher than average, the 62 percent estimate is well below the 85 percent fare box recovery achieved by the GO Transit commuter rail operation in Toronto in 2006-07. The estimate is comparable to a recent year Metrolink fare box recovery of 55 percent,[4] which was also above the U.S. commuter rail average.

5.1.7 Capital Costs

Table 5-1 also shows the estimated capital costs for the Principal Corridor System. An subsequent capital cost assessment of the difference in capital costs between the Principal Corridor system and the Baseline System revealed that the total cost of roughly $3 Billion was essentially the same, even though the five corridors in each of the two system plans are not identical. A general conclusion of the capital costs studies is that — for conceptual planning purposes – the capital cost for the rail and signaling infrastructure improvements outside of Loop 610 will be approximately $1 Billion, the cost of the rail and signaling infrastructure inside Loop 610 will be approximately $1 Billion, and the cost of stations, maintenance and operating facilities, and rolling stock will be approximately $1 Billion. The following discussion further describes how these costs break down.

Outlying Station Costs: These are a product of the number of such stations (other than the operational hub terminal described in Chapter 4 and the METRO NIT) multiplied by lump sum estimate of $8 million per station. The lump figure was based on a recent service expansion study effort for Altamont Commuter Express[5].

Line Improvement Costs: These costs are for track and structure improvements for each of the lines developed as part of the Principal Corridor selection process.

Shared Line Costs: These costs include the lead to the Eureka Yard Maintenance and Storage Facility, the NIT Loop (see Appendix D), and new track from West Junction to the NIT.

Maintenance and Storage Facility: This cost was based on the construction cost of a similar facility for the Caltrain commuter rail system on the San Francisco Peninsula.

Rolling Stock: These costs are for the 27 trains required for the preliminary operating plans for the Principal Corridor representative system, plus a 15 percent spare equipment ratio. The average train is composed of one locomotive, four trailing bi-level coaches, and one bi-level cab car (a coach with a driver's compartment allowing for bi-directional operations) having an estimated cost of $13.8 million.[6] The rolling stock is the same as deployed on several commuter rail systems, including Metrolink in Los Angeles, Altamont Commuter Express and Caltrain in the Bay Area, and Trinity Railway Express in Dallas-Fort Worth. The cab car, having an operator's compartment added to the bi-level passenger compartments, allows the trains to be run bi-directionally in a push-pull mode, obviating the need to "turn" the locomotive from one end of the train to the other.

In general, the capital costs total $2.9 Billion in 2008 dollars. This estimate is indicative of a public works project, from a cost perspective, on the scale of the I-10 Katy Freeway reconstruction project. Although the functional comparison of a single freeway corridor with a regional commuter rail system with 5 corridors is an apples and oranges comparison, the scale of funding and project execution complexity needed for implementation is a relevant comparison.

It is also noteworthy that some of the costs cover infrastructure that would also benefit the freight railroads and under the memorandum of understanding between the State of Texas and the Class 1 Railroads, signed on March 18, 2005, the public benefit versus the private benefit would determine how such mutually beneficial cost would be shared. It must be emphasized that no assessment has been made in this conceptual study of what the proportional share would be between the public and private entities.

It is also important to note that this capital cost estimate does not include the costs of two important operational facilities, the operational hub terminal and the METRO North Intermodal Terminal (NIT). The NIT has been budgeted for development as part of the METRO Solutions Plan, Phase 2 Implementation, and as such it was not included here as part of the new infrastructure funding requirements.

In the case of the operational hub terminal described in Chapter 4, the capital cost is highly contingent on the extent of other private development that would certainly be integrated into the Hub site. The preferred site location on the northwest side of the urban core as described in Chapter 4, is situated along the west side of the 610 Loop. This facility will inject major new development potential to the area, even beyond the inherent development prospects for this quadrant. It has therefore been assumed that the economic benefits of such a facility when located within the urban core would derive major transit oriented joint-development opportunities, and this aspect of financial benefit derived by the private sector would offset the capital costs of the public infrastructure investment for the facility. This simplifying assumption, and the complexity of predicting any associated capital costs, was the basis for not including these costs in the overall estimate.

Finally, it must be said that the capital costs are at best an order of magnitude estimate of the implementation of a regional commuter rail system, and are not the actual budgetary costs

[4] Metrolink Fact Sheet, prepared by the Metrolink Communications and Development Department, 2006 Metrolink.
[5] SJRRC Service Expansion Analysis, Draft Report, 2007. This report is being finalized by Wilbur Smith Associates.

[6] The cost for a commuter rail train includes a locomotive ($3.5 million), four trailing coaches ($8.0 million), and a cab car ($2.3 million). These costs were taken from the SJRRC draft report.

on which a specific work program can be based. The cost estimates are based on the conceptual Principal Corridor system, a system configuration which will certainly not be the actual first build system, as discussed in the section that follows. The costs do, however, establish a target cost of roughly $3 Billion (2008 dollars) which regional decision makers can reference when considering when and how to initiate a regional commuter rail system development program.

5.2 Funding Mechanisms

Sponsors of a future commuter rail system in the Houston area will likely look to various sources for financing construction, rolling stock acquisition, and ongoing operations and maintenance. This is because commuter rail will not generate sufficient funding from its fare revenue to cover these costs.

There are three generalized sources of funds available: federal, state and local sources. The specifics and the requirements of funding sources tend to change over time. Thus, there is no guarantee that today's funding mechanisms will be in place 10 of 20 years from now. Still, it is reasonable to assume that similar sources would exist in the future.

Federal funding is typically sought for construction and implementation. The largest source of funding for any commuter / regional rail transit improvement would be the FTA Section 5309 New Starts program. While certainly not impossible, securing significant federal capital support could be very difficult given that the competition for New Starts funding is intense. Other funding programs are available through FTA and other federal agencies.

Potential state sources do exist, but would likely be limited. Locally generated funding may provide the most reliable source of ongoing revenue needs.

The listing of funding sources that follows includes major funding sources, for which a commuter rail project in the region may be eligible if it were implemented today. The listing is meant to be illustrative. Depending on the specifics of a final implementation plan for commuter rail in Houston, other sources may become relevant.

All of the funding options discussed below presume at least one public agency authorized to obtain funding for a new Houston area commuter rail service. This could be accomplished by either empowering an existing organization(s) to do so, or by creating a new public agency. The former requires cooperative agreements between the agencies encompassing the service area. The latter assumes a new agency would be created with its own funding or taxing authority.

The possible distribution ranges of funding for these potential sources are given in **Table 5-2**. However, the example shown is not considered to be a complete list of possible funding sources.

5.2.1 Federal Funding Options (FTA extracts about each option are in Appendix H)

5.2.1.1 Section 5307 Large Urban Cities Program

This federal funding program can potentially provide federal funding for both capital and operating assistance, as well as for transportation planning purposes. The specific funding purposes can include design, evaluation, and funding of new track, rolling stock, maintenance and storage facilities, signaling systems, and even overhaul of such infrastructure.

Table 5-2: Potential Funding Sources for a Regional Commuter Rail System

• Federal Funding	30% to 60%
– 5307 Large Urban Cities Program	2% - 4%
– 5309 FTA New Starts Program	25%-50%
– STP, CMAQ, FTA Urban Formula Funds	3% - 6%
• State Funding	10% to 20%
– Texas Rail Relocation and Improvement Fund	
• Local Funding	30% to 60%
– Sales Tax / Transportation Related Fees	5% - 10%
– Local Jurisdiction (Counties and Municipalities)	5% - 10%
– Public/Private Partnerships	
o Stations/TOD	20%-40%
o Private Railroads	

5.2.1.2 Section 5309 New Start Program

The FTA New Starts program is a well know source of funding for transit system, including all types of rail transit, automated fixed guideway systems, and busway/HOV facilities. This type of funding has a prescribed process of capital investment planning and project development that if successful, results in a full funding grant agreement with FTA. There are necessary commitments of funding from both the federal side and the local side in this funding approach.

5.2.1.3 Flexible Funding for Highway and Transit

This type of funding allows local agencies to apply two types of funds for either highway or transit purposes, based on local priorities. These funds include certain types of Federal Highway Administration (FHWA) funds as well as certain Federal Transit Administration

(FTA) funds. These Surface Transportation Program (STP), Congestion Mitigation and Air Quality (CMAQ), and FTA Urban Formula Funds are described below.

Surface Transportation Program

STP funds are considered to be very "flexible, with the funds distributed in accord with population and programmatic criteria within each state. H-GAC is involved in the allocation of STP funds for projects ranging from all types of public transportation and associated planning initiatives.

Congestion Mitigation and Air Quality Improvement Program

CMAQ funds are tied to projects that improve air quality, usually associated with reducing traffic congestion. Transit projects can qualify for these funds, including work that will improve ridership on transit lines. These funds are allocated by a formula that is keyed to the severity of air quality problems for a given area.

5.2.1.4 Railroad Rehabilitation and Improvement Financing (RRIF) Program

The RRIF Program enables the Federal Railroad Administration (FRA) to provide loans and loan guarantees for railroad capital projects, including freight railroads, State and local passenger and commuter railroads, and Amtrak. The projects eligible for this funding include freight intermodal terminals, railroad equipment, track, bridges, and yards/shops.

5.2.1.5 Section 5316 Job Access and Reverse Commute (JARC) Grants

The goal of the JARC program is to improve access to transportation services to employment and employment related activities for welfare recipients and eligible low-income individuals and to transport residents of urbanized areas and non-urbanized areas to suburban employment opportunities. Toward this goal, the Federal Transit Administration provides financial assistance for transportation services planned, designed, and carried out to meet the transportation needs of eligible low-income individuals, and of reverse commuters regardless of income.

5.2.1.6 TIFIA Financing

The Transportation Infrastructure Finance and Innovation Act of 1998 established a new federal credit program called TIFIA under which the U.S. Department of Transportation may provide three forms of credit assistance – secured (direct) loans, loan guarantees, and standby lines of credit – for surface transportation projects of national or regional significance. Transit projects are eligible. However, a project's eligible costs, as defined under 23 U.S.C 181, must be reasonably anticipated to total at least $50 million, or alternatively, equal to one-third or more of the state's federal aid highway apportionments for the most recently completed fiscal year, whichever is less.

5.2.1.7 Highway Safety Improvement Program (HSIP), Section 148

The HSIP, codified by SAFETEA-LU as section 148 of title 23 U.S.C., is a newly-created "core funding" program administered by the Federal Highway Administration (FHWA). Section 148 establishes a set-aside program totaling $220 million each fiscal year for highway-rail crossing safety. The funds are to be used for crossing safety improvements.

5.2.2 State Funding Options

At the present time, there is no steady, ongoing source of funding for commuter rail available from the State of Texas. In 2005, the Texas Legislature created the Texas Rail Relocation and Improvement Fund, yet at the time of this report publication that fund lacks a revenue stream. However, according to the Finance Department of Dallas Area Rapid Transit (DART), state funded grants that can be used for commuter rail projects occasionally are available.[7] In the Dallas area, these grants have been administered by the local Metropolitan Planning Organization. DART is a co-sponsor of the Trinity Railway Express (TRE), the commuter rail service between Dallas and Fort Worth. The other sponsor is the Fort Worth Transportation Authority.

5.2.3 Local Funding Options

5.2.3.1 Sales Tax or Bonding

Other than federal transit-supportive programs, the more likely sources of major funding for a future Houston area commuter rail service would be local. Both DART and Houston METRO receive financing through a 1 percent sales tax. In the City of Houston, the sales tax has reached its state-mandated cap of 8.25 percent, with 1 percent used to support the Houston METRO service. However, conceivably the sales tax could be raised in areas outside of Houston (that is, in areas where the sales tax is less than 8.25 percent) to help cover costs of commuter rail serving these communities. Alternatively, action by the state legislature could raise the sales tax above the current 8.25 percent cap, or exempt the 1 percent for transit from counting toward the cap. Communities throughout the H-GAC TMA were previously given the opportunity to opt into the dedication of the 1% sales tax as described above. However, many municipalities, who would benefit from the improvements suggested within the body of this document, chose not to authorize this dedication of sales tax. Without a revision to the statute or a revision in the way that their communities allocate their funding streams, these communities would not be able to provide a revenue source through this mechanism for regional commuter rail service. Meanwhile, an alternative to revenue generation through a sales tax may be bonding for capital cost expenditures.

5.2.3.2 Support from Jurisdictions Served

To help defray costs related to stations, sponsors of a Houston area commuter rail service could look to the cities and other jurisdictions served. This is a model adopted by the

[7] Per a telephone conversation with a DART financial official on May 27, 2008.

Southern California Regional Rail Authority (SCRRA), sponsor of the Los Angeles area Metrolink commuter rail service. On the Metrolink system, the cities for the most part build and improve the stations.[8] The benefits for the cities have included their ability to influence development at or around station sites and to create stations with city-specific identities.

5.2.3.3 Public/Private Partnerships

Another potential source of funding for stations could be public/private development. Conceptually, the commuter rail sponsoring authority or a city served might make land available for a station and commercial/office co-development, and then look to a private developer to build the station. The benefit for the developer would come from the commercial/office development, whose attractiveness would be enhanced by the existence of the station.

As for main line improvements required to host commuter rail service, the sponsoring agency could look to the private railroads that own the existing facilities for capital contributions. The benefit for the freight railroads would be that the improvements would enhance capacity on the lines improved, allowing the freight railroads to move their trains more efficiently.

5.3 Baseline System Definition

During the course of presentation and discussion of the system concept defined herein as the Principal Corridor system, a variety of comments and suggestions have been received from key stakeholders, decision makers, and interested persons of the general public. The insight gained from this interactive dialogue has proven invaluable to assessing which corridors are realistic for first implementation. In particular, the operational needs and planning initiatives of Houston METRO, the Gulf Coast Freight Rail District (GCFRD), and the Class 1 Railroads has been paramount to the consideration of first build corridors. Based on this information, the following is a description of the resulting Baseline System Plan.

The Baseline System must represent a plan that provides suitable progressive implementation of conventional, FRA-compliant commuter trains and equipment, facilities and track infrastructure. Listed below are the corridors likely to be built first to represent a Baseline System. The selection of these specific corridors was based on public support, strength of ridership demand, and strategic need in light of the construction of other corridor specific transportation infrastructure (e.g., additional highway capacity within the Principal Corridors).

Of critical concern is the fact that several freight rail corridors are currently operating at or near their capacity, and as long as the current freight rail network remains the same with the terminal functions occurring around the existing rail yard configuration, some corridors cannot be realistically considered for implementing commuter rail. These corridors are the Glidden, Terminal, Palestine, and Mykawa Subdivisions. If, at some time, some of the rail yards are relocated (considerations for which the freight rail companies are currently examining) some of these corridors may re-emerge as prospective corridors for long distance commuter rail service.

Other factors include the interest of Houston METRO in implementing suburban commuter line service in some corridors using non FRA-compliant technology. Such implementation would provide near to medium term service to some corridors.

Table 5-3 summarizes the considerations used to identify the corridors in the Baseline System Plan.

Table ES-9: Baseline System Corridor Considerations

Principal Corridor Ranking	Principal Corridor	Corridor Description	Capacity Constrained Freight Optns	Regional Areas Served	METRO Surb. Commuter Rail Alt. Planned	Baseline System Plan Corridor
1	Eureka	US 290	No	Cypress / Waller Co.	Yes	Yes
2	Westpark	Westpark	No	West Houston / Harris Co.	Yes	No
3	Palestine	Hardy Toll Road	Yes	N. Harris / Montgomery Co	Unknown	No
4	Glidden	US 90A	Yes	Fort Bend Co	Yes	No
5	BNSF Houston	SH 249 / FM 1774	No	NW Harris / Montgomery Co	Unknown	Yes
6	UP Galveston	SH 3	No	Galveston Co	Unknown	Yes
7	Lufkin	US 59	Yes	NE Harris / E Montgomery Co	Unknown	No
8	Mykawa	SH 35	Yes	Brazoria Co	Unknown	No
9	Beaumont	Lake Hou. / Huffman	Yes	NE Harris / Liberty Co	Unknown	No
10	Popp	FM 521	No	Fort Bend Co	Unknown	No
New	--	SH 35 Tollway	No	Brazoria Co	Unknown	Yes
New	Galveston/Popp	SH 6 / FM 521	No	Fort Bend Co	Unknown	Yes

Designates Principal Corridors analyzed for ridership, operational impact, and cost

Designates Corridors in the Baseline System Plan

[8] In Riverside County, the Riverside County Transportation Commission built the Metrolink stations.

With these considerations, the recommended corridors in the Baseline System Plan are as follows:

US 290 / Eureka Subdivision Corridor – This high growth corridor has strong public support for commuter rail implementation, and with the initiation of several major roadway construction programs within the corridor over the next 15 to 20 years, the congestion is expected to get worse before it gets better. It also appears that there is political will to pursue the initiation of some type of commuter rail service in this corridor in the near term.

SH 3 / Galveston Subdivision Corridor – Commuter rail has been actively studied and promoted in this corridor by the City of Galveston. In fact, the initiation of some type of commuter rail service in this corridor is viewed by many as likely, and federal funding to initiate this service is already being pursued.

SH 249 / BNSF Houston Subdivision Corridor – This corridor was not part of the original Principal Corridor system definition. It actually scored well in the related Principal Corridor selection process, but the Oversight Task Force deliberations concluded that it may be redundant service coverage with the US290 corridor. But the Tier 2 ridership studies did find that the ridership remained strong even when it was included in the system along with the US290 corridor, showing that both of these corridors in the Northwest Quadrant of the region were viable for simultaneous commuter rail service. Furthermore, the proximity of the corridor to the preferred Hub terminal site would indicate that a direct connection to the recommended site of the operations hub terminal is possible as part of an early implementation program for a regional system.

South Fort Bend / BNSF Galveston/Popp Subdivision Corridor – This corridor was also considered in the Tier 2 ridership modeling, and it performed reasonably well under the assumptions used in the study. This alignment would provide service from the southern end of Fort Bend County, and most importantly it would provide long distance service connecting to the edge of the Texas Medical Center district.

SH 35 Tollway Corridor – This corridor was studied by TxDOT for freeway improvement, with consideration of other multimodal service provisions. Since this new tollway facility was not an existing or previous freight rail alignment, it was not specifically included in the Principal Corridor evaluations (although the nearby Mykawa Subdivision was included). In light of TxDOT's interest in providing a ROW for commuter rail, the direct service provided in the corridor to the high growth Pearland area, and the fact that an early implementation inside Loop 610 is plausible, this corridor was also included in the Baseline System Plan.

Overall, the Baseline System comprised of these five corridors would provide a level of regional coverage that is similar to that of the Principal Corridor system. With the new development areas served along the BNSF Galveston Subdivision (e.g., Siena Plantation and west Pearland area), and the TxDOT SH 35 corridor, the ridership is anticipated to remain in the order of the forecasted 40,000 riders a day (however, no compatible ridership studies for this system configuration have been done).

Figure 5-1 shows this proposed Baseline System Plan as envisioned at the end of this H-GAC study. The Baseline System is envisioned to arrive at the Hub Terminal west of 610 Loop and at METRO's North Intermodal Terminal, where essential connectivity is provided by METRO's Urban LRT system, thereby providing superior access to our region's largest Activity Centers

This Baseline System Plan is anticipated to be supported by the Class 1 Freight Rail companies as a commuter rail system that can be accommodated without serious detrimental impact on the future growth of freight rail service. This assumes, of course, that major track and signal infrastructure improvements are made in the Baseline System corridors such that simultaneous passenger and freight service is accommodated, especially the parts of the system inside Loop 610.

Regarding the specific alignment considerations inside of Loop 610, this part of the system infrastructure will be most difficult and costly of the system elements to implement, especially with the extent of grade separated aerial structures that would be required along the service roads lf I-45 and US 59. With the new corridors added to the configuration of the commuter rail network through the urban core, there will also need to be a substantial amount of abandoned ROW re-established for rail service, and certain connecting pieces of the ROW will need to be purchased and/or reconfigured for rail service. **Figure 5-2** shows the new connecting links as well as the new track to be implemented along-side the freight tracks.

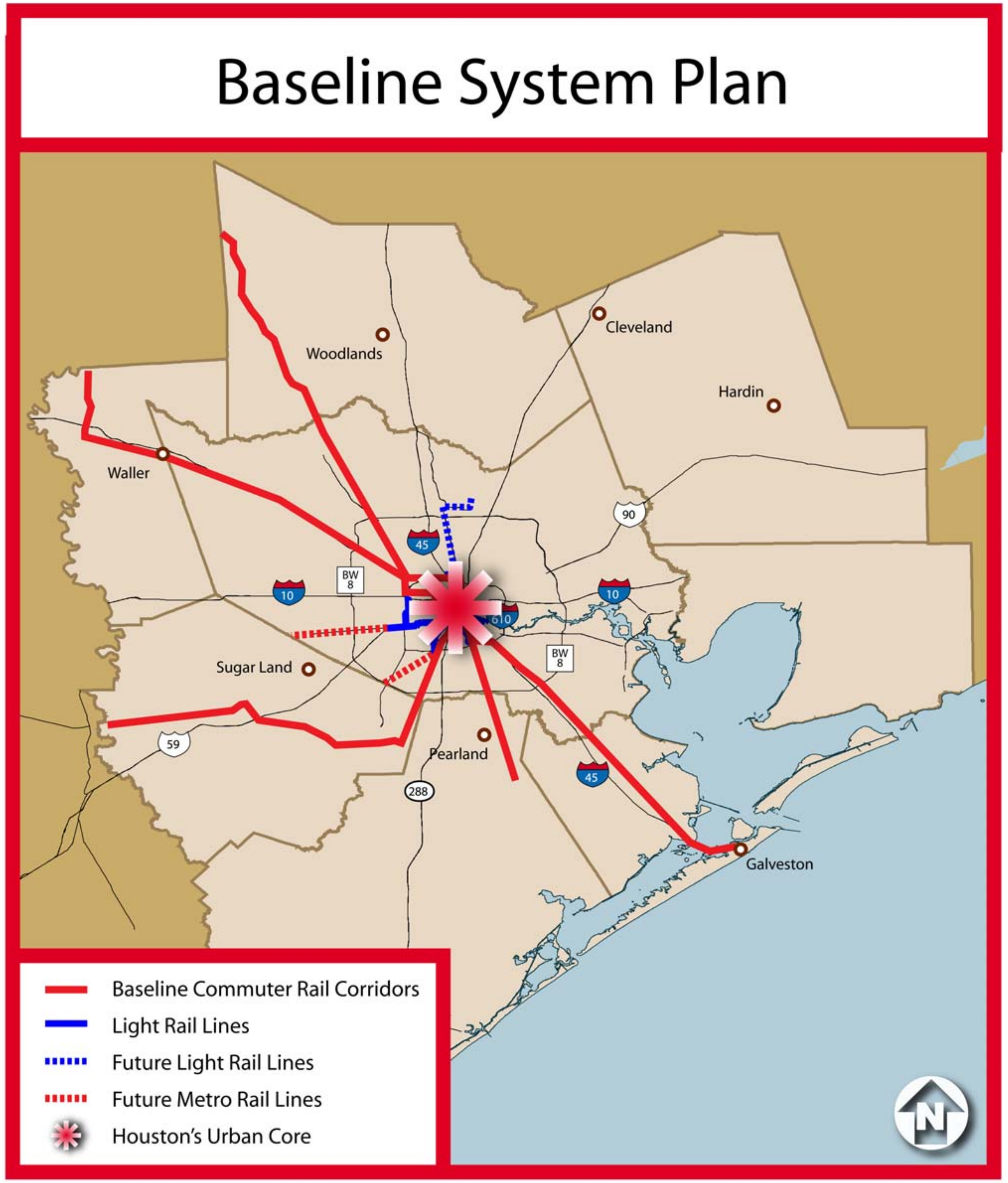

Figure 5-1: Baseline System Plan

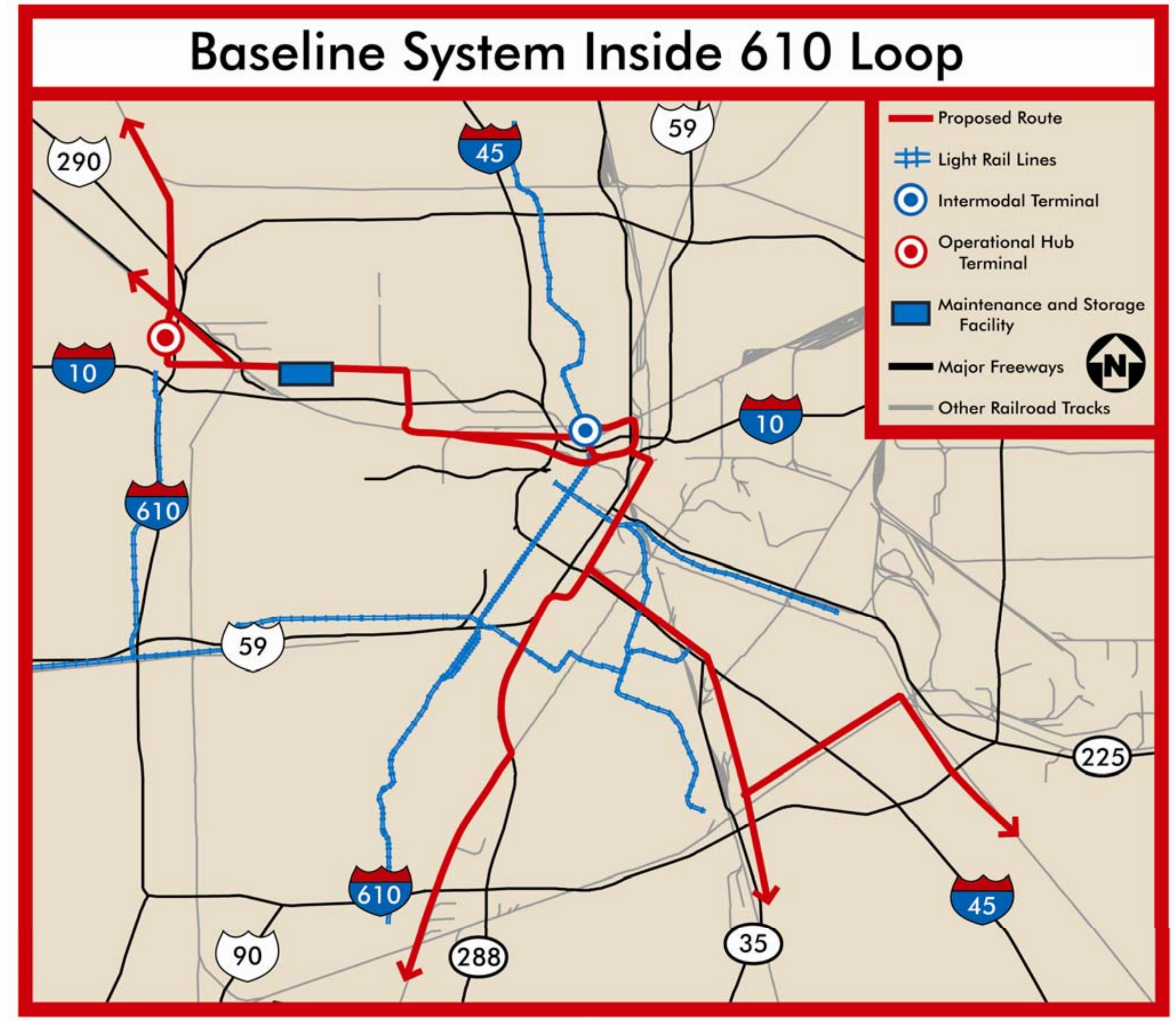

Figure 5-2: Baseline System Plan Inside Loop 610

Of particular note is the addition of the new "Hub Loop" that provides a double-ending of the operational hub terminal as shown in **Figure 4-16** (refer to section 4.4 of the previous chapter for additional information). This feature will allow trains to be dispatched to the M&SF while traveling in either direction out of the operations hub terminal's train yard. When combined with the NIT Loop in downtown and the M&SF facility located in the middle of these two loop tracks, the operational flexibility provided by the Baseline System is exceptionally good. If these aspects of the Baseline System Plan can in fact be achieved, the rail system infrastructure should be able to service a future commuter rail system much larger than what is represented here, with many more trains serving a broader regional coverage, as well as extensive intercity passenger rail service.

CHAPTER SIX – FINDINGS AND RECOMMENDATIONS

A long-distance commuter rail system can provide an important part of the future multimodal transit network that the Houston-Galveston region will require as several million more people move into the metropolitan area. The study of such a commuter rail system for the Houston-Galveston metropolitan region has shown that an FRA compliant, long-distance rail system is feasible to develop. Such a system would be compatible with the existing freight rail system, and could be implemented in a way that does not unreasonably hinder the necessary growth of the freight rail system.

As the work on the H-GAC Regional Commuter Rail Connectivity Study draws to a close, the price of gasoline is reaching all-time high levels with much higher prices predicted by many. The reality of our limited natural resources, the region's desire to make efforts to reduce the growth in our carbon emissions, and the economic situation facing the population of our region is causing a consideration of practical changes in our choice of transportation modes. It is this critical time in Houston's history that this study finds a timely state of affairs in which to present its findings.

The discussion below addresses the conclusions reached during the course of this two year study, as well as the recommendations of additional planning and design studies, necessary steps to be taken by transportation and governmental agencies, and important public interest initiatives needed to carry the prospects forward toward implementation. Not all conclusions and recommendations have necessarily been part of the specific study work, but the technical assessments and planning considerations have highlighted some things that are important to advance or preserve in order to prepare the way for the implementation of a regional commuter rail system. As such, they are included as part of the findings and recommendations to be considered by regional leaders.

Findings

1. The urban light rail transit (LRT) and Signature Bus Rapid Transit (BRT) System associated with METRO Solutions Plan, Phase II; which will soon interconnect the major urban districts in the core of Houston, is an essential first step toward providing the intermodal infrastructure that would effectively support a long-distance commuter rail system.
2. The constraints currently placed on the freight rail system will make the provision of FRA-compliant passenger rail difficult in all travel corridors. Where so constrained, these corridors will benefit from other high-speed transit service options to meet the demand for commuting options.
3. The liability constraints in which the freight railroads currently operate will require appropriate changes to state law, and possibly local ordinances, in order to provide a reasonable business climate in which the use of infrastructure and property owned by the freight railroads can also be used to accommodate passenger rail service.
4. Improvement and expansion of the current railroad right-of-way and track/signaling infrastructure can be accomplished over the course of time and in a manner that will allow commuter rail passenger service to operate on the same rail network as freight rail service.
5. Generally speaking, inside the urban core (i.e., inside the 610 Loop) the commuter rail network will require new track, substantially new or revitalized existing right-of-way, and in many places grade-separated aerial guideway structures to allow commuter trains to provide service to the urban districts.
6. An overall upgrade of the railroad signaling system to a Centralized Traffic Control (CTC) class of operational control will be required throughout the region, encompassing in particular all corridors served by commuter rail.
7. Design criteria must be established in cooperation with the freight railroad companies to serve as the general basis of advancing the planning, costing and preliminary engineering studies that follow (e.g., double track configuration with frequent cross-over locations; barrier walls to separate freight and passenger rail tracks in certain critical areas which are mutually determined as appropriate; etc.).
8. Decisions are required in the near term on the future location and configuration of necessary operating facilities (especially intermodal stations, the operational hub terminal, and maintenance and storage facilities) in order to support the development of the ultimate regional commuter rail and intercity passenger rail system that will sustain the region's growth over the next 50 years.
9. Each of the major urban districts that will ultimately be served by regional commuter rail (FRA compliant technology) along a nearby railroad corridor (as described in this report) must begin planning and implementing a suitable circulation and distribution system of dedicated transit and pedestrian facilities that will interconnect the designated commuter rail station site with the rest of the district (i.e., circulation/distribution systems must accommodate the surge flows of many hundreds of passengers with each train arrival).
10. The environmental impacts and environmental justice implications of implementing the operating system and facilities are manageable, and the inherent economic development potential is large and diverse.
11. The potential for leveraging a public/private development of the rail system infrastructure, the operational hub terminal site, and other intermodal facilities gives a great platform from which railroad company participation, public opinion affirmation, and political viability can be achieved.

12. Conceptual system ridership studies have shown that ridership in the order of 40,000 passenger trips per day generating reasonably good fare box recovery is plausible for a mature regional commuter rail system with five lines in service.
13. An order of magnitude capital cost of about $3 billion (2008 dollars) is the likely level of investment that is necessary to implement a full commuter rail system (e.g., the Principal Corridor Conceptual System, the Baseline System Plan, or another comparable plan), while preserving the necessary capacity needed to carry the freight rail operations. Note that this cost estimate is an approximate value, pending advanced planning studies of more precise system alignments.
14. The public comments and expressions of opinion concerning the concept of a regional commuter rail system have been positive overall, and summaries of the related issues and responses are included in Appendix I.

Recommendations

1. Advance the previous studies into the advanced planning stage under the auspices of the Gulf Coast Freight Rail District, with the objective being to establish a comprehensive framework for developing a coordinated freight and passenger rail system that will serve the Houston metropolitan region's needs over the next 50 years.
2. Establish in subsequent studies the priority corridors for early implementation, and the overall timeline and stages of development needed to create the Baseline commuter rail System (ref. previous **Figure 5-1**), or a revised version of the Baseline System that results from advanced planning studies, with an implementation objective of building a full system within the next 10 to 15 years.
3. Early implementation prospects exist for commuter rail deployment in highly congested commuter travel corridors where available capacity is available along the freight rail corridors. These corridors include the US-290 and the SH 3 corridors.
4. Steps should be taken to protect and preserve existing or dormant rail Right-of-Way along potential commuter rail alignments within the 610 Loop such as those shown in the previous **Figure 5-2**.
5. Coordination with TxDOT and HCTRA is essential to preserve commuter rail provisions within the planned toll-road/managed lane envelope along the SH 35 Tollway alignment between the Glidden RR Subdivision and I 45, as well as the area within the median of SH 288 between Holcomb Blvd. and the US-59 interchange.
6. Establish an interagency/governmental task force to coordinate the options for interconnecting the Baseline System Plan alignments inside the 610 Loop.
7. Begin right-of-way preservation activities for areas that may house a Hub Terminal location west of the 610 Loop and between Interstate 10 and US 290, as well as a Maintenance and Storage Facility proximate to the existing UP Eureka Yard.