Economic Benefits of Rail System Improvements

for Shippers in the
Houston-Galveston Region

Prepared for:

GULF COAST FREIGHT RAIL DISTRICT

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1 INTRODUCTION

1.1 Purpose of Study

The primary objective of this study is to identify the benefits associated with proposed rail infrastructure investments that improve the operational characteristics of Houston-Galveston rail network, and to assess the impacts of these improvements on businesses that rely on rail shipments. Some of the private and public benefits attributable to future rail system improvements have already been identified in the Houston Region Freight Study (HRFS).\(^1\) Rail infrastructure investments included in this analysis were those designed to address congestion at the key locations in the 8-county Greater Houston region, (Planning Case 1 – at a cost of approximately $91.4m). Additional investments were proposed to improve the throughput capacity for existing mainline tracks by making investments in yards, switching, and track capacity designed to increase train speeds and improve system operating performance (Planning Case 2 – at a cost of approximately $239m of additional, new rail infrastructure.) The combined investment package referred to in the HRFS as Planning Case 2 represents a total of $330.4 million in rail infrastructure investments.

There are three groups that benefit from the proposed operational enhancements envisioned in the HRFS:

- The public: primarily through reductions in waiting times at grade crossings, savings in travel time, fuel cost reductions, improved safety and air quality. These include both auto-based travelers and commercial travelers;
- Private carriers: including the effects on operating companies (Class I and regional rail operators) that result from improvements in train operating efficiency and train delay reduction. Benefits for this group are attributable to cost reductions for fuel, labor, maintenance and operational expenses; and
- Private shippers and receivers (businesses): through direct cost savings from reduced delay and improved reliability, as well as opportunities to improve business operations, logistics, and inventory management.

Previously published work has considered the proposed investment’s impact on the public and private carriers\(^1\). This report addresses a third and very important consideration by assessing the economic benefits to shippers that were not counted in prior studies of public benefits.

\(^1\) Houston Region Freight Study, Texas Department of Transportation, October 2007.
1.2 Summary of Study Findings

The analysis presented in this study focuses on those shippers directly affected by rail system improvements identified in Planning Case 2. This study uses project level information, capital costs and overall performance data developed in the HRFS. Information about the effects of improved operations on commodity movements was refined for this study by extracting subdivision-level delay information tied to manifest shipments for the entire Houston rail network. These data also provided information about subdivision level rail shipments by commodity type, which were then used to assess the effects of improved rail operations on the businesses involved in shipping these commodities.²

Information about the costs of delay and reliability on each of the business sectors most directly affected by the proposed improvements was developed through a series of surveys undertaken specifically for this study. Fifteen businesses representing eight industry sectors were interviewed to determine the effects of reliability improvements on their operations, logistics costs and other capital costs related to inventory management, railcar storage and detention, logistic operations (such as transloading), and productivity effects (such as production slowdown or stoppage). In addition to cost information, shipper surveys provided information that was more “qualitative” in character. This qualitative information provided insight into shippers’ perspectives on rail carrier operations and infrastructure conditions. The qualitative responses included questions about rail carrier operations, infrastructure conditions and PTRA operations.

The consensus with regard to rail carrier operations, especially for those companies with experience in other large rail markets, is that many of the reliability effects of rail congestion in the Houston region could be mitigated by developing a more collaborative and flexible planning process to align shipper requirements with the operating and commercial objectives of the carriers. In particular, shippers believe that rail operators in other regions are more sensitive to shipper costs and more willing to work collaboratively to balance shipper’s needs against their own operating requirements. Two important ideas emerged from the surveys. First, shippers favor developing crew and equipment scheduling that recognize the importance of scheduled operations and that also take into account the effects of reliability on the production cycle of rail-dependent businesses. Second, shippers believe that the presence of a third party with the authority to resolve shipper and carrier service disputes is the biggest missing element in managing rail operations in the region.

Although most shippers were able to identify key infrastructure elements of the HRFS that they felt would be helpful in terms of reducing rail system congestion,

² Special tabulations of data from an independent rail network performance evaluation were provided by Texas Department of Transportation. Appropriate disclosure restrictions as required by owners of the proprietary data used in these calculations were strictly observed.
they did not believe that the proposed improvements in the HRFS would result in alleviating rail congestion relative to their operations. They felt that the HRFS over-emphasized grade crossing improvements and under estimated the effects of rail system investments on the business climate in the region. Shippers cited chronic congestion inside the Beltway, and operations on the PTRA and on the Baytown subdivision as their key concerns. With regard to investments in rail infrastructure, improved rail capacity (weight-on-rail/double-tracking), improved carrier junction point operations, and increased classification yard capacity were the kinds of investments that shippers would most like to see. They also believe that prioritizing investments to target infrastructure that would directly improve PTRA operations would be the most effective in making immediate improvements in rail system reliability. Infrastructure improvement projects that address issues such as railcar storage and handling, switching interface improvements between Class I operators, and PTRA yard classification and switching operations should be prioritized.

Shippers believe that the PTRA gives too much priority to the operational needs of the Class I railroads and is too dependent on the Class I operators for establishing the objectives of day-to-day rail operations. They believe that current relationships with the operating companies limit the ability of the PTRA to act as an independent switching agent for the Port of Houston and area shippers. Consequently shippers believe that they are being forced to absorb a disproportionate share of the costs of deteriorating reliability. Survey respondents generally believed that infrastructure improvements being proposed in the HRFS need to be coupled with operational reform at the PTRA in order to achieve the anticipated reductions in delay and improvements in reliability. Although there was no consensus concerning specific changes that might be made to the structure or governance of the PTRA, the idea that the Port of Houston or some non-prejudicial entity must have significant governance authority and that the switching entity must be held accountable by strict performance metrics were identified as being important to re-orienting PTRA priorities and improving responsiveness to shippers needs.

Our assessment of the economic benefits of implementing the proposed Planning Case 2 improvements did not assume that any of the operational improvements suggested by shippers would be implemented. As such, the estimates of the economic benefits represented only the effects of infrastructure investments and operations that result from existing operating practices. They also included cost information developed using the quantitative information from the shipper surveys. Based on this information, we estimated that the investments in infrastructure identified in Planning Case 2 will result in $137.9 million in annual benefits to shippers through delay cost reductions and more reliable rail operations. This translates into a net present value (NPV) of business savings of $1.42 billion over 20 years, which is significantly higher than the NPV attributable to public benefits ($98 million) or to private carrier benefits ($73 million) estimated in the HRFS for the same 20-year time period. If shipper
savings (benefits) are included in the benefit cost calculations for the proposed improvements, the benefit cost ratio increases from 0.5 to 4.8 – a significant and meaningful change in the overall economic justification for the proposed rail system investments.

We used the business cost savings described above to estimate the overall impact of Planning Case 2 on entire economy of the Houston-Galveston 8-county region. These effects included not only the “direct” impacts described above, but several follow-on impacts as well. These included greater demand by local businesses from more industry purchasing (indirect effects) and secondary spending (induced effects) of goods and services used to provide inputs to their businesses. These “multiplier” effects produce a total economic impact of roughly $227 million in increased business sales (output) per year for the region, supporting roughly 610 permanent jobs and $32.0 million in annual wages.

Finally, we recommend several measures that can be used for assessing the performance of the rail system from both the operators’ and users’ perspectives. These measures should be considered whether or not the infrastructure investments contemplated by the HRFS are implemented. Two sets of performance measures are recommended. The first is a set of five rail system performance measures drawn directly from the model simulations and performance benchmarks cited in the HRFS. They are meaningful to both rail carriers and operating companies and can be implemented quickly based on the fact that they are all currently supported by data collection and modeling sponsored by the operating companies and the Texas Department of Transportation (TxDOT). They include the following:

- Train Counts
- Average Speeds
- Delay Ratios
- Delay Hours per Day
- Delay Minutes per 100 Train Hours

The second set of performance measures is based on shippers’ perspectives. Shipper-based performance measures focus on rail network operations as they affect internal operations and inventory management, specifically focused on the Port Terminal Railway Association (PTRA). Shippers’ perspectives differ from the rail operating companies, as they tend to be focused more on measuring on-time delivery rather than overall system operation efficiency. Shippers are also focused on the relationship between the variance of expected delivery times and marginal operating costs.

Measures of railcar activity suggested by shippers include the following:

- Comparison of velocity metrics for different service types, i.e. unit train operations vs. manifest freight.
- Average transit times to gateways on outbound shipments from the...
Chapter 1 - Introduction

Greater Houston area.
- Average transit times from last reporting point outside the Greater Houston area on inbound shipments.
- Statistical analysis of transit times to measure variability against projected trip plan cycles.

Of these suggested measures, the first (velocity by subdivision for non-unit trains) is currently available from existing sources. The remaining three suggested performance measures would require developing a way to identify and report transit times to and from the Greater Houston rail network gateways. These kinds of measures would provide important reliability and delay information that shippers could use in planning for and dealing with variable transit times.

Performance measures focused on PTRA operations include:
- Average transit times to Class I Rail Carriers on outbound shipments off of the PTRA lines.
- Average transit times from Class I Rail Carriers’ interchange to constructive placement on inbound shipments.
- Statistical analysis of transit times to measure variability.

The important issue for shippers is measuring the variability of transit times on outbound and inbound shipments, and the transit times required for interchange between the Class I railroads and the PTRA.

1.3 Report Structure

Chapter 2 of the report presents a summary of the surveys undertaken to support estimates of the industry impacts developed for this study. It reviews the process used to develop the surveys, the components of the survey, and the various shipper costs that are related to delay and reliability identified in the survey. Chapter 2 also provides discussion and insight into the qualitative responses from shippers to questions about regional rail operations.

Background on rail movements and commodity flows in the Houston-Galveston region are described in Chapter 3, as are the proposed investments and geographic distribution of those investments by rail subdivision. This chapter of the report also describes the characteristics of rail traffic affected by proposed improvements to the rail system, and presents a description of the methods used to evaluate rail system performance, reliability improvements, and commodity movements on the Houston-Galveston rail network.

Chapter 4 includes a summary of the savings that will accrue to shippers in the region as a result of the proposed investments in freight rail in the Houston region as envisioned in the 2007 Houston Region Freight Study. It includes a summary of the economic analysis undertaken for this study, and compares the results obtained from examining the benefits that accrue to shippers with those developed.
for the public and for rail system operators in the HRFS. Chapter 4 also provides describes the economic effects of increased shipper productivity associated with rail cost savings are measured and calculated. It provides an assessment of the economic impacts that shipper savings will have on the Houston-Galveston metropolitan area, including the effects of employment and wages.

Chapter 5 outlines recommendations for future methods that allow for monitoring the performance of the Houston regional rail system. The expected improvements in the system, identified in this study and others, can then be evaluated against the current performance of the system. Two kinds of measures are discussed: those that can be derived from information already included in the HRFS, and new information that could reflect the issues and concerns of shippers that have emerged from this study.

Appendix materials include a copy of the letter of introduction provided to shippers on behalf of the Gulf Coast Freight Rail District (GCFRD) requesting their assistance in this study, and a summary of the response to the questionnaire portion of the survey obtained through this request.
2 EFFECTS OF RAIL DELAY AND RELIABILITY ON HOUSTON AREA SHIPPERS

2.1 Approach to Evaluating Rail Delay and Its Consequences

The survey of shippers undertaken in this study addressed two major kinds of information requirements:

1) “Quantitative” estimates of the costs associated with rail system delays and reliability that can be used to measure the potential cost savings attributable to proposed changes in rail system infrastructure, and

2) “Qualitative” insights into shipper’s perspectives on current rail operations in the Houston-Galveston region that may be used to help address both the causes and costs associated with rail delay and reliability in the region.

The rail system in the Houston-Galveston region affects shippers in ways that can be measured in terms of the operational choices that they make in allocating labor and capital costs associated with their use of rail transportation. Some of these costs are based on their experience and planning associated with routine business operations. These “anticipated costs” are costs that are characteristic of typical rail system performance and the ways that businesses have managed their operations relative to the historical performance of the rail system. Costs associated with these kinds of planned expenses were identified as “delay costs.”

Shippers also allocate resources to cover various contingencies that they associate with rail shipping costs. These are costs that they would normally try to avoid incurring, but that they typically experience in conducting business in the Houston-Galveston area. Costs associated with these kinds of atypical, unplanned expenditures were identified as “reliability” costs.

Finally, shippers base their decision-making and budgeting on expectations of future rail system performance and their experience in dealing with various situations that influence their decision-making. These tend to be judgment-based and are related to how shippers perceive the operating conditions they are likely to face in the future. These experiences and expectations were documented in a second part of the survey that involved administering a series of questions about the experiences encountered by shippers in the Houston-Galveston region.
2.2 Shipper Survey Design

The survey asked shippers to provide estimates of costs that they incur for labor, capital, and materials (including inventory). These costs could be recurring, in the sense that they have become routine enough so that they have been incorporated into the cost structure of their operations. But, the key characteristics of these costs are that they are both potentially avoidable, and they are linked to delays on commodities shipped by rail.

2.2.1 Commodity Flows and Survey Respondents

Costs associated with reliability and delay were developed based on surveys of shippers and were designed to represent each of the major commodities shipped by rail to and from the Houston region. With over 900 shippers in the Houston-Galveston region using rail service, a complete survey of all shippers was not possible. Therefore, this study focused on major shippers of specific, high-volume commodity groups and on multiple shippers of commodities where there are relatively smaller volumes being shipped by rail. Commodities such as coal and gravel were found to have only a few shippers involved in their movement. Surveys analyzing multiple shippers focused on identifying the key shippers of specific commodities representing a high volume of railcar movements on the Houston rail network. This study also attempted to focus on those shippers most likely to be affected by the proposed improvements in the rail system proposed under the HRFS.

Shippers were selected based on a review of the volume of rail freight movements obtained from two sources. The sources included the HRFS prepared by the Texas Department of Transportation and the latest version of the Freight Analysis Framework (FAF2), developed by the US Federal Highway Administration as updated in 2007. After identifying the major commodities moved by rail, a number of potential companies were identified in consultation with the Gulf Coast Freight Rail District (GCFRD).

The FAF2 uses data from a variety of sources to estimate commodity flows on a regional and national scale. It provides freight flow by mode and commodity type. Since the FAF2 is generally considered to be representative of regional and national trends, it was used as a source of highway and rail freight commodity movements in several recent studies in the Houston Region. Its use in this study was restricted to an identification of high-volume commodity shipments moving into and out of the region. Because detailed information was not available from the samples used in the HRFS network analysis (due concerns about disclosure of proprietary and identifiable individual shipper information), the FAF2 was used as a basis to identify the distribution of commodities shipped in the Houston region. The FAF2 was also used to identify the commodity groups and shippers most heavily involved in either shipping or receiving the dominant rail-based commodities in the region.
The volume of all commodities shipped by rail in the Houston region is shown in Figure 1, and displayed by commodity type according to the 2-digit Standard Classification of Transported Goods (SCTG). This study reports results in terms of SCTG based on a set of conversion tables provided by US DOT. The FAF2 data used to develop the summary provide in Figure 1 provided a basis for identifying those establishments involved in shipping or receiving these commodities by rail.

![Bar chart of rail freight volumes for key industries](chart.png)

*Source: Freight Analysis Framework (FAF2), 2007*

**Figure 1 – Rail Freight Volumes for Key Industries**

Key logistics and transportation managers were identified in each candidate establishment and contacted to determine their interest and willingness to participate in a survey of their rail-related shipping costs. A letter of introduction was provided by the GCFRD (see Appendix A – Exhibit A1) and non-disclosure agreements were executed prior to scheduling interviews. Table 1 provides a listing of the proportion of total region-wide volume (in tons) of commodities shipped based on FAF2 rail data for which establishments were identified. These commodities represented 93 percent of all rail volume (in terms of tonnage) shipped in the Houston-Galveston region.

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3 FAF2 uses the SCTG, developed by the United States and Canada to provide better detail of commodities not typically carried by rail and better comparability with the Harmonized System (HS). (Report Number 4: FAF Commodity: Standard Transportation Commodity Code or Standard Classification of Transported Goods, FAF Commodity Classification, US DOT 2002.)
Chapter 2 – Effects of Rail Delay and Reliability on Houston Shippers

Table 1 – Profile of Surveyed Establishments

<table>
<thead>
<tr>
<th>Commodity Code (SCTG)</th>
<th>Primary Commodity Shipped/Received</th>
<th>Percent of Rail Volume Shipped (FAF, 2007)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Cerial Grains</td>
<td>4.8%</td>
</tr>
<tr>
<td>12</td>
<td>Gravel</td>
<td>1.1%</td>
</tr>
<tr>
<td>15</td>
<td>Utility Coal</td>
<td>9.8%</td>
</tr>
<tr>
<td>19</td>
<td>Coking Coal</td>
<td>46.0%</td>
</tr>
<tr>
<td>20</td>
<td>Base Chemicals</td>
<td>19.2%</td>
</tr>
<tr>
<td>22</td>
<td>Fertilizers</td>
<td>0.9%</td>
</tr>
<tr>
<td>24</td>
<td>Plastics</td>
<td>10.2%</td>
</tr>
<tr>
<td>32</td>
<td>Base Metals</td>
<td>1.0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>93.0%</strong></td>
</tr>
</tbody>
</table>

The industries selected for interviews were chosen because they shipped very large volumes of the listed commodities and their costs were generally representative of industry-wide costs faced by all such commodity shippers in the region. Table 2 shows the relationship between the 15 companies selected for participation in the survey and the 8 different commodity groups identified using the FAF2. Table 2 also shows the relationship between the number of railcars used in the HRFS model for the Houston-Galveston rail network and the number of railcars shipped or received by each of the surveyed establishments.\(^4\)

In many cases, these companies were responsible for the majority, if not all, of railcars for a specific commodity group moving on the network – a factor that also contributed to the need for maintaining confidentiality in surveying and reporting information obtained from this study. Thus, for some commodities like coking coal (SCTG 19) and gravel (SCTG 12), it was only possible to interview one firm. Other industries, such as those involved in shipping base chemicals and plastics, were represented by a large number of shippers so there were more opportunities to interview a variety of establishments.

\(^4\) The number of railcars by commodity carried on the network was provided through TxDOT from model results. The number of railcars shipped/received from each of the establishments was reported on survey results obtained for this study.
Table 2 – Profile of Surveyed Establishments

<table>
<thead>
<tr>
<th>Commodity Type (SCTG)</th>
<th>Railcars Sampled</th>
<th>Establishments Surveyed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereal grains (02)</td>
<td>100.0%</td>
<td>2</td>
</tr>
<tr>
<td>Other foodstuffs (07)</td>
<td>46.8%</td>
<td>*</td>
</tr>
<tr>
<td>Gravel (12)</td>
<td>100.0%</td>
<td>1</td>
</tr>
<tr>
<td>Coal (15)</td>
<td>96.5%</td>
<td>1</td>
</tr>
<tr>
<td>Coal-n.e.c. (19)</td>
<td>39.1%</td>
<td>1</td>
</tr>
<tr>
<td>Basic chemicals (20)</td>
<td>7.8%</td>
<td>5</td>
</tr>
<tr>
<td>Fertilizers (22)</td>
<td>45.6%</td>
<td>1</td>
</tr>
<tr>
<td>Chemical products (23)</td>
<td>33.2%</td>
<td>*</td>
</tr>
<tr>
<td>Plastics/ rubber (24)</td>
<td>60.3%</td>
<td>3</td>
</tr>
<tr>
<td>Wood products (26)</td>
<td>0.0%</td>
<td></td>
</tr>
<tr>
<td>Base metals (32)</td>
<td>0.0%</td>
<td></td>
</tr>
<tr>
<td>Articles-base metal (33)</td>
<td>7.7%</td>
<td>1</td>
</tr>
</tbody>
</table>

* Several establishments shipped/received more than one commodity by rail

Figure 2 compares the number of railcars that are “modeled” in the HRFS model for the Houston region (“Network Units”) compared to the number of railcars reportedly shipped/received by businesses responding to the survey (“Survey Units”).

Figure 2 – Comparison of Network and Surveyed Railcar Units
There are several notable characteristic of the survey respondents:

1. Based on self-reported railcar movements, those companies involved in shipping coal (SCTG 15), gravel (SCTG 12), and cereal grains (SCTG 02), accounted for effectively all (98.2%) of the railcar shipments of these commodities in the region. This group of commodities accounts for 15.6% of all commodities by tonnage shipped via rail in 2007 (from FAF2, 2007).

2. Three commodity groups – base chemicals (SCTG 20), plastics and rubber (SCTG 24), and coal products (not elsewhere classified) (SCTG 19) – have a relatively large number of Network Units versus Sample Units accounted for in the survey. Both base chemical manufacturers and plastics and rubber manufacturers tend to be produced at multiple sites with multiple producers. In all, five base chemical manufacturers and three plastics and rubber manufacturers were surveyed for this study. Plastics manufacturers surveyed accounted for over 60% of all railcar shipments in the region, but surveyed base chemical manufacturers accounted for only 7.8% of railcar movements. The one major shipper of commodities classified as coal-n.e.c. (SCTG 19) accounted for almost 40% of railcars involved in shipping this commodity group.

3. Some shippers identified as primary shippers of such commodities as cereal grains (SCTG 02) or base chemicals (SCTG 20), also shipped other commodities, such as other foodstuffs (SCTG 07), or chemical products (SCTG 02) and fertilizers (SCTG 22), respectively. Therefore the representation of commodities and railcar movements used in the analysis of delay and reliability of the system covered 97.4% of all commodity groups shipped by rail in the region – a greater percentage than the survey originally targeted (93.0% - see Table 1.)

2.2.2 Survey Structure and Implementation

The survey was designed to provide a profile of the costs faced by shippers directly involved with shipping a representative range of key commodities on the region’s rail network. Through this survey, we also confirmed general information obtained from the FAF2 and the HRFS, and gathered specific information from the firms interviewed in the following areas:

- Commodity types shipped by railcar (including both shipped and received commodities);
- Locations at which commodities were loaded on the rail network and the subdivisions over which their shipments typically move (including those subdivisions directly affected by the HRFS Planning Case 2 improvements);
- Direct and opportunity costs associated with 15 different measures of the economic impacts of rail operations – including both internal and external costs;
Chapter 2 – Effects of Rail Delay and Reliability on Houston Shippers

- Costs per unit for direct and opportunity costs associated with rail operations to allow evaluation of changes in operational conditions attributable to improved rail service anticipated under the HRFS;
- Responses to qualitative questions about infrastructure, rail carrier operations and performance of the PT
t
- Suggestions of ways to measure rail system performance from shipper’s perspectives.

Figure 3 shows the template used for the cost portion of the survey. These templates were used as part of the interview process for each of the interviewed businesses. Each shipper who agreed to be interviewed was sent a copy of the cost template in Figure 3 and a three-part set of questions (Appendix A – Exhibit A2). The cost template was reviewed with one or more representatives prior to scheduling a face-to-face meeting so that each respondent could ask clarifying questions about the costs being requested in the survey.

Because of the detailed costs involved and the limited number of shippers included in the study, strict confidentiality agreements for non-disclosure of firm-level costs and commodity-level details were entered into at the outset of the study. These agreements prohibited disclosure of results obtained from firms, or by commodity group. However, aggregate costs by type of expenditure were used for this study, as were system-wide traffic volumes by commodity type on the subdivisions identified in the survey.

Once non-disclosure agreements had been reviewed, approved and signed by each organization, face-to-face interviews were scheduled. For companies/respondents located outside of the Houston region, appropriate telephone interview protocols were established. All businesses participating in the survey were contacted directly by consultants working on the survey and the status of each interview was tracked on a bi-weekly basis. Interview status notes were entered on the tracking forms, as was the date of completion of the entire survey process.

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5 Four of the fifteen respondents had logistics managers or knowledgeable personnel with the ability to provide the requested information employed outside of the Houston region and the State of Texas.
Chapter 2 – Effects of Rail Delay and Reliability on Houston Shippers

| Shipper Name: |  |
| Corporate Affiliation: |  |
| GCFRD Shipping Points: |  |
| Serving Rail Carrier: |  |
| Planning Case 2 Route Segment: |  |

**SHIPPER ATTRIBUTES**

|  |  |
| Number of Rail Units Shipped |  |
| Number of Rail Units Received |  |

**SCTG COMMODITY GROUPINGS**

<table>
<thead>
<tr>
<th>02 Cereal Grains</th>
<th>07 Other Foods</th>
<th>12 Gravel</th>
<th>15 Utility Coal</th>
<th>19 Coking Coal</th>
<th>20 Base Chemicals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Rail Units Shipped</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Rail Units Received</td>
<td>5,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>22 Fertilizer</th>
<th>23 Chemical Prod.</th>
<th>24 Plastics</th>
<th>26 Wood Products</th>
<th>32 Base Metals</th>
<th>33 Metal Articles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Rail Units Shipped</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Rail Units Received</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DIRECT COST FACTORS**

| Unplanned Alternative Shipment Mode: |  |
| Unplanned Railcar to Truck Transloading: |  |
| Unplanned Product/Raw Material Storage (external): |  |
| Unplanned Product/Raw Material Storage (internal): |  |
| Unplanned Railcar Storage/ Detention (external): |  |
| Unplanned Railcar Storage/ Detention (internal): |  |
| Unplanned Railcar Switching (external): |  |
| Unplanned Railcar Switching (Internal): |  |

<table>
<thead>
<tr>
<th>Unit of Measure</th>
<th>$ per unit</th>
<th>Units per Day</th>
<th>Annual Occurrences (in days)</th>
<th>Annual Cost ($)</th>
</tr>
</thead>
</table>

**OPPORTUNITY COST FACTORS**

| Product Working Capital: | Pounds/Gallons |
| Raw Material Working Capital: | Pounds/Gallons |
| Private Railcar Ownership: | $ per day |
| Production Slowdown/Stoppage: | Pounds/Gallons |
| Late Delivery Penalties: | $ per day |
| Human Resources - Shipping Point: | $ per hour |
| Human Resources - Administrative: | $ per hour |

**Figure 3 – Survey Template for Commodity Flows, Delay and Reliability Cost Assessment**
Chapter 2 – Effects of Rail Delay and Reliability on Houston Shippers

The survey process involved several steps:

1. A time and date for a face-to-face (or telephone interview with out-of-state respondents) was scheduled and the purpose of the survey and interview process was reviewed to be sure that each respondent understood what was being requested;

2. A set of cost templates and questionnaires for each part of the survey was sent to each recipient or the designated representative of each organization;

3. Responses to the cost template were monitored and their receipt dates were noted. If any questions arose during the course of completing the data requests, these questions were answered in advance of the face-to-face meeting(s) and questions were clarified to the degree possible. If questions about specific data or cost elements remained, they were addressed during the face-to-face or telephone interviews.

4. Once initial data responses were received, meetings/telephone discussions were held with each respondent to review cost data received and to review responses to the survey questions. Any issues requiring further consideration or review by the respondent were noted and appropriate follow-up was scheduled by the interviewer.

5. Survey responses were reviewed by the consulting team upon completion and any questions or clarifications required of the shipper respondents by the interviewer or the technical reviewers were followed-up.

2.3 Delay and Reliability Cost Estimates

This section of the report discusses the methods used to estimate region-wide costs associated with rail system delay and reliability. Congestion introduces variability and uncertainty into any transportation system. It reduces reliability and often requires businesses to incur additional costs which ultimately impact their productivity and competitiveness. Effects of congestion reduction are often measured by estimating the value of time savings, improved safety, and emission reductions. These factors were examined in the HRFS from the perspective of rail operators – which is a valid and appropriate perspective.

This report extends the analysis of effects of delay beyond the traditional basis for estimating economic benefits of transportation infrastructure investment. It includes concepts that address business operations, logistics efficiencies, and congestion reduction that benefit shippers and receivers of commodities moved by railcar in the Houston region.

Information about the various kinds of costs incurred by surveyed firms was summarized by commodity type for each establishment and were associated with specific commodities. The volume(s) of each commodity shipped by firm was then used to estimate costs associated with rail operations for the total volume of commodities shipped in the region. The results were used as an estimate of
industry-wide shipping costs associated with both rail system costs attributable to delays (planned costs) and reliability (unplanned costs).

The survey respondents provided cost information about a number of factor costs relevant to measuring the effects of both delay and reliability (Figure 3). Cost factors associated with different types of delay were classified into two categories: direct costs and opportunity costs. Direct costs are primarily incurred for operations that are required or anticipated due to unexpected delay (e.g. alternative shipment mode or storage) whereas opportunity costs are mainly the value of working capital devoted to labor or materials that could have been used for other productive purposes if not for delay-related expenditures. Fixed factors are costs incurred (sunk costs) regardless of the magnitude of delay and therefore we not included in our cost savings calculations. These cost factor classifications are outlined in Table 3.

Table 3 – Cost Factors Affecting Shipper Delay and Reliability

<table>
<thead>
<tr>
<th>Category</th>
<th>Congestion Effects</th>
<th>Cost Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct</td>
<td>Reliability</td>
<td>Alternative Shipment Mode</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Railcar to Truck Transloading</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Product/Raw Material Storage (external)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Product/Raw Material Storage (internal)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Railcar Storage/ Detention (external)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Railcar Storage/ Detention (internal)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Railcar Switching (external)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Railcar Switching (Internal)</td>
</tr>
<tr>
<td>Opportunity</td>
<td>Delay</td>
<td>Product Working Capital</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Raw Material Working Capital</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Human Resources - Administrative</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Private Railcar Ownership</td>
</tr>
<tr>
<td>Reliability</td>
<td></td>
<td>Production Slowdown/Stoppage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Late Delivery Penalties</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Human Resources - Shipping Point</td>
</tr>
</tbody>
</table>

Several considerations went into the categorization of these costs. These considerations were driven by the eventual use of this cost data in evaluating the effects of improvements on current congestion in the rail system as described in the HRFS.

Delay costs commonly occur in almost any network/system but can usually be accounted and planned for. Delay factors are considered to be associated with working capital (product and raw materials) costs which are the opportunity cost of inventory. In reviewing the effects of the costs faced by shippers in the Houston region on their daily operations, four cost factors identified as opportunity costs were most closely associated with conditions directly related to planned delay. These included:
Chapter 2 – Effects of Rail Delay and Reliability on Houston Shippers

- Product Working Capital,
- Raw Material Working Capital,
- Private Railcar Ownership, and
- Administrative time and overhead-related costs.

Reliability factors are defined as costs incurred because of actions taken to manage production processes, logistics operations and inventory due to unexpected delay. Reliability, however, is related to uncertainty and variability of rail service that results in unplanned costs. Reliability can require costly decisions that constrain resources and negatively impact supply-chain networks. Both direct and opportunity costs were associated with reliability-related operational responses. Reliability costs included all of the eight direct cost factors cited in the survey and three of the opportunity costs including:

- Effects of production slowdown or stoppage,
- Late delivery penalties, and
- Labor costs for shipping/receiving point staffing, overtime and crew.

The survey results identified costs for each of the fifteen cost factors related to direct and opportunity costs. The respondents provided a breakdown for each of these 15 cost factors for 10 of the 12 highest volume commodities shipped on the Houston region’s rail system for a total of 180 possible cost factors associated with railcar operations. Using the classifications described above, the types of costs associated with delay and reliability were associated with the cost factors that most closely defined the delay/reliability effects of congestion for rail-based operations in the Houston region. Then using the reported volumes (railcar loads) shipped by each respondent, overall costs by delay/reliability cost factor were estimated for all shippers/receivers in the Houston region.

These estimates are presented in Table 4. The combined costs of delay and reliability total $429.3 million based on 2007 operations and congestion characteristics of the rail system. Of this, $283.5 million (66.0%) are associated with operational cost that can be directly attributable to delay and $145.8 million (34.0%) are associated with operational costs that can be attributable to rail system reliability.
Table 4 – Estimated Shipper Delay and Reliability Costs

<table>
<thead>
<tr>
<th>Class</th>
<th>Cost Factor</th>
<th>Total (in $1000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliability</td>
<td>Alternative Shipment Mode:</td>
<td>$ 97,850.7</td>
</tr>
<tr>
<td></td>
<td>Railcar to Truck Transloading:</td>
<td>$ 3,591.6</td>
</tr>
<tr>
<td></td>
<td>Product/Raw Material Storage (external):</td>
<td>$ 3,549.8</td>
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<tr>
<td></td>
<td>Product/Raw Material Storage (internal):</td>
<td>$ 1,771.0</td>
</tr>
<tr>
<td></td>
<td>Railcar Storage/ Detention (external):</td>
<td>$ 9,369.4</td>
</tr>
<tr>
<td></td>
<td>Railcar Storage/ Detention (internal):</td>
<td>$ 1,380.8</td>
</tr>
<tr>
<td></td>
<td>Railcar Switching (external):</td>
<td>$ 11,793.2</td>
</tr>
<tr>
<td></td>
<td>Railcar Switching (Internal):</td>
<td>$ 10,657.4</td>
</tr>
<tr>
<td></td>
<td>Production Slowdown/Stoppage:</td>
<td>$ 3,486.5</td>
</tr>
<tr>
<td></td>
<td>Late Delivery Penalties:</td>
<td>$ 104.1</td>
</tr>
<tr>
<td></td>
<td>Human Resources - Shipping Point:</td>
<td>$ 2,247.4</td>
</tr>
<tr>
<td>Subtotal: Reliability Costs</td>
<td></td>
<td>$ 145,801.7</td>
</tr>
<tr>
<td>Delay</td>
<td>Product Working Capital:</td>
<td>$ 167,538.5</td>
</tr>
<tr>
<td></td>
<td>Raw Material Working Capital:</td>
<td>$ 78,373.9</td>
</tr>
<tr>
<td></td>
<td>Private Railcar Ownership:</td>
<td>$ 36,206.1</td>
</tr>
<tr>
<td></td>
<td>Human Resources - Administrative:</td>
<td>$ 1,398.7</td>
</tr>
<tr>
<td>Subtotal: Delay Costs</td>
<td></td>
<td>$ 283,517.2</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>$ 429,318.9</td>
</tr>
</tbody>
</table>

Figure 4 shows the relative shares of the most important delay and reliability cost factors for the Houston region. Delay costs associated with raw material and product working capital comprise 57.3% of the total delay with the remaining 42.7% allocated to reliability costs. Both the magnitudes and relative shares of these costs are expected, as materials represent the primary costs of operating the businesses most likely to use railcars for transporting their inputs and outputs. The fact that relatively greater costs of product working capital are tied to delay is reasonable, given the value added for output from these industries. While all commodity shippers have accounted for product and raw material costs in their responses, the impacts are most concentrated in those industries with relatively high value added during production. These include those industries involved in shipping base chemicals, fertilizer, cereal grains and plastics.

Private railcar ownership ($36.2 million and 8.4% of all delay and reliability costs) is also a reasonably large element of delay costs for shippers. Although all commodity shippers bear some railcar ownership costs, the effects are most concentrated in those industries with either specialized shipping requirements or potentially hazardous cargoes. These include those industries involved in shipping base chemicals, plastics, and utility and coking coal.

Reliability costs are most directly associated with the costs of alternative modes of shipping. This reflects the trade-offs that businesses must make between losses incurred due to delivery penalties and those incurred by switching to other methods of delivery. Some bulk commodities like coal have no practical alternative, so these shippers usually stockpile adequate supplies to maintain
operations. The estimated reliability-related cost of using alternative shipping modes is $97.9 million – about 22.8% of all delay and reliability costs incurred in the Houston region. These costs are most heavily concentrated in industries involved in shipping plastics and base chemicals.

Figure 4 – Shares of Delay and Reliability Costs: All Rail Shippers

Railcar switching costs, and railcar storage and detention costs (with the exception of utility coal in this latter category) are incurred across the range of commodities shipped. The majority of these costs are associated with external switching and detention costs. Industries involved in shipping metal articles, plastics and coking coal are the most likely to be affected by these reliability-related costs.

2.4 Qualitative Shipper Survey Responses

This section of the report presents a summary of rail system performance issues identified by the shippers during the surveys conducted for this study. Responses were obtained from each of the 15 companies interviewed. The questions were qualitative in character and were designed to provide insight into shippers’ perspectives on a range of rail carrier operations and infrastructure conditions.

There were three groups of questions asked of each participant. These included ten (10) questions about rail carrier operations, eight (8) questions about infrastructure condition and ten (10) questions concerning the PTRA operations. Participants were asked about how congestion on the rail network is affecting
them, how carrier operating decisions influence their own planning and costs, and which of the proposed improvements in Planning Case 2 will benefit them most in terms of improved reliability.

There were general themes in the responses to the questions in each group:

1) Shippers recognize that the operating environment in the GCFRD’s service area is complicated by the number of carriers and different operating systems. But the consensus in regard to rail carrier operations, especially for those companies with experience in other large rail markets, is that many of the reliability effects of congestion could be mitigated by developing a more collaborative and flexible planning process to align shipper requirements with the operating and commercial objectives of the carriers.

2) Shippers agree unanimously that improved rail infrastructure is needed in the GCFRD. They cited inadequate switching and classification facilities, and inadequate sidings and passing tracks as the most apparent infrastructure problems from their perspectives. Although most shippers were able to identify key elements of the HRFS that they felt would be helpful in terms of reducing rail system congestion, there is no clear linkage in the shippers’ minds to the Planning Case 2 proposed improvements and the resulting impact upon alleviating congestion. They were especially concerned about the emphasis on grade crossings versus capacity expansion projects.

3) With regard to the PTRA, shippers expressed the belief there are inherent constraints in their organizational structure and management practices attributable to the size and resources available to PTRA, and their dependence on the Class I operators. This limits the PTRA’s ability to effectively absorb seasonal and/or volume fluctuations and to operate as an effective interchange carrier with the Class I Rail Carriers.

Responses to each of these sets of questions are summarized below. These summaries describe how shippers believe current rail carrier operations can be improved, their preferences for infrastructure prioritization, and shipper perspectives on the PTRA’s operations. A detailed compilation of the responses to each of the 28 questions include in the shipper survey is located in Appendix A – Exhibit A2.

2.4.1 Rail Carrier Operations

Variability in service (reliability) results in serious cost issues for shippers. As reflected in shipper responses to the costs of congestion, most shippers track their costs to some degree and compare those in the Gulf Coast to operations in other parts of the US and, if applicable, to those experienced in Europe. These internal comparisons are uniformly negative in that operating inefficiencies and
Chapter 2 – Effects of Rail Delay and Reliability on Houston Shippers

infrastructure deficiencies in the Houston region are seen as greater, on a relative basis, than those experienced in other major markets, and make the region less desirable for either investment or expansion. Although shippers have a range of views on both the adequacy of rail system infrastructure and operating practices, there is no consensus on cause (infrastructure vs. operations) of reliability problems in the Houston market.

As noted in the cost analysis, the reliability problems in the Houston region have the greatest consequences for shippers in the costs they bear for maintaining private railcar fleets and for the impact on material inventories. Although not a major cost item, the administrative burdens of oversight of logistics operations and the continuing efforts required to monitor and manage the consequences of unreliable service takes valuable personnel time that could be used for other, more strategic planning and management activities internal to shippers’ organizations. The opportunity costs of redirecting administrative personnel resources to reliability-related issues are difficult to quantify over and above the actual labor costs, but have become a drain on business effectiveness relative to operations in the Houston region when compared to other parts of the country.

Shippers were quite explicit about comparing Houston rail operations to their experience in other parts of the US. In particular, they believe that rail operators in other regions are more sensitive to shipper costs and more willing to work collaboratively to balance shipper’s needs against their own operating requirements. Shippers recognized that reliability of the Houston rail system and the operating environment may be more challenging for operators than elsewhere. However, based on the costs they are absorbing and the difficulties that they experience with service reliability, they have serious questions about the capability of the carriers to address the overall costs and competitive challenges of doing business in the Houston region.

Shippers were asked about how they would re-structure the relationships with rail carriers and the kinds of initiatives that would have the most positive impacts on their operations. Two important ideas emerged from the surveys. First, shippers recognize the importance of scheduled operations, especially the model employed by the Canadian National Railroad (CN) in other parts of the US. Although shippers recognize that the operating environment in Houston is complex, implementing a model for coordinating service in a way that supports scheduled operations could make a big impact on costs. Crew and equipment scheduling that recognizes the production cycle of businesses was cited as a major operational change that could address many of the reliability issues plaguing shippers. Along these lines, shippers would be willing to support 7-day per week tendering – thereby allowing operators more flexibility and opportunity to implement scheduled service.

Finally, shippers asked about what role, if any that the GCFRD might play in facilitating rail operations in the region. Shippers felt that the biggest missing
elements in operations management in the region is the presence of a third party with the authority to resolve shipper and carrier service disputes. Shippers would support the GCFRD’s role as facilitator/arbitrator of service issues, and would also support the role of GCFRD as evaluator of proposed infrastructure plans.

### 2.4.2 Infrastructure Needs and Gaps

Shippers clearly expressed a general dissatisfaction with the quality and quantity of rail infrastructure in the Houston region. They believe that relative regional competitiveness can be tied to infrastructure quality and investment, and those with operations in other regions cite the relationship between the kinds of service rail operators are able to provide and the level of consistent rail infrastructure investment.

Several shippers explicitly tied their own expansion and private industrial investment planning closely to both the performance of rail system and the level of investment that they see in rail system infrastructure. These shippers are carefully evaluating the effects of congestion on reliability and hesitate to make any major investments without evidence of improved rail system reliability. Although businesses in several sectors are ready to make expansion and investment decisions, they are hesitant due to chronic congestion in specific subdivisions in the rail system. Shippers cited chronic congestion inside the Beltway and operations on the PTRA and on the Baytown subdivision as their key concerns.

Nevertheless, many shippers are making capital investments in current operations in order to compensate for deteriorating reliability. These investments focus on improving or increasing the rail infrastructure directly associated with their manufacturing and production facilities. The largest infrastructure expenditures are being directed at avoiding the costs of rail carrier switching, detention and demurrage charges. As noted in the analysis of costs, these kinds of investments, while necessary in the current operating environment, divert investment capital from other areas of business operations that might enable Houston rail-dependent industries to focus on improving competitiveness in national and global markets, or to invest in productivity-enhancing process improvements.

Shippers as a group see no specific infrastructure projects in the HRFS that they would strongly favor. When asked to set priorities on a scale of 1 to 10 (with 10 being the highest priority and 1 being the lowest) for various kinds of rail system investments included in the HRFS, capacity and connectivity improvements in rail lines scored the highest (9.1) and improving grade crossings scored the lowest (1.8). Of the kinds of rail system improvements included in the HRFS, improving rail capacity (weight-on-rail/double-tracking), improved carrier junction point operations, and increased classification yard capacity were cited as those investments that shippers would most like to see. They also believe that prioritizing investments on infrastructure that would directly improve PTRA...
operations would be the most effective in making immediate improvements in rail system reliability.

2.4.3 Perceptions of Benefits and Limitations of PTRA Operations

Approximately 75% of all shippers interviewed said that they have at least some railcar activity that depended directly on PTRA operations. As a result, most were able to offer views on the PTRA drawn from their own experience. Most of the shippers expressed some degree of dissatisfaction with the current operations, structure, and governance practices of the PTRA. They believe that the current structure limits the ability of the PTRA to act as an independent switching agent for the Port of Houston and area shippers. Shippers expressed frustration at the perceived priority given to the operational needs of the Class I railroads – to the detriment of the commercial and operational interests of shippers. The consequence is that shippers are forced to absorb all of the costs of deteriorating reliability, which many feel are being exacerbated by operational decisions surrounding the PTRA.

Although there was no consensus concerning specific changes that might be made to the structure or governance of the PTRA, the following principles were identified as being important to re-orienting PTRA priorities and improving responsiveness to shippers needs:

- The Port of Houston or some non-prejudicial entity must have significant governance authority.
- The switching entity must be held accountable by strict performance metrics.
- The switching entity must be unencumbered from the commercial and operational interests of the area Class I Railroads.
- The fee structure for switching services must encourage operating efficiency while providing a mechanism for investment in infrastructure.

Specific infrastructure investments were cited as being of great importance to the PTRA. Most shippers recognized that the relative compactness of the PTRA means that surges in demand and even small disruptions in operations can quickly affect service. Thus, shippers believe that infrastructure improvement projects that address these issues – such as railcar storage and handling, switching interface improvements between Class I operators and PTRA yard classification and switching operations should be prioritized.

Survey respondents generally believed that infrastructure improvements being proposed in the HRFS need to be coupled with operational reform at the PTRA in order to achieve the anticipated reductions in delay and improvements in reliability. Their concern was that even though infrastructure investments seem to be targeted at key elements of the rail system that experience congestion and contribute to reliability, without concurrent changes in operating decision-making
and better coordination between shippers and rail operations, the costs of congestion would continue to fall disproportionately on shippers.

Shippers cited specific examples of non-infrastructure factors that result in excessive delay and degraded reliability. These include chronic shortages of PTRA crews, integrity of Class I/Interchange blocks upon release by shippers, and the ability of the PTRA to rapidly adjust their railcar processing and management practices to surges in activity (sometimes exacerbated by railcar dumping by the Class I operators).

As with the Class I operators, shippers seem to be willing to accept some operational responsibility to improve PTRA operations. These include a willingness to tender railcars on a 7-day schedule, maintaining efforts to build Class I and interchange blocks, and to participate in operational planning and coordination.
3 HOUSTON-GALVESTON RAIL NETWORK

3.1 Role of Houston-Galveston Rail Network

The rail network in the Houston-Galveston region plays a critical role in delivery and distribution of industrial products and commodities within the state of Texas, the Gulf Coast region, and most of the Central United States and upper Midwest. In addition to carrying various commodities that support local businesses and industries, the region’s rail system transports a significant portion of the container and bulk cargo traffic generated by the Port of Houston, which is among the largest ports in the US. It also accounts for nearly 8% of all rail tonnage transported in the US.

Freight shipments in the Houston-Galveston region are expected to grow over 80% by 2035, topping 1.86 billion tons. Figure 5 shows recent forecasts for all freight modes, including rail from 2005 to 2035. Freight forecasts developed for the Houston-Galveston area have cited three driving forces behind the freight forecasts.

1. Increased concentration of distribution centers in the Houston-Galveston region;
2. Expanding Mid-Western US population; and
3. Expansion of the Panama Canal to allow larger/wider vessels currently calling at US West Coast ports.

In addition, freight transportation in the Houston-Galveston region is a key element in North American trade corridors – supporting both east-west trade, primarily via the rail network, and north/south trade on both the rail and highway networks. Recent trends in trade have tended to concentrate the North/South flow of NAFTA trade (export/import) goods and domestically produced commodities such as coal, grain and agricultural products along the major Interstate highway and rail corridors.

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6 The Port of Houston is the second largest port in the US in terms of total export/import tonnage, and ranked in the top 12 North American ports in terms of containers (TEUs) for the past 10 years (American Association of Port Authorities, 2007 US Port Cargo Ranking by Ton and Container Traffic in North America, 2008.)
7 FAF2 Summary, 2007.
8 Freight Rail in the Houston Region: History, Volumes and Trends, Port of Houston Authority, 2007, p. 22.
Rail service to the Houston region has traditionally supported East/West flows of goods from Asia to major US markets. Increasing dependence on North/South trade tied to agriculture, manufacturing and energy related commodities coupled with Panama Canal expansion will also tend to focus more freight traffic on the Houston-Galveston region.

While some of these trends may be moderated due to recent economic conditions, it is clear that even an economic recovery that returns US economic performance to recent production and consumption levels will place significant demands on both the rail and highway network of the Houston region. These trends – those identified in the current forecasts and trends that are likely to emerge as the global economy recovers – support continued growth in long-distance freight transportation centered in the Houston area.

![Chart: Total Future Freight Volumes, 2005-2035](chart.png)

*Source: Freight Rail in the Houston Region, 2007*

**Figure 5 – Metropolitan Houston Freight Growth**

Long-term freight traffic growth will put more pressure on the existing freight rail infrastructure. Congestion on the existing rail network has affected the reliability of the rail system, and has raised concerns about the ability of the rail network to accommodate the long-term growth of the rail share of future freight traffic. With the renewed emphasis on using rail to reduce overall carbon emissions, a number of recent studies have been undertaken to address the current capacity and
operating constraints on both the highway and rail systems in the Houston region, and the effects of anticipated growth on the performance of these systems.

### 3.2 Houston-Galveston Rail Network

The capacity of the rail system is of special concern because of the effects that congestion attributable to increased railcar volumes has on delays and on the reliability of the rail system. As has been noted in other assessments of the effects of rail system congestion, delays and reliability issues also have an impact on non-rail operations at highway grade crossings. Highway delays have been examined with regard to their effects on a range of concerns at highway grade crossings. These include the effects of highway delays on air quality and fuel consumption, safety and the additional waiting time required by highway users.

The capacity of rail yards, branch lines and terminals to accommodate existing and future rail traffic has also been examined relative to their effects on the companies operating the rail system – both Class I railroad and short-line operators. However, the effects of rail system capacity constraints and ensuing congestion on the reliability of rail service for businesses that depend on the rail system to ship products into and out of the region have not been explicitly examined.

This section of the report presents results of a careful examination of the economic impacts of proposed rail system improvements on private sector businesses. To accomplish this goal, a number of factors specifically related to shippers’ perspectives and the conditions that they face relative to rail system congestion were addressed. These factors included:

1. Identification of rail system projects designed to alleviate the most significant and chronic congestion-related delays;
2. Measurement and simulation of relevant indicators of rail system performance before and after proposed rail improvements are made to the rail network; and
3. Determination of the effects that these projects would likely produce on measures of delay and reliability most likely to be experienced by shippers.

### 3.2.1 Characteristics of the Houston-Galveston Rail System

The Houston-Galveston rail network covers in 8 counties. Figure 6 shows the

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9 These studies include: the Texas Rail System Plan, Texas Department of Transportation, October 2005; The 2035 Houston-Galveston Regional Transportation Plan, Houston-Galveston Area Council, October 2007; the Houston Region Freight Study, Texas Department of Transportation, October 2007; and Freight Rail in the Houston Region: Influences, Volumes and Trends, Port of Houston Authority, October 2007.

10 Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Walker Counties.
location and configuration of each of the subdivisions in the region’s rail network, including the county or counties in which each subdivision is located.

Source: Houston Region Freight Study, 2007

Figure 6 – Houston Region Subdivisions

The rail system is comprised of 27 subdivisions, each providing rail service for businesses that use the rail system to transport their goods and materials. Subdivisions are classified as Terminals (primarily providing loading/unloading service), Branches (rail lines designed to accommodate meeting or passing trains), and Mainlines (primary rail line). Table 5 identifies by type each of the 27 rail system subdivisions in the Houston-Galveston region used to calculate system performance measures for this study.
3.2.2 Proposed Planning Case 2 Improvements

The HRFS involved an extensive inventory, simulation and evaluation of both highway and rail freight networks and operations. The study was part of a series of statewide analyses of freight transportation infrastructure conducted by the Texas Department of Transportation (TxDOT) as directed by the state legislature.\textsuperscript{11}

The HRFS focused on addressing four kinds of problems related to freight transportation in the region:

1. Providing grade separations for rail and highway traffic;
2. Closing or re-routing highway traffic at locations where grade separation was not feasible;
3. Improving the capacity and connectivity of existing rail lines; and
4. Designating new rail corridors to improve the overall performance of the rail system.

Four rail system improvement plans – designated as “Planning Cases” were evaluated in the HRFS. The improvements analyzed in this study correspond to those described in the Houston Region Freight Study as Planning Case 2. Planning Case 2 included all of the improvements specified for Planning Case 1 (see Figure 7) as well as several additional rail network improvements. As a result, Planning Case 2 includes projects and improvements that included ten (10)

\textsuperscript{11} House Bill 2702.

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Table 5 – Rail System Subdivisions

<table>
<thead>
<tr>
<th>Subdivision</th>
<th>Subdivision Type</th>
<th>Subdivision Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTC District</td>
<td>Terminal</td>
<td>Angleton</td>
</tr>
<tr>
<td>North District</td>
<td>Terminal</td>
<td>Baytown</td>
</tr>
<tr>
<td>Pasadena District</td>
<td>Terminal</td>
<td>Conroe</td>
</tr>
<tr>
<td>Terminal</td>
<td>Terminal</td>
<td>Cuero</td>
</tr>
<tr>
<td>West Belt</td>
<td>Terminal</td>
<td>East Belt</td>
</tr>
<tr>
<td>Beaumont</td>
<td>Mainline</td>
<td>Freeport</td>
</tr>
<tr>
<td>Carnegie</td>
<td>Mainline</td>
<td>Galveston</td>
</tr>
<tr>
<td>Eureka</td>
<td>Mainline</td>
<td>GH&amp;H</td>
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<tr>
<td>Glidden</td>
<td>Mainline</td>
<td>Mykawa</td>
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<td>Houston</td>
<td>Mainline</td>
<td>Navasota</td>
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<td></td>
</tr>
</tbody>
</table>

---

\textsuperscript{11} House Bill 2702.
Chapter 3 – Houston-Galveston Rail Network

of the twelve rail network improvements and relocations described in the HRFS.

As shown in Figure 7, Planning Case 1 focused on addressing congestion relief at five of the most significant rail system bottlenecks. These projects involve reconstructing two switching leads – one at the Settegast Yard located off the East Belt Subdivision main tracks, and a second between the north end of North Yard and Hunting Bayou. Both are designed to provide immediate relief to the East Belt Subdivision. Two other projects involve construction of second main tracks: one between Galena and Manchester Junctions and a second between Sinco and Deer Park Junctions. The last project evaluated in Planning Case 1 was a second main bridge and second main track across Buffalo Bayou on the East Belt Subdivision.

Projects included in Planning Case 2 are shown in Figure 8. These projects include a number of extensions and expansions of second main tracks, and extension of the Englewood East yard tracks to increase the receiving capacity for the Englewood Yards. Planning Case 2 also includes a major new second main track between Rosenberg and West Junction on the Glidden Subdivision. This new trackage is designed to relieve congestion by allowing trains to pass one another along the highly trafficked Glidden Subdivision. In addition, Planning Case 2 includes removing train stopping requirements on the West Belt Subdivision from Cullen Boulevard to Tower 26 by providing for a number of crossing closures, grade separations and pedestrian bridges (See Figure 8). Planning Case 2 also includes the re-routing of about 30 trains from the East Belt to the West Belt, thereby reducing overall train delays.

The total estimated cost for Planning Case 1 was $91.4 million, and the total cost estimate for all rail system crossings in Planning Case 2 was $239.0 million, for a total of $330.4 million in improvements for both planning cases. Although two other planning cases were evaluated in the HRFS, this study of the economic benefits of rail improvements on shippers focuses on these two planning cases because they provide the kinds of operating improvements most relevant to shippers in the region.
Figure 7 – Proposed Plan 1 Regional Rail Improvements

Figure 8 – Proposed Plan 2 Regional Rail Improvements

3.2.3 System Performance under HRFS

The Houston Region Freight Study (HRFS) compares Planning Case 2 to the “Base” case using system performance measures describing the number of trains, average speed, and delay information for each of the 12 subdivisions that are most directly affected by the cumulative effects of projects included in Planning Cases 1 and 2 on rail operations. The effects of Planning Case 2 improvements on the rail network were, per the HRFS, assessed using the Rail Traffic Controller (RTC) modeling software, which is the same modeling system used by the freight railroads. All estimates of improvements in delay ratios and train delay were developed using the HRFS and were based on STB waybill data and rail operations information available at the time that the HRFS was undertaken (2004).

Table 6 provides a description of the operating conditions on each of these subdivisions as measured by three key indicators: train volume (the average number of trains per week), the delays attributable to this volume (measured in total train hours of delay per day), and the delay ratio (the ratio of congestion-related delays to unimpeded flow).

**Table 6 – Performance Measures for Planning Case 2 from the HRFS**

<table>
<thead>
<tr>
<th>Subdivision</th>
<th>Trains</th>
<th>Avg. Speed (mph)</th>
<th>Delay Ratio (percent)</th>
<th>Delay Hours/Day</th>
<th>Delay Mins/100 TM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Base</td>
<td>Plan2</td>
<td>Base</td>
<td>Plan2</td>
<td>Base</td>
</tr>
<tr>
<td>Network</td>
<td>1895</td>
<td>1998</td>
<td>14.3</td>
<td>14.7</td>
<td>36.4</td>
</tr>
<tr>
<td>CTC District</td>
<td>202</td>
<td>349</td>
<td>6.1</td>
<td>6.2</td>
<td>48.6</td>
</tr>
<tr>
<td>North District</td>
<td>286</td>
<td>267</td>
<td>2.8</td>
<td>3.0</td>
<td>65.7</td>
</tr>
<tr>
<td>Pasadena District</td>
<td>223</td>
<td>208</td>
<td>2.7</td>
<td>2.8</td>
<td>48.5</td>
</tr>
<tr>
<td>Baytown</td>
<td>111</td>
<td>110</td>
<td>8.2</td>
<td>7.2</td>
<td>15.3</td>
</tr>
<tr>
<td>Beaumont</td>
<td>476</td>
<td>479</td>
<td>23.7</td>
<td>24.8</td>
<td>23.9</td>
</tr>
<tr>
<td>East Belt</td>
<td>586</td>
<td>547</td>
<td>4.6</td>
<td>4.3</td>
<td>30.4</td>
</tr>
<tr>
<td>Glidden</td>
<td>238</td>
<td>239</td>
<td>24.0</td>
<td>25.0</td>
<td>51.6</td>
</tr>
<tr>
<td>Lafayette</td>
<td>287</td>
<td>288</td>
<td>20.5</td>
<td>21.8</td>
<td>17.8</td>
</tr>
<tr>
<td>Strang</td>
<td>200</td>
<td>179</td>
<td>6.7</td>
<td>7.1</td>
<td>27.3</td>
</tr>
<tr>
<td>Terminal</td>
<td>610</td>
<td>620</td>
<td>8.1</td>
<td>8.5</td>
<td>38.8</td>
</tr>
<tr>
<td>West Belt</td>
<td>481</td>
<td>494</td>
<td>7.8</td>
<td>7.4</td>
<td>31.1</td>
</tr>
<tr>
<td>Mykawa</td>
<td>169</td>
<td>199</td>
<td>17.5</td>
<td>17.6</td>
<td>10.3</td>
</tr>
</tbody>
</table>

Source: Houston Region Freight Study
The information provided shows the weekly number of trains operating on each subdivision. For the entire network, there are approximately 1900 trains with complete, measurable runs operating on one or more of the 27 subdivisions. These include both manifest trains – those carrying freight for customers using the rail system – as well as local and yard engines. Based on the information used in the HRFS system model, yard and local trains account for fewer than 48% of all train movements. Only 30.1% are manifest trains.

An economic assessment, such as the one developed for rail system operators in the HRFS, properly assesses all of the relevant train movements (which would include yard and local movements). Manifest and unit train operations can be affected by yard and local locomotive movements. However, if the same mix of trains used for the HRFS, which included yard and local locomotive movements, is used to estimate train delay and reliability for service to shippers and receivers, train delay and delay ratios would be significantly overstated. Because the primary focus of this study is on the direct effects of proposed rail system improvements on manifest/unit train operations from a shippers’/receivers’ perspective, including operational delays and reliability attributable to yard and local equipment would lead to overestimating the effects of delay on manifest and unit train operations. Therefore, in this study, delay estimates and ratios included
the network effects of yard and local movements, but the train delay results only included the movement of manifest and unit trains.

This fact, combined with the limitation that not all 27 subdivisions are represented in Table 6, required additional information to describe the effects of changes in network-wide delay and reliability, and to define subdivision operating characteristics between the Base and Planning Case 2 scenarios. In response, a review of HRFS data and re-computation of delay rations and train delay was focused on train movements most likely to be encountered by shippers.

### 3.2.4 Evaluation of Improvements on Rail-Dependent Shippers

New network performance based on the HRFS models was estimated to exclude yard and local train movements.\(^{12}\) These results, shown in Table 7, provide a more realistic assessment of subdivision performance from a shipper’s perspective. The resulting delay ratios are lower than those shown in Table 6, which was developed for the HRFS. As shown in Table 7, changes in flows and delay reflect the resulting network flow conditions for the Base and Planning Case 2 scenario.

These new results also provided information on all 27 network subdivisions, not just the 12 on which Planning Case 2 improvements were made (shown in Table 6). This provided a system-wide assessment of the overall network response to manifest traffic, which was a primary objective of this study. The resulting change in delay ratios was a more representative measure of improved rail system performance for shippers and receivers, because it provided a basis for comparing the relative performance of rail system improvements across all subdivisions and controlled for various physical dimensions and operating conditions.

The HRFS defines the delay ratio as:

“…the ratio of congestion-related delay to “ideal” or “unimpeded”

---

\(^{12}\) It is important to note that although yard and local train movements are included in the network flows; they have been removed from the reported volume and delay statistics. Proprietary data used in quantifying HRFS network performance measures was not authorized for use in this study. Therefore, independent calculations of previously released HRFS data were provided for this study through a data sharing agreement with TxDOT and the GCFRD. Detailed information that could result in disclosure of and individual operator’s or shipper’s information was withheld to maintain the non-disclosure agreements required to prepare the aggregate data. All conclusions and economic effects attributable to the network performance characteristics provided under this agreement are the sole responsibility of the GCFRD and do not reflect the opinions of TxDOT.
running time. Unimpeded time equals the time it would take to operate all the trains...without any congestion-related delay.”

The ratio is therefore calculated as: **congestion delay / unimpeded delay**. The unimpeded delay is the same for the baseline as for any of the Planning Cases since it is “...the irreducible minimum amount of time that it would take to run the railroad.” This ratio allows the comparison of delay over different subdivisions where the train count may differ as well as comparison between the baseline and planning cases. As a general rule, the lower the delay ratio, the better the expected performance.¹³

Estimated shipper cost savings were determined using commodity-level unit costs obtained from the shipper survey results and the revised model estimates of rail system performance at the subdivision level. Chapter 4 describes the methods used to estimate delay and reliability savings using these information sources, and presents estimates of the direct benefits to shippers and the overall effects of these benefits on the Houston-Galveston regional economy.

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¹³ The average delay ratio decreased by 44.5% for Planning Case 2 compared to the Baseline for all train movements on the same subdivisions in the HRFS when they were analyzed using the revised operational assumptions.
### Table 7 – Network Performance Characteristics – Shippers Study

<table>
<thead>
<tr>
<th>Subdivision</th>
<th>Type</th>
<th>BASE</th>
<th></th>
<th>PLAN2</th>
<th></th>
<th>Change in Train Delay</th>
<th>Change in Delay Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Trains Per Week</td>
<td></td>
<td>Trains Per Week</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Train*hrs per day)</td>
<td></td>
<td>(Train*hrs per day)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Delay (Train*hrs per day)</td>
<td></td>
<td>Delay (Train*hrs per day)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Delay Ratio (%)</td>
<td></td>
<td>Delay Ratio (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CTC District</td>
<td>terminal</td>
<td>293</td>
<td>5.1</td>
<td>349</td>
<td>3.3</td>
<td>-1.9</td>
<td>-8.7</td>
</tr>
<tr>
<td>North District</td>
<td>terminal</td>
<td>258</td>
<td>7.6</td>
<td>267</td>
<td>5.4</td>
<td>-2.2</td>
<td>-5.8</td>
</tr>
<tr>
<td>Pasadena District</td>
<td>terminal</td>
<td>225</td>
<td>6.3</td>
<td>208</td>
<td>2.9</td>
<td>-3.4</td>
<td>-9.3</td>
</tr>
<tr>
<td>Terminal</td>
<td>terminal</td>
<td>617</td>
<td>10.0</td>
<td>620</td>
<td>6.8</td>
<td>-3.3</td>
<td>-5.8</td>
</tr>
<tr>
<td>West Belt</td>
<td>terminal</td>
<td>476</td>
<td>2.8</td>
<td>494</td>
<td>3.0</td>
<td>0.3</td>
<td>-1.1</td>
</tr>
<tr>
<td>Beaumont</td>
<td>main</td>
<td>475</td>
<td>4.9</td>
<td>479</td>
<td>3.5</td>
<td>-1.4</td>
<td>-2.6</td>
</tr>
<tr>
<td>Carnegie</td>
<td>main</td>
<td>110</td>
<td>-</td>
<td>35</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Eureka</td>
<td>main</td>
<td>83</td>
<td>1.1</td>
<td>82</td>
<td>0.9</td>
<td>-0.3</td>
<td>-1.3</td>
</tr>
<tr>
<td>Glidden</td>
<td>main</td>
<td>239</td>
<td>10.6</td>
<td>239</td>
<td>6.5</td>
<td>-4.1</td>
<td>-4.4</td>
</tr>
<tr>
<td>Houston</td>
<td>main</td>
<td>106</td>
<td>5.0</td>
<td>107</td>
<td>5.4</td>
<td>0.4</td>
<td>0.6</td>
</tr>
<tr>
<td>KCS Beaumont</td>
<td>main</td>
<td>234</td>
<td>2.1</td>
<td>234</td>
<td>2.6</td>
<td>0.5</td>
<td>1.4</td>
</tr>
<tr>
<td>Lafayette</td>
<td>main</td>
<td>286</td>
<td>6.9</td>
<td>288</td>
<td>4.4</td>
<td>-2.5</td>
<td>-4.2</td>
</tr>
<tr>
<td>Lufkin</td>
<td>main</td>
<td>72</td>
<td>2.4</td>
<td>72</td>
<td>1.9</td>
<td>-0.5</td>
<td>-1.5</td>
</tr>
<tr>
<td>Palestine</td>
<td>main</td>
<td>242</td>
<td>3.9</td>
<td>243</td>
<td>2.9</td>
<td>-1.0</td>
<td>-1.5</td>
</tr>
<tr>
<td>Smithville</td>
<td>main</td>
<td>9</td>
<td>-</td>
<td>9</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Angleton</td>
<td>branch</td>
<td>224</td>
<td>6.9</td>
<td>224</td>
<td>5.5</td>
<td>-1.4</td>
<td>-1.6</td>
</tr>
<tr>
<td>Baytown</td>
<td>branch</td>
<td>111</td>
<td>1.1</td>
<td>110</td>
<td>1.5</td>
<td>0.4</td>
<td>1.5</td>
</tr>
<tr>
<td>Conroe</td>
<td>branch</td>
<td>31</td>
<td>-</td>
<td>32</td>
<td>0.1</td>
<td>0.1</td>
<td>0.7</td>
</tr>
<tr>
<td>Cuero</td>
<td>branch</td>
<td>48</td>
<td>1.6</td>
<td>48</td>
<td>1.5</td>
<td>-0.1</td>
<td>-0.4</td>
</tr>
<tr>
<td>East Belt</td>
<td>branch</td>
<td>582</td>
<td>2.9</td>
<td>547</td>
<td>2.4</td>
<td>-0.5</td>
<td>-0.4</td>
</tr>
<tr>
<td>Freeport</td>
<td>branch</td>
<td>36</td>
<td>0.1</td>
<td>36</td>
<td>0.3</td>
<td>0.1</td>
<td>0.5</td>
</tr>
<tr>
<td>Galveston</td>
<td>branch</td>
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<td>11.0</td>
<td>360</td>
<td>10.8</td>
<td>-0.3</td>
<td>-0.3</td>
</tr>
<tr>
<td>GH&amp;H</td>
<td>branch</td>
<td>139</td>
<td>1.5</td>
<td>141</td>
<td>0.5</td>
<td>-1.0</td>
<td>-8.7</td>
</tr>
<tr>
<td>Mykawa</td>
<td>branch</td>
<td>169</td>
<td>0.9</td>
<td>169</td>
<td>0.8</td>
<td>-0.1</td>
<td>-0.5</td>
</tr>
<tr>
<td>Navasota</td>
<td>branch</td>
<td>155</td>
<td>1.5</td>
<td>155</td>
<td>1.0</td>
<td>-0.5</td>
<td>-2.4</td>
</tr>
<tr>
<td>Popp</td>
<td>branch</td>
<td>37</td>
<td>-</td>
<td>37</td>
<td>-</td>
<td>-</td>
<td>0.3</td>
</tr>
<tr>
<td>Strang</td>
<td>branch</td>
<td>209</td>
<td>2.9</td>
<td>179</td>
<td>0.9</td>
<td>-2.0</td>
<td>-11.5</td>
</tr>
</tbody>
</table>

*Source: Tabulations of the Baseline and Planning Case 2 of the HRFS provided by TxDOT, 2009.*
4 ECONOMIC IMPACTS OF PROPOSED RAIL IMPROVEMENTS

The economic effects of rail investments can be analyzed using two points of view: assessing the benefits and costs of investments, and evaluating the effects of cost savings and improved productivity on a regional economy.

This section of the report presents the effects of these cost savings from the following two perspectives:

1) In terms of benefit-cost analysis. It re-examines the assessment of public and private benefits and costs so that the benefits that are likely to accrue to shippers are considered; and

2) In terms of the implications of these potential shipper cost savings on the overall economic performance of the region. It examines the effects of shipper cost savings as they are distributed both directly and indirectly through the economy of the Houston-Galveston region.

As shown in Chapter 2, survey results indicate that shippers are currently paying substantial costs associated with rail system delays and reliability. Information about unit costs of shipping and changes in rail system performance obtained for railcar movements on affected subdivisions discussed in Chapter 3 were used to isolate the benefits that are likely to accrue to rail shippers from rail system improvements contemplated under Planning Case 2. Section 4.1 of this chapter describes how shipper cost information obtained from the survey and rail system operational improvements obtained from the HRFS model were used to distinguish between savings attributable to reductions in delay-related costs and savings related to improvements in system reliability.

Section 4.2 presents the direct benefits attributable to shipper cost savings and compares these savings to those already estimated for public and private (operator) benefits. Benefits and costs of rail improvements have already been assessed from the perspectives of the public sector (public benefits and costs) and from the perspectives of rail carriers and operators (private sector benefits.
and costs) as part of the benefit-cost analysis presented in the HRFS. Using assumptions comparable to those in the benefit-cost analysis presented in HRFS, this study compares benefits attributable to shipper cost savings to those already identified in the HRFS benefit-cost assessment.

Section 4.3 examines the effects of shipper savings from rail system improvements as they affect the overall economy of Houston-Galveston region. These economic impacts are broader in scope than those used in the benefit-cost analysis in that they reflect the ways that shippers pass on their savings to customers, increase output through investments in productivity enhancements, and improve their market access. These effects lead to both direct and indirect economic effects that increase overall regional output and value added for the Houston-Galveston economy. They also tend to increase employment opportunities directly for shippers and indirectly for their suppliers, and through the “multiplier effect” for suppliers of goods and services to these additional employees. Wages and salaries also increase due to these added employees. None of these effects are reflected in a benefit-cost analysis, but they may be important factors in evaluating the desirability of rail system improvements proposed under the HRFS – especially those in Planning Case 2.

### 4.1 Shipper Savings Attributable to Rail System Improvements

#### 4.1.1 Attributing Delay and Reliability Costs to Rail System Performance

As used in this study, delay and reliability are related in that they are both a function of congestion on the rail system. Delays that are anticipated and included in planning and operational decisions are typically factored into operating costs and form the basis of shipping, receiving, and production decisions. This is distinct from the concept of reliability, where unanticipated congestion forces shippers to incur additional costs. These costs from unreliable network flows stem from actions required by shippers and receivers to adjust to radical departures from expected delivery or pick-up times.

The key point is that, for a single shipment, some amount of delay is tolerable if it is relatively predictable. For rail system operations where the majority of pick-up and delivery times are reasonably close to expected times, businesses
can adapt to “tolerable” levels of delay (although, as has been discussed in Chapter 2, this may require investment in inventory management related to materials and production, and can also involve capital investments in transportation equipment for rail-dependent industries). It is when pick-up and delivery times begin to radically diverge from expected times that businesses must take costly actions such as seeking alternative shipment modes, purchase temporary storage, or even slowing down or stopping production.

Metrics available from the HRFS model provide a systematic way to assess the relationship between delay and reliability of the rail network, and to determine how proposed improvements may change the costs paid by shippers. Delay ratios and train delays reported in Chapter 3 were used to identify how likely a subdivision is to create a “radical” departure from an expected pick-up or delivery time.

For each type of subdivision (see Table 5), a delay ratio threshold was determined, above which reliability is assumed to be affected. Based on their familiarity with the rail network, Lodestar Logistics provided the following delay ratio thresholds:

- Terminal: 17.5%
- Branch Line: 12.5%
- Main Line: 7.5%

These delay ratio thresholds define the performance level at which a shipper will begin to incur costs that are attributable to reliability-related delays. This means that if a terminal subdivision is reported to have a delay ratio of 20%, the first 17.5% of delay hours are considered to be attributable to “planned” delay, and the remaining 2.5% of train delay is considered to be due to “unplanned or extreme delay events” incurring associated costs of variability.

Delay ratio thresholds were used to estimate and allocate the number of train hours attributed to delay and those attributable to variability for the Baseline and Planning 2 scenarios. This methodology was applied to the performance measures for each subdivision for all commodities shipped on that subdivision. Unit cost estimates developed for delay and reliability through the industry surveys were then applied to the estimated planned and unplanned hours of delay for each subdivision over which these commodities are shipped. The resulting cumulative delays were used to estimate shipper cost savings attributable to the improvements associated with Planning Case 2.
Responses from the surveys and data for annual train hours per commodity and per subdivision were used to determine commodity-specific railcar traffic on each of the 27 subdivisions. Origins based on information provided in the surveys as well as information describing network railcar routing were used to determine the percentage of commodities by type most likely to use each of the subdivisions. Estimates of the number of train-hours per day transporting each commodity group were then developed for each subdivision.

Conditions on the baseline network were used to determine the current unit costs of delay and reliability. The total delay hours on each subdivision, the values of baseline delay ratios and delay ratio thresholds were used to allocate overall delay (in terms of train hours per week) attributable to reliability (that portion of train delay in excess of estimated overall delay) and train hours attributable to expected delay (that portion of train delay equal to or less than the delay ratio threshold for each subdivision type.)

Table 8 illustrates typical allocations of delay and reliability delay hours for each type of subdivision. Where the baseline delay ratio exceeds the delay ratio threshold (in this example for the Terminal and Mainline subdivisions), train delay hours attributable to reliability are estimated using the total delay hours that exceed the appropriate threshold (in this case, the Terminal subdivision experiences 1,010 hours of delay attributable to reliability issues and the Mainline experiences 1,356 hours of delay attributable to reliability issues.) Because the Branch line’s delay ratio does not exceed the delay ratio threshold for branch lines, all delay hours are attributable to delay.

Table 8 – Estimates of Delay and Reliability Using Delay Ratios and Thresholds

<table>
<thead>
<tr>
<th>Subdivision Type</th>
<th>Total Delay Hours</th>
<th>Delay Ratio Threshold</th>
<th>Baseline Delay Ratio</th>
<th>Train Hours Attributable to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal</td>
<td>9844</td>
<td>17.5%</td>
<td>19.5%</td>
<td>8,834</td>
</tr>
<tr>
<td>Branch</td>
<td>1628</td>
<td>12.5%</td>
<td>7.8%</td>
<td>1,628</td>
</tr>
<tr>
<td>Mainline</td>
<td>3710</td>
<td>7.5%</td>
<td>11.8%</td>
<td>2,354</td>
</tr>
</tbody>
</table>

Costs for each of the 15 different delay and reliability cost factors shown in Figure 3 were used to establish costs per train delay hour attributable to each cost factor for each commodity type. The resulting unit costs provided the basis for determining the effects of reductions in train hour delays attributable to
system improvements envisioned in Planning Case 2 and presented in Table 7.

### 4.1.2 Estimated Shipper Cost Savings

Once the unit costs by commodity type were estimated and the rail system effects of Planning Case 2 were determined, it was possible to estimate the savings in shipper costs attributable to reductions in train delay hours and improvements in reliability due to these train hour delay reductions. Information in Table 7 was used to determine the new allocations of reduced train delay hours by subdivision. Train delays and delay ratios were used to define the operating characteristics of the rail network. Unit costs developed from the survey for commodity-specific delay and reliability costs were applied to the Planning Case 2 network performance to estimate shipper costs reflective of new operating characteristics.

Cost savings reflect three key attributes of rail shipments:

1. The unit cost of train hour delays associated with delay and reliability by commodity type for each of the 15 cost factors,
2. Changes in system performance attributable to Planning Case 2 infrastructure investments, and
3. Routes used by each of the twelve commodity types on each of the 27 subdivisions.

Table 9 summarizes shipper cost savings for all commodities based on these calculations. As discussed in Chapter 2, the total costs of congestion as measured by delay and reliability costs is currently estimated at $429.3 million, $283.5 million of which is attributable to delay and $145.8 million to reliability. Investments in rail infrastructure described in Planning Case 2 are estimated to result in savings of $28.5 million in costs associated with delay (approximately 20.7% of current delay-related costs,) and $109.4 million in reliability costs (approximately 79.3% of reliability-related costs.)

Under Planning Case 2, shippers would see a dramatic change in the composition of costs associated with rail shipping in the Houston region. Reliability costs – those that are most volatile and unpredictable – would be reduced from $145.8 million per year to $36.4 million per year. This changes the proportion of reliability-related costs from 34% to 12.5% of all congestion-related costs for rail shipping.
### Table 9 – Estimated Shipper Cost Savings from Plan 2

<table>
<thead>
<tr>
<th></th>
<th>Current Operations</th>
<th>Plan 2 Savings</th>
<th>New Shipper Costs</th>
<th>Percent Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delay (as % of Total Costs)</td>
<td>$283.5</td>
<td>$28.5</td>
<td>$255.0</td>
<td>-10.1%</td>
</tr>
<tr>
<td>Delay savings</td>
<td>$28.5</td>
<td>$28.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(as % of Total Costs)</td>
<td>66.0%</td>
<td>20.7%</td>
<td>87.5%</td>
<td></td>
</tr>
<tr>
<td>Reliability (as % of Total Costs)</td>
<td>$145.8</td>
<td>$109.4</td>
<td>$36.4</td>
<td>-75.0%</td>
</tr>
<tr>
<td>Reliability savings</td>
<td>$109.4</td>
<td>$109.4</td>
<td>$36.4</td>
<td></td>
</tr>
<tr>
<td>(as % of Total Costs)</td>
<td>34.0%</td>
<td>79.3%</td>
<td>12.5%</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>$429.3</td>
<td>$137.9</td>
<td>$291.4</td>
<td>-32.1%</td>
</tr>
</tbody>
</table>

### 4.2 Effects of Shipper Savings on the HRFS Benefit-Cost Assessment

The HRFS computed both public and private benefits attributable to investments in each of the planning cases outlined in the study. Anticipated public benefits include reduced delays at rail crossings, improved fuel consumption, improved air quality, improved public safety, and improved capacity of the highway network. The Net Present Value (NPV) of the public benefits over a 20 year timeline for the Planning Case 2 was estimated to be $98.0 million.

The HRFS study also calculated the benefits that private carriers would gain by reduction in delay hours due to the infrastructure investments. Based on the value of a delay hour for the carriers at $303/hr for switching and yard movement the NPV for private benefits was estimated to be $73.0 million.

Based on our analysis, we estimate the benefits (cost savings) to the third group, shippers, due to reduced congestion/delay to be $137.9 million per year. Our analysis did not factor in any expected growth rates or change in commodity mix which could have an impact on the expected savings due to the different cost structures of businesses involved in shipping the various commodity types under consideration. Using the same 20-year evaluation period as the HRFS and a discount rate of 7.0%, the NPV of shipper benefits are estimated to be worth $1.4 billion.

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14 Includes fuel consumption for idling locomotives, train crew labor costs, and the unavailability of locomotive power.  
15 An average cost of $303 per train delay hour, based on estimated costs applicable to fuel consumption for idling locomotives, train crew labor costs, and the unavailability of locomotive power was used to determine an estimated private burden.
Including shipper benefits significantly changes the conclusions that can be drawn from a benefit/cost assessment of Planning Case 2. Table 10 shows how including shipper benefits influences the assessment of benefits and costs of rail projects proposed for Planning Case 2. Without the benefits accruing to shippers, the costs of Planning Case 2 are approximately double the estimated benefits (a Benefit/cost ratio of 0.52). When shipper benefits are included, total costs are only 20% of the anticipated benefits – indicating that cost of investments in Planning Case 2 rail system improvements are far exceeded by the benefits that will accrue to public, private (operators) and shippers.

Table 10 – Benefit/Cost Ratios with and Without Shipper Savings

<table>
<thead>
<tr>
<th>Plan 2 Costs</th>
<th>Without Shipper Savings ($ million)</th>
<th>With Shipper Savings ($ million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public</td>
<td>$98.0</td>
<td>$98.0</td>
</tr>
<tr>
<td>Private</td>
<td>$73.0</td>
<td>$73.0</td>
</tr>
<tr>
<td>Shipper</td>
<td>$-</td>
<td>$1,423.0</td>
</tr>
<tr>
<td>Total</td>
<td>$171.0</td>
<td>$1,594.0</td>
</tr>
<tr>
<td>B/C Ratio</td>
<td>0.52</td>
<td>4.82</td>
</tr>
</tbody>
</table>

*Carrier and Public Benefits as calculated in HRFS, 2007.*

4.3 Regional Economic Impacts of Shipper Savings

The direct effects of rail system improvements presented in Table 10 can be used to estimate additional economic impacts that will accrue to the Houston region’s economy. Economic impact analysis is different than traditional benefit-cost analysis in that it accounts for the ways that the portion of cost savings (shipper benefits) passed on to consumers of goods and services affect overall regional output. This assessment accounts for the dynamic effects generated through business responses to transportation cost and market size changes, indirect effects due to inter-industry supplier-buyer linkages, and induced effects generated by the recirculation of wages and secondary purchases by businesses that supply goods and services to shippers into the local economy.
Shipper savings affect their operations and productivity. Shippers can use these savings in a number of ways. They can retain them as profits, pass savings on to their customers by reducing prices, or reinvest these savings in equipment that improves productivity of their operations. Each type of business faces different markets and production costs, so each will respond differently in terms of how they allocate cost savings realized on any aspect of their operations – including those associated with logistics. Typically, industries in competitive markets tend to apportion cost savings, such as those accounted for in this study, across all three of these areas roughly in response to the overall competitiveness and market conditions that they confront. Thus, only a portion of the overall savings shown in Table 9 will be passed on to the final consumer of the products and outputs produced by shippers who are affected by the improvements in rail operations attributable to the rail system improvements described in the HRFS Planning Case 2.

These effects – retained profits, exports, and operational savings not passed on to customers – are accounted for in the economic impact analysis. In this regard, the specific characteristics of rail-reliant businesses in Houston matter, and their overall production and competitive characteristics are reflected in estimates of the overall economic impacts of savings attributable to reduced delay and improved reliability of the rail system. While producing a more “conservative” estimate of the economic impacts of shipper savings on the regional economy, estimates of the overall effects of shipper savings that take these effects into account tend to be more realistic and reflective of how shipper cost savings will actually affect the Houston region’s economy.

Table 11 summarizes the effects of both the direct and indirect effects of cost savings on four important measures of Houston’s regional economy: employment, wages, output, and value added. These estimates represent the expected average annual increase in the level of each measure compared to 2007. Direct industry impacts shown in Table 11 describe the effects of cost savings on all of the businesses involved in shipping or receiving commodities by rail on the Houston network. The analysis shows that approximately 97 new employees (full time equivalents) will be added to the payroll of these industries, and that wage income for all employees will total approximately $9.1 million annually. The output of directly affected industries will increase by $162.0

16 The value added in each stage of production is the difference between the value of the output and the value of the inputs purchased from other firms. Gross value added is the value of output less the value of intermediate consumption; it is a measure of the contribution to GDP made by an industry.
million and the contribution to regional value added will be $26.9 million.

Indirect industry impacts include the effects on employment, wages, output and value added attributable to the effects of increased business for suppliers and the ripple effects of this business throughout the Houston metropolitan region that is generated by the increase in output and employment/wages for these industries. These effects will result in an additional 512 jobs and $23.0 million in wages. Output and value added for industries indirectly affected by shipper savings are $64.7 million and $40.1 million, respectively. Total economic impacts include the sum of the direct and indirect impacts.

Table 11 – Summary of Direct and Indirect Economic Impacts of Rail System Delay and Reliability Improvements

<table>
<thead>
<tr>
<th></th>
<th>Direct Industry Impacts (in $ million)</th>
<th>Indirect Industry Impacts (in $ million)</th>
<th>Total Economic Impacts (in $ million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in Employment</td>
<td>97</td>
<td>512</td>
<td>609</td>
</tr>
<tr>
<td>Change In Output</td>
<td>$162.0</td>
<td>$64.7</td>
<td>$226.6</td>
</tr>
<tr>
<td>Change in Value Added*</td>
<td>$26.9</td>
<td>$40.1</td>
<td>$66.9</td>
</tr>
<tr>
<td>Change in Wage Income</td>
<td>$9.1</td>
<td>$23.0</td>
<td>$32.0</td>
</tr>
</tbody>
</table>

* Value added expressed as Gross Regional Product (GRP)

Tables 12 and 13 provide more insight into the kinds of industries that will be affected by shipper cost savings and ways that gains in employment and output are concentrated in the various industrial sectors. Table 12 shows how these economic impacts are distributed among the directly affected manufacturing industries – which are identified by their respective North American Industry Classification System (NAICS) codes. Table 13 shows how the total economic impacts are distributed throughout the entire economy – including both direct and indirect effects.

As shown in Table 12, the industries most directly affected are in the Chemical Manufacturing (NAICS 325) which will add nearly 50 new jobs, and metal fabricating industries (NAICS 331 and 332) which will add nearly 30 new jobs. Other industries that ship large volumes of materials, such as the Petroleum and Coal Products (NAICS 324) have a relatively large increase in output, but because of the nature of their operations tend to be highly productive relative to the labor inputs of raw materials.
Table 12 – Direct Impacts of Delay and Reliability Savings on Houston-Galveston Region Industries (by NAICS)

<table>
<thead>
<tr>
<th>Direct Industry Impacts</th>
<th>NAICS Range</th>
<th>Change in Employment</th>
<th>Change In Output (in $1000)</th>
<th>Change in Value Added* (in $1000)</th>
<th>Change in Wage Income (in $1000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mining &amp; Support Activities</td>
<td>212-213</td>
<td>3 $</td>
<td>1,120 $</td>
<td>670 $</td>
<td>240</td>
</tr>
<tr>
<td>Food Products</td>
<td>311</td>
<td>7 $</td>
<td>2,540 $</td>
<td>510 $</td>
<td>320</td>
</tr>
<tr>
<td>Wood Products</td>
<td>321</td>
<td>2 $</td>
<td>320 $</td>
<td>110 $</td>
<td>70</td>
</tr>
<tr>
<td>Paper Manufacturing</td>
<td>322</td>
<td>1 $</td>
<td>170 $</td>
<td>70 $</td>
<td>50</td>
</tr>
<tr>
<td>Petroleum &amp; Coal Products</td>
<td>324</td>
<td>8 $</td>
<td>18,510 $</td>
<td>2,910 $</td>
<td>1,290</td>
</tr>
<tr>
<td>Chemical Manufacturing</td>
<td>325</td>
<td>47 $</td>
<td>131,290 $</td>
<td>19,680 $</td>
<td>5,380</td>
</tr>
<tr>
<td>Primary Metal Manufacturing</td>
<td>331</td>
<td>9 $</td>
<td>3,900 $</td>
<td>1,160 $</td>
<td>600</td>
</tr>
<tr>
<td>Fabricated Metal Products</td>
<td>332</td>
<td>20 $</td>
<td>4,140 $</td>
<td>1,780 $</td>
<td>1,130</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>97</strong></td>
<td><strong>$ 161,990</strong></td>
<td><strong>$ 26,890</strong></td>
<td><strong>$ 9,080</strong></td>
<td></td>
</tr>
</tbody>
</table>

* Value added expressed as Gross Regional Product (GRP)
### Economic Impacts of Proposed Rail Improvements

#### Table 13 – Total Regional Impacts of Shipper Savings on Houston-Galveston Region Industries (by NAICS)

<table>
<thead>
<tr>
<th>Regional Industry Impacts</th>
<th>NAICS Range</th>
<th>Change in Employment</th>
<th>Change In Output (in $1000)</th>
<th>Change in Value Added* (in $1000)</th>
<th>Change in Wage Income (in $1000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farming &amp; Agriculture</td>
<td>11</td>
<td>5</td>
<td>$120</td>
<td>$50</td>
<td>$40</td>
</tr>
<tr>
<td>Oil, Gas, Other Mining, &amp; Support Activities</td>
<td>21</td>
<td>44</td>
<td>$14,970</td>
<td>$9,470</td>
<td>$3,800</td>
</tr>
<tr>
<td>Utilities</td>
<td>22</td>
<td>9</td>
<td>$3,750</td>
<td>$2,850</td>
<td>$840</td>
</tr>
<tr>
<td>Construction</td>
<td>23</td>
<td>7</td>
<td>$640</td>
<td>$300</td>
<td>$270</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>31-33</td>
<td>100</td>
<td>$163,000</td>
<td>$26,810</td>
<td>$9,240</td>
</tr>
<tr>
<td>Wholesale Trade</td>
<td>42</td>
<td>42</td>
<td>$7,540</td>
<td>$5,080</td>
<td>$2,850</td>
</tr>
<tr>
<td>Retail Trade</td>
<td>44-45</td>
<td>48</td>
<td>$2,910</td>
<td>$1,910</td>
<td>$1,220</td>
</tr>
<tr>
<td>Transportation &amp; Warehousing</td>
<td>48-49</td>
<td>38</td>
<td>$4,800</td>
<td>$2,450</td>
<td>$1,780</td>
</tr>
<tr>
<td>Information</td>
<td>51</td>
<td>4</td>
<td>$1,480</td>
<td>$650</td>
<td>$280</td>
</tr>
<tr>
<td>Finance and Insurance</td>
<td>52</td>
<td>24</td>
<td>$3,670</td>
<td>$2,240</td>
<td>$1,300</td>
</tr>
<tr>
<td>Real Estate and Rental and Leasing</td>
<td>53</td>
<td>25</td>
<td>$2,690</td>
<td>$1,720</td>
<td>$450</td>
</tr>
<tr>
<td>Professional, Scientific,and Technical Services</td>
<td>54-55</td>
<td>86</td>
<td>$9,160</td>
<td>$5,340</td>
<td>$4,660</td>
</tr>
<tr>
<td>Administrative Support and Waste Management</td>
<td>56</td>
<td>31</td>
<td>$1,740</td>
<td>$1,060</td>
<td>$800</td>
</tr>
<tr>
<td>Educational Services</td>
<td>61</td>
<td>7</td>
<td>$320</td>
<td>$210</td>
<td>$190</td>
</tr>
<tr>
<td>Health Care and Social Assistance</td>
<td>62</td>
<td>37</td>
<td>$2,600</td>
<td>$1,630</td>
<td>$1,400</td>
</tr>
<tr>
<td>Arts, Entertainment, and Recreation</td>
<td>71</td>
<td>8</td>
<td>$330</td>
<td>$210</td>
<td>$150</td>
</tr>
<tr>
<td>Accommodation and Food Services</td>
<td>72</td>
<td>32</td>
<td>$1,610</td>
<td>$830</td>
<td>$560</td>
</tr>
<tr>
<td>Other Services (except Public Administration)</td>
<td>81</td>
<td>33</td>
<td>$1,710</td>
<td>$900</td>
<td>$650</td>
</tr>
<tr>
<td>Government</td>
<td>92</td>
<td>29</td>
<td>$3,600</td>
<td>$3,230</td>
<td>$1,550</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>609</strong></td>
<td></td>
<td><strong>226,640</strong></td>
<td><strong>66,940</strong></td>
<td><strong>32,030</strong></td>
</tr>
</tbody>
</table>

* Value added expressed as Gross Regional Product (GRP)
Table 13 shows the effects of improved rail network reliability and reduced delay on the entire economy of the Houston region. As expected, most of the effects are concentrated in the manufacturing (NAICS 33-33) and the oil, gas and mining support services (NAICS 21) (78.5% of the increased output of the region and 24% of new employment is concentrated in these industries.) Other industries that will receive important benefits in terms of increased output and employment include Professional, Scientific and Technical Services (NAICS 54-55), Retail and Wholesale Trades (NAICS 42 and 44-45), and Transportation and Warehousing (NAICS 48-49) (10.8% of the increased output of the region and 35% of new employment is concentrated in these industries.). Other industries will gain modest amounts of employment attributable to the indirect effects of increases in output and regional spending include service and support industries.
Chapter 5 – Recommendations for Future Rail Performance Evaluation

5 RECOMMENDATIONS FOR FUTURE RAIL PERFORMANCE EVALUATION

This chapter of the report presents several options that could be considered to measure the future performance of rail system investments—whether or not the infrastructure investments contemplated by the HRFS are implemented. Performance measures are typically developed with three goals in mind. First, they must, in fact, be readily “measurable” either directly through observations or data routinely collected during normal operations, or indirectly by deriving appropriate measures from available data or credible modeling efforts.

Second, they must be “meaningful” in the sense that there is a common understanding of the concepts that the measures are meant to represent. When considering the use of benchmarks to evaluate the impact of future investments, performance measures should be directly applicable these benchmarks, and should have real meaning when compared to day-to-day rail operations.

Finally, performance measures must be “manageable” in that the sheer number of measures employed should be limited and focused on the most important aspects of system performance. The tendency to try and offer a comprehensive set of performance measures covering all possible contingencies and dimensions of transportation operations often results in “over-specification” of measures without regard to the ability of users to understand and interpret what the measures are communicating. Moreover, extensive data collection and reporting can create management and technical burdens that may require costly administrative overhead to maintain. Therefore, the costs of managing and monitoring performance measures needs to be carefully balanced against the number and processing costs of maintaining and reporting a system of performance measures.

5.1 Potential Sources of Performance Measures

One of the challenges in the case of the Houston rail network is that there are currently no performance measures in place to evaluate the rail system at the state level. The Texas Statewide Rail Plan makes clear that this is a potentially challenging process involving both public and private sector interests and cooperation:
“TxDOT challenge is to establish goals, performance measures, and targets that support the objectives of the Commission over a railroad transportation system that is predominantly owned, operated, and funded by the private sector.”

The HRFS includes performance measures derived from the RTC model. Information derived from these measures has been used in this study, and, as such, they form one of the three sets of performance measures recommended for consideration by the GCFRD in evaluating how future infrastructure investments and operating improvements alter reliability of the rail system.

The other challenge in setting performance measures is that there is currently only ad hoc guidance for establishing best practices on rail systems at the national level. Two efforts are currently underway to enumerate both the process of specifying performance measures, and the state-of-the-practice in developing and implementing them.\(^\text{17}\) Both of these studies are due to be released late in 2009. Several states have recently completed a rail plan (or are in the process of completing them). Although these plans offer a range of performance measures, most are either too complex to implement at a regional level or require extensive data collection, modeling or reporting.

Given the current state-of-the-practice, this study lays out two sets of performance measures that could be considered in evaluating future performance of the freight rail system in the Houston region. The first set is drawn directly from the RTC model simulations and performance benchmarks cited in the HRFS. They include both the measures cited in HRFS Chapter 2 and the benchmarks used in this study. These performance measures are supported by data and computations used in the RTC model. To the extent that they reflect current rail operating practice, they are assumed to represent measures that have some meaning to both rail carriers and operating companies. Refinement of the HRFS measures and benchmarks should be considered as infrastructure and operational changes are made in Houston’s rail system.

The second set of performance measures draws upon information developed from shippers surveys conducted for this study. Two perspectives are included: 1) the perspectives of shippers regarding the performance that they can observe relative to railcar delivery and service from the Class I operators; and 2) PTRA operations. These suggestions are not currently supported by any systematic data or analysis. They reflect the feedback received from shippers and describe information on rail system performance that shippers may find useful in planning their logistics operations. Nevertheless, one or more of these measures would

\(^{17}\) AASHTO’s SCORT State Rail Planning Best Practices document and NCFRP 03 Performance Measures for Freight Transportation are both under development as of June 2009.
provide meaningful and measurable information about rail system performance that both shippers and the GCFRD may find helpful in assessing rail system operations and the effects of investments in freight rail infrastructure or changes in operating procedures by either of the Class I operators or the PTRA.

5.2 Houston Rail System Performance Measures

Rail system performance measures referenced in the HRFS are tied directly to the RTC model. There are five performance measures cited in the report, two of which were used in developing the delay and reliability costs cited in this report. The five rail system performance measures include the following:

- Train Count
- Average Speed
- Delay Ratio
- Delay Hours per Day, and
- Delay Minutes per 100 Train Miles

Definitions for each of these measures, as presented in the HRFS are shown in Table 14, along with either the relevant benchmark or a description of how a benchmark may be derived. The performance measures most relevant for assessing system performance relative to delay and reliability are the delay ratio and the delay minutes per 100 train miles.

It is important to note that all of these measures depend on the volumes of commodities moved through the Houston region. Recent declines in rail freight volumes due to reduced national demand and the recent economic downturn have reduced the volumes and number of trains and cars being moved on the Houston rail system. Hence, performance of the system (as measured by delay ratios, average speeds and delay/hour and delay/minutes per 100 train hours) should improve. However, such improvements should be attributed to changing market conditions, not necessarily to improved operations or infrastructure investments. Therefore, all performance measures need to be assessed in light of market conditions – both positive (increased rail traffic/improved demand) and negative (cyclical or commodity-specific reductions in demand) to provide meaningful year-over-year comparisons. In this regard, an analysis of the RTC simulations, from which these performance measures are derived, should be structured to account for both improved infrastructure capacity and volume-adjusted performance of the network.
**Chapter 5– Recommendations for Future Rail Performance Evaluation**

### Table 14 – Rail System Performance Measures

<table>
<thead>
<tr>
<th>Performance Measure</th>
<th>Description</th>
<th>Benchmark</th>
<th>Considerations in Setting Benchmark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Train Count</td>
<td>The number of trains over a period (per day or per week) measured in the model.</td>
<td>Train counts for manifest trains should be monitored for any changes inconsistent with improved operations. Use 2007 train counts by subdivision as benchmarks to avoid capturing effects of the 2008 economic downturn.</td>
<td>As described in Chapter 3, these train counts should include yard and switching movements, but train delay effects should not reflect the effects of delay on these types of trains if performance relative to shipper railcar loads is being evaluated.</td>
</tr>
<tr>
<td>Average Speed</td>
<td>The average operating speed, in miles per hour, of the measured trains operating across a specific part of the network (i.e., a railroad subdivision or district).</td>
<td>Use 2007 average speeds by subdivision as benchmarks to avoid capturing effects of the 2008 economic downturn.</td>
<td>Average speeds of manifest trains should be monitored for any reductions by subdivision. Non-unit train speeds by subdivision should improve (controlling for fluctuations in volume due to economic conditions) compared to the 2007 benchmark(s), as rail system improvements are introduced.</td>
</tr>
<tr>
<td>Delay Ratio</td>
<td>The ratio of congestion-related delay to “ideal” or “unimpeded” running time.</td>
<td>Delay ratios vary by subdivision type: - Terminals 17.5% - Branches 12.0% - Mainlines: 7.5%</td>
<td>The benchmark for performance of manifest trains (as differentiated from all trains operating on the system including yard and switching trains) should be used in these computations.</td>
</tr>
<tr>
<td>Delay Hours per Day</td>
<td>The absolute number of train-hours per calendar day lost to congestion-related delay.</td>
<td>Use 2007 delay hours per day by subdivision as benchmarks to avoid capturing effects of the 2008 economic downturn.</td>
<td>A freight train hour is the equivalent of one train, either sitting still or running, operating on the rail network for one hour. These vary by commodity group, and may be computed in the RTC model.</td>
</tr>
<tr>
<td>Delay Minutes per 100 Train Hours</td>
<td>A measure of normalized delay; it functions much like the delay ratio but the denominator is the distance trains travel over time, rather than just the time itself.</td>
<td>Use 2007 delay minutes per 100 train hours by subdivision as benchmarks to avoid capturing effects of the 2008 economic downturn.</td>
<td>These ratios often will be extremely high in terminals due to switch engine operational characteristics. Reductions in delay minutes per 100 train miles on branches and mainlines improve both asset and labor productivity and should be examined by commodity group.</td>
</tr>
</tbody>
</table>

Source: HRFS, Chapter 5, 2007 (Performance Measures and Descriptions, only).
5.3 Shipper-Oriented Performance Measures

Shippers provided important perspectives on the ways that they evaluate the performance of the rail system. Their perspectives on rail system performance are somewhat different than the rail operating companies, as they tend to be focused more on measuring on-time delivery rather than overall system operations. Shippers are also focused on the variance of expected delivery times and the relationship between delivery time variance and marginal operating costs.

Measures of railcar activity suggested by shippers include the following:

- Comparison of velocity metrics for different service types, i.e. unit train operations vs. manifest freight.
- Average transit times to gateways on outbound shipments from the Greater Houston area.
- Average transit times from last reporting point outside the Greater Houston area on inbound shipments.
- Statistical analysis of transit times to measure variability against the projected trip plan cycle.

Of these suggested measures, one is currently available from the RTC models (velocity by subdivision for non-unit trains). The remaining three suggested performance measures would require developing a way to identify and report transit times to and from the Greater Houston rail network gateways. However, such information would provide important reliability and delay information that shippers could use in planning for and dealing with variable transit times.

Shippers have also suggested three performance measures focused on PTRA operations. These include:

- Average transit times to Class I Rail Carriers on outbound shipments off of the PTRA lines.
- Average transit times from Class I Rail Carriers’ interchange to constructive placement on inbound shipments.
- Statistical analysis of transit times to measure variability.

As with suggested performance measures for the Greater Houston rail system, the important issue for shippers is measuring the variability of transit times on outbound and inbound shipments, and the transit times required for interchange between the Class I railroads and the PTRA. Because of the interchanges involved, information contained in the Surface Transportation Board’s Carload Waybill Sample may be suitable for estimating the volumes of shipments; however, estimates from the RTC model or a comparable analytical system rather than actual reported times may be the only available means of determining transit times.
APPENDIX A – SUMMARY OF SHIPPER SURVEYS ON RAIL SYSTEM PERFORMANCE

Exhibit A1 – Letter of Introduction

October 28, 2008

The City of Houston joined with Harris County and Fort Bend County to establish the Gulf Coast Freight Rail District (GCFRD). Chaired by civic leader Mark Ellis, the District’s charge is to work with railroad companies, shippers, and neighborhoods to support rail improvements that will sustain the region’s economic growth and enhance quality of life throughout the area. Please work with the GCFRD to provide an accurate assessment of local shipper needs.

Last year, the Texas Department of Transportation released the Houston Region Freight Study (HRFS). Undertaken with the support of Class I railroads operating throughout the region, the HRFS recommends $3.4 billion worth of infrastructure improvements that will provide both public (congestion and air quality) and private (service reliability) benefits.

The HRFS focuses on bottlenecks in the rail and roadway network that result in significant delay. The HRFS did not evaluate shipper congestion costs associated with the current rail system and benefits of proposed improvements to the more than 900 shippers in the region which rely on the Houston rail network. The GCFRD is undertaking an effort to collect that data before proceeding with any of the proposed HRFS projects.

I urge you to work closely with the Gulf Coast Freight Rail District in this effort to identify the needs of regional rail shippers. I understand that someone working with the Rail District will be contacting you or your logistics manager about this. Please help us so we can help you. Our rail network provides an excellent opportunity to manage increasing freight shipments, reduce roadway congestion.
and improve both air quality and energy efficiency. Please work with us to foster development of infrastructure that serves local needs.

Sincerely,

Bill White
Mayor

cc: Mark Ellis, Chair of Gulf Coast Freight Rail District
Appendix A – Summary of Shipper Surveys on Rail System Performance

Exhibit A2 – Survey Questions and Responses

RAIL CARRIER OPERATIONS:
1. **Strictly from an operational perspective, do you experience a satisfactory value proposition from the rail carrier service you receive?**

   1) The general consensus of Shippers is that the rail service value proposition is muddled by the high level of variability in transit performance. Absolute transit time was seen as less critical than the variability in transit time vs. plan.
   2) This variability creates issues both on plant operations and administrative business processes.
   3) There is not a single root cause for this variability, and it stems from both infrastructure constraints and Rail Carrier operating and management practices.

RAIL CARRIER OPERATIONS:
2. **If not, what operational changes do you believe your serving rail carrier(s) could make to improve your perception of value received and to help alleviate congestion and/or improve reliability? Is there a direct impact upon shipping volumes and/or the costs incurred as the result of congestion and/or lack of reliability?**

   1) There is a widely held view by the Shippers that the Rail Carriers fail to utilize effective operations planning practices; this seems to result in resource shortages both equipment and crews.
   2) There needs to be a better way to address the chronic resource shortages and/or mis-allocations.
   3) All Shippers agree that congestion and variability has a direct impact on shipping volumes and costs incurred, but there is no consensus on what is the best way to measure this impact.

RAIL CARRIER OPERATIONS:
3. **How have you changed your Gulf Coast business processes to mitigate rail congestion and/or improve reliability?**

   1) Significant adjustments have been made by Shippers in response to rail congestion and transit time variability. These adjustments are both administrative and operational.
   2) The administrative adjustments are characterized by a high level of oversight and proactive management of shipments to and from the District.
   3) There is also significant impact on product and raw material inventory management from time to time; often resulting in
product shortages and stock outs.

4) From an operational perspective, Shippers who utilize private rail fleets perceive that they must carry a 10%-15% buffer in their fleet size to address rail carrier performance variability.

5) Some Shippers have also invested significant capital into on-site rail infrastructure.

**RAIL CARRIER OPERATIONS:**

4. If you have operations in other parts of the country, how are your Gulf Coast business processes different as a result of rail congestion and/or lack of reliability?

1) While there is some level of rail congestion and transit variability in most parts of the rail network, the intensity of these issues is more pronounced within the area of responsibility of the Gulf Coast Freight Rail District (GCFRD).

2) This has resulted in an inordinate amount of resources being deployed to manage the resulting operational impacts.

**RAIL CARRIER OPERATIONS:**

5. Are there shipper / rail carrier business processes that are used in other parts of the country that would be applicable in the Gulf Coast, if there was a decrease in rail congestion and/or improved reliability?

1) There are some sections of the rail network outside of the District which benefit from greater utilization of operations planning and scheduling by the Rail Carriers.

2) Some Shippers feel that in other geographic areas the Rail Carriers more consistently seek alignment with Shipper requirements.

3) Six and/or seven day per week service is utilized in some high traffic segments of the network.

4) Some Shipper facilities have twice-per-day service.

5) The Shippers realize that the multi-Carrier environment in the GCFRD can complicate the planning and scheduling process.

**RAIL CARRIER OPERATIONS:**

6. If the rail carriers were supportive, are there changes to your business processes you could, or would like to make; either alone or with other rail shippers, that you believe could help alleviate some of the rail congestion and/or improve reliability in the Gulf Coast? If so what impact might these changes have on the costs incurred as the result of congestion and/or lack of reliability?

1) The Shippers feel strongly that with improved reliability and a decrease in variability they would be able to reduce the size of
Appendix A – Summary of Shipper Surveys on Rail System Performance

their private fleets by 5% to 15%.
2) Some of the Shippers referred to the scheduled operating environment utilized by the CN Railroad.
3) Most of the Shippers would be willing to support tendering of shipments at least six, and possibly seven days per week, if no significant economic penalties were incurred.
4) Tendering freight to the Rail Carriers additional days out of the week would better match production to existing rail capacity.

RAIL CARRIER OPERATIONS:
7. If you had the ultimate control and authority to change anything about the operations of your serving rail carrier (structure, operations, policies, etc.) what would you change?

1) Artificial barriers to efficient operations have occurred as the result of commercial considerations or posturing between the Class I Carriers. Service to Shippers on the Baytown branch line and the lack of an interchange at Dayton were pointed out as examples which result in additional costs to the Shippers and inefficient use of existing infrastructure.
2) Shippers feel that the rail operations in the GCFRD should be conducted in a more “open” environment, with service considerations taking precedent over commercial objectives.
3) Several Shippers feel that rail carrier crew scheduling is not done in coordination with Shipper operations. There are often crew shortages at the most inopportune times; which result in stranded or delayed shipments and additional expense to the Shippers.

RAIL CARRIER OPERATIONS:
8. What impact do you believe your changes would have on the costs incurred as the result of congestion and/or lack of reliability? (If served by multiple carriers, please respond separately for each carrier.)

1) There is general consensus that any well-thought out changes should help to reduce congestion and increase efficiency of operations; therefore increasing reliability.
2) However, there is also general recognition that the complexity of the rail network within the District will possibly be a limiting factor.

RAIL CARRIER OPERATIONS:
9. What measures of effectiveness and/or data could shippers use to determine if rail operations are improving or deteriorating?
Appendix A – Summary of Shipper Surveys on Rail System Performance

1) Average transit times to gateways on outbound shipments from the Greater Houston area.
2) Average transit times from last reporting point outside the Greater Houston area on inbound shipments.
3) Statistical analysis of transit times to measure variability against the projected trip plan cycle.
4) Comparison of velocity metrics for different service types, i.e. unit train operations vs. manifest freight.

RAIL CARRIER OPERATIONS:
10. What role do you believe the Gulf Coast Freight Rail District could play to help facilitate improved rail operations in the Gulf Coast?

1) The Shipper consensus is that the District should play the role of facilitator and perhaps arbitrator between Shipper and Rail Carrier interests.
2) The District should also play the primary role in the economic evaluation of proposed infrastructure improvement projects.

INFRASTRUCTURE:
1. Do you believe there is sufficient railroad infrastructure in the Gulf Coast?

1) The response is a unanimous NO, but with no clear indication of what type of infrastructure is needed.
2) There was at least one respondent who spoke to the difference between U.S. and European rail networks. The opinion was expressed that infrastructure in the European rail network may have more of a safety orientation.

INFRASTRUCTURE:
2. How has the amount and/or quality of rail infrastructure in the Gulf Coast impacted your company’s decision to expand or retain your operations in the area?

1) In the chemical and plastics sectors, the global nature of feedstock and product supply has pushed the development of new capacity closer to the sources of the feed stocks.
2) However, in order for the remaining Gulf Coast capacity to retain its relative competitiveness, there must be infrastructure improvements that will at least keep the rail carrier service from further degradation.
3) As mentioned elsewhere, some Shippers have allocated significant capital to in-plant rail infrastructure.
4) There are definite disadvantages in the GCFRD which limit the expansion of existing, or the development of new rail-served...
industries. Several specific cases were cited during the interviews.

**INFRASTRUCTURE:**
3. **Would improved rail infrastructure in the Gulf Coast allow your company to expand and/or retain operations in the area?**
   - 1) It is possible that the prospect of improved infrastructure may lead to expansion of industrial operations, however, the infrastructure improvements would have to come first.
   - 2) Shippers need to see an actual decrease in congestion and variability before expansions would be considered.

**INFRASTRUCTURE:**
4. **Which areas in the rail system serving the Gulf Coast do you believe consistently experience congestion?**
   - 1) Without exception, the Shippers consider that part of the network inside the Beltway to be chronically congested.
   - 2) In addition, there are also perceived chronic congestion issues on the PTRA, the Baytown branch line and the Galveston area.

**INFRASTRUCTURE:**
5. **What do you believe are the primary reasons for congestion occurring in the areas mentioned above?**
   - 1) Inadequate operational practices and business process variability.
   - 2) Infrastructure constraints in the following areas:
     - a. Inadequate switching and classification facilities.
     - b. Inadequate sidings and passing tracks.

**INFRASTRUCTURE:**
6. **What rail infrastructure capital projects (public or private) outlined in the Houston Region Freight Study do you believe could help alleviate rail congestion and/or increase reliability in the Gulf Coast? How might these projects reduce the costs incurred as a result of congestion and/or lack of reliability?**
   - 1) Double tracking main lines
   - 2) PTRA-related projects
   - 3) 286,000 gross weight on rail capability throughout the area.
   - 4) Improve carrier junction points
   - 5) Increase classification yard capacity.
Appendix A – Summary of Shipper Surveys on Rail System Performance

INFRASTRUCTURE:
7. Has your company made, or does it contemplate making capital expenditures to improve the rail infrastructure at your operating facilities? If so, how have these projects been justified?

1) Almost all of the larger Shippers have made, or are planning, capital expenditures to improve and/or increase the rail infrastructure in their manufacturing facilities.
2) The most significant economic drivers for the infrastructure expenditures have been cost avoidance of Rail Carrier switching, detention and demurrage charges.

INFRASTRUCTURE:
8. To the extent you believe rail congestion has a negative impact on your business, which type of infrastructure projects identified in the Houston Region Freight Study would have the greatest beneficial impact on the rail service to your company? (Rank 1-10 with 10 having the greatest beneficial impact.)

- Grade Crossing Closures / Grade Separation Projects: (1-10)
- Improvements to Existing Railroad Infrastructure, Improving Capacity and Connectivity on Existing Rail Lines and Adding New Rail Corridors: (1-10)

- Average of all respondents:
  - Grade Crossings: 1.8
  - Infrastructure Improvements: 9.1

PORT TERMINAL RAILROAD ASSOCIATION (PTRA):
1. Are any of your rail shipping operations served by the Port Terminal Railroad Association (PTRA)? (If not, please skip this section.)

- 73% of the respondents have some activity on the PTRA.

PORT TERMINAL RAILROAD ASSOCIATION (PTRA):
2. Where do you believe the PTRA experiences congestion on a recurring basis? How does this congestion impact service reliability?

1) The general consensus from the Shippers is that the PTRA network is so compact, that any disruption quickly impacts the entire system.
2) The most recurring perceived issues mentioned are:
   a. Ineffective coordination with the Class I Rail Carriers.
   b. Ineffective crew calling and scheduling leading to chronic crew shortages.
   c. Generally ineffective operating practices and performance measurement practices and tools.
PORT TERMINAL RAILROAD ASSOCIATION (PTRA):
3. **What do you believe to be the cause of congestion recurring at the points mentioned above?**

1) Inherent capacity constraints on the PTRA are unable to absorb volume fluctuations.
2) There is perceived ineffective operational coordination with the Class I Rail Carriers.
3) The PTRA is seen as a switching service that cannot operate independently, but is caught between several competing Rail Carriers.
4) Seasonal volume fluctuation in selected commodity traffic results in disproportional disruptions on other commodities.

PORT TERMINAL RAILROAD ASSOCIATION (PTRA):
4. **Are there rail infrastructure capital projects outlined in the Houston Region Freight Study that you believe could help alleviate congestion on the PTRA?**

1) Any of the projects which improve the PTRA interface with the Class I Rail Carriers
2) Increased railcar storage and handling capacity.

PORT TERMINAL RAILROAD ASSOCIATION (PTRA):
5. **If the PTRA was supportive, are there changes to your business processes you could, or would like to make, either alone or with other rail shippers, that you believe could help the PTRA alleviate some of the rail congestion and/or increase reliability?**

1) Because of the level of activity on the PTRA, there is general consensus the larger Shippers should receive service on six or seven days per week.
2) The Shippers would agree to tender billing on the additional days of rail service.
3) Some Shippers attempt to build Class I and/or Interchange blocks, but there is some question about whether the PTRA maintains the integrity of these blocks once released from the Shipper facility.

PORT TERMINAL RAILROAD ASSOCIATION (PTRA):
6. **What changes to the business processes or policies of the PTRA could help alleviate congestion and/or increase reliability?**

1) The PTRA has a finite capacity for yard classification and switching operations. There has been little evidence of business process modifications or adjustments when there is a surge in activity.
2) The PTRA appears to be chronically short of crews; the Shippers attribute the shortage to “poaching” by the Class I Rail Carriers and arbitrary constraints on human resource levels.

3) The PTRA appears to operate at the whim of the Class I Rail Carriers; often resulting in congestion created by “dumping” from one of the Class I’s.

PORT TERMINAL RAILROAD ASSOCIATION (PTRA):

7. If you had the ultimate control and authority to change anything about the PTRA (structure, operations, policies, etc.) what would you change? Why?

1) The Study respondents expressed broad dissatisfaction with the current operations, structure and governance practices of the PTRA. There is a perceived sense that the current structure limits the ability of the PTRA to act as an independent switching agent for the Port of Houston and area Shippers. There is frustration that the Shippers feel they are not seen as the customers of the PTRA, but that the PTRA serves only the needs of the Class I railroads. In this regard, the PTRA is trapped between the competing commercial and operational interests of the Class I Railroads and the requirement for unanimity in PTRA governance decisions is consistently at odds with these competing commercial and operational interests.

2) Without stipulation as to specific alternatives to the current PTRA structure the following are seen as prerequisites to efficient movement of freight within the GCFRD area of responsibility:
   - The Port of Houston or some non-prejudicial entity must have significant governance authority.
   - The switching entity must be held accountable by strict performance metrics.
   - The switching entity must be unencumbered from the commercial and operational interests of the area Class I Railroads.
   - The fee structure for switching services must encourage operating efficiency while providing a mechanism for investment in infrastructure.

PORT TERMINAL RAILROAD ASSOCIATION (PTRA):

8. What impact do you believe your changes would have on the costs incurred as the result of congestion and/or lack of reliability?

1) Almost all respondents feel that something other than the current operating practices of the PTRA should be employed.

2) Some different approach is the only perceived solution to addressing the chronic congestion caused by the operating constraints of the
Appendix A – Summary of Shipper Surveys on Rail System Performance

There are some necessary infrastructure improvements required, but they should be addressed in conjunction with an improvement in operating practices.

PORT TERMINAL RAILROAD ASSOCIATION (PTRA):
9. What measures of effectiveness and/or data could shippers use to determine if PTRA rail operations are improving or deteriorating?

1) Average transit times to Class I Rail Carriers on outbound shipments off of the PTRA.
2) Average transit times from Class I Rail Carriers interchange to constructive placement on inbound shipments.
3) Statistical analysis of transit times to measure variability and hold points.

PORT TERMINAL RAILROAD ASSOCIATION (PTRA):
10. What role do you believe the Gulf Coast Freight Rail District could play to help facilitate improved operations, alleviate congestion and increase reliability on the PTRA?

1) In the case of the PTRA, it may be necessary for the District to play a more proactive role with the Port of Houston and the Class I Rail Carriers.
2) There are considerable commercial factors that must be considered by a non-prejudicial entity.