ACCOMMODATING OVERSIZE AND OVERWEIGHT LOADS:

INSTRUCTOR AND STUDENT GUIDE

by

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and the
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ACKNOWLEDGMENTS

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- Ms. Darlene Goehl.
- Mr. Jon Holt.
- Mr. Ray Hutchinson (retired).
- Mr. Vincent Lewis.
- Ms. Janet Manley.
- Mr. Brian Merrill.
- Mr. Justin Obinna.
- Mr. Andrew Wanees.
- Mr. Dean Wilkerson.
- Dr. Duncan Stewart.
- Mr. Frank Espinosa.

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CHAPTER 1. INTRODUCTION

INTRODUCTION

This instructor and student guide is designed to guide the instructor in conveying information at the district level concerning Research Project 0-6404 "Accommodating Oversize and Overweight Loads." The specific information focuses on the Bryan District but could be adapted to other districts.

BACKGROUND

Effective and sufficient support to domestic and international freight movements is a key to a vibrant economy. In 2007, the U.S. transportation system moved 51 million tons of commodities worth $45 billion (*1*). Although temporarily decreasing between 2008 and 2009, the total tonnage started to rebound in 2010 and it is forecasted that annual tons per capita will increase 27 percent from 55 tons in 2010 to 70 tons in 2040. A significant proportion of this tonnage translates to oversize and/or overweight (OS/OW) truck loads that have to be routed to avoid permanent or temporary physical constraints of the transportation infrastructure.

Texas, along with many other states, has been making significant strides in developing the state transportation system to accommodate OS/OW loads. Available information based on research experience and interviews with the Texas Department of Transportation (TxDOT) indicate that many state permit offices experienced increased numbers of OS/OW permit requests and super-heavy load requests prior to the economic downturn. For example, TxDOT's Motor Carrier Division (MCD) experienced an increase in permit requests of 33 percent from 2003 to 2007 (*2*). Super-heavy requests increased 667 percent from 2004 to 2007, partly due to the statewide boom in wind energy and oil/gas development. Since 2007, TxDOT issued more than 500,000 OS/OW permits every year. Although decreasing in 2009, there is little doubt that OS/OW activities will bounce back and continue to grow nationwide.

To prompt safe and efficient routing for OS/OW loads, improve safety, and minimize deterioration to state highways, Texas formed an OS/OW working group consisting of engineers from the north and east Texas (NETx) district and division representatives. In 2007, TxDOT further organized a Super Heavy and Overweight Load/Seal Coat Damage Prevention Work Group consisting of staff from NETx districts, MCD, the Construction Division, and the Maintenance Division. In addition, TxDOT is currently in the process of developing GIS-integrated software, called TxPROS (Texas Permit Routing Optimization System), to automatically route OS/OW loads online (*3*).

As part of Research Project 0-6404, the research team processed and mapped a massive dataset of OS/OW permit routes into a GIS format. This instructor and student guide presents the objectives of the project along with some of the findings in tabular and graphical formats. It also briefly covers the methodology used to gather and process the information gathered from the MCD and industry stakeholders.

OBJECTIVES

The primary objectives of this research included:

- Identify the most common OS/OW dimension and weight groups.
- Identify criteria for assigning these OS/OW groups to existing road networks.
- Identify criteria for assigning current and projected OS/OW groups to the future road network upgraded to meet future demand.

ORGANIZATION OF THE GUIDE

This research report consists of three chapters organized as follows. Chapter 2 presents the methodology used to gather and process the information. Chapter 3 is a series of slides for use at the district level to inform district decision makers and solicit district-specific information regarding oversize/overweight permitting activities in that district. In its current form, it applies to the Bryan District and was used in a district workshop held on February 15, 2012.

CHAPTER 2. METHODOLOGY

INTRODUCTION

The research team acquired information along two separate tracks. The primary data for analysis came from six years of historical data provided by the Motor Carrier Division. The bulk of this chapter deals with the methodology for analyzing that data. The other track for gathering information from stakeholders used telephone calls to contact key individuals and organizations to ask questions about permit load movements.

For the purpose of this project, the research team requested OS/OW permit data from TxDOT MCD for the period FY2004 through FY2009. The original data contained more than three million permits over the six-year period. For most of the permits, the data included information such as load dimensions, weights, axle configurations, and load description. For a majority of the permits, the original database also included manually-entered descriptions of permit routes, route origins, and route destinations.

To enable GIS-based analysis of OS/OW loads and their routes, the research team mapped a large number of the permit routes including their origins and destinations as described in the original permit data into a GIS format. Based on the mapped routes, the research team conducted spatial analysis to understand how different groups of OS/OW loads historically traveled on the state highway network and how permanent restrictions impacted the route choices of such loads.

STAKEHOLDER INTERVIEWS

The TTI team solicited information from a comprehensive and broad-based list of agencies to gather information and data. TTI conducted phone and/or office interviews with knowledgeable personnel from each of the identified agencies. The other stakeholders included:

- Enforcement agencies.
- Escort companies.
- Metropolitan Planning Organizations.
- TxDOT.
    - Bridge Division.
    - District Permit Coordinators.
    - Maintenance Division.
    - Traffic Operations Division.
    - Transportation Planning and Programming.

GIS ROUTE AND ORIGIN-DESTINATION (OD) MAPPING

Historically, the MCD manually assigns permit routes when processing OS/OW permit applications based on the load dimensions and weights. As a result, the manually-entered route information in the original permit database was not immediately ready for use within a GIS. The syntax used for route starts, route ends, and route descriptions was not standardized and contained many spelling errors, inconsistent abbreviations, and unknown entries. A large number of records contained multi-line text in the route description field where only one line corresponded to the route information. In addition, many records contained different special characters that cluttered the data and made it more difficult to use.

The research team developed a multi-step process to map the permit routes into feature classes. The mapping process used the Route Analyst function available in ESRI ArcGIS® Desktop to convert text route descriptions into ESRI line features. In addition, the superior data storage and query capabilities of Oracle® database management software were utilized during the mapping process to improve processing speed. The entire route mapping process included the following general steps:

- Clean and standardize original route descriptions.
- Prepare a navigable route network based on a TxDOT on-system roadway layer.
- Create a route intersection layer (referred to as the junction layer hereafter) that contained all intersections, origins, and destinations involved in the original route descriptions.
- Map route descriptions into separate ESRI Shapefiles based on the route layer and junction layer.
- Further process the resulting Shapefiles for future GIS route analysis.

The research team used a similar approach as for permit route description to standardize the route origin and destination descriptions. For those that could not be standardized using scripts, the researchers identified meaningful records and manually processed the common entries among them. Because the future analysis required association between OD pairs and the actual mapped routes, the OD description cleansing was primarily focused on those records that contained valid route descriptions. The research team developed VBA scripts on the ArcGIS Desktop platform to map the unique OD pairs into line features. OD analysis results based on the original permit data were then appended to the corresponding OD pairs for further analysis and presentation.

OS/OW ROUTE ANALYSIS

Based on the GIS routes that were successfully mapped, the research team conducted several types of analysis to understand how OS/OW loads travel on the state highway network and how infrastructure restrictions affected the route choices. The analysis results constituted the foundation for the materials used in the pilot workshop in the Bryan District. Major analysis included:

- Frequent route analysis. During this analysis, the research team estimated the frequencies of OS, OW, and all permits on each individual roadway segment during each study year.

In addition, the total weight of the OW loads on each roadway segment was also determined for the corresponding roadway segment. Focusing on FY 2009 data, the research team also determined the numbers of loads of different categories grouped by load dimension and weight information for each individual roadway segment.

- OD analysis. For each OD pair, the research team determined the numbers of associated OS/OW loads of different load categories grouped based on load dimension and weight.
- Restriction analysis. Based on the permanent restriction data received, the research team identified road-locking height and weight restrictions on major OS/OW routes and compared them against the current OS/OW routes. The analysis helps readers to understand how such restrictions affected the route selection of OS/OW loads both globally and locally. In addition, it provides critical information to help identify the critical restrictions that impact significant numbers of OS/OW loads.
- Optimal route analysis. The research team generated optimal routes based on the top 500 OD pairs and OD pairs associated with loads that were higher and wider than 16 ft. This analysis helps readers to understand how the loads would travel in an ideal world without any restrictions. In addition, the research team also quantified the additional travel into both ton-miles and dollars based on a comparison study between the current routes and optimal routes.

CHAPTER 3. PRESENTATION SLIDES

INTRODUCTION

TxDOT's Bryan District (BRY) encompasses a 10-county area and is located in central Texas between Houston and Dallas. In terms of land area, the district covers 7,710 square miles. The district serves over 14 million daily vehicle miles traveled by all vehicles with 3,142 centerline miles of roadway. The population of the Brazos District is about 432,000 persons, and there are almost 389,000 registered vehicles within the district boundaries. Figure 1 shows the district and its general location with respect to potential OS/OW load origins and destinations (*4*).

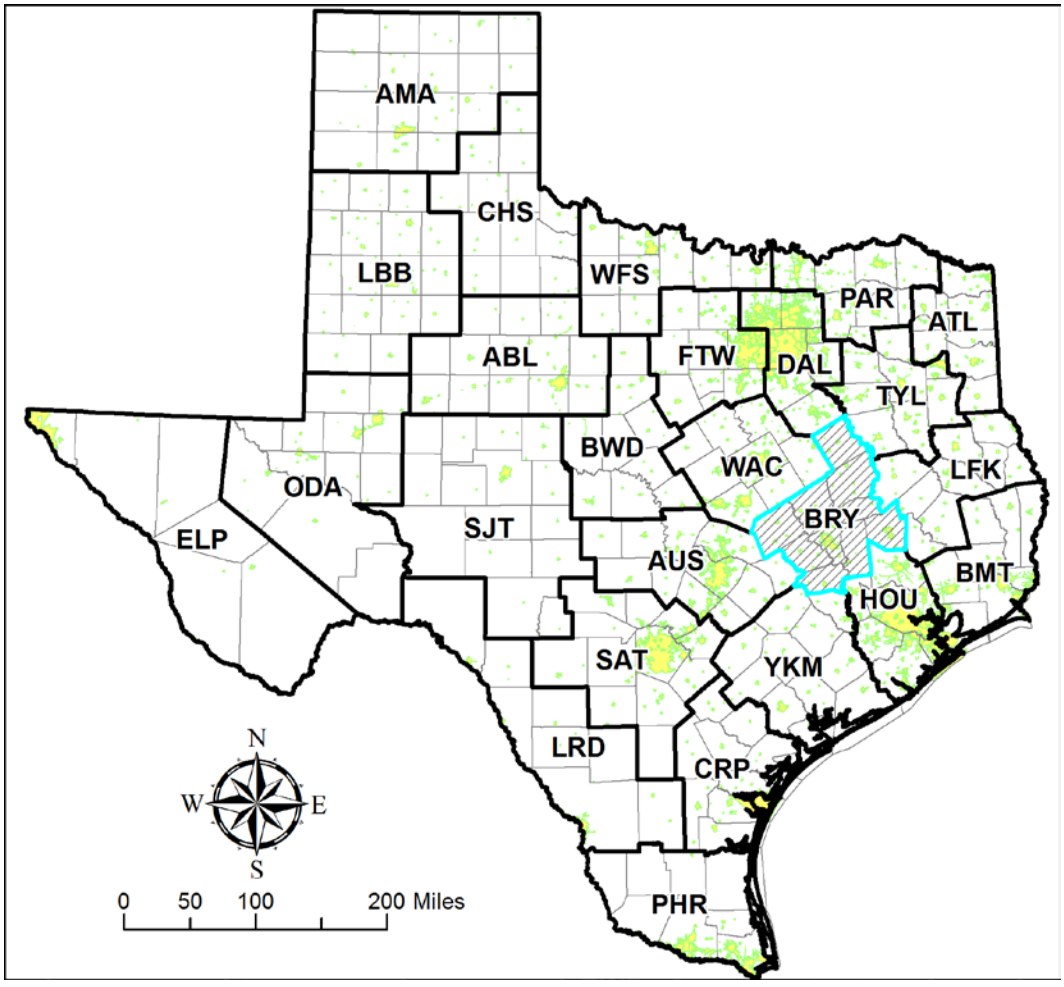


Figure 1. Bryan District.

PRESENTATION SLIDES

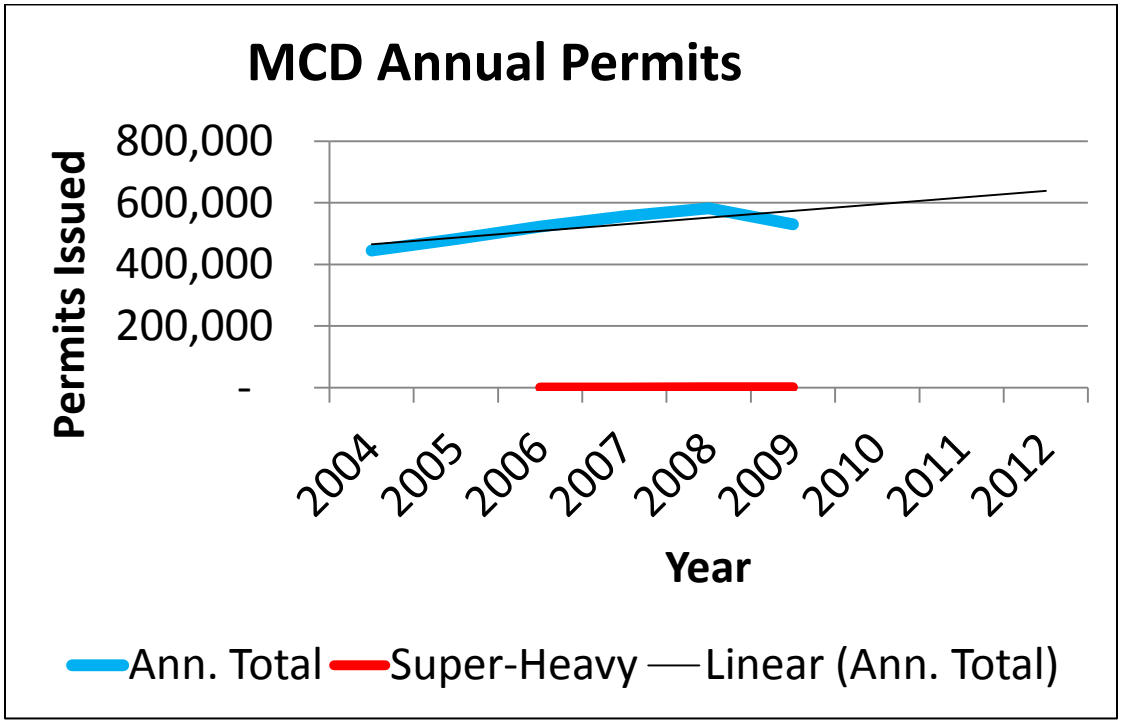
Slide #1 Title Slide

Slide #2 Research Team

TxDOT	TTI
Connie Flickinger (PD)	Dan Middleton (RS)
Darlene Goehl	Eric Li
Ray Hutchinson (retired)	Jerry Le
Jon Holt	Jodi Carson
Vincent Lewis	Nick Koncz
Janet Manley	Chi-Leung Chu
Brian Merrill	Cesar Quiroga
Justin Obinna	
Andrew Wanees	
Dean Wilkerson	
Duncan Stewart	
Frank Espinosa	

Slide #3 Project Motivation

- NETx Working Group Recommendations
  - Improve communications
  - Improve route options for OS/OW loads
  - Reduce seal coat damage
- MCD permit trends
  - Weights and sizes are increasing
- Promote commerce
  - Keep routes open



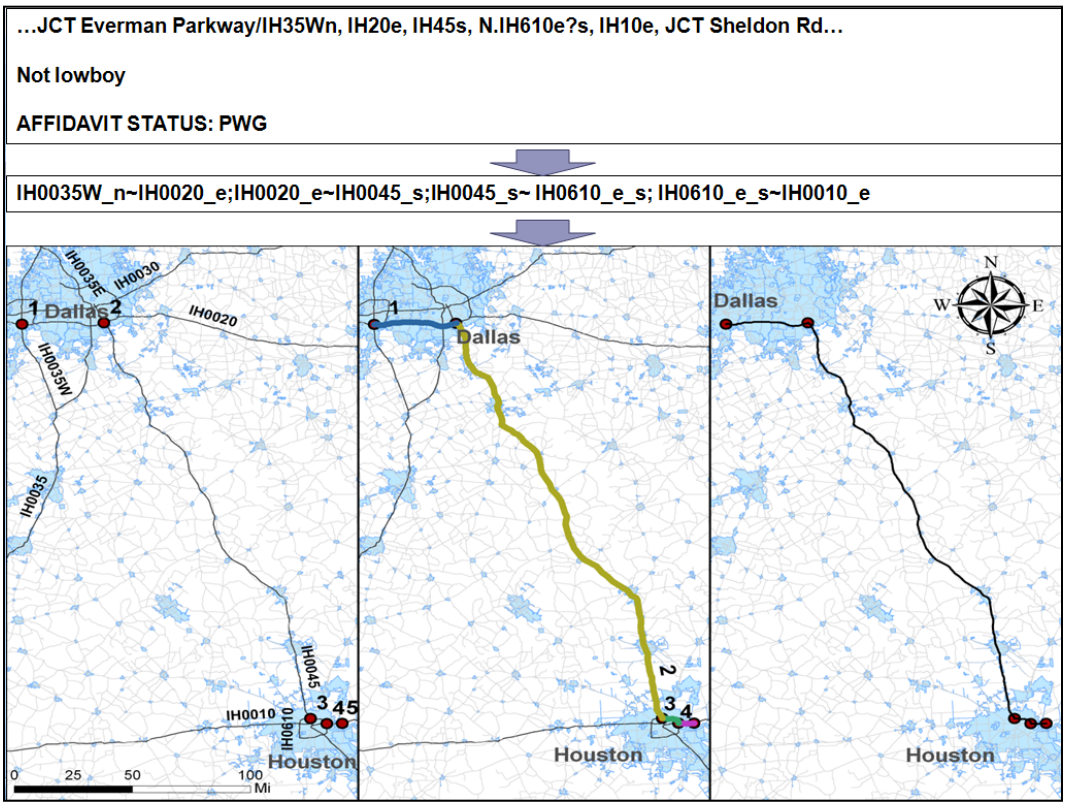
Slide #4 Research Objectives

- Identify a set of OS/OW dimension and weight groups and O-D routing needs.
- Identify criteria for assigning these OS/OW groups to road networks as they currently exist.
- Identify criteria for assigning these OS/OW groups to road networks upgraded to meet projected OS/OW freight demand.

Slide #5 Work Plan

- Task 1. Conduct literature and Internet review
- Task 2. Evaluate MCD Data & Stakeholder input
- Task 3. Review TxPROS
- Task 4. Criteria for OS/OW loads–existing network
- Task 5. Criteria for OS/OW loads–future network
- Task 6. Develop statewide map
- Task 7. Develop deliverables

Slide #6



Slide #7 Research Findings

Slide #8 Major Permit Types (2009)

Permit Type	Percent
General (single trip permits)	62.3%
Manufactured housing	12.5%
Over-axle weight tolerance (1547)	5.8%
Portable buildings	3.9%
30/60/90 day width	3.6%
HUB	3.5%
Temporary registration	2.9%
30/60/90 day length	1.5%
Concrete beam/girder (HB 2093)	1.1%
All others	<1% each

Slide #9 Historical MCD Data Processing

Year	Original Tabular Permit Data			Processed GIS Permit Routes		
	Total Permits	Permits with Valid Route Descriptions	Permits with Processed Routes	No. of Complete Routes	No. of Permits for these Routes	Percent of Total Permits
2004	444,326	385,912	225,083	99,739	225,077	50.7%
2005	447,876	417,263	238,772	79,723	170,464	38.1%
2006	522,696	445,976	240,399	83,440	181,152	34.7%
2007	554,198	463,621	233,653	86,123	186,024	33.6%
2008	580,410	483,136	268,240	109,051	210,776	36.3%
2009	527,447	428,920	255,490	134,011	254,452	48.2%

Slide #10 Description of Loads – Heights

FY	Truck Height (ft.)				
	<12	≥12 but <14	≥14 but <16	≥16 but <18	>18
2004	358(0.2%)	64,326(39.7%)	91,672(56.6%)	5,051(3.1%)	697(0.4%)
2005	418(0.2%)	67,704(39.9%)	95,352(56.2%)	5,463(3.2%)	647(0.4%)
2006	373(0.2%)	76,940(41.2%)	100,252(53.7%)	8,407(4.5%)	713(0.4%)
2007	282(0.1%)	71,310(36.7%)	111,778(57.5%)	**10,220(5.3%)**	646(0.3%)
2008	427(0.2%)	71,772(35.7%)	115,929(57.7%)	**12,114(6.0%)**	821(0.4%)
2009	537(0.3%)	66,482(37.7%)	97,412(55.3%)	**10,976(6.2%)**	792(0.4%)

Slide #11 Description of Loads – Widths

FY	Truck Width (ft.)					
	<9	≥9 but <11	≥11 but <13	≥13 but <15	≥15 but <17	>17
2004	3,173 (2.0%)	12,498 (7.7%)	36,369 (22.4%)	64,962 (40.1%)	39,091 (24.1%)	6,011 (3.7%)
2005	2,878 (1.7%)	12,368 (7.3%)	40,039 (23.6%)	66,798 (39.4%)	41,122 (24.2%)	6,379 (3.8%)
2006	4,374 (2.3%)	14,376 (7.7%)	42,456 (22.7%)	76,361 (40.9%)	42,135 (22.6%)	6,983 (3.7%)
2007	4,523 (2.3%)	16,768 (8.6%)	46,622 (24.0%)	78,193 (40.3%)	41,066 (21.1%)	7,064 (3.6%)
2008	5,733 (2.9%)	17,860 (8.9%)	47,926 (23.8%)	78,114 (38.9%)	43,851 (21.8%)	7,579 (3.8%)
2009	7,573 (4.3%)	16,714 (9.5%)	41,097 (23.3%)	66,021 (37.5%)	37,771 (21.4%)	7,023 (4.0%)

Slide #12 Description of Loads – Lengths

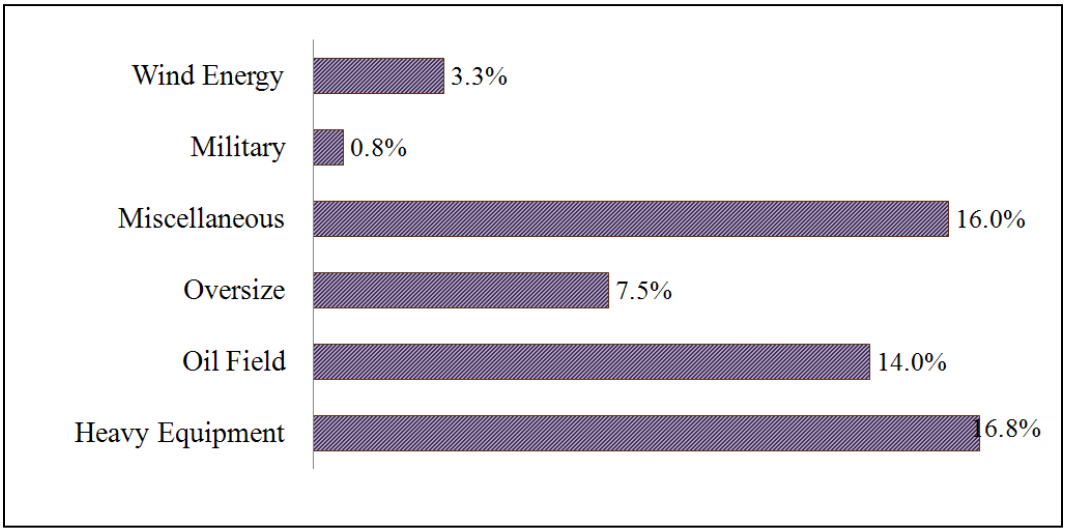
FY	Truck Length (ft.)				
	<80	≥80 but <100	≥100 but <120	≥120 but <140	>140
2004	20,105 (12.4%)	99,463 (61.4%)	39,659 (24.5%)	2,151 (1.3%)	726 (0.4%)
2005	21,068 (12.4%)	105,157 (62.0%)	39,500 (23.3%)	2,881 (1.7%)	978 (0.6%)
2006	21,693 (11.6%)	109,899 (58.9%)	48,896 (26.2%)	3,879 (2.1%)	2,318 (1.2%)
2007	20,896 (10.8%)	109,271 (56.3%)	56,076 (28.9%)	3,944 (2.0%)	4,049 (2.1%)
2008	20,723 (10.3%)	108,464 (53.9%)	61,036 (30.4%)	4,976 (2.5%)	5,864 (2.9%)
2009	19,029 (10.8%)	94,503 (53.6%)	52,055 (29.5%)	4,269 (2.4%)	6,343 (3.6%)

Slide #13 Identify OS/OW Groups

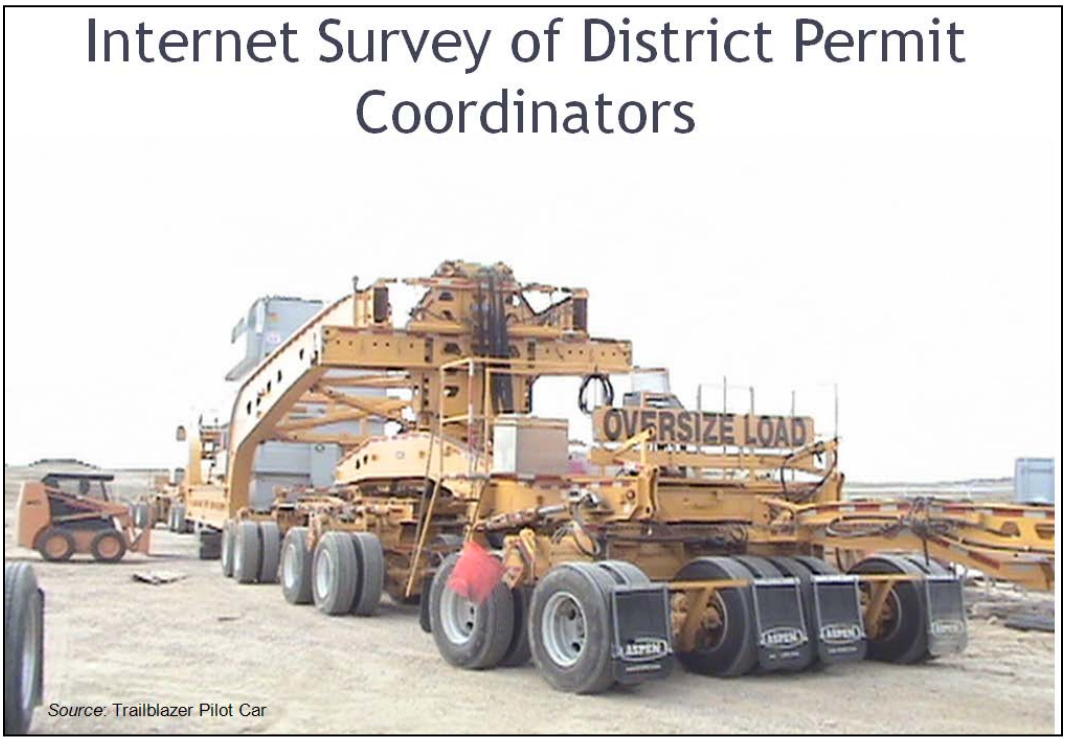
Category	Height (ft)	Width (ft)	Length (ft)	Gross Wt. (lb)
1	14.1 to 15	8.1 to 10	60 to 90	80k to 120k
2	15.1 to **(16)**	10.1 to 12	90.1 to **(120)**	120,001 to 150k
3	16.1 to 17	12.1 to 14	120.1 to 150	150,001 to 175k **(168K)**
4	17.1 to 18	14.1 to **(16)**	150.1 to 180	175,001 to 200k
5	18.1 to 19	16.1 to 18	>180	200,001 to 254k
6	19.1 to 20	18.1 to 20	N/A	>254k
7	N/A	>20	N/A	N/A

Shaded cells reach maximum at 95th percentile (indicated in red).

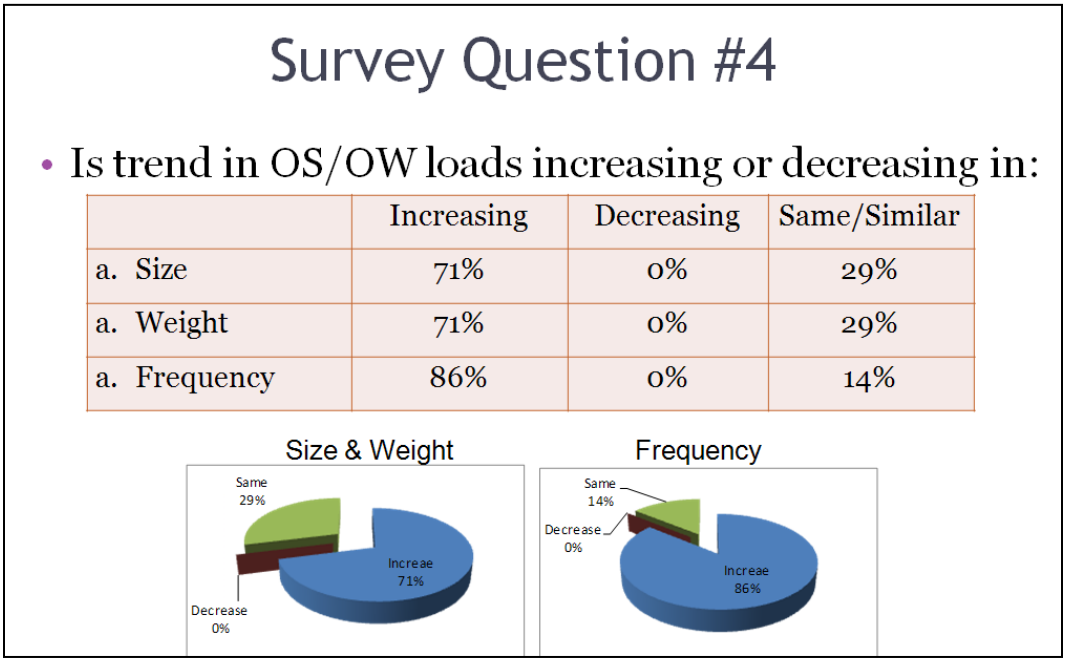
Slide #14 Load Categories



Slide #15 Internet Survey of District Permit Coordinators



Slide #16 Survey Question #4



	Increasing	Decreasing	Same/Similar
a. Size	71%	0%	29%
a. Weight	71%	0%	29%
a. Frequency	86%	0%	14%

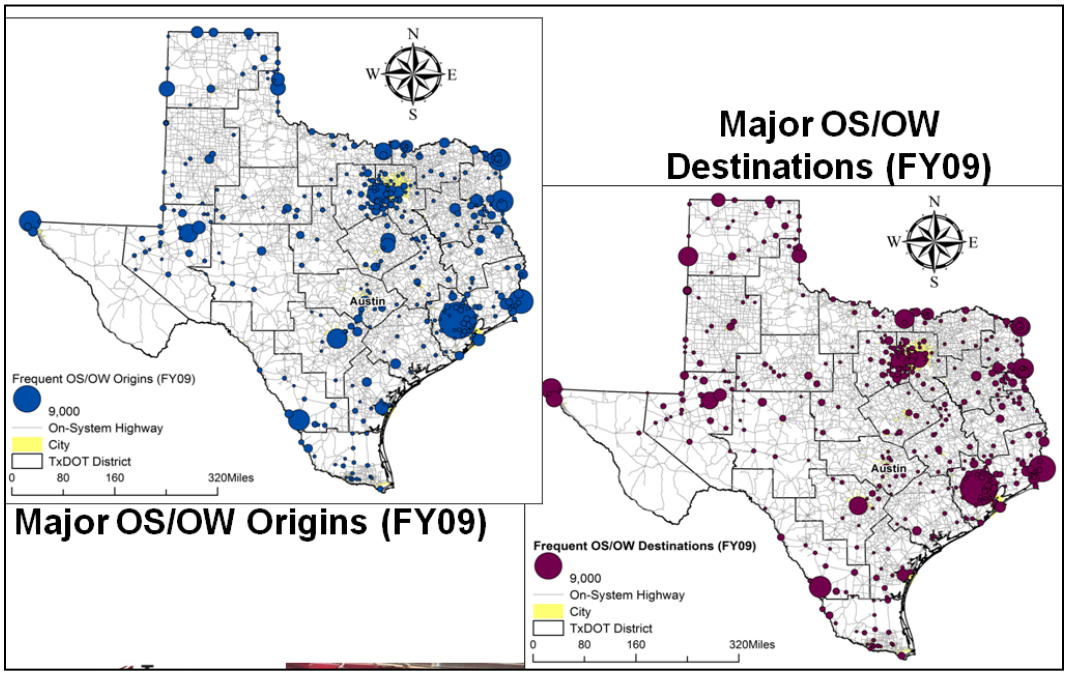
Slide #17 Survey Question #6

Survey Question #6

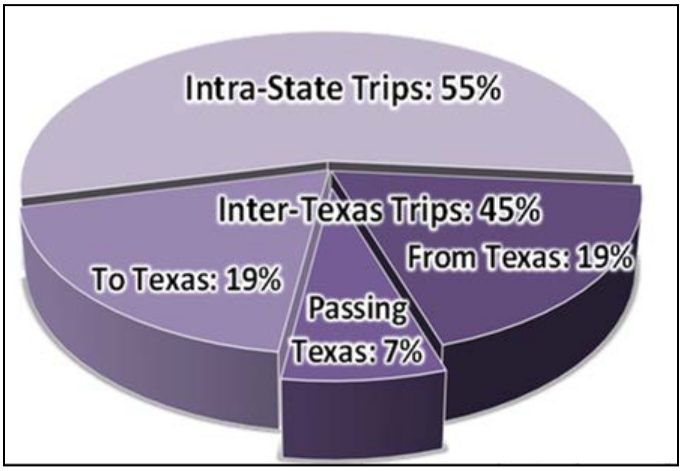
- a. What are the current impediments to movement of these OS/OW loads on trucks in your area?
  - Construction zones
  - Traffic signal mast arms instead of cables
  - Low bridges and underpasses, low hanging lines
- b. Do intermodal facilities need to be made larger or otherwise changed due to the predicted trends (yes)
  - More OS/OW loads could be transported by rail
  - Roads need to be built wider and stronger to accommodate the weight and turning (radius) of these loads.

Slide #18 Spatial Analysis Using ArcGIS

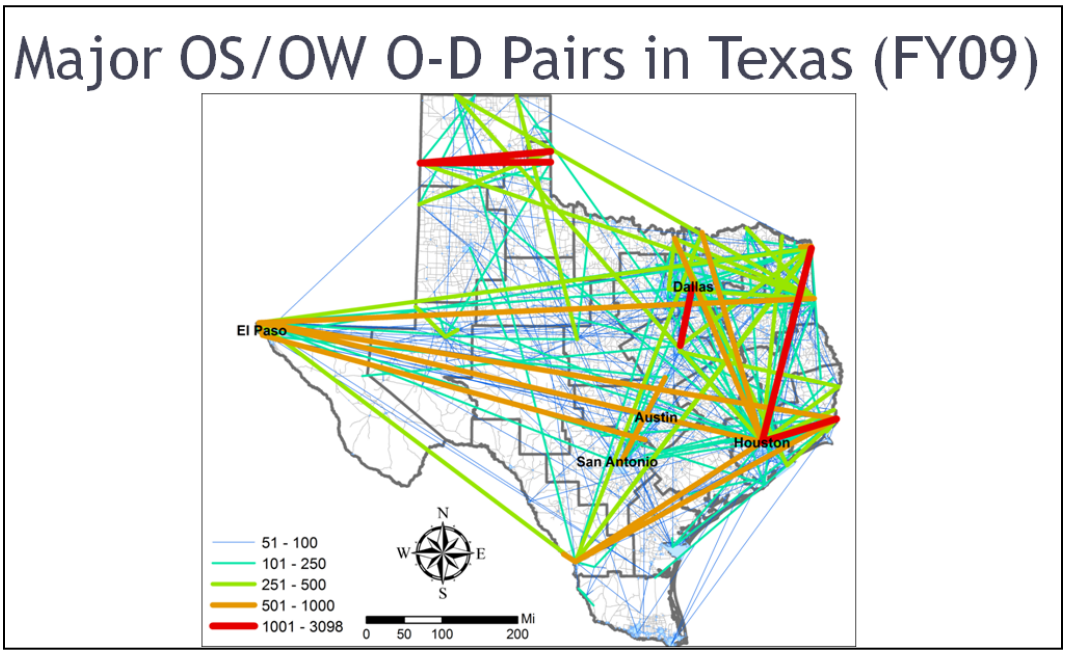
Slide #19 Major Origins and Destinations for 95th Percentile Loads (2009)



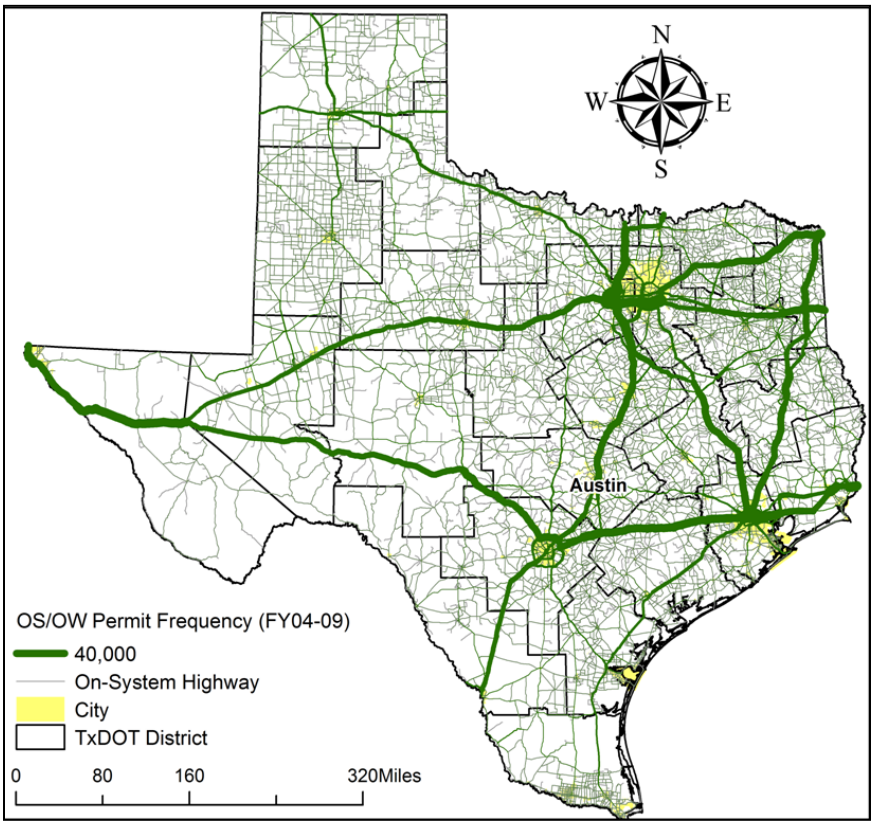
Slide #19a Animation Showing Trip Categories



Slide #20 Major OS/OW O-D Pairs in Texas (FY09)



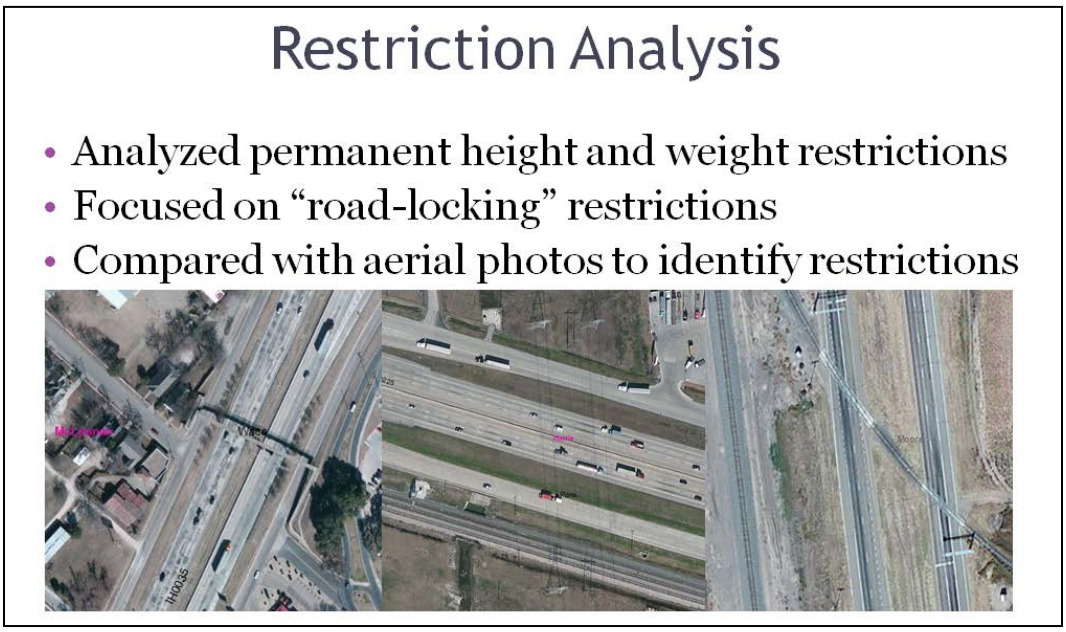
Slide #21 OS/OW Permit Frequency (FY04-09)



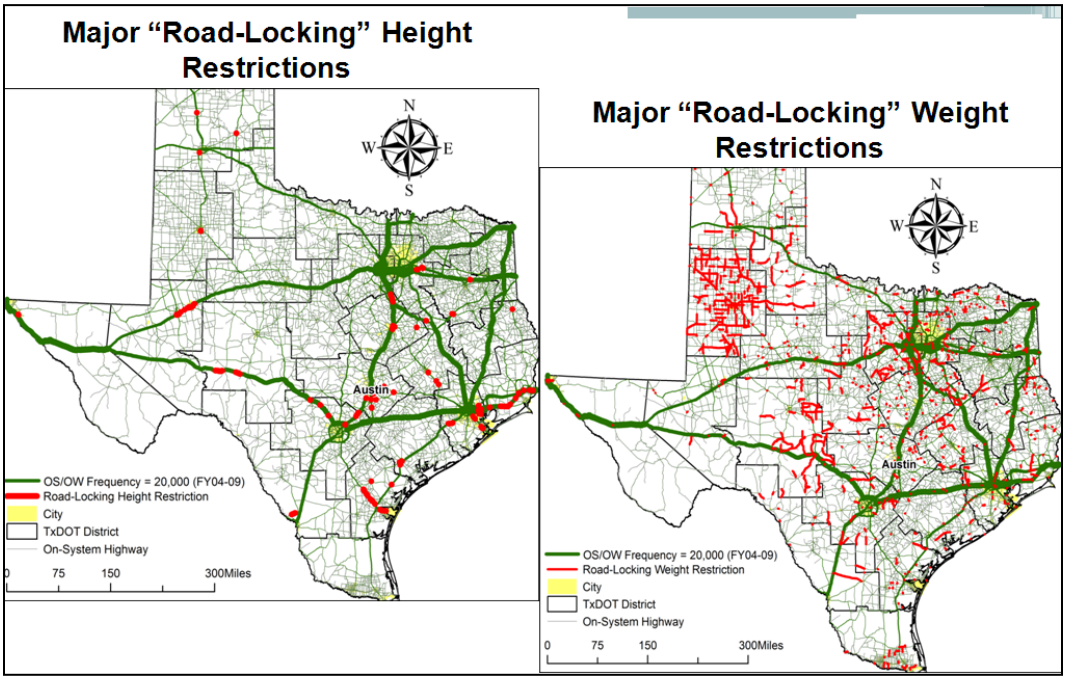
Slide #22 Restriction Analysis

- Apply “restrictions” from ProMiles
    - Compare actual vs. optimum routes
- Criteria for determining improvements
    - Number of loads bypassing per unit time
    - Difference in optimal routes and actual routes
    - Cost to motor carriers for extra mileage

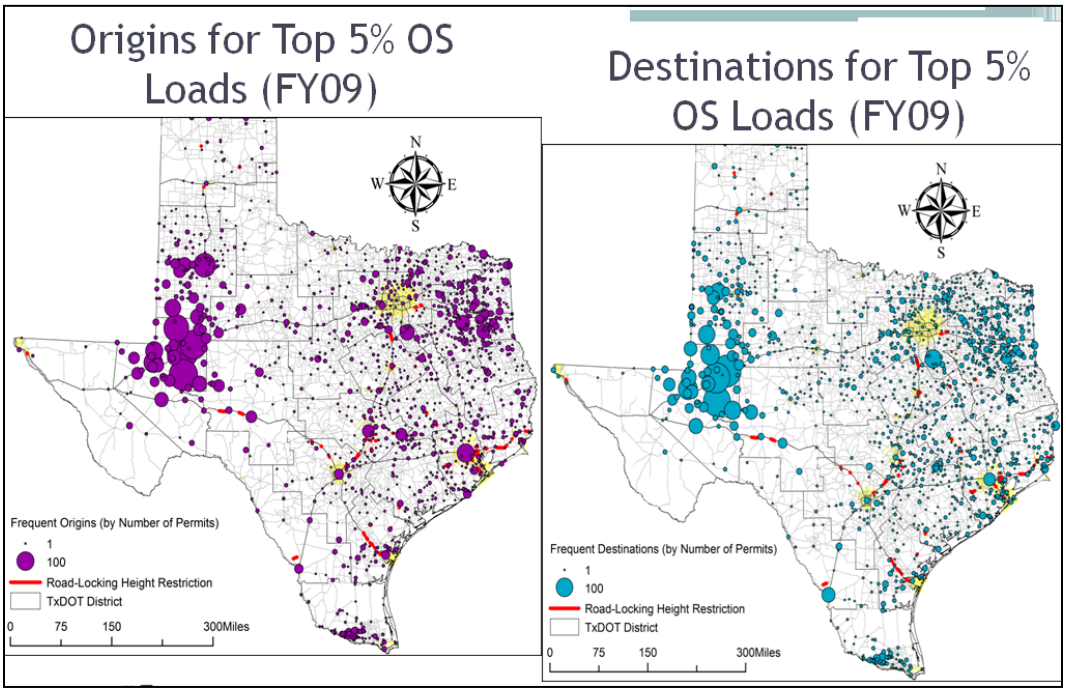
Slide #23 Restriction Analysis



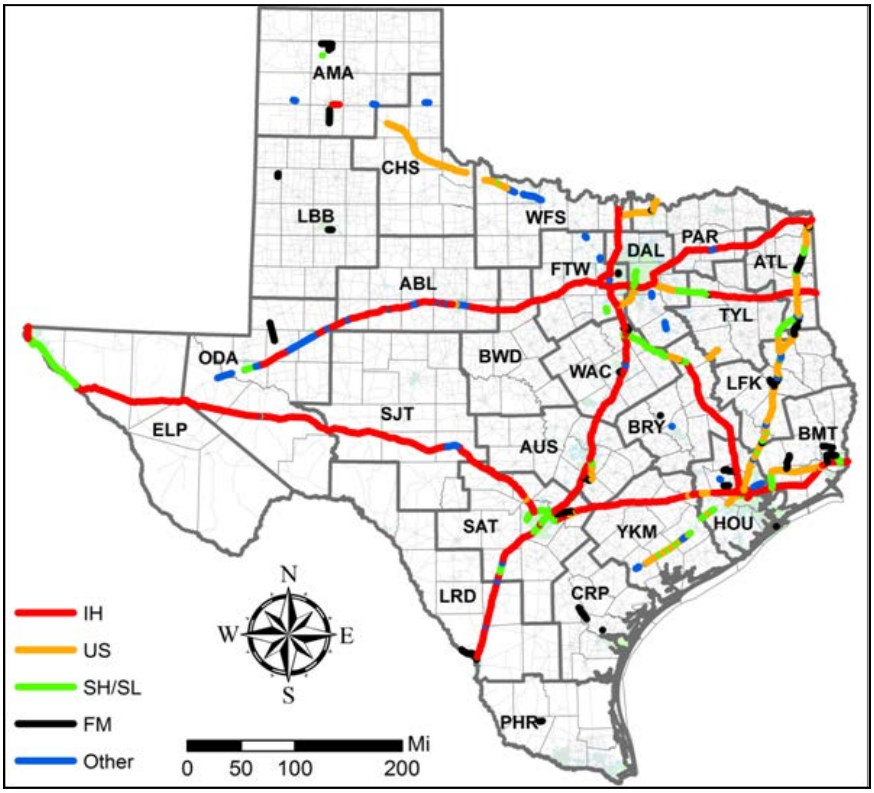
Slide #24 Height and Weight Restrictions



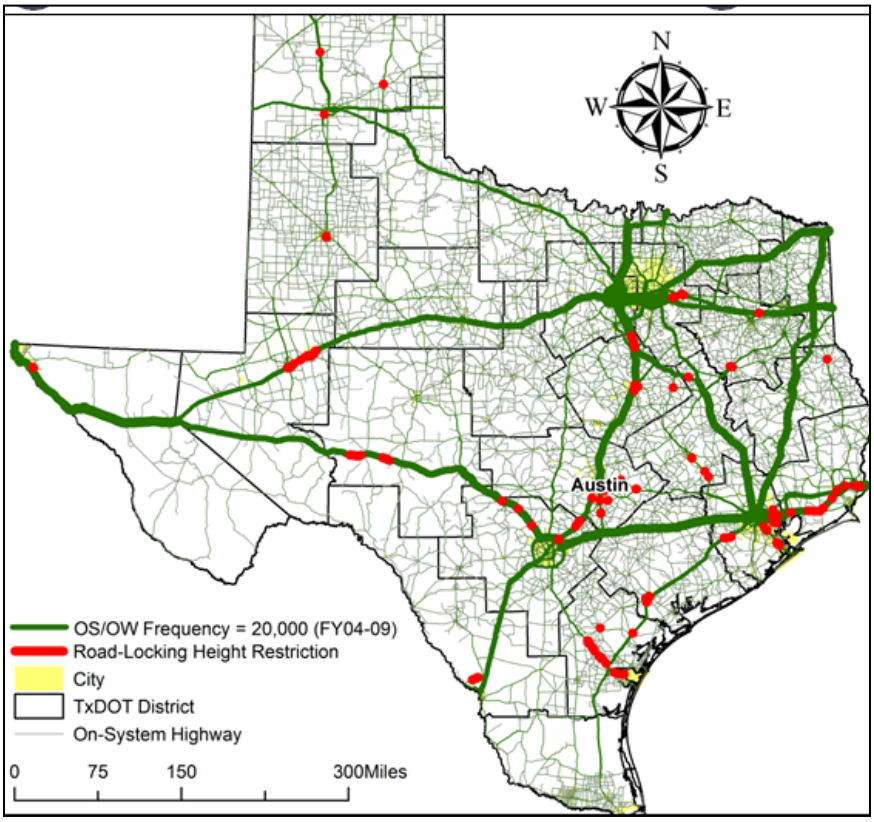
Slide #25 Origins and Destinations for Top 5% Loads (FY09)



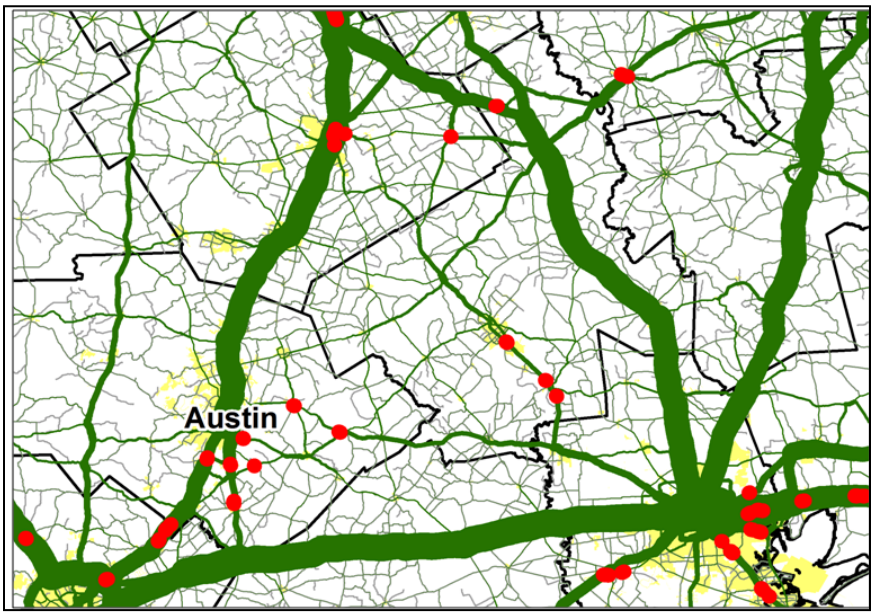
Slide #26 Top 50 OS/OW Corridors by Highway Type



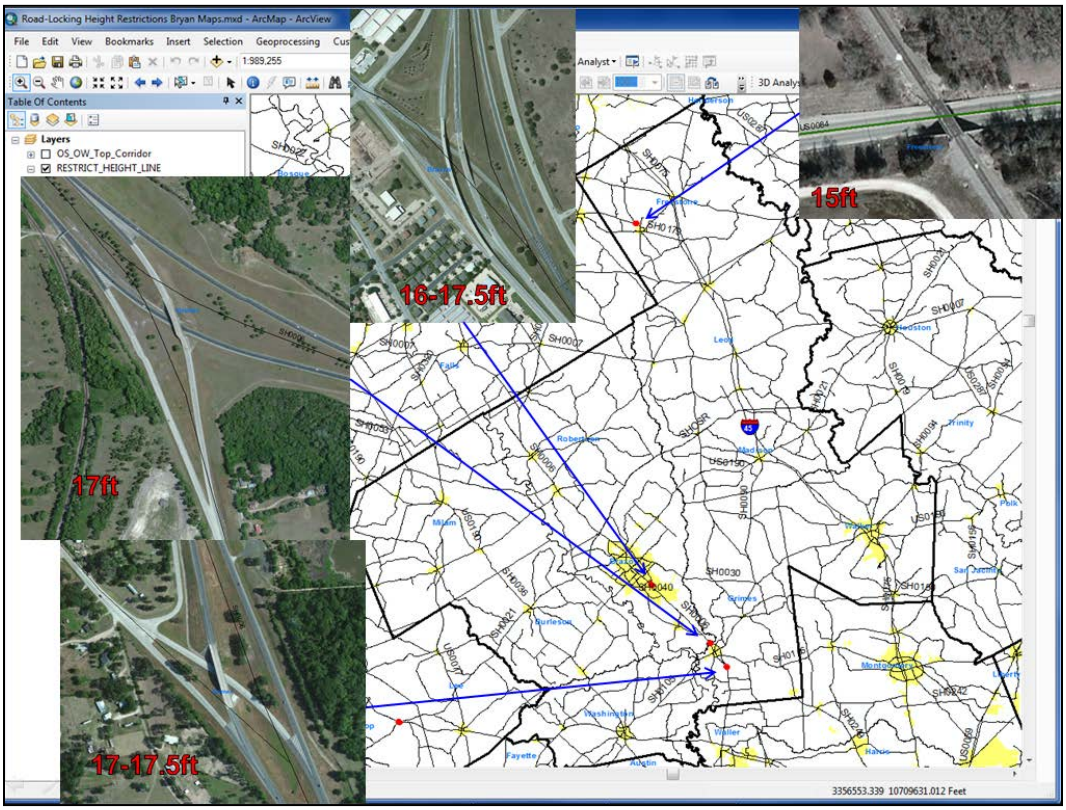
Slide #27 Height Restriction Segments



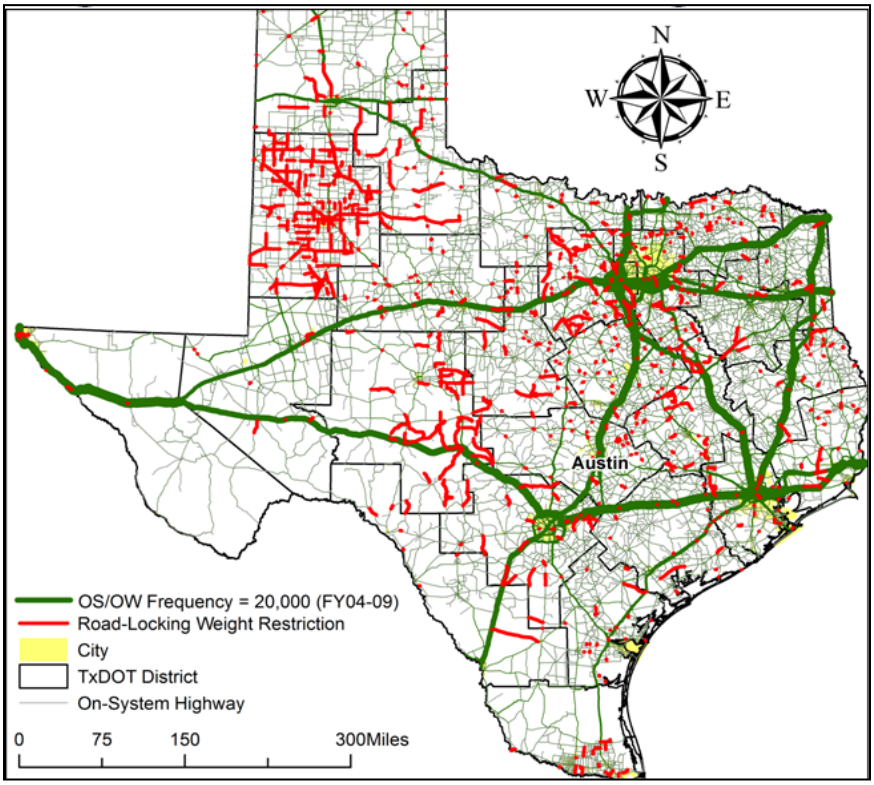
Slide #28 Height Restrictions Bryan District



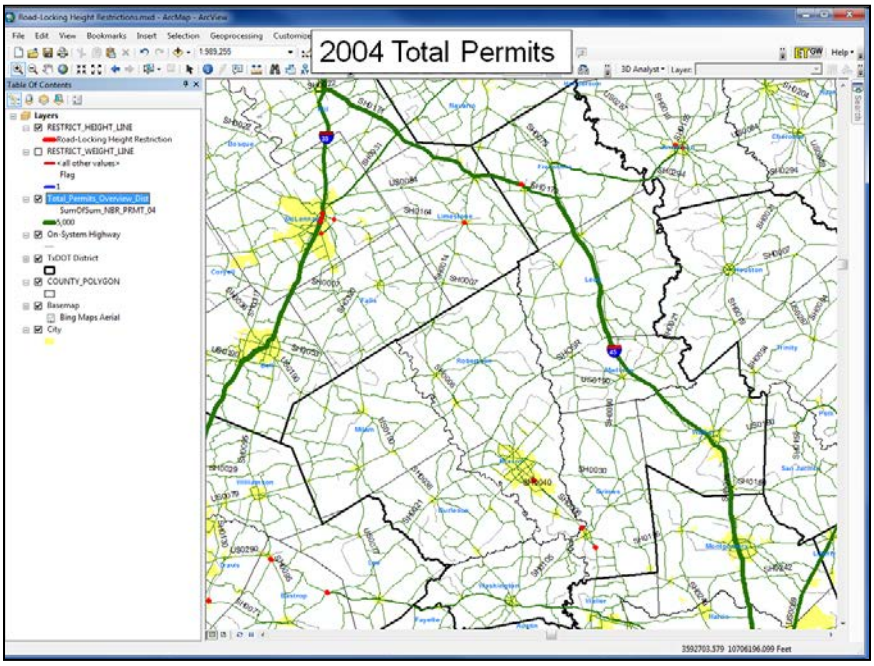
Slide #29 Map Showing Vertical Clearances in Bryan District



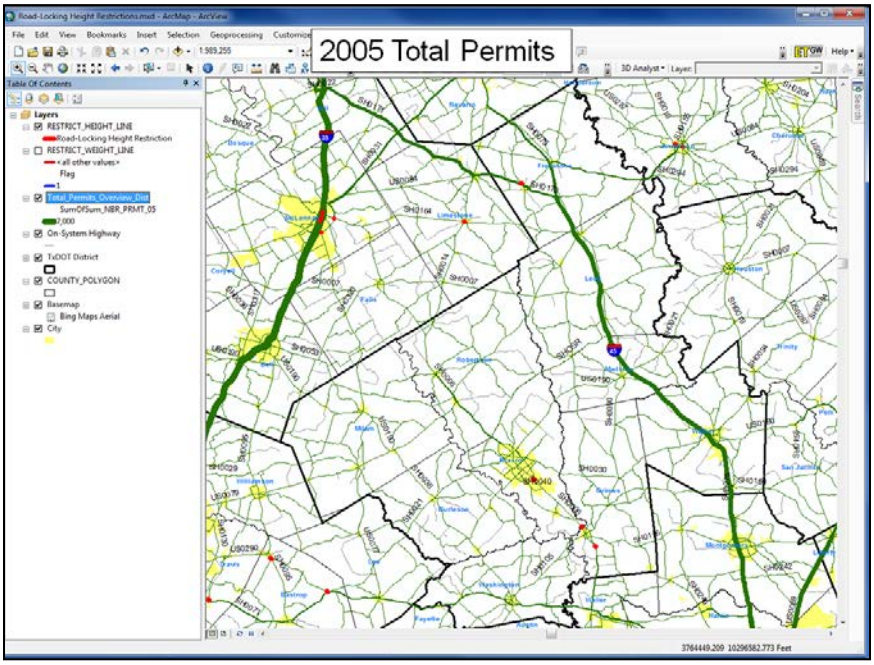
Slide #30 Weight Restriction Segments



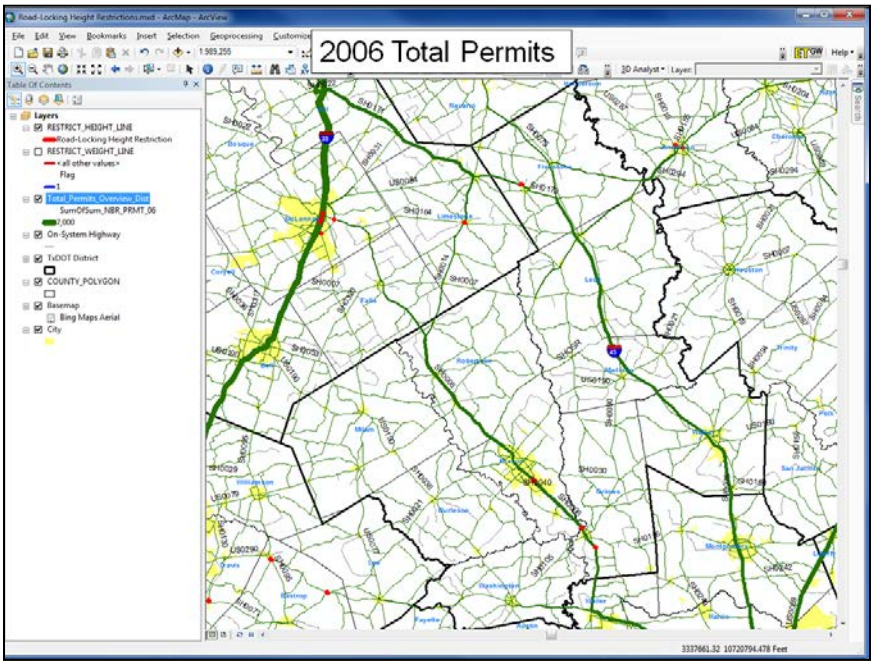
Slide #31 2004 Total Permits



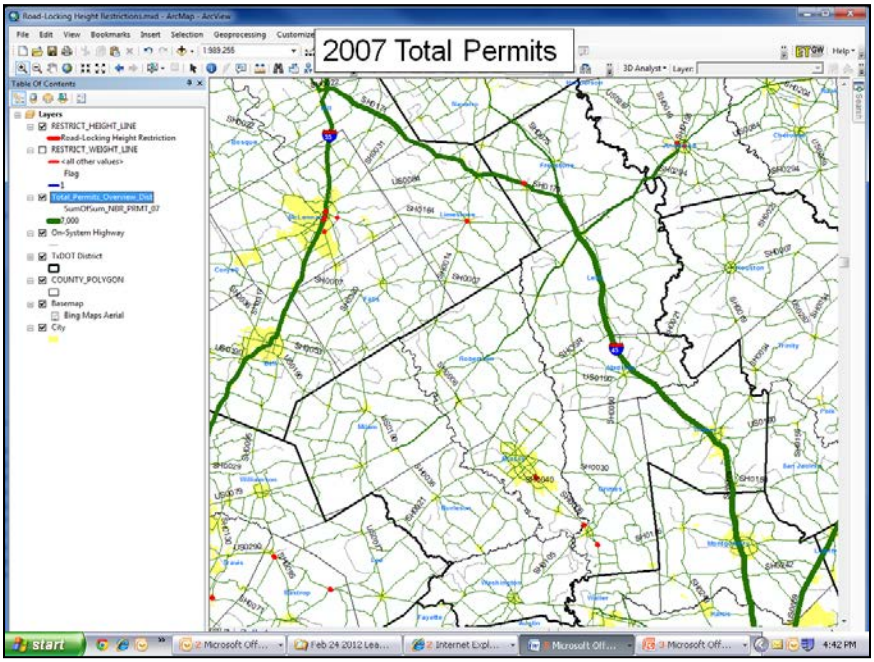
Slide #32 2005 Total Permits



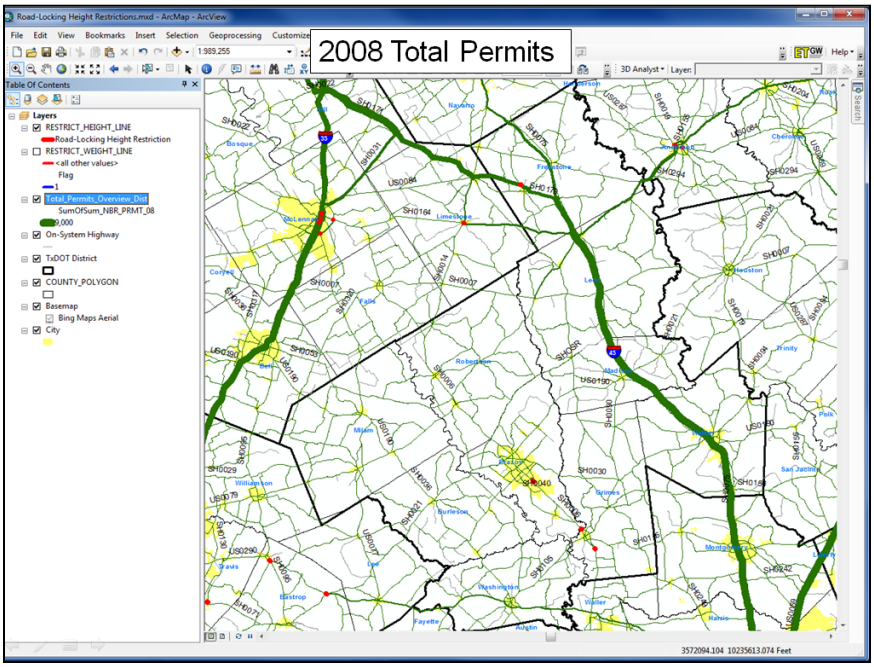
Slide #33 2006 Total Permits



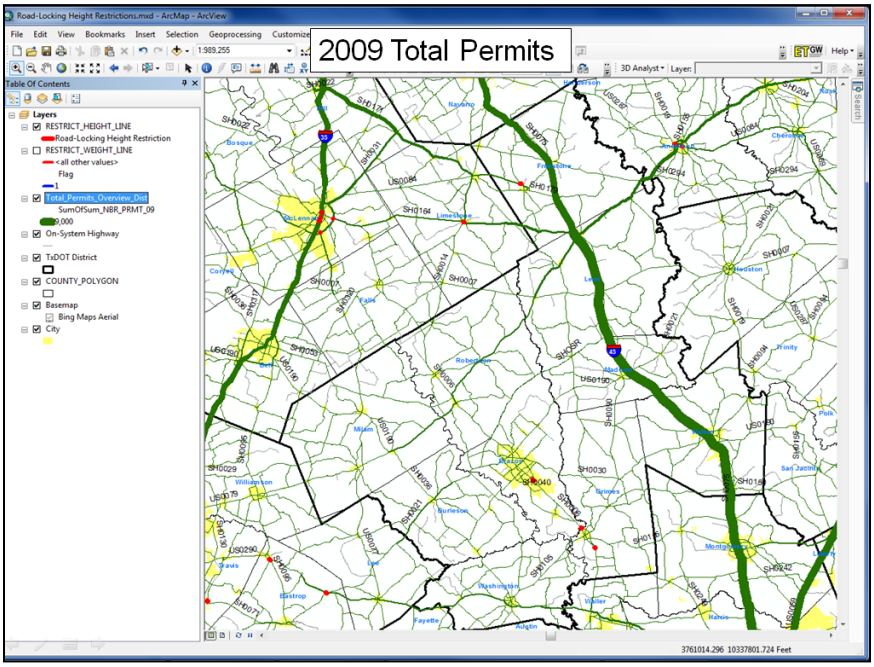
Slide #34 2007 Total Permits



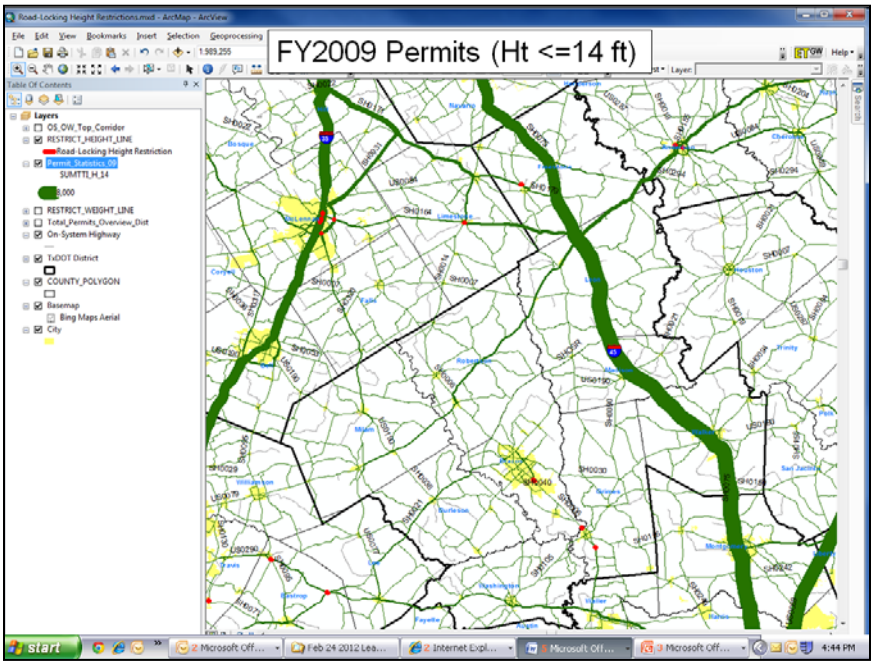
Slide #35 2008 Total Permits



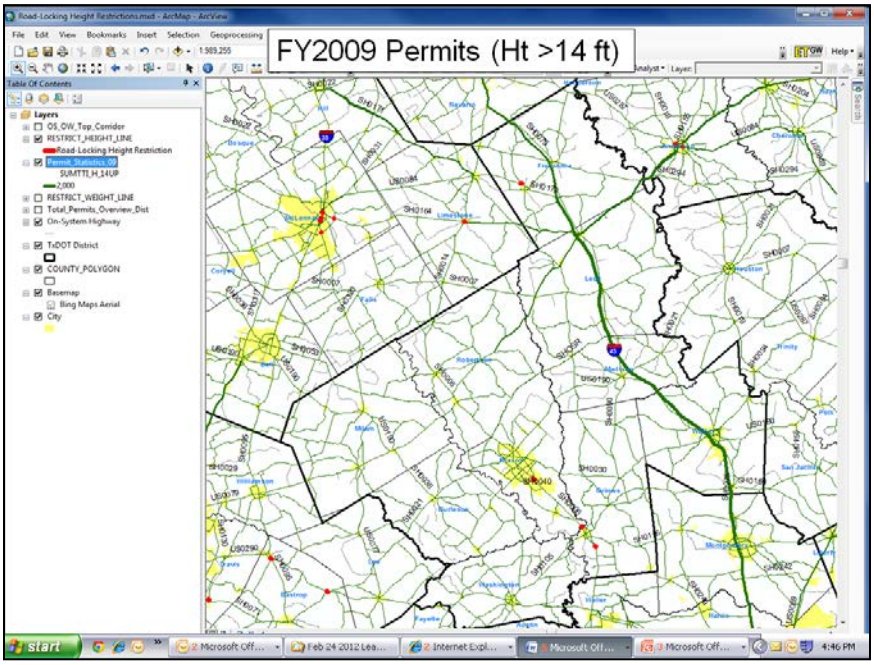
Slide #36 2009 Total Permits



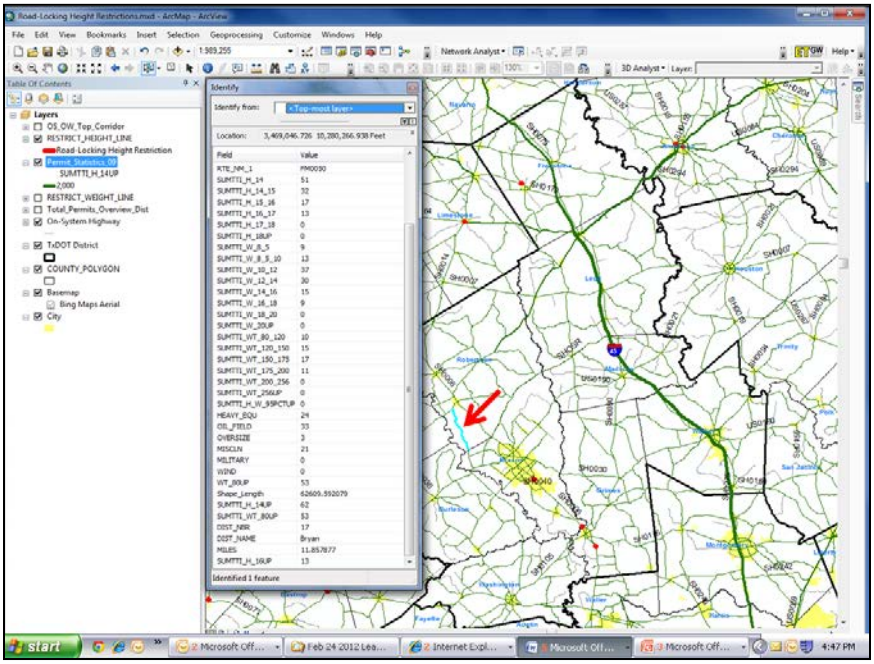
Slide #37 FY2009 Permits (Ht <=14 ft)



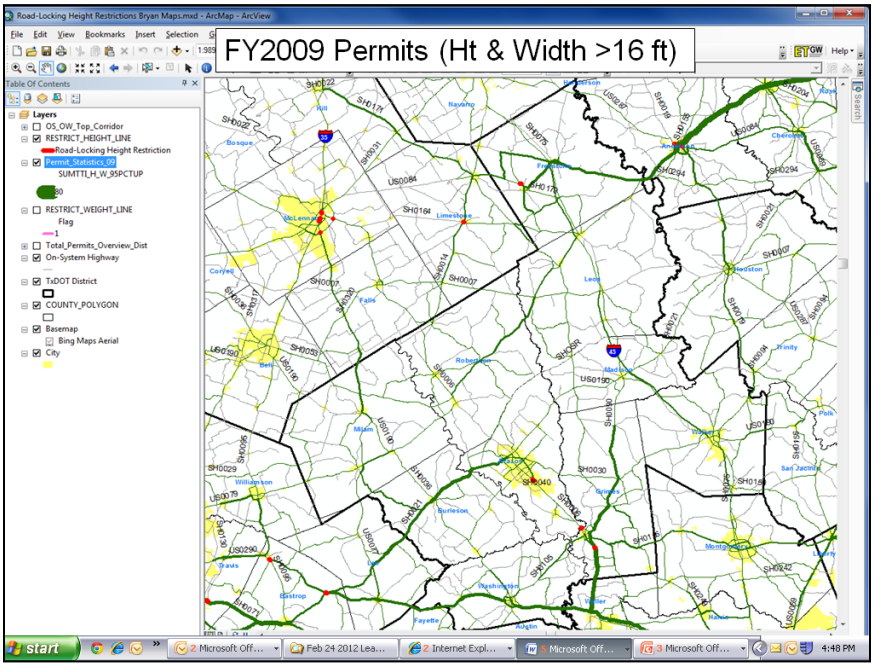
Slide #38 FY2009 Permits (Ht >14 ft)



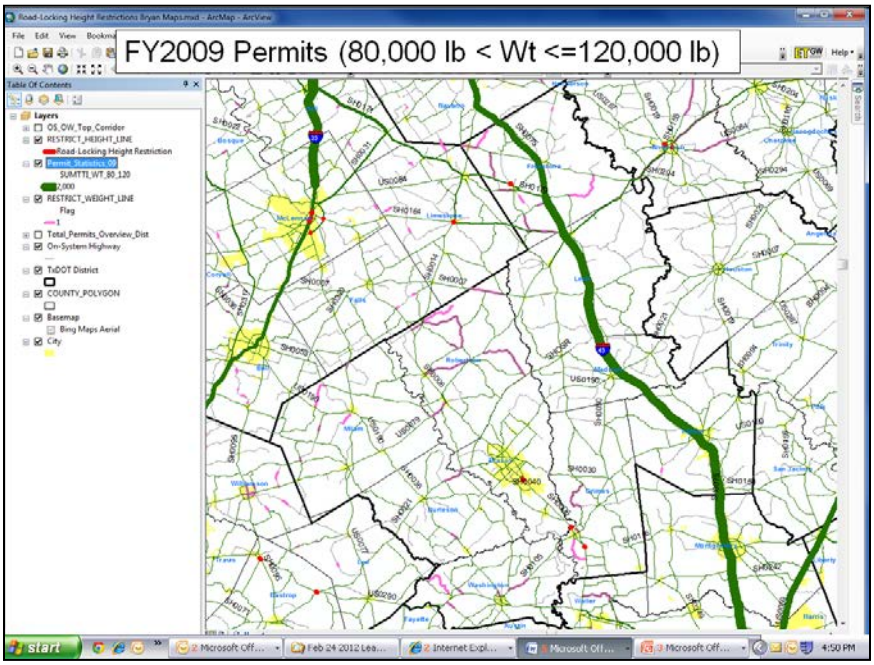
Slide #39 Route Information Showing Permit Loads



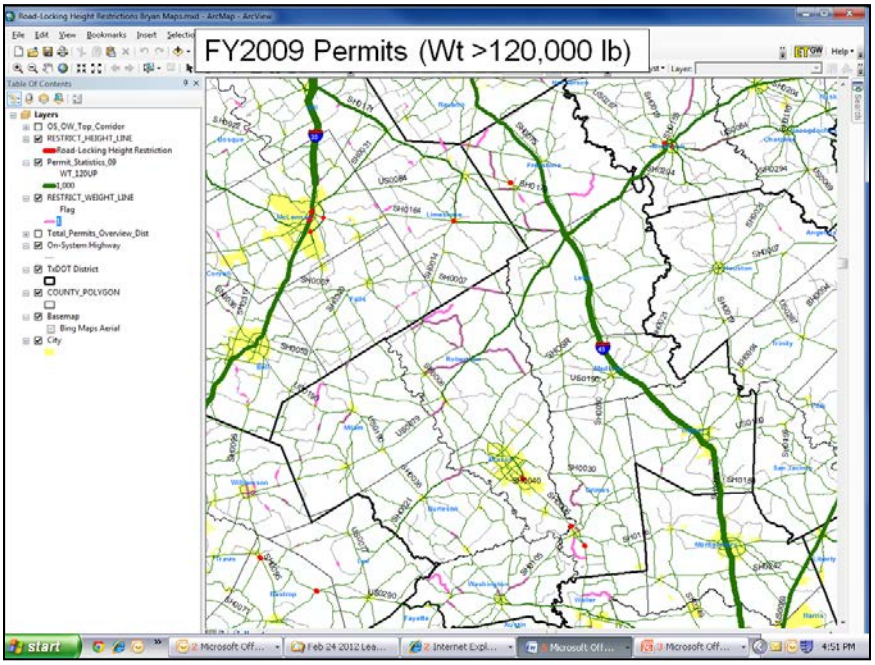
Slide #40 FY2009 Permits (Ht & Width >16 ft)



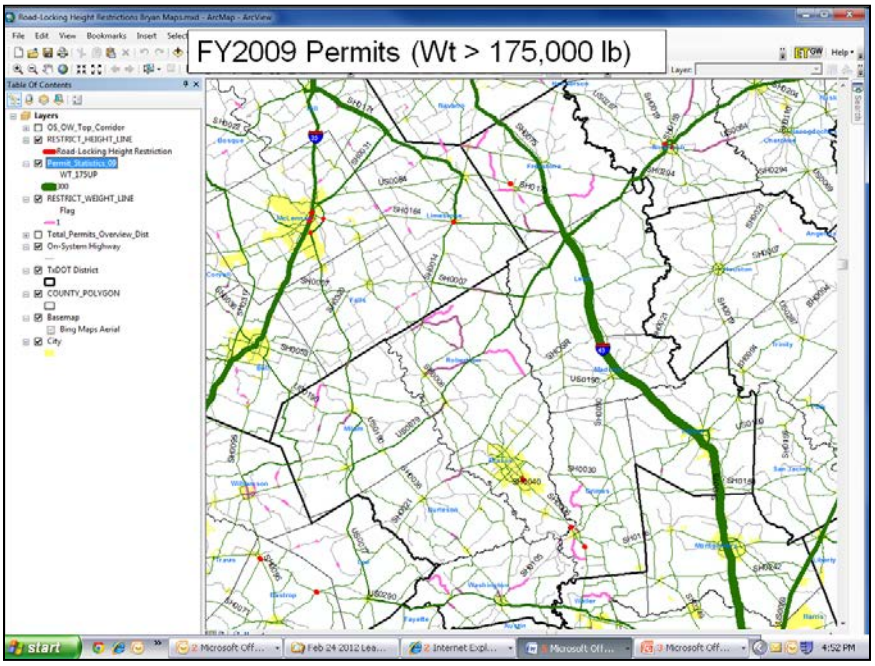
Slide #41 FY2009 Permits (80,000 lb < Wt <= 120,000 lb)



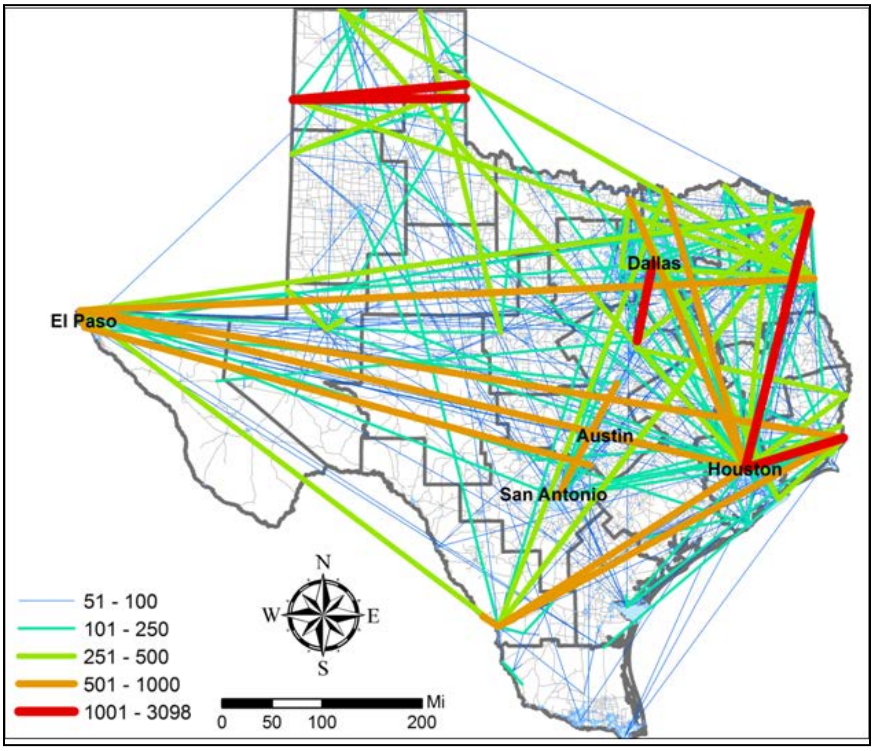
Slide #42 FY2009 Permits (Wt > 120,000 lb)



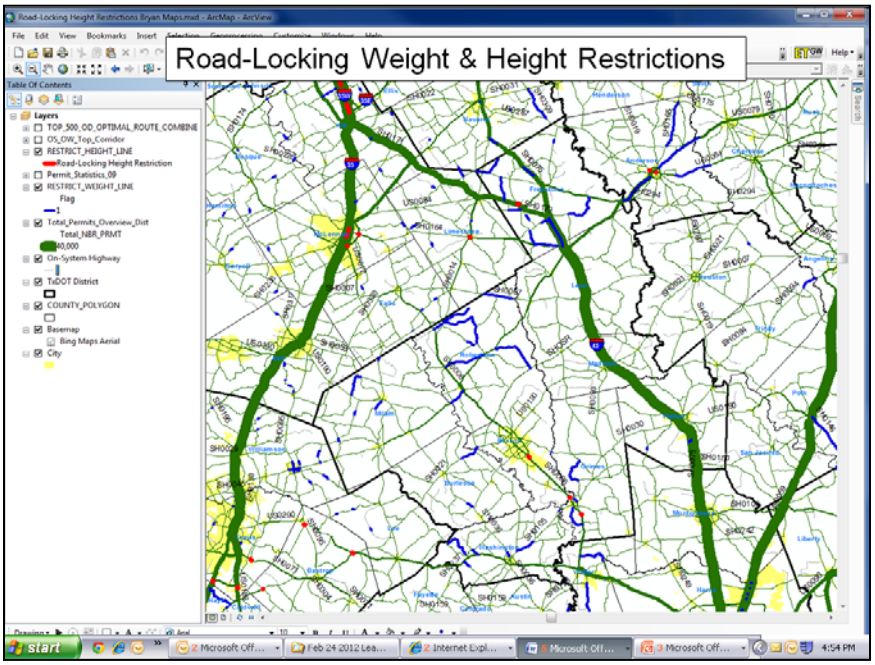
Slide #43 FY2009 Permits (Wt > 175,000 lb)



Slide #44 Major OS/OW OD Pairs in Texas (FY09)



Slide #45 Road-Locking Weight and Height Restrictions



Slide #46 Actual vs. Optimal Routes

Fiscal Year	Additional Ton-Miles (Selected)	Total Additional Ton-Miles based on	
		Average Difference	Median Difference
2004	21,334,582	438,892,449	252,639,771
2005	16,973,851	441,237,511	253,989,660
2006	19,047,574	513,329,491	295,487,984
2007	20,380,460	545,914,142	314,244,695
2008	23,974,935	572,333,733	329,452,611
2009	25,604,793	515,144,062	296,532,507
FY04-09	127,316,195	3,026,851,387	1,742,347,227
Average	--	504,475,231	290,391,205

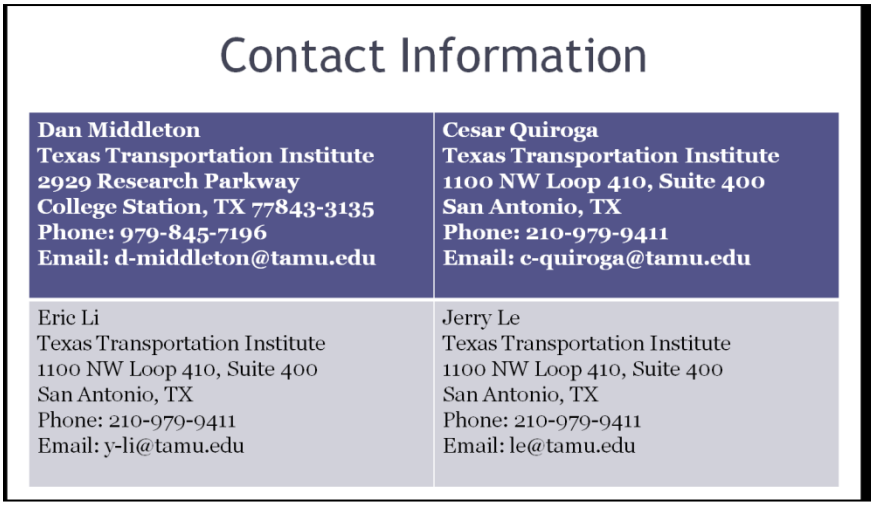
Slide #47 Summary: Actual vs. Optimal Routes

- Average difference of about 24 miles per trip
- OS/OW loads traveled about 504 million ton-miles more per year
- Additional cost of about $73 million per year
- Additional CO_2 Emission of about 75,000 tons

Slide #48 Conclusions and Recommendations

- Logical parallel OS/OW routes
  - IH-45 Houston to Dallas
  - SH 6 US 290 to IH-35 in Waco
  - Others as needed
- Height restrictions are minimal in Bryan District
- Weight restrictions mostly on minor connectors

Slide #49 Contact Information



1. Freight Facts and Figures 2010. Federal Highway Administration, 2010. http://ops.fhwa.dot.gov/freight/freight_analysis/nat_freight_stats/docs/10factsfigures/index.htm. Accessed July 2011.

2. Texas Department of Transportation 2007 Motor Carrier Division Annual Report. Texas Department of Transportation, 2007. ftp://ftp.dot.state.tx.us/pub/txdot-info/mcd/pdf/annualrpt07.pdf. Accessed July 2012.

3. Texas Permitting & Routing Optimization System (TxPROS). Texas Department of Transportation. http://www.txdot.gov/business/motor_carrier/overweight_permit/txpros.htm. Accessed March 2009.

4. http://www.txdot.gov/local_information/bryan_district/ accessed February 10, 2012.