Using the Field Calculator to Estimate International Freight on Corridors

The Case Study of Texas

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Agenda

- Overview
- Methodology
- Results
- Conclusions

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Overview

- Timely movement of freight vital to national economy
- To anticipate infrastructure needs, must have accurate estimates of freight volumes
- This research is a methodology to estimate international freight flows on corridors in Texas

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Federal Highway Administration's Freight Analysis Framework (FAF)

- FAF^3 is the most comprehensive publicly available dataset of freight movements
- FAF^3 estimates commodity movements over specific highways including data for 2007 and forecasts for 2040
- Accurate information identifying and anticipating capacity shortfalls and congestion nodes is important for improving strategic investment decisions

While FAF^3 provides reasonable estimates for national and multi-state corridor analyses, FAF^3 estimates do not have the sufficient level of disaggregation to support more local, regional, or state planning

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The objectives of the research are:

- Disaggregate national FAF^3 data
- Estimate tons of international freight through statewide roadways and railways
- Estimate current and future freight demand

Texas is used as a case study

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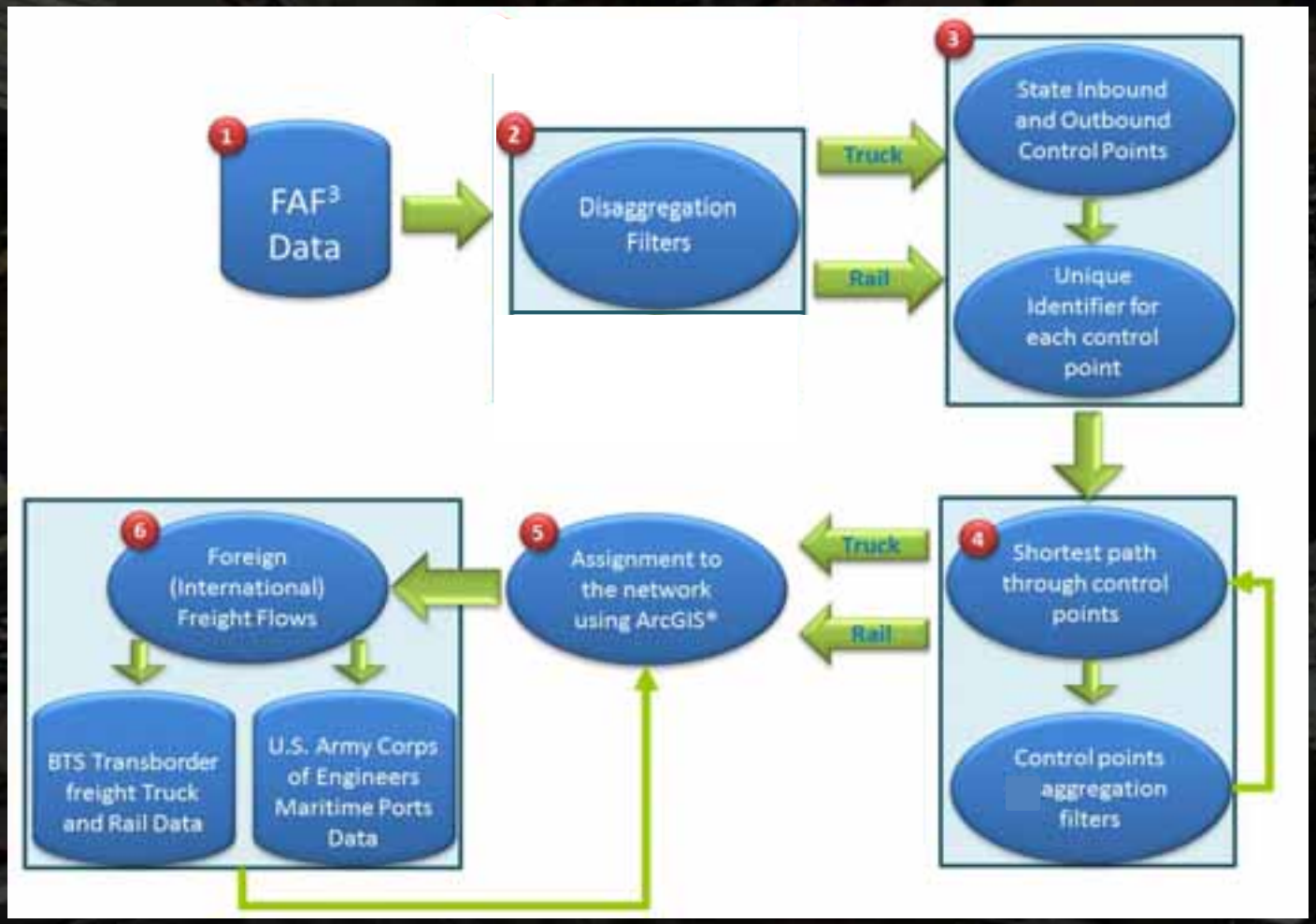
Methodology to Estimate Statewide Freight Flows



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FAF^3 Zone Structure—Commodity Flows Survey Zones

Source: Developed by TTI with data from the FHWA's Freight Analysis Framework (FAF^3), 2011

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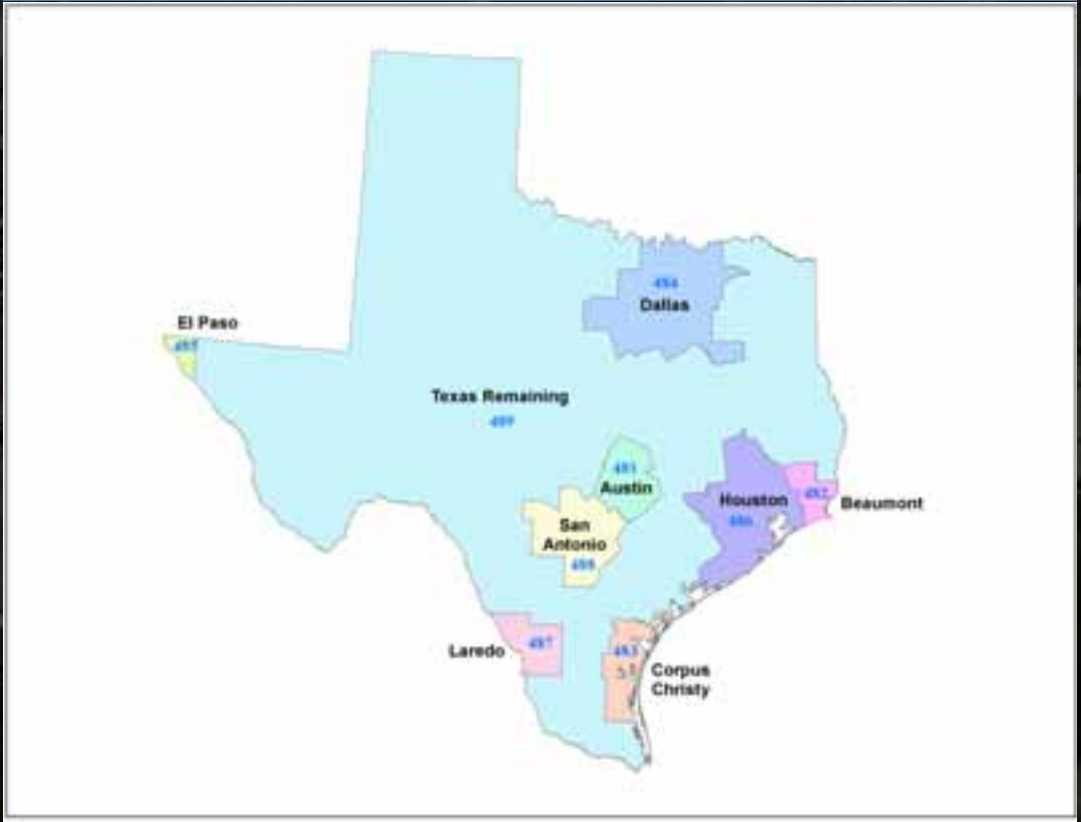
Created Database: Queries performed to export only O-D pairs within Texas zones

- Data filters applied in Excel to separate O-D pairs by:
  - Trade type
    - (imports/exports)
  - Domestic mode
    - (truck/rail)
  - Tons per year
    - (2007 & 2040 tons)

Texas Freight Analysis Zones



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Control points were located where freight moved in-and-out of the state

Interstate Highways (Truck Routes)	ID	Surface Ports of Entry	ID	Maritime Ports	ID
I-10 at El Paso TX to Los Angeles	1	El Paso	9	Houston	17
I-10 at Orange TX to Louisiana	2	Presidio	10	Corpus Christi	18
I-20 at Waskom to Louisiana	3	Del Rio	11	Beaumont	19
I-30 at Texarkana TX to Arkansas	4	Eagle Pass	12	Texas City	20
US 75 at Denison TX to Oklahoma	5	Laredo	13	Galveston	21
I-35 at Gainesville TX to Oklahoma	6	Hidalgo	14		
I-40 East of Amarillo	7	Brownsville	15		
I-40 West of Amarillo	8	Progreso	16		

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A Simplified Network using only major routes and Control Points

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Our Shortest Path and Data Summary Approaches:

- Used Google's "Get Directions"
- Where multiple options of similar travel time, route assigned to roads with larger capacity
- O-D Pair assigned to an inbound-outbound Control Point
- Unique ID for Control Points added to O-D Pairs in Excel
- Pivot tables used to summarize Flows from and to Texas through Control Points

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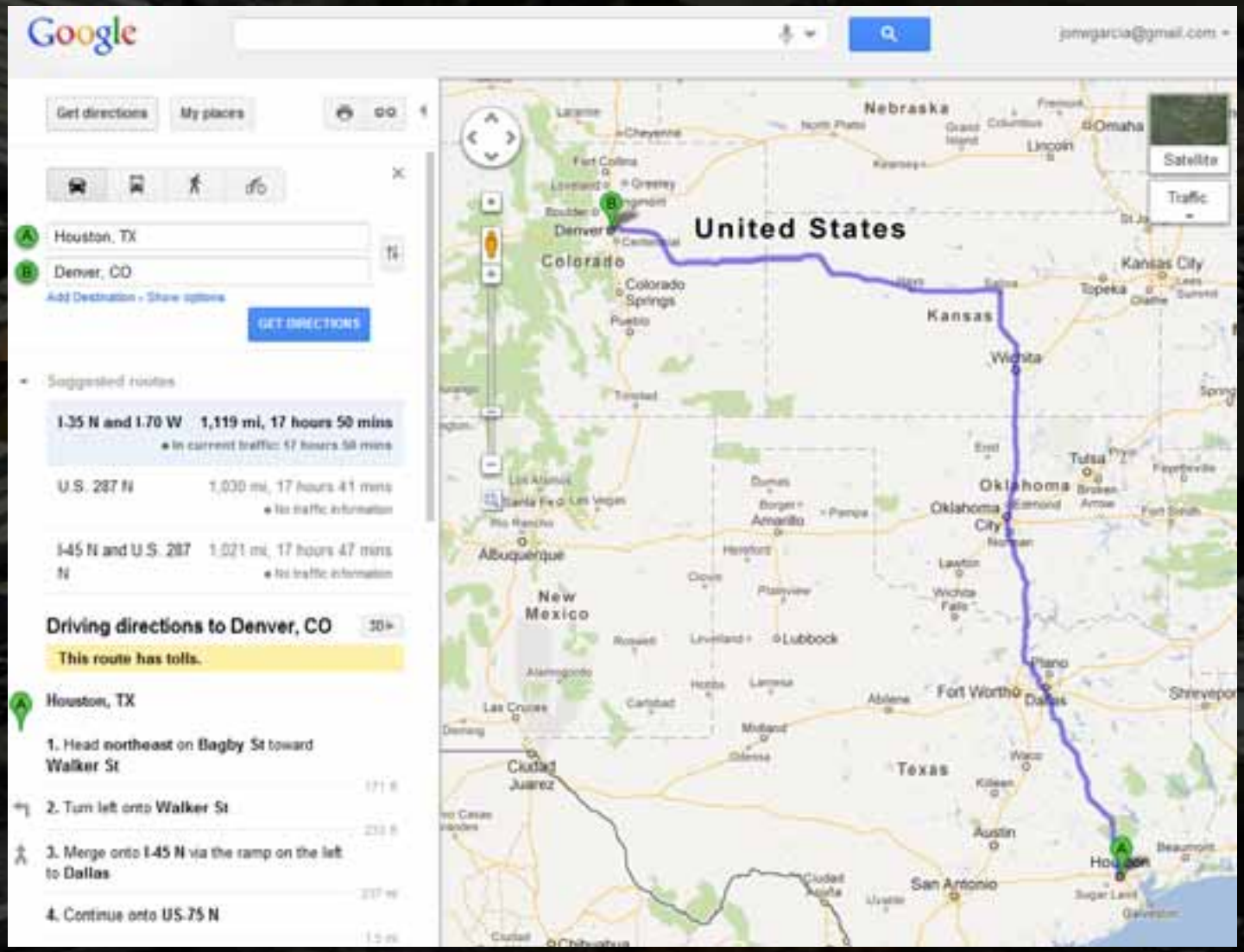
Used Google's "Get Directions"



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Database Preparation

	DEST_Name	DEST	ORIGIN	ORIGIN_Name	Origin in TX		Destination in TX		Total Tons through TX		
	ORIGIN (DEST) NAME	ORIGIN (DEST	DEST (ORIGIN)	DEST (ORIGIN) NAME	TX ORIGIN 2007	TX ORIGIN 2040	DEST TX 2007	DEST TX 2040	TOTAL 2007	TOTAL 2040	CONTROL POINTS
745	Houston	486	409	Remainder of Oklahoma	27.19	83.44	32.84	99.07	60.03	182.51	8
746	Houston	486	411	Portland, OR-WA MSA (OR Part)	15.21	43.03	100.77	143.33	115.99	186.36	8
747	Houston	486	419	Remainder of Oregon	17.42	38.98	0.28	1.89	17.70	40.87	8
748	Houston	486	421	Philadelphia, PA-NJ-DE-MD CSA (PA Pr	89.68	211.78	250.08	794.47	339.74	1,006.24	1
749	Houston	486	422	Pittsburgh, PA CSA	14.55	33.35	117.94	242.48	132.49	275.80	1
750	Houston	486	429	Remainder of Pennsylvania	27.67	77.73	61.30	78.16	88.97	155.89	1
751	Houston	486	440	Rhode Island	0.06	0.15	175.07	229.82	175.13	229.97	1
752	Houston	486	451	Charleston, SC MSA	78.72	248.38	126.82	349.13	205.54	597.51	1
753	Houston	486	452	Greenville, SC CSA	16.16	43.03	0.75	3.46	16.91	46.48	1
754	Houston	486	459	Remainder of South Carolina	1.95	4.88	9.74	19.83	11.69	24.71	1
755	Houston	486	460	South Dakota	0.77	1.70	0.52	3.13	1.28	4.83	6
756	Houston	486	471	Memphis, TN-MS-AR MSA (TN Part)	9.60	30.00	71.95	272.07	81.55	302.07	1
757	Houston	486	472	Nashville, TN CSA	11.62	25.34	1.97	40.03	13.59	65.37	1
758	Houston	486	479	Remainder of Tennessee	15.96	40.83	7.81	22.73	23.77	63.56	1
759	Houston	486	481	Austin, TX MSA	158.65	295.57			158.65	295.57	
760	Houston	486	482	Beaumont, TX MSA	1,323.26	3,034.10			1,323.26	3,034.10	
761	Houston	486	483	Corpus Christi, TX CSA	1,191.44	5,436.75			1,191.44	5,436.75	
762	Houston	486	484	Dallas-Fort Worth, TX CSA	2,054.31	4,345.33			2,054.31	4,345.33	
763	Houston	486	485	El Paso, TX MSA	1,625.73	3,771.02			1,625.73	3,771.02	
764	Houston	486	486	Houston, TX CSA	18,227.40	51,153.83			18,227.40	51,153.83	
765	Houston	486	487	Laredo, TX MSA	1,353.40	3,755.59			1,353.40	3,755.59	
766	Houston	486	488	San Antonio, TX MSA	352.91	770.06			352.91	770.06	
767	Houston	486	489	Remainder of Texas	2,742.65	6,244.56			2,742.65	6,244.56	
768	Houston	486	491	Salt Lake City, UT CSA	74.97	253.93	2.62	11.22	77.59	265.15	8
769	Houston	486	499	Remainder of Utah	1.52	3.41	0.09	0.51	1.61	3.92	8
770	Houston	486	500	Vermont	3.99	10.02	1.01	2.68	4.00	12.70	1
771	Houston	486	511	Richmond, VA MSA	3.62	9.29	30.51	57.31	34.13	66.59	1
772	Houston	486	512	Norfolk, VA-NC MSA (VA Part)	22.14	65.73	26.76	69.58	48.90	133.32	1
773	Houston	486	513	Washington, DC-MD-VA-WV CSA (VA P	772.91	1,770.10	23.76	53.10	796.67	1,823.20	1
774	Houston	486	519	Remainder of Virginia	0.20	0.48	18.97	100.94	17.16	101.43	1
775	Houston	486	531	Seattle, WA CSA	31.58	117.81	117.41	181.67	148.99	299.48	8
776	Houston	486	539	Remainder of Washington	172.43	351.08	71.70	186.35	244.13	537.43	8
777	Houston	486	540	West Virginia	4.47	12.03	0.36	0.74	4.84	12.77	1
778	Houston	486	551	Milwaukee, WI CSA	28.33	66.22	20.10	49.94	48.43	116.16	4
779	Houston	486	559	Remainder of Wisconsin	32.62	100.31	7.57	15.27	40.20	115.58	4
780	Houston	486	560	Wyoming	13.74	30.08	0.01	0.02	13.75	30.11	8
781	Houston	486	801	Canada	1,156.5	3,320.1	520.26	1,343.64	1,676.71	4,663.71	17
782	Houston	486	802	Mexico	5,858.3	14,860.3	3,247.76	9,102.35	9,106.10	23,962.61	13
783	Houston	486	803	Rest of Americas	3,858.2	12,983.0	8,034.29	19,563.69	11,892.54	32,546.70	13
784	Houston	486	804	Europe	2,842.8	8,590.3	4,013.40	8,047.75	6,855.18	16,638.05	17
785	Houston	486	805	Africa	960.4	2,795.8	3,929.98	8,214.99	4,886.41	11,010.81	17
786	Houston	486	806	Southern, Central, and Western Asia	1,278.5	4,616.4	1,634.01	3,181.41	2,912.47	7,798.05	17
787	Houston	486	807	Eastern Asia	2,203.5	7,476.8	6,031.62	16,054.04	8,235.08	23,530.80	17
788	Houston	486	808	South-Eastern Asia and Oceania	385.5	1,494.6	857.14	2,027.98	1,240.64	3,522.33	17

Control Points are Assigned to the O-D Pairs

Pivot Tables to Aggregate Data based on Control Points

	A	B	C
1	CONTROL POINTS	6	
2			
3		Values	
4	Row Labels	Sum of TOTAL 2007	Sum of TOTAL 2040
5	Austin	20.6944	82.1495
6	Beaumont	343.082	981.1608
7	Corpus Christy	650.8318	892.8932
8	Dallas	123.8864	374.0062
9	El Paso	1267.4544	3563.4782
10	Houston	801.6922	2128.0101
11	Laredo	780.7518	2114.8547
12	San Antonio	19.83	73.7824
13	**Grand Total**	**4008.223**	**10210.3351**
14			

	A	B	C
1	CONTROL POINTS	13	
2			
3		Values	
4	Row Labels	Sum of TOTAL 2007	Sum of TOTAL 2040
5	Austin	1,986.57	7,328.57
6	Beaumont	1,319.64	3,907.43
7	Corpus Christy	1,376.55	3,182.01
8	Dallas	12,361.64	29,077.63
9	Houston	20,998.64	56,509.31
10	Laredo	107.39	355.73
11	San Antonio	2,762.07	10,548.68
12	**Grand Total**	**40,912.51**	**110,909.35**
13			

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Freight Flows Assignment using ArcGIS

- Results from Google were adjusted to show flows only on truck routes
- The field calculator was used to assign freight to the links in the networks by selecting the shortest route & incrementally adding the values to the attribute fields

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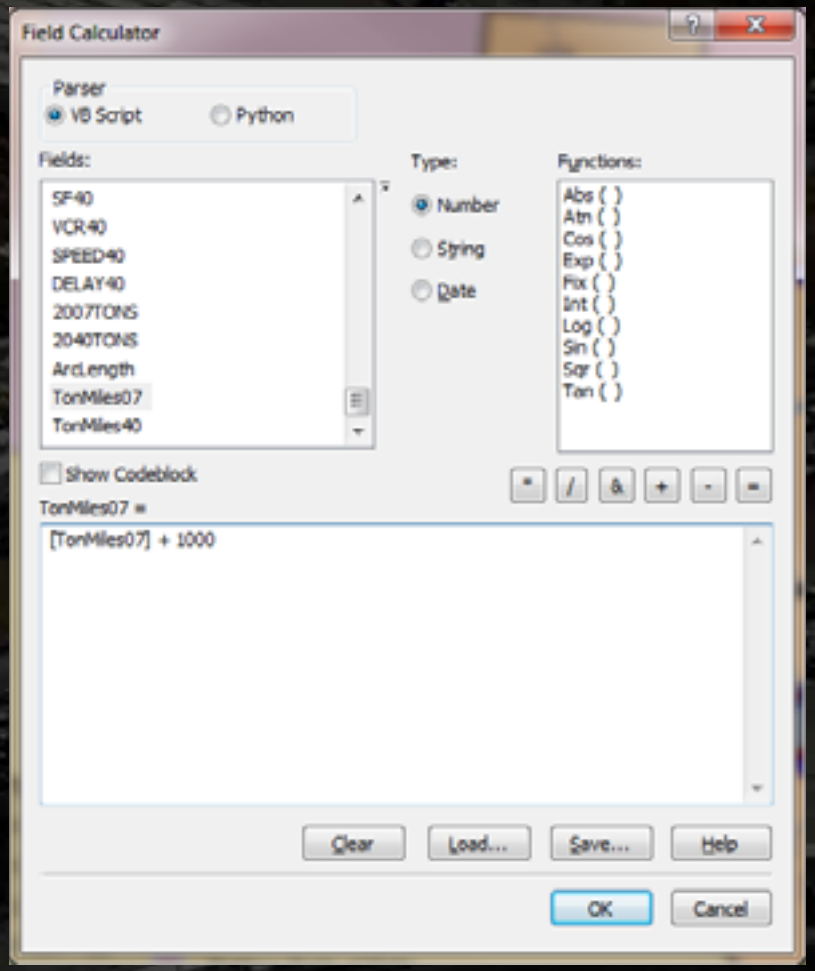
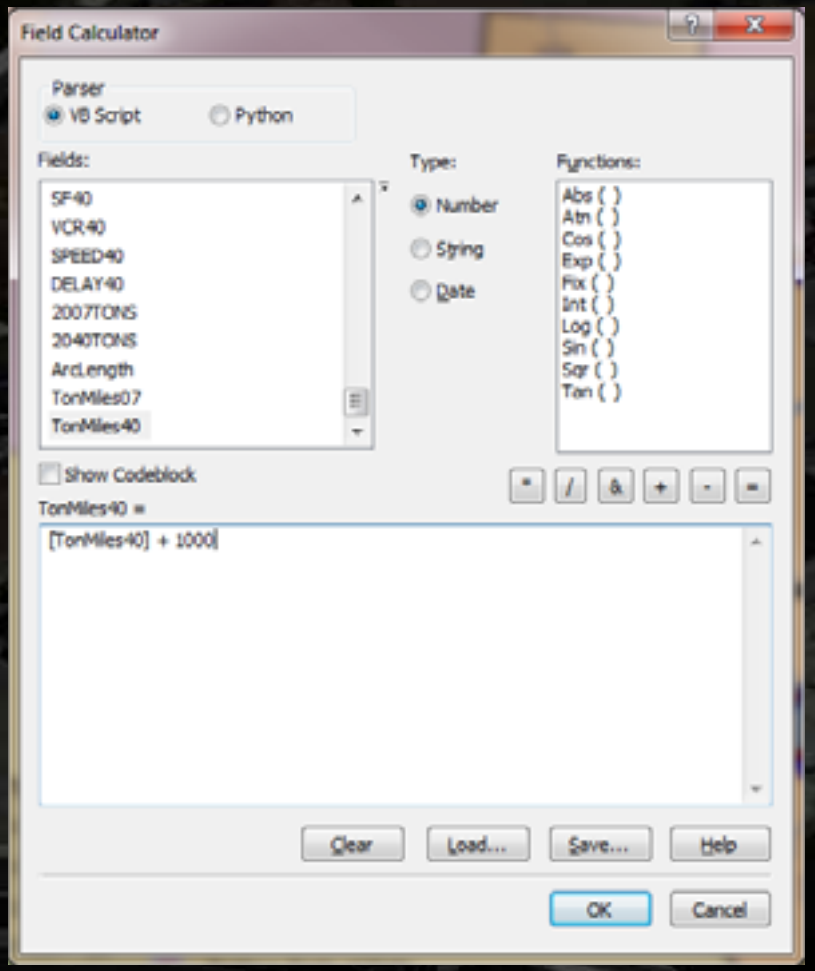
Assignment with the Field Calculator





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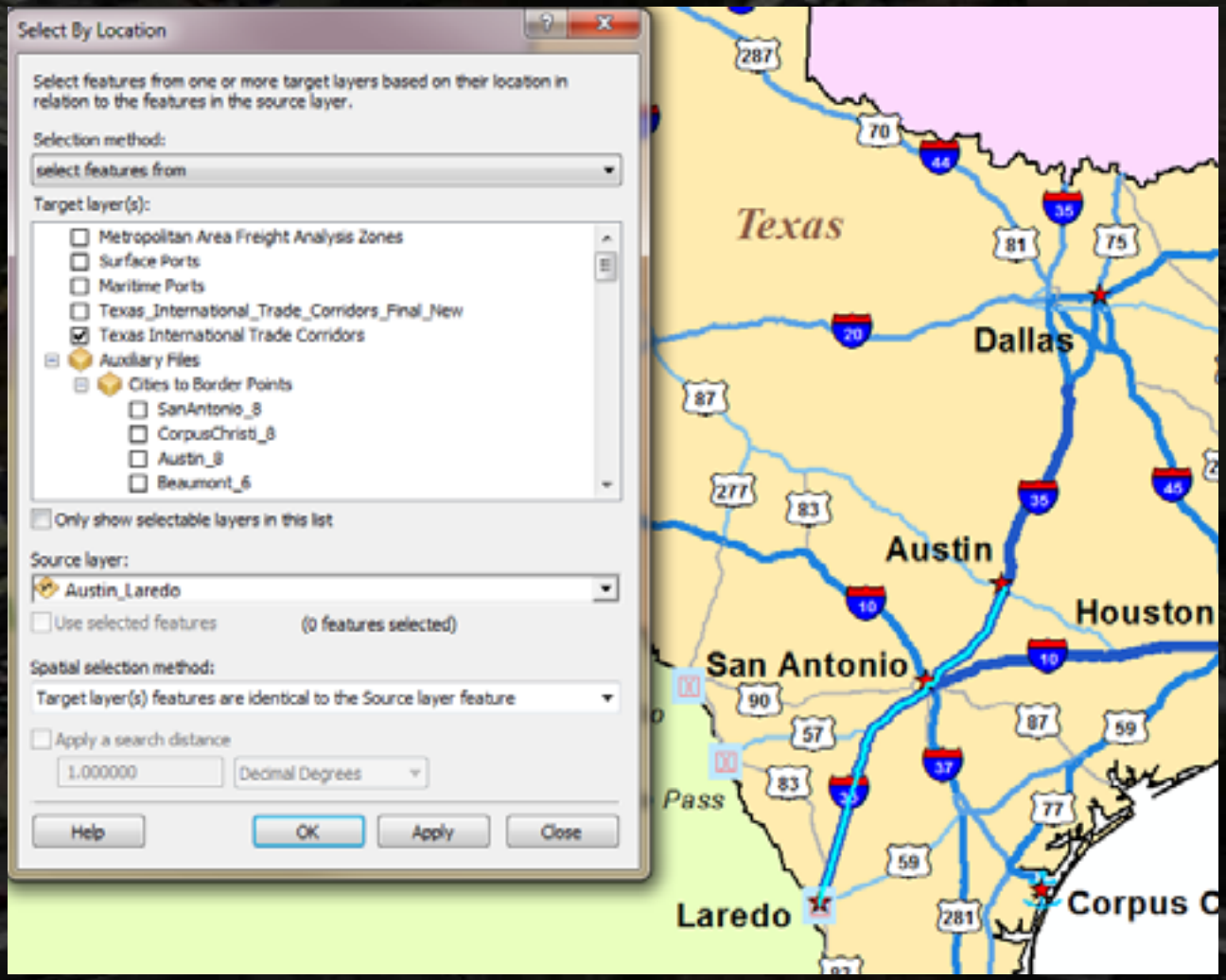
Saved Selections for Quick Work



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Results: 2007 Trucks

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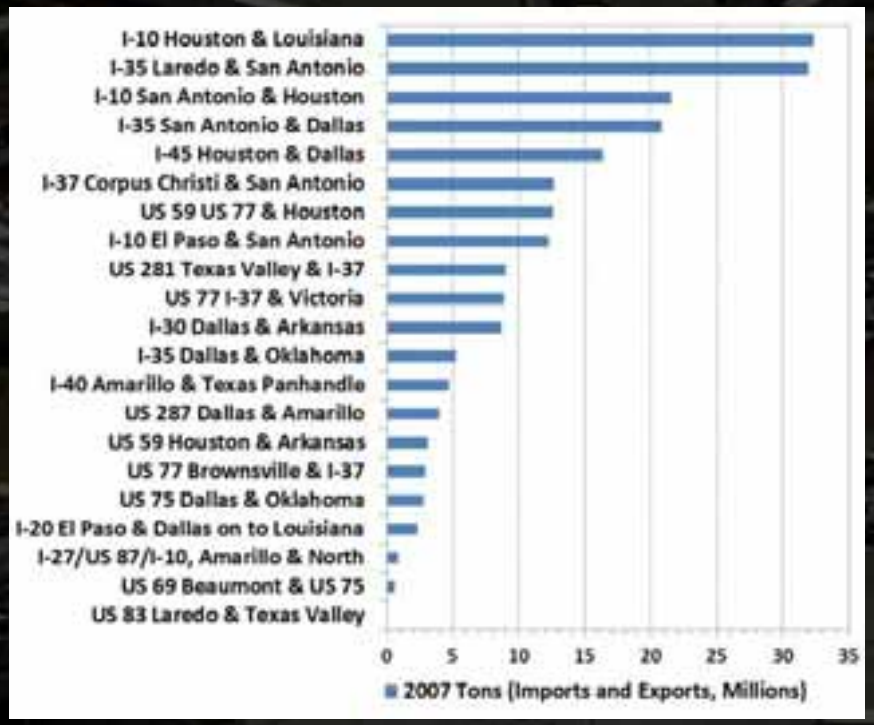

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Results: 2040 Trucks

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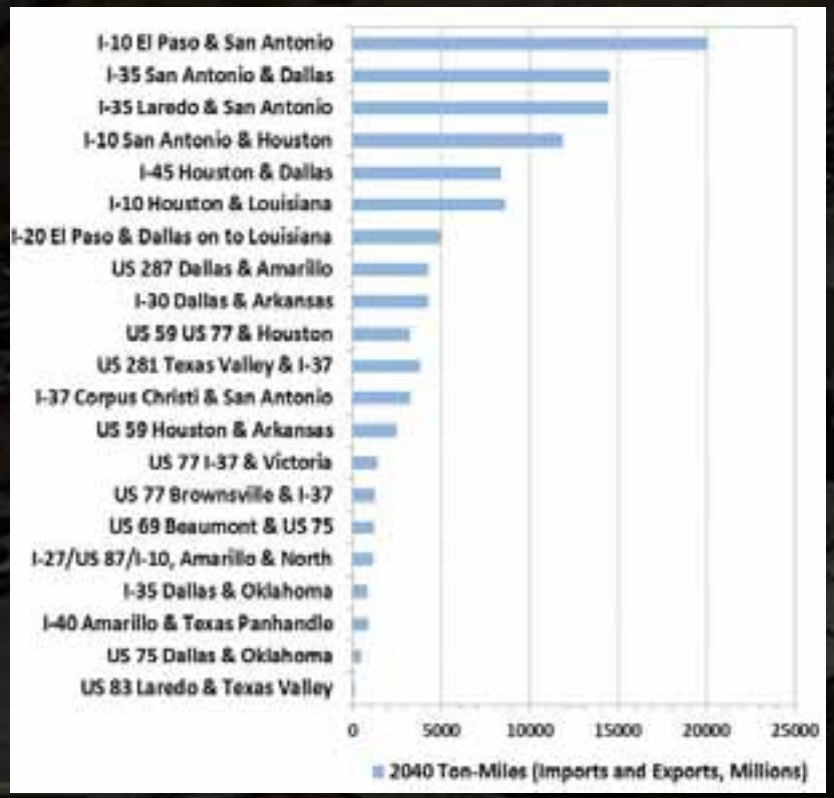
Results: 2040 Trucks



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Results: 2007 Rail

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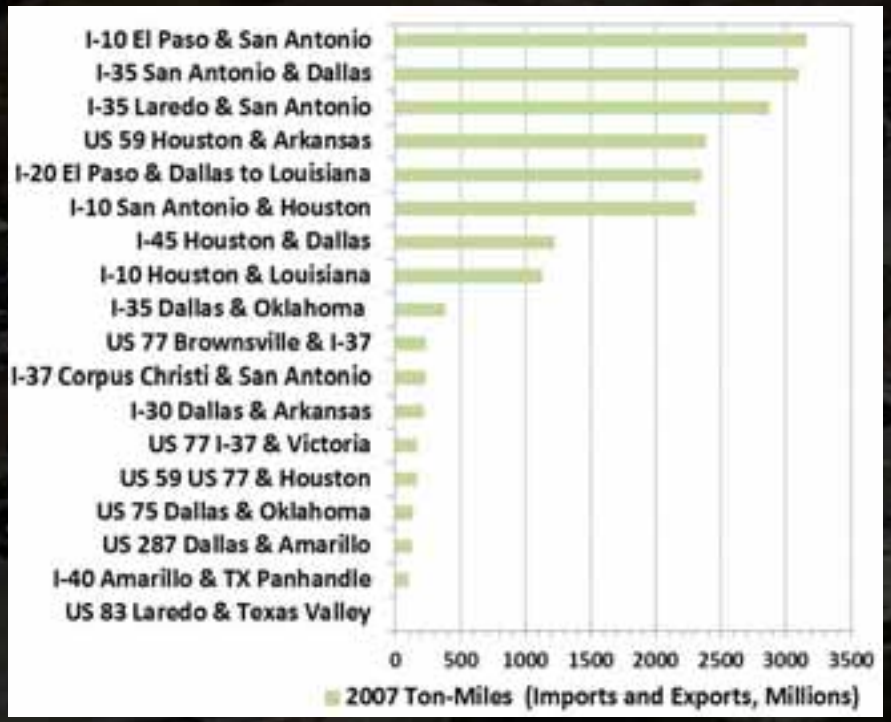
Results: 2007 Rail



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Results: 2040 Rail

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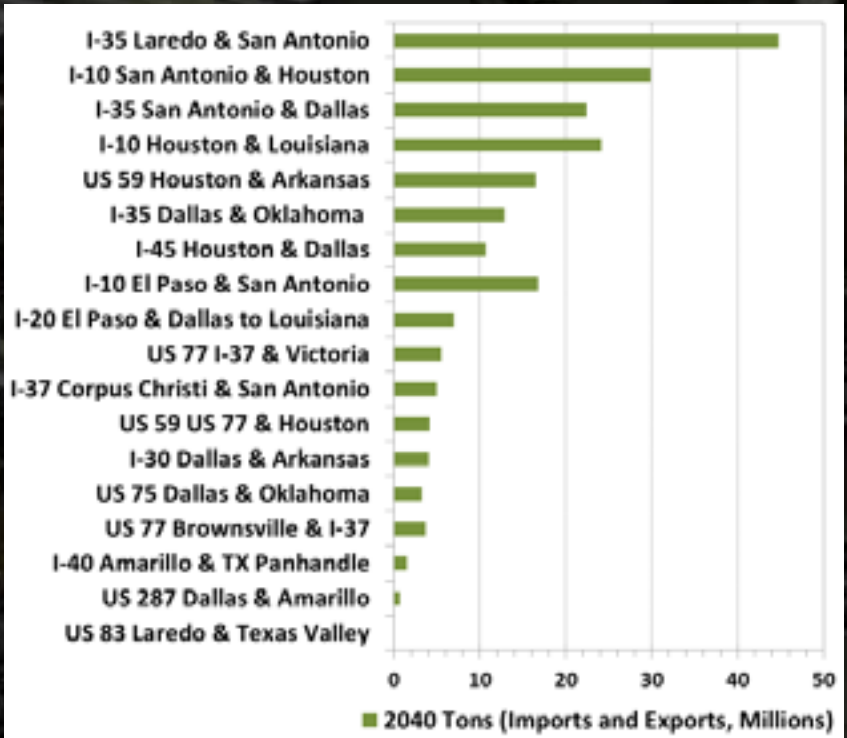
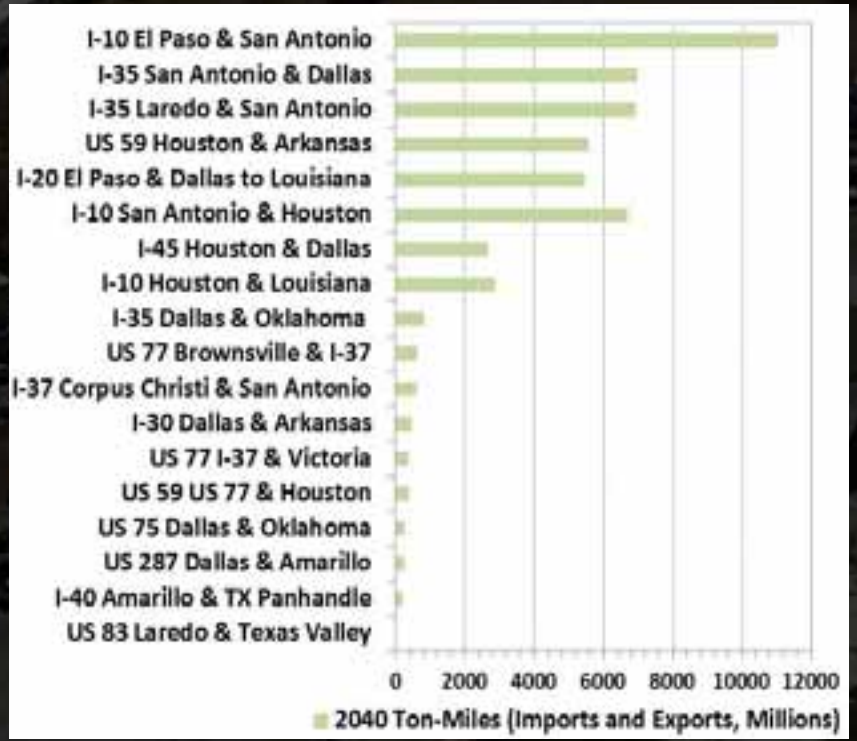
Results: 2040 Rail





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Conclusions

- Results from the case study demonstrate encouraging findings about this methodology and the application of ArcGIS along with data from FAF^3
- Further refinements needed to improve the estimation of freight flows include:
  - Assign flows using a bi-directional method
  - Account for various vehicle types and commodity payloads in developing truck-trip estimates and route choices
  - Conduct traffic counts at control points to improve calibration
  - Increase the granularity of the FAF^3 "TX Remaining FAZ 489" as it includes several major freight generators
  - Develop future scenarios to study the potential impacts of projected demand (examined in this report) upon current and planned infrastructure (the supply side)

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Questions?

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