U.S. 75 Dallas, Texas, Model Validation and Calibration Report

www.its.dot.gov/index.htm
Final Report – February 2010
FHWA-JPO-10-034
EDL Number 14941

U.S. Department of Transportation
Research and Innovative Technology Administration

Produced by the Technical Support and Assistance for the Federal Highway Administration's Office of Operations contract DTFH61-06-D-00004
U.S. Department of Transportation
Federal Highway Administration

Notice

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.	
FHWA-JPO-10-034	EDL No. 14941		
4. Title and Subtitle Integrated Corridor Management U.S. 75 Dallas, Texas – Model Validation and Calibration Report		**5. Report Date** February 2010 **6. Performing Organization Code**	
7. Author(s) Minh Le, Khaled Abdelghany, Christopher Poe, Vassilis Papayannoulis, and Vassili Alexiadis		**8. Performing Organization Report No.**	
9. Performing Organization Name and Address Cambridge Systematics, Inc. 555 12th Street, Suite 1600 Oakland, California 94607		**10. Work Unit No. (TRAIS)** **11. Contract or Grant No.** DTFH61-06-D-00004	
12. Sponsoring Organization Name and Address U.S. Department of Transportation Research and Innovative Technology Administration (RITA) 1200 New Jersey Avenue, SE Washington, DC 20590		**13. Type of Report and Period Covered** Final Report **14. Sponsoring Agency Code** HOP	
15. Supplementary Notes The COTM for FHWA is Dale Thompson.			
16. Abstract This report presents the model validation and calibration results of the Integrated Corridor Management (ICM) analysis, modeling, and simulation (AMS) for the U.S. 75 Corridor in Dallas, Texas. The purpose of the project was to estimate the benefits of applying ICM strategies to the U.S. 75 corridor. The base year for the U.S. 75 corridor modeling was 2007. The U.S. 75 team used the DIRECT traffic model developed by Southern Methodist University (SMU) as the mesoscopic model for this analysis.			
17. Key Words validation, calibration, mesoscopic, Integrated Corridor Management (ICM), incident, criteria, data, pioneer site, simulation, and Dallas, TX, US 75		**18. Distribution Statement** No Restrictions.	
19. Security Classification (of this report) unclassified	**20. Security Classification (of this page)** unclassified	**21. No. of Pages** 82	**22. Price** NA

Form DOT F 1700.7 (8-72) **Reproduction of completed page authorized**

Table of Contents

List of Tables

List of Figures

Chapter 1. Introduction

This report presents the model validation and calibration results of the Integrated Corridor Management (ICM) analysis, modeling, and simulation (AMS) for the U.S. 75 Corridor in Dallas, Texas. The purpose of the project was to estimate the benefits of applying ICM strategies to the U.S. 75 corridor. The base year for the U.S. 75 corridor modeling was 2007. The U.S. 75 team used the DIRECT traffic model developed by Southern Methodist University (SMU) as the mesoscopic model for this analysis.

1.1 Model Validation and Calibration Criteria

Before ICM strategies were analyzed, the U.S. 75 team, U.S. Department of Transportation (DOT), and Cambridge Systematics Inc. (CS) agreed upon the validation/calibration criteria that should be met in the modeling effort. The highway model validation/calibration criteria are shown in Table 1-1.

Table 1-1. Highway Model Validation and Calibration Criteria for the ICM Corridor AMS

Validation Criteria and Measures	Acceptance Targets
• Traffic flows within 15% of observed volumes for links with peak-period volumes greater than 2,000 vph	• For 85% of cases for links with peak-period volumes greater than 2,000 vph
• Sum of all link flows	• Within 5% of sum of all link counts
• Travel times within 15%	• >85% of cases
• Visual Audits *Individual Link Speeds: Visually Acceptable Speed-Flow Relationship*	• To analyst's satisfaction
• Visual Audits *Bottlenecks: Visually Acceptable Queuing*	• To analyst's satisfaction

Because of the strong transit presence in the U.S. 75 corridor and DIRECT's multimodal modeling capability, a set of validation and calibration criteria was established for the transit component of the analysis and modeling. These criteria are shown in Table 1-2.

Table 1-2. Transit Model Validation and Calibration Criteria for U.S. 75 ICM-Dallas

Validation Criteria and Measures	Acceptance Targets
• Light-rail station volumes within 20% of observed volumes	• For 85% of cases
• Light-rail park-and-ride lots	
– Parked cars in each lot	– Within 30%
– Total parked cars for all lots combined	– Within 20%

The model validation and calibration methodology used a diversified set of data, including the following:

- Traffic flows at individual links, as well as on screenlines across the arterial, freeway, and transit components of the ICM Corridor;
- Travel times along critical segments of the ICM Corridor freeway and arterial components;
- Origin-destination (O-D) surveys, identifying travel patterns along the freeway and arterial components of the ICM Corridor; and
- Queue observations along critical segments of the ICM Corridor freeway and arterial components.

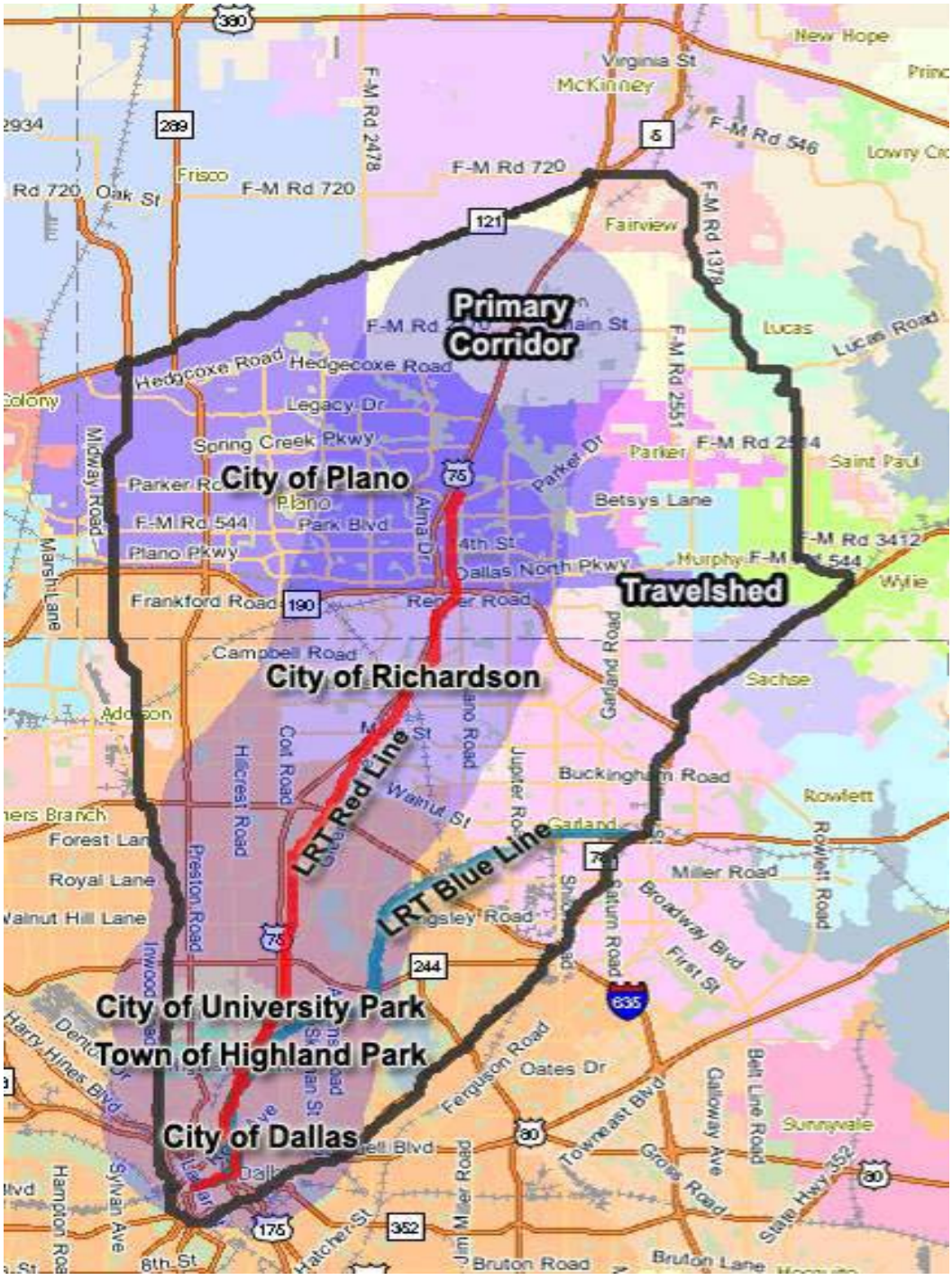
The model validation and calibration effort was subject to the budget and schedule constraints for the Pioneer Corridor AMS.

1.2 Model Validation/Calibration Approach

The U.S. 75 team followed the approach outlined below to validate and calibrate the DIRECT model for the U.S. 75 corridor. Selected steps are described in more detail in later sections. Some steps were performed simultaneously, while others were performed iteratively until the best results were achieved.

1. The first step was to import the roadway network from the regional macroscopic travel demand model. A geometry check was performed to ensure correct lane configurations and traffic signal locations. Figure 1-1 illustrates the U.S. 75 Corridor and the travel shed study area.
2. The AM peak period, O-D trip table (6:30-9:00 A.M. Peak) was extracted from the regional travel demand model for the U.S. 75 Corridor study area. For modeling purposes, this trip table was expanded to reflect the desired 5:30-11:00 a.m. simulation period.
3. After development of the trip tables and networks, the validation and calibration process was initiated. Several metrics were used to evaluate the model's performance, including screenline volumes, speed and flow rate profiles, and congestion patterns and bottleneck locations.
4. In addition to the year 2007 baseline model calibration, a "known incident" scenario was evaluated to test the sensitivity of the DIRECT model to a major incident along U.S. 75.
5. The model validation and calibration was performed with the year 2007 network, which did not include the U.S. 75 high-occupancy vehicle (HOV) lanes that opened in 2008. An additional test was performed that included the HOV lanes with the previously calibrated network to validate how DIRECT handles mode choice and assignment with an HOV lane. Slight increases in demand were made to the travel demand to account for growth between years 2007 and 2008.

Figure 1-1. U.S. 75 Corridor and Travel Shed



[Source: NCTCOG website dfwmaps.com.]

Chapter 2. Highway Validation/ Calibration

The first step in the validation and calibration process was to develop and check the roadway network to make sure year 2007 conditions were accurately reflected in the model. With some small adjustments, the U.S. 75 team felt the model network was acceptable. The next step was to ensure that the O-D trip table reflected the demand and the general travel patterns within the U.S. 75 Corridor. To accomplish that, model-estimated traffic volumes were compared against observed traffic volumes at a number of internal and external screenlines. After the validation of the screenlines was completed, the calibration of the model at individual links was initiated. Finally, comparison of travel times on selected routes was performed, and additional model calibration was performed to more closely match the travel time data.

2.1 Network Development

The Dallas/Fort Worth Metropolitan Planning Organization (North Central Texas Council of Governments – NCTCOG) travel demand model was used to produce the vehicular trip tables and networks for the U.S. 75 Corridor study area. Because NCTGOG had trip tables and networks available for year 2007, it was agreed that the base year for the U.S. 75 subarea model would be 2007. Once the roadway network was imported into DIRECT, two basic network checks were performed:

1. There are 11,300 links in the model roadway network. The number of lanes for each freeway and major arterial link was verified by using Google map aerials or available local data. Because auxiliary lanes were not included in the regional macroscopic model highway network, they were added to the DIRECT model freeway network, as needed.
2. There are 1,540 traffic signals within the model roadway network. Each location was verified by using Google map aerials. Due to time constraints, typical traffic signal timings were generated for each signal based on a 160 second cycle length and phasing splits for six general intersection classifications. The cycle length and splits were representative of actual signal timings within the study area. Certain signal timings were later adjusted as part of the validation and calibration process.

2.1 Origin-Destination Trip Table

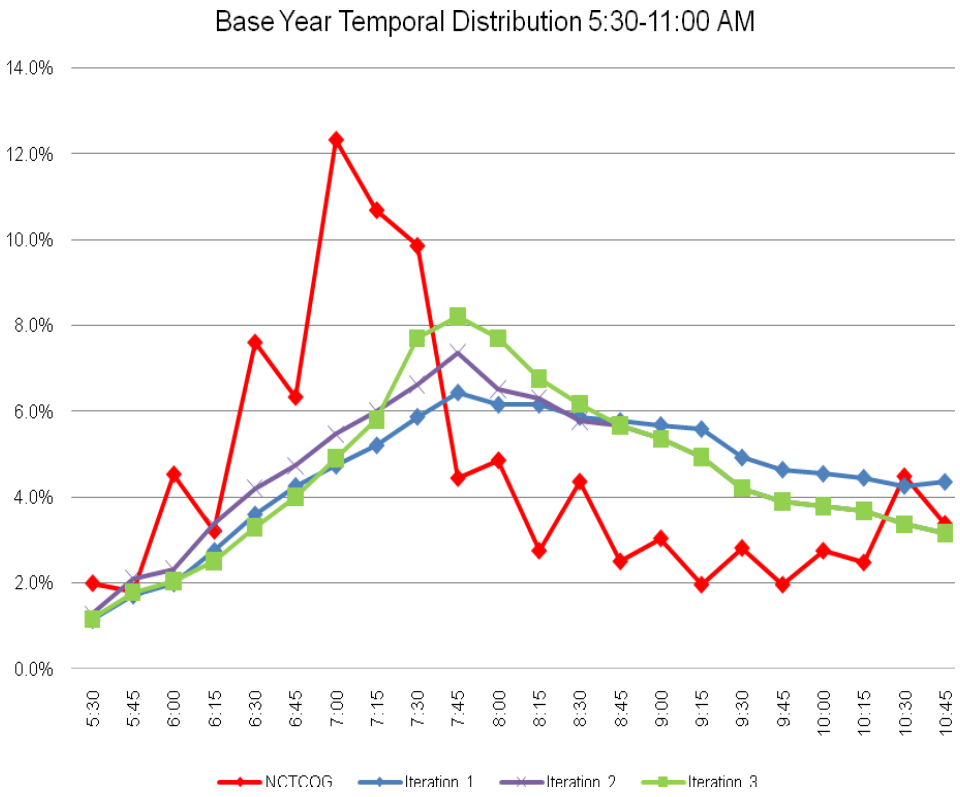
To better manage the required computer processing time, the 1,359 traffic analysis zones in the subarea trip table were aggregated to 230 super zones within DIRECT. The trip table contained vehicular trips for four modes: drive alone, shared ride not using HOV lanes, shared ride using HOV lanes, and trucks.

1. The initial trip table was only for the morning peak period from 6:30-9:00 a.m. However, it was deemed necessary to include additional “shoulder” hours so as to represent the

accumulation and dissipation of normal traffic congestion, as well as traffic congestion under a typical incident scenario, as defined later in this report. Therefore, the trip table was expanded to reflect 5:30-11:00 a.m. traffic patterns based on the process described in Appendix A.

2. The regional travel model was validated by NCTCOG to accurately reflect regional travel patterns; however, this validation may not be sufficient for a corridor study. As such, the trip tables in Step 1 were further adjusted utilizing an O-D Estimator application obtained from the University of Arizona. This process utilizes linear programming to develop a trip table that best fits available count data.
3. The trip table derived from the travel demand model does not reflect the diurnal distribution necessitated by the dynamic nature of DIRECT. As such, a preliminary diurnal distribution was developed utilizing the NCTCOG's household survey. However, it was observed that DIRECT was generally overestimating traffic flows for the 6:30-9:00 a.m. peak period, suggesting that the temporal distribution needed to be adjusted. Several iterations were made to adjust the temporal distribution, as shown in Figure 2-1.
4. In order to implement the mode choice component of DIRECT, the vehicular trip table then was converted to a "travelers" trip table utilizing regional occupancy values for the transit and HOV subgroups.
5. While the NCTCOG's subarea procedures allow for the extraction of vehicular demand for a subarea, similar procedures were not available for the transit component of the NCTCOG travel demand model. Therefore, the U.S. 75 team used the DART on-board survey to develop the transit trip table for the U.S. 75 corridor study area, as described in Appendix B.

Figure 2-1. Temporal Distribution Used in the U.S. 75 AMS

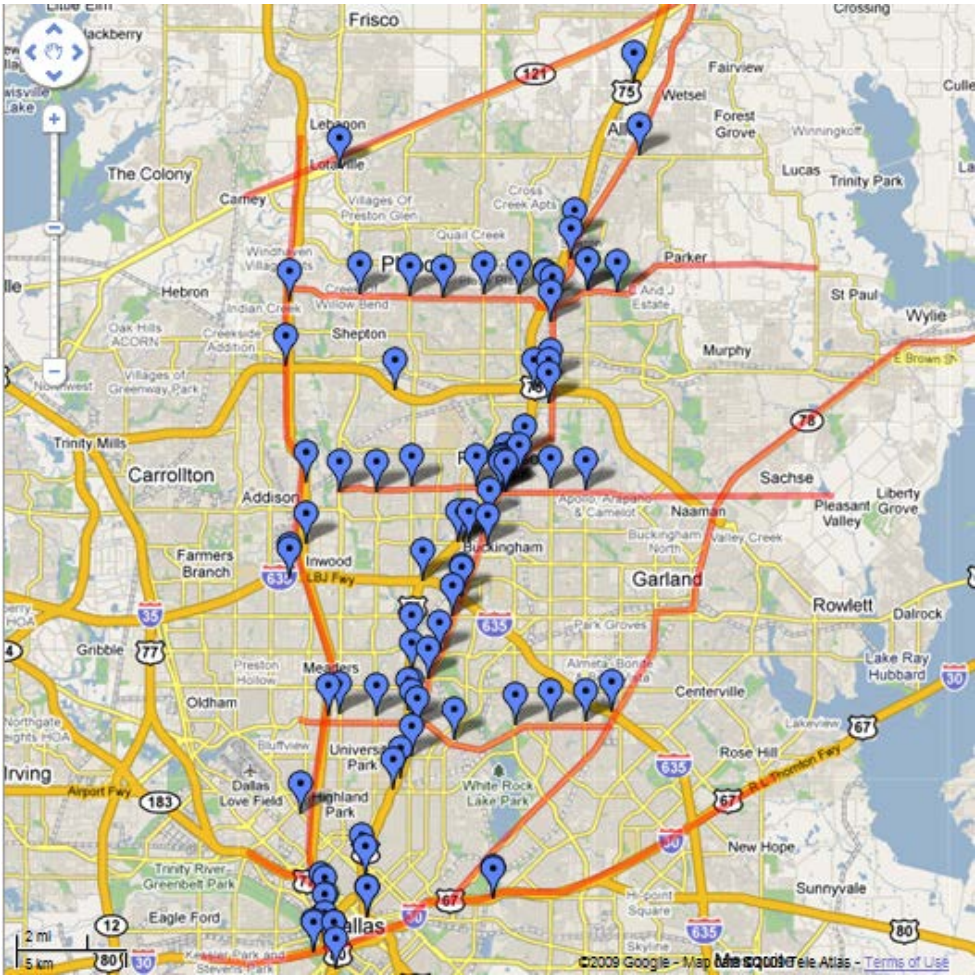


2.3 Screenline Assessment

To verify that the O-D trip table reflected observed trips in the corridor, four internal screenlines were established, and four boundary screenlines were identified. In addition, a table of ramp volumes at interchange direct connectors was established. It should be noted that while the term screenline is used, the links that comprise the screenlines are limited to those where either observed counts were available, or a reasonable estimate was made from other sources (typically arterials and major collectors). Based on the local knowledge of U.S. 75 team, those links account for the majority of traffic crossing the screenlines.

Roadway traffic volume data were obtained from both archived data and new data collection performed by Texas Transportation Institute (TTI). Archived traffic volume data were readily available for most roadways in the U.S. 75 corridor from Texas DOT, North Texas Tollway Authority (NTTA), and local cities. To supplement available data, TTI collected traffic volumes using machine counters or video equipment. The available count locations that were used for the base year validation are shown in Figure 2-2. There were a total of 179 locations used in the model validation and calibration process.

Figure 2-2. Observed Count Locations in the U.S. 75 Corridor



[Source: 2009 Google/DART – Map data ©2009Tele Atlas.]

Table 2-1 below shows that all but two screenline volume comparisons were within 15 percent of the observed 6:30-9:00 a.m. counts. The screenline comparison was deemed satisfactory. The two screenlines that are above the 15 percent target are at the boundary of the study area and are determined not to have significant impact on the U.S. 75 Corridor modeling. Appendix C shows the complete report for all links by screenline.

Table 2-1. Screenline Volumes Used in the U.S. 75 Model Calibration

Screenline	Observed 5:30-11:00	Model 5:30-11:00	Difference 5:30-11:00	Percent Difference 5:30-11:00	Observed 6:30-9:00	Model 6:30-9:00	Difference 6:30-9:00	Percent Difference 6:30-9:00
Arapaho_NB	78522	77357	-1165	-1.48%	43153	43482	329	1%
Arapaho_SB	105514	95839	-9675	-9.17%	57954	49945	-8009	-14%
DNT_EB	64295	58424	-5871	-9.13%	32382	32668	286	1%
DNT_WB	61730	52156	-9574	-15.51%	30632	28009	-2623	-9%
Greenville_EB	94182	88272	-5910	-6.28%	48853	49634	781	2%
Greenville_WB	156899	160003	3104	1.98%	89245	91779	2534	3%
IH30_NB	48917	53640	4723	9.66%	22484	30460	7976	35%
IH30_SB	32651	29795	-2856	-8.75%	15202	15969	767	5%
NW_HWY_NB	61587	59034	-2553	-4.15%	34692	33061	-1631	-5%
MW_HWY_SB	67685	68827	1142	1.69%	35754	37933	2179	6%
Parker_NB	64030	57445	-6585	-10.28%	33553	32143	-1410	-4%
Parker_SB	108664	103501	-5163	-4.75%	59052	58011	-1041	-2%
SH121_NB	19630	16614	-3016	-15.36%	9873	9369	-504	-5%
SH121_SB	18865	13878	-4987	-26.44%	8984	7303	-1681	-19%
SH78_EB	12960	11351	-1609	-12.42%	6539	6275	-264	-4%
SH78_WB	27895	25948	-1947	-6.98%	14269	12915	-1354	-9%

Traffic flows at other minor roadways, not included in the screenlines, also were examined to verify that model-estimated flows were reasonable. For these roadways, the DIRECT volumes were compared against NCTCOG's travel demand model volumes. Table 2-2 summarizes this comparison indicating that the DIRECT flow estimates are generally within 10 percent of the traffic estimated by NCTCOG's travel demand model.

Table 2-2. "Minor Roadway" Screenline Volumes

Screenline	NCTCOG TDM 5:30-11:00	DIRECT 5:30-11:00	Difference 5:30-11:00	Screenline Total 5:30-11:00 (Obs)	Percent Difference 5:30-11:00	NCTCOG TDM 6:30-9:00	DIRECT 6:30-9:00	Difference 6:30-9:00	Screenline Total 6:30-9:00 (Obs)	Percent Difference 6:30-9:00
Arapaho_NB	38961	44920	5959	117483	5%	23666	25424	1758	66819	3%
Arapaho_SB	62383	70987	8604	167897	5%	47721	39587	-8134	105675	-8%
NW_HWY_NB	27417	36112	8695	89004	10%	16416	19748	3332	51108	7%
NW_HWY_SB	40942	47840	6898	108627	6%	29557	27710	-1847	66021	-3%
Parker_NB	8780	16636	7856	72810	11%	5078	9825	4747	38631	12%
Parker_SB	19884	20771	887	128548	1%	16911	12251	-4660	74852	-6%

2.4 Individual Link Analysis Results

After the screenline evaluation, a more detailed evaluation was undertaken both in terms of total flow and in terms of individual link flows. Table 2-3 presents a comparison of the 6:30-9:00 a.m. observed and modeled total flow on all 179 links with observed counts, indicating that the DIRECT estimates are sufficiently close to the five percent target value.

Table 2-3. Individual Link Volume Comparison

	5:30-11:00 A.M.				6:30-9:00 A.M.			
	Observed	Model	Difference	Percent Difference	Observed	Model	Difference	Percent Difference
Total	1,599,755	1,430,855	-168,870	-11%	831,882	783,050	-48,832	-6%

Figure 2-3 shows a scatter plot comparing the simulated link volumes versus the observed counts for the 5:30-11:00 a.m. period. The orange line represents a perfect match, and the brown lines represent 15 percent error bands. This figure shows the significant improvement from the first run of DIRECT (Iteration 0) to the final run (Iteration 45). Appendix D presents a comparison between the original NCTCOG O-D trip table (Iteration 0) to the final trip table (Iteration 1). Overall, there was a decrease of 52,703 travelers or 3 percent between these two iterations. Sixty-nine percent of these decreases were between 0 and 25 travelers per O-D pair. These changes are considered minimal and are deemed reasonable given the large size of the study area.

Figure 2-3. Link Volume Comparison for the U.S. 75 Model Calibration

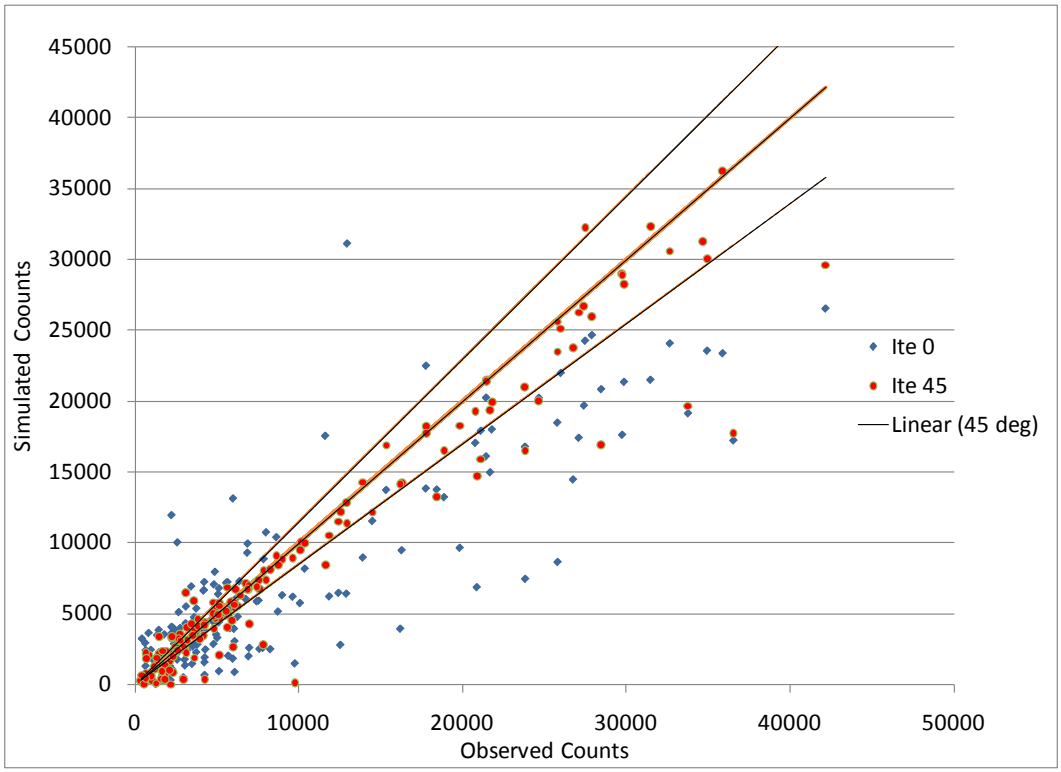


Figure 2-3 shows 51 links with 2,000 or more vehicles per hour, or 5,000 or more vehicles for the 2.5-hour peak period. Table 2-4 shows that 63 percent of these links are within 15 percent of observed totals for the 6:30-9:00 a.m. peak period, and 88 percent of links are within 20 percent of observed totals. A more robust way to compare modeled versus observed volumes is to use a volume-weighted percent error criterion,[1] which gives more weight to higher volume links. This alternative model calibration criterion calculates the total count-weighted average error reflecting how well 'high-total-count links' match observed volumes. The 51 links had a count-weighted average error of 14.4 percent, which is lower than the 15 percent target, thus satisfying this calibration criterion.

Table 2-4. Individual Link Summary, 6:30-9:00 A.M.

	Links			Counts		
	Number of Links	Percentage of Links Within ±15%	Percentage of Links Within ±20%	Percentage of Links Within ±25%	Counts	Counts-Weighted Percentage of Error
>=5,000	51	63	76	88	575,113	14.4

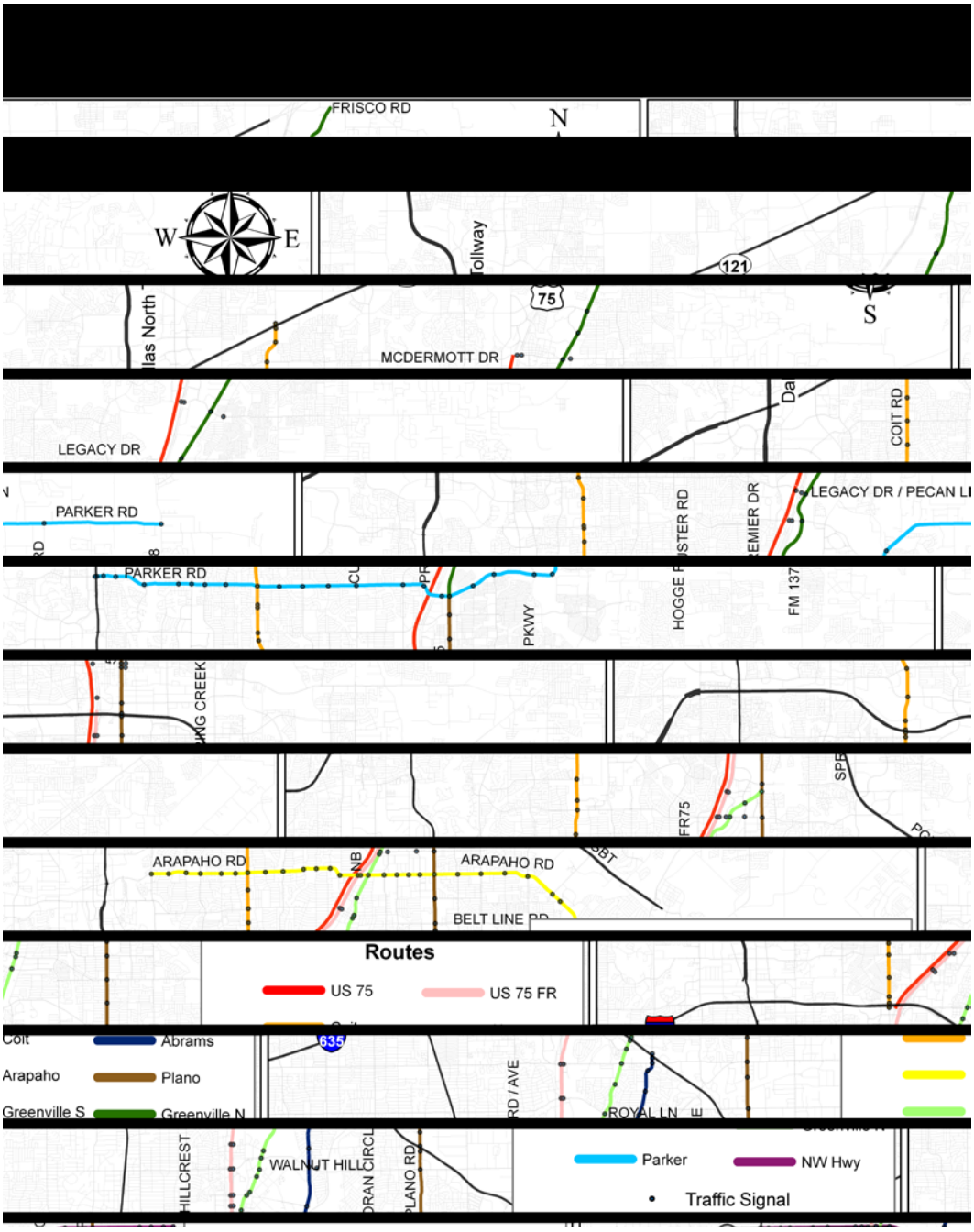
2.5 Roadway Travel Time Data

Only limited travel time data collected in 2007 exists for roadways in the U.S. 75 corridor. The U.S. 75 team collected significant amounts of travel time data to develop a good understanding of the travel times, congestion patterns, and bottlenecks on the freeway and strategic arterial routes. Travel time surveys were performed from November 3 to 21, 2008. There are 20 routes for a total of 139 centerline miles, as shown on Figure 2-4.

Travel times generated by DIRECT were compared against individual travel time observations. Average observed travel times over the AM peak period were compared against corresponding average travel times produced by DIRECT. Table 2-5 presents these travel times and comparisons. Overall, there are 21 out of 26 routes (i.e., 81 percent) within 15 percent of observed travel times and 23 out of 26 routes (i.e., 88 percent) within 20 percent. A few of the routes are short routes with small absolute differences in travel time. Given that travel times were collected in year 2008 while the model represents 2007 conditions, the DIRECT model is deemed to adequately represent travel times in the U.S. 75 corridor, and the travel time calibration is considered to be reasonable. Appendix E presents the speed profiles for the individual travel time surveys for U.S. 75.

[1] I-394 Corridor Model Calibration and Validation Report, University of Arizona and Cambridge Systematics, Inc., September 2009.

Figure 2-4. U.S. 75 ICM Travel Time Routes



[Source: DART.]

Table 2-5. Travel Time (Minutes), 6:30-9:00 A.M.

Route	6:30	7:00	7:30	8:00	8:30	Average	Direct	Percent Difference
Abrams_NB_AM	27.63	26.74	28.51	27.31		27.55	25.24	-8%
Abams_SB_AM	21.30	25.33	28.44	25.88		25.24	24.70	-2%
Arapaho_EB_AM	17.99	20.63	21.87	23.59	18.37	20.95	24.59	17%
Arapaho_WB_AM	17.64	21.30	27.02	27.04	21.56	22.91	24.56	7%
Coit_NB_AM	23.96	27.80	33.28	30.45		28.87	26.07	-10%
Coit_SM_AM	25.18	23.47	35.49	34.02		29.54	32.16	9%
Greenville_N_NB_AM	17.51	18.82	19.43	16.91		18.17	17.08	-6%
Greenville_N_SB_AM	19.41	19.19	21.92	18.29		19.70	17.57	-11%
Greenville_S_NB_AM			24.97	23.84	23.16	23.99	26.12	9%
Greenville_S_SB_AM		21.90	23.77	24.65	25.52	23.96	26.18	9%
NW_HWY_EB_AM		14.64	14.67	15.94	17.50	15.68	18.11	15%
NW_HWY_WB_AM	16.50	25.24	22.67	17.86		20.57	19.16	-7%
Parker_EB_AM		32.59		28.34		30.46	32.03	5%
Parker_WB_AM		31.21	38.57	27.72		32.50	32.68	1%
Plano_NB_AM	25.04	23.91	26.89	24.41	24.32	24.92	24.19	-3%
Plano_SB_AM	21.39	26.96	30.57	40.13	24.67	28.74	26.12	-9%
US75_FR_NB_AM_NWHWtoI635	9.08	9.41		9.51	7.92	8.98	9.54	6%
US75_FR_NB_AM_I635_PGPT	13.46	15.48		17.36	14.21	15.13	15.33	1%
US75_FR_SB_AM_PGPT_I635		15.72		16.96	13.66	15.45	19.90	29%
US75_FR_SB_AM_I635toHWHW		8.87		9.40	10.22	9.50	10.31	9%
US75_NB_AM_I635_to_Galatyn	5.30	5.18	5.02	5.06		5.14	615	20%
US75_NB_AM_Galatyn_to_Parker_Rd	3.63	3.77	3.50	3.73		3.66	4.11	12%
US75_NB_AM_Parker_Rd_to_ McDermott	4.84	4.68	4.34	4.64		4.62	6.03	30%
US75_SB_AM_McDermott_to_Parker_ Rd	6.23	7.93	9.06	8.59	5.20	7.40	7.14	-4%
US75_SB_AM_Parker_Rd_to_Galatyn	4.22	4.95	5.43	4.71	3.72	4.61	5.58	21%
US75_SB_AM_Galatyn_to_I635	5.40	6.98	8.83	10.24	6.76	7.64	6.90	-10%

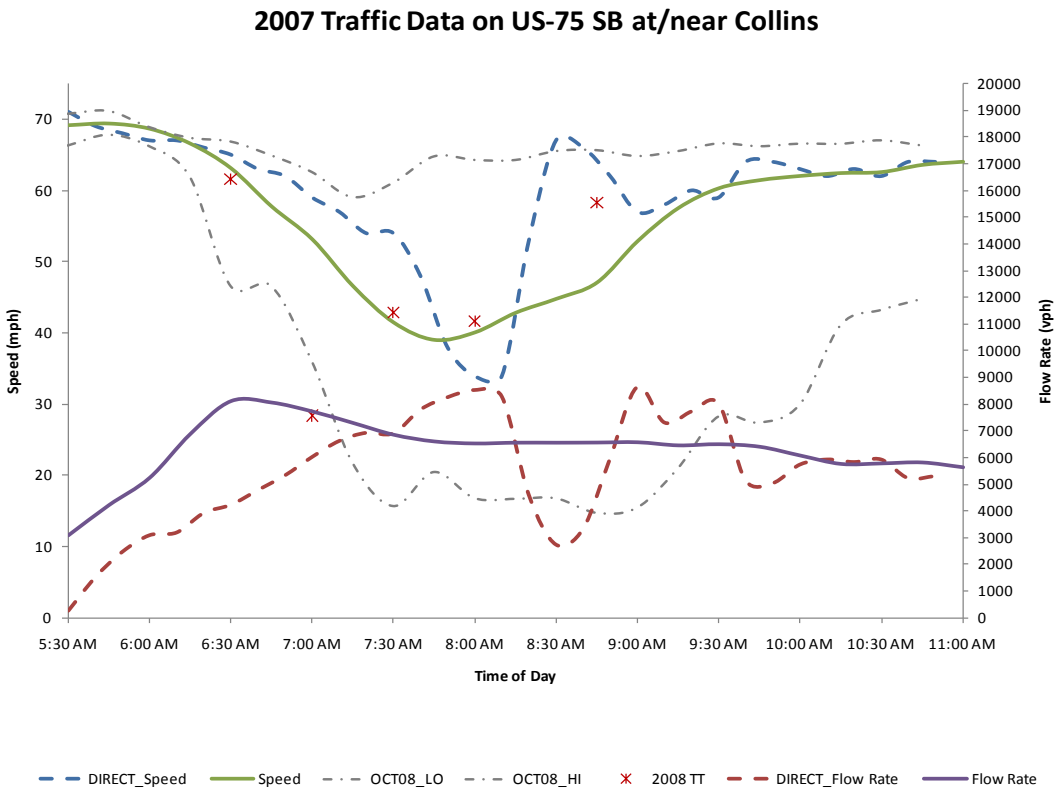
Chapter 3. Visual Audits

The model validation criteria requires visual audits of the speed-flow relationships and queuing. The U.S. 75 team relied on detector data from the Dallas Intelligent Transportation Systems (ITS), as well as the expertise of the stakeholders to generate comparison data. The next sections discuss the visual audits performed for individual link speed-flow relationships and queue patterns, as well as the adjustments made in the calibration process.

3.1 Individual Link Speeds

Graphs in Appendix F show comparisons of average link speed and traffic flow rates (volumes) from DIRECT against field ITS detector data along U.S. 75. DIRECT flow rates generally match observed flow rate patterns well. DIRECT also matches observed speeds well, except at locations where there were abrupt drops in observed speeds. Additional calibration was conducted to try and match the locations of abrupt drops as well. For example, Figure 3-1 shows speed and volume comparisons on U.S. 75 at Collins Street. The figure highlights that observed speeds (green line) begin to decrease at approximately 6:15 a.m.; the same time when flow rates begin to peak. This observed trend occurs at a number of freeway links and seems to reflect the normal breakdown in traffic operations once volumes have peaked and become unstable. This congestion tends to occur in high merge and weave areas. This trend also was observed in the 2008 travel time field data as shown by the red data points (shown in asterisks) in the figure. To better match these speed profiles, the speed-flow relationship in DIRECT was adjusted at these locations. The wide ranges of variation in speeds from day to day are displayed in Figure 3-1, with the lowest and highest observed daily speeds within one sample month (grey dot-dashed lines). Given these results, the U.S. 75 team is satisfied with the speed and volume profile patterns exhibited in DIRECT.

Figure 3-1. Speed and Volume Profile Example



3.2 Speed/Flow Adjustments

DIRECT uses the Greenshields flow model to relate speed, density, and flow on all links. Equation 1 and Figure 3-2 show this relationship.

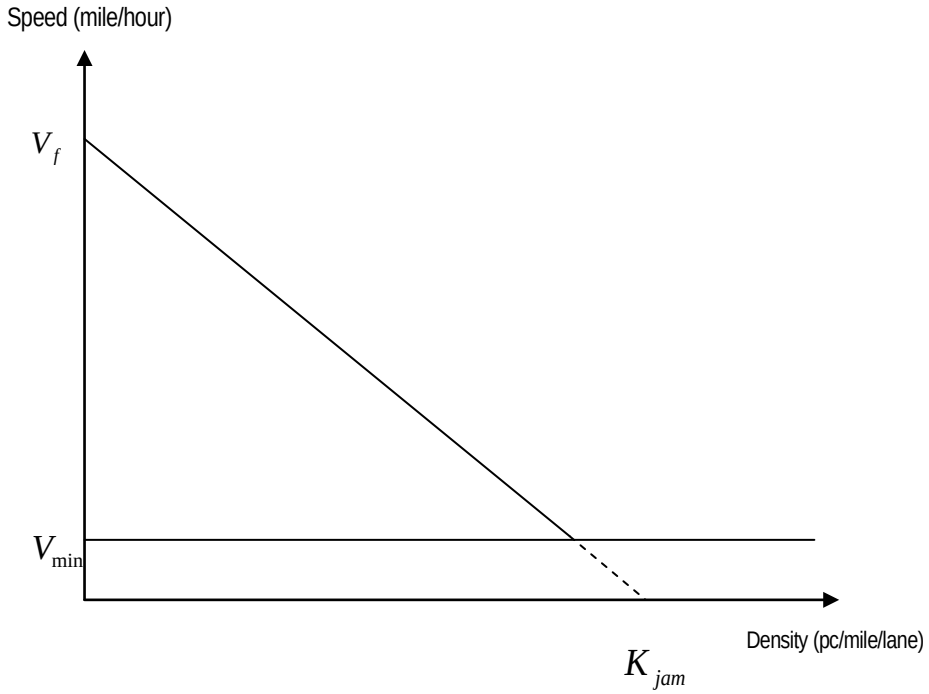
$$V = \begin{cases} V_f * (1 - \frac{k}{K_{jam}})^{\alpha} & \text{if } k < K_{jam} \\ V_{\min} & \text{if } k \geq K_{jam} \end{cases}$$

(Equation 1)

Where,

Vf = Free-flow speed;
Vmin = Minimum link speed;
k = Link density;
Kjam = Jam density; and
α = Speed-density curve shape term.

Figure 3.2. The Greenshields Model



[Source: Greenshields, B.D., A study of highway capacity. *Proceedings, Highway Research Record*, Washington, Volume 14, pp. 448-477, 1935.]

To better reflect operating conditions on freeways, research undertaken by Sia Ardekani and Shiva Nepal of the Department of Civil Engineering at the University of Texas at Arlington was used to provide initial values for the variables above based on field data. Initial model runs generally resulted in lower volumes on freeways than what was observed. Consequently, different values were tested before arriving at the final parameter values for the final traffic flow shown in Table 3-1. It is noted that the DRAKE model also was tested, but was later dropped because the Greenshields model yielded better results.

Table 3-1. Greenshields Model Parameters

Parameter	Value
Vmin	15 mph
Vf	Freeways = 65 mph, arterials = posted speed limit
Kjam	200 veh/mile/lane
α	1

DIRECT did not capture the breakdown in speeds that were observed on a few links. Consequently, a multiregime flow concept was introduced at the observed times of these breakdowns. Basically, the free-flow speed and jam densities were adjusted during these breakdowns. This was done until the resulting speed profile in DIRECT better reflected observed speed patterns. For example, Table 3-2

shows the parameter values for SB U.S. 75 at Collins. Table 3-3 shows the overall range of parameter values for all adjusted links. Figure 3-3 shows the speed profile on SB U.S. 75 at Collins before implementing this concept (as compared to Figure 3-1). This concept also was utilized during the validation and calibration of the Known Incident scenario, as needed.

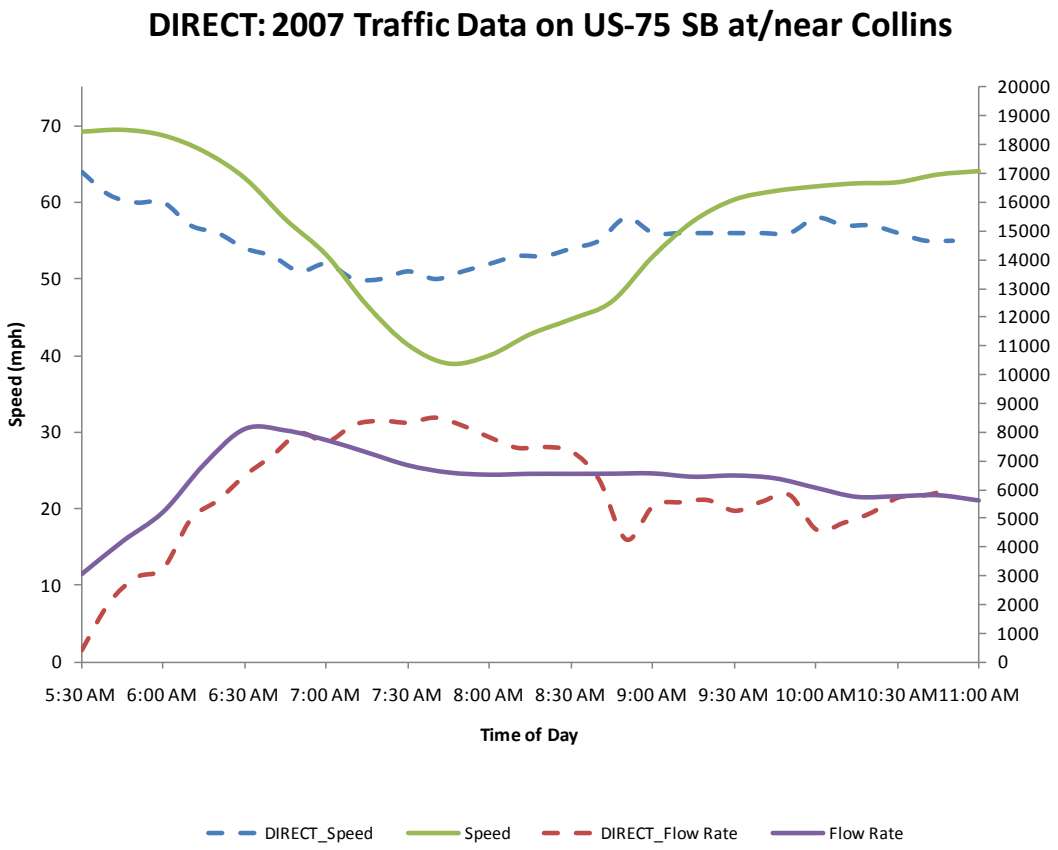
Table 3-2. Greenshields Model Parameters for SB U.S. 75 at Collins

Regime	Time	Parameter	Value
1	5:30-6:30	K_{jam}	200
		V_f	72
		V_{min}	15
2	6:30-9:00	K_{jam}	140
		V_f	72
		V_{min}	15
3	9:00-11:00	K_{jam}	200
		V_f	72
		V_{min}	15

Table 3-3. Range of Greenshields Model Parameters for Adjusted Links

Parameter	Value
Vmin	15 mph
Vf	Freeways = 55-72 mph
Kjam	100-200 veh/mile/lane
A	1

Figure 3-3. Speed and Volume Profile Example Before Implementing Multiregime



3.3 Bottlenecks

Speed contours from year 2007 detector data were compared against DIRECT speed profiles along U.S. 75. Tables 3-4 and 3-5 show the northbound observed and modeled speed contour profiles, respectively. With a few minor exceptions, the modeled and observed diurnal speed estimates and patterns generally match and show that there are no major bottlenecks in the northbound direction.

Tables 3-6 and 3-7 show the southbound observed and modeled speed contour profiles, respectively, indicating that generally, DIRECT predicts the congestion at the anticipated locations, but for shorter periods of time. For example at Collins, modeled speeds were below 50 mph from 7:40 to 8:10 a.m.; whereas, observed speeds were below 50 mph from 7:10 to 8:40 a.m. Similarly, modeled speeds at the Forest, were below 40 mph between 7:30 and 8:30 a.m.; whereas, the observed speeds were below 40 mph between 7:30 to 8:50 a.m. Overall, the Dallas AMS team finds that freeway bottlenecks are adequately represented in the DIRECT model for U.S. 75.

Table 3-4. Northbound Observed Speed Contours

Miles	Segment	5:30	5:40	5:50	6:00	6:10	6:20	6:30	6:40	6:50	7:00	7:10	7:20	7:30	7:40	7:50	8:00	8:10	8:20	8:30	8:40	8:50	9:00	9:10	9:20	9:30	9:40	9:50	10:00	10:10	10:20	10:30	10:40	10:50
6.7	Collins	70	70	71	70	69	68	67	67	67	68	68	68	68	67	67	67	67	68	67	67	67	67	66	66	66	66	67	67	67	67	67	67	68
3.6	Meadow South	59	58	58	58	59	60	60	60	61	62	62	62	61	61	61	60	59	59	59	59	59	60	60	61	61	62	62	62	62	62	62	62	62
0.4	Walnaut Hill	55	56	56	56	55	55	55	55	55	56	56	56	54	52	51	50	51	50	49	50	51	52	54	55	55	56	56	56	56	56	56	56	56
1.2	Park Lane	57	56	56	56	56	54	55	55	55	56	56	57	55	53	53	53	52	51	51	52	52	54	55	56	56	57	57	57	57	57	57	57	57
1.1	University Dr.	57	57	57	58	57	57	57	57	57	58	58	58	58	57	55	54	55	53	54	54	54	55	57	58	58	58	58	59	58	59	59	59	59
1.7	Yale	58	58	58	58	57	57	57	57	58	59	59	59	59	58	55	54	54	53	53	54	55	55	58	59	60	59	60	60	60	60	60	60	60
3.1	Hall	58	58	58	57	57	57	57	58	58	58	59	59	58	57	55	51	47	46	48	48	49	52	55	57	57	59	59	59	60	60	60	60	60

Table 3-5. Northbound Model Speed Contours

Miles	Segment	5:30	5:40	5:50	6:00	6:10	6:20	6:30	6:40	6:50	7:00	7:10	7:20	7:30	7:40	7:50	8:00	8:10	8:20	8:30	8:40	8:50	9:00	9:10	9:20	9:30	9:40	9:50	10:00	10:10	10:20	10:30	10:40	10:50
6.7	Collins	72	71	70	70	70	69	69	68	67	67	66	65	65	63	63	64	65	60	61	66	65	65	65	66	66	66	67	67	67	67	67	68	68
3.6	Meadow South	64	63	63	62	62	62	62	61	61	60	60	60	60	58	57	58	59	58	58	57	59	60	60	59	59	60	60	60	61	61	60	61	61
0.4	Walnaut Hill	64	62	61	61	61	60	60	59	58	57	56	57	56	53	52	54	55	54	53	53	56	56	56	55	55	57	57	57	58	59	57	58	59
1.2	Park Lane	69	67	67	66	66	66	66	64	65	65	63	62	63	63	60	56	61	63	62	59	60	64	64	61	62	63	65	64	65	64	64	65	65
1.1	University Dr.	69	67	66	66	65	65	64	63	63	62	60	61	57	53	48	47	52	57	54	57	58	58	59	59	57	60	62	61	63	62	63	63	63
1.7	Yale	64	63	63	63	62	62	62	61	62	61	58	59	59	58	52	50	60	58	57	59	55	57	61	59	59	61	61	61	61	61	62	61	62
3.1	Hall	64	63	63	62	62	62	62	61	61	60	60	57	58	59	57	51	50	50	49	48	52	60	60	59	59	61	58	59	61	61	61	61	62

Table 3-6. Southbound Observed Speed Contours

Miles	Segment	5:30	5:40	5:50	6:00	6:10	6:20	6:30	6:40	6:50	7:00	7:10	7:20	7:30	7:40	7:50	8:00	8:10	8:20	8:30	8:40	8:50	9:00	9:10	9:20	9:30	9:40	9:50	10:00	10:10	10:20	10:30	10:40	10:50
4.8	Collins	70	70	69	68	67	65	63	59	56	53	49	44	42	40	40	41	43	44	46	46	50	55	57	59	61	61	62	62	63	63	63	64	64
2.5	Coit	58	57	58	57	57	56	56	56	56	57	57	57	57	57	57	57	57	57	56	56	57	56	57	57	57	57	57	57	57	57	57	57	57
0.3	Forest	56	57	56	56	55	56	55	54	53	52	51	45	38	34	32	32	32	34	36	38	38	40	45	48	51	51	50	51	54	55	55	55	55
0.4	Royal North	62	62	63	62	63	63	64	66	68	69	70	69	68	67	67	66	66	66	66	67	68	68	69	70	70	70	70	71	71	71	71	71	72
0.5	Royal South	57	57	57	57	57	57	56	56	56	56	55	53	53	52	52	51	51	51	51	51	51	52	53	54	54	54	54	54	55	55	55	56	56
1.0	Meadow North	57	57	56	58	58	57	57	57	57	56	56	57	57	57	57	56	56	54	56	54	54	54	54	57	57	57	57	57	57	57	57	57	57
1.0	Park Blvd	60	61	61	60	60	60	60	61	62	63	63	63	63	63	62	62	61	61	61	61	61	62	62	63	63	63	63	63	63	64	63	64	64
0.6	Caruth Haven	57	57	57	57	56	56	56	56	56	56	56	55	55	54	54	53	52	52	53	52	53	53	55	56	56	57	57	58	57	58	58	58	57
0.9	Lovers	59	60	60	60	60	60	60	60	60	59	59	59	59	58	57	57	55	55	55	55	56	56	58	58	58	59	59	59	59	60	59	60	59
0.7	Mockingbird	59	59	59	59	60	59	60	59	59	59	60	59	58	57	56	54	54	54	53	54	53	54	55	56	56	57	57	58	58	58	58	58	58
0.4	McCommas	56	56	56	56	56	55	55	55	55	56	56	56	55	53	49	47	47	46	48	48	48	51	53	55	56	56	57	57	57	57	57	57	57
0.3	Monticello	56	56	56	56	56	57	57	57	56	57	57	56	55	53	53	52	52	52	51	51	52	53	53	55	56	57	57	58	58	58	58	58	58
0.3	Knox North	64	64	64	63	63	62	62	62	62	63	63	63	62	60	55	54	52	52	53	54	55	58	61	62	63	64	64	64	64	64	65	65	65
0.4	Knox South	68	68	68	68	67	66	66	65	64	64	63	62	61	59	58	58	59	58	57	58	58	60	62	62	64	64	63	64	65	65	65	65	65
0.4	Fitzhugh	66	66	66	66	66	66	65	65	64	64	63	62	61	60	59	59	58	57	57	58	58	58	60	61	63	63	63	65	65	66	65	65	65
0.3	Haskell	58	58	58	58	57	57	57	57	56	57	57	57	56	53	47	42	40	40	39	43	44	46	51	53	55	57	57	58	58	58	58	58	58
0.3	Lemmon	64	64	64	64	63	63	61	60	60	60	59	58	58	58	57	56	54	53	52	53	55	55	58	59	61	62	62	63	64	64	64	64	64

Table 3-7. Southbound Model Speed Contours

Miles	Segment	5:30	5:40	5:50	6:00	6:10	6:20	6:30	6:40	6:50	7:00	7:10	7:20	7:30	7:40	7:50	8:00	8:10	8:20	8:30	8:40	8:50	9:00	9:10	9:20	9:30	9:40	9:50	10:00	10:10	10:20	10:30	10:40	10:50
4.8	Collins	71	69	68	67	67	66	65	63	62	59	57	54	54	48	38	34	34	53	67	66	62	57	58	60	59	64	64	63	62	63	62	64	64
2.5	Coit	59	58	57	56	56	56	55	55	54	54	53	52	53	53	52	52	52	51	52	53	52	50	48	51	52	52	53	52	52	54	53	54	54
0.3	Forest	64	63	62	62	61	62	61	60	60	60	59	58	39	40	39	36	34	29	35	49	59	57	56	58	58	58	59	59	59	60	59	60	60
0.4	Royal North	64	63	62	61	60	60	59	59	58	58	56	55	54	54	53	52	52	51	52	52	54	51	49	52	54	53	56	56	56	58	57	57	58
0.5	Royal South	59	59	58	57	57	57	56	56	55	55	54	53	53	53	51	51	51	51	51	52	53	51	48	51	52	52	54	54	54	55	54	54	55
1.0	Meadow North	64	63	62	62	62	62	61	61	60	60	59	58	58	58	57	57	57	57	57	57	58	56	56	57	58	57	59	59	59	60	60	59	60
1.0	Park Blvd	64	63	61	60	60	60	59	58	57	56	56	55	56	55	55	54	53	54	54	55	55	56	52	55	56	55	55	56	55	57	56	57	57
0.6	Caruth Haven	64	63	62	61	61	61	60	59	58	58	57	51	55	53	41	53	47	28	42	58	50	56	51	47	58	56	56	58	57	58	58	58	59
0.9	Lovers	63	63	62	61	61	61	60	59	59	58	58	57	56	55	55	55	55	54	54	57	56	56	55	55	57	57	57	58	58	58	58	58	59
0.7	Mockingbird	59	58	58	57	57	56	56	55	55	55	54	53	52	51	50	50	50	51	50	50	52	52	51	52	52	52	53	54	54	54	54	54	55
0.4	McCommas	59	58	58	57	57	56	56	56	56	55	55	54	53	52	51	43	43	45	44	50	52	53	52	52	52	53	53	54	55	55	55	55	55
0.3	Monticello	59	58	58	57	57	57	57	56	56	55	55	54	53	52	52	52	51	52	52	52	53	53	52	53	53	54	53	55	55	55	55	55	55
0.3	Knox North	59	58	58	57	57	56	56	55	55	55	54	53	52	51	51	50	50	51	51	50	52	52	51	52	52	53	53	54	54	54	55	54	55
0.4	Knox South	64	63	63	62	62	62	62	61	61	60	60	59	58	57	57	56	56	57	57	56	58	58	57	58	58	58	58	59	60	60	60	60	60
0.4	Fitzhugh	64	63	62	62	61	61	61	60	60	59	58	57	57	55	54	53	52	55	54	54	55	55	55	56	56	57	56	58	58	58	59	59	59
0.3	Haskell	59	58	58	57	57	56	56	55	55	55	54	53	52	51	51	42	41	42	43	42	44	51	51	52	51	52	52	54	54	54	55	54	54
0.3	Lemmon	64	63	63	62	62	61	61	60	60	60	59	58	58	56	56	56	55	56	56	55	57	56	56	57	57	57	57	59	59	59	60	59	59

3.4 Level of Service and Queue Observations

TTI surveyed local jurisdictions and Texas DOT to identify where known congestion and queues exist within the study area. Using the year 2007 aerial photography data provided by NCTCOG and stakeholder input, the freeway level of service and arterial queues were mapped as shown in Appendix G. The DIRECT simulation was observed over the same areas, and DIRECT was found to reasonably match the congestion patterns on U.S. 75 and IH 635 in the peak hour. At the same time, arterial queues north of PGBT generally reflected those observed in the map. DIRECT queues were shorter than observed queue lengths south of PGBT.

Chapter 4. Transit Validation

Mode choice in DIRECT is governed by modeling logic related to the variables "willingness to use transit" and "willingness to carpool." Using shortest path algorithms updated for each time interval (i.e., 5 minutes) to reflect the latest network conditions, travelers select the best path (lowest generalized cost from minimizing travel time and travel costs) from among their available travel options.

Intrinsic to DIRECT's mode choice capabilities, a traveler will always have the choice to shift mode based on their willingness to use transit or carpool. DIRECT currently does not have the capability of modeling "captive" transit riders (i.e., travelers that will only choose transit, even if there are better nontransit modes/paths). The creation of the subarea model for U.S. 75 with external zones creates some transit O-D pairs that may not be served by transit. This is an issue in DIRECT because there is no way to simulate these riders if there is no transit service between a given O-D pair.

Given the above reasons, the fact that the light-rail transit (LRT) operation was critical to the ICM strategies, and that bus operations in the corridor do not serve parallel, long-distance trips (i.e., bus routes primary are feeder routes to the LRT stations), it was decided to focus on validating the Red Line LRT ridership, particularly in the southbound direction for the morning peak period being modeled. The captive ridership data from NCTCOG served as a minimum threshold for transit ridership simulated in DIRECT. If the transit ridership in DIRECT fell below the captive ridership, this indicated a red flag that not enough travelers are selecting transit.

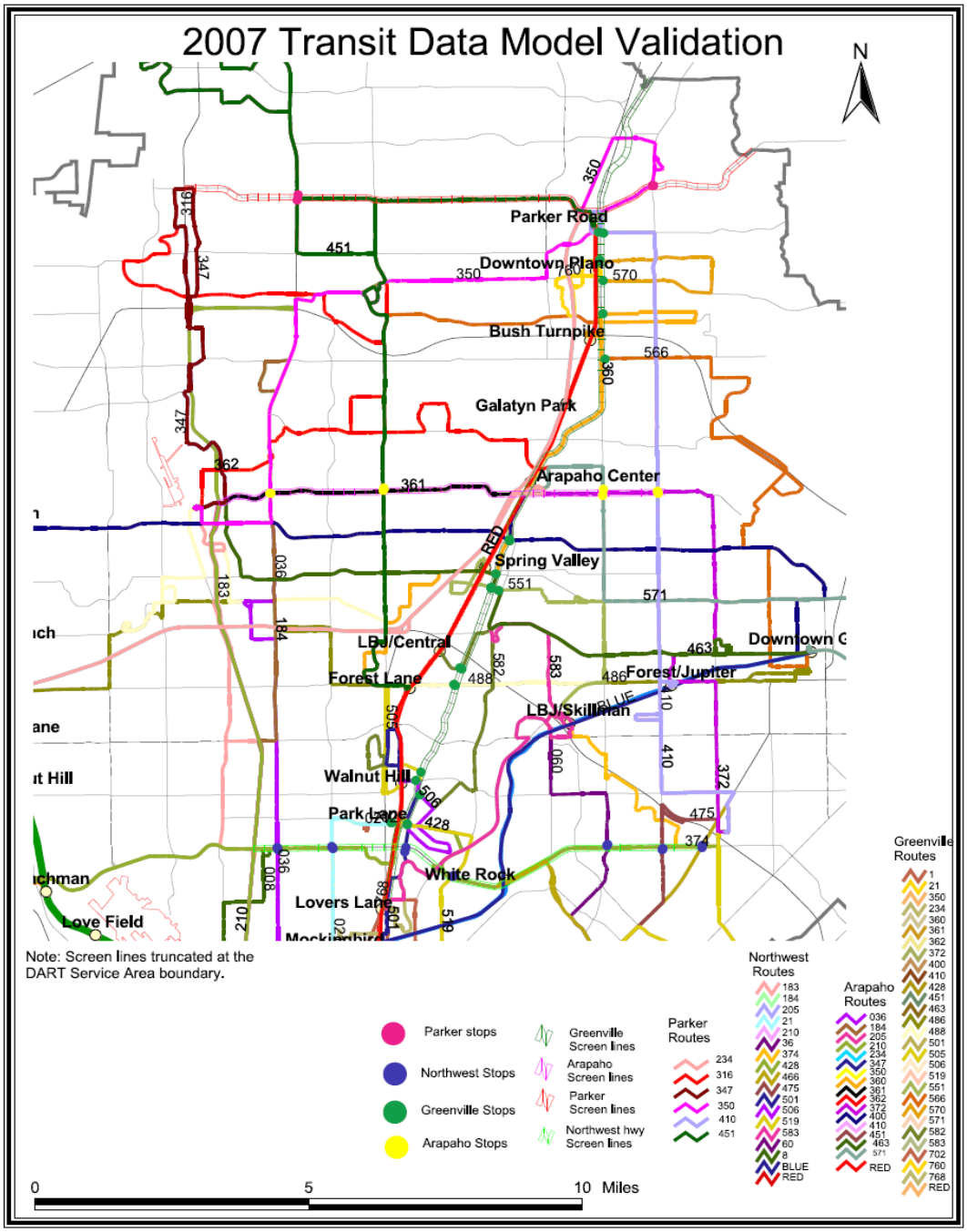
There were three main parameters used to adjust mode choice in DIRECT: 1) perceived waiting time; 2) maximum walking time to access transit line; and 3) percent willing to use transit. Numerous combinations were tested before arriving at the results presented later in this section.

The transit data include passenger ridership on LRT, buses, and the utilization of the LRT station park-and-ride lots. Figure 4-1 shows the locations of bus and LRT data provided by Dallas Area Rapid Transit (DART).

4.1 LRT Person Volumes

The LRT person volumes were obtained from DART. DART samples ridership on buses and the light-rail lines. Some of these data collected by DART was through automatic passenger counters, and some was through manual counts. The 5:30-11:00 a.m. ridership for the Red and Blue Lines are shown in Table 4-1. The critical transit line to match is the southbound Red line. Except for one station, the southbound Red line is entirely within 15 percent of observed volumes. That is, 92 percent of the station volumes from DIRECT are within 15 percent of the station counts. In the off-peak direction, 7 out of the 11 stations are within 15 percent in the northbound direction. All of the southbound Red line stations are within the 20 percent criteria.

Figure 4-1. Transit Count Locations



[Source: DART.]

Table 4-1. LRT Station Volumes, 5:30-11:00 A.M.

Red	Northbound				Southbound				
Stop	DART 5-11	Direct	Diff	%Diff	Stop	DART 5-11	Direct	Diff	%Diff
Mockingbird	2140	2141	1	0%	Parker	1953	1973	20	1%
Lovers	2120	2007	-113	-5%	Dtn Plano	2195	2045	-150	-7%
Park Ln	2029	1862	-167	-8%	Bush Tpk	2807	2786	-21	-1%
Walnut Hill	1864	1626	-238	-13%	Galatyn	2839	2756	-83	-3%
Forest Ln	1689	1252	-437	-26%	Arapaho	3300	2995	-305	-9%
LBJ/Central	1555	1445	-110	-7%	Spring Valley	3588	3073	-515	-14%
Spring Valley	1431	1273	-158	-11%	LBJ/Central	3595	4176	581	16%
Arapaho	987	1035	48	5%	Forest Ln	3882	3987	105	3%
Galatyn	864	609	-255	-30%	Walnut Hill	3924	4144	220	6%
Bush Tpk	710	410	-300	-42%	Park Ln	4124	4031	-93	-2%
Dtn Plano	579	401	-178	-31%	Lovers	4180	3782	-398	-10%
					Mockingbird	4135	3677	-458	-11%
Blue	**Northbound**				**Southbound**				
Stop	Dart 5-11	Direct	Diff	%Diff	Stop	DART 5-11	Direct	Diff	%Diff
Mockingbird	880	921	41	5%	Dtn Garl	1244	922	-322	-26%
White Rock	792	843	51	6%	Forest/Juniper	1594	1480	-114	-7%
LBJ/Skillman	612	763	151	25%	LBJ/Skillman	2126	2048	-78	-4%
Forest/Jupiter	442	519	77	17%	White R ock	2387	2511	124	5%
					Mockingbird	2425	2592	167	7%

Note: Stations south of Mockingbird are not included as they are in the tunnel section going into downtown.

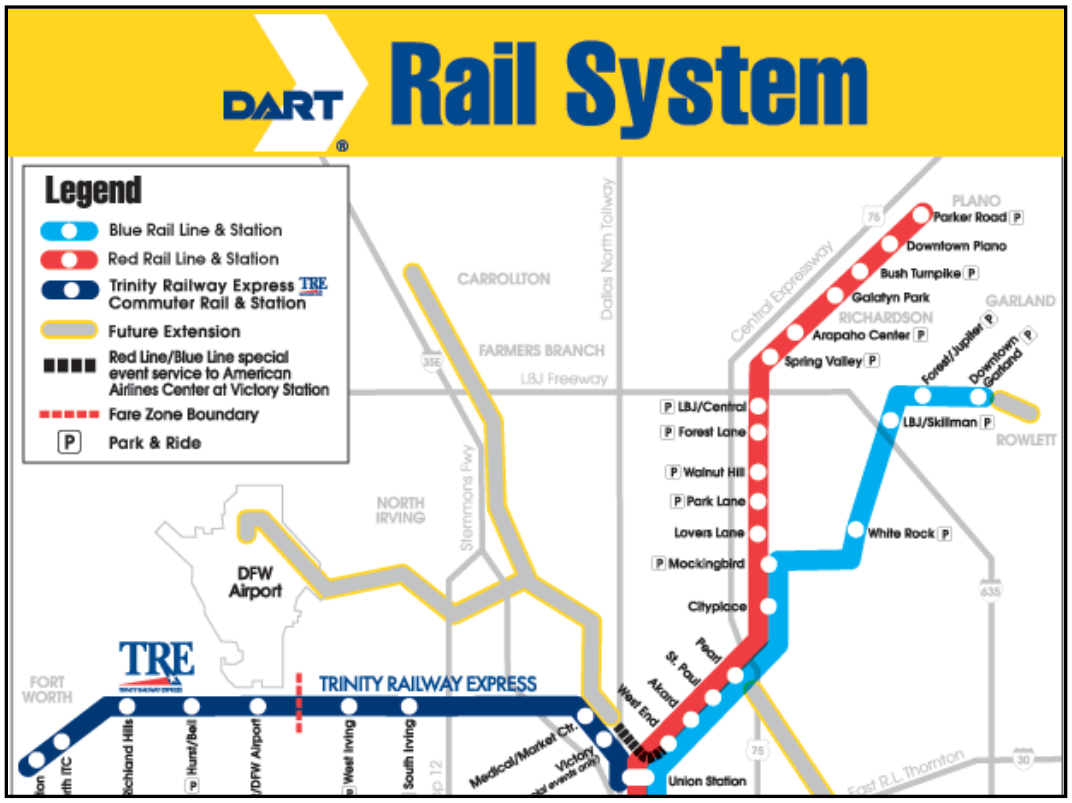
4.2 Bus Person Volumes

The bus person volumes on DART bus routes that cross the screenline locations also were obtained from DART. The bus ridership comparison at these locations is shown in Appendix H. Bus routes within the study area essentially "feed" the Red and Blue light-rail train routes with predominately east-west alignments. Based on ridership data, very few travelers are using the buses to get to the train stations. This fact made modeling the buses very challenging as evidenced by the underestimation of ridership by an average of 51 percent. However, given that only 2,115 bus riders were observed (out of the estimated 1.7 million travelers), the U.S. 75 team deemed the difference between observed and estimated was acceptable.

4.3 LRT Parking Lot Utilization

DART has constructed park-and-ride lots at most of their LRT stations (see Figure 4-2). The stations with the parking symbol indicate those stations with formal park-and-ride lots. In addition, there is informal parking on adjacent city streets. DART also analyzed the available spaces within a 0.3-mile radius of the park-and-ride stations (ancillary on-street parking).

Figure 4-2. DART Rail System Map



[Source: DART.]

DART collects data on most of their park-and-ride lots (missing park-and-ride lot data was supplemented with data collected by TTI). DART generally records the number of vehicles parked in the lots, as well as nearby on-street parking. Thus, some lots are operating at more than 100 percent of their official lot capacity.

The number of parked cars, total station parking capacities, and total parking percent occupied at these lots are shown below in Table 4-2. For DIRECT model calibration, the evaluation focused on the comparison of the total parked cars. As shown, only three park-and-ride facilities are at or overcapacity in DIRECT. The total parked cars in all lots combined in DIRECT meet the criteria established in Table 4-2 of being within 20 percent. However, four of the lots exceed the 30 percent difference criteria for individual lots. These lots are in the southern section of the corridor and are not critical in the analysis of scenarios. The lots in the north section of the corridor are critical to incident scenarios. Modeling of these four lots all match within 5 percent. It is anticipated that the first four lots listed (highlighted in yellow in Table 4-2) will be impacted by the ICM strategies under the incident scenario locations specified in the AMS Analysis Plan. Since the incident scenario at Forest Lane will only be tested as a minor incident, the potential impact to the LBJ and Forest Lane station due to mode shift will be minimal. These lots may experience higher demand as vehicular traffic shifts mode to use the Red Line. The two lots in this group that are at 100 percent occupied have been expanded by DART. DART expanded the Parker Road and Bush Turnpike stations in June 2009 by a combined 600 parking spaces, which will provide needed capacity for mode shift facilitated by future ICM strategies.

Table 4-2. LRT Parking Lot Utilization, 5:30-11:00 A.M.

	DART						DIRECT				
Location	Parked Cars in Lot	Lot Capacity	Lot Percent Occupied	Ancillary On-Street Capacity	Total Station Parking Capacity	Total Parking Percent Occupied	Parked Cars	Lot Percent Occupied	Total Parking Percent Occupied	Difference Parked Cars	Percent Difference
Parker Road	1,954	1,566	125%	420	1,986	98%	1,996	127%	101%	42	2%
Bush Turnpike	800	778	103%	0	778	103%	776	100%	100%	-24	-3%
Arapaho Center	513	1,105	46%	35	1,140	45%	511	46%	45%	-2	0%
Spring Valley	306	403	76%	40	443	69%	309	77%	70%	3	1%
LBJ/Central*	142	553	26%	83	636	22%	429	78%	67%	288	203%
Forest Lane*	126	271	46%	30	301	42%	233	86%	77%	108	86%
Walnut Hill*	76	215	35%	240	455	17%	144	67%	32%	69	91%
Park Lane*	163	346	47%	0	346	47%	194	56%	56%	32	19%
Mockingbird	542	735	74%	0	735	74%	737	100%	100%	195	36%
Total	4,621						5,329			708	15%

*TTI counts from 11/11/08 to 11/18/08 – does not include on-street and retail parking lots.

Note: Highlight represents the stations impacted by ICM strategies.

Chapter 5. Route Choice

DIRECT uses a multiobjective shortest path algorithm where each traveler chooses the shortest path (either vehicular, transit, or park-and-ride) based on a generalized cost function, as shown in Equation 2. More information on route choice in DIRECT is provided in Section 2 of the *"U.S. 75 ICM Analysis Plan."*

Generalized Cost = Travel Time x Value of Time + Travel Cost + Tarnsit Cost (Equation 2)

Where,

Travel Time = The sum of in-vehicle time and out-of-vehicle time, where in-vehicle time is estimated from the simulation and out-of-vehicle time (for transit users only) is a function of the transit service headway;

Value of Time = $12/hour; and

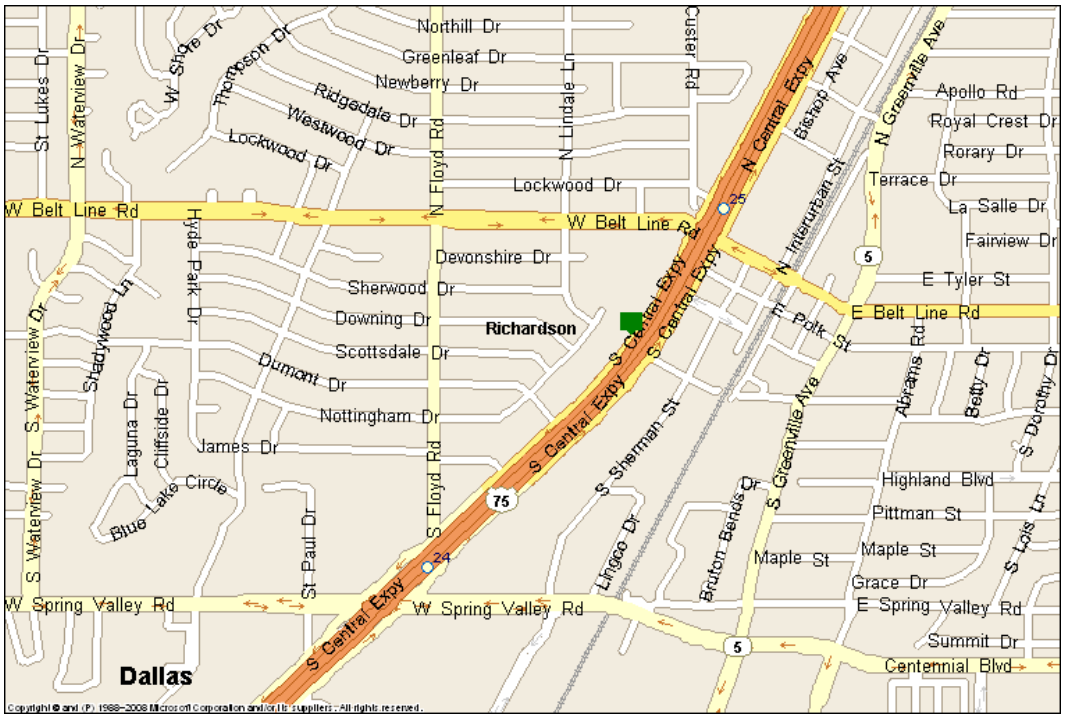
Travel Cost = The sum of operating cost and toll (if any), where operating cost is $0.25 per mile, toll is $0.10 per mile, and transit is $1 per ride.

These costs were originally developed from NCTCOG's travel demand model documentation, but were adjusted as part of the validation and calibration process. The shortest path is the path (route) that minimizes this cost function. The cost function is calculated at every five-minute interval of the simulation. DIRECT employs an incremental assignment rather than a Dynamic User Equilibrium (DUE); and therefore, the process of calculating the optimal path is not iterative (i.e., the shortest path during an interval is considered the optimal path).

Chapter 6. Known Incident Validation

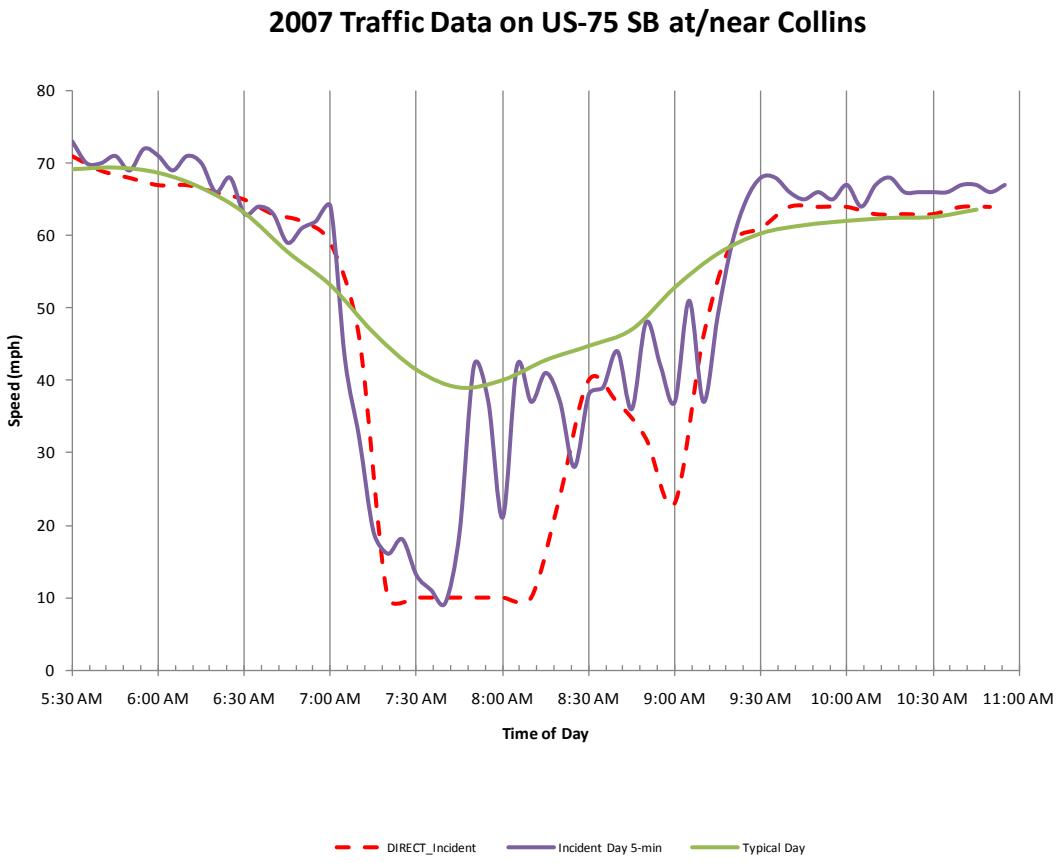
Based on the review of incident data along U.S. 75, a major incident was modeled to test DIRECT under incident conditions. Figure 6-1 illustrates the selected incident location along southbound U.S. 75, approximately one-quarter mile south of Belt Line (approximately midpoint of corridor). The two inside lanes (closest to median) were closed as a result of the incident. It was inferred from the police report that four cars were involved, thus the incident occupied approximately 200 linear feet of roadway. The incident started at 6:50 a.m. and was cleared by 7:40 a.m. Based on the detector data at Collins, worse than average speeds were observed until 9:20 a.m., as shown in Figure 6-2. The U.S. 75 team expected to observe queues develop back to the President George Bush Turnpike (4.2 miles).

Figure 6-1. Known Incident Location



[Source: NCTCOG.]

Figure 6-2. U.S. 75 at Collins Speed Profile for Known Incident



Based on discussion with stakeholders, traffic is diverted to parallel routes starting with the frontage roads then Greenville, Plano Road, K Avenue, Jupiter Road, and Coit Road (only in Plano, north of President George Bush Turnpike). This diversion was created in DIRECT by assuming a certain percentage of travelers are willing to divert from their historical path (baseline path without an incident) when they encounter congestion. Congestion was encountered when the density of either of the two links ahead of the vehicle's current position exceeds 80 percent of the link's jam density. When this occurs, the shortest path is evaluated for that vehicle (based on the current interval shortest path calculation), and the vehicle will change its route to the updated shortest path.

Table 6-1 shows the model validation/calibration criteria used for the known incident scenario based on U.S. DOT guidelines.

Table 6-1. Validation and Calibration Criteria for Known Incident

Validation Criteria and Measures	Validation Acceptance Targets
Incident-related congestion duration	Within 25% of observed duration
Extent of queue propagation	Within 20% of observed queues
Traffic flow Diversion	Reasonable changes in link volumes where expected

From Figure 6-2 above, the impact of the incident is approximately from 7:00 a.m. to 9:20 a.m., or 120 minutes. This is right after the start of the incident to when the Incident Day speeds (solid purple line) returns to the Typical Day speeds (solid green line). Based on speed, the duration (i.e., start and end time) of the incident in DIRECT matches the detector data, although DIRECT Incident speeds (dashed red line) show slower speeds than observed on the incident day between 7:15 a.m. to 8:10 a.m., and again at 9:00 a.m.

Diversion was evaluated by comparing link volumes on U.S. 75 and parallel strategic routes. Table 6-2 below shows the amount of traffic diverted to alternative roadways. The U.S. 75 team felt that this level of diverted traffic, and where they occur, are reasonable. Some of these link volumes also are shown graphically in Figure 6-3.

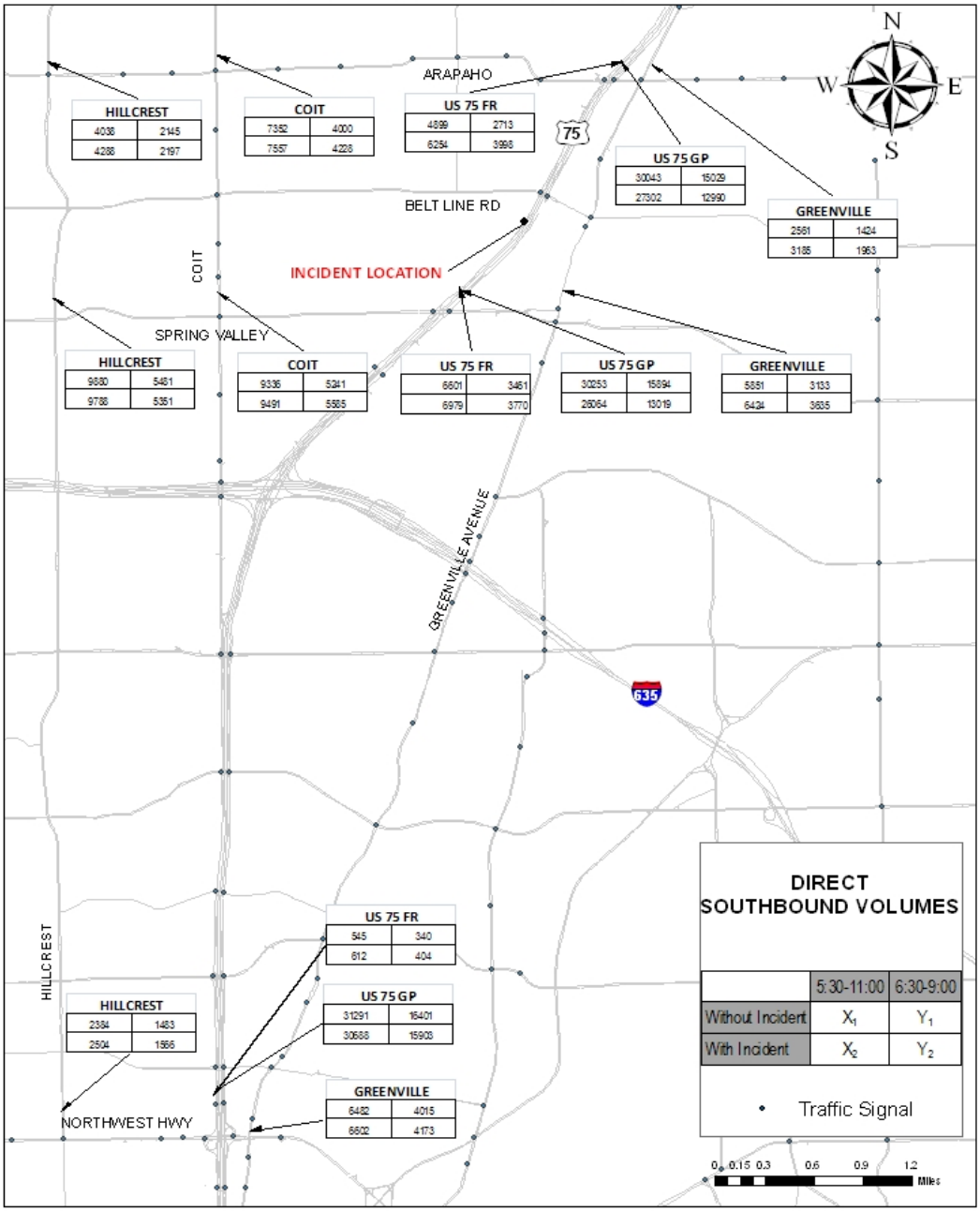
By visually inspecting the simulation, the development and dissipation of the southbound U.S. 75 queue was observed. Table 6-3 summarizes the extent of the queue propagation in DIRECT. The observed extent of queue in the field is approximately 4.2 miles, based on information received from stakeholders familiar with the corridor. This queue length criterion is met as the queue in DIRECT reaches 3.4 miles (with the +/-20% criterion range of 3.36 to 5.04 miles).

Table 6-2. Known Incident Model Diversions

		Baseline		Incident		Difference		Percent Difference	
Street Name	Screenline	5:30-11:00	6:30-9:00	5:30-11:00	6:30-9:00	5:30-11:00	6:30-9:00	5:30-11:00	6:30-9:00
Custer	ARAPAHO_SB	1,525	904	1,680	1,059	155	155	10%	17%
Waterview	ARAPAHO_SB	612	395	817	551	205	156	33%	39%
Coit	ARAPAHO_SB	7,352	4,000	7,557	4,228	205	228	3%	6%
Preston	ARAPAHO_SB	10,043	5,620	10,268	5,768	225	148	2%	3%
Hillcrest	ARAPAHO_SB	4,038	2,145	4,288	2,197	250	52	6%	2%
U.S. 75	ARAPAHO_SB	30,043	15,029	27,302	12,990	-2,741	-2,039	-9%	-14%
Jupiter	ARAPAHO_SB	4,662	2,756	5,042	2,901	380	145	8%	5%
Yale	ARAPAHO_SB	237	133	227	132	-10	-1	-4%	-1%
Glenville	ARAPAHO_SB	13	4	12	4	-1	0	-8%	0%
Plano	ARAPAHO_SB	4,154	2,299	4,250	2,337	96	38	2%	2%
Grove	ARAPAHO_SB	2,226	1,177	2,261	1,251	35	74	2%	6%
Greenville	ARAPAHO_SB	2,561	1,424	3,185	1,963	624	539	24%	38%
U.S. 75_Frontage Rd	ARAPAHO_SB	4,899	2,713	6,254	3,998	1,355	1,285	28%	47%
Total	ARAPAHO_SB	95,839	49,945	97,144	50,744	1,305	799	1%	2%
Preston	NW_HWY_SB	2,674	1,598	2,649	1,578	-25	-20	-1%	-1%
DNT	NW_HWY_SB	16,873	9,116	16,956	9,096	83	-20	0%	0%

		Baseline		Incident		Difference		Percent Difference	
Street Name	Screenline	5:30-11:00	6:30-9:00	5:30-11:00	6:30-9:00	5:30-11:00	6:30-9:00	5:30-11:00	6:30-9:00
Hillcrest	NW_HWY_SB	2,384	1,483	2,504	1,566	120	83	5%	6%
U.S. 75	NW_HWY_SB	31,291	16,401	30,688	15,903	-603	-498	-2%	-3%
Greenville	NW_HWY_SB	6,482	4,015	6,602	4,173	120	158	2%	4%
U.S. 75_Frontage Rd	NW_HWY_SB	545	340	612	404	67	64	12%	19%
Abrams	NW_HWY_SB	2,165	1,276	2,195	1,299	30	23	1%	2%
Plano	NW_HWY_SB	1,383	801	1,426	824	43	23	3%	3%
Audelia	NW_HWY_SB	2,352	1,340	2,300	1,318	-52	-22	-2%	-2%
Jupiter	NW_HWY_SB	2,678	1,563	2,704	1,570	26	7	1%	0%
Total	NW_HWY_SB	68,827	37,933	68,636	37,731	-191	-202	0%	-1%
U.S. 75	PARKER_SB	30,575	15,319	30,851	15,321	276	2	1%	0%
Custer	PARKER_SB	5,529	3,510	5,715	3,625	186	115	3%	3%
DNT	PARKER_SB	19,952	10,656	20,318	10,836	366	180	2%	2%
Coit	PARKER_SB	9,966	5,397	9,799	5,334	-167	-63	-2%	-1%
Preston	PARKER_SB	9,078	5,126	9,038	5,100	-40	-26	0%	-1%
Independence	PARKER_SB	6,707	4,224	6,671	4,203	-36	-21	-1%	0%
K	PARKER_SB	3,919	2,639	3,876	2,692	-43	53	-1%	2%
Alma	PARKER_SB	4,203	2,625	4,188	2,634	-15	9	0%	0%
U.S. 75_Frontage Rd	PARKER_SB	8,105	5,242	7,631	4,865	-474	-377	-6%	-7%
Jupiter	PARKER_SB	1,996	1,203	2,003	1,233	7	30	0%	2%
Spring_Creek	PARKER_SB	3,471	2,070	3,461	2,064	-10	-6	0%	0%
Total	PARKER_SB	103,501	58,011	103,551	57,907	50	-104	0%	0%
Coit	SH121_SB	640	410	635	406	-5	-4	-1%	-1%
U.S. 75	SH121_SB	13,238	6,893	13,225	6,893	-13	-0	0%	0%
Total	SH121_SB	13,878	7,303	13,860	7,299	-18	-4	0%	0%

Figure 6-3. Known Incident Model Diversions



[Source: NCTCOG.]

Table 6-3. Known Incident Model Queue on SB U.S. 75

Time	Approximate Queue Extent	Miles	Notes
6:50 a.m.	One quarter mile south of Beltline	0.0	Start Incident
7:00 a.m.	Two-thirds way between Beltline and Arapaho	0.8	
7:10 a.m.	One quarter way between Arapaho and Collins	1.2	
7:20 a.m.	Just north of Collins	1.7	
7:30 a.m.	Just south of Fallcreek	2.5	
7:40 a.m.	Just south of Palisades Creek Drive	3.3	End Incident
7:45 a.m.	Palisades Creek Drive	3.4	
7:50 a.m.	East Lookout Drive	3.1	
8:05 a.m.	Just north of Palisades Boulevard	3.0	
8:20 a.m.	Just north of Collins	1.7	
8:30 a.m.	Midway between Arapaho and Collins	1.5	
8:40 a.m.	Midway between Beltline and Arapaho	0.7	
8:50 a.m.	Just south of Beltline	0.2	
8:55 a.m.		0.0	End Queue

Chapter 7. HOV Validation

A sensitivity test was conducted to assess how DIRECT will handle the new HOV lanes on U.S. 75. The HOV lanes along U.S. 75 were opened in 2008. The 2007 traffic demand was used for the HOV validation and calibration. The DIRECT model results were compared to observed HOV volumes collected by TTI in 2008.

The 2008 observed HOV volume counts indicate that a majority of the traffic enters the HOV lane at the beginning of the lane (Plano North Entry point). The observed counts did find some entrance and exit traffic at the midpoint access point (Plano South Access point). Initial DIRECT runs revealed that the HOV volumes were too low at the Plano North entrance. Consequently, the percent willing to carpool parameter was adjusted for selected OD pairs that traversed these links to closely match the observed counts at these access points. Even with this adjustment, the Plano North entrance still showed lower volumes relative to observed counts. Thus, the demand for the OD pairs that traverses these links were increased by 3,420 travelers (0.2 percent out of 1.7 million travelers) in order to make up the difference, and was assumed to account for some of the growth from 2007 to 2008 in the corridor.

Table 7-1 shows that DIRECT was typically within 12 percent (5:30-11:00 a.m.) and 22 percent (6:30-9:00 a.m.) of observed volumes. This difference was deemed reasonable, given the time and budget constraints of the modeling effort. In addition, other links crossing the Parker Road and the Arapaho screenlines were reviewed. The DIRECT volumes for this HOV run on southbound U.S. 75 general purpose lanes (GP) are within 6 percent (5:30-11:00 a.m.) and 3 percent (6:30-9:00 a.m.) of the 2008 observed volumes at Collins. This difference is within the variability found between the observed 2007 and observed 2008 volumes at southbound (i.e., there was only a 6 to 7 percent difference between the 2007 and 2008 southbound GP volumes at this location).

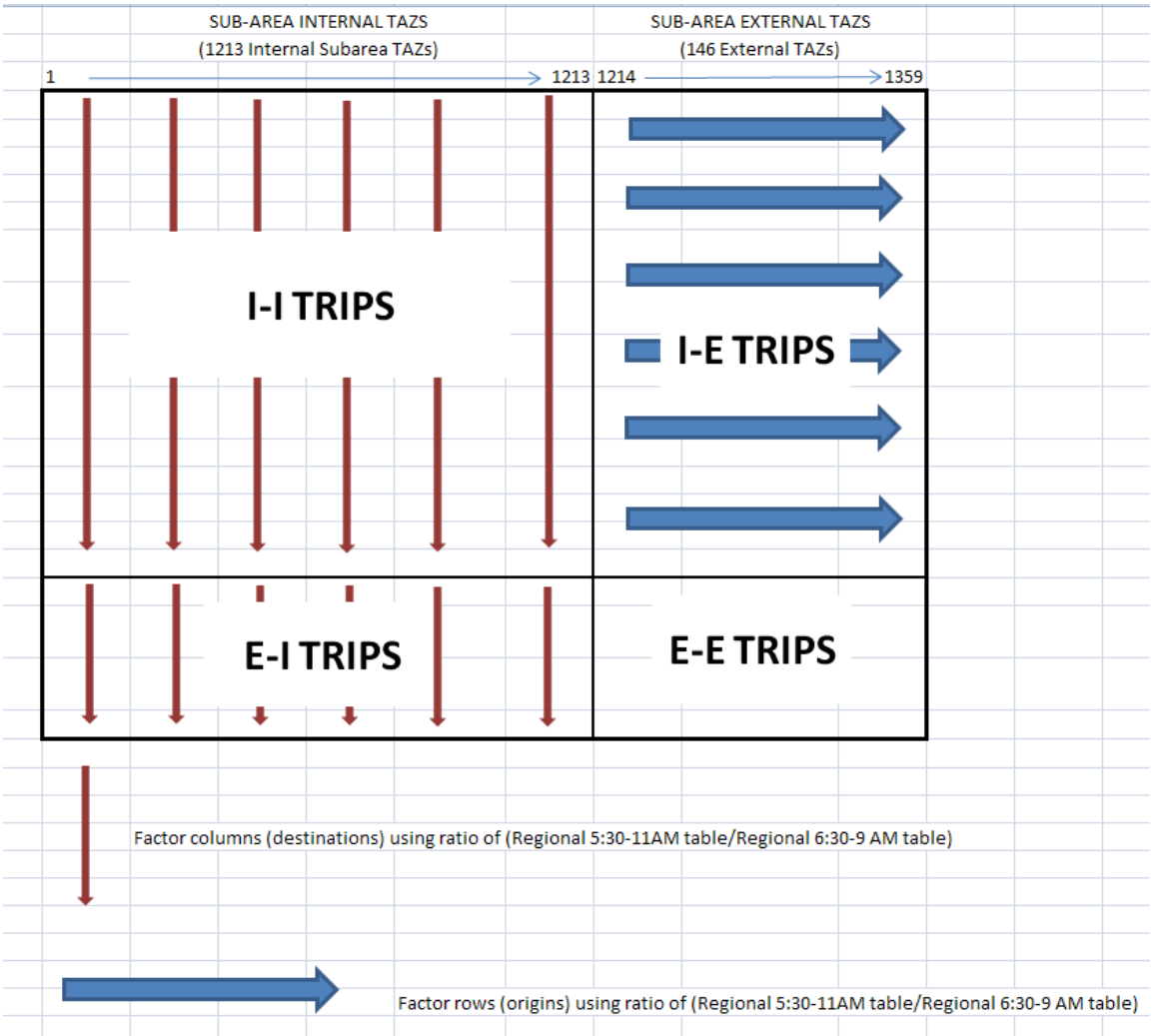
Table 7-1. HOV Lane Volumes

		Observed		Model		Difference	Percent Difference	Difference	Percent Different
Location Name	DIR	6:30-9:00	5:30-11:00	6:30-9:00	5:30-11:00	6:30-9:00	6:30-9:00	5:30-11:00	5:30-11:00
SB U.S. 75 Plano_North_Entrance	SB	2,164	3,213	1,710	3,112	-454	-21.0%	-101	-3.1%
SB U.S. 75 Plano_Middle_Counter	SB	2,164	3,213	1,707	3,106	-457	-21.1%	-107	-3.3%
SB U.S. 75 Plano_South_Exit	SB	500	744	315	644	-185	-37.0%	-100	-13.4%
SB U.S. 75 Plano_South_Entrance	SB	390	580	528	780	138	35.4%	200	34.5%
SB U.S. 75 Richardson	SB	2,054	3,049	1,834	3,184	-220	-10.7%	135	4.4%
SB U.S. 75 Exit_To_WB_635_HOV	SB	530	787	561	936	31	5.8%	149	18.9%
SB U.S. 75 HOV Exit_To_SB_GP_Lanes	SB	1,524	2,262	1,201	2,200	-323	-21.2%	-62	-2.7%
WB I-635_HOV_East of U.S. 75	WB	2,871	4,262	2,508	3,685	-363	-12.6%	-577	-13.5%
EB I-635_HOV_East of U.S. 75	EB	520	927	672	1,050	152	29.2%	123	13.3%

APPENDIX A. OD Vehicle Trip Table Expansion Procedures

A.1 Steps to Expand Morning Peak Period OD Matrix – March 10, 2009

1. Get the NCTCOG's off-peak regional trip table. This trip table represents the combined travel from 18 off-peak hours for the periods of 9:00 AM – 3:30 PM and 7:00 PM – 6:30 AM.
2. Separate the portion of the regional trips from 5:30 AM to 6:30 AM and 9 AM to 11 AM of the table above using the CS developed temporal distributions, by mode, from the 1996 survey.
3. Combine the trip tables created in step #2 above with the existing 6:30 AM – 9AM regional trip table to create a table that represents 5:30 AM – 11:00 AM regional trips.
4. For each internal TAZ destination, calculate the ratio of the new 5:30-11:00 AM regional trip table to the 6:30 AM – 9 AM regional table for each TAZ .
5. For the portion of the regional TAZs inside the sub-area, the ratios are applied to the destinations (columns). This will increase the number of I-I and E-I trips.
6. For the I-E trips, apply the same ratio to the rows that correspond to the internal TAZs, but only for the portion of the rows where an external station is the destination.
7. After step 5, for each external zone sum the number of E-I trips before and after the application of the ratios. Calculate a new ratio for each external zone, equal to the sum (E-I) after divided by sum (E-I) before. Apply this ratio only for the portion of the rows where an external station is an origin and a destination (E-E).
8. The revised 5:30 – 11:00 AM trip table is used for the new runs of DIRECT.



[Source. NCTCOG.]

APPENDIX B. OD Transit Trip Table Expansion Procedures

B.1 Steps to Expand the Morning Peak Period Transit OD Matrix

Background

SMU originally developed the transit OD matrix (6:30 AM – 9:00 AM) by writing a program to match the TAZ IDs in the DART data with the superzones created for DIRECT. In other words, the logic looped over all OD pairs in the DART data. If the origin TAZ belonged to superzone "A" and the destination TAZ belonged to superzone "B", the program added the trips of this TAZ pair to the trips between superzones AB. As SMU did not have the mapping between the TAZs outside the study area, this method only captured the transit trips with an origin AND destination within the 200 superzone study area (the transit OD matrix was created for the original 200 superzones that have since been revised to 212). The subarea transit OD matrix included 15,216 internal trips.

The following discussion lists the procedure to expand the transit OD matrix to include I-I, I-E, and E-I transit trips beginning between 5:30 AM and 10:59 AM for the 212 revised superzones.

Methodology to Expand the Transit Trip Table

1. Obtain DART's regional transit OD data from the 2007 transit onboard survey.
2. Correlate Trip ID (representing each unique bus or rail trip) with Trip Start Time.
3. Extract trips that start between 5:30 AM and 10:59 AM.
4. Use the "NEW_EXPWGT_NOLT" field included with the DART data, representing NCTCOG's corrected weights, to determine the number of estimated trips between each OD pair.
5. Obtain the list of TAZs and their superzone groupings that define the subarea and the subarea's external zones in DIRECT.
6. Using the table obtained in Step 5, extract the transit trips that have an origin within the subarea (excluding subarea external TAZs) and save in a table. Similarly, create a table of all trips that have a destination within the subarea (excluding subarea external TAZs).
7. Using either table developed in Step 6, extract the transit trips that have both an origin and destination within the subarea (I-I trips).
8. Using TRANSCAD, calculate the shortest distance between each TAZ in the Dallas/Ft. Worth region to one of the 80 subarea external TAZs. This correlation will allow us to assign transit trips that have a trip end outside of our subarea to one of the subarea external TAZs.

9. Remove the I-I trips from the two tables developed in Step 6, resulting in two tables that contain all of the I-E and E-I subarea transit trips.
10. Assign each external trip end in the I-E and E-I tables from Step 9 to one of the subarea external TAZs using the shortest distance assignment developed in Step 8.
11. Relate each TAZ in the I-I, I-E, and E-I tables to their appropriate superzone groupings.
12. Use a pivot table to sum the trips for each OD pair to create the expanded transit trip table. The expanded transit OD table from 5:30AM to 11AM is used for new runs of DIRECT.

Findings

Based on DART's regional transit OD data, adjusted by NCTCOG, there are approximately 216,000 weekday transit trips (bus and rail) in the Dallas region. Of these total trips, approximately 90,000 transit trips occur between 5:30 a.m. and 11:00 a.m.. Transit trips to, from, and within the US 75 subarea are allocated as follows:

- Trips with an origin in the subarea = 43,873 trips
- Trips with destination in the subarea = 53,824 trips
- I-I trips = 29,400 trips
- I-E trips = 14,473 trips
- E-I trips = 24,358 trips
- Total number of trips in the expanded transit OD table: 68,231 trips

APPENDIX C. Link Volumes by Screenline

20091005 Run 45 Ite 11 by Screenline

ARAPAHO_NB

From	To	DIR	Location Name	Street Name	Obs Total	Mod Total	Difference	Observed 6:30-9:00	Modeled 6:30-9:00	% Diff 630-9:00
178	176	NB	Custer-37_NB@Arapaho	Custer	712	734	22	358	446	25
2302	2301	NB	Coit-4_NB@Arapaho	Coit	4,843	4,865	22	2,514	2,669	6
2320	2306	NB	Preston_@_Arapaho	Preston	6,762	7,117	355	3,537	3,753	6
3186	2315	NB	Hillcrest_@_Arapaho	Hillcrest	3,753	3,967	214	1,963	2,157	10
3320	2297	NB	Waterview-14_NB@Arapaho	Waterview	664	742	78	397	434	9
4079	4081	NB	US75_NB@Collins	US75	29,744	28,900	-844	16,337	15,929	-2
4089	4088	NB	Jupiter-91_NB@Arapaho	Jupiter	4,810	4,820	10	2,817	2,760	-2
4091	4090	NB	Yale-83_NB@Arapaho	Yale	347	289	-58	222	216	-3
4093	4092	NB	Glenville-70_NB@Arapaho	Glenville	662	445	-217	360	291	-19
4095	4094	NB	Plano-71_NB@Arapaho	Plano	4,794	5,008	214	2,938	2,972	1
4220	4219	NB	Grove-57_NB@Arapaho	Grove	685	1,834	1,149	385	1,073	179
4222	4100	NB	Greenville-46_NB@Arapaho	Greenville	1,466	2,144	678	811	1,456	80
4227	4076	NB	US75_NB@FR-Arapaho	US75	3,076	2,368	-708	1,483	1,725	16
21107	2274	NB	DNT2_NB@Arapaho	DNT	16,204	14,124	-2,080	9,031	7,601	-16
ARAPAHO_NB (14 detail records)				*Screenline Total*	**78,522**	**77,357**	**-1,165**	**43,153**	**43,482**	**1%**
				Percent Difference			**-1%**			

ARAPAHO_SB

From	To	DIR	Location Name	Street Name	Obs Total	Mod Total	Difference	Observed 6:30-9:00	Modeled 6:30-9:00	% Diff 630-9:00
176	178	SB	Custer-37_SB@Arapaho	Custer	1,466	1,525	59	947	904	-5
2297	3320	SB	Waterview-14_SB@Arapaho	Waterview	984	612	-372	710	395	-44

2301	2302	SB	Coit-4_SB@Arapaho	Coit	8,012	7,352	-660	5,162	4,000	-23
2306	2320	SB	Preston_@_Arapaho	Preston	10,143	10,043	-100	5,306	5,620	6
2315	3186	SB	Hillcrest_@_Arapaho	Hillcrest	5,630	4,038	-1,592	2,945	2,145	-27
4082	21180	SB	US75_SB@Collins	US75	34,922	30,043	-4,879	17,727	15,029	-15
4088	4089	SB	Jupiter-91_SB@Arapaho	Jupiter	4,893	4,662	-231	3,060	2,756	-10
4090	4091	SB	Yale-83_SB@Arapaho	Yale	549	237	-312	409	133	-67
4092	4093	SB	Glenville-70_SB@Arapaho	Glenville	539	13	-526	270	4	-99
4094	4095	SB	Plano-71_SB@Arapaho	Plano	4,203	4,154	-49	2,484	2,299	-7
4219	4220	SB	Grove-57_SB@Arapaho	Grove	670	2,226	1,556	399	1,177	195
4222	195	SB	Greenville-46_SB@Arapaho	Greenville	2,605	2,561	-44	1,778	1,424	-20
4225	182	SB	US75_SB@FR-Arapaho	US75	5,095	4,899	-196	2,874	2,713	-6
21126	2280	SB	DNT2_SB@Arapaho	DNT	25,803	23,474	-2,329	13,883	11,346	-18
ARAPAHO_SB (14 detail records)				*Screenline Total*	**105,514**	**95,839**	**-9,675**	**57,954**	**49,945**	**-14%**
				Percent Difference			**-9%**			

DIS_1

From	*To*	*DIR*	*Location Name*	*Street Name*	*Obs Total*	*Mod Total*	*Difference*	*Observed 6:30-9:00*	*Modeled 6:30-9:00*	*% Diff 630-9:00*
4430	4448	EB	2661-EB-NB@PGBT-Interchange	US75_PGBT_INTERCHANGE	4,313	4,350	37	2,273	2,477	9
4430	4449	EB	2661-EB-SB@PGBT-Interchange	US75_PGBT_INTERCHANGE	5,146	2,052	-3,094	2,495	946	-62
4445	4451	NB	4139-NB-WB@PGBT-Interchange	US75_PGBT_INTERCHANGE	5,991	2,664	-3,327	3,493	1,338	-62
4445	4446	NB	4139-NB-EB@PGBT-Interchange	US75_PGBT_INTERCHANGE	3,052	2,637	-415	1,642	1,287	-22
4447	4448	WB	2656-WB-NB@PGBT-Interchange	US75_PGBT_INTERCHANGE	4,261	4,379	118	2,411	2,376	-1
4447	4449	WB	2656-WB-SB@PGBT-Interchange	US75_PGBT_INTERCHANGE	6,062	5,613	-449	2,747	2,862	4
4450	4451	SB	2648-SB-WB@PGBT-Interchange	US75_PGBT_INTERCHANGE	6,990	4,276	-2,714	3,892	1,576	-60
4450	4446	SB	2648-SB-EB@PGBT-Interchange	US75_PGBT_INTERCHANGE	2,941	2,638	-303	1,584	1,250	-21
DIS_1 (8 detail records)				*Screenline Total*	**38,756**	**28,609**	**-10,147**	**20,537**	**14,112**	**-31%**
				Percent Difference			**-26%**			

DIS_3

From	To	DIR	Location Name	Street Name	Obs Total	Mod Total	Difference	Observed 6:30-9:00	Modeled 6:30-9:00	% Diff 630-9:00
2291	3330	EB	Arapaho:E._of_Hampshire	Arapaho	4,190	3,465	-725	2,192	2,030	-7
3044	3091	EB	2662-EB-SB_DC@LBJ-Interchang	US75_IH635_INTERCHANGE	7,615	6,694	-921	3,674	2,956	-20
3044	3046	EB	2662-EB-NB_DC@LBJ-Interchang	US75_IH635_INTERCHANGE	9,638	8,894	-744	4,635	4,794	3
3047	3099	SB	2658-SB-EB_DC@LBJ-Interchang	US75_IH635_INTERCHANGE	7,821	2,804	-5,017	3,635	1,554	-57
3047	3048	SB	2658-SB-WB_DC@LBJ-Interchan	US75_IH635_INTERCHANGE	12,913	12,843	-70	6,229	7,034	13
3089	3046	WB	2660-WB-NB_DC@LBJ-Interchan	US75_IH635_INTERCHANGE	9,768	83	-9,685	5,072	43	-99
3089	3091	WB	2660-WB-SB_DC@LBJ-Interchan	US75_IH635_INTERCHANGE	4,259	358	-3,901	1,833	206	-89
3098	3099	NB	2654-NB-EB_DC@LBJ-Interchang	US75_IH635_INTERCHANGE	2,962	371	-2,591	1,568	170	-89
3098	3048	NB	2654-NB-WB_DC@LBJ-Interchan	US75_IH635_INTERCHANGE	5,706	4,920	-786	2,362	2,787	18
3330	2291	WB	Arapaho:E._of_Hampshire	Arapaho	6,285	5,529	-756	3,288	2,973	-10
DIS_3 (10 detail records)				*Screenline Total*	**71,157**	**45,961**	**-25,196**	**34,488**	**24,547**	**-29%**
				Percent Difference			**-35%**			

DIS_5

From	To	DIR	Location Name	Street Name	Obs Total	Mod Total	Difference	Observed 6:30-9:00	Modeled 6:30-9:00	% Diff 630-9:00
1397	1398	NB	NB_US_75_@_Hall	US75	25,788	25,600	-188	14,104	14,074	0
1839	1395	SB	SB_US_75_@_Lemmon	US75	17,774	18,200	426	9,058	9,889	9
2083	2084	NB	NB_US_75_@_Yale	US75	31,467	32,309	842	17,059	17,647	3
2090	733	SB	SB_US_75_@_Mockingbird	US75	25,998	25,117	-881	12,876	13,624	6
2144	579	NB	NB_US_75_@_Meadow	US75	27,411	26,701	-710	13,179	14,921	13

21224	588	SB	SB_US_75_@_Royal	US75	29,857	28,268	-1,589	15,285	14,820	-3
DIS_5 (6 detail records)				*Screenline Total*	**158,295**	**156,195**	**-2,100**	**81,561**	**84,975**	**4%**
				Percent Difference			**-1%**			

DIS_6

From	*To*	*DIR*	*Location Name*	*Street Name*	*Obs Total*	*Mod Total*	*Difference*	*Observed 6:30-9:00*	*Modeled 6:30-9:00*	*% Diff 630-9:00*
2017	201711	NB	2646_NB-WB@NW-Interchange	US75_NWHWY_INTERCHANGE	2,189	0	-2,189	1,182	0	-100
2017	2121	NB	2646_NB-EB@NW-Interchange	US75_NWHWY_INTERCHANGE	1,660	635	-1,025	750	350	-53
2023	2015	NB	4142_NB-Ex@NW-Interchange	US75_NWHWY_INTERCHANGE	2,715	2,745	30	1,345	1,526	13
2026	2029	SB	2663_SB-WB@NW-Interchange	US75_NWHWY_INTERCHANGE	2,273	1,984	-289	1,139	1,074	-6
2027	202711	SB	2650_SB-EB@NW-Interchange	US75_NWHWY_INTERCHANGE	1,033	292	-741	447	172	-62
2034	2025	NB	2649_NB-Ent@NW-Interchange	US75_NWHWY_INTERCHANGE	4,970	5,415	445	2,828	3,159	12
2109	2110	WB	2647_WB-SB@NW-Interchange	US75_NWHWY_INTERCHANGE	4,270	4,174	-96	2,202	2,192	0
DIS_6 (7 detail records)				*Screenline Total*	**19,110**	**15,245**	**-3,865**	**9,893**	**8,473**	**-14%**
				Percent Difference			**-20%**			

DNT_EB

From	*To*	*DIR*	*Location Name*	*Street Name*	*Obs Total*	*Mod Total*	*Difference*	*Observed 6:30-9:00*	*Modeled 6:30-9:00*	*% Diff 630-9:00*
932	865	EB	IH30_EB_(2)	IH30	27,091	26,254	-837	13,353	15,449	16
2369	2370	EB	EB_IH635_@_Welch	IH635	24,657	20,013	-4,644	12,467	10,734	-14
2916	2954	EB	SH190_EB	SH190	12,547	12,157	-390	6,562	6,485	-1
DNT_EB (3 detail records)				*Screenline Total*	**64,295**	**58,424**	**-5,871**	**32,382**	**32,668**	**1%**
				Percent Difference			**-9%**			

DNT_WB

From	To	DIR	Location Name	Street Name	Obs Total	Mod Total	Difference	Observed 6:30-9:00	Modeled 6:30-9:00	% Diff 630-9:00
867	931	WB	IH30_WB_(2)	IH30	18,872	16,498	-2,374	8,863	9,118	3
1200	1204	WB	LEMMON_AVE	Lemmon	7,871	8,015	144	4,117	4,431	8
2420	2404	WB	WB_IH635_@_Welch	IH635	21,117	15,896	-5,221	10,398	8,046	-23
2476	2475	WB	SPRING_VALLEY_RD	Spring_Valley	2,245	3,303	1,058	1,174	1,686	44
21218	578	WB	SH190_WB	SH190	11,625	8,444	-3,181	6,080	4,728	-22
DNT_WB (5 detail records)				*Screenline Total*	**61,730**	**52,156**	**-9,574**	**30,632**	**28,009**	**-9%**
				Percent Difference			**-16%**			

GREENVILLE_EB

From	To	DIR	Location Name	Street Name	Obs Total	Mod Total	Difference	Observed 6:30-9:00	Modeled 6:30-9:00	% Diff 630-9:00
17	18	EB	Park_EB@Greenville	Park	2,873	2,919	46	1,611	1,693	5
178	179	EB	Arapaho-36_EB@Greenville	Arapaho	4,219	4,311	92	2,252	2,558	14
194	195	EB	Main-47_EB@Greenville	Main	2,941	2,887	-54	1,365	1,636	20
204	205	EB	Centennial:W._of_Abrams	Centennial	5,042	4,816	-226	2,637	2,814	7
2035	2036	EB	Walnut_Hill_EB@Greenville	Walnut_Hill	3,746	3,726	-20	1,670	2,130	28
2050	2009	EB	Lovers_Lane_EB@Greenville	Lovers_Lane	3,688	3,594	-94	1,622	1,780	10
2233	2215	EB	Royal_EB@Greenville	Royal	2,149	1,641	-508	1,083	961	-11
3079	3076	EB	Walnut_EB@Greenville	Walnut	848	2,084	1,236	437	1,156	165
3220	3219	EB	Forest_EB@Greenville	Forest	2,758	2,503	-255	1,254	1,505	20
3227	3228	EB	LBJ-EB@GreenVille	IH635	23,810	20,996	-2,814	11,415	11,432	0
3247	3223	EB	LBJ-EB_FrontageRd@GreenVille	IH635_FrontageRd	1,372	1,710	338	726	904	25
3297	3323	EB	Spring_Valley-32_EB@Greenville	Spring_Valley	3,555	3,541	-14	1,763	2,053	16
3302	3305	EB	Prestonwood-31_EB@Greenville	Prestonwood	575	63	-512	288	33	-89
4096	4361	EB	Collins:E._of_Alma	Collins	2,127	995	-1,132	1,112	525	-53

4100	4218	EB	Arapaho:W._of_Greenville	Arapaho	5,998	5,706	-292	3,138	3,235	3
4139	4140	EB	PGBT6-EB@Greenville	PGBT	3,624	1,865	-1,759	1,799	1,099	-39
4303	4300	EB	Renner-64_EB@Greenville	Renner	3,830	4,571	741	2,610	2,678	3
4376	4378	EB	Collins-60_EB@Greenville	Collins	2,971	2,663	-308	1,912	1,387	-27
4386	4387	EB	Campbell-62_EB@Greenville	Campbell	6,097	5,711	-386	3,466	3,141	-9
4428	4282	EB	PlanoPkwy_EB@Greenville	Plano_Pkwy	3,449	4,246	797	1,935	2,353	22
5707	5671	EB	Spring_Creek_EB@Greenville	Spring_Creek	3,130	2,257	-873	1,755	1,335	-24
5821	5669	EB	Legacy_EB@Greenville	Legacy	2,772	3,097	325	1,642	1,845	12
6006	6007	EB	E-Main_EB@Greenville	E-Main	2,608	2,370	-238	1,361	1,381	1
GREENVILLE_EB (23 detail records)				*Screenline Total*	**94,182**	**88,272**	**-5,910**	**48,853**	**49,634**	**2%**
				Percent Difference			**-6%**			

GREENVILLE_WB

From	*To*	*DIR*	*Location Name*	*Street Name*	*Obs Total*	*Mod Total*	*Difference*	*Observed 6:30-9:00*	*Modeled 6:30-9:00*	*% Diff 630-9:00*
18	17	WB	Park_WB@Greenville	Park	3,763	4,224	461	2,110	2,674	27
179	178	WB	Arapaho-36_WB@Greenville	Arapaho	4,795	5,782	987	2,674	3,202	20
195	194	WB	Main-47_WB@Greenville	Main	6,092	5,385	-707	3,583	3,042	-15
205	204	WB	Centennial:W._of_Abrams	Centennial	7,562	7,392	-170	3,956	3,966	0
2009	2050	WB	Lovers_Lane_WB@Greenville	Lovers_Lane	5,659	6,829	1,170	3,445	3,951	15
2036	2035	WB	Walnut_Hill_WB@Greenville	Walnut_Hill	6,892	6,734	-158	4,040	3,949	-2
2215	2233	WB	Royal_WB@Greenville	Royal	5,139	4,683	-456	3,385	2,988	-12
3076	3079	WB	Walnut_WB@Greenville	Walnut	2,731	3,580	849	1,658	2,416	46
3211	3052	WB	LBJ-WB@GreenVille	IH635	35,871	36,235	364	18,262	18,585	2
3212	3250	WB	LBJ-WB_FrontageRd@GreenVille	IH635_FrontageRd	2,341	846	-1,495	1,101	403	-63
3219	3220	WB	Forest_WB@Greenville	Forest	5,588	5,153	-435	3,203	2,926	-9
3305	3302	WB	Prestonwood-31_WB@Greenville	Prestonwood	1,290	59	-1,231	889	34	-96

3323	3297	WB	Spring_Valley-32_WB@Greenville	Spring_Valley	6,395	6,278	-117	3,858	3,503	-9
4100	4223	WB	Arapaho:W._of_Greenville	Arapaho	8,997	8,861	-136	4,706	5,151	9
4282	4428	WB	PlanoPkwy_WB@Greenville	Plano_Pkwy	5,142	5,738	596	2,884	3,839	33
4286	4453	WB	PGBT_FR:_E.of_US_75	PGBT_FrontageRd	1,353	1,876	523	702	1,028	46
4300	4303	WB	Renner-64_WB@Greenville	Renner	6,129	6,739	610	4,176	3,963	-5
4361	4096	WB	Collins:E._of_Alma	Collins	3,190	4,051	861	1,669	2,580	55
4378	4376	WB	Collins-60_WB@Greenville	Collins	1,474	3,385	1,911	939	2,167	131
4386	4355	WB	Campbell-62_WB@Greenville	Campbell	5,835	5,835	0	3,407	3,561	5
5669	5821	WB	Legacy_WB@Greenville	Legacy	3,586	5,917	2,331	2,207	3,606	63
5671	5707	WB	Spring_Creek_WB@Greenville	Spring_Creek	8,738	8,435	-303	4,901	4,877	0
6007	6006	WB	E-Main_WB@Greenville	E-Main	5,903	4,490	-1,413	3,548	2,687	-24
21181	4137	WB	PGBT6-WB@Greenville	PGBT	12,434	11,496	-938	7,942	6,681	-16
GREENVILLE_WB (24 detail records)				*Screenline Total*	**156,899**	**160,003**	**3,104**	**89,245**	**91,779**	**3%**
				Percent Difference			**2%**			

IH30_NB

From	*To*	*DIR*	*Location Name*	*Street Name*	*Obs Total*	*Mod Total*	*Difference*	*Observed 6:30-9:00*	*Modeled 6:30-9:00*	*% Diff 630-9:00*
1429	1431	NB	IH45_NB	IH45	21,434	21,389	-45	9,915	11,326	14
80006	335	NB	IH35E_NB	IH35E	27,483	32,251	4,768	12,569	19,134	52
IH30_NB (2 detail records)				*Screenline Total*	**48,917**	**53,640**	**4,723**	**22,484**	**30,460**	**35%**
				Percent Difference			**10%**			

IH30_SB

From	*To*	*DIR*	*Location Name*	*Street Name*	*Obs Total*	*Mod Total*	*Difference*	*Observed 6:30-9:00*	*Modeled 6:30-9:00*	*% Diff 630-9:00*
357	383	SB	IH35E_SB	IH35E	20,783	19,273	-1,510	9,778	10,618	9

21071	1435	SB	IH45_SB	IH45		11,868	10,522	-1,346	5,424	5,351	-1
IH30_SB (2 detail records)					*Screenline Total*	**32,651**	**29,795**	**-2,856**	**15,202**	**15,969**	**5%**
					Percent Difference			**-9%**			

INDIVIDUAL_LOC

From	*To*	*DIR*	*Location Name*	*Street Name*	*Obs Total*	*Mod Total*	*Difference*	*Observed 6:30-9:00*	*Modeled 6:30-9:00*	*% Diff 630-9:00*
338	868	WB	WB_IH30_@_Jefferson	IH30	21,440	21,490	50	10,257	10,789	5
852	896	SB	SB_IH35E_@_Woodall_Rodgers	IH35E	23,827	16,517	-7,310	11,717	7,369	-37
855	21254	NB	NB_IH35E_@_Woodall_Rodgers	IH35E	36,532	17,728	-18,804	16,196	10,401	-36
864	33711	EB	EB_IH30_@_Jefferson	IH30	20,871	14,689	-6,182	10,138	7,707	-24
910	920	NB	NB_IH35E_@_Hi_Line	IH35E	42,148	29,585	-12,563	19,735	16,074	-19
944	851	SB	SB_IH35E_@_Hi_Line	IH35E	33,764	19,657	-14,107	16,564	9,525	-42
1931	1895	EB	IH30_EB	IH30	17,765	17,703	-62	8,547	9,538	12
3326	3284	NB	US_75_FR:_Spring_Valley	US75_FrontageRd	6,947	6,944	-3	2,914	4,117	41
3328	3298	SB	US_75_FR:_Spring_Valley	US75_FrontageRd	10,083	9,512	-571	5,152	5,160	0
3413	3414	WB	PGBT7-WB	PGBT	26,744	23,792	-2,952	15,967	12,279	-23
3419	3420	EB	PGBT7-EB	PGBT	19,829	18,255	-1,574	11,643	9,523	-18
21074	1900	WB	IH30_WB	IH30	28,461	16,919	-11,542	13,952	9,505	-32
INDIVIDUAL_LOC (12 detail records)				*Screenline Total*	**288,411**	**212,791**	**-75,620**	**142,782**	**111,987**	**-22%**
				Percent Difference			**-26%**			

NW_HWY_NB

From	*To*	*DIR*	*Location Name*	*Street Name*	*Obs Total*	*Mod Total*	*Difference*	*Observed 6:30-9:00*	*Modeled 6:30-9:00*	*% Diff 630-9:00*
604	601	NB	Preston_NB@NW-HWY	Preston	1,874	754	-1,120	831	451	-46
2002	2001	NB	Hillcrest_NB@NW-HWY	Hillcrest	1,691	1,327	-364	831	860	3

2103	2020	NB	Greenville_NB@NW-HWY	Greenville	2,655	2,650	-5	1,444	1,576	9
2105	2106	NB	US_75-NB@NW_Hwy	US75	29,698	29,000	-698	16,134	15,950	-1
2122	2015	NB	2657_NB-FR@NW-Interchange	US75_NWHWY_INTERCHANGE	1,725	257	-1,468	944	144	-85
2183	2182	NB	Abrams_NB@NW-HWY	Abrams	1,235	1,095	-140	658	655	0
3721	3722	NB	Plano_NB@NW-HWY	Plano	2,687	3,191	504	1,708	1,765	3
3743	3742	NB	Jupiter_NB@NW-HWY	Jupiter	3,623	3,885	262	2,058	2,271	10
3748	3726	NB	Audelia_NB@NW-HWY	Audelia	2,482	2,618	136	1,697	1,521	-10
21010	1179	NB	DNT1_NB@NW-HWY	DNT	13,917	14,257	340	8,387	7,868	-6
NW_HWY_NB (10 detail records)				*Screenline Total*	**61,587**	**59,034**	**-2,553**	**34,692**	**33,061**	**-5%**
				Percent Difference			**-4%**			

NW_HWY_SB

From	*To*	*DIR*	*Location Name*	*Street Name*	*Obs Total*	*Mod Total*	*Difference*	*Observed 6:30-9:00*	*Modeled 6:30-9:00*	*% Diff 630-9:00*
601	604	SB	Preston_SB@NW-HWY	Preston	2,797	2,674	-123	1,224	1,598	31
1191	775	SB	DNT1_SB@NW-HWY	DNT	15,343	16,873	1,530	8,685	9,116	5
2001	2002	SB	Hillcrest_SB@NW-HWY	Hillcrest	2,406	2,384	-22	1,190	1,483	25
2013	2124	SB	US_75-SB@NW_Hwy	US75	34,664	31,291	-3,373	18,194	16,401	-10
2020	2103	SB	Greenville_SB@NW-HWY	Greenville	3,099	6,482	3,383	1,616	4,015	148
2167	2022	SB	2648_SB-FR@NW-Interchange	US75_FrontageRd	643	545	-98	273	340	25
2182	2183	SB	Abrams_SB@NW-HWY	Abrams	2,258	2,165	-93	1,070	1,276	19
3722	3721	SB	Plano_SB@NW-HWY	Plano	1,807	1,383	-424	977	801	-18
3726	3748	SB	Audelia_SB@NW-HWY	Audelia	1,877	2,352	475	1,077	1,340	24
3742	3743	SB	Jupiter_SB@NW-HWY	Jupiter	2,791	2,678	-113	1,448	1,563	8
NW_HWY_SB (10 detail records)				*Screenline Total*	**67,685**	**68,827**	**1,142**	**35,754**	**37,933**	**6%**
				Percent Difference			**2%**			

PARKER_NB

From	To	DIR	Location Name	Street Name	Obs Total	Mod Total	Difference	Observed 6:30-9:00	Modeled 6:30-9:00	% Diff 630-9:00
53	5732	NB	US75_NB@Park	US75	21,685	19,353	-2,332	10,750	10,924	2
131	5127	NB	DNT3_NB@Parker	DNT	16,288	14,216	-2,072	9,356	7,838	-16
4978	4977	NB	Custer_NB@Parker	Custer	2,506	2,418	-88	1,297	1,352	4
5045	5398	NB	Preston_NB@Parker	Preston	7,446	6,894	-552	4,176	3,639	-13
5382	5379	NB	Coit_NB@Parker	Coit	3,876	4,091	215	1,865	2,130	14
5428	5430	NB	Independence_NB@Parker	Independence	3,201	3,105	-96	1,795	1,813	1
5633	5757	NB	Springcreek_@_Parker	Spring_Creek	2,246	3,374	1,128	1,260	2,051	63
5699	5700	NB	US75_NB-FR@Parker	US75_FrontageRd	1,580	389	-1,191	500	255	-49
5708	5712	NB	K_NB@Parker	K	1,851	346	-1,505	859	214	-75
5722	5718	NB	Alma_NB@Parker	Alma	1,664	910	-754	763	576	-25
5755	5754	NB	Jupiter_NB@Parker	Jupiter	1,687	2,349	662	932	1,351	45
PARKER_NB (11 detail records)				*Screenline Total*	**64,030**	**57,445**	**-6,585**	**33,553**	**32,143**	**-4%**
				Percent Difference			**-10%**			

PARKER_SB

From	To	DIR	Location Name	Street Name	Obs Total	Mod Total	Difference	Observed 6:30-9:00	Modeled 6:30-9:00	% Diff 630-9:00
20	4482	SB	US75_SB@Park	US75	32,648	30,575	-2,073	15,849	15,319	-3
4977	4978	SB	Custer_SB@Parker	Custer	5,138	5,529	391	3,399	3,510	3
5175	5193	SB	DNT3_SB@Parker	DNT	21,791	19,952	-1,839	11,396	10,656	-6
5379	5382	SB	Coit_SB@Parker	Coit	10,376	9,966	-410	6,324	5,397	-15
5398	5045	SB	Preston_SB@Parker	Preston	8,643	9,078	435	4,848	5,126	6
5430	5428	SB	Independence_SB@Parker	Independence	6,872	6,707	-165	3,854	4,224	10
5712	5708	SB	K_SB@Parker	K	4,831	3,919	-912	3,084	2,639	-14
5718	5722	SB	Alma_SB@Parker	Alma	4,245	4,203	-42	2,762	2,625	-5

5727	9	SB	US75_SB-FR@Parker	US75_FrontageRd	8,274	8,105	-169	4,031	5,242	30
5754	5755	SB	Jupiter_SB@Parker	Jupiter	2,336	1,996	-340	1,536	1,203	-22
5757	5633	SB	Springcreek_@_Parker	Spring_Creek	3,510	3,471	-39	1,969	2,070	5
PARKER_SB (11 detail records)				*Screenline Total*	**108,664**	**103,501**	**-5,163**	**59,052**	**58,011**	**-2%**
				Percent Difference			**-5%**			

SH121_NB

From	*To*	*DIR*	*Location Name*	*Street Name*	*Obs Total*	*Mod Total*	*Difference*	*Observed 6:30-9:00*	*Modeled 6:30-9:00*	*% Diff 630-9:00*
5356	5355	NB	SH289	SH289	3,963	3,228	-735	1,907	1,783	-7
5471	5488	NB	COIT_RD	Coit	1,170	1,258	88	713	768	8
21232	6022	NB	US75_NB	US75	14,497	12,128	-2,369	7,253	6,818	-6
SH121_NB (3 detail records)				*Screenline Total*	**19,630**	**16,614**	**-3,016**	**9,873**	**9,369**	**-5%**
				Percent Difference			**-15%**			

SH121_SB

From	*To*	*DIR*	*Location Name*	*Street Name*	*Obs Total*	*Mod Total*	*Difference*	*Observed 6:30-9:00*	*Modeled 6:30-9:00*	*% Diff 630-9:00*
5488	5471	SB	COIT_RD	Coit	438	640	202	211	410	94
5513	6023	SB	US75_SB	US75	18,427	13,238	-5,189	8,773	6,893	-21
SH121_SB (2 detail records)				*Screenline Total*	**18,865**	**13,878**	**-4,987**	**8,984**	**7,303**	**-19%**
				Percent Difference			**-26%**			

SH78_EB

From	*To*	*DIR*	*Location Name*	*Street Name*	*Obs Total*	*Mod Total*	*Difference*	*Observed 6:30-9:00*	*Modeled 6:30-9:00*	*% Diff 630-9:00*
3958	3661	SB	IH635_SB	IH635	12,960	11,351	-1,609	6,539	6,275	-4

SH78_EB (1 detail record)				*Screenline Total*	**12,960**	**11,351**	**-1,609**	**6,539**	**6,275**	**-4%**
				Percent Difference			**-12%**			

SH78_WB

From	*To*	*DIR*	*Location Name*	*Street Name*	*Obs Total*	*Mod Total*	*Difference*	*Observed 6:30-9:00*	*Modeled 6:30-9:00*	*% Diff 630-9:00*
3939	3934	NB	IH635_NB	IH635	27,895	25,948	-1,947	14,269	12,915	-9
SH78_WB (1 detail record)				*Screenline Total*	**27,895**	**25,948**	**-1,947**	**14,269**	**12,915**	**-9%**
				Percent Difference			**-7%**			

	Obs Total	*Mod Total*	*Difference*	*Observed 6:30-9:00*	*Modeled 6:30-9:00*	*Difference*
Total Across All Screenlines	**1,599,755**	**1,430,885**	**-168,870**	**831,882**	**783,050**	**-48,832**
			-11%			**-6%**

APPENDIX D. OD Comparison Statistics

Iteration 0
District Demand Data
==========

From/to	1	2	3	4	5	6	7	8	9	10	Sum
1	25545	18805	8241	4424	7059	6822	4818	32768	2394	2782	113658
2	15025	57501	15210	10125	12720	10581	7005	48156	3667	4441	184431
3	8154	16515	37751	6513	16991	8852	5681	29070	2969	9890	142386
4	1672	7805	3408	30308	12283	9662	5156	40825	2498	3312	116929
5	1980	5825	7230	10265	83637	9836	18569	27630	3806	20806	189584
6	1190	2464	1575	5946	4565	32922	15800	29563	18684	5123	117832
7	1274	2486	2106	6655	22821	30565	76120	35312	22222	20150	219711
8	7600	18045	8080	26544	18947	40726	19464	132484	16591	12532	301013
9	1000	1690	1241	3837	4968	57964	29144	37712	48867	8583	195006
10	1335	4097	7976	6349	36552	18987	24389	33121	13810	60617	207233
Sum	64775	135233	92818	110966	220543	226917	206146	446641	135508	148236	1787783

Iteration 1
District Demand Data
==========

From/to	1	2	3	4	5	6	7	8	9	10	Sum
1	18218	22065	4973	4380	5724	3421	2366	24163	1982	1613	88905
2	16371	64126	7942	12175	12123	9178	7631	37362	1203	2060	170171
3	10561	18588	48711	16168	18114	6385	4116	39303	1081	6899	169926
4	2783	8476	5755	20808	10713	8846	4516	23574	2528	2046	90045
5	6626	10239	11094	15404	74635	8483	20422	30027	2062	19101	198093
6	1089	2488	1274	5885	5642	24709	16763	24202	25084	2588	109724
7	1227	3705	1677	10592	22292	21301	73528	24628	14404	18247	191601
8	3832	18247	11141	31472	30889	31846	19931	95632	20391	19600	282981
9	2122	2923	1266	4789	6121	28787	24152	50058	91801	11403	223422
10	3389	9881	6018	7091	42135	8638	8803	29142	34595	60477	210169
Sum	66218	160738	99851	128764	228388	151594	182228	378091	195131	144034	1735037

Iteration 0

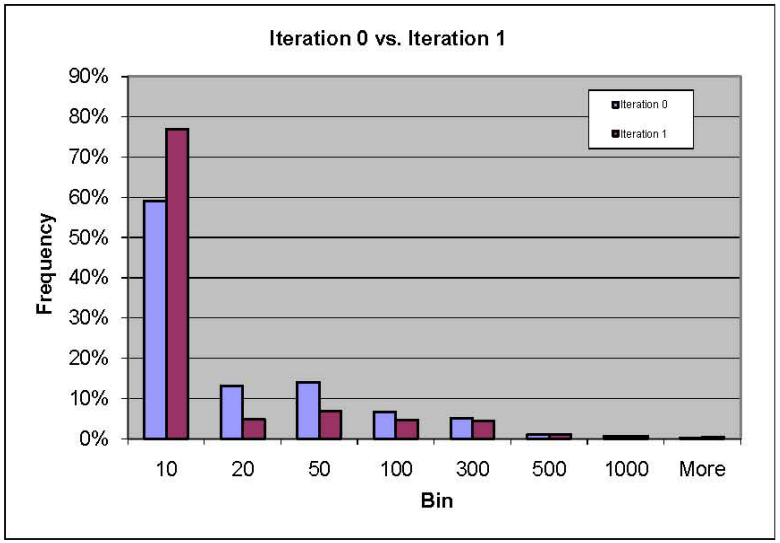
Bin	Frequency	% Frequency	Minimum	Maximum	Median	Average
10	31260	59.1%	0.0	10.0	2.0	3.1
20	6948	13.1%	11.0	20.0	15.0	14.9
50	7435	14.1%	21.0	50.0	31.0	32.3
100	3559	6.7%	51.0	100.0	68.0	70.6
300	2717	5.1%	101.0	300.0	153.0	165.6
500	545	1.0%	301.0	500.0	369.0	378.0
1000	324	0.6%	501.0	996.0	659.5	685.0
More	112	0.2%	1027.0	5934.0	1598.0	1946.9
	52900					

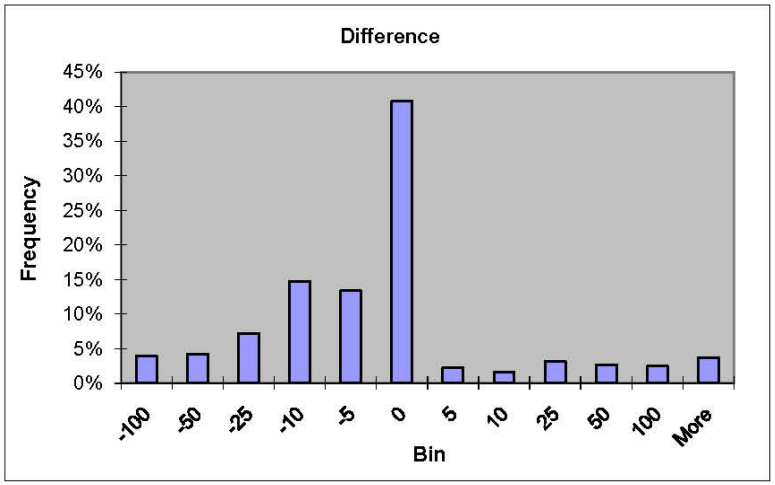
Iteration 1

Bin	Frequency	% Frequency	Minimum	Maximum	Median	Average
10	40734	77.0%	0.0	10.0	0.0	0.6
20	2566	4.9%	11.0	20.0	15.0	15.1
50	3658	6.9%	21.0	50.0	32.0	32.9
100	2477	4.7%	51.0	100.0	70.0	71.6
300	2342	4.4%	101.0	300.0	156.0	169.7
500	536	1.0%	301.0	500.0	373.0	382.2
1000	363	0.7%	501.0	1000.0	674.0	699.9
More	224	0.4%	1002.0	38605.0	1493.5	2319.2

Difference between Iteration 0 and Iteration 1

Bin	Frequency	% Frequency	Minimum	Maximum	Median	Average
-100	2081	3.9%	-4610.0	-100.0	-179.0	-287.5
-50	2233	4.2%	-99.0	-50.0	-66.0	-68.8
-25	3789	7.2%	-49.0	-25.0	-34.0	-34.7
-10	7797	14.7%	-24.0	-10.0	-15.0	-15.5
-5	7068	13.4%	-9.0	-5.0	-7.0	-6.7
0	21565	40.8%	-4.0	0.0	-1.0	-1.3
5	1197	2.3%	1.0	5.0	3.0	2.9
10	828	1.6%	6.0	10.0	8.0	8.0
25	1649	3.1%	11.0	25.0	17.0	17.2
50	1420	2.7%	26.0	50.0	36.0	36.4
100	1304	2.5%	51.0	100.0	70.0	71.8
More	1969	3.7%	101.0	37460.0	218.0	428.5
	52900					



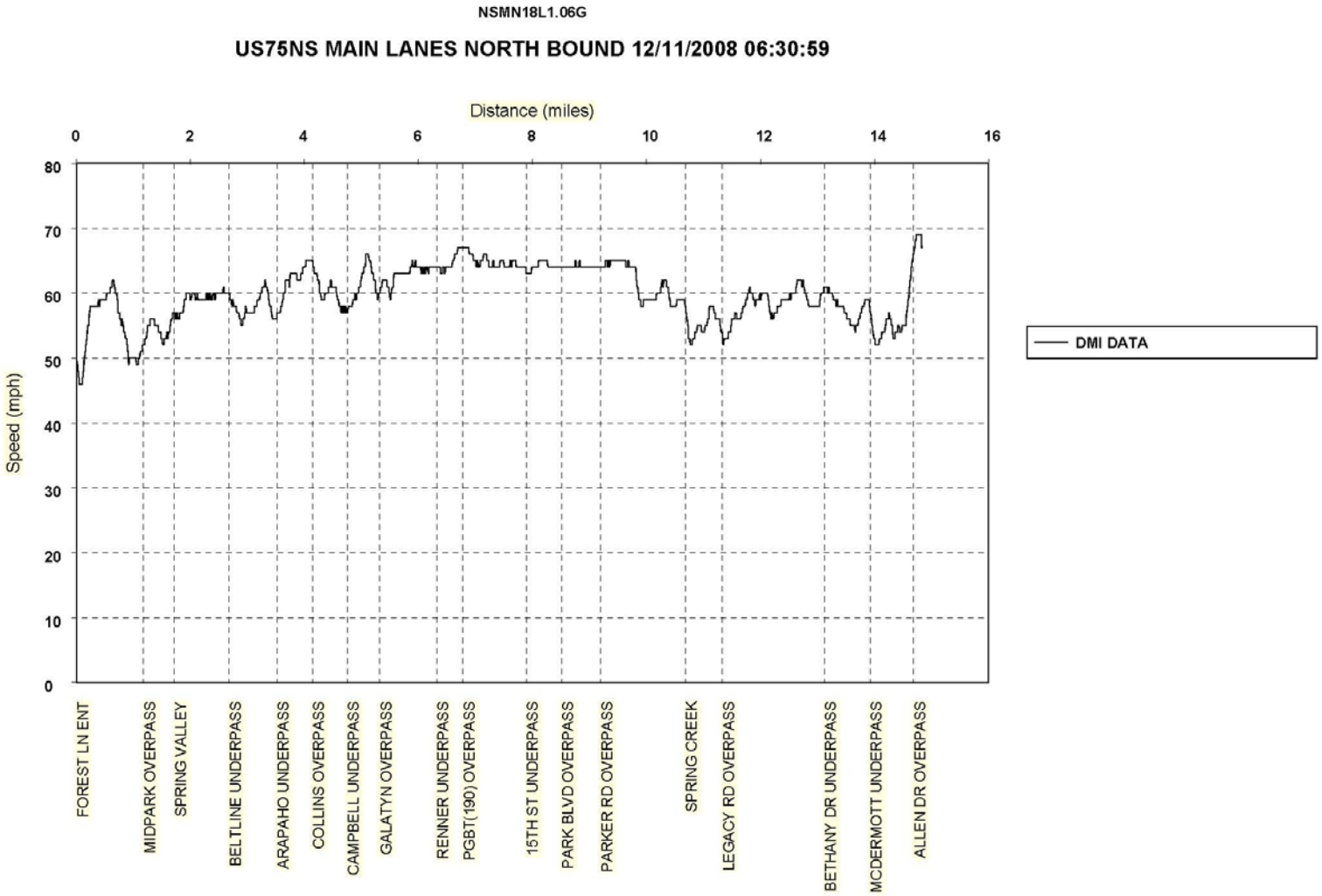


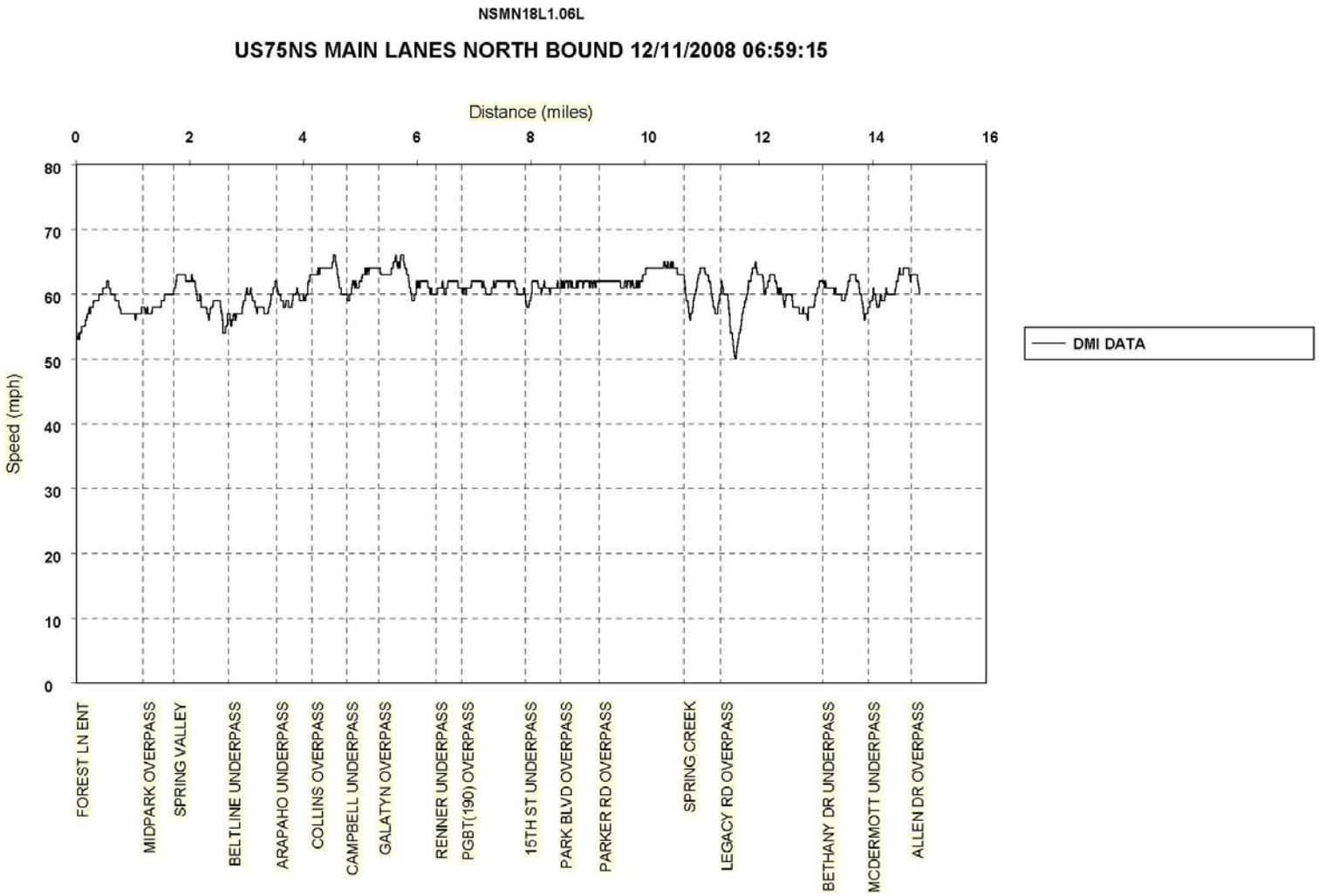
Iteration 0 vs. Iteration 1

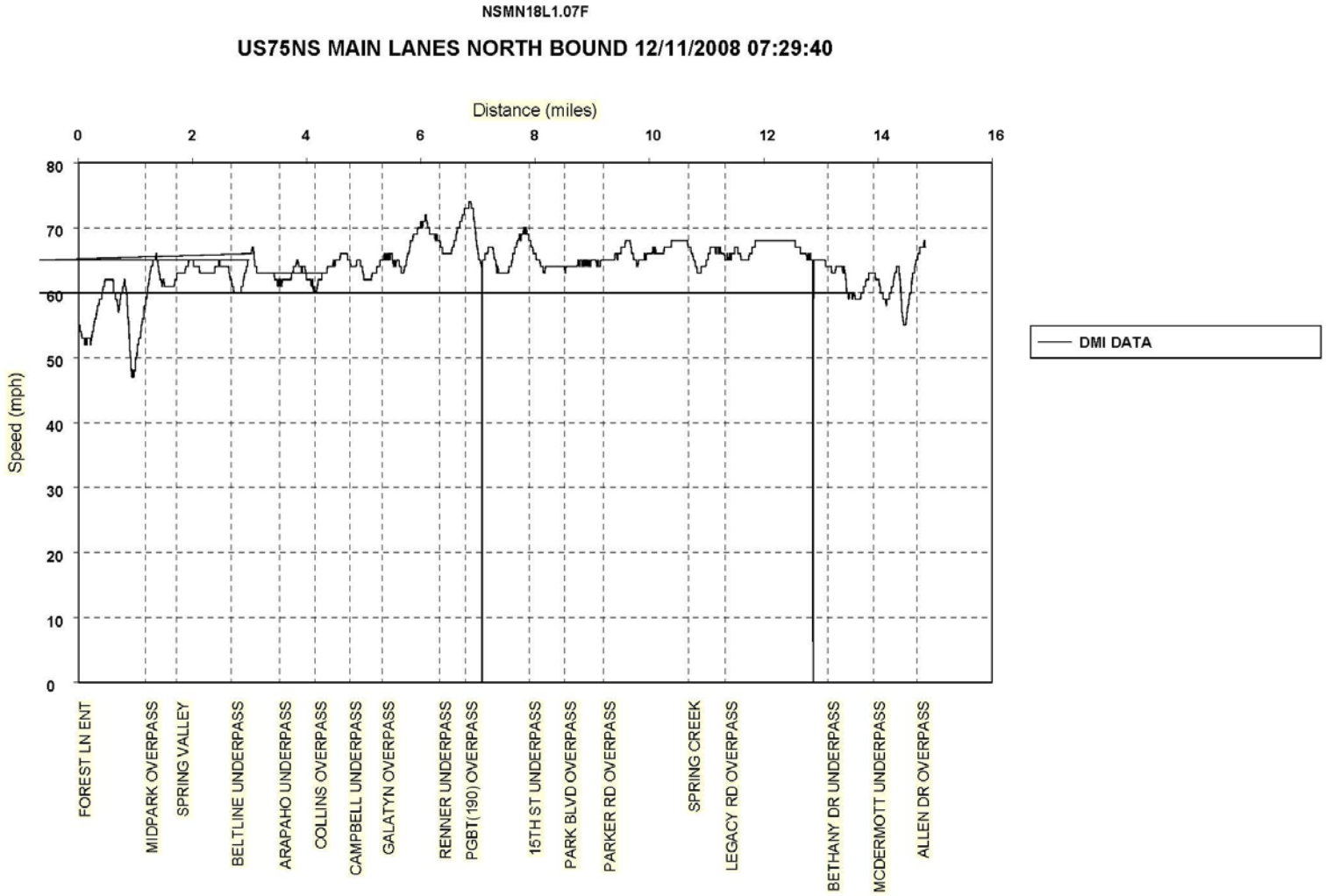
	Iteration 0	*Iteration 1*	diff	% diff
total travelers	1787783	1735080	-52703	-3%
ave	33.8	32.8	-1	
freq of "0"	7875	36209	28334	
max	5934.0	38605.0	32671	
std dev	125.7	263.1	137	
median	7.0	0.0	-7	

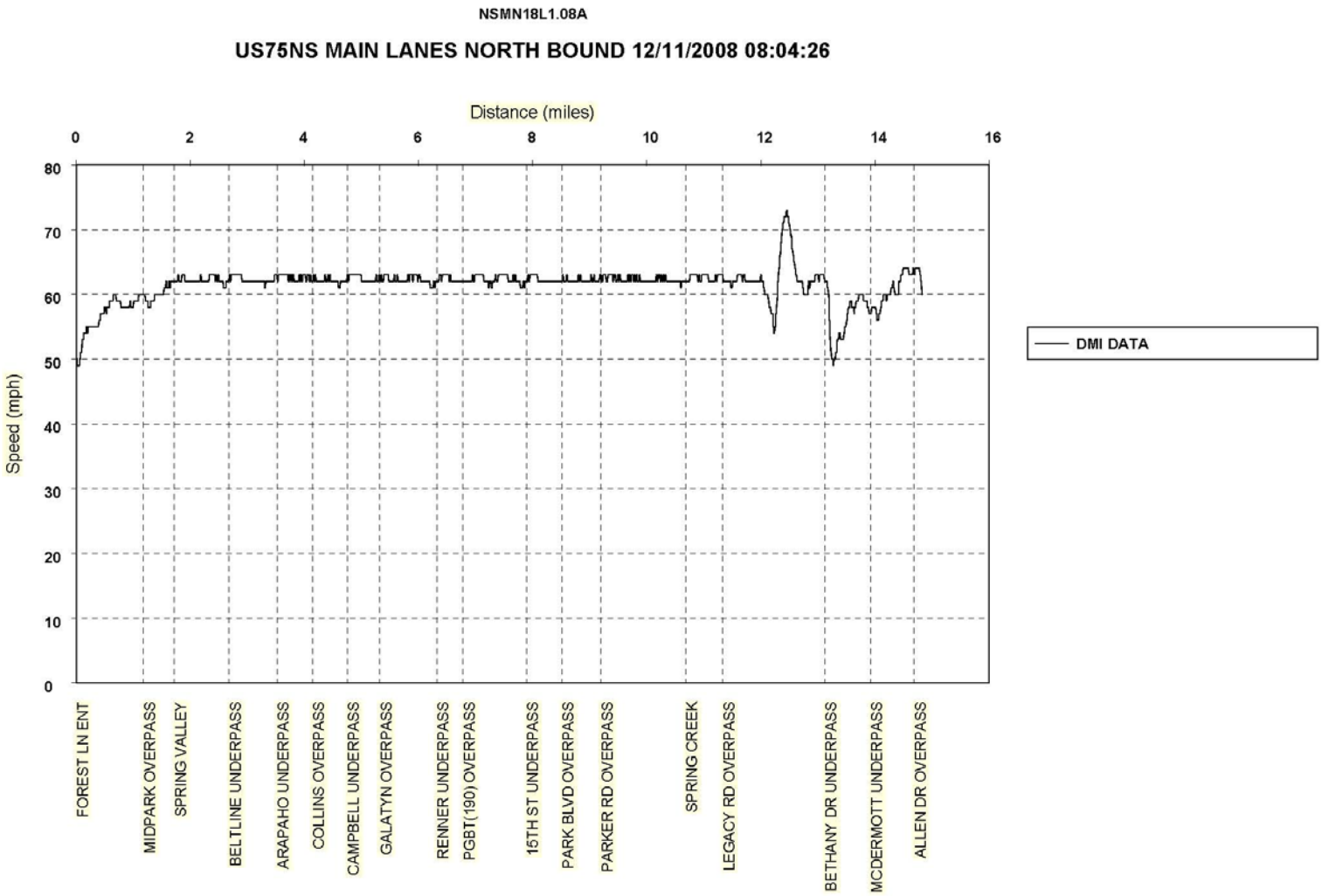
	Difference
cells changed	44805
cells unchanged	8095
max increase	37460.0
max decrease	-4610.0
avg increase	122.83
avg decrease	-29.65

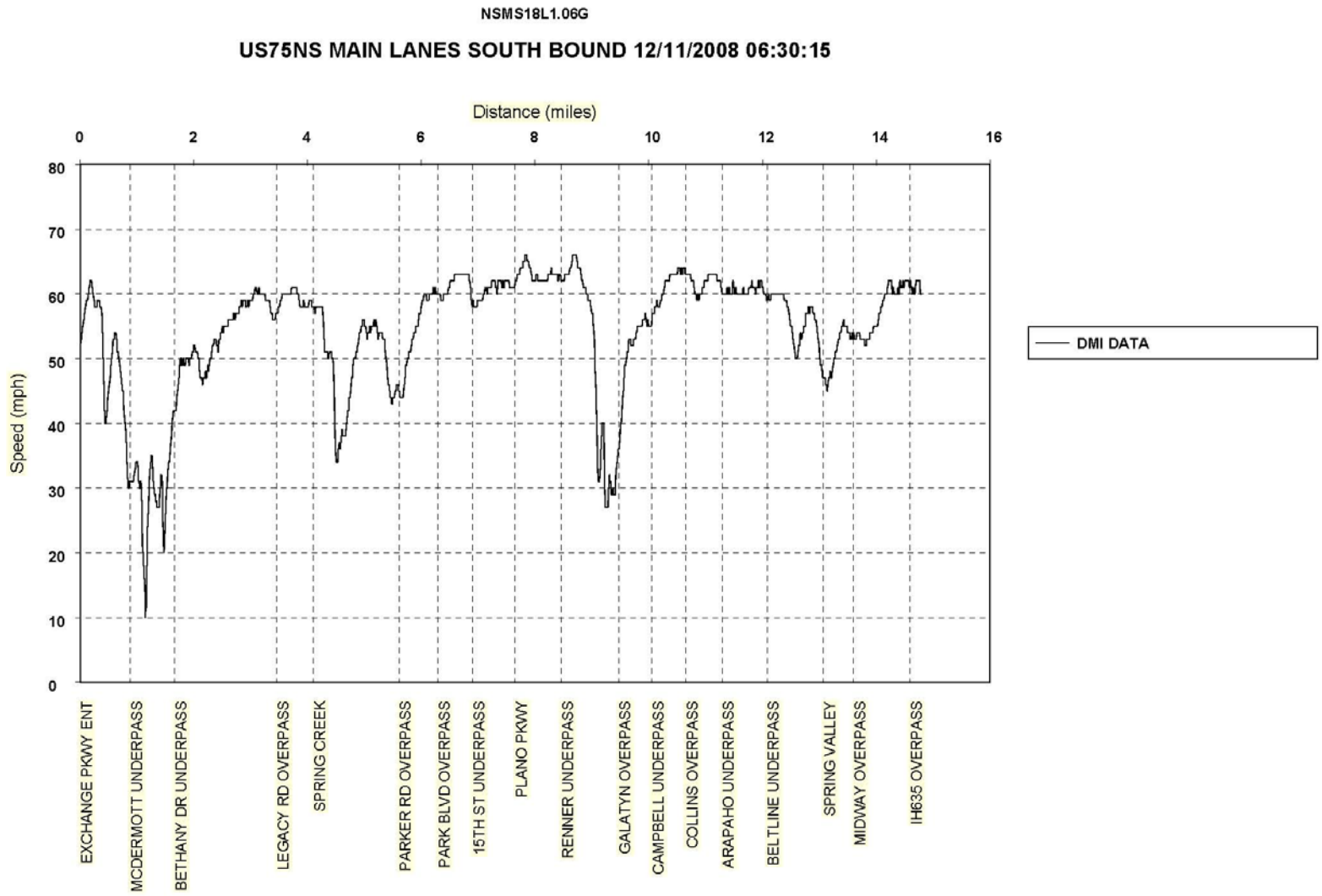
APPENDIX E. U.S. 75 Travel Time Surveys

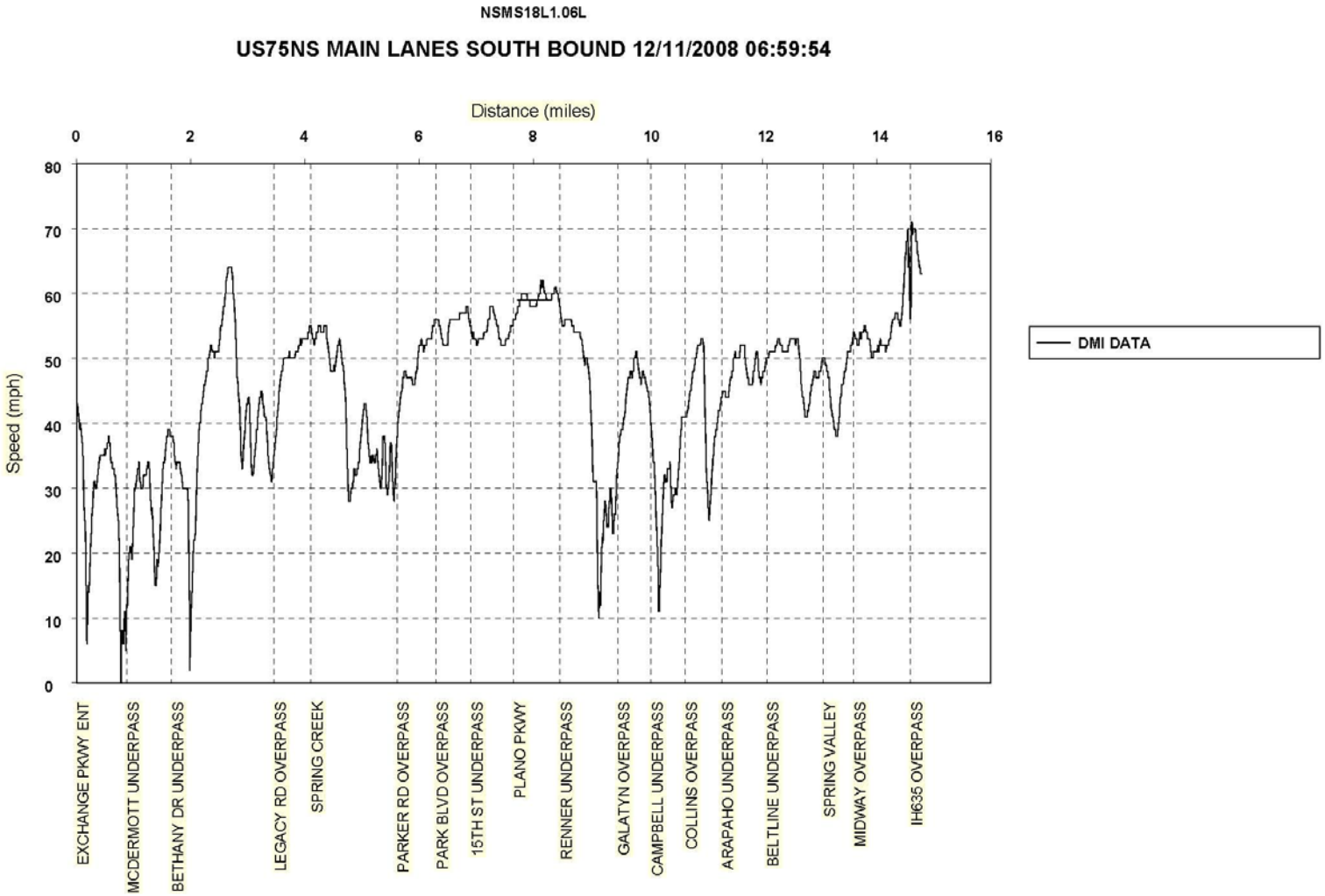


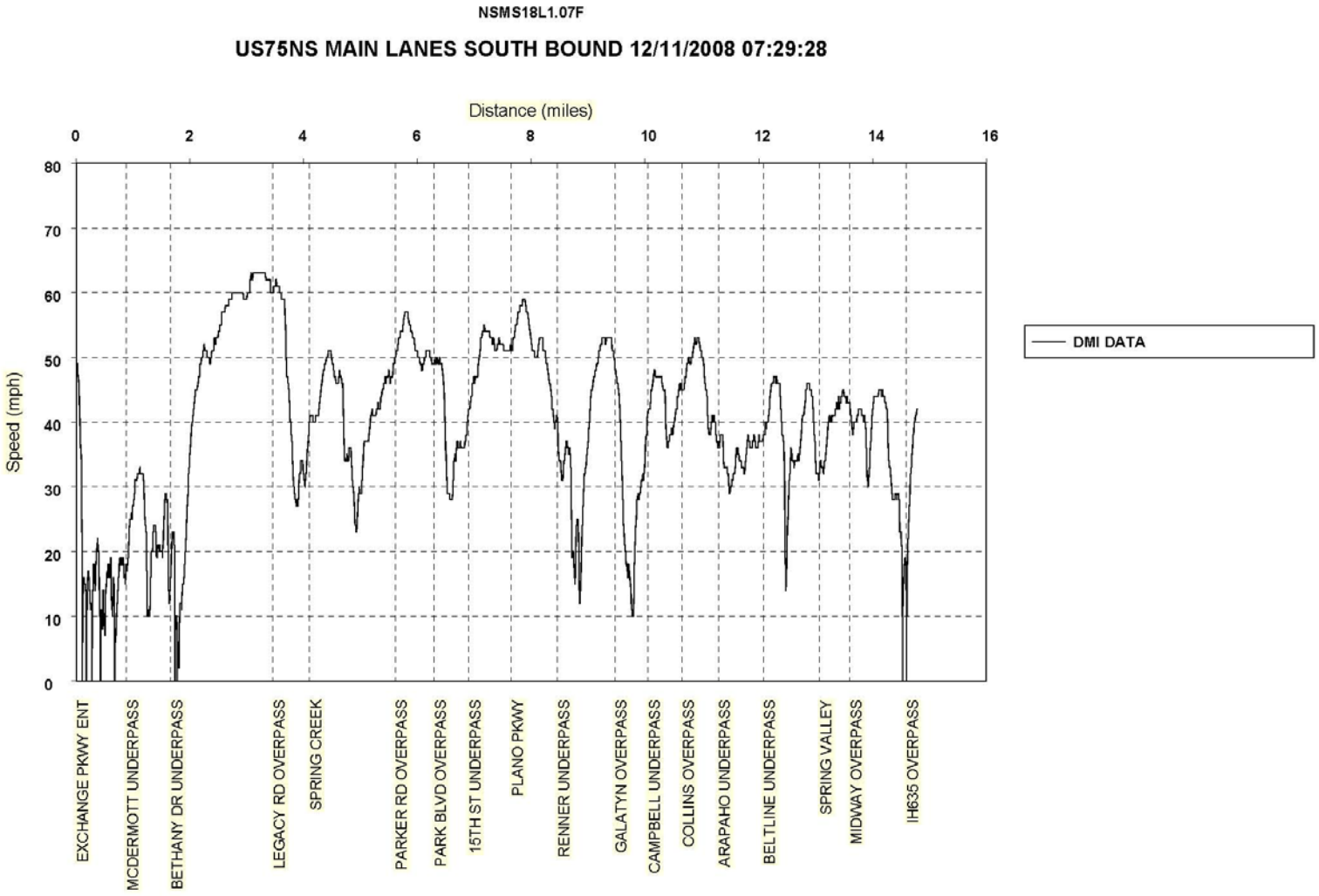

NSMN18L1.06L
US75NS MAIN LANES NORTH BOUND 12/11/2008 06:59:15
Distance (miles)
0
2
4
6
8
10
12
14
16
Speed (mph)
80
70
60
50
40
30
20
10
0
FOREST LN ENT
MIDPARK OVERPASS
SPRING VALLEY
BELTLINE UNDERPASS
ARAPAHO UNDERPASS
COLLINS OVERPASS
CAMPBELL UNDERPASS
GALATYN OVERPASS
RENNER UNDERPASS
PGBT(190) OVERPASS
15TH ST UNDERPASS
PARK BLVD OVERPASS
PARKER RD OVERPASS
SPRING CREEK
LEGACY RD OVERPASS
BETHANY DR UNDERPASS
MCDERMOTT UNDERPASS
ALLEN DR OVERPASS
DMI DATA

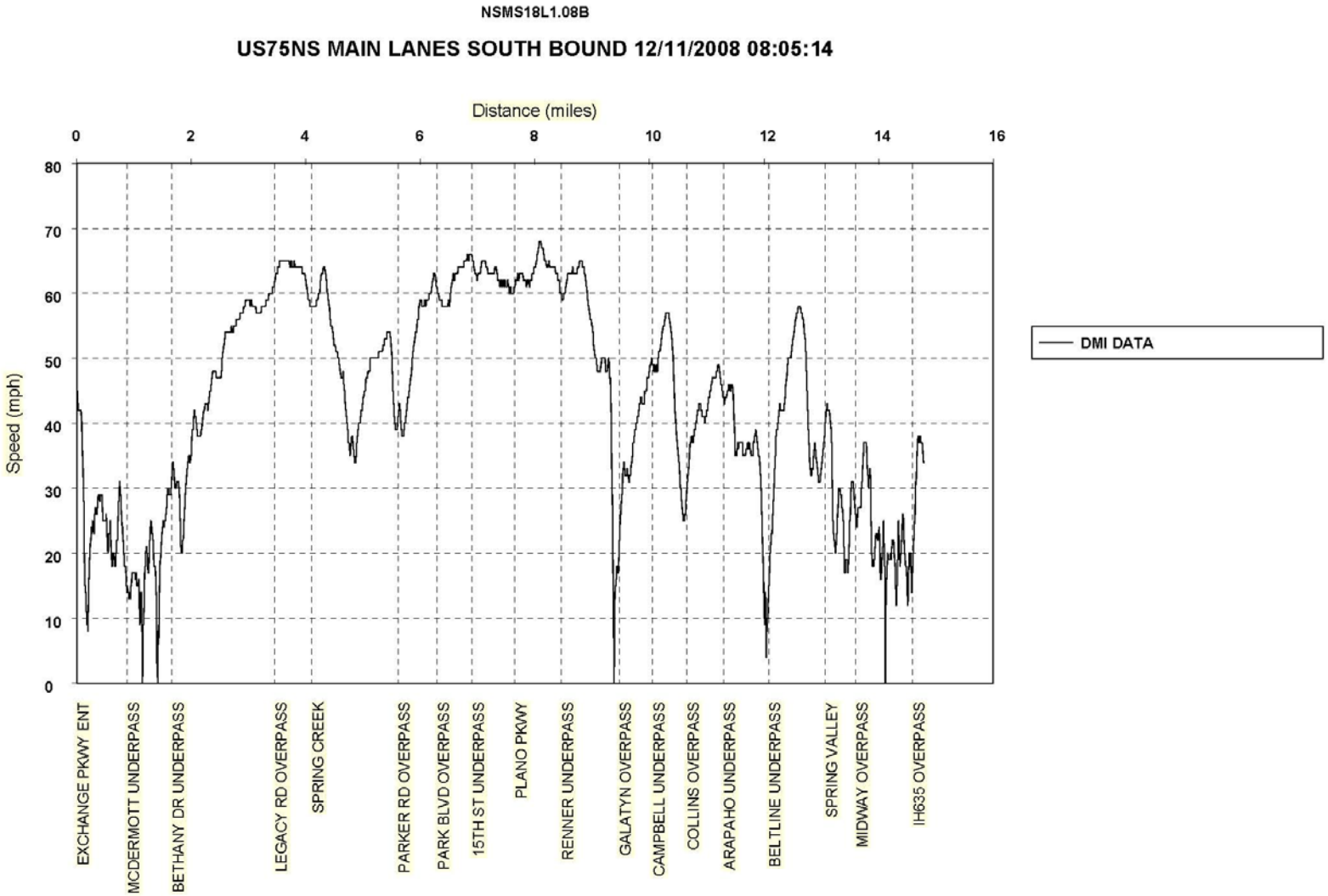

NSMN18L1.07F
US75NS MAIN LANES NORTH BOUND 12/11/2008 07:29:40
Distance (miles)
0
2
4
6
8
10
12
14
16
Speed (mph)
80
70
60
50
40
30
20
10
0
DMI DATA
FOREST LN ENT
MIDPARK OVERPASS
SPRING VALLEY
BELTLINE UNDERPASS
ARAPAHO UNDERPASS
COLLINS OVERPASS
CAMPBELL UNDERPASS
GALATYN OVERPASS
RENNER UNDERPASS
PGBT(190) OVERPASS
15TH ST UNDERPASS
PARK BLVD OVERPASS
PARKER RD OVERPASS
SPRING CREEK
LEGACY RD OVERPASS
BETHANY DR UNDERPASS
MCDERMOTT UNDERPASS
ALLEN DR OVERPASS

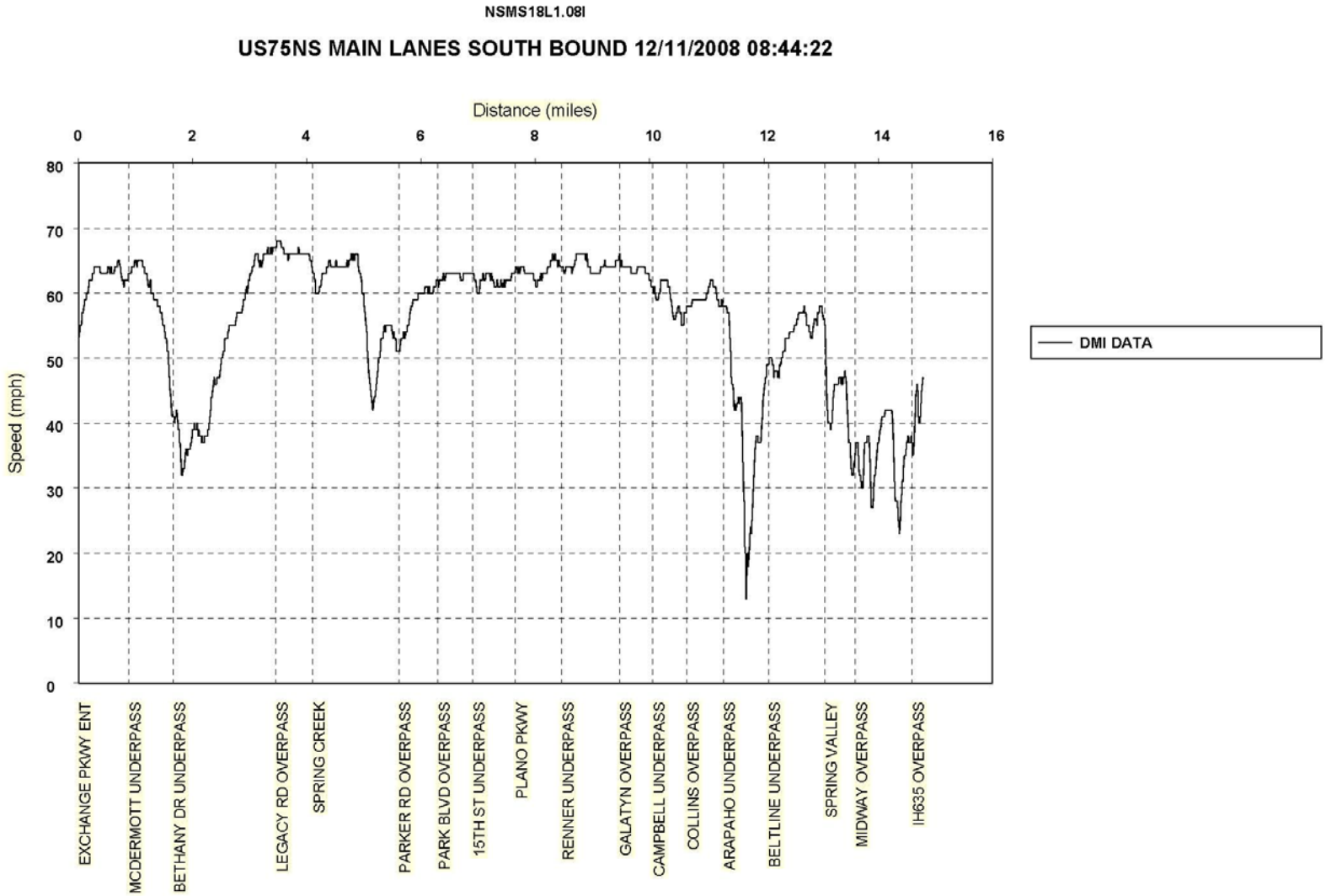

NSMN18L1.08A
US75NS MAIN LANES NORTH BOUND 12/11/2008 08:04:26
Distance (miles)
0
2
4
6
8
10
12
14
16
Speed (mph)
80
70
60
50
40
30
20
10
0
FOREST LN ENT
MIDPARK OVERPASS
SPRING VALLEY
BELTLINE UNDERPASS
ARAPAHO UNDERPASS
COLLINS OVERPASS
CAMPBELL UNDERPASS
GALATYN OVERPASS
RENNER UNDERPASS
PGBT(190) OVERPASS
15TH ST UNDERPASS
PARK BLVD OVERPASS
PARKER RD OVERPASS
SPRING CREEK
LEGACY RD OVERPASS
BETHANY DR UNDERPASS
MCDERMOTT UNDERPASS
ALLEN DR OVERPASS
DMI DATA


NSMS18L1.06G
US75NS MAIN LANES SOUTH BOUND 12/11/2008 06:30:15
Distance (miles)
0
2
4
6
8
10
12
14
16
Speed (mph)
80
70
60
50
40
30
20
10
0
EXCHANGE PKWY ENT
MCDERMOTT UNDERPASS
BETHANY DR UNDERPASS
LEGACY RD OVERPASS
SPRING CREEK
PARKER RD OVERPASS
PARK BLVD OVERPASS
15TH ST UNDERPASS
PLANO PKWY
RENNER UNDERPASS
GALATYN OVERPASS
CAMPBELL UNDERPASS
COLLINS OVERPASS
ARAPAHO UNDERPASS
BELTLINE UNDERPASS
SPRING VALLEY
MIDWAY OVERPASS
IH635 OVERPASS
DMI DATA

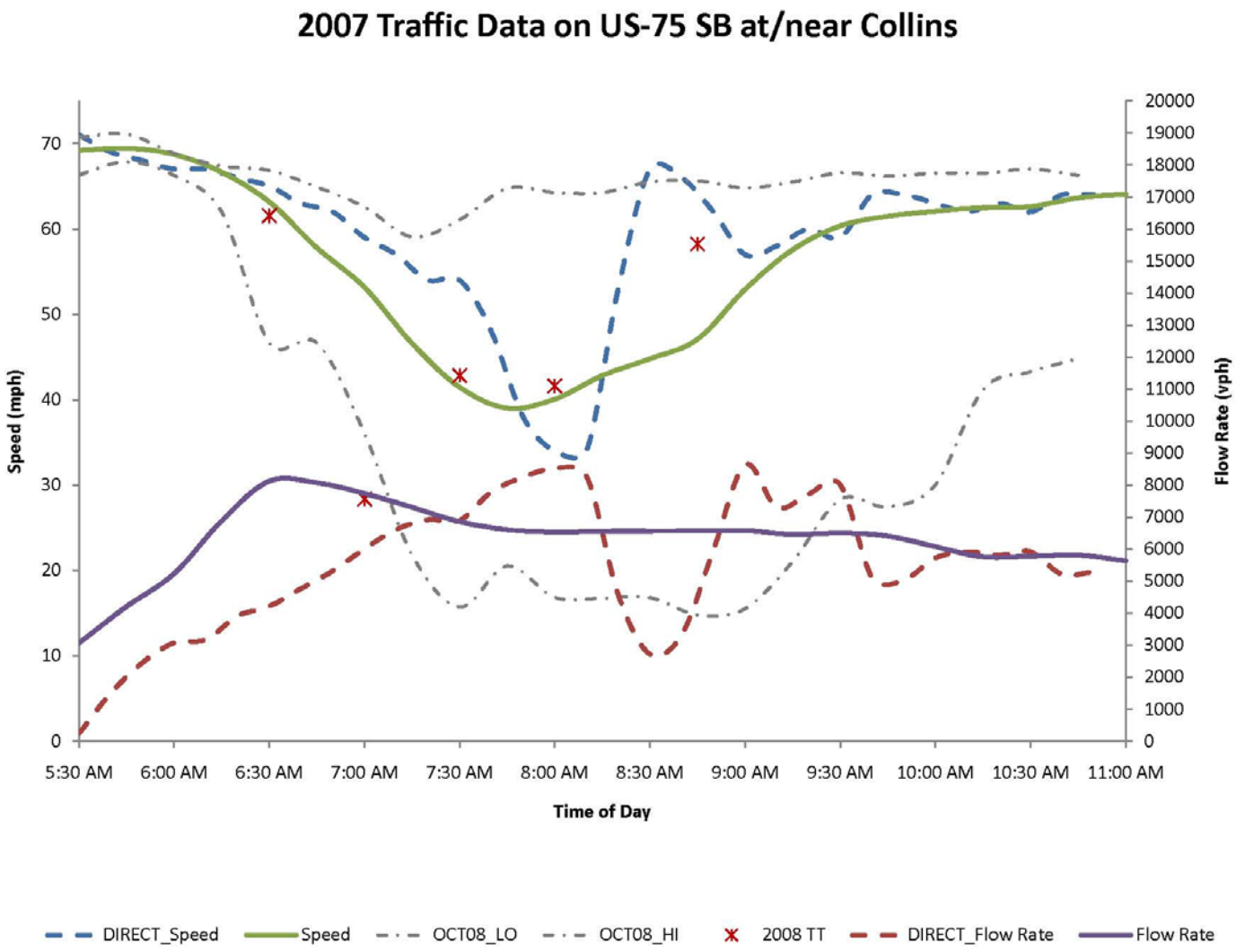

NSMS18L1.06L
US75NS MAIN LANES SOUTH BOUND 12/11/2008 06:59:54
Distance (miles)
0
2
4
6
8
10
12
14
16
Speed (mph)
80
70
60
50
40
30
20
10
0
DMI DATA
EXCHANGE PKWY ENT
MCDERMOTT UNDERPASS
BETHANY DR UNDERPASS
LEGACY RD OVERPASS
SPRING CREEK
PARKER RD OVERPASS
PARK BLVD OVERPASS
15TH ST UNDERPASS
PLANO PKWY
RENNER UNDERPASS
GALATYN OVERPASS
CAMPBELL UNDERPASS
COLLINS OVERPASS
ARAPAHO UNDERPASS
BELTLINE UNDERPASS
SPRING VALLEY
MIDWAY OVERPASS
IH635 OVERPASS

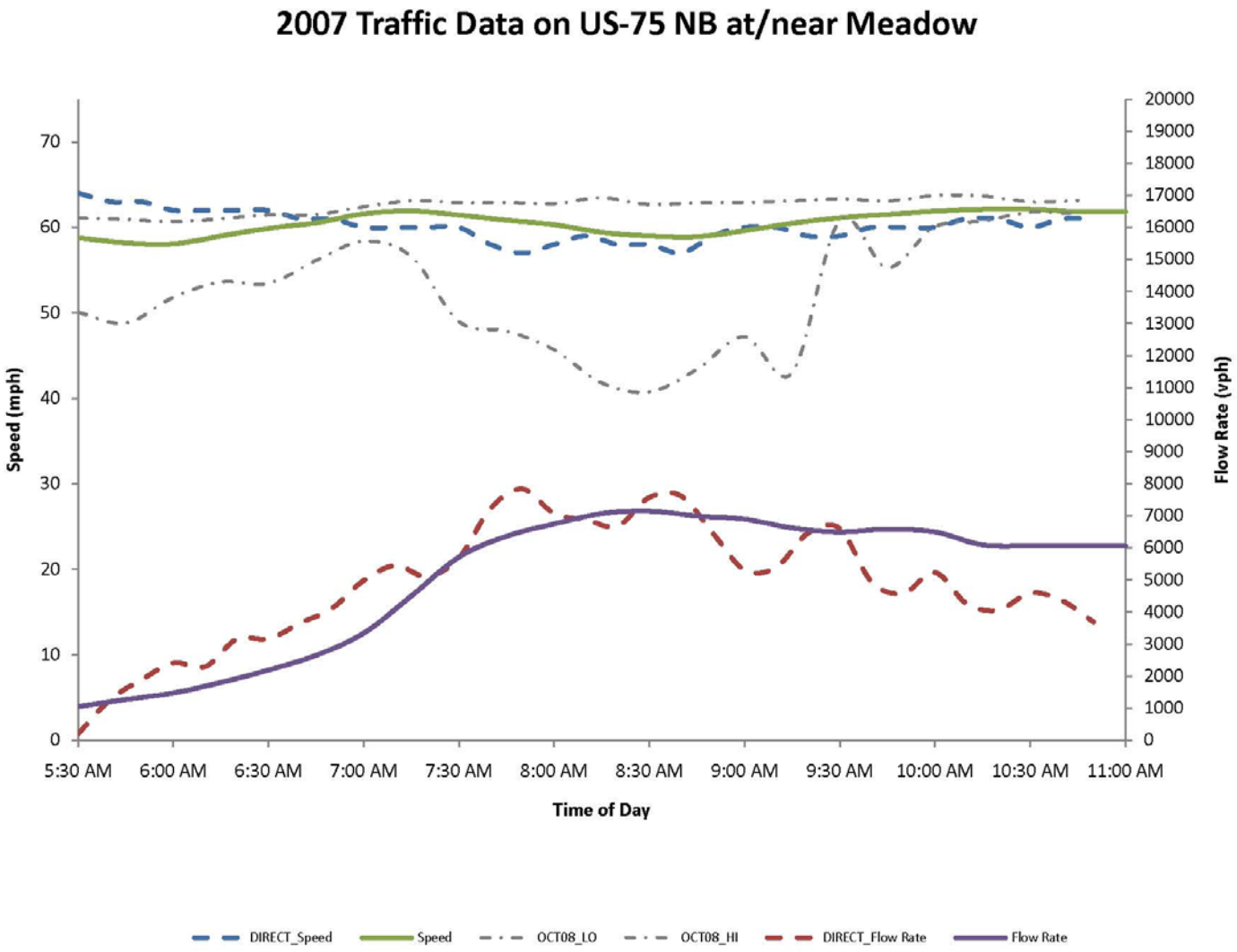

NSMS18L1.07F
US75NS MAIN LANES SOUTH BOUND 12/11/2008 07:29:28
Distance (miles)
0
2
4
6
8
10
12
14
16
Speed (mph)
80
70
60
50
40
30
20
10
0
DMI DATA
EXCHANGE PKWY ENT
MCDERMOTT UNDERPASS
BETHANY DR UNDERPASS
LEGACY RD OVERPASS
SPRING CREEK
PARKER RD OVERPASS
PARK BLVD OVERPASS
15TH ST UNDERPASS
PLANO PKWY
RENNER UNDERPASS
GALATYN OVERPASS
CAMPBELL UNDERPASS
COLLINS OVERPASS
ARAPAHO UNDERPASS
BELTLINE UNDERPASS
SPRING VALLEY
MIDWAY OVERPASS
IH635 OVERPASS

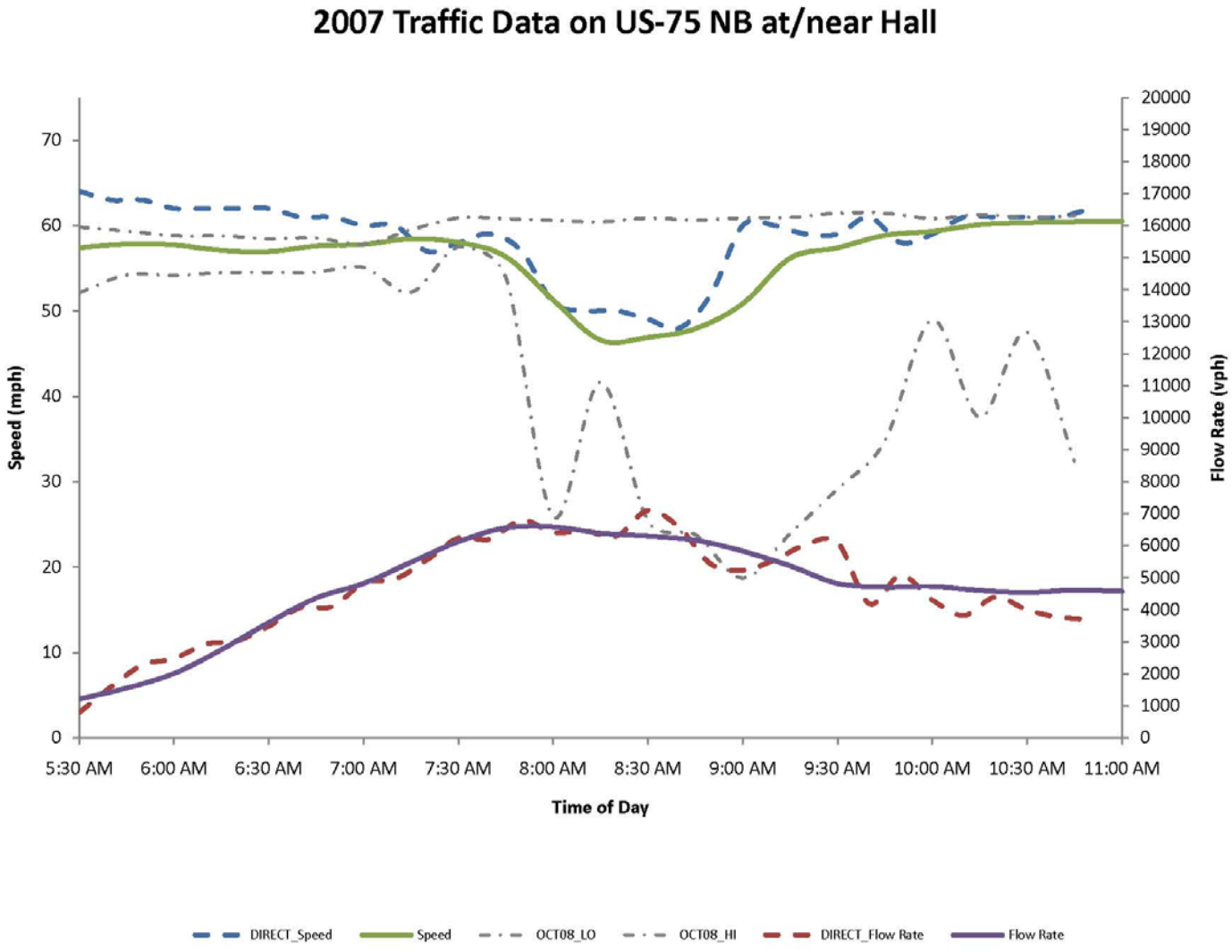

NSMS18L1.08B
US75NS MAIN LANES SOUTH BOUND 12/11/2008 08:05:14
Distance (miles)
0
2
4
6
8
10
12
14
16
Speed (mph)
80
70
60
50
40
30
20
10
0
DMI DATA
EXCHANGE PKWY ENT
MCDERMOTT UNDERPASS
BETHANY DR UNDERPASS
LEGACY RD OVERPASS
SPRING CREEK
PARKER RD OVERPASS
PARK BLVD OVERPASS
15TH ST UNDERPASS
PLANO PKWY
RENNER UNDERPASS
GALATYN OVERPASS
CAMPBELL UNDERPASS
COLLINS OVERPASS
ARAPAHO UNDERPASS
BELTLINE UNDERPASS
SPRING VALLEY
MIDWAY OVERPASS
IH635 OVERPASS

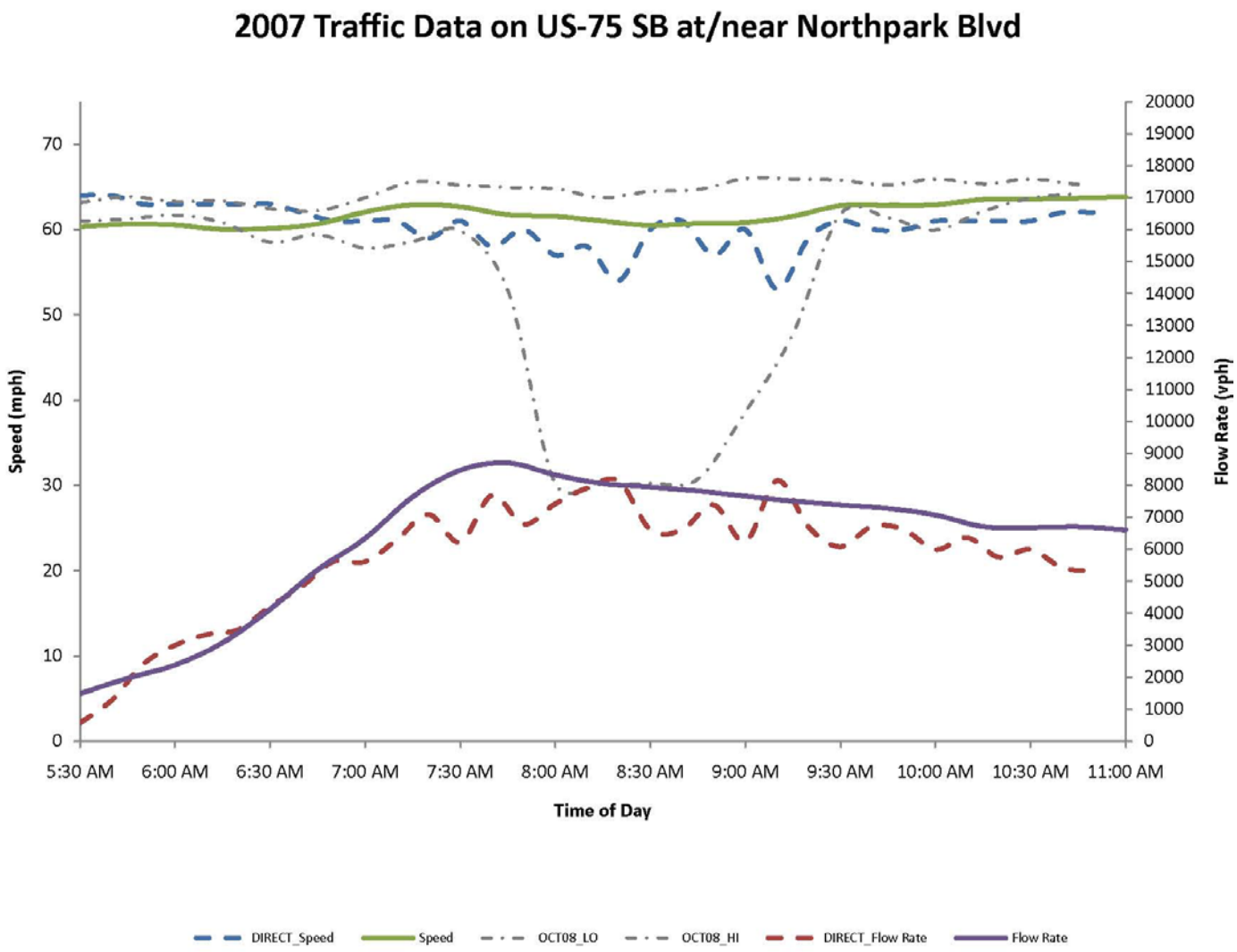

NSMS18L1.08I
US75NS MAIN LANES SOUTH BOUND 12/11/2008 08:44:22
Distance (miles)
0
2
4
6
8
10
12
14
16
Speed (mph)
80
70
60
50
40
30
20
10
0
DMI DATA
EXCHANGE PKWY ENT
MCDERMOTT UNDERPASS
BETHANY DR UNDERPASS
LEGACY RD OVERPASS
SPRING CREEK
PARKER RD OVERPASS
PARK BLVD OVERPASS
15TH ST UNDERPASS
PLANO PKWY
RENNER UNDERPASS
GALATYN OVERPASS
CAMPBELL UNDERPASS
COLLINS OVERPASS
ARAPAHO UNDERPASS
BELTLINE UNDERPASS
SPRING VALLEY
MIDWAY OVERPASS
IH635 OVERPASS

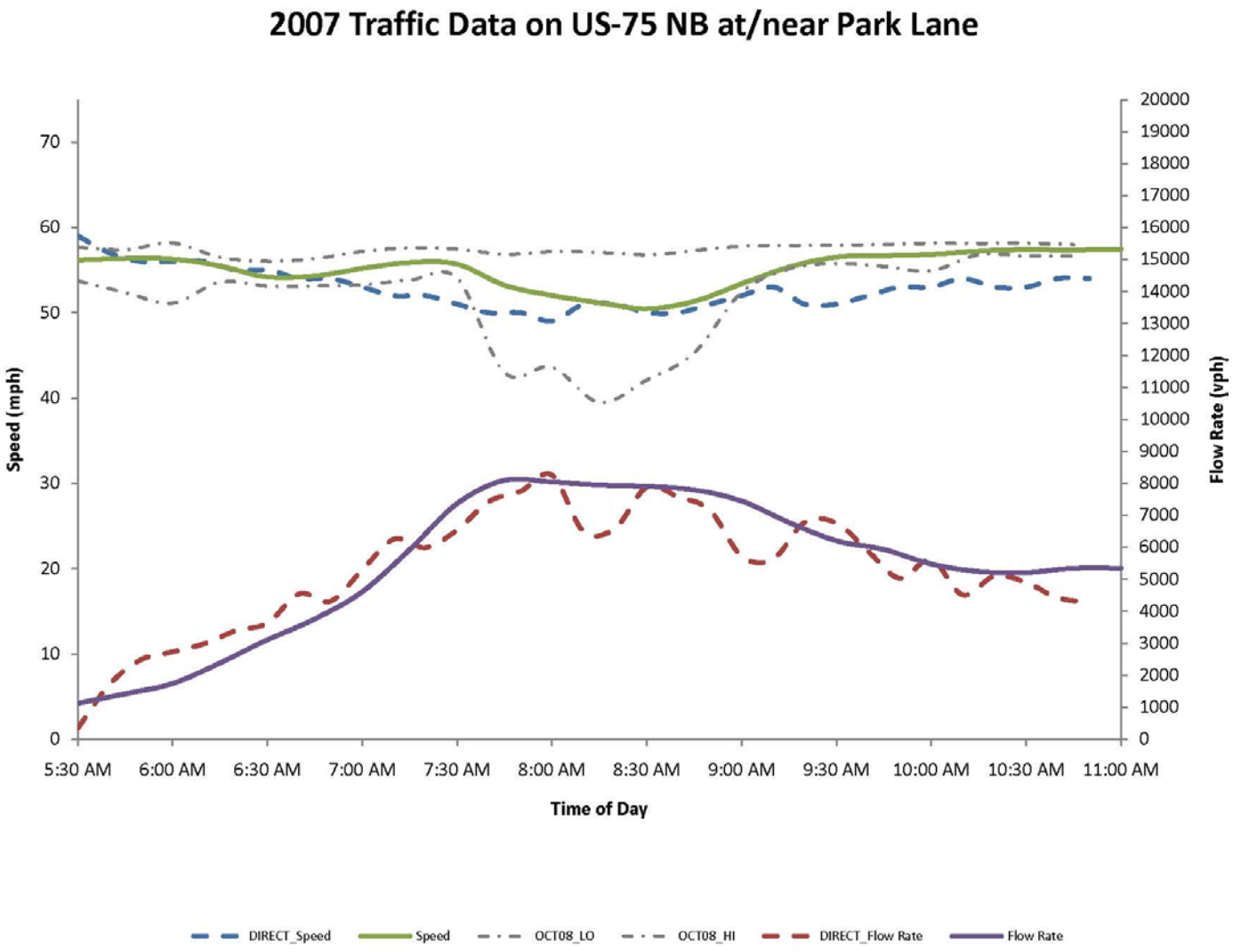
APPENDIX F. Speed and Volume Profiles

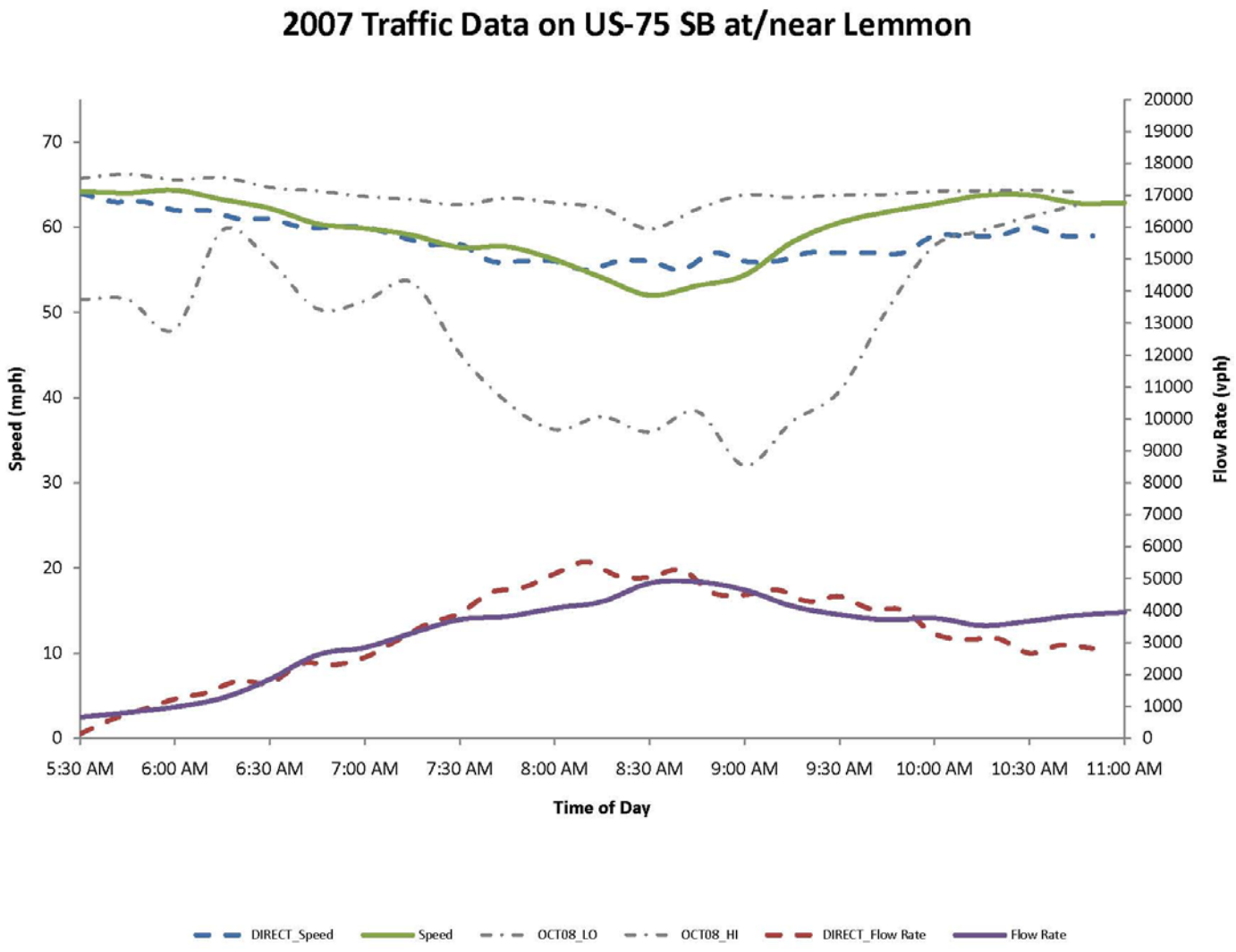

2007 Traffic Data on US-75 SB at/near Collins
Speed (mph)
Flow Rate (vph)
Time of Day
0
10
20
30
40
50
60
70
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
13000
14000
15000
16000
17000
18000
19000
20000
5:30 AM
6:00 AM
6:30 AM
7:00 AM
7:30 AM
8:00 AM
8:30 AM
9:00 AM
9:30 AM
10:00 AM
10:30 AM
11:00 AM
DIRECT_Speed
Speed
OCT08_LO
OCT08_HI
2008 TT
DIRECT_Flow Rate
Flow Rate

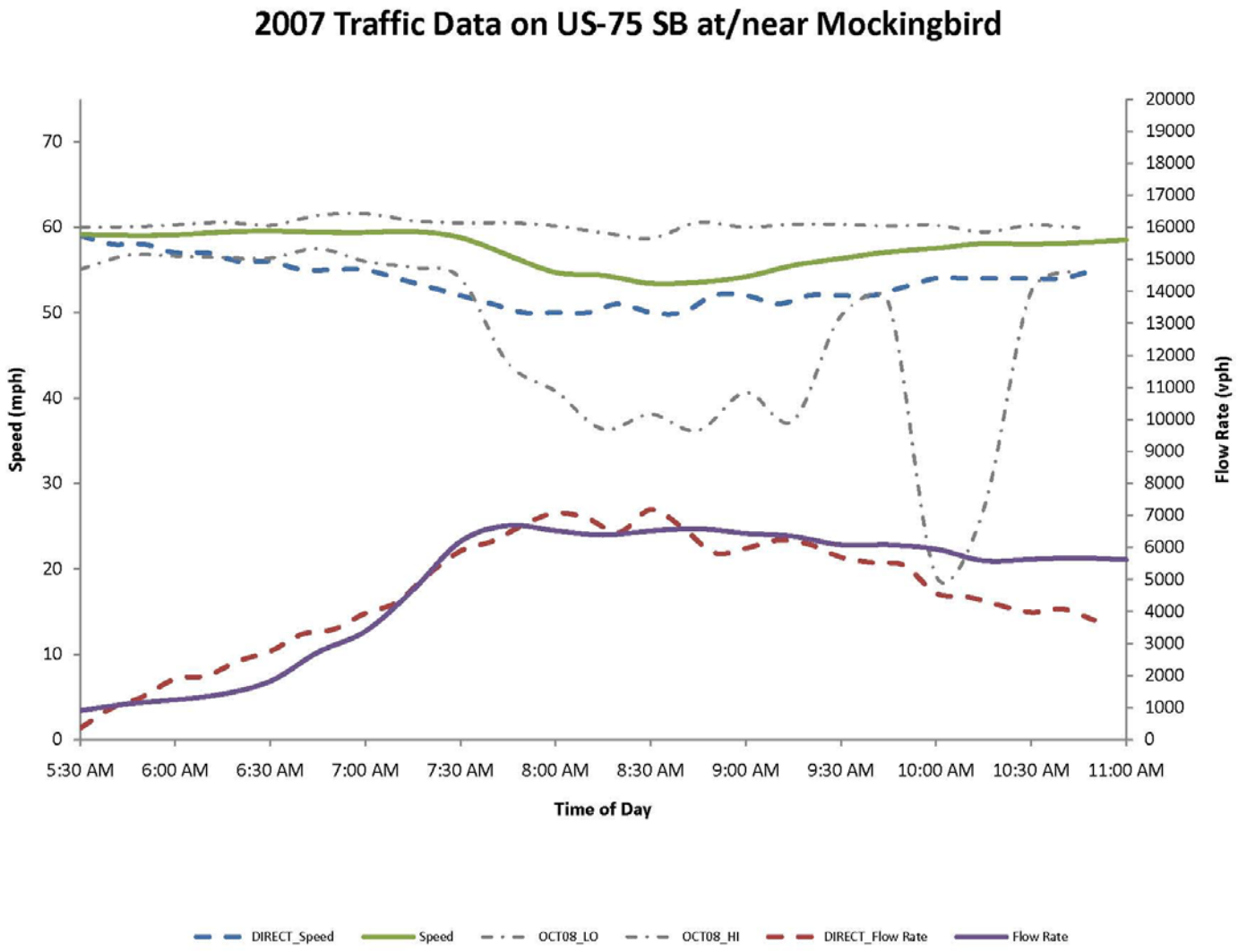

2007 Traffic Data on US-75 NB at/near Meadow
Speed (mph)
Flow Rate (vph)
Time of Day
0
10
20
30
40
50
60
70
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
13000
14000
15000
16000
17000
18000
19000
20000
5:30 AM
6:00 AM
6:30 AM
7:00 AM
7:30 AM
8:00 AM
8:30 AM
9:00 AM
9:30 AM
10:00 AM
10:30 AM
11:00 AM
DIRECT_Speed
Speed
OCT08_LO
OCT08_HI
DIRECT_Flow Rate
Flow Rate

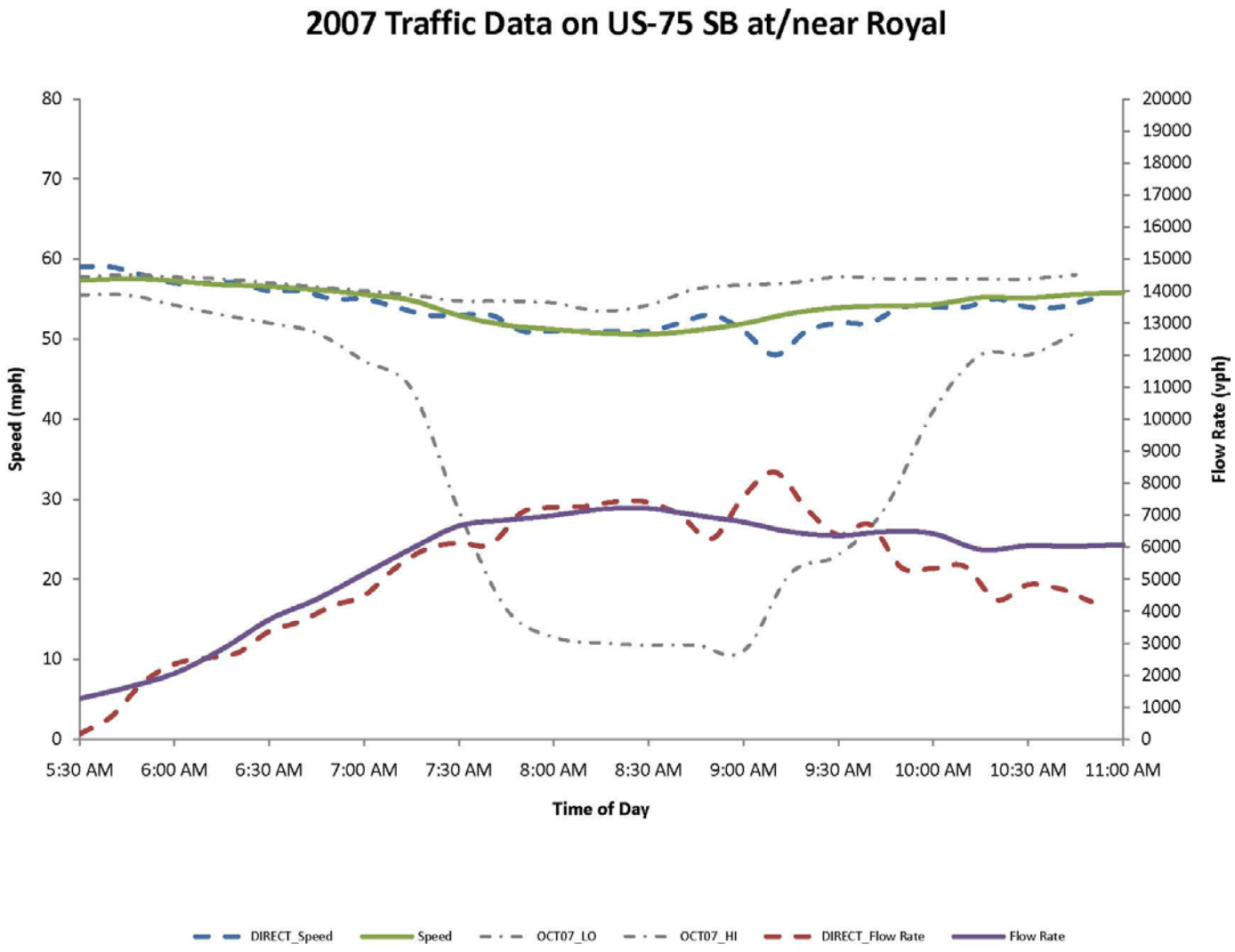

2007 Traffic Data on US-75 NB at/near Hall
Speed (mph)
Flow Rate (vph)
Time of Day
0
10
20
30
40
50
60
70
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
13000
14000
15000
16000
17000
18000
19000
20000
5:30 AM
6:00 AM
6:30 AM
7:00 AM
7:30 AM
8:00 AM
8:30 AM
9:00 AM
9:30 AM
10:00 AM
10:30 AM
11:00 AM
DIRECT_Speed
Speed
OCT08_LO
OCT08_HI
DIRECT_Flow Rate
Flow Rate

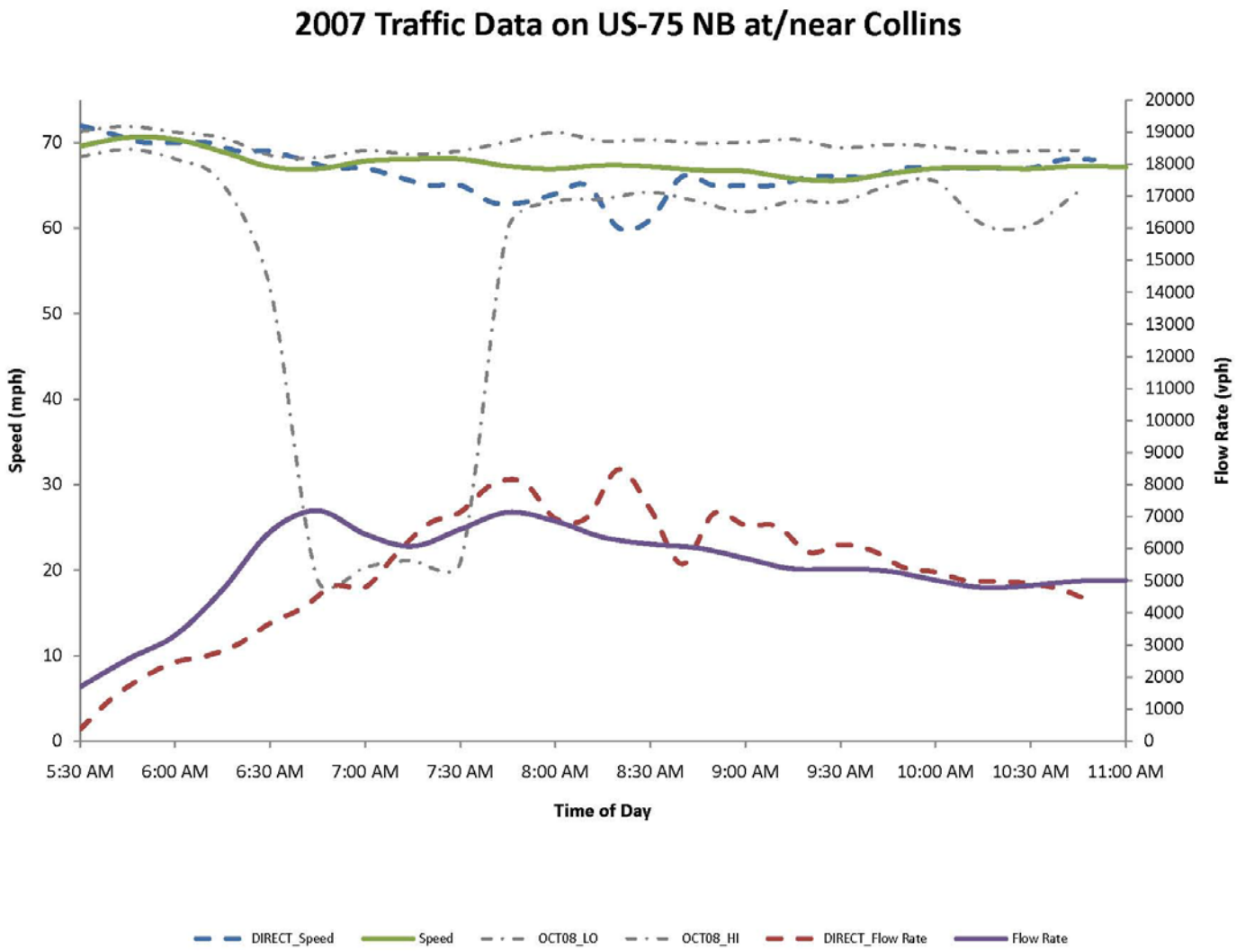

2007 Traffic Data on US-75 SB at/near Northpark Blvd
Speed (mph)
Flow Rate (vph)
Time of Day
0
10
20
30
40
50
60
70
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
13000
14000
15000
16000
17000
18000
19000
20000
5:30 AM
6:00 AM
6:30 AM
7:00 AM
7:30 AM
8:00 AM
8:30 AM
9:00 AM
9:30 AM
10:00 AM
10:30 AM
11:00 AM
DIRECT_Speed
Speed
OCT08_LO
OCT08_HI
DIRECT_Flow Rate
Flow Rate

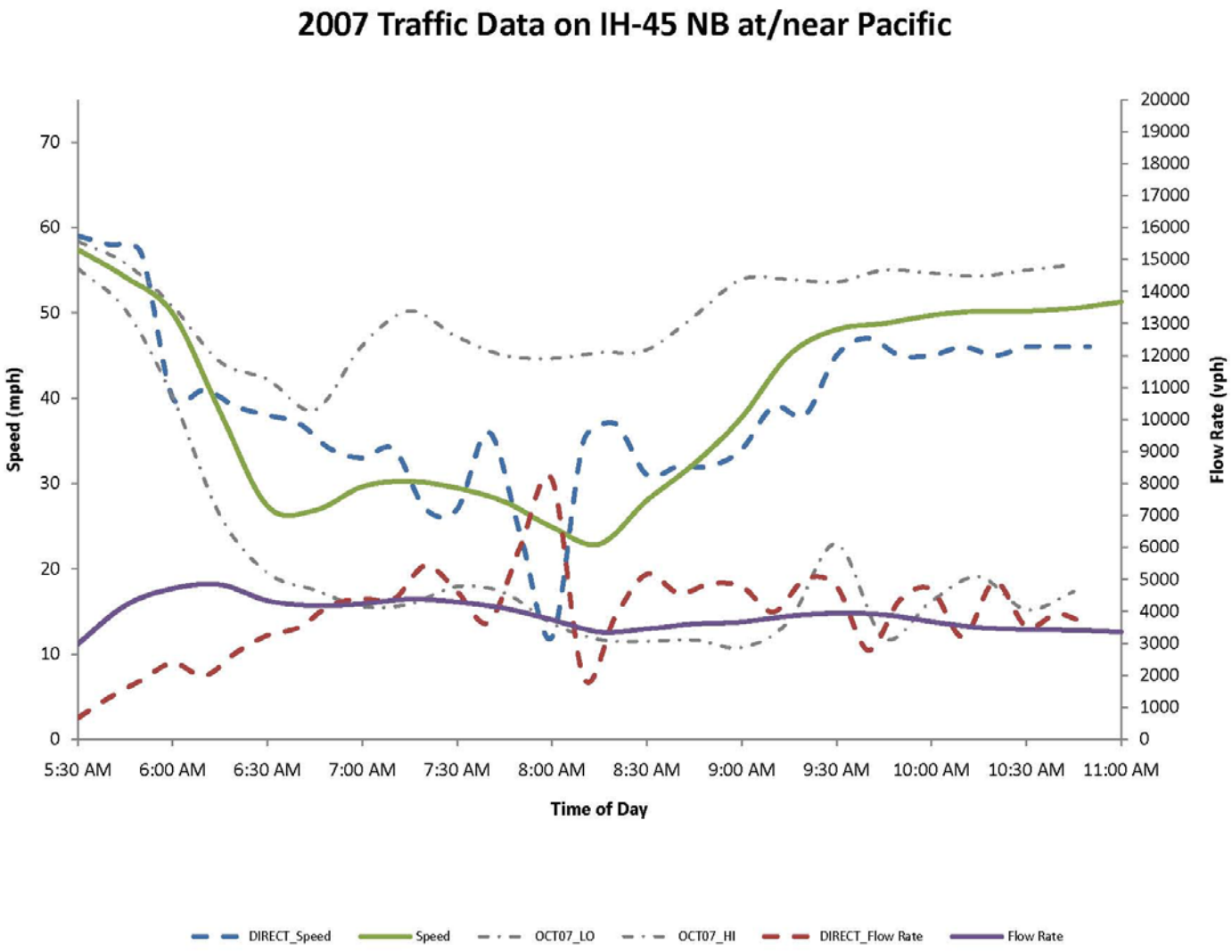

2007 Traffic Data on US-75 NB at/near Park Lane
Speed (mph)
Flow Rate (vph)
Time of Day
0
10
20
30
40
50
60
70
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
13000
14000
15000
16000
17000
18000
19000
20000
5:30 AM
6:00 AM
6:30 AM
7:00 AM
7:30 AM
8:00 AM
8:30 AM
9:00 AM
9:30 AM
10:00 AM
10:30 AM
11:00 AM
DIRECT_Speed
Speed
OCT08_LO
OCT08_HI
DIRECT_Flow Rate
Flow Rate

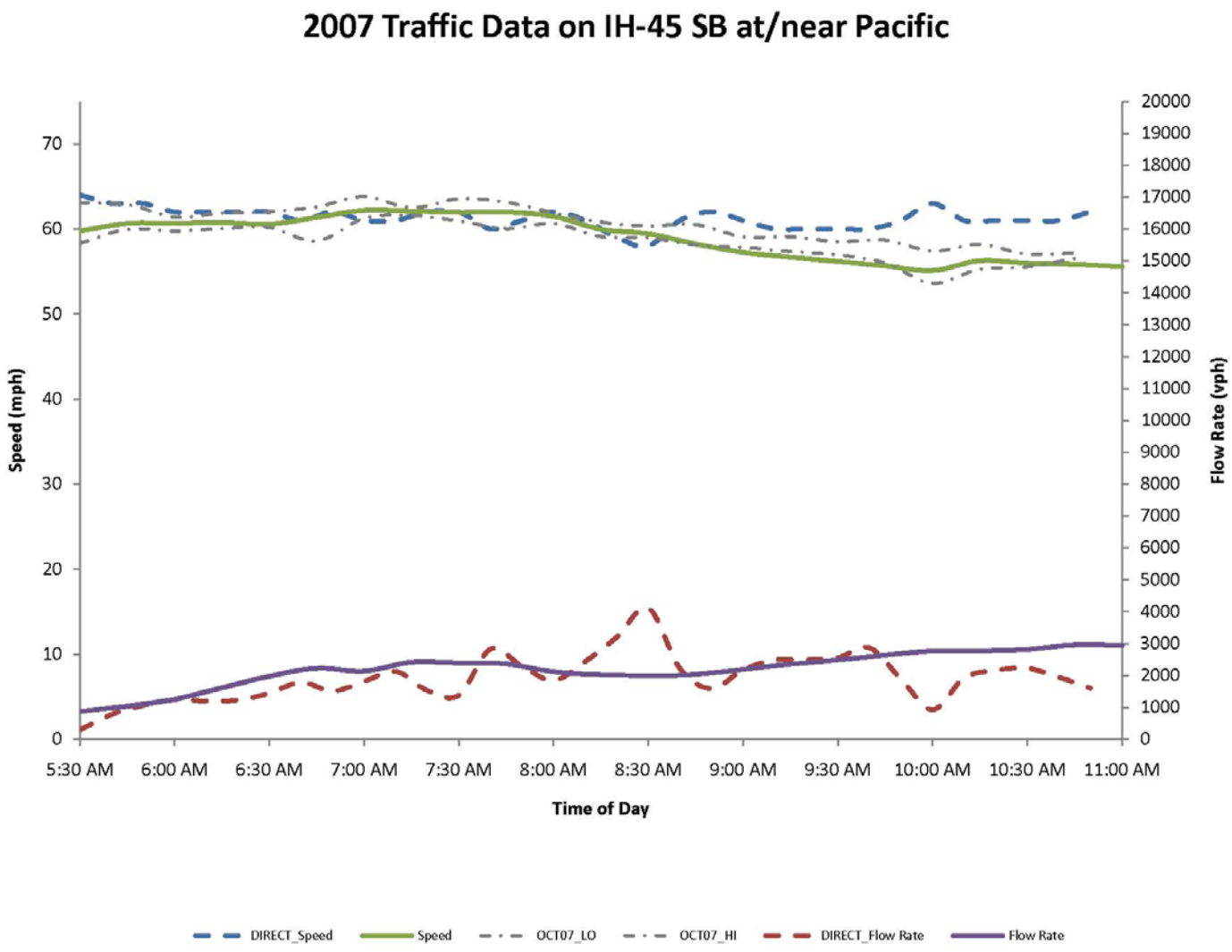

2007 Traffic Data on US-75 SB at/near Lemmon
Speed (mph)
Flow Rate (vph)
Time of Day
5:30 AM
6:00 AM
6:30 AM
7:00 AM
7:30 AM
8:00 AM
8:30 AM
9:00 AM
9:30 AM
10:00 AM
10:30 AM
11:00 AM
DIRECT_Speed
Speed
OCT08_LO
OCT08_HI
DIRECT_Flow Rate
Flow Rate


2007 Traffic Data on US-75 SB at/near Mockingbird
Speed (mph)
Flow Rate (vph)
Time of Day
0
10
20
30
40
50
60
70
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
13000
14000
15000
16000
17000
18000
19000
20000
5:30 AM
6:00 AM
6:30 AM
7:00 AM
7:30 AM
8:00 AM
8:30 AM
9:00 AM
9:30 AM
10:00 AM
10:30 AM
11:00 AM
DIRECT_Speed
Speed
OCT08_LO
OCT08_HI
DIRECT_Flow Rate
Flow Rate

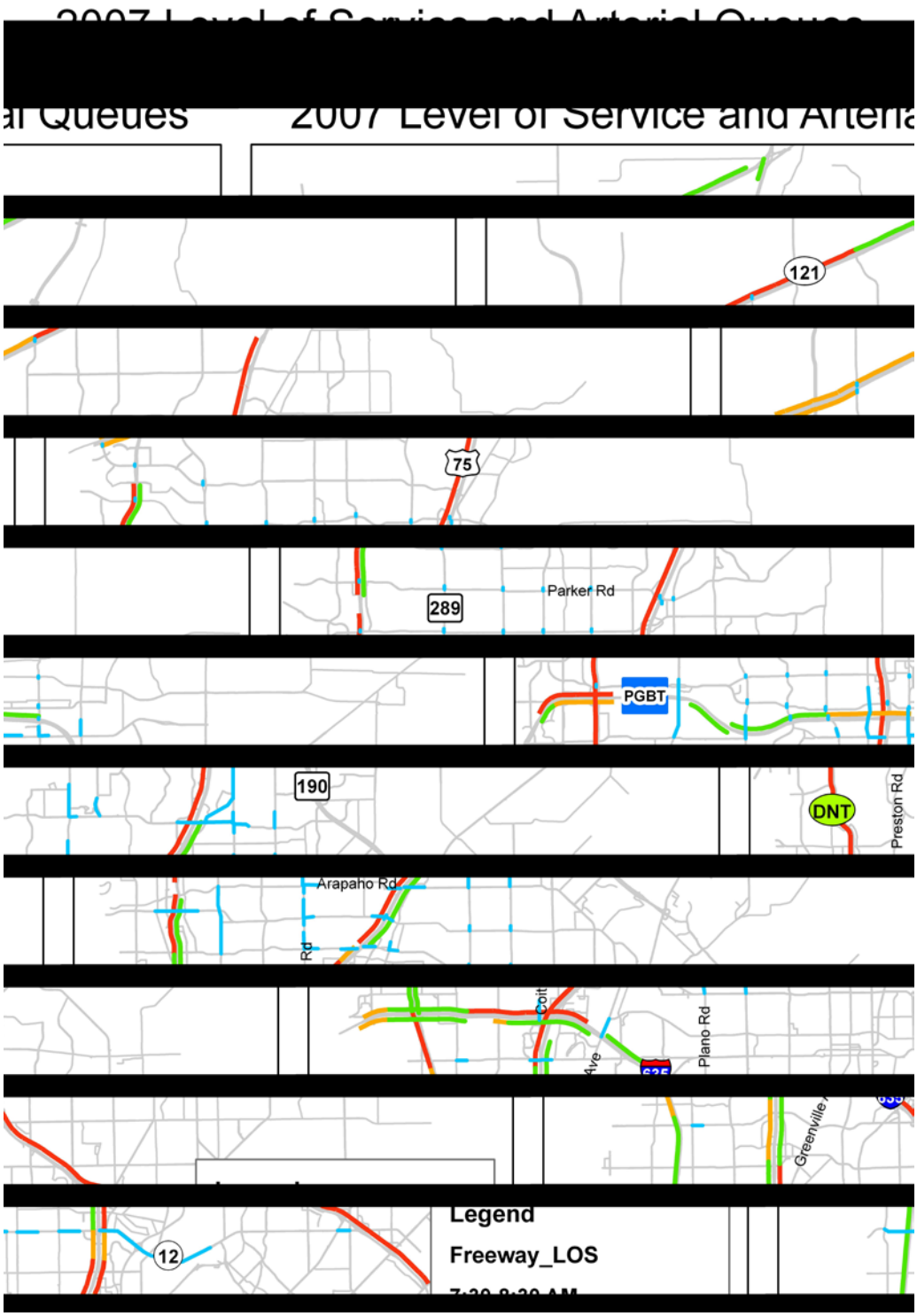

2007 Traffic Data on US-75 SB at/near Royal
Speed (mph)
Flow Rate (vph)
Time of Day
0
10
20
30
40
50
60
70
80
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
13000
14000
15000
16000
17000
18000
19000
20000
5:30 AM
6:00 AM
6:30 AM
7:00 AM
7:30 AM
8:00 AM
8:30 AM
9:00 AM
9:30 AM
10:00 AM
10:30 AM
11:00 AM
DIRECT_Speed
Speed
OCT07_LO
OCT07_HI
DIRECT_Flow Rate
Flow Rate


2007 Traffic Data on US-75 NB at/near Collins
Speed (mph)
Flow Rate (vph)
Time of Day
0
10
20
30
40
50
60
70
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
13000
14000
15000
16000
17000
18000
19000
20000
5:30 AM
6:00 AM
6:30 AM
7:00 AM
7:30 AM
8:00 AM
8:30 AM
9:00 AM
9:30 AM
10:00 AM
10:30 AM
11:00 AM
DIRECT_Speed
Speed
OCT08_LO
OCT08_HI
DIRECT_Flow Rate
Flow Rate


2007 Traffic Data on IH-45 NB at/near Pacific
Speed (mph)
Flow Rate (vph)
Time of Day
0
10
20
30
40
50
60
70
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
13000
14000
15000
16000
17000
18000
19000
20000
5:30 AM
6:00 AM
6:30 AM
7:00 AM
7:30 AM
8:00 AM
8:30 AM
9:00 AM
9:30 AM
10:00 AM
10:30 AM
11:00 AM
DIRECT_Speed
Speed
OCT07_LO
OCT07_HI
DIRECT_Flow Rate
Flow Rate


2007 Traffic Data on IH-45 SB at/near Pacific
Speed (mph)
Flow Rate (vph)
Time of Day
5:30 AM
6:00 AM
6:30 AM
7:00 AM
7:30 AM
8:00 AM
8:30 AM
9:00 AM
9:30 AM
10:00 AM
10:30 AM
11:00 AM
DIRECT_Speed
Speed
OCT07_LO
OCT07_HI
DIRECT_Flow Rate
Flow Rate

APPENDIX G. Level of Service and Arterial Queues



[Source. DART.]

APPENDIX H. DART Bus Person Volumes

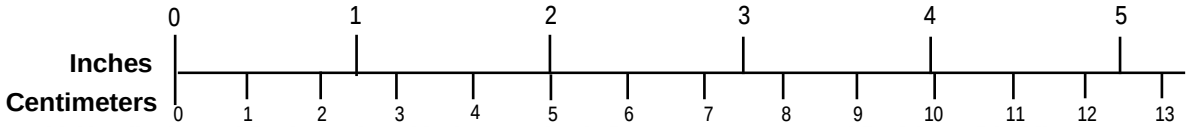
DART				DIRECT		
NW HWY_NB	LINEABBR	Total		Total	DIFF	%DIFF
Preston	36	77		28	-49	-64%
Hillcrest	21	32		9	-23	-72%
Shady Brook	501	17		10	-7	-41%
Abrams	519	48		3	-45	-94%
Plano	60	23		5	-18	-78%
Jupiter	475	51		0	-51	-100%
Garland	466	74		0	-74	-100%
NW HWY_SB						
Preston	36	64		25	-39	-61%
Shady Brook	501	17		22	5	29%
Abrams	519	50		0	-50	-100%
Plano	60	37		40	3	8%
Jupiter	475	41		8	-33	-80%
Garland	466	73		2	-71	-97%
Greenville_EB						
Park Lane	21	21		9	-12	-57%
Pineland	506	33		0	-33	-100%
Meadow	505	5		0	-5	-100%
Forest	488	41		16	-25	-61%
Buckingham	551	14		1	-13	-93%
Belt Line	400	56		46	-10	-18%
Renner	566	11		8	-3	-27%
Summit	360	48		13	-35	-73%
14th	570	6		1	-5	-83%
Park	410	57		46	-11	-19%
Greenville_WB						
Park Lane	21	76		0	-76	-100%
Walnut Hill	506	76		0	-76	-100%
Forest	488	153		19	-134	-88%
Buckingham	551	33		1	-32	-97%
Centennial	463	105		16	-89	-85%
Belt Line	400	112		124	12	11%
Renner	566	10		10	0	0%
18th	570	13		1	-12	-92%
Park	410	47		0	-47	-100%
Arapaho_NB						
Preston	350	40		4	-36	-90%
Coit	451	67		143	76	113%
Plano	571	35		7	-28	-80%
Jupiter	410	76		23	-53	-70%
Arapaho _SB						
Preston	350	48		42	-6	-13%
Coit	451	31		22	-9	-29%
Plano	571	18		47	29	161%
Jupiter	410	57		49	-8	-14%
Parker_NB						
Preston	451	37		50	13	35%
Jupiter	350	26		15	-11	-42%
Parker_SB						
Preston	451	35		30	-5	-14%
Jupiter	350	25		12	-13	-52%

[Source. DART.]

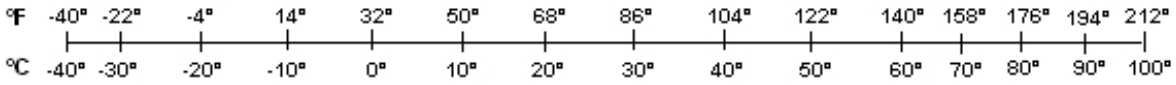
APPENDIX I. Metric/English Conversion Factors

ENGLISH TO METRIC	METRIC TO ENGLISH)
LENGTH (APPROXIMATE)	**LENGTH (APPROXIMATE)**
1 inch (in) = 2.5 centimeters (cm)	1 millimeter (mm) = 0.04 inch (in)
1 foot (ft) = 30 centimeters (cm)	1 centimeter (cm) = 0.4 inch (in)
1 yard (yd) = 0.9 meter (m)	1 meter (m) = 3.3 feet (ft)
1 mile (mi) = 1.6 kilometers (km)	1 meter (m) = 1.1 yards (yd)
	1 kilometer (km) = 0.6 mile (mi)
AREA (APPROXIMATE)	**AREA (APPROXIMATE)**
1 square inch (sq in, in^2) = 6.5 square centimeters (cm^2)	1 square centimeter (cm^2) = 0.16 square inch (sq in, in^2)
1 square foot (sq ft, ft^2) = 0.09 square meter (m^2)	1 square meter (m^2) = 1.2 square yards (sq yd, yd^2)
1 square yard (sq yd, yd^2) = 0.8 square meter (m^2)	1 square kilometer (km^2) = 0.4 square mile (sq mi, mi^2)
1 square mile (sq mi, mi^2) = 2.6 square kilometers (km^2)	10,000 square meters (m^2) = 1 hectare (ha) = 2.5 acres
1 acre = 0.4 hectare (he) = 4,000 square meters (m^2)	
MASS - WEIGHT (APPROXIMATE)	**MASS - WEIGHT (APPROXIMATE)**
1 ounce (oz) = 28 grams (gm)	1 gram (gm) = 0.036 ounce (oz)
1 pound (lb) = 0.45 kilogram (kg)	1 kilogram (kg) = 2.2 pounds (lb)
1 short ton = 2,000 pounds (lb) = 0.9 tonne (t)	1 tonne (t) = 1,000 kilograms (kg) = 1.1 short tons
VOLUME (APPROXIMATE)	**VOLUME (APPROXIMATE)**
1 teaspoon (tsp) = 5 milliliters (ml)	1 milliliter (ml) = 0.03 fluid ounce (fl oz)
1 tablespoon (tbsp) = 15 milliliters (ml)	1 liter (l) = 2.1 pints (pt)
1 fluid ounce (fl oz) = 30 milliliters (ml)	1 liter (l) = 1.06 quarts (qt)
1 cup (c) = 0.24 liter (l)	1 liter (l) = 0.26 gallon (gal)
1 pint (pt) = 0.47 liter (l)	
1 quart (qt) = 0.96 liter (l)	
1 gallon (gal) = 3.8 liters (l)	
1 cubic foot (cu ft, ft^3) = 0.03 cubic meter (m^3)	1 cubic meter (m^3) = 36 cubic feet (cu ft, ft^3)
1 cubic yard (cu yd, yd^3) = 0.76 cubic meter (m^3)	1 cubic meter (m^3) = 1.3 cubic yards (cu yd, yd^3)
TEMPERATURE (EXACT)	**TEMPERATURE (EXACT)**
[(x-32)(5/9)] °F = y °C	[(9/5) y + 32] °C = x °F

QUICK INCH - CENTIMETER LENGTH CONVERSION



QUICK FAHRENHEIT - CELSIUS TEMPERATURE CONVERSION



For more exact and or other conversion factors, see NIST Miscellaneous Publication 286, Units of Weights and Measures. Price $2.50 SD Catalog No. C13 10286

U.S. Department of Transportation
ITS Joint Program Office-HOIT
1200 New Jersey Avenue, SE
Washington, DC 20590

Toll-Free “Help Line” 866-367-7487
www.its.dot.gov

FHWA-JPO-10-034
EDL No. 14941

U.S. Department of Transportation

Research and Innovative Technology Administration