Signal Operations Dodge Street Midtown

Final Report

Omaha, Nebraska

October 17, 2022

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EXECUTIVE SUMMARY

The City of Omaha Public Works Department is updating signal timing plans for different corridors in the city to accommodate current traffic patterns and incorporate safety enhancements. The program grouped various corridors together for different projects to retime the traffic signals. HDR conducted a signal operations study for multiple corridors including Dodge Street in the Midtown area. The objective of this project was to prepare and implement optimized traffic signal timing plans and document measures of effectiveness. Short-term safety and operational improvements were also identified in the study area. In addition, a benefit-cost analysis was conducted for the signal timing optimization.

The Signal Operations project for Dodge Street and the Midtown area retimed 37 existing traffic signals along Dodge Street, Farnam Street, Harney Street, Saddle Creek Road, and 42nd Street. Below is a list of the limits for each corridor that signal timings were updated for:

- Dodge Street: 67th Street to 33rd Street
- Farnam Street: Dodge Street to 32nd Street
- Harney Street: 42nd Street to 33rd Street
- Saddle Creek Road: Emile Street to California Street
- 42nd Street: Emile Street to Dodge Street

Network performance measures were estimated using Synchro models for the existing and implemented signal timings. **Table ES-1** below shows a summary of the existing and implemented network performance measures. Travel time runs were also collected for the Dodge Street corridor for the existing and implemented signal timings using Tru-Traffic software.

Table ES-1. Estimated Network Performance Measures

	Plan 1 - MD			Plan 2 - AM		
	Existing	Implemented	Difference	Existing	Implemented	Difference
Total Delay (hr)	128	104	-23%	128	140	9%
Stops (#)	17,338	16,847	-3%	17,111	17,496	2%
Fuel Consumed (gal)	598	577	-4%	612	620	1%
Total Travel Time (hr)	441	417	-6%	451	462	2%
	Plan 3 - PM			**Plan 4 - OP**		
	Existing	Implemented	Difference	Existing	Implemented	Difference
Total Delay (hr)	215	211	-2%	84	67	-25%
Stops (#)	29,712	26,747	-11%	12,194	12,467	2%
Fuel Consumed (gal)	873	848	-3%	435	424	-3%
Total Travel Time (hr)	629	625	-1%	318	301	-6%

A benefit-cost analysis was conducted to calculate the benefit-cost ratio and value added by the project. Overall benefits of the project were estimated using a methodology that the City has developed using US Department of Transportation (USDOT) guidelines for monetizing performance measures. **Table ES-2** summarizes the benefits of this project.

Table ES-2. Anticipated Five Year Project Benefits

Performance Measure	Project Benefit	Present Value
Delay Reduction	30,295 hours	$752,835
Fuel Consumption Reduction	47,518 gallons	$161,474
Emission Reduction	424 tons	$32,467
Crash Reduction	53 crashes	$2,893,882

The total cost of the project is not to exceed $131,972. This results in a benefit-cost ratio of 29:1 over a five-year period.

1 INTRODUCTION

1.1 BACKGROUND

The City of Omaha Public Works Department is updating signal timing plans for different corridors in the city to accommodate current traffic patterns and incorporate safety enhancements. The program grouped various corridors together for different projects to retime the traffic signals. HDR conducted a signal operations study for multiple corridors including Dodge Street in the Midtown area. The objective of this project was to prepare and implement optimized traffic signal timing plans and document measures of effectiveness. Short-term safety and operational improvements were also identified in the study area. In addition, a benefit-cost analysis was conducted for the signal timing optimization.

1.2 SIGNAL LOCATIONS

The project included 37 signalized intersections along/near Dodge Street, Farnam Street, Harney Street, 42nd Street, and Saddle Creek Road. Study intersections are listed and shown in **Table 1-1** and **Figure 1-1**.

Table 1-1. List of Signalized Project Intersections

Signal ID	Location	Signal ID	Location
279	33rd St & Dodge St	602	36th St & Farnam St
289	35th Ave & Dodge St	1177	38th St & Farnam St
300	38th St & Dodge St	307	40th St & Farnam St
306	40th St & Dodge St	323	42nd St & Farnam St
320	42nd St & Dodge St	340	44th St & Farnam St
339	44th St & Dodge St	76	Saddle Creek Rd & Farnam St
344	46th St & Dodge St	362	50th St & Farnam St
355	49th St & Dodge St	379	52nd St & Farnam St
361	50th St & Dodge St	28	Happy Hollow Blvd & Farnam St
378	52nd St & Dodge St	283	33rd St & Harney St
27	Happy Hollow Blvd & Dodge St	291	36th St & Harney St
1220	Farnam St & Dodge St	309	40th St & Harney St
401	60th St & Dodge St	326	42nd St & Harney St
421	62nd St & Dodge St	319	42nd St & Dewey St
428	66th St & Dodge St	321	42nd St & Emile St
432	67th St & Dodge St	75	Saddle Creek Rd & Emile St
1103	32nd St & Farnam St	74	Saddle Creek Rd & Davenport St
280	33rd St & Farnam St	73	Saddle Creek Rd & California St
1102	34th St & Farnam St		

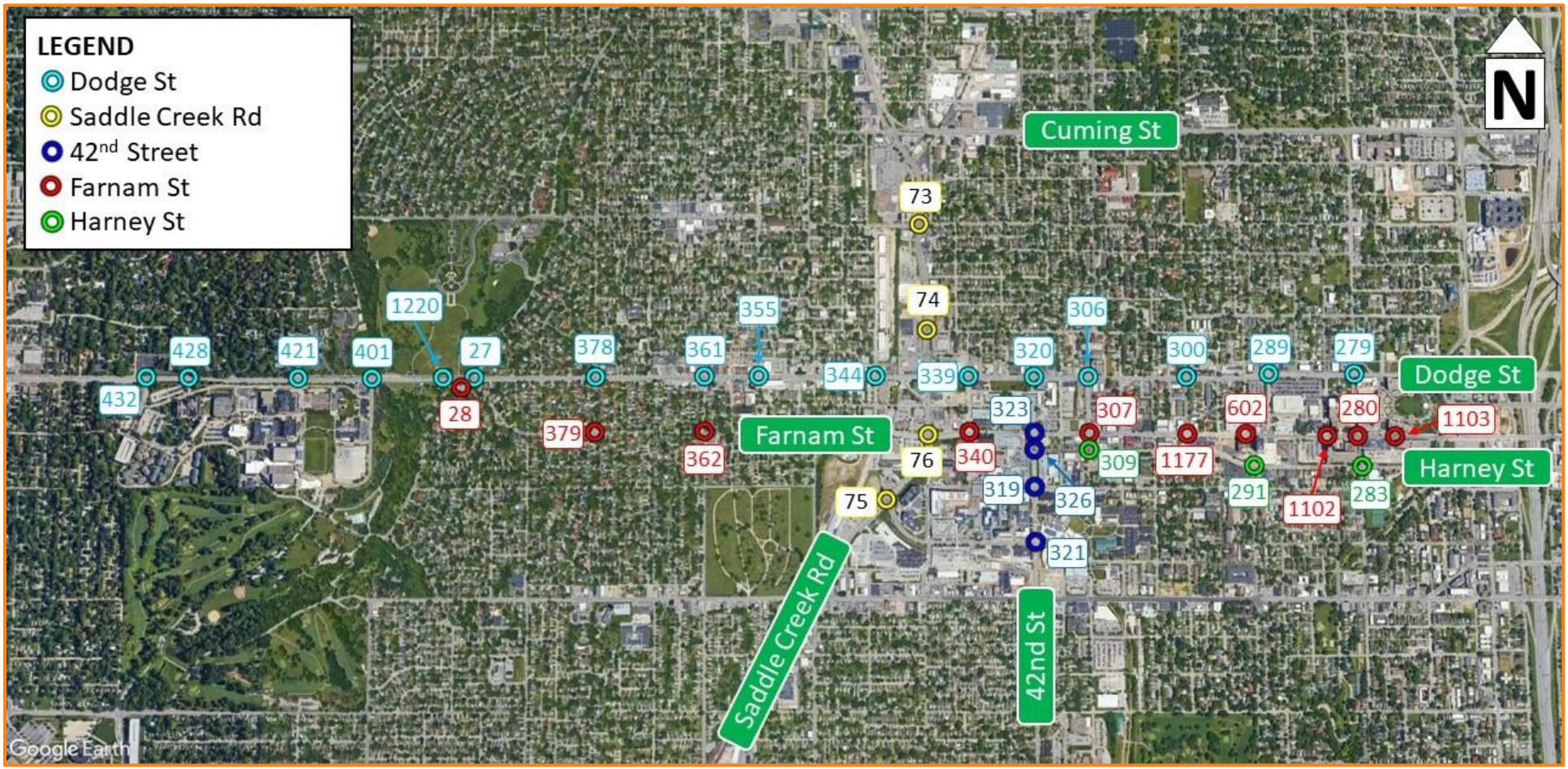


Figure 1-1. Map of Signalized Project Intersections

Table 1-2 details the speed and cross-sectional characteristics of the corridors analyzed for the project.

Table 1-2. Corridor Characteristics

Corridor	Segment	Speed Limit (mph)	Lanes
Dodge St	**Turner Blvd – 68th St**	35	2 EB / 2 WB / 1 Reversible[1]
Dodge St	**68th St – 69th St**	35	3 EB / 3 WB
Farnam St	**Turner Blvd – 36th St**	30	1 EB / 2 WB Angle parking both sides
Farnam St	**36th St – 40th St**	30	1 EB / 1 WB / 1 Center LT Lane Parallel parking both sides
Farnam St	**40th St – 42nd St**	30	1 EB / 2 WB Parallel parking south side
Farnam St	**42nd St – Saddle Creek Rd**	30	2 EB / 2 WB
Farnam St	**Saddle Creek Rd – Dodge St**	30	1 EB / 1 WB[2]
Harney St	**Turner Blvd – Dewey St**	30	2 EB Parallel parking both sides Cycle track south side
Harney St	**Dewey St – 41st St**	30	2 EB Parallel parking south side
Harney St	**41st St – Farnam St**	30	3 EB
Saddle Creek Rd	**Cuming St – Leavenworth St**	35	2 NB / 2 SB / 1 Center LT Lane
42nd St	**Dodge St – Leavenworth St**	30	1 NB / 1 SB / 1 Center LT Lane

[1] Reversible lane operates EB 6:00–9:00 AM on weekdays and WB the remainder of the time.

[2] Operates as 2 EB lanes 7:00–9:00 AM and 2 WB lanes 4:00–6:00 PM.

2 PROJECT ADMINISTRATION

2.1 PROJECT TEAM

The project was guided and completed through efforts from team members comprised from the City of Omaha, Nebraska Department of Transportation (NDOT) and HDR staff listed below.

- Bryan Guy (City of Omaha, Project Manager)
- Jeff Riesselman (City of Omaha, City Traffic Engineer)
- Garret Schram (City of Omaha)
- Nick Gordon (City of Omaha)
- Jenna Habegger (NDOT)
- Mike Forsberg (HDR, Project Manager)
- Kevin Brown (HDR)
- Tahsin Emtenan (HDR)
- Bryce Hallmark (HDR)
- Charlie Fankhauser (HDR)

2.2 PROJECT MEETINGS

Project meetings were held throughout the project to inform team members of activities, get input and make project decisions. Project meetings held are listed below. Meeting minutes can be found in **Appendix**.

- May 2nd, 2022 – Project Kickoff Meeting
- June 9th, 2022 – Progress Meeting #1
- June 22nd, 2022 – Progress Meeting #2
- July 11th, 2022 – Progress Meeting #3
- July 18th, 2022 – Pre-Implementation Meeting
- July 27th, 2022 – Progress Meeting #4
- August 24th, 2022 – Progress Meeting #5
- October 5th, 2022 – Progress Meeting #6

3 DATA COLLECTION

3.1 EXISTING TRAFFIC OPERATIONS MODELS

Exiting traffic operations models via Synchro were provided by City of Omaha for AM, MD (midday), PM and OP (off-peak) plans.

3.2 LANE CONFIGURATIONS

Lane configurations were collected and verified through use of aerial photography and field observations.

3.3 SIGNAL TIMING DATA

Signal timing data was obtained via remote access to the City of Omaha's MaxView and TrafficView traffic management systems.

3.4 DETECTION DATA

Signal as-builts showing detection and conversation with City of Omaha were used to identify signal detection.

3.5 24-HOUR WEEK COUNTS

24-hour week-long counts were collected at the locations listed in **Table 3-1**. Also shown in the table are the 2018 Metropolitan Area Planning Agency (MAPA) Average Annual Weekday Traffic (AAWT) volumes.

Table 3-1. 24-Hour Count Locations and Daily Traffic

Location	Dates of Counts	Average Weekday Traffic	Average Weekend Day Traffic	2018 MAPA AAWT
Dodge Street east of 48th Street	6/9/22-6/16/22	36,000	27,600	35,100
Farnam Street east of 38th Street	6/6/22-6/13-22	8,900	8,400	9,400
Harney Street east of 35th Street	6/6/22-6/13-22	3,400	2,500	4,400
Saddle Creek Road north of Farnam Street	6/24/22-7/1/22	27,300	21,500	21,900

Summary of the collected count data is shown in **Figure 3-1** through **Figure 3-4**. This data was used to support the updates to the day plans that define when specific timing patterns operate at each signal. Tables of the data used for these figures can be found in **Appendix**.

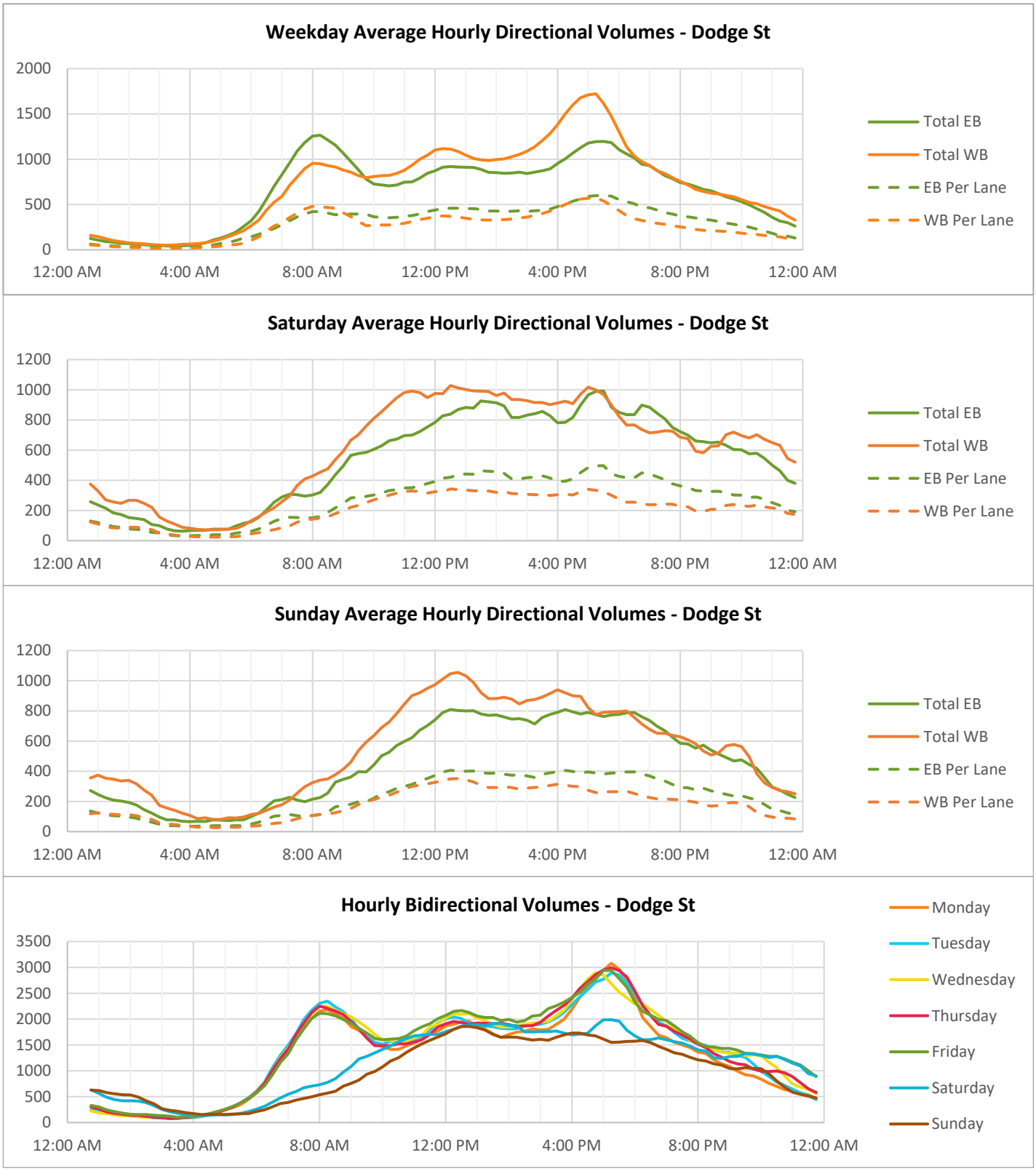


Figure 3-1. 24-Hour Counts on Dodge Street East of 48th Street

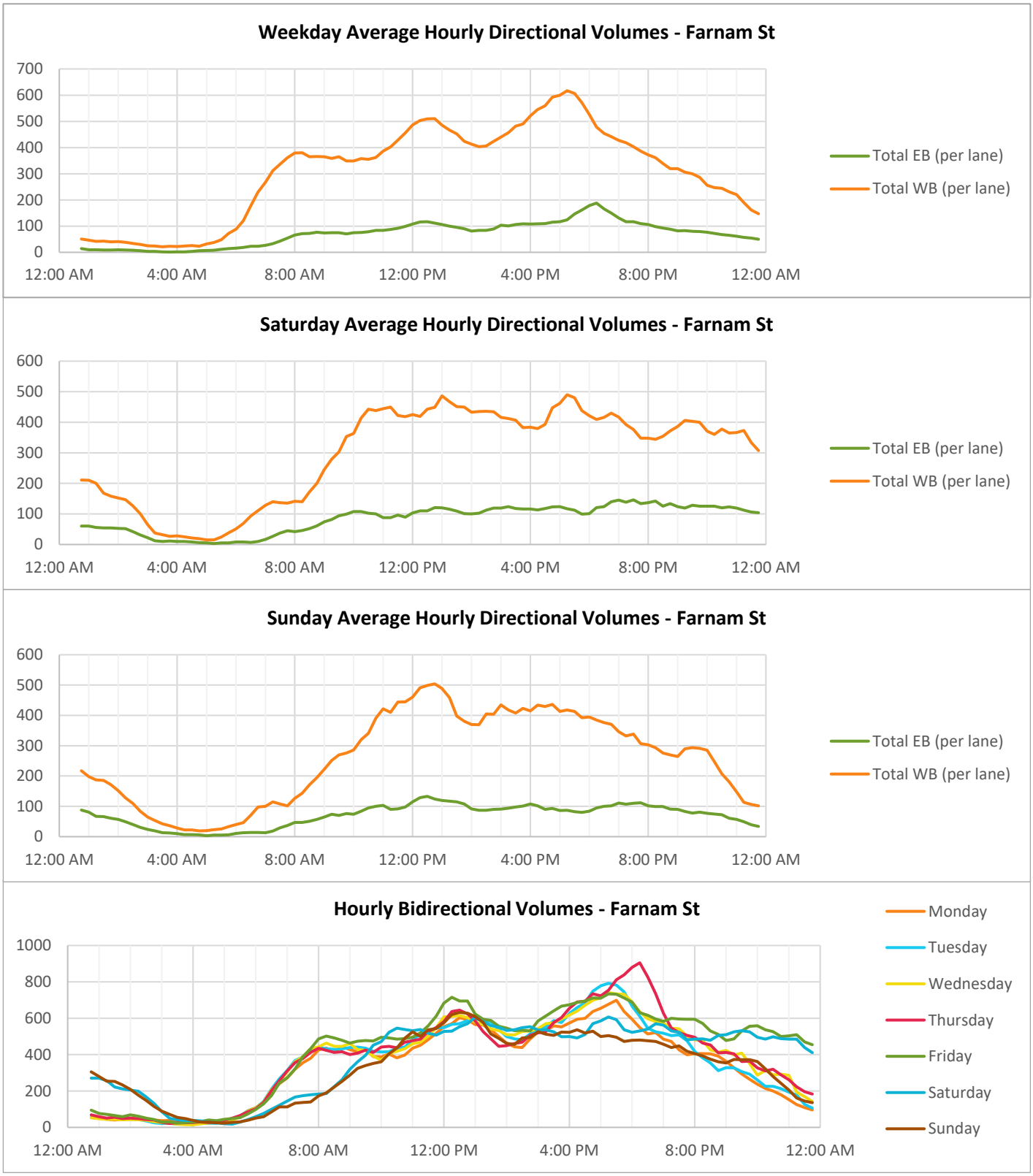


Figure 3-2. 24-Hour Counts on Farnam Street East of 38th Street

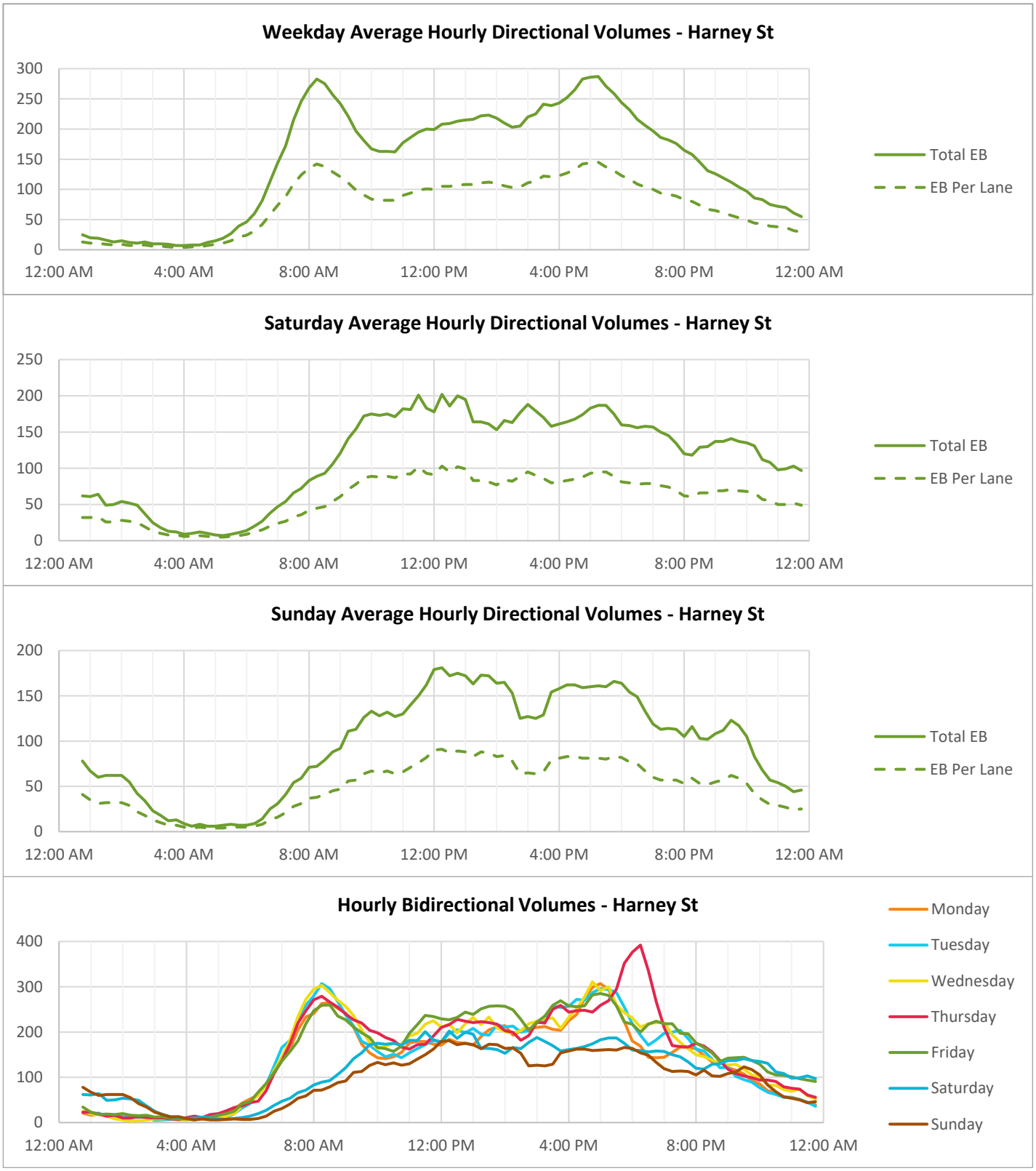


Figure 3-3. 24-Hour Counts on Harney Street East of 35th Street

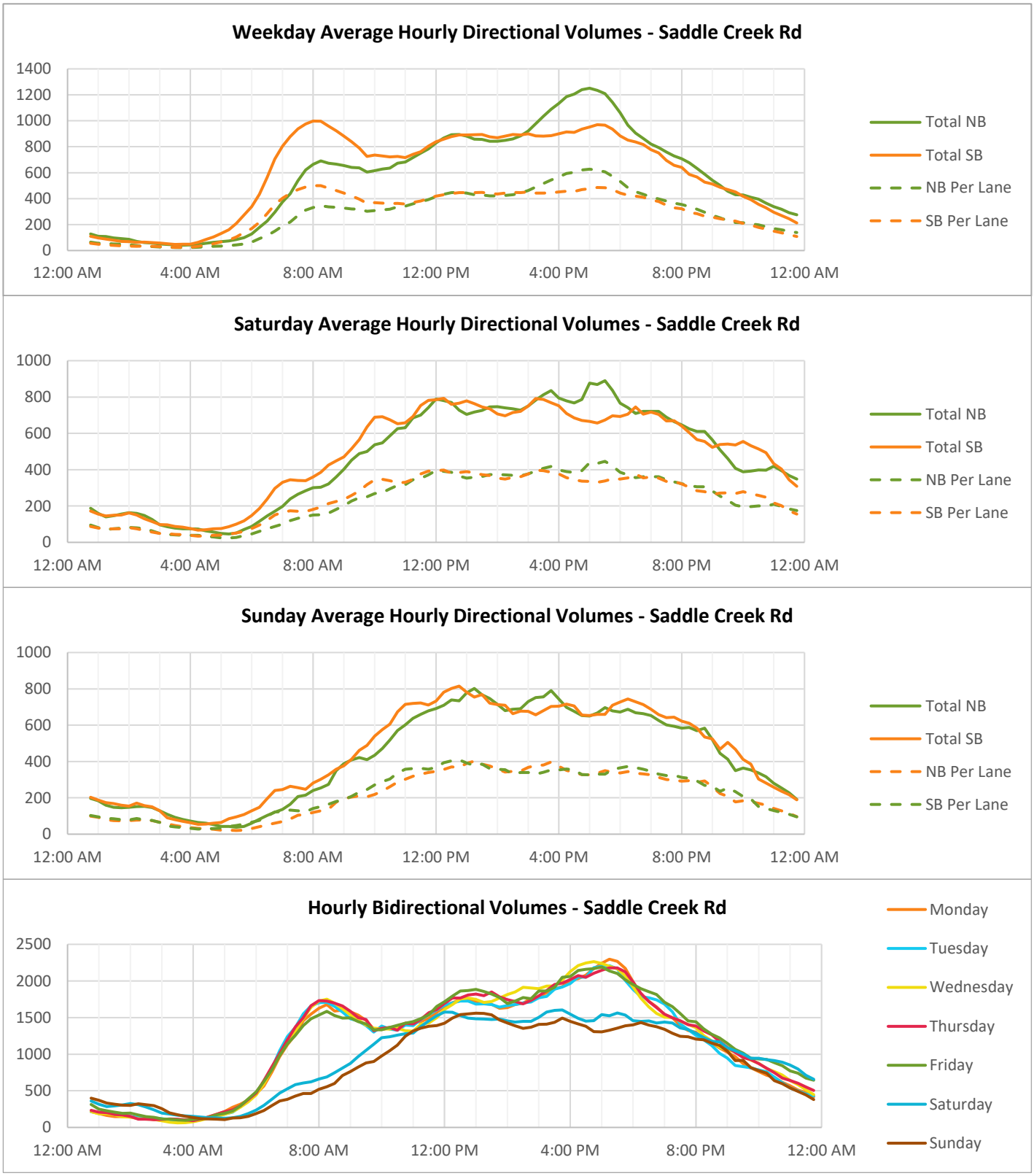


Figure 3-4. 24-Hour Counts on Saddle Creek Road north of Farnam Street

3.6 TURNING MOVEMENT COUNTS

Turning movement counts at study intersections were provided by City of Omaha. Counts were collected across 2019 – 2022. Counts were collected for the 8-hour period of 7 – 11 AM and 2 – 6 PM. Peak hours during signal time plan periods were determined to be:

- Plan 1 MD peak hour: 2:00–3:00 PM; the peak hour is generally over the lunch hour, however, turning movement counts were only available from 2:00–3:00 PM so the 24-hour counts were used to determine adjustment factors to increase the 2:00–3:00 PM volumes to the true peak
    - Dodge Street counts from 2:00–3:00 PM were factored up 6.2%
    - Farnam Street counts west of Saddle Creek Road from 2:00–3:00 PM were factored up 6.2%
    - Farnam Street counts east of 44th Street from 2:00–3:00 PM were factored up 22.0%
    - Harney Street counts from 2:00–3:00 PM were factored up 8.4%
    - 44th Street & Farnam Street count from 2:00–3:00 PM was factored up 15.2% (average of factors on 42nd Street at Farnam Street and Harney Street)
    - 42nd Street counts south of Harney Street from 2:00–3:00 PM were factored up 8.4%
    - Saddle Creek Road counts from 2:00–3:00 PM were factored up 0.6%
- Plan 2 AM peak hour: 7:30–8:30 AM
- Plan 3 PM peak hour: 4:30–5:30 PM
- Plan 4 OP peak hour: 9:00–10:00 AM

Adjustments to some counts were made to account for fluctuations in traffic demand over the past few years and better balance traffic volumes throughout the study area. Specifically, in 2019 counts were higher than current traffic demand and in 2020 counts were lower than current traffic demand. 2019 counts were reduced by 20% and 2020 counts were increased by 20%. Then, additions and subtractions to through volumes, generally plus or minus 100-200 vehicles per hour, were made a spot locations to better balance traffic volumes between intersections. Peak hour volumes at spot locations within the study area are shown in **Table 3-2**.

Table 3-2. Adjusted Peak Hour Segment Volumes During Timing Plan Peak Hours

Location	Direction	Plan 1 MD Peak Hour 2:00-3:00 PM	Plan 2 AM Peak Hour 7:30-8:30 AM	Plan 3 PM Peak Hour 4:30-5:30 PM	Plan 4 OP Peak Hour 9:00-10:00 AM
Dodge Street east of 60th Street	EB	1,118	1,464	1,244	862
	WB	1,189	1,069	1,801	842
Dodge Street east of 50th Street	EB	958	1,455	1,169	807
	WB	1,195	906	1,728	826
Dodge Street east of 40th Street	EB	865	1,006	1,054	626
	WB	927	775	1,233	747
Farnam Street east of 50th Street	EB	173	417		220
	WB	233		517	86
Farnam Street east of 40th Street	EB	84	75	115	69
	WB	550	390	631	367
Harney Street east of 40th Street	EB	254	263	299	175
Saddle Creek Road north of Davenport Street	NB	1,038	729	1,420	661
	SB	943	998	875	683
Saddle Creek Road south of Farnam Street	NB	678	496	935	507
	SB	726	918	787	611

3.7 TRAVEL TIME RUNS

Travel time runs were collected along Dodge Street from Turner Boulevard to 69th Street for the existing and implemented signal timings. Travel time runs were collected using a GPS device connected to a computer operating TruTraffic v10 software. A minimum of five runs per travel direction were collected during the following periods:

- AM Peak: 7:00 – 9:00 AM
- Offpeak: 9:00 – 11:00 AM
- MD Peak: 11:00 AM – 1:00 PM
- PM Peak: 3:30 – 6:00 PM
- Weekend MD: 11:00 AM – 1:00 PM

A summary of travel time run data from before and after update to signal timings is provided in the **Performance Measures** chapter of this report. Time-space diagram plots for the existing and implemented for each time period can be found in **Appendix**.

4 EXISTING INTERSECTION OPERATIONS

4.1 EXISTING DAY PLAN AND SPECIAL PLANS

For a detailed breakdown of the day plans, the existing are shown side-by-side with the implemented day plans in the **Implemented Day Plan** section of the Implemented Timing Development chapter.

Only one intersection had a pattern that was not called in the existing day plan.

- 46th St & Dodge St (344) – Pattern 26 (Owl Ride Event Plan, 90 second cycle)

4.2 TRAFFIC OBSERVATIONS

Traffic observations were conducted during the month of June 2022. Observations were made during travel time runs, field visits to the intersections, and virtually through use of the City's camera network. Below is a summary of the observations that were made:

- Happy Hollow Boulevard & Farnam Street Eastbound
  - Eastbound traffic queuing into right eastbound through lane on Dodge Street around 3:00 PM.
- 33rd Street & Farnam Street Eastbound
  - No eastbound left-turn lane. During the PM peak period, there are limited gaps in westbound traffic to allow turns. Waited through multiple cycles waiting for vehicles to turn left.
- 34th Street & Farnam Street Westbound
  - Lane utilization is about 80/20 in the two westbound lanes through this section, favoring the right/outside lane.
- 38th Street & Farnam Street Westbound
  - Observed long westbound queue extending through 36th Street intersection around noon.
- Farnam East of 42nd Street
  - Very little eastbound traffic during the AM period.
- Farnam between Dodge Street and Saddle Creek Road
  - Operates with two-lanes eastbound during the AM peak period and two-lanes westbound during the PM peak period. The remainder of the day it operates two-way with one lane in each direction.
  - It was observed that during the AM peak period, most of the vehicles would stay in the right lane and avoided crossing the yellow dashed centerline. The left lane was used primarily as a left-turn lane or a passing lane to get around slow vehicles. Vehicles would then get back in the right lane. Once the median starts west of Saddle Creek Road, vehicles would split into both eastbound lanes. Lane utilization is about 70/30 in the two eastbound lanes through this section, favoring the right lane.

- It operated very similar during the PM peak period. Vehicles traveling westbound at Saddle Creek Road follow the guidance of the "Lane Ends Merge Left" signage and would merge into the left lane. Then once vehicles got to the two-lane section most of the traffic would stay in the right lane and avoided crossing the yellow dashed centerline. The left lane was used almost as a left-turn lane or a passing lane to get around slow traffic. At the intersection with Happy Hollow Boulevard, if the left lane was unoccupied, traffic in the right lane would split into both of the westbound lanes while in the intersection. Lane utilization is about 70/30 in the two westbound lanes through this section, favoring the right lane.
- Both of these conditions create potential conflict points where vehicles merge and diverge on each end of the corridor.

- 42nd Street Between Emile Street and Dewey Avenue
  - High pedestrian volume during much of the day slowed traffic at unsignalized pedestrian crossing.
- Farnam Street Through Blackstone District
  - Recent modifications to roadway geometry have had the intended result of slowing vehicular traffic and enhancing pedestrian crossing. Higher pedestrian volume during the MD and PM periods stopped traffic at unsignalized crossing.

4.3 EXISTING MODEL VERIFICATION

Synchro files for the existing AM, MD, OP and PM timing plans were provided by the City of Omaha. The following checks were performed to review and update models to current conditions:

- The files were checked to make sure that the number of intersections matches in the networks. 49th Street & Dodge Street was added to the OP network. 33rd Street & Davenport Street and 55th Street & Leavenworth Street were removed from MD.
- Signal IDs in the Synchro networks were checked against GIS ID numbers provided by the City.
- The number of lanes on each intersection approach in the Synchro files were checked using Google Earth and field observations. Many updates were made.
- External links lengths were checked for minimum length of 500 feet. Some links were less than 500 feet and updated.
- The approaches at each intersection were checked for cardinal direction.
- Street names were checked to match City of Omaha naming conventions.
- Turn bay storage lengths at the intersections were measured using Google Earth and necessary adjustments were made to the existing storage lengths in the Synchro networks.
- Link speeds in the Synchro files were verified using street view images from Google Earth and field observations.
- Crosswalk widths were set to 16 feet and lane widths were set to 12 feet.
- A growth factor of 1 and a heavy vehicle percentage of 2% were used.

- Detectors in the networks were reviewed and updated at spot locations to match as-builts provided by the City. A detection zone length of 50 feet was used for lanes where the detection zone length was unknown.
- Traffic volumes from turning movement counts were imported into Synchro.
- Base signal timings, cycle lengths, splits and offsets at each study intersection were checked with MaxView and Wapiti and updated in Synchro to match.

5 IMPLEMENTED TIMING DEVELOPMENT

5.1 BASIC SIGNAL TIMING PARAMETERS

City staff had recently done a review and update of the Yellow, Red, Walk, and Flash Don't Walk clearance times so they were not reviewed as part of this project.

A review of the existing Minimum Green times and Minimum Splits was conducted for compliance with the City's current guidelines and nature of the intersection approaches. Table 5-1 shows the existing and implemented timings for the Min Green and Min Split.

Table 5-1. Updates to Min Green and Min Split Times

Intersection Name	Signal ID	Phase/ Direction	Min Green		Min Split	
			Existing	Implemented	Existing	Implemented
49th St & Dodge St	**355**	4/SB	10	8	15	13
		8/NB	10	8	15	13
42nd St & Dewey St	**319**	4/SB	15	20		
		8/NB	15	20		
42nd St & Emile St	**321**	4 / SB	15	20	20	25
		8 / NB	15	20	20	25
Saddle Creek Rd & Davenport St	**74**	2 / EB	10	8	15	13
		4 / SB	15	20	20	25
		6 / WB	10	8	15	13
		8 / NB	15	20	20	25
Saddle Creek Rd & California St	**73**	2 / EB	9	10	15	16
		6 / WB	9	10	15	16

5.2 VARIABLE LEFT-TURN MODE ANALYSIS

A review and analysis of left-turn movements with existing permitted plus protected (Pm+Pt) phasing was conducted to determine movements to be modified to permitted phasing during specific timing plans. Historical crashes from 2014 to 2020 were reviewed prior to final determination on left-turn phase recommendations and found the only location with left-turn crashes was the southbound, left movement at Saddle Creek Road & California Street with only one crash. This was not enough to warrant a protected left-turn phase. Left-turn phase recommendations by time of day and changes to existing left-turn phase operation are shown in Table 5-2. The left-turn warrant spreadsheets for each movement can be found in Appendix.

Table 5-2. Left-Turn Phase Recommendations

Location - Movement		Plan 1 – MD	Plan 2 – AM	Plan 3 – PM	Plan 4 – OP
Saddle Creek Rd & California St – NB Left	Existing	Pm+Pt	Pm+Pt	Pm+Pt	Pm+Pt
	Implemented	Perm	Pm+Pt	Pm+Pt	Perm
Saddle Creek Rd & California St – SB Left	Existing	Pm+Pt	Pm+Pt	Pm+Pt	Pm+Pt
	Implemented	Perm	Perm	Perm	Perm
Saddle Creek Rd & Farnam St – EB Left	Existing	Perm	Perm	Perm	Perm
	Implemented	Perm	Perm[1]	Perm	Perm
Saddle Creek Rd & Farnam St – NB Left	Existing	Perm	Perm	Pm+Pt	Pm+Pt
	Implemented	Perm	Perm	Pm+Pt	Perm
Saddle Creek Rd & Farnam St – SB Left	Existing	Pm+Pt	Pm+Pt	Pm+Pt	Pm+Pt
	Implemented	Pm+Pt	Pm+Pt	Pm+Pt	Perm
Saddle Creek Rd & Emile St – SB Left	Existing	Pm+Pt	Pm+Pt	Pm+Pt	Pm+Pt
	Implemented	Pm+Pt	Pm+Pt	Perm	Pm+Pt
42nd St & Emile St – NB Left	Existing	Pm+Pt	Pm+Pt	Pm+Pt	Pm+Pt
	Implemented	Pm+Pt	Pm+Pt	Perm	Pm+Pt

[1] Continue to operate Saddle Creek & Farnam EB left as protected during Plan 2 – AM when north leg ped phase is not activated.

5.3 LEADING PEDESTRIAN INTERVALS

A leading pedestrian interval (LPI) is a signal timing adjustment where the walk display is displayed a few seconds prior to the onset of green for the concurrent vehicular movement. The objective is to allow pedestrians to enter the intersection prior to the display of green, making them more visible to turning vehicles during green. LPI usually gives pedestrians 3-7 seconds of a head start entering the intersection, depending on the crossing distance. LPIs have been identified by the Federal Highway Administration (FHWA) as a Proven Safety Countermeasure and have several safety and operational benefits.

Table 5-3 shows the LPI locations and phases implemented with this project based on warrant criteria provided by the City and the corresponding durations in seconds. The LPI warrant spreadsheets for each intersection can be found in **Appendix**.

Table 5-3. Leading Pedestrian Interval Locations and Time

Intersection Name	Signal ID	Phase 2		Phase 4		Phase 6		Phase 8	
		LPI	Time (sec)	LPI	Time (sec)	LPI	Time (sec)	LPI	Time (sec)
33rd St & Dodge St	279			X	5			X	5
35th Ave & Dodge St	289			X	6			X	5
38th St & Dodge St	300			X	5			X	5
40th St & Dodge St	306			X	5			X	5
42nd St & Dodge St	320			X	5			X	5
44th St & Dodge St	339			X	5				
46th St & Dodge St	344			X	5			X	5
49th St & Dodge St	355			X	5			X	5
50th St & Dodge St	361			X	5			X	5
52nd St & Dodge St	378			X	3			X	3
60th St & Dodge St	401			X	6				
62nd St & Dodge St	421			X	5			X	5
66th St & Dodge St	428			X	5				
67th St & Dodge St	432							X	5
32nd St & Farnam St	1103	X	3	X	3			X	3
33rd St & Farnam St	280	X	3	X	3	X	3	X	3
34th St & Farnam St	1102			X	3	X	3	X	3
36th St & Farnam St	602	X	3	X	3			X	3
38th St & Farnam St	1177	X	3	X	3	X	3	X	3
40th St & Farnam St	307	X	3	X	3	X	3	X	3
42nd St & Farnam St	323	X	3	X	3	X	3	X	3
44th St & Farnam St	340			X	5			X	5
Saddle Creek Rd & Farnam St	76	X	5			X	5		
50th St & Farnam St	362	X	3	X	3	X	3	X	3
52nd St & Farnam St	379	X	3	X	3	X	3	X	3
33rd St & Harney St	283			X	3			X	3
42nd St & Harney St	326	X	3						
42nd St & Dewey St	319	X	3	X	3	X	3	X	3
42nd St & Emile St	321	X	3			X	3		
Saddle Creek Rd & Emile St	75					X	5	X	5

5.4 PASSAGE TIME ADJUSTMENTS

A review of phase passage time was conducted to determine locations where passage time is not consistent with typical values for detection type/equipment and intersection movement. The following locations were identified and adjusted:

- Saddle Creek Road & Emile Street southbound left-turn phase 7 (radar detection) – Updated passage time from 2.2 seconds to 0.7 seconds
- Farnam Street & 34th Street southbound approach phase 3 (radar detection) – Updated passage time from 3.0 seconds to 1.4 seconds

5.5 CYCLE LENGTH OPTIMIZATION

Multiple cycle lengths were considered at study intersections during each of the four timing plans. **Table 5-4** summarizes the combination of cycle length scenarios considered. Additional tables provide network performance metrics for the cycle length scenarios. Selected cycle lengths for implementation are shown in **Table 5-9**. Performance index is a function of total delay and the number of stops in the analysis area. Overall performance index from the scenario trials were the primary performance metric used to recommend cycle lengths for implementation; however, number of dilemma vehicles and green-band for progression were also used to support selection of cycle length on Dodge Street during the AM plan.

Table 5-4. Cycle Length Scenarios for Trial

Timing Plan – Scenario (Dodge Corridor Cycle Length)	Cycle Length by Corridor or Subarea			
	Dodge St	Farnam St at 50th and 52nd St	Farnam St / Harney St East of 42nd St[1]	Saddle Creek Rd
Plan 1 MD - Existing	90	60	60	90
Plan 1 MD – Scenario 1 (60)	60	60	60	90
Plan 1 MD – Scenario 2 (90)	90	45	60	90
Plan 1 MD – Scenario 3 (120)	120	60	60	90
Plan 2 AM - Existing	90	60	60	90
Plan 2 AM – Scenario 1 (60)	60	60	60	90
Plan 2 AM – Scenario 2 (90)	90	45	60	90
Plan 2 AM – Scenario 3 (120)	120	60	60	90
Plan 3 PM - Existing	90	60	60	90
Plan 3 PM – Scenario 1 (60)	60	60	60	90
Plan 3 PM – Scenario 2 (75)	75	75	75	90
Plan 3 PM – Scenario 3 (90)	90	45	60	90
Plan 3 PM – Scenario 4 (120)	120	60	60	90
Plan 4 OP – Scenario 1 (60)[2]	60	60	60	60
Plan 4 OP – Scenario 2 (90)	90	45	60	90

[1] Includes 42nd St & Dewey St and 42nd St & Emile St. Includes 44th St & Farnam St during Plans 1, 3 and 4 (44th St & Farnam St will use Saddle Creek cycle during Plan 2).

[2] OP plan was new for implementation and did not have an existing set of cycle lengths.

Table 5-5. Plan 1 MD Cycle Length Trial Network Performance

Heading	Existing (90 sec Dodge)	Scenario 1 (60 sec Dodge)	Scenario 2 (90 sec Dodge)	Scenario 3 (120 sec Dodge)
Control Delay / Veh (s/v)	12	11	11	12
Total Delay (hr)	323	290	304	325
Stops / Veh	0.38	0.37	0.36	0.36
Stops (#)	36,662	35,505	34,062	34,406
Average Speed (mph)	20	21	21	20
Total Travel Time (hr)	830	797	811	832
Fuel Consumed (gal)	1,131	1,100	1,099	1,117
Unserved Vehicles (#)	65	65	65	65
Vehicles in dilemma zone (#)	2,483	2,477	2,210	1,813
Performance Index	424.4	388.2	399	420.3

Scenario 1 was selected for the MD period since it showed the least amount of overall delay. It also reduced the number of stops compared to the existing. Scenarios 2 and 3 would provide a wider green band for Dodge Street, but the overall delay was higher than Scenario 2 due to side street delay.

Table 5-6. Plan 2 AM Cycle Length Trial Network Performance

Heading	Existing (90 sec Dodge)	Scenario 1 (60 sec Dodge)	Scenario 2 (90 sec Dodge)	Scenario 3 (120 sec Dodge)
Control Delay / Veh (s/v)	12	11	12	12
Total Delay (hr)	346	311	330	342
Stops / Veh	0.37	0.37	0.37	0.36
Stops (#)	37,779	37,641	37,233	36,363
Average Speed (mph)	20	21	21	20
Total Travel Time (hr)	888	853	873	885
Fuel Consumed (gal)	1,196	1,172	1,181	1,184
Unserved Vehicles (#)	27	27	27	27
Vehicles in dilemma zone (#)	2,397	2,370	2,013	1,758
Performance Index	450.5	415.1	433.2	443.1

While Scenario 2 did not have the lowest overall delay, it was still selected due to the AM period being more commuter based with heavy eastbound traffic. This allowed for a wider green band than the 60 second cycle for Dodge Street while still reducing the delay compared to the existing. The wider green band also provides some resiliency for future traffic demand as employees continue to transition from working from home.

Table 5-7. Plan 3 PM Cycle Length Trial Network Performance

Heading	Existing (90 sec Dodge)	Scenario 1 (60 sec Dodge)	Scenario 2 (75 sec Dodge)	Scenario 3 (90 sec Dodge)	Scenario 4 (120 sec Dodge)
Control Delay / Veh (s/v)	17	17	16	15	17
Total Delay (hr)	595	595	557	556	597
Stops / Veh	0.47	0.47	0.44	0.43	0.43
Stops (#)	60,339	60,339	56,975	55,336	55,495
Average Speed (mph)	18	18	18	18	18
Total Travel Time (hr)	1,269	1,269	1,231	1,231	1,271
Fuel Consumed (gal)	1,702	1,702	1,651	1,639	1,670
Unserved Vehicles (#)	206	206	206	206	206
Vehicles in dilemma zone (#)	2,907	2,907	3,303	2,783	2,779
Performance Index	762.9	762.9	715.5	710.2	751.2

For the PM period, Scenario 3 was selected since it had the least amount of delay and provided a wide enough green band for the heavier westbound commute from downtown. It also had the least number of stops compared to the other scenarios and the existing.

Table 5-8. Plan 4 OP Cycle Length Trial Network Performance

Heading	Existing (90 sec Dodge)	Scenario 1 (60 sec Dodge)	Scenario 2 (90 sec Dodge)
Control Delay / Veh (s/v)	9	8	9
Total Delay (hr)	184	160	174
Stops / Veh	0.36	0.34	0.33
Stops (#)	25,579	24,613	23,446
Average Speed (mph)	22	23	23
Total Travel Time (hr)	564	540	554
Fuel Consumed (gal)	793	769	770
Unserved Vehicles (#)	0	0	0
Vehicles in dilemma zone (#)	1,883	2,071	1,763
Performance Index	255.2	227.9	239.1

For the OP period, Scenario 1 was selected since a shorter cycle length would provide more responsive signals for side street traffic when Dodge Street traffic is lower. This resulted in a lower overall delay than Scenario 2.

Table 5-9. Selected Cycle Lengths for Implementation

Timing Plan – Scenario (Dodge Corridor Cycle Length)	Cycle Length by Corridor or Subarea			
	Dodge St	Farnam St at 50th and 52nd St	Farnam St / Harney St East of 42nd St[1]	Saddle Creek Rd
Plan 1 MD - Existing	90	60	60	90
Plan 1 MD – Scenario 1 (60)	60	60	60	90
Plan 2 AM - Existing	90	60	60	90
Plan 2 AM – Scenario 2 (90)	90	60[2]	60	90
Plan 3 PM - Existing	90	60	60	90
Plan 3 PM – Scenario 3 (90)	90	60[2]	60	90
Plan 4 OP – Scenario 1 (60)[3]	60	60	60	60

[1] Includes 42nd St & Dewey St and 42nd St & Emile St. Includes 44th St & Farnam St during Plans 1, 3 and 4 (44th St & Farnam St will use Saddle Creek cycle during Plan 2).

[2] Modified from initial trials of 45 seconds based on added LPI and ped recall which require longer cycle.

[3] OP plan was new for implementation and did not have an existing set of cycle lengths.

5.6 IMPLEMENTED DAY PLAN

Implemented day plans for optimized timings are shown alongside the existing in **Figure 5-1** through **Figure 5-6.** Existing and Implemented Sunday Day Plan for Harney, 42nd, & Saddle Creek. The start and end times for each period align with the rising and falling traffic volumes throughout the day as seen in the **24-Hour Week Counts**.

One of the biggest changes to the day plan for the Dodge Street corridor is changing operations from coordinated along Dodge Street to free. This makes the signals more responsive for side street traffic during low traffic times which will now be served a green sooner than they typically would in coordination.

The one intersection with a pattern that was not called in the existing day plan will remain in place per City request for potential future use.

- 46th St & Dodge St (344) – Pattern 26 (Owl Ride Event Plan, 90 second cycle)

Dodge St

EXISTING SCHEDULES: MONDAY - THURSDAY

12 am	1 am	2 am	3 am	4 am	5 am	6 am	7 am	8 am	9 am	10 am	11 am	12 pm	1 pm	2 pm	3 pm	4 pm	5 pm	6 pm	7 pm	8 pm	9 pm	10 pm	11 pm	12 am	Signal ID	Signal Location
1 [60]							e	2 [60]		1 [60]		1 [60]				3 [60]			1 [60]			1 [60]			79	Turner Blvd & Dodge St
1 [90]							b	2 [90]		1 [90]		1 [90]				3 [90]			1 [90]			1 [90]			279	33rd St & Dodge St
1 [90]							b	2 [90]		1 [90]		1 [90]				3 [90]			1 [90]			1 [90]			289	35th Ave & Dodge St
1 [90]							b	2 [90]		1 [90]		1 [90]				3 [90]			1 [90]			1 [90]			300	38th St & Dodge St
1 [90]							b	2 [90]		1 [90]		1 [90]				3 [90]			1 [90]			1 [90]			306	40th St & Dodge St
1 [90]							b	2 [90]		1 [90]		1 [90]				3 [90]			1 [90]			1 [90]			320	42nd St & Dodge St
1 [90]							b	2 [90]		1 [90]		1 [90]				3 [90]			1 [90]			1 [90]			339	44th St & Dodge St
1 [90]							b	2 [90]		1 [90]		1 [90]				3 [90]			1 [90]			1 [90]			344	46th St & Dodge St
1 [90]							b	2 [90]		1 [90]		1 [90]				3 [90]			1 [90]			1 [90]			355	49th St & Dodge St
1 [90]							b	2 [90]		1 [90]		1 [90]				3 [90]			1 [90]			1 [90]			361	50th St & Dodge St
1 [90]							b	2 [90]		1 [90]		1 [90]				3 [90]			1 [90]			1 [90]			378	52nd St & Dodge St
1 [90]							b	2 [90]		1 [90]		1 [90]				3 [90]			1 [90]			1 [90]			27	Happy Hollow Blvd & Dodge St
1 [90]							b	2 [90]		1 [90]		1 [90]				3 [90]			1 [90]			1 [90]			1220	Farnam St & Dodge St
1 [90]							b	2 [90]		1 [90]		1 [90]				3 [90]			1 [90]			1 [90]			401	60th St & Dodge St
1 [90]							b	2 [90]		1 [90]		1 [90]				3 [90]			1 [90]			1 [90]			421	62nd St & Dodge St
1 [90]							b	2 [90]		1 [90]		1 [90]				3 [90]			1 [90]			1 [90]			428	66th St & Dodge St
1 [90]							b	2 [90]		1 [90]		1 [90]				3 [90]			1 [90]			1 [90]			432	67th St & Dodge St
11 [90]							Adaptive [varies]									3 [150]			Adaptive [varies]			11 [90]			437	69th St & Dodge St

b: 2 [90] e: 2 [60]

IMPLEMENTED SCHEDULES: MONDAY - THURSDAY

12 am	1 am	2 am	3 am	4 am	5 am	6 am	7 am	8 am	9 am	10 am	11 am	12 pm	1 pm	2 pm	3 pm	4 pm	5 pm	6 pm	7 pm	8 pm	9 pm	10 pm	11 pm	12 am	Signal ID	Signal Location
1 [60]							2 [60]		2 [60]		1 [60]			1 [60]			3 [60]			1 [60]			1 [60]		79	Turner Blvd & Dodge St
20 [FREE]							4 [60]		2 [90]		4 [60]			1 [60]			3 [90]			4 [60]			20 [FREE]		279	33rd St & Dodge St
20 [FREE]							4 [60]		2 [90]		4 [60]			1 [60]			3 [90]			4 [60]			20 [FREE]		289	35th Ave & Dodge St
20 [FREE]							4 [60]		2 [90]		4 [60]			1 [60]			3 [90]			4 [60]			20 [FREE]		300	38th St & Dodge St
20 [FREE]							4 [60]		2 [90]		4 [60]			1 [60]			3 [90]			4 [60]			20 [FREE]		306	40th St & Dodge St
20 [FREE]							4 [60]		2 [90]		4 [60]			1 [60]			3 [90]			4 [60]			20 [FREE]		320	42nd St & Dodge St
20 [FREE]							4 [60]		2 [90]		4 [60]			1 [60]			3 [90]			4 [60]			20 [FREE]		339	44th St & Dodge St
20 [FREE]							4 [60]		2 [90]		4 [60]			1 [60]			3 [90]			4 [60]			20 [FREE]		344	46th St & Dodge St
20 [FREE]							4 [60]		2 [90]		4 [60]			1 [60]			3 [90]			4 [60]			20 [FREE]		355	49th St & Dodge St
20 [FREE]							4 [60]		2 [90]		4 [60]			1 [60]			3 [90]			4 [60]			20 [FREE]		361	50th St & Dodge St
20 [FREE]							4 [60]		2 [90]		4 [60]			1 [60]			3 [90]			4 [60]			20 [FREE]		378	52nd St & Dodge St
4 [60]							4 [60]		2 [90]		4 [60]			1 [60]			3 [90]			4 [60]			4 [60]		27	Happy Hollow Blvd & Dodge St
4 [60]							4 [60]		2 [90]		4 [60]			1 [60]			3 [90]			4 [60]			4 [60]		1220	Farnam St & Dodge St
20 [FREE]							4 [60]		2 [90]		4 [60]			1 [60]			3 [90]			4 [60]			20 [FREE]		401	60th St & Dodge St
20 [FREE]							4 [60]		2 [90]		4 [60]			1 [60]			3 [90]			4 [60]			20 [FREE]		421	62nd St & Dodge St
20 [FREE]							4 [60]		2 [90]		4 [60]			1 [60]			3 [90]			4 [60]			20 [FREE]		428	66th St & Dodge St
20 [FREE]							4 [60]		2 [90]		4 [60]			1 [60]			3 [90]			4 [60]			20 [FREE]		432	67th St & Dodge St
11 [90]							Adaptive [varies]									3 [150]			Adaptive [varies]			11 [90]		437	69th St & Dodge St

e: 2 [60] h: 4 [60]

Farnam St

EXISTING SCHEDULES: MONDAY - THURSDAY

12 am	1 am	2 am	3 am	4 am	5 am	6 am	7 am	8 am	9 am	10 am	11 am	12 pm	1 pm	2 pm	3 pm	4 pm	5 pm	6 pm	7 pm	8 pm	9 pm	10 pm	11 pm	12 am	Signal ID	Signal Location
1 [60]							2 [60]			1 [60]						3 [60]			1 [60]						81	Turner Blvd & Farnam St
1 [60]							e	2 [60]		1 [60]		1 [60]				3 [60]			1 [60]			1 [60]			1103	32nd St & Farnam St
1 [60]							e	2 [60]		1 [60]		1 [60]				3 [60]			1 [60]			1 [60]			280	33rd St & Farnam St
1 [120]							k	2 [120]		1 [120]		1 [120]				3 [120]			1 [120]			1 [120]			1102	34th St & Farnam St
1 [60]							e	2 [60]		1 [60]		1 [60]				3 [60]			1 [60]			1 [60]			602	36th St & Farnam St
1 [60]							e	2 [60]		1 [60]		1 [60]				3 [60]			1 [60]			1 [60]			1177	38th St & Farnam St
1 [60]							e	2 [60]		1 [60]		1 [60]				3 [60]			1 [60]			1 [60]			307	40th St & Farnam St
1 [60]							e	2 [60]		1 [60]		1 [60]				3 [60]			1 [60]			1 [60]			323	42nd St & Farnam St
20 [FREE]							e	2 [60]		1 [60]		1 [60]				3 [60]			1 [60]			20 [FREE]			340	44th St & Farnam St
20 [FREE]							a	2 [90]		1 [90]		1 [90]				3 [90]			1 [90]			20 [FREE]			76	Saddle Creek Rd & Farnam St
20 [FREE]							g	e	2 [60]	e	20 [FREE]		1 [60]			f	3 [60]	f		20 [FREE]			20 [FREE]			362	50th St & Farnam St
20 [FREE]							g	e	2 [60]	e	20 [FREE]		1 [60]			f	3 [60]	f		20 [FREE]			20 [FREE]			379	52nd St & Farnam St
1 [90]							b	2 [90]	c	1 [90]		1 [90]			c	3 [90]		c	1 [90]			1 [90]			28	Happy Hollow Blvd & Farnam St
1 [90]							b	2 [90]		1 [90]		1 [90]				3 [90]			1 [90]			1 [90]			1220	Farnam St & Dodge St

a: 1 [90] b: 2 [90] c: 3 [90] e: 2 [60] f: 3 [60] g: 20 [FREE] k: 2 [120]

IMPLEMENTED SCHEDULES: MONDAY - THURSDAY

12 am	1 am	2 am	3 am	4 am	5 am	6 am	7 am	8 am	9 am	10 am	11 am	12 pm	1 pm	2 pm	3 pm	4 pm	5 pm	6 pm	7 pm	8 pm	9 pm	10 pm	11 pm	12 am	Signal ID	Signal Location
1 [60]							2 [60]			1 [60]						3 [60]			1 [60]						81	Turner Blvd & Farnam St
4 [60]							h	2 [60]		4 [60]		1 [60]				3 [60]			4 [60]			4 [60]			1103	32nd St & Farnam St
4 [60]							h	2 [60]		4 [60]		1 [60]				3 [60]			4 [60]			4 [60]			280	33rd St & Farnam St
4 [60]							h	2 [60]		4 [60]		1 [60]				3 [60]			4 [60]			4 [60]			1102	34th St & Farnam St
4 [60]							h	2 [60]		4 [60]		1 [60]				3 [60]			4 [60]			4 [60]			602	36th St & Farnam St
4 [60]							h	2 [60]		4 [60]		1 [60]				3 [60]			4 [60]			4 [60]			1177	38th St & Farnam St
4 [60]							h	2 [60]		4 [60]		1 [60]				3 [60]			4 [60]			4 [60]			307	40th St & Farnam St
4 [60]							h	2 [60]		4 [60]		1 [60]				3 [60]			4 [60]			4 [60]			323	42nd St & Farnam St
4 [60]							h	2 [90]		4 [60]		1 [60]				3 [60]			4 [60]			4 [60]			340	44th St & Farnam St
20 [FREE]							h	2 [90]		4 [60]		1 [90]				3 [90]			4 [60]			20 [FREE]			76	Saddle Creek Rd & Farnam St
20 [FREE]							h	e	2 [60]	e	4 [60]		1 [60]			f	3 [60]	f		4 [60]			20 [FREE]			362	50th St & Farnam St
20 [FREE]							h	e	2 [60]	e	4 [60]		1 [60]			f	3 [60]	f		4 [60]			20 [FREE]			379	52nd St & Farnam St
4 [60]							h	2 [90]	c	4 [60]		1 [90]			c	3 [90]		c	4 [60]			4 [60]			28	Happy Hollow Blvd & Farnam St
4 [60]							h	2 [90]		4 [60]		1 [90]				3 [90]			4 [60]			4 [60]			1220	Farnam St & Dodge St

b: 2 [90] c: 3 [90] e: 2 [60] f: 3 [60] g: 20 [FREE] h: 4 [60]

Figure 5-1. Existing and Implemented Weekday (Mon-Thurs) Day Plan for Dodge & Farnam

Harney St

EXISTING SCHEDULES: MONDAY - THURSDAY

Signal ID	Signal Location	12 am – 6 am	7 am – 9 am	10 am – 3 pm	4 pm – 6 pm	7 pm – 12 am
82	Turner Blvd & Harney St	1 [60]	2 [60]	1 [60]	3 [60]	1 [60]
283	33rd St & Harney St	1 [60]	2 [60]	1 [60]	3 [60]	1 [60]
291	36th St & Harney St	1 [60]	e 2 [60]	1 [60]	1 [60]	3 [60]	1 [60]	1 [60]
309	40th St & Harney St	1 [60]	e 2 [60]	1 [60]	1 [60]	3 [60]	1 [60]	1 [60]
326	42nd St & Harney St	1 [60]	e 2 [60]	1 [60]	1 [60]	3 [60]	1 [60]	1 [60]

e: 2 [60]

IMPLEMENTED SCHEDULES: MONDAY - THURSDAY

Signal Location	12 am – 6 am	7 am – 9 am	10 am – 11 am	12 pm – 3 pm	4 pm – 6 pm	7 pm – 12 am
Turner Blvd & Harney St	1 [60]	2 [60]	1 [60]		3 [60]	1 [60]
33rd St & Harney St	4 [60]	h 2 [60]	4 [60]	1 [60]	3 [60]	4 [60]	4 [60]
36th St & Harney St	4 [60]	h 2 [60]	4 [60]	1 [60]	3 [60]	4 [60]	4 [60]
40th St & Harney St	4 [60]	h 2 [60]	4 [60]	1 [60]	3 [60]	4 [60]	4 [60]
42nd St & Harney St	4 [60]	h 2 [60]	4 [60]	1 [60]	3 [60]	4 [60]	4 [60]

h: 4 [60]

42nd St

EXISTING SCHEDULES: MONDAY - THURSDAY

Signal ID	Signal Location	12 am – 5 am	6 am – 9 am	10 am – 11 am	12 pm – 3 pm	4 pm – 6 pm	7 pm – 12 am
330	42nd St & Leavenworth St	4 [60]	h 2 [90]	4 [60]	1 [90]	3 [90]	4 [60]
321	42nd St & Emile St	1 [60]	2 [60]	1 [60]		3 [60]	1 [60]
319	42nd St & Dewey St	20 [FREE]	d 2 [60]	1 [60]		3 [60]	1 [60]	20 [FREE]
326	42nd St & Harney St	1 [60]	e 2 [60]	1 [60]	1 [60]	3 [60]	1 [60]	1 [60]
323	42nd St & Farnam St	1 [60]	e 2 [60]	1 [60]	1 [60]	3 [60]	1 [60]	1 [60]
320	42nd St & Dodge St	1 [90]	e 2 [90]	1 [90]	1 [90]	3 [90]	1 [90]	1 [90]

d: 1 [60] e: 2 [60] h: 4 [60]

IMPLEMENTED SCHEDULES: MONDAY - THURSDAY

Signal Location	12 am – 6 am	7 am – 9 am	10 am – 11 am	12 pm – 3 pm	4 pm – 6 pm	7 pm – 12 am
42nd St & Leavenworth St	4 [60]	h 2 [90]	4 [60]	1 [90]	3 [90]	4 [60]
42nd St & Emile St	4 [60]	h 2 [60]	4 [60]	1 [60]	3 [60]	4 [60]	4 [60]
42nd St & Dewey St	4 [60]	h 2 [60]	4 [60]	1 [60]	3 [60]	4 [60]	4 [60]
42nd St & Harney St	4 [60]	h 2 [60]	4 [60]	1 [60]	3 [60]	4 [60]	4 [60]
42nd St & Farnam St	4 [60]	h 2 [60]	4 [60]	1 [60]	3 [60]	4 [60]	4 [60]
42nd St & Dodge St	4 [60]	h 2 [90]	1 [90]	1 [90]	3 [90]	4 [60]	4 [60]

h: 4 [60]

Saddle Creek Rd

EXISTING SCHEDULES: MONDAY - THURSDAY

Signal ID	Signal Location	12 am – 5 am	6 am – 9 am	10 am – 11 am	12 pm – 3 pm	4 pm – 6 pm	7 pm – 12 am
77	Saddle Creek Rd & Leavenworth St	4 [60]	2 [90]	4 [60]	1 [90]	3 [90]	4 [60]
75	Saddle Creek Rd & Emile St	20 [FREE]	b 2 [90]	1 [90]	1 [90]	3 [90]	1 [90]	20 [FREE]
76	Saddle Creek Rd & Farnam St	20 [FREE]	a 2 [90]	1 [90]	1 [90]	3 [90]	1 [90]	20 [FREE]
74	Saddle Creek Rd & Davenport St	33 [FLASH]	a 2 [90]	1 [90]	1 [90]	1 [90]	3 [90]	1 [90]	33 [FLASH]
73	Saddle Creek Rd & California St	20 [FREE]	a 2 [90]	1 [90]	1 [90]	1 [90]	3 [90]	1 [90]	20 [FREE]
53	Saddle Creek Rd & Cuming St	20 [FREE]	a 2 [90]	1 [90]		3 [90]	1 [90]	20 [FREE]

a: 1 [90] b: 2 [90]

IMPLEMENTED SCHEDULES: MONDAY - THURSDAY

Signal Location	12 am – 6 am	7 am – 9 am	10 am – 11 am	12 pm – 3 pm	4 pm – 6 pm	7 pm – 12 am
Saddle Creek Rd & Leavenworth St	4 [60]	h 2 [90]	4 [60]	1 [90]	3 [90]	4 [60]
Saddle Creek Rd & Emile St	20 [FREE]	h 2 [90]	4 [60]	1 [90]	3 [90]	4 [60]	20 [FREE]
Saddle Creek Rd & Farnam St	20 [FREE]	h 2 [90]	4 [60]	1 [90]	3 [90]	4 [60]	20 [FREE]
Saddle Creek Rd & Davenport St	33 [FLASH]	h 2 [90]	4 [60]	1 [90]	3 [90]	4 [60]	33 [FLASH]
Saddle Creek Rd & California St	20 [FREE]	h 2 [90]	4 [60]	1 [90]	3 [90]	4 [60]	20 [FREE]
Saddle Creek Rd & Cuming St	20 [FREE]	a 2 [90]	1 [90]		3 [90]	1 [90]	20 [FREE]

a: 1 [90] h: 4 [60]

Figure 5-2. Existing and Implemented Weekday (Mon-Thurs) Day Plan for Harney, 42nd, & Saddle Creek

Dodge St

EXISTING SCHEDULES: SATURDAY / **IMPLEMENTED SCHEDULES: SATURDAY**

Timeline (each schedule): 12 am, 1 am, 2 am, 3 am, 4 am, 5 am, 6 am, 7 am, 8 am, 9 am, 10 am, 11 am, 12 pm, 1 pm, 2 pm, 3 pm, 4 pm, 5 pm, 6 pm, 7 pm, 8 pm, 9 pm, 10 pm, 11 pm, 12 am

Existing					Signal ID	Signal Location	Implemented				
1 [60]	d	1 [60]	1 [60]	1 [60]	79	Turner Blvd & Dodge St	1 [60]	d	1 [60]	1 [60]	1 [60]
1 [90]	a	1 [90]	1 [90]	1 [90]	279	33rd St & Dodge St	20 [FREE]	g	4 [60]	1 [60]	4 [60]
1 [90]	a	1 [90]	1 [90]	1 [90]	289	35th Ave & Dodge St	20 [FREE]	g	4 [60]	1 [60]	4 [60]
1 [90]	a	1 [90]	1 [90]	1 [90]	300	38th St & Dodge St	20 [FREE]	g	4 [60]	1 [60]	4 [60]
1 [90]	a	1 [90]	1 [90]	1 [90]	306	40th St & Dodge St	20 [FREE]	g	4 [60]	1 [60]	4 [60]
1 [90]	a	1 [90]	1 [90]	1 [90]	320	42nd St & Dodge St	20 [FREE]	g	4 [60]	1 [60]	4 [60]
1 [90]	a	1 [90]	1 [90]	1 [90]	339	44th St & Dodge St	20 [FREE]	g	4 [60]	1 [60]	4 [60]
1 [90]	a	1 [90]	1 [90]	1 [90]	344	46th St & Dodge St	20 [FREE]	g	4 [60]	1 [60]	4 [60]
1 [90]	a	1 [90]	1 [90]	1 [90]	355	49th St & Dodge St	20 [FREE]	g	4 [60]	1 [60]	4 [60]
1 [90]	a	1 [90]	1 [90]	1 [90]	361	50th St & Dodge St	20 [FREE]	g	4 [60]	1 [60]	4 [60]
1 [90]	a	1 [90]	1 [90]	1 [90]	378	52nd St & Dodge St	20 [FREE]	g	4 [60]	1 [60]	4 [60]
1 [90]	a	1 [90]	1 [90]	1 [90]	27	Happy Hollow Blvd & Dodge St	4 [60]	h	4 [60]	1 [60]	4 [60]
1 [90]	a	1 [90]	1 [90]	1 [90]	1220	Farnam St & Dodge St	4 [60]	h	4 [60]	1 [60]	4 [60]
1 [90]	a	1 [90]	1 [90]	1 [90]	401	60th St & Dodge St	20 [FREE]	g	4 [60]	1 [60]	4 [60]
1 [90]	a	1 [90]	1 [90]	1 [90]	421	62nd St & Dodge St	20 [FREE]	g	4 [60]	1 [60]	4 [60]
1 [90]	a	1 [90]	1 [90]	1 [90]	428	66th St & Dodge St	20 [FREE]	g	4 [60]	1 [60]	4 [60]
1 [90]	a	1 [90]	1 [90]	1 [90]	432	67th St & Dodge St	20 [FREE]	g	4 [60]	1 [60]	4 [60]
11 [90]	i	Adaptive [varies]			437	69th St & Dodge St	11 [90]	i	Adaptive [varies]		

Existing: a: 1 [90] d: 1 [60] i: 11 [90]

Implemented: d: 1 [60] g: 20 [FREE] h: 4 [60] i: 11 [90]

Farnam St

EXISTING SCHEDULES: SATURDAY / **IMPLEMENTED SCHEDULES: SATURDAY**

Timeline (each schedule): 12 am, 1 am, 2 am, 3 am, 4 am, 5 am, 6 am, 7 am, 8 am, 9 am, 10 am, 11 am, 12 pm, 1 pm, 2 pm, 3 pm, 4 pm, 5 pm, 6 pm, 7 pm, 8 pm, 9 pm, 10 pm, 11 pm, 12 am

Existing					Signal ID	Signal Location	Implemented				
1 [60]	1 [60]				81	Turner Blvd & Farnam St	1 [60]	1 [60]			
1 [60]	d	2 [60]	1 [60]	1 [60]	1103	32nd St & Farnam St	4 [60]	h	4 [60]	1 [60]	4 [60]
1 [60]	d	2 [60]	1 [60]	1 [60]	280	33rd St & Farnam St	4 [60]	h	4 [60]	1 [60]	4 [60]
1 [120]	j	1 [120]	1 [120]	1 [120]	1102	34th St & Farnam St	4 [60]	h	4 [60]	1 [60]	4 [60]
1 [60]	d	2 [60]	1 [60]	1 [60]	602	36th St & Farnam St	4 [60]	h	4 [60]	1 [60]	4 [60]
1 [60]	d	2 [60]	1 [60]	1 [60]	1177	38th St & Farnam St	4 [60]	h	4 [60]	1 [60]	4 [60]
1 [60]	d	2 [60]	1 [60]	1 [60]	307	40th St & Farnam St	4 [60]	h	4 [60]	1 [60]	4 [60]
1 [60]	d	2 [60]	1 [60]	1 [60]	323	42nd St & Farnam St	4 [60]	h	4 [60]	1 [60]	4 [60]
20 [FREE]	g	1 [60]	1 [60]	1 [60]	340	44th St & Farnam St	4 [60]	h	4 [60]	1 [60]	4 [60]
20 [FREE]	g	1 [90]	1 [90]	1 [90]	76	Saddle Creek Rd & Farnam St	20 [FREE]	g	4 [60]	1 [90]	4 [60]
20 [FREE]	g	20 [FREE]	1 [60]	20 [FREE]	362	50th St & Farnam St	20 [FREE]	g	4 [60]	1 [60]	4 [60]
20 [FREE]	g	20 [FREE]	1 [60]	20 [FREE]	379	52nd St & Farnam St	20 [FREE]	g	4 [60]	1 [60]	4 [60]
1 [90]	a	1 [90]	1 [90]	1 [90]	28	Happy Hollow Blvd & Farnam St	4 [60]	h	4 [60]	1 [60]	4 [60]
1 [90]	a	1 [90]	1 [90]	1 [90]	1220	Farnam St & Dodge St	4 [60]	h	4 [60]	1 [60]	4 [60]

Existing: a: 1 [90] d: 1 [60] g: 20 [FREE] j: 1 [120]

Implemented: g: 20 [FREE] h: 4 [60]

Figure 5-3. Existing and Implemented Saturday Day Plan for Dodge & Farnam

Harney St

EXISTING SCHEDULES: SATURDAY

12 am	1 am	2 am	3 am	4 am	5 am	6 am	7 am	8 am	9 am	10 am	11 am	12 pm	1 pm	2 pm	3 pm	4 pm	5 pm	6 pm	7 pm	8 pm	9 pm	10 pm	11 pm	12 am	Signal ID	Signal Location
1 [60]						1 [60]																			82	Turner Blvd & Harney St
1 [60]						1 [60]																			283	33rd St & Harney St
1 [60]						d	1 [60]					1 [60]						1 [60]							291	36th St & Harney St
1 [60]						d	1 [60]					1 [60]						1 [60]							309	40th St & Harney St
1 [60]						d	1 [60]					1 [60]						1 [60]							326	42nd St & Harney St

d: 1 [60]

IMPLEMENTED SCHEDULES: SATURDAY

12 am	1 am	2 am	3 am	4 am	5 am	6 am	7 am	8 am	9 am	10 am	11 am	12 pm	1 pm	2 pm	3 pm	4 pm	5 pm	6 pm	7 pm	8 pm	9 pm	10 pm	11 pm	12 am	Signal ID	Signal Location
1 [60]						1 [60]																			82	Turner Blvd & Harney St
4 [60]						h	4 [60]					1 [60]						4 [60]							283	33rd St & Harney St
4 [60]						h	4 [60]					1 [60]						4 [60]							291	36th St & Harney St
4 [60]						h	4 [60]					1 [60]						4 [60]							309	40th St & Harney St
4 [60]						h	4 [60]					1 [60]						4 [60]							326	42nd St & Harney St

h: 4 [60]

42nd St

EXISTING SCHEDULES: SATURDAY

12 am	1 am	2 am	3 am	4 am	5 am	6 am	7 am	8 am	9 am	10 am	11 am	12 pm	1 pm	2 pm	3 pm	4 pm	5 pm	6 pm	7 pm	8 pm	9 pm	10 pm	11 pm	12 am	Signal ID	Signal Location
4 [60]						4 [60]																			330	42nd St & Leavenworth St
1 [60]						1 [60]																			321	42nd St & Emile St
20 [FREE]						d	2 [60]																		319	42nd St & Dewey St
1 [60]						d	1 [60]					1 [60]						1 [60]							326	42nd St & Harney St
1 [60]						d	2 [60]					1 [60]						1 [60]							323	42nd St & Farnam St
1 [90]						a	1 [90]					1 [90]						1 [90]							320	42nd St & Dodge St

d: 1 [60]

IMPLEMENTED SCHEDULES: SATURDAY

12 am	1 am	2 am	3 am	4 am	5 am	6 am	7 am	8 am	9 am	10 am	11 am	12 pm	1 pm	2 pm	3 pm	4 pm	5 pm	6 pm	7 pm	8 pm	9 pm	10 pm	11 pm	12 am	Signal ID	Signal Location
4 [60]						4 [60]																			330	42nd St & Leavenworth St
4 [60]						h	4 [60]					1 [60]						4 [60]							321	42nd St & Emile St
4 [60]						h	4 [60]					1 [60]						4 [60]							319	42nd St & Dewey St
4 [60]						h	4 [60]					1 [60]						4 [60]							326	42nd St & Harney St
4 [60]						h	4 [60]					1 [60]						4 [60]							323	42nd St & Farnam St
4 [60]						h	4 [60]					1 [60]						4 [60]							320	42nd St & Dodge St

h: 4 [60]

Saddle Creek Rd

EXISTING SCHEDULES: SATURDAY

12 am	1 am	2 am	3 am	4 am	5 am	6 am	7 am	8 am	9 am	10 am	11 am	12 pm	1 pm	2 pm	3 pm	4 pm	5 pm	6 pm	7 pm	8 pm	9 pm	10 pm	11 pm	12 am	Signal ID	Signal Location
4 [60]						4 [60]																			77	Saddle Creek Rd & Leavenworth St
20 [FREE]						g	1 [90]					1 [90]						1 [90]							75	Saddle Creek Rd & Emile St
20 [FREE]						g	1 [90]					1 [90]						1 [90]							76	Saddle Creek Rd & Farnam St
33 [FLASH]						a	2 [90]																		74	Saddle Creek Rd & Davenport St
20 [FREE]						a	1 [90]																		73	Saddle Creek Rd & California St
20 [FREE]						1 [90]																			53	Saddle Creek Rd & Cuming St

a: 1 [90] g: 20 [FREE]

IMPLEMENTED SCHEDULES: SATURDAY

12 am	1 am	2 am	3 am	4 am	5 am	6 am	7 am	8 am	9 am	10 am	11 am	12 pm	1 pm	2 pm	3 pm	4 pm	5 pm	6 pm	7 pm	8 pm	9 pm	10 pm	11 pm	12 am	Signal ID	Signal Location
4 [60]						4 [60]																			77	Saddle Creek Rd & Leavenworth St
20 [FREE]						g	4 [60]					1 [90]						4 [60]							75	Saddle Creek Rd & Emile St
20 [FREE]						g	4 [60]					1 [90]						4 [60]							76	Saddle Creek Rd & Farnam St
33 [FLASH]						g	4 [60]					1 [90]						4 [60]							74	Saddle Creek Rd & Davenport St
20 [FREE]						g	4 [60]					1 [90]						4 [60]							73	Saddle Creek Rd & California St
20 [FREE]						1 [90]																			53	Saddle Creek Rd & Cuming St

g: 20 [FREE]

Figure 5-4. Existing and Implemented Saturday Day Plan for Harney, 42nd, & Saddle Creek

Dodge St

EXISTING SCHEDULES: SUNDAY / **IMPLEMENTED SCHEDULES: SUNDAY**

Signal ID	Signal Location	Existing 12 am–6 am	Existing 6 am–8 am	Existing 8 am–11 am	Existing 11 am–5 pm	Existing 5 pm–10 pm	Existing 10 pm–12 am	Implemented 12 am–6 am	Implemented 6 am–8 am	Implemented 8 am–11 am	Implemented 11 am–5 pm	Implemented 5 pm–10 pm	Implemented 10 pm–12 am
79	Turner Blvd & Dodge St	1 [60]	1 [60]	1 [60]	1 [60]	1 [60]	1 [60]	1 [60]	1 [60]	1 [60]	1 [60]	1 [60]	1 [60]
279	33rd St & Dodge St	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	20 [FREE]	20 [FREE]	4 [60]	1 [60]	4 [60]	20 [FREE]
289	35th Ave & Dodge St	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	20 [FREE]	20 [FREE]	4 [60]	1 [60]	4 [60]	20 [FREE]
300	38th St & Dodge St	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	20 [FREE]	20 [FREE]	4 [60]	1 [60]	4 [60]	20 [FREE]
306	40th St & Dodge St	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	20 [FREE]	20 [FREE]	4 [60]	1 [60]	4 [60]	20 [FREE]
320	42nd St & Dodge St	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	20 [FREE]	20 [FREE]	4 [60]	1 [60]	4 [60]	20 [FREE]
339	44th St & Dodge St	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	20 [FREE]	20 [FREE]	4 [60]	1 [60]	4 [60]	20 [FREE]
344	46th St & Dodge St	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	20 [FREE]	20 [FREE]	4 [60]	1 [60]	4 [60]	20 [FREE]
355	49th St & Dodge St	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	20 [FREE]	20 [FREE]	4 [60]	1 [60]	4 [60]	20 [FREE]
361	50th St & Dodge St	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	20 [FREE]	20 [FREE]	4 [60]	1 [60]	4 [60]	20 [FREE]
378	52nd St & Dodge St	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	20 [FREE]	20 [FREE]	4 [60]	1 [60]	4 [60]	20 [FREE]
27	Happy Hollow Blvd & Dodge St	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	4 [60]	4 [60]	4 [60]	1 [60]	4 [60]	4 [60]
1220	Farnam St & Dodge St	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	4 [60]	4 [60]	4 [60]	1 [60]	4 [60]	4 [60]
401	60th St & Dodge St	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	20 [FREE]	20 [FREE]	4 [60]	1 [60]	4 [60]	20 [FREE]
421	62nd St & Dodge St	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	20 [FREE]	20 [FREE]	4 [60]	1 [60]	4 [60]	20 [FREE]
428	66th St & Dodge St	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	20 [FREE]	20 [FREE]	4 [60]	1 [60]	4 [60]	20 [FREE]
432	67th St & Dodge St	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	20 [FREE]	20 [FREE]	4 [60]	1 [60]	4 [60]	20 [FREE]
437	69th St & Dodge St	11 [90]	11 [90]	Adaptive [varies]			11 [90]	11 [90]	11 [90]	Adaptive [varies]			11 [90]

Farnam St

EXISTING SCHEDULES: SUNDAY / **IMPLEMENTED SCHEDULES: SUNDAY**

Signal ID	Signal Location	Existing 12 am–6 am	Existing 6 am–8 am	Existing 8 am–11 am	Existing 11 am–5 pm	Existing 5 pm–10 pm	Existing 10 pm–12 am	Implemented 12 am–6 am	Implemented 6 am–8 am	Implemented 8 am–11 am	Implemented 11 am–5 pm	Implemented 5 pm–10 pm	Implemented 10 pm–12 am
81	Turner Blvd & Farnam St	1 [60]	1 [60]					1 [60]	1 [60]				
1103	32nd St & Farnam St	1 [60]	1 [60]	1 [60]	1 [60]	1 [60]	1 [60]	4 [60]	4 [60]	4 [60]	1 [60]	4 [60]	4 [60]
280	33rd St & Farnam St	1 [60]	1 [60]	1 [60]	1 [60]	1 [60]	1 [60]	4 [60]	4 [60]	4 [60]	1 [60]	4 [60]	4 [60]
1102	34th St & Farnam St	1 [120]	1 [120]	1 [120]	1 [120]	1 [120]	1 [120]	4 [60]	4 [60]	4 [60]	1 [60]	4 [60]	4 [60]
602	36th St & Farnam St	1 [60]	1 [60]	1 [60]	1 [60]	1 [60]	1 [60]	4 [60]	4 [60]	4 [60]	1 [60]	4 [60]	4 [60]
1177	38th St & Farnam St	1 [60]	1 [60]	1 [60]	1 [60]	1 [60]	1 [60]	4 [60]	4 [60]	4 [60]	1 [60]	4 [60]	4 [60]
307	40th St & Farnam St	1 [60]	1 [60]	1 [60]	1 [60]	1 [60]	1 [60]	4 [60]	4 [60]	4 [60]	1 [60]	4 [60]	4 [60]
323	42nd St & Farnam St	1 [60]	1 [60]	1 [60]	1 [60]	1 [60]	1 [60]	4 [60]	4 [60]	4 [60]	1 [60]	4 [60]	4 [60]
340	44th St & Farnam St	20 [FREE]	20 [FREE]	1 [60]	1 [60]	1 [60]	20 [FREE]	4 [60]	4 [60]	4 [60]	1 [60]	4 [60]	4 [60]
76	Saddle Creek Rd & Farnam St	20 [FREE]	20 [FREE]	1 [90]	1 [90]	1 [90]	20 [FREE]	20 [FREE]	20 [FREE]	4 [60]	1 [90]	4 [60]	20 [FREE]
362	50th St & Farnam St	20 [FREE]	20 [FREE]	20 [FREE]	1 [60]	20 [FREE]	20 [FREE]	20 [FREE]	20 [FREE]	4 [60]	1 [60]	4 [60]	20 [FREE]
379	52nd St & Farnam St	20 [FREE]	20 [FREE]	20 [FREE]	1 [60]	20 [FREE]	20 [FREE]	20 [FREE]	20 [FREE]	4 [60]	1 [60]	4 [60]	20 [FREE]
28	Happy Hollow Blvd & Farnam St	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	4 [60]	4 [60]	4 [60]	1 [60]	4 [60]	4 [60]
1220	Farnam St & Dodge St	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	4 [60]	4 [60]	4 [60]	1 [60]	4 [60]	4 [60]

Figure 5-5. Existing and Implemented Sunday Day Plan for Dodge & Farnam

Harney St

EXISTING SCHEDULES: SUNDAY

12 am – 5 am	6 am	7 am – 8 am	9 am	10 am – 10 pm	11 pm – 12 am	Signal ID	Signal Location
1 [60]		1 [60]				82	Turner Blvd & Harney St
1 [60]		1 [60]			1 [60]	283	33rd St & Harney St
1 [60]	1 [60]	1 [60]	1 [60]	1 [60]	1 [60]	291	36th St & Harney St
1 [60]	1 [60]	1 [60]	1 [60]	1 [60]	1 [60]	309	40th St & Harney St
1 [60]	1 [60]	1 [60]	1 [60]	1 [60]	1 [60]	326	42nd St & Harney St

IMPLEMENTED SCHEDULES: SUNDAY

12 am – 5 am	6 am – 6 pm	7 pm – 12 am
1 [60]		1 [60]
4 [60]	4 [60]	4 [60]
4 [60]	4 [60]	4 [60]
4 [60]	4 [60]	4 [60]
4 [60]	4 [60]	4 [60]

42nd St

EXISTING SCHEDULES: SUNDAY

12 am – 5 am	6 am	7 am – 8 am	9 am – 10 pm	11 pm – 12 am	Signal ID	Signal Location
4 [60]		4 [60]			330	42nd St & Leavenworth St
1 [60]		1 [60]			321	42nd St & Emile St
20 [FREE]	d	2 [60]		20 [FREE]	319	42nd St & Dewey St
1 [60]	1 [60]	1 [60]	1 [60]	1 [60]	326	42nd St & Harney St
1 [60]	1 [60]	1 [60]	1 [60]	1 [60]	323	42nd St & Farnam St
1 [90]	1 [90]	1 [90]	1 [90]	1 [90]	320	42nd St & Dodge St

d: 1 [60]

IMPLEMENTED SCHEDULES: SUNDAY

12 am – 5 am	6 am – 6 pm	7 pm – 12 am
4 [60]		4 [60]
4 [60]	4 [60]	4 [60]
4 [60]	4 [60]	4 [60]
4 [60]	4 [60]	4 [60]
4 [60]	4 [60]	4 [60]
4 [60]	4 [60]	4 [60]

Saddle Creek Rd

EXISTING SCHEDULES: SUNDAY

12 am – 5 am	6 am	7 am – 10 pm	11 pm – 12 am	Signal ID	Signal Location
4 [60]		4 [60]		77	Saddle Creek Rd & Leavenworth St
20 [FREE]	20 [FREE]	1 [90]	20 [FREE]	75	Saddle Creek Rd & Emile St
20 [FREE]	20 [FREE]	1 [90]	20 [FREE]	76	Saddle Creek Rd & Farnam St
33 [FLASH]	a	2 [90]	33 [FLASH]	74	Saddle Creek Rd & Davenport St
20 [FREE]	a	1 [90]	20 [FREE]	73	Saddle Creek Rd & California St
20 [FREE]		1 [90]	20 [FREE]	53	Saddle Creek Rd & Cuming St

a: 1 [90]

IMPLEMENTED SCHEDULES: SUNDAY

12 am – 5 am	6 am – 6 pm	7 pm – 12 am
4 [60]		4 [60]
20 [FREE]	20 [FREE]	20 [FREE]
20 [FREE]	20 [FREE]	20 [FREE]
33 [FLASH]	20 [FREE]	33 [FLASH]
20 [FREE]	20 [FREE]	20 [FREE]
20 [FREE]		20 [FREE]

Figure 5-6. Existing and Implemented Sunday Day Plan for Harney, 42nd, & Saddle Creek

5.7 SPLIT OPTIMIZATION

Prior to optimizing split times, the following updates were made in Synchro models that coincided with timing changes:

- Add Pm+Pt left-turn phasing for southbound left at Saddle Creek Rd & Davenport St during Plan 3 PM.
- Add pedestrian recall for the following locations to coincide with LPIs:
  - 32nd St & Farnam St – Phases 4/8 (NB/SB)
  - 33rd St & Farnam St – Phases 4/8 (NB/SB)
  - 34th St & Farnam St – Phases 4/8 (NB/SB)
  - 50th St & Farnam St – Phases 4/8 (NB/SB)
  - 52nd St & Farnam St – Phase 4 (NB/SB)
- Add 3 seconds of lost time to the following locations with recall and LPI:
  - 32nd St & Farnam St – Phases 2/6/8 (all vehicular phases)
  - 33rd St & Farnam St – All phases
  - 34th St & Farnam St – Phases 2/4/6 (all vehicular phases)
  - 36th St & Farnam St – Phases 2/6/8 (all vehicular phases)
  - 38th St & Farnam St – All phases
  - 40th St & Farnam St – All phases
  - 42nd St & Farnam St – All phases
  - 50th St & Farnam St – All phases
  - 52nd St & Farnam St – All phases
  - 33rd St & Harney St – Phases 4/8 (NB/SB)
  - 42nd St & Harney St – Phase 2 (EB)
  - 42nd St & Dewey St – All phases
  - 42nd St & Emile St – Phases 2/6 (EB/WB)

Split times were updated to meet current vehicle demand and account for pedestrian signal timings. Adjustments to transit signal priority (TSP) timings on the Dodge Street corridor were also made to reflect the updated split times. The following provides detailed information by plan.

5.7.1 PLAN 1 MD SPLIT OPTIMIZATION

Split times for minor road through phases at Dodge Street intersections were set to accommodate pedestrian crossing times to prevent signals from going into transition following a pedestrian actuation.

Split times on Farnam Street, Harney Street and 42nd Street accommodate pedestrian crossing times via recall.

5.7.1.1 DODGE STREET & FARNAM STREET & HAPPY HOLLOW BOULEVARD

Using a 60-second cycle at Dodge Street & Happy Hollow Boulevard during Plan 1 MD required a lower pedestrian walk of 7 seconds (reduced from 10 seconds) for Phase 4 to allow the split to accommodate the pedestrian time.

Using a 60-second cycle at Farnam Street & Happy Hollow Boulevard during Plan 1 MD required a lower pedestrian walk of 7 seconds (reduced from 11 seconds) for Phase 2 and 6 seconds (reduced from 10 seconds) for Phase 8 to allow the split to accommodate the pedestrian time.

5.7.2 PLAN 2 AM SPLIT OPTIMIZATION

Split times for minor road through phases at Dodge Street and Saddle Creek Road intersections were set to accommodate pedestrian crossing times based mostly on a relatively high number of pedestrians crossing in the peak hour (8 or more) and to prevent signals on these corridors from going into transition following a pedestrian actuation.

Split times on Farnam Street, Harney Street and 42nd Street accommodate pedestrian crossing times via recall.

5.7.3 PLAN 3 PM SPLIT OPTIMIZATION

Split times for minor road through phases at Dodge Street and Saddle Creek Road intersections were set to accommodate pedestrian crossing times based mostly on a relatively high number of pedestrians crossing in the peak hour (8 or more) and to prevent signals on these corridors from going into transition following a pedestrian actuation.

Split times on Farnam Street, Harney Street and 42nd Street accommodate pedestrian crossing times via recall.

5.7.4 PLAN 4 OP SPLIT OPTIMIZATION

Split times for minor road through phases at Dodge Street intersections were set to accommodate pedestrian crossing times to prevent signals from going into transition following a pedestrian actuation.

Split times on Farnam Street, Harney Street and 42nd Street accommodate pedestrian crossing times via recall.

5.7.4.1 DODGE STREET & FARNAM STREET & HAPPY HOLLOW BOULEVARD

Using a 60-second cycle at Dodge Street & Happy Hollow Boulevard during Plan 4 OP required a lower pedestrian walk of 7 seconds (reduced from 10 seconds) for Phase 6 to allow the split to accommodate the pedestrian time.

Using a 60-second cycle at Farnam Street & Happy Hollow Boulevard during Plan 4 OP required a lower pedestrian walk of 7 seconds (reduced from 11 seconds) for Phase 2 and 6 seconds (reduced from 10 seconds) for Phase 8 to allow the split to accommodate the pedestrian time.

5.7.4.2 FARNAM STREET & SADDLE CREEK ROAD

Using a 60-second cycle at Farnam Street & Saddle Creek Road during Plan 4 OP required a lower pedestrian walk of 7 seconds (reduced from 12 seconds) for Phases 4 and 8. Phase 7 was also changed from Pm+Pt to Permitted during Plan 4 OP.

5.8 OFFSET AND SEQUENCE OPTIMIZATION

Offsets were adjusted and phase sequencing was reviewed and adjusted during the four timing plans. The offset strategies, particularly how corridors were coordinated with adjacent locations, and modified sequences are highlighted in the following sections. A summary of the implemented changes to lead/lag sequencing is shown in **Table 5-10**.

Table 5-10. Locations with Lagging Left Turn

		Plan 1 MD	Plan 2 AM	Plan 3 PM	Plan 4 OP
Saddle Creek Road & Emile Street – SBL	Existing	Lead	Lead	Lead	Lead
	Implemented	Lag	Lag	No left-turn phase (Permissive only)	Lag

5.8.1 PLAN 1 MD OFFSET AND SEQUENCE OPTIMIZATION

- Dodge Street – Balanced stops eastbound and westbound and coordinated with Turner Boulevard & Dodge Street.
- 42nd Street – Coordinate northbound 42nd Street with 42nd Street & Dodge Street.
- Saddle Creek Road – Minimized stops on Saddle Creek Road and coordinated with Saddle Creek Road & Leavenworth Street and Saddle Creek Road & Cuming Street intersections.
    - Modified sequence at Saddle Creek Road & Emile Street to lag Phase 7 southbound left (sequence 9).
- Farnam Street west of Saddle Creek Road – Coordinated northbound/southbound with Dodge Street.
- Farnam Street east of 42nd Street – Coordinated westbound traffic with Turner Boulevard & Farnam Street.
- Harney Street east of 42nd Street – Coordinated eastbound traffic with 42nd Street & Harney Street.

5.8.2 PLAN 2 AM OFFSET AND SEQUENCE OPTIMIZATION

- Dodge Street – Continued to favor eastbound progression but looked for way to improve westbound.
- 42nd Street – Coordinated 42nd Street between Emile Street and Farnam Street to have zero or one stop.
- Saddle Creek Road – Minimized stops on Saddle Creek Road and coordinated with Saddle Creek Road & Leavenworth Street and Saddle Creek Road & Cuming Street intersections.
    - Modified sequence at Saddle Creek Road & Emile Street to lag Phase 7 southbound left (sequence 9).
- Farnam Street west of Saddle Creek Road – Coordinated 50th Street and 52nd Street together with arrivals from eastbound Dodge Street arriving at 52nd Street & Farnam Street on green half of the time due to different cycle lengths.
- Farnam Street east of 42nd Street – Coordinated westbound traffic between Turner Boulevard & Farnam Street and 42nd Street & Farnam Street.
- Harney Street east of 42nd Street – Coordinated eastbound traffic with 42nd Street & Harney Street.

5.8.3 PLAN 3 PM OFFSET AND SEQUENCE OPTIMIZATION

- Dodge Street – Continued to favor westbound progression but introduced a stop at 52nd Street to reduce the frequency and duration of stops in the eastbound direction.
- 42nd Street – Coordinated 42nd Street between Emile Street and Farnam Street to have zero or one stop. Set 42nd Street & Farnam Street offset to allow for westbound progression on Farnam Street between Turner Boulevard and 42nd Street.
- Saddle Creek Road – Minimized stops on Saddle Creek Road and coordinated with Saddle Creek Road & Leavenworth Street and Saddle Creek Road & Cuming Street intersections.
- Farnam Street west of Saddle Creek Road – Coordinated 50th Street and 52nd Street together with arrivals westbound platoons from 52nd Street arriving at Happy Hollow Boulevard on green two out of three cycles due to different cycle lengths.
- Farnam Street east of 42nd Street – Coordinated westbound traffic between Turner Boulevard & Farnam Street and 42nd Street & Farnam Street.
- Harney Street east of 42nd Street – Coordinated eastbound traffic with 42nd Street & Harney Street.

5.8.4 PLAN 4 OP OFFSET AND SEQUENCE OPTIMIZATION

- Dodge Street – Balanced stops eastbound and westbound and coordinated with Turner Boulevard & Dodge Street.
- 42nd Street – Coordinated northbound 42nd Street with 42nd Street & Dodge Street and 42nd Street & Leavenworth Street.
- Saddle Creek Road – Minimized stops on Saddle Creek Road and coordinated with Saddle Creek & Leavenworth intersection.
    - Modified sequence at Saddle Creek Road & Emile Street to lag Phase 7 southbound left (sequence 9).
- Farnam Street west of Saddle Creek Road – Coordinated northbound/southbound with Dodge Street.
- Farnam Street east of 42nd Street – Coordinated westbound traffic with Turner Boulevard & Farnam Street.
- Harney Street east of 42nd Street – Coordinated eastbound traffic with 42nd Street & Harney Street.

6 IMPLEMENTATION

6.1 DATABASE PROGRAMMING

Database programing of the new signal timings started on July 28th and was completed on August 3rd. The latest database was used to make sure any recent changes made by City staff were included in the base timings. New timings were entered via the MaxView and TrafficView databases.

6.2 IMPLEMENTATION DAY

Implementation of the new signal timings took place the on August 8th. Each intersection had an upload done to check for any recent changes since programming began prior to download. Then intersections were observed in-person from the field while the database for that signal was downloaded to the controller to ensure proper operations before moving to the next intersection. HDR and City staff continued to monitor traffic cameras especially during transitions between timing plans.

6.3 FINE TUNING

Fine tuning of the new signal timings started immediately following implementation starting with PM peak plan on August 8th and was largely completed by August 15th. Fine tuning involved making observations during each timing plan throughout the day to verify proper progression of traffic throughout each of the corridors. Intersections were also observed to ensure proper operations of pedestrian signals, LPI, and any other hardware at the intersections. Updates to signal timings were conducted through VPN to the City's controller software. Changes were documented daily and sent to the City. Change log forms were also sent for any changes made to signals with Wapiti controllers.

6.4 PUBLIC COMMENT

At this time, no public requests for changes or re-evaluation have been received related to the implemented signal timings.

7 PERFORMANCE MEASURES

7.1 NETWORK MEASURES OF EFFECTIVENESS

Measures of effectiveness (MOEs) were estimated using Synchro based on the existing and implemented signal timings. **Table 7-1** shows the MOEs broken out by corridor and summed for network-wide performance. The Synchro reports for network MOEs can be found in **Appendix**.

Table 7-1. Corridor and Network Performance Measures

		Dodge Street			Farnam Street			Harney Street			Saddle Creek Road			42nd Street			Network[1]		
		Exist.	Implement	Diff.	Exist.	Implement	Diff.	Exist.	Implement	Diff.	Exist.	Implement	Diff.	Exist.	Implement	Diff.	Exist.	Implement	Diff.
Plan 1 - MD	Total Delay (hr)	72	51	-41%	19	18	-6%	3	3	0%	22	20	-10%	12	12	0%	128	104	-23%
	Stops (#)	9,143	9,050	-1%	3,078	2,673	-15%	602	524	-15%	2,642	2,535	-4%	1,873	2,065	9%	17,338	16,847	-3%
	Fuel Consumed (gal)	365	349	-5%	76	73	-4%	15	15	0%	105	102	-3%	37	38	3%	598	577	-4%
	Total Travel Time (hr)	264	243	-9%	58	57	-2%	12	12	0%	76	74	-3%	31	31	0%	441	417	-6%
	Performance Index	97.5	76.5	-27%	27.9	25.3	-10%	4.9	4.7	-4%	29.1	26.6	-9%	17.0	18.0	6%	176.4	151.1	-17%
Plan 2 - AM	Total Delay (hr)	75	72	-4%	18	32	44%	3	3	0%	20	19	-5%	12	14	14%	128	140	9%
	Stops (#)	9,371	9,082	-3%	2,984	3,366	11%	531	598	11%	2,110	2,040	-3%	2,115	2,410	12%	17,111	17,496	2%
	Fuel Consumed (gal)	392	387	-1%	75	87	14%	16	17	6%	92	90	-2%	37	39	5%	612	620	1%
	Total Travel Time (hr)	284	280	-1%	56	70	20%	13	13	0%	68	67	-1%	30	32	6%	451	462	2%
	Performance Index	101.3	96.7	-5%	26.2	41.7	37%	4.3	4.6	7%	25.9	24.2	-7%	17.9	20.8	14%	175.6	188.0	7%
Plan 3 - PM	Total Delay (hr)	126	115	-10%	35	41	15%	5	5	0%	35	35	0%	14	15	7%	215	211	-2%
	Stops (#)	17,257	14,524	-19%	4,753	4,851	2%	907	806	-13%	4,309	4,072	-6%	2,486	2,494	0%	29,712	26,747	-11%
	Fuel Consumed (gal)	554	525	-6%	109	115	5%	23	23	0%	141	139	-1%	46	46	0%	873	848	-3%
	Total Travel Time (hr)	387	376	-3%	85	91	7%	18	18	0%	101	102	1%	38	38	0%	629	625	-1%
	Performance Index	174.1	155.6	-12%	47.7	54.1	12%	7.4	7.4	0%	47.1	46.8	-1%	21.3	22.0	3%	297.6	285.9	-4%
Plan 4 - OP	Total Delay (hr)	50	35	-43%	11	11	0%	2	2	0%	14	11	-27%	7	8	13%	84	67	-25%
	Stops (#)	6,656	6,598	-1%	2,096	1,804	-16%	398	340	-17%	1,747	2,127	18%	1,297	1,598	19%	12,194	12,467	2%
	Fuel Consumed (gal)	273	262	-4%	52	50	-4%	11	11	0%	74	74	0%	25	27	7%	435	424	-3%
	Total Travel Time (hr)	197	182	-8%	38	39	3%	8	9	11%	54	50	-8%	21	21	0%	318	301	-6%
	Performance Index	68.2	53.2	-28%	16.7	16.4	-2%	3.1	3.2	3%	19.2	16.5	-16%	11.0	12.3	11%	118.2	101.6	-16%

[1] Network MOEs shown in this table are a sum of the MOEs for each corridor and may not exactly match values shown in **Appendix**.

The network delay values show an improvement from the existing to the implemented during all plans except the AM plan. Reviewing the delays for each corridor during the AM plan, the majority of the network-wide increase in delay came from Farnam Street. While not as large, the Farnam Street delay also increased during the PM plan. Farnam Street is where the majority of LPIs were implemented with a pedestrian recall to enhance pedestrian safety. The recalls and LPIs result in added vehicular delay caused by serving and extending the side street phase during all times and delaying the start of Farnam Street traffic. To determine the amount of impact these safety measures had on vehicular delay, the LPIs and pedestrian recalls were removed from the implemented Synchro models. **Table 7-2** shows the MOEs for existing, implemented, and implemented without LPI or pedestrian recalls. These results indicate there would have been a reduction to delay and stops on Farnam Street with the implemented timings during all plans if LPIs and pedestrian recalls had not been added.

Table 7-2. Farnam Street LPI and Recall Sensitivity

		Exist.	Imp.	No LPI or Ped Recall
Plan 1 - MD	Total Delay (hr)	20	20	16
	Stops(#)	3,078	2,673	2,362
	Fuel Consumed (gal)	76	73	69
	Total Travel Time (hr)	58	57	53
	Performance Index	27.9	25.3	20.7
Plan 2 - AM	Total Delay (hr)	18	28	17
	Stops(#)	2,984	3,366	2,659
	Fuel Consumed (gal)	75	87	71
	Total Travel Time (hr)	56	70	53
	Performance Index	26.2	41.7	22.7
Plan 3 - PM	Total Delay (hr)	26	31	23
	Stops(#)	4,753	4,851	4,150
	Fuel Consumed (gal)	109	115	101
	Total Travel Time (hr)	85	91	77
	Performance Index	47.7	54.1	38.2
Plan 4 - OP	Total Delay (hr)	15	17	15
	Stops(#)	2,096	1,804	1,701
	Fuel Consumed (gal)	52	50	49
	Total Travel Time (hr)	38	39	37
	Performance Index	16.7	16.4	14.2

7.2 INTERSECTION OPERATIONS

Intersection operations were also compared between the existing and implemented signal timings. **Table 7-3** summarizes the number of intersections where delay decreased, was unchanged, increased by less than five seconds, and increased by more than five seconds. Existing and implemented Synchro reports for individual intersections can be found in **Appendix**.

Table 7-3. Intersection Delay Change Summary

Number of Intersections Where:	Plan 1 MD	Plan 2 AM	Plan 3 PM	Plan 4 OP
Delay Decreased	26	18	17	22
Delay Unchanged	0	1	0	0
Delay Increased <=5 sec/veh	11	15	18	15
Delay Increased >5 sec/veh	0	3	2	0

Further review was completed for intersections that had an increase of more than five seconds of delay. The intersections that had delay increases during a plan are shown in **Table 7-4**.

Table 7-4. Intersections with Delay Increase Over Five Seconds

Intersection	Plan	Existing Delay and LOS	Implemented Delay and LOS	Difference
32nd St & Farnam St	Plan 2 AM	2.4 - A	17.0 - B	14.6
33rd St & Farnam St	Plan 2 AM	7.2 - A	24.8 - C	17.6
	Plan 3 PM	10.9 - B	27.1 - C	16.2
34th St & Farnam St	Plan 2 AM	2.7 - A	7.8 - A	5.1
Saddle Creek Rd & Davenport St	Plan 3 PM	8.4 - A	16.1 - B	7.7

Similar to the results shown in the network performance measures, most of the locations that saw a larger increase in delay were locations where LPI and pedestrian recalls were implemented to enhance awareness of pedestrians crossing the street. At these locations, if the LPI and pedestrian recalls are removed, the resulting delay is similar to existing. Below is a list of reasons for the increased delay at each intersection listed in **Table 7-4**:

- 32nd Street & Farnam Street (AM): Implementation of LPI and pedestrian recall.
- 33rd Street & Farnam Street (AM): Implementation of LPI and pedestrian recall.
- 33rd Street & Farnam Street (PM): Implementation of LPI and pedestrian recall.
- 34th Street & Farnam Street (AM): Implementation of LPI and pedestrian recall.
- Saddle Creek Road & Davenport Street (PM): This intersection was changed to a set stop during the PM for better overall progression on Saddle Creek Road.

7.3 DODGE STREET TRAVEL TIME RUN PERFORMANCE

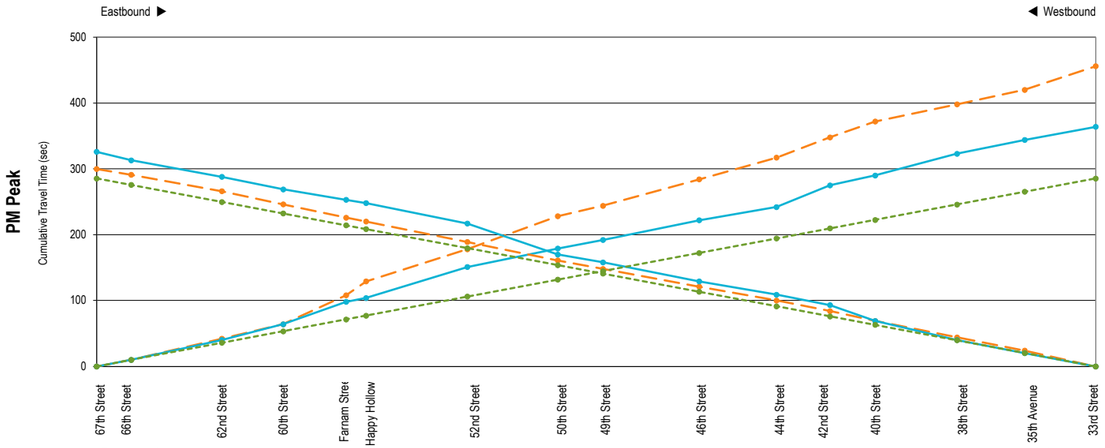
Travel time runs were conducted during five periods as detailed in the **Travel Time Runs** section of Chapter 3. The average travel time run data from the existing and implemented travel time runs were plotted for comparison with free flow travel conditions based on the posted speed limit. The difference between the lines illustrates the difference in travel time between scenarios. All five graphs and a table with the average travel time and delay for each scenario can be found in **Figure 7-1** on the following page. Time-space diagram plots for the existing and implemented for each time period can be found in **Appendix**.

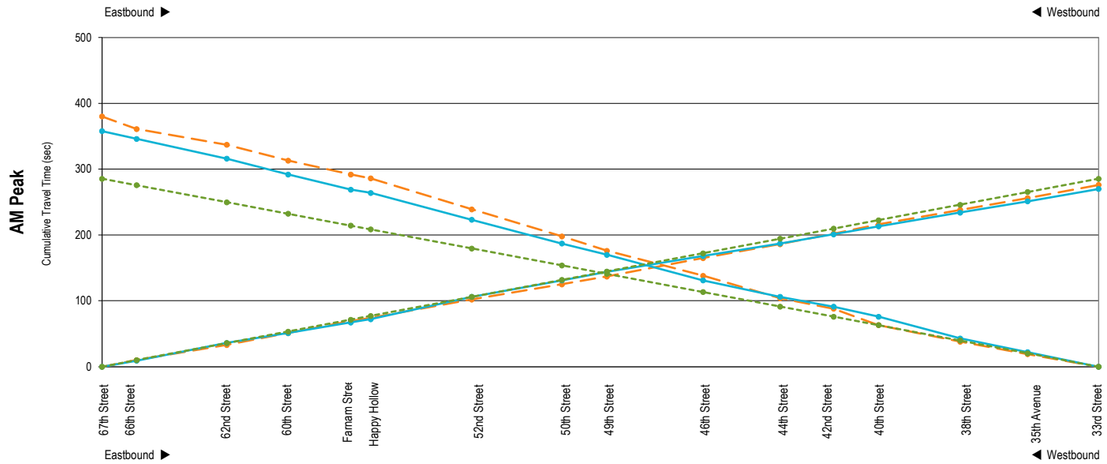
Average Total Travel Time & Delay

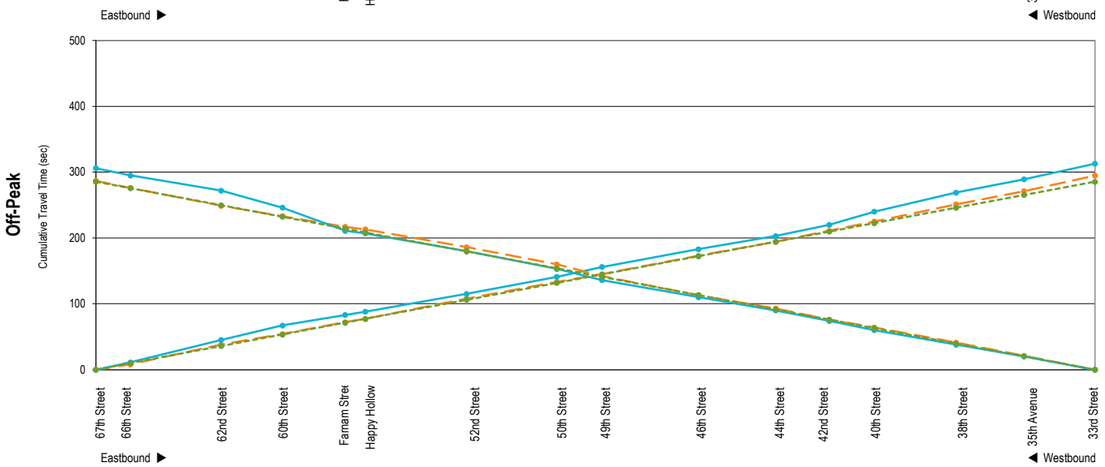
Dodge Street: 2.8 miles

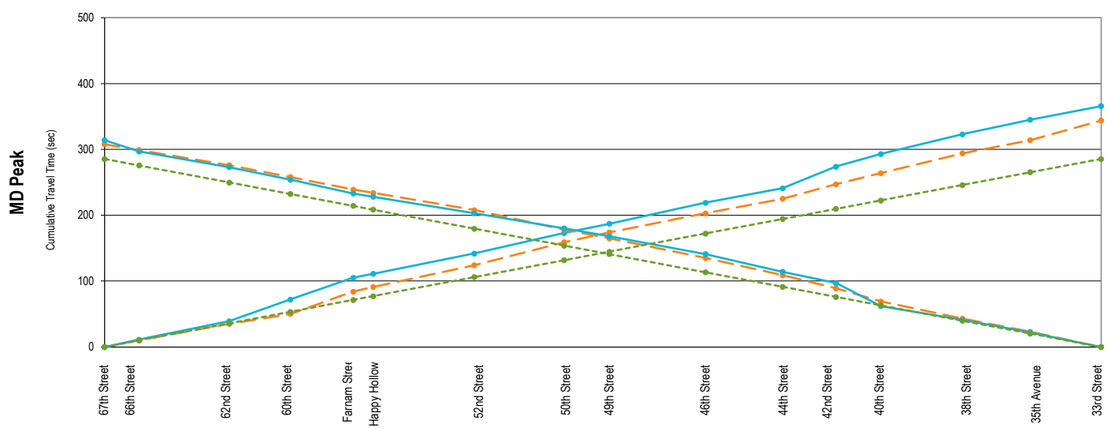
		AM Peak		MD Peak		PM Peak		Off-Peak		Weekend MD Peak	
		Travel Time (s)	Delay (s)	Travel Time (s)	Delay (s)	Travel Time (s)	Delay (s)	Travel Time (s)	Delay (s)	Travel Time (s)	Delay (s)
Eastbound	Existing	276	-12	344	56	456	168	295	8	346	58
	Implemented	270	-18	366	78	364	77	313	25	319	31
	Difference	-6		22		-92		18		-27	
	% Difference	-2.2%	50.0%	6.4%	39.3%	-20.2%	-54.8%	6.1%	225.0%	-7.8%	-46.6%
Westbound	Existing	380	93	308	21	300	13	287	-1	312	24
	Implemented	358	70	314	27	326	38	306	18	293	5
	Difference	-22		6		26		19		-19	
	% Difference	-5.8%	-23.7%	1.9%	28.6%	8.7%	200.0%	6.6%	-1900.0%	-6.1%	-79.2%

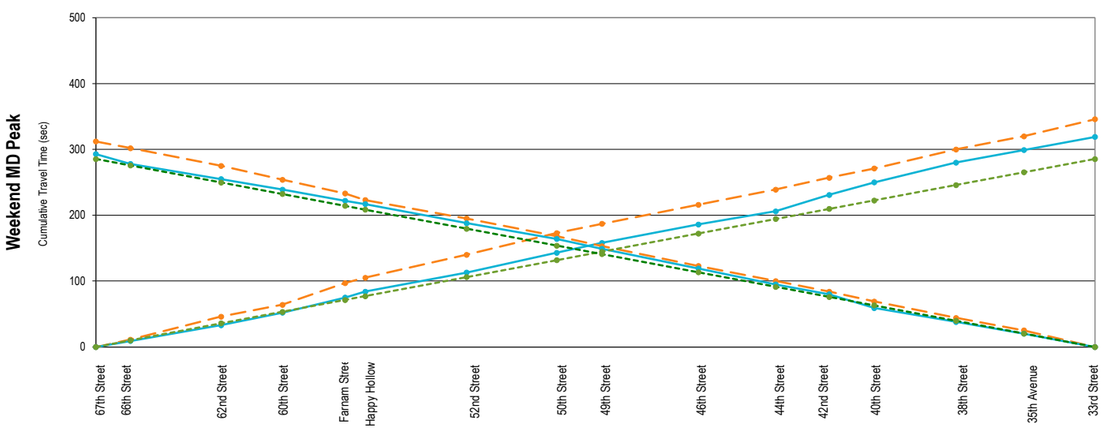
Eastbound: 67th Street to 33rd Street
Westbound: 33rd Street to 67th Street











Existing
Implemented
Free Flow

Figure 7-1

Average Corridor Travel Time & Delay

Dodge Street - 33rd Street to 67th Street

The results from the eastbound AM travel time runs showed that the implemented timings remained nearly the same as the existing with no stops. . In the westbound direction, there was an improvement of about 22 seconds and two fewer stops on average with the implemented timings.

During the MD, travel times in the eastbound direction increased by 22 seconds from the existing to the implemented timings. In the westbound direction, it stayed nearly the same with a slight increase of six seconds. While a shorter cycle length on Dodge Street led to longer travel times and more delay for Dodge Street traffic, the overall delay (including side street delay) in **Table 7-1** shows a decrease in delay. This means that the reduction in side street delay was greater than the increase in Dodge Street delay.

The PM travel time results show an increase in travel time of 26 seconds in the westbound direction, but a decrease of 92 seconds in the westbound direction. On average, the westbound direction added one stop at 52nd Street compared to the existing. The eastbound direction averaged three or four stops instead of the five to seven stops with the existing signal timings.

OP travel times increased by about 20 seconds in both directions from the existing to the implemented timings. Similar to the MD timings, the cycle length was decreased on Dodge Street to better serve traffic on the side streets. **Table 7-1** shows a decrease in overall delay on Dodge Street during the OP plan once side street delay is taken into account.

The weekend travel time runs were conducted during the portion of the day using the MD timing plan. However, there was less side street traffic compared to weekday MD travel time runs so Dodge Street traffic was stopped less frequently and the travel times decreased in both directions. The travel time decreased by 27 seconds in the eastbound direction and 19 seconds in the westbound direction.

8 BENEFIT COST ANALYSIS

A benefit-cost analysis was conducted using the network performance measures from the previous chapter. The analysis used the estimated delay, fuel consumption, CO emissions, NOx emissions, and VOC emissions to estimate the overall benefits of the project. An estimation of benefits from crash reduction was also made using US Department of Transportation (USDOT) guidelines and the number of crashes per year citywide. **Appendix** shows the estimated benefits in each of the categories.

The City has developed a methodology for monetizing project benefits over five years using USDOT guidelines. The total project benefits are estimated to be $3.8 million. The total costs for the project were $131,972. This results in a benefit-cost ratio of 29:1 over a five-year period.

Table 8-1. Anticipated Five Year Project Benefits

Performance Measure	Project Benefit	Present Value
Delay Reduction	30,295 hours	$752,835
Fuel Consumption Reduction	47,518 gallons	$161,474
Emission Reduction	424 tons	$32,467
Crash Reduction	53 crashes	$2,893,882

9 SAFETY AND OPERATIONAL RECOMMENDATIONS

Observations for safety and operational deficiencies were noted throughout the project and the following recommendations are made with supporting observations.

- Perform tree maintenance on Farnam Street at the following locations:
  - Farnam Street – Dodge Street to Saddle Creek Road
    - Street signs are partially blocked in both directions at multiple locations throughout.
  - Farnam Street – Westbound approaching Turner Boulevard
    - Only one of three traffic signal heads are visible when approaching intersection due to overgrown trees on the northwest corner.
- Review operations on north leg of 44th Street & Dodge Street for potential one-way operation.
  - The north leg of intersection operates with two-way traffic despite only being wide enough for a single vehicle. There is no signage at or approaching the intersection indicating that it is one-way.
- Review need for existing school crossing signs at 35th Street & Dodge Street.
  - School crossing signs are installed on the signal mast arm on all four approaches. This intersection is within the attendance area for Gifford Park Elementary, but there may be closer crossings of Dodge Street that are more appropriate.
- Consider restricting right-turn-on-red for westbound traffic at 42nd Street & Farnam Street.
  - The sight distance for westbound right-turn traffic is poor at the intersection due to a retaining wall close to the roadway making it difficult to see southbound traffic. The City should review crashes at this location during consideration.
- Consider restricting right-turn-on-red for southbound traffic at 50th Street & Dodge Street.
  - The sight distance for southbound right-turn traffic is poor at the intersection due to buildings close to the roadway making it difficult to see westbound traffic. The City should review crashes at this location during consideration.
- Consider restricting right-turn-on-red for southbound traffic at 52nd Street & Dodge Street.
  - The sight distance for southbound right-turn traffic is poor at the intersection due to a retaining wall close to the roadway and vertical grade making it difficult to see westbound traffic. The City should review crashes at this location during consideration.
- Add louvers or optically programmed signal heads for the eastbound approach of Turner Boulevard & Douglas Street
  - Eastbound Dodge Street traffic curves south at 31st Street to create a one-way pair with Douglas Street. At the intersection with Turner Boulevard, the eastbound approaching traffic can see both the eastbound signal heads and the southbound signal heads. This signal was reconstructed in 2022.

APPENDIX