

## 2.0 TRAFFIC ANALYSIS

The data presented in this chapter summarize the Traffic Report prepared for this project.

### 2.1 EXISTING TRAFFIC DATA

Northern Avenue is currently a two-lane (one lane in each direction) minor arterial with at-grade intersections from the SR 303L/Estrella Freeway (Loop 303) to 112<sup>th</sup> Avenue. The speed limit along this section of Northern Avenue is 50 mph. Northern Avenue widens to four lanes, with a continuous center turn lane, at 112<sup>th</sup> Avenue, and continues as a four-lane roadway east to Grand Avenue. The posted speed limit is typically 45 mph on this section of Northern Avenue.

As of November 2007, traffic signals are located on Northern Avenue at Loop 303, Litchfield Road, Dysart Road, 107<sup>th</sup> Avenue, SR 101L/Agua Fria Freeway (Loop 101) west side ramps, Loop 101 east side ramps, 93<sup>rd</sup> Avenue, 91<sup>st</sup> Avenue, 83<sup>rd</sup> Avenue, 75<sup>th</sup> Avenue and Grand Avenue. Northern Avenue is stop controlled at Sarival Avenue, Reems Road, El Mirage Road, 103<sup>rd</sup> Avenue, and 99<sup>th</sup> Avenue.

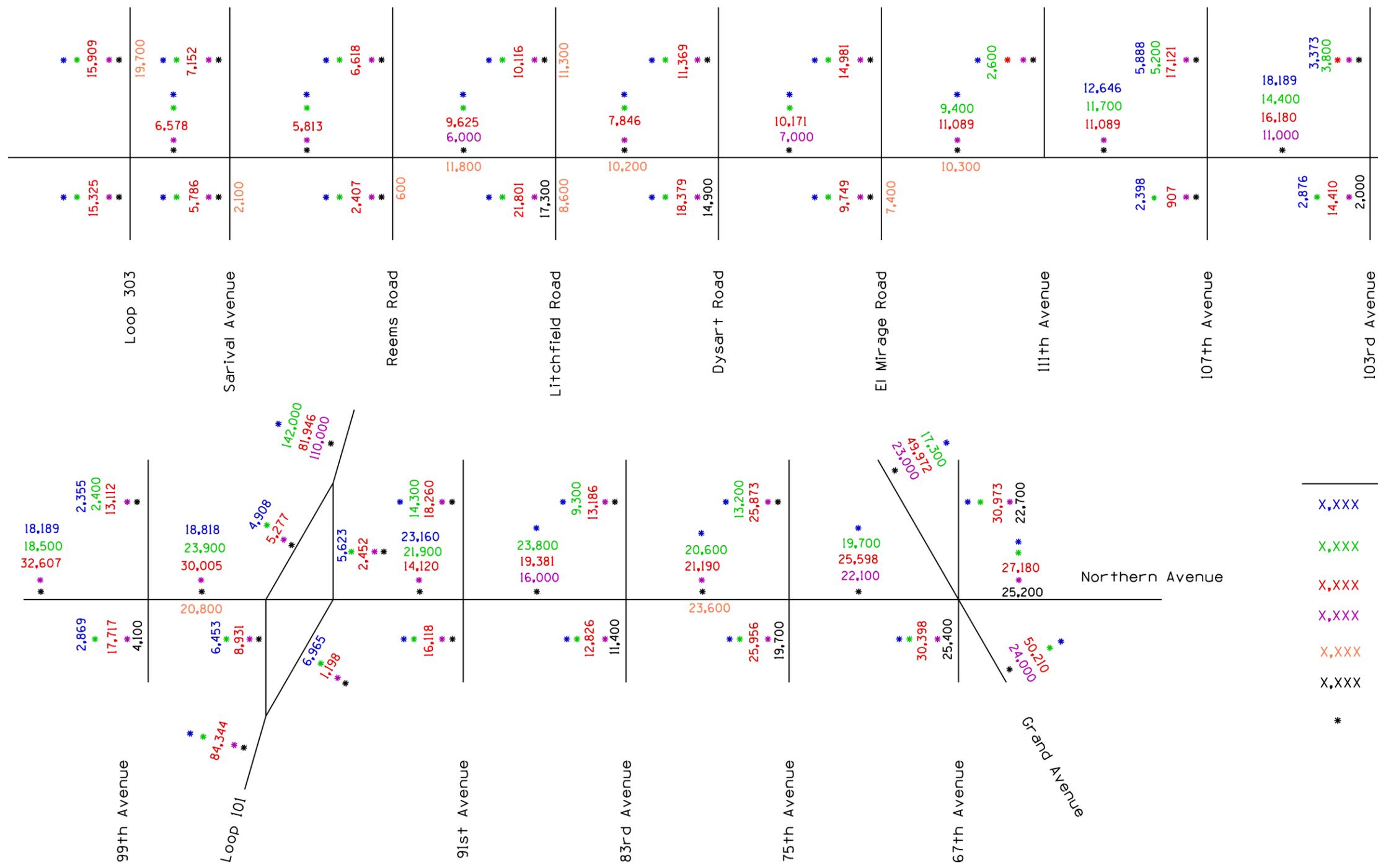
URS reviewed available traffic count data from various sources (MAG, City of Glendale, City of Peoria, and obtained traffic counts by Field Data Services) to document existing 24-hour traffic volumes along facilities within the influence area for this project. A summary of the existing daily traffic data available along the Northern Avenue corridor is shown in Figure 2-1. Also shown are the MAG 2004 simulated traffic volumes.

A comparison of the MAG 2004 simulated traffic volumes to the existing traffic counts revealed that the MAG 2004 model was estimating higher volumes than actual counts on 107<sup>th</sup> Avenue, 103<sup>rd</sup> Avenue, 99<sup>th</sup> Avenue, 91<sup>st</sup> Avenue; on Northern Avenue between 107<sup>th</sup> Avenue and Loop 101; and on Grand Avenue. This information is useful in judging the accuracy of the MAG forecast future design year.

### 2.2 CRASH DATA

#### 2.2.1 Crash History

Collision data along Northern Avenue from Loop 303 to Grand Avenue from January 1, 1999 through February 28, 2005 were obtained from the ADOT Traffic Records Branch. These data include the collision manner, type, and severity of each crash. Of the recorded 700 accidents, 502 were intersection related while the remaining 198 were mid-block accidents along Northern Avenue. A summary of the collision manners along Northern Avenue is shown in Table 2-1.



**LEGEND**

- x,xxx 2005 Daily Traffic Counts (FDS)
- x,xxx 2007 Daily Traffic Counts (City of Peoria website)
- x,xxx 2004 Traffic Volumes (MAG model)
- x,xxx 2005 Daily Traffic Counts (MAG website)
- x,xxx 2006 Traffic Volumes (MCDOT Website)
- x,xxx 2007 Daily Traffic Counts (City of Glendale website)
- \* Traffic Counts Not Available

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**FIGURE 2-1  
EXISTING TRAFFIC CONDITIONS**

**Table 2-1 Collision Manner Summary for Northern Avenue**

Manner Summary	Year							Total	Percent
	1999	2000	2001	2002	2003	2004	2005*		
Rear-end	31	31	19	40	46	56	10	233	33.3
Angle	7	16	23	41	32	49	6	174	24.9
Left-turn	8	12	8	23	20	22	7	100	14.3
Single Vehicle	14	13	10	15	14	14	2	82	11.7
Sideswipe (same direction)	9	7	12	8	11	12	5	64	9.1
U-turn	3	3	2	2	3	3	2	18	2.6
Backing	2	0	0	3	3	5	1	14	2.0
Other	1	1	0	0	3	2	0	7	1.0
Head-on	1	0	1	0	0	2	0	4	0.6
Sideswipe (opposite direction)	1	0	0	0	0	1	0	2	0.3
Non-contact (non-motorcycle)	0	2	0	0	0	0	0	2	0.3
Right-turn	0	0	0	0	0	0	0	0	0.0
Driveway/Alley	0	0	0	0	0	0	0	0	0.0
Non-contact (motorcycle)	0	0	0	0	0	0	0	0	0.0
<b>Total</b>	<b>77</b>	<b>85</b>	<b>75</b>	<b>132</b>	<b>132</b>	<b>166</b>	<b>33</b>	<b>700</b>	<b>100.0</b>

\* Collision data collected from January 1, 2005 through February 28, 2005.

As shown in Table 2-1, 233 (33 percent) of the 700 collisions were rear-end collisions and 174 (25 percent) were angle collisions. These two collision manners account for 58 percent of the total collisions along Northern Avenue from January 1999 through February 2005. Also reflected in Table 2-1 is the increase in total collisions per year. From January 1, 1999 to January 1, 2005, annual collisions increased by 116 percent from 77 to 166. A summary of the accidents by collision type is shown in Table 2-2.

**Table 2-2 Collision Type Summary for Northern Avenue**

Type Summary	Year							Total	Percent
	1999	2000	2001	2002	2003	2004	2005*		
Collision with other MV	63	70	65	119	119	153	31	620	88.6
Fixed Object	10	10	6	11	11	10	2	60	8.6
Miscellaneous	0	1	1	1	0	2	0	5	0.7
Overturning	1	2	0	0	0	1	0	4	0.6
Other	0	1	2	1	0	0	0	4	0.6
Object in Roadway	2	0	0	0	0	0	0	2	0.3
Pedal cyclist	0	0	1	0	1	0	0	2	0.3
Collision with Pedestrian	0	0	0	0	1	0	0	1	0.1
Animal	0	1	0	0	0	0	0	1	0.1
Unknown	1	0	0	0	0	0	0	1	0.1
<b>Total</b>	<b>77</b>	<b>85</b>	<b>75</b>	<b>132</b>	<b>132</b>	<b>166</b>	<b>33</b>	<b>700</b>	<b>100.0</b>

\* Collision data collected from January 1, 2005 through February 28, 2005.

As indicated Table 2-2, 620 of the 700 collisions involved other motor vehicles and accounts for 89 percent of the total collisions along Northern Avenue from January 1, 1999 through February 28, 2005. A summary of the collisions by severity is displayed in Table 2-3.

**Table 2-3 Collision Severity Summary for Northern Avenue**

Severity Summary	Year							Total	Percent
	1999	2000	2001	2002	2003	2004	2005*		
No Injury	95	111	102	183	180	247	58	<b>976</b>	<b>70.4</b>
Possible Injury	21	19	10	30	25	36	1	<b>142</b>	<b>10.2</b>
Non-incapacitating Injury	12	11	15	19	27	33	4	<b>121</b>	<b>8.7</b>
Unknown	14	14	11	15	24	17	0	<b>95</b>	<b>6.9</b>
Incapacitating Injury	6	6	7	14	8	3	1	<b>45</b>	<b>3.2</b>
Fatality	0	0	0	2	2	3	0	<b>7</b>	<b>0.5</b>
<b>Total</b>	<b>148</b>	<b>161</b>	<b>145</b>	<b>263</b>	<b>266</b>	<b>339</b>	<b>64</b>	<b>1,386</b>	<b>100.0</b>

\* Collision data collected from January 1, 2005 through February 28, 2005.

A total of 403 (29 percent) individuals were either injured or possibly injured in the 700 collisions and a total of 7 fatalities occurred along Northern Avenue between Loop 303 and Grand Avenue from January 1, 1999 through February 28, 2005.

Accidents were totaled for each segment of Northern Avenue, and an accident rate per million vehicle-miles traveled (VMT) was calculated for each segment as shown in Table 2-4. The segments were generally defined as a one-mile length of Northern Avenue centered on the cross street listed in the table. The average ADT values listed in the table are the average of the traffic counts values shown in Figure 2-1. It was assumed that the ADT's were constant from 1999 to 2004 (6 years).

**Table 2-4 Northern Avenue Accident Rates**

Segment Location	Segment Length (mi)	Number of Accidents	Average ADT	VMT (million)	Accident Rate per VMT (million)
Sarival	0.5	16	5,800	6.35	2.5
Reems	2.0	32	7,100	31.10	1.0
Litchfield	1.0	40	7,800	17.08	2.3
Dysart	1.0	20	8,400	18.40	1.1
El Mirage Road	1.5	27	9,400	30.88	0.9
107 <sup>th</sup> Avenue	1.5	36	12,900	42.38	0.8
99 <sup>th</sup> Avenue/ Loop 101	1.0	136	17,500	38.33	3.5
91 <sup>st</sup> Avenue	1.0	64	18,200	39.86	1.6
83 <sup>rd</sup> Avenue	1.0	69	18,700	40.95	1.7
75 <sup>th</sup> Avenue	1.0	90	19,200	42.05	2.1
67 <sup>th</sup> Avenue/Grand Avenue	1.0	150	20,800	45.55	3.3

As shown in Table 2-4, the accident rates are highest in the 99<sup>th</sup> Avenue/Loop 101 and the 67<sup>th</sup> Avenue/Grand Avenue segments which include major intersections. These two segments are the only segments that exceed the City of Phoenix average arterial accident rate of 2.63 per million VMT for the years 2001 to 2003.

## 2.2.2 Safety Benefits of Improvements

Crash history of Northern Avenue shows the majority of crashes are rear-end, angle and left-turn type accidents. These types of accidents, in particular rear-end and left turns, are related to intersections and driveways. Establishing an Access Management Plan (see Section 5.4) and then establishing proper design criteria will result in the reduction of some types of crashes along Northern Parkway. Building grade separated intersections (GSI) eliminates vehicle conflicts and therefore will significantly reduce crashes. According to the data in Table 2-5, providing a median to separate opposing traffic could reduce crashes by 30 percent. Widening, lighting, and other project features would improve safety as well.

According to the National Highway Traffic Safety Administration (NHTSA) *Traffic Safety Facts 2004: A Compilation of Motor Vehicle Crash Data from the Fatality Analysis Reporting System and the General Estimates System*, of all crashes around 30 percent occur on two-lane undivided roadways (see Table 2-6 and Figure 2-2).

**Table 2-5 Evaluation of Safety Improvements**

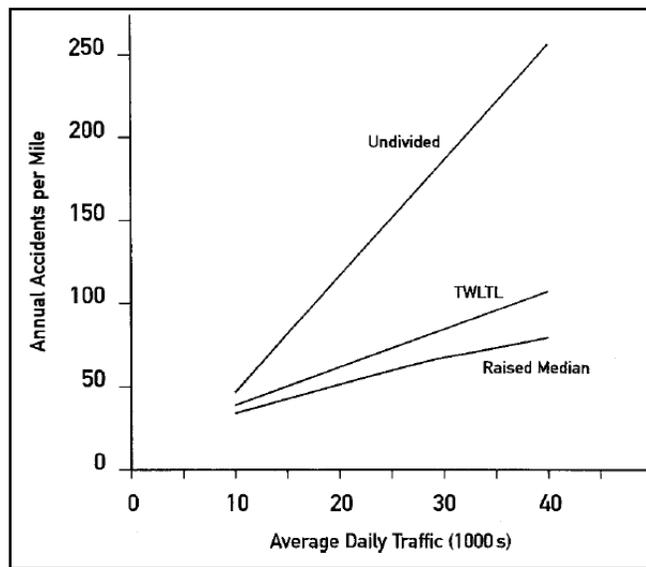
EVALUATION OF SAFETY IMPROVEMENTS BY CONSTRUCTION CLASSIFICATION 1974 -1994			
Construction Classification	Percent Reduction in Accident Rates After Improvements		
	Fatal	Nonfatal Injury	Combined Fatal+Nonfatal Injury
<b>INTERSECTIONS AND TRAFFIC CONTROL</b>			
Turning lanes & Traffic Channelization	48	26	26
Sight Distance Improvements	*56	*43	*43
Traffic Signs	32	15	15
Pavement Markings & Delineators	15	5	6
Illumination	38	14	14
Upgraded Traffic Signals	40	22	22
New Traffic Signals	*53	22	23
<b>STRUCTURES</b>			
Widen or Modify Bridge	49	30	31
New Bridge	86	69	70
Replace or Improve Minor Structure	36	20	21
Upgrade Bridge Rail	75	29	33
<b>ROADWAY</b>			
Construct Median for Traffic Separation	71	28	30
Widen or Improve Shoulder	21	12	12
Realign Roadway	63	41	42
Overlay for Skid Treatment	18	18	18
Groove Pavement for Skid Treatment	33	15	15
<b>ROADSIDE</b>			
Relocated/Breakaway Utility Poles	32	45	44
Upgrade Guardrail	36	8	9
Upgrade Median Barrier	*65	20	22
New Median Barrier	64	12	15
Impact Attenuators	*38	34	34
Flatten Side Slopes	*26	27	27
Remove Obstacles	60	23	25
<b>RAILROAD-HIGHWAY CROSSINGS</b>			
Upgrade Flashing Lights	85	35	44
New Flashing Lights	87	79	81
New Flashing Lights & Gates	92	85	86
New Gates	92	74	78

Note: \* indicates no significant change at the 95 percent confidence level.

(Adapted from The 1996 Annual Report on Highway Safety Improvement Programs. Publication No. FHWA-SA-96-040)

**Table 2-6 Crashes by Number of Lanes**

Crashes by Number of Lanes, Trafficway Flow, and Crash Severity					
Number of Lanes	Trafficway Flow				Total
	Not Divided	Divided	One-Way	Unknown	
All Crashes					
One Lane	24,000	26,000	117,000	2,000	169,000
Two Lanes	1,876,000	574,000	62,000	70,000	2,582,000
Three Lanes	217,000	432,000	44,000	17,000	710,000
Four Lanes	376,000	250,000	18,000	12,000	657,000
More Than Four	503,000	133,000	7,000	20,000	663,000
Unknown	377,000	118,000	28,000	878,000	1,400,000
<b>Total</b>	<b>3,374,000</b>	<b>1,533,000</b>	<b>276,000</b>	<b>999,000</b>	<b>6,181,000</b>



**Figure 2-2 Accidents per Median Type**

### 2.3 GROWTH AND TRAFFIC FORECASTS

MAG utilized the land use elements of adopted general/comprehensive plans for cities and towns within the Northern Parkway study area as the basis for its forecasts. The population and employment forecast are provided in Figure 1-4 and Table 1-1.

Substantial growth in both population and employment is projected to occur within the influence area of the Northern Parkway corridor in the next three decades. Table 1-1 shows the estimated population and employment data for the years 2004, 2010, 2020, and 2030. Population within the

influence area is expected to grow from about 616,000 in 2004 to over 954,000 by 2030. The western portion of the influence area, along Loop 303, is expected to have the most growth, with increases of 200 percent and more.

## **2.4 FORECASTED TRAFFIC VOLUMES**

MAG provided travel forecasting for this project. Ten model runs were used to analyze various options outlined in the Traffic Report. The following four Alternatives are discussed in this section of the report:

- 2030 Alternative 1 – Northern Avenue Alignment, Option 1 (with two traffic signals)
- 2030 Alternative 2 – Northern Avenue Alignment, Option 2 (no traffic signals)
- 2030 Alternative 3 – Southern Alignment
- 2030 No Build Alternative

Based on forecasted future traffic volumes, the directional design hour volumes (DDHV's) were developed for 2030 Alternative 1, 2030 Alternative 2 and 2030 Alternative 3 using a K-factor (Peak Hour Volume/ADT) of 0.085 and a D-factor (Directional Distribution) of 0.60 in the peak directions for Northern Parkway and each of the intersecting north-south arterials between Loop 303 and Grand Avenue. Due to the large overestimation of traffic volumes on 107<sup>th</sup> and 103<sup>rd</sup> avenues seen in Figure 2-1, the forecasted volumes were reduced by 50 percent on these arterials for the analysis of each 2030 alternative.

### **2.4.1 2030 Alternative 1 – Northern Avenue Alignment, Option 1 (with two traffic signals)**

Alternative 1 refers to the Northern Parkway alternative that contains traffic signals at 111<sup>th</sup> Avenue and 107<sup>th</sup> Avenue. This forecast is defined in the MAG EMME/2 model: 2030URS Glendale request Northern as fwyVL2005/31/0511:47 AM, Build Option 1, dated 09/13/06.

In this option, Northern Parkway from Loop 303 to 115<sup>th</sup> Avenue is modeled by MAG as three lanes per direction with a “Collector Distributor” (CD) classification. A CD-Road classification has the per-lane capacity of a freeway with a speed of 50 mph. The specifics of the roadway assumptions included in the model are contained in the Traffic Report.

The average daily traffic volume for the corridor is expected to be approximately 86,000 vpd. Figure 2-3, Figure 2-4, and Figure 2-5 show the forecasted average daily traffic volumes in each direction for Northern Parkway and adjacent arterials for 2030 Alternative 1.

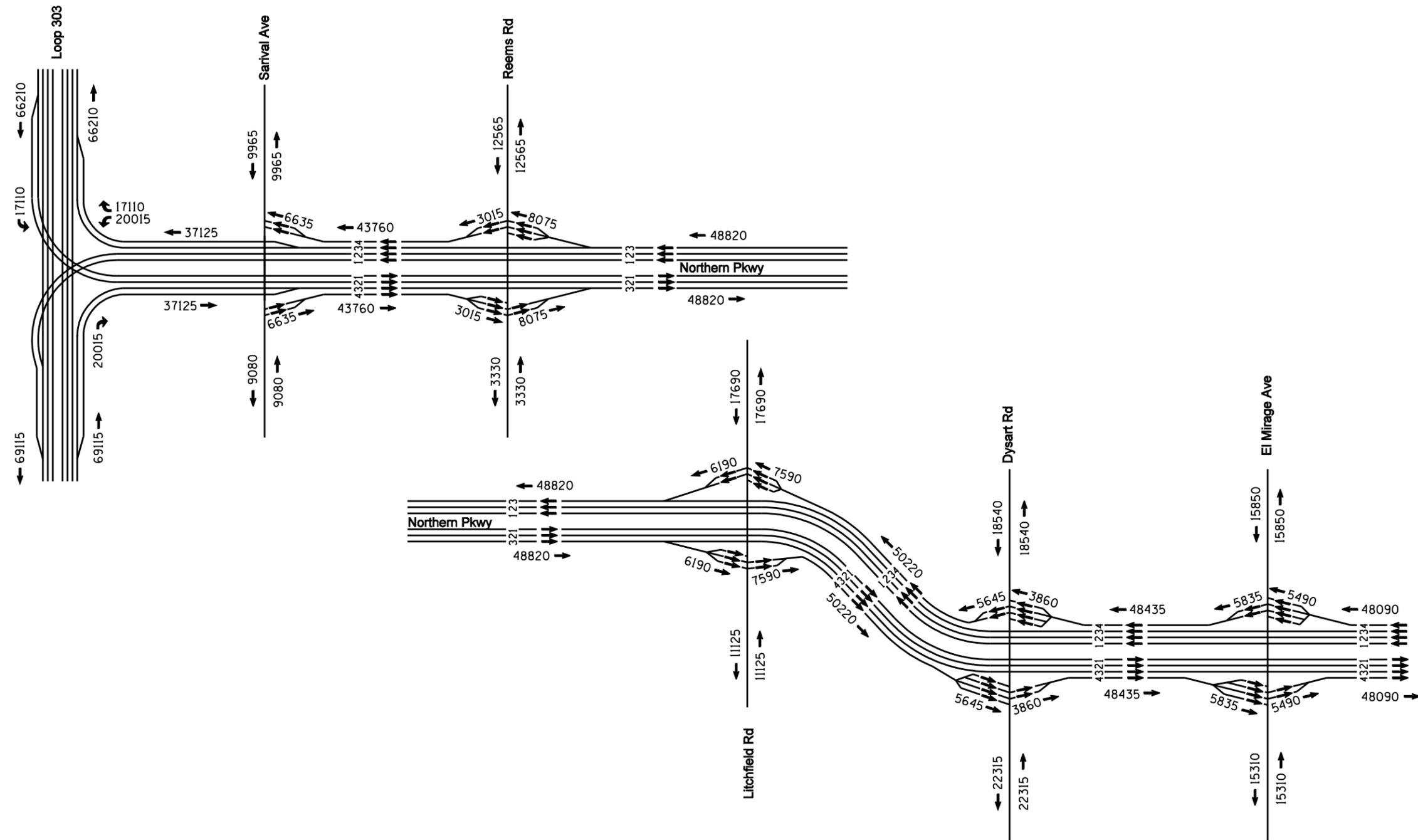


FIGURE 2-3  
 2030 ALTERNATIVE 1 DAILY TRAFFIC PROJECTIONS





## **2.4.2 2030 Alternative 2 – Northern Avenue Alignment, Option 2 (no traffic signals)**

Alternative 2 refers to the Northern Parkway alignment that contains grade separations at 115<sup>th</sup> Avenue and 107<sup>th</sup> Avenue. 111<sup>th</sup> Avenue is a right-in/right-out intersection with Northern Parkway. This forecast is defined as MAG EMME/2 model: 2030URSURS Northern BO 1VL2005/28/1004:53 PM, Build Option 2, dated 11/04/05. The specifics of the roadway assumptions included in the model are contained in the Traffic Report.

The average daily traffic volume for the corridor is expected to be approximately 95,000 vpd. Figure 2-6, Figure 2-7, and Figure 2-8 show the projected directional average daily traffic volumes for Northern Parkway and adjacent arterials for 2030 Alternative 2.

## **2.4.3 2030 Alternative 3 - Southern Alignment**

In the Southern Alignment alternative, Northern Parkway diverts from the Alternative 1 and Alternative 2 alignment east of Dysart Road, and moves south to Glendale Avenue at El Mirage Road. The parkway continues east, traveling parallel to Glendale Avenue to Glen Harbor Boulevard. The parkway travels northeast from Glendale Avenue east of Glen Harbor Boulevard, meeting the Alternative 1 and Alternative 2 alignment at 91<sup>st</sup> Avenue. The Southern Alignment is fully access controlled from Loop 303 to 91<sup>st</sup> Avenue, and includes a system interchange with Loop 101. The Southern Alignment is modeled as a CD-Road from Loop 303 to 83<sup>rd</sup> Avenue. This forecast is defined as MAG EMME/2 model: 2030URSGlendale request Northern as fwyVL2005/31/0511:47 AM (Scenario 10000).

The average daily traffic volume for the corridor is expected to be approximately 95,000 vpd.

Figure 2-9, Figure 2-10, and Figure 2-11 show the projected average daily traffic volumes for Northern Parkway and adjacent arterials for 2030 Southern Alignment.

## **2.4.4 2030 No Build Alternative**

The No Build model consists of no improvements to Northern Avenue from the existing configuration, and other arterial streets in the vicinity improved per local agency future plans. A traffic forecast of the 2030 No Build network was obtained from MAG (see Figure 2-12) and is defined as MAG EMME/2 model: 2030 URSGlendale Request 2030NBLVD2005/30/0604:11PM, dated July 26, 2005.

The average daily traffic volume for the corridor is expected to be approximately 24,000 vpd. Figure 2-12 shows the projected average daily traffic volumes for Northern Parkway and adjacent arterials for 2030 No Build condition.

Screen lines are shown in Figure 2-12 and used in the volume-to-capacity comparisons described in Section 2.4.5.

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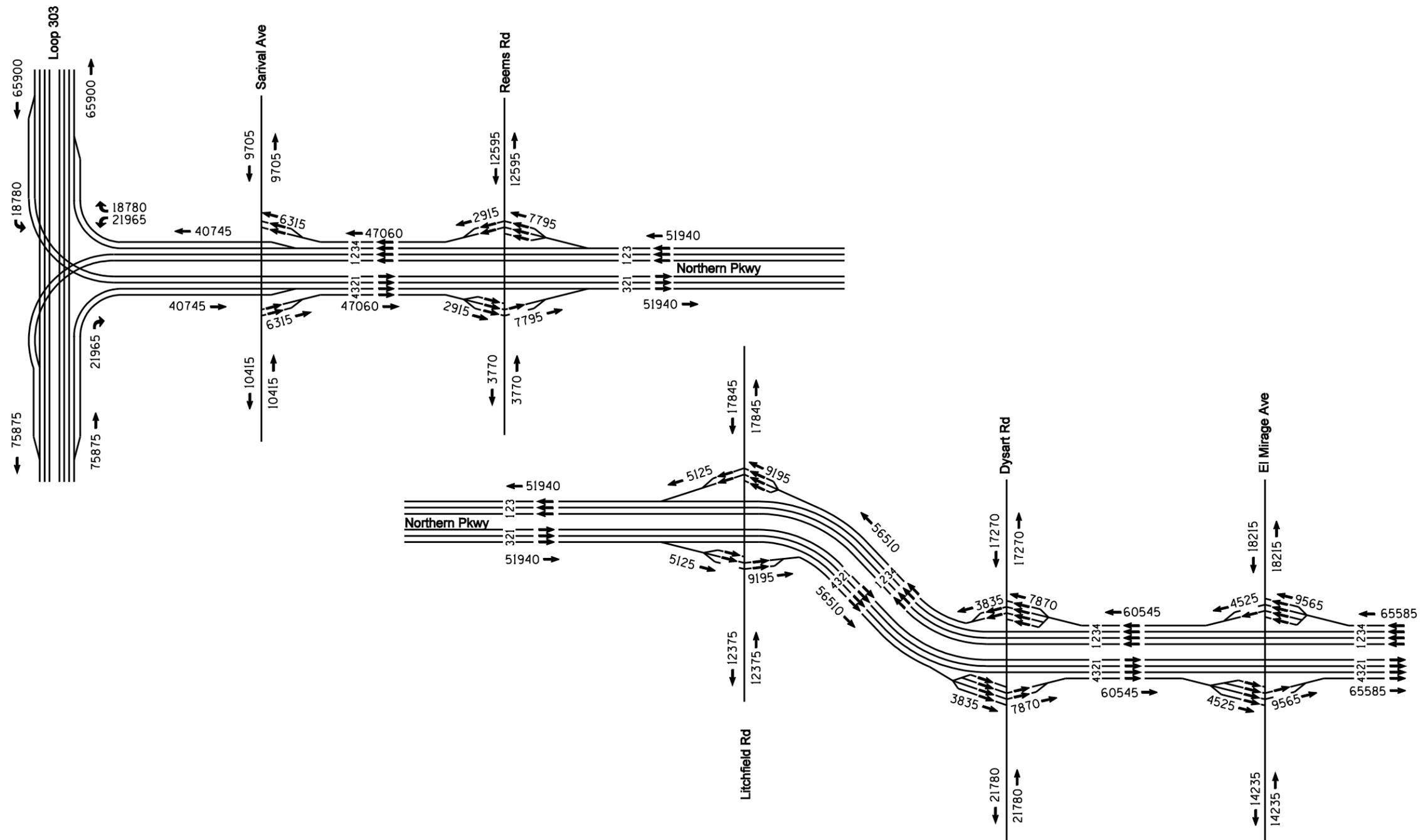
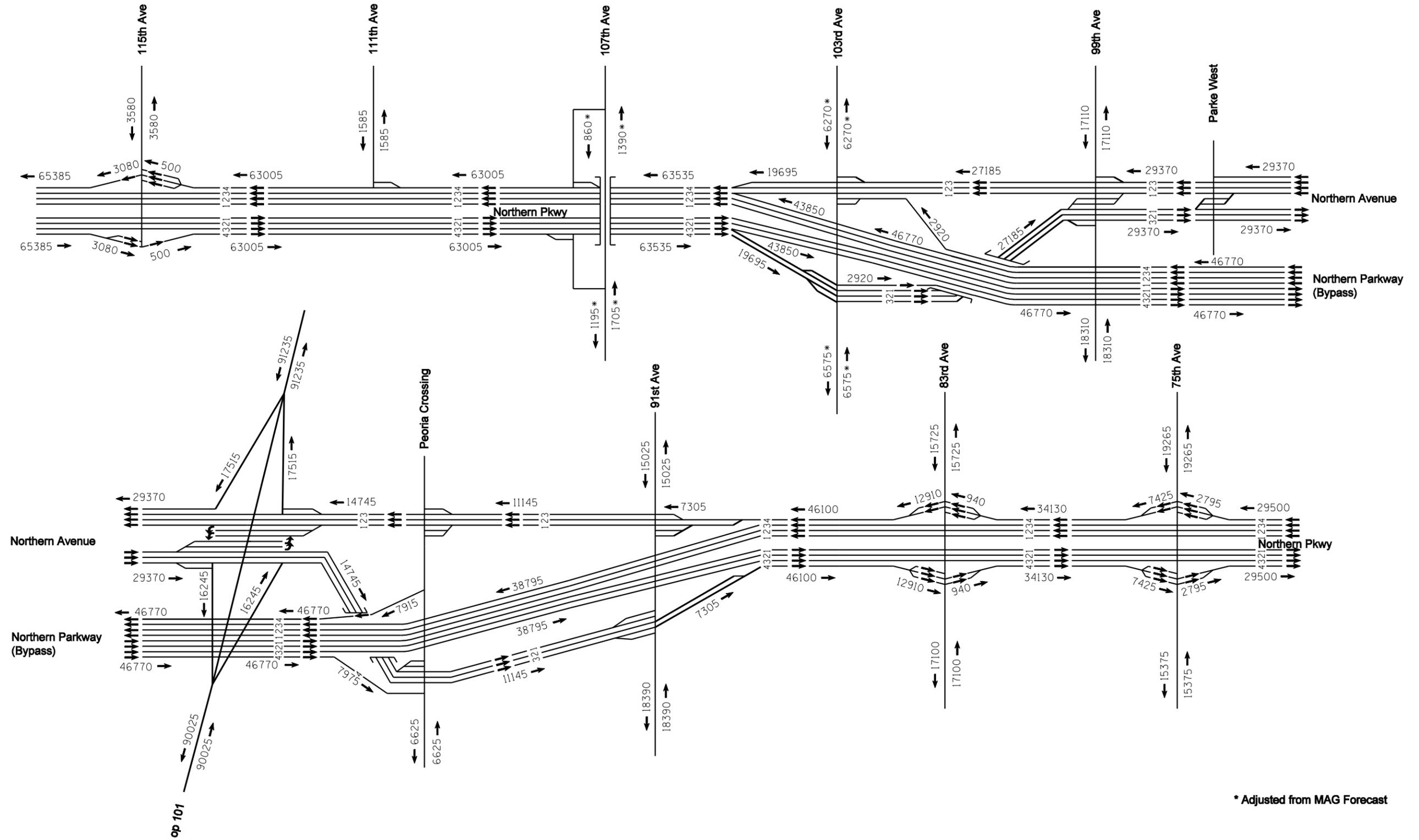


FIGURE 2-6  
2030 ALTERNATIVE 2 DAILY TRAFFIC PROJECTIONS

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\* Adjusted from MAG Forecast

FIGURE 2-7  
2030 ALTERNATIVE 2 DAILY TRAFFIC PROJECTIONS (CONTINUED)



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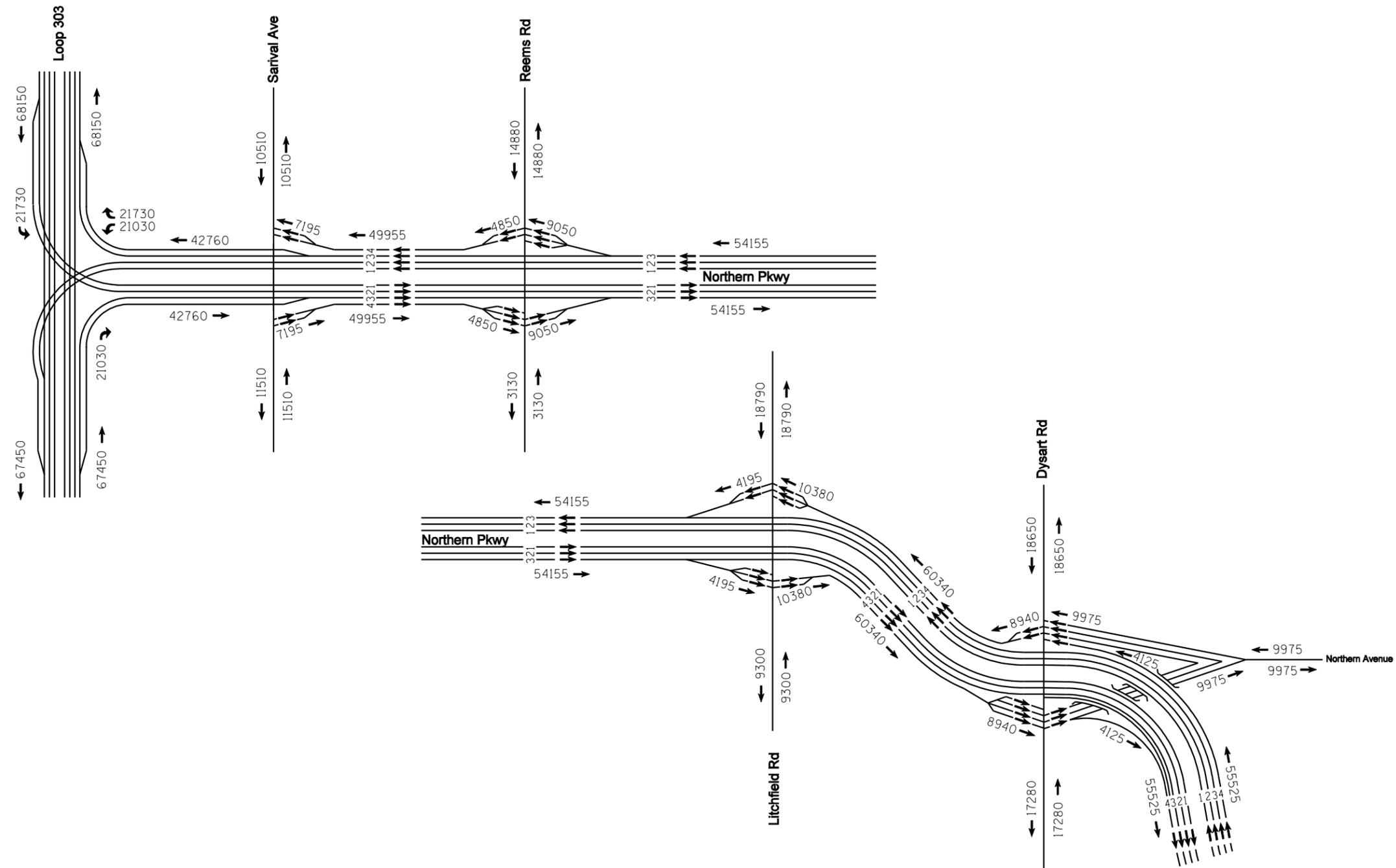
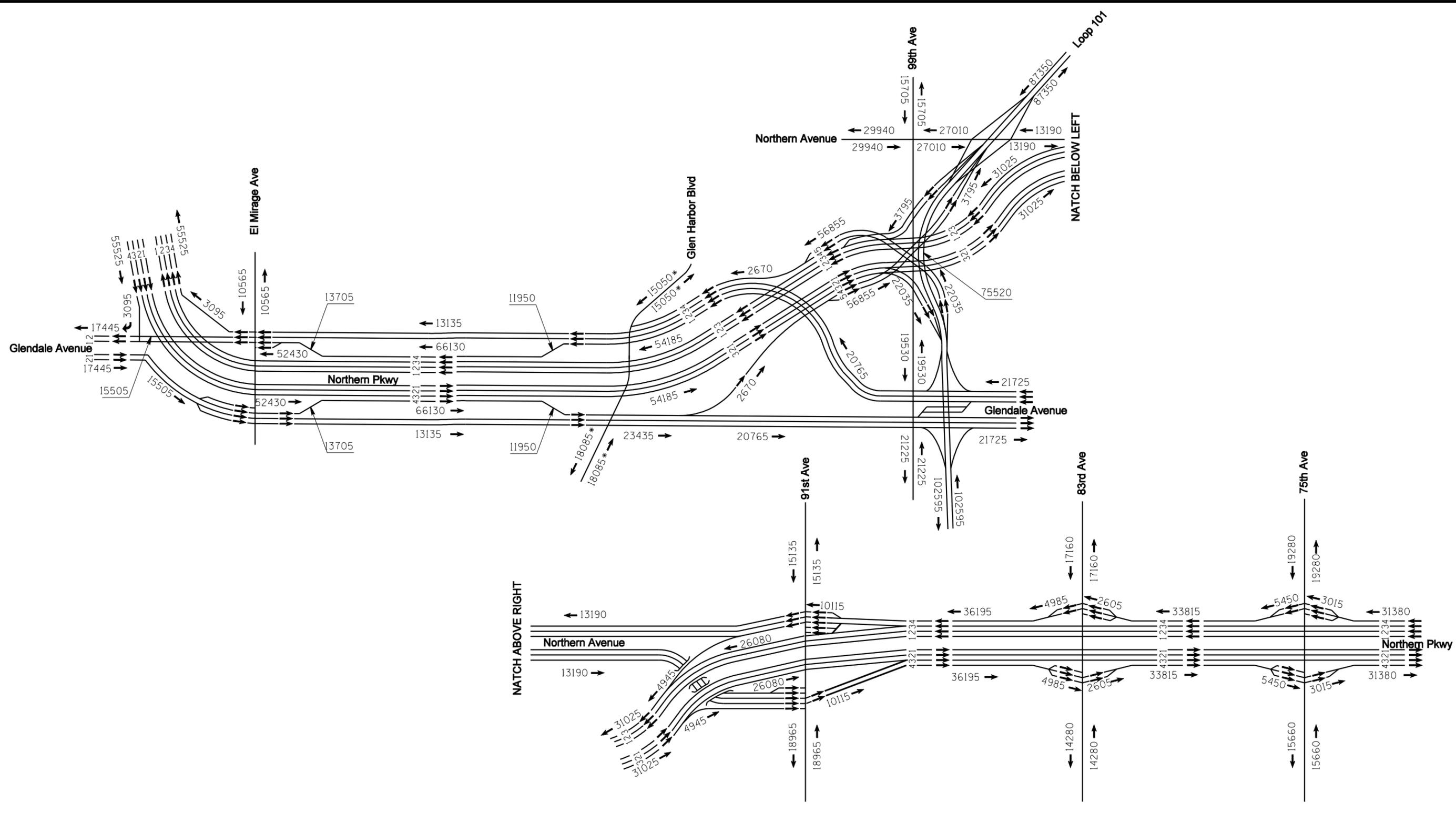


FIGURE 2-9  
2030 ALTERNATIVE 3 DAILY TRAFFIC PROJECTIONS



\* Adjusted from MAG Forecast

FIGURE 2-10  
2030 ALTERNATIVE 3 DAILY TRAFFIC PROJECTIONS (CONTINUED)

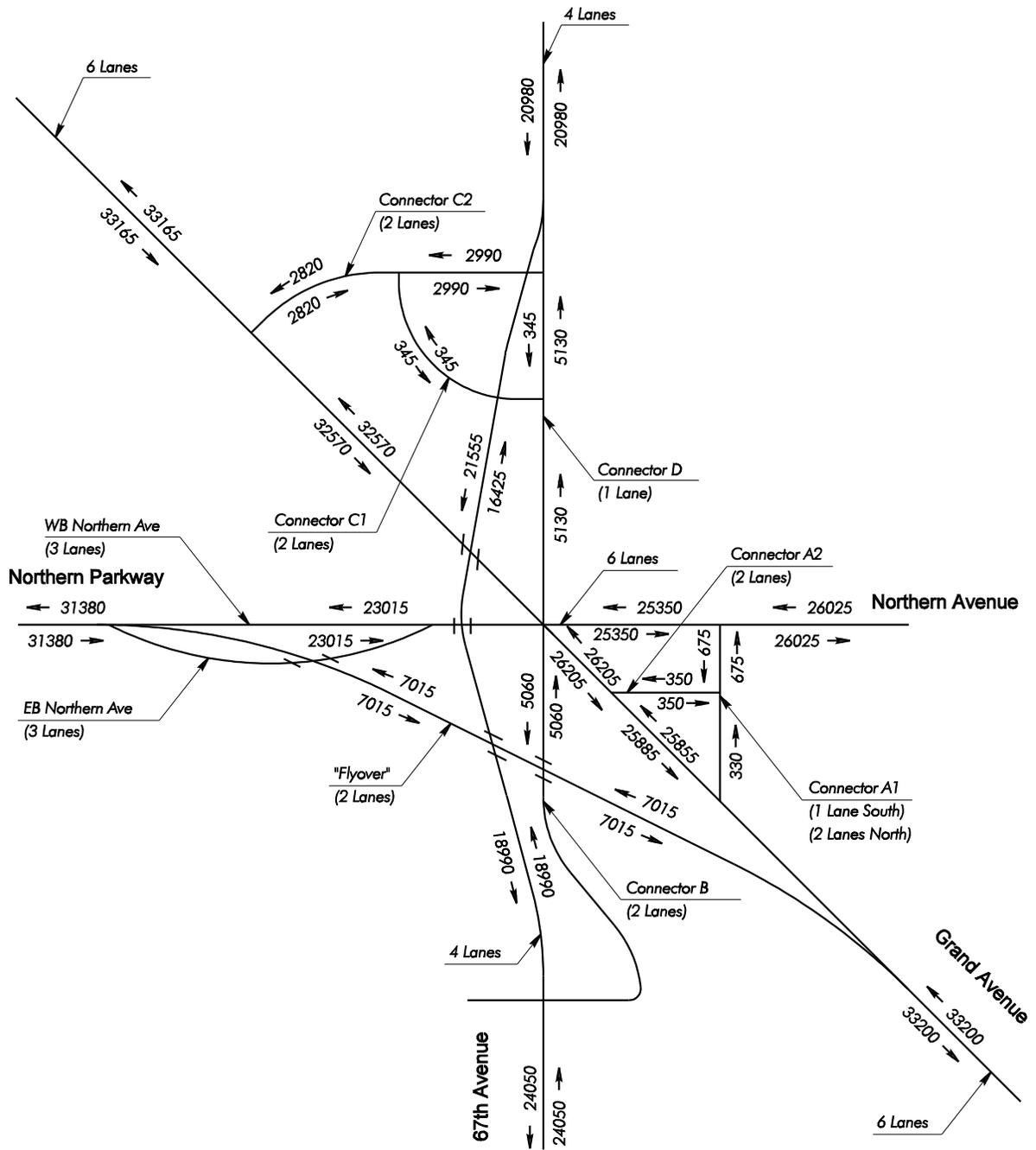
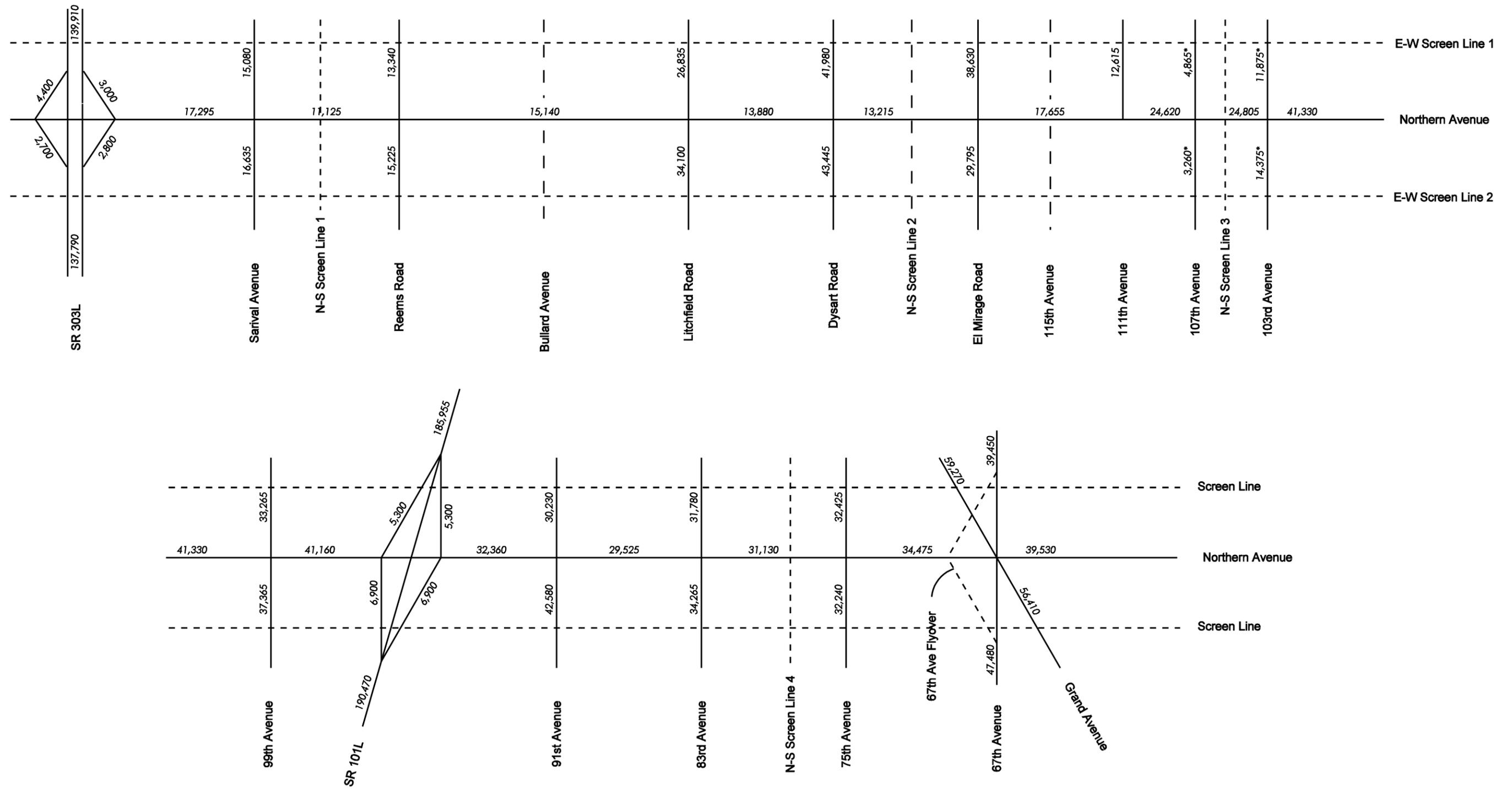


FIGURE 2-11  
2030 ALTERNATIVE 3 DAILY TRAFFIC PROJECTIONS AT GRAND AVENUE



\* Adjusted from MAG Forecast

FIGURE 2-12  
2030 NO-BUILD DAILY TRAFFIC PROJECTIONS

## 2.4.5 Build and No Build Volume-to-Capacity Analysis

A comparison of the 2030 No-Build, Alternative 1, Alternative 2 and Alternative 3 v/c ratios was developed by comparing the forecasted traffic volumes along roadways crossing six screen lines. Screen lines are imaginary lines used to compare traffic volumes for different alternatives. Four north-south screen lines and two east-west screen lines, shown in Figure 2-12, were used to evaluate the impact of the Northern Parkway project on the surrounding roadway network. The volumes along the north-south and east-west screen lines were averaged for a broad comparison. A summary of this comparison can be seen in Table 2-7. The average traffic volume along five major east-west arterials crossing the four north-south screen lines is provided to show an estimate of the impact that Northern Parkway would have over the entire study area. The large decreases in volume on Peoria Avenue, Olive Avenue, Glendale Avenue, and Bethany Home Road indicate that Northern Parkway would significantly increase east-west capacity in this region. The north-south arterials in the study area would experience a variety of changes along the two east-west screen lines. No roadway is likely to experience congestion due to the construction of Northern Parkway. Northern Parkway is not expected to increase volumes on roadways forecasted to be congested in the No Build scenario. The total increase in ADT and decrease in v/c ratio estimated with the build options indicates that Northern Parkway would greatly improve the mobility in the area by increasing the capacity and improving the quality of service provided in the region.

Table 2-8 shows a comparison of the mid-block Level of Service (LOS) on the arterials crossing the screen lines. The east-west arterials each would have a drastic improvement in LOS, indicating that the objective of improving capacity in that direction would likely be successful.

A more detailed comparison of the Build and No Build alternatives is provided in the traffic report.

**Table 2-7 No Build Volume-to-Capacity Comparison**

Roadway	Average Daily Traffic				Difference in ADT			Volume/Capacity Ratio			
	No Build	Alt 1	Alt 2	Alt 3	Alt 1	Alt 2	Alt 3	No Build	Alt 1	Alt 2	Alt 3
<b>North-South Screenline Averages</b>											
Peoria Avenue	23,955	19,815	18,240	19,845	-17%	-24%	-17%	0.72	0.59	0.55	0.60
Olive Avenue	39,780	33,440	30,855	31,630	-16%	-22%	-20%	0.80	0.67	0.62	0.63
Northern Parkway	20,070	89,445	104,595	97,935	346%	421%	388%	0.80	0.44	0.52	0.52
Glendale Avenue	40,685	27,730	26,855	31,940	-32%	-34%	-21%	0.89	0.61	0.59	0.70
Bethany Home Road	24,190	22,655	21,500	21,070	-6%	-11%	-13%	0.73	0.68	0.65	0.63
<b>North-South SL Total*</b>	<b>148,680</b>	<b>193,085</b>	<b>202,045</b>	<b>202,420</b>	<b>30%</b>	<b>36%</b>	<b>36%</b>	<b>0.79</b>	<b>0.53</b>	<b>0.55</b>	<b>0.58</b>
<b>East-West Screenline Averages</b>											
SR 303L	138,850	135,325	141,775	135,605	-3%	2%	-2%	0.77	0.75	0.79	0.75
Sarival Avenue	15,860	19,045	20,120	19,415	20%	27%	22%	0.48	0.57	0.60	0.58
Reems Road	14,280	15,895	16,365	18,010	11%	15%	26%	0.43	0.48	0.49	0.54
Litchfield Road	30,465	28,815	30,220	28,090	-5%	-1%	-8%	0.91	0.86	0.91	0.84
Dysart Road	42,710	40,855	39,050	35,930	-4%	-9%	-16%	0.85	0.82	0.78	0.72
El Mirage Road	34,210	31,160	32,450	27,030	-9%	-5%	-21%	0.82	0.75	0.78	0.81
111th Avenue	12,615	8,590	3,170	-	-32%	-75%	-	0.38	0.52	0.19	-
107th Avenue	4,065	10,075	3,700	-	148%	-9%	-	0.12	0.30	0.11	-
103rd Avenue	13,125	14,035	12,845	30,110	7%	-2%	129%	0.39	0.42	0.39	0.90
99th Avenue	35,315	30,600	35,420	40,760	-13%	0%	15%	0.94	0.73	0.85	0.82
SR 101L	188,210	179,790	181,260	167,125	-4%	-4%	-11%	0.78	0.75	0.76	0.70
91st Avenue	36,405	33,630	33,415	34,100	-8%	-8%	-6%	1.09	0.81	0.80	0.82
83rd Avenue	33,025	32,240	32,825	31,440	-2%	-1%	-5%	0.99	0.77	0.79	0.75
75th Avenue	32,330	34,870	34,640	34,945	8%	7%	8%	0.97	0.84	0.83	0.84
Grand Avenue	57,840	66,340	63,255	66,040	15%	9%	14%	1.16	1.33	1.27	1.32
67th Avenue	43,465	44,275	46,285	45,030	2%	6%	4%	0.95	0.89	0.93	0.90
<b>East-West SL Total*</b>	<b>732,780</b>	<b>725,540</b>	<b>726,795</b>	<b>713,620</b>	<b>-1%</b>	<b>-1%</b>	<b>-3%</b>	<b>0.78</b>	<b>0.75</b>	<b>0.76</b>	<b>0.78</b>

\*Totals based on screen line averages

Note: v/c ratios based on MAG capacities

**Table 2-8 No Build Level of Service Comparison**

Roadway	Level of Service			
	No Build	Alt 1	Alt 2	Alt 3
<b>North-South Screenline Averages</b>				
Peoria Avenue	C	A	A	A
Olive Avenue	C	B	B	B
Northern Parkway	C	A	A	A
Glendale Avenue	D	A	A	B
Bethany Home Road	C	B	B	B
<b>East-West Screenline Averages</b>				
SR 303L	C	C	C	C
Sarival Avenue	A	A	A	A
Reems Road	A	A	A	A
Litchfield Road	E-F	D	D	D
Dysart Road	D	D	C	C
El Mirage Road	D	C	C	D
111th Avenue	A	A	A	-
107th Avenue	A	A	A	-
103rd Avenue	A	A	A	D
99th Avenue	E-F	C	D	D
SR 101L	C	C	C	B
91st Avenue	E-F	C	C	D
83rd Avenue	E-F	C	C	C
75th Avenue	E-F	D	D	D
Grand Avenue	E-F	E-F	E-F	E-F
67th Avenue	E-F	D	E-F	D

## 2.5 TRADITIONAL TRAFFIC OPERATIONAL ANALYSIS

An operational analysis was performed on Alternative 1, Alternative 2, and Alternative 3 to predict each alternative’s performance during the design year..

### 2.5.1 Alternative 1 Roadway Operation Analysis

The Northern Parkway mainline LOS from Loop 303 to Grand Avenue was analyzed for the 2030 Alternative 1 during the morning and evening peak hours using the Level of Service criteria from the Highway Capacity Manual (HCM) and the results are summarized in Table 2-9. Each segment analyzed has 3 lanes in each direction except for the flyover ramp which has one lane in each direction. Table 2-9 shows that all segments operate at LOS D or better with 2030 projected traffic volumes. The directional design hour volumes (DDHV’s) were derived in the Traffic Report.

**Table 2-9 Northern Parkway Free Flow Mainline Sections – 2030 Alternative 1  
Operations Summary**

Northern Parkway Segment	ADT Per Direction	DDHV AM (PM)		LOS AM (PM)	
		EB	WB	EB	WB
Loop 303 to Sarival Avenue	37,125	3485 (2990)	2990 (3485)	C (C)	C (C)
Between Reems Road west and east ramps	40,745	3845 (3140)	3140 (3845)	C (C)	C (C)
Reems Road to Litchfield Road	48,820	4775 (3320)	3320 (4775)	D (C)	C (D)
Between Litchfield Road west and east ramps	42,630	4245 (2900)	2900 (4245)	D (C)	C (D)
Between Dysart Road west and east ramps	44,575	4545 (3030)	3030 (4545)	D (C)	C (D)
Between El Mirage Avenue west and east ramps	42,600	4345 (2970)	2970 (4345)	D (C)	C (D)
Between 111 <sup>th</sup> Avenue and 107 <sup>th</sup> Avenue	44,610	4550 (3035)	3035 (4550)	D (C)	C (D)
Between 103 <sup>rd</sup> Avenue and 91 <sup>st</sup> Avenue (bypass)	47,200	4655 (3205)	3205 (4655)	D (C)	C (D)
Between 83 <sup>rd</sup> Avenue west and east ramps	35,195	3590 (2395)	2395 (3590)	D (C)	C (D)
Between 75 <sup>th</sup> Avenue west and east ramps	28,075	2865 (2355)	2355 (2865)	C (C)	C (C)
Flyover Ramp	7,145	730 (485)	485 (730)	B (B)	B (B)

### 2.5.2 Alternative 1 Signalized Intersection Operations Analysis

This section summarizes the results of the signalized intersection operational analysis for the intersections proposed in the alternative. This analysis was performed in Synchro using the 2030 forecasted volumes obtained from MAG. Table 2-10 summarizes the LOS for each intersection. The table is divided into 4 groups of intersections beginning with ramp intersections with arterial streets at GSI locations, intersections on mainline Northern Parkway, intersections on Northern Avenue parallel streets, and intersections on Grand Avenue.

The projected operations of the signalized intersections at GSIs were analyzed assuming tight urban diamond interchanges (TUDIs) at Sarival Avenue, Reems Road, and Litchfield Road, and SPUIs at the remaining GSIs. The analysis utilized the peak hour volumes provided in the Northern Parkway Traffic Report.

As indicated in Table 2-10, the majority of the signalized intersections are projected to operate with LOS D or better during both the AM and PM peak hours. Level of Service E or F is predicted in 2030 at the mainline intersections of 111<sup>th</sup> and 107<sup>th</sup> avenues, at the Northern Avenue street intersection at 103<sup>rd</sup>, and at Grand and Myrtle avenues. The 111<sup>th</sup> Avenue and 107<sup>th</sup> Avenues intersections are located in existing neighborhoods. Physical constraints with the location of homes plus the need to provide access to the neighborhoods combined to make a less than optimal situation. The intersection configurations are maximized with 4 through lanes in each direction and exclusive left and right turn lanes. There may be an opportunity to install grade separation structures at 115<sup>th</sup> and 107<sup>th</sup> in the future that could alleviate these deficiencies at the signalized intersections as described in Alternative 2.

The intersection of 103<sup>rd</sup> Avenue, the east ramps, and the beginning of the Northern Avenue street section is also constricted physically by residential and industrial development. High volumes of traffic are predicted to pass through this intersection since it will serve as the Northern Parkway connection to Loop 101.

Physical constrictions also govern the intersection of Grand Avenue and Myrtle Avenue. This intersection is not part of the Northern Parkway project and improvements are planned with an ADOT project to be constructed in 2010.

The analysis output sheets for the signalized intersections are included in the Northern Parkway Traffic Report.

**Table 2-10 2030 Alternative 1 Signalized Intersection Operations Summary**

	AM Peak Hour			PM Peak Hour		
	V/C <sup>(1)</sup>	Average Delay <sup>(2)</sup>	LOS <sup>(3)</sup>	V/C <sup>(1)</sup>	Average Delay <sup>(2)</sup>	LOS <sup>(3)</sup>
<b>Northern Parkway Ramp Intersections at GSIs</b>						
Sarival Avenue	0.69	15.5	B	0.67	24.3	C
Reems Road	0.54	20.1	C	0.51	18.0	B
Litchfield Road	0.62	31.5	C	0.92	43.5	D
Dysart Road	0.83	25.0	C	0.76	26.5	C
El Mirage Road	0.60	25.6	C	0.66	26.9	C
83 <sup>rd</sup> Avenue	0.72	21.9	C	0.74	54.1	D
75 <sup>th</sup> Avenue	0.74	32.6	C	0.74	33.0	C
<b>Northern Parkway Mainline Intersections</b>						
111 <sup>th</sup> Avenue	1.33	80.1	F	1.62	179.5	F
107 <sup>th</sup> Avenue	1.66	237.6	F	1.44	185.4	F
<b>Northern Avenue Street Intersections</b>						
103 <sup>rd</sup> Avenue	1.25	132.1	F	1.13	149.2	F
99 <sup>th</sup> Avenue	0.95	52.9	D	0.98	54.9	D
Parke West Access	0.84	18.4	B	0.74	16.0	B
Loop 101 Southbound Ramps	0.65	13.0	B	0.70	16.1	B
Loop 101 Northbound Ramps	0.69	27.7	C	0.93	52.8	D
93 <sup>rd</sup> Avenue/Peoria Crossings	0.87	44.8	D	0.79	46.6	D
91 <sup>st</sup> Avenue	0.74	36.7	D	0.91	44.5	D
Grand Avenue	1.04	41.7	D	1.23	54.3	D
<b>Grand Avenue Intersections</b>						
Connector C2	0.81	16.7	B	0.98	17.1	B
Connector A2	0.72	26.0	C	0.93	31.2	C
Myrtle Avenue	1.09	71.8	E	1.19	84.3	F

- (1) Volume to Capacity Ratio
- (2) Average Delay in seconds
- (3) Level-of-service

### 2.5.3 Alternative 1 Weaving Areas and Ramp Junction Analysis

Merge/diverge and weaving areas for the 2030 Alternative 1 were analyzed using HCS 2000 and the lane configuration and design hour volumes are shown in the Traffic Report. The results of the Northern Parkway merge/diverge and weaving analyses for the AM and PM peak hours are summarized in Table 2-11. The 2030 Alternative 1 merge/diverge and weaving area operational analyses details are provided in the Traffic Report.

**Table 2-11 2030 Alternative 1 Merge/Diverge and Weaving Analyses**

Location	Merge/Diverge LOS		Weaving Area LOS	
	AMPeak	PMPeak	AMPeak	PMPeak
<b>Eastbound Northern Parkway</b>				
Major Merge – From Loop 303	C	B		
Weave – Between Sarival Avenue and Reems Road			C	B
Merge – From Reems Road on-ramp	D	B		
Diverge – To Litchfield Road off-ramp	C	B		
Weave – Between Litchfield Road and Dysart Road			D	B
Weave – Between Dysart Road and El Mirage Road			C	B
Merge – Lane Add from El Mirage on-ramp	C	C		
Diverge – Bypass and Avenue split	B	B		
Merge – Lane Add from 103 <sup>rd</sup> Avenue ramp to Bypass	F	C		
Weave – Between 103 <sup>rd</sup> Avenue and Peoria Crossing (Bypass)			B	B
Merge – Bypass and Avenue merge	C	B		
Weave – Between 91 <sup>st</sup> Avenue and 83 <sup>rd</sup> Avenue			C	B
Weave – Between 83 <sup>rd</sup> Avenue and 75 <sup>th</sup> Avenue			C	B
Weave – Between 75 <sup>th</sup> Avenue and Flyover ramp			C	B
<b>Westbound Northern Parkway</b>				
Weave – Between Flyover ramp and 75 <sup>th</sup> Avenue			B	C
Weave – Between 75 <sup>th</sup> Avenue and 83 <sup>rd</sup> Avenue			B	C
Weave – Between 83 <sup>rd</sup> Avenue and 91 <sup>st</sup> Avenue			B	C
Diverge – Bypass and Avenue split	A	B		
Merge – Lane Add from Peoria Crossing ramp to Bypass	D	C		
Weave – Between Peoria Crossing and 103 <sup>rd</sup> Avenue (Bypass)			B	B
Merge – Bypass and Avenue merge	C	C		
Weave – Between El Mirage Road and Dysart Road			B	C
Weave – Between Dysart Road and Litchfield Road			B	D
Merge – From Litchfield on-ramp	C	B		
Diverge – to Reems Road off-ramp	B	D		
Weave – Between Reems Road and Sarival Avenue			B	C
Major Diverge – To Loop 303	B	B		
<b>SR 101 Loop</b>				
Merge - From Northern Avenue on to 101 Northbound	B	C		
Merge - From Northern Avenue on to 101 Southbound	C	B		

Most of the merge, diverge, and weaving areas are expected to operate with an LOS of D or better. The ramp from 103<sup>rd</sup> Avenue to Northern Parkway in the eastbound direction is likely to experience congestion in the AM peak hour.

#### 2.5.4 Alternative 2 Roadway Operation Analysis

The Northern Parkway mainline LOS from Loop 303 to Grand Avenue was analyzed for the 2030 Alternative 2 during the morning and evening peak hours using the Level of Service criteria from the HCM and is summarized in Table 2-12 and provided in the Traffic Report. Each segment analyzed has 3 lanes in each direction except for the flyover ramp which has one lane in each direction.

Alternative 2 is forecasted to attract higher traffic volumes during the peak hours than Alternative 1 due to the elimination of the at-grade traffic signals in Alternative 1, resulting in several segments with LOS E, as seen in Table 2-12.

**Table 2-12 Northern Parkway Free Flow Sections – 2030 Alternative 2 Operations Summary**

Northern Parkway Segment	ADT Per Direction	DDHV AM (PM)		LOS AM (PM)	
		EB	WB	EB	WB
Loop 303 to Sarival Avenue	40,745	3860 (3230)	3230 (3860)	C (C)	C (C)
Between Reems Road west and east ramps	44,145	4210 (3165)	3165 (4210)	D (C)	C (D)
Reems Road to Litchfield Road	51,940	5155 (3695)	3695 (5155)	D (C)	C (D)
Between Litchfield Road west and east ramps	47,315	4630 (3220)	3220 (4630)	D (C)	C (D)
Between Dysart Road west and east ramps	52,675	5370 (3580)	3580 (5370)	E (C)	C (E)
Between El Mirage Avenue west and east ramps	56,020	5715 (3920)	3920 (5715)	E (D)	D (E)
Between 115 <sup>th</sup> Avenue and 107 <sup>th</sup> Avenue	63,005	6425 (4285)	4285 (6425)	E (D)	D (E)
Between 103 <sup>rd</sup> Avenue and 91 <sup>st</sup> Avenue (bypass)	46,770	4770 (3180)	3180 (4770)	E (D)	D (E)
Between 83 <sup>rd</sup> Avenue west and east ramps	33,190	3385 (1820)	1820 (3385)	D (B)	B (D)
Between 75 <sup>th</sup> Avenue west and east ramps	26,705	2725 (1815)	1815 (2725)	C (B)	B (C)
Flyover Ramp	8,195	835 (555)	555 (835)	C (B)	B (C)

#### 2.5.5 Alternative 2 Signalized Intersection Operations Analysis

This section summarizes the results of the signalized intersection operational analysis for the intersections proposed in Alternative 2. This analysis was performed in Synchro using the 2030 forecasted volumes obtained from MAG. Table 2-13 summarizes the LOS for each intersection. The table is divided into 3 groups of intersections beginning with ramp intersections with arterial streets at GSI locations, intersections on Northern Avenue parallel street, and intersections on Grand Avenue.

The projected operations of the signalized intersections at the GSIs were analyzed assuming tight urban diamond interchanges (TUDIs) at Sarival Avenue, Reems Road, and Litchfield Road, and SPUIs at the remaining GSIs. The analysis utilized the peak hour volumes developed in the Traffic Report. The results of the signalized intersection analysis are summarized in Table 2-13.

As indicated in Table 2-13, the majority of the signalized intersections are projected to operate with LOS D or better during both the AM and PM peak hours, with the exception of 103<sup>rd</sup> Avenue, 99<sup>th</sup> Avenue, and Grand Avenue at Myrtle Avenue and Connector A2. The intersection of 103<sup>rd</sup> Avenue, the east ramps, and the beginning of Northern Avenue street is constricted physically by residential and industrial development. High volumes of traffic are predicted to pass through this intersection since it will serve as the Northern Parkway connection to Loop 101.

Increased traffic for Alternative 2 also has an impact to the Northern Avenue street intersection with 99<sup>th</sup> Avenue. Although Northern Avenue at 99<sup>th</sup> Avenue consists of 3 through lanes in each direction plus dual left-turn lanes and exclusive right-turn lanes, this intersection still will experience some congestion in peak hours. Additional lanes would be difficult to add due to the location of the Northern Parkway bypass and existing commercial development on the northwest corner of the intersection.

The Myrtle Avenue intersection with Grand Avenue is congested with Alternative 2 as it is in Alternative 1.

The analysis output sheets for the signalized intersections are included in the Traffic Report.

**Table 2-13 2030 Alternative 2 Signalized Intersection Operations Summary**

	AM Peak Hour			PM Peak Hour		
	V/C <sup>(1)</sup>	Average Delay <sup>(2)</sup>	LOS <sup>(3)</sup>	V/C <sup>(1)</sup>	Average Delay <sup>(2)</sup>	LOS <sup>(3)</sup>
<b>Northern Parkway Ramp Intersections at GSIs</b>						
Sarival Avenue	0.64	10.9	B	0.74	21.2	C
Reems Road	0.48	20.6	C	0.58	19.7	B
Litchfield Road	0.64	42.0	D	0.67	43.7	D
Dysart Road	0.86	52.6	D	0.95	48.2	D
El Mirage Road	0.75	34.3	C	0.80	33.1	C
115 <sup>th</sup> Avenue	0.35	22.3	C	0.36	22.6	C
83 <sup>rd</sup> Avenue	0.84	36.6	D	0.78	32.7	C
75 <sup>th</sup> Avenue	0.79	43.9	D	0.77	34.6	C
<b>Northern Avenue Street Intersections</b>						
103 <sup>rd</sup> Avenue	1.37	143.2	F	1.37	114.9	F
99 <sup>th</sup> Avenue	1.07	73.1	E	0.92	55.2	E
Parke West Access	0.84	24.6	C	0.96	40.4	D
Loop 101 Southbound Ramps	0.81	13.6	B	0.98	32.1	C
Loop 101 Northbound Ramps	0.90	30.4	C	0.89	32.1	C
93 <sup>rd</sup> Avenue/Peoria Crossings	0.87	51.3	D	0.82	44.2	D
91 <sup>st</sup> Avenue	0.61	35.8	D	0.81	40.5	D
Grand Avenue	0.89	27.6	C	1.13	48.6	D
<b>Grand Avenue Intersections</b>						
Connector C2	0.83	14.4	B	1.01	41.6	D
Connector A2	0.87	27.7	C	1.06	67.5	E
Myrtle Avenue	1.17	116.2	F	1.27	111.8	F

- (1) Volume to Capacity Ratio
- (2) Average Delay in seconds
- (3) Level-of-service

### 2.5.6 Alternative 2 Weaving Areas and Ramp Junction Analysis

Merge/diverge and weaving areas for the 2030 Alternative 2 were analyzed using HCS 2000 and the lane configuration and design hour volumes shown in the Traffic Report. The results of the Northern Parkway merge/diverge and weaving analyses for the AM and PM design hours are summarized in Table 2-14. The 2030 Alternative 2 merge/diverge and weaving area operational analyses details are provided in the Traffic Report.

**Table 2-14 2030 Alternative 2 Merge/Diverge and Weaving Analyses**

Location	Merge/Diverge LOS		Weaving Area LOS	
	AM Peak	PM Peak	AM Peak	PM Peak
<b>Eastbound Northern Parkway</b>				
Major Merge – From Loop 303	D	C		
Weave – Between Sarival Avenue and Reems Road			C	B
Merge – From Reems Road on-ramp	D	C		
Diverge – To Litchfield Road off-ramp	D	C		
Weave – Between Litchfield Road and Dysart Road			E	B
Weave – Between Dysart Road and El Mirage Road			F	C
Weave – Between El Mirage Road and 115 <sup>th</sup> Avenue			F	C
Merge – Lane Add from 115 <sup>th</sup> Avenue on-ramp	F	C		
Diverge – Bypass and Avenue split	C	B		
Merge – Lane Add from 103 <sup>rd</sup> Avenue ramp to Bypass	F	C		
Weave – Between 103 <sup>rd</sup> Avenue and Peoria Crossing (Bypass)			B	B
Merge – Bypass and Avenue merge	C	B		
Weave – Between 91 <sup>st</sup> Avenue and 83 <sup>rd</sup> Avenue			C	B
Weave – Between 83 <sup>rd</sup> Avenue and 75 <sup>th</sup> Avenue			B	B
Weave – Between 75 <sup>th</sup> Avenue and Flyover ramp			C	B
<b>Westbound Northern Parkway</b>				
Weave – Between Flyover ramp and 75 <sup>th</sup> Avenue			B	C
Weave – Between 75 <sup>th</sup> Avenue and 83 <sup>rd</sup> Avenue			B	B
Weave – Between 83 <sup>rd</sup> Avenue and 91 <sup>st</sup> Avenue			B	D
Diverge – Bypass and Avenue split	B	B		
Merge – Lane Add from Peoria Crossing ramp to Bypass	D	F		
Weave – Between Peoria Crossing and 103 <sup>rd</sup> Avenue (Bypass)			B	C
Merge – Bypass and Avenue merge	C	E		
Diverge - From 115th Avenue off-ramp	C	F		
Weave – Between 115 <sup>th</sup> Avenue and El Mirage Road			C	F
Weave – Between El Mirage Road and Dysart Road			C	F
Weave – Between Dysart Road and Litchfield Road			B	E
Merge – From Litchfield on-ramp	C	D		
Diverge – to Reems Road off-ramp	B	D		
Weave – Between Reems Road and Sarival Avenue			B	C
Major Diverge – To Loop 303	B	B		
<b>SR 101 Loop</b>				
Merge - From Northern Avenue on to 101 Northbound	C	C		
Merge - From Northern Avenue on to 101 Southbound	C	B		

Most of the merge, diverge, and weaving areas are expected to operate with an LOS of D or better in Alternative 2. The merge areas eastbound at 115<sup>th</sup> Avenue, and 103<sup>rd</sup> Avenue and westbound at 115<sup>th</sup> Avenue and Peoria Crossing are likely to experience congestion in 2030. The weaving areas between Litchfield Road and 115<sup>th</sup> Avenue are also expected to experience

congestion due to the high volumes forecasted in Alternative 2. The merge at the Bypass and Northern Avenue in the westbound PM is a Level of Service E, representing congestion, though not as heavy as Level of Service F. Adding a travel lane between Litchfield Road and 115<sup>th</sup> Avenue would improve all of the weaving sections in that area to a LOS D or better. Also, adding a lane to Northern Parkway between the ramps at 115<sup>th</sup> Avenue would improve the merge and diverge at that point to LOS C.

### 2.5.7 Alternative 3 Roadway Operation Analysis

The Northern Parkway mainline LOS from Loop 303 to Grand Avenue was analyzed for the 2030 Southern Alignment during the morning and evening peak hours using the Level of Service criteria from the HCM, and the results are summarized in Table 2-15. Each segment analyzed has 3 lanes in each direction except for the flyover ramp which has one lane in each direction.

The Southern Alignment is forecasted to attract higher traffic volumes than Alternative 1 due to the elimination of the traffic signals and the addition of the system interchange with Loop 101, resulting in several segments with LOS E during the peak hours as shown in Table 2-15.

**Table 2-15 Northern Parkway Free Flow Sections – 2030 Alternative 3 Operations Summary**

Northern Parkway Segment	ADT Per Direction	DDHV AM (PM)		LOS AM (PM)	
		EB	WB	EB	WB
Loop 303 to Sarival Avenue	42,760	4360 (2910)	2910 (4360)	D (C)	C (D)
Between Reems Road west and east ramps	49,960	4600 (3065)	3065 (4600)	D (C)	C (D)
Reems Road to Litchfield Road	54,155	5525 (3685)	3685 (5525)	E (C)	C (E)
Between Litchfield Road west and east ramps	49,960	5095 (3400)	3400 (5095)	D (C)	C (D)
Between Dysart Road west and east ramps	51,400	5245 (3495)	3495 (5245)	E (C)	C (E)
Between El Mirage Avenue west and east ramps	52,430	5350 (3565)	3565 (5350)	E (C)	C (E)
Between Glen Harbor Blvd west and east ramps	54,180	5525 (3680)	3680 (5525)	E (C)	C (E)
West of System Interchange with SR 101	56,855	5800 (3865)	3865 (5800)	E (C)	C (E)
East of System Interchange with SR 101	31,025	3165 (2110)	2110 (3165)	C (B)	B (C)
Between 91st Avenue west and east ramps	26,080	2660 (1775)	1775 (2660)	C (B)	B (C)
Between 83 <sup>rd</sup> Avenue west and east ramps	31,210	3180 (2120)	2120 (3180)	D (B)	B (D)
Between 75 <sup>th</sup> Avenue west and east ramps	28,365	2895 (1930)	1930 (2895)	C (B)	B (C)
Flyover Ramp	7,015	715 (475)	475 (715)	B (B)	B (B)

### 2.5.8 Alternative 3 Signalized Intersection Operations Analysis

This section summarizes the results of the signalized intersection operational analysis for the intersections proposed in Alternative 3. This analysis was performed in Synchro using the 2030 forecasted volumes obtained from MAG. Table 2-16 summarizes the LOS for each intersection.

The table is divided into 2 groups of intersections including ramp intersections with arterial streets at GSI locations, and intersections on Grand Avenue.

The projected operations of the signalized intersections at the GSIs were analyzed assuming tight urban diamond interchanges (TUDIs) at Sarival Avenue, Reems Road, and Litchfield Road, and SPUIs at the remaining GSIs. The analysis utilized the peak hour volumes developed in the Traffic Report. The results of the signalized intersection analysis are summarized in Table 2-13.

**Table 2-16 2030 Alternative 3 Signalized Intersection Operations Summary**

	AM Peak Hour			PM Peak Hour		
	V/C <sup>(1)</sup>	Average Delay <sup>(2)</sup>	LOS <sup>(3)</sup>	V/C <sup>(1)</sup>	Average Delay <sup>(2)</sup>	LOS <sup>(3)</sup>
<b>Northern Parkway Ramp Intersections at GSIs</b>						
Sarival Avenue	0.33	18.7	B	0.33	19.9	B
Reems Road	0.31	31.3	C	0.31	30.4	C
Litchfield Road	0.40	29.6	C	0.39	25.5	C
Dysart Road	0.89	35.6	D	0.88	32.9	C
El Mirage Road	1.53	103.5	F	1.34	85.4	F
Glen Harbor Boulevard	1.14	69.1	E	1.24	88.9	F
91st Avenue	0.95	33.6	C	1.03	46.7	D
83 <sup>rd</sup> Avenue	0.81	26.4	C	0.71	27.1	C
75 <sup>th</sup> Avenue	0.87	30.0	C	0.81	28.3	C
<b>Grand Avenue Intersections</b>						
Northern Avenue	1.15	50.8	D	1.42	122.0	F
Myrtle Avenue	1.17	116.2	F	1.27	111.8	F
Connector C2	0.85	10.3	B	1.06	32.9	C
Connector A2	0.78	7.0	A	0.91	62.4	E

(1) Volume to Capacity Ratio

As indicated in Table 2-16, the majority of the signalized intersections are projected to operate with LOS D or better during both the AM and PM peak hours, with the exceptions of El Mirage Road at Northern Parkway and Connector A2 at Grand Avenue in the PM peak hour. The analysis output sheets for the signalized intersections are included in the Traffic Report.

### 2.5.9 Alternative 3 Weaving Area and Ramp Junction Analysis

Merge/diverge and weaving areas for the 2030 Alternative 3 were analyzed using HCS 2000 and the lane configuration and design hour volumes are shown in the Traffic Report. The results of the Northern Parkway merge/diverge and weaving analyses for the AM and PM design hours are summarized in Table 2-17. The 2030 Alternative 3 merge/diverge and weaving area operational analyses details are provided in the Traffic Report.

**Table 2-17 2030 Alternative 3 Merge/Diverge and Weaving Analyses**

Location	Merge/Diverge LOS		Weaving Area LOS	
	AM Peak	PM Peak	AM Peak	PM Peak
<b>Eastbound Northern Parkway</b>				
Major Merge – From Loop 303	D	C		
Weave – Between Sarival Avenue and Reems Road			D	B
Merge – From Reems Road on-ramp	D	C		
Diverge – To Litchfield Road off-ramp	D	B		
Weave – Between Litchfield Road and Dysart Road			F	C
Weave – Between Dysart Road and El Mirage Road			D	B
Merge – From El Mirage Avenue on-ramp	F	C		
Diverge – To Glen Harbor Blvd off-ramp	D	C		
Weave – Between Glen Harbor Blvd and Loop 101			F	D
Diverge - To 91st Avenue off-ramp	C	B		
Weave – Between 91 <sup>st</sup> Avenue and 83 <sup>rd</sup> Avenue			B	B
Weave – Between 83 <sup>rd</sup> Avenue and 75 <sup>th</sup> Avenue			B	B
Weave – Between 75 <sup>th</sup> Avenue and Flyover ramp			B	B
<b>Westbound Northern Parkway</b>				
Weave – Between Flyover ramp and 75 <sup>th</sup> Avenue			B	C
Weave – Between 75 <sup>th</sup> Avenue and 83 <sup>rd</sup> Avenue			B	B
Weave – Between 83 <sup>rd</sup> Avenue and 91 <sup>st</sup> Avenue			B	C
Merge - From 91st Avenue on-ramp	B	B		
Merge - From NB Loop 101 on Ramp	B	C		
Merge - From SB Loop 101 on Ramp	A	B		
Weave – Between Loop 101 and Glen Harbor Blvd			D	F
Merge – From Glen Harbor Blvd on-ramp	F	F		
Diverge – To El Mirage Avenue off-ramp	C	D		
Weave – Between El Mirage Road and Dysart Road			B	D
Weave – Between Dysart Road and Litchfield Road			C	F
Merge – From Litchfield on-ramp	C	D		
Diverge – to Reems Road off-ramp	B	C		
Weave – Between Reems Road and Sarival Avenue			B	D
Major Diverge – To Loop 303	B	C		
<b>SR 101 Loop</b>				
Merge - From Northern Parkway on to NB Loop 101	A	A		
Merge - From Northern Parkway on to SB Loop 101	C	B		

Most of the merge, diverge, and weaving areas are expected to operate with an LOS of D or better in Alternative 3. The merge/diverge area between El Mirage Avenue and Glen Harbor Boulevard both eastbound and westbound, as well as the weaving sections between Litchfield and Dysart, and Glen Harbor and Loop 101 are likely to experience congestion in 2030. The Loop 101 will continue to operate at an acceptable level of service.

## 2.6 TURNING LANE ANALYSIS

A Turn Lane Analyses was completed for Alternative 1 to determine the number of right-turn and left-turn lanes needed at GSI ramp/arterial intersections and estimate the storage length of the turn lane. The methodology to determine the number of turn lanes primarily used for the cross-streets to Northern Parkway is the MCDOT Roadway Design Manual (RDM). Per the RDM, when the design hour right-turn volume exceeds 300 vph, a separate right-turn lane should be constructed. When the design hour left-turn volumes exceed 300 vph, a double left-turn lane should be constructed.

An exclusive left turn was provided at all signalized intersections along the parkway and at ramp/arterial intersections. Some locations require dual left-turn lanes. Some locations have heavy right-turn volumes and would benefit from free-flow right configuration.

The reference utilized to determine the impact on through traffic from traffic that would enter or exit Northern Parkway by a right turn is “Impacts of Access Management Techniques,” by the Transportation Research Board (TRB). This document is also identified as National Cooperative Highway Research Program (NCHRP) Report 420. Page 45 of the NCHRP Report 420 provides an empirically derived equation to determine the percentage of through traffic that is impacted by right-turning traffic. The length of each turn lane was determined assuming a length per vehicle of 25 feet and a cycle length for each signal of 120 seconds. Therefore, if the right-turn queue is 10 vehicles, then the turn lane length needed is 250 feet. Using the above methodologies and the outputs from the Synchro software for 2030 peak hour volume, the number of turn lanes and lengths were determined at all cross-streets to Northern Parkway as shown in Table 2-18 and Table 2-19. These turning volumes are preliminary and are subject to change as the area develops. Further analysis should be conducted on updated traffic data during final design.

**Table 2-18 Intersecting Arterial Turning Lane Storage Length Recommendations**

Cross Street	Direction	Right Turn Lane				Left Turn Lane			
		DHV (vph)	Lanes	Queue Length (veh)	Storage Length (ft)	DHV (vph)	Lanes	Queue Length (veh)	Storage Length (ft)
Sarival Avenue	NB	265	1	9	225	-	-	-	-
Reems Road	NB	-	-	-	-	95	1	4	160*
Litchfield Road	NB	-	-	-	-	170	2	3	160*
Dysart Road	NB	255	1	9	160*	425	2	8	200
El Mirage Road	NB	-	-	-	-	245	2	5	160*
107th Avenue	NB	-	-	-	-	490	1	17	425
103rd Avenue	NB	640	1	22	275	115	2	2	160*
99th Avenue	NB	520	1	18	225	515	2	9	225
SR 101L	NB	140	1	5	160*	1180	2	20	500
93rd Avenue	NB	-	-	-	-	620	2	11	275
91st Avenue	NB	415	1	14	160*	860	2	15	375
83rd Avenue	NB	-	-	-	-	470	2	8	200
75th Avenue	NB	-	-	-	-	260	2	5	160*
Sarival Avenue	SB	-	-	-	-	410	2	7	175
Reems Road	SB	-	-	-	-	715	2	12	300
Litchfield Road	SB	360	1	12	300	680	2	12	300
Dysart Road	SB	-	-	-	-	115	2	2	160*
El Mirage Road	SB	-	-	-	-	310	2	6	160*
111th Avenue	SB	500	1	17	225	95	1	4	160*
107th Avenue	SB	-	-	-	-	385	1	13	325
103rd Avenue	SB	-	-	-	-	565	2	10	250
99th Avenue	SB	505	1	17	225	840	2	14	350
SR 101L	SB	755	1	26	160*	755	2	13	325
91st Avenue	SB	320	1	11	275	265	2	5	160*
83rd Avenue	SB	470	1	16	160*	70	2	2	160*
75th Avenue	SB	575	1	20	160*	175	2	3	160*
Grand Avenue	SB	590	1	20	500	-	-	-	-

\*Minimum storage length of 160', per MCDOT RDM.

Storage length calculations use 25' average vehicle length and 120 second cycle lengths

**Table 2-19 Northern Parkway/Ramp Turning Lane Storage Length Recommendations**

Cross Street	Direction	Right Turn Lane				Left Turn Lane			
		DHV (vph)	Lanes	Queue Length (veh)	Storage Length (ft)	DHV (vph)	Lanes	Queue Length (veh)	Storage Length (ft)
Reems Road	EB	95	1	4	160*	230	2	4	160*
Litchfield Road	EB	170	1	6	160*	360	2	6	160*
Dysart Road	EB	425	1	15	160*	125	2	3	160*
El Mirage Road	EB	240	1	8	160*	285	2	5	160*
111th Avenue	EB	-	-	-	-	500	1	17	425
107th Avenue	EB	305	1	11	275	120	1	4	160*
103rd Avenue	EB	105	1	4	160*	90	2	2	160*
99th Avenue	EB	515	1	18	160*	505	2	9	225
SR 101L	EB	900	1	30	275	1165	2	20	500
93rd Avenue	EB	355	1	12	300	-	-	-	-
91st Avenue	EB	860	1	29	275	320	2	6	160*
83rd Avenue	EB	470	1	16	160*	470	2	8	200
75th Avenue	EB	575	1	20	160*	575	2	10	250
Grand Avenue	EB	375	1	13	160*	-	-	-	-
Sarival Avenue	WB	265	1	9	225	265	2	5	160*
Reems Road	WB	215	1	8	160*	215	2	4	160*
Litchfield Road	WB	680	1	23	160*	195	2	4	160*
Dysart Road	WB	115	1	4	160*	235	2	4	160*
El Mirage Road	WB	310	1	11	160*	200	2	4	160*
107th Avenue	WB	175	1	6	160*	440	1	15	375
103rd Avenue	WB	705	1	24	330	840	2	14	350
99th Avenue	WB	840	1	28	225	520	2	9	225
SR 101L	WB	205	1	7	160*	420	2	7	175
93rd Avenue	WB	-	-	-	-	530	2	9	225
91st Avenue	WB	265	1	9	225	415	2	7	175
83rd Avenue	WB	70	1	3	160*	50	2	1	160*
75th Avenue	WB	175	1	6	160*	50	2	1	160*
Grand Avenue	WB	875	1	30	300	-	-	-	-

\*Minimum storage length of 160', per MCDOT RDM.

Storage length calculations use 25' average vehicle length and 120 second cycle lengths