

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 111th Avenue. The speed limit along this section of Northern Avenue is 50 mph. Northern Avenue widens to four lanes, with a center turn lane, at 111th 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, 107th Avenue, SR 101L/Agua Fria Freeway (Loop 101) west side ramps, Loop 101 east side ramps, 93rd Avenue, 91st Avenue, 83rd Avenue, 75th Avenue and Grand Avenue. Northern Avenue is stop controlled at Sarival Avenue, Reems Road, El Mirage Road, 103rd Avenue, and 99th Avenue.

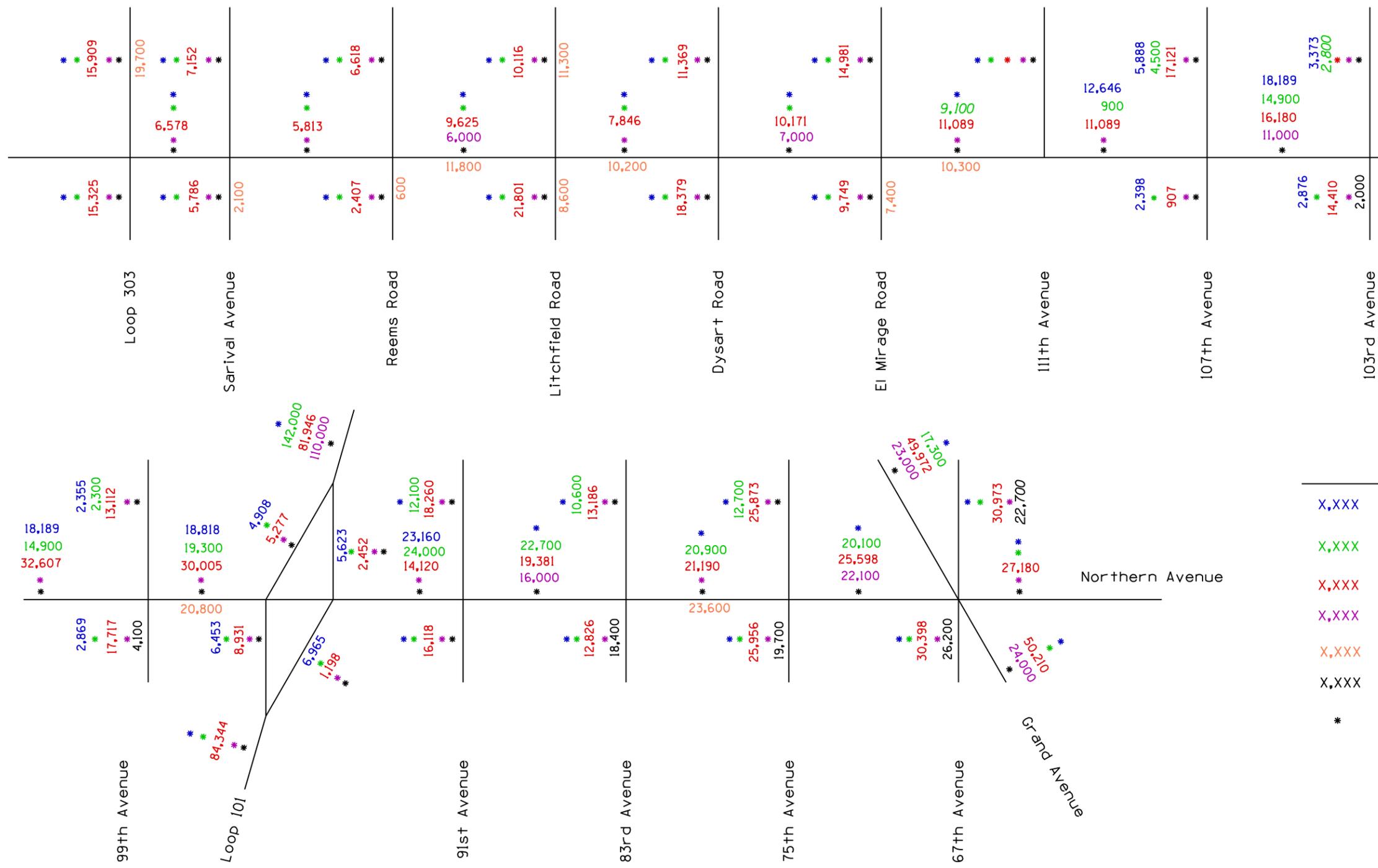
URS reviewed available traffic count data from various sources (MAG, City of Glendale, City of Peoria, and obtained traffic counts by Field Data Services) to document existing 24-hour traffic volumes along facilities within the influence area for this project. A summary of the existing daily traffic 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 107th Avenue, 103rd Avenue, 99th Avenue, 91st Avenue; on Northern Avenue between 107th 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	2005-2006 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	2003 Daily Traffic Counts (City of Glendale website)
*	Traffic Counts Not Available

FIGURE 2-1
EXISTING TRAFFIC CONDITIONS

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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
Total	77	85	75	132	132	166	33	700	100.0

* 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
Total	77	85	75	132	132	166	33	700	100.0

* 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	976	70.4
Possible Injury	21	19	10	30	25	36	1	142	10.2
Non-incapacitating Injury	12	11	15	19	27	33	4	121	8.7
Unknown	14	14	11	15	24	17	0	95	6.9
Incapacitating Injury	6	6	7	14	8	3	1	45	3.2
Fatality	0	0	0	2	2	3	0	7	0.5
Total	148	161	145	263	266	339	64	1,386	100.0

* 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 th Avenue	1.5	36	12,900	42.38	0.8
99 th Avenue/ Loop 101	1.0	136	17,500	38.33	3.5
91 st Avenue	1.0	64	18,200	39.86	1.6
83 rd Avenue	1.0	69	18,700	40.95	1.7
75 th Avenue	1.0	90	19,200	42.05	2.1
67 th 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 99th Avenue/Loop 101 and the 67th 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
INTERSECTIONS AND TRAFFIC CONTROL			
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
STRUCTURES			
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
ROADWAY			
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
ROADSIDE			
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
RAILROAD-HIGHWAY CROSSINGS			
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
Total	3,374,000	1,533,000	276,000	999,000	6,181,000

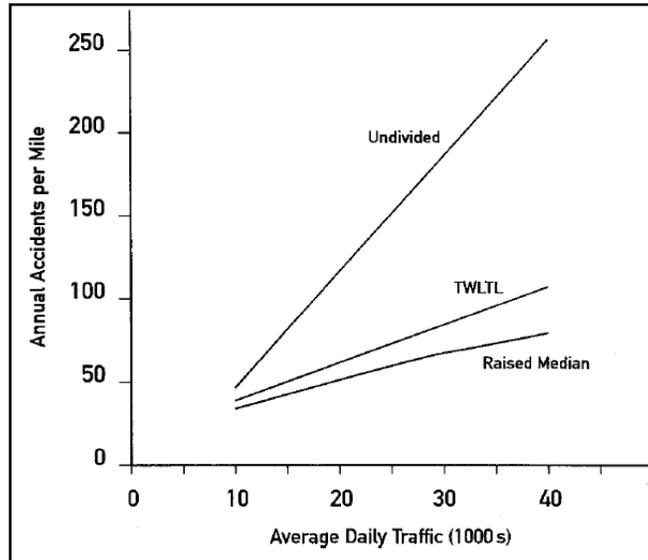


Figure 2-2 Accidents per Median Type

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 1-3 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 for the analysis:

- 2015 Interim (at-grade)
- 2015 West to East
 - With Loop 303 System Interchange
 - Without Loop 303 System Interchange
 - Interim (four lanes)
- 2030 Option 1
- 2030 Option 2
- 2030 Southern Alignment
- 2030 West to East
- 2030 West to East (four lanes)
- 2030 No-Build

Based on forecasted future traffic volumes, the directional design hour volumes (DDHV's) were developed for 2030 Option 1 and 2030 Option 2 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 107th and 103rd 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 2015 Interim (at-grade)

The MAG 2015 model utilized an interpolated socioeconomic data set from two existing databases, 2010 and 2020. The network in the 2015 model incorporated likely roadway improvements included in the master plans of area communities. The 2015 model also included the current MAG RTP Improvements scheduled for implementation by 2015. This forecast is defined in the MAG EMME/2 model: 2015URSCONTRACT No. C-4544VL2005/08/0609:13 AM.

The 2015 Interim condition assumes that Northern Parkway will be a new four-lane divided arterial with at-grade signalized intersections on the Butler Alignment between Loop 303 and

Dysart Road. Between Dysart Road and 112th Avenue, the existing two-lane Northern Avenue would be widened to four lanes. East of 112th Northern Avenue would remain the same as existing (four-lane) in this 2015 model. Average daily traffic volumes on Northern Parkway will range from 12,600 vehicles per day (vpd) between Sarival Avenue and Reems Road to 30,300 vpd between 75th Avenue and Grand Avenue. The average daily traffic volume for the corridor will be approximately 23,300 vpd. Figure 2-3 shows the average daily traffic volumes for Northern Avenue/Parkway and adjacent arterials for the 2015 Interim condition.

2.4.2 2015 West to East

The 2015 West to East traffic forecasts were based on the socioeconomic data developed for the 2015 Interim condition, using interpolated 2010 and 2020 databases. This alternative calls for a phased construction of Northern Parkway beginning from the west end of the corridor and progressing east with the planned improvements by 2015 consistent with the Option 1 design. The 103rd Avenue GSI and the bypass between 103rd and 91st avenues are not included. The existing Northern Avenue between Loop 101 and Grand Avenue would remain as currently configured. Three separate forecasts were created to account for possible phasing options. The first forecast models the West to East network with a system interchange at Loop 303. The second does not have this interchange, and Northern Parkway begins at Sarival Avenue. The third option includes the connection to Loop 303 and GSI; however, only the outer two lanes in each direction would be constructed by 2015 from Loop 303 to El Mirage Road.

With Loop 303 System Interchange

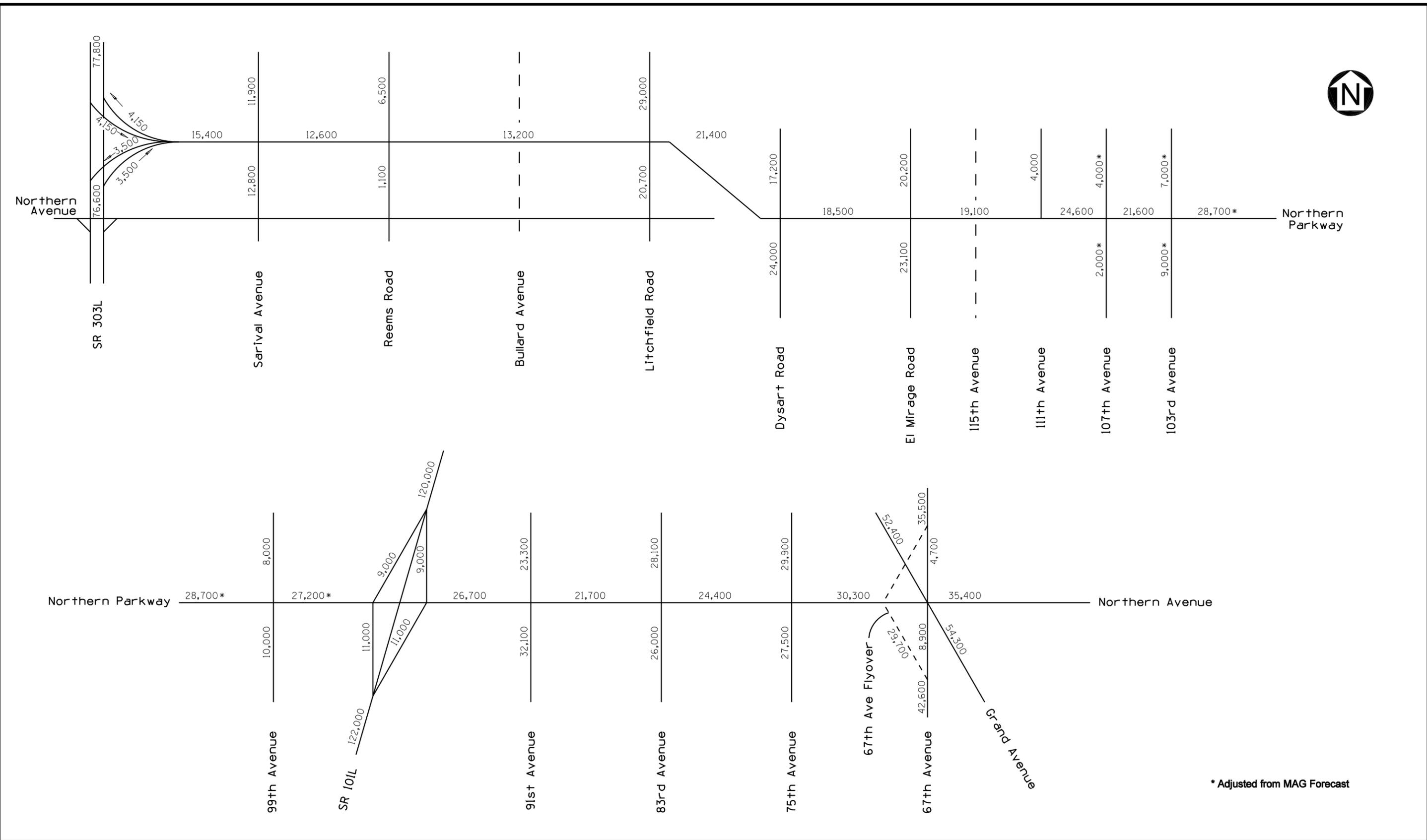
This forecast is defined in the MAG EMME/2 model: 2015URSCONTRACT No. C-4544VL2005/08/0609:13 AM (Scenario 4005), dated 05/07/07. Average daily traffic volumes on Northern Parkway will range from 21,700 vpd between 91st Avenue and 83rd Avenue to 47,500 vpd between 99th Avenue and Loop 101.

Figure 2-4 shows the average daily traffic volumes for Northern Parkway and adjacent arterials for the 2015 West to East alternative with a system interchange at Loop 303.

Without Loop 303 System Interchange

This forecast is defined in the MAG EMME/2 model: 2015URSCONTRACT No. C-4544VL2005/08/0609:13 AM (Scenario 4006), dated 5/08/07. Average daily traffic volumes on Northern Parkway will range from 15,400 vpd between Sarival Avenue and Reems Road to 45,800 vpd between 99th Avenue and Loop 101. Figure 2-5 shows the average daily traffic volumes for Northern Parkway and adjacent arterials for the 2015 West to East alternative without a system interchange at Loop 303.

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* Adjusted from MAG Forecast

FIGURE 2-3
2015 INTERIM (AT GRADE) DAILY TRAFFIC PROJECTIONS

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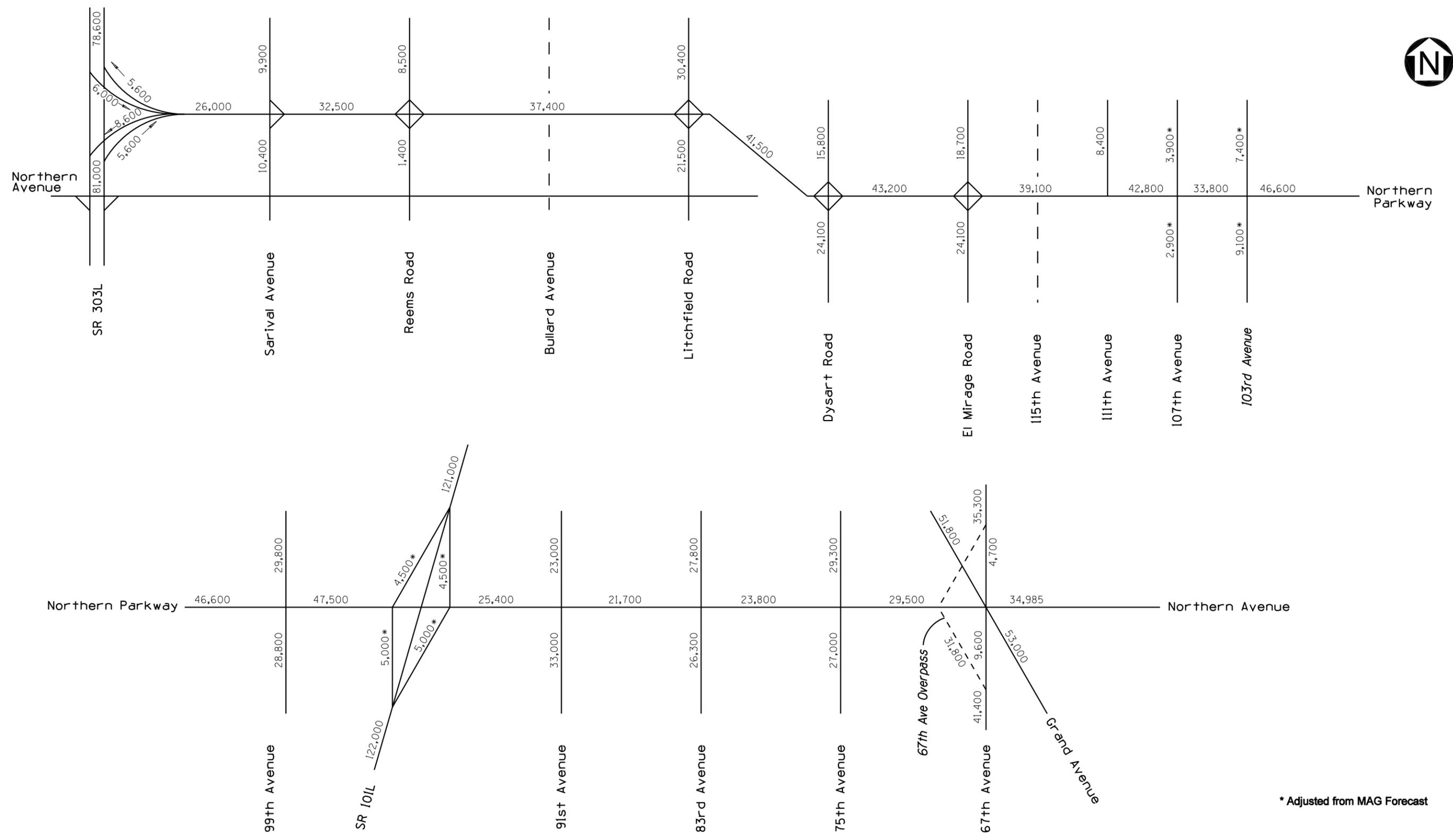
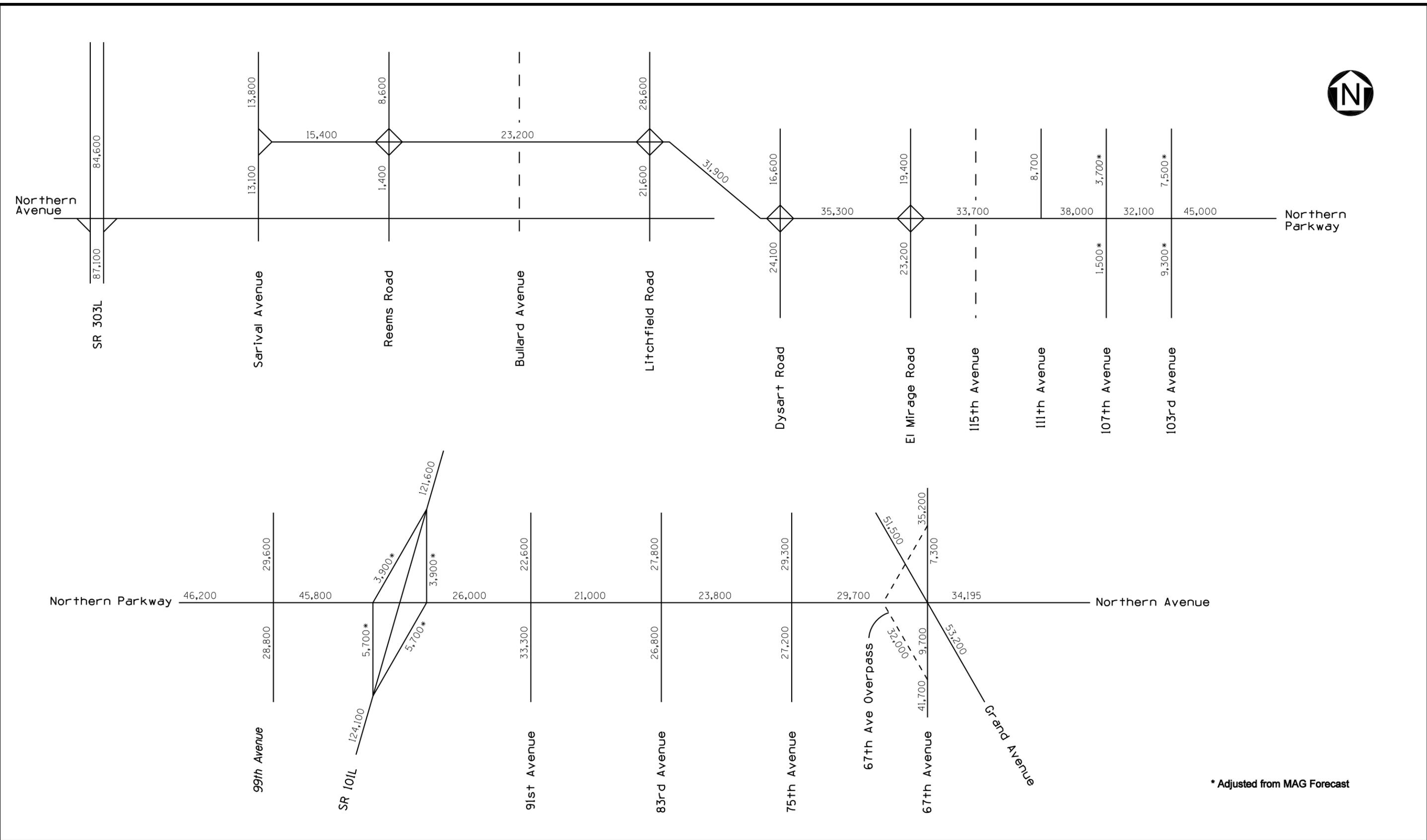


FIGURE 2-4
 2015 WEST TO EAST WITH LOOP 303 SYSTEM INTERCHANGE
 DAILY TRAFFIC PROJECTIONS

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* Adjusted from MAG Forecast

FIGURE 2-5
2015 WEST TO EAST WITHOUT LOOP 303 SYSTEM INTERCHANGE
DAILY TRAFFIC PROJECTIONS

2.4.3 Interim (Four Lanes)

This forecast is defined in the MAG EMME/2 model: 2015URSCONTRACT No. C-4544VL2005/08/0609:13 AM (Scenario 4004), dated 5/07/07. Average daily traffic volumes on Northern Parkway will range from 22,100 vpd between 91st and 83rd avenues to 47,300 vpd between 99th Avenue and Loop 101. Figure 2-6 shows the average daily traffic volumes for Northern Parkway and adjacent arterials for the 2015 West to East interim alternative with four lanes and GSI.

2030 Option 1

Option 1 refers to the Northern Parkway alternative that contains traffic signals at 111th Avenue and 107th 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 115th 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.

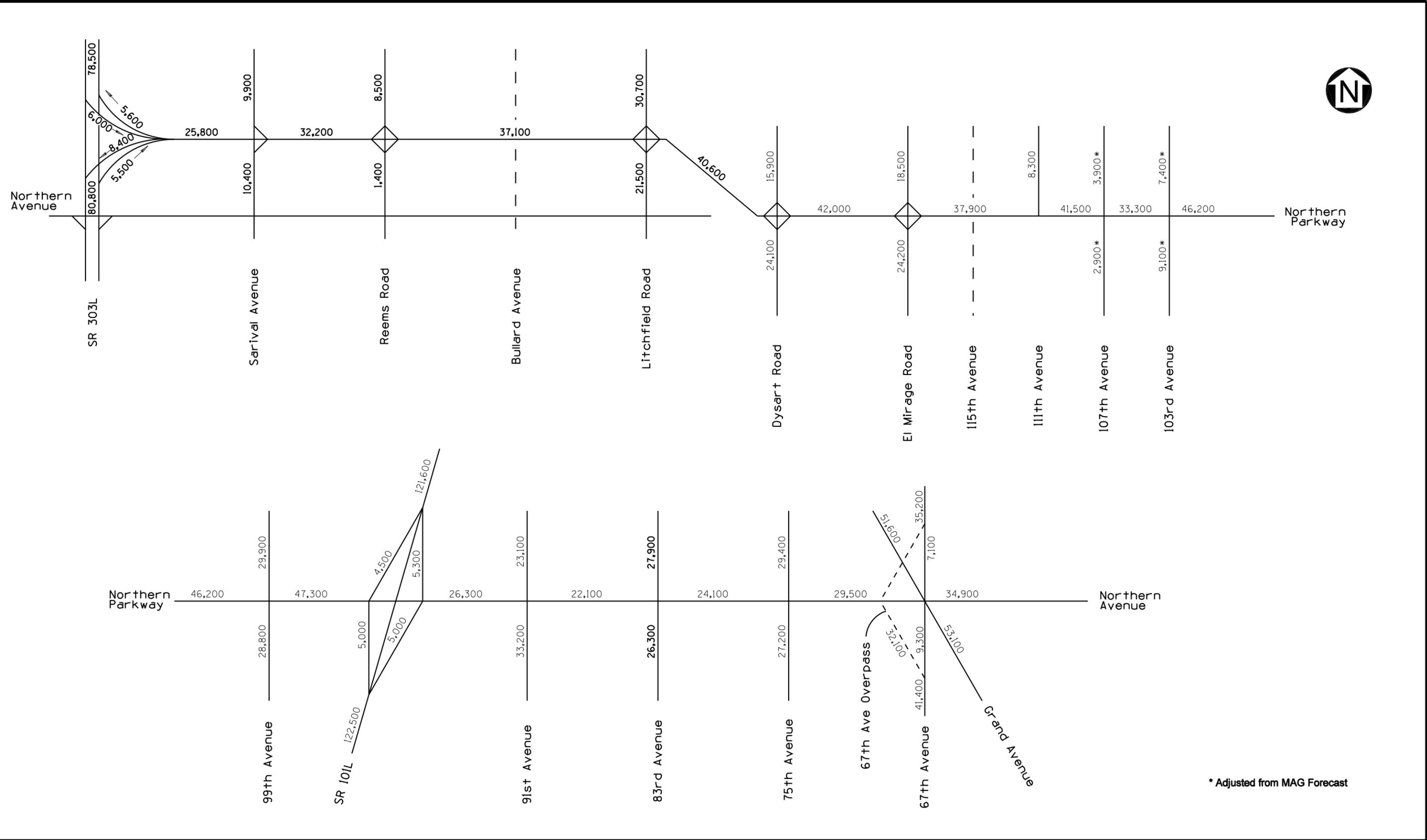
The average daily traffic volume for the corridor is expected to be approximately 86,000 vpd. Figure 2-7, Figure 2-8, and Figure 2-9 show the forecasted average daily traffic volumes in each direction for Northern Parkway and adjacent arterials for 2030 Option 1.

2.4.3 2030 Option 2

Option 2 refers to the Northern Parkway alignment that contains grade separations at 115th Avenue and 107th Avenue. 111th Avenue is a right-in/right-out intersection with Northern Parkway. This forecast is defined as MAG EMME/2 model: 2030URS 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 2-10, Figure 2-11, and Figure 2-12 show the projected directional average daily traffic volumes for Northern Parkway and adjacent arterials for 2030 Option 2.

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* Adjusted from MAG Forecast

FIGURE 2-6
2015 WEST TO EAST INTERIM (4-LANES)
DAILY TRAFFIC PROJECTIONS

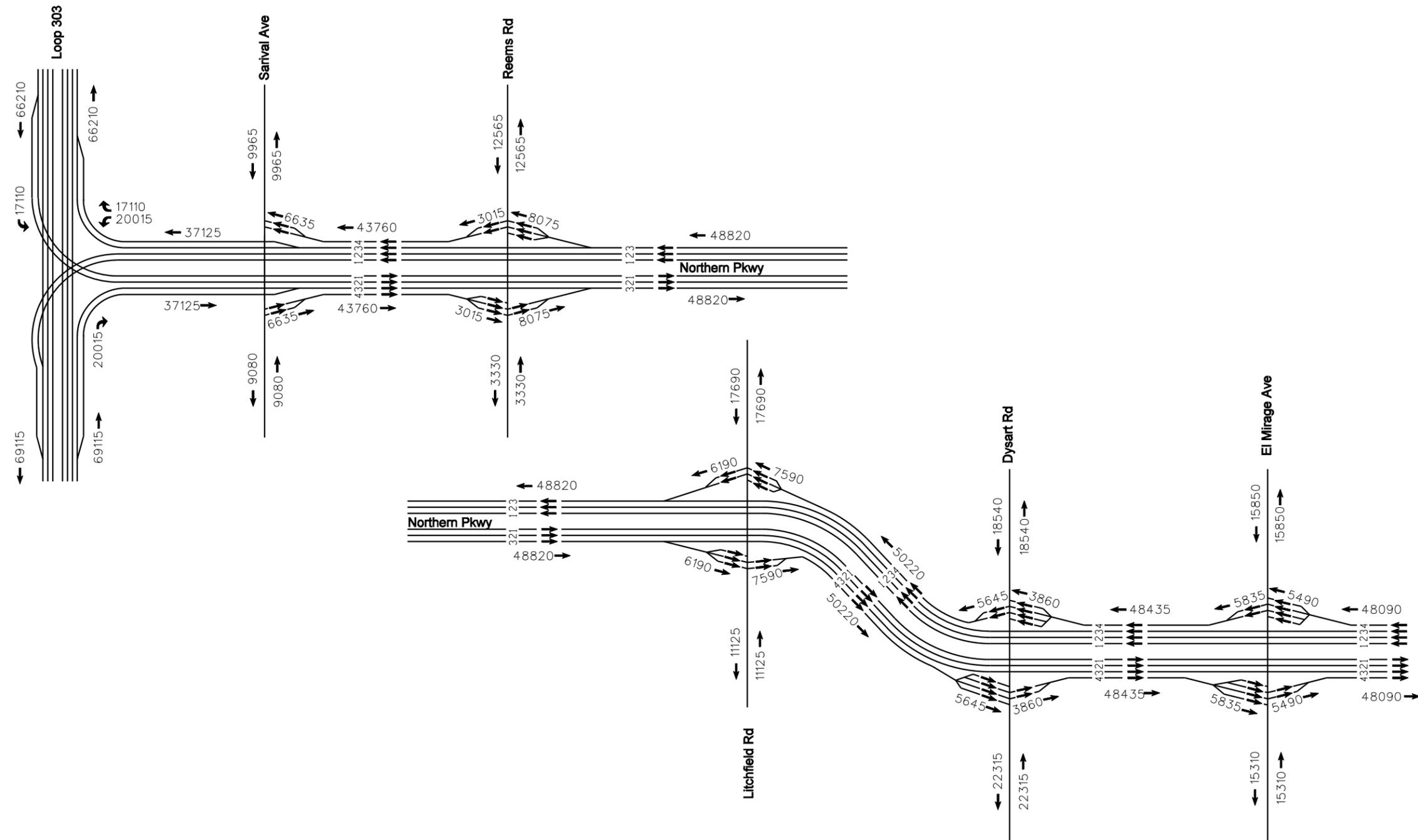
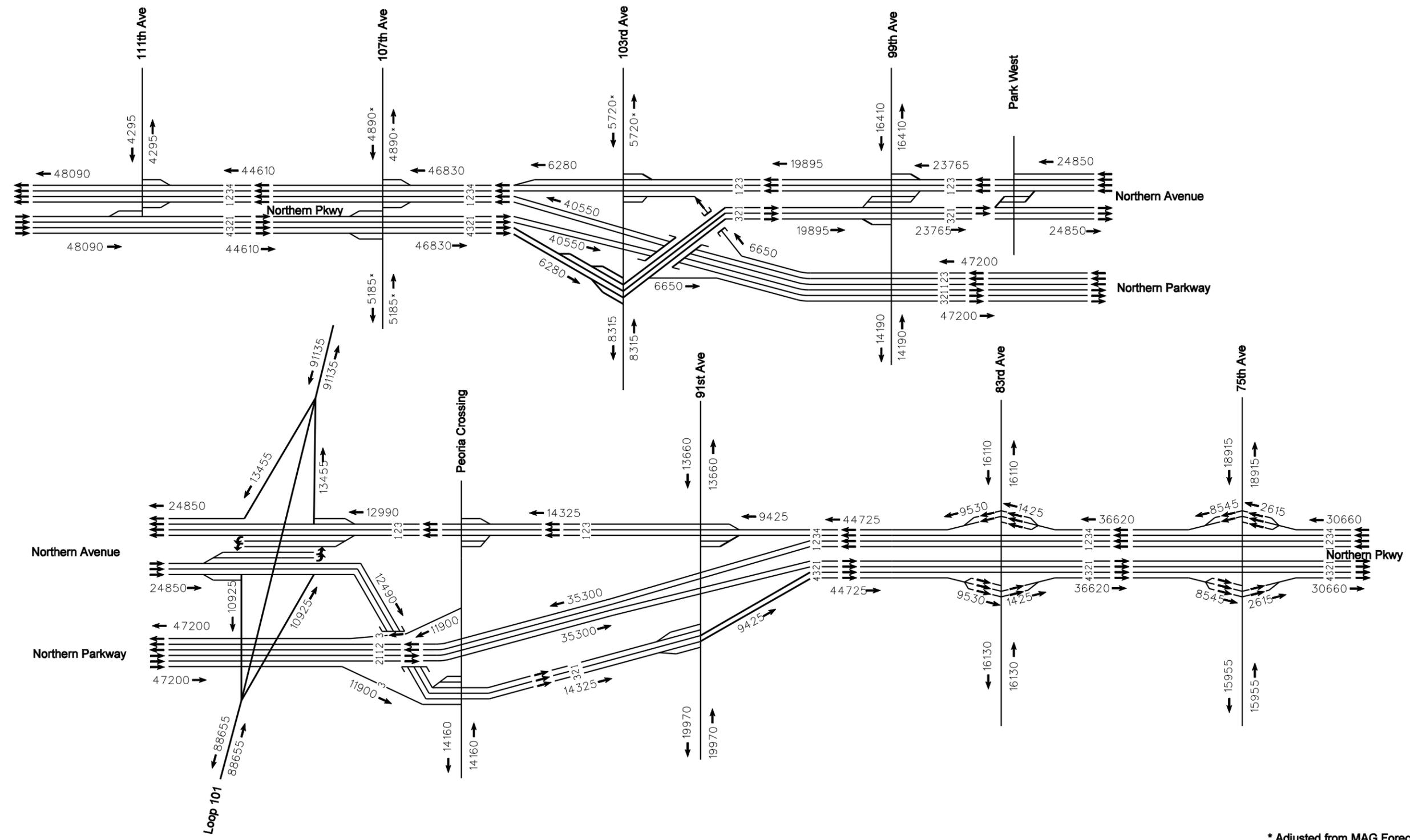


FIGURE 2-7
2030 OPTION 1 DAILY TRAFFIC PROJECTIONS

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* Adjusted from MAG Forecast

FIGURE 2-8
2030 OPTION 1 DAILY TRAFFIC PROJECTIONS (CONTINUED)

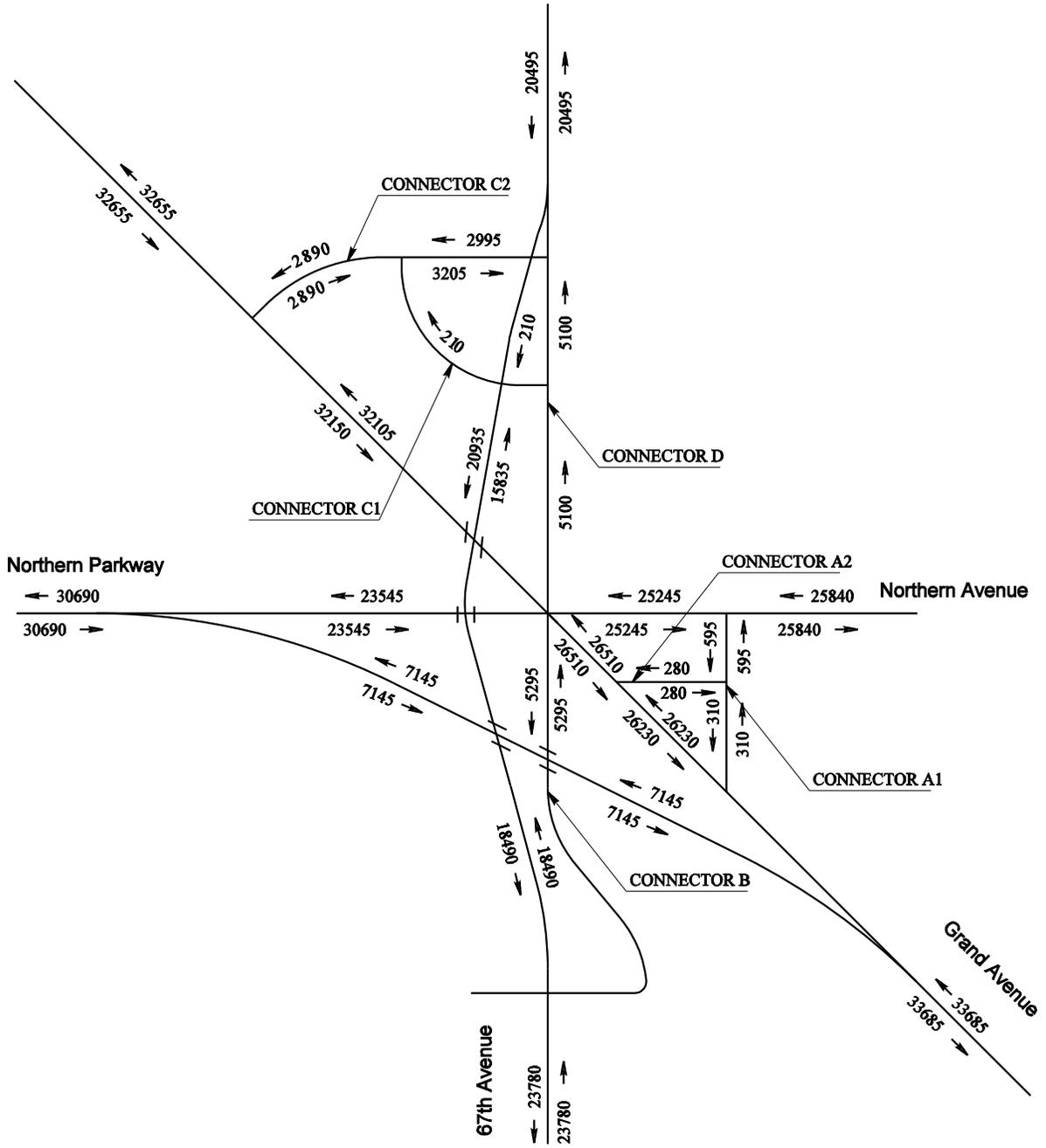


FIGURE 2-9
2030 OPTION 1 DAILY TRAFFIC PROJECTIONS AT GRAND AVENUE

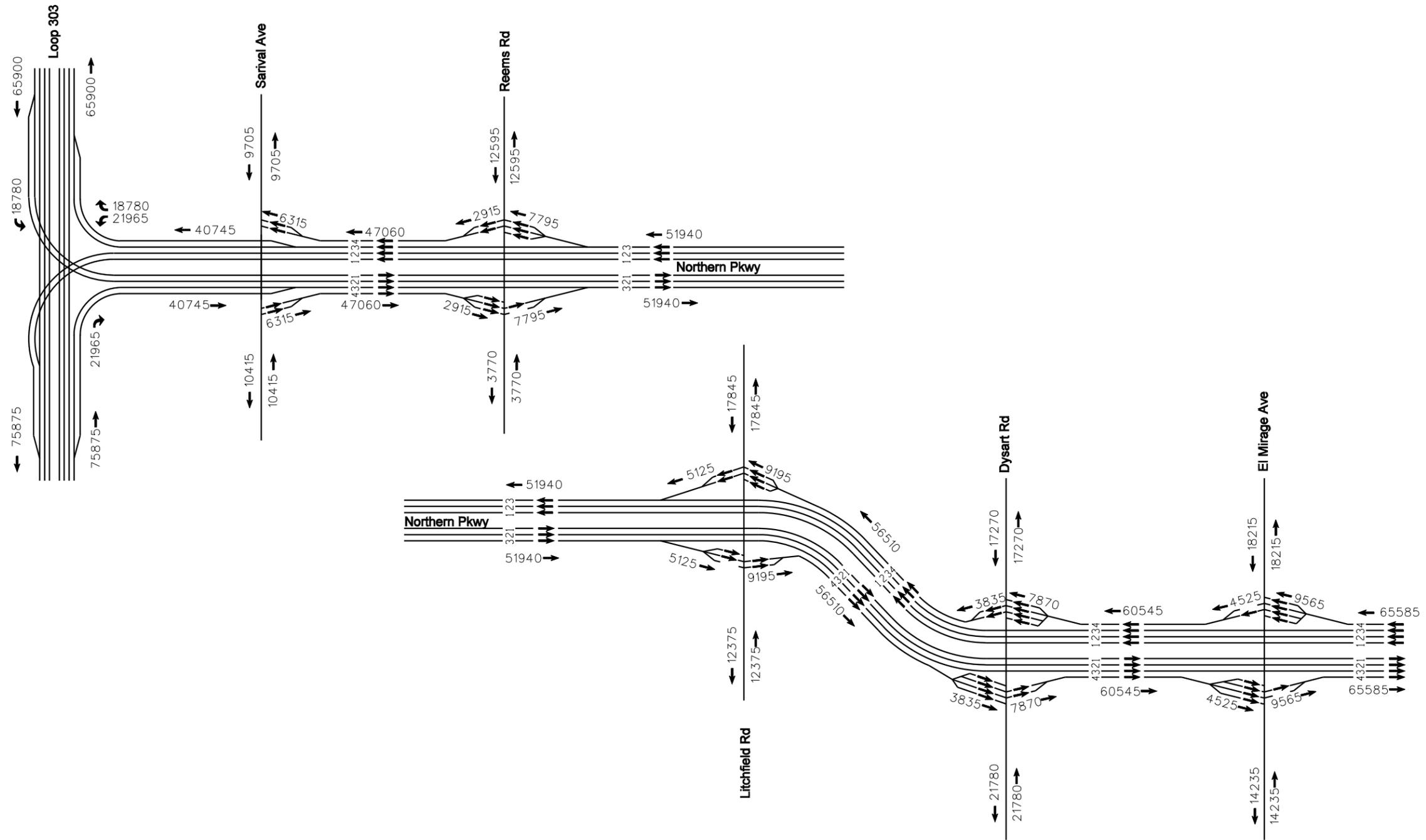
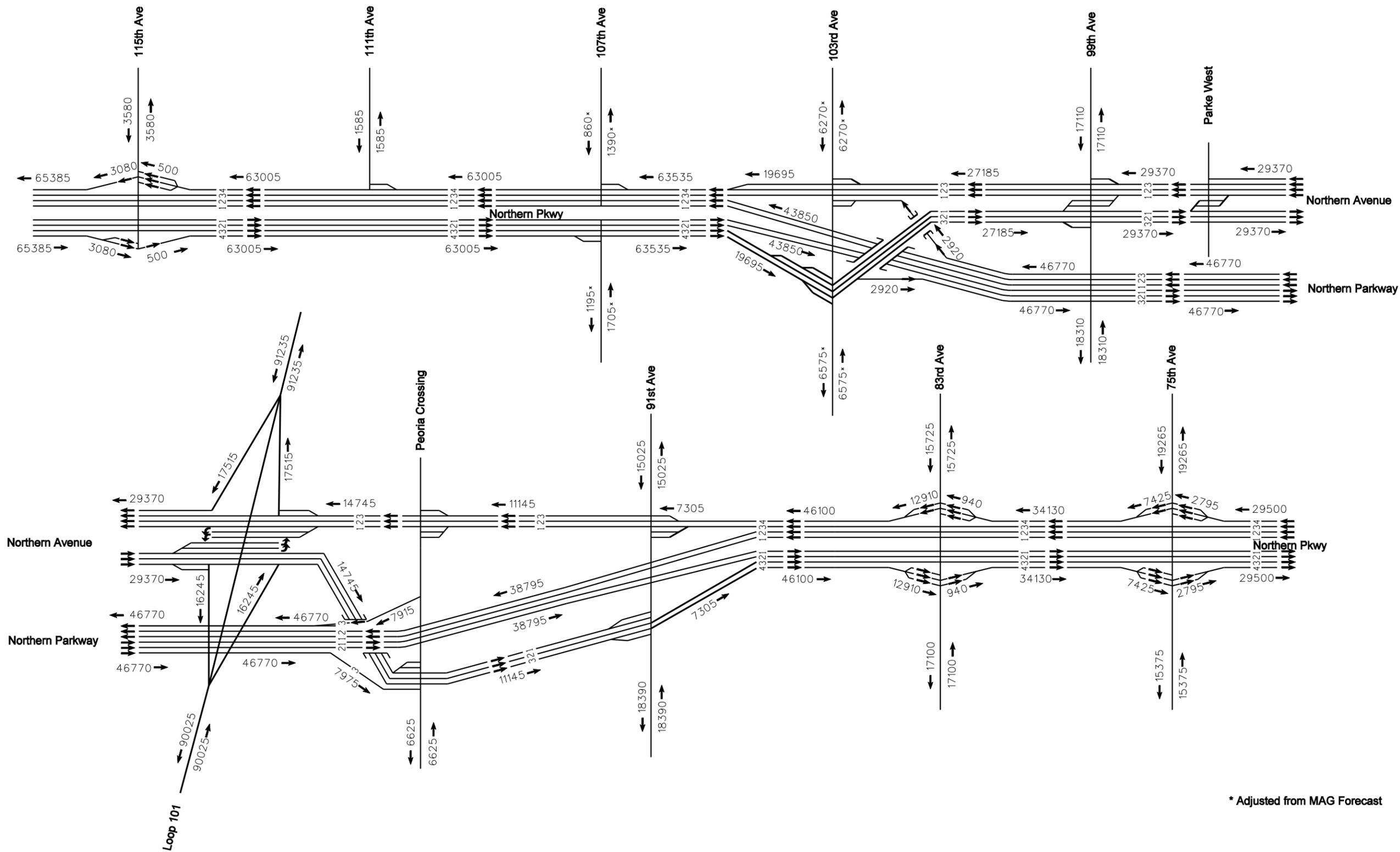


FIGURE 2-10
2030 OPTION 2 DAILY TRAFFIC PROJECTIONS

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* Adjusted from MAG Forecast

FIGURE 2-11
2030 OPTION 2 DAILY TRAFFIC PROJECTIONS (CONTINUED)

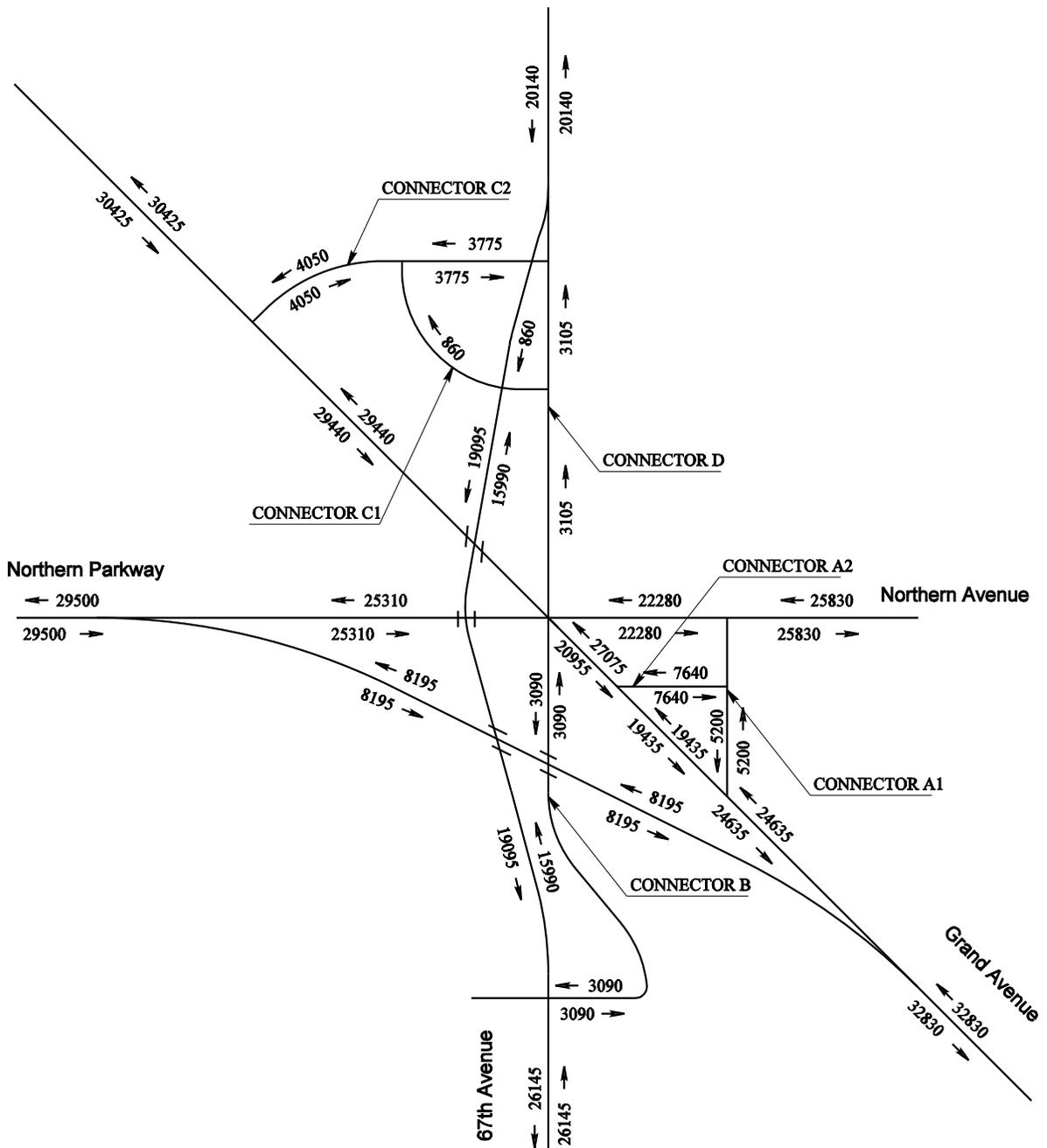


FIGURE 2-12
2030 OPTION 2 DAILY TRAFFIC PROJECTIONS AT GRAND AVENUE

2.4.4 2030 Southern Alignment

In the Southern Alignment alternative, Northern Parkway diverts from the Option 1 and Option 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 Option 1 and Option 2 alignment at 91st Avenue. The Southern Alignment is fully access controlled from Loop 303 to 91st Avenue, and includes a system interchange with Loop 101. The Southern Alignment is modeled as a CD-Road from Loop 303 to 83rd 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 2-13, Figure 2-14, and Figure 2-15 show the projected average daily traffic volumes for Northern Parkway and adjacent arterials for 2030 Southern Alignment.

2.4.5 2030 West to East

The 2030 West to East phased alternative is the same network as the 2015 West to East with a system interchange at Loop 303, with the 2030 improvements included on the surrounding roadways. This forecast is defined as MAG EMME/2 model 2030URSGlendale request Northern as fwyVL2005/31/0511:47 AM (Scenario 8002).

The 2030 average daily traffic volume for the corridor is expected to be approximately 62,500 vpd. Figure 2-16, Figure 2-17, and Figure 2-18 show the projected directional average daily traffic volumes for Northern Parkway and adjacent arterials for 2030 West to East alternative.

2.4.6 2030 West to East (Four Lanes)

The 2030 West to East (Four Lanes) phased alternative is the same network as the 2015 West to East Interim (Four Lanes) with a system interchange at Loop 303, with the 2030 improvements included on the surrounding roadways. This forecast is defined as MAG EMME/2 model 2030URSGlendale request Northern as fwyVL2005/31/0511:47 AM (Scenario 8003).

The 2030 average daily traffic volume for the corridor is expected to be approximately 54,500 vpd. Figure 2-19, Figure 2-20, and Figure 2-21 show the projected directional average daily traffic volumes for Northern Parkway and adjacent arterials for 2030 West to East (Four Lanes) alternative.

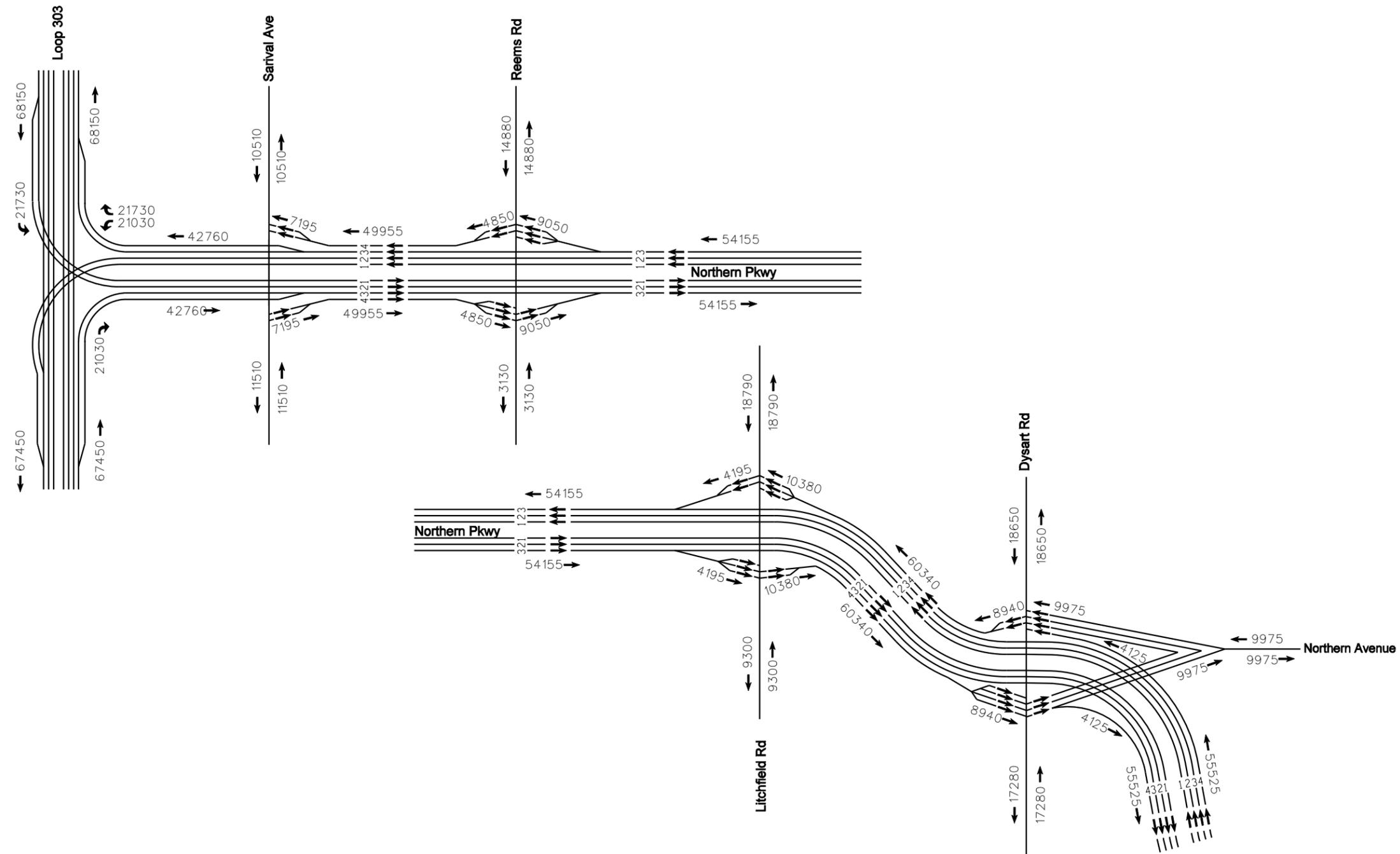
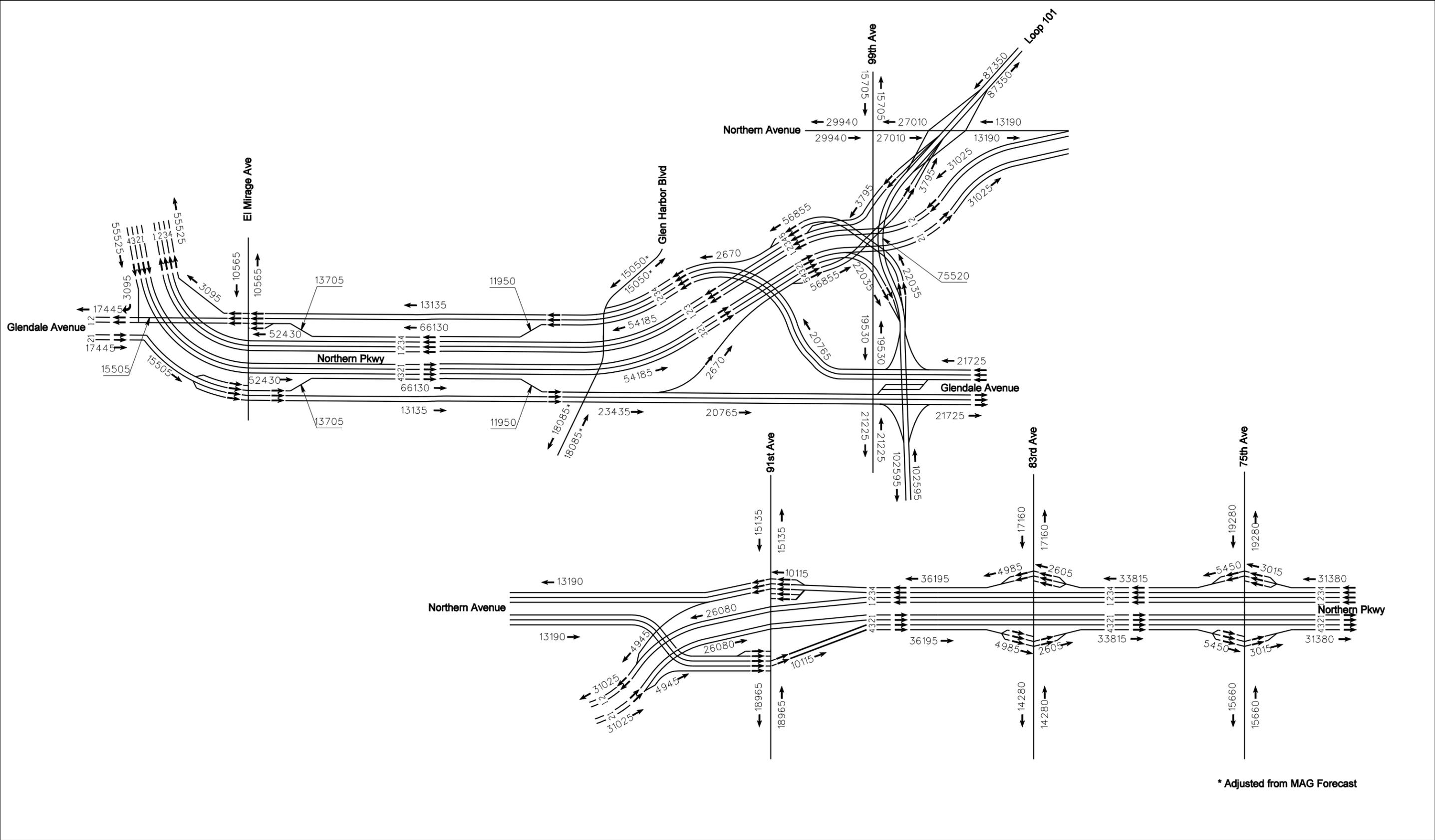


FIGURE 2-13
2030 SOUTHERN ALIGNMENT DAILY TRAFFIC PROJECTIONS

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* Adjusted from MAG Forecast

FIGURE 2-14
2030 SOUTHERN ALIGNMENT DAILY TRAFFIC PROJECTIONS (CONTINUED)

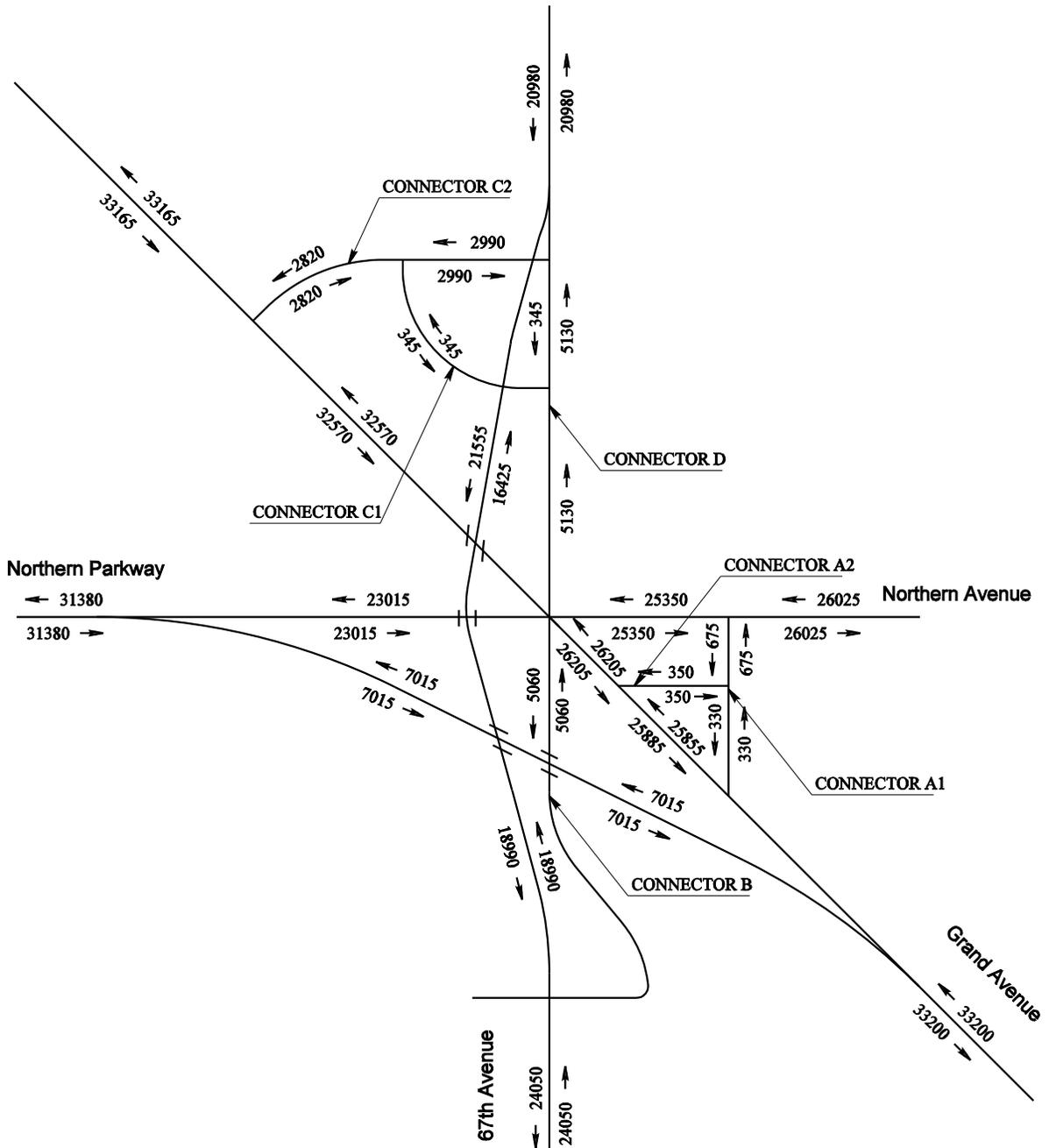


FIGURE 2-15
2030 SOUTHERN ALIGNMENT DAILY TRAFFIC PROJECTIONS AT GRAND AVENUE

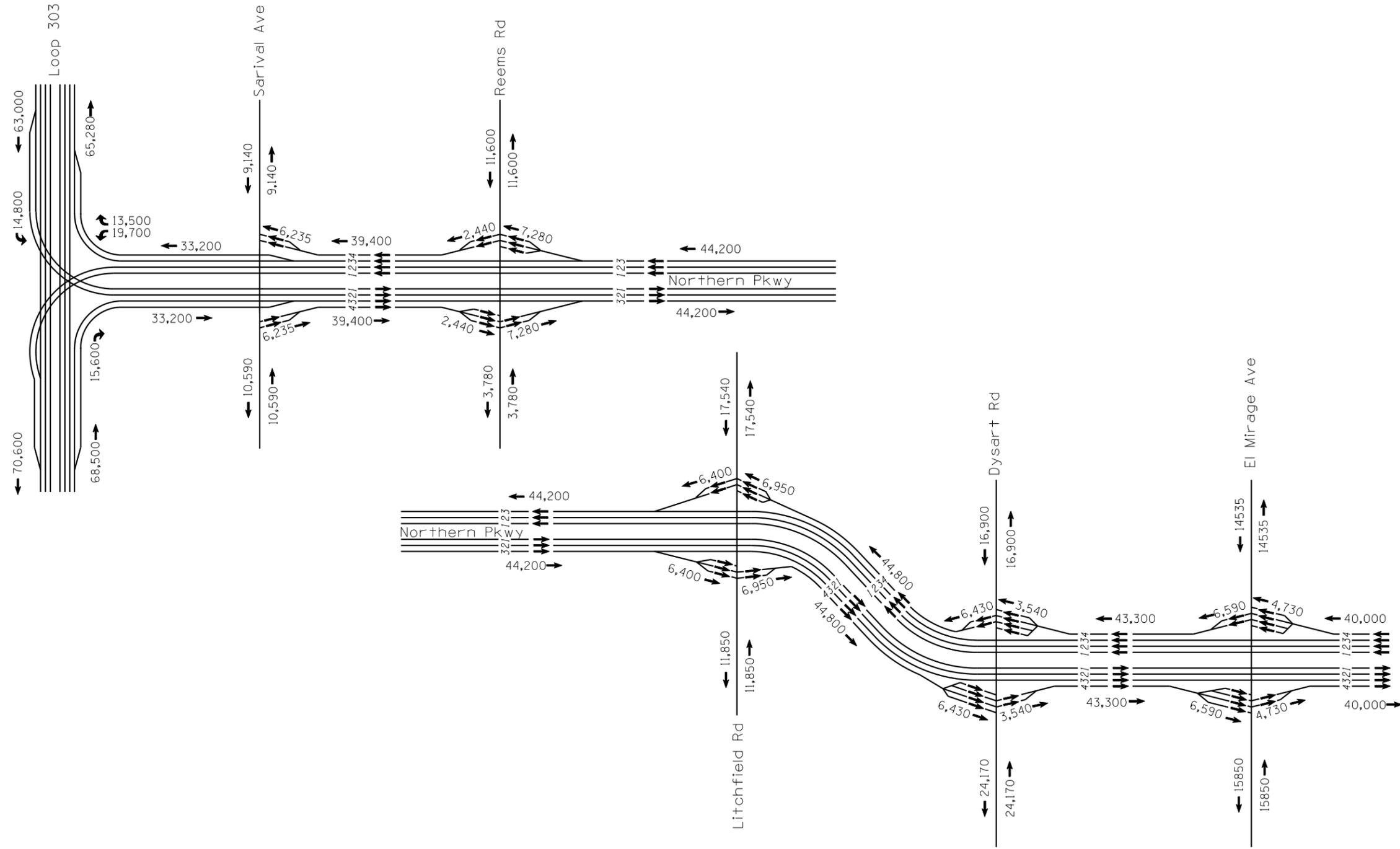


FIGURE 2-16
2030 WEST TO EAST DAILY TRAFFIC PROJECTIONS

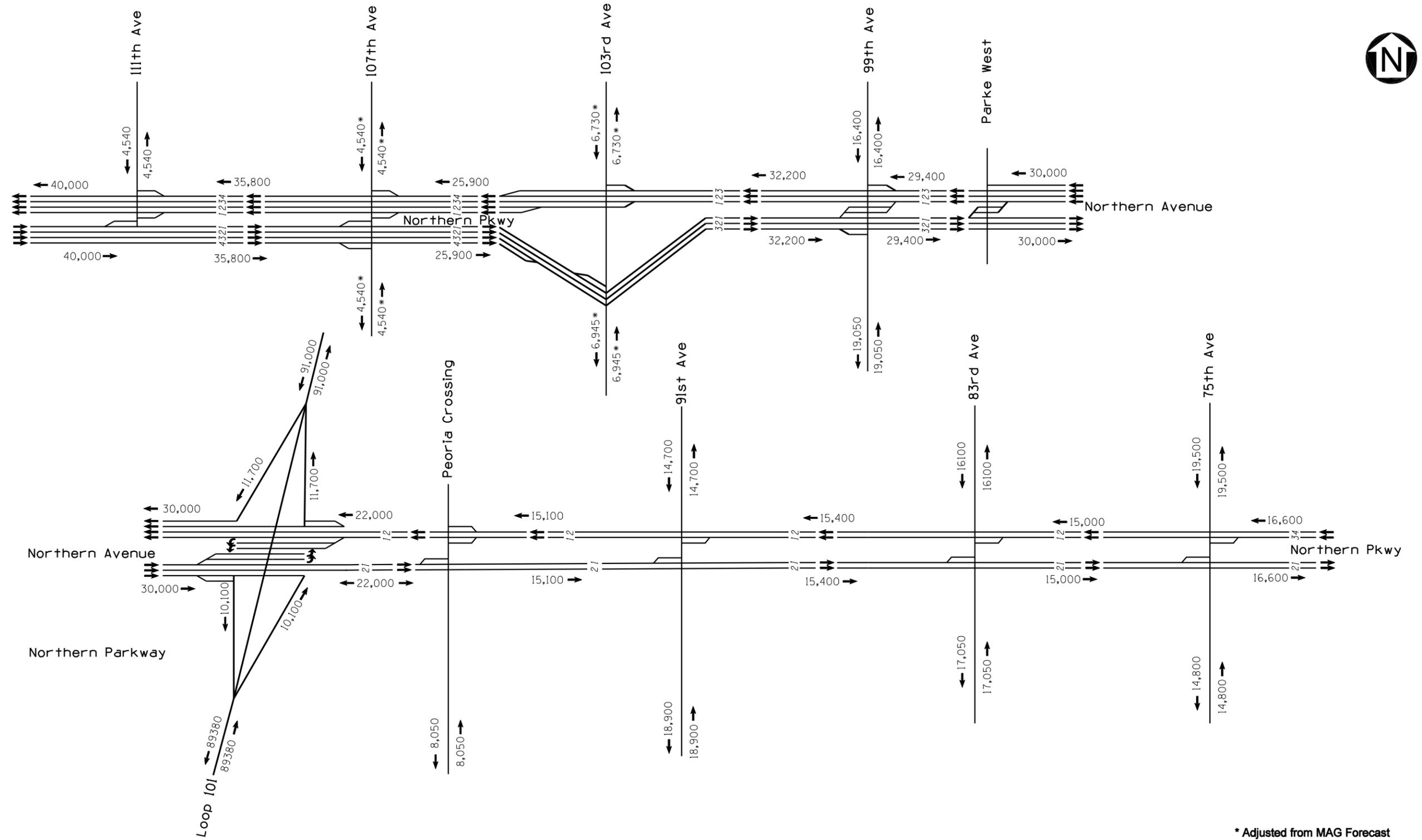


FIGURE 2-17
 2030 WEST TO EAST DAILY TRAFFIC PROJECTIONS (CONTINUED)

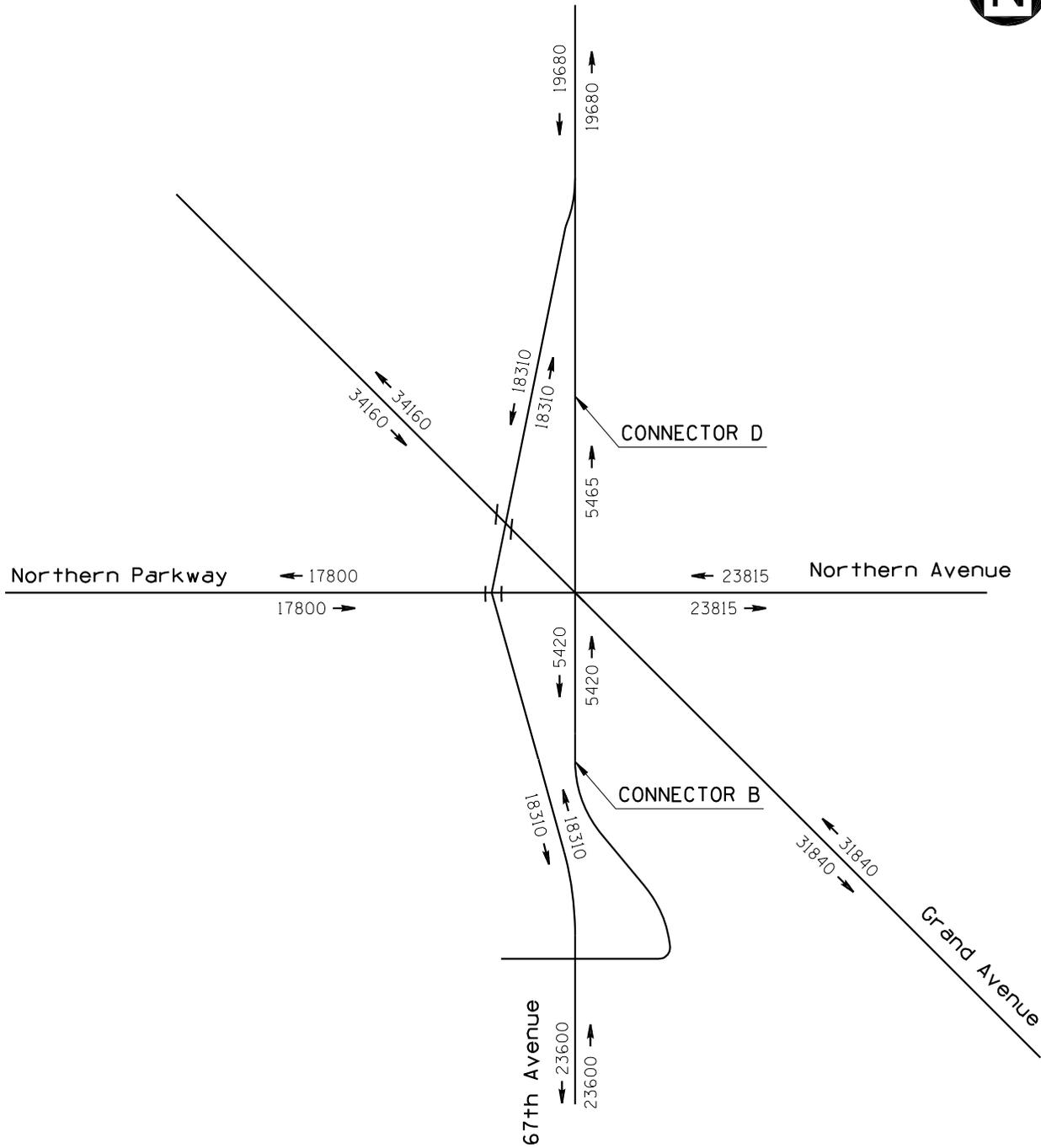


FIGURE 2-18
2030 WEST TO EAST DAILY TRAFFIC PROJECTIONS AT GRAND AVENUE

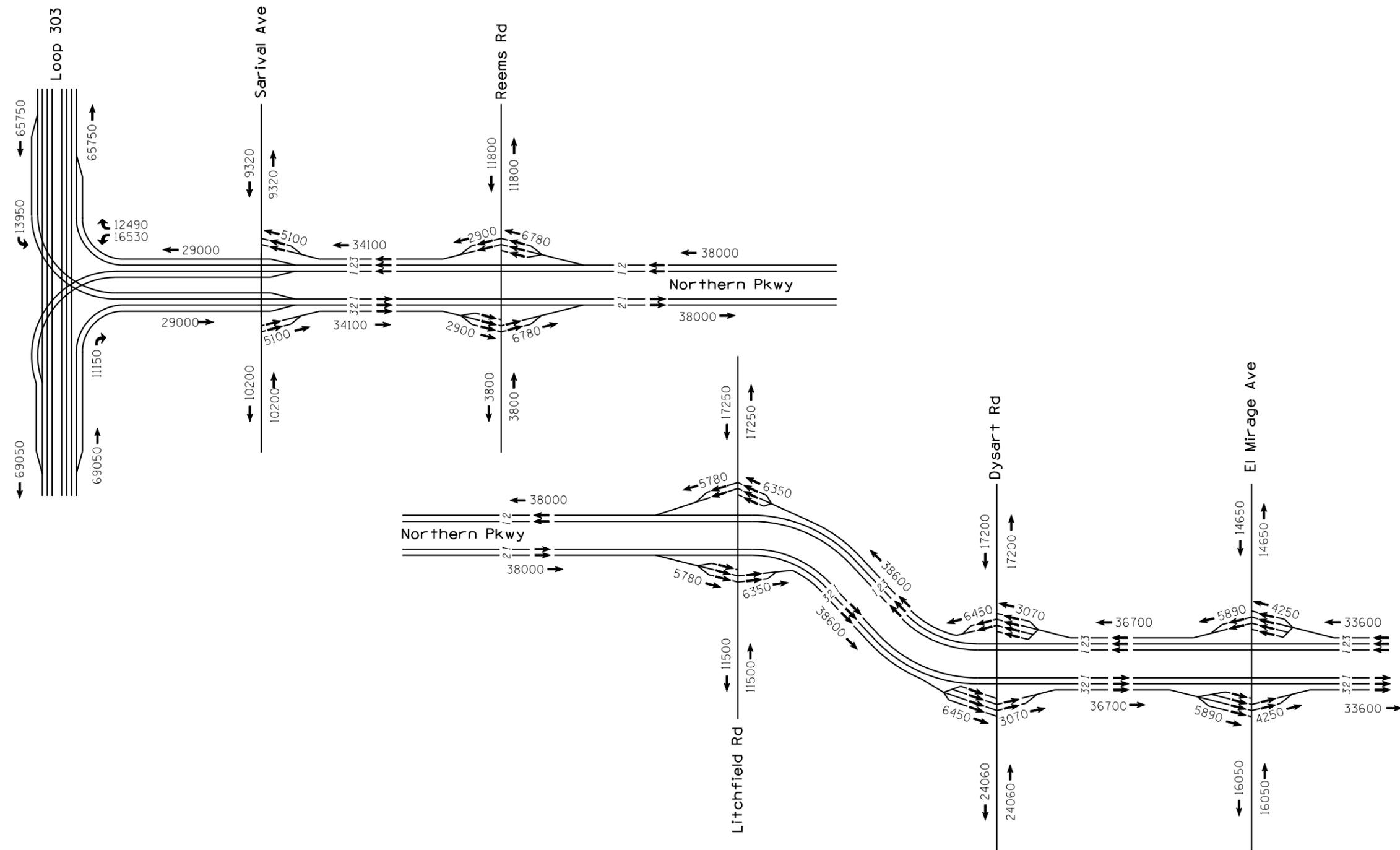
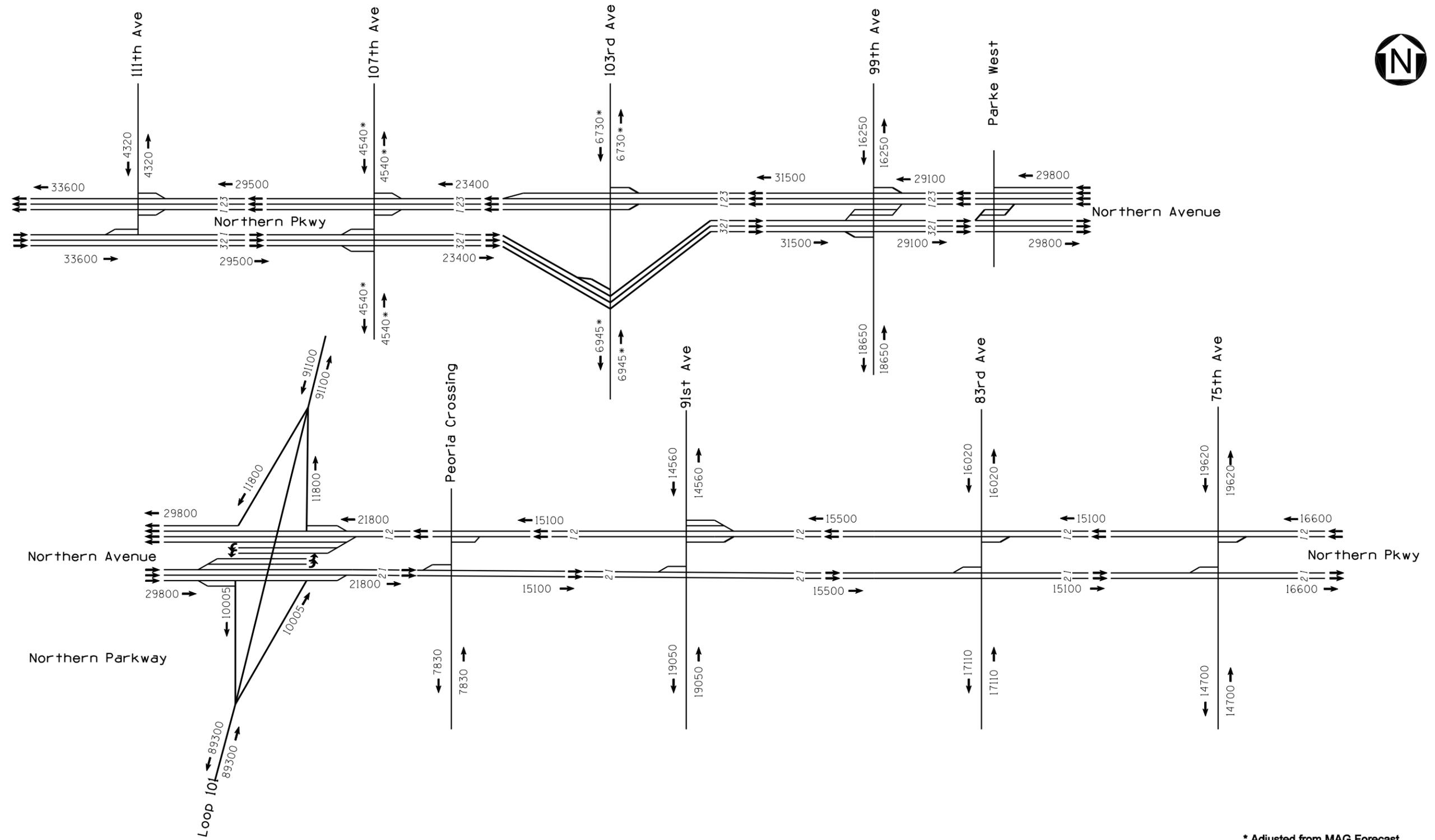


FIGURE 2-19
2030 WEST TO EAST (4-LANES) DAILY TRAFFIC PROJECTIONS

P:\City_of_Glendale\NorthernDCR30\Traffic\CADD\DCR_Traffic_Figure 2.20_DTP.dgn
P:\City_of_Glendale\NorthernDCR30\DCR\Drawings\Figures\200801\Fig2-20_2030WestToEast4lanesDailyTrafficProjections_11x17L.pdf 01-21-08 R.J.W



* Adjusted from MAG Forecast

FIGURE 2-20
2030 WEST TO EAST (4-LANES) DAILY TRAFFIC PROJECTIONS (CONTINUED)

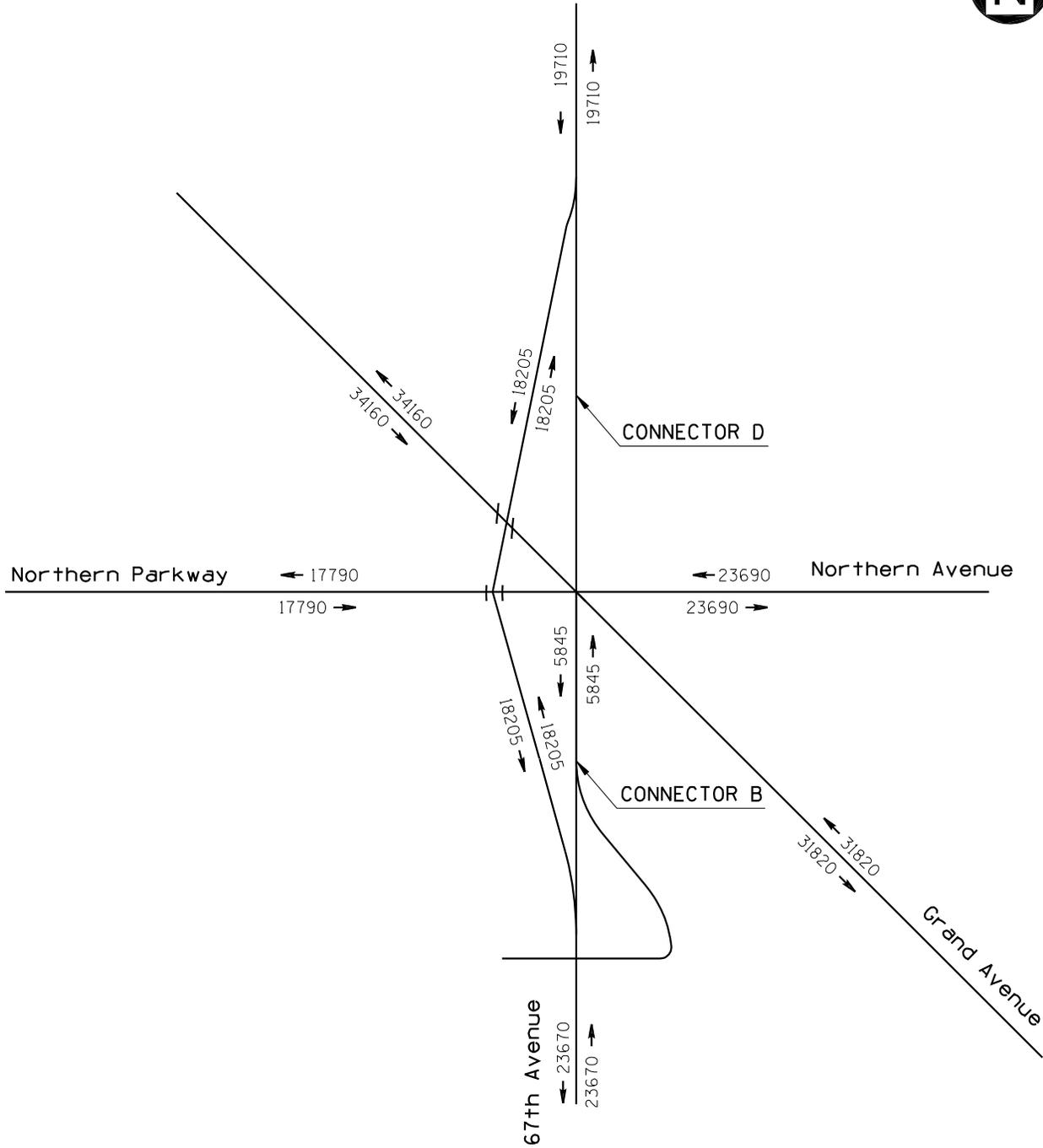


FIGURE 2-21
2030 WEST TO EAST (4-LANES) DAILY TRAFFIC PROJECTIONS AT GRAND AVENUE

2.4.7 2030 No-Build

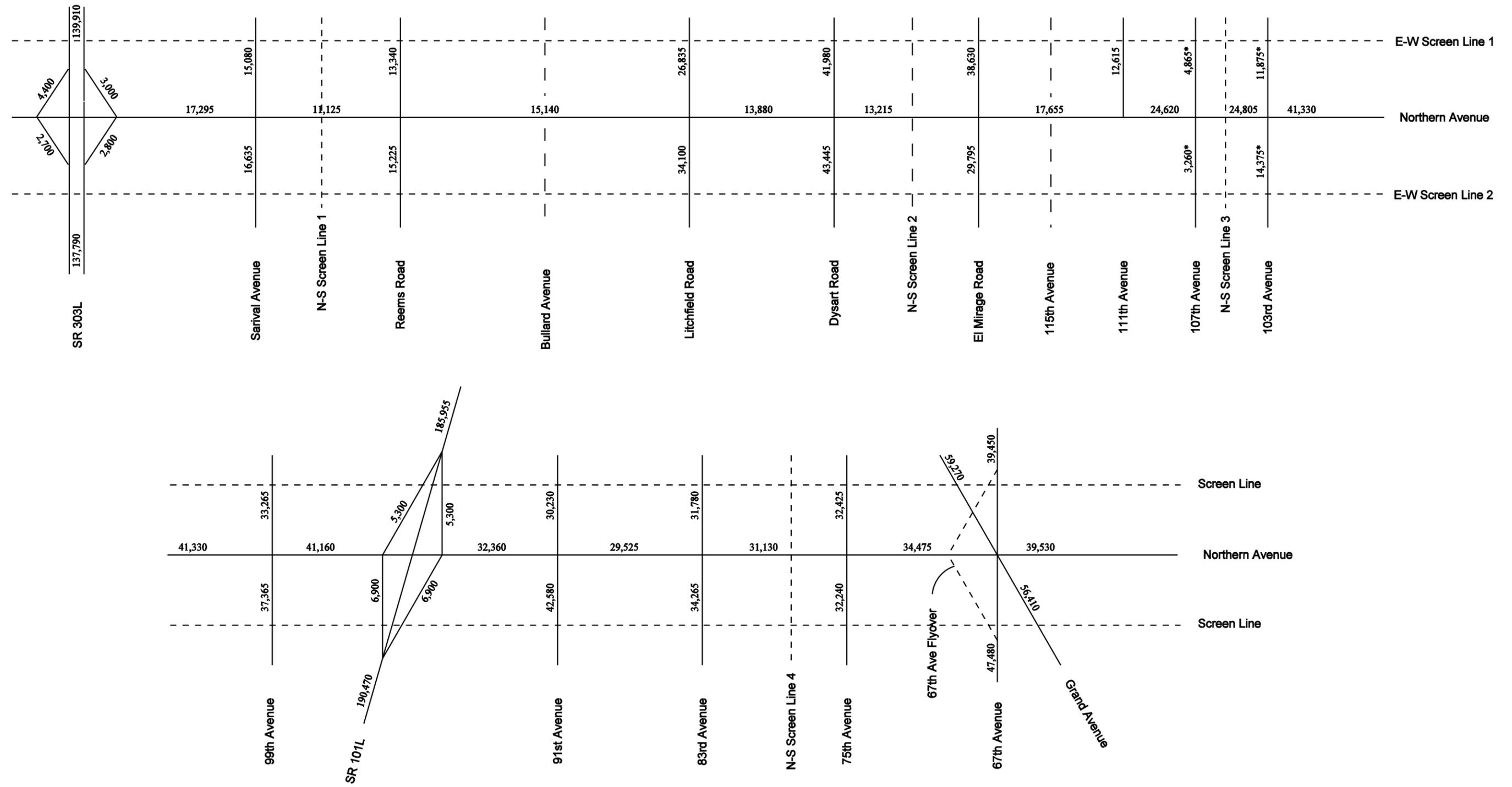
The No-Build model consists of no improvements to Northern Avenue from the existing configuration, and other arterial streets in the vicinity improved per local agency future plans. A traffic forecast of the 2030 No Build network was obtained from MAG (see Figure 2-22) and is defined as MAG EMME/2 model: 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 2-22 shows the projected average daily traffic volumes for Northern Parkway and adjacent arterials for 2030 No Build condition.

Screen lines are shown in Figure 2-22 and used in the volume-to-capacity comparisons described in Section 2.4.8.

2.4.8 Build and No-Build Volume-to-Capacity Analysis

A comparison of the 2030 No-Build, Option 1 and Option 2 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 2-22, 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.



* Adjusted from MAG Forecast

FIGURE 2-22
2030 NO-BUILD DAILY TRAFFIC PROJECTIONS

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	Option 1	Option 2	Option 1	Option 2	No-Build	Option 1	Option 2
North-South Screenline Averages								
Peoria Avenue	23,955	19,815	18,240	-17%	-24%	0.72	0.59	0.55
Olive Avenue	39,780	33,440	30,855	-16%	-22%	0.80	0.67	0.62
Northern Parkway	20,070	89,445	104,595	346%	421%	0.80	0.44	0.52
Glendale Avenue	40,685	27,730	26,855	-32%	-34%	0.89	0.61	0.59
Bethany Home Road	24,190	22,655	21,500	-6%	-11%	0.73	0.68	0.65
North-South SL Total*	148,680	193,085	202,045	30%	36%	0.79	0.53	0.55
East-West Screenline Averages								
SR 303L	138,850	135,325	141,775	-3%	2%	0.77	0.75	0.79
Sarival Avenue	15,860	19,045	20,120	20%	27%	0.48	0.57	0.60
Reems Road	14,280	15,895	16,365	11%	15%	0.43	0.48	0.49
Litchfield Road	30,465	28,815	30,220	-5%	-1%	0.91	0.86	0.91
Dysart Road	42,710	40,855	39,050	-4%	-9%	0.85	0.82	0.78
El Mirage Road	34,210	31,160	32,450	-9%	-5%	0.82	0.75	0.78
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	7%	-2%	0.39	0.42	0.39
99th Avenue	35,315	30,600	35,420	-13%	0%	0.94	0.73	0.85
SR 101L	188,210	179,790	181,260	-4%	-4%	0.78	0.75	0.76
91st Avenue	36,405	33,630	33,415	-8%	-8%	1.09	0.81	0.80
83rd Avenue	33,025	32,240	32,825	-2%	-1%	0.99	0.77	0.79
75th Avenue	32,330	34,870	34,640	8%	7%	0.97	0.84	0.83
Grand Avenue	57,840	66,340	63,255	15%	9%	1.16	1.33	1.27
67th Avenue	43,465	44,275	46,285	2%	6%	0.95	0.89	0.93
East-West SL Total*	732,780	725,540	726,795	-1%	-1%	0.78	0.75	0.76

Table 2-8 No-Build Level of Service Comparison

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

2.5 TRADITIONAL TRAFFIC OPERATIONAL ANALYSIS

An operational analysis was performed on Option 1, Option 2, and the Southern Alignment to predict each alternative’s performance during the design year. An analysis of weaving areas and ramp junctions is provided in the Traffic Report.

2.5.1 Option 1 Roadway Operation Analysis

The Northern Parkway mainline LOS from Loop 303 to Grand Avenue was analyzed for the 2030 Option 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 and provided in the Traffic Report. The directional design hour volumes (DDHV’s) were derived in the Traffic Report.

Table 2-9 Northern Parkway Free Flow Sections – 2030 Option 1 Operations Summary

Northern Parkway Segment	ADT Per Direction	DDHV		LOS	
		AM (PM)	AM (PM)	AM (PM)	AM (PM)
		EB	WB	EB	WB
Loop 303 to Sarival Avenue	37,125	3485 (2990)	2990 (3485)	C (C)	C (C)
Between Reems Road on- and off-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 on- and off-ramps	42,630	4245 (2900)	2900 (4245)	D (C)	C (D)
Between Dysart Road on- and off-ramps	44,575	4545 (3030)	3030 (4545)	D (C)	C (D)
Between El Mirage Avenue on- and off-ramps	42,600	4345 (2970)	2970 (4345)	D (C)	C (D)
Between 111 th Avenue and 107 th Avenue	42,600	4550 (3035)	3035 (4550)	D (C)	C (D)
Between 103 rd Avenue and 91 st Avenue (bypass)	47,200	4655 (3205)	3205 (4655)	D (C)	C (D)
Between 83 rd Avenue on- and off-ramps	35,195	3590 (2395)	2395 (3590)	D (C)	C (D)
Between 75 th Avenue on- and off-ramps	28,075	2865 (2355)	2355 (2865)	C (C)	C (C)
East of Flyover ramp	23,545	2400 (1600)	1600 (2400)	C (B)	B (C)
Flyover Ramp	7,145	730 (485)	485 (730)	B (B)	B (B)

2.5.2 Option 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.

The 2030 Option 1 contains GSI at the following locations along the Northern Parkway corridor:

- Sarival Avenue
- Reems Road
- Litchfield Road
- Dysart Road
- El Mirage Road
- 103rd Avenue
- 93rd Avenue
- 91st Avenue
- 83rd Avenue
- 75th Avenue

The intersections that were analyzed are the north-south arterial intersection with the Northern Parkway ramps.

The 2030 Option 1 contains at-grade intersections at the following locations along the Northern Parkway corridor:

- 111th Avenue at Northern Parkway
- 107th Avenue at Northern Parkway
- 99th Avenue at Northern Avenue

- Parke West Access at Northern Avenue
- Loop 101 Southbound ramps at Northern Avenue
- Loop 101 Northbound ramps at Northern Avenue
- Grand Avenue at Northern Avenue
- Grand Avenue at Connector C2
- Grand Avenue at Connector A2
- Grand Avenue at Myrtle Avenue

The projected operations of the grade separated signalized intersections 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. The results of the signalized intersection analysis are summarized in Table 2-10.

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. The GSI at 103rd Avenue is projected to experience congestion in 2030. The split of Northern Parkway with Northern Avenue will occur at this GSI so it is expected that it would be more susceptible to congestion due to the high expected turning movement volumes.

The parkway at-grade signalized intersections at 107th Avenue and to a lesser degree at 111th Avenue are projected to be congested. Similarly, the Grand Avenue at-grade signalized intersection with Myrtle Avenue is expected to be congested. The analysis output sheets for the signalized intersections are included in the Northern Parkway Traffic Report.

Table 2-10 2030 Option 1 Signalized Intersection Operations Summary

	AM Peak Hour			PM Peak Hour		
	V/C ⁽¹⁾	Average Delay ⁽²⁾	LOS ⁽³⁾	V/C ⁽¹⁾	Average Delay ⁽²⁾	LOS ⁽³⁾
Northern Parkway GSI						
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 rd Avenue	0.72	21.9	C	0.74	54.1	D
75 th Avenue	0.74	32.6	C	0.74	33.0	C
Northern Parkway Intersection						
111 th Avenue	1.33	80.1	F	1.62	179.5	F
107 th Avenue	1.66	237.6	F	1.44	185.4	F
Northern Avenue Intersection						
103 rd Avenue	1.25	132.1	F	1.13	149.2	F
99 th 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 rd Avenue/Peoria Crossings	0.87	44.8	D	0.79	46.6	D
91 st Avenue	0.74	36.7	D	0.91	44.5	D
Grand Avenue	1.04	41.7	D	1.23	54.3	D
Grand Avenue Intersection						
C2 (Connector A)	0.81	16.7	B	0.98	17.1	B
A2 (Connector C)	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 Option 2 Roadway Operation Analysis

The Northern Parkway mainline LOS from Loop 303 to Grand Avenue was analyzed for the 2030 Option 2 during the morning and evening peak hours using the Level of Service criteria from the HCM and is summarized in Table 2-11 and provided in the Traffic Report.

Option 2 is forecasted to carry high traffic volumes during the peak hours, resulting in several segments with LOS E, seen in Table 2-11.

Table 2-11 Northern Parkway Mainline – 2030 Option 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 on- and off-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 on- and off-ramps	47,315	4630 (3220)	3220 (4630)	D (C)	C (D)
Between Dysart Road on- and off-ramps	52,675	5370 (3580)	3580 (5370)	E (C)	C (E)
Between El Mirage Avenue on- and off-ramps	56,020	5715 (3920)	3920 (5715)	E (D)	D (E)
Between 103 rd Avenue and 91 st Avenue (bypass)	46,770	4770 (3180)	3180 (4770)	E (D)	D (E)
Between 83 rd Avenue on- and off-ramps	33,190	3385 (1820)	1820 (3385)	D (B)	B (D)
Between 75 th Avenue on- and off-ramps	26,705	2725 (1815)	1815 (2725)	C (B)	B (C)
East of Flyover ramp	25,310	2175 (1450)	1450 (2175)	B (B)	B (B)
Flyover Ramp	8,195	835 (555)	555 (835)	C (B)	B (C)

2.5.4 Option 2 Signalized Intersection Operations Analysis

The 2030 Option 2 contains grade separated interchanges at the following locations along the Northern Parkway corridor:

- Sarival Avenue
- Reems Road
- Litchfield Road
- Dysart Road
- El Mirage Road
- 115th Avenue
- 103rd Avenue
- 93rd Avenue
- 91st Avenue
- 83rd Avenue
- 75th Avenue

The 2030 Option 2 contains at-grade intersections at the following locations along the Northern Avenue and Grand Avenue:

- 99th Avenue at Northern Avenue
- Parke West Access at Northern Avenue
- Loop 101 Southbound ramps at Northern Avenue
- Loop 101 Northbound ramps at Northern Avenue

- Grand Avenue at Northern Avenue
- Grand Avenue at Connector C2
- Grand Avenue at Connector A2
- Grand Avenue at Myrtle Avenue

The projected operations of the grade separated signalized intersections 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 2-12.

As indicated in Table 2-12, 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 103rd Avenue, 99th Avenue, and Grand Avenue at Myrtle Avenue and Connector A2. The analysis output sheets for the signalized intersections are included in the Traffic Report.

Table 2-12 2030 Option 2 Signalized Intersection Operations Summary

	AM Peak Hour			PM Peak Hour		
	V/C ⁽¹⁾	Average Delay ⁽²⁾	LOS ⁽³⁾	V/C ⁽¹⁾	Average Delay ⁽²⁾	LOS ⁽³⁾
Northern Parkway GSI						
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 th Avenue	0.35	22.3	C	0.36	22.6	C
83 rd Avenue	0.84	36.6	D	0.78	32.7	C
75 th Avenue	0.79	43.9	D	0.77	34.6	C
Northern Avenue Intersection						
103 rd Avenue	1.37	143.2	F	1.37	114.9	F
99 th 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 rd Avenue/Peoria Crossings	0.87	51.3	D	0.82	44.2	D
91 st Avenue	0.61	35.8	D	0.81	40.5	D
Grand Avenue	0.89	27.6	C	1.13	48.6	D
Grand Avenue Intersection						
C2 (Connector A)	0.83	14.4	B	1.01	41.6	D
A2 (Connector C)	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

2.5.5 Southern Alignment 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 is summarized in Table 2-13.

The Southern Alignment is forecasted to carry high traffic volumes, resulting in several segments with LOS E, seen in Table 2-13, during the peak hours.

**Table 2-13 Northern Parkway Mainline – 2030 Southern Alignment Operations
Summary**

Northern Parkway Segment	ADT Per Direction	DDHV		LOS	
		AM (PM)		AM (PM)	
		EB	WB	EB	WB
Loop 303 to Sarival Avenue	42,760	4465 (2910)	2910 (4465)	D (C)	C (D)
Between Reems Road on- and off-ramps	49,960	4600 (3110)	3110 (4600)	D (C)	C (D)
Reems Road to Litchfield Road	54,155	5525 (3685)	3685 (5525)	E (C)	C (E)
Between Litchfield Road on- and off-ramps	49,960	5095 (3400)	3400 (5095)	D (C)	C (D)
Between Dysart Road on- and off-ramps	51,400	5245 (3495)	3495 (5245)	E (C)	C (E)
Between El Mirage Avenue on- and off-ramps	52,430	5350 (3565)	3565 (5350)	E (C)	C (E)
Between 103rd Avenue on- and off-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 on- and off-ramps	26,080	2660 (1775)	1775 (2660)	C (B)	B (C)
Between 83 rd Avenue on- and off-ramps	31,210	3180 (2120)	2120 (3180)	D (B)	B (D)
Between 75 th Avenue on- and off-ramps	28,365	2895 (1930)	1930 (2895)	C (B)	B (C)
East of Flyover ramp	23,015	2350 (1565)	1565 (2350)	C (B)	B (C)
Flyover Ramp	7,015	715 (475)	475 (715)	B (B)	B (B)

2.6 TURNING LANE ANALYSIS

A Turn Lane Analyses was completed to determine the number of right-turn and left-turn lanes to incorporate into the project to ensure adequate access to and from Northern Parkway. 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 2-14 and Table 2-15. 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 2-14 Intersecting Arterial Turning Lane Storage Length Recommendations

Cross Street	Direction	Right Turn Lane					Left Turn Lane			
		DHV (vph)	Lanes	Queue Length	Storage Length (ft)	Note	DHV (vph)	Lanes	Queue Length	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*	3	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	1	115	2	2	160*
99th Avenue	NB	520	1	18	225	1	515	2	9	225
SR 101L	NB	140	1	5	160*	2	1180	2	20	500
93rd Avenue	NB	-	-	-	-	-	620	2	11	275
91st Avenue	NB	415	1	14	160*	3	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	3	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	4	840	2	14	350
SR 101L	SB	755	1	26	160*	2	755	2	13	325
91st Avenue	SB	320	1	11	275	3	265	2	5	160*
83rd Avenue	SB	470	1	16	160*	3	70	2	2	160*
75th Avenue	SB	575	1	20	160*	3	175	2	3	160*
Grand Avenue	SB	590	1	20	500	4	-	-	-	-

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

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

Notes:

1. Shared through/right-turn lane is recommended.
2. Right-turn lane is free-flow, therefore minimal queuing is expected. Alternate length is recommended.
3. Due to G/C Ratio (as determined using Synchro software), alternate length is recommended.
4. Due to geometrical constraints, alternate length is recommended.

Table 2-15 Northern Parkway/Ramp Turning Lane Storage Length Recommendations

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

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

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

Notes:

1. Shared through/right-turn lane is recommended.
2. Right-turn lane is free-flow, therefore minimal queuing is expected. Alternate length is recommended.
3. Due to G/C Ratio (as determined using Synchro software), alternate length is recommended.
4. Due to geometrical constraints, alternate length is recommended.