Alpine Highway to North County Boulevard Connector Study

prepared by

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1 SUMMARY OF FINDINGS

An area in Highland and American Fork lacks an east-west connection between Alpine Highway (SR-74) and North County Boulevard (SR-129). This area is bounded by SR-92 on the north and 300 North on the south and creates a gap in east-west travel that is 3.4 miles long. In 2019, American Fork City will connect the east and west sides of 700 North, thereby reducing the gap in east-west accessibility to 2.8 miles, which is still unusually long for an urbanized area.

The Utah Department of Transportation commissioned a study to evaluate the traffic and transportation feasibility of an east-west connector in this area. The study was not intended to get into the details of specific connector routes or alignments, but rather to focus on how the connector concepts effect the area's transportation system. Three connector options were evaluated: one in the northern part of the gap area, one in the central part, and one in the southern part. ***Figure 1*** shows the study area and the general location of the three connector options. The bullets below summarize the findings of the evaluation.

- Demand exists for a new east-west connector
  - If the connector were built today, it would carry an estimated 4,700 to 6,200 vehicles per day depending on the option, with the central connector carrying the most traffic.
  - In 2040, the connector is estimated to carry 7,200 to 8,500 vehicles per day, with the southern connector carrying the most traffic.
- The connector will primarily serve local trips
  - The average trip length for people using the connector is estimated to be 6.3 miles.
  - By comparison, the average trip length for people using North County Boulevard is estimated to be nearly 11 miles (70 percent longer than the connector).
- The connector will improve traffic operations throughout the study area, particularly on SR-92
  - The connector reduces existing and 2040 delay at the intersection of SR-92 and North County Boulevard by 3 to 32 percent, with the northern connector reducing delay the most.
  - By reducing out-of-direction travel, total study area travel time is reduced by up to 40 hours per day under existing conditions and by up to 120 hours per day in 2040.

The study shows that an east-west connector would benefit the study area by providing better local access and connectivity between Alpine Highway and North County Boulevard. The connector would predominantly be used for short local trips, leaving the longer regional trips on SR-92 and North County Boulevard. The determination of the specific location of the connector would require additional information, such as cost and property impacts. However, a northern connector would provide the most direct traffic benefit to SR-92, while a central connector provides the greatest reduction in out-of-direction travel.

2 INTRODUCTION

In the Highland and American Fork area, there is a gap in the east-west roadway network between SR-92 on the north and 300 North on the south. This gap is 3.4 miles long and can be found between the north-south roads of Alpine Highway (SR-74) and North County Boulevard (SR-129). In 2019, American Fork City plans to connect the east and west sides of 700 North, thereby reducing the gap in east-west roadways to 2.8 miles, which is still unusually long for an urbanized area. Over the years, there has been talk of building a connector in this area to improve east-west accessibility. The Utah Department of Transportation commissioned this study to evaluate the traffic and transportation feasibility of an east-west connector in this area.

This memo describes the traffic evaluation of the proposed east-west connector. It includes a discussion on network characteristic, traffic volumes and intersection measures of effectiveness (MOE) and network measures of effectiveness. The traffic models prepared for this evaluation were used to compare the existing traffic operations with the expected traffic operations of the future 2040 no-build condition. ***Figure 1*** shows the study area. The following connector options were analyzed for both the current and future conditions:

- North Connector Option
- Central Connector Option
- South Connector Option

The study did not consider specific connector alignments or locations, but rather the general vicinity of where a connector might be located. The determination of the specific location would require additional information, such as cost and property impacts, which is beyond the purpose of this study.

3 ANALYSIS METHODOLOGY

The analyses performed for this study used the jointly owned and maintained Wasatch Front Regional Council (WFRC)/Mountainland Associated of Governments (MAG) travel demand model and the Synchro traffic operations evaluation software. This section describes how each of these tools were used.

3.1 Travel Demand Modeling

The WFRC/MAG travel demand model (TDM) is a tool used to predict future travel and traffic volumes for the Wasatch Front area. WFRC and MAG are the Metropolitan Planning Organizations for the Wasatch Front and are responsible for coordinating transportation planning in the region. MAG is responsible for Utah County and WFRC for Weber, Davis, and Salt Lake Counties. Version 8.1 of the travel demand model was used for this study.

The travel demand model has two primary inputs: land use data and transportation system data. The land use data consists of residential and employment data for the entire region. This data is prepared in geographic blocks called Traffic Analysis Zones (TAZs). The travel model inputs are prepared for a base year, which in this case was 2015, and for a future year, which in this case was 2040. A base year of 2015 was used because both travel model inputs and published traffic volume data are available for that year. In travel modeling, the base year always lags the current year by a few years because of the need to have land use input and calibration data. In consultation with region's cities, WFRC and MAG prepare future land use projections. These projections are used by the MPOs to develop the Regional Transportation Plan (RTP), which is the plan for the development of the future transportation system. The RTP includes a list of projects that are planned to meet future transportation needs over a 20+ year horizon.

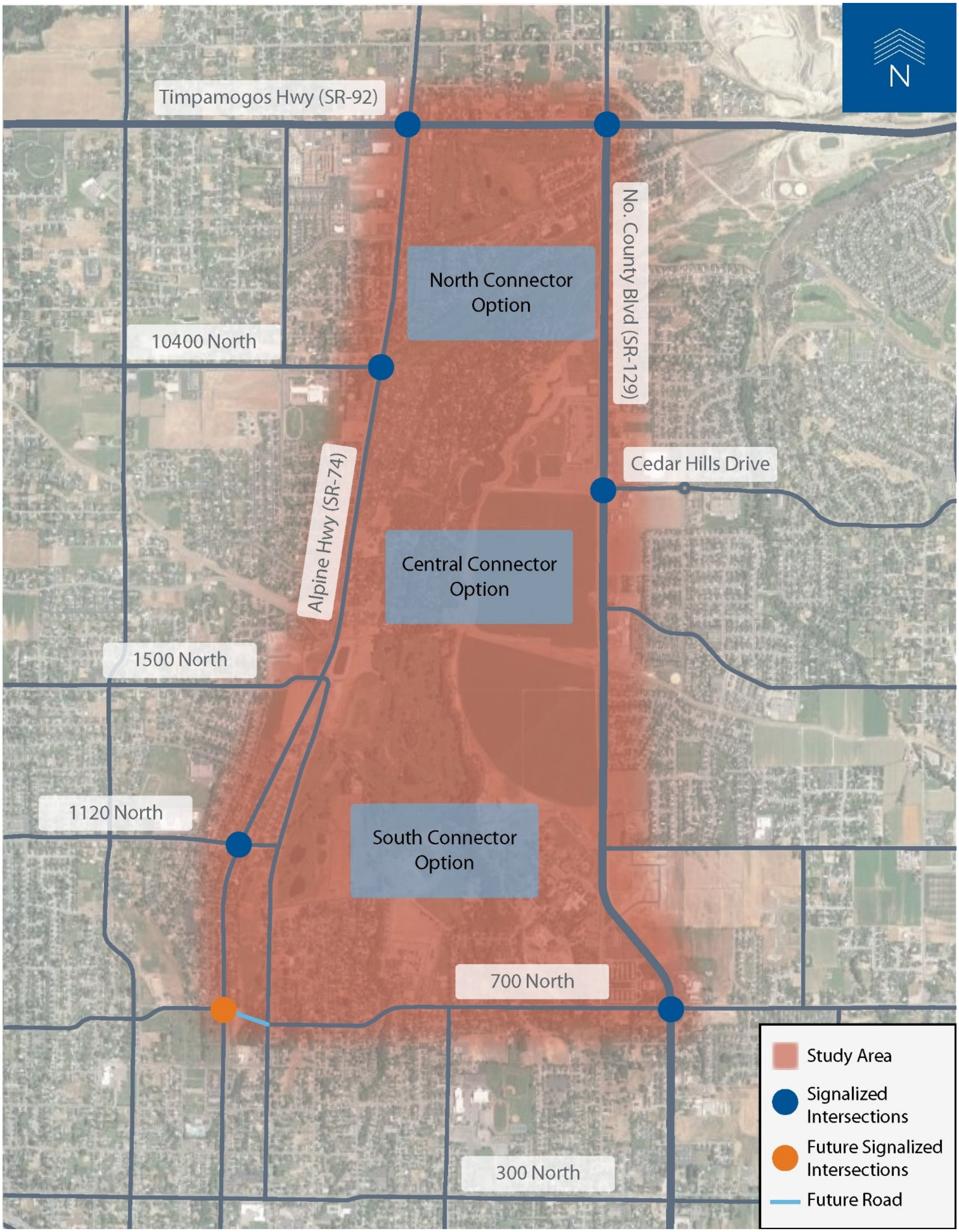


Figure 1: Study Area

Using the land use and transportation system inputs, the travel model predicts how many trips will be generated in the region, where those trips are going, the mode by which they will be made, and the transportation facilities that will be used to get there. To prepare the model for use, several TAZs were split in the study area to improve the resolution of the model in the area and to more accurately reflect local travel patterns.

MODEL CALIBRATION

A segment-by-segment comparison was made between model volumes and observed traffic volumes[1]. Daily volume data was obtained from UDOT for the study area, including recent daily counts conducted on the three state routes bordering the study area. A review of the initial base year travel demand model results showed that the model was high on Alpine Highway and low on North County Boulevard.

In the travel demand model, travel times between trip origins and destinations are an important factor in determining travel routes. Based on this understanding, the model was calibrated by adjusting free-flow travel speeds in the study area. Speeds were decreased on Alpine Highway and 100 West on the west side of the study area and increased on North Country Boulevard on the east side. The result of this process was a model that better matches observed traffic volumes and can therefore more reliably predict future travel in the study area.

3.2 Traffic Operations Analysis

The Synchro software was used to evaluate traffic operations. Synchro is a micro-simulation tool that was selected for this study because it allows for the evaluation of individual intersections based on *Highway Capacity Manual* (HCM) guidelines.

Traffic Counts

To prepare the Synchro model, existing traffic volumes were collected on Wednesday, December 14, 2016. Intersection turning movement counts were collected between 7:00 AM and 9:00 AM and between 4:00 PM and 6:00 PM at:

- Timpanogos Highway (SR-92) & Alpine Highway (SR-74)
- Timpanogos Highway (SR-92) & North County Boulevard (SR-129)
- Alpine Highway (SR-74) & 10400 North
- North County Boulevard (SR-129) & Cedar Hills Drive
- Alpine Highway (SR-74) & 1500 North
- Alpine Highway (SR-74) & 1120 North
- Alpine Highway (SR-74) & 740 North
- 700 North & 200 East
- North County Boulevard (SR-129)& 700 North

The peak hours were determined to be from 7:15 AM to 8:15 AM for the AM peak and 5:00 PM to 6:00 PM for the PM peak. Peak hour Synchro models were used to evaluate each signalized intersection for existing conditions. The peak hour volumes were used as the base from which 2040 volumes were developed.

1 The majority of the observed volumes are based on *2015 Traffic on Utah Highways* data published by UDOT and adjusted to reflect average weekday traffic

Existing traffic signal timing data were obtained from the UDOT Traffic Operations Center and entered into the Synchro models. The intersections were modeled based on existing conditions, including the number of lanes, exclusive turn lanes, storage lengths and movement volumes. The study area was modeled as a network; however, the analysis was completed for each intersection independently.

AM and PM peak hour volumes were developed for 2040 using principles described in the National Highway Cooperative Research Program (NCHRP) Report 255 document. The 2040 peak hour intersection volumes were developed from the existing peak hour traffic volumes. The WFRC/MAG travel demand model was run for the base year (2015) and for the future year (2040) and the difference between these models was used to estimate the traffic increase. These volumes were balanced to ensure the correct number of inbound and outbound vehicles on each leg of the intersection.

3.3 Measures of Effectiveness

Measures of Effectiveness (MOE) are used to evaluate the analysis objectives and compare the results of the various concepts. They quantify the results of the analysis and is often expressed as levels on how well the concept will perform.

For each Synchro analysis (e.g. existing conditions, 2040 no-build, 2040 build), the intersection results were calculated by Synchro following the procedures and equations described in the 2010 HCM. Two key measures of effectiveness were extracted from the Synchro models. The first was average delay per vehicle for the overall intersection and for each turning movement, which was used to determine level of service (LOS), as described in the HCM. LOS describes the operating performance of an intersection or roadway, is measured quantitatively, and is reported on a scale from A to F, with A representing the best performance and F the worst. ***Table 1*** provides a brief explanation for each LOS and the associated average delay per vehicle for signalized intersections.

Table 1. Signalized Intersection Level of Service

Level of Service	Traffic Conditions	Average Delay (seconds/vehicle)
A	Free Flow Operations / Insignificant Delay	0 ≤ 10.0
B	Smooth Operations / Short Delays	> 10.0 and ≤ 20.0
C	Stable Operations / Acceptable Delays	> 20.0 and ≤ 35.0
D	Approaching Unstable Operations / Tolerable Delays	> 35.0 and ≤ 55.0
E	Unstable Operations / Significant Delays Begin	> 55.0 and ≤ 80.0
F	Very Poor Operations / Excessive Delays Occur	> 80.0

Source: *Highway Capacity Manual 2010*, Transportation Research Board National Research Council, Washington D.C

The second key measure of effectiveness extracted from Synchro was the estimated 95th percentile queue length for each turning movement at the study intersections. This represents the vehicle queue length that would only be exceeded five percent of the time during the analysis period. It helps identify issues such as queuing between intersections and queues that exceed their available storage.

MOEs were also extracted from the travel demand model. Three study area network MOEs were evaluated: overall delay, vehicle miles of travel (VMT), and vehicle hours of travel (VHT). The study area network considered for the study was the roads within the borders of SR-92 on the north, 300 North on the south, 100 West on the west and North County Boulevard on the east and included all roads entering the study area. The MOEs were calculated by the TDM for each link and then aggregated to a study area level.

Information was extracted from the TDM for key roadway segments and used as an MOE to better understand user characteristics for each roadway, including trips by purpose, trip origins and destinations, and average trip lengths.

4 ANALYSIS RESULTS

Three connector options were analyzed to consider what effects a new connector would have on traffic in the study area. The options evaluated a connector placed in the northern third, central third, and southern third of the east-west access gap area. The location of the connector was placed independent of alignment feasibility, land use impacts, or cost. Each connector option was analyzed for both existing and 2040 conditions and compared to “no-build” conditions without a connector.

4.1 Roadway and Network Characteristics

4.1.1 Physical Description

The analysis was completed on a roadway network including north-south roadways of North County Boulevard (SR-129) and Alpine Highway (SR-74). North County Boulevard is a four-lane Principal Arterial owned and maintained by UDOT. Alpine Highway is a two-lane Minor Arterial owned and maintained by UDOT. The north extents of the analysis is SR-92 which is also a four-lane Principal Arterial owned and maintained by UDOT. The south extents of the analysis is 700 North, which is a 2 lane major collector owned and maintained by American Fork City. Currently there is 2.8 miles with no connecting road allowing east-west vehicle travel between SR-92 and 700 North.

4.1.2 Functional Types

The proposed connection between Alpine Highway and North County Boulevard was analyzed as a two lane Major Collector. A Major Collector is defined by the Federal Highway Administration (FHWA) to have the following characteristics[2]:

- Serve both land access and traffic circulation in higher density residential, and commercial/industrial areas
- Penetrate residential neighborhoods, often for significant distances
- Distribute and channel trips between Local Roads and Arterials, usually over a distance of greater than three quarters of a mile
- Operating characteristics include higher speeds and more signalized intersections

The Major Collector is described to supply service to a community level, with average trip lengths from 5 to 10 miles. The collector should support volumes between 5,000 and 10,000 vehicles per day and have intersections spaced every 300 to 600 feet. In contrast, an Arterial services both a community and region with average trip lengths between 7 and 35 miles, supports 5,000 to 40,000 vehicles per day, and has intersections spaced every 300 to 1,320 feet.

[2] “Highway Functional Classification: Concepts, Criteria and Procedures” 2013 Edition, FHWA

4.1.3 Street Connectivity

The American Planning Association (APA) defines street connectivity as "the quality and quantity of connections in the street network. The purpose of the street network is to connect one place to another."[3] The APA recommends that Major Collectors be spaced one-half mile from Arterials, with Arterials being spaced every 1 to 3 miles.

In reviewing street connectivity in the study area, the spacing between Alpine Highway and North County Boulevard meets the spacing guidelines of both the APA and the FHWA. The spacing between SR-92 and 700 North does not meet the guidelines for Collectors. Additional Collectors would be required to meet these guidelines.

4.1.4 Trip Details

An analysis was completed to determine the length and types of trips using a new east-west connector and North County Boulevard. A summary of the trip length details is shown in ***Table 2***. The results show that the average daily trip length of 6.8 miles falls within the FWHA thresholds for a Major Collector. The average trip length for North County Boulevard is 60 to 70 percent longer than the average trip on the connector, depending on the year, which is consistent with the regional nature of North County Boulevard versus the more local nature of an east-west connector. The analysis also showed that 20% of the trips on a connector would be work (commuting) trips compared to 30% on North County Boulevard, again indicative of the local nature of a connector.

Table 2. Average Trip Length (Miles)

Street	2015	2040
New East-West Connector	6.3	6.8
North County Boulevard (SR-129)	10.8	10.8

4.2 Traffic Volumes

As part of the analysis, the TDM was used to determine how traffic volumes in the study area would change with a new east-west connector. If the connector were built today, the central connector would have the highest demand with an estimated 6,200 vehicles per day (vpd). Traffic volumes for the northern and southern connectors are estimated at 4,700 and 5,400 vpd, respectively. The northern connector removes the most traffic from SR-92, which is the most congested road in the study area, an estimated 3,000 vpd. The southern connector removes the highest volume from 700 North, an estimated 1,600 vpd. The central connector removes an estimated 2,300 vpd from SR-92 and 900 vpd from 700 North. The analysis shows that all three options have demand volumes consistent with the FHWA thresholds for a Major Collector. Table 3 summarizes the estimated daily traffic volumes for each option if a connector were built today, while more detailed figures showing the change in daily study area traffic volumes for each option can be found in Appendix B.

[3] "Planning and Urban Design Standards", APA

Table 3. Daily Traffic Volumes Summary – Existing Conditions

Roadway	No Connector	Northern Connector	Central Connector	Southern Connector
Timpanogas Highway (SR-92)	16,000	13,000 (-3,000)	13,700 (-2,300)	14,800 (-1,200)
New Major Collector	n/a	4,700	6,200	5,400
700 North	4,000	3,500 (-500)	3,100 (-900)	2,400 (-1,600)

For 2040, the southern connector is estimated to have the highest demand with an estimated 8,500 vpd with the northern and central connectors' demand being estimated at 7,200 and 7,800 trips per day, respectively. The northern connector removes the most traffic from SR-92, an estimated 5,100 vpd. The southern connector removes the highest volume from 700 North, an estimated 6,300 vpd. The central connector removes an estimated 2,200 vpd from SR-92 and 4,800 vpd from 700 North. Table 4 summarizes the estimated daily traffic volumes for each option if a connector were built today, while more detailed figures showing the change in 2040 daily study area traffic volumes can be found in the appendix.

Table 4. Daily Traffic Volumes Summary – 2040 Conditions

Roadway	No Connector	Northern Connector	Central Connector	Southern Connector
Timpanogas Highway (SR-92)	27,000	21,900 _(-5,100)	24,800 (-2,200)	25,700 (-1,300)
New Major Collector	n/a	7,200	8,500	7,800
700 North	14,500	13,500 (-1,000)	9,700 (-4,800)	8,200 (-6,300)

A comparison between the existing conditions model and the 2040 option without connector option was also completed to determine how the volumes are expected to change over the next 20+ years. North County Boulevard and SR-92 are each expected to increase by 60 to 70 percent, while Alpine Highway is anticipated to have relatively minor growth at 5 to 10 percent. With the addition of the planned connector between 200 East and Alpine Highway, 700 North had the highest estimated growth at 200 to 300 percent. Figures showing the daily growth comparison between existing conditions and 2040 can be found in Appendix B.

4.3 Intersection Analysis

Each signalized intersection in the study area was analyzed for the AM and PM peak hours for existing and future (2040) conditions. The results show that the AM peak hour is the critical period, largely due to the high school on North County Boulevard, which affects the AM peak but not the PM peak. Figures 2 and 3 on the following pages show the results of the intersection analysis. They show that a new east-west connector reduces average vehicle delay at most intersections. The northern option has the greatest positive effect on the intersection of SR-92 and North County Boulevard, while the greatest positive effect at the other intersections come from the central and southern options. Note the 2040 options include a signalized intersection at 740 North and Alpine Highway, which is assumed to occur as part of the 700 North connector project.

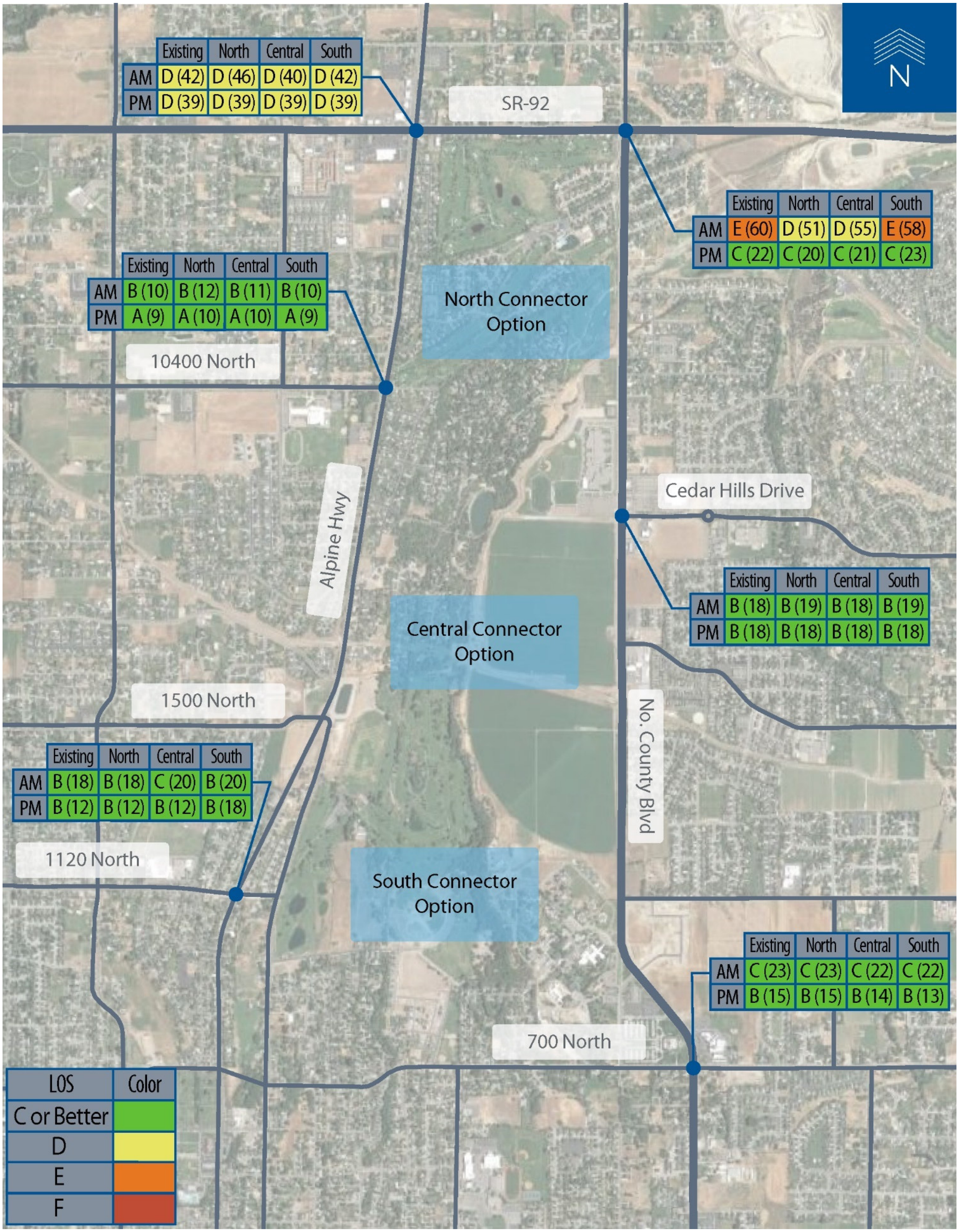


Figure 2: Intersection Level of Service - 2016

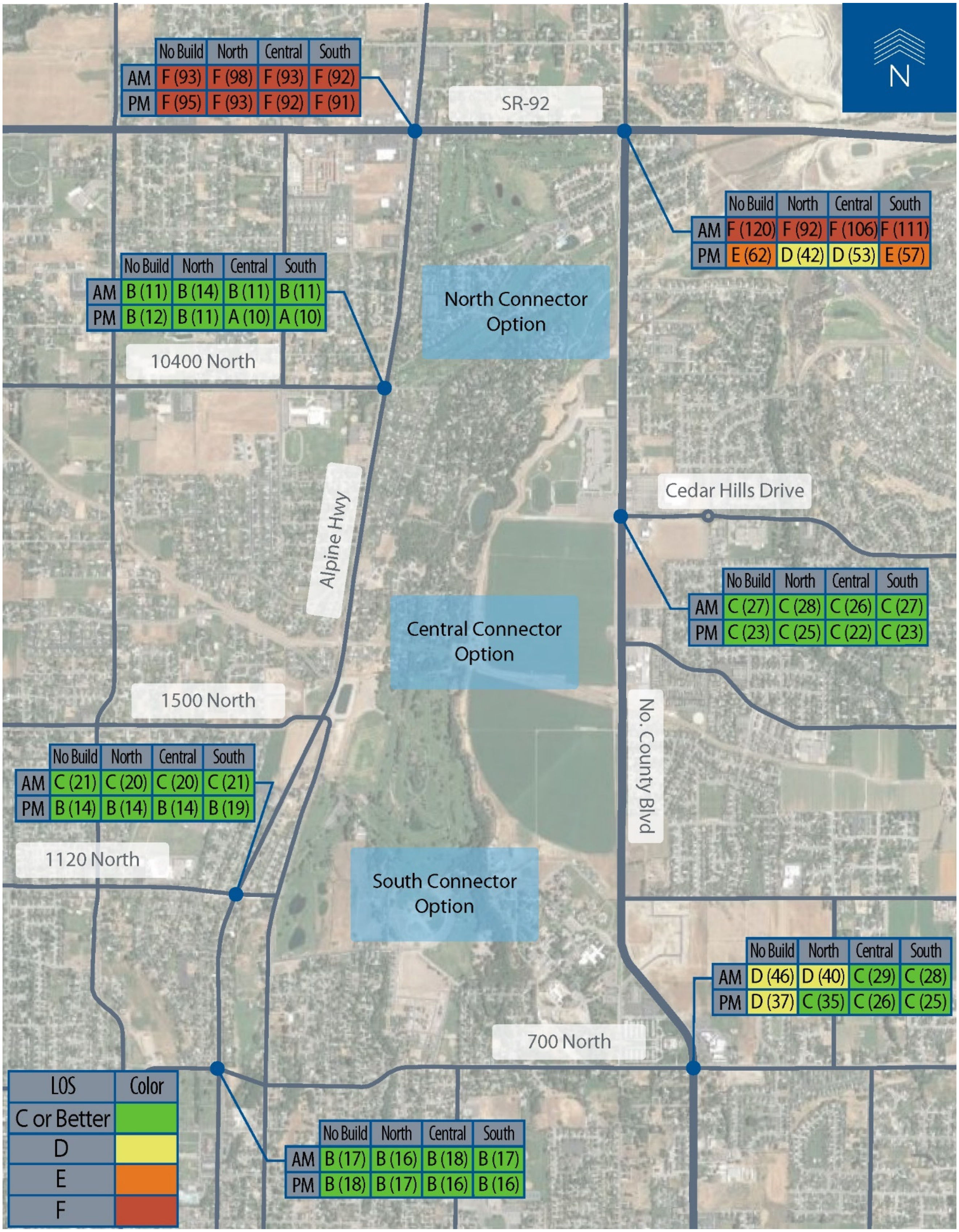


Figure 3: Intersection Level of Service - 2040

4.4 Network Analysis

A study area analysis was conduct at a network level to compare the options for each study year. The analysis measured the daily total delay, vehicle hours traveled, and vehicle miles traveled in the study area. The network includes all of the roads that intersect and are within the study area. The results are summarized in Tables 5 and 6 and show that a connector, independent of location, improves the network in both study years. The results show that in the 2016 year the northern and central delays are similar. In the future, the results show the central option performing with the lowest MOE values and a 10% reduction in delays.

Table 5. Daily Network MOEs - 2016

Option	Delay (hr)[1]	VHT[1]	VMT[2]
Existing Conditions	240	9,360	280,000
Northern Connector	230	9,360	280,000
Central Connector	230	9,340	279,000
Southern Connector	240	9,320	279,000

[1] Rounded to the nearest 10. Minor changes may not be represented.

[2] Rounded to the nearest 1,000. Minor changes may not be represented.

Table 6. Daily Network MOEs - 2040

Option	Delay (hr)[1]	VHT[1]	VMT[2]
Without Connector	770	13,080	403,000
Northern Connector	730	13,040	401,000
Central Connector	690	12,960	398,000
Southern Connector	720	13,020	400,000

[1] Rounded to the nearest 10. Minor changes may not be represented.

[2] Rounded to the nearest 1,000. Minor changes may not be represented.

5 CONCLUSIONS

The options were evaluated based on roadway and network characteristics, traffic volumes, intersection operations, and network performance. The results showed volume demand ranging from an estimated 4,700 to 6,200 trips per day in year 2016 and increasing to an estimated 7,200 to 8,500 trips per day in year 2040, based on the location of the connector. The volumes, trip lengths, and proposed spacing correspond to the Major Connector functional class that is proposed for the road and are consistent with similar streets in the area.

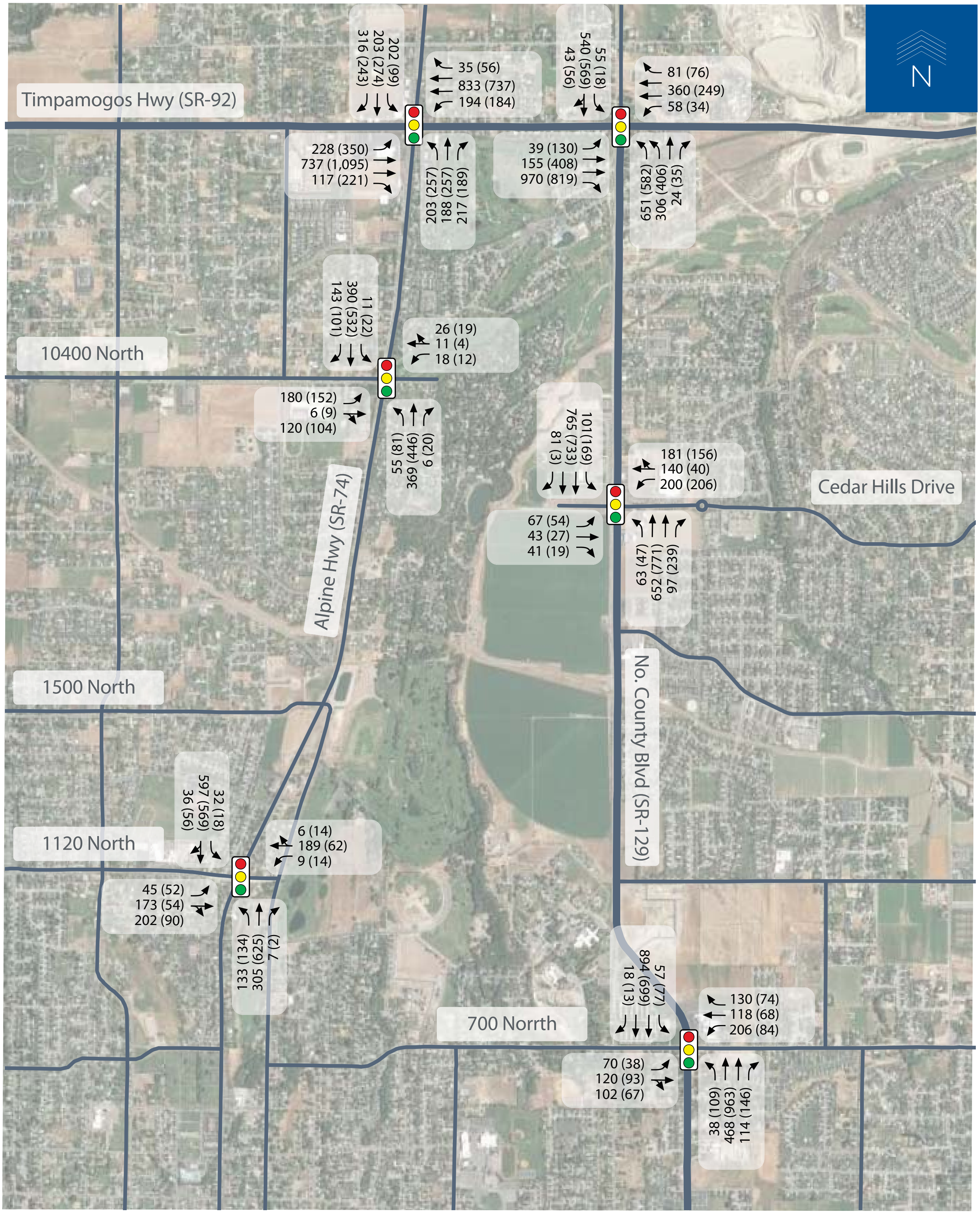
The analysis shows that generally the intersection delays decreased and operations improved with the addition of the proposed connector independent of location. The intersections along SR-92 have the largest decrease in delays where decreases ranged from 1 to 28 seconds depending on intersection and location of the connector. The results show a reduction in delays for drivers and the amount and distances drivers were traveling within the study area. Overall daily delays are reduced by 10 to 80 hours, with VHT and VMT reduced by 10 to 120 hours and 1,000 to 5,000 miles, respectively.

The evaluation of the effects of adding an east-west connector between SR -92 and 700 North shows that it will have a positive impact on the local network, regardless of location. The proposed connector decreases intersection delay and reduces the amount of travel time and distance for drivers in the area.

Appendix A

Intersection Traffic Volumes

Existing Conditions Movement Volumes -2016



AM (PM) Peak Hour Volumes - Collected December 14, 2016

2016 AM Peak Turning Movements

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBR	WBT	WBR
Existing Conditions												
SR-92 & SR-74	203	188	217	202	203	316	228	737	117	194	833	35
10400 N & SR-74	55	369	6	11	390	143	180	6	120	18	11	26
1120 N & SR-74	133	305	7	32	597	36	45	173	202	9	189	6
SR-92 & SR-129	651	306	24	55	540	43	39	155	970	58	360	81
Cedar Hills & SR-129	63	652	97	101	765	81	67	43	41	200	140	181
700 N & SR-129	38	468	114	57	894	18	70	120	102	206	118	130
North Connector Option												
SR-92 & SR-74	200	170	175	190	175	365	255	715	105	140	785	35
10400 N & SR-74	95	315	5	15	400	130	215	20	125	10	25	45
1120 N & SR-74	135	310	10	35	605	40	50	170	205	10	185	10
SR-92 & SR-129	580	315	30	60	550	35	35	145	905	70	330	85
Cedar Hills & SR-129	65	680	95	110	795	95	75	45	45	190	145	195
700 N & SR-129	40	470	120	60	890	20	70	120	100	210	115	130
Central Connector Option												
SR-92 & SR-74	200	175	180	195	185	350	250	720	110	150	790	35
10400 N & SR-74	80	390	10	15	385	145	175	10	150	25	15	25
1120 N & SR-74	135	345	10	35	650	40	50	155	195	10	180	10
SR-92 & SR-129	585	305	25	55	545	45	40	145	915	60	335	85
Cedar Hills & SR-129	60	595	105	105	725	75	60	45	40	220	145	180
700 N & SR-129	35	435	115	60	850	20	65	115	95	205	110	130
South Connector Option												
SR-92 & SR-74	205	185	210	200	200	325	235	725	115	180	800	35
10400 N & SR-74	60	360	10	15	375	145	180	10	125	20	15	25
1120 N & SR-74	135	335	90	50	605	5	10	220	185	100	235	10
SR-92 & SR-129	615	310	25	60	545	45	40	155	945	60	350	85
Cedar Hills & SR-129	65	635	105	105	760	80	65	45	45	215	145	180
700 N & SR-129	35	425	115	60	830	20	65	115	90	205	110	135

2016 PM Peak Turning Movements

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBR	WBT	WBR
Existing Conditions												
SR-92 & SR-74	257	257	189	99	274	243	350	1,095	221	184	737	56
10400 N & SR-74	81	446	20	22	532	101	152	9	104	12	4	19
1120 N & SR-74	134	625	2	18	569	56	52	54	90	14	62	14
SR-92 & SR-129	582	406	35	57	284	93	130	408	819	34	249	76
Cedar Hills & SR-129	47	771	239	169	733	3	54	27	19	206	40	156
700 N & SR-129	109	963	146	77	699	13	38	93	67	84	68	74
North Connector Option												
SR-92 & SR-74	240	200	115	85	230	305	425	1,020	215	115	680	45
10400 N & SR-74	105	425	10	35	470	135	155	30	150	10	20	20
1120 N & SR-74	125	650	5	35	580	45	40	85	80	30	90	25
SR-92 & SR-129	490	420	40	65	300	80	110	375	710	40	225	85
Cedar Hills & SR-129	50	805	220	190	780	5	65	30	20	190	45	175
700 N & SR-129	105	960	160	75	700	15	35	85	65	95	65	75
Central Connector Option												
SR-92 & SR-74	245	220	135	90	245	290	400	1,040	215	135	695	50
10400 N & SR-74	115	435	25	20	530	100	145	15	145	20	10	20
1120 N & SR-74	110	700	5	35	625	45	40	70	75	25	70	25
SR-92 & SR-129	500	405	35	65	290	95	130	385	720	35	230	85
Cedar Hills & SR-129	45	705	270	165	650	5	50	30	20	230	40	155
700 N & SR-129	95	925	175	70	655	10	20	60	50	100	55	65
South Connector Option												
SR-92 & SR-74	255	250	175	100	270	255	365	1,070	220	170	715	55
10400 N & SR-74	85	425	20	25	510	105	150	10	105	15	5	20
1120 N & SR-74	140	620	70	75	530	10	5	140	55	185	110	25
SR-92 & SR-129	555	405	35	60	290	95	130	395	790	35	240	80
Cedar Hills & SR-129	50	760	255	170	725	5	55	30	20	225	45	155
700 N & SR-129	85	925	175	75	655	10	20	55	40	95	50	70

2040 AM Peak Turning Movements

Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBR	WBT	WBR
Without Connector												
SR-92 & SR-74	240	190	240	240	220	390	310	1,090	160	240	1,190	50
10400 N & SR-74	60	380	10	20	410	150	190	10	120	20	20	30
1120 N & SR-74	180	310	10	30	600	80	80	140	220	10	150	10
740 N & SR-74	60	400	200	90	780	50	30	240	210	50	300	100
SR-92 & SR-129	1,040	380	30	50	620	70	60	170	1,370	50	350	60
Cedar Hills & SR-129	140	1,040	120	110	1,210	150	120	60	90	230	180	180
700 N & SR-129	120	710	80	110	1,330	150	260	190	130	110	350	200
North Connector Option												
SR-92 & SR-74	230	160	170	210	170	460	340	1,050	140	150	1,110	40
10400 N & SR-74	110	300	10	10	390	160	230	30	160	10	40	50
1120 N & SR-74	170	290	10	30	610	90	80	140	210	10	150	10
740 N & SR-74	60	380	200	80	780	50	30	230	210	50	280	90
SR-92 & SR-129	910	400	30	50	630	50	50	160	1,250	60	320	70
Cedar Hills & SR-129	140	1,060	120	110	1,240	160	120	60	90	220	180	180
700 N & SR-129	110	730	80	110	1,340	130	240	180	130	130	330	200
Central Connector Option												
SR-92 & SR-74	240	190	220	230	210	410	320	1,050	160	210	1,160	50
10400 N & SR-74	70	360	10	20	380	150	180	10	140	20	20	30
1120 N & SR-74	170	390	10	30	600	70	90	140	220	10	150	10
740 N & SR-74	70	440	130	50	800	80	70	190	230	10	260	70
SR-92 & SR-129	990	390	30	50	620	60	60	160	1,300	50	330	70
Cedar Hills & SR-129	140	1,000	130	110	1,160	140	110	60	90	250	190	180
700 N & SR-129	90	710	120	100	1,320	80	140	160	120	180	280	200
South Connector Option												
SR-92 & SR-74	240	190	230	230	210	400	320	1,070	160	220	1,170	50
10400 N & SR-74	60	370	10	20	390	150	180	10	130	20	20	30
1120 N & SR-74	120	340	80	60	590	10	10	270	170	100	310	20
740 N & SR-74	70	450	110	50	780	100	70	160	250	10	240	50
SR-92 & SR-129	1,010	390	30	50	620	60	60	160	1,340	50	340	70
Cedar Hills & SR-129	140	1,030	130	110	1,200	140	110	60	90	240	190	180
700 N & SR-129	80	710	130	100	1,300	60	120	150	110	200	250	210

2040 PM Peak Turning Movements

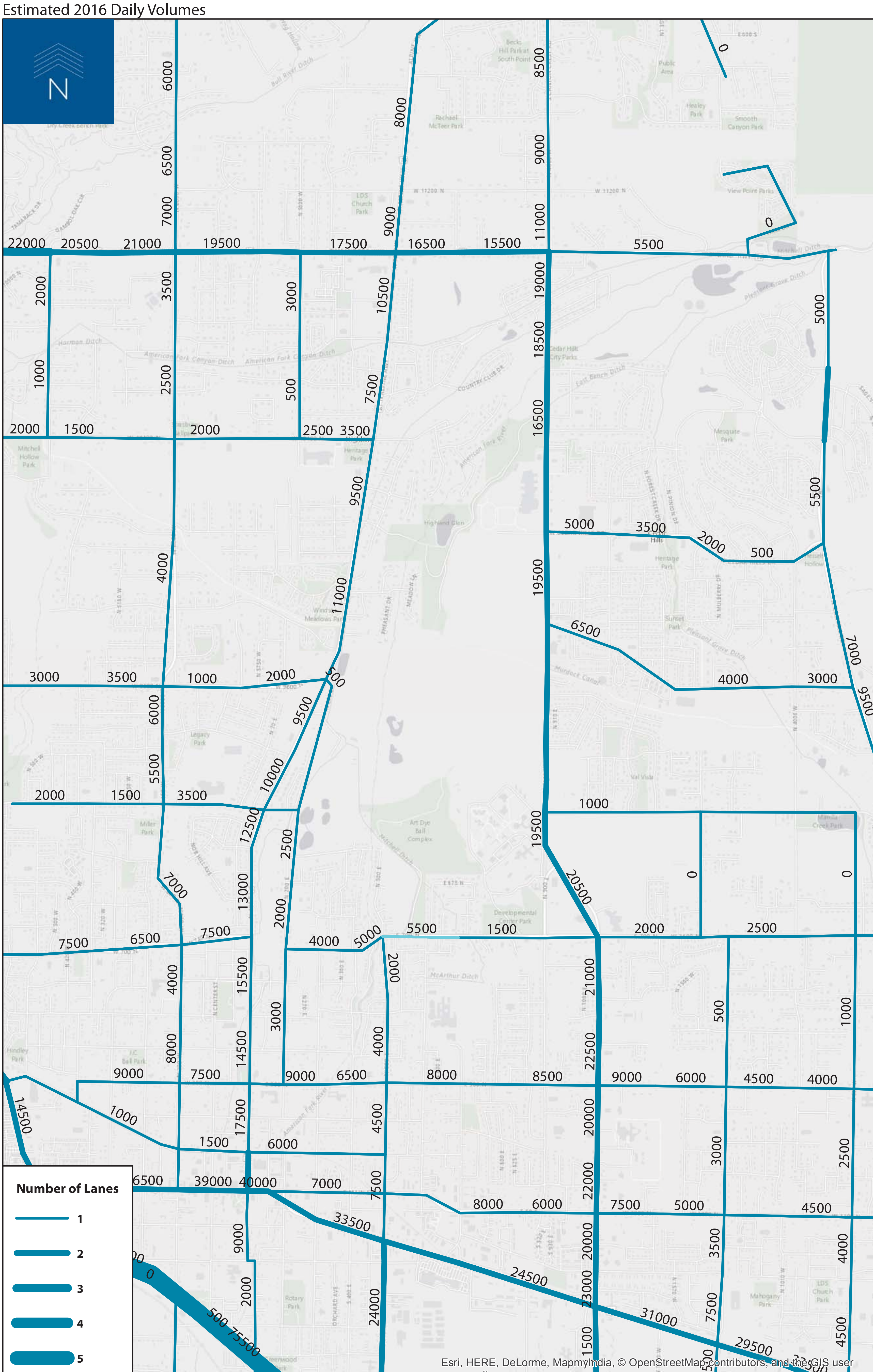
Intersection	NBL	NBT	NBR	SBL	SBT	SBR	EBL	EBT	EBR	WBR	WBT	WBR
Without Connector												
SR-92 & SR-74	320	290	250	140	290	320	420	1,560	250	260	1,230	90
10400 N & SR-74	90	480	30	30	550	120	190	20	120	20	10	30
1120 N & SR-74	240	550	10	10	570	80	70	40	170	10	40	10
740 N & SR-74	190	720	100	130	570	40	50	310	100	110	310	140
SR-92 & SR-129	1,050	480	40	60	340	140	170	490	1,250	40	340	70
Cedar Hills & SR-129	90	1,270	260	190	1,170	10	90	30	40	220	50	180
700 N & SR-129	240	1,240	60	200	1,000	190	330	250	100	30	210	140
North Connector Option												
SR-92 & SR-74	290	200	130	100	230	410	530	1,440	240	140	1,120	60
10400 N & SR-74	140	430	10	30	460	170	190	50	190	10	40	20
1120 N & SR-74	240	550	10	10	560	90	70	40	160	10	40	10
740 N & SR-74	200	720	90	110	560	40	50	290	100	120	290	120
SR-92 & SR-129	860	490	50	70	350	120	140	450	1,030	40	300	80
Cedar Hills & SR-129	90	1,320	240	200	1,230	10	100	30	30	210	60	190
700 N & SR-129	230	1,260	70	200	1,020	160	290	240	100	30	200	140
Central Connector Option												
SR-92 & SR-74	320	260	200	120	270	350	460	1,500	250	210	1,180	80
10400 N & SR-74	110	430	30	20	510	110	160	20	140	20	10	20
1120 N & SR-74	200	630	10	10	610	100	90	40	140	10	40	10
740 N & SR-74	210	730	80	90	540	90	100	250	100	120	250	100
SR-92 & SR-129	970	480	40	60	340	140	170	460	1,160	40	310	70
Cedar Hills & SR-129	80	1,170	290	180	1,110	10	90	40	40	260	50	170
700 N & SR-129	190	1,290	130	180	1,020	60	150	230	110	70	170	140
South Connector Option												
SR-92 & SR-74	320	270	220	130	280	330	440	1,530	250	230	1,200	80
10400 N & SR-74	90	440	20	30	520	120	180	20	110	20	10	20
1120 N & SR-74	230	510	90	70	490	10	10	220	90	190	150	20
740 N & SR-74	210	720	70	100	540	100	120	240	110	100	250	80
SR-92 & SR-129	1,000	480	40	60	340	140	170	470	1,200	40	320	70
Cedar Hills & SR-129	90	1,270	270	180	1,170	10	90	40	40	240	50	180
700 N & SR-129	190	1,260	150	160	990	50	120	220	110	80	160	130

Appendix B

Change in Daily Volumes Maps

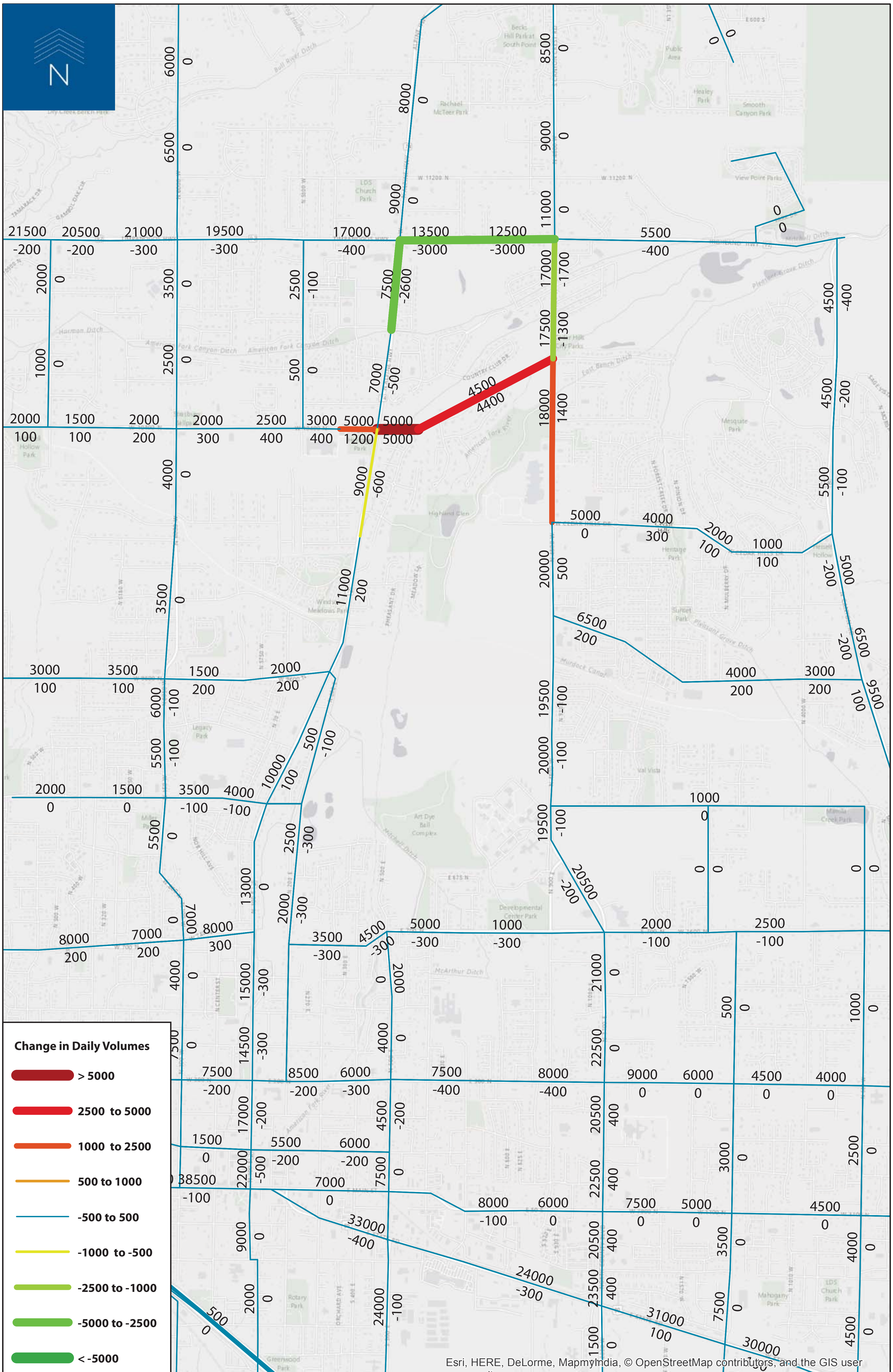
Existing Conditions

Estimated 2016 Daily Volumes



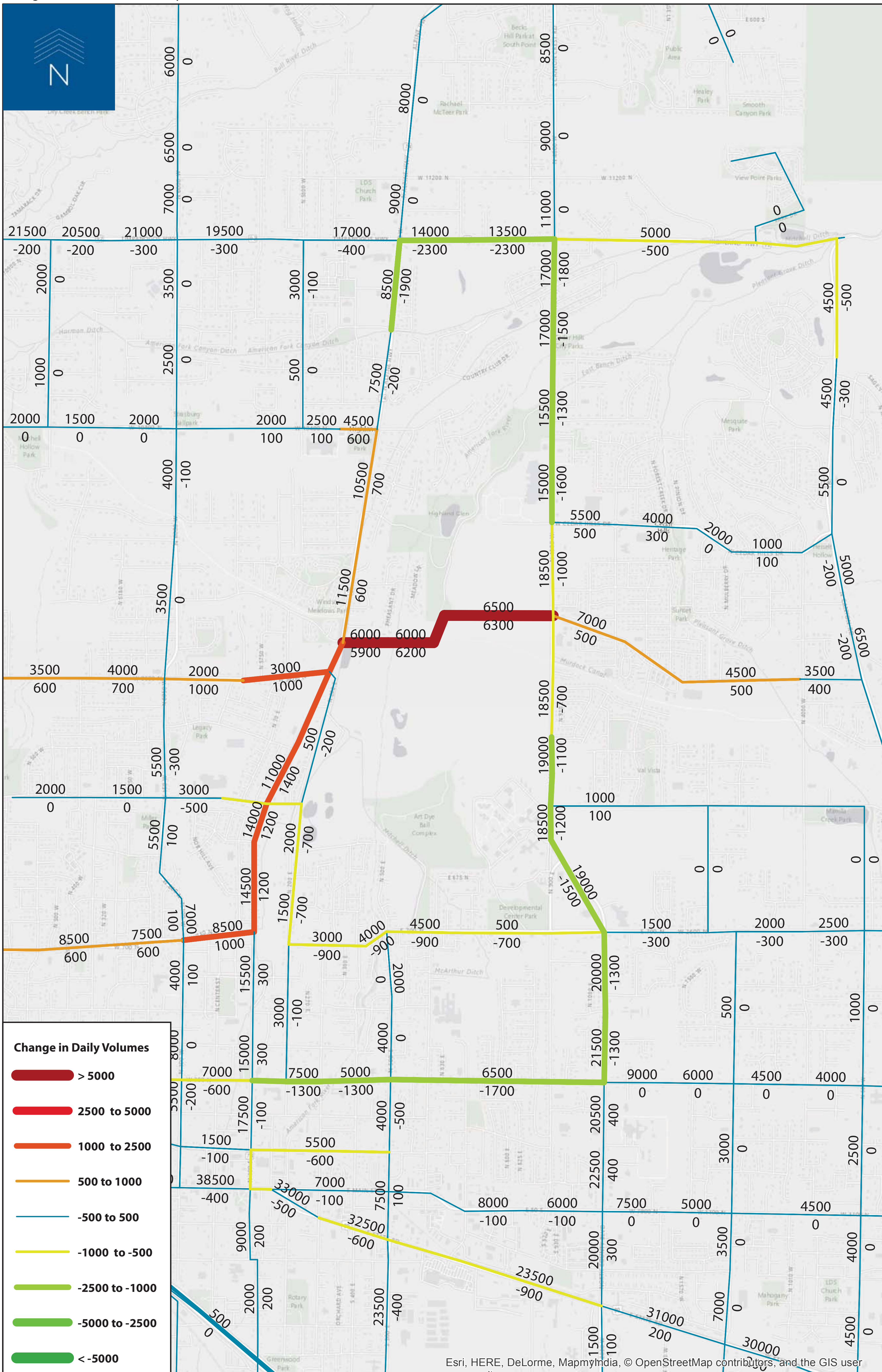
Murdock Connector Northern Option

Change in Estimated 2016 Daily Volumes



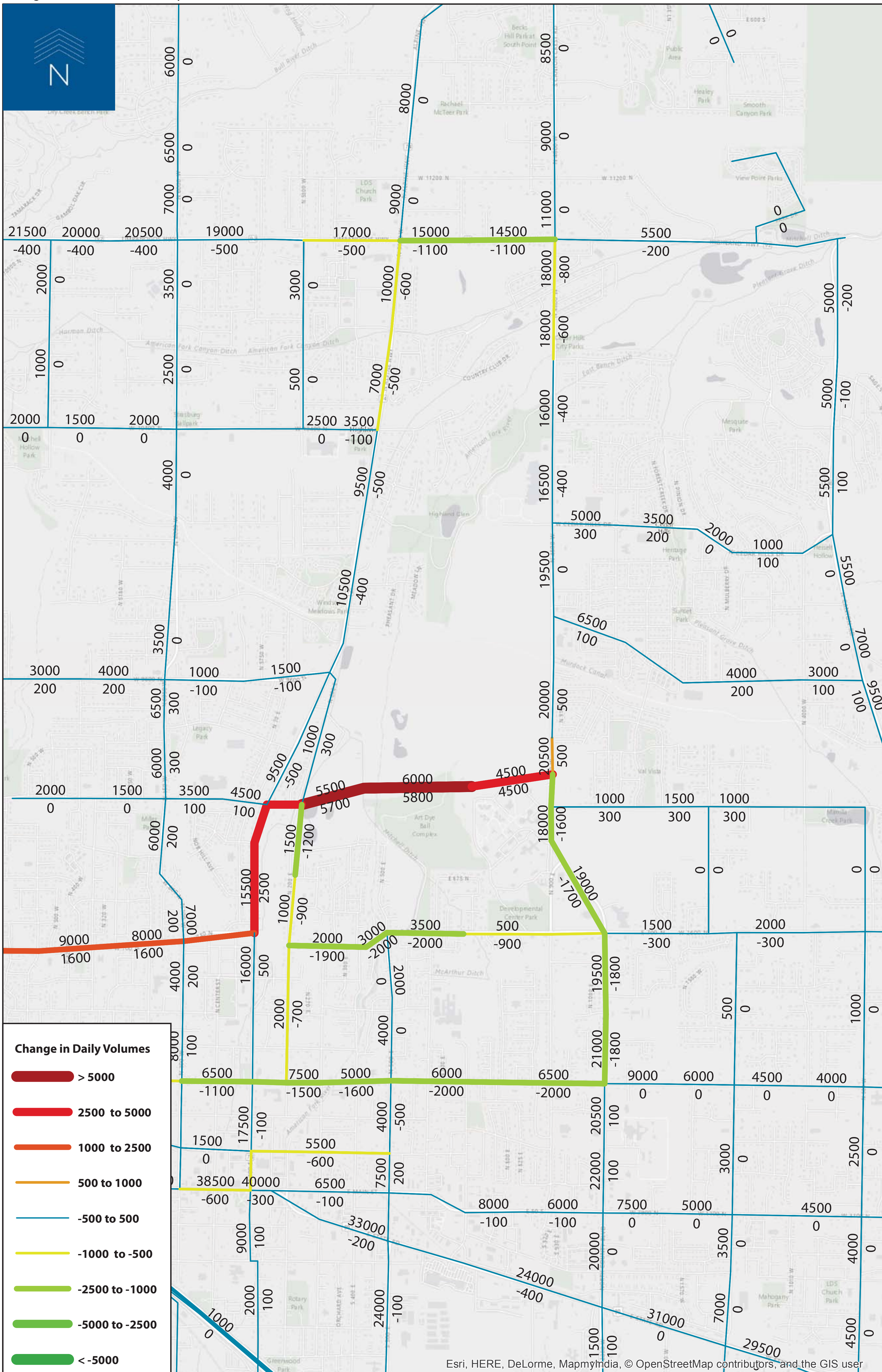
Murdock Connector Central Option

Change in Estimated 2016 Daily Volumes



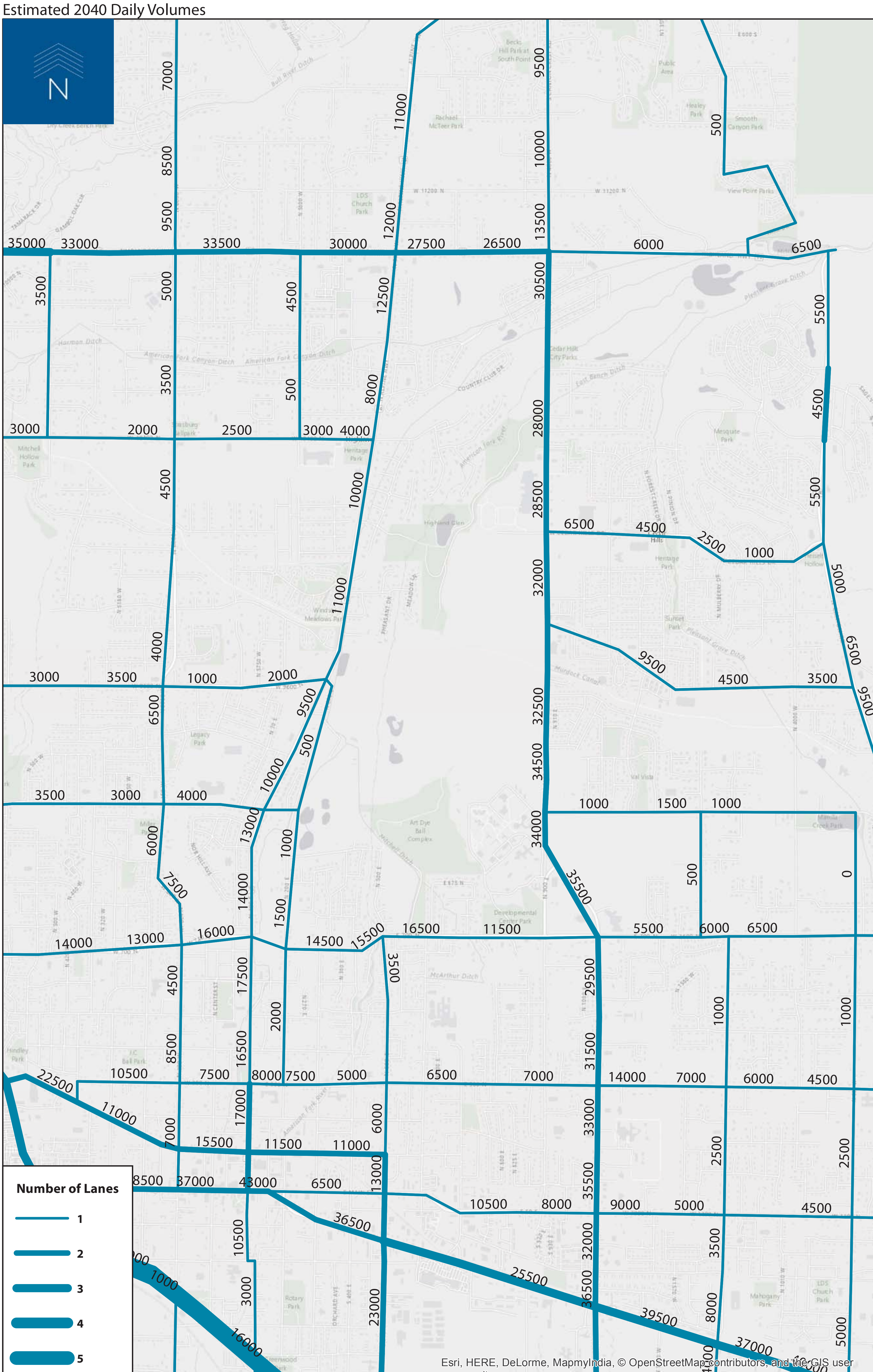
Murdock Connector Southern Option

Change in Estimated 2016 Daily Volumes



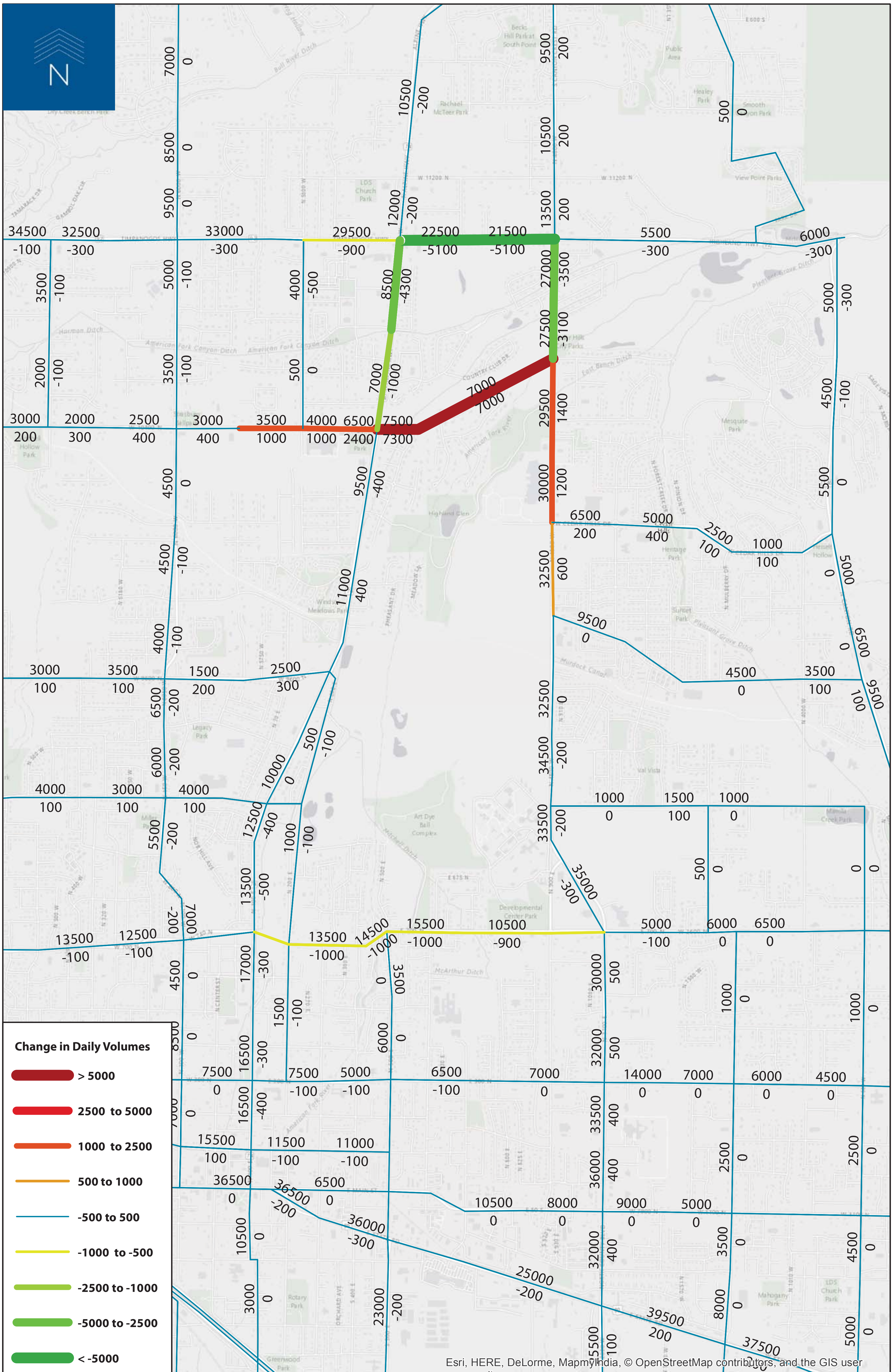
With No Connector

Estimated 2040 Daily Volumes



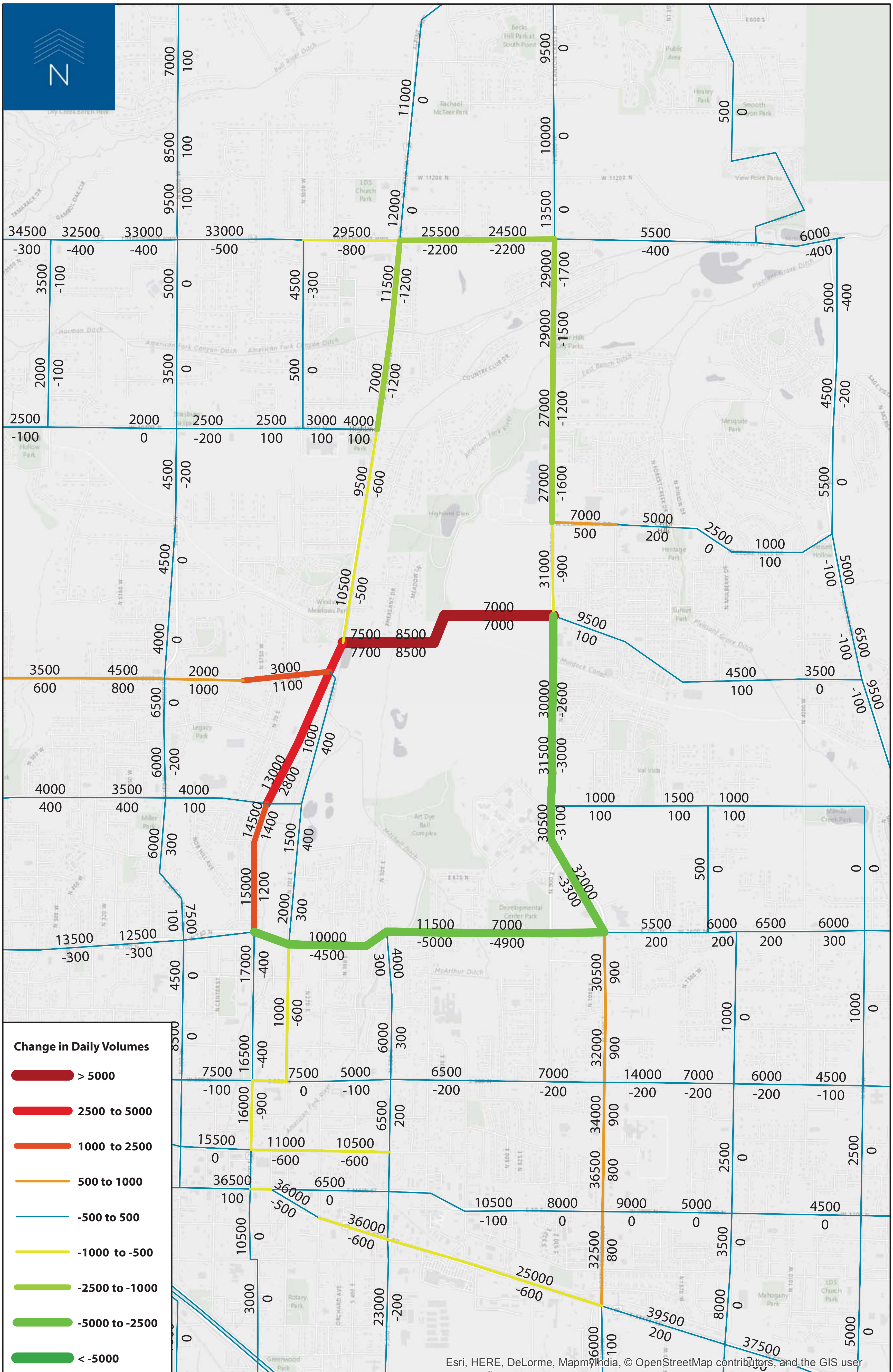
Murdock Connector Northern Option

Change in Estimated 2040 Daily Volumes



Murdock Connector Central Option

Change in Estimated 2040 Daily Volumes



Murdock Connector Southern Option

Change in Estimated 2040 Daily Volumes