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1.0 INTRODUCTION

This report documents a traffic impact analysis performed as part of the Chanhassen Alternative Urban Area Report (AUAR), Section 21, for a proposed development surrounded by Lyman Boulevard, the proposed Powers Boulevard alignment, Pioneer Trail, and Audubon Road in the City of Chanhassen, Minnesota.

1.1 REPORT PURPOSE AND OBJECTIVES

The purpose of this study is to address traffic and transportation impacts of the proposed development on surrounding streets and intersections. This traffic impact study was prepared based on criteria set forth by the AUAR guidelines. The following specific information, per AUAR recommended content, should be provided:

- *A description and map of the existing and proposed roadway system, including state, regional, and local roads to be affected by the development of the AUAR area. This information should include existing and proposed roadway capacities and existing and projected background (i.e., without the AUAR development) traffic volumes;*

- *Trip generation data —trip generation rates and trip totals—for each major development scenario broken down by land use zones and/or other relevant subdivisions of the area. The projected distributions onto the roadway system must be included;*

- *Analysis of impacts of the traffic generated by the AUAR area on the roadway system, including: comparison of peak period total flows to capacities and analysis of Levels of Service and delay times at critical points (if any);*

- *A discussion of structural and non-structural improvements and traffic management measures that are proposed to mitigate problems;*

Note: in the above analyses the geographical scope must extend outward as far as the traffic to be generated would have a significant effect on the roadway system and traffic measurements and projections should include peak days and peak hours, or other appropriate measures related to identifying congestion problems, as well as ADTs.

2.0 PROPOSED DEVELOPMENT

2.1 SITE LOCATION

The AUAR development is located in the City of Chanhassen, Minnesota. The site is bordered by Lyman Boulevard to the north, the proposed Powers Boulevard alignment to the east, Pioneer Trail to the south, and Audubon Road to the west. The project location is shown in Figure 1.

2.2 LAND USE

The overall development consists of a mix of residential, office and general light industrial. The total site area is on approximately 625 acres. The site consists of eight traffic analysis zones (TAZ) with TAZs 2 and 3 referred to as the Town and County Development. Table 1 illustrates the land use of the proposed AUAR development by TAZ.

Table 1 - Land Use

TAZ	Land Use	Size
1 (Degler Property)	School	1,700 Students
2 (Town and Country)	Residential – Attached Office/Light Industrial	313 DU 56,584 SF
3 (Town and Country)	Residential – Attached Office/Light Industrial	227 DU 242,673 SF
4	Office/Light Industrial	153,026 SF
5	Residential - Detached Office	11 DU 271,531 SF
6	Residential – Detached Residential – Attached	401 DU 140 DU
7	Residential – Detached	207 DU
8	Residential – Detached	335 DU

DU – dwelling units
SF – square feet

The comprehensive plan indicates that TAZ 1 would be developed as general light industrial. A school was proposed in TAZ 1 based upon an underlying need and because the overall trip generation of the school is more intense than the light industrial land-use.

2.3 SITE PLAN

The layout of the site is illustrated in Figure 2. Starting in the northwest quadrant with TAZ 1, the remaining TAZs are numbered in a somewhat counter-clockwise pattern with TAZ 3 in the southwest corner, TAZ 5 in the southeast corner and TAZ 8 in the northeast corner of the AUAR development. The Bluff Creek meanders north/south through the AUAR development.

In addition to the existing roadway network, the site plan shows the future Trunk Highway 212/312 (TH 212/312) and Powers Boulevard roadway alignments. The construction of TH 212/312 and Powers Boulevard will involve realigning Pioneer Trail and Bluff Creek Drive as shown on the site plan.

The locations of the intersections of the internal roadway system with the perimeter streets were based upon coordination with MnDOT and Carver County. An east-west collector roadway is proposed to

intersect Audubon Road at Butternut Drive and the proposed Powers Boulevard at the southwest-bound TH 212/312 ramp, which will be referred to as the Butternut Collector. A connector road is proposed in the northeast quadrant connecting the Butternut Collector to Lyman Boulevard between Audubon Road and Powers Boulevard. The southwest quadrant shows a connecting roadway from the Butternut collector to Pioneer Trail, also between Audubon Road and Powers Boulevard. These roadways will be referred to as the North and South Connectors, respectively. Access to TAZ 1 will be provided by an interior roadway that intersects Audubon Road at Lakeview Drive and Lyman Boulevard at the north leg of Audubon Road. Access to TAZ 5 is proposed to intersect Pioneer Trail at Bluff Creek Drive and Powers Boulevard at a point approximately 660 feet south of the northeast-bound TH 212/312 ramp; a connection between these access points is not planned through TAZ 5.

2.4 ANALYSIS SCENARIOS

Table 2 describes the scenarios analyzed for this AUAR. The background/base volumes for 2003 and 2010 and the background plus AUAR development volumes, also for 2003 and 2010, are part of the subsequent analyses.

Table 2 - Traffic Analysis Scenarios

Scenario	Analysis
Without AUAR Development	
E-1	2003 Existing Traffic; Existing Network
F-1	2010 Projected Traffic; includes TH 212/312
With AUAR Development	
E-2	2003 Existing Traffic; Partial AUAR Development (TAZ 2 and 3); Audubon Road/Butternut Connection Only; does not include extended TH 212/312
F-2	2010 Projected Traffic; Full AUAR Development; includes all internal roads and construction of TH 212/312

3.0 STUDY AREA

3.1 STUDY AREA

The study area includes the existing and future intersections that have a significant effect on the roadway system due to the AUAR development. These intersections include:

- Audubon Road/Lyman Boulevard
- Audubon Road/Lakeview Drive
- Audubon Road/Butternut Drive
- Audubon Road/Pioneer Trail
- Pioneer Trail/Future South Connector
- Pioneer Trail/Bluff Creek Drive
- Pioneer Trail/Future Powers Boulevard
- Future Powers Boulevard/TH 212/312 Ramp (northeast-bound)
- Future Powers Boulevard/TH 212/312 Ramp (southwest-bound)
- Powers Boulevard/Lyman Boulevard
- Lyman Boulevard/Future North Connector
- Lyman Boulevard/Audubon Road (north leg)
- Future Butternut Collector/South Connector
- Future Butternut Collector/North Connector

The study was prepared to support AUAR recommended content for Section 21. Each of the major development scenarios was analyzed and the impacts were documented. The projected build out for the AUAR development is anticipated in 2010. Construction of the Town and Country Development is anticipated in the immediate future (assuming 2003). Therefore, the horizon years analyzed for this study are 2003 and 2010.

3.2 ADJACENT LAND USE

The land uses adjacent to the AUAR development are mainly residential with a golf course located to the south. Currently the only access points on Deer Valley Road between 75th Avenue and 83rd Avenue are at Lone Cactus, 80th Avenue, and Hillcrest Boulevard. All three of these intersections are T-intersections. The intersection of Hillcrest Boulevard and Deer Valley Road is a desirable location for signalization on Deer Valley Road due to its half-mile location between 75th Avenue and 83rd Avenue; therefore, the intersection of Hillcrest Boulevard and Deer Valley Road could be signalized as more development occurs in the vicinity. Currently, there is a gravel yard to the east of the proposed development. The proposed site is bounded by the New River to the southeast. There is a horse property to the west of the site.

3.3 SITE ACCESSIBILITY

The site is accessed locally via Audubon Road, Lyman Boulevard, Pioneer Trail and the future Powers Boulevard. Regional access is expected to be provided by the future TH 212/312 and by the other principal arterials in the vicinity such as Trunk Highway 5, Trunk Highway 41, Trunk Highway 101, and the existing Trunk Highway 169/212.

3.4 SITE CIRCULATION

The locations of the intersections of the internal roadway system with the perimeter streets were based upon coordination with MnDOT and Carver County. The site plan is shown in previously referenced Figure 2. An east-west collector roadway will provide access to Audubon Road at Butternut Drive and Powers Boulevard at the southwest-bound TH 212/312 ramp, which will be referred to as the Butternut Collector. A connector road in the northeast quadrant connects the Butternut Collector to Lyman Boulevard between Audubon Road and Powers Boulevard. The southwest quadrant shows a connecting roadway from the Butternut collector to Pioneer Trail, also between Audubon Road and Powers Boulevard. These roadways will be referred to as the North and South Connectors, respectively. Access to TAZ 1 will be provided by an interior roadway that intersects Audubon Road at Lakeview Drive and Lyman Boulevard at the north leg of Audubon Road. Access to TAZ 5 is proposed to intersect Pioneer Trail at Bluff Creek Drive and Powers Boulevard at a point approximately 660 feet south of the northeast-bound TH 212/312 ramp; a connection through TAZ 5 is not planned between these access points.

4.0 EXISTING CONDITIONS

4.1 PHYSICAL CHARACTERISTICS

The existing roadway network within the study area includes Lyman Boulevard, Audubon Road, Pioneer Trail, Powers Boulevard, and Bluff Creek Drive. Several streets that compose the existing roadway network will carry trips generated by the AUAR Development. Major characteristics of these roadways are summarized in Table 3.

Lyman Boulevard (CSAH 18) is an east-west roadway that runs along the northern boundary of the AUAR development. The Chanhassen Comprehensive Plan states that if TH 212/312 is construction by 2020, capacity improvements (4-lanes) on Lyman Boulevard should be considered.

Audubon Road (CSAH 17) runs north-south in the vicinity of the site. Audubon Road has offset intersections at Lyman Boulevard, which are approximately 1,530 feet apart. The westernmost intersection is signalized and the easternmost intersection is stop-controlled in the north-south direction.

Pioneer Trail (CSAH 14) is an east-west route that is adjacent to the southern border of the AUAR development. Pioneer Trail has two lanes in each direction in the vicinity of the site. The Chanhassen Comprehensive Plan states that if TH 212/312 is construction by 2020, capacity improvements (4-lanes) on Pioneer Trail east of Audubon Road should be considered.

Powers Boulevard (CSAH 17) runs north-south and currently terminates at Lyman Boulevard. Powers Boulevard is planned to be extended from Lyman Boulevard to Pioneer Trail in the future and construction of a four-lane cross section should be considered.

Bluff Creek Drive connects Pioneer Trail and the existing TH 212/312. The Chanhassen Comprehensive Plan describes the existing roadway as a collector route between Pioneer Trail and TH 212/312.

Table 3 - Summary of Existing Roadway Conditions

Street Name	Street Number	Functional Classification	Number of Lanes	Posted Speed	Median	Comments
Lyman Boulevard	CSAH 18	"B" Minor Arterial (1)(2) Minor Arterial Reliever (3)	2	50 mph	No	Currently has bypass lanes at unsignalized "T" intersections.
Audubon Road North of Lyman	None	Major Class 1 Collector (3)	2	-	No	
Audubon Road South of Lyman	CSAH 17	"B" Minor Arterial (1) "A" Minor Arterial (2) Minor Arterial Reliever (3)	2	50 mph	No	Currently has bypass lanes at unsignalized "T" intersections. Path along west side. Curb and gutter at major intersections.
Pioneer Trail	CSAH 14	Minor Arterial Reliever (3)	2	45 mph	No	Currently has bypass lanes at the unsignalized "T" intersections.

Street Name	Street Number	Functional Classification	Number of Lanes	Posted Speed	Median	Comments
Powers Boulevard	CSAH 17	"B" Minor Arterial (1) "A" Minor Arterial (2) Minor Arterial Expander (3)	4	50 mph	Yes	There are left turn lanes and right turn lanes at all street intersections. Path along west side.
Bluff Creek Drive		Major Class I Collector (3)	2	50 mph	No	

(1) Metropolitan Councils' Functional Classification Plan (future)
(2) City of Chanhassen Comprehensive Plan 1998
(3) Carver County Comprehensive Plan

The following intersections exist in the AUAR development and are shown with existing traffic control.

- Audubon Road/Lyman Boulevard – Signalized, protected phasing
- Audubon Road/Lakeview Drive – Stop-controlled in east-west direction
- Audubon Road/Butternut Drive – Stop-controlled in east-west direction
- Audubon Road/Pioneer Trail – Signalized, protected phasing
- Pioneer Trail/Bluff Creek Drive – Stop-controlled in north-south direction
- Powers Boulevard/Lyman Boulevard – Stop-controlled in north-south direction
- Lyman Boulevard/Audubon Road (north leg) – Stop-controlled in north-south direction

4.2 TRAFFIC VOLUMES

Average daily traffic volumes (ADT) were obtained from the MnDot's *Transportation Data and Analysis Traffic Volumes Maps*. Volumes for existing roadways within the study area are summarized in Table 4.

Table 4 - Existing Average Daily Traffic Volumes

Roadway	From	To	1999 ADT	2001 ADT
Lyman Blvd	west	Audubon	6,700	6,600
	Audubon	Audubon	9,000	9,700
	Audubon	Powers	7,300	8,300
	Powers	east	3,500	4,050
Audubon Rd	north	Lyman	3,250	3,200
	Lyman	Pioneer	9,400	11,800
	Pioneer	south	9,000	-
Pioneer Tr	west	Audubon	8,700	-
	Audubon	Bluff Creek	7,600	-
	Bluff Creek	east	5,000	5,700
Powers Blvd	north	Lyman	4,200	5,900
Bluff Creek	Pioneer	south	2,800	3,250

Turning movement counts were performed August 21, 2003 at the intersections of Lyman/Audubon, Butternut/Audubon, and Pioneer/Audubon. These counts were collected while observing the operations at these intersections during the PM peak period at five minute intervals.

Table 5 - Existing Turning Movements

Intersection	NB			SB			EB			WB		
	L	T	R	L	T	R	L	T	R	L	T	R
Lyman/Audubon	6		20					9	11	34	6	
Butternut/Audubon	1	34			49	1	1		1			
Pioneer/Audubon	1	26	23	12	22	2	6	27	5	12	16	4

5.0 PROJECTED TRAFFIC

5.1 SITE TRAFFIC FORECASTS

5.1.1 Trip Generation

The Institute of Transportation Engineers' (ITE) *Trip Generation, 6th Edition*, was used to obtain daily and peak-hour trip generation rates and inbound-outbound percentages, which were then used to estimate the number of daily and peak hour trips that can be attributed to the proposed development. The trip generation characteristics of the site are summarized in Table 6.

Table 6 - Project Trip Generation

TAZ	Land Use	ITE Code	Quantity	Units	Daily	AM Peak			PM Peak		
					Total	In	Out	Total	In	Out	Total
1	High School	530	1,700	Number of Students	2,361	464	212	676	87	126	213
2	Attached Housing	230	313	DU	2,075	26	134	160	130	64	194
2	General Light Industrial	110	56,584	SF	394	46	6	52	7	48	55
3	Attached Housing	230	227	DU	1,505	19	97	116	94	47	141
3	General Light Industrial	110	242,673	SF	1,691	196	27	223	29	209	238
4	General Light Industrial	110	153,026	SF	1,067	124	17	141	18	132	150
5	Detached Housing	210	11	DU	109	2	7	9	8	4	12
5	General Office	710	271,531	SF	2,990	373	51	424	69	336	405
6	Detached Housing	210	401	DU	3,840	75	226	301	259	146	405
6	Attached Housing	230	140	DU	927	11	60	71	58	29	87
7	Detached Housing	210	207	DU	1,984	39	116	155	134	75	209
8	Detached Housing	210	335	DU	3,208	63	188	251	217	122	339
Total School			1,700	Students	2,361	464	212	676	87	126	213
Total Residential			1,635	DU	13,648	235	828	1,063	900	487	1,387
Total General Light Industrial			452,283	SF	3,152	366	50	416	54	389	443
Total General Office			271,531	SF	2,990	373	51	424	69	336	405
Total Trip Generation					22,151	1,438	1,141	2,579	1,110	1,338	2,448

The AUAR development is expected to generate 22,151 daily trips, with 2,579 trips occurring in the AM peak hour and 2,448 trips occurring in the PM peak hour.

5.1.2 Trip Reductions

Owing to the mix of both residential and non-residential land uses in the AUAR development, it is reasonable to expect trip interactions would result (e.g., home-based school trips). The percentage of total trips that are "captured" within the confines of the site is referred to as the internal capture rate. This interaction effectively double-counts the trips considered to be captured. The trips that are captured by certain types of non-residential uses (schools, shopping, employment, etc.) within the site have been assigned as home-based school trip. The resulting school-based home trips have been reduced accordingly such that the double-counted trips are deducted from the total trip generation.

The magnitude of the internal capture rate for home-based school trips comprises 5.0, 10.0, and 3.0 percent of the total number of daily trips, AM peak trip, and PM peak trips, respectively. Based on the assumed levels of interaction between AUAR land uses, the modified trip generation is shown in Table 7.

It should be noted that pass-by trips were not included as part of this analysis; therefore, this document is representative of a more conservative analysis.

Table 7 - Trip Reductions

Total Residential				13,648	235	828	1,063	900	487	1,387
Internal Capture:	Daily	AM	PM							
- Trips from Home to School	5%	10%	3%	682	24	83	106	27	15	42
- Trips from School to Home	22%	14%	16%	682	83	24	106	15	27	42
Total Internal Capture: Home-based/School				1,365	106	106	213	42	42	83
Gross Total School				3,043	547	235	782	102	153	255
Deduct School to Home Trips (covered by Home to School Trips)				682	83	24	106	15	27	42
Net Total External School Trips				2,361	464	212	676	87	126	213

5.1.3 Trip Distribution and Traffic Assignment

Daily trips were distributed based on the Metropolitan Council's estimate of total residential population and employment opportunities within an 11.8-mile radius of the site. This radius is based on the average trip length to office and residential land uses discussed in the *NPTS Urban Travel Patterns* report (December 1999). This distribution was further refined by considering the future roadway network near the site. Figure 3 illustrates the trip distribution for the study area.

Trips were assigned to the roadway network on the basis of the trip distribution and the likely travel patterns to and from the site. Figure 4 shows the results of the traffic assignment.

5.2 FUTURE TRAFFIC FORECASTING

The background traffic volumes for the buildout year 2010 were calculated based on 2007 and 2025 average daily traffic (ADT) volumes for the "Build TH 212/312" scenario and the calculated annual traffic growth rate. The ADT volumes were provided by the City of Chanhassen. Copies of the maps showing the projected ADT are attached. Table 8 shows the closest available ADT's in the vicinity of the site and the corresponding growth rate.

Table 8 – Traffic Growth

Roadway	From	To	2007 ADT	2025 ADT	Growth Rate (%)
Lyman Blvd	west	Audubon	8,500	11,500	1.69
	Audubon	Powers	11,000	15,000	1.74
	Powers	east	2,500	2,500	0.00
Audubon Rd	north	Lyman	4,800	5,800	0.55
	Lyman	Pioneer	6,500	10,000	2.42
	Pioneer	south	5,900	7,400	1.27
Pioneer Tr	west	Audubon	8,800	11,700	1.60
	Audubon	Bluff Creek	9,000	12,100	1.66
	Bluff Creek	Powers	5,600	6,500	0.83
	Powers	east	5,600	7,500	1.64
Powers Blvd	north	Lyman	11,500	13,000	0.68
	Lyman	Pioneer	10,000	13,000	1.47
Bluff Creek	Pioneer	south	3,600	5,100	1.95

Taking into consideration the above growth rates, an annual growth rate of 1.5 percent per year was applied to the turning movement counts to obtain background traffic volumes for the year 2010 with the exception of Lyman/Audubon, which was grown based on a 2.0 percent growth rate. It should be noted that the projected volumes for the AUAR development assume the construction of TH 212/312 and the extension of Powers Boulevard from Lyman Boulevard to Pioneer Trail.

For 2003 and 2010 background traffic, peak hour traffic volumes were estimated as 10 percent of the ADT during the AM and PM peak periods. A 60/40 directional split was also used, with the peak traffic

movement traveling away from the AUAR development in the morning and toward the development in the evening. Peak hour turning movements at each intersection were determined based on peak hour approach volumes using methodology outlined in *Estimation of Turning Flows for Automatic Counts*, published as Transportation Research Record #795 (1981). The background average daily traffic and the AM and PM peak hour turning movements are shown in the in Figure 6 and Figure 7.

5.3 TOTAL TRAFFIC

The results of the traffic assignment were added to the year 2003 and 2010 background traffic volumes shown in Figure 6 and Figure 7 to produce total traffic volumes for the study area. These total traffic volumes are shown in Figure 8 and Figure 9.

6.0 TRAFFIC AND IMPROVEMENT ANALYSIS

Traffic generated for the proposed development was assigned to existing and future roadway networks. From this traffic assignment that included background traffic growth, potential future traffic impacts were determined.

The analysis of Scenario E-2 was used to assess developmental-related traffic impacts of the construction of the Town and Country parcels (TAZ's 2 and 3) and to identify necessary roadway improvements to mitigate traffic impacts. Scenarios F-1 and F-2 demonstrate future conditions with and without the AUAR development and with TH 212/312. These were used to demonstrate the combined impact of background traffic growth and the proposed AUAR development. Table 9 describes the scenarios analyzed in this document.

Table 9 - Traffic Analysis Scenarios

Scenario	Analysis
Without AUAR Development	
E-1	2003 Existing Traffic; Existing Network
F-1	2010 Projected Traffic; includes TH 212/312
With AUAR Development	
E-2	2003 Existing Traffic; Town and Country Development (TAZ 2 and 3); Audubon Road/Butternut Connection Only; does not include extended TH 212/312
F-2	2010 Projected Traffic; Full AUAR Development; includes all internal roads and construction of TH 212/312

6.1 LEVEL OF SERVICE ANALYSIS

Level of service (LOS) analysis was conducted for the AM (7 to 9 AM) and PM (4 to 6 PM) peak hours at each study intersection for 2003 and 2010. LOS is a qualitative measure used by traffic engineers to describe the operations of an intersection. It ranges from A to F, with A being the best and F being the worst level of operation. LOS A conditions are characterized by minimal vehicle delay and free-flow conditions, while LOS F is characterized by long vehicle delay—usually when demand exceeds available roadway capacity. Although LOS E is defined as at-capacity, LOS D is generally the minimum acceptable level of operation at an intersection. Each study intersection was analyzed for each analysis scenario based on the 2000 Highway Capacity Manual.

6.1.1 2003 Level of Service Analysis

The LOS for the unsignalized intersections is shown in Table 10. LOS for the signalized intersections is shown in Table 11. The intersection geometry shown in Figure 10 was used for the analysis.

Table 10 – 2003 Level of Service: Unsignalized Intersections

Intersection	NB			SB			EB			WB		
	L	T	R	L	T	R	L	T	R	L	T	R
Lyman Boulevard & Powers Boulevard												
AM – Scenario E-1				D		A	A	-			-	-
PM – Scenario E-1				C		B	A	-			-	-
AM – Scenario E-2				F		B	A	-			-	-
PM – Scenario E-2				D		C	A	-			-	-

Intersection	NB			SB			EB			WB		
	L	T	R	L	T	R	L	T	R	L	T	R
Pioneer Trail & Bluff Creek Drive												
AM – Scenario E-1	C		B					-	-	A	-	
PM – Scenario E-1	C		B					-	-	A	-	
AM – Scenario E-2	C		B					-	-	A	-	
PM – Scenario E-2	C		B					-	-	A	-	
Audubon Road & Butternut Drive												
AM – Scenario E-1	A	-			-	-	F		B			
PM – Scenario E-1	A	-			-	-	E		B			
AM – Scenario E-2	A	-	-	B	-	-	F	-	B	F	-	D
PM – Scenario E-2	A	-	-	A	-	-	F	-	B	F	-	C

(1) Darkened boxes = movement not available.

The unsignalized intersections of Powers/Lyman and Pioneer/Bluff Creek operate at acceptable LOS for both the existing (Scenario E-1) and initial development (Scenario E-2). The eastbound left turn movement at the unsignalized intersection of Audubon/Butternut operates at a poor LOS under Scenario E-1 conditions. For Scenario E-2 conditions, both the eastbound and westbound left turn movements at the intersection of Audubon/Butternut operate poorly, with the addition of northbound and southbound left turn lanes. It should be noted that this condition improves once the Collector Road is extended to the east to the Powers Boulevard alignment.

Table 11 - 2003 Level of Service: Signalized Intersections

Intersection	Scenario E-1 AM Peak	Scenario E-1 PM Peak	Scenario E-2 AM Peak	Scenario E-2 PM Peak
Lyman Boulevard & Audubon Road	C	E	E	F
Pioneer Trail & Audubon Road	D	C	D	D

The signalized intersection of Lyman and Audubon operates at unacceptable LOS for the both the existing (Scenario E-1) and initial development (Scenario E-2). It is anticipated that in order to accommodate total traffic conditions for Scenario E-2 the intersection of Lyman and Audubon will require dual left-turn lanes for the westbound to southbound maneuver. This mitigation would require the construction of an additional lane south of Lyman Road in order to accept the dual turning movements. Signal phasing modifications and/or signal retiming is anticipated to ameliorate the existing adverse delay associated with this left turn movement prior to the build out of TAZ 2 and TAZ 3.

6.1.2 2010 Level of Service Analysis

The LOS for the unsignalized and signalized intersections is shown in Table 12 and Table 13. The intersection geometry shown in Figure 11 was used for the LOS analysis.

Table 12 – 2010 Level of Service: Unsignalized Intersections

Intersection	NB			SB			EB			WB		
	L	T	R	L	T	R	L	T	R	L	T	R
Audubon Road & Butternut Drive												
AM – Scenario F-1	A	-	-	A	-	-	C	-	A	C	-	A
PM – Scenario F-1	A	-	-	A	-	-	C	-	A	C	-	A
AM – Scenario F-2	A	-	-	A	-	-	F	-	B	F	-	B
PM – Scenario F-2	A	-	-	A	-	-	E	-	B	E	-	B
Audubon Road & Lakeview Drive												
AM – Scenario F-2	A	-	-	A	-	-	-	-	-	C	-	B
PM – Scenario F-2	A	-	-	A	-	-	-	-	-	C	-	B
North Audubon Road & Lyman Boulevard												
AM – Scenario F-1				D		B	A	-			-	-
PM – Scenario F-1				C		C	A	-			-	-
AM – Scenario F-2	F	-	B	F	-	B	A	-	-	B	-	-
PM – Scenario F-2	F	-	B	F	-	C	A	-	-	A	-	-
Lyman Boulevard & North Connector												
AM – Scenario F-2	E		C					-	-	A	-	
PM – Scenario F-2	D		B					-	-	A	-	
Pioneer Trail & South Connector												
AM – Scenario F-2				D		B	A	-			-	-
PM – Scenario F-2				F		B	A	-			-	-
Butternut Collector & North Connector												
AM – Scenario F-2				C		B	A	-			-	-
PM – Scenario F-2				C		B	A	-			-	-
Butternut Collector & South Connector												
AM – Scenario F-2	C		A					-	-	A	-	
PM – Scenario F-2	C		B					-	-	A	-	

(1) Darkened boxes = movement not available.

All AUAR area intersections are expected to operate at acceptable levels of service with the exception of the eastbound and westbound left-turn movements at Audubon Road and Butternut Drive, the northbound and southbound left turn at Audubon Road and Lyman Boulevard, the northbound left turn at Lyman Boulevard and the North Connector, and the southbound left turn lane at Pioneer Trail and the South Connector. The delays accompanying this LOS are common to stop-controlled intersections along major streets during the peak hour due to reduction in acceptable gaps in traffic. Future signalization of these intersections may provide better progression and longer gaps during the peak hour.

Table 13 - 2010 Level of Service: Signalized Intersections

Intersection	Scenario F-1 AM Peak	Scenario F-1 PM Peak	Scenario F-2 AM Peak	Scenario F-2 PM Peak
Lyman Boulevard & Audubon Road	C	C	C	C
Pioneer Trail & Audubon Road	C	C	C	C
Powers Boulevard & Lyman Boulevard	C	C	C	C
Powers Boulevard & TH 212/312 North Ramp	C	C	D	C
Powers Boulevard & TH 212/312 South Ramp	C	C	C	C
Powers Boulevard & Pioneer Trail	C	C	C	C
Pioneer Trail & Bluff Creek Drive	C	C	C	C

All AUAR area signalized intersections are expected to operate at acceptable levels of service based on the geometry shown in Figure 11.

6.2 LEFT-TURN STORAGE ANALYSIS

At most of the existing "T" intersections there are bypass lanes along the unsignalized roadway used to avoid vehicles turning left from that direction of travel. It is recommended that left turn lanes be installed at those intersections where a fourth leg is being constructed. These intersections include Powers Boulevard/Lyman Boulevard, Lyman Boulevard/North Audubon Road, Audubon Road/Lakeview Drive, Audubon Road/Butternut Drive, and Pioneer Trail/Bluff Creek Drive.

The intersections in the AUAR study area were analyzed to determine the left-turn storage needed to accommodate the expected traffic volumes in the year 2010. Table 14 shows the recommended storage lengths.

Table 14 – Left-Turn Storage

Intersection and Approach	Recommended Minimum
Powers/Lyman	
- Northbound Approach:	100 feet
- Southbound Approach:	100 feet
- Eastbound Approach:	150 feet
- Westbound Approach:	100 feet
Powers/TH 212/312 North Ramp	
- Northbound Approach:	125 feet
- Southbound Approach:	100 feet
- Eastbound Approach:	100 feet
- Westbound Approach:	150 feet
Powers/TH 212/312 South Ramp	
- Northbound Approach:	100 feet
- Southbound Approach:	275 feet
- Eastbound Approach:	100 feet
- Westbound Approach:	100 feet
Powers/Pioneer	
- Southbound Approach:	125 feet
- Eastbound Approach:	200 feet
Pioneer/Bluff Creek	
- Northbound Approach:	150 feet
- Southbound Approach:	100 feet
- Eastbound Approach:	100 feet
- Westbound Approach:	100 feet
Pioneer/South Connector	
- Southbound Approach:	100 feet
- Eastbound Approach:	100 feet
Pioneer/Audubon	
- Northbound Approach:	100 feet
- Southbound Approach:	100 feet
- Eastbound Approach:	100 feet
- Westbound Approach:	100 feet

Intersection and Approach	Recommended Minimum
Audubon/Butternut	
- Northbound Approach:	100 feet
- Southbound Approach:	100 feet
- Eastbound Approach:	75 feet
- Westbound Approach:	75 feet
Audubon/Lakeview	
- Northbound Approach:	100 feet
- Southbound Approach:	100 feet
- Eastbound Approach:	75 feet
- Westbound Approach:	75 feet
Audubon/Lyman	
- Northbound Approach:	100 feet
- Westbound Approach:	175 feet
Lyman/North Audubon	
- Northbound Approach:	75 feet
- Southbound Approach:	75 feet
- Eastbound Approach:	100 feet
- Westbound Approach:	100 feet
Lyman/North Connector	
- Northbound Approach:	75 feet
- Westbound Approach:	100 feet
Butternut Collector/South Connector	
- Northbound Approach:	75 feet
- Westbound Approach:	75 feet
Butternut Collector/North Connector	
- Southbound Approach:	75 feet
- Eastbound Approach:	75 feet

6.3 RIGHT-TURN LANES

It is recommended that right turn lanes be installed at those intersections where a fourth leg is being constructed. These intersections include Powers Boulevard/Lyman Boulevard, Lyman Boulevard/North Audubon Road, Audubon Road/Lakeview Drive, Audubon Road/Butternut Drive, and Pioneer Trail/Bluff Creek Drive.

7.0 CONCLUSIONS AND RECOMMENDATIONS

The following salient observations and recommendations regarding site planning were noted:

7.1 2003 LEVEL OF SERVICE ANALYSIS

This analysis was completed to determine the impact of existing traffic volumes on the existing roadway network with and without the proposed Town and Country development (TAZ 2 and 3), assuming that roadway improvements recommended in this study are implemented. Results of the traffic analysis are the following:

- With the exception of Lyman and Audubon the signalized intersections operate at acceptable LOS for the both the existing (Scenario E-1) and initial development (Scenario E-2). It is anticipated that in order to accommodate total traffic conditions for Scenario E-2 the intersection of Lyman and Audubon will require dual left-turn lanes for the westbound to southbound maneuver. This mitigation would require the construction of an additional lane south of Lyman Road in order to accept the dual turning movements. Signal phasing modifications and/or signal retiming is anticipated to ameliorate the existing adverse delay associated with this left turn movement prior to the build out of TAZ 2 and TAZ 3.

- The unsignalized intersections of Powers/Lyman and Pioneer/Bluff Creek operate at acceptable LOS for both the existing (Scenario E-1) and initial development (Scenario E-2).

- The eastbound left turn movement at the unsignalized intersection of Audubon/Butternut operates at a poor LOS under Scenario E-1 conditions.

- For Scenario E-2 conditions, both the eastbound and westbound left turn movements at the intersection of Audubon/Butternut operate poorly, with the addition of northbound and southbound left turn lanes. It should be noted that this condition improves once the Collector Road is extended to the east to the Powers Boulevard alignment.

7.2 2010 LEVEL OF SERVICE ANALYSIS

In addition to 2003 analyses, an analysis of 2010 conditions was completed. This analysis was completed to determine the impact of future traffic volumes on the future roadway network with and without the proposed AUAR development, assuming that roadway improvements recommended in this study are implemented.

Area traffic forecasts were computed for full development conditions and also on an initial-phase basis to determine the timing of needed roadway improvements. Results of the traffic analysis are the following:

- With improvements already planned, the proposed TH 212/312 interchange on the east side of the AUAR Development will be able to accommodate project traffic at acceptable levels of service.

- Improvements to Lyman Boulevard to accommodate increased traffic volumes include adding right- and left-turn lanes on the eastbound and westbound (Lyman Bouleveard) approaches to intersections with North Audubon Road, the North Collector, and Powers Boulevard.

- Improvements to Audubon Road include adding right- and left-turn lanes on the northbound and southbound (Audubon Road) approaches to intersections with Butternut Drive and Lakeview Drive.

- Improvements to the Pioneer Trail realignment include adding right- and left-turn lanes on the eastbound and westbound (Pioneer Trail realignment) approaches to intersections with the South Connector, Bluff Creek Drive, and Powers Boulevard.

- Powers Boulevard between Lyman Boulevard and Pioneer Trail will require a four-lane cross section with right- and left-turn lanes at intersections with Lyman Boulevard, the westbound TH 212/312 Ramp, the eastbound TH 212/312 Ramp, and Pioneer Trail. The Highway Capacity Manual recommends dual left turn lanes be installed when volumes exceed 300 vehicles per hour; such as the southbound left turn from Powers Boulevard to the eastbound TH 212/312 Ramp. Although the intersection of Powers Boulevard and the South Ramp is projected to operate at a LOS C during the peak periods with a single left turn lane on the southbound approach, the volumes exceed the Highway Capacity Manual's left turn volume threshold. Mn/Dot may typically require that dual left-turn lanes be provided when volumes exceed 300 vehicles per hour; however, proposed operational conditions at the Powers Blvd/TH212/312 ramp do not necessitate this provision. Based on the proposed configuration of this intersection and the combined low volume of opposing and side street traffic volumes, the southbound left-turn volumes can be served by a single lane.

- When signal warrants are met, the following intersections will need to be signalized prior to the full build out of the proposed AUAR development:
  - Powers Boulevard/Lyman Boulevard
  - Powers Boulevard/westbound TH 212/312 Ramp
  - Powers Boulevard/eastbound TH 212/312 Ramp
  - Pioneer Trail/Bluff Creek Drive
- The following intersections may need to be signalized at or following full build out of the proposed AUAR development:
  - Pioneer Trail/Powers Boulevard
  - Pioneer Trail/South Connector
  - Lyman Boulevard/North Connector
  - Lyman Boulevard/North Audubon Road
  - Audubon Road/Butternut Drive
  - Audubon Road/Lakeview Drive

  It is recommended to periodically review the aforementioned intersections to determine when signal warrants are met.

7.3 MITIGATION PLAN

7.3.1 Scenario E-2

Proposed improvements to accommodate Scenario E-2 (TAZ 2 and 3) traffic includes the following:

- Construct the collector road connection from the eastern boundary of TAZ's 2 and 3 to Audubon Road at Butternut Drive prior to development of TAZ's 2 and/or 3.

- Construct dedicated northbound and southbound left turn lanes and a northbound right turn lane at the intersection of Audubon/Butternut.

- Prior to construction of any additional TAZ's adjacent to the Collector Road, it is recommended that the Collector Road be extended to Powers Boulevard.

- It is not expected that signalization will be required at the intersection of Audubon/Butternut when the Collector Road is extended to Powers Boulevard, but it should be monitored periodically to determine if it meets signal warrants.

- It is anticipated that in order to accommodate total traffic conditions for Scenario E-2 the intersection of Lyman and Audubon will require dual left-turn lanes for the westbound to southbound maneuver. This mitigation would require the construction of an additional lane south of Lyman Road in order to accept the dual turning movements. Signal phasing modifications and/or signal retiming is anticipated to ameliorate the existing adverse delay associated with this left turn movement prior to the build out of TAZ 2 and TAZ 3.

7.3.2 Scenario F-2

Proposed improvements to accommodate the proposed AUAR development traffic include the following:

- With the improvements already planned, the planned TH 212/312 interchange at the east end of the AUAR Development will be able to accommodate project traffic at acceptable levels of service.

- Improvements to Lyman Boulevard to include adding right- and left-turn lanes on the eastbound and westbound (Lyman Boulevard) approaches to intersections with North Audubon Road, the North Collector, and Powers Boulevard. It should be mentioned that the dual westbound left-turn lanes at Lyman and Audubon recommended in Scenario E-2 are not forecasted to be warranted following the construction of TH212/312.

- Improvements to Audubon Road include adding right- and left-turn lanes on the northbound and southbound (Audubon Road) approaches to the intersection with Lakeview Drive.

- Improvements recommended for the Pioneer Trail realignment include adding right- and left-turn lanes on the eastbound and westbound (Pioneer Trail) approaches to intersections with the South Connector, Bluff Creek Drive, and Powers Boulevard.

- Powers Boulevard between Lyman Boulevard and Pioneer Trail will require a four-lane cross section with right- and left-turn lanes at intersections with Lyman Boulevard, the westbound 212/312 Ramp, the eastbound TH 212/312 Ramp, and Pioneer Trail. The Highway Capacity Manual recommends dual left turn lanes be installed when volumes exceed 300 vehicles per hour; such as the southbound left turn from Powers Boulevard to the eastbound TH 212/312 Ramp. Although the intersection of Powers Boulevard and the South Ramp is projected to operate at a LOS C during the peak periods with a single left turn lane on the southbound approach, the volumes exceed the Highway Capacity Manual's left turn volume threshold. Mn/Dot may typically require that dual left-turn lanes be provided when volumes exceed 300 vehicles per hour; however, proposed operational conditions at the Powers Blvd/TH212/312 ramp do not necessitate this provision. Based on the proposed configuration of this intersection and the combined low volume of opposing and side street traffic volumes, the southbound left-turn volumes can be served by a single lane.

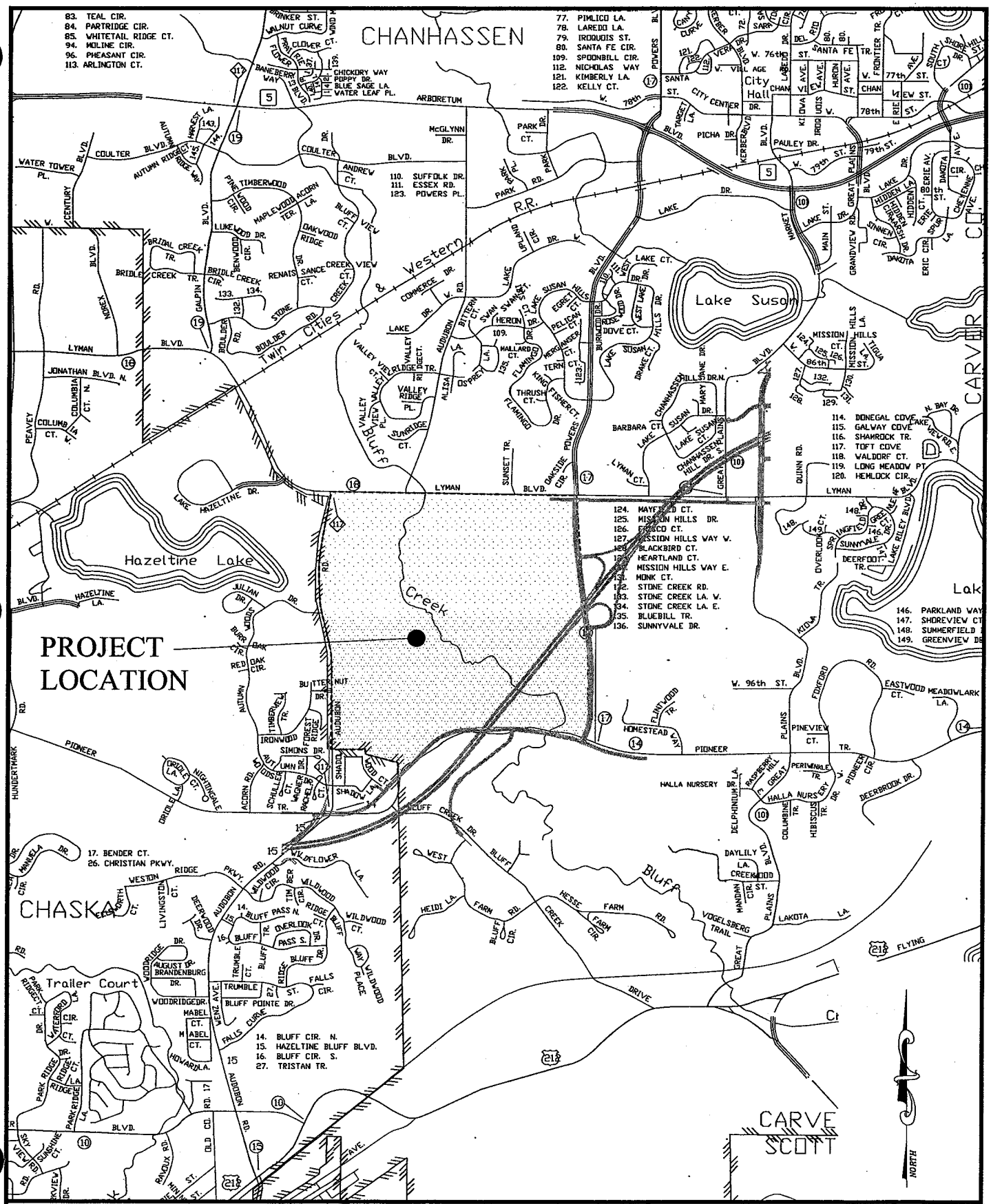
- When signal warrants are met, the following intersections will need to be signalized prior to the full build out of the proposed AUAR development:
    - Powers Boulevard/Lyman Boulevard
    - Powers Boulevard/westbound TH 212/312 Ramp
    - Powers Boulevard/eastbound TH 212/312 Ramp
    - Pioneer Trail/Bluff Creek Drive

- The following intersections may need to be signalized at or following full build out of the proposed AUAR development:
  - Pioneer Trail/Powers Boulevard
  - Pioneer Trail/South Connector
  - Lyman Boulevard/North Connector
  - Lyman Boulevard/North Audubon Road
  - Audubon Road/Butternut Drive
  - Audubon Road/Lakeview Drive

  It is recommended to periodically review the aforementioned intersections to determine when signal warrants are met.

8.0 FIGURES

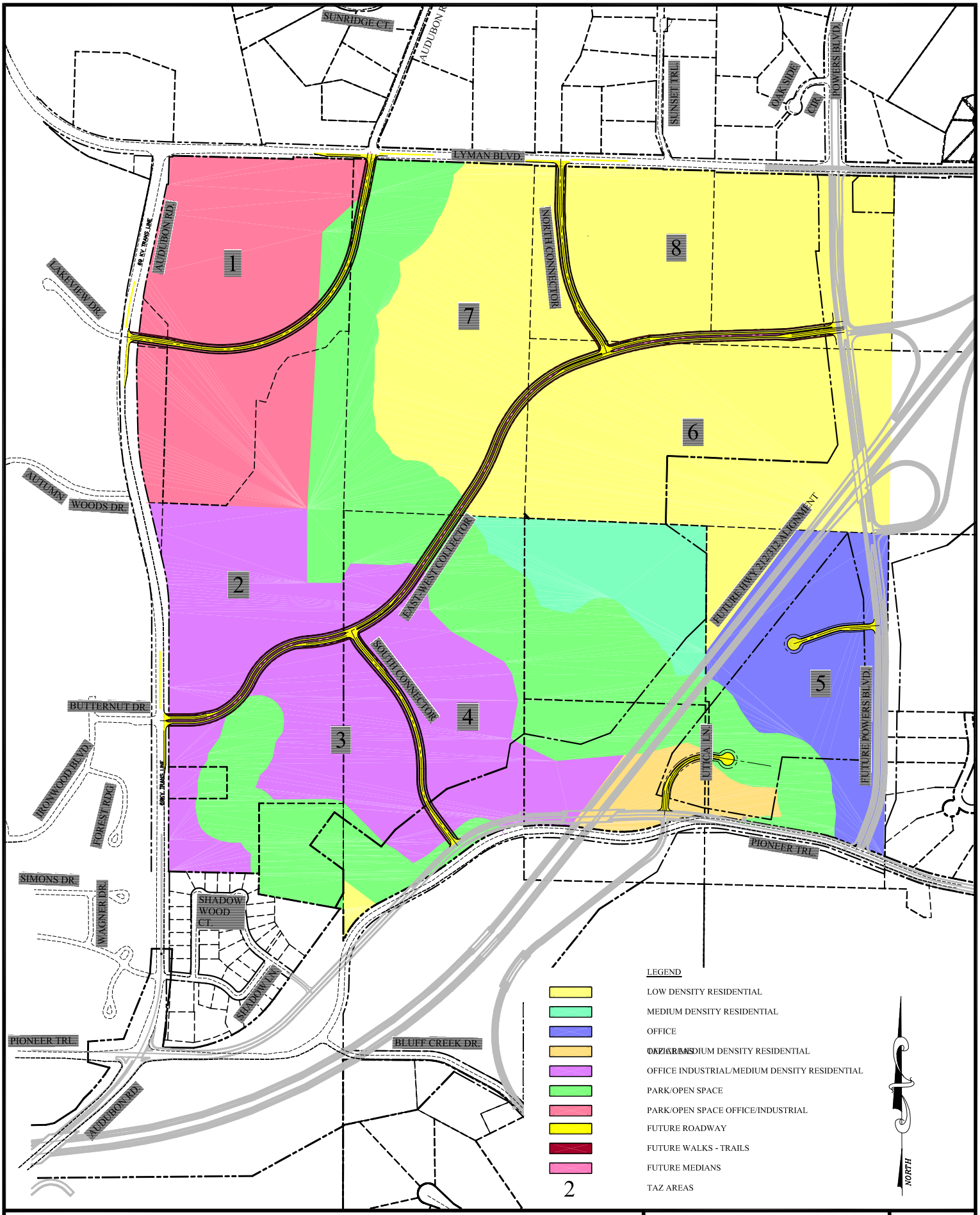
Figure 1 – Vicinity Map



CHANHASSEN AUAR
2010 – BUILD HWY 212/312
FIGURE 1 – PROJECT LOCATION

Kimley-Horn and Associates, Inc.
2550 UNIVERSITY AVE. WEST, SUITE 345N
ST. PAUL, MINNESOTA 55114
TEL. NO. (651) 645-4197
FAX. NO. (651) 645-5116

Figure 2 – Site Plan

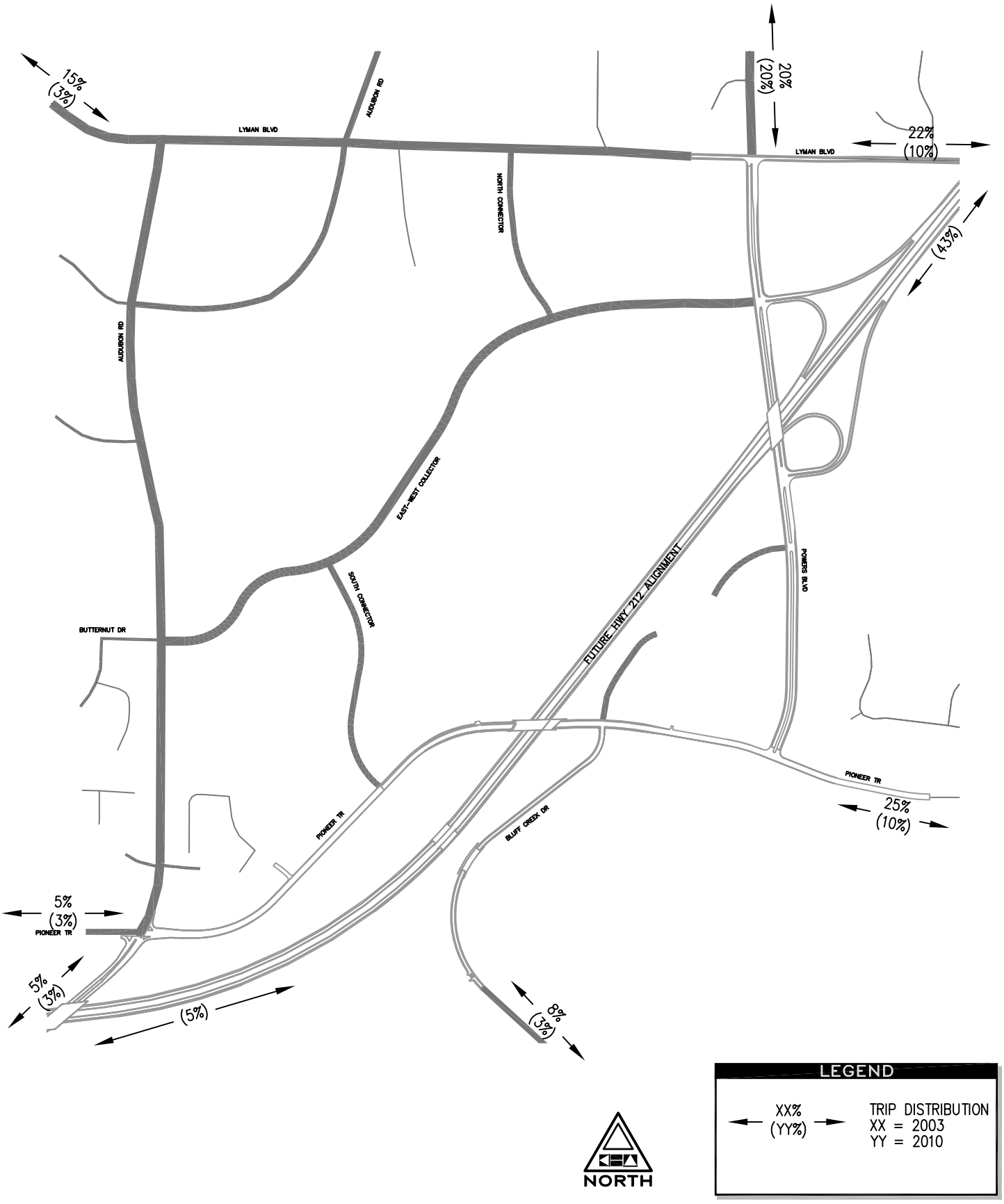


CHANHASSEN AUAR
2010 - BUILD HWY 212/312
FIGURE 2 - SITE PLAN

Kimley-Horn and Associates, Inc.
2550 UNIVERSITY AVE. WEST, SUITE 345N
ST. PAUL, MINNESOTA 55114
TEL. NO. (651) 645-4197
FAX. NO. (651) 645-5116

Figure 3 – Trip Distribution

TRIP DISTRIBUTION



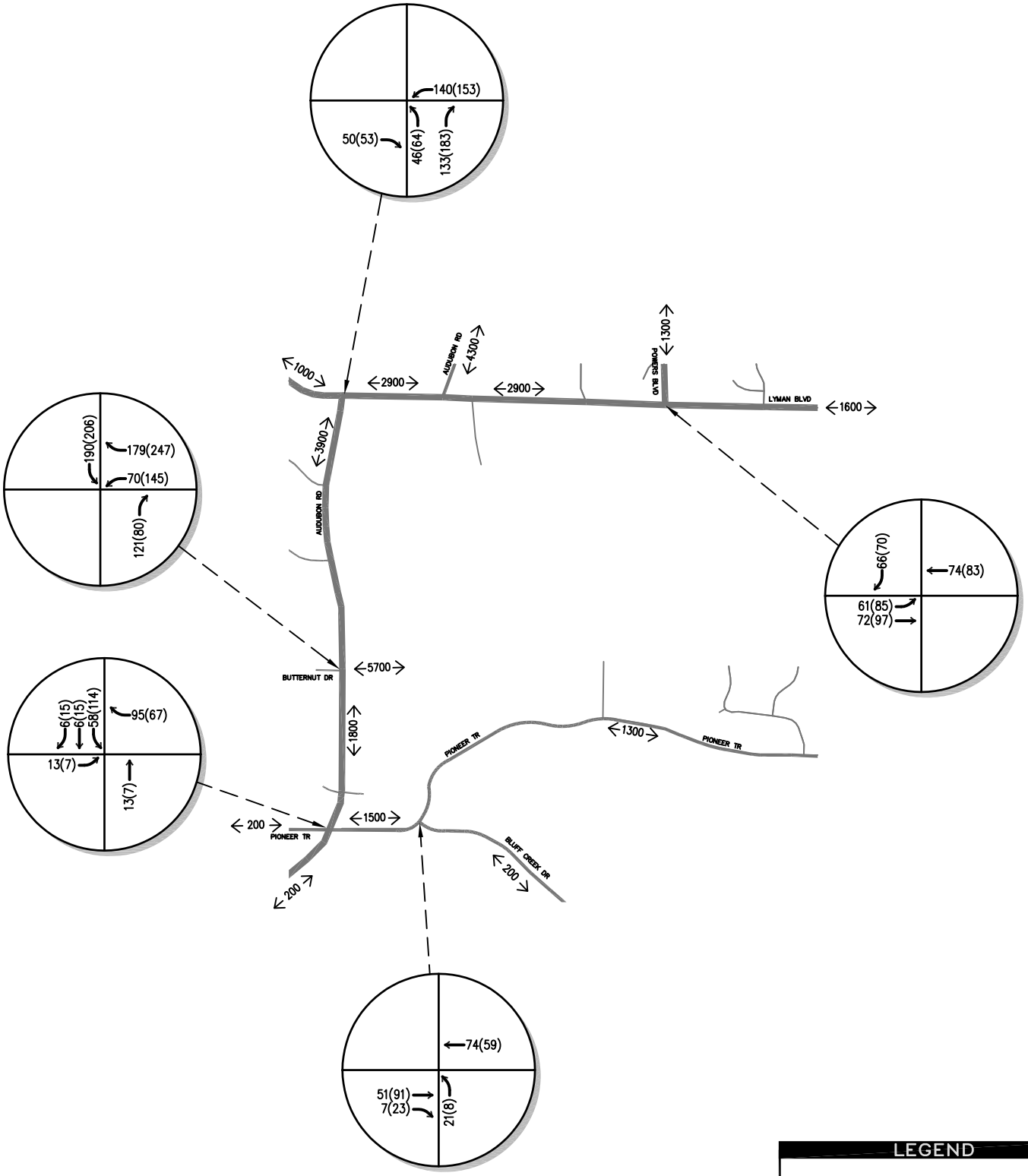
CHANHASSEN AUAR
TRIP DISTRIBUTION
FIGURE 3 - 2003 & 2010 TRIP DISTRIBUTION

Kimley-Horn and Associates, Inc.
Engineering, Planning, and Environmental Consultants
2550 University Avenue West, Suite 345N
St. Paul, Minnesota 55114 (651) 645-4197

DATE: OCTOBER 2003

Figure 4 – 2003 Traffic Assignment

2003 TRAFFIC ASSIGNMENT



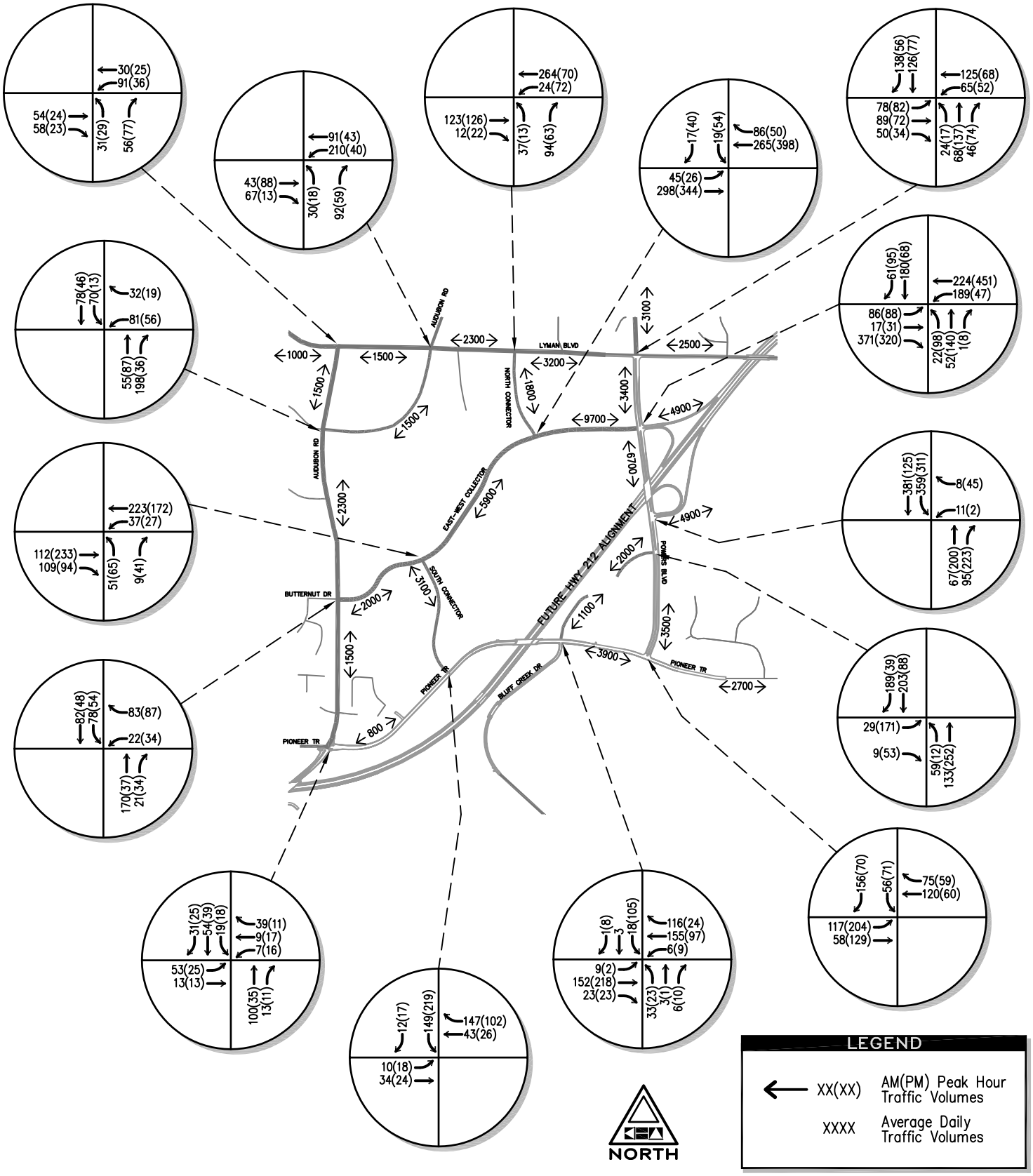
CHANHASSEN AUAR
2003 EXISTING CONDITIONS
FIGURE 4 - 2003 TRAFFIC ASSIGNMENT

Kimley-Horn and Associates, Inc.
Engineering, Planning, and Environmental Consultants
2550 University Avenue West, Suite 345N
St. Paul, Minnesota 55114 (651) 645-4197

DATE: OCTOBER 2003

Figure 5 - 2010 Traffic Assignment

2010 SITE-GENERATED TRAFFIC ASSIGNMENT



CHANHASSEN AUAR
2010 - BUILD HWY 212
FIGURE 5 - 2010 TRAFFIC ASSIGNMENT

Kimley-Horn and Associates, Inc.

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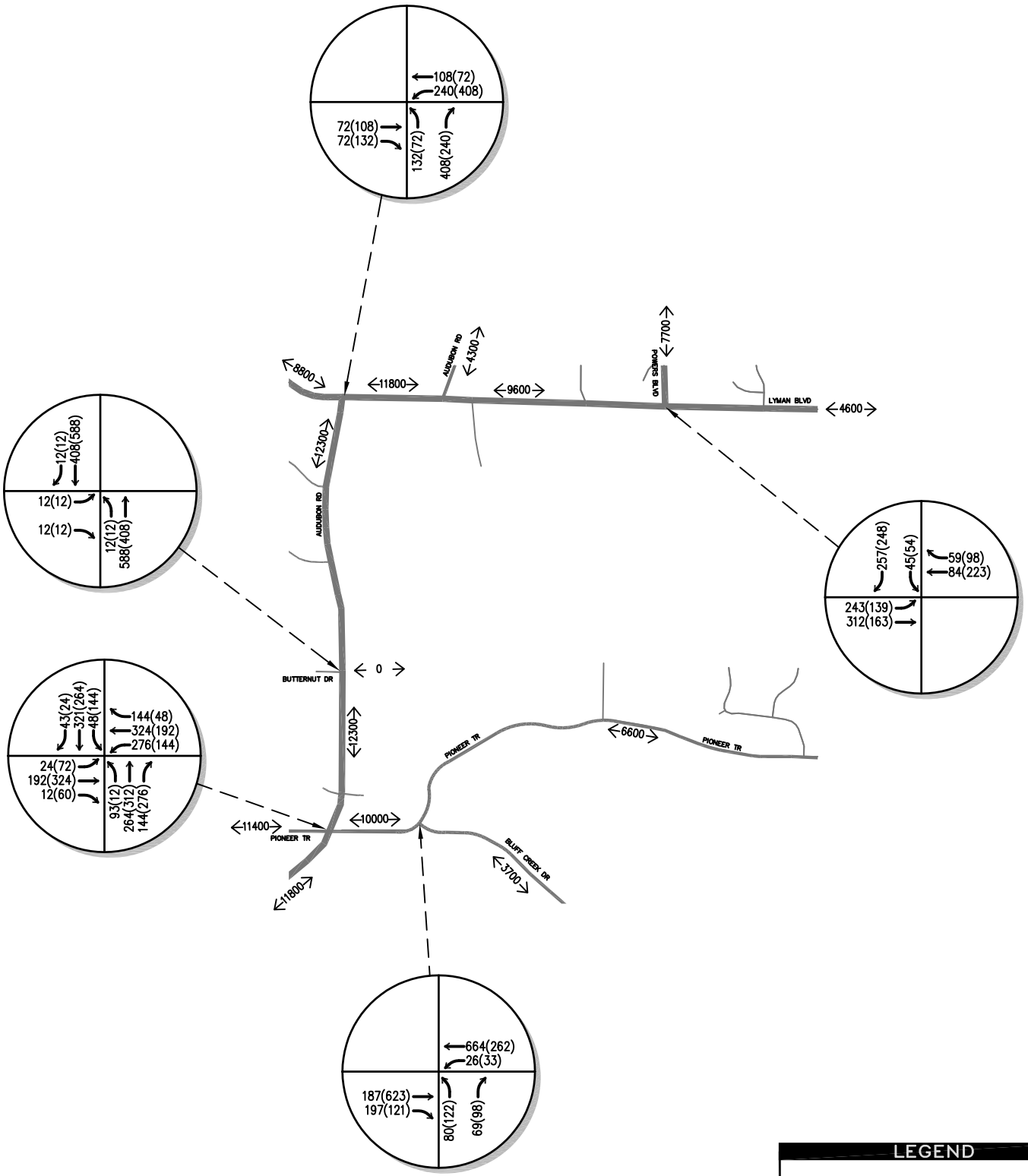
2550 University Avenue West, Suite 345N
St. Paul, Minnesota 55114 (651) 645-4197

DATE: OCTOBER 2003

Figure 6 – 2003 Background Traffic

2003 BACKGROUND TRAFFIC



CHANHASSEN AUAR
2003 EXISTING CONDITIONS
FIGURE 6 - 2003 BACKGROUND TRAFFIC

Kimley-Horn and Associates, Inc.
Engineering, Planning, and Environmental Consultants
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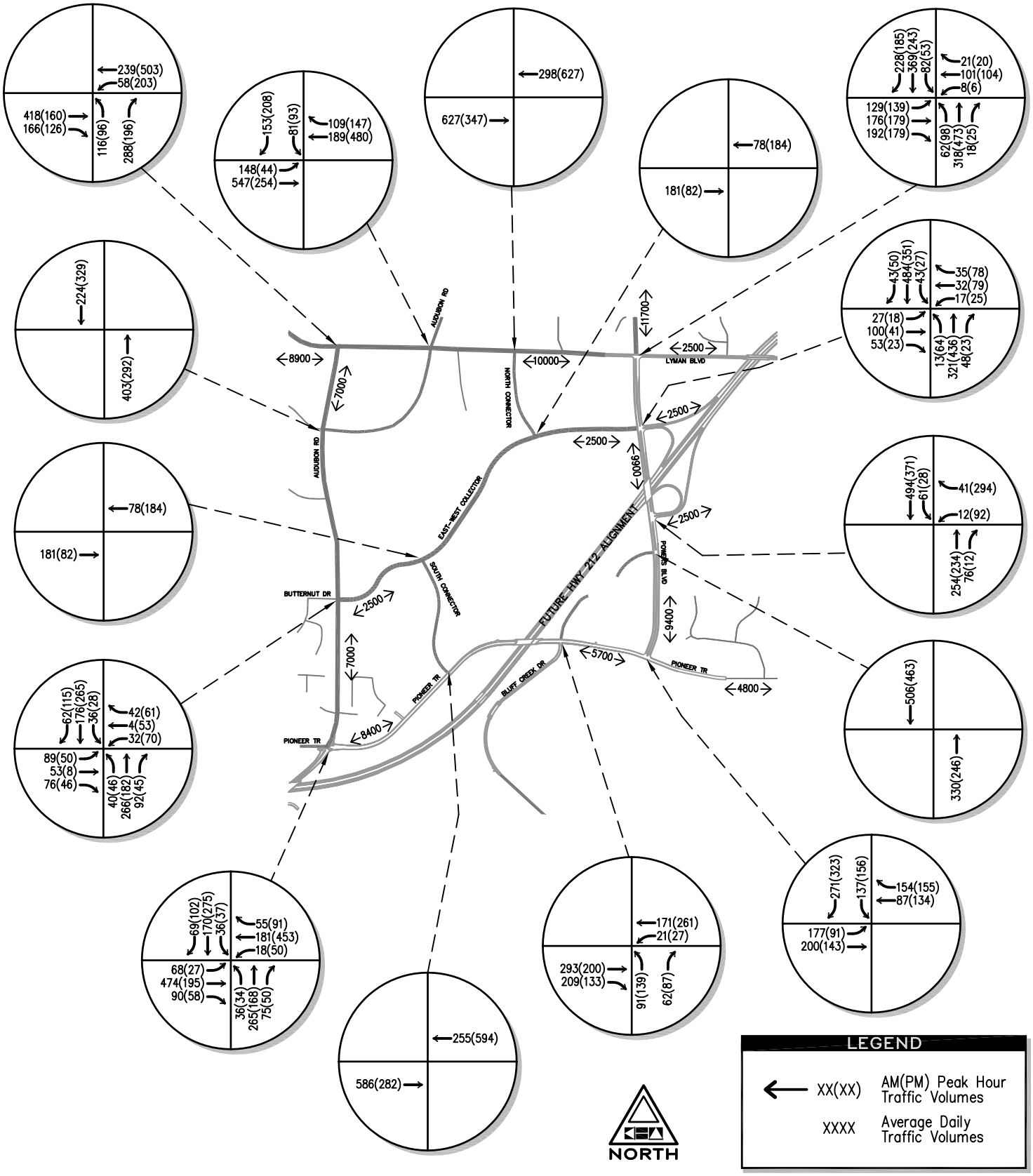
St. Paul, Minnesota 55114 (651) 645-4197

DATE: OCTOBER 2003

Figure 7 – 2010 Background Traffic

2010 BACKGROUND TRAFFIC



CHANHASSEN AUAR
2010 - BUILD HWY 212/312
FIGURE 7 - 2010 BACKGROUND TRAFFIC

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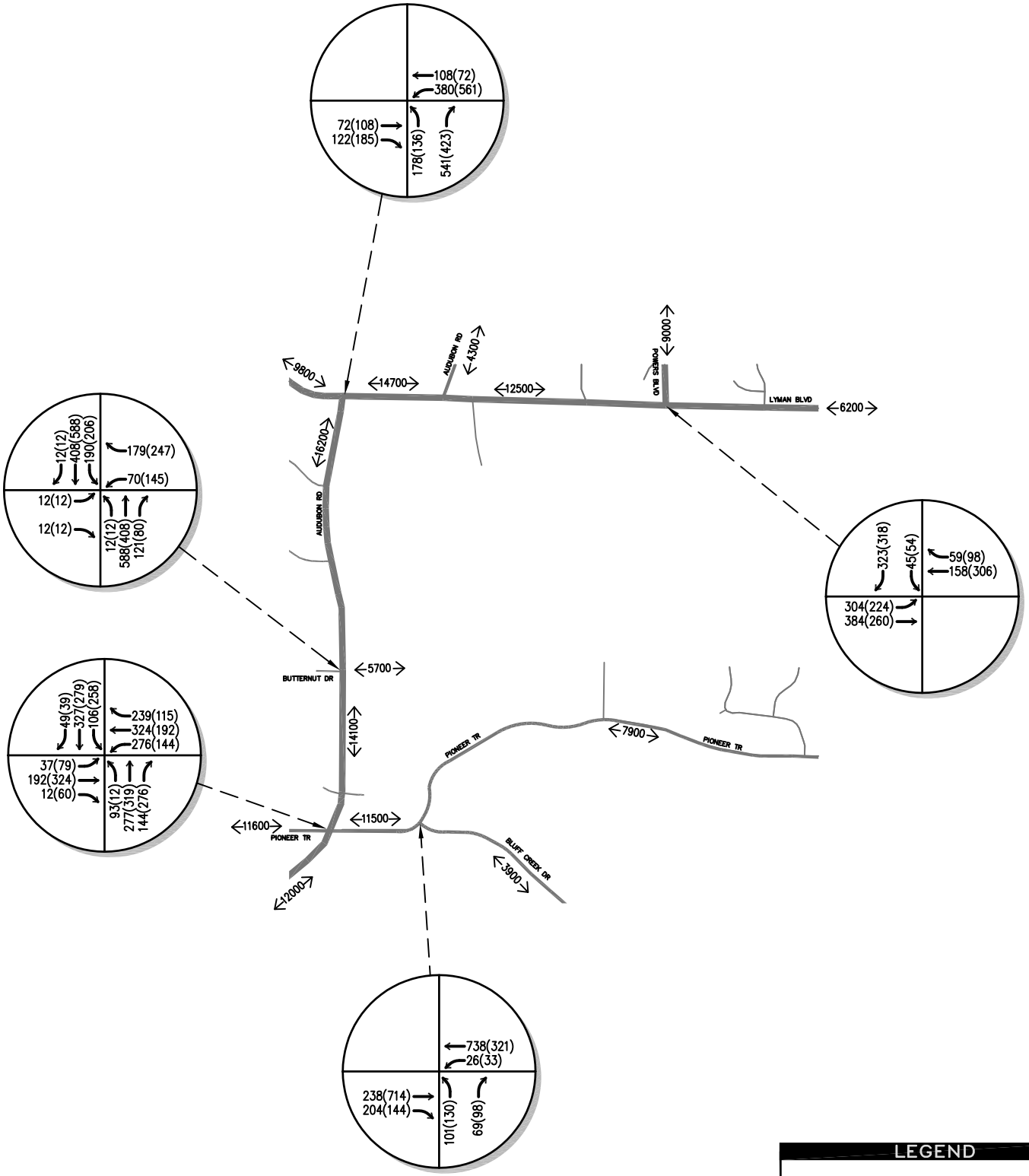
St. Paul, Minnesota 55114 (651) 645-4197

DATE: OCTOBER 2003

Figure 8 – 2003 Total Traffic

2003 TOTAL TRAFFIC



CHANHASSEN AUAR
2003 EXISTING CONDITIONS
FIGURE 8 - 2003 TOTAL TRAFFIC

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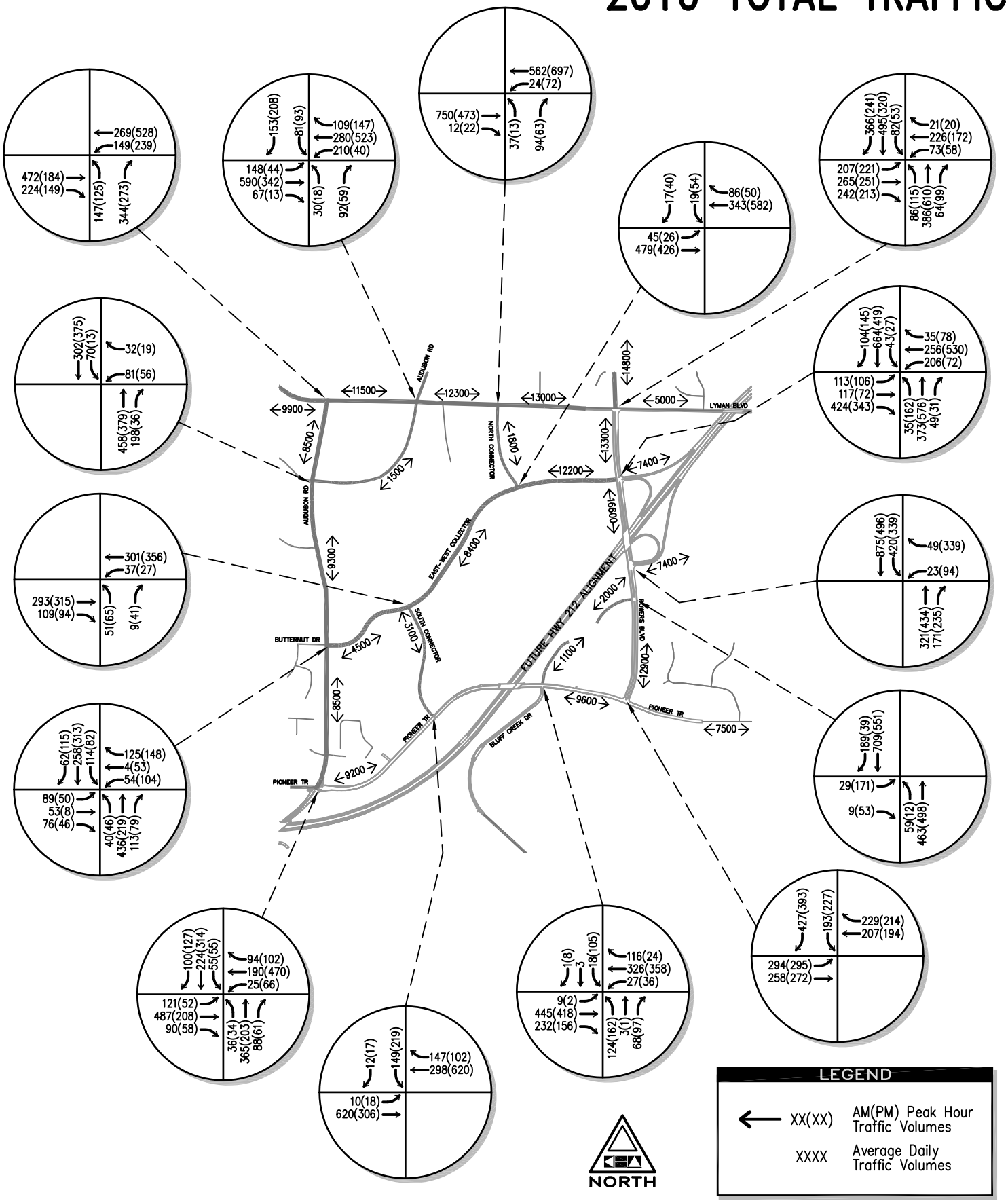
DATE: OCTOBER 2003

Figure 9 – 2010 Total Traffic

2010 TOTAL TRAFFIC



CHANHASSEN AUAR
2010 - BUILD HWY 212/312
FIGURE 9 - 2010 TOTAL TRAFFIC

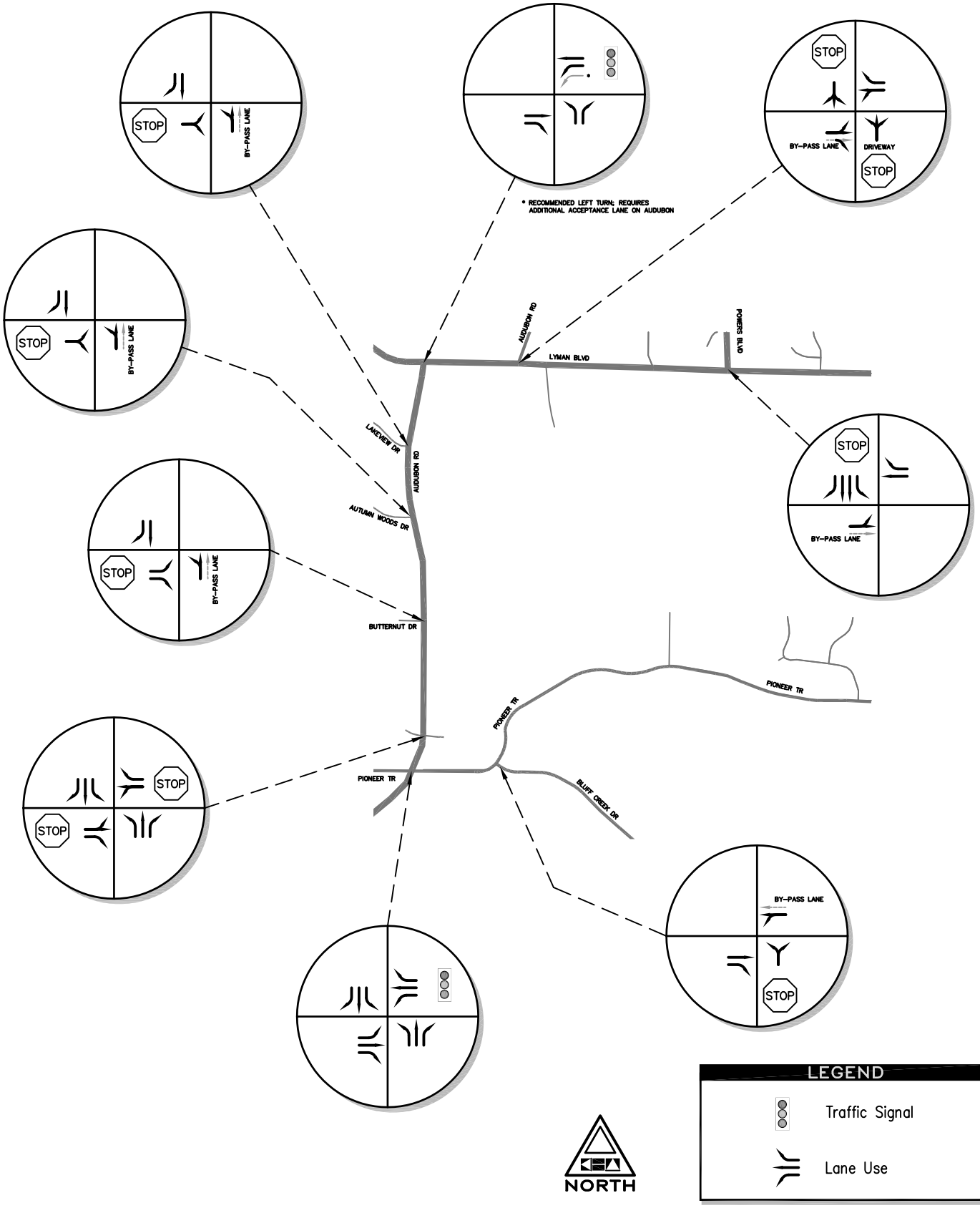
Kimley-Horn and Associates, Inc.

Engineering, Planning, and Environmental Consultants
2550 University Avenue West, Suite 345N
St. Paul, Minnesota 55114 (651) 645-4197

DATE: OCTOBER 2003

Figure 10 - Existing Geometry (2003 Analysis)

EXISTING LANE USE AND TRAFFIC CONTROL



CHANHASSEN AUAR
2003 EXISTING CONDITIONS
FIGURE 10 - EXISTING LANE USE AND TRAFFIC CONTROL

Kimley-Horn and Associates, Inc.
Engineering, Planning, and Environmental Consultants
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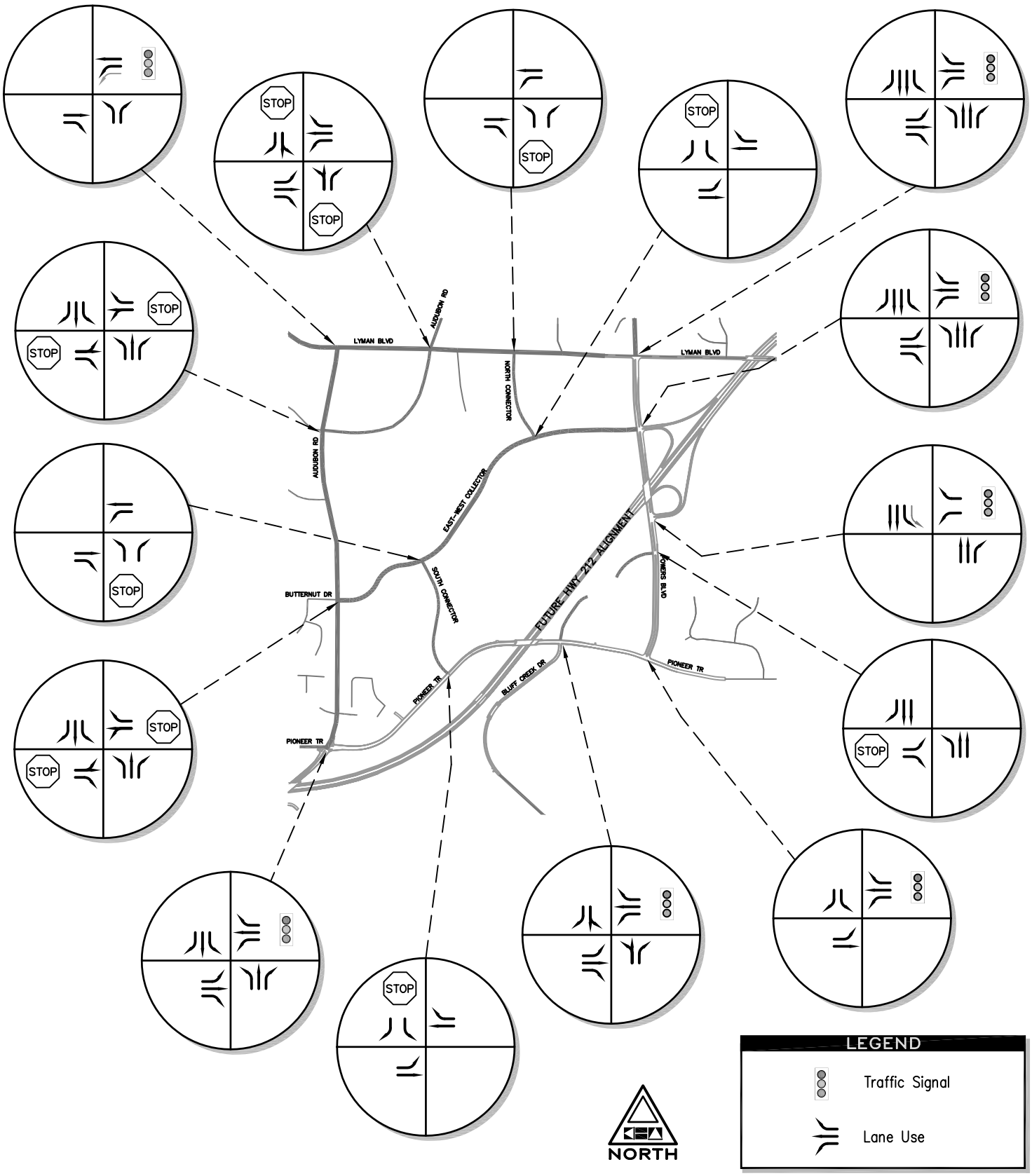
St. Paul, Minnesota 55114 (651) 645-4197

DATE: OCTOBER 2003

Figure 11 – Future Geometry (2010 Analysis)

PROPOSED LANE USE AND TRAFFIC CONTROL



CHANHASSEN AUAR
2010 - BUILD HWY 212/312
FIGURE 11 - FUTURE LANE USE AND TRAFFIC CONTROL

Kimley-Horn and Associates, Inc.
Engineering, Planning, and Environmental Consultants
2550 University Avenue West, Suite 345N
St. Paul, Minnesota 55114 (651) 645-4197

DATE: OCTOBER 2003

9.0 TRIP GENERATION

TAZ	Land Use	ITE Code	Quantity	Units	Daily Total	AM Peak In	AM Peak Out	AM Peak Total	PM Peak In	PM Peak Out	PM Peak Total
1	High School	530	1,700	Number of Students	3,043	547	235	782	102	153	255
2	Attached Housing	230	313	DU	2,075	26	134	160	130	64	194
2	General Light Industrial	110	56,584	SF	394	46	6	52	7	48	55
3	Attached Housing	230	227	DU	1,505	19	97	116	94	47	141
3	General Light Industrial	110	242,673	SF	1,691	196	27	223	29	209	238
4	General Light Industrial	110	153,026	SF	1,067	124	17	141	18	132	150
5	Detached Housing	210	11	DU	109	2	7	9	8	4	12
5	General Office	710	271,531	SF	2,990	373	51	424	69	336	405
6	Detached Housing	210	401	DU	3,840	75	226	301	259	146	405
6	Attached Housing	230	140	DU	927	11	60	71	58	29	87
7	Detached Housing	210	207	DU	1,984	39	116	155	134	75	209
8	Detached Housing	210	335	DU	3,208	63	188	251	217	122	339
	Total School		1,700	Students	3,043	547	235	782	102	153	255
	Total Residential		1,635	DU	13,648	235	828	1,063	900	487	1,387
	Total General Light Industrial		452,283	SF	3,152	366	50	416	54	389	443
	Total General Office		271,531	SF	2,990	373	51	424	69	336	405
				Total Trip Generation	22,833	1,521	1,164	2,685	1,125	1,365	2,490

Internal Capture for Home-based/School Trips

Total Residential				13,648	235	828	1,063	900	487	1,387
Internal Capture:	Daily	AM	PM							
- Trips from Home to School	5%	10%	3%	682	24	83	106	27	15	42
- Trips from School to Home	22%	14%	16%	682	83	24	106	15	27	42
Total Internal Capture: Home-based/School				1,365	106	106	213	42	42	83
Gross Total School				3,043	547	235	782	102	153	255
Deduct School to Home Trips (covered by Home to School Trips)				682	83	24	106	15	27	42
Net Total External School Trips				2,361	464	212	676	87	126	213

General Light Industrial (ITE 6th Edition)

Daily (ITE 110)	T = 6.97 x (1000's of SF)	50% In	50% Out
AM Peak Hour (ITE 110)	T = 0.92 x (1000's of SF)	88% In	12% Out
PM Peak Hour (ITE 110)	T = 0.98 x (1000's of SF)	12% In	88% Out

Single-Family Detached Housing (ITE 6th Edition)

Daily (ITE 210)	T = 9.57 x (number of DU's)	50% In	50% Out
AM Peak Hour (ITE 210)	T = 0.75 x (number of DU's)	25% In	75% Out
PM Peak Hour (ITE 210)	T = 1.01 x (number of DU's)	64% In	36% Out

General Office (ITE 6th Edition)

Daily (ITE 710)	T = 11.01 x (1000's of SF)	50% In	50% Out
AM Peak Hour (ITE710)	T = 1.56 x (1000's of SF)	88% In	12% Out
PM Peak Hour (ITE 710)	T = 1.49 x (1000's of SF)	17% In	83% Out

High School (ITE 6th Edition)

Daily (ITE 530)	T = 1.79 x (number of Students)	50% In	50% Out
AM Peak Hour (ITE 530)	T = 0.46 x (number of Students)	70% In	30% Out
PM Peak Hour (ITE 530)	T = 0.15 x (number of Students)	40% In	60% Out

Residential Condominium/Townhouse (ITE 6th Edition)

Daily (ITE 230)	T = 5.86 x (number of DU's)	50% In	50% Out
AM Peak Hour (ITE 230)	T = 0.44 x (number of DU's)	17% In	83% Out
PM Peak Hour (ITE 230)	T = 0.54 x (number of DU's)	67% In	33% Out