University Avenue Rehabilitation & Widening

IRIS Program No. Z632130000
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Traffic Analysis Report

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Abbreviations

AADT	Annual Average Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
AM	Morning
CDS	Coordinated Data System, containing DOT&PF route numbers
CFR	Crash reduction factors
DOT&PF	Alaska Department of Transportation and Public Facilities
FHWA	Federal Highway Administration
FMATS	Fairbanks Metropolitan Area Transportation System
HCM	Highway Capacity Manual
Hr(s)	Hour(s)
HV%	Heavy Vehicle Percentage
KE	Kinney Engineering, LLC
LOS	Level of Service (performance grade)
MACS	Metropolitan Area Commuter System
MEV	Million Entering Vehicles
MTP	Metropolitan Transportation Plan
mph	Miles per Hour
MUTCD	Manual on Uniform Traffic Control Devices
MVM	Million Vehicle Miles
NCHRP	National Cooperative Highway Research Program
PGDHS	*A Policy on Geometric Design of Highways and Streets*
PHF	Peak Hour Factor
PM	Evening
s or sec	Seconds
TA&SR	Traffic Analysis and Safety Report
TMC	Turning Movement Count
TMV	Turning Movement Volume
v/c or V/C	Volume to Capacity Ratio

Definition of Terms

Access: Ability to enter and exit a given location from a public roadway.

Annual Average Daily Traffic: Measurement of the number of vehicles traveling on a segment of highway each day, averaged over the year.

Capacity: Value of the maximum flow rate

Control Delay: Portion of total delay a vehicle experiences at a traffic-controlled intersection, given in seconds per vehicle.

Crash Rate: Number of crashes per a unit of exposure. Common units of exposure include million vehicle miles traveled for roadway segments and million entering vehicles for intersections.

Flow Rate: Measurement of the number of vehicles passing a given point within a set amount of time, usually an hour.

Functional Area of an Intersection: The area beyond the physical intersection that encompasses the turn-lane storage lengths, the distance drivers need to make decisions and maneuver through the intersection and the distance it takes to recover from the conditions of the intersection. It is desirable to limit driveways and other access points within the functional area so that drivers can focus on safely maneuvering through the intersection.

Level of Service (LOS): Performance measure concept used to quantify the operational performance of a facility and present the information to users and operating agencies. The actual performance measure used varies by the type of facility; however, all use a scale of A (best conditions for individual users) to F (worst conditions). Often, LOS C or D in the most congested hours of the day will provide the optimal societal benefits for the required construction and maintenance costs.

Mobility: Ability of people and goods to move from one place to another.

Peak Hour: Hour-long period in which the volume of a given road is the highest for the day or other time period. Morning, midday, and evening peak hours are often used for analysis, although peak hours may occur at other times, such as at school dismissal.

Peak Hour Factor (PHF): Measure of traffic variability over an hour period, calculated by dividing the hourly flow rate by the peak 15-minute flow rate. PHF values can vary from 0.25 (all traffic for the hour arrives in the same 15-minute period) to 1.0 (traffic is spread evenly throughout the hour).

Continuous Counting Station (CCS): Previously referred to as Permanent Traffic Recorder (PTR). Permanently installed device that counts all vehicles on a given roadway. The device may record other information as well, such as vehicle classification.

Safety: Count of crashes by severity at a given location.

Volume to Capacity Ratio (v/c): Measure of how much of the available capacity is being used, calculated by dividing the demand volume by the capacity of the facility. Values of 0.85 or less indicate adequate capacity to serve the demand volume. When v/c is greater than 0.85, drivers begin to feel uncomfortably crowded.

Executive Summary

University Avenue is a state-owned, north-south, four-lane, undivided, urban principal arterial roadway between Fairbanks International Airport and College Road. The project limits are between, but not including, Mitchell Expressway, and Thomas Street. The proposed design consists of reconstructing University Avenue to include two continuous through lanes (northbound and southbound), raised median, and auxiliary lanes at median break locations. Signalized intersections will be improved. In addition, a pedestrian hybrid beacon (PHB) is proposed at Sandvik Drive.

Within the project limits, at the PM peak hour period (analysis period), the major signalized intersections operate or are projected to operate at LOS E currently and in 2040 without capacity improvements done (2040 No-Build) and LOS D in 2040 with the proposed improvement implemented (2040 Build). Many of the stop controlled cross-street approaches currently experience LOS E or F due to the large traffic volumes and insufficient gaps on University Avenue. These approaches are projected to continue to operate at LOS F with the 2040 No-Build scenario. Many of the unsignalized approaches are still projected to operate at LOS F with the 2040 Build scenario; however, many others improve to LOS C or better. University Avenue arterial operations are or are expected to be LOS D for existing conditions and the 2040 No-Build scenario. Arterial operations are projected to improve to LOS C for the 2040 Build scenario.

Crash data between 2010-2014 indicates that crash patterns; predominantly rear-end, left-turn, and right-angle; have not changed significantly since the project was initiated. University Avenue intersections with Davis Road, Airport Way, Geist Road/Johansen Expressway, and Sandvik Street maintain crash rates above the state average for similar facilities. Proposed design features, such as auxiliary turn lanes and center raised median, are estimated to have reduced crashes by 9% to 11%.

Pedestrians experience a long delay in attempting to cross University Avenue at unsignalized intersections and at mid-block locations. With the proposed design, pedestrians may be able to use the center raised median as a pedestrian refuge and reduce their delay during mid-block crossings. In addition, the PHB will significantly improve the pedestrian delay at Sandvik Drive.

Four MACS transit routes use University Avenue, including the Blue Line, which has the highest ridership of all MACS lines in the Fairbanks vicinity. These routes will experience the same delay as other users as described by the LOS in the existing, 2040 No-Build, and 2040 Build conditions.

Proposed auxiliary turn lane lengths were compared with recommended auxiliary turn lane lengths, which were based on the design speed and revised 2040 projected traffic queue lengths. Most of the currently designed turn lane lengths appear to be adequate for the new values; however, in a few locations, lengths are recommended to be longer or shorter than currently designed.

None of the currently unsignalized intersections met traffic volume or crash based warrants for new signals for any of the conditions. A 2015 analysis of Sandvik Street and University Avenue concluded with a warrant for a pedestrian hybrid beacon to assist neighborhood students and other pedestrians wishing to cross University Avenue at this un-signalized intersection.

1 Introduction

The Alaska Department of Transportation and Public Facilities (DOT&PF) proposes to rehabilitate and widen University Avenue from Thomas Street to the Mitchell Expressway.

The purpose of the project is to improve access control, safety, and pedestrian and bicycle facilities; replace the Chena River Bridge; and upgrade the Airport Way and Geist Road intersections. This Traffic Analysis & Safety Report (TA&SR) presents the existing conditions of the corridor; future conditions based on forecast traffic volumes for the year 2040; and the recommended design to address vehicle operations.

1.1 Project Location

The project is located within the city limits of Fairbanks, Alaska. As shown in Figure 1, the study area extends along University Avenue between Thomas Street and the Mitchell Expressway.

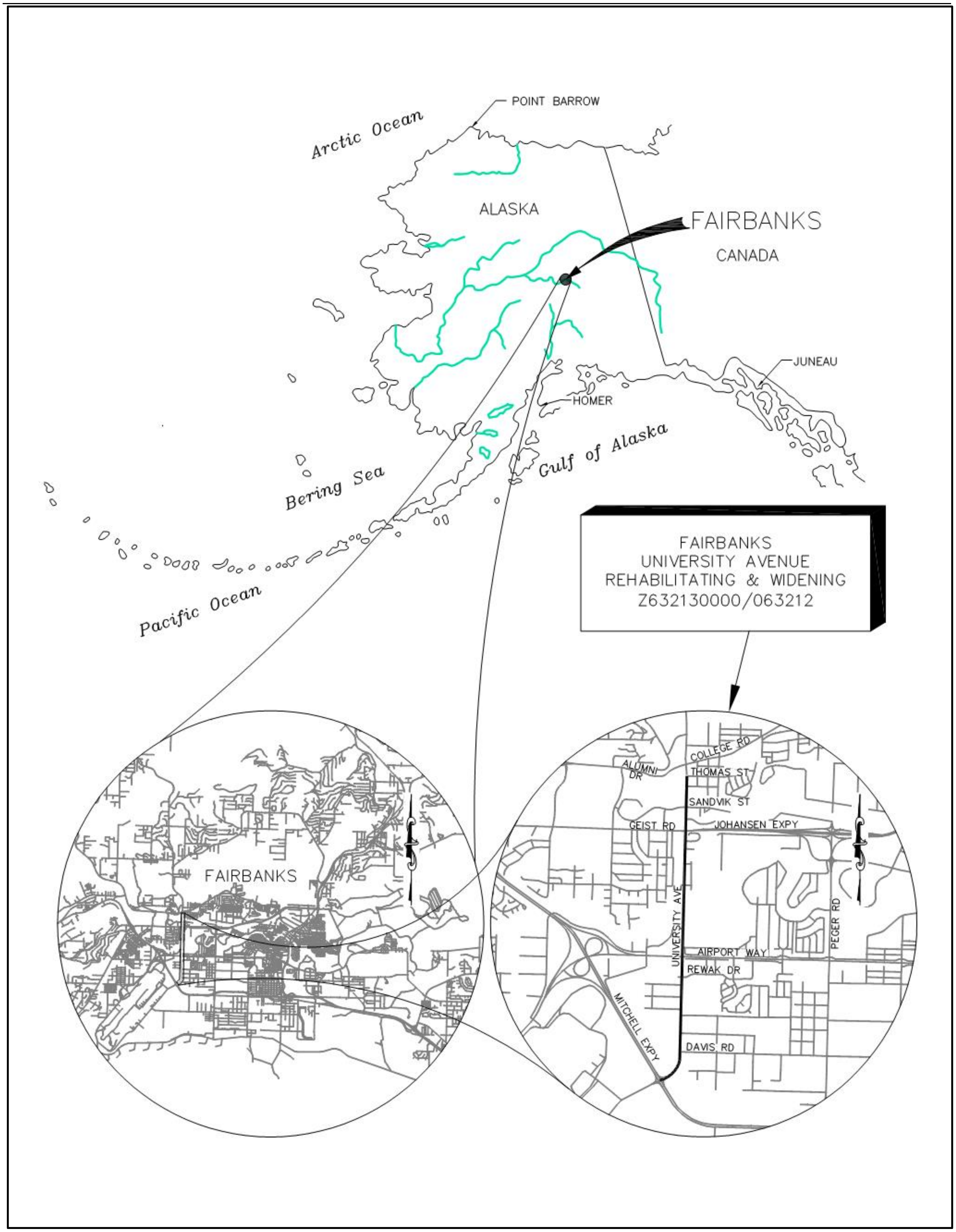

Figure 1: Project Vicinity Map

2 Existing Conditions

Section Highlights

Functional Classification and Geometry

- University Avenue is functionally classified as an urban principal arterial road.
- Three signalized intersections are within project study: Rewak Drive, Airport Way, and Geist Road-Johansen Expressway.
- Signalized intersections are not coordinated.

2017 AADT

- University Avenue is separated into four segments as shown below:

University Avenue Road Segment	2017 AADT	PM Peak PHF	HV% of AADT
Mitchell Expressway to Davis Road	6,500	0.91	3.0%
Davis Road to Rewak Drive	9,500	0.94	3.5%
Rewak Drive to Geist Road/Johansen Expwy	16,750	0.97	3.5%
Geist Road/Johansen Expwy to Thomas Street	17,500	0.94	3.0%

Speed

- Posted speed limit is 40 mph; observed 85th percentile speed between Mitchell Expressway and Geist Road/Johansen Expressway is 48 mph.

Safety

- Rear-end, right-angle, and left-turn crashes are the predominant crash types.
- University Avenue intersections with Davis Road, Airport Way, Geist Road/Johansen Expressway, and Sandvik Street have crash rates above the state average for similar facilities.
- The Rewak Drive to Airport Way segment has a crash rate above the state average crash rate where it was previously below the state average.

Existing Operations

- Arterial LOS
  - Northbound & southbound LOS D
- Signalized Intersection LOS
  - Rewak Drive LOS C
  - Airport Way **LOS E**
  - Geist Road/Johansen Expressway **LOS E**
- Pedestrian LOS
  - Unsignalized intersection and mid-block crossings **LOS F** (delay >5 mins)
- Signal Warrants
  - No new signals warranted per MUTCD within project area
  - Pedestrian Hybrid Beacon is warranted at University Avenue and Sandvik Street

2.1 Functional Classification

University Avenue and streets with coordinated data system (CDS) assigned route numbers that intersect University Avenue are functionally classified by DOT&PF. Table 1 summarizes the functional classification of University Avenue and those intersecting cross-streets with CDS route numbers.

Table 1: DOT&PF Roadway Functional Classifications

Road	DOT&PF Functional Classification
University Avenue	Principal Arterial - Other
Davis Road	Major Collector
Rewak Drive	Minor Collector
Airport Way	Principal Arterial - Other
Geraghty Avenue	Minor Collector
Geist Road/Johansen Expressway	Principal Arterial - Other
Sandvik Street	Local Road

The intersecting named cross-streets that are not listed in the table do not have CDS route numbers and include: Holden Road, 19th Avenue, Swenson Avenue, Erickson Avenue, Mitchell Avenue, Sportsman Way, Goldizen Avenue, Widener Lane, Indiana Avenue, Wolf Run, Dead End Alley, Cameron Street, and Thomas Street. Most of these non-CDS roadways would be functionally classified as local roads. Possible exceptions include 19th Avenue, Erickson Avenue, and Thomas Street, which because of their hierarchical position in the street network, may function as minor collectors.

The project study area is partially within the city limits of Fairbanks, which has a population of over 5,000, and fully within the Fairbanks Metropolitan Transportation System (FMATS) urban boundary; therefore, roads within the project are classified as urban.

2.2 Geometry and Traffic Control

2.2.1 University Avenue

University Avenue is a principal arterial roadway owned and maintained by DOT&PF. The road extends from the Fairbanks International Airport to College Road, where it turns into Farmers Loop Road. Within the project study area, between Mitchell Expressway and Thomas Street, it is a north/south undivided roadway with two lanes in each direction. The speed limit on University Avenue is 40 mph. All intersecting streets and driveways are under stop sign control (or yielding) except those in the subsections below.

2.2.2 Rewak Drive Signalized Intersection

The Rewak Drive intersection with University Avenue is a 4-leg signalized intersection. The signal is actuated and uncoordinated with other signals in the street network. The intersection configuration is presented in Figure 2. The Rewak Drive left-turn movements are phased as permissive-only, and the University Avenue left-turn movements are phased permissive-protected.

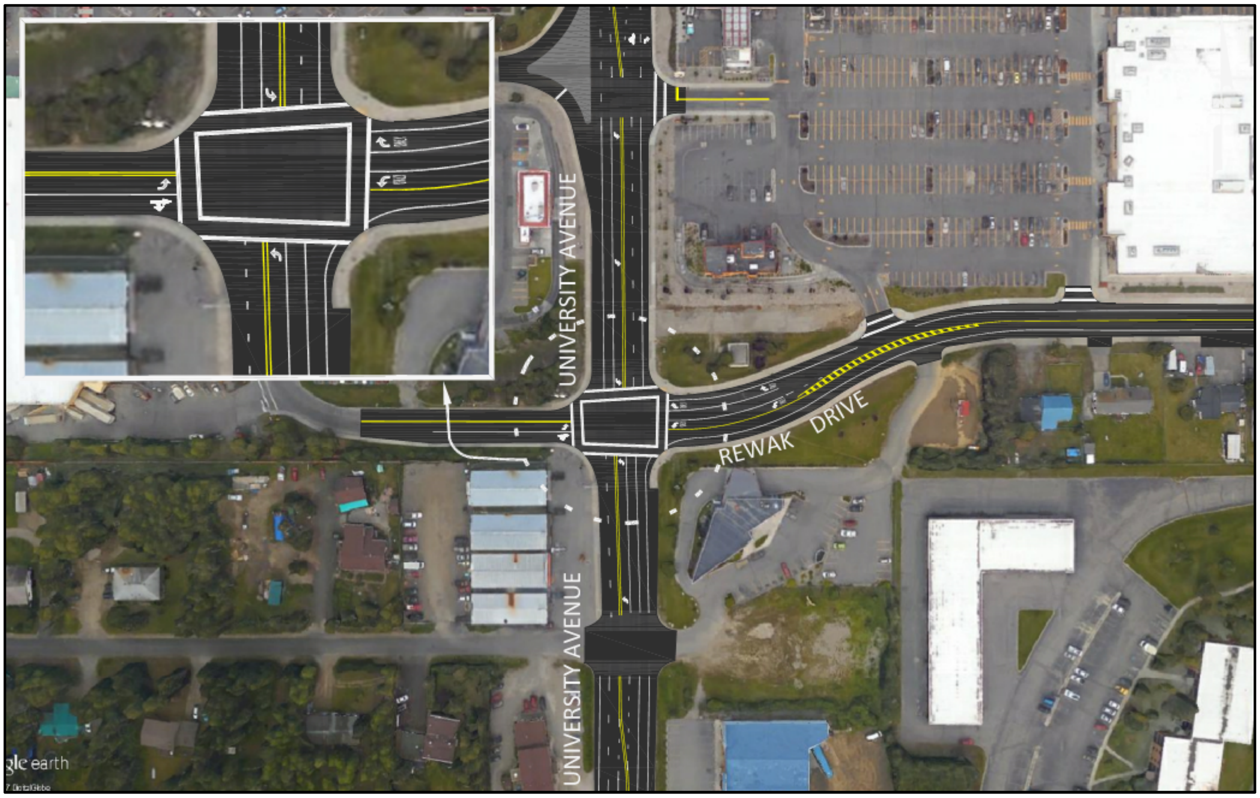

Figure 2: University Avenue & Rewak Drive Existing Lane Configuration

2.2.3 Airport Way Intersection

The Airport Way intersection with University Avenue is a 4-leg signalized intersection. The signal is actuated and uncoordinated with other signals in the street network. The intersection configuration is presented in Figure 3. The north and south University Avenue approaches are split-phased, and the east-west Airport Way left-turn movements proceed under protected-permitted indications.

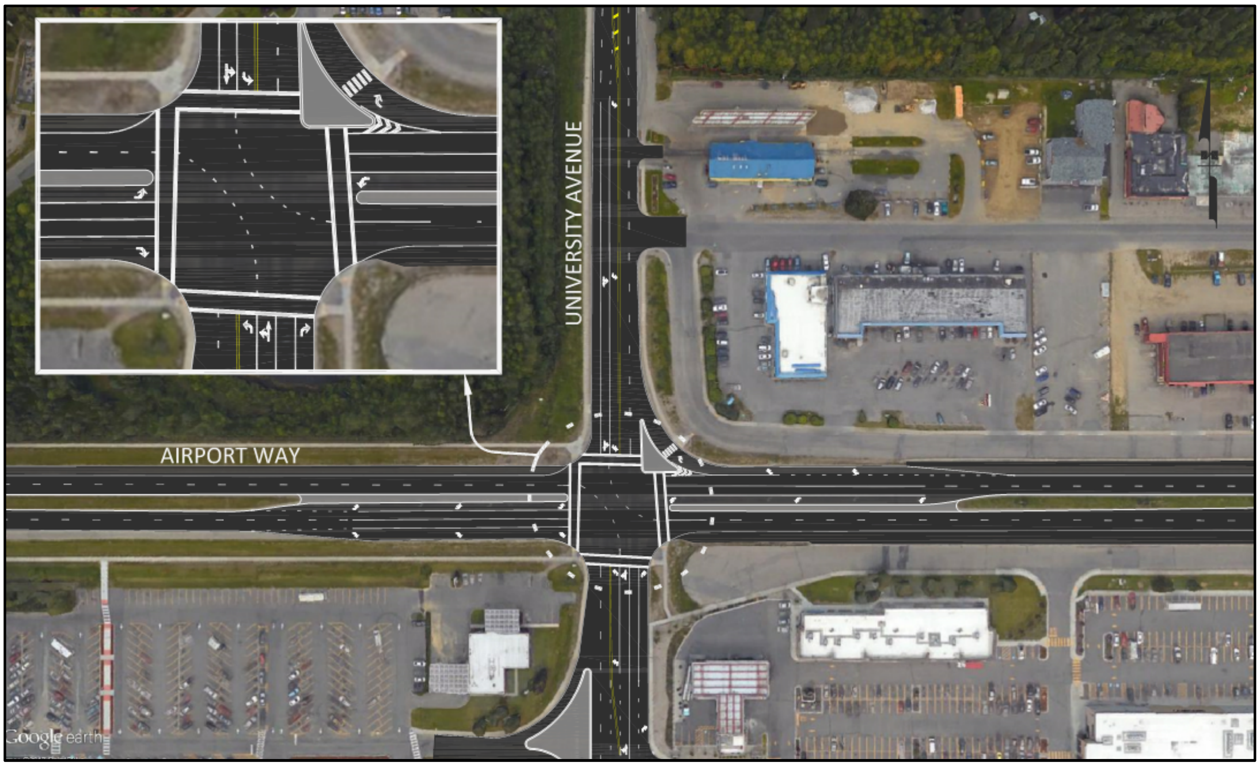

Figure 3: University Avenue & Airport Way Existing Lane Configuration

2.2.4 Geist Road/Johansen Expressway Intersection

The Geist Road/Johansen Expressway intersection with University Avenue is a 4-leg signalized intersection. The signal is actuated and uncoordinated with other signals in the street network. The intersection configuration is presented in Figure 4. The north-south University Avenue approaches are split-phased, and east-west approach left-turn movements are phased protected-permitted.

Figure 4: University Avenue & Geist Rd/Johansen Expwy Existing Lane Configuration

2.3 AADT

Average Annual Daily Traffic (AADT) volumes were collected from the DOT&PF Northern Region *Annual Traffic Volume Report(s)* for 2007 to 2015. AADT values for 2016 were obtained directly from DOT&PF.

To determine 2017 AADT, traffic was counted using radar automatic traffic data collectors at two locations on University Avenue, near Davis Road and at the Chena River bridge, during August and September 2017. The traffic counts were analyzed and factored to an estimated 2017 AADT using DOT&PF's adjustment factors for near-by permanent traffic recorders (PTRs). These AADT values were used for University Avenue between Davis and the Chena River Bridge. AADT values for the remaining sections, within the project area of University Avenue, were factored based on a historical traffic volume comparison between the segments.

Table 2 summarizes, by segment as published in the DOT&PF Northern Region *Annual Traffic Volume Report(s)*, the AADT from 2007 to 2015 for University Avenue. The 2016 AADT was provided by Northern Region Planning and support Services Staff. The 2017 AADT is the result of the aforementioned 2017 data collection analysis.

Table 2: AADTs – University Avenue Segments (2007-2017)

Segment	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Mitchell Expwy to Davis Rd.	6,387	5,930	6,191	6,754	6,572	6,153	6,398	6,978	6,594	6,628	6,445
Davis Rd to Rewak Dr.	9,214	9,449	8,971	9,757	9,744	9,336	9,588	10,029	9,548	9,316	9,416
Rewak Dr. to Chena River Bridge	19,250	19,250	19,200	20,120	20,075	17,797	17,904	17,602	17,509	17,520	15,283
Chena River Bridge to Geist Rd/Johansen Expwy.	18,005	17,555	17,840	18,340	18,000	17,800	17905	17,605	17,525	17,520	17,143
Geist Rd/Johansen Expwy. to College Rd	21,100	20,730	20,950	21,450	21,200	20,900	21,000	18,665	17,525	17,629	17,523

For this study, University Avenue was segmented and assigned AADT traffic volumes as presented in Table 3.

Table 3: Project Segments and 2017 AADT

University Avenue Road Segment	Year 2017 AADT
Mitchell Expressway to Davis Road	6,500
Davis Road to Rewak Drive	9,500
Rewak Drive to Geist Road/Johansen Expwy	16,750
Geist Road/Johansen Expwy to Thomas Street	17,500

2.4 Speed

The radar automatic traffic data collectors deployed at two locations on University Avenue, near Davis Road and at the Chena River bridge, also recorded individual vehicle speeds. The 85th percentile speeds are summarized in Table 4.

Table 4: Measured 85th Percentile Speeds

University Avenue Road Segment	Northbound 85th Percentile Speed	Southbound 85th Percentile Speed
Davis Road to Rewak Drive (north of Davis Road)	48 mph	48 mph
Geraghty Avenue to Geist Road/Johansen Expwy (at Chena River Bridge)	47 mph	49 mph

The data indicates that 85th percentile speeds are about 48 mph at the data collection points and is assumed to be representative of University Avenue 85th percentile speeds between Mitchell Expressway and Geist Road/Johansen Expressway. This is considerably higher than the posted speed limit of 40 mph for University Avenue. Speed data was not collected north of Johansen Expressway. For this study, the posted speed limit was used for analyses north of Johansen Expressway, which is consistent with the land use and density of driveways and cross-streets in that section.

2.5 Crashes

The latest 5-years of reported crashes (2010 through 2014) were analyzed and compared with the 2003 to 2012 crash data analysis performed by Kinney Engineers, LLC (KE) in 2015 to determine if there were any new contributing factors to consider with the design of the project. The analysis indicates that crashes during the five-year study period have patterns consistent with the crash trends rates identified in the 2015 Safety Analysis Update. As such, those crash countermeasures that were proposed in the 2015 report are likely to still be effective.

Segment and intersection crash rates for the 2010 to 2014 period were calculated and compared to the statewide average for similar facilities published in the 2017 HSIP Handbook. The data is presented in Table 5 (segments) and Table 6 (intersections). Where the critical rate for an intersection or segment is exceeded, there is statistical evidence that the crash rate is unusually high, and the high frequency of crashes is likely due to specific contributing factors instead of randomness. Note that none of the study area segments or intersections exceed the critical crash rate.

Table 5: Segment Crash Rates (2010 to 2014)

Segment	Crash Frequency (2010 to 2014)	ADT 5-year Average	Crash Rate (crashes per MVM)	Facility Type Statewide Average Rate (crashes per MVM)	Critical Rate @ 95% confidence (crashes per MVM)
Mitchell Expressway to Davis Road	1	6,572	0.33	1.90	3.37
Davis Road to Rewak Drive	3	9,692	0.33	1.90	2.71
Rewak Drive to Airport Way	11	20,002	2.12	1.90	2.99
Airport Way to Geraghty Avenue	0	20,002	0.00	1.90	4.34
Geraghty Avenue to Goldizen Avenue	12	20,002	0.73	1.90	2.49
Goldizen Avenue to Geist Road/Johansen Expressway	4	17,929	0.33	1.90	2.59
Geist Road/Johansen Expressway to Sandvik Street	3	20,641	0.50	1.90	2.91
Sandvik Street to Cameron Street	8	20,641	1.50	1.90	2.97
Cameron Street to Alumni Drive/College Road	0	20,641	0.00	1.90	2.93

Table 6: Intersection Crash Rates (2010 to 2014)

Intersection	Crash Frequency (2010 to 2014)	ADT 5-year Average	Crash Rate (crashes per MEV)	Facility Type Statewide Average Rate (crashes per MEV)	Critical Rate @ 95% Confidence (crashes per MEV)
Davis Road	15	10,504	0.78	0.52	0.82
Holden Road	1	9,692	0.06	0.52	0.84
19th Avenue	2	9,692	0.11	0.52	0.84
Swenson Avenue	2	9,692	0.11	0.52	0.84
Erickson Avenue	7	9,692	0.40	0.55	0.87
Mitchell Avenue	1	9,692	0.06	0.52	0.84
Rewak Drive	25	16,861	0.81	1.57	1.96
Airport Way	110	34,824	1.73	1.57	1.84
Geraghty Avenue	12	28,948	0.23	0.52	0.70
Goldizen Avenue	9	17,929	0.28	0.52	0.75
Widener Lane	11	17,929	0.34	0.52	0.75
Indiana Avenue	17	17,929	0.52	0.52	0.75
Wolf Run	12	17,929	0.37	0.52	0.75
Geist Road/Johansen Expressway	119	38,548	1.69	1.57	1.82
Sandvik Street	28	21,111	0.73	0.55	0.76
Cameron Street	5	20,641	0.13	0.52	0.73
Thomas Street	16	20,641	0.42	0.52	0.73

The 2010-2014 crash data shows that the most predominant crashes on the corridor are rear-end (49%), right-angle (17%), and left-turn crashes (12%), as shown in Figure 5.

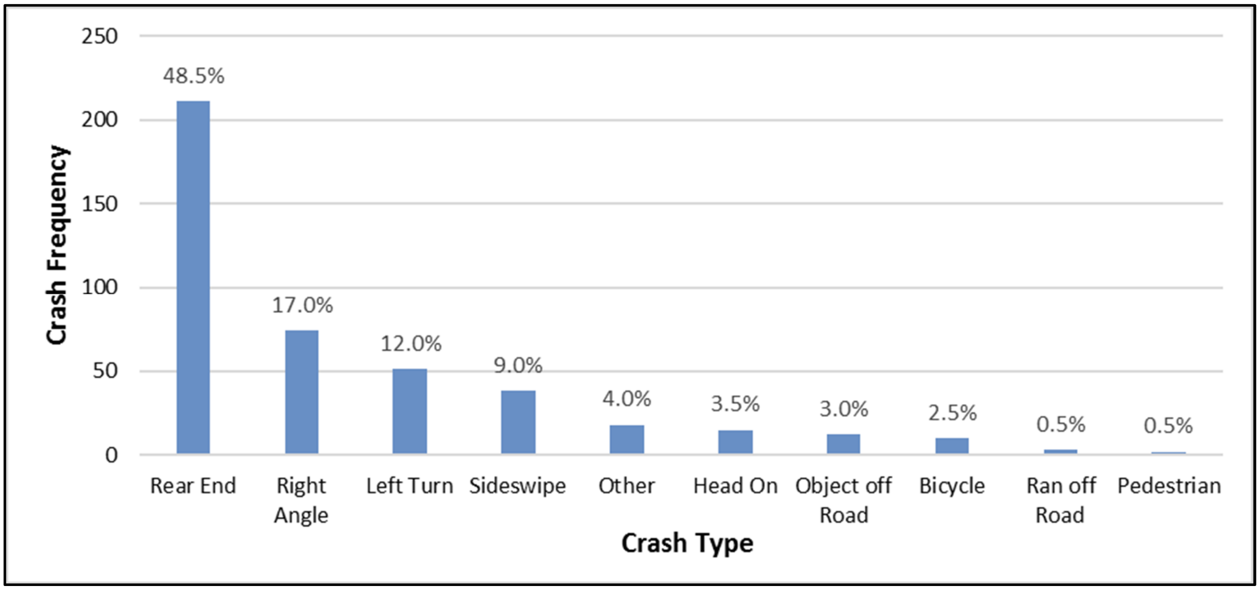

Figure 5: Crashes by Crash Type from 2010 through 2014

Appendix B contains the 2017 Safety Analysis Update, as well as the 2015 report for this project.

2.6 Operational Parameters

2.6.1 Turning Movement Volumes

Turning movement volumes (TMVs) for numerous intersections along University Avenue were collected by DOT&PF and/or KE. The Design Designations Report, found in Appendix A, discusses the process for 2017 TMV values.

Figure 6 and Figure 7 presents TMVs during the evening peak hour (PM). The PM peak was determined to be highest volume period of the day and represents current and future design conditions.

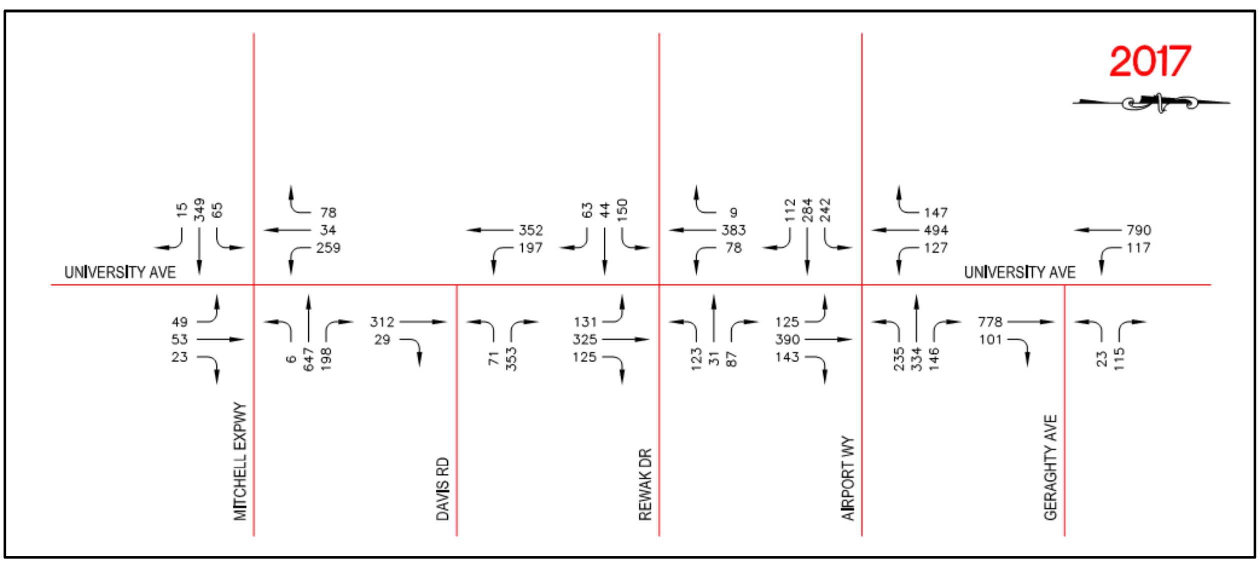

Figure 6: 2017 PM Turning Movement Volumes Summary – Mitchell Expwy to Geraghty Ave

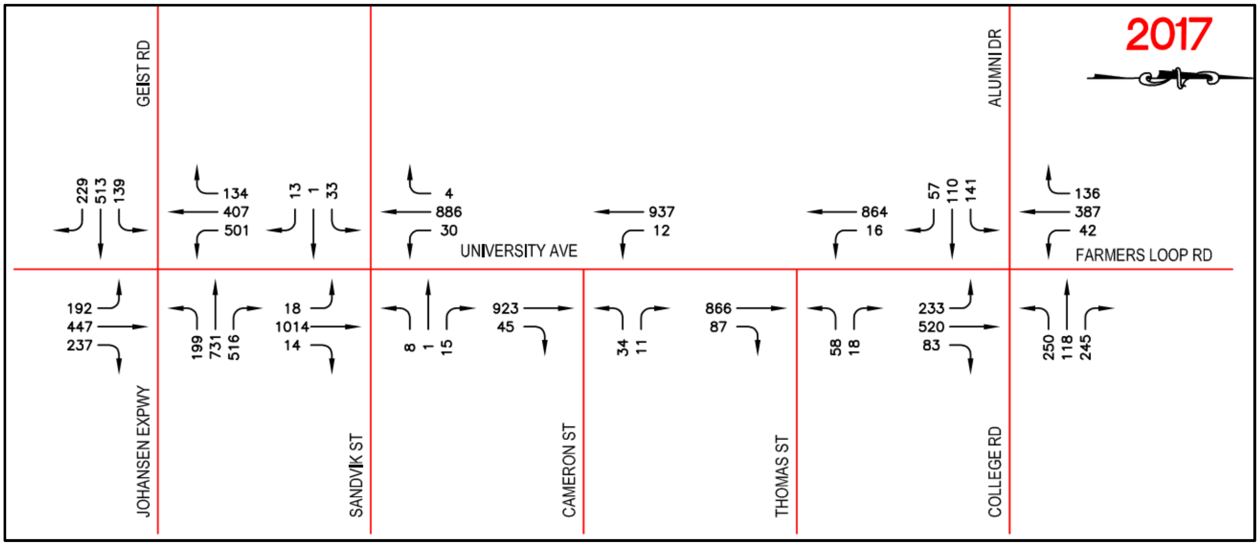

Figure 7: 2017 PM Turning Movement Volumes Summary – Geist Rd to College Rd

Peak hour factors (PHFs) convert hourly volumes to 15-minute design flow rates for capacity analyses. They represent the uniformity of traffic volumes over an hourly period and range from 0.25 (all traffic arrives in one 15-minute period and no additional traffic arrives for the rest of the hour) to 1.0 (equal number of vehicles arrive during each 15-minute period).

PHFs were derived from the TMVs. Intersection PHF for PM peak hour are shown in Table 7.

Table 7: 2017 Intersection PHFs for PM Peak Periods

Intersection with University Avenue	PHF
Mitchell Expressway	0.89
Davis Road	0.88
Rewak Drive	0.95
Airport Way	0.96
Geraghty Avenue	0.98
Geist Road/Johansen Expwy	0.97
Sandvik Street	0.92
Cameron Street	0.93
Thomas Street	0.93

Table 8 below presents the segment PM peak hour PHFs for segment within the study area.

Table 8: 2017 Segment PHFs for PM Peak Periods

Segment	PHF
Mitchell Expressway to Davis Road	0.89
Davis Road to Rewak Drive	0.92
Rewak Drive to Geist Road/Johansen Expwy	0.97
Geist Road/Johansen Expwy to Thomas Street	0.94

2.6.2 Heavy Vehicle Percentages

Heavy vehicle percentages (HV%) were determined using TMV from DOT&PF and historical data from the permanent traffic recorders (PTRs) located on Airport Way east of University Avenue, Geist Road west of Thompson Drive, and Johansen Expressway east of University Avenue. For roads that intersect University Avenue and did not have HV% data, HV% was based on general land use of the roads. Table 9 shows the HV% for University Avenue based on DOT&PF TMVs.

Table 9: Recommended Segment Heavy Vehicle Percent

Segment	HV% of AADT
Mitchell Expressway to Davis Road	3.0%
Davis Road to Rewak Drive	3.5%
Rewak Drive to Geist Road/Johansen Expwy	3.5%
Geist Road/Johansen Expwy to Thomas Street	3.0%

2.6.3 Capacity

AASHTO's PGDHS has guidelines for appropriate LOS thresholds for different functional classifications and area and terrain types. Based on current design guidelines, University Avenue should operate at LOS C or D in the design year.

Capacity analyses were conducted using Synchro software that is based on Highway Capacity Manual (HCM) methodologies. As part of an urban street network, the facility is under the interrupted-flow regime; therefore, intersection operations dominate operational quality and LOS.

The existing intersection PHFs mentioned in Section 2.6.1 were used to approximate flow conditions during the highest 15-minute period of each peak hour.

2.6.3.1 Existing Conditions Intersection LOS

Capacity analyses at intersections focus on control delay by movement, by approach, or for the entire intersection, to determine the LOS for the approach, lane group, or intersection. Table 10 and Table 11 summarize the results for each movement at the signalized and unsignalized intersections, respectively: volume to capacity ratio (v/c), 95^{th} percentile queue length, control delay, and the LOS.

All signalized intersections, except Rewak Drive, currently operate at an LOS E, indicating improvements to these intersections are needed to handle the current and future volume of traffic to meet AASHTO operational objectives of LOS C or D. The majority of stop control intersections operate at a LOS E or F, indicating traffic entering University Avenue from a minor street experience a long delay before an acceptable gap in main traffic occurs.

Table 10: 2017 PM Signalized Intersection LOS

Intersection	Approach	Control	Movement	PM Peak				Approach LOS	Intersection LOS
				V/C Ratio	Queue Length (ft.)	Control Delay (sec/veh)	LOS		
Rewak Drive	Eastbound	Signal	Left	0.70	197	62.5	E	E	C
			Thru + Right	0.25	94	50.7	D		
	Westbound	Signal	Left	0.65	167	60.2	E	D	
			Thru	0.11	51	48.9	D		
			Right	0.06	44	48.5	D		
	Northbound	Signal	Left	0.27	96	6.7	A	A	
			Thru + Right	0.24	146	10.0	B		
	Southbound	Signal	Left	0.14	47	7.6	A	B	
			Thru + Right	0.19	140	10.5	B		
Airport Way	Eastbound	Signal	Left	0.50	284	29.4	C	D	E
			Thru	0.22	209	40.3	D		
			Right	0.08	56	38.0	D		
	Westbound	Signal	Left	0.45	274	30.2	C	D	
			Thru	0.26	248	41.8	D		
		Yield	Right	0.21	20	11.4	B		
	Northbound	Signal	Left	0.51	230	77.4	E	F	
			Left + Thru	0.84	351	92.9	F		
			Right	0.10	72	71.9	E		
	Southbound	Signal	Left	0.39	235	65.4	E	F	
			Left + Thru Thru + Right	0.91	492	89.4	F		

Intersection	Approach	Control	Movement	PM Peak				Approach LOS	Intersection LOS
				V/C Ratio	Queue Length (ft.)	Control Delay (sec/veh)	LOS		
Geist Road - Johansen Expwy	Eastbound	Signal	Left	0.51	138	34.4	C	D	E
			Thru	0.56	323	47.3	D		
			Right	0.16	77	40.7	D		
	Westbound	Signal	Left	0.60	220	32.1	C	D	
			Thru	0.75	466	49.2	D		
			Right	0.61	338	46.1	D		
	Northbound	Signal	Left	0.48	255	46.3	D	D	
			Right + Thru	0.81	384	56.1	E		
	Southbound	Signal	Left	0.86	495	70.8	E	E	
			Left + Thru Thru + Right	0.83	393	60.3	E		

Table 11: 2017 PM Unsignalized Intersection LOS

Intersection	Approach	Control	Movement	PM Peak				Approach LOS
				V/C Ratio	Queue Length (ft.)	Control Delay (sec/veh)	LOS	
Davis Road	Westbound	Stop	Left	0.50	61	47.8	E	C
			Right	0.57	89	16.5	C	
	Southbound	Stop	Left + Thru	0.20	19	6.4	A	-
Holden Road	Westbound	Stop	Left + Right	0.26	26	16.8	C	C
	Southbound	Yield	Left + Thru	0.01	1	0.7	A	-
19th Avenue	Westbound	Stop	Left + Right	0.27	27	20.6	C	C
	Southbound	Yield	Left + Thru	0.05	4	1.9	A	-
Swenson Avenue	Eastbound	Stop	Left + Right	0.40	46	24.6	C	C
	Northbound	Yield	Left	0.03	2	1.2	A	-
Erickson Avenue	Eastbound	Stop	Left + Thru + Right	0.17	15	34.4	D	D
	Westbound	Stop	Left + Thru + Right	0.63	87	58.7	F	F
	Northbound	Yield	Left + Thru	0.06	5	1.9	A	-
	Southbound	Yield	Left	0.09	7	9.7	A	-
Fred Meyer-Safeway D/W	Eastbound	Yield	Right	0.06	5	10.6	B	B
	Westbound	Stop	Left + Right	0.49	65	22.5	C	C
	Southbound	Yield	Left	0.15	13	5.5	A	-
Geraghty Avenue	Westbound	Stop	Left + Right	0.34	37	16.8	C	C
	Southbound	Yield	Left	0.10	8	9.5	A	-
Sportsman Way	Eastbound	Stop	Left + Right	0.13	11	29.9	D	D
	Northbound	Yield	Left + Thru	0.01	1	0.2	A	-
Goldizen Avenue	Eastbound	Stop	Left + Thru + Right	0.69	90	91.5	F	F
	Westbound	Stop	Left + Thru + Right	0.89	121	153.2	F	F
	Northbound	Yield	Left + Thru	0.03	2	0.9	A	-
	Southbound	Yield	Left + Thru	0.02	2	0.6	A	-

Intersection	Approach	Control	Movement	PM Peak				Approach LOS
				V/C Ratio	Queue Length (ft.)	Control Delay (sec/veh)	LOS	
Widener Lane	Westbound	Stop	Left + Right	0.52	63	51.3	F	F
	Southbound	Yield	Left + Thru	0.04	3	1.3	A	-
Indiana Avenue	Westbound	Stop	Left + Right	0.45	52	41.8	E	E
	Southbound	Yield	Left + Thru	0.02	1	0.6	A	-
Wolf Run	Westbound	Stop	Left + Right	0.47	56	37.9	E	E
	Southbound	Yield	Left + Thru	0.03	2	1.1	A	-
Sandvik Street	Eastbound	Stop	Left + Thru + Right	0.44	45	79.7	F	F
	Westbound	Stop	Left + Thru + Right	0.23	21	46.6	E	E
	Northbound	Yield	Left + Thru	0.03	2	0.9	A	-
	Southbound	Yield	Left + Thru	0.05	4	1.5	A	-
Cameron Street	Westbound	Stop	Left + Right	0.49	54	71.1	F	F
	Southbound	Yield	Left	0.06	5	11.5	B	-
Thomas Street	Westbound	Stop	Left + Right	0.78	107	112.2	F	F
	Southbound	Yield	Left	0.09	7	11.6	B	-

2.6.3.2 Existing Conditions Arterial LOS

Arterial capacity analyses use average speed as the performance measure and LOS indicator. Table 12 and Table 13 shows the results of the existing arterial LOS along University Avenue in the northbound and southbound directions, respectively, during the PM peak period.

Table 12: 2017 PM University Avenue Arterial LOS – Northbound

Northbound							
Cross Street	**Flow Speed (mph)**	**Running Time (sec)**	**Signal Delay (sec)**	**Travel Time (sec)**	**Distance (mi)**	**Arterial Speed (mph)**	**Arterial LOS**
Mitchell Expwy							
Rewak Drive*	40	85.8	106.8	192.6	0.91	17.0	E
Airport Way							
	40	77.3	54.8	132.1	0.86	23.4	C
Geist Rd - Johansen Expwy							
	40	42.9	54.3	97.2	0.45	16.7	E
College Road							
Total		206.0	215.9	421.9	2.2	18.9	D

* Due to the extremely short distance between Rewak Drive and Airport Way, the arterial LOS for the Mitchell Expwy to Airport Way is presented. This is more representative of arterial flow conditions.

Table 13: 2017 PM University Avenue Arterial LOS – Southbound

Southbound							
Cross Street	**Flow Speed (mph)**	**Running Time (sec)**	**Signal Delay (sec)**	**Travel Time (sec)**	**Distance (mi)**	**Arterial Speed (mph)**	**Arterial LOS**
College Road							
	40	42.9	63.3	106.2	0.45	15.3	E
Geist Rd - Johansen Expwy							
	40	77.3	88.6	165.9	0.86	18.6	D
Airport Way							
Rewak Drive*	40	85.8	39.4	125.2	0.91	26.2	B
Mitchell Expwy							
Total		206.0	191.3	397.3	2.2	20.1	D

* Due to the extremely short distance between Rewak Drive and Airport Way, the arterial LOS for the Mitchell Expwy to Airport Way is presented. This is more representative of arterial flow conditions.

2.6.4 Pedestrians and Bicycles

During this study, pedestrians and bicyclists were not counted.

The 2012 FMATS Non-Motorized Transportation Plan conducted bicycle and pedestrian counts for multiple intersections, including one within this University Avenue study – University Avenue/Airport Way. This plan reported 55 pedestrians during a 3-hour period and 115 bicycles during a 2-hour period at the intersection.

FMATS conducts annual bicycle and pedestrian counts at the intersections of University Avenue/Airport Way and University Avenue/Geist Road-Johansen Expressway. Non-motorized traffic is on the rise in these two intersections according to the 2011-2017 FMATS bicycle and pedestrian counts, which occur from 4:30 pm to 6:30 pm, one day each year, usually in mid-May. Of the 36 intersections counted, these two intersections are within the top 6 for non-motorized traffic. Non-motorized traffic will be accommodated with roadway shoulders, sidewalks, and pathways.

Pedestrian delay and level of service for unsignalized intersections (two-way stop controlled) within the study area were determined using the HCM 2010 methodology. This method determines pedestrian LOS based on the length of delay that a pedestrian experiences at the crossing. Because of the high volume of traffic and absence of a mid-crossing refuge such as a wide median, every unsignalized intersection currently operates at a pedestrian LOS F during the PM period; that is there are not enough gaps of sufficient length to permit crossings. During the PM peak hour, pedestrians can expect to only be able to cross at a signalized intersection.

2.6.5 Transit

Four Metropolitan Area Commuter System (MACS) transit lines utilize University Avenue: Blue Line, Orange Line, Red Line, and Yellow Line.

The Blue Line is a loop route and experiences the highest ridership out of all the MACS lines. Within the study limits, the Blue Line runs from Geist Road to the Fred Meyers at the Airport Way intersection. The Blue Line also runs along Rewak Drive through the University Avenue intersection.

The Orange Line is primarily an east-west route with low ridership. Within the study limits, it begins/ends at the Fred Meyers at the Airport Way intersection and travels to/from Davis Road, where it leaves the study limits.

The Red Line is a loop route and is the second highest ridership counts. Within the study limits, the route travels westbound through the Rewak Drive intersection to Fred Meyers and then travels along University Avenue from Airport Way through Thomas Street, where it leaves the study limits.

The Yellow Line is a loop route primarily serving Fairbanks west of University Avenue. Within the study limits, the line operates between Airport Way through Thomas Street, making various movements at the Airport Way intersection. This bus travels both northbound and southbound on University Avenue.

Table 14 identifies each MACS Line within the study area and the operation impacts it experiences within major intersections. None of the bus lines operate on Sunday.

Table 14: MACS Transit 2017 LOS

MACS Line	Intersection with University Avenue	Movement	Delay (sec/veh)	Movement LOS	Weekday Movements per Day	Saturday Movements per Day	Notes
Blue	Airport Way	SB Thru	89	F	21	8	
	Fred Meyer D/W	SB Right	0	A	21	8	2 lanes shared with right or left
	Geist Road	EB Left	34	C	21	8	
	Rewak Drive	EB Thru	51	D	21	8	shared with right turn
Orange	Airport Way	NB Left	77	E	23	-	shared with thru
	Davis Road	SB Left	6.4	A	23	-	
	Rewak Drive	EB Right	51	D	23	-	2 lanes, one shared with right turn
	Rewak Drive	NB Thru	10	B	23	-	
Red	Airport Way	EB Left	29	C	19	6	
	Rewak Drive	WB Thru	49	D	19	6	
Yellow	Airport Way	NB Left	77	E	8	-	
	Airport Way	EB Left	29	C	8	-	
	Fred Meyer D/W	SB Right	0	A	8	-	2 lanes, one shared with thru
	Geist Road	SB Thru	60	E	8	-	
	Geist Road	NB Thru	56	D	8	-	2 lanes, share with right or left
	Rewak Drive	EB Left	63	E	8	-	2 lanes, share with right or left

2.6.6 Signal Warrants

The Federal Highway Administration (FHWA) publication Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD, also a supporting document of the Alaska Traffic Manual) includes a widely accepted methodology for studying the applicability of traffic signals at intersections. The MUTCD signal warrant analysis compares existing and future traffic conditions at the study intersection with historical performance for similar intersections to determine whether the location is a favorable candidate for a traffic signal.

A signal should only be considered if one or more of these warrants established by the MUTCD are satisfied; however, additional factors are examined as part of an engineering study to determine if a signal will improve the overall safety and/or operation of the intersection. These factors include the following:

- A traffic signal usually reduces minor street delay, but delay is increased for the major road traffic, which may increase overall system delay.

- While traffic signals generally reduce right angle and left turn collisions, rear end and same-direction sideswipe collisions may increase, especially on high-speed approaches that formerly had free-flow conditions.

- Signals incur ongoing maintenance and operations costs.

Furthermore, satisfying signal warrants do not necessarily require signal installation. The MUTCD recommends other treatments or strategies be evaluated and, if feasible, be deployed before signalization.

Unsignalized intersections along University Avenue with available TMC data were analyzed for warranting a signal using the MUTCD methods as described below:

- Warrant 1 – 8-Hour Vehicular Volume. This warrant was analyzed for all unsignalized intersections that have the potential for signalization.
    - Condition A – Minimum Vehicular Volume: Meets warrant using minimum entering intersection traffic volume thresholds for 8 hours of the day.
    - Condition B – Interruption of Continuous Flow: Based on insufficient gaps in the major road traffic to accommodate minor road movements. Meets warrant with minimum major road traffic volume thresholds for 8 hours of the day.
    - Combination A&B: Meets warrant using combined minimum threshold traffic volumes for 8 hours of the day

- Warrant 2 – 4-Hour Vehicular Volume: Meets warrant using minimum entering intersection traffic volume thresholds for 4 hours of the day. This warrant was analyzed for all unsignalized intersections that have the potential for signalization.

- Warrant 3 – Peak Hour Volume: Meets warrant using minimum traffic volume thresholds for 1 hour of the day due to a generator that discharges a large number of vehicles in a short period of time, such as office complexes, manufacturing plants, industrial complexes, or high-occupancy vehicle facilities. None of the potentially signalized intersections serve a near-by high-discharge facility; and therefore, none were analyzed for this warrant.

- Warrant 4 – Pedestrian Volume: Meets warrant based on pedestrian volumes and insufficient gaps to accommodate pedestrians crossing the road. Pedestrian counts were not performed for this analysis; however, the volume threshold is high enough that no location would satisfy the warrant and therefore none of the potentially signalized intersections were analyzed for this warrant.

- Warrant 5 – School Crossing: Meets warrant based on insufficient gaps to accommodate school children crossing the road and a minimum of 20 schoolchildren use the crossing during the highest crossing hour. Only Sandvik Street serves near-by schools. This intersection was analyzed for a pedestrian hybrid beacon, which is discussed below.

- Warrant 6 – Coordinated Signal System: Meets warrant based on insufficient platooning of vehicles in a coordinated signal system. The project corridor is currently not within a coordinated signal system; therefore, none of the potentially signalized intersections were analyzed for this warrant. It should be noted that the system may be coordinated in the future, and warranting a signal for any particular unsignalized intersection under Warrant 6 would only occur if unsignalized cross-street traffic experiences long delay or increased crashes. Furthermore, intersection should be on a spacing that is compatible with existing signalized intersection spacing, ideally on a consistent ¼- or ½-mile spacing between signals.

- Warrant 7 – Crash Experience: Meets warrant based on minimum traffic volume thresholds for 8 hours of the day and a minimum of 5 intersection crashes that are correctable by a signal.

- Warrant 8 – Roadway Network: Meets warrant based on the intersection containing 2 or more major routes with at least 1,000 entering vph and the 5-year projected volumes meeting Warrant 1, 2, or 3. None of the currently unsignalized intersections contain 2 or more major routes, therefore, none of the potentially signalized intersections were analyzed for this warrant.

- Warrant 9 – Proximity to Grade Crossing: Meets warrant based on at-grade railroad crossing with stop- or yield control within 140 feet of the intersection and minimum traffic volumes. None of the potentially signalized intersections are within 140 feet of a highway-railroad grade crossing; therefore, none of the potentially signalized intersections were analyzed for this warrant.

For this analysis, the most recent TMC were used. The MUTCD instructs engineering judgment should be used in determining whether or not to include right-turn volumes in the approach volumes for the minor street movement. *NCHRP Report 457 – Evaluating Intersection Improvements: An Engineering Study Guide* was referenced to determine inclusion of right-turn volumes on the minor approaches. Based on the PM peak hour TMC data, all evaluated intersections removed the right-turn volumes from the analyses.

In addition to TMC data, observed 85th percentile speed, as described in Section 2.4, were used for this analysis. Because the observed 85th percentile speed on University Avenue between Mitchell Expressway and Geist Road/Johansen Expressway is greater than 40 mph, a lower threshold of 70% of the minimum traffic volume may be used to meet warrant at Davis Road, Erickson Avenue, and Geraghty Avenue.

At the existing traffic volume and speed, none of the analyzed intersections warrant a traffic signal based on the MUTCD Signal Warrants.

The intersection of University Avenue and Sandvik Street is used by students attending a nearby high school and university. In 2015, KE performed a pedestrian hybrid beacon warrant analysis. The Draft Pedestrian Hybrid Beacon Warrants and Analysis report can be found in Appendix C. DOT&PF took pedestrian counts at this intersection on September 1, 2015 between 2:30 and 3:30 pm. Based on pedestrian and vehicular volumes at the time, a pedestrian hybrid beacon was warranted per MUTCD Chapter 4F.

Table 15 through Table 17 present the results of the analyzed MUTCD Signal Warrants.

Table 15: 2017 MUTCD Signal Warrant 1

Intersection	MUTCD Warrant 1 - 8 Hr. Volume (Criteria = 8 Hrs.)					
	Condition A - Min Volume		Condition B - Interruption of Continuous Traffic		Combo Condition A & B - Min Volume	
	Value	Met?	Value	Met?	Value	Met?
Davis Road	0 Hrs	No	1 Hr	No	0 Hrs	No
Erickson Road	0 Hrs	No	0 Hrs	No	0 Hrs	No
Geraghty Avenue	0 Hrs	No	0 Hrs	No	0 Hrs	No
Sandvik Street	1 Hr	No	2 Hr	No	1 Hr	No
Cameron Street	0 Hrs	No	1 Hr	No	0 Hrs	No

Table 16: 2017 MUTCD Signal Warrant 2

Intersection	MUTCD Warrant 2 - 4 Hr. Volume (Criteria = 4 Hrs.)	
	Value	Met?
Davis Road	0 Hrs	No
Erickson Road	1 Hr	No
Geraghty Avenue	0 Hrs	No
Sandvik Street	1 Hr	No
Cameron Street	0 Hrs	No

Table 17: 2017 MUTCD Signal Warrant 7

Intersection	MUTCD Warrant 7 - Crash Experience		
	Condition B – No. of Crashes (Criteria = 5 Crashes)	Condition C – Volume (Criteria = 8 Hrs.)	Met?
	Value	Value	
Davis Road	1 Crashes	2 Hrs	No
Erickson Road	0 Crashes	1 Hr	No
Geraghty Avenue	2 Crashes	1 Hr	No
Sandvik Street	2 Crashes	3 Hr	No
Cameron Street	2 Crashes	4 Hrs	No

2.6.7 Operations Summary

Under existing conditions, traffic volumes in the PM peak hour along University Avenue are such that drivers traveling between Mitchell Expressway and College Road experience a LOS D. Through major signalized intersections, drivers can expect to encounter LOS D or worse. The signals are uncoordinated, which raises the possibility of a University Avenue vehicle having to stop at each signalized intersection. In general, turning and through movements within the Airport Way and University Avenue intersection operate at the worst LOS of all the studied area signalized intersections. The majority of the two-way stop-controlled intersections with minor cross-streets operate at a LOS F on the stopped leg approaches due to inadequate gaps of traffic on University Avenue.

There are multiple driveways and minor roads within the functional area of the signalized intersections. For safety and operations, these access points will be limited to right-in/right-out movements; however, for all but Dead End Alley, vehicles have other fairly direct routes to make a left turn movement onto or from University Avenue.

Non-motorized traffic volumes are relatively high for 2 intersections within the study area; Airport Way/University Avenue and Geist Road-Johansen Expressway/University Avenue. The 2012 FMATS Non-Motorized Transportation Plan reported 55 pedestrians during a 3-hour period and 115 bicycles during a 2-hour period at the Airport Way intersection. The FMATS annual bicycle and pedestrian counts at both intersections indicated non-motorized traffic is on the rise and are within the top 6 highest intersections for pedestrian and bicycle traffic within the Fairbanks area.

Pedestrians experience LOS F crossing at the unsignalized intersections along University Avenue. They can expect to wait longer than 5 minutes before an acceptable gap in traffic occurs for them to cross.

Four MACS transit routes also use portions of University Avenue: Blue, Orange, Red, and Yellow Lines. These vehicles make various turning movements within the study area and most movements operate at a LOS D or worse.

None of the existing unsignalized intersections meet the MUTCD warrants for a signal based on traffic volume and crash data. A pedestrian hybrid beacon is warranted at the intersection of University Avenue and Sandvik Street.

3 Traffic Volume Forecasts

Section Highlights

2040 AADT

University Avenue Road Segment	2040 AADT
Mitchell Expressway to Davis Road	7,750
Davis Road to Rewak Drive	12,250
Rewak Drive to Geist Road/Johansen Expwy	20,750
Geist Road/Johansen Expwy to Thomas Street	21,000

3.1 Travel Demand Model

Design volumes were forecasted based on the 2040 FMATS Travel Demand Model.

Future traffic generation in the model is based on land use and development forecasts derived from estimates of population and employment growth from various sources. Population and employment growth within the model containment area were projected to be 1.1%; however, the local traffic growth may vary due to available undeveloped land. The distribution of traffic is based on segment capacity and travel time.

The base year for the model is 2013, which is the year for which the model was calibrated and validated. The model is designed to produce daily volumes as well as volumes in the AM and PM peak hours. The University Avenue study uses only the daily volume outputs from the model and applies observed design hour volume percentages to derive PM peak hour estimates. The model is designed to include all road improvement projects that were published in the FMATS 2040 MTP, which includes construction of this project.

3.1.1 Post-processing Analysis

A post-processing analysis was applied to the 2040 model volumes in accordance with *NCHRP Report 765: Analytical Travel Forecasting Approaches for Project-Level Planning and Design*. The analysis included University Avenue from Mitchell Expressway to College Road and the first segments of the intersecting roads that had model volumes. The Design Designation report, found in Appendix A, contains more information about the post-processing.

The final post-processed design year volumes are depicted in Figure 8 and Figure 9.

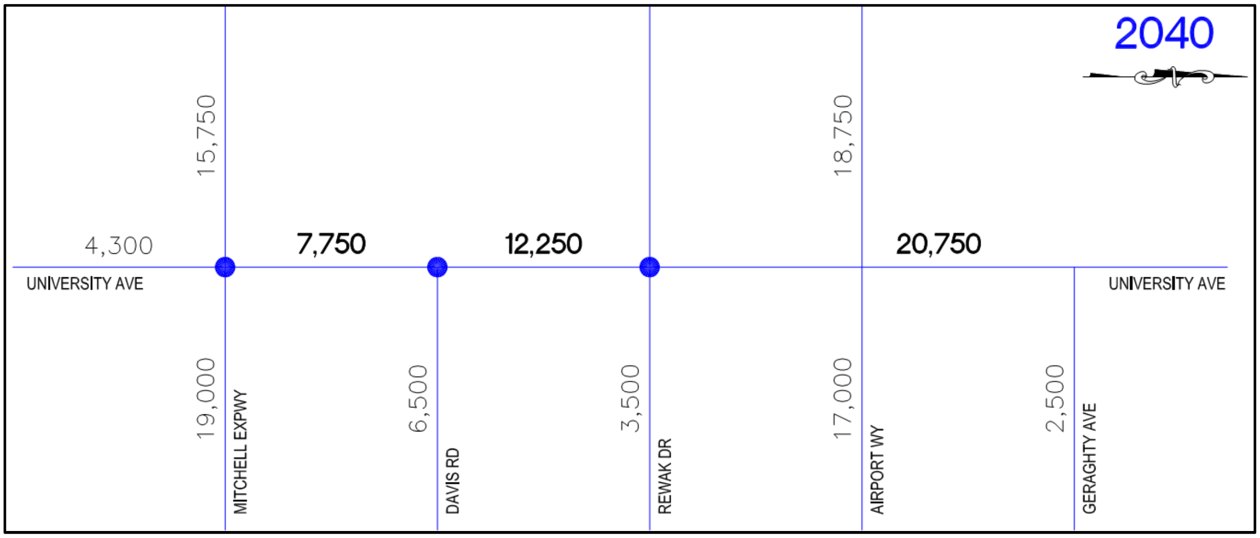

Figure 8: 2040 AADT Volumes - Mitchell Expwy to Geraghty Ave

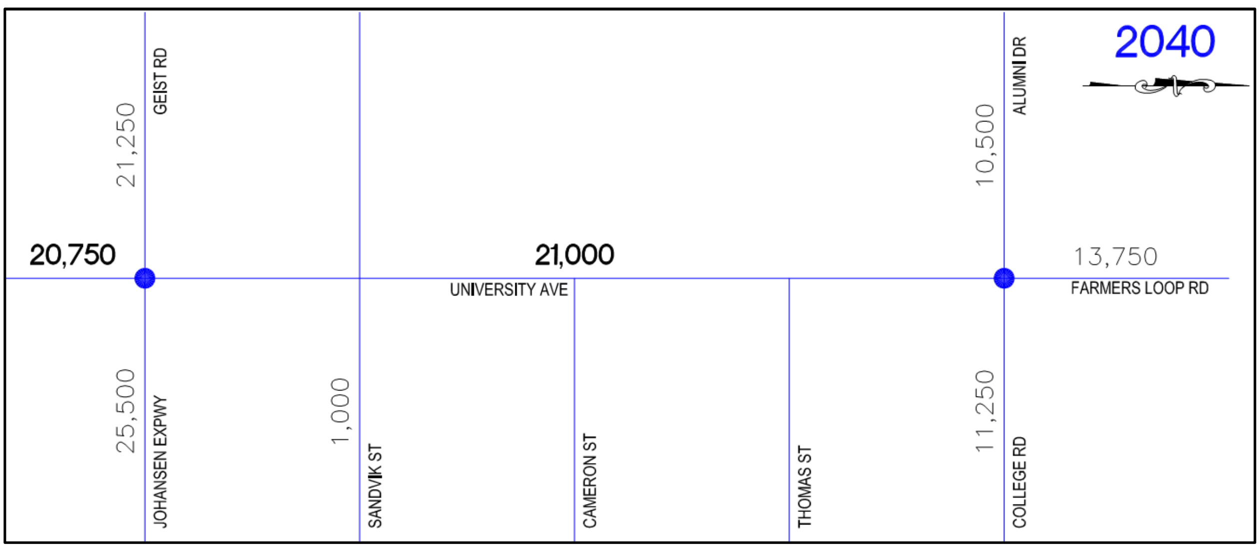

Figure 9: 2040 AADT Volumes - Geraghty Ave to College Rd

3.2 Design Turning Movements

Future intersection turning movement volumes (TMVs) were calculated using the methodology found in the *NCHRP Report 765*. The methodology predicts future intersection peak hour movements based on AADT projections for the approach roads, design hour volumes of AADT, and expected turning movement proportions. The turning movement proportions in this case were taken from the observed counts shown in Figure 6 and Figure 7 and the post-processed design volumes output by the FMATS 2040 travel demand model. The design turning movements in Figure 10 and Figure 11 present the design turning movement volumes for the PM peak hour.

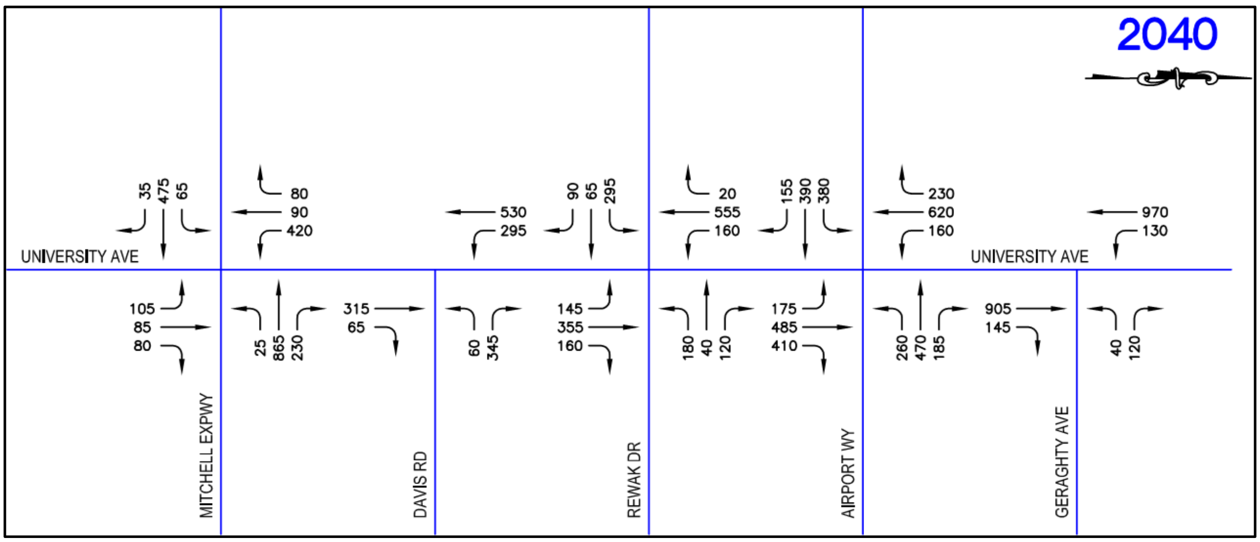

Figure 10: 2040 PM Peak Turning Movement Volumes – Mitchell Expwy to Geraghty Ave

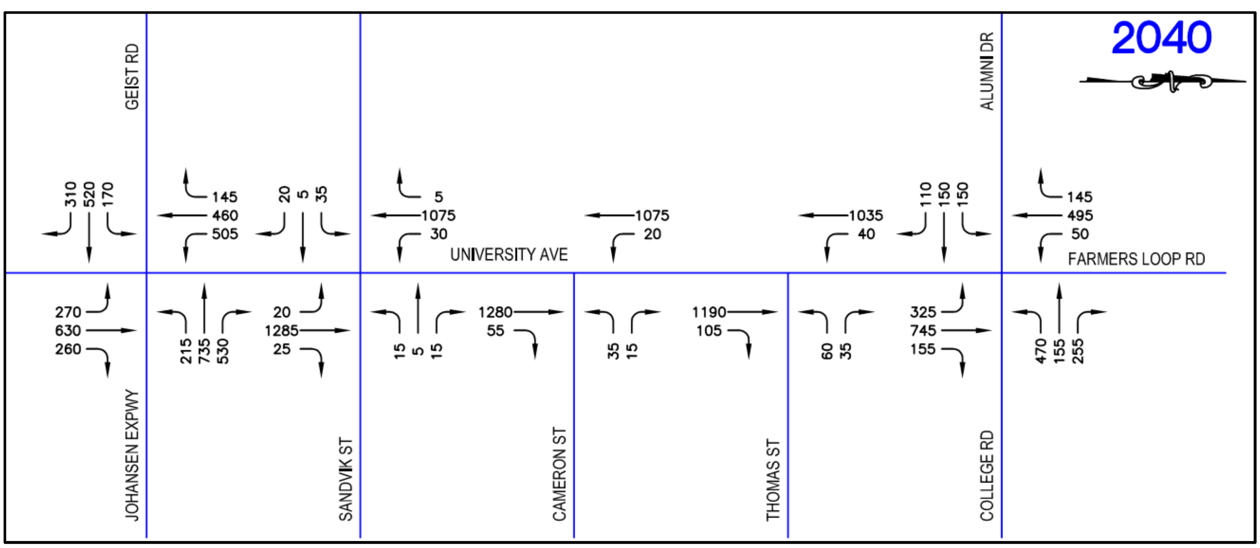

Figure 11: 2040 PM Peak Turning Movement Volumes - Geist Rd to College Rd

4 Future Operations of Existing Conditions (No-Build)

Section Highlights

2040 No-Build Operations

- Arterial LOS
    - Northbound LOS E
    - Southbound LOS E
- Signalized Intersection LOS
    - Rewak Drive LOS C
    - Airport Way LOS E
    - Geist Road/Johansen Expressway LOS E

4.1 No-Build Intersection 2040 LOS

The forecasted 2040 volumes were used to model the future performances for University Avenue.

The 2040 No-Build model projects the majority of the intersection movements will operate at an unacceptable LOS E or F, as shown in Table 18 and Table 19.

Table 18: 2040 PM No-Build Signalized Intersection LOS

Intersection	Approach	Control	Movement	PM Peak				Approach LOS	Intersection LOS
				V/C Ratio	Queue Length (ft.)	Control Delay (sec/veh)	LOS		
Rewak Drive	Eastbound	Signal	Left	0.93	406	83.4	F	E	C
			Thru + Right	0.30	140	42.2	D		
	Westbound	Signal	Left	0.71	238	54.6	D	D	
			Thru	0.09	57	39.3	D		
			Right	0.09	47	39.3	D		
	Northbound	Signal	Left	0.33	95	12.3	B	B	
			Thru + Right	0.30	192	17.4	B		
	Southbound	Signal	Left	0.33	102	12.1	B	B	
			Thru + Right	0.32	232	17.7	B		
Airport Way	Eastbound	Signal	Left	0.94	682	69.9	E	E	E
			Thru	0.39	295	54.5	D		
			Right	0.11	66	49.3	D		
	Westbound	Signal	Left	0.63	327	47.8	D	E	
			Thru	0.56	358	66.2	E		
		Yield	Right	0.31	33	13.5	B		
	Northbound	Signal	Left	0.58	301	75.1	E	F	
			Left + Thru	0.86	422	89.2	F		
			Right	0.49	215	72.2	E		
	Southbound	Signal	Left	0.36	237	60.0	E	F	
			Left + Thru Thru + Right	1.02	736	108.7	F		

Intersection	Approach	Control	Movement	PM Peak				Approach LOS	Intersection LOS
				V/C Ratio	Queue Length (ft.)	Control Delay (sec/veh)	LOS		
Geist Road - Johansen Expwy	Eastbound	Signal	Left	0.79	209	58.4	E	E	E
			Thru	0.65	328	58.2	E		
			Right	0.22	88	50.0	D		
	Westbound	Signal	Left	0.70	238	44.2	D	E	
			Thru	0.89	526	68.3	E		
			Right	0.75	443	63.7	E		
	Northbound	Signal	Left + Thru	0.58	361	50.4	D	E	
			Right + Thru	0.94	593	73.0	E		
	Southbound	Signal	Left	0.95	628	92.1	F	F	
			Left + Thru Thru + Right	0.94	530	78.1	E		

Table 19: 2040 PM No-Build Unsignalized Intersection LOS

Intersection	Approach	Control	Movement	PM Peak				Approach LOS
				V/C Ratio	Queue Length (ft.)	Control Delay (sec/veh)	LOS	
Davis Road	Westbound	Stop	Left	1.02	146	192.4	F	E
			Right	0.52	77	15.7	C	
	Southbound	Yield	Left + Thru	0.32	34	7.6	A	-
Holden Road	Westbound	Stop	Left + Right	0.88	182	75.3	F	F
	Southbound	Yield	Left + Thru	0.01	1	0.5	A	-
19th Avenue	Westbound	Stop	Left + Right	0.39	43	37.2	E	E
	Southbound	Yield	Left + Thru	0.05	4	1.6	A	-
Swenson Avenue	Eastbound	Stop	Left + Right	0.63	94	42.9	E	E
	Northbound	Yield	Left + Thru	0.05	4	1.9	A	-
Erickson Avenue	Eastbound	Stop	Left + Thru + Right	0.54	69	48.9	E	E
	Westbound	Stop	Left + Thru + Right	4.65	>740	>900	F	F
	Northbound	Yield	Left + Thru	0.07	6	2.3	A	-
	Southbound	Yield	Left	0.25	25	10.6	B	-
Fred Meyer-Safeway D/W	Eastbound	Yield	Right	0.20	19	12.7	B	B
	Westbound	Stop	Left + Right	1.29	499	184.1	F	F
	Southbound	Yield	Left	0.18	17	5.6	A	-
Geraghty Avenue	Westbound	Stop	Left + Right	0.84	152	78.0	F	F
	Southbound	Yield	Left	0.19	17	11.4	B	-
Sportsman Way	Eastbound	Stop	Left + Right	0.23	21	54.2	F	F
	Northbound	Yield	Left	0.01	1	0.5	A	-
Goldizen Avenue	Eastbound	Stop	Left + Thru + Right	4.79	>740	>900	F	F
	Westbound	Stop	Left + Thru + Right	3.97	>740	>900	F	F
	Northbound	Yield	Left + Thru	0.05	4	1.5	A	-
	Southbound	Yield	Left + Thru	0.06	5	1.6	A	-

Intersection	Approach	Control	Movement	PM Peak				Approach LOS
				V/C Ratio	Queue Length (ft.)	Control Delay (sec/veh)	LOS	
Widener Lane	Westbound	Stop	Left + Right	0.94	136	154.0	F	F
	Southbound	Yield	Left	0.05	4	1.5	A	-
Indiana Avenue	Westbound	Stop	Left + Right	1.20	212	225.5	F	F
	Southbound	Yield	Left + Thru	0.06	5	1.8	A	-
Wolf Run	Westbound	Stop	Left + Right	0.72	101	81.3	F	F
	Southbound	Yield	Left + Thru	0.05	4	1.6	A	-
Sandvik Street	Eastbound	Stop	Left + Thru + Right	1.96	183	708.6	F	F
	Westbound	Stop	Left + Thru + Right	1.28	106	465.6	F	F
	Northbound	Yield	Left + Thru	0.04	3	1.1	A	-
	Southbound	Yield	Left + Thru	0.06	5	1.8	A	-
Cameron Street	Westbound	Stop	Left + Right	0.90	103	199.4	F	F
	Southbound	Yield	Left	0.05	4	13.4	B	-
Thomas Street	Westbound	Stop	Left + Right	4.30	>740	>900	F	F
	Southbound	Yield	Left	0.09	8	13.6	B	-

4.2 No-Build Arterial 2040 LOS

As shown in Table 20 and Table 21, the 2040 No-Build alternative will continue to operate at a LOS D in both directions.

Table 20: 2040 PM No-Build University Avenue Arterial LOS – Northbound

Northbound							
Cross Street	Flow Speed (mph)	Running Time (sec)	Signal Delay (sec)	Travel Time (sec)	Distance (mi)	Arterial Speed (mph)	Arterial LOS
Mitchell Expwy							
Rewak Drive*	40	85.8	108.9	194.7	0.91	16.8	D
Airport Way	40	77.3	71.6	148.9	0.86	20.8	D
Geist Rd - Johansen Expwy	40	42.9	60.1	103	0.45	15.8	E
College Road							
Total		206.0	240.6	446.6	2.2	17.9	D

* Due to the extremely short distance between Rewak Drive and Airport Way, the arterial LOS for the Mitchell Expwy to Airport Way is presented. This is more representative of arterial flow conditions.

Table 21: 2040 PM No-Build University Avenue Arterial LOS – Southbound

Southbound							
Cross Street	Flow Speed (mph)	Running Time (sec)	Signal Delay (sec)	Travel Time (sec)	Distance (mi)	Arterial Speed (mph)	Arterial LOS
College Road	40	42.9	78.2	121.1	0.45	13.4	E
Geist Rd - Johansen Expwy	40	77.3	103.1	180.4	0.86	17.1	D
Airport Way							
Rewak Drive*	40	85.8	48.8	134.6	0.91	24.3	C
Mitchell Expwy							
Total		206.0	230.1	436.1	2.2	18.3	D

* Due to the extremely short distance between Rewak Drive and Airport Way, the arterial LOS for the Mitchell Expwy to Airport Way is presented. This is more representative of arterial flow conditions.

4.3 Pedestrians and Bicycles

As future vehicular traffic volumes increase, pedestrian crossing opportunities at unsignalized locations along University Avenue decrease. Without improvements to accommodate pedestrians, such as a wide center median, pedestrians will continue to experience very long delays for an acceptable gap in traffic to successfully cross University Avenue.

5 2040 Proposed Design Performance

Section Highlights

2040 Proposed Design Operations

- Arterial LOS
  - Northbound LOS D
  - Southbound LOS C
- Signalized Intersection LOS
  - Rewak Drive LOS C
  - Airport Way LOS D
  - Geist Road/Johansen Expressway LOS D
- Pedestrian LOS
  - Unsignalized intersection and mid-block crossings LOS D-F (delay <3 mins)
- Signal Warrants
  - Based on 2040 traffic volume projections, no new signals warranted per MUTCD within project area
- Crashes
  - 9-11% crash reduction

5.1 2040 Proposed Design Objectives

The proposed design will address the following primary concerns identified for the University Avenue:

- There were several intersections with higher than average crash rate compared to similar facilities statewide. Identified crash patterns include the following:
  - Rear-end
  - Left-turn crashes
  - Right-angle crashes

- There are a fair number of access points on University Avenue within the functional area of signalized intersections, as described in Appendix D, that degrades intersection capacity and safety.

- Inadequate capacity in the 2040 design year to serve the forecasted traffic, resulting in poor LOS in the design year.

5.2 Geometrics

5.2.1 University Avenue

The proposed design includes the following for University Avenue:

- Add sidewalk on both sides from Mitchell Expressway to Rewak Drive. Replace sidewalk on both sides from Rewak Drive to Thomas Street.

- Provide 4.5-foot wide shoulders on both sides for bicyclists. This will allow bicyclists to be more visible to vehicular traffic and reduce conflicts between pedestrians and bicyclists.

- Add a center raised median with breaks at selected unsignalized intersections. In 2014, KE performed an analysis of median treatment alternatives and the effect of the proposed raised medians compared to two-way left-turn lanes, including the effects on crashes, vehicular traffic, pedestrian traffic, bicycle traffic, etc. Based on updated traffic volume projections and crash analysis, the findings during the median analysis still apply. The discussion on medians can be found in Appendix D.

- Add left-turn lanes at the following approaches:
  - Southbound at Davis Road
  - Southbound at Holden Road
  - Northbound at Erickson Avenue
  - Northbound and southbound at Goldizen Avenue
  - Northbound and southbound at Sandvik Street.

  Left-turn lanes remove the turning traffic from the through lanes and reduce rear-end crashes at intersections.

- Coordinate traffic signals for a better flow of traffic. This should result in less platooning at signals.

- Install flashing yellow arrows for permissive-protected left-turn movements or install protected-only left-turn phasing.

Figure 12 depicts the typical cross section of the University Avenue recommended alternative design.

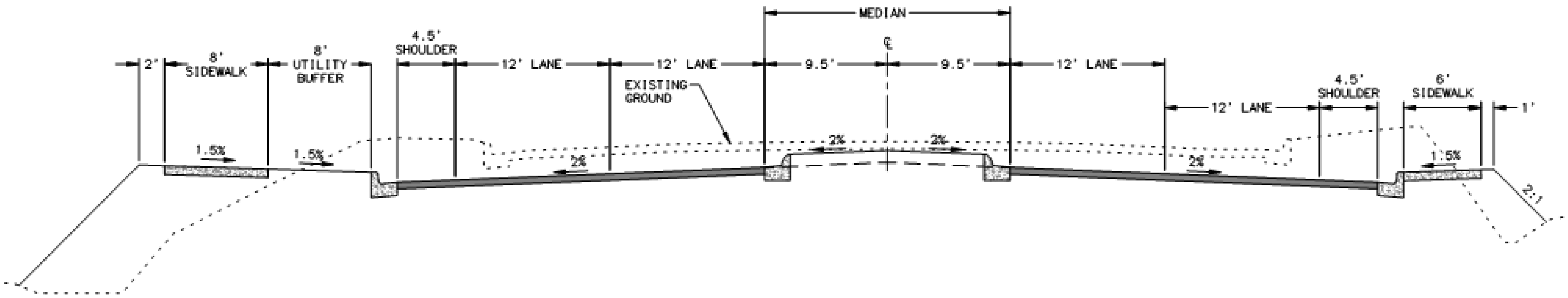

Figure 12: University Avenue Proposed Design Typical Section

5.2.2 Rewak Drive Signalized Intersection

The proposed design configuration of the Rewak Drive intersection with University Avenue is presented in Figure 13.

The Rewak Drive and University Avenue left-turn movements will be phased as protected-permitted (with flashing yellow arrow permitted phase). The University Avenue left-turn lanes are offset to improve sight distance.

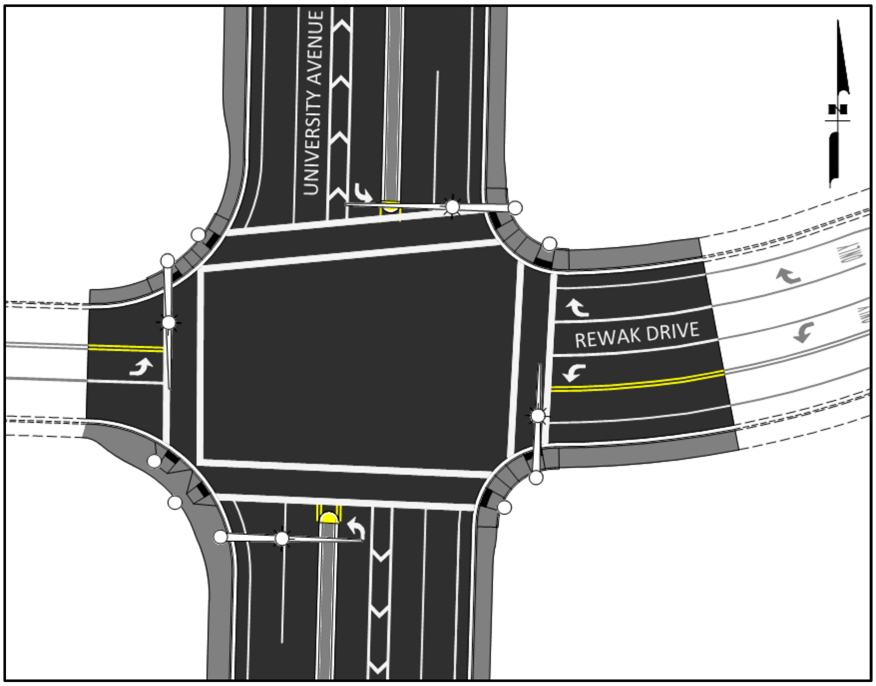

Figure 13: Rewak Drive-University Avenue Recommended Alternative Design

5.2.3 Airport Way Intersection

The proposed design configuration of the Airport Way intersection with University Avenue is presented in Figure 14. The design includes offset left-turn lanes at this intersection to improve sight distance by allowing opposing left-turn vehicles to see past each other at opposing through traffic.

The Airport Way and University Avenue left-turn movements will be phased as protected-permitted (with flashing yellow arrow permitted phase).

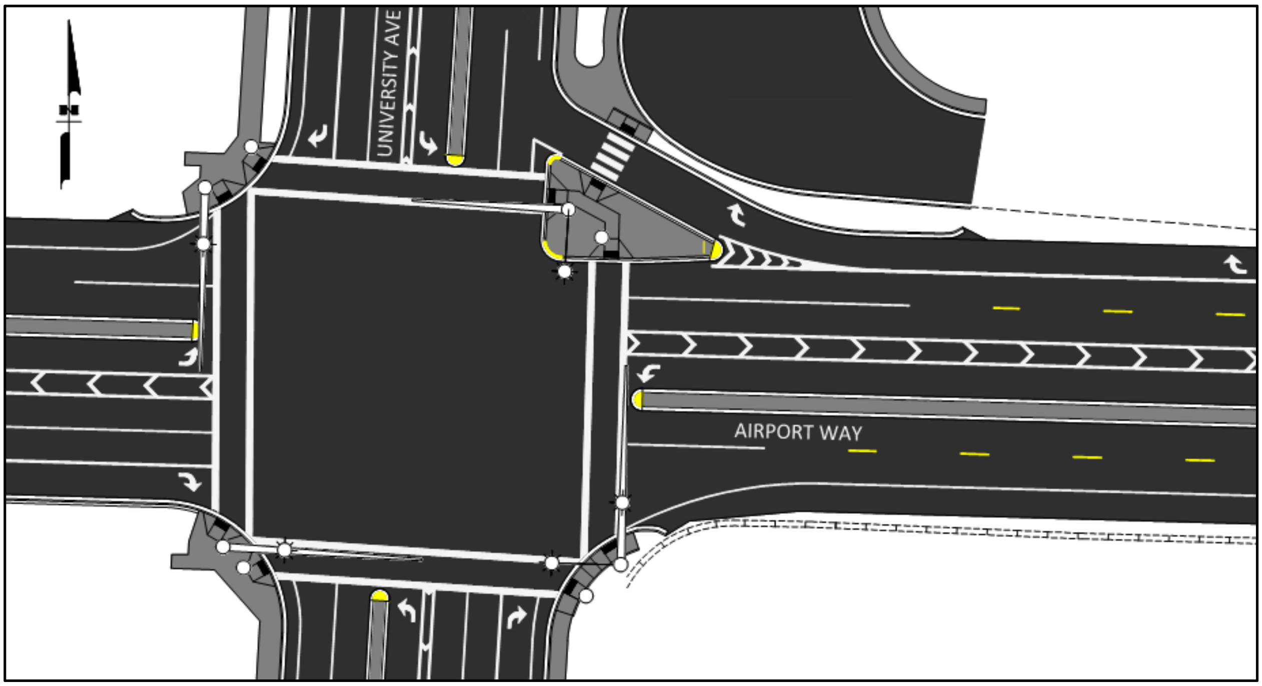

Figure 14: Airport Way-University Avenue Recommended Alternative Design

5.2.4 Geist Road/Johansen Expressway Intersection

The proposed design configuration of the Geist Road/Johansen Expressway intersection with University Avenue is presented in Figure 15. The design includes right-turn channelization for the northbound and westbound traffic. This will improve pedestrian visibility to motorists by placing the crossing paths perpendicular to each other. This will also separate the pedestrian-vehicle interaction from the vehicle-vehicle interactions, by allowing turning vehicles to first encounter and focus on the cross-walk activities before proceeding to focus on roadway operations.

Wolf Run direct access to University Avenue will be closed off due to the close proximity of the intersections. The existing Wolf Run approach is within the Geist Road/Johansen Expressway functional area; the design calls for traffic to be rerouted south and access University Avenue outside the functional area.

The design will also provide dual left-turn only lanes at all approaches of the Geist Road-Johansen Expressway intersection to ease queue length and delay.

The Geist Road/Johansen Expressway and University Avenue left-turn movements will be phased as protected only because of the dual left-turn lane configuration.

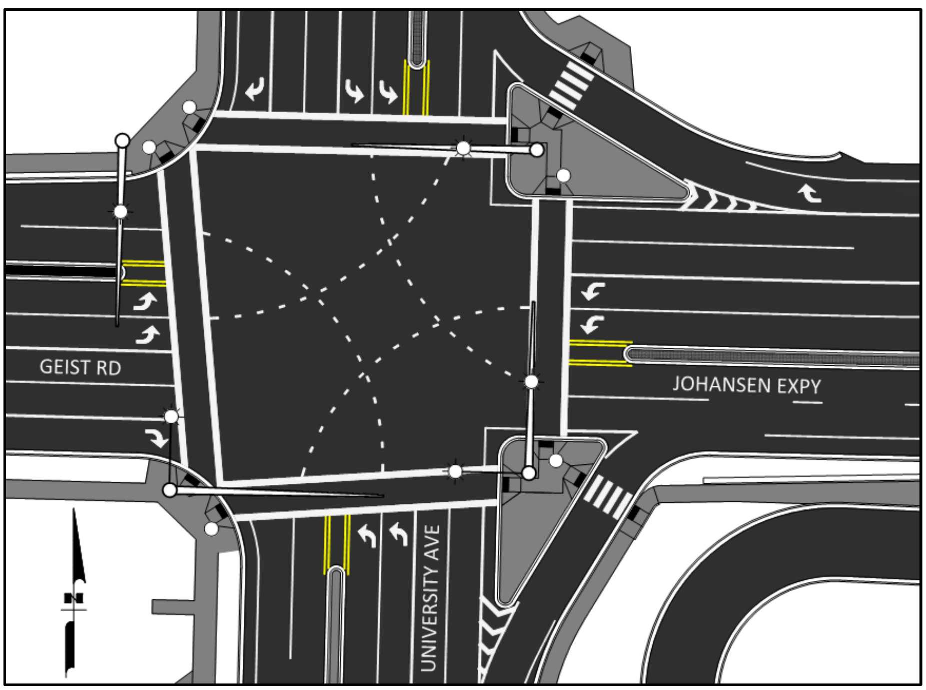

Figure 15: Geist Rd/Johansen Expwy-University Avenue Recommended Alternative Design

5.2.5 Sandvik Street Intersection

The proposed design configuration of the Sandvik Street intersection with University Avenue is presented in Figure 16. This intersection includes a pedestrian hybrid beacon, which is manually activated by pedestrians wishing to cross University Avenue.

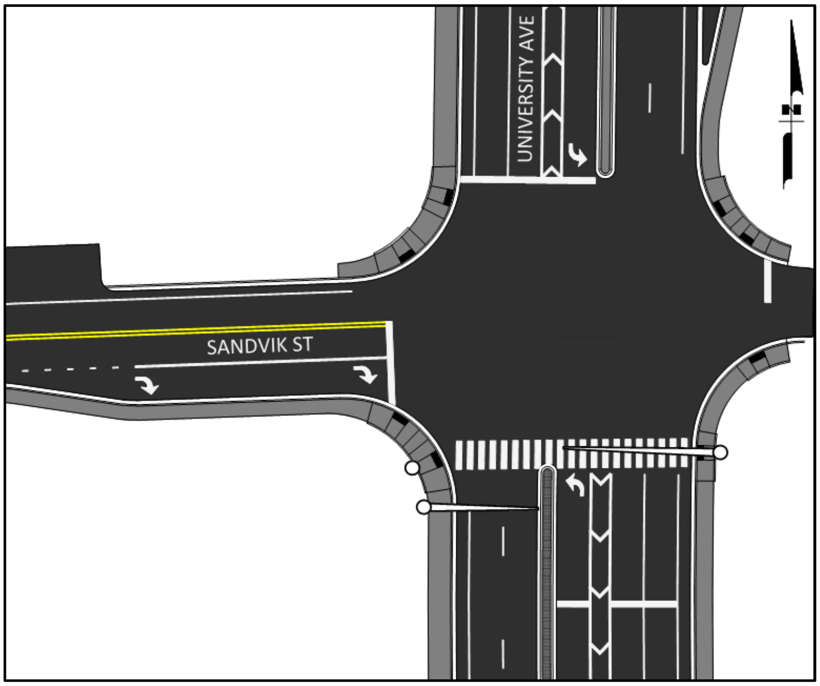

Figure 16: Sandvik Street-University Avenue Recommended Alternative Design

5.3 Crashes

Crashes between 2010 and 2014 on the University Avenue corridor were analyzed to determine crash trends to consider with the design of the project. The analysis indicates that crashes from 2010 to 2014 were consistent to the crashes analyzed from 2003 to 2012.

Potential mitigation measures to reduce the higher than expected crash rate and to improve future intersection operations include:

- Constructing center medians. Left-turn related crashes are eliminated except where median breaks are allowed, by preventing left turns in or out of minor roads and driveways. Center medians also reduce pedestrian conflicts by providing a mid-refuge for pedestrians crossing a busy street. This also improves capacity for the arterial.
- Reducing conflicts within the functional area of a signalized intersection, as described in Appendix D, by limiting driveway and street access. This reduces driver cognitive load, allowing the driver to focus on effectively maneuvering through the intersection. The center median will prevent left-turning conflicts within the functional area. In addition, direct access to/from Wolf Run will be removed, which is currently within the functional area of Geist Road/Johansen Expressway. Instead, traffic from Wolf Run will be diverted south to access University Avenue outside of the queuing traffic at the intersection.

- Installing left-turn lanes to separate decelerating and/or stopped traffic preparing to turn and the through traffic continuing at speed, as appropriate. This improves capacity and reduces all crashes by approximately 30% based on past studies.
- Changing the left-turn phasing for signalized intersections to either flashing yellow arrow or protected only and offsetting left turn lanes that operate under protected-permitted phasing.
- Channelizing right-turn lanes to reduce the pedestrian crossing distance while increasing intersection capacity at Geist Road/Johansen Expressway.

Crash reduction factors (CRFs) corresponding to the proposed design features were applied to applicable crashes to determine the number of crashes that would have been reduced if the proposed design had been in place during the combined study period of 2010 to 2014. CRF values were determined for the following proposed design features: installing center raised medians, installing left-turn lanes, offsetting left-turn lanes, changing left-turn phasing to either protected-only or to flashing yellow arrow, and channelizing right-turn lanes.

The calculations indicate that the proposed design would have reduced approximately 37 to 47 crashes (9-11%) out of the 434 total crashes reported from 2010 to 2014. Table 22 demonstrates the crash reductions that would have been expected if the proposed design feature(s) were present during the study period.

Table 22: Crash Reduction for Proposed Design Features

Segment or Intersection	2010 to 2014 Crash Frequency	Proposed Design Features	Crash Reduction Over Study Period
Mitchell Expressway to Davis Road	0	Center Raised Median	0
Davis Road	15	SB Left-Turn Lane	1 to 2
Davis Road to Rewak Drive (and minor intersections)	16	Center Raised Median, Median Opening with Left Turn Lane at Holden Rd and at Erickson Ave	6 to 7
Rewak Drive	25	Offset Left-Turn Lanes with Flashing Yellow Arrows	3 to 4
Rewak Drive to Airport Way	11	Center Raised Median	1
Airport Way	110	Offset Left-Turn Lanes with Flashing Yellow Arrows	10 to 11
Airport Way to Geraghty Avenue	0	Center Raised Median	0
Geraghty Avenue	12	Center Raised Median (Right-in-right-out only)	0 to 1
Geraghty Avenue to Goldizen Avenue	12	Center Raised Median	0 to 1
Goldizen Avenue	9	Median Opening with Left-Turn Lane	1
Goldizen Avenue to Geist Road/Johansen Expressway (and minor intersections)	44	Center Raised Median, Median Opening with Offset Left-Turn Lane at Indiana Ave	1 to 2
Geist Road/Johansen Expressway	119	All Left Turns Protected-Only Phasing and Channelized Right-Turn Lanes	11 to 12
Geist Road to Sandvik Street	3	Center Raised Median	0 to 1
Sandvik Street	28	Offset Left-Turn Lanes	2 to 3
Sandvik Street to Cameron Street	8	Center Raised Median	1
Cameron Street	5	Median Opening with Left-Turn Lane	0
Cameron Street to Alumni Drive/College Road (and minor intersections)	16	Center Raised Median to Thomas St	0
Total Crash Reduction			**37 to 47**

Crash Experience for University Avenue is discussed under Section 2.5 Crashes, on page 9. The analysis indicates that crash rates for intersections and segments are not abnormally high compared to Statewide population rates. Nevertheless, the proposed intersection and access control improvements will reduce crashes by about 10%.

5.4 Capacity Analyses of Proposed Design

Using the forecasted 2040 volumes, the future performances for the proposed University Avenue design was modeled.

5.4.1 Proposed Design Intersection 2040 LOS

Table 23 and Table 24 presents the results for each movement at the signalized and unsignalized intersections, respectively in the 2040 build scenario: volume to capacity ratio (v/c), 95th percentile queue length, control delay, and the LOS.

Table 23: 2040 PM Build Signalized Intersection LOS

Intersection	Approach	Control	Movement	PM Peak V/C Ratio	PM Peak Queue Length (ft.)	PM Peak Control Delay (sec/veh)	PM Peak LOS	Approach LOS	Intersection LOS
Rewak Drive	Eastbound	Signal	Left	0.88	368	72.1	E	E	C
			Thru + Right	0.27	126	42.3	D		
	Westbound	Signal	Left	0.67	225	52.5	D	D	
			Thru	0.09	55	39.9	D		
			Right	0.09	44	39.9	D		
	Northbound	Signal	Left	0.34	113	19.4	B	B	
			Thru + Right	0.30	217	17.7	B		
	Southbound	Signal	Left	0.35	55	9.8	A	A	
			Thru + Right	0.32	132	10.0	B		
Airport Way	Eastbound	Signal	Left	0.85	384	45.3	D	D	D
			Thru	0.37	218	40.7	D		
			Right	0.11	56	36.7	D		
	Westbound	Signal	Left	0.60	230	29.6	C	D	
			Thru	0.62	305	55.4	E		
		Yield	Right	0.31	33	13.5	B		
	Northbound	Signal	Left	0.62	133	27.0	C	D	
			Thru	0.58	290	46.0	D		
			Right	0.29	90	57.8	E		
	Southbound	Signal	Left	0.75	234	43.0	D	D	
			Thru	0.58	355	36.7	D		
			Right	0.16	35	29.6	C		

<table>
<tr><th rowspan="2">Intersection</th><th rowspan="2">Approach</th><th rowspan="2">Control</th><th rowspan="2">Movement</th><th colspan="4">PM Peak</th><th rowspan="2">Approach LOS</th><th rowspan="2">Intersection LOS</th></tr>
<tr><th>V/C Ratio</th><th>Queue Length (ft.)</th><th>Control Delay (sec/veh)</th><th>LOS</th></tr>
<tr><td rowspan="12">Geist Road - Johansen Expwy</td><td rowspan="3">Eastbound</td><td rowspan="3">Signal</td><td>Left</td><td>0.67</td><td>125</td><td>73.1</td><td>E</td><td rowspan="3">D</td><td rowspan="12">D</td></tr>
<tr><td>Thru</td><td>0.42</td><td>273</td><td>36.9</td><td>D</td></tr>
<tr><td>Right</td><td>0.22</td><td>75</td><td>34.1</td><td>C</td></tr>
<tr><td rowspan="3">Westbound</td><td rowspan="2">Signal</td><td>Left</td><td>0.67</td><td>150</td><td>69.7</td><td>E</td><td rowspan="3">D</td></tr>
<tr><td>Thru</td><td>0.56</td><td>387</td><td>37.6</td><td>D</td></tr>
<tr><td>Yield</td><td>Right</td><td>0.85</td><td>236</td><td>33.8</td><td>D</td></tr>
<tr><td rowspan="3">Northbound</td><td rowspan="2">Signal</td><td>Left</td><td>0.71</td><td>165</td><td>60.9</td><td>E</td><td rowspan="3">D</td></tr>
<tr><td>Thru</td><td>0.86</td><td>379</td><td>55.9</td><td>E</td></tr>
<tr><td>Yield</td><td>Right</td><td>0.48</td><td>66</td><td>17.4</td><td>C</td></tr>
<tr><td rowspan="3">Southbound</td><td rowspan="3">Signal</td><td>Left</td><td>0.86</td><td>222</td><td>44.7</td><td>D</td><td rowspan="3">C</td></tr>
<tr><td>Thru</td><td>0.48</td><td>99</td><td>23.7</td><td>C</td></tr>
<tr><td>Right</td><td>0.10</td><td>0</td><td>5.1</td><td>A</td></tr>
</table>

Table 24: 2040 PM Build Unsignalized Intersection LOS

Intersection	Approach	Control	Movement	PM Peak				Approach LOS
				V/C Ratio	Queue Length (ft.)	Control Delay (sec/veh)	LOS	
Davis Road	Westbound	Stop	Left	1.03	147	196.2	F	F
			Right	0.53	78	15.9	C	
	Southbound	Yield	Left	0.32	34	9.9	A	-
Holden Road	Westbound	Stop	Left + Right	0.94	202	91.2	F	F
	Southbound	Yield	Left	0.03	2	9.4	A	-
19th Avenue	Westbound	Stop	Right	0.13	11	12.8	B	B
Swenson Avenue	Eastbound	Stop	Right	0.19	18	13.4	B	B
Erickson Avenue	Eastbound	Stop	Left + Thru + Right	0.53	66	53.5	F	F
	Westbound	Stop	Left + Thru + Right	4.33	>515	>760	F	F
	Northbound	Yield	Left	0.07	6	9.2	A	-
	Southbound	Yield	Left	0.25	25	10.7	B	-
Fred Meyer-Safeway D/W	Eastbound	Yield	Right	0.15	13	10.1	B	B
	Westbound	Stop	Right	0.66	122	22.2	C	C
Geraghty Avenue	Westbound	Stop	Right	0.22	21	13.4	B	B
Sportsman Way	Eastbound	Stop	Right	0.23	22	17.9	C	C
Goldizen Avenue	Eastbound	Stop	Left + Thru + Right	4.80	>515	>760	F	F
	Westbound	Stop	Left + Thru + Right	3.85	>515	>760	F	F
	Northbound	Yield	Left	0.05	4	11.4	B	-
	Southbound	Yield	Left	0.05	4	11.3	B	-
Widener Lane	Westbound	Stop	Right	0.12	11	15.7	C	C

Intersection	Approach	Control	Movement	PM Peak				Approach LOS
				V/C Ratio	Queue Length (ft.)	Control Delay (sec/veh)	LOS	
Indiana Avenue	Eastbound	Stop	Left + Thru + Right	0.35	35	46.2	E	E
	Westbound	Stop	Left + Thru + Right	1.92	301	562.8	F	F
	Northbound	Yield	Left	0.01	1	10.0	B	-
	Southbound	Yield	Left	0.04	3	12.0	B	-
Sandvik Street	Eastbound	Stop	Left + Thru	2.06	186	758.6	F	F
	Westbound	Stop	Left + Thru + Right	1.28	107	470.1	F	F
	Northbound	Yield	Left	0.04	3	11.7	B	-
	Southbound	Yield	Left	0.07	5	12.8	B	-
Cameron Street	Westbound	Stop	Left + Thru + Right	0.91	104	202.2	F	F
	Southbound	Yield	Left	0.05	4	13.4	B	-
Thomas Street	Westbound	Stop	Left + Right	1.53	221	404.0	F	F
	Southbound	Yield	Left	0.09	8	2.9	A	-

5.4.2 Proposed Design Arterial 2040 LOS

As shown in Table 25 and Table 26, the overall arterial LOS will be C in the northbound and southbound directions, which is an acceptable LOS per current design standards. This is an improvement from 2040 LOS if upgrades to University Avenue are not completed.

Table 25: 2040 PM Build University Avenue Arterial LOS – Northbound

Northbound							
Cross Street	Flow Speed (mph)	Running Time (sec)	Signal Delay (sec)	Travel Time (sec)	Distance (mi)	Arterial Speed (mph)	Arterial LOS
Mitchell Expwy							
Rewak Drive*	40	85.8	64.2	150.0	0.9	21.8	D
Airport Way							
	40	77.2	58.3	135.5	0.86	22.8	C
Geist Rd - Johansen Expwy							
	40	42.9	29.6	72.5	0.45	22.4	C
College Road							
Total		205.9	152.1	358.0	2.2	22.3	C

* Due to the extremely short distance between Rewak Drive and Airport Way, the arterial LOS for the Mitchell Expwy to Airport Way is presented. This is more representative of arterial flow conditions.

Table 26: 2040 PM Build University Avenue Arterial LOS – Southbound

Southbound							
Cross Street	Flow Speed (mph)	Running Time (sec)	Signal Delay (sec)	Travel Time (sec)	Distance (mi)	Arterial Speed (mph)	Arterial LOS
College Road							
	40	42.9	24.4	67.3	0.45	24.2	C
Geist Rd - Johansen Expwy							
	40	77.2	37.2	114.4	0.86	27	C
Airport Way							
Rewak Drive*	40	85.8	43.8	129.6	0.91	25.3	C
Mitchell Expwy							
Total		205.9	105.4	311.3	2.2	25.7	C

* Due to the extremely short distance between Rewak Drive and Airport Way, the arterial LOS for the Mitchell Expwy to Airport Way is presented. This is more representative of arterial flow conditions.

5.5 Pedestrians and Bicycles

The right-turn channelization islands proposed at the Airport Way/University Avenue and Geist Road-Johansen Expressway/University Avenue intersection will allow for safer non-motorized crossing at this location. Right-turn islands shorten crossing lengths and pedestrian exposure to traffic.

As in the 2040 No-Build alternative, at unsignalized intersections and mid-block crossings, pedestrians can continue to expect increased waiting times for road crossing opportunities in the 2040 Recommended Alternative PM peak hour. The roadway will be widened to accommodate increasing traffic volumes, which also increases the distance a pedestrian must take to get across the street. At mid-block locations, however, the center raised median may provide pedestrian refuge and allow for a two-stage crossing maneuver, thus significantly reducing the crossing distance. Pedestrians will also be able to focus on one direction of traffic at a time while awaiting acceptable gaps.

The existing pedestrian overpass near the University Avenue and Sandvik Street intersection is proposed to be removed with this project. A pedestrian hybrid beacon (PHB) is proposed to replace the overpass to reduce the pedestrian delay at Sandvik Street.

5.6 Transit

Transit routes utilize University Avenue with various movements. Table 27 compares the recommended alternative design bus movements LOS with the existing bus movements LOS. Bold LOS values indicate 2040 LOS the same or better than existing LOS.

Table 27: 2040 Recommended Alternative Design MACS LOS

MACS Line	Intersection with University Avenue	Movement	2040 Proposed Design		Existing	
			Delay (sec/veh)	Movement LOS	Delay (sec/veh)	Movement LOS
Blue	Airport Way	SB Thru	37	**D**	89	F
Blue	Fred Meyer D/W	SB Right	0	**A**	0	A
Blue	Geist Road	EB Left	73	E	34	C
Blue	Rewak Drive	EB Thru	42	**D**	51	D
Orange	Airport Way	NB Left	27	**C**	77	E
Orange	Davis Road	SB Left	10	**A**	6	A
Orange	Rewak Drive	EB Right	42	**D**	51	D
Orange	Rewak Drive	NB Thru	18	**B**	10	B
Red	Airport Way	EB Left	45	D	29	C
Red	Rewak Drive	WB Thru	40	**D**	49	D
Yellow	Airport Way	NB Left	27	**C**	77	E
Yellow	Airport Way	EB Left	45	D	29	C
Yellow	Fred Meyer D/W	SB Right	0	**A**	0	A
Yellow	Geist Road	SB Thru	24	**C**	60	E
Yellow	Geist Road	NB Thru	56	**E**	56	E
Yellow	Rewak Drive	EB Left	72	**E**	63	E

5.7 Auxiliary Turn Lane Lengths

The turn-lane lengths were calculated using *NCHRP Report 279: Intersection Channelization Design Guide*. The turn-lane lengths are based on 95th percentile queues and, if approaching speeds exceed 35 mph, deceleration. At some locations, turn-lane lengths are adjusted from the recommended based on geometry of the road or project limitations. Table 28 presents the recommended turn-lane lengths. Bold values indicate locations where the current design turn-lane length is shorter than the recommended turn-lane length derived from this analysis.

Table 28: Recommended Turn-Lane Lengths

Intersection	Auxiliary Lane Movement	Adjacent Lane Queue Length (ft.)	Desired Auxiliary Lane Length (ft.)	As designed Auxiliary Lane Length (ft.)	Comments
Davis Road	SB Left Turn	0	300	415	Previous summary report listed 375'. Could shorten lane to 300' if needed.
	WB Left Turn	82	200	**75**	Based on adjacent lane queue length, current design is acceptable.
	WB Right Turn	89	175	**75**	Based on adjacent lane queue length, current design is acceptable
Holden Road	SB Left Turn	0	250	100	Length is limited by fire station D/W north of intersection.
University Avenue / Erickson Avenue	NB Left Turn	0	275	**100**	No previous recommendations were given on this intersection. Based on design speed, consider lengthening the left-turn lane if ROW and utility impacts allow.
	SB Left Turn	0	275	130	Length is limited by Rewak Dr. NB left-turn lane.
University Avenue / Rewak Drive	NB Left Turn	217	375	370	Previous summary report listed 275'. Current design is ok.
	SB Left Turn	132	325	215	Previous summary report listed 150'. Length is limited by Airport Way NB left-turn lane.

Intersection	Auxiliary Lane Movement	Adjacent Lane Queue Length (ft.)	Desired Auxiliary Lane Length (ft.)	As designed Auxiliary Lane Length (ft.)	Comments
University Avenue / Airport Way	NB Left Turn	290	400	360	Previous summary report listed 350’. Length is limited by Rewak Dr. SB left-turn lane
	NB Right Turn	290	350	215	Previous summary report listed 325’. Length is limited by Carrs D/W
	SB Left Turn	355	500	**429**	Previous summary report listed 500’. Current design length is longer than the minimum length and adjacent lane queue length of 355’ but shorter than desirable length. If project limits are not constraining the length, consider lengthening the left-turn lane if ROW and utility impacts allow.
	SB Right Turn	355	350	**295**	Previous summary report listed 325’. Current design length is longer than the minimum but could get blocked by the adjacent lane queue length. Consider lengthening the right-turn lane if ROW and utility impacts allow.
	WB Left Turn	305	500	579	Previous summary report listed 500’. Could shorten lane to 500’ if needed.
	WB Right Turn	305	325	395	Previous summary report listed 475’. Could shorten lane to 325’ if needed.
	EB Left-Turn	218	650	730	Previous summary report listed 575’. Could shorten lane to 650’ if needed.
	EB Right Turn	218	325	425	Previous summary report listed 375’. Could shorten lane to 325’ if needed.
University Avenue / Goldizen Avenue	NB Left Turn	0	250	130	Length is limited by bridge.
	SB Left Turn	0	250	285	

Intersection	Auxiliary Lane Movement	Adjacent Lane Queue Length (ft.)	Desired Auxiliary Lane Length (ft.)	As designed Auxiliary Lane Length (ft.)	Comments
University Avenue / Indiana Avenue	NB Left Turn	0	250	**150**	No previous recommendations were given on this intersection. Based on design speed, consider lengthening the left-turn lane if ROW and utility impacts allow.
	SB Left Turn	0	250	175	Length is limited by NB Geist Rd left-turn lane.
University Avenue / Johansen Expwy	Dual NB Left Turn	379	425	435	Previous summary report listed 375'. Current design length is ok.
	NB Right Turn	379	375	285	Previous summary report listed 400'. Length is limited by ROW.
	Dual SB Left Turn	99	475	**400**	Previous summary report listed 400'. Current design length is longer than the minimum length and adjacent lane queue length of 99' but shorter than desirable length. Lane is near end of the project. Current design length is acceptable.
	Dual WB Left Turn	387	400	410	Previous summary report listed 400'. Current design length is ok.
	WB Right Turn	387	450	511	Previous summary report listed 450'. Could shorten to 450' if needed.
	Dual EB Left-Turn	273	375	280	Previous summary report listed 450' Length is limited by Wilcox Ave WB left-turn lane.
	EB Right Turn	273	325	245	Previous summary report listed 400'. Length is limited by Ginko Rd D/W.
University Avenue / Sandvik Street	NB Left Turn	0	250	225	Previous summary report listed 100'. Length is limited by Geist Rd SB left-turn lane.
	SB Left Turn	0	275	324	Previous summary report listed 250'. Could shorten lane to 275' if needed.
Cameron Street	SB Left Turn	0	250	120	Length is limited by Thomas St median break.

All driveways and minor roads within the functional areas of the signalized intersections have other access points outside of the functional area except Dead End Alley north of Geist Road/Johansen Expressway. Vehicles wishing to make a left turn from Dead End Alley onto

University Avenue will be required to turn right onto University Avenue and then use other roads for redirection. Vehicles traveling south on University Avenue wishing to turn left onto Dead End Alley would be required to make a U-turn maneuver at Geist Road/Johansen Expressway then continue to Dead End Alley for a right-in movement.

5.8 Signal Warrants

MUTCD offers methods for determining if existing conditions through 5 years out warrant new signals. For future design year signal warrants, CalTrans methodologies are utilized. Existing unsignalized intersections along University Avenue were analyzed for signal warrants in the 2040 design year using the CalTrans methods based on future traffic volumes. Table 29 presents the results of the future signal warrant analysis.

Table 29: 2040 CalTrans Signal Warrants

Intersection	Approach	Cal Trans Warrants									
		Warrant 1 – Min Volume			Warrant 2 - Interruption of Continuous Traffic			Warrant 3 - Combination			
		Criteria	Value	Met?	Criteria	Value	Met?	Criteria 2	Criteria 1	Value	Met?
Davis Road	Major Road	6,720	10,000	No	10,080	10,000	No	5,376	8,064	10,000	No
	Minor Road	1,680	544		850	544		1,344	680	544	
Erickson Road	N/A. DOT&PF does not have AADT values for Erickson; therefore, future values cannot be estimated.										
Geraghty Avenue	Major Road	6,720	21,375	No	10,080	21,375	No	5,376	8,064	21,375	No
	Minor Road	1,680	200		850	200		1,344	680	200	
Sandvik Street	Major Road	9,600	21,000	No	14,400	21,000	No	7,680	11,520	21,000	No
	Minor Road	2,400	350		1,200	350		1,920	960	350	
Cameron Street	N/A. DOT&PF does not have AADT values for Erickson; therefore, future values cannot be estimated.										

6 References

- *FMATS Non-Motorized Transportation Plan*, Fairbanks Metropolitan Area Transportation System, March 2012.
- *FMATS Bike and Pedestrian Counts*, Fairbanks Metropolitan Area Transportation System, 2011-2017 < http://fmats.us/fmats-bike-and-pedestrian-counts/>
- *A Policy on Geometric Design of Streets and Highways*, American Association of State Highway and Transportation Officials, 2011.
- *Fairbanks Metro 2040*, Fairbanks Metropolitan Area Transportation System, January 2015.
- *NCHRP Report 765: Highway Analytical Travel Forecasting Approaches for Project-Level Planning and Design: Traffic Data for Urbanized Area Project Planning and Design*, Pederson and Samdahl; Transportation Research Board, 2014.
- *Northern Region Annual Traffic Report*, DOT&PF, Volumes for 2004 to 2014.
- *NCHRP Report 457 – Evaluating Intersection Improvements: An Engineering Study Guide*, Bonneson and Fontaine; Transportation Research Board, 2001

Appendix A Design Designations

University Avenue Rehabilitation & Widening – Traffic Study

IRIS Program No. Z632130000
Federal Project No. 063213

Design Designations Report

November 2017

Prepared for
Alaska Department of Transportation and Public Facilities

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Table of Contents

Tables

Figures

ACRONYMS AND ABBREVIATIONS

The following table presents acronyms and abbreviations used throughout this document.

AASHTO	American Association of State Highway and Transportation Officials
ADT, AADT	Average Daily Traffic, Annual Average Daily Traffic
CCS	Continuous Counting Station
CV%	Commercial Vehicle Percentage
DD%	Directional Distribution Percentage
DHV	Design Hourly Volume
DOT&PF	Alaska Department of Transportation and Public Facilities
D/W	Driveway
ESAL	Equivalent Single Axle Load
FHWA	Federal Highway Administration
FMATS	Fairbanks Metropolitan Area Transportation System
GDHS	Policy on the Geometric Design of Highways and Streets
HV%	Heavy Vehicle Percentage
ITE	Institute of Transportation Engineers
KE	Kinney Engineering, LLC
NCHRP	National Cooperative Highway Research Program
PHF	Peak Hour Factor
RV%	Recreational Vehicle Percentage
TMV	Turning Movement Volume
VMT	Vehicle miles traveled
vpd	Vehicles per day

1. INTRODUCTION

The University Avenue Rehabilitation & Widening project will reconstruct University Avenue from the Mitchell Expressway to Thomas Street. Design designations were originally completed in 2006 for the project, with an expected construction year of 2015 and a design year of 2035. The project now has a new expected construction year of 2018 and a design year of 2040. Traffic data was collected in August and September 2017 for the purpose of updating the design designations to the current design year.

2. SEGMENT LIMITS

The 2006 design designations were published as a single segment of University Avenue between Mitchell Expressway and Thomas Street. In analyzing the existing and design year Average Annual Daily Traffic volumes (AADT), there are significant differences in traffic volume between the south and north legs of multiple intersections along University Avenue. Therefore, the 2017 design designations are divided in to four segments as indicated in Table 1.

Table 1: Project Segment Identifications

Segment No.	Segment Limits
1	Mitchell Expressway to Davis Road
2	Davis Road to Rewak Drive
3	Rewak Drive to Geist Road/Johansen Expwy
4	Geist Road/Johansen Expwy to Thomas Street

3. DESIGN FUNCTIONAL CLASSIFICATION & AREA TYPE

The project study area is within the city limits of Fairbanks. The city of Fairbanks has a population of well over 5,000 (Alaska Department of Commerce, Community, and Economic Development, Community and Regional Affairs reports 31,535 in 2010; currently around 32,000 as reported by numerous sources); therefore, roads within the boundaries of Fairbanks meet the urban areas defined by AASHTO for design.

The Alaska Department of Transportation and Public Facilities (DOT&PF) classifies roadways within their system on the webpage:

http://www.dot.alaska.gov/stwdplng/fclass/fclassmaps.shtml

The following table identifies the Functional Classifications for each segment.

Table 2: Project Segment Functional Classifications

Segment	Area Type	DOT&PF Functional Classification
Mitchell Expressway to Davis Road	Urban	Principal Arterial-Other
Davis Road to Rewak Drive	Urban	Principal Arterial-Other
Rewak Drive to Geist Road/Johansen Expwy	Urban	Principal Arterial-Other
Geist Road/Johansen Expwy to Thomas Street	Urban	Principal Arterial-Other

4. Construction Type

The project consists of roadway widening, replacing the Chena River Bridge No. 263, constructing continuous sidewalks, and intersection improvements. As such, the project design designations and design criteria are under the New Construction/Reconstruction category.

5. Project Design Life

The project design life is 20 years. The "Existing" or base year is 2017. For this analysis, the construction year will be 2018, the mid-life year will be 2030, and the design year will be 2040.

6. Design Volumes

The following section will discuss the results of the AADT and turning movement volumes (TMV) analysis for the project.

Annual Average Daily Traffic Volumes

Base Year: Traffic counts were taken using radar automatic traffic data collectors at two locations on University Avenue, near Davis Road and at the Chena River Bridge, during August and September 2017. The traffic counts were analyzed and normalized to 2017 AADT using DOT&PF's adjustment factors for nearby continuous counting stations (CCSs). These AADT values were used for University Avenue between Davis and the Chena River Bridge. AADT values for the remaining sections, within the project area of University Avenue, were factored based on a historical traffic volume comparison between the segments. Appendix A details the development of the 2017 AADT values.

Design Year: The design year volumes were generated using the Fairbanks Metropolitan Area Transportation System (FMATS) 2040 traffic demand model. The 2040 model volumes were post-processed using recent traffic counts and the methodology presented in the NCHRP 765: *Analytical Travel Forecasting Approaches for Project-Level Planning and Design*.

The 2040 FMATS traffic demand model uses a model base year of 2013 to project 2040 traffic volumes throughout the Fairbanks area. The Northern Region DOT&PF Annual Traffic Volume Report was referenced to identify actual recorded 2013 AADT values. These recorded values were compared to the 2013 base model values. The 2040 model values were adjusted based on the 2013 model vs DOT&PF comparison. In addition, the 2017 traffic data was included in the calibration process. The figure below illustrates the AADT value comparisons. In general, the FMATS 2040 traffic demand model projected higher AADT values than the traffic trends from recent history.

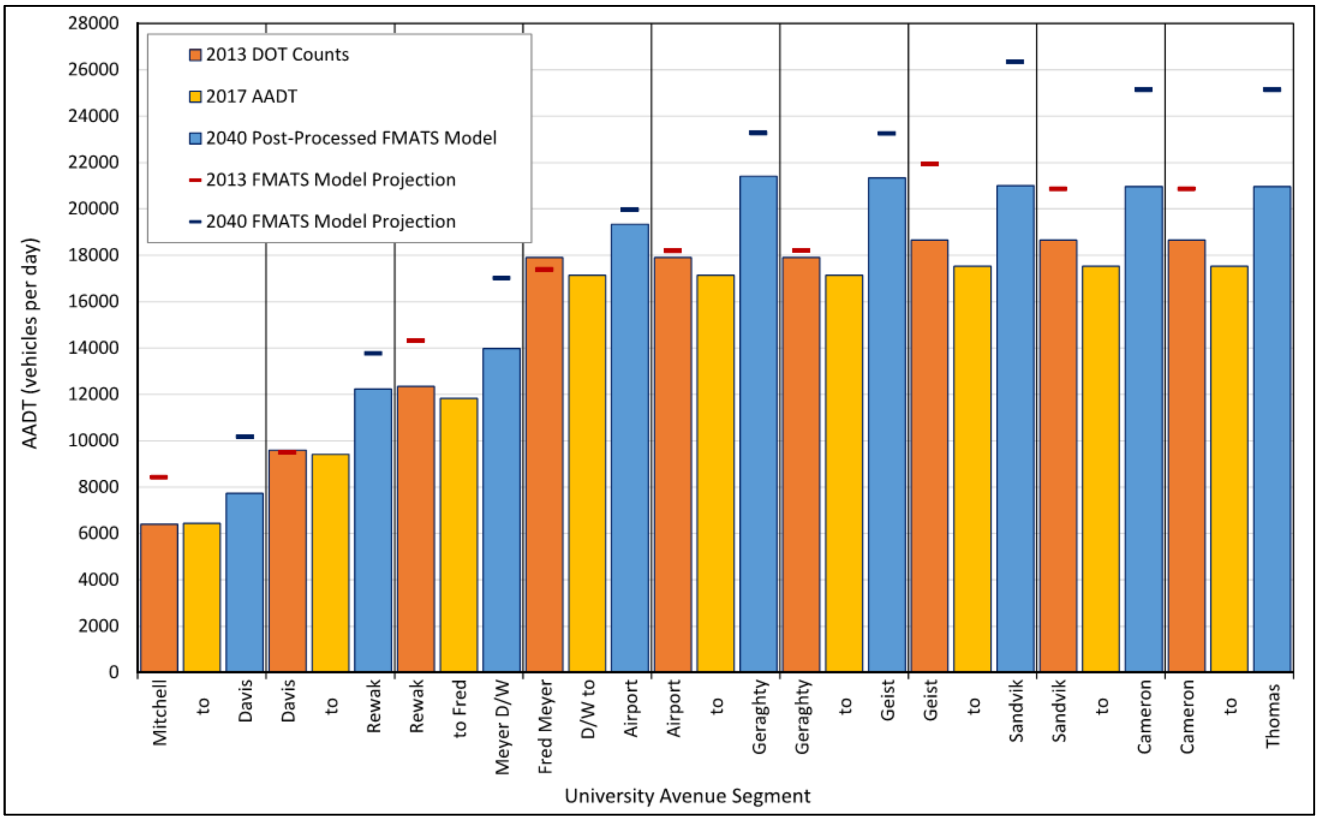

Figure 1: 2040 FMATS Model AADT Value Comparison

<u>Mid-Year:</u> The mid-year volumes were derived by applying compound growth rates, which were determined from the base year and design year AADT volumes.

In order to appropriately segment University Avenue, AADT for the existing, mid, and design years were examined. Traffic count data was captured in August and September 2017 to determine existing AADT along University Avenue. Post-processed FMATS 2040 traffic demand model was used to determine design year AADT values. Mid-year AADT values were also derived from the 2040 FMATS traffic demand model, by applying the calculated compounded growth rate between the model's post-processed 2017 and 2040 values to the year 2030. University Avenue from Mitchell Expressway to Thomas Street was then segmented based on similar link AADT values, with DOT&PF's published segments being the base for this design designations' segment limits. The link AADT values were converted to vehicle miles traveled (VMT) and then divided by the segment length to determine the segment AADT. Table 3 summarizes the segment AADT values:

Table 3: Segment AADT Basis

FMATS Link	LENGTH (mi)	2017 (Based on traffic data collection)				2030 (Based on refined FMATS 2040 model)				2040 (Based on refined FMATS 2040 model)			
		AADT	% difference from previous segment	VMT	Equal AADT	AADT	% difference from previous segment	VMT	Equal AADT	AADT	% difference from previous segment	VMT	Equal AADT
Mitchell to Davis	0.25	6,445		1,611	6,445	7,396		1849	7,396	7,734		1934	7,734
Davis to Rewak	0.52	9,416	46%	4,896	9,416	11,217	52%	5833	11,217	12,227	58%	6358	12,227
Rewak to Fred Meyer D/W	0.07	11,829	26%	828	16,767	12,222	9%	856	18,983	13,977	14%	978	20,676
Fred Meyer D/W to Airport	0.07	17,143	45%	1,200		17,268	41%	1209		19,333	38%	1353	
Airport to Geraghty	0.06	17,143	0%	1,029		18,541	7%	1112		21,411	11%	1285	
Geraghty to Geist	0.79	17,143	0%	13,543		19,768	7%	15617		21,333	0%	16853	
Geist to Sandvik	0.17	17,523	2%	2,979	17,523	21,003	6%	3571	20,520	21,006	-2%	3571	20,986
Sandvik to Cameron	0.14	17,523	0%	2,453		20,278	-3%	2839		20,969	0%	2936	
Cameron to Thomas	0.07	17,523	0%	1,227		19,831	-2%	1388		20,969	0%	1468	

The design volume AADTs for University Avenue are presented in the following table:

Table 4: Projected AADT Design Volumes: University Avenue

University Avenue Road Segment	Year		
	2017	2030	2040
Mitchell Expressway to Davis Road	6,500	7,500	7,750
Davis Road to Rewak Drive	9,500	11,250	12,250
Rewak Drive to Geist Road/Johansen Expwy	16,750	19,000	20,750
Geist Road/Johansen Expwy to Thomas Street	17,500	20,500	21,000

The 2006 design designations projected the 2035 AADT to be 28,080 for University Avenue from Mitchell Expressway to Thomas Street. This is significantly higher than the projected 2040 AADTs computed from this 2017 design designation. The 2006 design designations based the AADT from the 2005-2025 FMATS Long Range Transportation Plan, which included a higher growth rate between 2005 and 2025 than what has actually occurred. Furthermore, in general, recent AADT values for University Avenue have been lower than the 2006 AADT values.

Turning Movement Volumes

Existing intersection PM Peak TMV were derived from past DOT&PF turning movement counts (TMC) at various intersections along University Avenue. Each intersection count was taken on a specific day between 2012 and 2017. Because the TMCs were taken at different years, they were factored to represent current 2017 existing data. If the TMC-year AADT value for the intersection was higher than the 2017 AADT value (calculated from 2017 traffic data by KE), the TMC values were used as 2017 counts. If the TMC-year AADT value for the intersection was less than the 2017 AADT value, the TMC values were adjusted by the percent difference between the TMC-year AADT and the 2017 AADT. In all but one intersection, the TMC-year AADT was more than the 2017 AADT; and therefore, the DOT&PF TMC data was used as the 2017 TMC values. Table 5 is a summary of the DOT&PF TMC adjustments:

Table 5: DOT&PF TMC Adjustment Summary

Intersection with University Avenue	Date of DOT TMC	Year AADT Percent Difference*	Adjustment to 2017 TMC
Mitchell Expressway	4-25-2017	0%	None
Davis Road	5-17-2012	4%	4%
Rewak Drive	9-8-2016	0%	None
Airport Way	6-1-2016	-2%	None
Geraghty Avenue	5-31-2012	-13%	None
Geist Road / Johansen Expressway	6-16-2015	-2%	None
Sandvik Street	9-1-2015	0%	None
Cameron Street	4-25-2012	-16%	None
Thomas Street	4-25-2012	-16%	None

* Percent difference between the 2017 AADT based on KE traffic count data and the DOT&PF published AADT for the year of TMC.

Future intersection PM Peak TMVs were calculated using the methodology found in NCHRP Report 765 to predict future intersection peak hour movements based on AADT projections for the approach roads, design hour volume percentages of AADT, and expected turning movement proportions. As shown in the Directional Distribution Percent section, traffic volumes generally increase throughout the day until the PM peak hour then quickly drop off. Because of this, PM peak hour was determined to be the controlling time; AM and noon peak hours are relatively insignificant and were not analyzed further.

Figures 2 and 3 depict the 2017, 2030, and 2040 projected PM peak hour turning movement volumes.

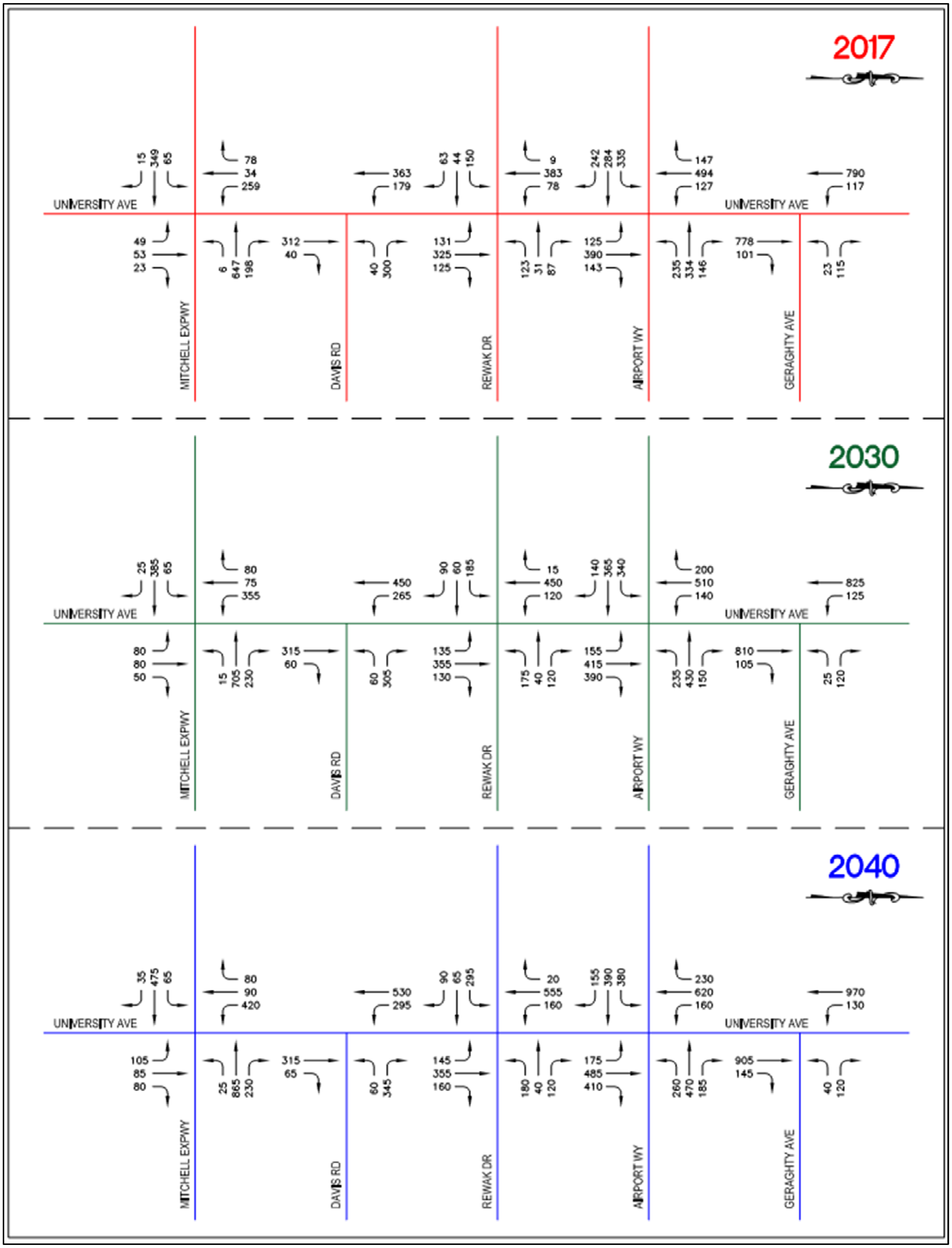

Figure 2: University Avenue PM Peak Turning Movement Volumes – Mitchell Expwy to Geraghty Ave

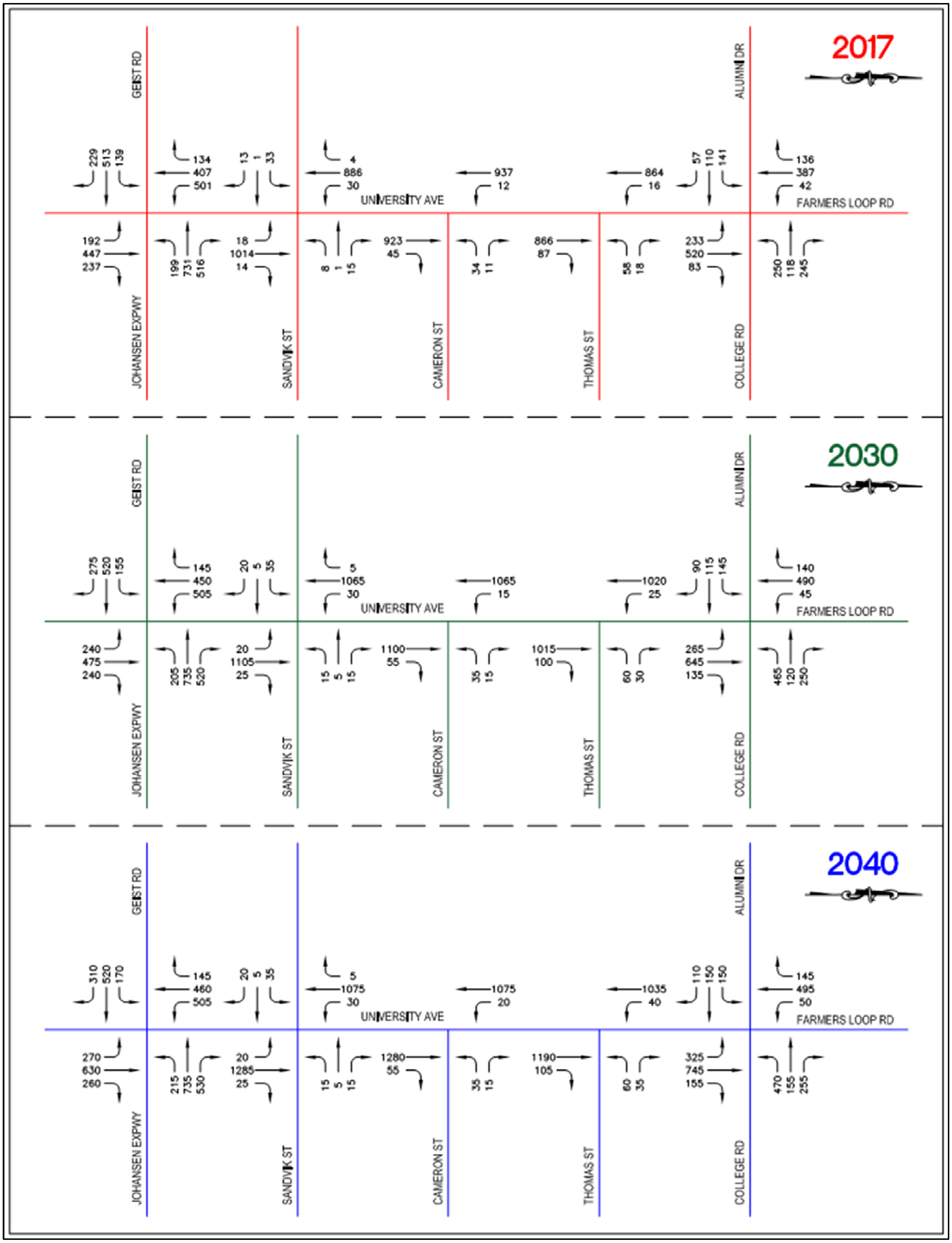

Figure 3: University Avenue PM Peak Turning Movement Volumes – Geraghty Ave to College Rd

7. Design Hour Volume Percentage

The design hour volume (DHV) percentage represents an approximate peak hour volume for design which is typically the 30^{th} highest hour for the design year.

The DHV percentage calculated from the 2017 traffic data for University Avenue was 9%. For this calculation, the peak hour traffic volume was compared to the total day traffic. The CCS at the Chena River Bridge on University Avenue indicates the 30^{th} highest hourly volume has been about 10% of the yearly AADT since at least 2010. The previous design designations for this project included a DHV of 10%. Therefore, it is more reasonable to use a DHV percentage of 10% for this analysis.

Table 6: Design Hour Volume Percentages

Segment	DHV Percentage
Mitchell Expressway to Davis Road	10%
Davis Road to Rewak Drive	10%
Rewak Drive to Geist Road/Johansen Expwy	10%
Geist Road/Johansen Expwy to Thomas Street	10%

8. Peak Hour Factors

Peak hour factors (PHFs) are used to convert volumes to 15-minute design flow rates, for capacity analyses.

Existing year PHFs were determined from the vehicle turning movement counts provided by DOT&PF.

The following table presents the recommended PHFs per segment.

Table 7: Recommended PHFs for Design

Segment	PHF
Mitchell Expressway to Davis Road	0.91
Davis Road to Rewak Drive	0.94
Rewak Drive to Geist Road/Johansen Expwy	0.97
Geist Road/Johansen Expwy to Thomas Street	0.94

9. Directional Distribution Percent

Directional distribution percentages (DD%) are used to adjust peak hour volumes into directional volumes on road segments. DD% was determined using the volume data from the radar detectors. The following figures present the volume data from the two radar locations.

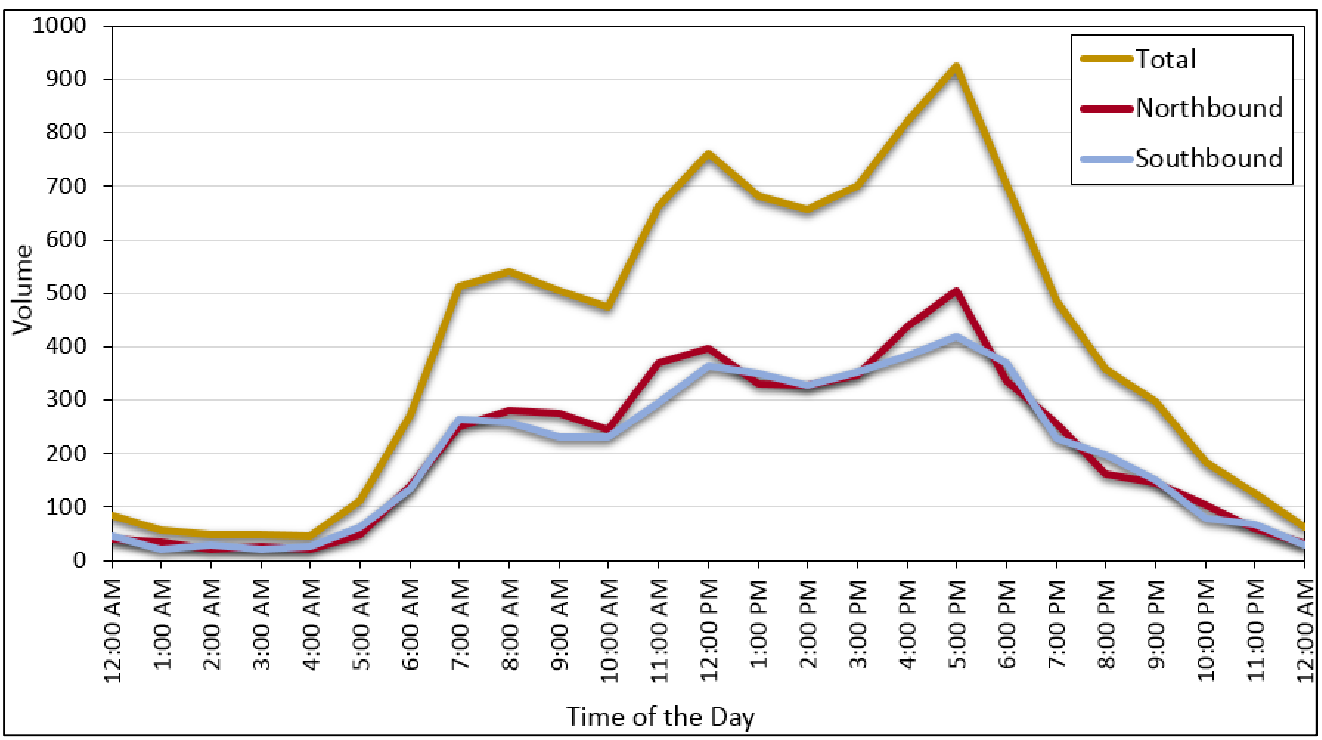

Figure 4: 24-Hour Volume Data – University Avenue at Davis Road (August 31, 2017)

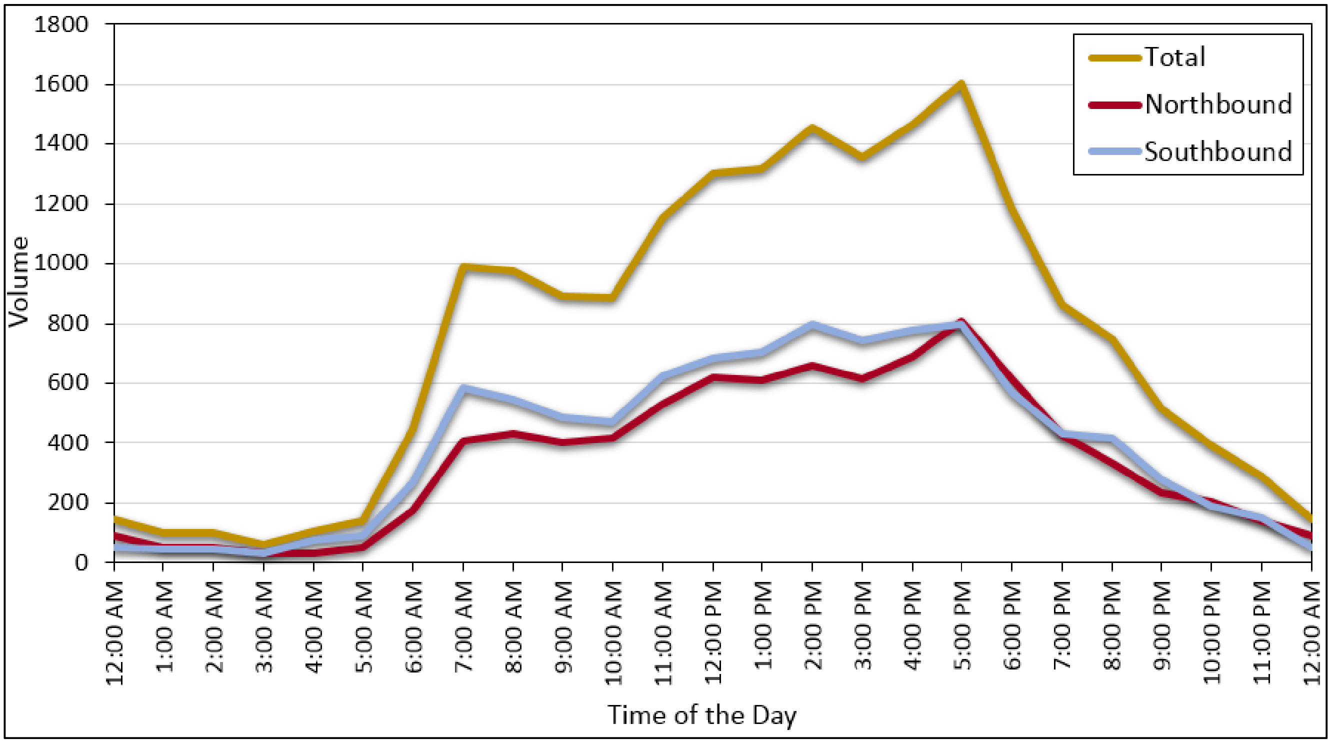

Figure 5: 24-Hour Volume Data – University Avenue at Chena River Bridge (September 7, 2017)

Note that both locations exhibit daily peak hours in the AM, Noon, and PM peak periods, however traffic volume generally increases gradually throughout the day until the PM peak hours and then quickly drops off. The PM peak hours experience significantly higher traffic volumes than the rest of the day. There are higher daily volumes on the north end of University Avenue; however, the peaks are more pronounced on the south end of the project area, with a higher percentage of the daily traffic occurring in the peaks. Table 1 presents the observed peak hour volumes during each peak period for the two locations. The table also shows the calculated percent of the total daily traffic and the directional distribution that existed during that hour.

Table 1: 24-Hour Study Summary

Location	24-Hour Volume	Peak Period Volume and Percentage								
		AM			Noon			PM		
		Period Volume	% of Daily Volume	Directional Distribution % (N/S)	Period Volume	% of Daily Volume	Directional Distribution % (N/S)	Period Volume	% of Daily Volume	Directional Distribution % (N/S)
Davis Road	10,070	8:00 to 9:00			12:00 to 1:00			5:00 to 6:00		
		540	5%	55 / 45	762	8%	55 / 45	925	9%	50 / 50
Chena River Bridge	18,477	7:00 to 8:00			2:00 to 3:00			5:00 to 6:00		
		989	5%	40 / 60	1456	8%	45 / 55	1602	9%	50 / 50

The following figures present the daily directional distributions for all segments.

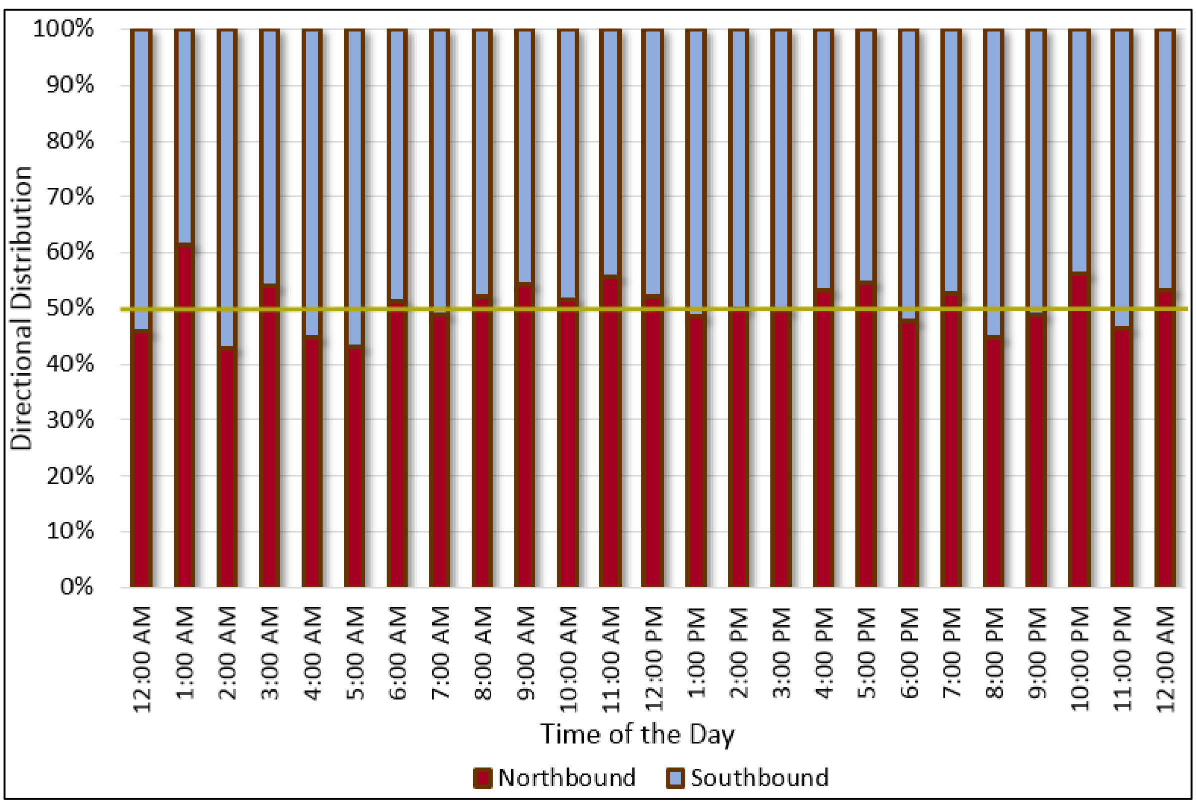

Figure 6: Daily Directional Distributions – Davis Road (August 31, 2017)

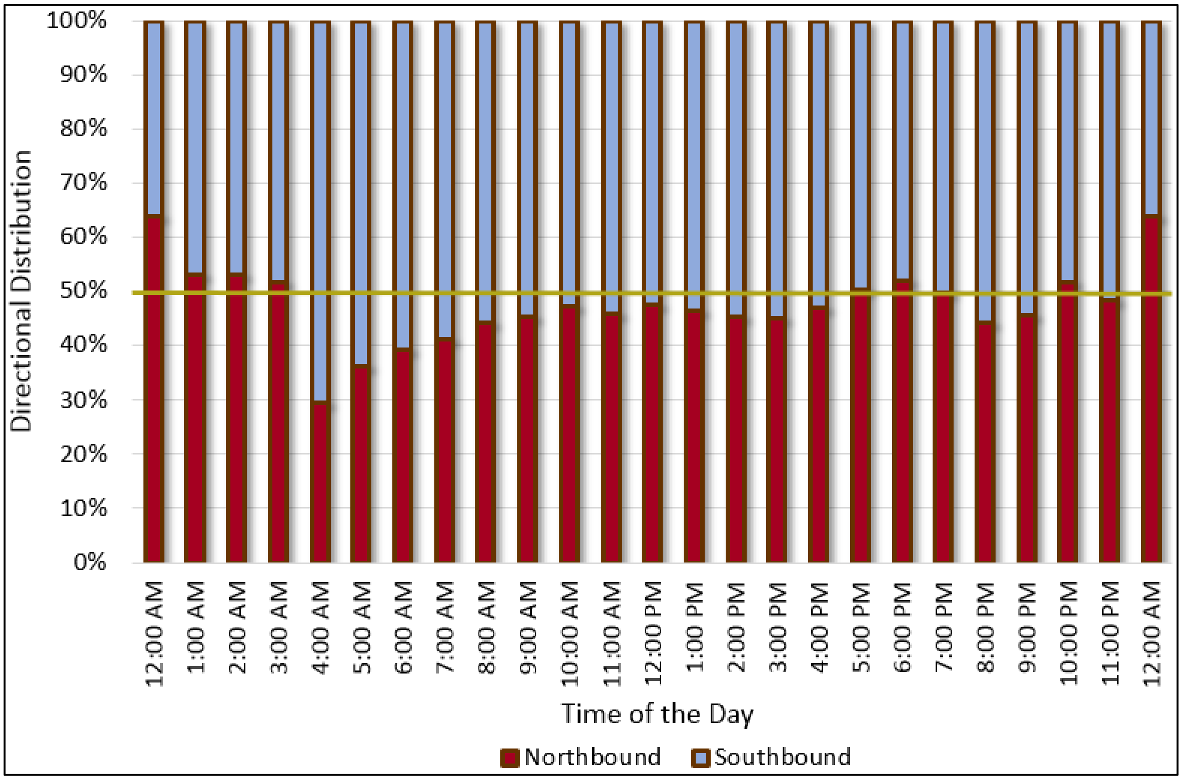

Figure 7: Daily Directional Distributions – Chena River Bridge (September 7, 2017)

The recommended DD% is summarized in Table 8.

Table 8: Recommended Direction Distributions

Segment	Distribution (Northbound / Southbound)
Mitchell Expressway to Davis Road	55 / 45
Davis Road to Rewak Drive	55 / 45
Rewak Drive to Geist Road/Johansen Expwy	45 / 55
Geist Road/Johansen Expwy to Thomas Street	45 / 55

10. Heavy Vehicle Percentages

The Heavy Vehicle Percentage (HV%) is the percent of the AADT that is made up of heavy vehicles. The HV% is used in capacity analysis and in the calculation of Equivalent Single Axle Loads (ESALs) for pavement design.

The Federal Highway Administration (FHWA) classifications can be used to determine heavy vehicle percentages since any vehicle identified as class 4 or higher is counted as a heavy vehicle. The FHWA classification system is provided in the appendix.

As part of the FMATS Freight Mobility Plan, HDR prepared The Existing Conditions Report (approved May 17, 2017). This report indicates University Avenue is part of the National Highway Freight Network, Primary Highway Freight System; however, it is not a key freight route.

HV% is shown as 4% in the previous design designations for University Avenue.

The HV% for this design designations analysis were calculated using the TMC provided by DOT&PF on multiple intersections along University Avenue. For each intersection with vehicle mix breakdowns, only the turning movements resulting in travel within the project area was counted towards HV%. For example, side street through movements were excluded in the calculation. The following table summarizes HV% by intersection:

Table 9: DOT&PF TMC HV%

Intersection with University Avenue	Date of DOT TMC	HV%
Mitchell Expressway	4-25-2017	2.7%
Rewak Drive	9-8-2016	3.6%
Airport Way	6-1-2016	3.1%
Alumni Drive / College Road	8-17-2016	2.6%

Based on the HV% as shown in Table 9, the recommended HV% values for this design designation analysis are presented in Table 10.

The HV% is the sum of the commercial vehicle percentage (CV%) and recreational vehicle percentage (RV%). The design designation forms report the CV% and RV%, not HV%.

The data did not separate RVs from other HV, though based on previous traffic counts taken around the Fairbanks area, RV volumes are expected to be insignificant to this analysis. Therefore, all heavy vehicles are assumed to be commercial.

Table 10: Recommended Heavy Vehicle Percentages

Segment	RV% of AADT	CV% of AADT
Mitchell Expressway to Davis Road	0.0%	3.0%
Davis Road to Rewak Drive	0.0%	3.5%
Rewak Drive to Geist Road/Johansen Expwy	0.0%	3.5%
Geist Road/Johansen Expwy to Thomas Street	0.0%	3.0%

11. Pedestrians and Bicyclists

During this study, pedestrians and bicyclists were not counted. FMATS conducts annual bicycle and pedestrian counts at the intersections of University Avenue/Airport Way and University Avenue/Geist Road-Johansen Expressway. According to the 2011-2017 FMATS bicycle and pedestrian counts, occurring one day each year, usually in mid-May, non-motorized traffic is on the rise in these two intersections. Of the 36 intersections counted, these two intersections are within the top 6 for non-motorized traffic. Non-motorized traffic will be accommodated with sidewalks and pathways.

12. Equivalent Single Axle Loads

ESALs are used for pavement design, and are calculated using DOT&PF calculation methods and forms. These calculations require the percent of truck type according to axle grouping.

The 2006 design designations listed percentiles of the total AADT for each truck category. The current analysis did not capture updated truck mix volumes; but instead, used a ratio of the previous truck mix to the overall HV%. The following truck mix was used for the ESAL calculation:

Table 11: Percent of Truck Axles per AADT: University Avenue

Truck Axles	Percent of AADT	
	3.0% Total HV%	3.5% Total HV%
2	2.3%	2.6%
3	0.7%	0.9%
4	0%	0%
5	0%	0%
>=6	0%	0%
Total Heavy Vehicles	3.0%	3.5%

Another notable difference between the 2006 design designations and this analysis is the traffic lane distribution. In 2006, the lane distribution was set as though traffic used each lane equally. A traffic count performed for a noise analysis on University Avenue in May 2017 revealed unequal usage of each lane. Table summarizes the lane distribution for each segment:

Table 12: Lane Distribution

Segment	Southbound		Northbound	
	Outer Lane	Inner Lane	Outer Lane	Inner Lane
Mitchell Expressway to Davis Road	15%	40%	20%	25%
Davis Road to Rewak Drive	15%	40%	20%	25%
Rewak Drive to Geist Road/Johansen Expwy	25%	30%	20%	25%
Geist Road/Johansen Expwy to Thomas Street	25%	30%	20%	25%

Table 13 provides a summary of the equivalent single axle loads recommended for use in design for the life of the project. These ESAL values are lower than the previous design designation. Prior to 2012, load factors (ESALs per Truck) were calculated from local scale house data. In 2012, DOT&PF set consistent load factors to be used throughout the state. The 2006 design designations used local scale house load factors, which were considerably higher than the set values use today.

Table 13: Design ESALs

Segment	10-Year Design ESALs (2020 to 2030)	20-Year Design ESALs (2020 to 2040)
Mitchell Expressway to Davis Road	180,000	365,000
Davis Road to Rewak Drive	315,000	660,000
Rewak Drive to Geist Road/Johansen Expwy	410,000	860,000
Geist Road/Johansen Expwy to Thomas Street	370,000	740,000

DESIGN DESIGNATION FORMS

DESIGN DESIGNATION

State Route Number: **175900** Route Name: **University Avenue**

Project Limits: **University Avenue: Mitchell Expressway to Davis Road**

IRIS Project Number: **Z632130000** Federal Aid Number: **63213**

Project Description: **Rehabilitation and Widening**

Design Functional Classification: ☑ Urban Arterial ☐ Rural Arterial ☐ Major Collector ☐ Minor Collector ☐ Local

New Construction - Reconstruction: ☐ Rehabilitation (3R): ☐ Other

Project Design Life (Years): 5 ☐ 10 ☐ 20 ☑ 25 ☐ Other

	Existing Year	Construction Year	Mid - Life Year	Future Year
	2017	**2018**	**2030**	**2040**
ADT*	**6,500**	**6,575**	**7,500**	**7,750**
DHV	**650**	**675**	**750**	**775**
Peak Hour Factor	**0.91**	**0.91**	**0.91**	**0.91**
PM Directional Distribution (North/South)	**55 / 45**	**55 / 45**	**55 / 45**	**55 / 45**
Recreational Vehicle Percentage (RV%)	**0%**	**0%**	**0%**	**0%**
Commercial Vehicle Percentage (CV%)	**3%**	**3%**	**3%**	**3%**
Compound Growth Rate	**1.1%**	**1.1%**	**0.3%**	
Pedestrians (Number/Day)				
Bicyclists (Number/Day)				

*If urban then ADT is not required. Intersection diagrams shall be attached as part of this document.

Design Vehicles for Turning: **WB-52**

Design Vehicle Loading: HS15 ☐ HS20 ☑ HS25 ☐ Other

Equivalent Axle Loads: **180,000 (10-year); 365,000 (20-year)**

APPROVED ______________________ DATE ________

Regional Preconstruction Engineer

Figure 1100-1
Design Designation Form

Figure 8: Design Designations Form – Mitchell Expwy to Davis Rd

DESIGN DESIGNATION

State Route Number: **175900** Route Name: **University Avenue**

Project Limits: **University Avenue: Davis Road to Rewak Drive**

IRIS Project Number: **Z632130000** Federal Aid Number: **63213**

Project Description: **Rehabilitation and Widening**

Design Functional Classification: ☑ Urban Arterial ☐ Rural Arterial ☐ Major Collector ☐ Minor Collector ☐ Local

New Construction - Reconstruction: ☑ Rehabilitation (3R): ☐ Other ______

Project Design Life (Years): 5 ☐ 10 ☐ 20 ☑ 25 ☐ Other ______

	Existing Year	Construction Year	Mid - Life Year	Future Year
	2017	**2018**	**2030**	**2040**
ADT*	**9,500**	**9,625**	**11,250**	**12,250**
DHV	**950**	**975**	**1125**	**1225**
Peak Hour Factor	**0.95**	**0.95**	**0.95**	**0.95**
PM Directional Distribution (North/South)	**55 / 45**	**55 / 45**	**55 / 45**	**55 / 45**
Recreational Vehicle Percentage (RV%)	**0%**	**0%**	**0%**	**0%**
Commercial Vehicle Percentage (CV%)	**3.5%**	**3.5%**	**3.5%**	**3.5%**
Compound Growth Rate	**1.3%**	**1.3%**	**0.9%**	
Pedestrians (Number/Day)				
Bicyclists (Number/Day)				

*If urban then ADT is not required. Intersection diagrams shall be attached as part of this document.

Design Vehicles for Turning: **WB-52**

Design Vehicle Loading: HS15 ☐ HS20 ☑ HS25 ☐ Other ______

Equivalent Axle Loads: **315,000 (10-year); 660,000 (20-year)**

APPROVED ______________________ DATE ______
Regional Preconstruction Engineer

Figure 1100-1
Design Designation Form

Figure 9: Design Designations Form – Davis Rd to Rewak Dr

DESIGN DESIGNATION

State Route Number: **175900** Route Name: **University Avenue**

Project Limits: **University Avenue: Rewak Drive to Geist Road**

IRIS Project Number: **Z632130000** Federal Aid Number: **63213**

Project Description: **Rehabilitation and Widening**

Design Functional Classification: ☑ Urban Arterial ☐ Rural Arterial ☐ Major Collector ☐ Minor Collector ☐ Local

New Construction - Reconstruction: ☑ Rehabilitation (3R): ☐ Other _____

Project Design Life (Years): 5 ☐ 10 ☐ 20 ☑ 25 ☐ Other _____

	Existing Year	Construction Year	Mid - Life Year	Future Year
	2017	**2018**	**2030**	**2040**
ADT*	**16,750**	**16,925**	**19,000**	**20,750**
DHV	**1675**	**1700**	**1900**	**2075**
Peak Hour Factor	**0.95**	**0.95**	**0.95**	**0.95**
PM Directional Distribution (North/South)	**45 / 55**	**45 / 55**	**45 / 55**	**45 / 55**
Recreational Vehicle Percentage (RV%)	**0%**	**0%**	**0%**	**0%**
Commercial Vehicle Percentage (CV%)	**3.5%**	**3.5%**	**3.5%**	**3.5%**
Compound Growth Rate	**1.0%**	**1.0%**	**0.9%**	
Pedestrians (Number/Day)				
Bicyclists (Number/Day)				

*If urban then ADT is not required. Intersection diagrams shall be attached as part of this document.

Design Vehicles for Turning: **WB-52**

Design Vehicle Loading: HS15 ☐ HS20 ☑ HS25 ☐ Other _____

Equivalent Axle Loads: **410,000 (10-year); 860,000 (20-year)**

APPROVED ____________________ DATE ________
Regional Preconstruction Engineer

Figure 1100-1
Design Designation Form

Figure 10: Design Designations Form – Rewak Dr to Geist Rd

DESIGN DESIGNATION

State Route Number: **175900** Route Name: **University Avenue**

Project Limits: **University Avenue: Geist Road to College Road**

IRIS Project Number: **Z632130000** Federal Aid Number: **63213**

Project Description: **Rehabilitation and Widening**

Design Functional Classification: ☒ Urban Arterial ☐ Rural Arterial ☐ Major Collector ☐ Minor Collector ☐ Local

New Construction - Reconstruction: ☒ Rehabilitation (3R): ☐ Other ________

Project Design Life (Years): 5 ☐ 10 ☐ 20 ☒ 25 ☐ Other ________

	Existing Year	Construction Year	Mid - Life Year	Future Year
	2017	**2018**	**2030**	**2040**
ADT*	**17,500**	**17,725**	**20,500**	**21,000**
DHV	**1750**	**1775**	**2050**	**2100**
Peak Hour Factor	**0.95**	**0.95**	**0.95**	**0.95**
PM Directional Distribution (North/South)	**45 / 55**	**45 / 55**	**45 / 55**	**45 / 55**
Recreational Vehicle Percentage (RV%)	**0%**	**0%**	**0%**	**0%**
Commercial Vehicle Percentage (CV%)	**3%**	**3%**	**3%**	**3%**
Compound Growth Rate	**1.2%**	**1.2%**	**0.2%**	
Pedestrians (Number/Day)				
Bicyclists (Number/Day)				

*If urban then ADT is not required. Intersection diagrams shall be attached as part of this document.

Design Vehicles for Turning: **WB-52**

Design Vehicle Loading: HS15 ☐ HS20 ☒ HS25 ☐ Other ________

Equivalent Axle Loads: **370,000 (10-year); 740,000 (20-year)**

APPROVED ____________________ DATE ________
Regional Preconstruction Engineer

Figure 1100-1
Design Designation Form

Figure 11: Design Designations Form – Geist Rd to Thomas St

ESAL Calculation Sheets

Project Name:	University Avenue Rehabilitation & Widening	Designer	KE
Project Number:	Z632130000/632`	Date:	11/3/17

Traffic Data for Design and Historic ESALs

Design Data Input

Design Construction Year:	2020
Design Length in Years:	10
Base Year:	2017
Base Year Total AADT:	6500
Growth Rate % per Year:	1.11

% of Base Year AADT for Each Lane

Lane	%
1	15
2	40
3	20
4	25
5	0
6	0

Truck Category	Load Factor (ESALs per Truck)	% AADT in Truck Category
2-Axle	0.5	2.3
3-Axle	0.85	0.7
4-Axle	1.2	0
5-Axle	1.55	0
>=6-Axle	2.24	0

TOTAL DESIGN ESALs: **180,020**

Historic Data Input

Historic Construction Year:	
Backcast % per Year:	

% of Base Year AADT for Each Lane

Lane	%
1	
2	
3	
4	
5	
6	

Truck Category	Load Factor (ESALs per Truck)	% AADT in Truck Category
2-Axle	0.5	
3-Axle	0.85	
4-Axle	1.2	
5-Axle	1.55	
>=6-Axle	2.24	

TOTAL HISTORIC ESALs: **-**

Construction Year ESAL Calculations

Truck Category	Design Lane AADT	% AADT in Truck Category	Load Factor for Truck Category	Construction Year ESALs
2-Axle	2688	2.3	0.5	11,283
3-Axle	2688	0.7	0.85	5,838
4-Axle	2688	0	1.2	0
5-Axle	2688	0	1.55	0
>=6-Axle	2688	0	2.24	0
			Total Construction Year ESALs:	17,121

Historic Construction Year ESAL Calculations

Truck Category	Design Lane AADT	% AADT in Truck Category	Load Factor for Truck Category	Historic Construction Year ESALs
2-Axle		0	0.5	0
3-Axle		0	0.85	0
4-Axle		0	1.2	0
5-Axle		0	1.55	0
>=6-Axle		0	2.24	0
			Total Historic Construction Year ESALs:	0

CLICK HERE FOR MORE INFORMATION ON ESAL CALCULATIONS

Figure 12: 10 Year ESAL Calculations – Mitchell Expwy to Davis Rd

Project Name:	University Avenue Rehabilitation & Widening	Designer	J Miranda
Project Number:	Z632130000/632	Date:	11/3/17

Traffic Data for Design and Historic ESALs

Design Data Input

Design Construction Year:	2020
Design Length in Years:	10
Base Year:	2017
Base Year Total AADT:	9500
Growth Rate % per Year:	1.31

% of Base Year AADT for Each Lane

Lane	%
1	15
2	40
3	20
4	25
5	0
6	0

Truck Category	Load Factor (ESALs per Truck)	% AADT in Truck Category
2-Axle	0.5	2.6
3-Axle	0.85	0.9
4-Axle	1.2	0
5-Axle	1.55	0
>=6-Axle	2.24	0

TOTAL DESIGN ESALs:

315,972

Historic Data Input

Historic Construction Year:	
Backcast % per Year:	

% of Base Year AADT for Each Lane

Lane	%
1	
2	
3	
4	
5	
6	

Truck Category	Load Factor (ESALs per Truck)	% AADT in Truck Category
2-Axle	0.5	
3-Axle	0.85	
4-Axle	1.2	
5-Axle	1.55	
>=6-Axle	2.24	

TOTAL HISTORIC ESALs:

-

Construction Year ESAL Calculations

Truck Category	Design Lane AADT	% AADT in Truck Category	Load Factor for Truck Category	Construction Year ESALs
2-Axle	3951	2.6	0.5	18,747
3-Axle	3951	0.9	0.85	11,032
4-Axle	3951	0	1.2	0
5-Axle	3951	0	1.55	0
>=6-Axle	3951	0	2.24	0
		Total Construction Year ESALs:		29,779

Historic Construction Year ESAL Calculations

Truck Category	Design Lane AADT	% AADT in Truck Category	Load Factor for Truck Category	Historic Construction Year ESALs
2-Axle		0	0.5	0
3-Axle		0	0.85	0
4-Axle		0	1.2	0
5-Axle		0	1.55	0
>=6-Axle		0	2.24	0
	Total Historic Construction Year ESALs:			0

CLICK HERE FOR MORE INFORMATION ON ESAL CALCULATIONS

Figure 13: 10 Year ESAL Calculations – Davis Rd to Rewak Dr

Project Name:	University Avenue Rehabilitation & Widening	Designer	KE
Project Number:	Z632130000/632	Date:	11/3/17

Traffic Data for Design and Historic ESALs

Design Data Input

Design Construction Year:	2020
Design Length in Years:	10
Base Year:	2017
Base Year Total AADT:	16750
Growth Rate % per Year:	0.97

% of Base Year AADT for Each Lane

Lane	%
1	25
2	30
3	20
4	25
5	0
6	0

Truck Category	Load Factor (ESALs per Truck)	% AADT in Truck Category
2-Axle	0.5	2.6
3-Axle	0.85	0.9
4-Axle	1.2	0
5-Axle	1.55	0
>=6-Axle	2.24	0

TOTAL DESIGN ESALs:

407,367

Historic Data Input

Historic Construction Year:	
Backcast % per Year:	

% of Base Year AADT for Each Lane

Lane	%
1	
2	
3	
4	
5	
6	

Truck Category	Load Factor (ESALs per Truck)	% AADT in Truck Category
2-Axle	0.5	
3-Axle	0.85	
4-Axle	1.2	
5-Axle	1.55	
>=6-Axle	2.24	

TOTAL HISTORIC ESALs:

-

Construction Year ESAL Calculations

Truck Category	Design Lane AADT	% AADT in Truck Category	Load Factor for Truck Category	Construction Year ESALs
2-Axle	5173	2.6	0.5	24,546
3-Axle	5173	0.9	0.85	14,444
4-Axle	5173	0	1.2	0
5-Axle	5173	0	1.55	0
>=6-Axle	5173	0	2.24	0
		Total Construction Year ESALs:		38,990

Historic Construction Year ESAL Calculations

Truck Category	Design Lane AADT	% AADT in Truck Category	Load Factor for Truck Category	Historic Construction Year ESALs
2-Axle		0	0.5	0
3-Axle		0	0.85	0
4-Axle		0	1.2	0
5-Axle		0	1.55	0
>=6-Axle		0	2.24	0
	Total Historic Construction Year ESALs:			0

CLICK HERE FOR MORE INFORMATION ON ESAL CALCULATIONS

Figure 14: 10 Year ESAL Calculations – Rewak Dr to Geist Rd / Johansen Expwy

Project Name:	University Avenue Rehabilitation & Widening	Designer	KE
Project Number:	Z632130000/632	Date:	11/3/17

Traffic Data for Design and Historic ESALs

Design Data Input

Design Construction Year:	2020
Design Length in Years:	10
Base Year:	2017
Base Year Total AADT:	17500
Growth Rate % per Year:	1.22

% of Base Year AADT for Each Lane

Lane	%
1	25
2	30
3	20
4	25
5	0
6	0

Truck Category	Load Factor (ESALs per Truck)	% AADT in Truck Category
2-Axle	0.5	2.3
3-Axle	0.85	0.7
4-Axle	1.2	0
5-Axle	1.55	0
>=6-Axle	2.24	0

TOTAL DESIGN ESALs: **366,472**

Historic Data Input

Historic Construction Year:	
Backcast % per Year:	

% of Base Year AADT for Each Lane

Lane	%
1	
2	
3	
4	
5	
6	

Truck Category	Load Factor (ESALs per Truck)	% AADT in Truck Category
2-Axle	0.5	
3-Axle	0.85	
4-Axle	1.2	
5-Axle	1.55	
>=6-Axle	2.24	

TOTAL HISTORIC ESALs: **-**

Construction Year ESAL Calculations

Truck Category	Design Lane AADT	% AADT in Truck Category	Load Factor for Truck Category	Construction Year ESALs
2-Axle	5445	2.3	0.5	22,855
3-Axle	5445	0.7	0.85	11,825
4-Axle	5445	0	1.2	0
5-Axle	5445	0	1.55	0
>=6-Axle	5445	0	2.24	0
		Total Construction Year ESALs:		34,680

Historic Construction Year ESAL Calculations

Truck Category	Design Lane AADT	% AADT in Truck Category	Load Factor for Truck Category	Historic Construction Year ESALs
2-Axle		0	0.5	0
3-Axle		0	0.85	0
4-Axle		0	1.2	0
5-Axle		0	1.55	0
>=6-Axle		0	2.24	0
	Total Historic Construction Year ESALs:			0

CLICK HERE FOR MORE INFORMATION ON ESAL CALCULATIONS

Figure 15: 10 Year ESAL Calculations – Geist Rd / Johansen Expwy to Thomas St

Project Name:	University Avenue Rehabilitation & Widening	Designer	J Miranda
Project Number:	Z632130000/632`	Date:	11/3/17

Traffic Data for Design and Historic ESALs

Design Data Input

Design Construction Year:	2020
Design Length in Years:	20
Base Year:	2017
Base Year Total AADT:	6500
Growth Rate % per Year:	0.77

% of Base Year AADT for Each Lane

Lane	%
1	15
2	40
3	20
4	25
5	0
6	0

Truck Category	Load Factor (ESALs per Truck)	% AADT in Truck Category
2-Axle	0.5	2.3
3-Axle	0.85	0.7
4-Axle	1.2	0
5-Axle	1.55	0
>=6-Axle	2.24	0

TOTAL DESIGN ESALs:

364,960

Historic Data Input

Historic Construction Year:	
Backcast % per Year:	

% of Base Year AADT for Each Lane

Lane	%
1	
2	
3	
4	
5	
6	

Truck Category	Load Factor (ESALs per Truck)	% AADT in Truck Category
2-Axle	0.5	
3-Axle	0.85	
4-Axle	1.2	
5-Axle	1.55	
>=6-Axle	2.24	

TOTAL HISTORIC ESALs:

-

Construction Year ESAL Calculations

Truck Category	Design Lane AADT	% AADT in Truck Category	Load Factor for Truck Category	Construction Year ESALs
2-Axle	2661	2.3	0.5	11,170
3-Axle	2661	0.7	0.85	5,779
4-Axle	2661	0	1.2	0
5-Axle	2661	0	1.55	0
>=6-Axle	2661	0	2.24	0
		Total Construction Year ESALs:		16,949

Historic Construction Year ESAL Calculations

Truck Category	Design Lane AADT	% AADT in Truck Category	Load Factor for Truck Category	Historic Construction Year ESALs
2-Axle		0	0.5	0
3-Axle		0	0.85	0
4-Axle		0	1.2	0
5-Axle		0	1.55	0
>=6-Axle		0	2.24	0
	Total Historic Construction Year ESALs:			0

CLICK HERE FOR MORE INFORMATION ON ESAL CALCULATIONS

Figure 16: 20 Year ESAL Calculations – Mitchell Expwy to Davis Rd

Project Name:	University Avenue Rehabilitation & Widening	Designer	J Miranda
Project Number:	Z632130000/632`	Date:	11/3/17

Traffic Data for Design and Historic ESALs

Design Data Input

Design Construction Year:	2020
Design Length in Years:	20
Base Year:	2017
Base Year Total AADT:	9500
Growth Rate % per Year:	1.11

% of Base Year AADT for Each Lane

Lane	%
1	15
2	40
3	20
4	25
5	0
6	0

Truck Category	Load Factor (ESALs per Truck)	% AADT in Truck Category
2-Axle	0.5	2.6
3-Axle	0.85	0.9
4-Axle	1.2	0
5-Axle	1.55	0
>=6-Axle	2.24	0

TOTAL DESIGN ESALs:

658,921

Historic Data Input

Historic Construction Year:	
Backcast % per Year:	

% of Base Year AADT for Each Lane

Lane	%
1	
2	
3	
4	
5	
6	

Truck Category	Load Factor (ESALs per Truck)	% AADT in Truck Category
2-Axle	0.5	
3-Axle	0.85	
4-Axle	1.2	
5-Axle	1.55	
>=6-Axle	2.24	

TOTAL HISTORIC ESALs:

-

Construction Year ESAL Calculations

Truck Category	Design Lane AADT	% AADT in Truck Category	Load Factor for Truck Category	Construction Year ESALs
2-Axle	3928	2.6	0.5	18,638
3-Axle	3928	0.9	0.85	10,968
4-Axle	3928	0	1.2	0
5-Axle	3928	0	1.55	0
>=6-Axle	3928	0	2.24	0
		Total Construction Year ESALs:		29,606

Historic Construction Year ESAL Calculations

Truck Category	Design Lane AADT	% AADT in Truck Category	Load Factor for Truck Category	Historic Construction Year ESALs
2-Axle		0	0.5	0
3-Axle		0	0.85	0
4-Axle		0	1.2	0
5-Axle		0	1.55	0
>=6-Axle		0	2.24	0
	Total Historic Construction Year ESALs:			0

CLICK HERE FOR MORE INFORMATION ON ESAL CALCULATIONS

Figure 17: 20 Year ESAL Calculations – Davis Rd to Rewak Dr

Project Name:	University Avenue Rehabilitation & Widening	Designer	KE
Project Number:	Z632130000/632	Date:	11/3/17

Traffic Data for Design and Historic ESALs

Design Data Input

Design Construction Year:	2020
Design Length in Years:	20
Base Year:	2017
Base Year Total AADT:	16750
Growth Rate % per Year:	0.94

% of Base Year AADT for Each Lane

Lane	%
1	25
2	30
3	20
4	25
5	0
6	0

Truck Category	Load Factor (ESALs per Truck)	% AADT in Truck Category
2-Axle	0.5	2.6
3-Axle	0.85	0.9
4-Axle	1.2	0
5-Axle	1.55	0
>=6-Axle	2.24	0

TOTAL DESIGN ESALs:

852,694

Historic Data Input

Historic Construction Year:	
Backcast % per Year:	

% of Base Year AADT for Each Lane

Lane	%
1	
2	
3	
4	
5	
6	

Truck Category	Load Factor (ESALs per Truck)	% AADT in Truck Category
2-Axle	0.5	
3-Axle	0.85	
4-Axle	1.2	
5-Axle	1.55	
>=6-Axle	2.24	

TOTAL HISTORIC ESALs:

-

Construction Year ESAL Calculations

Truck Category	Design Lane AADT	% AADT in Truck Category	Load Factor for Truck Category	Construction Year ESALs
2-Axle	5168	2.6	0.5	24,522
3-Axle	5168	0.9	0.85	14,430
4-Axle	5168	0	1.2	0
5-Axle	5168	0	1.55	0
>=6-Axle	5168	0	2.24	0
		Total Construction Year ESALs:		38,952

Historic Construction Year ESAL Calculations

Truck Category	Design Lane AADT	% AADT in Truck Category	Load Factor for Truck Category	Historic Construction Year ESALs
2-Axle		0	0.5	0
3-Axle		0	0.85	0
4-Axle		0	1.2	0
5-Axle		0	1.55	0
>=6-Axle		0	2.24	0
	Total Historic Construction Year ESALs:			0

CLICK HERE FOR MORE INFORMATION ON ESAL CALCULATIONS

Figure 18: 20 Year ESAL Calculations – Rewak Dr to Geist Rd / Johansen Expwy

Project Name:	University Avenue Rehabilitation & Widening	Designer	KE
Project Number:	Z632130000/632	Date:	11/3/17

Traffic Data for Design and Historic ESALs

Design Data Input

Design Construction Year:	2020
Design Length in Years:	20
Base Year:	2017
Base Year Total AADT:	17500
Growth Rate % per Year:	1.22

% of Base Year AADT for Each Lane

Lane	%
1	25
2	30
3	20
4	25
5	0
6	0

Truck Category	Load Factor (ESALs per Truck)	% AADT in Truck Category
2-Axle	0.5	2.3
3-Axle	0.85	0.7
4-Axle	1.2	0
5-Axle	1.55	0
>=6-Axle	2.24	0

TOTAL DESIGN ESALs:

780,190

Historic Data Input

Historic Construction Year:	
Backcast % per Year:	

% of Base Year AADT for Each Lane

Lane	%
1	
2	
3	
4	
5	
6	

Truck Category	Load Factor (ESALs per Truck)	% AADT in Truck Category
2-Axle	0.5	
3-Axle	0.85	
4-Axle	1.2	
5-Axle	1.55	
>=6-Axle	2.24	

TOTAL HISTORIC ESALs:

-

Construction Year ESAL Calculations

Truck Category	Design Lane AADT	% AADT in Truck Category	Load Factor for Truck Category	Construction Year ESALs
2-Axle	5445	2.3	0.5	22,855
3-Axle	5445	0.7	0.85	11,825
4-Axle	5445	0	1.2	0
5-Axle	5445	0	1.55	0
>=6-Axle	5445	0	2.24	0
		Total Construction Year ESALs:		34,680

Historic Construction Year ESAL Calculations

Truck Category	Design Lane AADT	% AADT in Truck Category	Load Factor for Truck Category	Historic Construction Year ESALs
2-Axle		0	0.5	0
3-Axle		0	0.85	0
4-Axle		0	1.2	0
5-Axle		0	1.55	0
>=6-Axle		0	2.24	0
		Total Historic Construction Year ESALs:		0

CLICK HERE FOR MORE INFORMATION ON ESAL CALCULATIONS

Figure 19: 20 Year ESAL Calculations – Geist Rd / Johansen Expwy to Thomas St

Project Name:	University Avenue Rehabilitation & Widening	Designer	J Miranda
Project Number:	Z632130000/632'	Date:	11/3/17

Traffic Data for Design and Historic ESALs

Design Data Input

Design Construction Year:	2020
Design Length in Years:	20
Base Year:	2017
Base Year Total AADT:	8200
Growth Rate % per Year:	1.15

% of Base Year AADT for Each Lane

Lane	%
1	22.5
2	22.5
3	27.5
4	27.5
5	0
6	0

Truck Category	Load Factor (ESALs per Truck)	% AADT in Truck Category
2-Axle	0.5	2.25
3-Axle	0.85	0.75
4-Axle	1.2	0
5-Axle	1.55	0
>=6-Axle	2.24	0

TOTAL DESIGN ESALs: 335,486

Historic Data Input

Historic Construction Year:	
Backcast % per Year:	

% of Base Year AADT for Each Lane

Lane	%
1	
2	
3	
4	
5	
6	

Truck Category	Load Factor (ESALs per Truck)	% AADT in Truck Category
2-Axle	0.5	
3-Axle	0.85	
4-Axle	1.2	
5-Axle	1.55	
>=6-Axle	2.24	

TOTAL HISTORIC ESALs: -

Construction Year ESAL Calculations

Truck Category	Design Lane AADT	% AADT in Truck Category	Load Factor for Truck Category	Construction Year ESALs
2-Axle	2334	2.25	0.5	9,584
3-Axle	2334	0.75	0.85	5,431
4-Axle	2334	0	1.2	0
5-Axle	2334	0	1.55	0
>=6-Axle	2334	0	2.24	0
		Total Construction Year ESALs:		15,015

Historic Construction Year ESAL Calculations

Truck Category	Design Lane AADT	% AADT in Truck Category	Load Factor for Truck Category	Historic Construction Year ESALs
2-Axle		0	0.5	0
3-Axle		0	0.85	0
4-Axle		0	1.2	0
5-Axle		0	1.55	0
>=6-Axle		0	2.24	0
		Total Historic Construction Year ESALs:		0

CLICK HERE FOR MORE INFORMATION ON ESAL CALCULATIONS

Figure 20: 20 Year ESAL Calculations – Mitchell Expwy to Rewak Dr

Project Name:	University Avenue Rehabilitation & Widening	Designer	J Miranda
Project Number:	Z632130000/63213	Date:	11/3/17

Traffic Data for Design and Historic ESALs

Design Data Input

Design Construction Year:	2020
Design Length in Years:	20
Base Year:	2017
Base Year Total AADT:	16800
Growth Rate % per Year:	0.95

% of Base Year AADT for Each Lane

Lane	%
1	22.5
2	22.5
3	27.5
4	27.5
5	0
6	0

Truck Category	Load Factor (ESALs per Truck)	% AADT in Truck Category
2-Axle	0.5	2.25
3-Axle	0.85	0.75
4-Axle	1.2	0
5-Axle	1.55	0
>=6-Axle	2.24	0

TOTAL DESIGN ESALs:

670,008

Historic Data Input

Historic Construction Year:	
Backcast % per Year:	

% of Base Year AADT for Each Lane

Lane	%
1	
2	
3	
4	
5	
6	

Truck Category	Load Factor (ESALs per Truck)	% AADT in Truck Category
2-Axle	0.5	
3-Axle	0.85	
4-Axle	1.2	
5-Axle	1.55	
>=6-Axle	2.24	

TOTAL HISTORIC ESALs:

-

Construction Year ESAL Calculations

Truck Category	Design Lane AADT	% AADT in Truck Category	Load Factor for Truck Category	Construction Year ESALs
2-Axle	4753	2.25	0.5	19,517
3-Axle	4753	0.75	0.85	11,060
4-Axle	4753	0	1.2	0
5-Axle	4753	0	1.55	0
>=6-Axle	4753	0	2.24	0
		Total Construction Year ESALs:		30,577

Historic Construction Year ESAL Calculations

Truck Category	Design Lane AADT	% AADT in Truck Category	Load Factor for Truck Category	Historic Construction Year ESALs
2-Axle		0	0.5	0
3-Axle		0	0.85	0
4-Axle		0	1.2	0
5-Axle		0	1.55	0
>=6-Axle		0	2.24	0
	Total Historic Construction Year ESALs:			0

CLICK HERE FOR MORE INFORMATION ON ESAL CALCULATIONS

Figure 21: 20 Year ESAL Calculations – Rewak Dr to Thomas St

APPENDIX A – 2017 AADT CALCULATIONS

Radar data captured ADT volumes at two locations on University Avenue for a specific month and day in 2017. These ADT values were normalized to represent equivalent 2017 AADT values by applying adjustment factors based on published data from DOT&PF CCSs. Table A is a summary of the 2017 collected data and the adjusted AADT.

Table A: 2017 Factored ADT Development

Data Collection Site	Data Collection Location	Date of Collection	Raw ADT Value (vpd)	MADT	AADT (vpd)
1	Davis Road	August 31, 2017	10,070	106.6%	9,416
2	Chena River Bridge	September 7, 2017	18,477	107.1%	17,143

DOT&PF publishes AADT and ADT per month for each year of gathered CCS data. For this analysis, data from two CCSs were used – Airport Way East of University Avenue and University Avenue at the Chena River Bridge. The Airport Way CCS is near the location of the Davis Road data collection site and was used to calibrate that data set. The University Avenue CCS was used to calibrate the data set from the Chena River Bridge site.

Adjustment factors were derived from calculating the specific month percentage of the total AADT (MADT). Five years of data were examined for a trending pattern. The MADT have slightly fluctuated up and down but overall remained relatively constant since 2010; therefore, the five-year average was used for the 2017 AADT conversion process. Between 2013 and 2014, the published CCS data format changed. In 2013 and earlier, the CCS data included the MADT percent for every month. In 2014 and later, the CCS data included average ADT per month values in which the MADT percentage is calculated. The MADT values for 2010 through 2015 are shown in Table B.

The factored AADT from the data collectors at Sites 1 and 2 were used as the 2017 AADT for Davis Road to Rewak Drive and Rewak Drive to Chena River Bridge, respectively. Historical percentages between segments of University Avenue, as published by DOT&PF, were averaged and used to estimate the AADT on other portions of corridor. Table C shows the progression of 2017 AADT for all segments of University Avenue, as published by DOT&PF.

Table B: MADT Adjustment Factors

CCS ID & Description	Adjustment Month	2010	2011	2012	2013	2014			2015			Average MADT
		Percent of AADT	Percent of AADT	Percent of AADT	Percent of AADT	AADT (vpd)	Average Monthly ADT	Percent of AADT	AADT (vpd)	Average Monthly ADT	Percent of AADT	
11900035 Airport Way east of University Avenue	August	104.7%	106.3%	105.2%	106.8%	14,141	15,450	109.3%	13,921	14,931	107.3%	106.6%
1110617U University Avenue at Chena River Bridge	September	107.6%	108.9%	105.6%	105.5%	17,602	19,187	109.0%	17,509	18,524	105.8%	107.1%

Table C: University Avenue Segment 2017 AADT

Segment	AADT (Percent of near Data Site)							Average Percent	2017 AADT (vpd)
	2010	2011	2012	2013	2014	2015	2016		
Mitchell Expwy to Davis Road	6,754 (69%)	6,572 (67%)	6,153 (66%)	6,398 (67%)	6,978 (70%)	6,594 (69%)	6,628 (70%)	68%	6,445
Davis Road to Rewak Drive (Data Site 1)	9,757	9,744	9,336	9,588	10,029	9,548	9,316		9,416
Rewak Drive to Chena River Bridge (Data Site 2)	20,120	20,075	19,810	17,904	17,602	17,509	17,520		17,143
Chena River Bridge to Geist Road	18,340 (N/A⁺)	18,000 (N/A⁺)	17,800 (N/A⁺)	17,905 (N/A⁺)	17,605 (100%)	17,525 (100%)	17,520 (100%)	100%	17,143
Geist Road to College Road	21,450 (N/A⁺)	21,200 (N/A⁺)	20,900 (N/A⁺)	21,000 (N/A⁺)	18,665 (106%)	17,525 (100%)	17,629 (101%)	102%	17,523

⁺ New CCS installed on Geist Road near University Avenue. Data here may be inaccurate.

Appendix B Crash Analysis

- DRAFT Safety Analysis Update – 2003 through 2012 (February 2015)
- Safety Analysis Update – 2010 through 2014 (February 2018)

University Avenue Rehabilitation & Widening 63213

DRAFT Safety Analysis Update – 2003 through 2012

February 2015

Kinney Engineering, LLC
750 West Dimond Boulevard
Suite 203
Anchorage, AK 99515

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Abbreviations

AADT	Annual average daily traffic
AASHTO	American Association of State Highway and Transportation Officials
ADOT&PF	Alaska Department of Transportation and Public Facilities
HSIP	Highway Safety Improvement Program
HSM	Highway Safety Manual
ITE	Institute of Transportation Engineers
KE	Kinney Engineering, LLC
MEV	Million entering vehicles
MVM	Million vehicle-miles
NCHRP	National Cooperative Highway Research Program
UCL	Upper control limit

Executive Summary

Kinney Engineering, LLC (KE) was retained by the Alaska Department of Transportation and Public Facilities (ADOT&PF) Northern Region to provide an updated safety analysis for the University Avenue Rehabilitation and Widening project along University Avenue in Fairbanks, Alaska using the most recent 10 years of crash data (2003 through 2012). The purpose of updating the analysis is to determine if there are any new crash trends to consider as the design moves forward and to examine the effect of the proposed design on crashes.

KE identified four intersections as having crash rates that were statistically higher than expected based on average crash rates for similar intersections across the state. These are:

- Davis Road
- Airport Way
- Geist Road/Johansen Expressway
- Sandvik Street

No segments had crash rates that were statistically higher than expected based on average crash rates for similar segments across the state.

Crash types that are most prevalent in the study area include rear end crashes and left turn crashes.

The proposed design will mitigate the existing crash patterns by installing a center raised median with left turn lanes at median openings at key intersections. Many of the left turn lanes will be offset to improve sight distance for opposing left turn vehicles. In addition, channelized right turn lanes will be installed at two approaches to the Geist Road/Johansen Expressway intersection and the phasing for eastbound and westbound left turns at the Geist Road intersection will change to protected-only.

There were 926 recorded crashes in the study area during the study period. If the improvements proposed with the University Avenue Rehabilitation and Widening project had been constructed throughout this time period, it is expected that there would have been 113 to 123 fewer crashes.

1 Introduction

This report presents the results of an updated safety analysis for the University Avenue Rehabilitation and Widening project along University Avenue in Fairbanks, Alaska. The Environmental Assessment report for this project (August 2005) includes a summary of the crash history for University Avenue from 1994 through 2003. The Alaska Department of Transportation and Public Facilities Northern Region (ADOT&PF) retained Kinney Engineering, LLC (KE) to update this safety analysis using crash data from 2003 through 2012.

This updated analysis identifies:

- Crash trends from 2003 through 2012
- Project area locations with higher than expected crash rates and crash patterns at these locations
- Crash reductions expected based on proposed design

University Avenue is a four-lane undivided highway classified as a principal arterial in the City of Fairbanks, Alaska. The study area is between the Robert Mitchell Expressway and Alumni Drive/College Road, excluding these two intersections. (See Figure 1.) The proposed design would construct two northbound and two southbound lanes separated by a raised median, with median openings at key intersections. In addition, major intersections will be channelized for auxiliary left-turn and right-turn lanes.

For reference, Table 1 presents historical and projected 2035 annual average daily traffic (AADT) volumes.

Segment	AADTs	
	2010	2035
Mitchell Expressway to Davis Road	6,755	14,041
Davis Road to Rewak Drive	9,760	15,307
Rewak Drive to Chena River	20,120	23,016
Chena River to Geist Road/Johansen Expressway	18,340	23,417
Geist Road/Johansen Expressway to College Road	21,450	22,944

Table 1 - Historical and Projected Traffic Volumes

Figure 1 – University Avenue Study Area Map

2 Corridor Crash Overview: 2003 to 2012

There were 926 recorded crashes on University Avenue from the Mitchell Expressway (Parks Highway) to College/Alumni Road (excluding the intersections at each end) from 2003 through 2012. Figure 2 shows the distribution of these crashes by year and severity. The figure shows that the total number of crashes in this corridor varies each year, with a spike in the number of crashes in 2004.

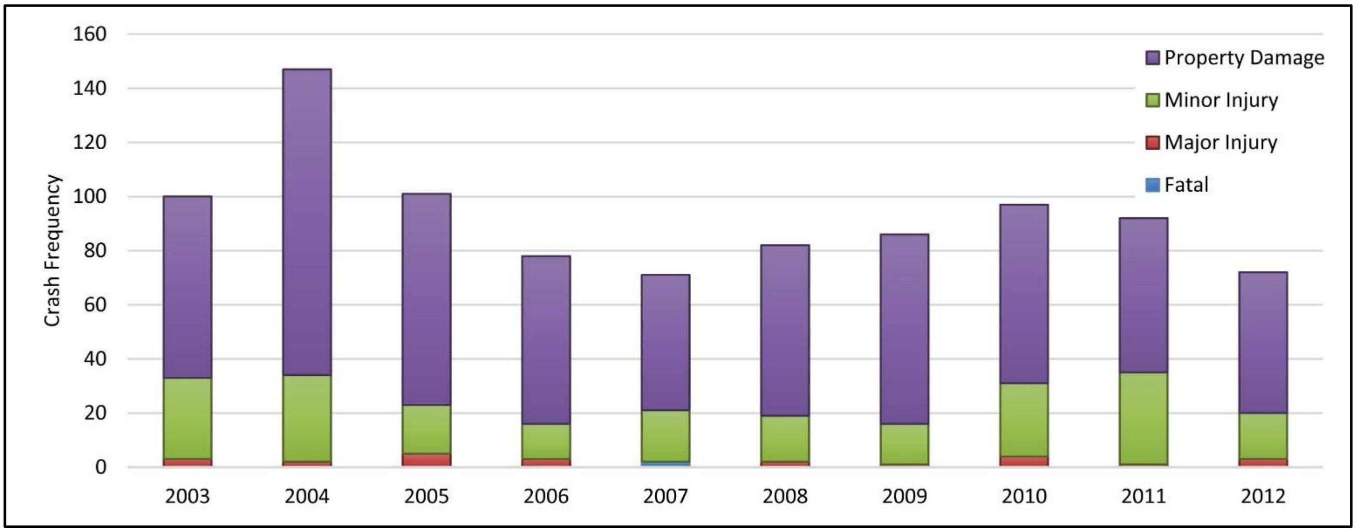

Figure 2 - Corridor Crash History by Severity 2003 through 2012

There were 2 fatal crashes during the 10-year study period. Both of these occurred at the Geist Road/Johansen Expressway intersection in 2007. The first of these was a sideswipe crash that occurred in July between two southbound motorcyclists who were turning left simultaneously. The second fatal crash occurred in August when a northbound bicyclist entered the crosswalk against the pedestrian signal and was struck by an eastbound passenger car.

2.1 Crash Type

Figure 3 presents the crash types for crashes that occurred during the study period. Figure 4 illustrates common two-vehicle crash types. Table 2 shows how the percentage of crashes in certain categories has changed from when the Environmental Assessment was completed (using crashes from 1994 through 2003) to this analysis (2003 through 2012). Rear end crashes remain the most frequent crash type in the corridor and the percentage of rear end crashes has increased. Crashes related to intersections (right angle, left turn, etc.) have decreased in percentage, but still make up just under a third of all corridor crashes.

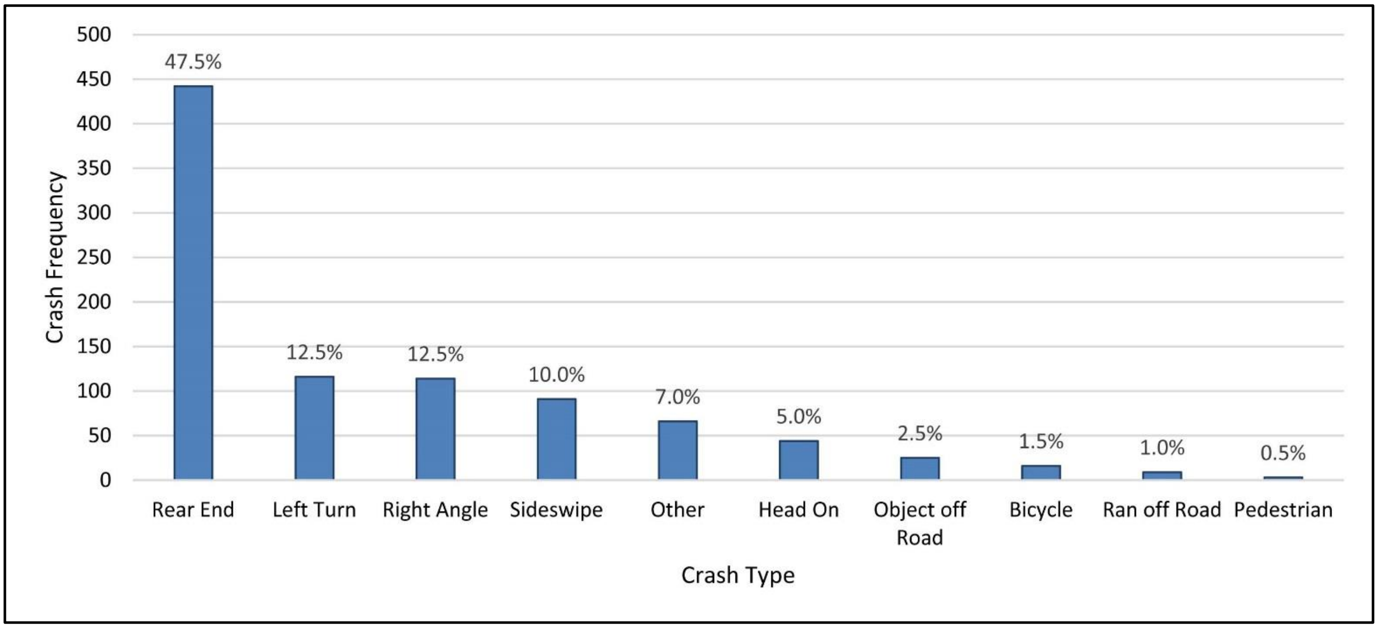

Figure 3 – Percentage of Crashes by Crash Type (2003 through 2012)

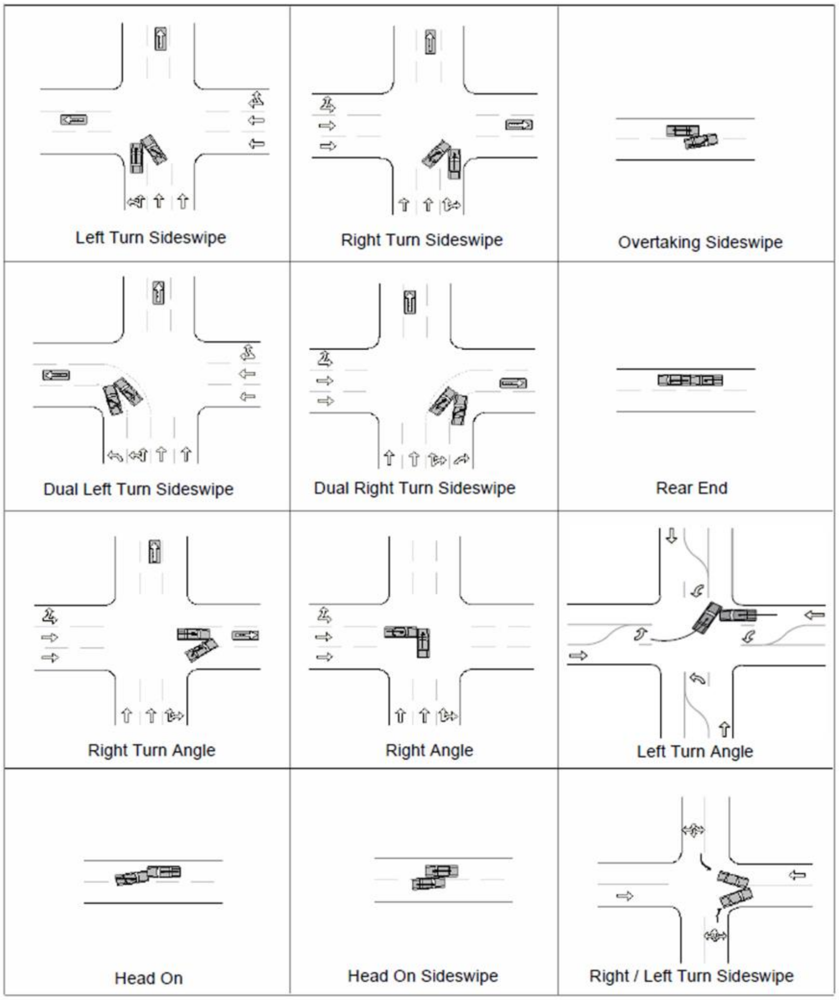

Figure 4 – Illustration of Two-Vehicle Crash Types (SOURCE: Annual Traffic Report, Municipality of Anchorage)

Crash Type Category	Percentage of Crashes (1994 to 2003)	Percentage of Crashes (2003 to 2012)
Rear End and Sideswipe	45%	57.5%
Left Turn, Right Angle, and Head On	47%	30%
Other	2%	7%
Ran off Road or Struck Object off Road	3%	3.5%
Bicycle and Pedestrian	2%	2%
Animal	1%	0%

Table 2 –Percentage of Crashes by Crash Type, 1994 to 2003 Compared to 2003 to 2012

There were a total of 533 rear end and sideswipe crashes in the study area from 2003 to 2012. Rear end and sideswipe crashes occur most frequently when the lead vehicle slows or stops and the following vehicle does not adjust to the speed change quickly enough. Figure 5 shows that the majority of rear end and sideswipe crashes on this corridor occur when vehicles are traveling along University Avenue (northbound or southbound). About 40% of the northbound and southbound rear end and sideswipe crashes occur at signalized intersections. Most of these crashes occur when the signal changes and the lead car stops abruptly or the following car has difficulty stopping. The most common mitigation for this type of crash is to adjust the yellow change and red clearance times to match the Institute of Transportation Engineers (ITE) recommended "Proposed Recommended Practice for Determining Vehicle Change Intervals." Since ADOT&PF uses the recommended practice to develop signal timing, this project is not expected to affect the number of rear end crashes at signalized intersections. The other 60% of the northbound and southbound rear end and sideswipe crashes occur at uncontrolled locations. Most of these crashes occur when the lead vehicle slows or stops to make a turn. Left turns on 4-lane sections where the roadway is undivided are especially problematic because the turning vehicle must sit in the inside through lane while awaiting a safe gap. The proposed design will install a center raised median on University Avenue and channelized left turn lanes at all median openings. This will help remove turning vehicles from the through lanes, which is expected to reduce crashes. The expected crash reduction is presented for each intersection individually.

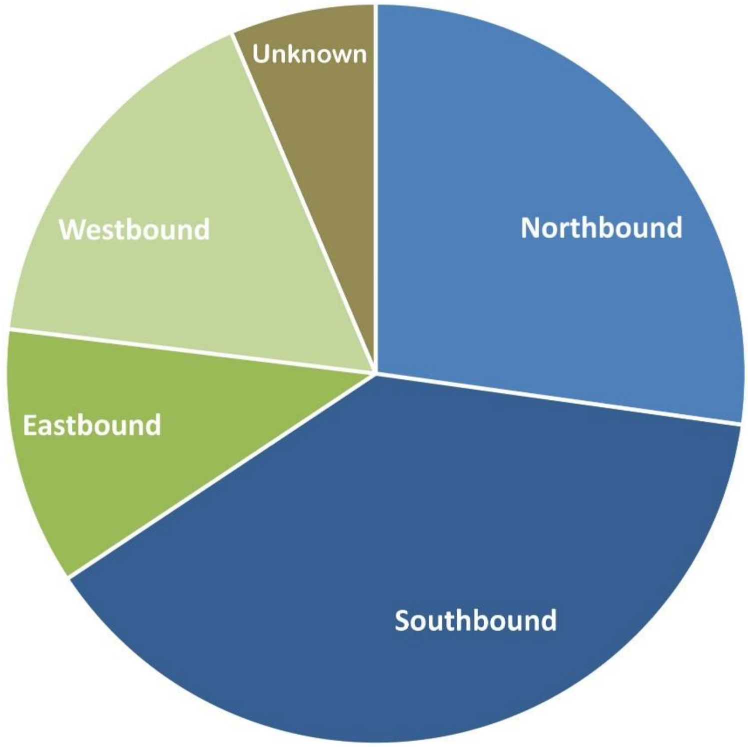

Figure 5 – Travel Direction for Corridor Rear End and Sideswipe Crashes, 2003 to 2012

2.2 Roadway Lighting

Approximately one-third of all corridor crashes occurred during periods of darkness. Figure 6 shows how crashes were distributed throughout the day by month of the year and by reported lighting condition. In the figure, bins with darker shading indicate time periods where there were more crashes throughout the study period. Two patterns are apparent in the figure: crashes tend to be concentrated in the PM peak period (when traffic is heaviest) and crashes are concentrated in the winter months, regardless of lighting condition. From this, it does not appear that street lighting is a contributing factor to the crashes on this corridor. The proposed design will replace the continuous lighting in the corridor to maintain standard lighting levels with the widening of the roadway.

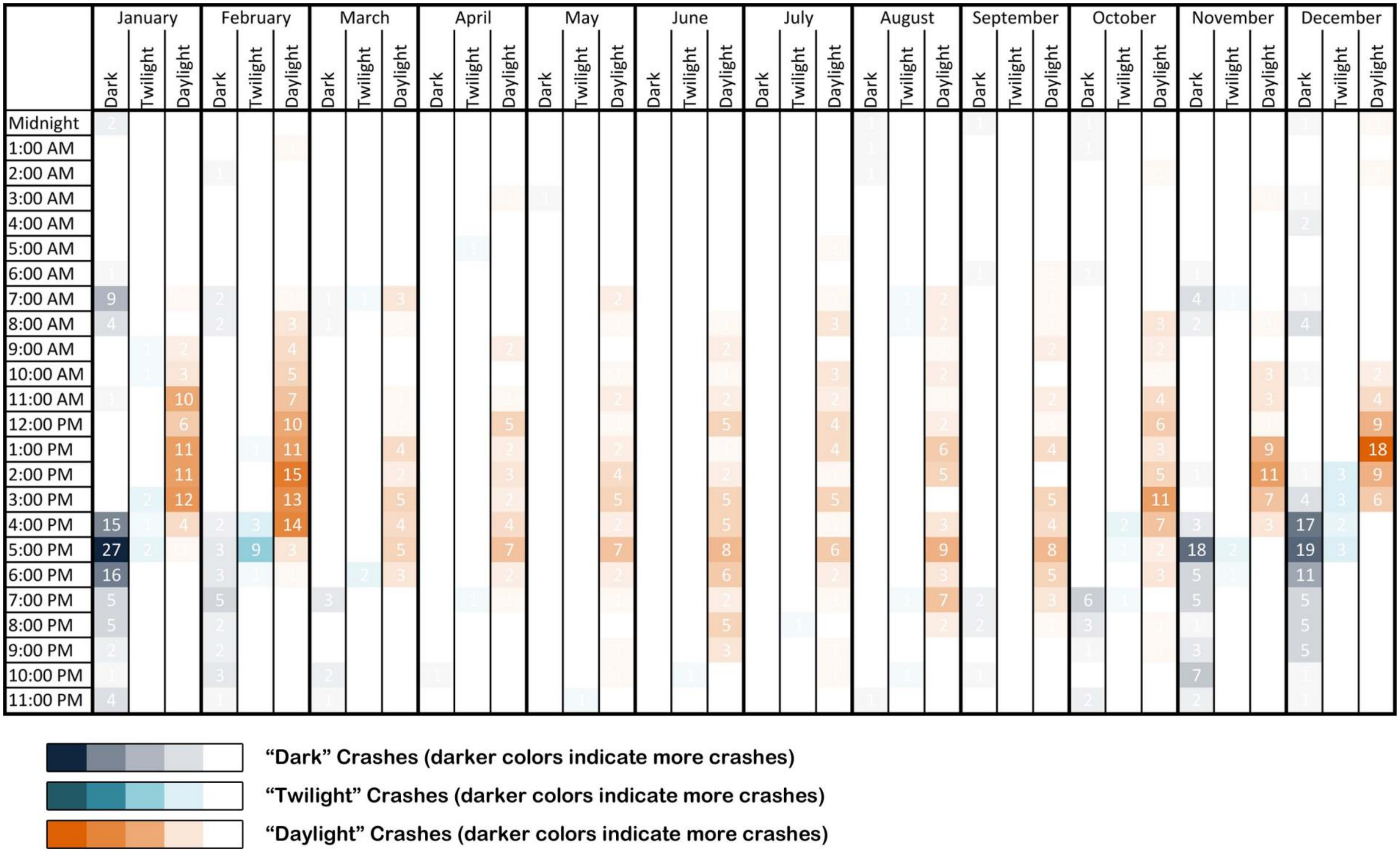

Figure 6 – Number of Crashes by Time of Day, Month of Year, and Lighting Condition, 2003 to 2012

2.3 Roadway Surface Condition

For almost 30% of all crashes, the road surface was identified as a contributing factor in the crash. The road surface condition at the time of the crash was identified as "ice" for over 80% of these crashes. Figure 7 shows the road surface condition for each of the 926 crashes in the study area. It is clear from the figure that ice, slush, and snow are correlated with the increased number of crashes in the winter months.

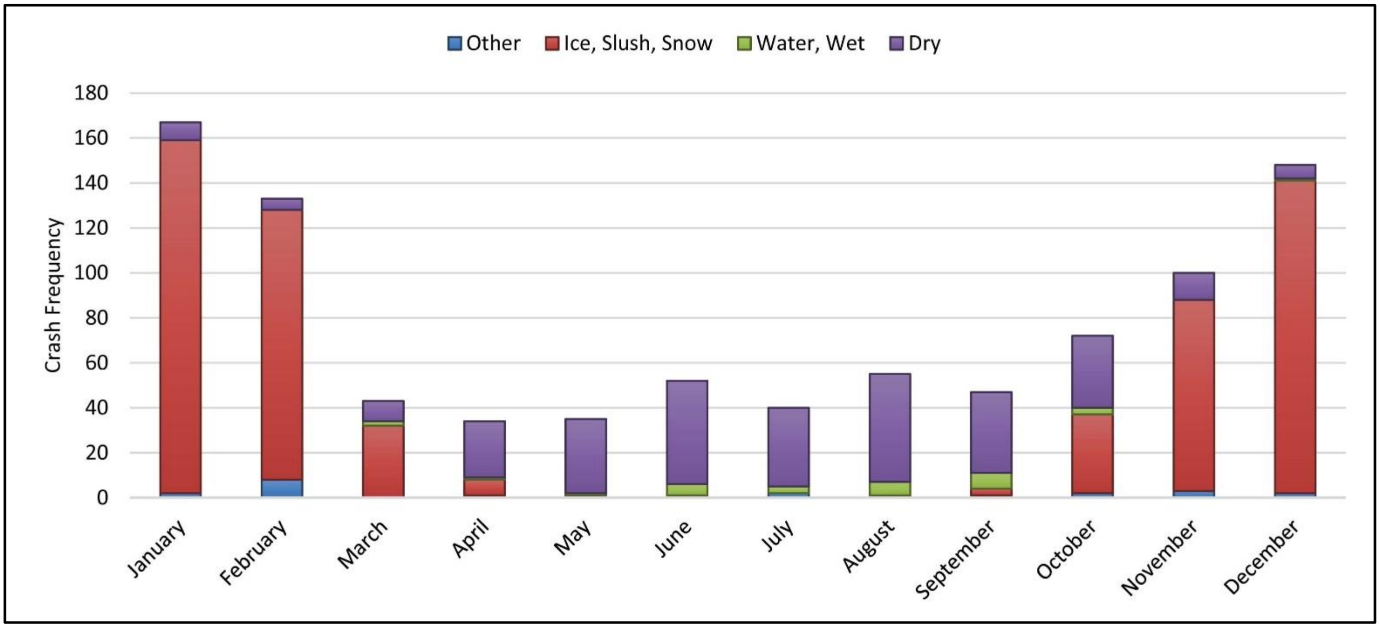

Figure 7 - Crashes by Road Surface Condition and Month, 2003 to 2012

2.4 Pedestrian and Bicycle Crashes

There were 3 pedestrian crashes and 16 bicycle crashes in the study area between 2003 and 2012. The vehicle was turning right in 2 of the pedestrian crashes and in 7 of the bicycle crashes. This is a common crash type where the vehicle driver is looking to their left to see if there is a gap in traffic and fails to see a pedestrian or bicyclist coming from their right. Features of the proposed design that are expected to improve safety for pedestrians and bicyclists include right turn channelizing islands (to be installed at Airport Way and at University Avenue) and bicycle lanes. It is expected that the bicycle lanes will help make bicyclists more visible to motorists and will reduce conflicts between bicyclists and pedestrians.

3 Intersection Crashes

The majority of corridor crashes (868 crashes) occur at intersections. Crash rates were calculated for each of the study area intersections. Intersections with higher than average rates are not necessarily significant problems. An upper control limit, or critical rate, is the threshold of concern. The Rate Quality Control Method establishes an upper control limit (UCL) to determine if a facility's crash rate is significantly higher than crash rates in facilities with similar characteristics. The UCL is determined statistically as a function of the statewide average crash rate for a facility and the vehicle exposure at the location being studied. Facilities with rates that exceed the UCL are inferred to be above the population average at the stated confidence level, so that the observed high crash experience is not likely to be due solely to chance. Table 3 shows the crash rate for each intersection and highlights those intersections where the crash rate is above or very close to the UCL.

Intersection	Number of Crashes	Average Entering AADT	Crashes / MEV	Control Type	State Average	Upper Control Limit at 95% Confidence	Above Average?	Above Critical (UCL)?
Davis Road	29	10,946	0.726	Stop	0.522	0.723	yes	yes
Holden Road	3	10,238	0.080	Stop	0.522	0.730	no	no
19th Avenue	2	10,290	0.053	Stop	0.522	0.729	no	no
Swenson Avenue	2	10,278	0.053	Stop	0.522	0.729	no	no
Erickson Avenue	24	11,344	0.580	Stop	0.636	0.852	no	no
Mitchell Avenue	6	10,258	0.160	Stop	0.522	0.730	no	no
Rewak Drive	46	16,521	0.763	Signal	1.376	1.633	no	no
Airport Way	230	34,006	1.853	Signal	1.376	1.553	yes	yes
Geraghty Avenue	46	19,970	0.631	Stop	0.522	0.668	yes	no
Goldizen Avenue	17	18,344	0.254	Stop	0.522	0.675	no	no
Widener Lane	24	18,254	0.360	Stop	0.522	0.675	no	no
Indiana Avenue	35	18,361	0.522	Stop	0.522	0.675	yes	no
Wolf Run	18	18,270	0.270	Stop	0.522	0.675	no	no
Geist / Johansen Expressway	287	39,106	2.011	Signal	1.376	1.541	yes	yes
Sandvik Street	59	20,446	0.791	Stop	0.636	0.795	yes	no
Cameron Street	6	20,221	0.081	Stop	0.522	0.667	no	no
Thomas Street	27	20,127	0.368	Stop	0.522	0.667	no	no

Table 3 - Intersection Crashes and Crash Rates, 2003 to 2012

3.1 Davis Road

There were 29 crashes at Davis Road during the study period. Figure 8 shows the distribution of crashes by year. Figure 9 shows the distribution of crashes by crash type.

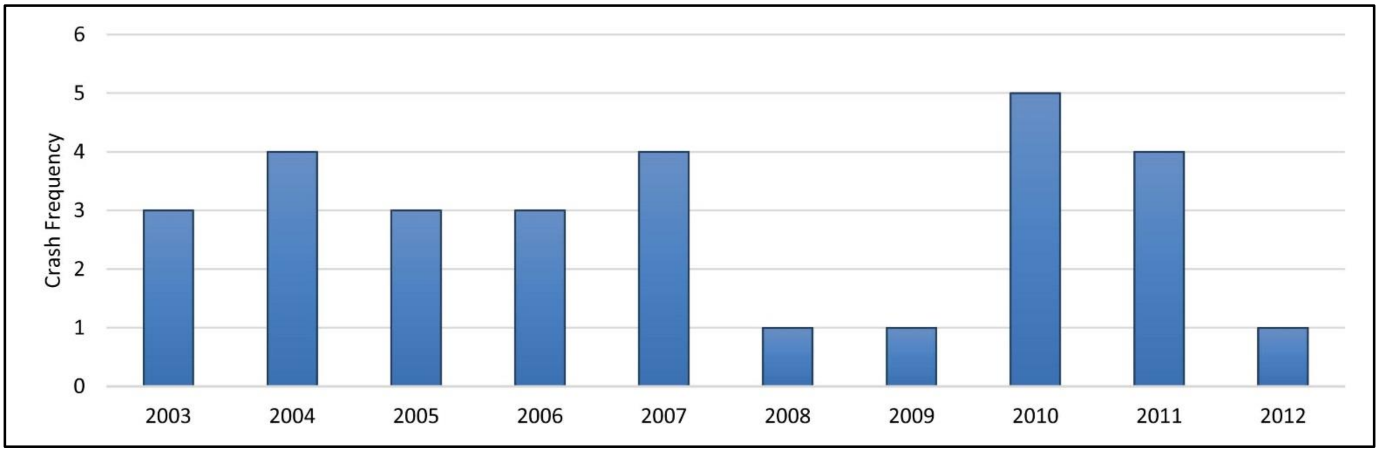

Figure 8 – Crashes per Year at Davis Road Intersection, 2003 to 2012

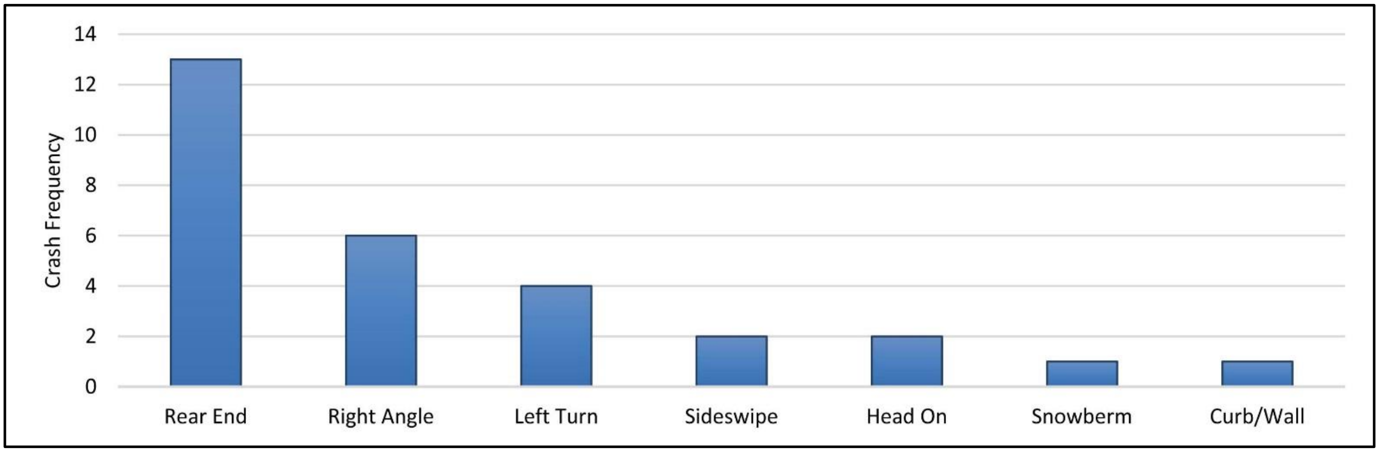

Figure 9 – Crash Types at Davis Road Intersection, 2003 to 2012

Rear end and sideswipe crashes made up the largest category of crashes at this intersection. Of the 15 rear end and sideswipe crashes, 6 involved southbound drivers. These are mostly related to southbound vehicles slowing or stopping to turn left onto Davis Road. The proposed design would install a southbound left turn lane at this intersection. According to the Highway Safety Improvement Program (HSIP) Handbook, installing a southbound left turn lane will reduce southbound rear end and sideswipe crashes at this location by 55% (a reduction of 3 to 4 crashes).

The next highest category of crashes occurring at this intersection is right angle and left turn crashes, which account for 10 crashes during the study period. One possible crash mitigation for these types of crashes is through the installation of a traffic signal, which has been proposed at this intersection; however, there is not a sufficient right angle crash pattern to satisfy a crash-based traffic signal warrant.

3.2 Erickson Avenue

This intersection does not currently have a higher than average crash rate; however, a history of southbound rear end crashes related to left turning vehicles led to the installation of a southbound left turn lane in 2008. Figure 10 shows the distribution of crashes at this intersection by year from 2003 to 2012. The figure clearly shows a significant reduction in rear end and sideswipe crashes after the left turn lane was constructed in 2008. This safety benefit will be maintained under the proposed design.

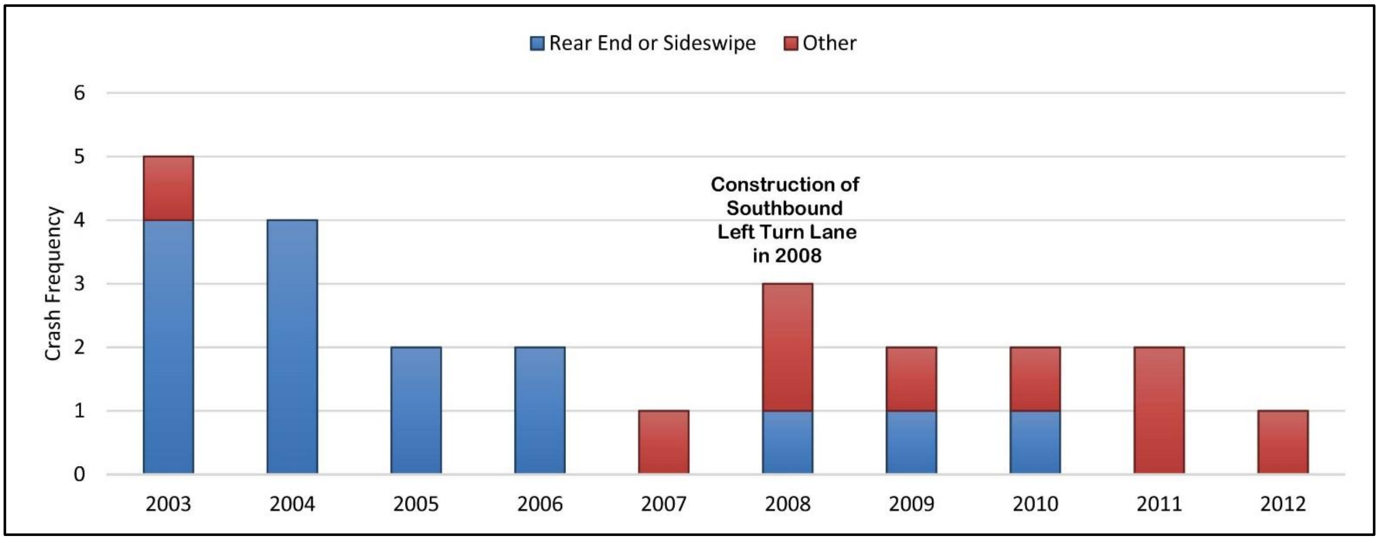

Figure 10 – Crashes per Year by Crash Type at Erickson Avenue Intersection, 2003 to 2012

3.3 Airport Way

There were 230 crashes at Airport Way in the study period. Figure 11 shows the distribution of crashes by year. Figure 12 shows the distribution of crashes by crash type.

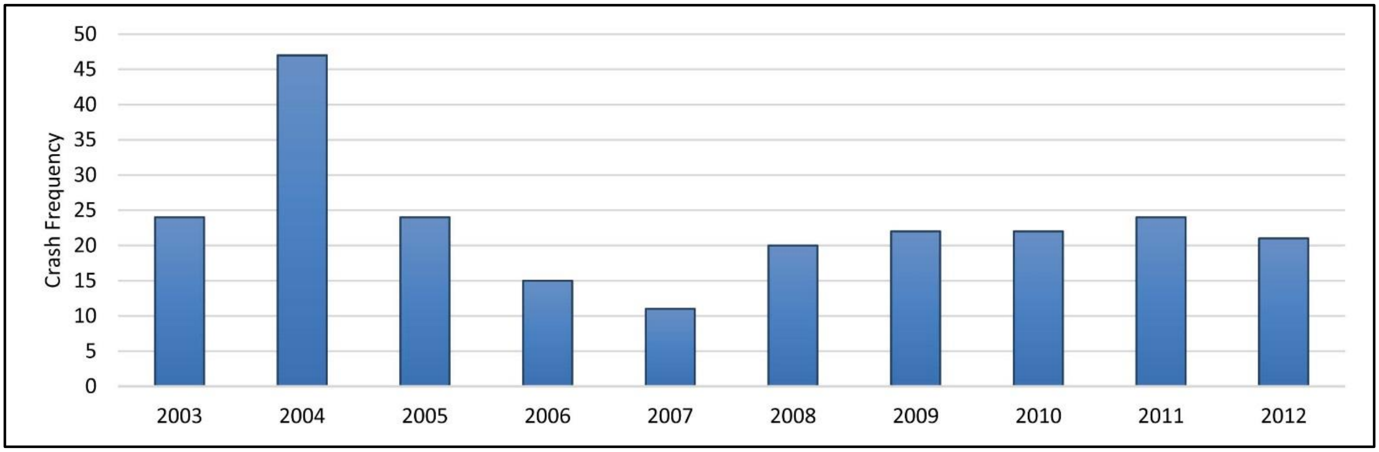

Figure 11 – Crashes per Year at Airport Way Intersection, 2003 to 2012

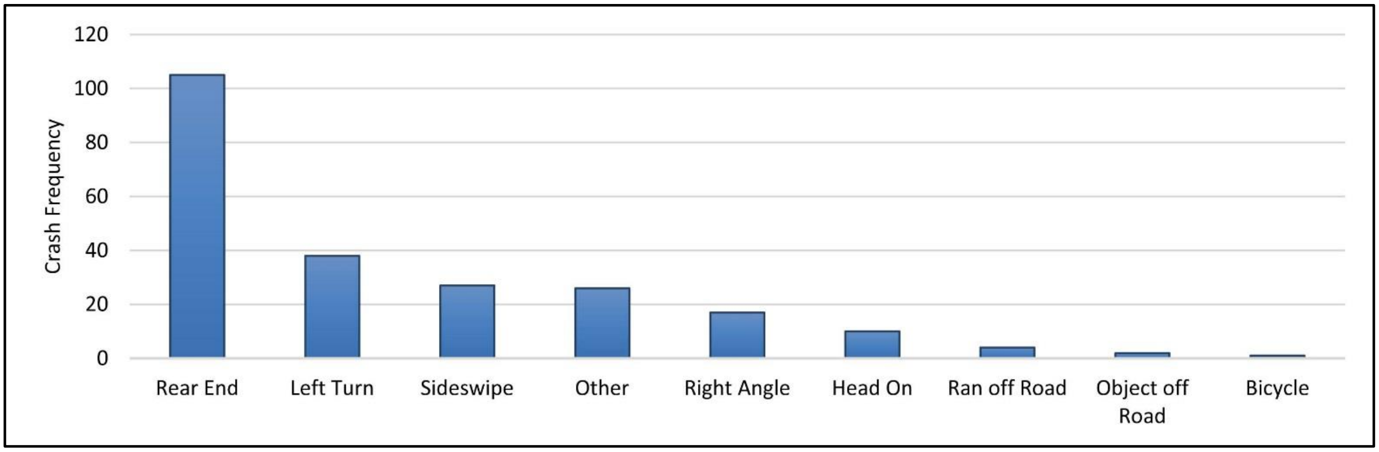

Figure 12 – Crash Types at Airport Way Intersection, 2003 to 2012

Just over half of all crashes at Airport Way were rear end crashes. Rear end crashes are evenly distributed across all approaches to this intersection and are most likely related to the change of the signal phase from green to yellow and then red. The most common mitigation for this type of crash is to adjust the yellow change and red clearance times to match the ITE-recommended “Proposed Recommended Practice for Determining Vehicle Change Intervals.” Since ADOT&PF already uses the recommended practice to develop signal timing, this project is not expected to affect the number of rear end crashes at this location.

Left turn crashes make up nearly 20% of the crashes at this intersection. Thirty-five of the 38 left turn crashes involve eastbound or westbound vehicles turning left. Under the existing conditions, these are protected-permitted left turn movements. Vehicles in opposing left turn lanes block the view of left turn drivers, making it difficult to determine if there is an adequate gap to complete the left turn maneuver. Under the proposed design, left turns will still operate protected-permitted for all left turn movements; however, all of the left turn lanes will be positively offset so that left turn drivers will have sufficient sight distance to see past stopped vehicles in the opposing left-turn lane and determine if there is an adequate gap to complete the left turn maneuver. According to the Crash Modification Factors Clearinghouse, this is expected to reduce the number of left turn crashes by 38% (a reduction of 14 to 15 crashes).

The bicycle crash at this location occurred in June 2012 when a bicyclist traveling eastbound was struck by a southbound passenger car that was turning left.

3.4 Geist Road / Johansen Expressway

There were 287 crashes at the Geist Road / Johansen Expressway intersection during the study period. Figure 13 shows the distribution of crashes by year. Figure 14 shows the distribution of crash types.

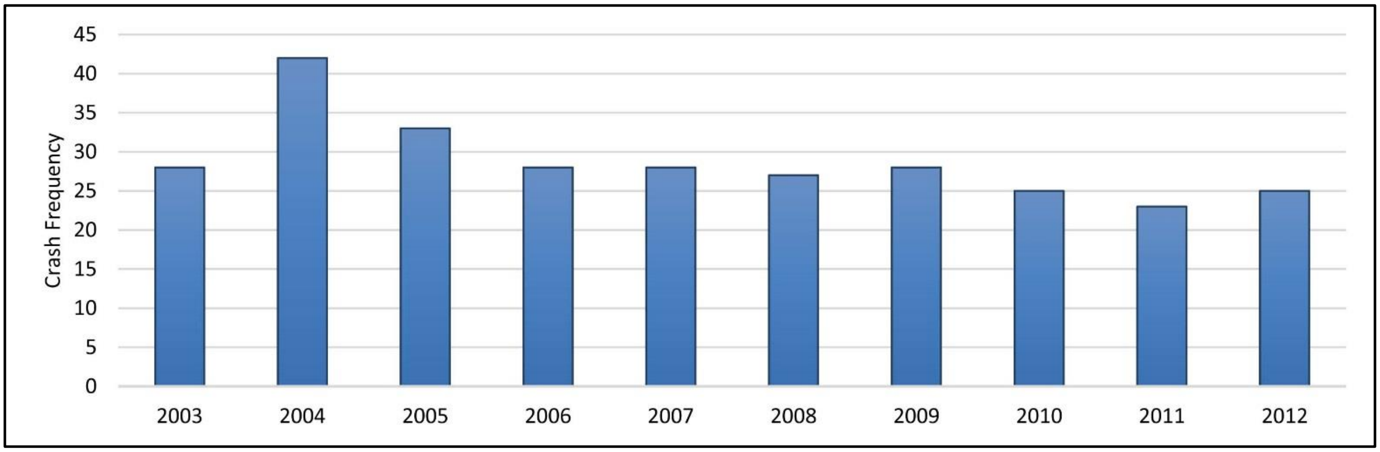

Figure 13 – Crashes per Year at Geist Road / Johansen Expressway Intersection, 2003 to 2012

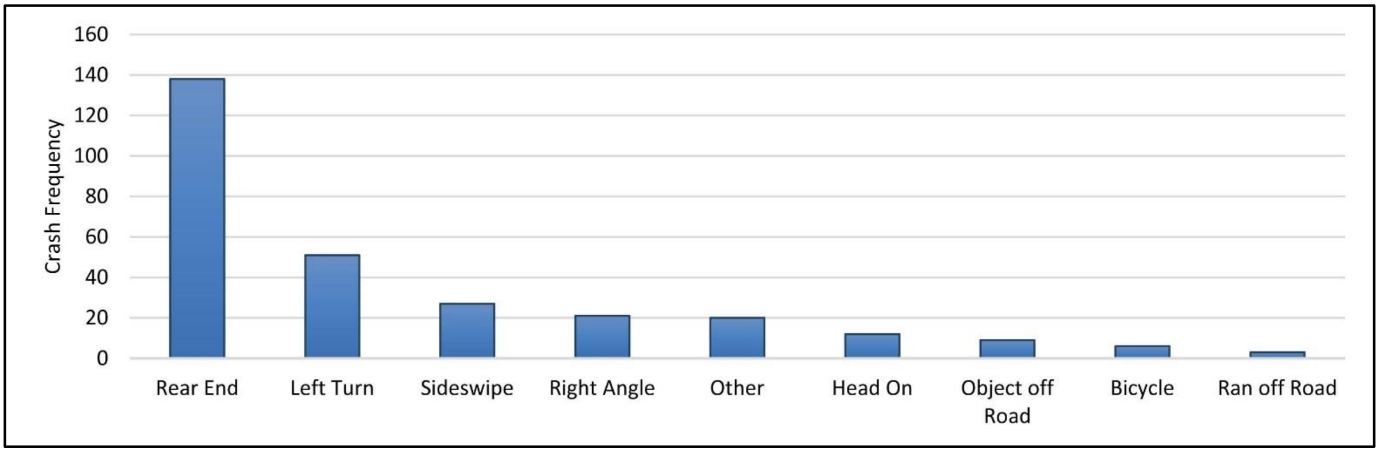

Figure 14 – Crash Types at Geist Road / Johansen Expressway Intersection, 2003 to 2012

Almost half of all crashes at Geist Road/Johansen Expressway are rear end crashes. Rear end crashes are evenly distributed across all approaches to this intersection and are most likely related to the change of the signal phase from green to yellow and then red. The most common mitigation for this type of crash is to adjust the yellow change and red clearance times to match the ITE-recommended "Proposed Recommended Practice for Determining Vehicle Change Intervals." Since ADOT&PF already uses the recommended practice to develop signal timing, this project is not expected to affect the number of rear end crashes at this location.

Left turn crashes make up nearly 20% of the crashes at this intersection. Forty of the 51 left turn crashes at this intersection involved eastbound or westbound vehicles turning left. As with the Airport Way intersection, these are protected-permitted left turn movements. Frequently, vehicles in opposing left turn lanes block the view of left turn drivers, making it difficult to determine if there is an adequate gap to complete the left turn maneuver. Under the proposed design, an additional left turn lane will be installed on all approaches (dual turn lane), requiring the left turn phasing to be converted to protected-only thereby removing the driver error associated with selecting inadequate gaps during a permissive phase. According to the Highway Safety Manual (HSM) published by the American Association of State Highway and Transportation Officials (AASHTO), this is expected to reduce the total number of crashes by 10% (a reduction of 28 to 29 crashes of various crash types).

There were 6 bicycle crashes and no pedestrian crashes at this intersection during the study period. This is the largest concentration of bicycle crashes in the corridor. Four of the 6 crashes involved a right-turning vehicle. This is a common crash type where the vehicle driver is looking to their left to see if there is a gap in traffic and fails to see a pedestrian or bicyclist coming from their right. Under the proposed design, right turn channelizing islands will be constructed for northbound vehicles and for westbound vehicles. One advantage of this design is that it allows turning vehicles to first interact with pedestrians and bicyclists at the crosswalk before moving forward and interacting with the cross traffic. At the crosswalk, the vehicle and pedestrian paths are perpendicular to each other, improving the visibility of pedestrians and vehicles to each other. The National Cooperative Highway Research Program (NCHRP) recently published NCHRP w208: Design Guidance for Channelized Right-Turn Lanes. This study found that locations with right turn lanes that are not channelized have 70 to 80% more pedestrian crashes than locations with channelized right turn lanes (a reduction of about 2 pedestrian or bicycle crashes).

3.5 Sandvik Street

There were 59 crashes at the Sandvik Street intersection during the study period. Although the crash rate at Sandvik Street is below the UCL, it is very close to the UCL; therefore, the crashes at Sandvik Street were examined as if the crash rate were above the UCL. Figure 15 shows the distribution of crashes by year. Figure 16 shows the distribution of crash types.

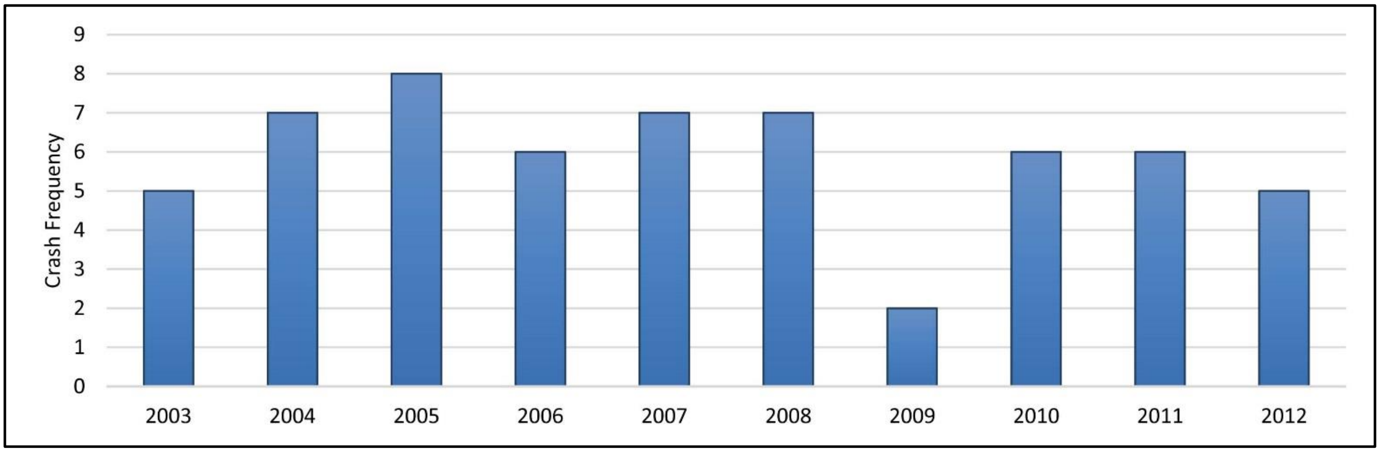

Figure 15 – Crashes per Year at Sandvik Street Intersection, 2003 to 2012

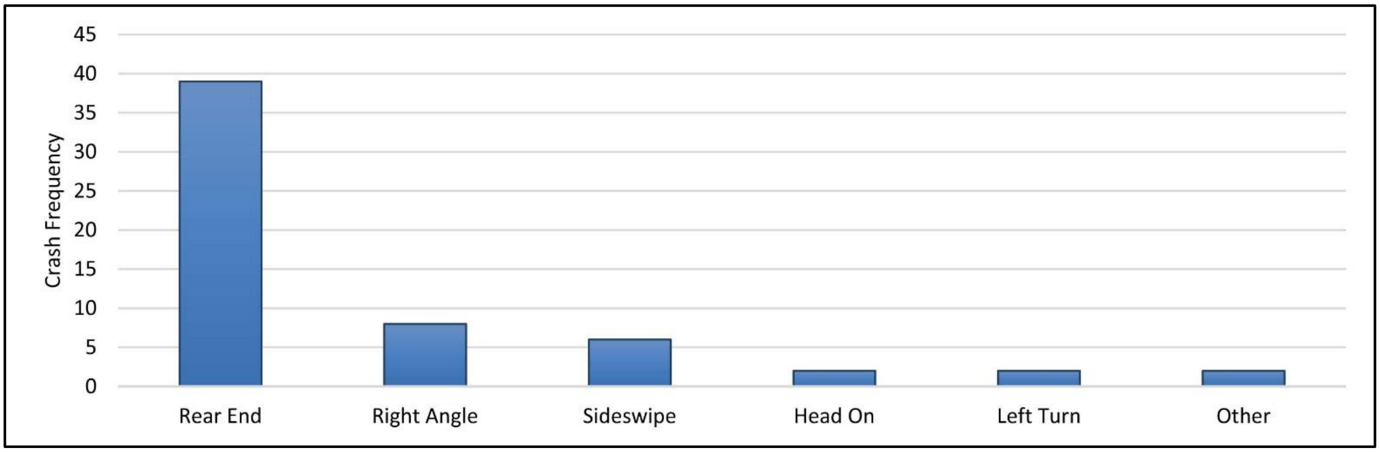

Figure 16 – Crash Types at Sandvik Street Intersection, 2003 to 2012

Approximately 66% of the crashes at this location are rear end crashes. Of the 45 rear end crashes, 40 involved northbound or southbound drivers. Many of these crashes indicate that the lead vehicle was slowing, stopping, or turning. The proposed design will construct left turn lanes at this intersection. This will allow left turning traffic to move out of the travel lanes as they slow down or stop before completing their turn. According to the HSIP Handbook, installing a southbound left turn lane will reduce rear end and sideswipe crashes at this location by 50% (a reduction of 20 crashes).

The next highest category of crashes occurring at this intersection is right angle and left turn crashes, which account for 10 crashes during the study period. One possible crash mitigation for these types of crashes is a traffic signal, which has been proposed at this intersection; however, there is not a sufficient right angle crash pattern to satisfy a crash-based traffic signal warrant.

Sandvik Street provides access to two high schools – Hutchison Institute of Technology and West Valley High School; however, the ages of at-fault drivers involved in crashes at Sandvik Street mirror the ages of at-fault drivers throughout the corridor, indicating that there is not a specific crash concern related to the high school students at this intersection. (See Figure 17.)

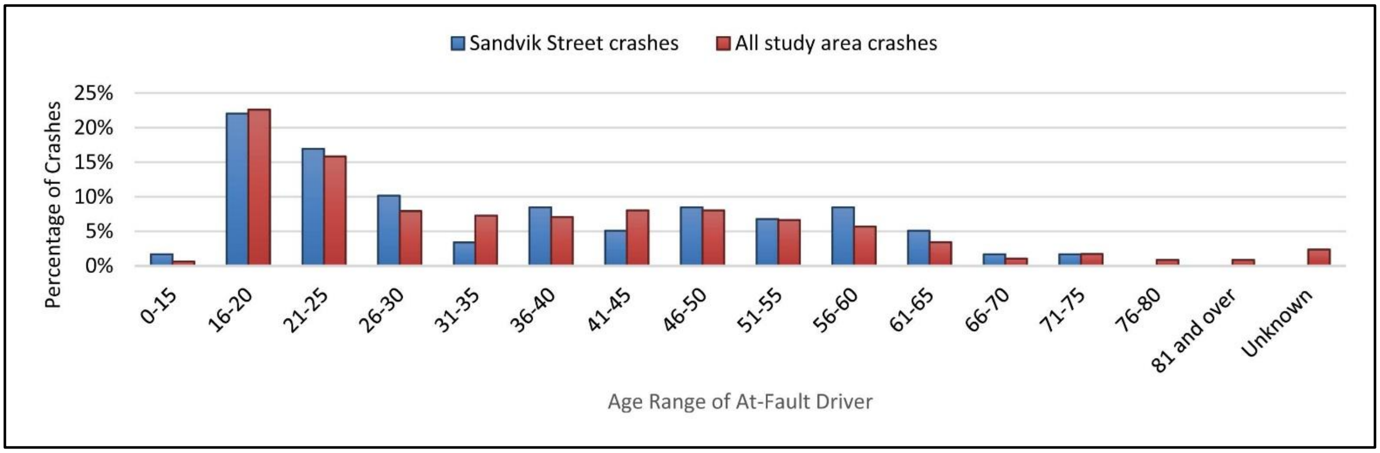

Figure 17 – Age of At-Fault Drivers, Sandvik Street Compared to Study Area, 2003 to 2012

The existing pedestrian overcrossing structure over University Avenue just south of Sandvik Street is to be removed as part of the proposed University Avenue upgrades. The structure used to serve an elementary school on the west side of University Avenue north of Sandvik Street; however, the school has since been converted to a university facility. As such, the removal of the structure will not have an effect on school walking routes. Observations of this intersection during school dismissal time for the high schools showed that some high school students use the overpass to cross University Avenue and others cross at-grade at mid-block locations north of Sandvik Street. With the proposed design, students will have the choice of walking 1/8 of a mile to the signal at Geist Road or to cross at an uncontrolled crossing. To aid those who choose to use the uncontrolled crossing, it is desirable to provide a minimum 6-foot median for pedestrian refuge.

4 Segment Crashes

There were 66 segment crashes that cannot be attributed to an intersection during the study period. Crash rates were calculated for each of the study area segments. Segments with higher than average rates are not necessarily significant problems. An upper control limit, or critical rate, is the threshold of concern. The Rate Quality Control Method is used to establish an upper control limit (UCL) to determine if a facility's crash rate is significantly higher than crash rates in facilities with similar characteristics. Facilities with rates that exceed the UCL are inferred to be above the population average at the stated confidence level, so that the observed high crash experience is not likely to be due solely to chance. Table 4 shows the crash rate for each segment. For none of the segments is the crash rate above or very close to the UCL.

As shown in Figure 18, rear end crashes make up the majority of the segment crashes for this corridor. Of the 42 rear end crashes, 38 crashes involved northbound or southbound drivers. Many of these crashes indicate that the lead vehicle was slowing, stopping, or turning. The proposed design will construct a center median restricting left turn access to median openings with left turn lanes. This will allow left turning traffic to move out of the travel lanes as they slow down or stop before completing their turn. This improvement is expected to reduce segment rear end crashes by 33%.

There were 3 bicycle and 2 pedestrian crashes attributed to segments in the corridor. The majority of these occurred at driveway locations, with a vehicle entering the travel way. The proposed design will construct bicycle lanes, which will make faster moving bicycles more visible to motorists. It is unknown what effect bicycle lanes will have on the number of bicycle crashes.

Intersection	**Number of Crashes**	**Segment Length (Miles)**	**Average Entering AADT**	**Crashes / MVM**	**State Average**	**Upper Control Limit** 95% Confidence	**Above Average ?**	**Above Critical (UCL)?**
Mitchell Expressway to Davis Road	0	0.253	6,432	0.000	2.119	3.186	no	no
Davis Road to Rewak Drive	0	0.515	10,190	0.000	2.119	2.692	no	no
Rewak Drive to Airport Way	15	0.142	19,354	1.495	2.119	2.925	no	no
Airport Way to Geraghty Avenue	0	0.034	19,354	0.000	2.119	3.872	no	no
Geraghty Avenue to Goldizen Avenue	27	0.452	19,354	0.846	2.119	2.558	no	no
Goldizen Avenue to Geist Road/Johansen Expressway	0	0.375	18,222	0.000	2.119	2.618	no	no
Geist Road/Johansen Expressway to Sandvik Street	7	0.16	20,021	0.599	2.119	2.862	no	no
Sandvik Street to Cameron Street	17	0.142	20,021	1.638	2.119	2.910	no	no
Cameron Street to Alumni Drive/College Road	0	0.154	20,021	0.000	2.119	2.877	no	no

Table 4 – Segment Crashes and Crash Rates, 2003 to 2012

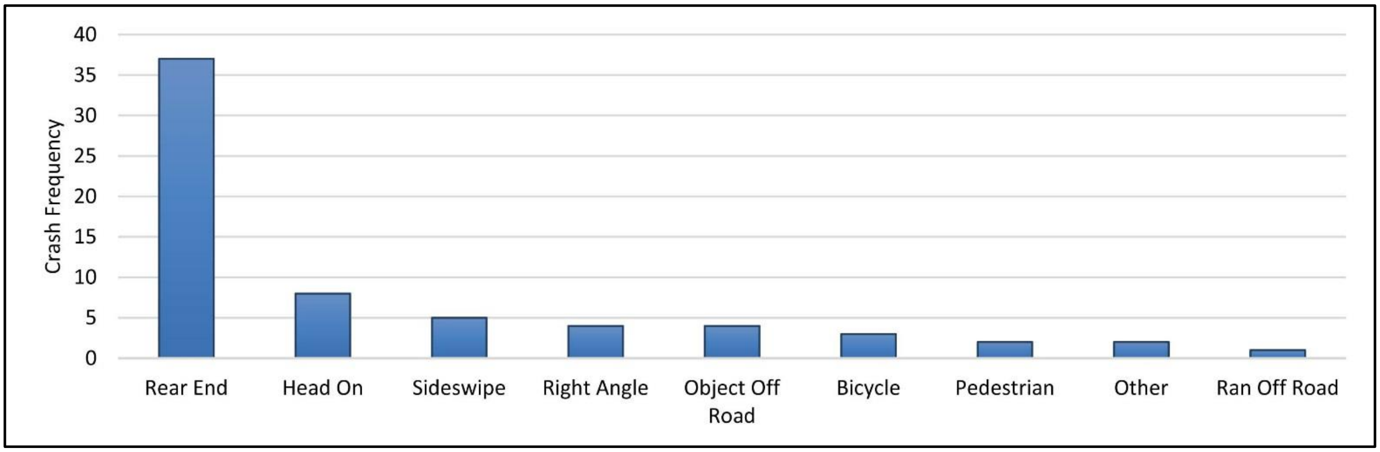

Figure 18 – Crash Types for Segment Crashes, 2003 to 2012

5 Summary

The University Avenue Rehabilitation and Widening project will widen the existing four-lane highway to include a raised median, with median openings and channelized left turn lanes at key intersections. The signalized intersections of Airport Way and Geist Road/Johansen Expressway will be upgraded to make safety and operational improvements. Although earlier designs included plans for signal installations at the Davis Road and Sandvik Street intersections, recent analyses have found that signal warrants are not met at these intersections; therefore, the current design does not include signalization of these two intersections. This report corroborates that the crash experience at these two intersections does not suggest a need for signalization.

This report analyzes the 926 reported crashes in the project corridor from 2003 through 2012 and identifies locations with higher than expected crash rates, crash patterns at these locations, and expected crash reductions based on the proposed design. The crash reduction factors that were used are shown in Table 5. Table 6 summarizes the crash reduction that would have occurred if the proposed design had been in place during the study period.

Proposed Design Features	Crash Reduction Factors	Crash Types	Reference
Center Raised Median	-20%	Cross over and segment access-related collisions.	HSIP Handbook
Install Left Turn Lanes on Major Road	-55% (3-Leg Intersection) -50% (4-Leg Intersection)	Rear ends and sideswipes on major road	HSIP Handbook
Provide Offset for Existing Left Turn Lanes	-38%	Left turn crashes from major road	Crash Modification Factors Clearinghouse
Change Left Turn Phasing to Protected-Only	-10%	All	AASHTO HSM
Channelized Right Turn	-55%	Pedestrian or bicycle crashes with right-turning vehicles	NCHRP w208

Table 5 – Crash Reduction Factors Associated with Design Features

Segment or Intersection	2003 to 2012 Crash Frequency	Crash Rate Statistically Higher than Average?	Proposed Design Features	Crash Reduction Over Study Period
Mitchell Expressway to Davis Road	0	No	Center Raised Median	0
Davis Road	29	Yes	SB Left Turn Lane	3 to 4
Davis Road to Rewak Drive (and minor intersections)	37	No	Center Raised Median, Median Opening with Left Turn Lane at Holden, Erickson	7 to 8
Rewak Drive	46	No	Offset Left Turn Lanes	2 to 3
Rewak Drive to Airport Way	14	No	Center Raised Median	1 to 2
Airport Way	230	Yes	Offset Left Turn Lanes	14 to 15
Airport Way to Geraghty Avenue	0	No	Center Raised Median	0
Geraghty Avenue	46	No	Center Raised Median (Right-in-right-out only)	4
Geraghty Avenue to Goldizen Avenue	27	No	Center Raised Median	0 to 1
Goldizen Avenue	17	No	Median Opening with Left Turn Lane	6 to 7
Goldizen Avenue to Geist Road/Johansen Expressway (and minor intersections)	77		Center Raised Median, Median Opening with Offset Left Turn Lane at Indiana	26 to 27
Geist Road/Johansen Expressway	287	Yes	All Left Turns Protected-Only Phasing	30 to 31
Geist Road to Sandvik Street	7	No	Center Raised Median	0
Sandvik Street	59	Yes?	Offset Left Turn Lanes	20
Sandvik Street to Cameron Street	17	No	Center Raised Median	0 to 1
Cameron Street	6	No	Median Opening with Left Turn Lane	0
Cameron Street to Alumni Drive/College Road	27	No	Center Raised Median to Thomas	0
Total Crash Reduction				**113 to 123**

Table 6 – Crash Reduction if Proposed Design Had Been in Place

6 References

- *Design Study Report: University Avenue Rehabilitation and Widening Project No. STP-RS-M-0617(3) / State Project No. 63213*. State of Alaska Department of Transportation and Public Facilities Northern Region, July 2010 (rev. April 2011 and November 2011). Accessed at http://www.dot.state.ak.us/stwdplng/projectinfo/project_pages/university_ave/ on July 20, 2011.

- *University Avenue Rehabilitation & Widening- Traffic Study/63213 Task 10 Capacity Studies /Design Modifications, Final Report*, April 13, 2012

- *Alaska Highway Safety Improvement Program Handbook*, 13th edition. Alaska Department of Transportation and Public Facilities, April 4, 2014.

- *Highway Safety Manual,* 1st edition. American Association of State Highway and Transportation Officials, 2010.

- *Crash Modification Factors Clearinghouse.* (website) Federal Highway Administration. Accessed at http://www.cmfclearinghouse.org/index.cfm on January 29, 2015.

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University Avenue Rehabilitation &Widening

IRIS Program No. Z632130000
Federal Project No. 0617003

Safety Analysis Update – 2010 through 2014

February 2018

Prepared For:
Alaska Department of Transportation & Public Facilities

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Table of Contents

Figures

Tables

Abbreviations

CAR	Critical Accident Rate
CRF	Crash Reduction Factor
DOT&PF	Alaska Department of Transportation and Public Facilities
HSIP	Highway Safety Improvement Program
KE	Kinney Engineering
MEV	Million Entering Vehicles
MVM	Million Vehicle Miles
NCHRP	National Cooperative Highway Research Program

1 Introduction

The Alaska Department of Transportation and Public Facilities (DOT&PF) retained Kinney Engineering (KE) to update the crash analysis for University Avenue Rehabilitation and Widening Project, including an update to include 2013 and 2014 crashes. This report analyzes the last 5 years of crash data (2010 through 2014) to identify any crash trends to determine if there are any new crash patterns to consider with the design of the project.

2 Corridor Crashes

There were 434 reported crashes on University Avenue from the Mitchell Expressway to College Road/Alumni Drive (excluding the intersections at each end) from 2010 through 2014; 392 intersection crashes and 42 segment crashes. Figure 1 presents the frequency of crashes by intersection and Figure 2 presents the crashes by segment. Note that only locations with crashes are shown in the figures.

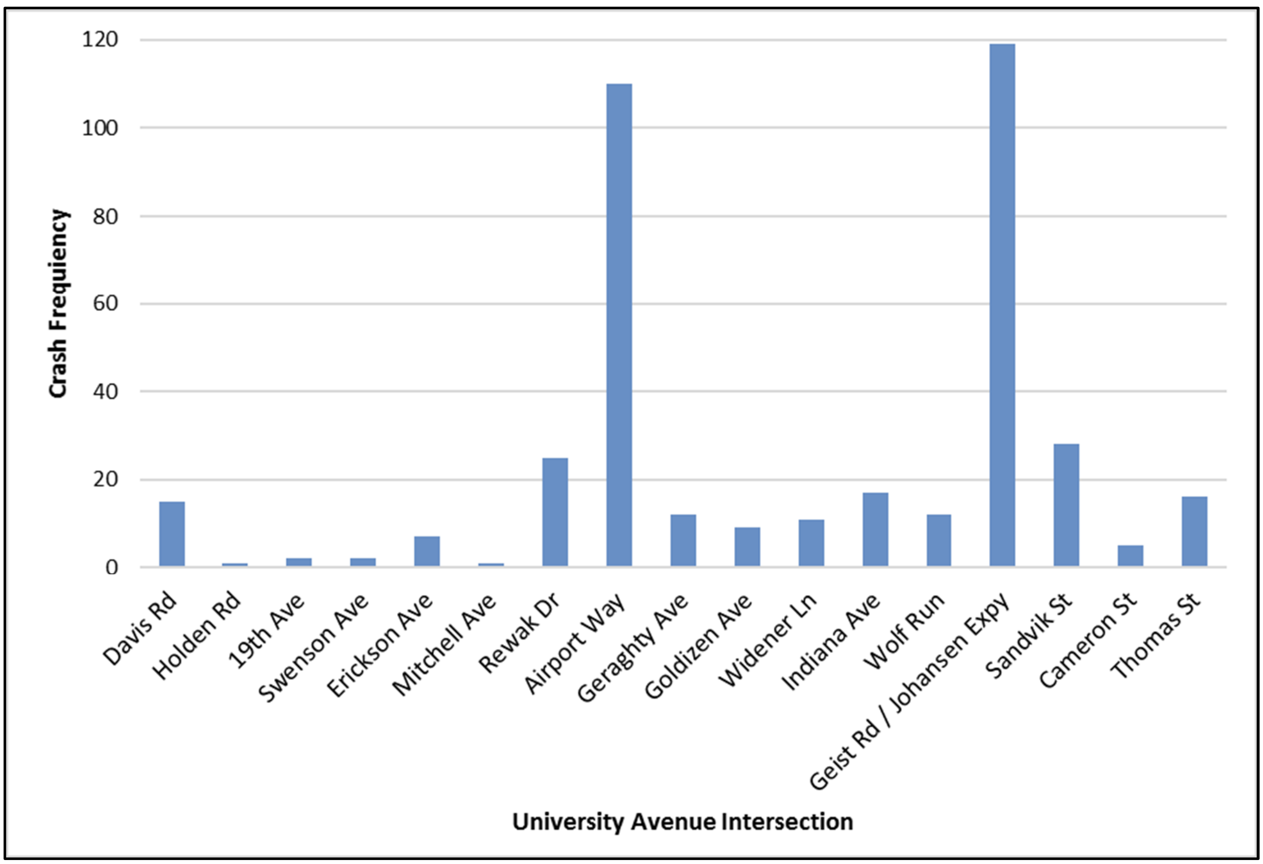


Figure 1: Crash Frequency at University Avenue Intersections (2010 to 2014)

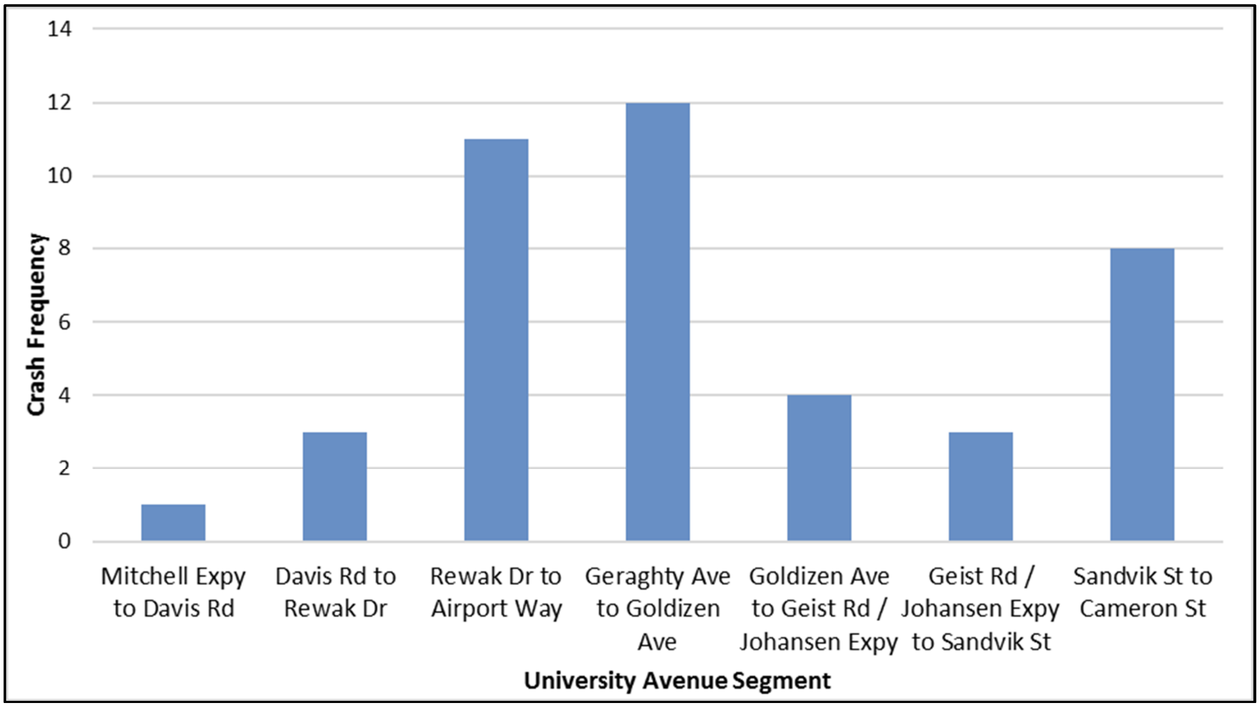


Figure 2: Crash Frequency on University Avenue Segments (2010 to 2014)

2.1 Crash Severity

Figure 3 presents the severity of the crashes per year.

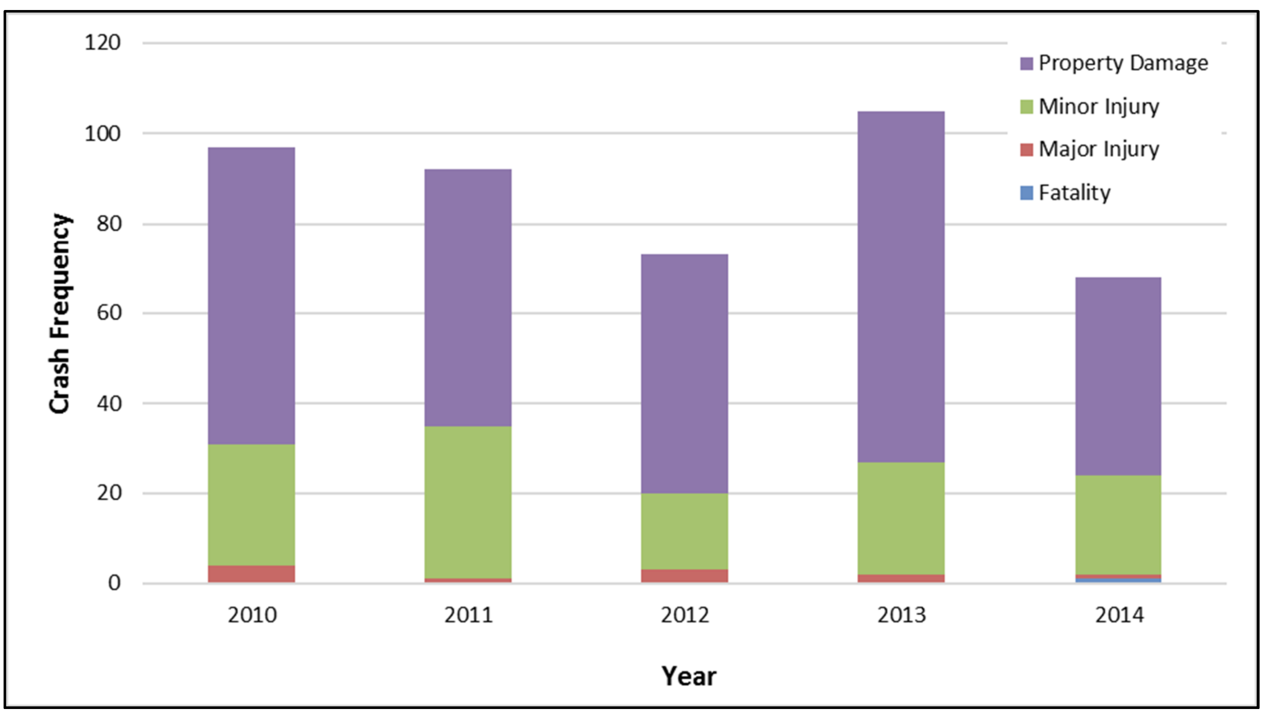


Figure 3: Crashes by Crash Severity (2010 to 2014)

Approximately 30% of the crashes resulted in minor to fatal injuries. One fatal crash occurred in 2014 at the Airport Way intersection. The fatal left-turn crash occurred in December when a speeding westbound vehicle collided with an eastbound vehicle turning left.

2.2 Crash Type

Figure 4 presents the crashes reported from 2010 through 2014 by crash type. The predominant crashes in the corridor are rear-end, right-angle, and left-turn crashes.

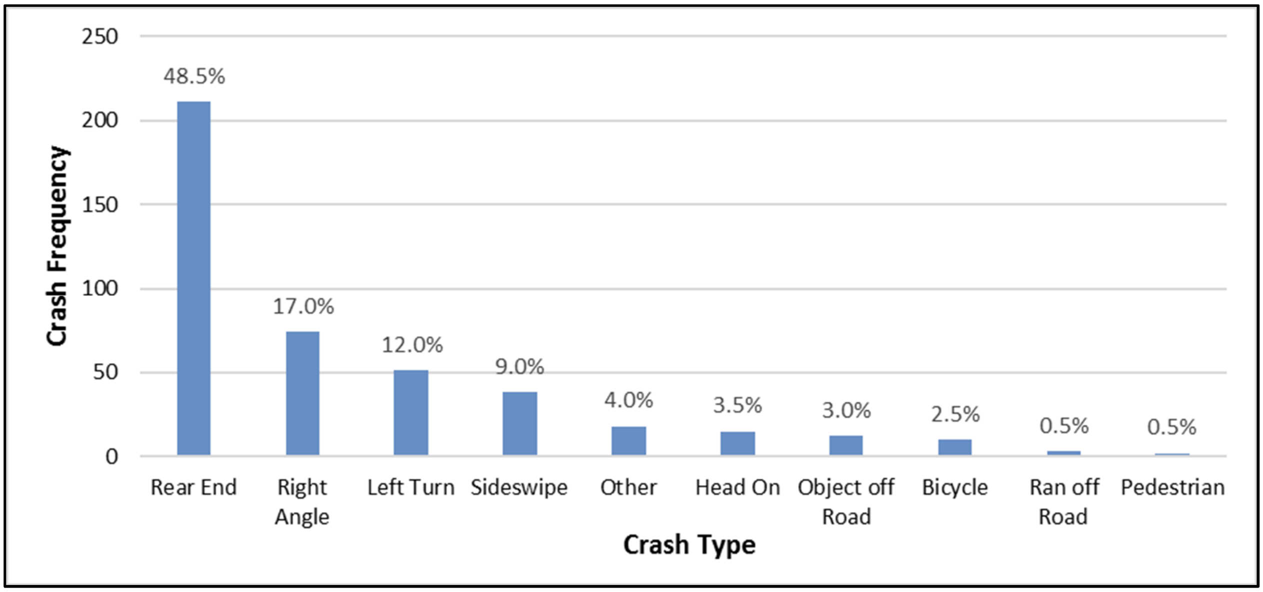


Figure 4: Crashes by Crash Type (2010 to 2014)

There were 2 pedestrian and 10 bicycle crashes within the study area. Of the crashes, one pedestrian and six bicycle crashes involved the vehicle turning right. This is a common crash type where drivers look to the left to see if there is a gap in traffic and fail to see a pedestrian or bicycle coming from the right side. The proposed design includes right-turn channelizing islands at the Airport Way and Geist Road/Johansen Expressway intersections and bicycle lanes on the travel way, which are both expected to help make pedestrians and bicyclists more visible to motorists.

There were 249 rear-end and sideswipe crashes within the project study area from 2010 to 2014. Almost 65% of these crashes occurred on University Avenue (northbound and southbound vehicles). While 90% of the rear-end and sideswipe crashes occurred at the intersections, 60% occurred at signalized intersections. Most of these crashes occurred when the signal changes and either the lead car abruptly stops, or the following car has difficulty stopping.

While right-angle crashes occurred throughout the entire corridor, left-turn crashes were more localized and occurred mostly at the University Avenue intersections at Airport Way and at Geist Road/Johansen Expressway. The proposed intersection configuration at the Geist Road/Johansen

Expressway intersection will require protected-only left-turn phasing. The left-turn lanes at the Airport Way intersection and other locations will be offset to improve sight distance by allowing opposing left-turn vehicles to see past each other and at opposing through traffic.

2.3 Roadway Lighting

Figure 5 presents the crashes by lighting conditions per month. The figure shows that during the darker winter months, there is just as much crashes during daylight hours as there are crashes in the dark. This indicates that lighting is not a contributing factor to the crashes.

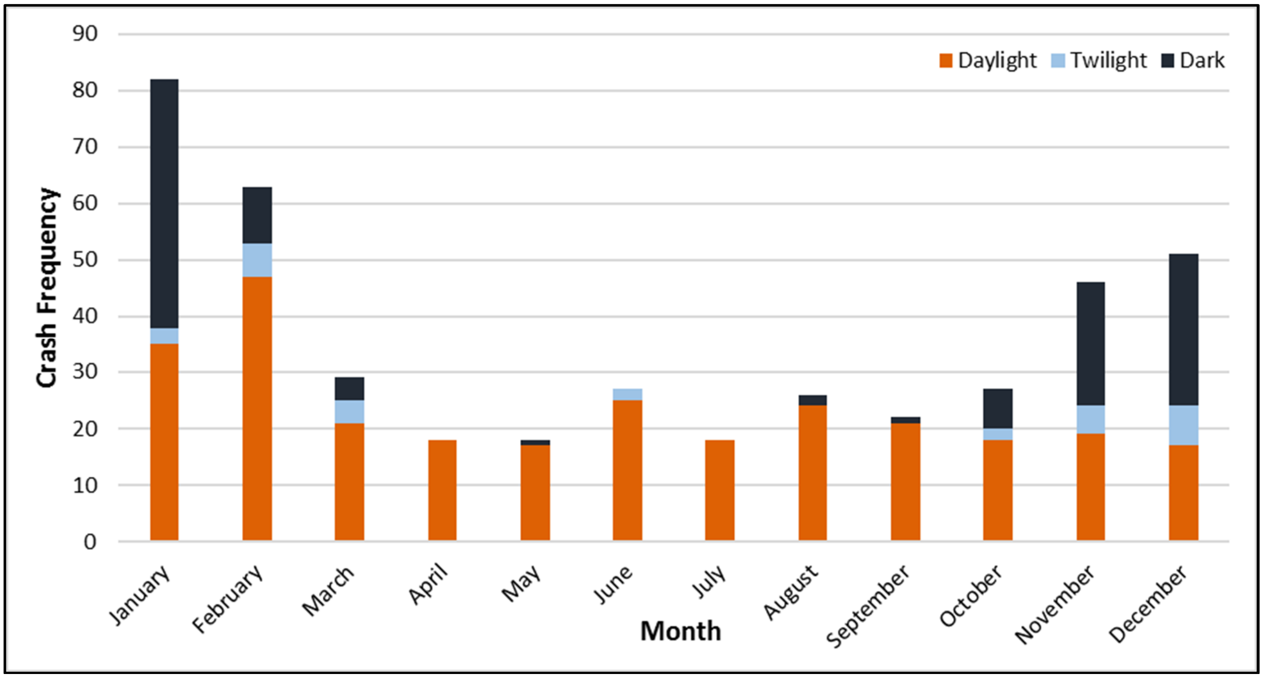


Figure 5: Crashes by Lighting Conditions (2010 to 2014)

2.4 Roadway Surface Condition

Figure 6 presents the road conditions of each crash by month. The figure indicates that there are more crashes during the winter months and that the crashes are correlated with the presence of ice, slush, or snow on the roadway. Thirty-two percent of crashes reported road surface conditions as a contributing factor. Of the crashes that reported surface conditions as a contributing factor, 94% (269 crashes) were on roads with either ice, slush, or snow on the surface.

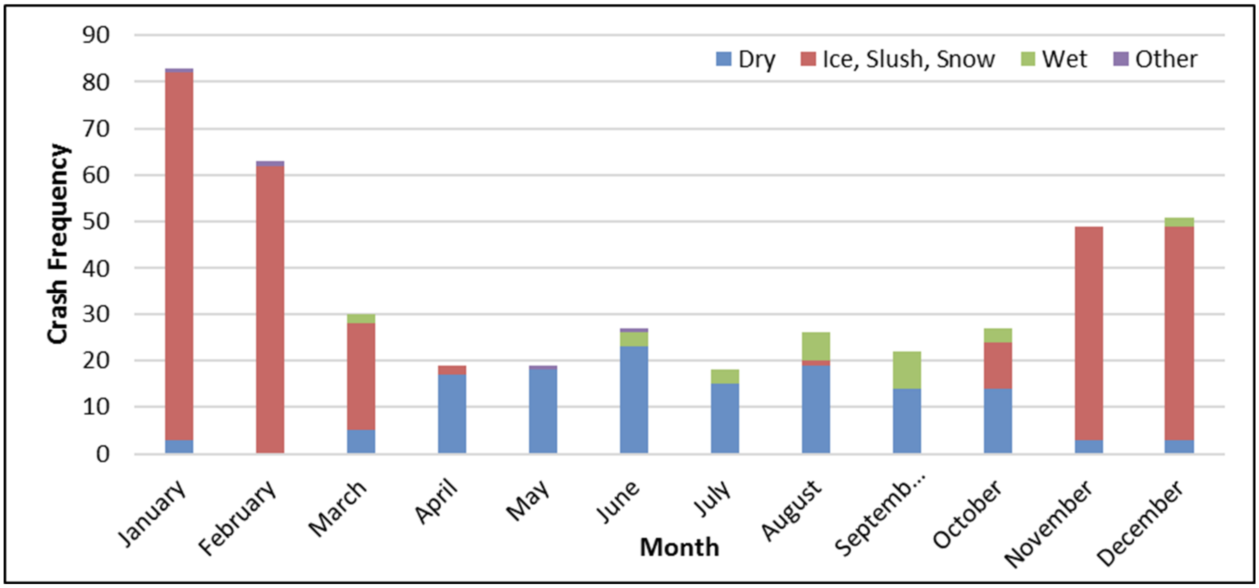


Figure 6: Crashes by Road Surface Condition (2010 to 2014)

3 Intersection Crashes

Table 1 presents the crash rates at the University Avenue intersections and compares them to statewide averages for similar facilities and the critical accident rate (CAR) at a 95% confidence level. The University Avenue intersections with Davis Road, Airport Way, Geist Road/Johansen Expressway, and Sandvik Street have crash rates above the state average for similar facilities but below the CAR. Although the crash rates for these intersections are below the CAR, they are very close to the UCL and, thus, were analyzed further.

Table 1: Crash Rates at University Avenue Intersections (2010 to 2014)

Intersection	Crash Frequency	Entering AADT	Crashes/ MEV	State Average	CAR @ 95% Confidence
Davis Road	15	10,504	**0.78**	**0.52**	0.82
Holden Road	1	9,692	0.06	0.52	0.84
19th Avenue	2	9,692	0.11	0.52	0.84
Swenson Avenue	2	9,692	0.11	0.52	0.84
Erickson Avenue	7	9,692	0.40	0.55	0.87
Mitchell Avenue	1	9,692	0.06	0.52	0.84
Rewak Drive	25	16,861	0.81	1.57	1.96
Airport Way	110	34,824	**1.73**	**1.57**	1.84
Geraghty Avenue	12	28,948	0.23	0.52	0.70
Goldizen Avenue	9	17,929	0.28	0.52	0.75
Widener Lane	11	17,929	0.34	0.52	0.75
Indiana Avenue	17	17,929	0.52	0.52	0.75
Wolf Run	12	17,929	0.37	0.52	0.75
Geist Road/ Johansen Expressway	119	38,548	**1.69**	**1.57**	1.82
Sandvik Street	28	21,111	**0.73**	**0.55**	0.76
Cameron Street	5	20,641	0.13	0.52	0.73
Thomas Street	16	20,641	0.42	0.52	0.73

AADT = Annual Average Daily Traffic
MEV = million entering vehicles

3.1 Davis Road

There were 15 crashes at the Davis Road intersection from 2010 through 2014. Figure 7 presents the crashes by crash type.

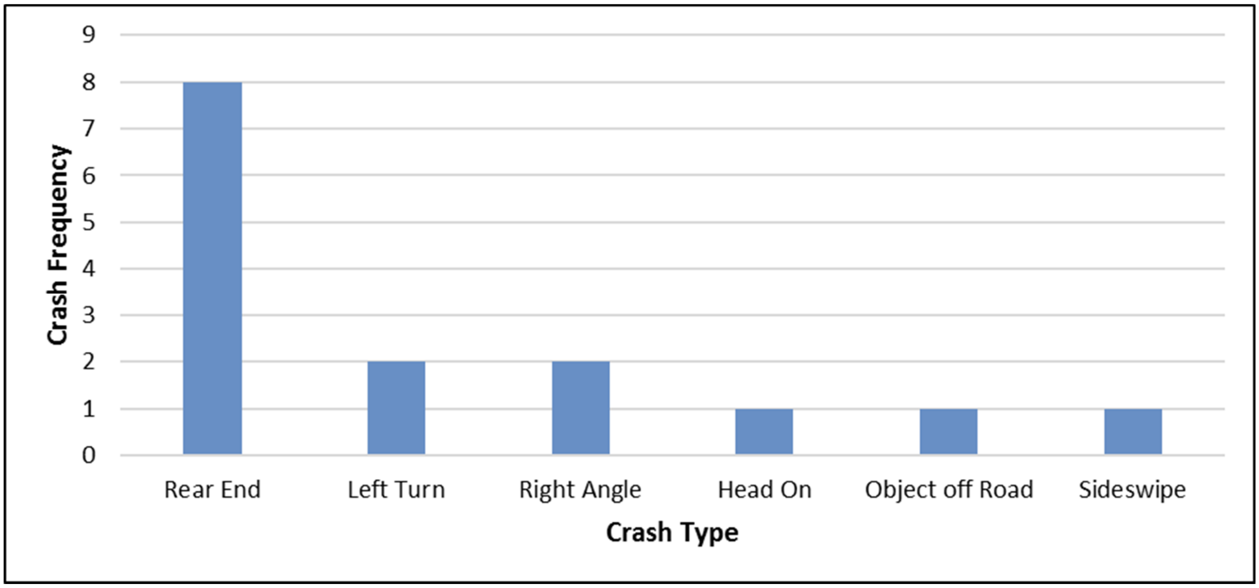


Figure 7: Crash Types at the Davis Road Intersection (2010 to 2014)

The most predominant crash type at the intersection are rear-end crashes. Of the 9 rear-end and sideswipe crashes, 5 were related to southbound vehicles that were slowing, stopped, or turning left to enter David Road. The proposed design includes a southbound left-turn lane at this intersection, removing vehicles desiring to turn left from the southbound through lanes.

3.2 Airport Way

There were 110 crashes at the Airport Way intersection. Figure 8 presents the crashes by crash type. Rear-end, left-turn, and sideswipe crashes are the most predominant crash types.

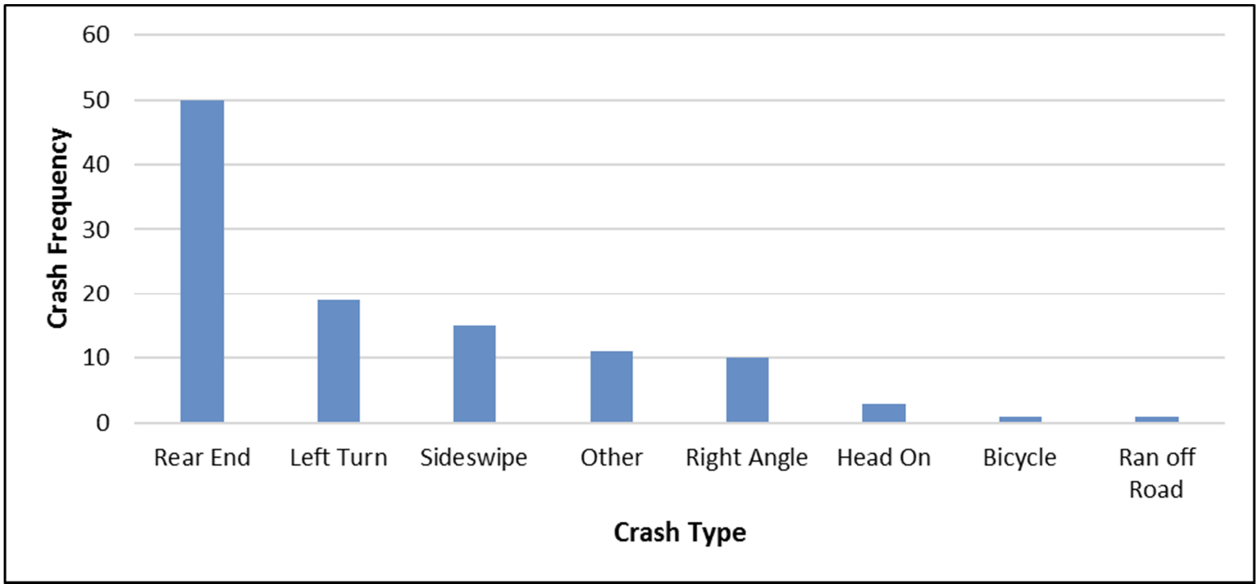


Figure 8: Crash Types at the Airport Way Intersection (2010 to 2014)

Rear-end and sideswipe crashes account for almost 60% of crashes at the intersection. These crashes were distributed evenly on the approaches of the intersection, suggesting that the crashes were related to the signal phases changing from green to yellow and red.

Left-turn crashes make up over 15% of crashes at the intersection. Of the 19 left-turn crashes, 18 crashes involved eastbound or westbound vehicles turning left. The Airport Way intersection currently has protected-permitted left-turn phasing for the eastbound and westbound directions, and the eastbound and westbound left-turn lanes are offset negatively with respect to each other as shown in Figure 9. The negative offset of two opposing left-turn vehicles may restrict sight distance of the oncoming through traffic as the opposing left turn blocks longer sight lines. This can contribute to left-turn crashes during the permissive left-turn phase because of the inability of the turning vehicle to see all approaching vehicles and judge adequate gaps.

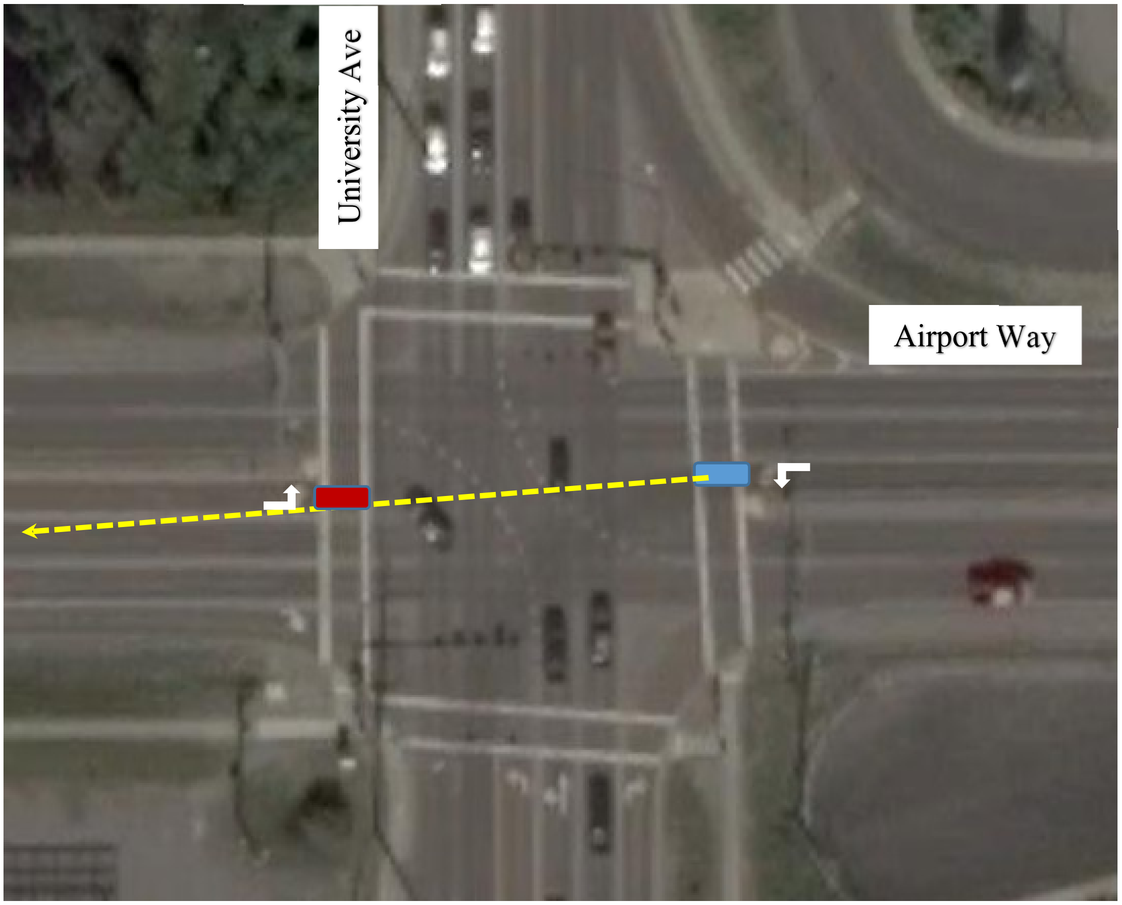
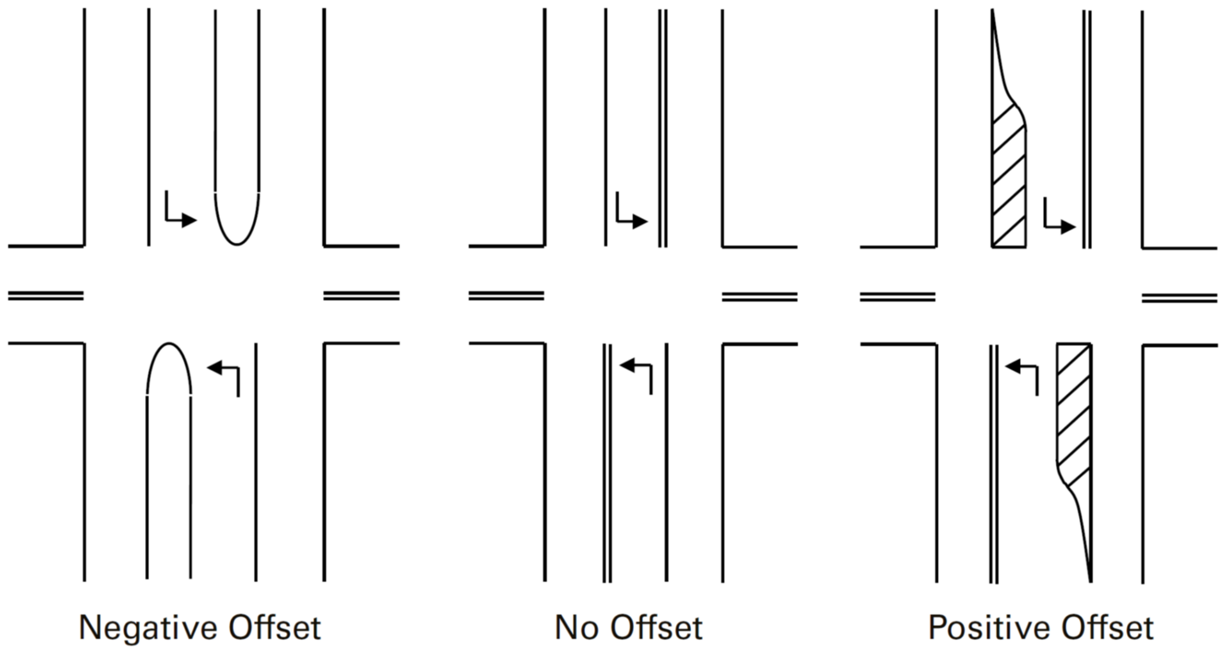


Figure 9: Airport Way Eastbound and Westbound Left-Turn Lane Alignment

The sight distance for left-turning vehicles is improved by replacing the negative offset of left-turn lanes to no or positive offset as shown in Figure 10.



Source: Safety Evaluation of Offset Improvements for Left-Turn Lanes, FHWA-HRT-09-035

Figure 10: Left Turn Lane Offset Configurations

While the proposed design will still operate at protected-permitted phasing for all left-turn movements, the left-turn lanes will be offset from the through lanes, allowing opposing left-turn vehicles to see past each other and better perceive opposing through traffic and adequate gaps.

3.3 Geist Road/Johansen Expressway

There were 119 crashes at the Geist Road/Johansen intersection. Figure 11 presents the crashes by crash type.

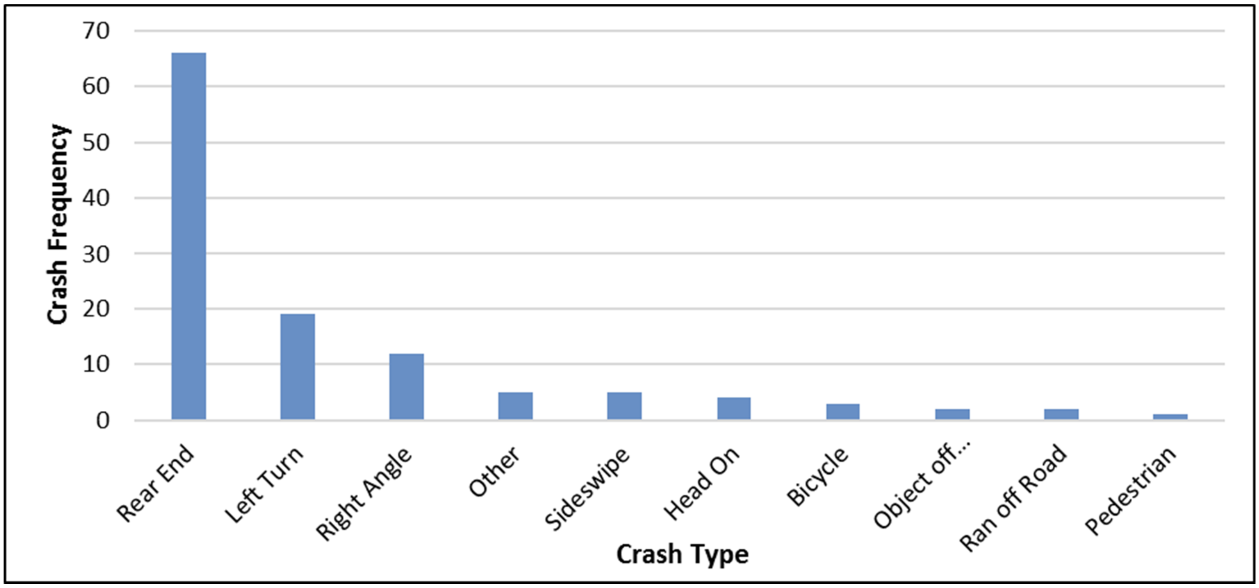


Figure 11: Crash Types at the Geist Road/Johansen Expressway Intersection (2010 to 2014)

Rear-end and sideswipe crashes are evenly distributed among all the approaches at the intersection. This suggests that the crashes were most likely related to the signal phases changing from green to yellow and then to red.

Left-turn crashes make up over 15% of crashes at the intersection. Eighteen of the 19 crashes involved eastbound or westbound vehicles turning left. The eastbound and westbound left-turn phasing is currently protected-permitted. As with Airport Way, the opposing left-turning lanes are negatively offset, restricting sight distance and making it difficult to determine if there is an adequate gap in traffic to complete a left turn. The proposed design at the Geist Road/Johansen Expressway will install dual left-turn lanes and, as such, requires protected-only left-turn phasing for all approaches. This would remove the driver error associated with selecting inadequate gaps during the permissive left-turn phase.

There were one pedestrian and three bicycle crashes at the intersection. All four crashes involved vehicles turning right. The proposed design will install channelized right-turn lanes on the south and east legs of the intersection. This will improve the line of sight between drivers turning right and pedestrians and bicyclists.

3.4 Sandvik Street

There were 28 crashes at the Sandvik Street intersection. Figure 12 presents the crashes by crash type. Rear-end crashes were the predominant crash type.

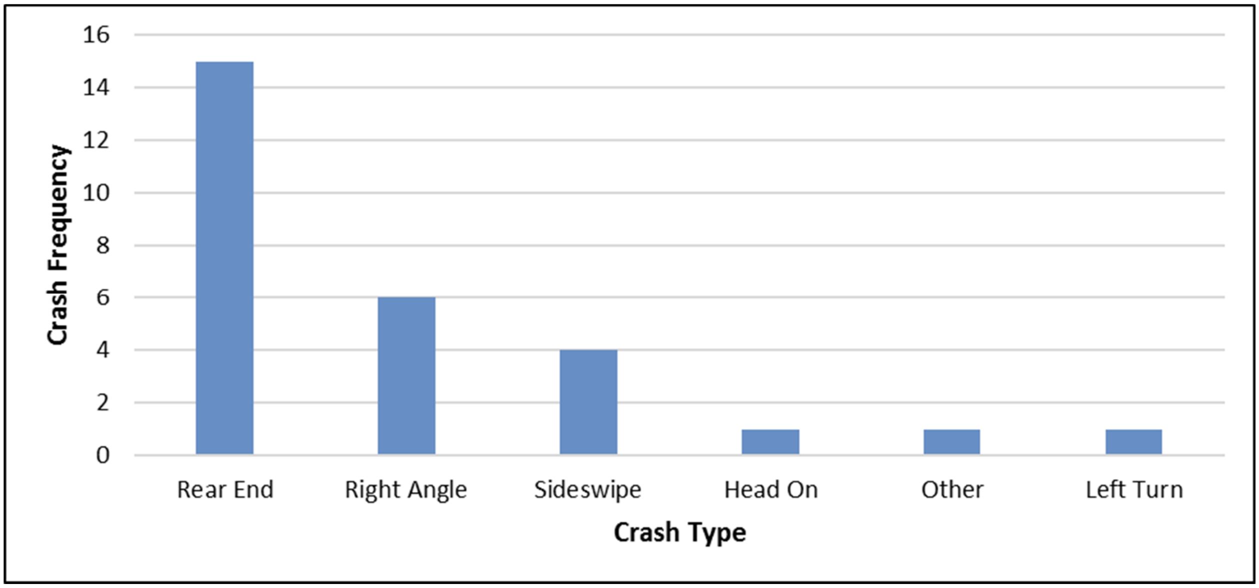


Figure 12: Crash Types at the Sandvik Street Intersection (2010 to 2014)

Eleven out of 15 rear-end crashes involved northbound or southbound vehicles that were either stopped or slowing down. The proposed design will construct left-turn lanes at this intersection, removing left-turning vehicles out of the travel lanes as they slow down or stop to complete the turn.

4 Segment Crashes

Table 2 presents the crash rates for the University Avenue segments and compares them to the state average for similar facilities and the CAR. The University Avenue segment from Davis Road to Rewak Drive has a crash rate above the state average but below the CAR, indicating that the crash rate is not statistically significant. The crash rates at the remaining segments all fall below the state average.

Table 2: Crash Rates on University Avenue Segments (2010 to 2014)

Segment	Crash Frequency	Average AADT	Crashes/ MVM	State Average	CAR @ 95% Confidence
Mitchell Expressway to Davis Road	1	6,572	0.33	1.90	3.37
Davis Road to Rewak Drive	3	9,692	0.33	1.90	2.71
Rewak Drive to Airport Way	11	20,002	**2.12**	**1.90**	2.99
Airport Way to Geraghty Avenue	0	20,002	0.00	1.90	4.34
Geraghty Avenue to Goldizen Avenue	12	20,002	0.73	1.90	2.49
Goldizen Avenue to Geist Road/Johansen Expressway	4	17,929	0.33	1.90	2.59
Geist Road/Johansen Expressway to Sandvik Street	3	20,641	0.50	1.90	2.91
Sandvik Street to Cameron Street	8	20,641	1.50	1.90	2.97
Cameron Street to Alumni Drive/College Road	0	20,641	0.00	1.90	2.93

MVM = million vehicle miles

5 Conclusion

The latest 5-years of reported crashes (2010 through 2014) were analyzed to determine if there were contributing factors to consider during the design of the project. The analysis indicates that crashes during the five-year study period have patterns consistent with the crash trends identified in previous crash analyses for the project.

The most predominant crashes on the corridor are rear-end, right-angle, and left-turn crashes. The majority of the left-turn crashes occurred at the University Avenue intersections at Airport Way and at Geist Road/Johansen Expressway. The proposed design will mitigate the left-turn crashes at these intersections. At Geist Road/Johansen Expressway will have dual left-turn lanes on all approaches with protected-only left-turn phasing. Many of the left-turn lanes including at the Airport Way intersection will be offset to improve sight distance between opposing left-turn vehicles. The left-turn lanes will also remove turning vehicles from the travel way as they slow down or stop to make complete their movement.

Four University Avenue intersections and one segment were identified to have crash rates fall above the state average but below the CAR, indicating that the crashes during the five-year study period are not statistically significant and that there is insufficient evidence that there is a probable cause of the crashes.

A crash reduction factor (CRF) is the percent reduction in crashes that might be expected if a mitigation measure is implemented. The CRF is applied to affected historical crashes to determine the number of crashes that would not have occurred during the study period if a proposed design had been in place. Table 3 presents the CRF values for the proposed design features and the applicable crash types. Table 4 presents the number of crashes reduced if the proposed design had taken place during the 2010 to 2014 study period.

Table 3: Crash Reduction Factors for Proposed Design Features

Proposed Design Features	Crash Reduction Factors	Crash Types	Reference
Center Raised Median	-20%	Cross over and segment access-related collisions.	HSIP Handbook
Install Left-Turn Lanes on Major Road	-55% (3-Leg Intersection) -50% (4-Leg Intersection)	Rear ends and sideswipes on major road	HSIP Handbook
Provide Offset for Existing Left-Turn Lanes	-38%	Left-turn crashes from major road	Crash Modification Factors Clearinghouse
Change Left-Turn Phasing to Protected-Only	-60%	Angle crashes involving the targeted left-turn movement	HSIP Handbook
Change Left-Turn Phasing to Flashing Yellow Arrow	-30% (protected-permissive) -40% (permissive to protected-permissive)	Angle crashes involving the targeted left-turn movement	HSIP Handbook
Channelized Right Turn	-55%	Pedestrian or bicycle crashes with right-turning vehicles	NCHRP W208

HSIP = Highway Safety Improvement Program
NCHRP = National Cooperative Highway Research Program

Table 4: Crash Reduction if Proposed Designs Had Been in Place

Segment or Intersection	2010 to 2014 Crash Frequency	Proposed Design Features	Crash Reduction Over Study Period
Mitchell Expressway to Davis Road	0	Center Raised Median	0
Davis Road	15	SB Left-Turn Lane	1 to 2
Davis Road to Rewak Drive (and minor intersections)	16	Center Raised Median, Median Opening with Left Turn Lane at Holden Rd and at Erickson Ave	6 to 7
Rewak Drive	25	Offset Left-Turn Lanes with Flashing Yellow Arrows	3 to 4
Rewak Drive to Airport Way	11	Center Raised Median	1
Airport Way	110	Offset Left-Turn Lanes with Flashing Yellow Arrows	10 to 11
Airport Way to Geraghty Avenue	0	Center Raised Median	0
Geraghty Avenue	12	Center Raised Median (Right-in-right-out only)	0 to 1
Geraghty Avenue to Goldizen Avenue	12	Center Raised Median	0 to 1
Goldizen Avenue	9	Median Opening with Left-Turn Lane	1
Goldizen Avenue to Geist Road/Johansen Expressway (and minor intersections)	44	Center Raised Median, Median Opening with Offset Left-Turn Lane at Indiana Ave	1 to 2
Geist Road/Johansen Expressway	119	All Left Turns Protected-Only Phasing and Channelized Right-Turn Lanes	11 to 12
Geist Road to Sandvik Street	3	Center Raised Median	0 to 1
Sandvik Street	28	Offset Left-Turn Lanes	2 to 3
Sandvik Street to Cameron Street	8	Center Raised Median	1
Cameron Street	5	Median Opening with Left-Turn Lane	0
Cameron Street to Alumni Drive/College Road (and minor intersections)	16	Center Raised Median to Thomas St	0
Total Crash Reduction			**37 to 47**

6 References

- Alaska Highway Safety Improvement Program Handbook, 17th Edition. DOT&PF, January 2017.
- Crash Modification Factor Clearinghouse. US Department of Transportation Federal Highway Administration. Web. 12 December 2018. <http://www.cmfclearinghouse.org>.
- NCHRP W208: Design Guidance for Channelized Right-Turn Lanes. Potts, et al. Transportation Board, 2011.
- University Avenue Rehabilitation & Widening 63213: Safety Analysis Update – 2003 through 2012, Draft Report. DOT&PF, February 2015.

Appendix C Pedestrian Hybrid Beacon Warrants and Analysis

- Draft Pedestrian Hybrid Beacon Warrants and Analysis – University Ave & Sandvik Rd. (October 2015)

University Avenue Rehabilitation & Widening 63213

DRAFT Pedestrian Hybrid Beacon Warrants and Analysis

University Avenue

Sandvik Road

October 2015

Kinney Engineering, LLC
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Abbreviations

AADT	Annual Average Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
ADOT&PF	Alaska Department of Transportation and Public Facilities
ATM	Alaska Traffic Manual
HCM	Highway Capacity Manual
MUTCD	Manual on Uniform Traffic Control Devices
PHB	Pedestrian Hybrid Beacon
PPH	People per Hour
VPD	Vehicles per Day
VPH	Vehicles per Hour

1 Introduction

The Alaska Department of Transportation and Public Facilities (ADOT&PF) Northern Region is considering a Pedestrian Hybrid Beacon (PHB) for University Avenue in the vicinity of Sandvik Street as part of the University Avenue Rehabilitation and Widening Project. University Avenue is being widened from four lanes undivided to include a center median, bicycle lanes, and off-set left turn lanes at key intersections, including at Sandvik Street. The widening of the roadway necessitates the removal of the current pedestrian overpass just south of Sandvik Street. A Pedestrian Hybrid Beacon (PHB) has been proposed as a possible treatment to aid pedestrian crossings of University Avenue. This report presents the results of this PHB warrant and suitability analysis.

The intersection at University Avenue and Sandvik Street is two-way-stop controlled with stop signs controlling east- and westbound traffic from Sandvik Street. In 2012 University Avenue had an annual average daily traffic (AADT) of 19,350 vehicles per day (vpd), and Sandvik Street had an AADT of 930 vpd. To the west of University Avenue, there is a University of Alaska Fairbanks building, West Valley High School, and Hutchinson High School. Counts performed by the ADOT&PF show that pedestrian traffic is heaviest between 2:30 and 3:30 pm. This corresponds to dismissal of both West Valley High School and Hutchinson High at 2:15 pm. Students leaving the high schools who desire to cross University currently use either the pedestrian overpass about 100 feet south of the intersection, cross at signals along University Avenue that are about 1,500 feet to the north of 750 feet to the south, or cross at unsignalized locations along University Avenue when they find gaps in the through traffic.

At Sandvik Street, the reconstruction of University Avenue will add offset left turn lanes in the north and southbound directions, a 7 foot median (3 feet face-of-curb to face-of-curb), and bike lanes along University. University Avenue will be widened from 46 to 86 feet.

Figure 1 shows the study area of University Avenue.

Figure 1 University Avenue Study Area

2 Pedestrian Delay and Level of Service

Figure 2 shows existing peak hour (pedestrian peak) traffic volumes. The width and level of conflicting volumes contribute to a considerable difficulty and delay for pedestrians that wish to cross University Avenue at-grade. According to methodologies presented in the Highway Capacity Manual (HCM), computed pedestrian delay is 35 minutes to cross the 46-foot-wide undivided roadway with a volume of 1,550 to 1,600 vehicles per hour. Of course, this wait is not practical, and instead those pedestrians that cross at grade would likely dash out, or cross ½ of the street at a time, both of which are undesirable actions. In fact, HCM states that any delay over 45 seconds is a LOS of F and with this type of delay, the HCM indicates there is a "high likelihood of pedestrian risk taking."

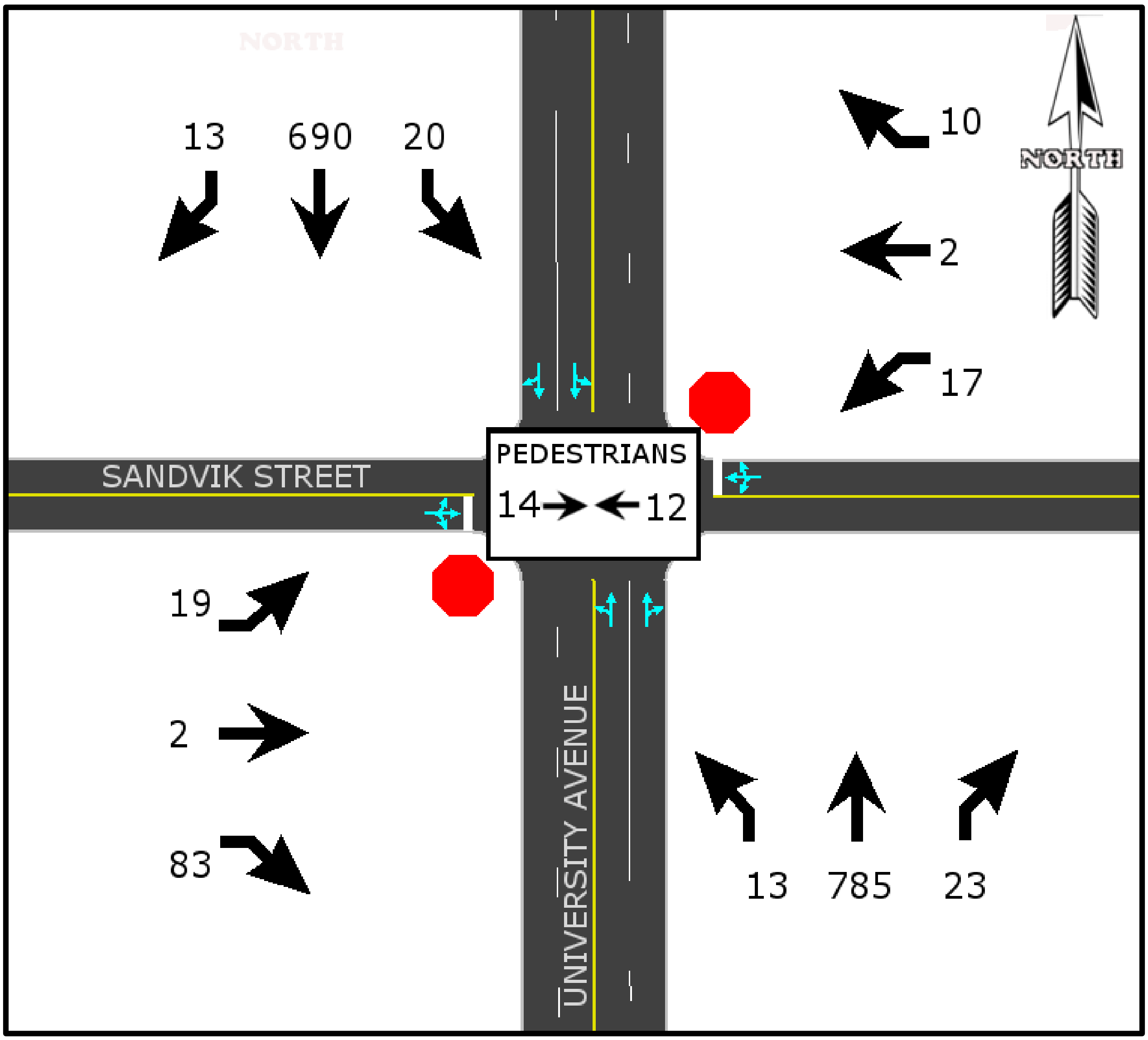

Figure 2 Vehicle and Pedestrian Volumes at University Avenue and Sandvik Street (Peak Pedestrian Hour – 2:30 to 3:30 PM)

This methodology for average pedestrian crossing delay takes into account average pedestrian delay as a function of traffic volume and width of the roadway being crossed. It does not take into account the effect of signals and platooning. The signals at Geist Road to the south and at College Road to the north will provide pedestrians with crossing opportunities; however, walking to the signals may require significant out-of-direction travel.

With the reconstruction of University Avenue, a median is being installed to divide through traffic. Medians can serve as a refuge for pedestrians crossing a roadway. The American Association of State Highway and Transportation Officials (AASHTO) *Guide for the Planning, Design, and Operation of Pedestrian Facilities* states that for a newly constructed median the minimum width for a pedestrian crossing refuge is 6 feet or more to accommodate wheel chairs or more than one pedestrian. A width of 8 feet is recommended to accommodate groups of bicycles, pedestrians, and pedestrians with travel aids.

University Avenue in the vicinity of Sandvik Street will be 86 feet wide from curb face to curb face. The median that will be in place is a channelized median with a curb-face to curb face width of just 4 feet, making it unsuitable for refuge. Using current traffic volumes, the typical wait for a pedestrian to cross University Avenue will be very long. Highway Capacity Manual methodologies returned a theoretical average wait of over 30 hours, a LOS of F.

Constructing a median refuge allows pedestrians to wait between lanes of traffic and cross the road in stages. Being able to cross the road in stages presents more gaps for the pedestrian. If the median could be utilized as a refuge, then pedestrians could cross University Avenue in two stages. A left turn lane is being installed in both directions. Analysis was done on the south approach where there are two through lanes for southbound traffic and two through lanes and left turn lane for northbound traffic. Pedestrians crossing from the west side of University Avenue to the median will have an average wait of half a minute and pedestrians crossing between the median and the east side of University Avenue will have an average wait of 2 minutes. Level of service for average pedestrian delay with a median refuge is an F for crossing northbound traffic and an E for crossing southbound traffic. Thus, widening the median to 6 feet in width or more would not reduce the LOS for the crossing to less than LOS F (2.5 minutes to completely cross the roadway).

	Crosswalk Length (feet)	Wait (minutes)	LOS -
Existing	46	35	F
Planned	86	60	F
With a Median Refuge - NB	49	2	F
With a Median Refuge - SB	30	0.5	E

Table 1 Comparison of Pedestrian Crossing Conditions for University Avenue at Sandvik Street

To summarize, removal of the existing pedestrian overpass would require pedestrian crossings at street level and will result in long delays, with potential undesirable risk-taking by the pedestrian. The pedestrian might walk to the north or south to the signalized intersection crossings, but this in fact may result in out-of-direction travel for some, and consequently will likely be avoided by many.

3 Pedestrian Hybrid Beacon

Pedestrian Hybrid Beacons are proving to be an effective way to let pedestrians cross a street safely by providing signalization for the pedestrian crossing while minimizing traffic delay. With the impending removal of the pedestrian overpass on University Avenue, a possible replacement for the overpass is a pedestrian activated crosswalk known as a Pedestrian Hybrid Beacon, also known as a high-intensity activated crosswalk. The PHB has two red lenses side by side and a yellow lens below the two red (Figure 3). The lights remain off until a pedestrian actuates it. The yellow light then begins to blink and then goes solid, informing traffic of the impending red light. After a determined amount of solid red time the two red lights blink alternatively. While the red lights are blinking traffic may pass through the intersection if it is clear of pedestrians.

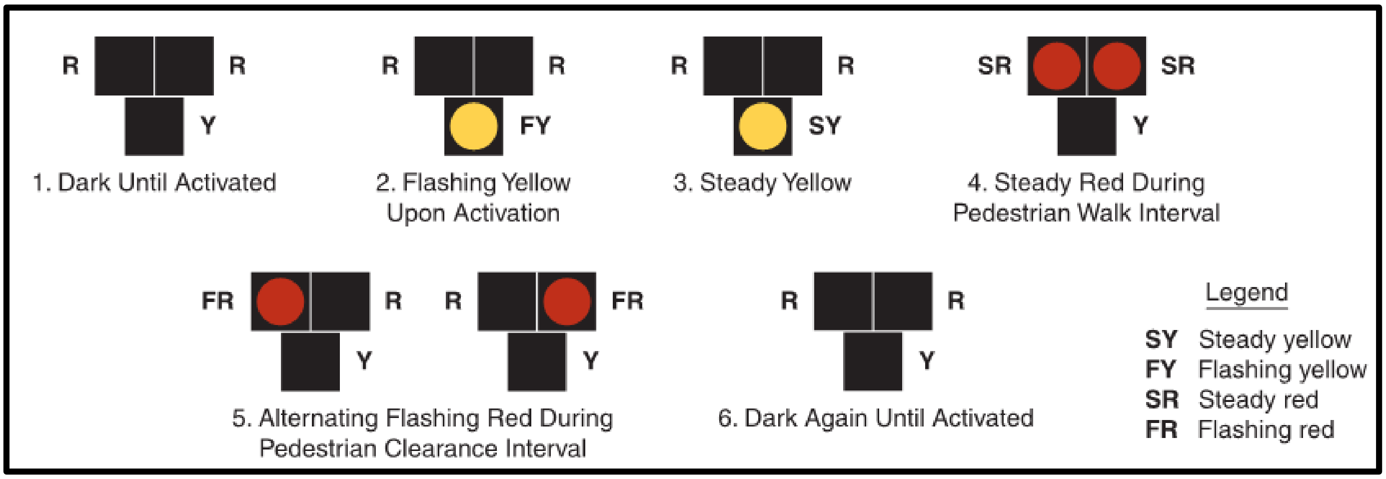

Figure 3 The PHB Operation Sequence (From MUTCD Figure 4F-3)

3.1 Warrant

A warrant is a threshold that if met on average conditions, justifies the further study of an implementation of a safety treatment. The FHWA publication Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD) includes a widely accepted methodology for studying the applicability of traffic devices at intersections. The MUTCD PHB warrant analysis compares existing and future traffic conditions at the study intersection with historical performance for similar intersections to determine whether the location is a favorable candidate for a PHB.

The MUTCD states that PHBs should be considered for locations where there are not adequate gaps in traffic to permit pedestrians to cross, where vehicle speeds are too high to permit a pedestrian to cross, or where there is excessive pedestrian delay. In determining PHB warrants, the MUTCD (2009) uses crosswalk length (road width), number of crossing pedestrians, traffic volume, and traffic speed as criteria. Figure 4 shows criteria for roads with speeds of 35 mph or greater. University Avenue has a speed limit of 40 mph, so this table was used to assess the warrant for a PHB. As cross walk lengths (L) and traffic volumes increase, appropriate gaps for pedestrians to cross a road decrease in frequency, and the required number of pedestrians crossing the major road needed to meet the warrant decreases. If the plotted point representing the major road traffic and the number of pedestrians crossing is above the curve corresponding to the crosswalk length, then the need for a pedestrian hybrid beacon should be considered.

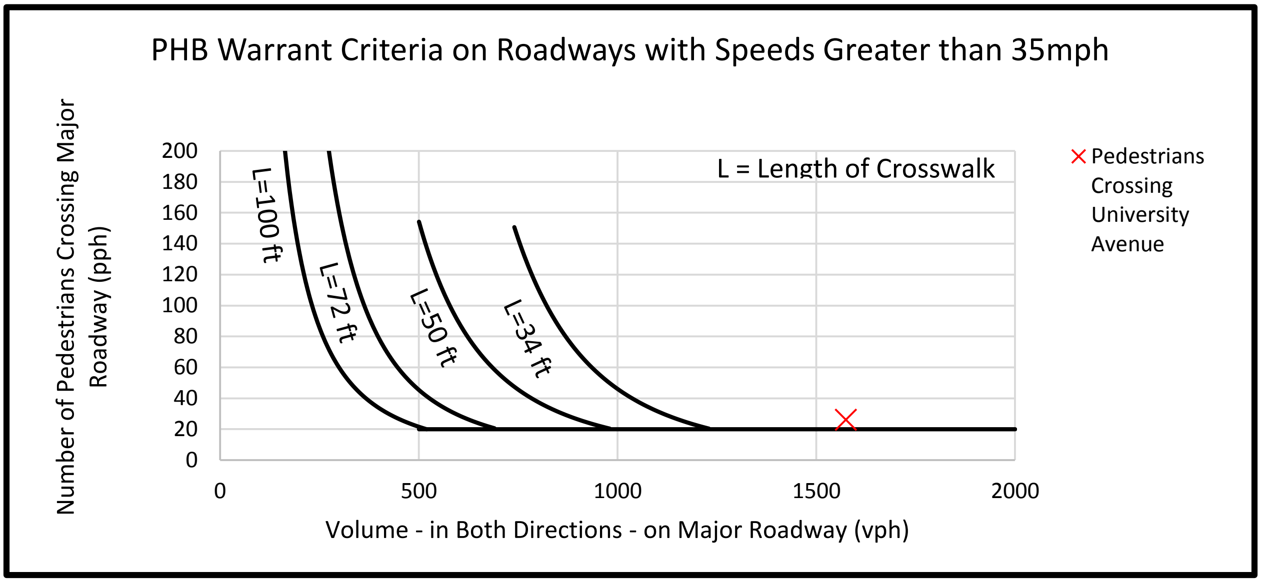

Figure 4 Warrant Criteria for Installing a Pedestrian Hybrid Beacon (Adopted from the MUTCD Figure 4F-2

The ADOT&PF performed pedestrian counts at University Avenue and Sandvik Street on September 1, 2015. Pedestrian traffic volumes peaked between 2:30 and 3:30pm, consistent with West Valley High and Hutchinson High dismissal times at 2:15 pm. During this hour, 26 pedestrians were counted crossing University Avenue. During the same time period, University Avenue has a volume around 1,550 and 1,600 vehicles per hour. Figure 4 shows traffic volume on the horizontal axis, pedestrian volume on the vertical axis, and 4 curved lines that represent different crosswalk lengths. Based on this warrant, a PHB should be considered.

Kinney Engineering, LLC. performed a follow up count on September 24, 2015 to determine overpass. The count was performed at the indicated peak hour, 2:30 to 3:30 pm. Figure 5 shows observed movements. The volume of pedestrians was lower than the ADOT&PF count. Only 9 pedestrians were counted crossing University Avenue. Six of eight pedestrians used the overpass. All pedestrians who used the overpass came from the direction of the 3 campuses located to the west of University Avenue. The two pedestrians who did not use the overpass crossed University Avenue east to west. A bicyclist was also observed crossing University Avenue at-grade.

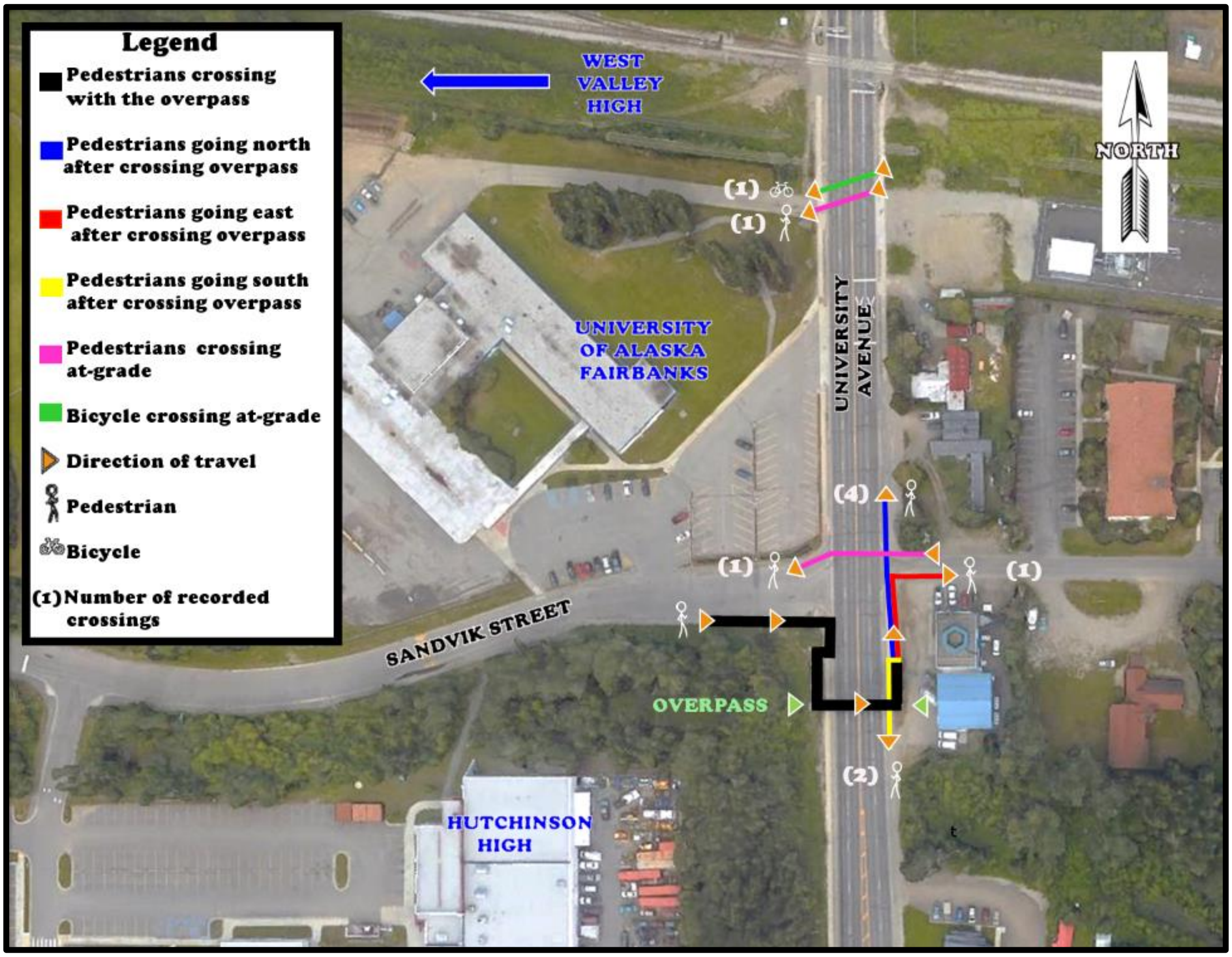

Figure 5 Pedestrian Movements on Septmeber 24, 2015 During the Peak Pedestrain Hour (2:30 to 3:30 PM)

3.2 Location

The MUTCD guidance is that the PHB should be at least 100 feet from the stop or yield controlled street. However, the Alaska Traffic Manual (ATM) states that this is not necessary in Alaska. Some considerations in placing a PHB on University Avenue are listed below.

Left turn lanes will be constructed for both north and southbound traffic on University Avenue. If the PHBs were placed through left turn lanes, once actuated, the PHBs could cause queuing which could overflow into the through lanes.

There is a set of railroad tracks about 500 feet north of Sandvik Street. Using Synchro, analysis was performed to see the effects of a PHB on University Avenue traffic and to see if queued traffic would back up onto the railroad tracks. Using estimated 2035 traffic volumes and conservative values for the PHB timing southbound through traffic queued up to 240 feet while the PHB is actuated leaving a distance of about 260 feet between the back of the queue and railroad tracks.

About 730 feet south of Sandvik Street there is a signalized intersection where University Avenue intersects Geist Road/Johansen Expressway. Calculations were performed to confirm that the PHB would not cause traffic to queue into Geist Road/Johansen Expressway. Using the estimated 2035 traffic volumes and conservative PHB timings, a queue of 380 feet was calculated when the PHB is actuated. A distance of 350 feet would be left between the back of the queue and intersection.

There is a sidewalk on the south side Sandvik Street. Placing the PHB on the south approach of University Avenue is direct access to pedestrians who wish to use the PHB. In addition, the current crossing is located south of Sandvik Street and placing the PHB on the south approach will be more familiar to pedestrians.

4 Summary and Recommendations

A pedestrian hybrid beacon is an at-grade alternative to replace the existing overpass at University Avenue. The pedestrian and vehicular volumes in this area meet the MUTCD volume warrants for consideration of a PHB. To provide safety to pedestrians and efficiency to traffic a PHB may be placed on the south approach of the intersection of at University Avenue and Sandvik Street. Placing the PHB here will grant easier access to pedestrians and will provide less overflow queuing form the left turn lanes into the through lanes and onto the railroad tracks in the southbound direction.

5 References

- *Guide for the Planning, Design, and Operation of Pedestrian Facilities*. American Association of State Highway and Transportation Officials. July 2004

- *Highway Capacity Manual*, 2010 edition. Transportation Research Board of the National Academies, 2010

- *Manual on Uniform Traffic Control Devices*, 2009 edition. Federal Highway Administration, December 2009.

Appendix D Median Evaluation

- Technical Memorandum: Median Width and Length (October 2015)
- Roadway Typical Section and Traffic Signal Reevaluation (March 2014)

TECHNICAL MEMORANDUM

TO:	Sarah Schacher, PE
FROM:	Ron Martindale Jeanne Bowie, PE, PhD, PTOE
DATE:	28 October 2015
SUBJECT:	University Avenue Rehabilitation and Widening (63213): Median Width and Length

We have prepared the following questions and responses based on your email query dated October 2, 2015 regarding width and length of the medians being designed for the University Avenue Rehabilitation and Widening project.

What documents give guidance or standards for median width and length?

The ADOT&PF Preconstruction Manual (PCM), Alaska Traffic Manual (ATM), and the Manual on Uniform Traffic Control Devices (MUTCD) (published by the Federal Highways Administration) give guidance for how median widths and lengths should be determined based on the desired uses for the median. Additional guidance can be found in the Access Management Manual (from the Transportation Research Board of the National Academies), the Guide for the Planning, Design, and Operation of Pedestrian Facilities (from the American Association of State Highway and Transportation Officials (AASHTO)), and A Policy on Geometric Design of Highways and Streets (also from AASHTO).

Why was 16 feet chosen as the basic median width for the raised median as part of the University Avenue Rehabilitation and Widening project?

At median openings where left turn lanes will be installed, the median will be narrowed to accommodate a left turn lane. The minimum width for the raised median next to a left turn lane is 4 feet (PCM, AASHTO). This width allows a sign or signal pole to be placed in the median. The desired width for a left turn lane next to a raised median is 12 feet (PCM). Although AASHTO allows a minimum width of 10 feet for the left turn lane as a general standard, lanes often become narrower in winter months due to buildup of snow and ice near the median; therefore, 12-foot left turn lanes are preferred. Thus, the total nominal width of the median at median openings is 16 feet (a 4-foot raised median plus a 12-foot turn lane). At locations away from a median opening, the median width of 16 feet was chosen to maintain the same width of roadway for the majority of the corridor.

Wider medians can be beneficial in several instances. For example, to better accommodate u-turns (18 to 30 feet total width), to accommodate refuge for pedestrians (minimum 6 feet raised – equivalent to 18 feet total width at median openings), or to provide positive off-set for opposing left turn vehicles (variable additional width). (Positive off-set left turn lanes shift the turn lanes so that opposing left turn vehicles don't block the view of left turning drivers who are looking for gaps in oncoming through traffic.) On high speed roads, wider medians provide greater separation for opposing traffic, reducing cross-median crashes.

If there is sufficient distance between median openings, it is possible to reduce the overall median width for a segment of the road. For instance, no median openings are proposed for approximately ½ mile between Airport Way and Goldizen Avenue. Because there were few head-on collisions (5 in a 10-year period), there are no median openings, and there is adequate length to transition between a wider cross section at the ends and a narrower cross section in the middle, the median width can be reduced to 6 feet in this area (this accommodates placing signs in the median and allows for pedestrian refuge).

Why are raised medians placed at signalized intersections? What determines the length of these medians?

Raised medians at signalized intersections have many benefits. They:

- Provide separation between opposing directions of traffic.
- Control turning traffic at driveway locations near the signalized intersections.

- Help guide turning drivers into turn lanes and identify the appropriate receiving lanes in adverse weather conditions.
- Provide protected space for signal poles and signs.
- Help traffic signal hardware correctly distinguish between queued vehicles stopped for the light and turning vehicles traveling in the opposite direction.

When raised medians are placed on intersection approaches, the functional (or influence) area of the intersection, illustrated in Figure 1, is considered in determining the length of the median. The functional area represents the area upstream and downstream of the physical intersection where drivers have many things to think about and do at once (such as changing lanes, decelerating and accelerating, and watching out for pedestrians). Figure 2 illustrates the three parts of the upstream functional area: the distance a vehicle travels while the driver is perceiving the intersection ahead (known as perception-reaction time), the distance needed to decelerate from travel speed to stop behind queued vehicles, and the length of the vehicle queue during peak travel times. The downstream functional area includes the distance it takes to recover from the conditions of the intersection, for instance the distance to accelerate back up to travel speed. Within the functional area of an intersection, it is desirable to limit access (driveways and turning movements) so that drivers can focus on the tasks of maneuvering through the intersection. Raised medians help to restrict turning movements within the vehicle decelerating and queuing area, reducing conflicts within the functional area of the intersection.

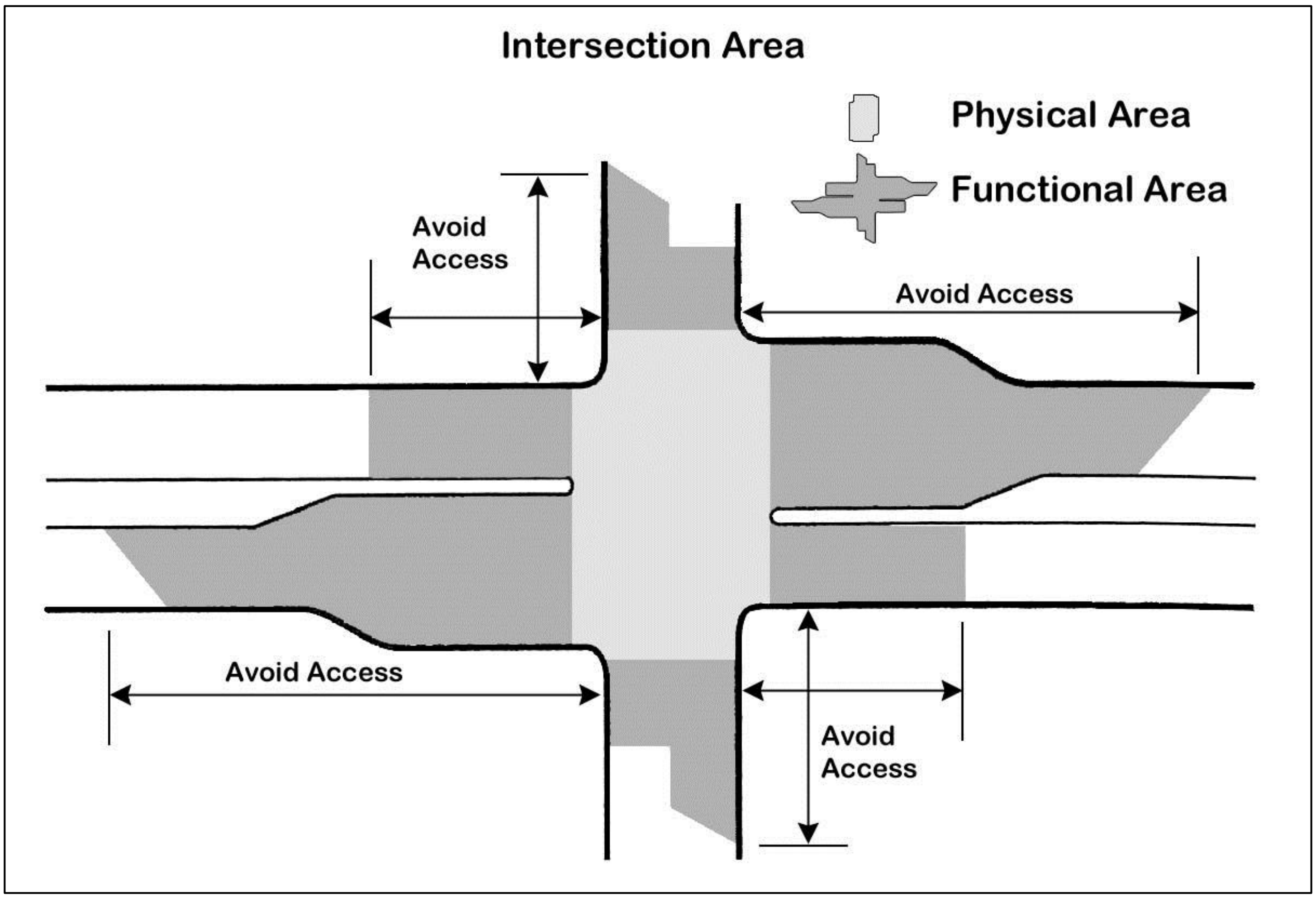

Figure 1 – Intersection Functional Area

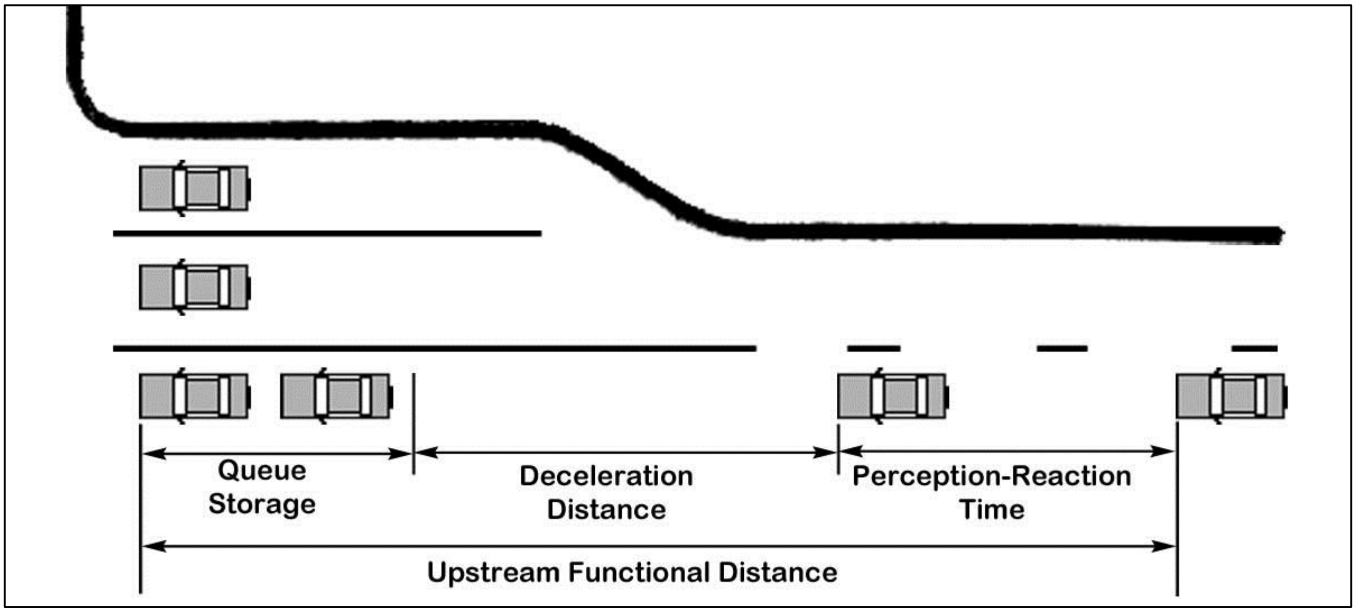

Figure 2 – Components of Upstream Functional Distance

Figure 3 shows the functional area of the major and signalized intersections within the project area based on perception-reaction time, deceleration requirements, and anticipated peak period vehicle queues. Ideally, no driveways would be allowed within the functional area of the intersections. Where driveways must be accommodated due to site restrictions, it is recommended to limit turning movements to right-in-right-out using raised medians.

Figure 4 identifies parcels that will have their access restricted to right-in-right-out by the installation of raised medians along University Avenue and along the side street approaches to signalized intersections. All access points within the functional area of the intersection will be limited to right-in-right-out.

Could we narrow the road by using a center two-way-left-turn lane instead of raised median?

The desirable width for a center two-way-left-turn lane is 14 feet. The actual center width for a raised median is 19 feet. This includes the 16-foot median and 1½ feet to either side to provide “shy” distance from the curb (the width of the gutter pan). Thus, a roadway with a center two-way-left-turn lane can be 5 feet narrower than a roadway with raised median. However, opportunities for installing center two-way-left-turn lanes along this corridor are minimal due to the need for raised median in the functional areas at signalized intersections, as described above.

Only two segments of University Avenue could function adequately if center two-way-left-turn lane were installed in place of raised median: the segment from Davis Road to Erickson Avenue and the segment from Goldizen Avenue to Indiana Avenue. Even in these segments, raised medians have numerous advantages over a center two-way-left-turn lane, including:

- Raised medians promote higher mobility by limiting access of adjacent properties directly onto University Avenue and by organizing left turns at selected median openings. University Avenue is functionally classified as an urban principal arterial roadway, which is intended to emphasize high mobility – characterized by higher speeds and longer travel distances.

Raised medians are safer than center two-way-left-turn lanes because they provide a barrier separating opposing traffic flows and provide a refuge for pedestrians who choose to cross at locations other than signalized intersections.

Figure 3 – Functional Area of Major and Signalized Intersections in Project Area

Figure 4 – Anticipated Access Changes for Parcels on University Avenue Due to Installation of Raised Median

University Avenue Rehabilitation & Widening 63213

Roadway Typical Section and Traffic Signal Reevaluation

March 2014

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Table of Contents

Figures

Tables

Abbreviations

AADT	Annual average daily traffic
AASHTO	American Association of State Highway and Transportation Officials
ADT	Average daily traffic
AHS	Alaska Highway System
DOT&PF	Alaska Department of Transportation and Public Facilities
FHWA	Federal Highway Administration
FOC	Face of curb
HSIP	Highway Safety Improvement Program
KE	Kinney Engineering, LLC
LOS	Level of service
MUTCD	Manual on Uniform Traffic Control Devices for Streets and Highways
NHS	National Highway System
sec	second(s)
TRB	Transportation Research Board
TWLTL	Two-way-left-turn lane
UAF	University of Alaska Fairbanks
UCL	Upper control limit
VE	Value engineering

Executive Summary

Kinney Engineering, LLC (KE) was retained by the Alaska Department of Transportation and Public Facilities (DOT&PF) Northern Region to:

1. Provide an updated evaluation of the proposed raised median treatment for the entire project corridor (University Avenue from the Mitchell Expressway to Thomas Street), including identification and analysis of reasonable alternatives, and,
2. Update the analysis of the intersection of University Avenue at Sandvik Street to identify safety and operational concerns at this location, consider the need for signal control as proposed in the current DSR, and identify and evaluate alternatives to signal control for this location.

Based on the analysis described in the subsequent sections of this memo, alternative treatments to those proposed in the current DSR could be considered for the following segments and intersections.

<u>Davis Road to Erickson Avenue and Goldizen Avenue to Indiana Avenue</u>. Although a median two-way-left-turn-lane (TWLTL) is superior to the present 4-lane two-way configuration and could be considered in these two segments based on crash experience, design/posted speed, and traffic volumes, KE recommends retention of the raised median. The raised median concept has been shown to be a safer treatment than a TWLTL in numerous studies as it has the advantage of controlling present and future access to and from University Avenue and adjacent property, limits and organizes left turns from University Avenue at selected median openings which reduces friction, and provides refuge for pedestrians who choose to cross at locations other than signalized intersections, which are spaced as far as ¾ miles apart (Airport Way to Geist Road). Additionally, the TRB Access Management Manual traffic volume threshold for consideration of a non-traversable median is nearly reached on the Goldizen Avenue to Indiana Avenue segment by 2035.

University Avenue is functionally classified as an urban principal arterial roadway, which is intended to emphasize high mobility – characterized by higher speeds and longer travel distances. To the extent possible, access to land parcels that are adjacent to arterial roadways should be provided on side streets, frontage, or backage roadways, so that only other arterial or collector roadways connect directly to the arterial roadway.

<u>Geraghty Avenue to Goldizen Avenue</u>. The proposed raised median in this segment can be narrowed from the proposed 16 foot face of curb to face of curb (FOC) width to 6 feet (including on the new the Chena River Bridge) without negatively impacting crashes or operations as there are no affected side street or driveway access points in this area.

<u>Sandvik Street Intersection Alternative Intersection Treatments.</u> KE recommends that this intersection remain unsignalized, rather than being signalized as proposed in the current DSR although consideration should be given to plumbing the intersection for a future signal. The only signal warrant that may be met at this location by the 2035 design year is Warrant 3 – Peak Hour Volume, which indicates that the Sandvik Street eastbound approach experiences enough delay during the school dismissal period that a signal could be considered for that one hour. No other present or future signal warrants are met at this location based on either crashes or present and future traffic volumes. This alteration will have little effect on crashes, even with redirected traffic from Hutchison Institute of Technology eastern driveway on Geist Road, which is to be blocked by a raised median as part of

University Avenue at Geist/Johansen Expressway intersection reconstruction, and will maintain mobility on University Avenue.

The removal of the existing pedestrian overcrossing, which was originally installed for access to an elementary school whose use has since been converted into a University of Alaska Fairbanks (UAF) facility, is not expected to have a negative effect on pedestrian crossing. However, it is still desirable to provide a minimum 6-foot median here for pedestrian refuge.

This report updates a memo that was submitted to the department in draft form on February 13, 2014. The following represent the major changes between the initial memo and the current report:

- Changed memo to report format, adding table of contents, abbreviations summary, etc. and formatting to match previous University Avenue traffic analysis reports.
- Added discussion of functional classification of University Avenue (report section 1.1).
- Reorganized sections to clarify that memo section 3 (report section 2) describes the analysis methodology, moved Sandvik intersection control analysis (memo section 5, now report section 4) to in front of Analysis by Segment and Intersection (memo section 4, now report section 5).
- Expanded discussion of Sandvik intersection control to include existing conditions (report section 4.1) including an expanded discussion of existing volumes and delay. Conducted vehicle stop delay analysis and presented results.
- Clarified role of signal warrants in decisions on whether or not to install signals (report section 4.4).
- Adjusted signal warrant analysis to show that the volume threshold requirements of Warrant 3 – Peak Hour Volume is met for the one-hour school dismissal peak if right turns are included in the Sandvik approach volumes (existing intersection geometry) and if latent demand is considered (existing intersection geometry or with eastbound right turn lane) – see section 4.4.
- Expanded unsignalized intersection level of service analysis to show existing AM and Noon peak. Described role of peak hour factor in analysis.
- Revised figure (memo Figure 2, report Figure 12) to reflect that there will not be access to University Avenue or Geist Road from the southwest corner land use.
- Made minor changes to text in section 5, Analysis of University Avenue Corridor by Segment and Intersection, to clarify that raised median is the current design condition, not the existing condition.
- Clarified recommendations (Executive Summary and Summary of Findings).

1 Introduction

The proposed design for University Avenue as described in the 2010 design study report, found at http://dot.alaska.gov/nreg/university_ave/assets/university_ave_dsr.pdf, and currently shown on the design plans calls for a continuous raised median for the entire project length with median openings (including left turn channelization) at selected intersections. The proposed median breaks included with the current design were not specifically designed to accommodate U-turn maneuvers; however, the arterial network of roadways in Fairbanks will allow most drivers to access land uses along University Avenue by changing their route, rather than forcing U-turn maneuvers. Table 1 summarizes proposed median and intersection treatments from the DSR and current design plans along with those segments and intersections where the analysis shows that alternative treatments can be considered.

Roadway Segment or Intersection	Proposed Median and/or Intersection Treatment	Alternative Treatment
Mitchell Expressway (Parks Hwy) Intersection	Traffic Signal (existing)	None
Mitchell Expressway to Davis Road	Raised Median	None
Davis Road Intersection	Traffic Signal (proposed)	None
Davis Road to Erickson Avenue	Raised Median (median breaks at Holden Road and 19th Avenue)	TWLTL
Erickson Avenue Intersection	Median opening with left turn lane channelization	None (Recommend additional evaluation of intersection traffic volumes in support of possible future intersection improvements.)
Erickson Avenue to Airport Way	Raised Median. Traffic Signal (existing) at Rewak Drive.	None
Airport Way Intersection	Traffic Signal (existing)	None
Airport Way to Geraghty Avenue	Raised Median	None
Geraghty Avenue to Goldizen Avenue	Raised Median	Narrowed raised median (from 16 feet FOC to FOC to 6-foot to provide pedestrian refuge)
Goldizen Avenue to Indiana Avenue	Raised Median	TWLTL
Indiana Avenue to Geist/Johansen Expressway	Raised Median	None
Geist/Johansen Expressway Intersection	Traffic Signal (existing)	None
Geist/Johansen Expressway to Sandvik Street	Raised Median	None
Sandvik Street Intersection	Traffic Signal (proposed)	Removal of traffic signal
Sandvik Street to Thomas Street	Raised Median (median break at Cameron Street)	None
Thomas Street to College Road/Alumni Drive	Existing median	None (existing)
College Road/Alumni Drive Intersection	Traffic Signal (existing)	None (existing)

Table 1 – University Avenue Roadway Segment and Intersections: Proposed Treatment and Evaluated Alternatives

Traffic forecasts for this report are from the University Avenue Rehabilitation & Widening- Traffic Study/63213 *Task 5 Average Daily Traffic Volume Forecasts and Comparison to 2000 Traffic Study Forecasts* (November 2011). In the Task 5 analysis, it was determined that the original design year volumes for this project, generated for the design year of 2020, are substantially the same as independent forecasts developed by KE for the new design year of 2035. As such, the original design traffic average annual daily traffic volumes, now attributed to the year 2035 are used in this analysis.

1.1 Functional Classification

Road functional classification is an important consideration in the determination of highway design characteristics. The American Association of State Highway and Transportation Officials (AASHTO) *A Policy on Geometric Design of Highways and Streets* is the primary reference for roadway design. AASHTO and other agencies generally classify roads, streets, and highways under one of three functional classes:

1. **Arterial** - Arterials emphasize mobility and are designed to carry large volumes at an efficient speed.

2. **Collector** - Collector roads gather and distribute trips between local streets and arterials.

3. **Local Road** - Local roads are oriented towards access to homes and businesses at the terminal ends of a trip.

AASHTO and other agencies further provide sub-categories of the classes. For example, arterials may be classified as freeways, expressways, principal arterials or minor arterials and collectors may include major or minor collectors. Figure 1, on page 3, illustrates the mobility and access balance for each functional class. It is desirable for a road network to provide a trip movement up and down the hierarchy of functional classes as shown in Figure 2 on page 3.

DOT&PF presents the most recent functional classifications on their webpage (http://www.dot.alaska.gov/stwdplng/fclass/fclassmaps.shtml). According to this website, the functional classification of University Avenue is “Urban Other Principal Arterial.” This classification indicates that University Avenue is intended to emphasize vehicle mobility and should be accessed mainly by roadways that are collector or arterial level.

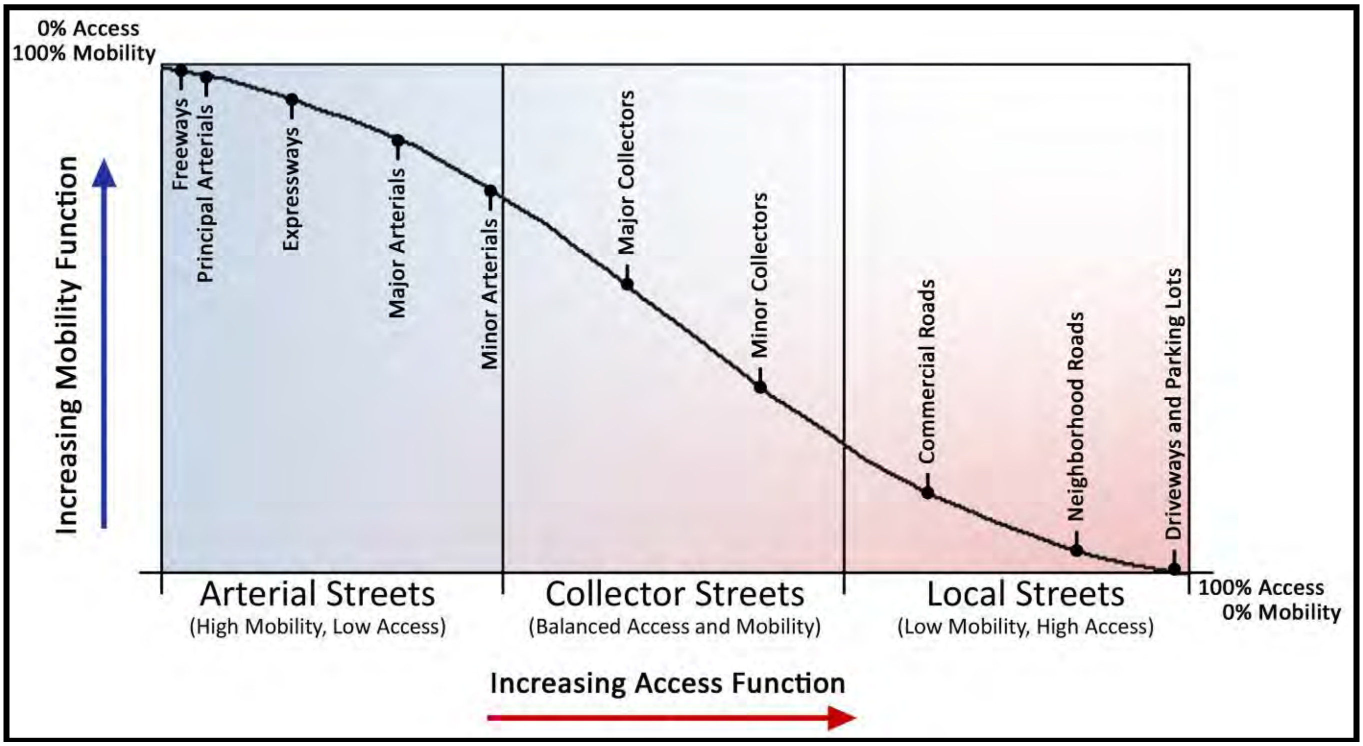

Figure 1 - Functional Classification Mobility and Access Relationship

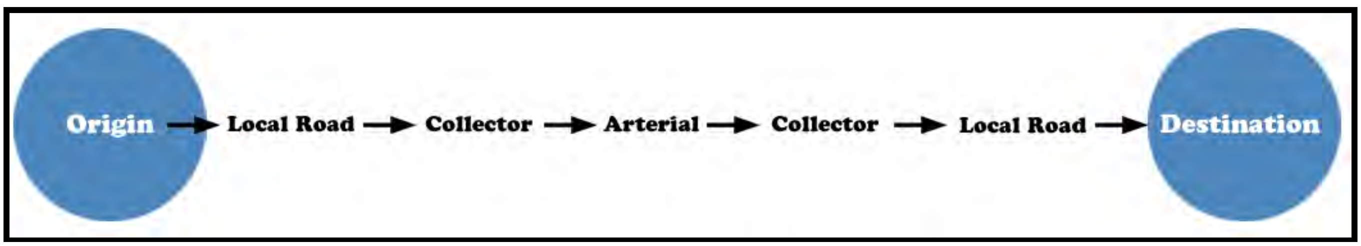

Figure 2 - Desirable Road Classification Progression

2 Methodology

2.1 Corridor Crash Evaluation

KE conducted an analysis of the crashes in the project corridor for the most recent 11-year period for which crash data is available (2000-2010), evaluated the segment and intersection crash rates for the corridor, and analyzed over-represented crash types, and contributing factors as they relate to the median treatment alternatives for the segments in the project corridor. KE also performed a separate analysis of crashes at the Sandvik Street intersection as part of a reevaluation of the proposed traffic signal installation.

2.2 Median Evaluation

KE performed an analysis of median treatment alternatives and the effect of the proposed raised medians compared to TWLTLs, including the effects on crashes, vehicular traffic, pedestrian traffic, bicycle traffic, etc. Specific issues examined included:

- The intersection functional area as it relates to the need for raised median channelization.
- The need for raised or flush median channelization as it relates to crashes and crash mitigation.
- Operational aspects of TWLTL compared to raised medians to determine how each alternative functions under the forecasted annual average daily traffic (AADT) for each segment of the project corridor.
- The impacts of traffic circulation under the different alternatives, noting that U-turn opportunities are not provided for under the proposed configuration.

2.3 Sandvik Street at University Avenue Intersection Control

KE analyzed traffic operations and safety as well as pedestrian operations and safety that affect the intersection control treatment at this intersection including:

- The effects of removing the existing overhead pedestrian crossing treatment just south of Sandvik Street.
- The effect on Sandvik Street of trips displaced by the proposed raised median on Geist Road at the Hutchison Institute of Technology eastern driveway.
- Pedestrian demand for crossing University Avenue at the Sandvik Street intersection.
- The need for the proposed traffic signal at the Sandvik Street intersection and a discussion of intersection control alternatives.
- The interaction of Sandvik Street intersection control alternatives with the adjacent Geist/Johansen Expressway intersection to the south and the railroad/highway grade crossing to the north.

2.4 Projected Annual Average Daily Traffic Volumes

AADT volumes have been forecast for the 2035 design year and are presented in Table 2.

Segment	AADTs	
	2010	2035
Mitchell to Davis	6,755	14,041
Davis to Rewak	9,760	15,307
Rewak to Chena River	20,120	23,016
Chena River to Geist	18,340	23,417
Geist to College	21,450	22,944

Table 2 - Historical and Projected Volumes indicating Segments over DOT&PF Median Closure Threshold

2.5 Two Way Left Turn Lane versus Raised Median Considerations

The projected AADT's shown in Table 2 were used to evaluate the need for non-traversable medians on University Avenue. DOT&PF has guidelines pertaining to divided highway corridors and the use of traversable verses non-traversable medians on National Highway System (NHS) and Alaska Highway System (AHS) highways. DOT&PF Policy and Procedure 05.05.050 states:

"Highways with design speeds of 45 MPH or higher and with forecast average daily traffic of 20,000 vehicles per day or greater will be planned, designed and constructed with non-traversable medians to provide positive separation between opposite direction traffic."

The policy calls for median separation with non-traversable medians and median openings on roadways with the following design designations:

Policy and Procedure Requirements	University Avenue	Meet requirement for non-traversable median?
National Highway System (NHS) or Alaska Highway System (AHS)	NHS	Yes
Functional Classification – Arterial (Principal or Minor)	Other Principal Arterial	Yes
Design Life of 10 Years or Greater	20 Years	Yes
New Construction - Reconstruction, or Rehabilitation (3R)	Reconstruction	Yes
Design Year ADT =/> 20,000 Vehicles Per Day	2035 AADT 15,300 (Davis to Rewak) 23,400 (Chena River to Geist)	**No** (Davis to Rewak) Yes (Chena River to Geist)
Design Year Design Speed =/> 45 mph	40 MPH	No

Table 3 - Comparison of DOT&PF Non-Traversable Median Policy Guidelines with University Avenue Design Elements

As shown in Table 3, the design speed criteria for University Avenue and the design year ADT on some of the University Avenue segments does not meet the thresholds for automatic consideration of non-traversable medians, KE reviewed additional guidance concerning the use of a TWLTL verses a raised median.

The *Access Management Manual*, Transportation Research Board (TRB), 2003, is referenced by the Federal Highway Administration (FHWA) as a source for technical information on access management techniques. This manual contains additional guidance on the use of a TWLTL verses a non-traversable medians. The following are guidelines for selecting a median type from the Access Management Manual:

Use of a TWLTL

Evaluations indicate that a TWLTL may be appropriate for the following roadways:

- Roadways in urban and suburban areas with a projected ADT of less than 24,000 vehicles per day
- Collector streets in developing residential areas where residences front on local streets that intersect with the collector street;
- Collector streets in developing sub- urban areas where direct access is to be provided to small abutting properties; and
- Collector streets in developed urban and suburban areas where there is no crash pattern that is correctable by a raised median.

Use of a Non-traversable Median

A non-traversable median is more desirable than a TWLTL for the following situations:

- All new multilane urban arterial roadways;
- Existing multilane urban arterial roadways with ADT in excess of 24,000 to 28,000 vehicles per day, depending on local conditions;
- Rural multilane roadways;
- Bypass of an urban area;
- Roadways where aesthetic considerations are a high priority;
- Multilane roadways with a high level of pedestrian activity; and
- High crash locations or areas where it is desirable to limit left turns to improve safety.

A non-traversable or raised median has the added benefit of providing refuge for pedestrians who choose to cross the roadway at locations other than signalized intersections. At present, traffic signal spacing on University Avenue is as much as ¾ mile (Airport Way to Geist Road). Since the design speed of University Avenue does not meet the threshold for automatic consideration of a non-traversable median, KE has used the ADT threshold of 24,000 when considering TWLTL verses raised median types on segments where a TWLTL has been evaluated.

2.6 Functional Area for Signalized Intersections

The functional area of an intersection is the area beyond the physical intersection of two controlled access facilities that comprises decision and maneuver distance, plus any required vehicle storage length, and is protected through corner clearance standards and connection spacing standards. A depiction of this intersection functional area is contained in Figure 3 below.

Intersection functional area is critical to the operational and safety performance of an intersection, including areas upstream and downstream of the physical intersection where motorists are responding to intersection conflicts and conditions, decelerating, and maneuvering into the appropriate lane to stop or complete a turn. As such, much of the raised medians currently proposed for University

Avenue will need to remain in order to preserve this functional area. Functional areas for each signalized intersection on University Avenue were determined and reported in the KE University Avenue Rehabilitation & Widening- Traffic Study/63213 *Task 10 Capacity Studies /Design Modifications, Final Report*, April 13, 2012 and are summarized in Section 4 beginning on page14.

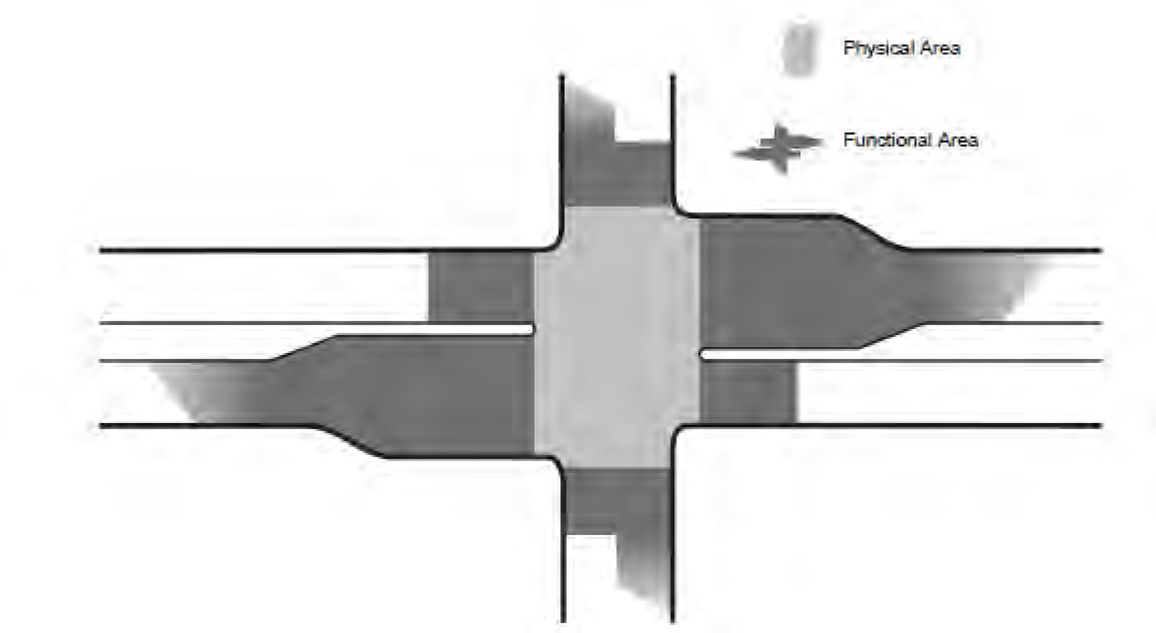

Figure 3 - Functional Area of an Intersection
Source: *Access Management Manual*, Transportation Research Board (TRB), 2003

3 Corridor Crash Overview: 2000-2010 Crashes

2000-2010 crashes on University Avenue between the Mitchell (Parks) Expressway and the College /Alumni Road intersection were evaluated for this analysis. Table 4 summarizes the number of crashes and crash severity by roadway segment and intersection.

Comparing the crash rate of the intersection or segment being studied to the DOT&PF average crash rate is one assessment of facility performance; however, facilities with higher than average rates are not necessarily significant problems. An upper control limit, or critical rate, is the threshold of concern. The Rate Quality Control Method establishes an upper control limit (UCL) to determine if a facility's crash rate is significantly higher than crash rates in facilities with similar characteristics. The UCL is determined statistically as a function of the statewide average crash rate for a facility and the vehicle exposure at the location being studied. Facilities with rates that exceed the UCL are inferred to be above the population average at the stated confidence level, so that the observed high crash experience is not likely to be due solely to chance.

Table 5 and Table 6 summarize the crash rates for the higher volume intersections and corresponding highway segments, respectively, studied along University Avenue. Statewide averages and UCLs are listed for comparison. The stated confidence level for the analysis is 95%.

Segment or Intersection		Fatal	Major Injury	Minor Injury	Property Damage Only	Grand Total
Mitchell Expressway/Parks	Intersection	1	2	20	53	76
Davis Road	Intersection		1	7	23	31
Davis Road-Holden Road	Segment				1	1
Holden Road	Intersection				2	2
19th Avenue	Intersection				1	1
Swenson Avenue	Intersection				1	1
Swenson Avenue-Erickson Avenue	Segment			1	1	2
Erickson Avenue	Intersection			9	21	30
Mitchell Avenue	Intersection				4	4
Rewak Drive	Intersection		1	24	36	61
Rewak Drive-Airport Way	Segment		1	7	21	29
Airport Way	Intersection		3	50	198	251
Geraghty Avenue	Intersection		2	17	31	50
Geraghty Avenue-Goldizen Avenue	Segment		2	8	29	39
Goldizen Avenue	Intersection		1	9	11	21
Goldizen Avenue-Widener Lane	Segment			3	3	6
Widener Lane	Intersection			3	8	11
Widener Lane-Indiana Avenue	Segment		1	3	10	14
Indiana Avenue	Intersection			5	13	18
Indiana Avenue-Wolf Run	Segment			4	8	12
Wolf Run	Intersection		1	4	4	9
Geist/Johansen/Expressway	Intersection	2	12	73	245	332
Geist/Johansen Expressway-Sandvik Street	Segment			1	5	6
Sandvik Street	Intersection		2	16	37	55
Sandvik Street-Cameron Street	Segment			3	19	22
Cameron Street	Intersection		1		3	4
Thomas Street	Intersection			4	20	24
College/Alumni/Farmers Loop	Intersection		3	22	90	115
Grand Total		3	33	293	898	1227

Table 4 - University Avenue Crashes and Crash Severity by Segment and Intersection, 2000 to 2010

Segments	Segment Crashes 2000 to 2010	Segment Length (Miles)	Average AADT 2000 to 2010	Crashes / MVM	State Popu-lations	Upper Control Limit at 95% Confidence	Crash Rate Above Average?	Crash Rate Above Critical (UCL)?
Davis Rd.-Holden Rd.	1	0.133	10,265	0.182	1.152	1.997	no	no
Swenson Ave.-Erickson Ave.	2	0.083	10,265	0.585	1.152	2.253	no	no
Rewak Dr.-Airport Way	29	0.142	18,241	2.788	1.152	1.748	yes	yes
Geraghty Ave.-Goldizen Ave.	39	0.425	18,241	1.253	1.152	1.485	yes	no
Goldizen Ave.-Widener Ln.	6	0.144	18,498	0.561	1.152	1.739	no	no
Widener-Indiana	14	0.105	18,498	1.795	1.152	1.848	yes	no
Indiana-Wolf Run	12	0.050	18,498	3.231	1.152	2.203	yes	yes
Johansen/Geist-Sandvik St.	6	0.160	19,330	0.483	1.152	1.693	no	no
Sandvik St.-Cameron St.	22	0.142	19,330	1.996	1.152	1.729	yes	yes
Total Crashes	131							

Table 5 - Roadway Segment Crashes and Crash Rates, 2000 to 2010

Intersection	Intersection Crashes 2000 to 2010	Average Entering AADT 2000 to 2010	Crashes / MEV	Control Type	State Popu-lations	Upper Control Limit at 95% Confidence	Above Average ?	Above Critical (UCL)?
Mitchell/Parks	76	16,799	1.127	Signal	1.376	1.618	no	no
Davis Road	31	11,097	0.696	Stop	0.522	0.711	yes	no
Holden Road	2	10,313	0.048	Stop	0.522	0.719	no	no
19th Avenue	1	10,365	0.024	Stop	0.522	0.718	no	no
Swenson Ave.	1	10,353	0.024	Stop	0.522	0.718	no	no
Erickson	30	11,499	0.650	Stop	0.636	0.840	yes	no
Mitchell Ave.	4	10,333	0.096	Stop	0.522	0.719	no	no
Rewak Drive	61	17,323	0.877	Signal	1.376	1.615	no	no
Airport Way	251	32,750	1.909	Signal	1.376	1.548	yes	yes
Geraghty Ave.	50	18,529	0.672	Stop	0.522	0.667	yes	yes
Goldizen Ave.	21	18,620	0.281	Stop	0.522	0.666	no	no
Widener Lane	11	18,562	0.148	Stop	0.522	0.666	no	no
Indiana Ave.	18	18,637	0.241	Stop	0.522	0.666	no	no
Wolf Run	9	18,594	0.121	Stop	0.522	0.666	no	no
Geist Johansen Expressway	332	38,806	2.131	Signal	1.376	1.534	yes	yes
Sandvik Street	55	20,080	0.682	Stop	0.636	0.788	yes	no
Cameron Street	4	19,530	0.051	Stop	0.522	0.663	no	no
Thomas Street	24	19,544	0.306	Stop	0.522	0.663	no	no
College/Alumni/ Farmers Loop	115	22,381	1.280	Signal	1.376	1.585	no	no
Total Crashes	1096							

Table 6 - Intersection Crashes and Crash Rates, 2000 to 2010

As shown in Table 5, segment crash rates for the Rewak/Airport Way, Indiana/Wolf Run and Sandvik/Cameron segments are above critical segment crash rates when compared to similar segments statewide. Table 6 shows that the two major intersections at Airport Way and at Geist/Johansen Expressway as well as the Geraghty Avenue intersection are also above the UCL.

Crash types which are overrepresented when compared to statewide averages are presented in Table 7.

Crash Type	Number of Crashes	% of TOTAL	SOA Population %	Crash Type Overrepresented?
Animal	3	0.24%	0.87%	No
Bicycle	16	1.30%	1.40%	No
Bridge	3	0.24%	0.13%	No
Crash Cushion	1	0.08%	0.05%	No
Curb/Wall	3	0.24%	0.70%	No
Ditch	6	0.49%	3.58%	No
Divider	9	0.73%	0.39%	No
Embankment	3	0.24%	0.98%	No
Fence	1	0.08%	0.68%	No
Guardrail	1	0.08%	1.77%	No
Head On	40	3.26%	1.92%	Yes
Light Support	3	0.24%	0.59%	No
Moose	3	0.24%	5.21%	No
Other	28	2.28%	3.41%	No
Other Fixed Object	3	0.24%	0.96%	No
Overturn	7	0.57%	1.37%	No
Parked	8	0.65%	3.13%	No
Pedestrian	5	0.41%	1.16%	No
Ran off Road	7	0.57%	3.20%	No
Rear End	576	46.94%	26.16%	Yes
Right Angle	349	28.44%	33.55%	No
Sideswipe	137	11.17%	2.98%	Yes
Sign Post	8	0.65%	1.15%	No
Traffic Light	2	0.16%	0.16%	No
Tree/Shrub	1	0.08%	0.67%	No
Utility Post	4	0.33%	0.57%	No
TOTAL	1227			

Table 7 - Overrepresented Crash Types Compared to Statewide Averages, 2000 to 2010

As shown in Table 7, Head-on, Rear End and Sideswipe crashes tend to be overrepresented when compared to statewide crash type averages. Contributing factors associated with these overrepresented crash types are shown in Table 8.

Crash Type	Head On	Rear End	Sideswipe	Grand Total
Follow too Closely	0	49	1	50
Failure to Yield	5	10	5	20
Unsafe Speed	9	66	11	86
Driver Inattention	4	67	10	81
Red Light 0r Stop Sign Violation	0	1	1	2
Missing, Unknown, N/A, No Improper Driving	12	371	94	477
Other	2	12	2	16
Improper Lane Use, Change, Turn or Wrong Side	8	0	13	21
Total, Overrepresented Crashes	40	576	137	753

Table 8 - Crash Contributing Factors Associated with Overrepresented Crashes

Of those overrepresented crashes where a crash contributing factor was cited by police, unsafe speed was most often cited followed by driver inattention and following too closely. Crashes where a pedestrian or bicycle involved are shown in Table 9.

Segment or Intersection		Fatal	Major Injury		Minor Injury		Property Damage		Grand Total	Bike or Pedestrian Crossing University
		Bike	Bike	Pedes-trian	Bike	Pedes-trian	Bike	Pedes-trian		
Erickson	Intersection				1				1	
Rewak-Airport	Segment			1	1				2	1
Airport Way	Intersection					1			1	1
Geraghty	Intersection		1						1	
Geraghty-Goldizen	Segment				1			1	2	
Goldizen-Widener	Segment				1				1	
Indiana-Wolf Run	Segment				1				1	
Wolf Run	Intersection			1					1	1
Johansen / Geist	Intersection	1	1		5		1		8	3
College / Alumni / Farmers Loop	Intersection				1	1	1		3	1
Grand Total		1	2	2	11	2	2	1	21	6

Table 9 - Pedestrian and Bicycle Related Crashes on University Avenue, 2000-2010

Of the 21 pedestrian and bicycle related crashes recorded on University Avenue during the study period, only 6 which specified a direction for the pedestrian or bicyclist indicated that they were crossing University Avenue at the time of the crash. The remaining crashes were either travelling parallel to University Avenue or their direction could not be determined based on the crash data.

4 Sandvik Street Intersection Analysis

KE conducted a separate analysis of the Sandvik Street intersection to evaluate traffic operations and safety as well as pedestrian operations and safety that affect the intersection control treatment. The effects considered at this intersection include:

a) The effects of removing the existing overhead pedestrian crossing treatment just south of Sandvik Street.
b) The effect on Sandvik Street of trips displaced by the proposed raised median on Geist Road at the Hutchison Institute of Technology eastern driveway.
c) Pedestrian demand for crossing University Avenue at the Sandvik Street intersection.
d) The need for the proposed traffic signal at the Sandvik Street intersection and a discussion of intersection control alternatives.
e) The interaction of Sandvik Street intersection control alternatives with the adjacent Geist/Johansen Expressway intersection to the south and the railroad/highway grade crossing to the north.

4.1 Existing Conditions

Sandvik Street, located just north of Geist Road/Johansen Expressway along University Avenue, serves Hutchison Institute of Technology, West Valley High School, and the UAF University Park Building to the west of University Avenue and serves several residences to the east of University Avenue. The existing intersection geometry is shown in Figure 4. The eastbound approach is one-lane; however, the approach is wide enough that right-turning and left-turning vehicles can form separate lanes at the intersection. The westbound approach is a narrower one-lane approach, with only enough room for one lane of cars.

Turning movement volumes at the intersection of Sandvik Street with University Avenue were collected by DOTPF on March 26, 2009 during the hours of 7 to 10 AM, 11 AM to 1 PM, and 3 to 6 PM. The peak hour volumes are shown in Figure 5. Note that this count did not include the hour from 2 to 3 PM, which is the school dismissal peak period for both Hutchison Institute of Technology and West Valley High School. KE collected turning movement volumes into and out of the Hutchison Institute of Technology driveways on January 21, 2014 during school arrival and school dismissal periods. A summary of these counts is shown in Figure 6.

KE measured stop delay for the eastbound approach of the intersection of Sandvik Street and University Avenue at school arrival and dismissal periods on March 11, 12, and 13, 2014. Field observations show that during peak periods, some drivers on the eastbound approach to Sandvik Street travel through the University Park Building parking lot north of Sandvik Street to avoid the queues on the eastbound approach to Sandvik Street. As a result, stop delay was also measured for vehicles accessing University Avenue from the University Park Building during the same time periods. Figure 7 and Figure 8 show the 5-mintue moving average delay for the eastbound approach during the AM school arrival period and the PM school dismissal period, respectively. Summary information for each time period is shown in Table 10 on page 17.

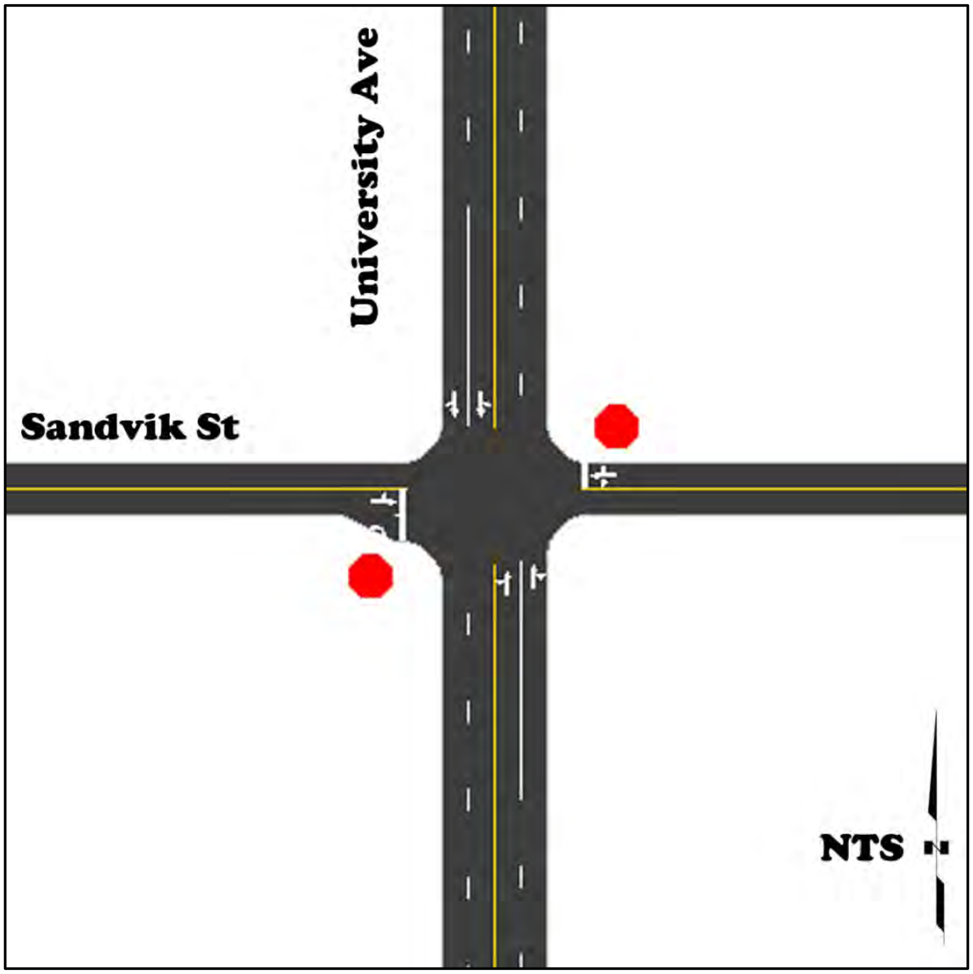

Figure 4 – Existing Intersection Geometry at Sandvik Street and University Avenue

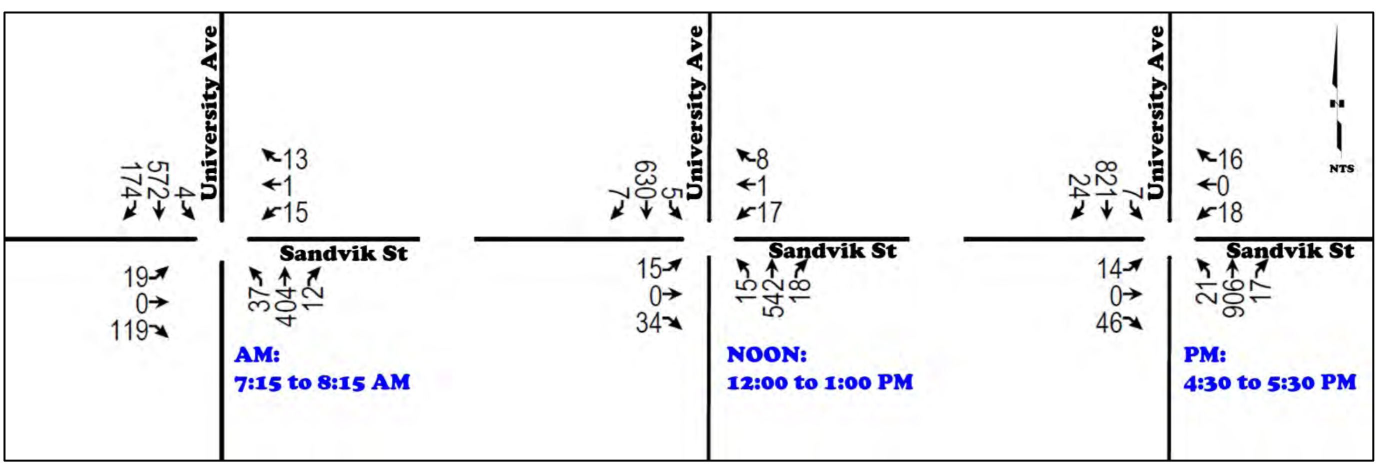

Figure 5 – Sandvik Street and University Avenue Existing Turning Movement Counts, 2009

Figure 6 – Hutchison Institute of Technology Existing Driveway Counts, 2014

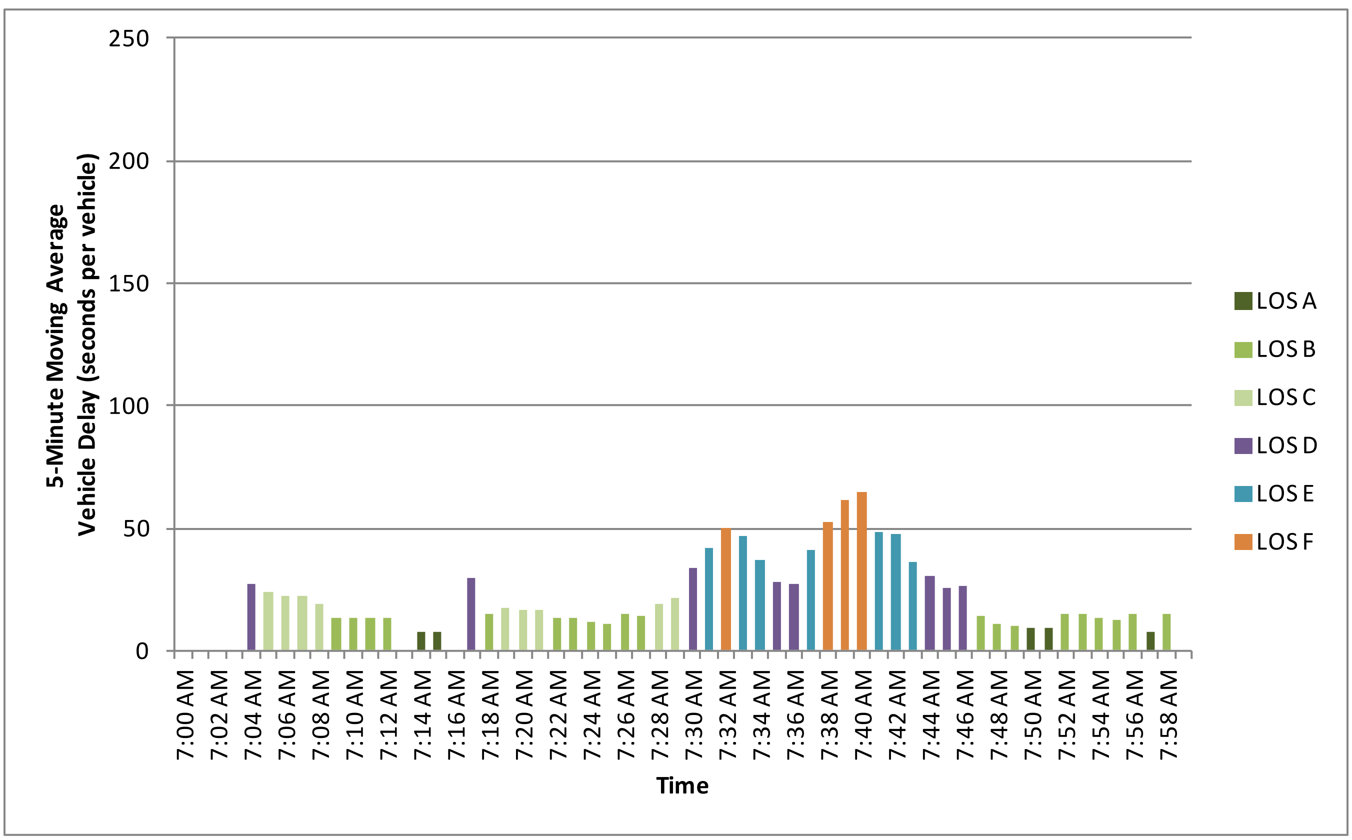

Figure 7 – 5-Minute Moving Average Delay for Eastbound Sandvik Street Approach, 7 to 8 AM

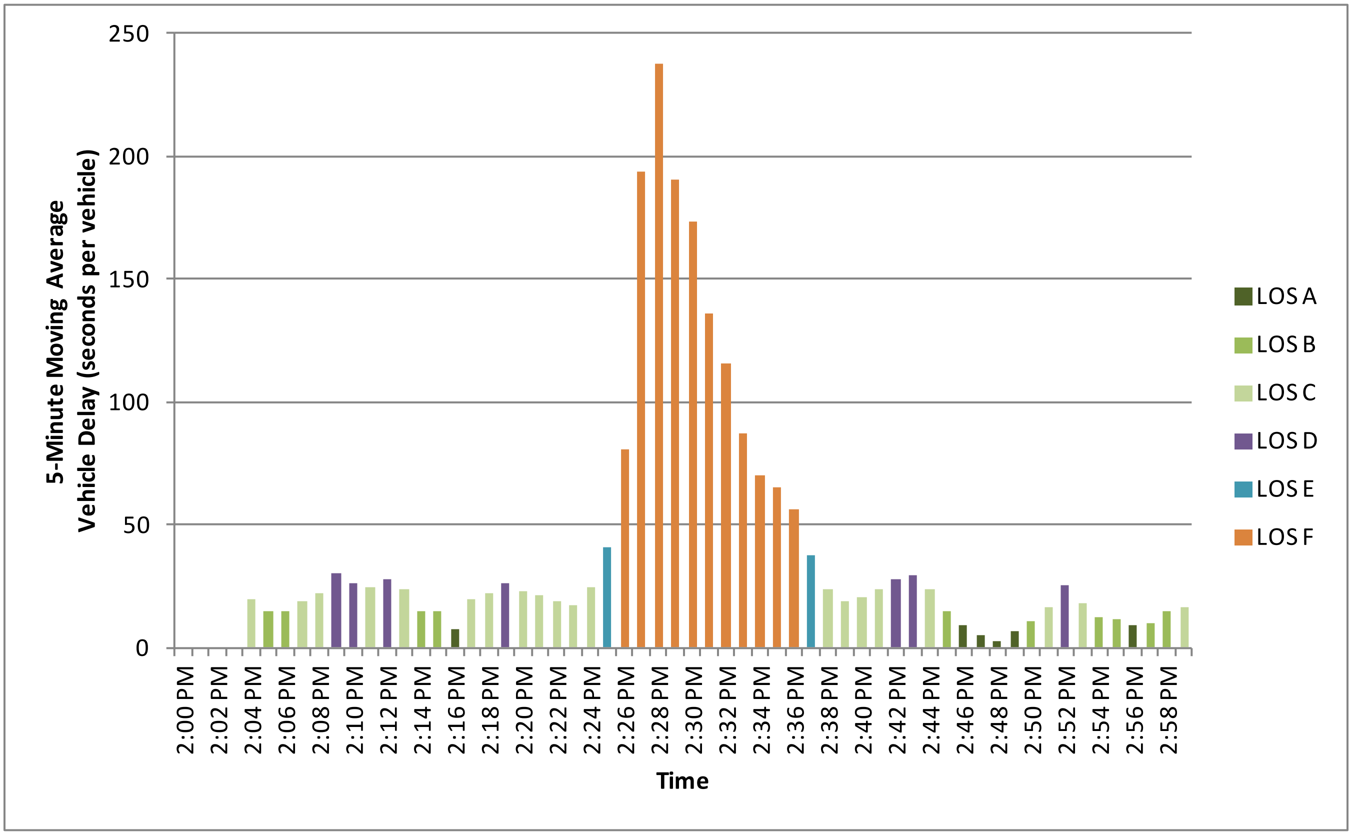

Figure 8 – 5-Minute Moving Average Delay for Eastbound Sandvik Street Approach, 2 to 3 PM

	AM School Arrival Period (7 AM to 8 AM)	PM School Dismissal Period (2 PM to 3 PM)
Total Approach Volume	153 vehicles	158 vehicles
Average Vehicle Delay	28.1 seconds (LOS D)	48.8 seconds (LOS E)
Total Delay	1.2 vehicle-hours	2.1 vehicle-hours
Maximum queue length	11 vehicles	18 vehicles

Table 10 – Stop Delay Study Summary for Eastbound Sandvik Street Approach

4.2 Sandvik Street Intersection Control Evaluation

The current planned design for the intersection of Sandvik Street and University Avenue is a traffic signal with left turn channelization on the University Avenue approaches, and a right turn lane on Sandvik Street on the eastbound approach, as shown in Figure 9 on page 18. Design peak hour volumes for the PM peak hour were developed for the KE University Avenue Rehabilitation & Widening- Traffic Study/63213 *Task 10 Capacity Studies /Design Modifications, Final Report*, April 13, 2012 and are shown in Figure 10 on page 18.

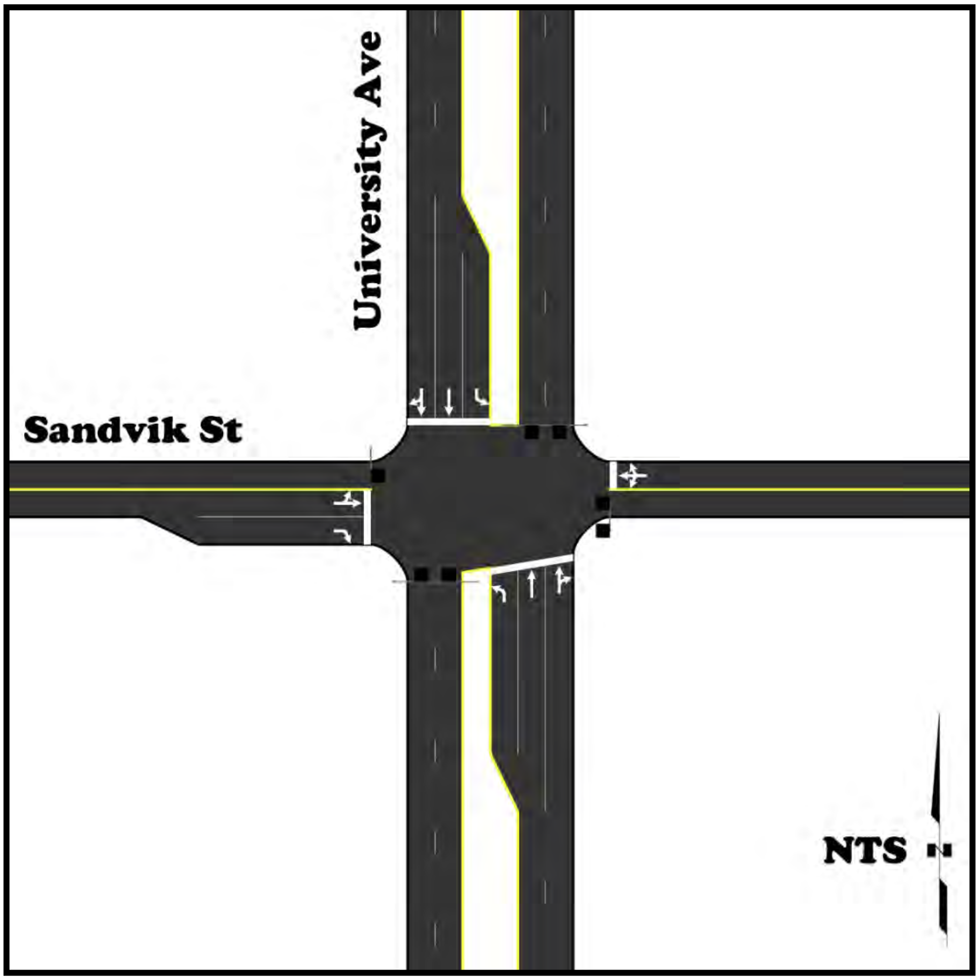

Figure 9 - Proposed Signal Design at University and Sandvik

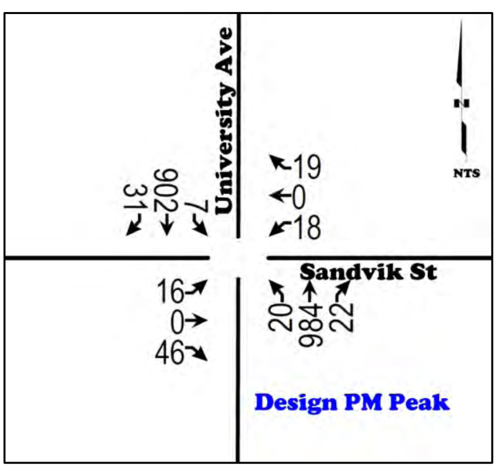

Figure 10 – Sandvik Street and University Avenue Design Turning Movement Counts, 2035

4.3 Diverted Hutchison Institute Volumes and Crashes

4.3.1 Effect on Traffic Volumes

As part of the University Avenue project, the eastbound approach to the intersection at Geist/Johansen and University Avenue will be built with a raised median which extends to the west far enough to block left turns in and out of the eastern-most driveway accessing the Hutchison Institute of Technology. It is likely that a portion of the diverted traffic that can no longer access this driveway would use the Sandvik Street intersection, while some would use the alternative access on the west. The maximum increase in traffic on the Sandvik Street approach to University Avenue due only to the proposed construction of raised median on Geist Road would be approximately 160 ADT, with 60 additional vehicles during the AM school arrival peak and 100 additional vehicles during the PM school dismissal peak.

4.3.2 Effect on Crashes

As part of the evaluation of the proposed traffic signal at this intersection, KE evaluated how this traffic signal might affect operations at the Hutchison Institute of Technology and its access to Geist Road where one of 2 access points will be blocked by the proposed median on Geist Road to accommodate the proposed dual eastbound left turn lanes onto University Avenue. Some of the 2000-2010 crashes that occurred at the Hutchison Institute of Technology driveways could have been diverted to Sandvik Street if the proposed Geist Road raised median had been in place, thus further supporting both a volume and a crash-based traffic signal warrant. Table 11 summarizes crashes that might have occurred at the University Avenue/Sandvik Street intersection under these circumstances:

Crash Type	Crashes involving EBLT Vehicles	Crashes involving SB vs. WB vehicles
Right Angle	1	4
Rear End	1	
TOTAL	2	4

Table 11 - Eastern Hutchison Institute of Technology Driveway Crashes Affected by Geist Road Median: 2000-2010

Only 4 crashes were recorded at the western Hutchison Institute of Technology driveway that may be attributable to this driveway and none of these would have been affected by the proposed Geist Road raised median.

If all the Hutchison Institute of Technology traffic were diverted to the Sandvik Street intersection, it could have accounted for as many as 5 additional right angle crashes during the study period for a possible total of 19 right angle crashes here from 2000-2010. The 19 crashes spread out over 11 years produces an average of less than 2 right angle crashes per year, which is significantly less than is required to satisfy a crash-based traffic signal warrant.

4.4 MUTCD Signal Warrants

The FHWA publication Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD) includes a widely accepted methodology for studying the applicability of traffic signals at intersections. The MUTCD signal warrant analysis compares existing and future traffic conditions at the study intersection with historical performance for similar intersections to determine whether the location is a favorable candidate for a traffic signal.

A signal should only be considered if one or more of these warrants established by the MUTCD are satisfied; however, satisfying one or more signal warrants does not mean that a signal should be installed. To install a signal, an engineering study should indicate that a signal will improve the overall safety and/or operation of the intersection. When an intersection is signalized, minor street delay is usually reduced, but the major road traffic is penalized, which in some cases may increase overall system delay. In addition, while right angle and left turn collisions are generally reduced by signalization, rear end and same-direction sideswipe collisions may increase, especially on high-speed approaches that formerly had free-flow conditions. Finally, signals require ongoing maintenance and operations. All of these factors should be considered when determining whether or not to install a signal.

The MUTCD analysis considers 9 different traffic warrants, which are as follows:

- Warrant 1 - 8-Hour Vehicular Volume
- Condition A – Minimum Vehicular Volume
- Condition B – Interruption of Continuous Flow
- Combination A&B
- Warrant 2 - 4-Hour Vehicular Volume
- Warrant 3 - Peak Hour Volume
- Warrant 4 - Pedestrian Volume
- Warrant 5 - School Crossing
- Warrant 6 - Coordinated Signal System
- Warrant 7 - Crash Experience
- Warrant 8 - Roadway Network
- Warrant 9 - Proximity to Grade Crossing

MUTCD warrant 1 analyzes the distribution of traffic volumes over a peak 8-hour period. Other warrant conditions consider situations where intersections with lower volume roads may still meet warrants if certain conditions exist, such as very high peak periods, high pedestrian demand, high correctable crash history, or proximity to an at-grade rail crossing.

For the existing condition warrant analysis, the 2009 intersection turning movement count was used. A second analysis was performed using the existing count with the additional traffic that could be added due to the closing of the eastern-most Hutchison Institute driveway onto Geist Road to left turns. A third analysis considered latent demand for a traffic signal – the traffic volumes that could be assumed to use the Sandvik Street intersection if a signal were installed.

As shown in Figure 5 on page 15, the right-turn volume for the eastbound approach at Sandvik Street is much higher than the left-turn volume. The MUTCD instructs that engineering judgment should be used in determining whether or not to include right-turn volumes in the approach volumes for the minor street movement. Generally, if there is a separate right turn lane and right turns can made with little delay, only left-turn and through volumes should be considered as part of the minor road approach volume; however, if there is not a right turn lane or if right turn vehicles also experience significant delay, right-turn volumes should be included as part of the minor road approach volume. Under the existing conditions, right turn vehicles are inter-mixed with left turn vehicles on the approach and should be included with the minor road approach volume.

According to the methodology *NCHRP Report 457: Evaluating Intersection Improvements*, a right turn lane is advised for the eastbound approach to the Sandvik Street intersection with University Avenue based on the school dismissal period approach volumes measured by KE in March 2014. If the right turn lane were to be built as part of the future design, then it would probably not be appropriate to include the full right turn volumes in the signal warrant analysis; however, it is likely that some drivers that currently turn right would desire to turn left if there was less delay for this movement (because of the construction of a right turn lane or the installation of a traffic signal, for example). Therefore, assuming construction of a right turn lane, it would still be appropriate to include some of the existing right turn volume in the minor approach volume for the signal warrant analysis.

4.4.1 Signal Warrant Analysis: 2009 Turning Movement Counts

The results of the MUTCD warrant analysis using the 2009 turning movement counts and including the right turn volumes in the minor approach volume are summarized in Table 12 below.

MUTCD Warrant Condition	Warrants Met?
Warrant 1 - 8-Hour Vehicular Volume, Condition A- Minimum Vehicular Volume	No
Warrant 1 - 8-Hour Vehicular Volume, Condition B- Interruption of Continuous Traffic	No
Warrant 1 - 8-Hour Vehicular Volume, Combination of A & B	No
Warrant 2 - 4-Hour Vehicular Volume	No
Warrant 3 - Peak Hour Volume	Yes (if right turns are included)
Warrant 4 - Minimum Pedestrian Volumes	No
Warrant 5 - School Crossings	No
Warrant 6 - Coordinated Signal System	No
Warrant 7 - Crash Experience	No
Warrant 8 - Roadway Network	No

Table 12 - Existing MUTCD Warrant Summary: Sandvik Street and University Avenue

The MUTCD states that Warrant 3 – Peak Hour Volume is to be "applied only in unusual cases, such as office complexes, manufacturing plants, industrial complexes, or high-occupancy vehicle facilities that attract or discharge large numbers of vehicles over a short time." All of these uses represent facilities where drivers may not have a choice of when to travel and may have limited choice of travel mode – thus creating a situation where there is very heavy sides street traffic for one hour of the day. It is unclear whether school traffic is applicable under this warrant, as some of the school traffic is made up of parents or students who choose to drive rather than take the school bus or walk. Thus, at schools it may be appropriate to pursue travel demand modifications that would encourage walking or riding the bus rather than the installation of a signal. That said, if a school facility is deemed appropriate for this warrant, then the combination of major road and minor road traffic volumes during the school dismissal period are sufficient to meet Warrant 3, Condition B, if right turn volumes are included in the side street total volume. [Note: Sandvik Street approach volumes during the school dismissal period are taken from KE's stopped delay study of this approach. The University Avenue approach volumes during this hour are assumed based on counts taken during the surrounding hours and hourly AADT percentages for University Avenue taken from the Permanent Traffic Recorder station on University Avenue at the Chena River.]

4.4.2 Signal Warrant Analysis: Additional Traffic due to Installation of Median on Geist Road

As previously explained, raised median is expected to be installed on Geist Road on the approach to the University Avenue intersection as part of the University Avenue Rehabilitation project. This will close the eastern-most driveway to the Hutchison Institute of Technology to left turn movements (both left-in and left-out). This analysis assumes that all of the left-out traffic would be diverted to the Hutchison driveway that exits on to Sandvik Street and from there to the Sandvik Street intersection with University Avenue. The signal warrant analysis for this situation does not change from the analysis shown in section 4.4.1 – because the driveway volumes are concentrated only during the school arrival and dismissal periods and due to lower volumes on the main street in the AM school arrival period, no additional hours are met for any of the warrant conditions.

4.4.3 Signal Warrant Analysis: Latent Demand

Under the existing traffic conditions, it is reasonable to assume that some drivers desire to turn left from Sandvik Street onto University Avenue, but instead take a different path because of the high left turn delay at this location due to heavy through volumes on University Avenue. If a traffic signal were installed, the left turn delay would be reduced and these drivers will follow their desired route. Some other drivers may decide to use the signalized intersection rather than their shortest route because the signalized intersection has less delay or because they perceive it as being safer. To model these types of behavior changes, KE assumed that overall background volumes on the Sandvik Street approaches would increase by 10% if a signal were installed. In addition, some vehicles that are currently making right turns would choose to make left turns instead. In the peak school arrival and dismissal periods when delay is high at stop control locations, additional traffic may choose to use the signalized location with lower delay.

Table 13 shows the warrant analysis using these assumed volumes for latent demand. Warrant 3 is still the only warrant where traffic volumes meet the necessary thresholds; however, under the assumed latent demand volumes, the warrant volume thresholds are met even if right turn volumes are excluded from the minor road volume.

4.4.4 CAL-Trans Future Signal Warrants

Cal-Trans has a methodology for evaluating signal warrants based on future volumes (found in the ITE Manual of Traffic Signal Design, Second Edition). This method uses future estimated ADT as the input variables and estimates whether the intersection is likely to meet the MUTCD signal Warrant 1 for condition A, B or the combination condition allowed in MUTCD procedure.

The method uses future estimated ADT as the input variables and includes the AADT for the major road and the highest minor approach entering volume. Since the key minor road value is entering volume, it is derived by dividing the minor road AADT in half. In order to exclude right turn volumes from the minor road, the minor road AADT could be reduced by the percentage of right turns during the peak period.

The design volumes used in this analysis are the volumes projected using the FMATS traffic demand model and the growth rate projections reported in the DSR.

MUTCD Warrant Condition	Warrants Met?
Warrant 1 - 8-Hour Vehicular Volume, Condition A- Minimum Vehicular Volume	No
Warrant 1 - 8-Hour Vehicular Volume, Condition B- Interruption of Continuous Traffic	No
Warrant 1 - 8-Hour Vehicular Volume, Combination of A & B	No
Warrant 2 - 4-Hour Vehicular Volume	No
Warrant 3 - Peak Hour Volume	Yes
Warrant 4 - Minimum Pedestrian Volumes	No
Warrant 5 - School Crossings	No
Warrant 6 - Coordinated Signal System	No
Warrant 7 - Crash Experience	No
Warrant 8 - Roadway Network	No

Table 13 - MUTCD Warrant Summary Assuming Latent Demand: Sandvik Street and University Avenue

The results of the warrant analysis over time for Condition A are shown in Figure 11 on page 24 and for Condition B in Figure 12 on page 24. A warrant is met if both the major road volume and the minor road volume are projected to be over their respective thresholds.

The volumes on University Avenue are well above the required threshold for signal warrants at the current time, since the volumes along the entire corridor are greater than the 9,600 entering ADT limit. This means that side streets with a future daily entering volume greater than 2,400 would likely meet condition A, and those with a future daily entering volume greater than 1,200 would likely meet condition B. The projected 2035 design AADT for Sandvik is 1,500, which results in an entering volume of 750, which does not satisfy either of the conditions of the warrant. The combination A&B warrant would likewise not be met by the design year.

The results of the Cal-Trans warrants are summarized in Table 14 on page 25.

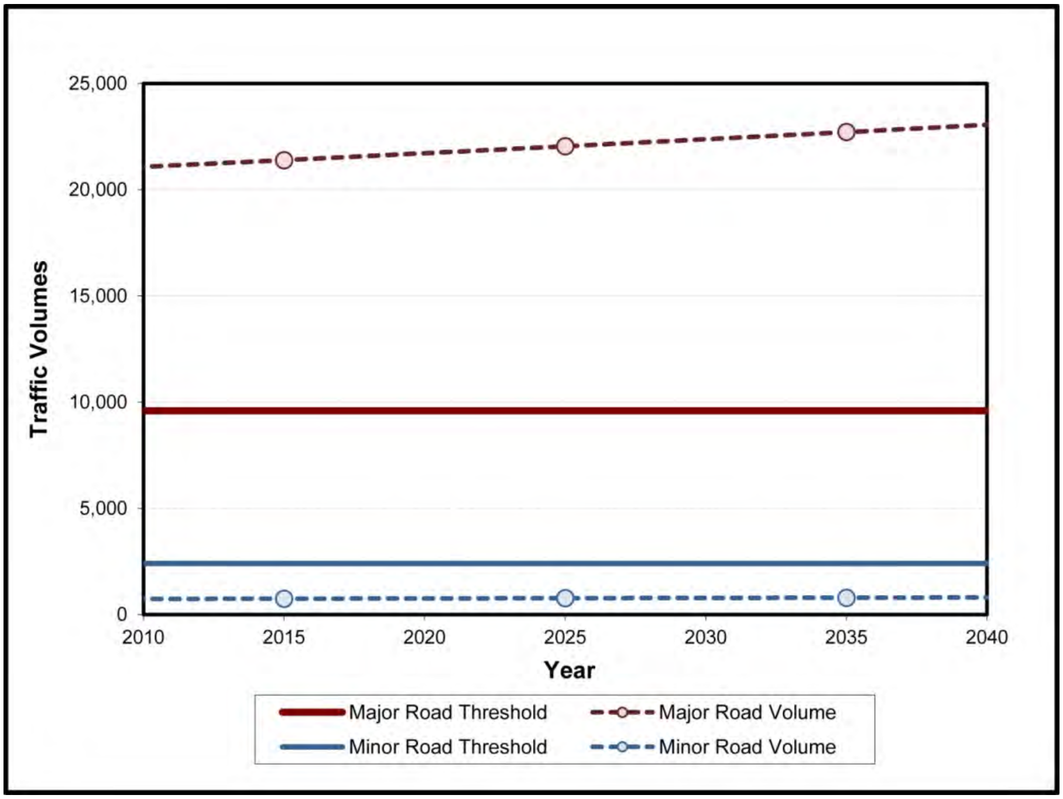

Figure 11 - Cal-Trans MUTCD Warrant 1 - Condition A (2035 volumes)

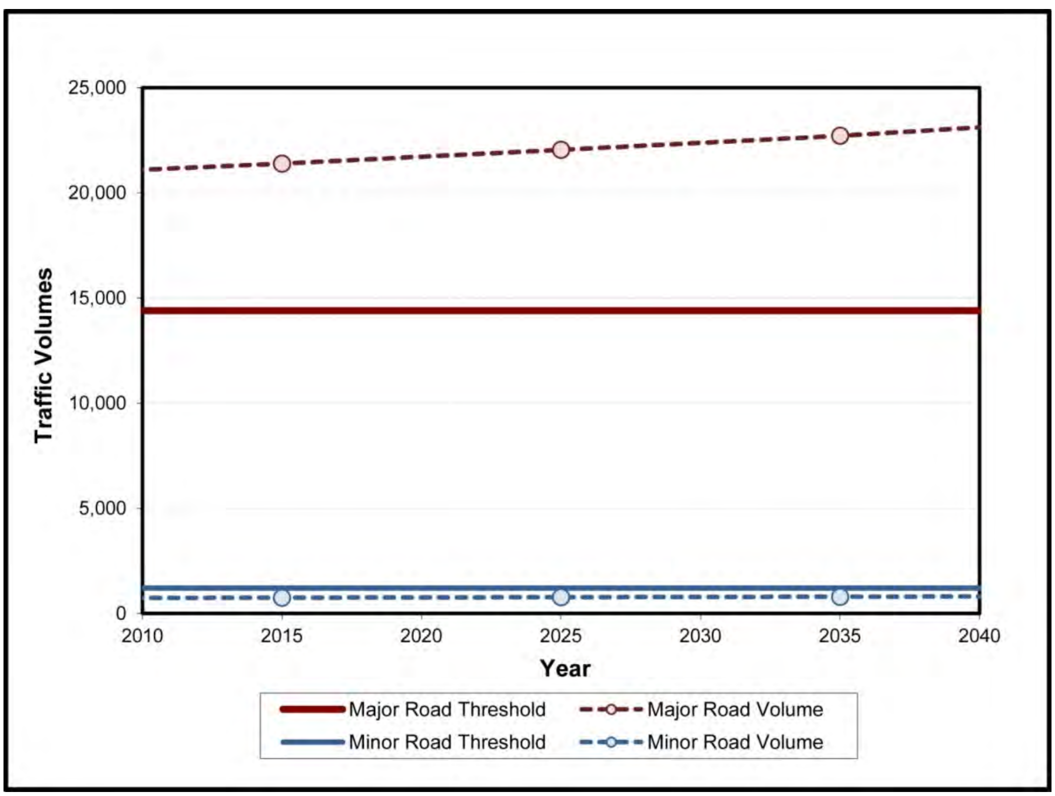

Figure 12 - Cal-Trans MUTCD Warrant 1 - Condition B (2035 volumes)

MUTCD Warrant Condition	Warrants Met in Design Year?
Warrant 1 - 8-Hour Vehicular Volume, Condition A- Minimum Vehicular Volume	No
Warrant 1 - 8-Hour Vehicular Volume, Condition B- Interruption of Continuous Traffic	No
Warrant 1 - 8-Hour Vehicular Volume, Combination of A & B	No

Table 14 - Design Year Cal-Trans Warrant Summary: Sandvik and University (2035 volumes)

4.5 Existing Pedestrian Overcrossing South of Sandvik Street

The existing pedestrian overcrossing structure over University Avenue just south of Sandvik Street used to serve an elementary school on the west side of University Avenue north of Sandvik Street. This school has since been converted to a UAF facility and no longer serves elementary school students. This area is now served by Anne Wien (east side of University Avenue) and University Park (west side of University Avenue) Elementary Schools.

This structure is set to be removed as part of the proposed University Avenue upgrades. The removal of the structure will not have an effect on school walking routes since the former school is no longer a walking facility and there are no specific pedestrian generators which would require pedestrians to cross University Avenue at this location. In addition, there were no pedestrian or bicycle related crashes recorded at this intersection from 2000-2010. Therefore, possible deletion of the proposed traffic signal is not expected to have a negative effect on pedestrian crossing. However, it is still desirable to provide a minimum 6-foot median here for pedestrian refuge.

4.6 Summary Discussion – Crash Warrants

This intersection does not currently meet crash-based traffic signal warrants. The majority of crashes (33) occurring here are rear end crashes which are predicted to be reduced by 1/3rd following the installation of separated left turn lane channelization, by removing these movements from the thru traffic stream. In addition, the 4 sideswipe crashes involved vehicles travelling in the same direction either slowing or attempting to change lanes to avoid a stopped vehicle at the time of the crash. These are also likely to be partially mitigated through the installation of separate left turn channelization. There were 14 crashes of the type susceptible to correction through the installation of a traffic signal in the 11 year evaluation period, or an average of 1.2 crashes/year and not more than 3 crashes in any 12-month period. The crash-based traffic warrant requires 5 crashes susceptible to correction by a traffic signal in a 12 month period. Therefore, this intersection does not meet a crash-based warrant.

4.7 Queue Length Concerns at Signalized Sandvik Intersection

There is concern about the southbound queue caused by traffic stopped at a signal at Sandvik Street backing up into the railroad crossing to the north. Using the design volumes from the DSR report, and the intersection configuration shown in Figure 9 on page 18, the 95th percentile queues are calculated to be 260 feet long in the design year, using HCM analysis methods. The spacing from the signal stop bar to the clearance zone of the railroad track is approximately 450 feet. As such, it appears that there is adequate separation between the ARRC tracks and the signalized Sandvik intersection, at least for the design life of this project.

4.8 Unsignalized Design and LOS

If the signal is not being constructed at Sandvik Street and University Avenue, the cross street approaches would be designed similar to the other median opening intersections along the project corridor. A potential unsignalized intersection design configuration is shown in Figure 13 below, improving the existing condition to include an eastbound right turn lane and north- and southbound left turn lanes.

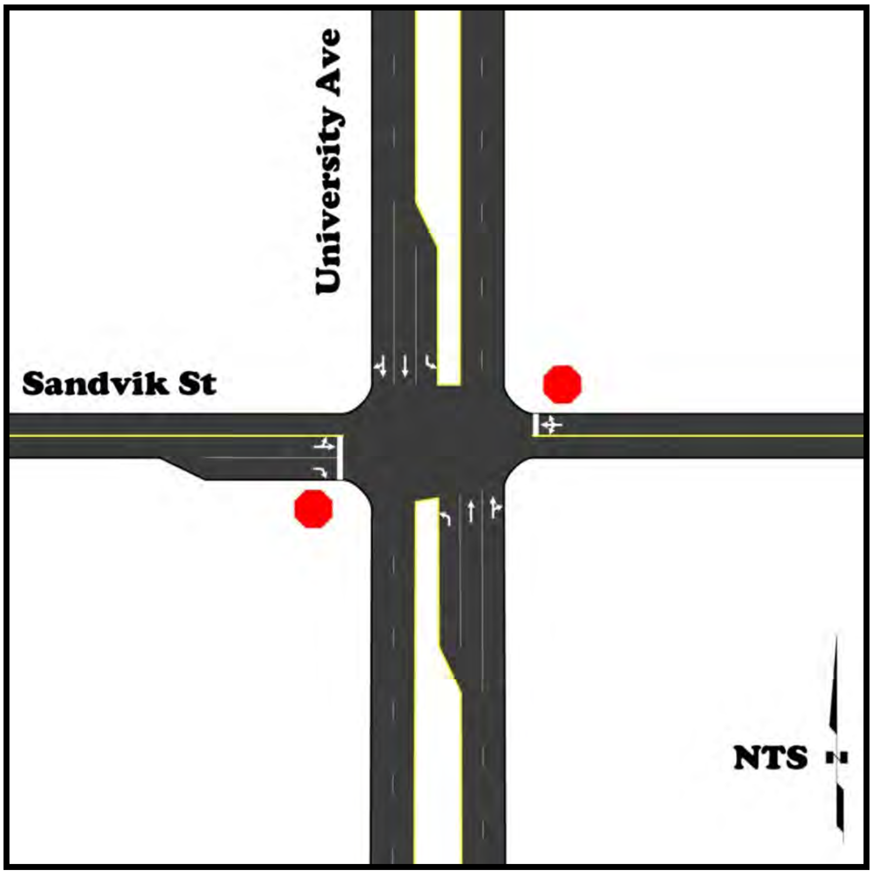

Figure 13 - Unsignalized Alternative at University and Sandvik

The performance of this configuration was evaluated in Synchro using both the existing volumes and the design year PM peak hour volumes. Note that design year volumes have not been developed for the AM or Mid-day peaks. For the existing volumes, the peak 15-minute volume is converted to an hourly flowrate and a peak hour factor of 1.0 was used. Because of the need to represent the heavy peaking behavior on Sandvik Street during the school arrival and dismissal periods, approach peak hour factors were used for the design year analysis.

The levels of service on the eastbound and westbound approaches at Sandvik are currently LOS D in both the AM and PM peak hours. As through volumes on University Avenue increase over time, the LOS is expected to deteriorate with delays that would likely further reduce the number of left turns from the side street approaches.

A signalized intersection would decrease the delay for the side street approaches, but would increase delay for the major University Avenue north/south traffic, which is currently free-flowing.

Street	Approach	Movement	2009 Existing Configuration	
			Delay (sec)	LOS
University Ave	Northbound	Left	10.4	B
		Thru-Right	0.3	A
	Southbound	Left	8.1	A
		Thru-Right	0.1	A
Sandvik St	Eastbound	Left-Thru-Right	27.2	D
	Westbound	Left-Thru-Right	30.8	D

Table 15 - HCM Unsignalized LOS: Existing Sandvik Intersection, AM

Street	Approach	Movement	2009 Existing Configuration	
			Delay (sec)	LOS
University Ave	Northbound	Left	9.4	A
		Thru-Right	0.1	A
	Southbound	Left	8.7	A
		Thru-Right	0.0	A
Sandvik St	Eastbound	Left-Thru-Right	24.2	C
	Westbound	Left-Thru-Right	24.7	C

Table 16 - HCM Unsignalized LOS: Existing Sandvik Intersection, Noon

Street	Approach	Movement	2009 Existing Configuration		2035 Unsignalized with left turn lanes	
			Delay (sec)	LOS	Delay (sec)	LOS
University Ave	Northbound	Left	10.5	B	10.9	B
		Thru-Right	0.5	A	0.5	A
	Southbound	Left	9.7	A	10.6	B
		Thru-Right	0.1	A	0.2	A
Sandvik St	Eastbound	Left-Thru-Right	28.8	D	49.9	E
	Westbound	Left-Thru-Right	34.7	D	89.9	F

Table 17 - HCM Unsignalized LOS: Existing and Design Year Sandvik Intersection, PM

5 Analysis of University Avenue Corridor by Segment and Intersection

The following narrative discusses each roadway segment and intersection from the Mitchell Expressway (Parks) to Thomas Street including crash types and crash severities, alternatives to the proposed configuration that were evaluated, effects of proposed or alternative treatment on U-turn demand, and a discussion of crash and capacity issues associated with the segment or intersections including the effect of any alternative treatment.

Figure 14 on page 29 depicts roadway segments and intersections which were evaluated and summarizes the effects to adjacent property of the raised medians as currently proposed. The properties that are tinted yellow have their direct access to University Avenue restricted to right-in, right-out movements by the proposed raised median; however, these yellow-tinted properties may use local neighborhood streets to travel to a proposed full median opening that is within close proximity to make left-turns in and out of their neighborhood.

The red tinted properties, on the other hand, are limited to right-in, right-out movements by the proposed median without any convenient opportunities to use a nearby full- median opening for left-turn movements. The red-tinted properties would have to accommodate out-of-direction travel circulation changes on University Avenue and its intersecting streets. Although not an uncommon situation in developed urban areas, it would be a change for residents along University Avenue.

5.1 Mitchell Expressway Intersection

5.1.1 Crash Statistics

- 2000-2010 Crashes: 76

Crash Severity

- 1 Fatal Crash (right angle)
- 2 Major Injury Crashes
- 20 Minor Injury Crashes
- 53 Property Damage Only Crashes

Crash Types

- 36 Right Angle
- 17 Rear End
- 5 Sideswipe
- 6 Run off Road
- 7 Fixed Object
- 2 Animal
- 3 Others

5.1.2 Alternatives Evaluated: None.

No revisions to proposed improvements are planned at this location.

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Figure 14 – University Avenue Roadway Segments and Intersections Evaluated for Alternative Treatments and Effects to Adjacent Property of the Currently Proposed Raised Medians

5.2 Mitchell Expressway to Davis Road

5.2.1 Crash Statistics

2000-2010 Crashes: None

5.2.2 Alternatives Evaluated: **None.**

Proposed median should remain due to roadway geometry.

5.2.3 Effect on U-Turn Demand: **No change.**

Vehicles wishing to ingress or egress cross street or driveway intersections in the raised median areas may want to make a U-turn at the closest median break, which is not expected to accommodate u-turns for vehicles other than some types of passenger cars.

5.3 Davis Road Intersection

5.3.1 Crash Statistics

- 2000-2010 Crashes: 31

Crash Severity

- 1 Major Injury Crash
- 7 Minor Injury Crashes
- 23 Property Damage Only Crashes

Crash Types:

- 18 Rear End
- 10 Right Angle
- 1 Head-on
- 2 Others

5.3.2 Alternatives Evaluated: **None.**

A traffic signal is currently proposed for this intersection. No revisions to proposed improvements are planned at this location. Medians near the intersection are required to control the functional area of the intersection as discussed in Section 2.6 on page 6. These values, identified in the KE *Task 10 Capacity Studies /Design Modifications, Final Report*, are 250 feet for the northbound left turn and 450 feet for the southbound left turn. (Note: these values may exceed available space but were identified as the desirable auxiliary lane lengths.)

5.3.3 Effect on U-Turn Demand

Vehicles wishing to ingress or egress cross street or driveway intersections in the raised median areas may choose to make a U-turn at this intersection, which is not expected to accommodate u-turns for vehicles other than some types of passenger cars. However, southbound vehicles wishing to make a left turn between Erickson Avenue and Davis Road would not be redirected to this intersection if a TWLTL were installed in the segment north of Davis Road.

5.3.4 Crash Discussion

The proposed traffic signal and separated left turn lane channelization at this intersection is predicted to result in a 13% crash reduction. Crashes expected to be reduced include northbound and southbound rear end crashes (as a result of the separated left turn lane) and southbound left turning crashes (as a result of the proposed traffic signal), based on HSIP crash reduction factors for the installation of a traffic signal and separate left turn channelization.

A TWLTL segment north of Davis Road could also reduce the crash potential for southbound vehicles which may otherwise attempt a U-turn at this intersection to access properties on the east side of University Avenue.

5.4 Davis Road to Erickson Avenue

5.4.1 Crash Statistics

- 2000-2010 Crashes: 7

Crash Severity

- 1 Minor Injury
- 6 Property Damage Only

Crash Types:

- 4 Rear End
- 2 Right Angle
- 1 Sideswipe

5.4.2 Alternatives Evaluated:

Conversion of the proposed 16-foot FOC to FOC raised median to a 14-foot width TWLTL and narrowing the overall width of the roadway by 4 feet. (No change in median opening.) A raised median section would be maintained in the functional area of the Davis Road intersection as discussed in Section 5.3.2. Figure 15 shows the effects to adjacent property of the raised median for the alternative with TWLTL between Davis Road and Erickson Avenue. Comparison with Figure 14 shows that the TWLTL would allow direct access to University Avenue for the properties on Swenson Avenue and for the two properties on the east side of University Avenue between Holden Road and 19th Avenue.

5.4.3 Effect on U-Turn Demand:

The TWLTL alternative allows vehicles within this segment to ingress or egress side street or driveway intersections directly. These trips will not be diverted.

5.4.4 DOT&PF and TRB Access Management Manual Thresholds for TWLTL verses Raised Median

The design speed and traffic volumes for this segment are forecast to be 40 mph and 15,307, respectively in 2035, well below the DOT&PF Policy and Procedure 05.05.050 threshold of 45 MPH design speed and 20,000 vehicles per day for a non-traversable median. These thresholds are discussed in Section 2.5 on page 5.

If future commercial development such as a large retail or office complex were to occur that was not anticipated in the traffic volume projections, ADOT&PF has the ability to require a traffic impact analysis and set requirements for the development including median restoration, if needed.

Figure 15 – Effects to Adjacent Property of the TWLTL Alternative (Davis to Erickson)

5.4.5 Crash Discussion:

The 4 rear end crashes occurring in this segment would be redirected to left turn lanes at adjacent median breaks under this alternative configuration. However, these crashes will be partially mitigated with the installation of the TWLTL that will remove stopped or turning traffic from the thru traffic stream.

The 2 right angle crashes would not have occurred at their present locations with the proposed raised median. However, these crashes might have occurred at nearby median opening as a U-turn crash. Therefore, the removal of the raised median here is not expected to have a significant negative impact on angle crashes.

In the case of the sideswipe crash, both vehicles were travelling in the same direction with the lead vehicle stopped. Either the raised median or the TWLTL might have prevented this crash.

There were no head-on type crashes which might benefit from a raised median. Therefore, the conversion of the raised median design to a TWLTL in this area will not negatively impact crashes as the TWLTL itself will help mitigate rear end crashes.

5.5 Erickson Avenue Intersection

5.5.1 Crash Statistics

- 2000-2010 Crashes: 30

Crash Severity

- 9 Minor Injury Crashes
- 21 Property Damage Only Crashes

Crash Types

- 16 Rear End
- 7 Right Angle
- 3 Sideswipe
- 1 Bicycle
- 3 Others

5.5.2 Alternatives Evaluated

The intersection median break will remain as proposed. Since the crash experience was higher at this intersection, the crash types were evaluated to determine if some other mitigation including a traffic signal should be considered here.

5.5.3 Effect on U-Turn Demand

Vehicles wishing to ingress or egress cross street or driveway intersections between Davis Road and Erickson Avenue will not be redirected to this intersection if the TWLTL option is chosen for the preceding segment.

There were 3 segment related crashes between Davis and Erickson that are affected by the currently proposed raised median. 2 were rear end crashes and 1 was a sideswipe crash. These crashes might have occurred at an adjacent median opening under the raised median scenario; however, they would be reduced by the construction of left turn lanes. Similarly, these crashes are also likely to be improved with the TWLTL alternative being considered for this segment.

5.5.4 Crash and Operational Discussion

As stated earlier, the majority of crashes occurring at this intersection were rear end crashes. A Highway Safety Improvement Program (HSIP) project was nominated and constructed to install a southbound left turn lane at this intersection. The 2008 Erickson Avenue HSIP design study report indicated that there were 15 recorded crashes at this intersection between 2002 and 2006, 12 of them were rear-end collisions, accounting for 80% of all accidents at this intersection. All of the rear-end collisions involved two vehicles traveling south on University Avenue. A review of 2000-2010 crashes at this intersection show that southbound rear end crashes were reduced from 1.9/year prior to 2007 to 0.75/year following the installation of the southbound left turn lane.

The east leg of the intersection serves a 148 room hotel and a large apartment complex (over 150 units) with this approach being the primary access. Since the traffic generators on this approach are significant, existing and future traffic volume growth should be evaluated to determine if a traffic signal could be warranted based on future volume warrants. The intersection does not currently meet a crash-based traffic signal warrant. If a traffic signal is warranted in the future, the intersection should be designed to accommodate it.

5.6 Erickson Avenue to Airport Way (including Rewak Drive)

5.6.1 Crash Statistics

- 2000-2010 Crashes: 94 (4 at Mitchell, 61 at Rewak, 29 between Rewak and Airport Way)

Crash Severity

- 2 Major Injury Crashes
- 31 Minor Injury Crashes
- 61 Property Damage Only Crashes

Crash Types

- 20 Rear End
- 52 Right Angle
- 12 Sideswipe
- 5 Head-on
- 1 Bicycle,
- 1 Pedestrian
- 3 Others

5.6.2 Alternatives Evaluated: **None.**

Medians near the signalized intersections are required to control the functional area of the intersection as discussed in Section 2.6 on page 6. These values, identified in the KE Task 10 Capacity Studies /Design Modifications, Final Report, are 300 feet for the northbound left turn and 350 feet for the southbound left turn at Rewak Drive and 375 feet for the northbound left turn at Airport Way. (Note: these values may exceed available space but were identified as the desirable auxiliary lane lengths.)

5.6.3 Effect on U-Turn Demand: **No change**

Vehicles wishing to ingress or egress cross street or driveway intersections in the raised median areas may choose to make a U-turn at the closest median break, which is not expected to accommodate u-turns for vehicles other than some types of passenger cars.

5.6.4 Crash Discussion

The proposed raised median, particularly between Rewak Drive and Airport Way, is projected to reduce right angle crashes in this area by up to 20% based on HSIP crash reduction factors for the installation of a raised median.

5.7 Airport Way Intersection

5.7.1 Crash Statistics

- 2000-2010 Crashes: 251

Crash Severity

- 3 Major Injury Crashes
- 50 Minor Injury Crashes
- 198 Property Damage Only Crashes

Crash Types

- 135 Rear End
- 58 Right Angle
- 33 Sideswipe
- 4 Head-on
- 1 Pedestrian
- 20 Others

5.7.2 Alternatives Evaluated: **None.**

The design of this intersection should remain as proposed.

5.8 Airport Way to Geraghty Avenue (includes Geraghty Avenue Intersection)

5.8.1 Crash Statistics

- 2000-2010 Crashes: 50 (all coded to Geraghty Avenue)

Crash Severity

- 2 Major Injury Crashes
- 17 Minor Injury Crashes
- 31 Property Damage Only Crashes

Crash Types

- 19 Right Angle
- 12 Rear End
- 9 Sideswipe
- 6 Head-on
- 1 Bicycle
- 3 Others

5.8.2 Alternatives Evaluated: **None.**

Medians near the signalized intersections are required to control the functional area of the intersection as discussed in Section 2.6 on page 6. This value, identified in the KE *Task 10 Capacity Studies /Design Modifications, Final Report*, is 375 feet for the southbound left turn at Airport Way. (Note: these values may exceed available space but were identified as the desirable auxiliary lane lengths.)

Therefore, the proposed median should remain due to proximity of the Airport Way traffic signal and need to control the intersection functional area including Geraghty Avenue. Also, nearly ½ of all crashes occurring here (including 6 head on crashes involving northbound vs. southbound vehicles) will be improved with installation of the raised median, based on HSIP crash reduction factors for the installation of raised medians.

5.8.3 Effect on U-Turn Demand: **No change**

Vehicles wishing to ingress or egress cross street or driveway intersections in the raised median segment may choose to make a U-turn at the closest median break, which is not expected to accommodate u-turns for vehicles other than some types of passenger cars.

5.8.4 Crash Discussion

Fourteen of the crashes occurring in this area involved southbound left or westbound left turning vehicles which will no longer be able to make these movements under the raised median scenario. These vehicles and possibly some of the crash activity could move to the Airport Way/Washington Drive intersection. However, the Washington Drive intersection is signalized so these left turning movements are more protected at that location than at the University Drive/Geraghty Avenue intersection.

5.9 Geraghty Avenue to Goldizen Avenue

5.9.1 Crash Statistics

- 2000-2010 Crashes: 39

Crash Severity

- 2 Major Injury Crashes
- 8 Minor Injury Crashes
- 29 Property Damage Only Crashes

Crash Types

- 20 Rear End
- 5 Head On
- 3 Bridge
- 3 Sideswipe
- 2 Bike/pedestrian
- 6 Others

5.9.2 Alternatives Evaluated: **Narrowed Median**

The operational effects of a narrower median (no median breaks) to reduce the right of way footprint in this segment has been evaluated. The proposed median is 16 feet from FOC to FOC. University Avenue could be narrowed by 10 feet in this area to retain a 6-foot raised median with sufficient space for pedestrian refuge.

5.9.3 Effect on U-Turn Demand: **No change**

Vehicles wishing to ingress or egress cross street or driveway intersections in the raised median areas may choose to make a U-turn at the closest median break, which is not expected to accommodate u-turns for vehicles other than some types of passenger cars.

5.9.4 Crash and Operational Discussion

The 5 head on crashes will be somewhat mitigated by the presence of a raised median. However, narrowing the median from 16 feet FOC to FOC to 6 feet FOC to FOC might reduce the effectiveness of the raised median in reducing head-on crashes.

16 of the 20 rear end crashes involved southbound vehicles. Vehicles involved in these crashes were either stopped, changing lanes, or out of control at the time of the crash. The presence and/or width of the raised median should have little impact on these crashes.

The 3 sideswipe crashes were same direction crashes and would probably not be affected by the presence and/or width of the median either.

For the bicycle and pedestrian related crashes, the bicycle or pedestrian did not appear to be crossing University Avenue at the time of the crash. A minimum of 6 feet of raised median (instead of the proposed 16 feet) will still provide refuge for bicycles and pedestrians wishing to cross University Avenue.

DOT&PF Northern Region retained DOWL/HKM to conduct a value engineering (VE) study in 2010 to make recommendations concerning modifications to the proposed University Avenue design. The following are excerpted from that study:

“The study also focused on the wide raised median, noting that it uses a standard 19-foot section (gutter pan to gutter pan), even where there are long sections without turning pockets. It can thereby be reduced in width through those sections and realize substantial reductions in utility relocations and right of way takes.”

This concept was ultimately dismissed due in part to concerns with vehicles needing to perform U-turns at the median openings. However, this recommendation was retained for the Chena River Bridge area where the VE study recommended reducing the median width to 9 feet across the bridge, eliminating the 8-foot utility buffer, reducing the, bike path to 9 feet, reducing the sidewalk to 6 feet, increasing the shoulders to 6 feet (match roadway shoulder), and retaining left turns into Goldizen Avenue.

KE evaluated the recommended median reduction to determine the geometric revisions required to accomplish a reduction in the median from 16 feet FOC to FOC to 6 feet north of Geraghty, across the Chena River, and increase the median to accommodate a northbound left turn lane between the north abutment of the Chena River Bridge and Goldizen Avenue. The following summarizes roadway width transition points to accommodate the recommend median narrowing:

- Sta. 64+25: Match 16-foot FOC to FOC median adjacent to Geraghty. Begin 40 MPH 5-foot shifting taper ($WS^2/60$ or $5*40^2/60$) to 6-foot median.
- Sta. 65+40: Begin 6-foot FOC to FOC median
- Sta. 77+00: South Chena River Bridge Abutment
- Sta. 80+10: North Chena River Bridge Abutment
- Sta. 80+15: End 6-foot FOC to FOC median. Begin transition to 16-foot median. (Same shifting taper as above)
- Sta. 81+50: Begin 16-foot FOC to FOC median. Begin 120-foot bay taper into NB Goldizen Avenue left turn lane.
- Sta. 82+70: begin Left Turn Lane (100-foot length)
- Sta. 83+70: Begin Goldizen median opening.

5.10 Goldizen Avenue Intersection

5.10.1 Crash Statistics

- 2000-2010 Crashes: 21

Crash Severity

- 1 Major Injury Crash
- 9 Minor Injury Crashes
- 11 Property Damage Only Crashes

Crash Types

- 17 Rear End
- 2 Right Angle
- 2 Sideswipe

5.10.2 Alternatives Evaluated: **None**

The intersection median break should remain as proposed.

5.10.3 Effect on U-Turn Demand

Vehicles wishing to ingress or egress cross street or driveway intersections in the raised median areas may choose to make a U-turn at this intersection, which is not expected to accommodate u-turns for vehicles other than some types of passenger cars. However, southbound vehicles wishing to make a left turn between Indiana Avenue and Goldizen Avenue would not be redirected to this intersection if a TWLTL were installed in the segment north of Goldizen Avenue.

5.10.4 Crash Discussion

The proposed design does not call for improvements at this intersection beyond separate left turn channelization. At present, neither traffic volumes nor crash history support the need for additional controls such as a traffic signal. However, if a traffic signal becomes warranted in the future, the design of the intersection geometry should support such an installation. To accommodate a future traffic signal, a minimum 14-foot FOC to FOC median would be needed at this intersection to provide a 10-foot width left-turn lane and 4-foot raised median. Assuming a narrowing of the median to 6 feet FOC to FOC across the Chena River Bridge just south of the intersection, the roadway will need to be widened by 8 feet between the north bridge abutment and Goldizen Avenue to accommodate the northbound left turn lane. As discussed in the previous section, it is possible to widen the median sufficiently between the north abutment of the Chena River Bridge and the Goldizen Avenue intersection to provide 100 feet of left turn storage.

Rear end crashes at this intersection are equally divided between northbound and southbound directions. The proposed median break with separate left turn lanes will help mitigate these crashes. Right angle crashes may also be partially mitigated as the proposed northbound and southbound left turn lanes will get these left turning vehicles out of the thru traffic stream and should improve the visibility of the left turner for oncoming traffic.

Goldizen Avenue may receive additional left turn or U-turn movements diverted from Widener and parcels between Goldizen and the Chena River Bridge as a result of the raised median. However, nearly all of the crashes at Widener are rear end crashes involving vehicles stopped at the intersection. These vehicles will be diverted to locations with left turn channelization, reducing the instance of a rear end crash by over 33%.

5.11 Goldizen Avenue to Indiana Avenue

5.11.1 Crash Statistics

- 2000-2010 Crashes: 31

Crash Severity

- 1 Major Injury Crash
- 9 Minor Injury Crashes
- 21 Property Damage Only Crashes

Crash Types

- 21 Rear End
- 4 Head-on
- 3 Sideswipe
- 1 Bicycle
- 2 Other.

5.11.2 Alternatives Evaluated

A TWLTL and narrower median have been evaluated for this segment. (No change in median opening.) The proposed median width could be reduced from 16 feet (FOC to FOC) to 14 feet for a TWLTL. This would reduce the overall roadway width by 4 feet from 79 feet to 75 feet. At Goldizen Avenue, the left turn lane could be 10 feet in width with a 4-foot raised island for intersection control and to provide for future traffic signal channelization. Such a raised median could be omitted until or if signalization is warranted. Figure 16 shows the effects to adjacent property of the raised median for the alternative with TWLTL between Davis Road and Erickson Avenue. Comparison with Figure 14 shows that the TWLTL would allow direct access to University Avenue for the properties on Swenson Avenue and for the two properties on the east side of University Avenue between Holden Road and 19th Avenue.

Figure 16 – Effects to Adjacent Property of the TWLTL Alternative (Goldizen to Indiana)

5.11.3 Effect on U-Turn Demand:

The TWLTL alternative allows vehicles within this segment to ingress or egress side street or driveway intersections directly. These trips will not have to be diverted.

5.11.4 DOT&PF and TRB Access Management Manual Thresholds for TWLTL verses Raised Median

The 40 MPH design speed for this segment is below the DOT&PF Policy and Procedure 05.05.050 threshold of 45 MPH design speed for a non-traversable median. The forecast ADT volume for 2035 is 23,417, above the DOT&PF Policy and Procedure 05.05.050 threshold of 20,000 vehicles per day but below the TRB Access Management Manual threshold of 24,000 vehicles per day for a non-traversable median. These thresholds are discussed in Section 2.5 on page 5.

If future commercial development such as a large retail or office complex were to occur that was not anticipated in the traffic volume projections, DOT&PF has the ability to require a traffic impact analysis and set requirements for the development including median restoration, if needed.

5.11.5 Crash Discussion

Conversion of the median design to a TWLTL configuration along this segment presents the opportunity to delete the proposed Ward Street access road north of Goldizen Avenue.

Of the 17 rear end crashes recorded in this segment, over ½ of these could be mitigated through the installation of a center TWLTL to remove turning traffic from the through traffic stream, based on HSIP crash reduction factors for the installation of a center TWLTL on a 4 lane undivided roadway.

In the case of the 4 head on crashes, converting the raised median design to a flush median design will result in a greater possibility of these types of crashes occurring in the future, although the opposing traffic flows would be separated by a 14-foot TWLTL, affording some buffer space not presently available.

For the bicycle related crash, the bicycle did not appear to be crossing University Avenue at the time of the crash. There were no pedestrian related crashes recorded in this segment during the study period. A 14-foot TWLTL space provides an opportunity to provide pedestrian refuge at selected location(s) along this segment if a pedestrian crossing need is identified.

5.12 Indiana Avenue Intersection

5.12.1 Crash Statistics

- 2000-2010 Crashes: 18

Crash Severity

- 5 Minor Injury Crashes
- 13 Property Damage Only Crashes

Crash Types

- 9 Rear End
- 4 Right Angle
- 4 Sideswipe
- 1 Fixed Object

5.12.2 Alternatives Evaluated: **None**

The proposed median break should remain as proposed.

5.12.3 Effect on U-Turn Demand:

Vehicles wishing to ingress or egress cross street or driveway intersections between Goldizen Avenue and Indiana Avenue will not be redirected if the TWLTL option is chosen for the preceding segment.

5.12.4 Crash Discussion

Had the proposed raised median been in place south of Indiana Avenue during the study period, up to 11 of the 31 crashes recorded between Goldizen Avenue and Indiana Avenue from 2000-2010 might have occurred at Indiana Avenue instead. However, the proposed left turn lane would have mitigated nearly ½ of those, based on HSIP crash reduction factors for the installation of separate left turn channelization.

The TWLTL alternative will provide the left turning lane separate from the thru lanes, address many of the rear end crashes occurring in the previous segment, and will not cause northbound trips bound for the segment between Goldizen Avenue and Indiana Avenue to be redirected to Indiana Avenue.

5.13 Indiana Avenue to Geist/Johansen Expressway

5.13.1 Crash Statistics

- 2000-2010 Crashes: 21

Crash Severity

- 1 Major Injury Crash
- 8 Minor Injury Crashes
- 12 Property Damage Only Crashes

Crash Types

- 14 Rear End
- 1 Right Angle
- 1 Sideswipe
- 1 Bicycle
- 1 Pedestrian
- 3 Other

5.13.2 Alternatives Evaluated: **None**

Medians near the signalized intersections are required to control the functional area of the intersection as discussed in Section 2.6 on page 6. This value, identified in the KE *Task 10 Capacity Studies /Design Modifications, Final Report*, is 525 feet for the northbound left turn at Geist/Johansen Expressway. (Note: these values may exceed available space but were identified as the desirable auxiliary lane lengths.) Therefore, the proposed median should remain due to proximity of traffic signals and need to control intersection functional area.

5.13.3 Effect on U-Turn Demand: **No change**

Vehicles wishing to ingress or egress street or driveway intersections in the raised median areas may choose to make a U-turn at the closest median break, which is not expected to accommodate u-turns for vehicles other than some types of passenger cars.

5.13.4 Crash Discussion

The proposed raised median between Indiana Avenue and Geist/Johansen is projected to reduce rear end crashes in this area by over 30% based on HSIP crash reduction factors for the installation of a raised median, although some of the crashes attributed to the Indiana Avenue to Geist/Johansen intersection may actually be associated with the Geist/Johansen traffic signal, as approximately 1/2 are northbound rear end crashes.

5.14 Geist/Johansen Expressway Intersection

5.14.1 Crash Statistics

- 2000-2010 Crashes: 332

Crash Severity

- 2 Fatal Crashes
- 12 Major Injury Crashes
- 73 Minor Injury Crashes
- 245 Property Damage Only Crashes

Crash Types

- 159 Rear End
- 94 Right Angle
- 39 Sideswipe
- 10 Head-on
- 8 Bicycle
- 6 Concrete Divider
- 4 Overturned
- 12 Others

5.14.2 Alternatives Evaluated: **None.**

The design of this intersection should remain as proposed.

5.14.3 Effect on U-Turn Demand: **No change**

Vehicles wishing to ingress or egress cross street or driveway intersections in the raised median areas may choose to make a U-turn at the closest median break, which is not expected to accommodate u-turns for vehicles other than some types of passenger cars.

5.14.4 Crash Discussion

The proposed design of the Geist/Johansen intersection should reduce the number of bicycle related crashes here by providing right turn channelizing islands on northeast and southeast corners of the intersection.

5.15 Geist/Johansen Expressway to Sandvik Street

5.15.1 Crash Statistics

- 2000-2010 Crashes: 6

Crash Severity

- 1 Minor Injury Crash
- 5 Property Damage Only Crashes

Crash Types

- 5 Rear End
- 1 Right Angle

5.15.2 Alternatives Evaluated: **None.**

Medians near the signalized intersections are required to control the functional area of the intersection as discussed in Section 3.6 on page 7. These values, identified in the KE *Task 10 Capacity Studies /Design Modifications, Final Report,* are 425 feet for the southbound left turn at Geist/Johansen Expressway and 275 feet for the northbound left turn at Sandvik Street under the current traffic signal proposal. (Note: these values may exceed available space but were identified as the desirable auxiliary lane lengths.) Therefore, the proposed raised median should remain due to the proximity of the Geist/Johansen intersection and the need to control the intersection functional areas between Geist/Johansen and Sandvik Street.

5.15.3 Effect on U-Turn Demand: **No change**

Vehicles wishing to ingress or egress cross street or driveway intersections in the raised median areas may choose to make a U-turn at the closest median break, which is not expected to accommodate u-turns for vehicles other than some types of passenger cars.

5.15.4 Crash Discussion

The proposed raised median in this area is projected to reduce right angle crashes in this area by up to nearly 1/2 based on HSIP crash reduction factors for the installation of a raised median.

5.16 Sandvik Street Intersection

5.16.1 Crash Statistics

- 2000-2010 Crashes: 55

Crash Severity

- 2 Major Injury Crashes
- 16 Minor Injury Crashes
- 37 Property Damage Only Crashes

Crash Types

- 33 Rear End
- 14 Right Angle
- 4 Sideswipe
- 2 Head-on
- 2 Others

5.16.2 Alternatives Evaluated

Removal of the proposal to install a traffic signal (median opening and left turn lanes to remain as proposed). The Sandvik Street intersection control, including a discussion of traffic signal warrants, traffic volumes and crashes, is discussed in more detail in Section 4 on page 14.

5.16.3 Effect on U-Turn Demand: **No change**

Vehicles wishing to ingress or egress cross street or driveway intersections in the raised median areas may choose to make a U-turn at the closest median break, which is not expected to accommodate u-turns for vehicles other than some types of passenger cars. However, removal of the proposed traffic signal at this location would eliminate the protected left turn/U-turn movement for northbound or southbound vehicles.

5.17 Sandvik Street to Thomas Street (most crashes coded to Cameron or Thomas Streets)

5.17.1 Crash Statistics

- 2000-2010 Crashes: 50

Crash Severity

- 1 Major Injury Crash
- 7 Minor Injury Crashes
- 42 Property Damage Only Crashes

Crash Types

- 22 Rear End
- 16 Right Angle
- 7 Sideswipe
- 2 Head-on
- 3 Others

5.17.2 Alternatives Evaluated: **None.**

Medians near the signalized intersections are required to control the functional area of the intersection as discussed in Section 3.6 on page 7. This value, identified in the *KE Task 10 Capacity Studies /Design Modifications, Final Report*, is 250 feet for the southbound left turn at Sandvik Street under the current traffic signal proposal. (Note: these values may exceed available space but were identified as the desirable auxiliary lane lengths.) The proposed median should remain due to the need to control intersection functional area to the south to accommodate a future traffic signal and the proximity of the railroad/highway grade crossing to the north which is approximately 460 feet north of Sandvik Street and 270 feet south of Cameron Street. Since there is less than 400 feet between Cameron and Thomas Streets, the proposed raised median should remain in this area as well.

5.17.3 Effect on U-Turn Demand: **No change;**

Vehicles wishing to ingress or egress cross street or driveway intersections in the raised median areas may choose to make a U-turn at the closest median break, which is not expected to accommodate u-turns for vehicles other than some types of passenger cars.

5.17.4 Crash Discussion

The raised median is expected to reduce crashes by approximately 25%, including mostly rear end crashes between Sandvik Street and Thomas Street through the installation of the raised median. The 24 crashes at Thomas Street are not expected to be effected by the proposed design as it matches the existing typical section at this location.

6 Summary of Findings

As a result of our segment and intersection evaluation, KE has prepared the following table summarizing those segments where alternative median treatments may be appropriate, intersections where alternative intersection control could be considered, and the recommended treatment.

Roadway Segment or Intersection	Proposed Median and/or Intersection Treatment	Acceptable Alternative Treatment	Recommended Treatment
Davis Road to Erickson Avenue	Raised Median (median breaks at Holden Road and 19th Avenue)	TWLTL	Retain Raised Median
Erickson Avenue Intersection	Median opening with left turn lane channelization	None (Recommend additional evaluation of intersection traffic volumes in support of possible future intersection improvements.)	N/A
Geraghty Avenue to Goldizen Avenue	Raised Median	Narrowed raised median (16-foot FOC to FOC to 6-foot FOC to FOC with pedestrian refuge)	Narrowed Raised Median
Goldizen Avenue to Indiana Avenue	Raised Median	TWLTL	Retain Raised Median
Sandvik Street Intersection	Traffic Signal (proposed)	Removal of traffic signal	Removal of traffic signal

Table 18 – University Avenue Acceptable Median and Intersection Treatment Alternatives

6.1 Raised Median vs. TWLTL

As discussed in Section 5.4 on page 31 and Section 5.11 on page 38, the Davis Road to Erickson Avenue and Goldizen Avenue to Indiana Avenue segments could function adequately with a center TWLTL in place of the proposed raised median, which is superior to the present 4-lane two-way configuration. However, KE recommends retention of the raised median. The raised median concept has been shown to be a safer treatment than a TWLTL in numerous studies and has a number of advantages over the TWLTL. Among them are:

- A raised median has the advantage of controlling present and future access to and from University Avenue and adjacent property.
- A raised median limits and organizes left turns from University Avenue at selected median openings which reduces friction on University Avenue.
- A raised median provides refuge for pedestrians who choose to cross at locations other than signalized intersections, which are spaced as far as ¾ miles apart (Airport Way to Geist Road).
- A raised median promotes higher mobility. University Avenue is functionally classified as an urban principal arterial roadway, which is intended to emphasize high mobility – characterized by higher speeds and longer travel distances. To the extent possible, access to land parcels that are adjacent to arterial roadways should be provided on side streets, frontage, or backage roadways, so that only other arterial or collector roadways connect directly to the arterial roadway.

- The TRB Access Management Manual traffic volume threshold for consideration of a non-traversable median is nearly reached on the Goldizen Avenue to Indiana Avenue segment by 2035.

6.2 Narrowed Median

On the Geraghty Avenue to Goldizen Avenue segment, the proposed raised median can be narrowed from the proposed 16 foot face of curb to face of curb (FOC) width to 6 feet (including on the new Chena River Bridge) without negatively impacting crashes or operations as there are no affected side street or driveway access points in this area.

6.3 Sandvik Street Intersection Alternative Intersection Treatments.

KE recommends that this intersection remain unsignalized, rather than being signalized as proposed in the current DSR, although consideration should be given to plumbing the intersection for a future signal. The only signal warrant that may be met at this location in the 2035 design year is Warrant 3 – Peak Hour Volume, which indicates that the Sandvik Street eastbound approach experiences enough delay during the school dismissal period that a signal could be considered for that one hour. No other present or future signal warrants are met at this location based on either crashes or present and future traffic volumes. This conversion is expected to have little effect on crashes or operations, even with redirected traffic from Hutchison Institute of Technology eastern driveway on Geist Road, which is to be blocked by a raised median as part of University Avenue at Geist/Johansen Expressway intersection reconstruction.

The removal of the existing pedestrian overcrossing, which was originally installed for access to an elementary school whose use has since been converted into a University of Alaska Fairbanks (UAF) facility, is not expected to have a negative effect on pedestrian crossing. However, it is still desirable to provide a minimum 6-foot median here for pedestrian refuge.

7 References

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- *Manual on Uniform Traffic Control Devices for Streets and Highways*, 2009 edition. Federal Highway Administration, December 2009. Accessed at http://mutcd.fhwa.dot.gov/kno_2009.htm on January 29, 2010.

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