

## Appendix D

### Traffic, Safety and Alternatives Analysis

**Municipality of Anchorage**  
**Eklutna River Bridge Replacement**

**MOA Project No. 12-40**  
**Draft Report**

**Traffic and Safety Analysis**

**November 2013**

**Prepared for:**  
**Municipality of Anchorage**  
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## Acronyms and Abbreviations

The following table presents acronyms and abbreviations that may be commonly used throughout this document.

ADT	Average Daily Traffic
AADT	Annual Average Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
AMATS	Anchorage Area Metropolitan Area Solutions
ATM	Alaska Traffic Manual
CTWLTL	Continuous-two-way left turn lane
DCM	Design Criteria Manual
DOT&PF, DOTPF	State of Alaska Department of Transportation and Public Facilities
EB, EBL, EBT, EBR	Eastbound, eastbound left turn, eastbound through, eastbound right turn
FHWA	Federal Highway Administration
GDHS	A Policy on the Geometric Design of Highways and Streets
HCM	Highway Capacity Manual
Hwy	Highway
ITE	Institute of Transportation Engineers
LOS	Level of Service (intersection performance grade)
LT	Left turn(s)
MOA	Municipality of Anchorage
MOE	Measure of Effectiveness
mph	Miles Per Hour
MTP	Metropolitan Transportation Plan
MUTCD	Manual of Uniform Traffic Control Devices
NB, NBL, NBT, NBR	Northbound, northbound left turn, northbound through, northbound right turn
NCHRP	National Cooperative Highway Research Program
OSHP	MOA's Official Streets and Highways Plan
Ped	Pedestrian
PTR	Permanent Traffic Recorder
Rd	Road
RT	Right turn(s)
SB, SBL, SBT, SBR	Southbound, southbound left turn, southbound through, southbound right turn
Sec	Second
sf	Square feet
St	Street
TIA	Traffic Impact Analysis (report or process)
T, Thru	Through
v/c	Volume to Capacity
Veh	Vehicle
WB, WBL, WBT, WBR	Westbound, westbound left turn, westbound through, westbound right turn

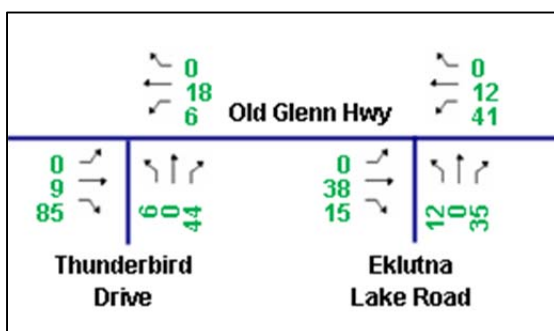
## Executive Summary of Recommendations

The Municipality of Anchorage (MOA), in partnership with the Alaska Department of Transportation and Public Facilities (DOT&PF), is replacing the Eklutna River Bridge along the Old Glenn Highway. The project includes upgrades to the Old Glenn from Thunderbird Drive to Eklutna Lake Road.

This traffic and safety analysis addresses traffic engineering and transportation planning for a broader study area that includes the Old Glenn Highway, Eklutna Village Road, and the on/off-ramps of the Glenn Highway, at both the Thunderbird Falls exit and the Eklutna interchange. Roadway segments, intersections, and the freeway ramps are evaluated to determine future performance. Performance is the basis for recommended design designations.

The analysis uses a construction year of 2015 and a design year of 2035 with the following findings:

- Traffic Volumes.** Past and present traffic volume data and turning movement counts were collected for roadway segments and intersections from DOT&PF, field studies, and the Metropolitan Transportation Plan Travel Demand Model. Future traffic volumes were forecasted using a growth rate of five percent. Average Annual Daily Traffic is predicted to be 2,598 for the design year with the following turning movements:



### Executive Summary Figure A – Turning Movements for Project Corridor

- Crash Studies.** Crash data were evaluated within the study area for crash rate and overrepresentation of crash type or contributing factor. No crashes were found within the project corridor and those within the study were few with no significant trends.
- Operations Analysis.** Roadway segments, intersections, and on-off ramps are predicted to have adequate capacity during the design year. The Old Glenn Highway is predicted to have LOS B, the intersection at Thunderbird Drive a LOS A, and the intersection at Eklutna Lake Road a LOS A.

- **Pedestrians.** Pedestrian usage within the project corridor is expected to be low with volumes of 50 or less per day. Pedestrian capacity along the Old Glenn Highway is good with expected LOS A.

### **Recommendations**

Recommendations for the roadway improvements are based on MOA's Design Criteria Manual. Lane width should be 11 feet with shoulders a minimum of 4 feet with a separated pedestrian pathway. Passing zones or auxiliary turning lanes are not required.

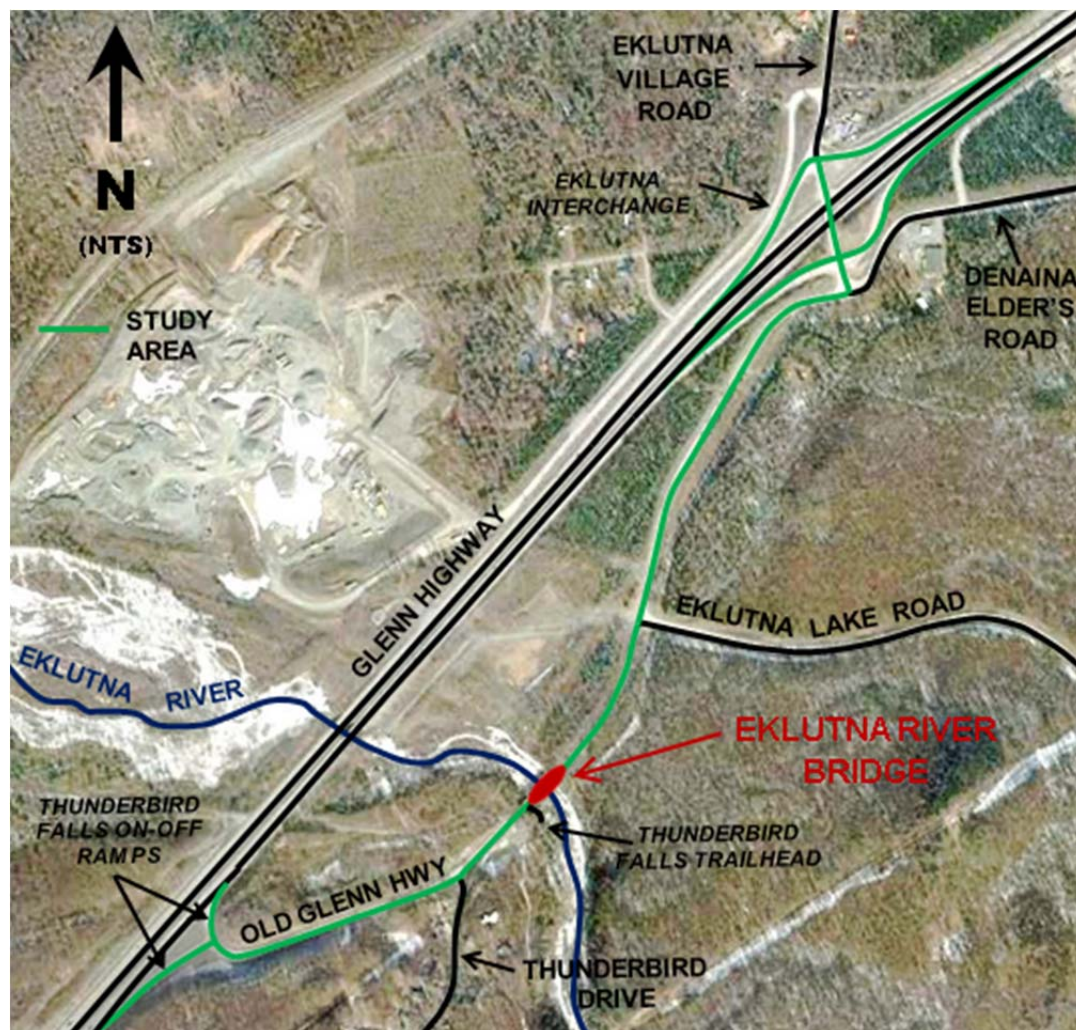
Additional design designations are as follows:

- *Design Functional Classification:* Rural Residential Collector
- *Construction Type:* New
- *Design Life:* 20 years
- *Design Hour Volume Percent:* 12.8%
- *Peak Hour Factor:* 0.88
- *Directional Distribution Percent:* 70%/30%
- *Heavy Vehicles:* 3%
- *Equivalent Single Axle Loads:* To be determined.

# 1 Project Description

The Municipality of Anchorage (MOA), in partnership with the Alaska Department of Transportation and Public Facilities (DOT&PF), is replacing the Eklutna River Bridge along the Old Glenn Highway. The bridge is located just north of the Chugach State Park's Thunderbird Falls Trailhead. The project includes bridge replacement and upgrades on the Old Glenn Highway between Thunderbird Drive and Eklutna Lake Road.

This traffic and safety analysis addresses traffic engineering and transportation planning elements required for the project. The analysis evaluates how the Old Glenn Highway, Eklutna Village Road, and the on/off-ramps of the Glenn Highway, at both the Thunderbird Falls exit and the Eklutna interchange, will perform under future conditions. The analysis study area is shown in Figure 1.



Aerial Photography Source: Google Earth

**Figure 1. Traffic and Safety Analysis Study Area**



The analysis uses a construction year of 2015 and a design year of 2035 with the following elements.

- **Traffic Volumes.** Past and present traffic volume data and turning movement counts were collected for roadway segments and intersections. Future traffic volumes, both Average Annual Daily Traffic (AADT) and peak hour turning movements, were forecasted for the construction and design years. Past volumes apply to the crash studies and forecasted volumes apply to capacity studies and the design designations.
- **Crash Studies.** Crash data were collected from 2000 to 2010 and evaluated for crash rate and overrepresentation of crash type or contributing factor.
- **Operations Analysis.** Roadway segments and intersections were evaluated for existing and forecasted capacity and Level of Service (LOS).
- **Pedestrians.** The expected LOS and delay experienced by pedestrians was calculated for key unsignalized crossings.

### **1.1 Existing Conditions**

The Eklutna River Bridge was closed to vehicular traffic in May 2012. The northbound approach is blocked just north of the Thunderbird Falls Trailhead parking area. The southbound approach is blocked just south of the Old Glenn Highway and Eklutna Lake Road intersection. Because the Glenn Highway exit at Thunderbird Falls functions with a right-in-right-out configuration in the northbound direction only, with no southbound exit or interchange, area residents living in the Thunderbird Heights subdivision and park users of the Thunderbird Falls Trailhead are required to detour around the closure by utilizing either the Eklutna interchange to the north or the Mirror Lake interchange to the south.

The Old Glenn Highway is a paved, two lane roadway with no shoulders or pedestrian facilities. At both the Thunderbird Drive and Eklutna Lake Road intersections, the Old Glenn has free-flowing movement while the minor roadways have stop control. Both intersections are three way approaches, two on the Old Glenn Highway and one on the minor roadway. The intersection of the Old Glenn Highway, Denaina Elder's Road, and Eklutna Village Road is also a three way approach. The Old Glenn Highway is free-flowing with yield control on the right-turn bypass lane on Denaina Elder's Road and stop control on Eklutna Village Road. The northbound off-ramp of the Glenn Highway at the Thunderbird Falls exit intersects with the Old Glenn Highway under a yield condition. The Old Glenn Highway is free-flowing with the westbound lane turning into the Glenn Highway northbound on-ramp and merging with northbound traffic.

There are two additional accesses along the Old Glenn Highway. The first is the entrance to the Thunderbird Falls Trailhead parking area located just south of the

Eklutna River Bridge. The second is a utility access for a cellular phone tower located just south of the Denaina Elder’s Road/Eklutna Village Road intersection.

The portion of Eklutna Village Road located within the study area is a paved, two lane roadway with variable width shoulders and no pedestrian facilities. The north and southbound Glenn Highway off-ramps intersect with Eklutna Village Road on either side of the highway overpass. The off-ramps are single lanes with stop control at Eklutna Village Road. The north and southbound Glenn Highway on-ramps are single lane merge ramps. Eklutna Village Road has a right turn bypass lane at the southbound on-ramp.

## **1.2 Functional Classification**

Both MOA and DOT&PF maintain roadways within the study area. The Old Glenn Highway as well as Thunderbird Drive and the portion of Denaina Elder’s Road located within the study area are maintained by MOA. The Glenn Highway, Eklutna Lake Road, and the portion of Eklutna Village Road located within the study area are maintained by DOT&PF. Functional classifications for each roadway were obtained from the 2011 draft MOA *Official Streets and Highways Plan (OSHP)* as well as the DOT&PF CDS route logs. Table 1 provides a summary of these classifications.

Street	Roadway Functional Class	
	MOA	DOT&PF
Old Glenn Highway	Neighborhood Collector, IB	Rural Local Road
Eklutna Village Road	Local Road	Rural Major Collector
Glenn Highway On-Off Ramps	Freeway	Rural Interstate
Thunderbird Drive	Neighborhood Collector, IB	Rural Local Road
Eklutna Lake Road	Neighborhood Collector, IB	Rural Major Collector
Denaina Elder’s Road	Neighborhood Collector, IB	Rural Local Road

MOA Source: *Official Streets and Highways Plan (OSHP)*, 2011 Draft

DOT&PF Sources: CDS Logs

**Table 1. Functional Roadway Classifications**

## **1.3 Future Projects**

MOA’s *2035 Metropolitan Transportation Plan (MTP)* identifies two projects along the Glenn Highway that could impact the study area.

- MTP Project 137 calls for an operational analysis of the Glenn Highway from Muldoon Road, in the Anchorage Bowl, to the Old Glenn Highway interchange, north of Eklutna. The analysis will review roadway capacity, freight movement, and safety along the corridor. This project will provide an in depth look at potential future congestion along the Glenn Highway. Future congestion will have operational impacts on the ramps at the Thunderbird Falls exit and the Eklutna Interchange.

The project is listed under short term in the MTP and is planned for completion before 2023.

- MTP Project 204 plans to widen the Glenn Highway to add an additional non-standard occupancy vehicle lane in each direction from Artillery Road to the Peter's Creek interchange. The project is proposed to ease the Glenn Highway commute and will include interchange improvements at the Peter's Creek bridge. This project will improve the primary access route to the study area from the Anchorage Bowl. This project is listed under long term in the MTP and is planned for completion before 2035.

## 1.4 Speeds

Speed limits on roadways within the project area were obtained from the MOA Traffic Data Management System. The speed limit on Old Glenn Highway is 30 mph north of the intersection with Eklutna Lake Road and 35 mph south of the intersection. The speed limit on the portion of Eklutna Village Road located within the study area is 30 mph. It should be noted that not all of the speed limits are posted.

A speed study was conducted in September 2013 along the Old Glenn Highway between the Glenn Highway on-off ramps and Thunderbird Drive. Data was collected using continuous automatic traffic data recorders. This speed study shows an 85<sup>th</sup> percentile speed of 39 mph. This is approximately five miles per hour over the MOA speed limit identified for this roadway segment. The 85th percentile speed indicates that 40 mph should be used for the traffic analysis, for example in capacity analysis. Speed limits and collected speed data are shown in Table 2.

Street	Posted Speed Limit	85 <sup>th</sup> Percentile Speed	Speed Used for Traffic Analysis
Old Glenn Highway – Glenn Highway to Eklutna Lake Road	35 mph	39 mph	40 mph
Old Glenn Highway – Eklutna Lake road to Denaina Elder's Road/Eklutna Village Road	30 mph	NA	NA
Eklutna Village Road	30 mph	NA	NA
Glenn Highway	65 mph	NA	NA
Thunderbird Drive	25 mph	NA	NA
Eklutna Lake Road	35 mph	NA	NA
Denaina Elder's Road	25 mph	NA	NA

Source: MOA Traffic Data Management System and September 2013 Speed Study

**Table 2. Speeds Limits and Collected Speed Data**

## 2 Traffic Volumes

This analysis utilizes historic and predicted AADT volumes along with current turning movement patterns to prepare construction and design year traffic forecasts. The methodology is described below.

### 2.1 AADT Volumes

Historic AADT volumes were collected for the last ten years from the DOT&PF annual volume reports for 2002 through 2012. Volumes were not available through DOT&PF or MOA for Thunderbird Drive or Denaina Elder's Road. The historic AADT volumes show an average growth in the Eklutna area of approximately one and a half percent per year for the eleven year period. This average does not include growth along the Glenn Highway.

In comparison, predicted AADT volumes were obtained from the 2035 MTP Travel Demand Model. Using the DOT&PF AADT volumes for 2012 as the base year, the model predicts an average annual growth rate of approximately five percent. Historic and predicted AADT volumes are shown in Table 3.

Segment	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2035 TDM
Eklutna Village Road (CDS 135700)												
Old Glenn End of Road	817	810	800	810	854	870	850	762	903	900	759	2,868
Glenn Highway NB Off Ramp at Eklutna (CDS 135701)												
Glenn Highway NB Eklutna Village Road	310	210	210	210	288	290	280	290	300	401	400	142
Glenn Highway SB Off Ramp at Eklutna (CDS 135702)												
Glenn Highway SB Eklutna Village Road	220	210	210	210	221	220	210	284	290	267	270	1,202
Glenn Highway NB On Ramp at Eklutna (CDS 135703)												
Eklutna Village Road Glenn Highway NB	280	214	210	210	214	200	190	200	200	275	270	86
Glenn Highway SB On Ramp at Eklutna (CDS 135704)												
Eklutna Village Road Glenn Highway SB	660	548	540	550	660	676	660	690	710	716	720	1,648
Eklutna Lake Road (CDS 135730)												
Old Glenn Chugach State Park	482	490	373	445	450	460	510	540	550	572	570	1,400
Old Glenn Highway at Eklutna (CDS 135750)												
Glenn Highway Eklutna Lake Road	720	710	467	470	568	580	560	626	640	640	784	2,598
Eklutna Lake Road Eklutna Village Road	740	730	651	660	773	807	780	820	789	790	790	2,639
Glenn Highway NB Off Ramp at Thunderbird Falls (CDS 135751)												
Glenn Highway NB Old Glenn	470	480	423	430	416	420	410	477	490	480	480	576
Glenn Highway NB On Ramp at Thunderbird Falls (CDS 135752)												
Old Glenn Glenn Highway NB	80	80	64	70	69	70	70	136	140	137	140	1,976

**Table 3. Historic and Predicted AADT**

## **2.2 Turning Movements**

Turning movement counts were collected during September 2013 at the intersection of the Old Glenn Highway with the northbound Glenn Highway on-off ramps at the Thunderbird Falls exit; the intersections of the Old Glenn Highway and Thunderbird Drive, Eklutna Lake Road, and Denaina Elder's Road/Eklutna Village Road; and the intersections of the north and southbound Glenn Highway on-off ramps at the Eklutna interchange with Eklutna Village Road. These counts were taken between 4:00 PM and 6:00 PM on varying weekdays. As such, the peak hour varied slightly at each intersection. The intersections of Old Glenn Highway with Thunderbird Drive and Old Glenn Highway with Eklutna Lake Road both had a peak hour between 4:30 and 5:30 PM. The other four intersections had a peak hour between 5:00 and 6:00 PM. To account for these variations in weekday traffic and peak hour times, the turning movement counts were manually balanced. Balancing the counts provides for continuity along the study corridor between key intersections. This consistency allows us to better model the capacity of each intersection.

Assumptions for redistributing traffic based on reopening of the Eklutna River Bridge also needed to be made. Using the average distribution of traffic moving along the Old Glenn Highway as shown by the DOT&PF historic volumes, turning movement directions for vehicles entering the Old Glenn Highway from Thunderbird Drive and Eklutna Lake Road were adjusted. These adjustments required redistribution of turning movements along the entire corridor.

Figure 2 on page 8 shows both the balanced field counts, addressing weekday and peak hour variations in the data, and the adjusted counts, addressing reopening of the bridge.

The adjusted counts were used to develop design PM peak hour turning movement volumes. These volumes are used for modeling intersection operations and are the volumes for which measures of effectiveness (MOE) are reported. The design turning movement volumes were developed by applying a growth rate of five percent per year to the adjusted counts. As previously mentioned, this growth rate was developed using the 2012 AADT reported by DOT&PF and the 2035 MTP Travel Demand Model. This rate is significantly higher than the historic DOT&PF traffic volumes would indicate, but is based on future planning for the study area and is an appropriate estimate for use in forecasting future traffic. Figure 3 on page 9 summarizes the design peak hour turning movement counts at each intersection in the study area for both 2015 and 2035.

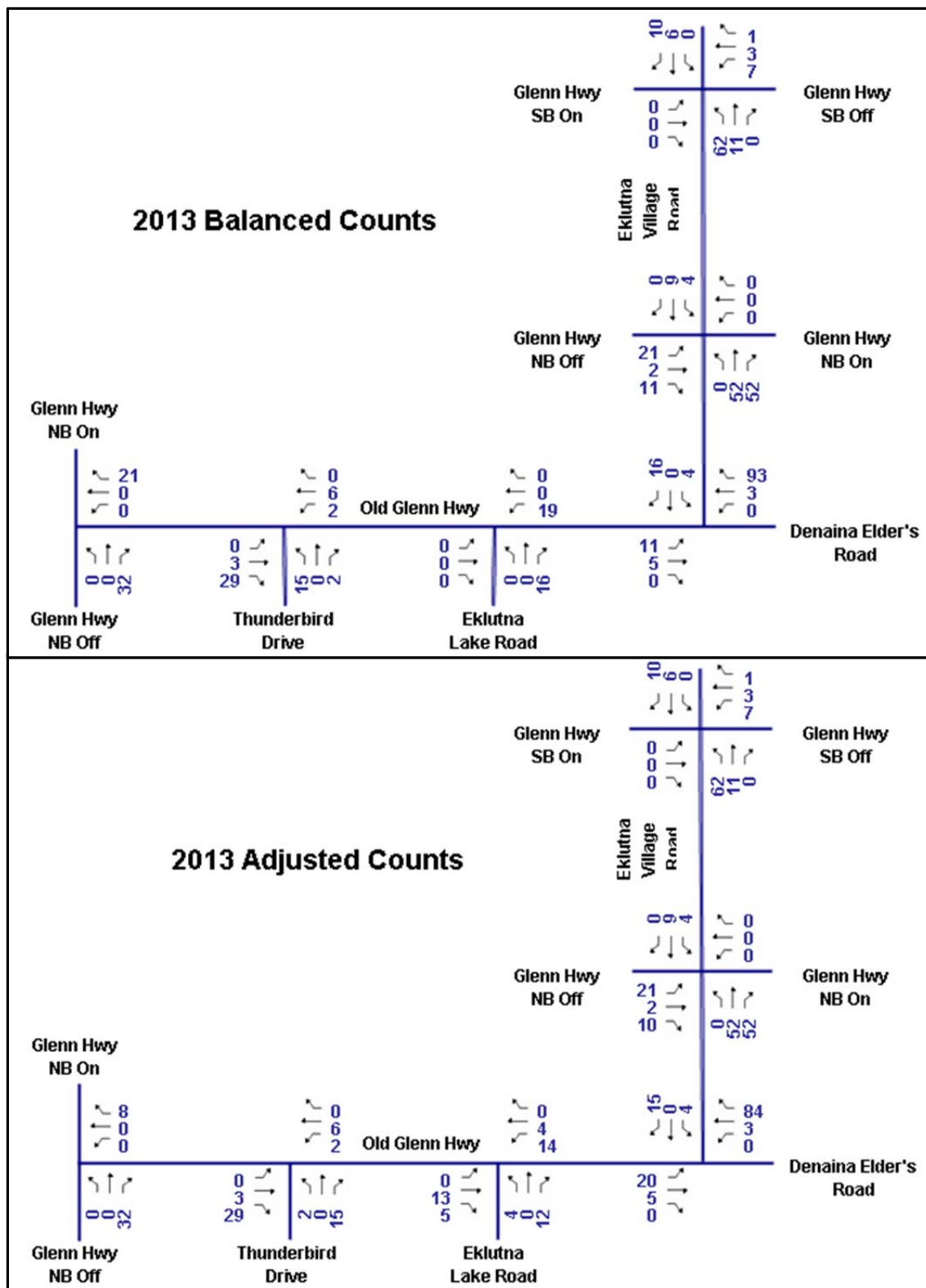


Figure 2. 2013 Peak Hour Turning Movements, Balanced and Adjusted Counts

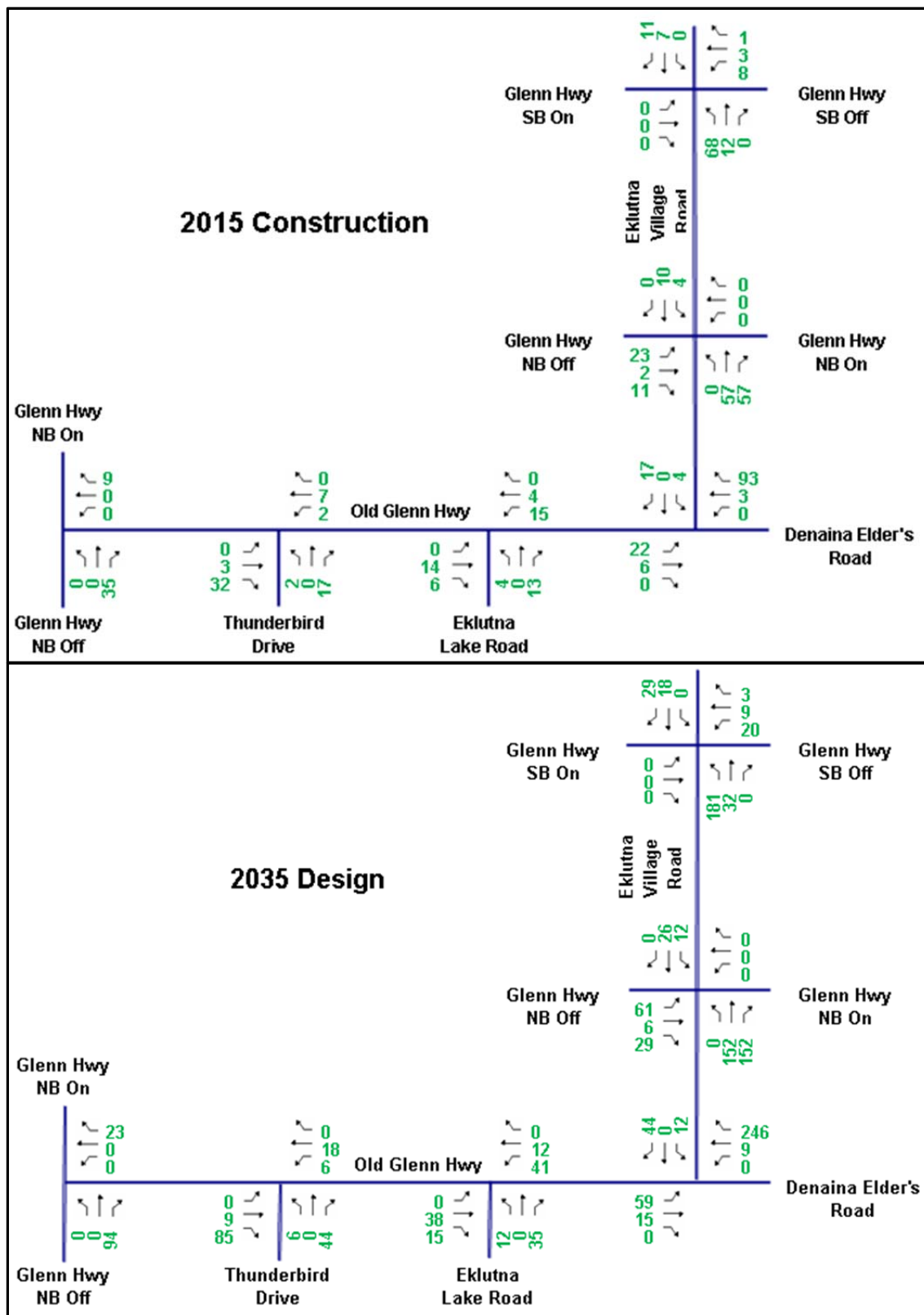


Figure 3. 2015 and 2035 PM Peak Hour Turning Movements



### 3 Crash Experience

Crash data for the study area were collected from DOT&PF for the eleven-year period from 2000 to 2010. Three crashes were reported during this period, two on Eklutna Village Road and one on the northbound Glenn Highway on-ramp at the Eklutna interchange. Note that the data excludes crashes occurring on the Glenn Highway since the highway itself is not included in the study.

The first crash on Eklutna Village Road occurred in June 2004 at the intersection with the northbound Glenn Highway off-ramp. The roadway was dry and the crash occurred on a clear day. The driver was traveling north at an unsafe speed, skidded out of control and went into the roadside ditch, colliding with a utility pole. This was a single vehicle incident and the driver sustained minor injuries. The driver was cited with careless driving.

The second crash on Eklutna Village Road occurred in September 2004 at the intersection with the southbound Glenn Highway off-ramp. The roadway was dry and the crash occurred on a clear day. The driver was traveling south and did not have control of the vehicle. The vehicle went into the roadside ditch, colliding with a fence. No injuries were sustained and the driver was not cited.

The crash on the northbound Glenn Highway on-ramp occurred approximately 100 feet north of Eklutna Village Road in October 2008. The roadway was covered with some sort of substance such as mud, oil, sand, or gravel. The crash occurred after dark, at approximately 1:45 AM, on a cloudy morning. The driver was traveling north at an unsafe speed. The vehicle left the roadway, hit a fence, and overturned. No injuries were sustained. The driver was cited with failure to exercise due care, causing damage to the highway.

Only three incidents occurring in the study area in eleven years suggests a low accident rate with no significant trends. The study period is prior to 2012 when the bridge was closed to vehicular traffic, so the bridge was operational when all three crashes occurred. This means that there is no parallel between diverted traffic and accident occurrence and reopening the bridge would not change the conditions that were in place at the time of the accidents.

### 4 Operations

Each roadway segment, intersection, and freeway ramp in the study area was analyzed for PM peak hour capacity in both the construction and design years using the HCM2000 method in the McTrans Highway Capacity Software. AASHTO guidance suggests that an acceptable LOS for rural collector roads should be LOS C or better, that an acceptable LOS for rural local roads may be LOS D, and that suburban freeways should operate at LOS C or D.

#### 4.1 Segment Analysis

The Old Glenn Highway and Eklutna Village Road were evaluated as two-lane highway segments. Two-lane highways are undivided roadways with one lane in each direction. Passing a slow moving vehicle on a two-lane highway requires the use of the opposite lane or, as on the Old Glenn Highway and Eklutna Village Road, is prohibited by no passing zones. Both the Old Glenn Highway and Eklutna Village Road are considered Class II highways for the purpose of this analysis. Class II highways are those on which drivers do not expect to travel at high speeds. Two-lane highways that function as access routes or serve as scenic or recreational routes are examples.

LOS for Class II two-lane highway segments is a measure of the percentage of time a vehicle spends following the queue that forms behind a slower moving vehicle. As the Percent Time Spent Following (PTSF) increases, the LOS decreases. LOS A is defined as less than or equal to a percent time spent following of 40, LOS B is between 40 and 55, and LOS C is between 55 and 70.

The two-lane highway analysis outlined in HCM is primarily designed for roadway segments longer than one mile with nominal free flow speeds of 45 mph or greater. Although neither the Old Glenn Highway nor Eklutna Village Road meet these criteria, as both segments are below one mile in length and neither has a regulatory or field observed speed greater than 40 mph, the analysis still provides a planning level look at the LOS that can be expected along each roadway.

Table 4 shows the LOS for each road segment for the construction and design years. LOS is expected to be good for each segment through the design year.

Street	Begin	End	2015		2035	
			LOS	PTSF	LOS	PTSF
Old Glenn Highway	Northbound Glenn Highway	Denaina Elder's Road / Eklutna Village Road	B	46.1	C	57.7
Eklutna Village Road	Old Glenn Highway	Southbound Glenn Highway	B	50.9	C	68.0

**Table 4. Two Lane Highway Segment Capacity**

#### 4.2 Intersection Analysis

The capacity analyses for intersections focuses primarily on LOS of the minor stop or yield controlled approaches. The analyses return MOE for the stop or yield controlled approaches by combining the results for the left, through, and right-turning movements for the approach. For the free flowing approaches MOE are only returned for the left-turning movement. MOE for each intersection are summarized below.

#### 4.2.1 Old Glenn Highway and Northbound Glenn Highway

The intersection of the Old Glenn Highway and the northbound Glenn Highway on-off ramps is a three leg approach with yield control on the northbound off ramp and free flowing traffic on the Old Glenn Highway. While the intersection has three approaches, two of these approaches are single direction with the northbound on-ramp carrying vehicles out of the intersection and the northbound off-ramp bringing vehicles into the intersection. The free flowing movement along the Old Glenn Highway has no left-turn. The capacity analysis, therefore, only returns MOE for the northbound approach as summarized in Table 5. This intersection is expected to have adequate LOS for the construction and design volumes.

Old Glenn Highway and Northbound Glenn Highway		NB LTR Glenn Highway Off Ramp
2015 PM Peak	Volume/Capacity Ratio	0.04
	Queue Length 95th (veh.)	1
	Approach Delay (s)	8.5
	<b>Approach LOS</b>	A
2035 PM Peak	Volume/Capacity Ratio	0.10
	Queue Length 95th (veh.)	1
	Approach Delay (s)	8.7
	<b>Approach LOS</b>	A

**Table 5. MOE for Old Glenn Highway / Northbound Glenn Highway Intersection**

#### 4.2.2 Old Glenn Highway and Thunderbird Drive

The intersection of the Old Glenn Highway and Thunderbird Drive is a three leg approach with stop control on westbound Thunderbird Drive. Each approach has two-way traffic. MOE are summarized in Table 6. This intersection is expected to have adequate LOS for the construction and design volumes.

Old Glenn Highway and Thunderbird Drive		WB LTR Thunderbird Drive	SB L Old Glenn Highway
2015 PM Peak	Volume/Capacity Ratio	0.02	0.00
	Queue Length 95th (veh.)	1	0
	Approach Delay (s)	8.5	7.3
	<b>Approach LOS</b>	A	A
2035 PM Peak	Volume/Capacity Ratio	0.06	0.00
	Queue Length 95th (veh.)	1	1
	Approach Delay (s)	8.8	7.4
	<b>Approach LOS</b>	A	A

**Table 6. MOE for Old Glenn Highway / Thunderbird Drive Intersection**

#### 4.2.3 Old Glenn Highway and Eklutna Lake Road

The intersection of the Old Glenn Highway and Eklutna Lake Road is a three leg approach with stop control on westbound Eklutna Lake Road. Each approach has two-way traffic. MOE are summarized in Table 7. This intersection is expected to have adequate LOS for the construction and design volumes.

Old Glenn Highway and Eklutna Lake Road		WB LTR Eklutna Lake Road	SB L Old Glenn Highway
2015 PM Peak	Volume/Capacity Ratio	0.02	0.01
	Queue Length 95th (veh.)	1	1
	Approach Delay (s)	8.7	7.3
	<b>Approach LOS</b>	A	A
2035 PM Peak	Volume/Capacity Ratio	0.05	0.03
	Queue Length 95th (veh.)	1	1
	Approach Delay (s)	9.0	7.4
	<b>Approach LOS</b>	A	A

**Table 7. MOE for Old Glenn Highway / Eklutna Lake Road Intersection**

#### 4.2.4 Old Glenn Highway, Denaina Elder's Road, and Eklutna Village Road

The intersection of the Old Glenn Highway, Denaina Elder's Road, and Eklutna Village Road is a three leg approach with stop control on eastbound Eklutna Village Road and yield control on the right-turn bypass lane on Denaina Elder's Road. Each approach has two-way traffic. MOE are summarized in Table 8. This intersection is expected to have adequate LOS for the construction and design volumes.

Old Glenn Highway, Denaina Elder's Road, and Eklutna Village Road		EB LTR Eklutna Village Road	NB L Glenn Highway Off Ramp
2015 PM Peak	Volume/Capacity Ratio	0.03	0.02
	Queue Length 95th (veh.)	1	1
	Approach Delay (s)	8.6	7.3
	<b>Approach LOS</b>	A	A
2035 PM Peak	Volume/Capacity Ratio	0.06	0.00
	Queue Length 95th (veh.)	1	0
	Approach Delay (s)	8.6	7.2
	<b>Approach LOS</b>	A	A

**Table 8. MOE for Old Glenn Highway / Denaina Elder's Road / Eklutna Village Road Intersection**

#### 4.2.5 Eklutna Village Road and Northbound Glenn Highway

The intersection of Eklutna Village Road and the northbound Glenn Highway on-off ramps at the Eklutna interchange is a four leg intersection approach with stop control on the northbound off ramp. While the intersection has four approaches, two of these approaches are single direction with the northbound on-ramp carrying vehicles out of the intersection and the northbound off-ramp bringing vehicles into the intersection. The free flowing movement along Eklutna Village Road only has a left-turn in one direction. The capacity analysis, therefore, only returns MOE for the northbound approach and the eastbound left-turn as summarized in Table 9. This intersection is expected to have adequate LOS for the construction and design volumes.

Eklutna Village Road and Northbound Glenn Highway		EB L Eklutna Village Road	NB LTR Glenn Highway
2015 PM Peak	Volume/Capacity Ratio	0.00	0.07
	Queue Length 95th (veh.)	1	1
	Approach Delay (s)	7.7	9.5
	<b>Approach LOS</b>	A	A
2035 PM Peak	Volume/Capacity Ratio	0.01	0.14
	Queue Length 95th (veh.)	1	1
	Approach Delay (s)	8.0	10.7
	<b>Approach LOS</b>	A	B

**Table 9. MOE for Eklutna Village Road / Northbound Glenn Highway Intersection**

#### 4.2.6 Eklutna Village Road and Southbound Glenn Highway

The intersection of Eklutna Village Road and the southbound Glenn Highway on-off ramps at the Eklutna interchange is a four leg intersection approach with stop control on

the southbound off ramp and yield control on the right-turn bypass lane on Eklutna Village Road. While the intersection has four approaches, two of these approaches are single direction with the southbound on-ramp carrying vehicles out of the intersection and the southbound off-ramp bringing vehicles into the intersection. The free flowing movement along Eklutna Village Road only has a left-turn in one direction. The capacity analysis, therefore, only returns MOE for the southbound approach and the westbound left-turn as summarized in Table 10. This intersection is expected to have adequate LOS for the construction and design volumes.

Eklutna Village Road and Southbound Glenn Highway		WB L Eklutna Village Road	SB LTR Glenn Highway
2015 PM Peak	Volume/Capacity Ratio	0.07	0.03
	Queue Length 95th (veh.)	1	1
	Approach Delay (s)	7.5	10.5
	<b>Approach LOS</b>	A	B
2035 PM Peak	Volume/Capacity Ratio	0.13	0.07
	Queue Length 95th (veh.)	1	1
	Approach Delay (s)	7.6	13.1
	<b>Approach LOS</b>	A	B

**Table 10. MOE for Eklutna Village Road / Southbound Glenn Highway Intersection**

### **4.3 On-Off Ramp Analysis**

Freeway on-off ramps are designed to allow vehicles entering or exiting the freeway to merge with or diverge from the through moving freeway traffic with as little disruption to that traffic as possible. LOS is defined in terms of vehicle density in passenger cars per mile per lane (pcpmpl). LOS criteria and descriptions are as follows:

- LOS A represents unrestricted operations where vehicle density is low enough to permit smooth merging and diverging with virtually no disruption to the through traffic. Density is less than or equal to 10 pcpmpl,
- LOS B is when the merging and diverging movements become noticeable to through drivers and minimal disruption occurs. Merging drivers must adjust speeds to accomplish smooth transitions from the acceleration lane to the freeway. Densities range from 10 to 20 pcpmpl.
- LOS C is when speeds within the merge or diverge areas begin to decline and some disruption occurs. Both ramp and freeway vehicles begin to adjust their speeds to accommodate smooth transitions. Densities range from 20 to 28 pcpmpl.

- LOS D occurs when speeds within the merge or diverge areas are significantly decreased in order to accommodate the merging or diverging vehicles. Densities range from 28 to 35 pcpmpl.

The LOS for the on-off ramps of the Glenn Highway at the Thunderbird Falls exit and the Eklutna interchange are shown in Table 11. LOS is expected to be adequate for all ramps except the northbound on-ramp at the Thunderbird Falls exit. At this location, while the on-ramp volume is expected to remain low, congestion on the Glenn Highway is expected to increase making merge operations more difficult. The 2035 LOS for the Glenn Highway (as a freeway) is LOS D using forecasted traffic and the existing 4-lane typical section, which no doubt is the dominating influence on ramp LOS as well.

Ramp	2015		2035	
	LOS	Density (pcpmpl)	LOS	Density (pcpmpl)
NB On-Ramp, Thunderbird Falls	B	19.3	D	30.0
NB Off-Ramp, Thunderbird Falls	B	15.1	C	27.0
NB On-Ramp, Eklutna	B	16.0	C	27.4
NB Off-Ramp, Eklutna	B	14.2	C	26.1
SB On-Ramp, Eklutna	B	15.6	C	27.3
SB Off-Ramp, Eklutna	B	14.8	C	26.7

**Table 11. On-Off Ramp Capacity**

## 5 Pedestrian Elements

There are no marked pedestrian crossings along the Old Glenn Highway within the project corridor. Pedestrians wishing to cross must do so by looking for gaps in the traffic large enough to cross the entire width of the roadway. Pedestrian crossing LOS was calculated at the intersections of the Old Glenn Highway with Thunderbird Drive and the Old Glenn Highway with Eklutna Lake Road, which are the two most likely locations for crossing pedestrians. It is possible that recreational traffic could park along the west side of the Old Glenn Highway and cross over at these two intersections either for use of the separated pedestrian path or as overflow parking at the Thunderbird Falls Trailhead. The PM peak MOE for the design year are shown in Table 12. Pedestrian LOS is expected to be acceptable.

<b>Old Glenn Highway at Thunderbird Drive</b>	<b>North Approach</b>	<b>South Approach</b>
Pedestrian Crossing Distance (ft)	24	24
Critical Gap (s)	9.9	9.9
Conflicting Traffic Volume (vph)	118	77
Available Gaps per Minute	5.87	6.01
Average Pedestrian Delay (s)	1.8	1.1
Level of Service	A	A
<b>Old Glenn Highway at Eklutna Lake Road</b>	<b>North Approach</b>	<b>South Approach</b>
Pedestrian Crossing Distance (ft)	24	24
Critical Gap (s)	9.9	9.9
Conflicting Traffic Volume (vph)	77	126
Available Gaps per Minute	6.01	5.84
Average Pedestrian Delay (s)	1.1	1.9
Level of Service	A	A

**Table 12. Pedestrian Capacity and Level of Service for Old Glenn Highway**

## 6 Typical Section Design Standards

As previously mentioned, the project includes upgrade of the Old Glenn Highway from Thunderbird Drive to Eklutna Lake Road. This segment is maintained by MOA and is classified as a *neighborhood collector* in the OSHP; however, using the MOA's Design Criteria Manual (DCM) and reviewing land use, speed data, and forecasted volumes, the recommended design classification is ***rural residential collector***.

Based on the DCM, collectors serve both access and mobility functions. A neighborhood collector places a higher emphasis on the access function with a significant number of direct lot accesses and pedestrian activity. A residential collector has limited direct lot access, placing higher emphasis on the mobility function, moving traffic from residential areas to arterials and providing direct access to land. There are residential accesses that connect directly to the Old Glenn Highway, and as such the primary function of the Old Glenn Highway is to provide a connection from the Thunderbird Heights subdivision to the Glenn Highway and to provide access to recreational park lands via the Thunderbird Falls Trailhead and Eklutna Lake Road. As such, Old Glenn Highway functions as a de facto residential collector.

Design and posted speed recommendations differ for neighborhood and residential collectors. The OSHP recommends that streets designated as neighborhood collectors utilize a design speed of 35 mph and a posted speed of 30 mph. Those streets designated as residential collectors may have design speeds up to 45 mph with posted speeds of 35 to 40 mph. Speed data collected in September 2013 indicates an 85th percentile speed along the Old Glenn Highway of 40 mph and the MOA Traffic Data Management System indicates a speed limit of 35 mph. Based on these cited references, designed and posted speeds of 35 mph or more would be appropriate for this project.



Both the OSHP and the DCM note that a rural classification is to be implemented on collector roadways in the more rural residential developments of Chugiak, Birchwood, Eagle River, and on the Anchorage hillside. Given the rural nature of the Thunderbird Heights Subdivision and the limited additional land that could be subdivided along this section of the Old Glenn Highway, a rural classification is appropriate. The typical section criteria for rural residential collectors are outlined in the DCM. These criteria are based on forecasted volumes, whereby rural residential collectors with volumes of 2,000 vehicles per day or less may utilize 10-foot travel lanes and those with projected volumes in excess of 2,000 vehicles per day must utilize a minimum 11-foot travel lane. The DCM also calls for 4-foot shoulders and a separated multi-use pathway on at least one side of the roadway.

## **7 Design Designations**

The following subsections address design designations elements for the Old Glenn Highway between Thunderbird Drive and Eklutna Lake Road, which include:

- Design Functional Classification
- Construction Type
- Design Life
- Traffic Volumes
- Design Hour Volume Percent
- Peak Hour Factor
- Directional Distribution Percent
- Heavy Vehicles
- Compound Growth Rate
- Pedestrians and Bicyclists
- Equivalent Single Axle Loads

### **7.1 Design Functional Classification**

The Old Glenn Highway within the project area is functionally classified by the OHSP as a Neighborhood Collector IB. As discussed in Section 6 on page 17, the design functional classification for the Old Glenn Highway should be as a rural residential collector. This classification is based on criteria set forth in the OSHP and the DCM.

## **7.2 Construction Type**

The project will be new construction. New construction standards for rural residential collectors should be applied.

## **7.3 Project Design Life**

The project design life is 20 years. The construction year will be 2015 and the design year will be 2035.

## **7.4 Traffic Volumes**

Traffic volumes for the construction and design years are based on the 2012 DOT&PF AADT volumes and the 2035 MTP traffic demand model growth rate. Traffic volumes are forecasted to be 2,598 for the 2035 design year.

## **7.5 Design Hour Volume**

The Design Hour Volume (DHV) for this project will be the 30<sup>th</sup> Highest Hour Volume in the design year as recommended by AASHTO's *Geometric Design of Highway and Streets*. AASHTO indicates that DHVs in rural areas typically range from 12 to 18 percent of the AADT.

The Glenn Highway, which runs adjacent to the project area, has a permanent traffic recorder (PTR) located at Eklutna Flats. This site shows a 30<sup>th</sup> Highest Hour Volume of 11.9 percent. However, the PTR also shows an average 5:00 PM percent of AADT of 8.7 whereas our forecasted turning movement counts show 9.4 based on the travel demand model forecasted AADT volume. This higher percentage is supported by the speed study whereby the average 5:00 PM percent of the counted daily traffic for a four day period was 9.8 percent.

The Old Glenn Highway traffic is drawn to the area during the PM peak hour not only because of the Thunderbird Heights Subdivision and the evening commuters returning home, but also because of the evening recreational opportunities at both Thunderbird Falls and Eklutna Lake. Based on the ratio of observed and forecasted 5:00 PM percent AADT on the Old Glenn Highway to that at the PTR site, a 30<sup>th</sup> Highest Hour Volume of 12.8% is appropriate. This 30<sup>th</sup> Highest Hour Volume correlates well to the AASHTO standard.

## **7.6 Peak Hour Factor**

Peak hour factors (PHFs) are used to convert volumes to 15-minute design flow rates, for capacity analyses. As traffic levels increase, the traffic distribution within the peak

hour is assumed to become more uniform. As the distribution of traffic becomes more uniform the PHF approaches a value of 1.0.

Observed PHFs along the Old Glenn Highway range from 0.58 to 0.88. As traffic volumes approach the design year levels and with the Eklutna River Bridge reopened, it is believed that the PHFs will become more uniform throughout the study area and increase. The PHF of 0.88, occurring at the Thunderbird Drive intersection, was chosen as a conservative value for design.

Note that, given the expected congestion along the Glenn Highway in the design year (computed as LOS D), a higher PHF of 0.95, was used for the ramp analysis. This peak hour factor is specific to traffic movement along the Glenn Highway, not traffic movement within the study area.

### **7.7 Directional Distribution Percent**

Directional distribution percentages (DD%) are used to adjust peak hour volumes into directional volumes on road segments. DD% was determined from the forecasted turning movement counts. These counts show that 71 percent of the traffic is traveling northbound and 29 percent is traveling southbound during the PM peak hour; therefore, the recommended directional distribution for the future design is 70 percent northbound and 30 percent southbound.

### **7.8 Heavy Vehicles**

Observed heavy vehicle percentages along the Old Glenn Highway exceed 12% in some areas. These high percentages are due, in part, to the low peak hour volumes whereby one or two trucks or busses make up a large percent of the small traffic stream. Heavy vehicle usage along the Old Glenn Highway is expected to remain about the same as the observed 2013 condition; however, passenger car volume will increase significantly through the design year and heavy vehicles will make up less and less of the traffic stream. A design heavy vehicle percentage of 3% is recommended based on 2013 truck and bus counts with 2035 AADT.

### **7.9 Compound Growth Rate**

The growth rate used to develop design turning movement volumes for intersection analysis is 5.0 percent. This rate is based on the aggregate 2012 DOT&PF AADT volumes for the study area with and the aggregate 2035 travel demand model predictions for the study area.

Design volumes for segment and ramp analysis are directly from the 2035 travel demand model.

### **7.10 Pedestrians and Bicyclists**

Pedestrian and bicycle volumes are assumed to be less than 50 per day on all segments, based on observations of volumes during the turning movement counts made in September 2013.

### **7.11 Equivalent Single Axle Loads**

The equivalent single axle loads analysis is underway.