Seward Highway & Alyeska Highway Intersection Improvements Design Services

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DRAFT Existing Conditions Report

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and
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Abbreviations

AADT	Annual Average Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
CAR	Critical Accident Rate
CCS	Continuous Count Station
DCM	*Design Criteria Manual*
DOT&PF	Alaska Department of Transportation and Public Facilities
DHV	Design hour volume
EB	Eastbound
GVT	Glacier Valley Transit
HCM	*Highway Capacity Manual*
HV	Heavy Vehicle
KE	Kinney Engineering
LOS	Level of Service (performance grade)
MADT	Monthly Average Daily Traffic
MEV	Million Entering Vehicles
mph	Miles per Hour
MOA	Municipality of Anchorage
MUTCD	*Manual on Uniform Traffic Control Devices for Streets and Highways*
MVM	Million Vehicle Miles
PGDHS	*A Policy on Geometric Design of Highways and Streets*
PCM	*Alaska Preconstruction Manual*
PHF	Peak Hour Factor
TMC	Turning Movement Count
TMV	Turning Movement Volume
v/c or V/C	Volume to Capacity Ratio
WB	Westbound

Definition of Terms

Average Annual Daily Traffic (AADT): A 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.

Crash Severity: Scale of bodily harm up to and including death, suffered by the occupants of the vehicle involved in a crash. There are four levels of crash severity used: property damage only (PDO), non-incapacitating/possible injury (minor injury), incapacitating injury (major injury), and fatal.

Critical Accident Rate (CAR): Statistical measure used in crash rate analysis to determine statistical significance. If the crash rate of the location in question is above the CAR for that location, the crash rate is above the average crash rate for similar facilities to a statistically significant level.

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.

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 flowrate by the peak 15-minute flowrate. PHF values can vary from 0.25 (all traffic for the hour arrives in the same 15-minute period) to 1.00 (traffic is spread evenly throughout the hour).

Volume to Capacity Ratio (v/c): Measure of how much of the available capacity of a facility is being used, calculated by dividing the demand volume by the capacity of a 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

The Alyeska Highway intersection at Milepost 90 of the Seward Highway provides access to Girdwood and serves all traffic traveling to and from Anchorage and destinations to the south of Girdwood. It is a major stop for fuel and groceries between Anchorage and Seward to the south and Sterling/Soldotna to the southwest. The study intersection is located within the Seward Highway Safety Corridor, one of the four corridors in Alaska with a higher-than-average incidence of fatal and serious injury crashes.

The Seward Highway is an Interstate Highway (principal arterial) and part of the National Highway System. It provides the only access into and out of Anchorage from the south. North of Alyeska Highway, the Annual Average Daily Traffic (AADT) on the Seward Highway is around 7,500 vehicles per day, while south of the Alyeska Highway the Seward Highway carries around 5,000 vehicles per day. The interstate has a posted speed limit of 55 miles per hour (mph) at the study intersection which increases to 65 mph approximately 1,200 feet on the Anchorage side and 2,200 on the Turnagain side of the intersection. Radar data collected by Kinney Engineering (KE) in September 2020 suggests that 85th percentile speeds traveling eastbound through the study intersection (towards the Placer River) average around 63 mph while 85th percentile speeds traveling westbound (towards Anchorage) are around 66 mph. However, data was collected near a construction site and as such 85th percentile speeds under normal conditions may be higher. See Section 4.1.2 Data Collection and Data Limitations for more details.

The Alyeska Highway is a minor arterial that provides access to the scenic resort town of Girdwood, which lies within the Municipality of Anchorage (MOA). The Alyeska Highway carries around 2,800 AADT and has a posted speed limit of 45 mph. 2020 KE radar data suggests 85th percentile speeds of 48 mph on the Alyeska Highway.

There are no pedestrian and bicyclist accommodations in the study area, although two bicyclists were observed during traffic counts. Pedestrians and bicyclists are accommodated instead by the Bird to Gird pathway which parallels the Alaska Railroad and crosses the Alyeska Highway north of the study intersection.

Glacier Valley Transit serves the project area, with a stop at the Girdwood Station Mall and seasonal travel through the study intersection to make a southbound right from Alyeska Highway onto the Seward Highway en route to serve the Train Depot.

This Existing Conditions Report has identified three main concerns for the intersection:

- The Girdwood Station Mall in the northeast corner of the study intersection generates a significant number of pass-by trips. While direct access from the Seward Highway (an arterial) to the mall and nearby residences should be restricted, both a driveway intersection and a side street intersection are located within 400’ of the Alyeska Highway.

- Angle crashes between southbound left turn vehicles from the Alyeska Highway and westbound through vehicles on the Seward Highway are a concern (5 of 12 crashes in the last 10 years). Contributing factors to this type of crash are westbound right turn vehicles and large vehicles parked along the Seward Highway blocking the sight lines for the southbound left turning driver and the westbound driver continuing through the intersection.
- Traffic volumes have significant seasonal variation in the study area, with summer daily volumes approximately twice the AADT and winter volumes approximately half the AADT. The peak traffic volume hours are on the weekends. Southbound left turn drivers from the Alyeska Highway experience very poor level of service (LOS) during the weekend peak period in the summer (LOS F with over a minute and a half of delay per vehicle). Drivers experience less delay if they turn from the Girdwood Station Mall driveway or from Main Street directly onto the Seward Highway (because there are fewer eastbound left turn movements at these intersections). This contributes to the friction that through traffic on Seward Highway experiences in this area.

In addition to these concerns that are specific to the study intersection, the project should address general goals for the Seward Highway, including:

- Maintain a reasonable day’s drive between control cities for the Seward Highway (Homer, Seward, and Anchorage). Note that Girdwood is designated as an intermediate destination for the Seward Highway.
- Support freight mobility for trucks and rail carrying goods throughout Alaska.

1 Introduction

1.1 Project Description

The Alaska Department of Transportation and Public Facilities (DOT&PF) has retained Kinney Engineering, LLC (KE), working as a subcontractor to R&M Consultants, Inc., to prepare this Existing Conditions Report for the Seward Highway & Alyeska Highway Intersection Improvement Design Services project. The purpose of this project is to select and advance a preferred alternative that alleviates the delay associated with the current intersection configuration. The project is located within the limits of the Municipality of Anchorage (MOA), as depicted in Figure 1.

In the project area, the Seward Highway is a two-lane, undivided interstate highway running generally north-south between Anchorage and Seward. It begins in Seward and heads north to Moose Pass where it curves west, intersecting with the Sterling Highway and then meandering north towards Portage, where it again turns west and follows the Turnagain Arm, intersecting with the Alyeska Highway, passing Potter Marsh, and then heading north to enter the Anchorage Bowl. At Potter Marsh, the Seward Highway becomes a four- to six-lane, divided freeway. At the study intersection, the Seward Highway is generally oriented east-west. Note that for analysis and for this report, the Seward Highway is referred to as an east-west highway, and the Alyeska Highway is referred to as a north-south highway.

The Seward Highway provides the only southern access to and from Anchorage. It carries both local and tourist traffic, providing access to towns, state parks, and recreation and fishing areas on the Kenai Peninsula. Near Milepost 90, it intersects with the Alyeska Highway, which serves the resort town of Girdwood. The intersection is the last major stop for fuel and groceries between Anchorage and Seward to the south and Sterling/Soldotna to the southwest. North of Alyeska Highway, the Seward Highway carries around 7,500 Annual Average Daily Traffic (AADT), while south of the Alyeska Highway it carries around 5,000 AADT. The Alyeska Highway is a minor arterial and has an AADT of about 2,800.

In addition to the intersection of Seward Highway at Alyeska Highway, the study area also includes four nearby intersections, as shown in Figure 2.

This Existing Conditions Report presents the existing conditions of the intersection, as well as the future 2045 no build condition.

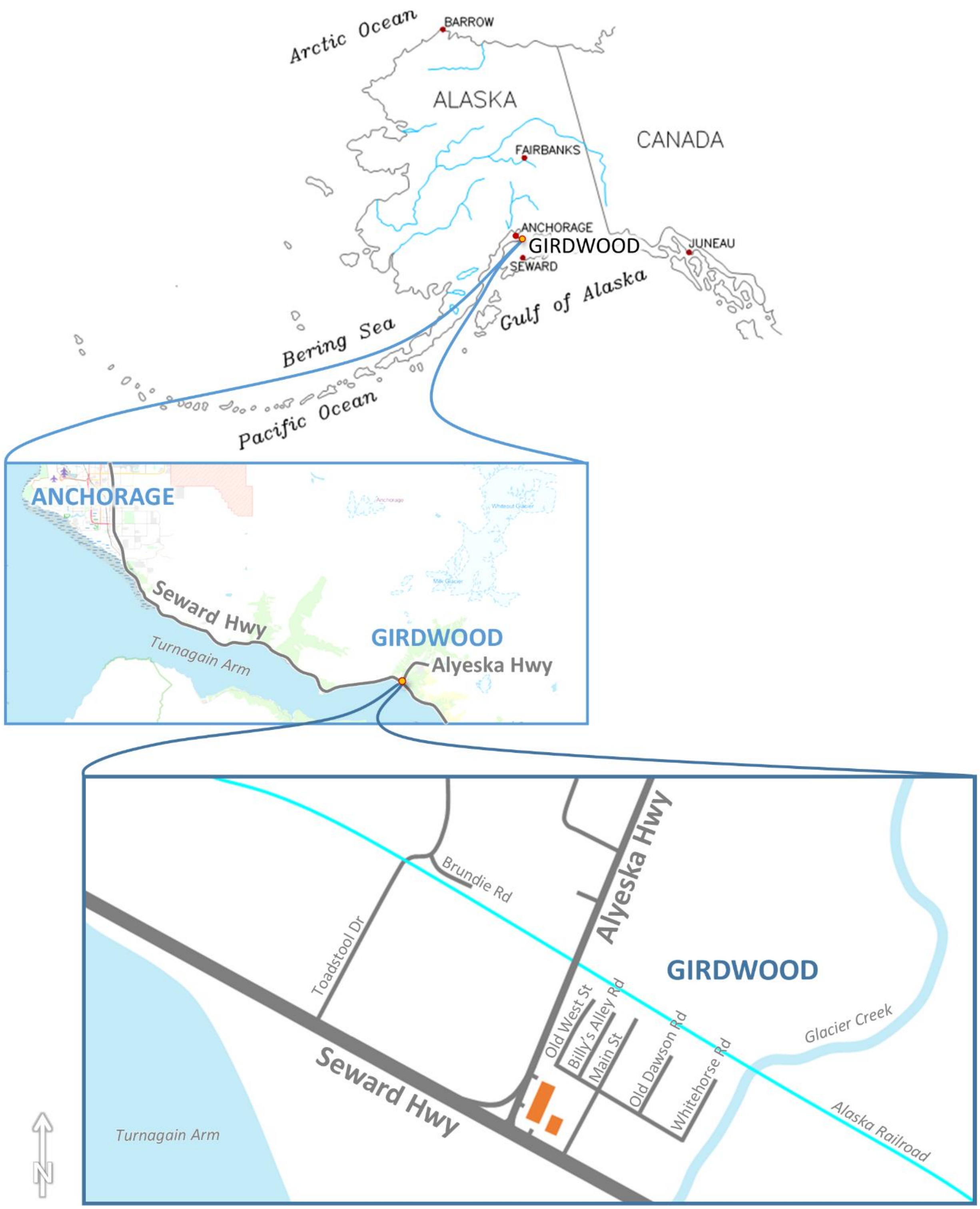

Figure 1: Project Vicinity Map

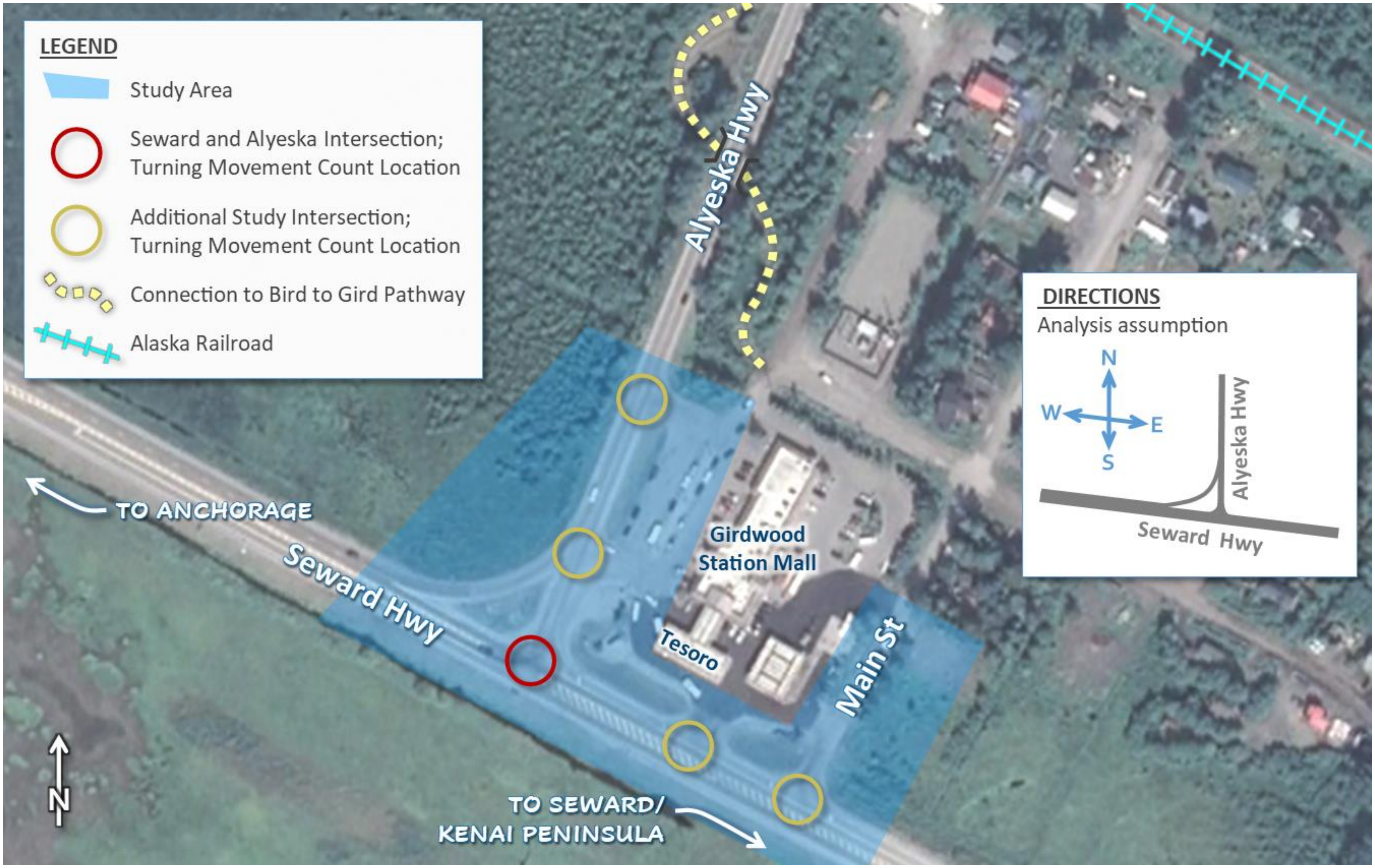

Figure 2: Study Area

1.2 Functional Classification

DOT&PF uses the functional classification of a roadway for selecting Level of Service (LOS), design speed, and other geometric criteria. As presented in Figure 3, AASHTO's *A Policy on the Geometric Design of Highways and Streets*, 2018, 7th Edition (PGDHS) has guidelines for appropriate LOS thresholds for different functional classifications and area and terrain types.

Within the project limits, the Seward Highway is classified as an interstate highway, a subclassification of principal arterial. The Alyeska Highway is classified as a minor arterial. Arterial roads are intended for high mobility and low access and are designed to carry large volumes at an efficient speed.

Main Street, which intersects with the Seward Highway east of the study intersection and within the project area, is classified as a local road.

The PGDHS describes urban areas as "those places within boundaries set by the responsible State and local officials having a population of 5,000 or more" and rural areas as "those areas outside the boundaries of urban areas." The PGDHS goes on to say, "it is important to recognize that a roadway's formal classification as urban or rural may differ from actual site circumstances or prevailing conditions…The area type classification should be based on actual roadway conditions, not boundaries shown on maps."

While the town of Girdwood has a population of around 1,800 (rural town), both Girdwood and the project study area are located within the MOA (urban). Figure 3 suggests that an appropriate LOS for arterials in a rural town or in an urban environment is LOS C or D, while an appropriate LOS for a local road in any context is LOS D. As such, it is suggested that LOS D be used as the threshold for improvements in the project area. Note that this guideline refers to the whole intersection, and not to specific movements. Additionally, the LOS D designation refers to the average volume condition; operations during seasonal peak hour volumes (summer high volume case and winter resort volume case, see Section 4.1.3 Existing Turning Movement Volumes) will be checked to ensure that capacity is not exceeded.

Functional Class	Customary Level of Service for Specified Combination of Context and Terrain Type			
	Rural Level	Rural Rolling	Rural Mountainous	Suburban, Urban, Urban Core, and Rural Town
Freeway	B	B	C	C or D
Arterial	B	B	C	C or D
Collector	C	C	D	D
Local	D	D	D	D

Source: Modified from 2018 AASHTO PDGHS Table 2-3

Figure 3: Guidelines for Selection of Design Levels of Service

1.3 Access Management

Within the study area there are currently three driveways accessing the Girdwood Station Mall, two from the Alyeska Highway and one from the Seward Highway. Additionally, the intersection of the Seward Highway with Main Street provides access to the Girdwood Station Mall and is within 400’ of the Seward with Alyeska intersection. Sight distance and safety concerns (discussed in Sections 2.2 Sight Distance and 3.2 Crash Types and Severity (2008 – 2017)) related to the close proximity of these access points have been identified. This section presents a brief access management study to present standards applicable to the study area.

Section 1120.2.4 of the 2018 *Alaska Highway Preconstruction Manual* (PCM) states:

> “In urban and suburban areas, legal access to interstate roadways should only be via a public roadway; there should be no private access points. In rural areas, public roadways are desirable access points.”

Section 1190.1 of the PCM states that for all driveways within the MOA, municipal geometric standards approved for use on Department roads should be used in lieu of PCM standards. Chapter 1.9 F of the MOA’s 2007 *Design Criteria Manual* (DCM) requires that driveways must be designed in accordance with the latest version of the Traffic Department’s *Policy on Driveway Standards*, located in Appendix 1D of the DCM.

Appendix 1D in the DCM is entitled “Municipality of Anchorage Driveway Standards.” It states that arterials should have few, if any, private driveways, and further specifies that driveways will not be allowed on arterials if other access is available. If a driveway on an arterial is required, its location and design must be strictly controlled. Based on this guidance, access to the Girdwood Station Mall from the Seward Highway (principal arterial) should be restricted; if access from the Alyeska Highway (minor arterial) is required, it must be strictly controlled.

Table 1 details the design parameters for driveways that provide access to commercial developments within the MOA as specified in Appendix 1D of the DCM. These standards are applicable to the driveways that provide access to the Girdwood Station Mall.

Table 1: Driveway Standards for Commercial Developments

Curb Return	15' curb return (large volume commercial development); large truck traffic may require larger radii to accommodate truck base turning radius for largest vehicle required to use roadway
Width	24' - 34' maximum width (commercial/residential)
Angle	should be 90 degrees, and should not be less than 60 degrees unless one-way right-turn in only
Profile	maximum grade of +/-8% (commercial)
Landing Grade	20 foot long landing area of +/-2% maximum grade where the driveway intersects with the roadway; for semi-tractors or trailers, 30 foot long landing area of +/-2% maximum grade where the driveway intersects with the roadway
Number	frontages of 50' - 1000' → 2 driveways

Appendix 1D of the DCM also provides standards for the distance between driveways, corner clearance, and sight distance as presented in Table 2 through Table 4.

Table 2: Distance Between Driveways with Hourly Volume > 10 vph

Speed (mph)	Rural Arterial and Collector Roads (feet)	Urban Arterial and Collector Roads (feet)	Urban and Rural Local Streets and Roads (feet)	Applicable to:
25	350	150	150	Main Street
30	370	200	200	
35	400	260	250	
40	440	340	310	
45	540	430	390	Alyeska Highway
50	690	510	490	

Note: Yellow highlighting denotes value applicable to each roadway.

Distance between driveways is the minimum distance between driveways on the same parcel, measured along the right-of-way line between the adjacent edges of the driveways.

Table 3: Corner Clearance for Driveways with Hourly Volume > 10 vph

Speed (mph)	Major Generator >250 vph (feet)	Medium Generator 100 - 250 vph (feet)	Small Generator <100 vph (feet)	Applicable to:
25	150	120	60	Main Street
30	200	150	80	
35	260	210	110	
40	330	260	150	
45	390	310	180	Alyeska Highway
50	460	340	230	

Note: Yellow highlighting denotes value applicable to each roadway.

Corner clearance is the minimum distance from the nearest face of curb, or nearest edge of traveled way for uncurbed roadways, of an intersecting public roadway to the nearest edge of driveway.

Table 4: Sight Distance* for Passenger Cars

Posted Speed (mph)	Sight Distance for Passenger Cars (feet)	**Sight Distance for Combination Trucks (feet)** calculated from PGDHS as per DCM, Appendix 1D)	Applicable to:
65	720	1100	
60	665	1015	
55	610	930	
50	555	845	
45	500	760	Alyeska Highway
40	445	675	
35	390	590	
30	335	510	
25	280	425	Main Street
20	225	340	

Notes: Yellow highlighting denotes value applicable to each roadway.
*If roadway has median or grades greater than 3%, adjust time gap as per PGDHS.

Sight distance is for the vehicle on the driveway or minor street entering the major street. Sight distance is measured 14.5 feet back from the edge of a major roadway with no sidewalk, or 12 feet from edge of back of sidewalk. Sight distances measurements assume a driver's eyesight of 3.5' above road surface and assume all vehicles approaching the intersection will travel in the center of their lane.

2 Existing Infrastructure

2.1 Intersections and Traffic Control

The existing roadway characteristics in the project area are presented in Figure 4.

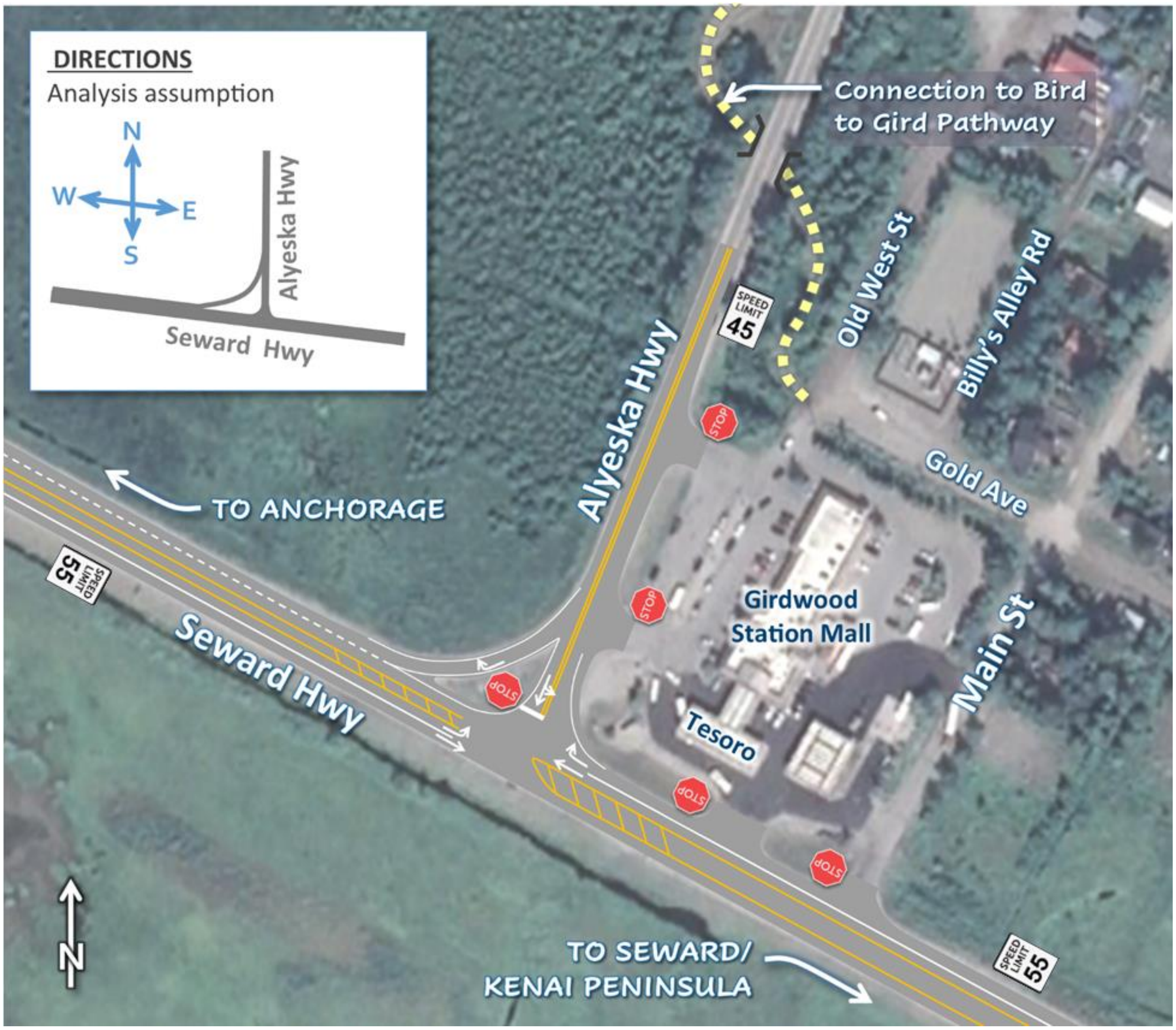

Figure 4: Existing Project Area Roadway Characteristics

The study intersection is a 3-leg unsignalized intersection with a free channelized southbound right from the Alyeska Highway onto the Seward Highway. The only movements that experience delay due to intersection control are the left turn movements; the southbound left turn from Alyeska onto Seward is stop controlled, while vehicles wishing to make an eastbound left from Seward onto Alyeska must yield to westbound Seward traffic.

During traffic counts at the study intersection, the traffic movements shown in Figure 5 were observed. The U-turn movements observed during traffic counts resulted when vehicles appeared to tire of waiting for a gap in traffic to turn left onto the Seward Highway, and instead made a U-turn to cut through the Girdwood Station Mall driveway. For capacity analysis it was assumed that no vehicles make uncommon turning movements.

Figure 5: Observed Traffic Movements at the Intersection of Seward Highway with Alyeska Highway

Four other intersections are also included in the study area as shown in Figure 4:

1) Alyeska Highway with north Girdwood Station Mall driveway
2) Alyeska Highway with south Girdwood Station Mall driveway
3) Seward Highway with Girdwood Station Mall driveway
4) Seward Highway with Main Street

All movements at the four intersections are unrestricted. Intersections 1, 3 and 4 are T-intersections with stop-control on the minor leg.

Intersection 2, which has stop-control on the Girdwood Station Mall driveway, functions as a 4-leg intersection, with the channelized right from Alyeska onto the Seward serving as a one-way fourth leg. The traffic movements shown in Figure 6 were observed in the field at Intersection 2. For capacity analysis it was assumed that no vehicles make the uncommon turning movement.

Figure 6: Observed Turning Movements at Intersection 2

Characteristics of the study area roadways related to geometric design of the roadway are shown in Table 5. Characteristics of the roadways approaching the study intersection are also included, as consideration of these characteristics may impact intersection improvement decisions.

Table 5: Roadway Characteristics

Name	Approximate Location	Classification	Cross Section	Speed Limit (mph)	Sidewalks/ Pathways	Bike lane
Seward Highway	Study Area (MP 90)	Principal Arterial: Interstate Highway	2-Lane with designated turn lanes, southbound right receiving lane, median striping and median rumble strips	55	Not at study intersection	Wide shoulders with rumble strips
Seward Highway	West of Toadstool Dr	Principal Arterial: Interstate Highway	3-Lane Undivided with 2 lanes westbound, 1 lane eastbound and median rumble strip	65	Bird to Gird Pathway	Wide shoulders with rumble strips
Seward Highway	Approximately 2000' east of Alyeska Hwy	Principal Arterial: Interstate Highway	2-Lane Undivided with median rumble strip	65	No	Wide shoulders with rumble strips
Alyeska Highway	Study Area	Minor Arterial	2-Lane Undivided	45	Separated Pathway	Separated Pathway

2.2 Sight Distance

KE measured sight distance at all analyzed intersections in the study area. Chapter 9.5 in the 2018 PGDHS discusses intersection sight distance and specifies how to ensure that intersection approach legs provide a driver with a clear view of potentially conflicting vehicles. Desirably, a driver stopped on a driveway/minor road would have adequate intersection sight distance to confidently judge when to enter major road traffic when making either a left turn or a right turn from the driveway/minor road on to the major road, as shown in Table 6. At a minimum, a driver on a major road approaching a driveway/minor road must have adequate stopping sight distance to see and react to a driver entering the major roadway from the driveway/minor road, as shown in Table 7.

Table 6: Intersection Sight Distance (Desirable)

	major road speed limit, v_{major}	time gap, t_g	Intersection (Decision) Sight Distance, $1.47\ v_{major}t_g$
Left turn from driveway onto Alyeska Highway	45 mph	11.5 sec	760 ft
Left turn from driveway/minor street onto Seward Highway	55 mph	11.5 + 0.7*2.5 = 13.25 sec[¥]	1075 ft
Right turn from driveway onto Alyeska Highway	45 mph	10.5 sec	695 ft
Right turn from driveway/minor street onto Seward Highway	55 mph	10.5 sec	850 ft

[¥] For left turns from minor road, add 0.7 seconds for trucks for each additional 12' lane, including turn lanes and medians.

Table 7: Stopping Sight Distance (at Minimum)

	speed limit, v	acceleration, a	brake reaction time, t	Stopping Sight Distance $1.47\ vt\ +\ 1.075\ v^2/a$
Vehicle on Alyeska Highway approaching driveway	45 mph	11.2 ft/sec^2	2.5 sec	360 ft
Vehicle on Seward Highway approaching driveway/minor street	55 mph	11.2 ft/sec^2	2.5 sec	495 ft

Figure 7 compares sight distances measured in the field with sight distances calculated based on the PGDHS guidance. Along the Alyeska Highway, some sight distances do not meet desired sight distances due to the proximity of the Seward Highway. Of particular concern, the distance between the south Girdwood Station Mall driveway at Alyeska Highway and the Seward

Highway is only 165 feet, which meets neither desirable nor minimum sight distance requirements.

Sight distances in the study area along the Seward Highway are not obstructed by existing signage, foliage, shrubbery, permanent structures, or roadway geometry. However, cars turning into and out of driveways often block drivers' line of sight. Field observations identified that vehicles in the westbound right lane obstruct the line of sight for the following vehicles:

1) Vehicles wishing to make a southbound left from Alyeska onto the Seward Highway,
2) Vehicles wishing to make a southbound left from the Girdwood Station Mall/Main Street onto the Seward Highway, and
3) Vehicles traveling westbound on the Seward Highway – vehicles in westbound right lane obscure vehicles described in 1) and 2).

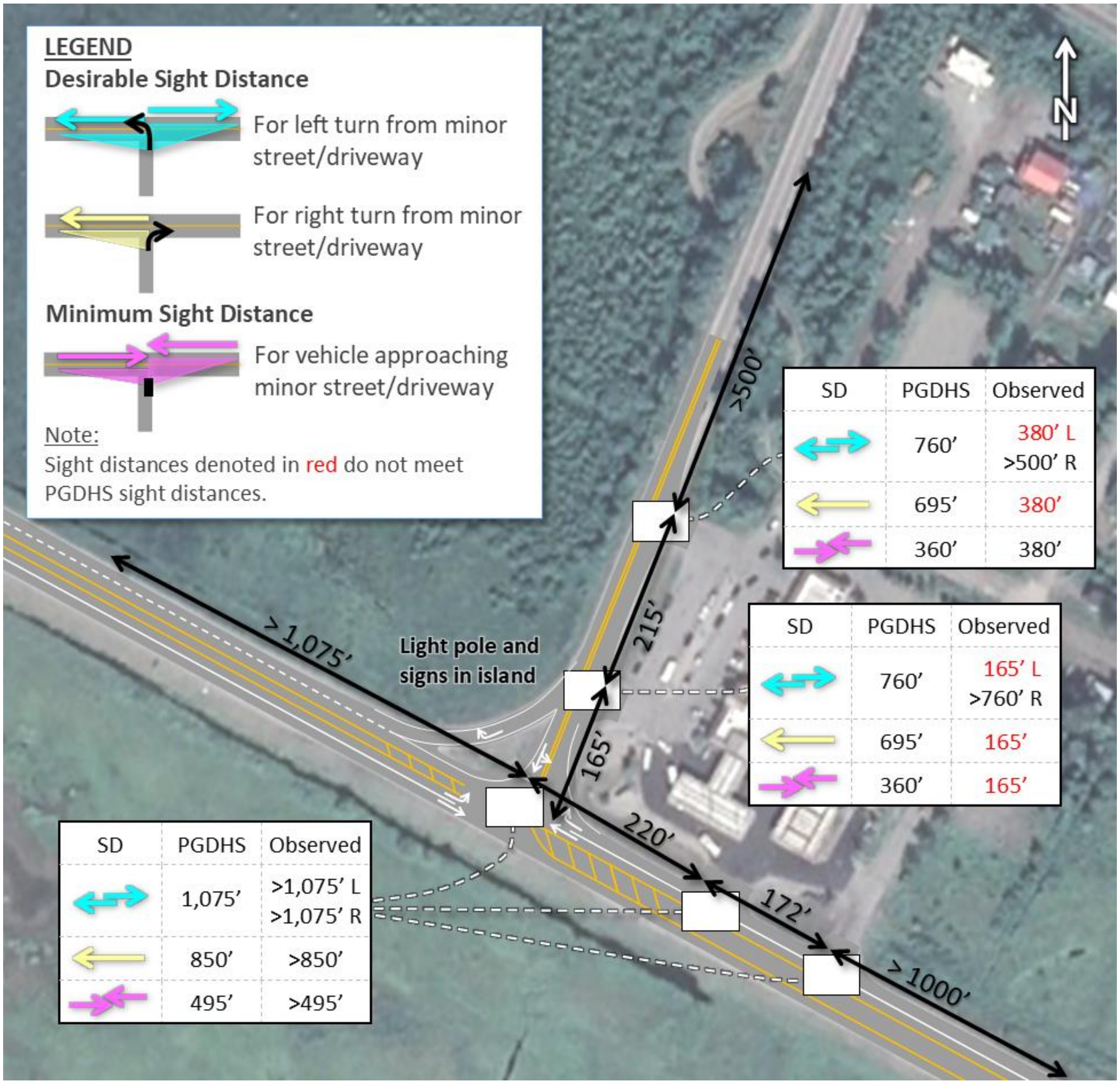

Figure 7: Sight Distances in the Study Area

2.3 Pedestrian and Bicycle Facilities

Currently, there are no designated pedestrian crossings at the study intersection. As shown in Figure 8, wide shoulders with rumble strips on the Seward Highway can accommodate bicyclists, although not comfortably. The Bird to Gird Pathway follows the Alaska Railroad from Indian to the Alyeska Highway, connecting to a separated pathway running along the west side of the Alyeska Highway.

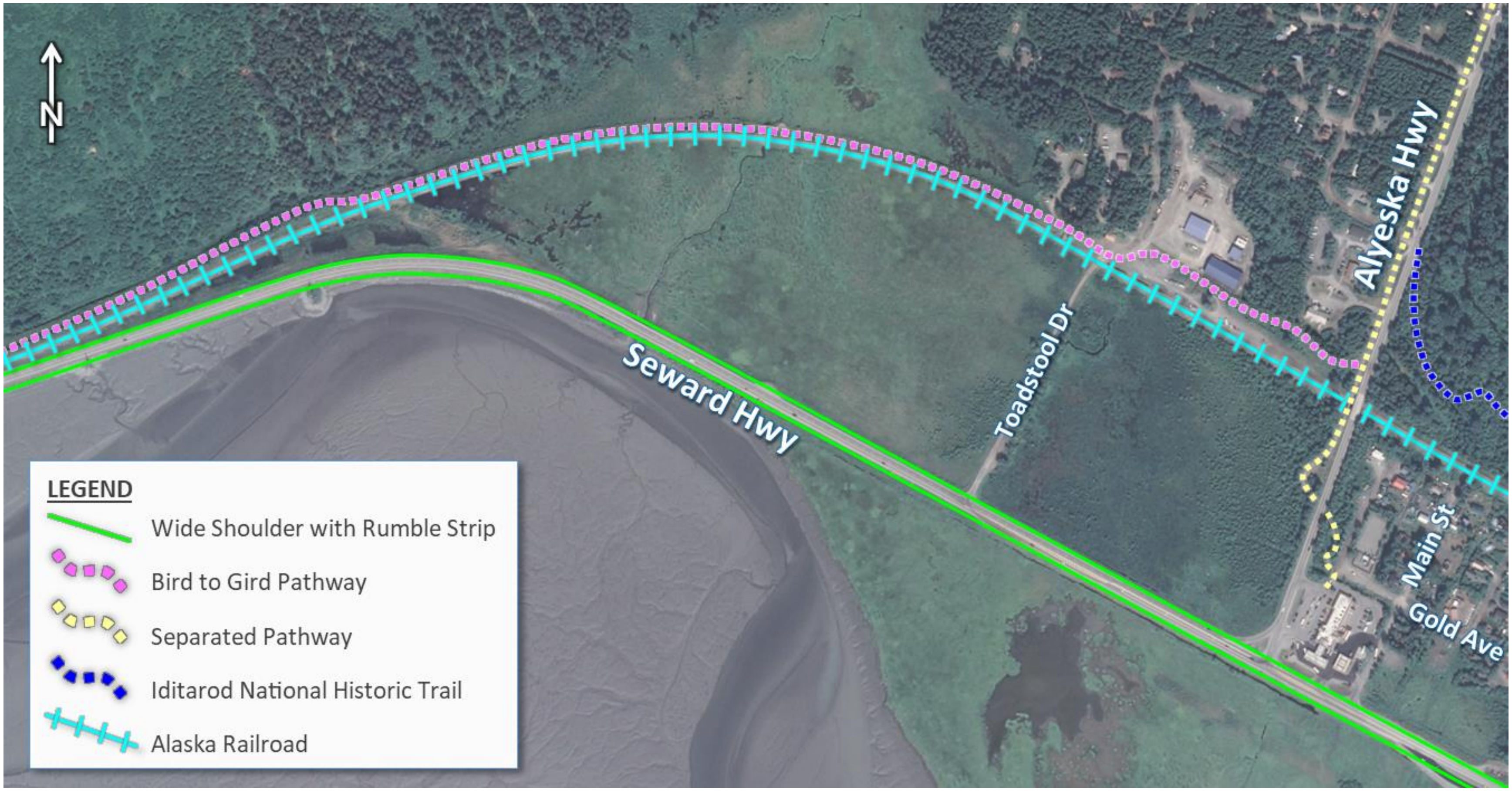

Figure 8: Existing Pedestrian and Bicycle Facilities near the Study Intersection

2.4 Transit

Glacier Valley Transit (GVT) serves the project area, as shown in Figure 9. There is one bus stop in the project area at the Ice Cream Shop & Coast Pizza in the Girdwood Station Mall. It is serviced hourly from 7:32 am until 8:36 pm with a final stop at 9:45 pm. Transit also travels through the study intersection to access the Train Depot bus stop, making a southbound right from Alyeska onto Seward and then turning right on Toadstool Drive. During winter, flex-route service to the train depot is available; a transit patron can call GVT or the bus driver to arrange a trip. During summer, the train depot receives regular transit service corresponding to the Alaska Railroad schedule.

Figure 9: Glacier Valley Transit Routes in the Study Area

On December 7, 2020, KE had a phone conversation with Sam Marshall, the Operations Manager for GVT. Marshall stated that he would like to offer service to the Alaska Wildlife

Conservation Center 11 miles to the south of Girdwood. However, he is unwilling to do so until the intersection is reconfigured to alleviate the delay and associated safety concerns for vehicles making an eastbound left turn from Alyeska onto the Seward.

3 Crash Analysis

DOT&PF provided available crash data for the roadways and intersections in the study area from 1977 through 2017. Crashes from the most recent 5-year period (2013-2017) were used to calculate and compare intersection and segment crash rates with 5-year statewide average crash rates. Intersection crashes were defined as crashes that occurred within 250 feet of the study intersection or within an intersection turn lane, even if the turn extended further than 250 from the intersection. Segment crashes were defined as crashes that occurred along segments listed in Table 9, but not within 250 feet of any intersection or within an intersection turn lane.

The 10-year period from 2008 to 2017 was used to analyze crash trends. A broader historical analysis considered historical crash data from 1997 through 2007. Crashes prior to and after 2006, when the Seward Highway segment from MP 87 to MP 117 was designated as a Safety Corridor, were also analyzed and compared.

For each crash listed in the DOT&PF database, the crash type and location were carefully reviewed and adjusted using engineering judgement to improve the analysis.

3.1 Intersection and Segment Crash Rates (2013 – 2017)

Crash rates were calculated based on the number of crashes, the number of years in the study period, and annual average daily traffic (AADT). The crash rates were then compared to the most recent published statewide averages for similar facilities, found in the 2017 Highway Safety Improvement Program (HSIP) Handbook, and the Critical Accident Rate (CAR) was calculated. The CAR is a threshold above which the observed rate is considered statistically higher than average at a 95% confidence level. When a crash rate exceeds the CAR, there is strong evidence that crashes are caused by underlying contributing factors instead of just random occurrences. Crash rates at intersections are given in terms of crashes per million entering vehicles (MEV). Crash rates on segments are given in terms of crashes per million vehicle miles (MVM). Table 8 presents the intersection crash rate and Table 9 presents the segment crash rates.

The Seward Highway at Alyeska Highway intersection has a crash rate above the statewide average but below the CAR for similar facilities, indicating that the crash rate is not statistically different from the average for similar facilities.

The segment crash rate analysis shows that the Seward Highway and Alyeska Highway road segments fall below the statewide average, indication no statistical evidence that the segments have poor safety performances or an unusually high crash rate.

Table 8: Intersection Crashes (2013 to 2017)

Intersection	Total Crashes	Entering AADT (vpd)	Crash Rate (Crashes/MEV)			Above Average?	Above CAR?
			Calculated	Statewide Average	CAR @ 95.00% Confidence		
Seward Hwy at Alyeska Hwy	9	7,520	0.66	0.52	0.88	Yes	No

Table 9: Segment Crashes (2013 to 2017)

Segment	Total Crashes	Segment Length (Miles)	Average AADT (vpd)	Crash Rate (Crashes/MVM Traveled)			Above Average?	Above CAR?
				Calculated	Statewide Average	CAR @ 95.00% Confidence		
Seward Hwy: Glacier Creek Bridge to Alyeska Hwy	3	0.21	4,942	1.58	2.30	4.38	No	No
Seward Hwy: Alyeska Hwy to Toadstool Dr	2	0.27	7,389	0.55	2.30	3.74	No	No
Alyeska Hwy: Seward Hwy to Forest Station Rd	1	0.30	2,709	0.67	2.30	4.69	No	No

3.2 Crash Types and Severity (2008 – 2017)

Crash types at the study intersection were examined. Figure 10 presents the frequency of crashes at the intersection by crash type. The predominant crash type are right-angle crashes (75% of all crashes), with the majority of the right-angle crashes involving westbound Seward Highway vehicles and southbound left-turning vehicles.

Of the nine right-angle crashes, five crashes were related to vehicles in the westbound right-turn lane to Alyeska Highway. Three of these right-angle crashes involved a southbound left-or-right turning vehicle entering Seward Highway from the Girdwood Station Mall or Main Street in front of a vehicle in the westbound right-turn lane; the crash reports indicated that there was confusion regarding which driveway the westbound vehicle was using to turn right. Two of the right-angle crashes occurred between a southbound left-turning vehicle and a westbound vehicle at the intersection of Seward with Alyeska; the crash reports indicated that a large vehicle was present in the westbound right-turn lane, suggesting that sight distance was obstructed during these crashes.

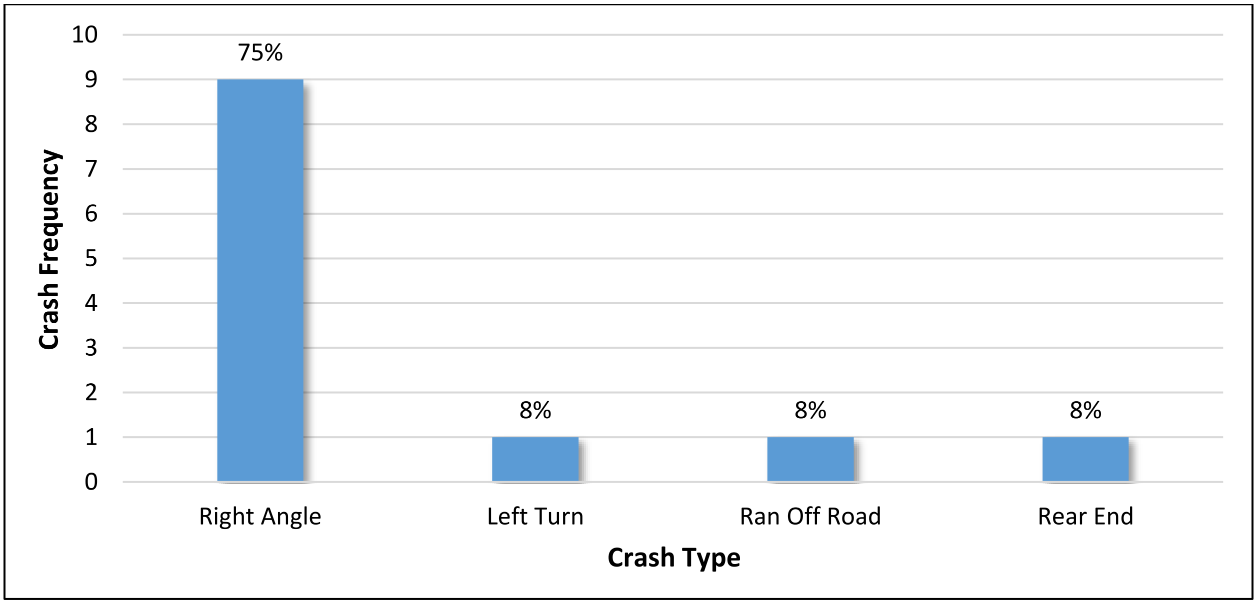

Figure 10: Crash Type Distribution at the Seward Highway with Alyeska Highway Intersection (2008-2017)

Figure 11 presents the severity of crashes at the Seward Highway with Alyeska Highway intersection. There were no fatalities at the intersection. Three crashes resulted in minor or major injuries. Of the injury-related crashes, two were right-angle crashes and one was a rear-end crash.

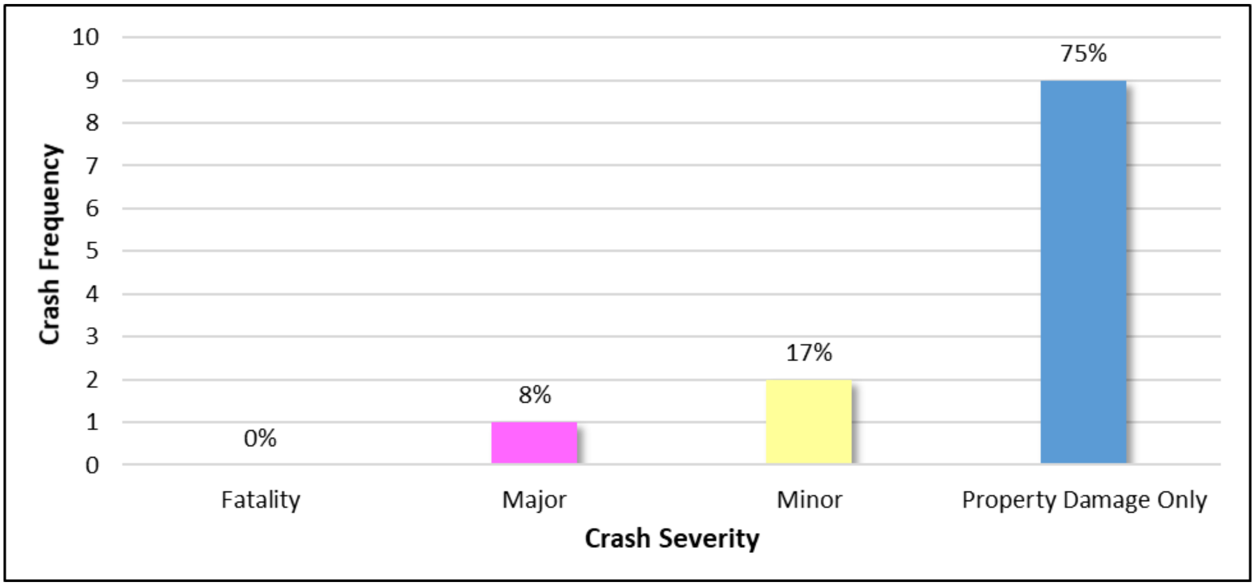

Figure 11: Crash Severity at Seward Highway-Alyeska Highway Intersection (2008-2017)

3.3 Historical Crashes (1977 – 2007)

KE analyzed the available crash data for the years 1977 through 2007 by measures consistent across the different years of data, considering crash frequency, crash type, crash severity, season, road conditions and road illumination. No patterns relating crash frequency, type or severity to time of year, road condition or road illumination were apparent.

Crashes by year are shown in Figure 12. No crashes were reported in 1993, 1995, 1997, 1998, 1999, 2005, 2006 or 2007. The highest number of crashes in any year were recorded in 1978 and 2001. On average, there were just under 2 crashes per year at the study intersection throughout this time period.

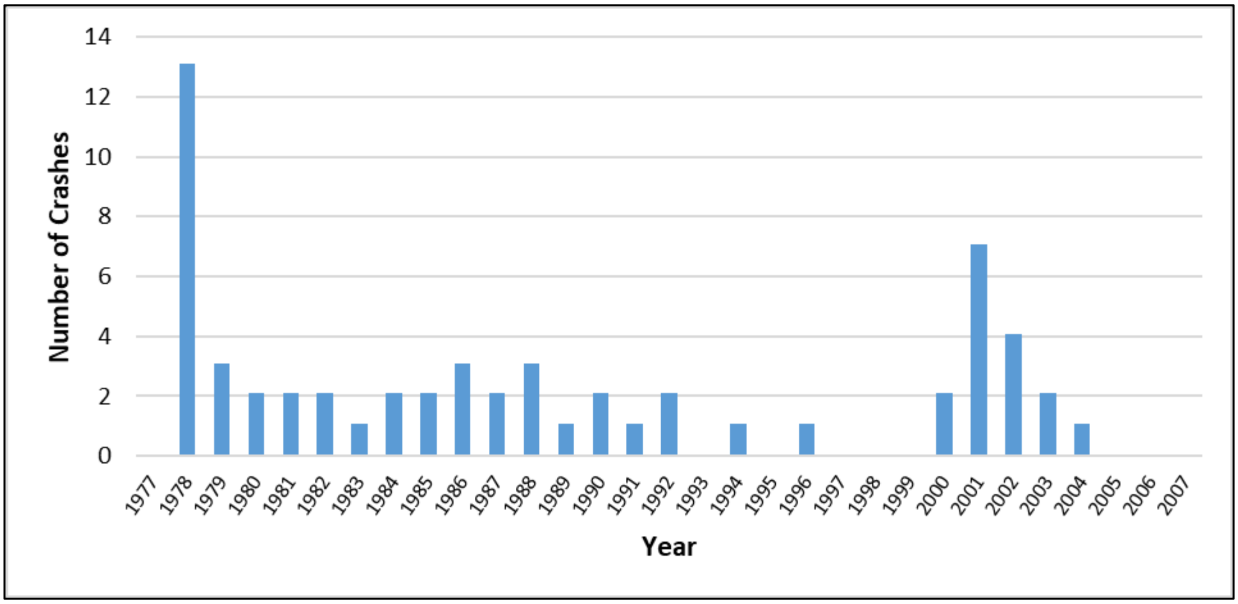

Figure 12: Number of Crashes by Year (1977 to 2007)

Over time, the information provided on crash reports has changed. Prior to 2000, recorded information about crash types is in general less detailed and less complete than information recorded from 2000 and on. Figure 13 presents the frequency of recorded crashes at the intersection by crash type from 1977 through 1999. Ran off road crashes include all vehicles leaving the roadway, including ran into tree, ditch, or signpost and overturn. Left turn crashes are crashes that involve an eastbound left-turning vehicle, turning from the Seward Highway onto the Alyeska Highway, and a vehicle traveling westbound on the Seward Highway.

Of the eleven recorded rear end crashes, six reports had crash details. Of note because they involve vehicles in turning lanes, three of the rear end crashes resulted when a vehicle attempting to make southbound right turn was struck from the rear, while two occurred when an eastbound vehicle collided with a vehicle attempting to make an eastbound left.

Of the eleven recorded right-angle crashes, six reports provided crash details. Three of the six crashes involved either westbound or southbound left turning vehicles.

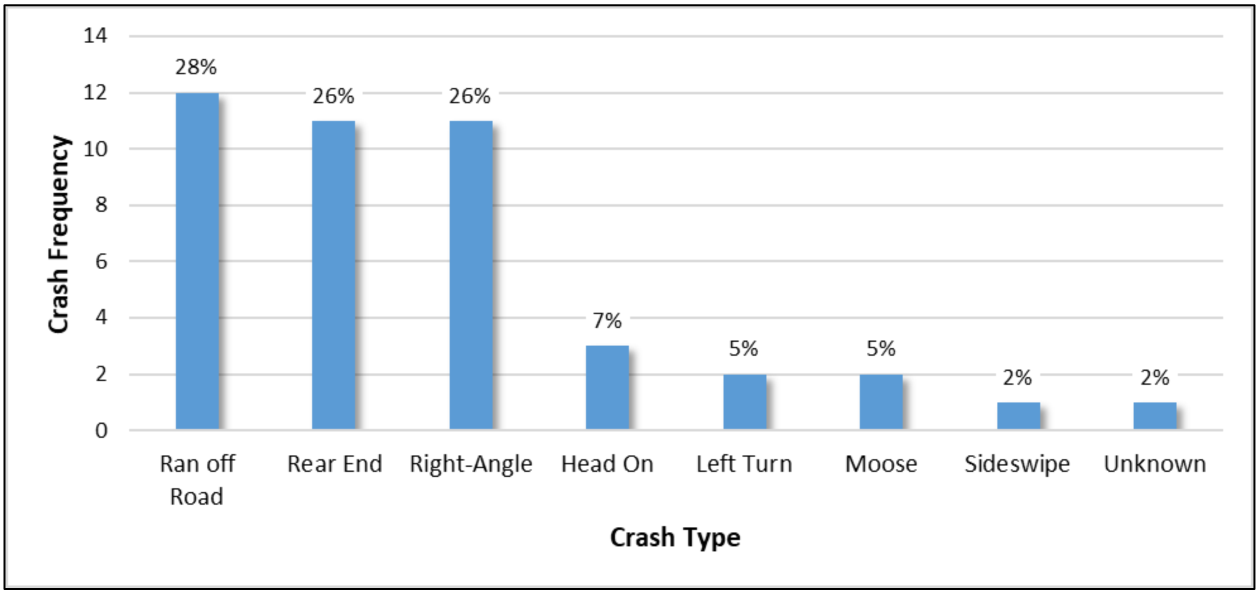

Figure 13: Crash Distribution at the Seward Highway with Alyeska Highway Intersection (1977 – 1999)

The crash reports from 2000 to 2007 had more detail, and crash types for this period are shown in Figure 14. Four left turn crashes between an eastbound left turning vehicle (from the Seward Highway onto the Alyeska Highway) and a westbound vehicle were recorded. Four right angle crashes occurred. Two resulted from a southbound left turning vehicle (from the Alyeska Highway onto the Seward Highway) colliding with a westbound vehicle; two occurred when southbound vehicles exiting the Girdwood Station Mall driveway onto the Seward Highway collided with westbound vehicles. Two eastbound drivers traveling on the Seward Highway, impaired by alcohol, ended up in a ditch.

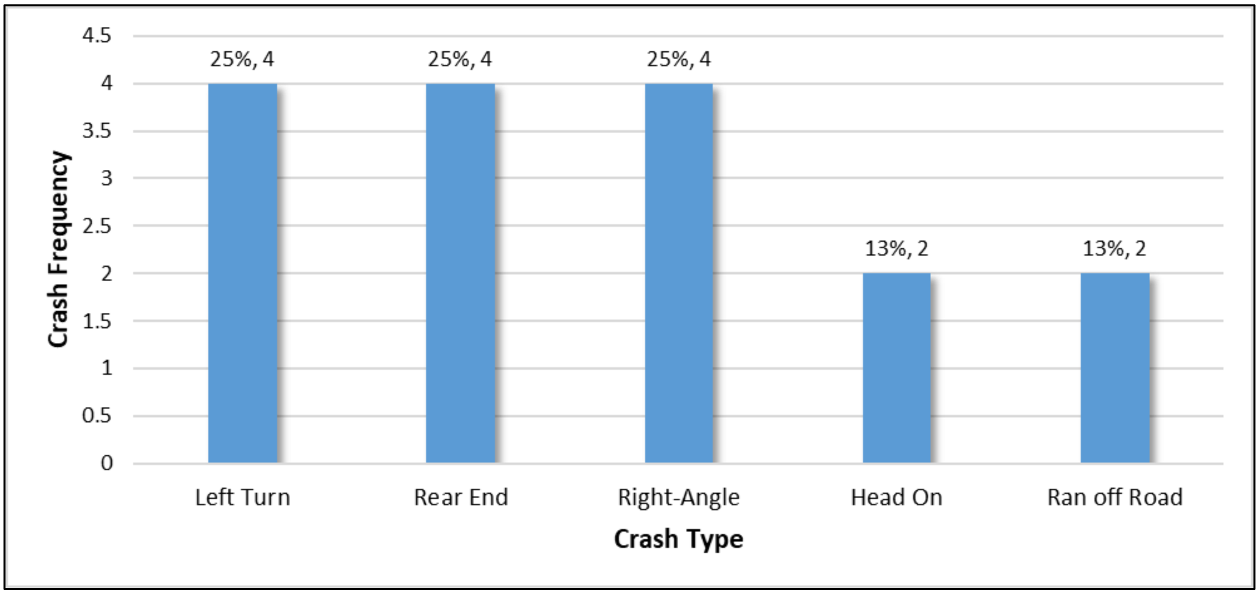

Figure 14: Crash Distribution at the Seward Highway with Alyeska Highway Intersection (2000 – 2007)

Crashes were also analyzed by injury severity to identify if the intersection has historically had a high occurrence of severe crashes. Note that severity information was not available from 1977-1979, so Figure 15 presents crashes from 1980 to 2007.

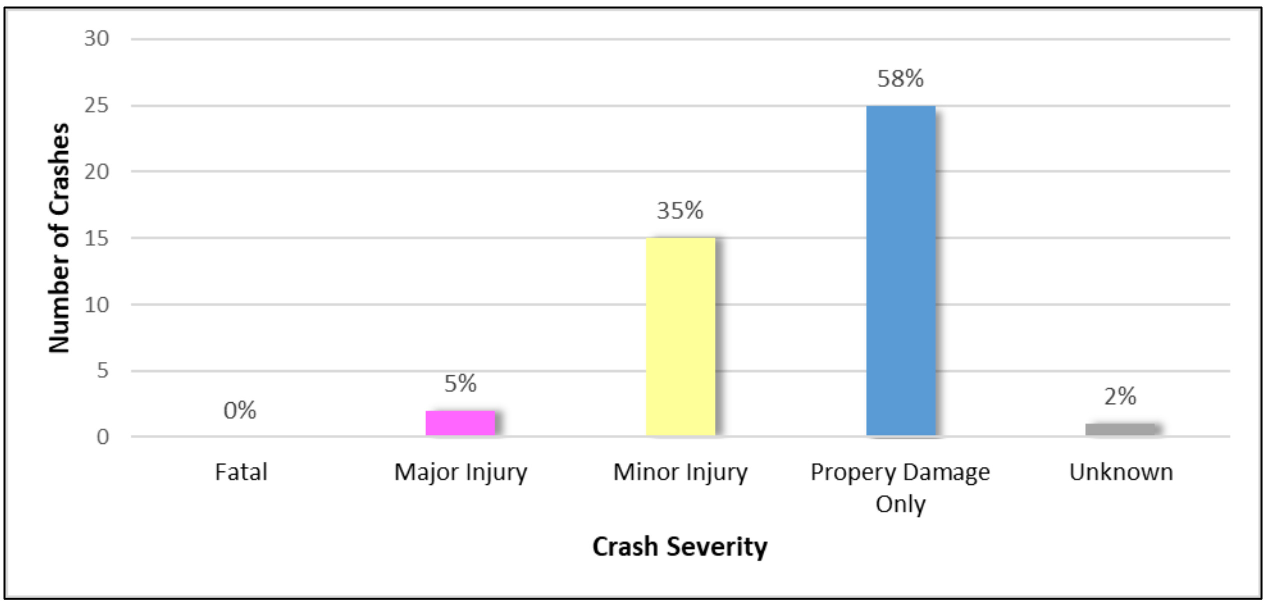

Figure 15: Crash Severity at Seward Highway-Alyeska Highway Intersection (1980-2007)

Compared to the crash severity distribution from 2008 to 2017, crashes from 1980 to 2007 were twice as likely to result in minor injuries.

No fatalities were recorded at the intersection. However, one crash involving a vulnerable party was recorded. A motorcycle crash occurred on June 2, 2001 at 8:40 pm. An eastbound motorcycle was speeding on the Seward Highway, lost control, struck a westbound passenger car, and ultimately overturned. The crash was reported as property damage only and was evaluated as a head on crash type.

3.4 Crashes Before and After Safety Corridor Designation in 2006

In 2006, the Seward Highway segment from MP 87 (Girdwood) to MP 117 (Potter's Marsh) was designated as a Safety Corridor. The DOT&PF Safety Corridor website states, "A Designated Safety corridor is a segment of a state highway that has been identified as having a higher than average incidence of fatal and serious injury crashes". Note that although the intersection of Alyeska Highway at Seward Highway falls within the safety corridor, there have been no fatal injury crashes reported at the intersection during the study period. The designation is accompanied by a commitment to provide funding to raise public awareness about safety concerns (education, orange-and-white "Safety Corridor" signs), to provide enforcement (enforce speed limits and daylight headlight laws), to support emergency response agencies, and to provide cost-effective engineering solutions.

To evaluate how the Safety Corridor designation in 2006 may have affected safety at the study intersection, the 11-year crash period from 1995-2005 was analyzed and compared to the 11-year crash period from 2007-2017, as shown in Table 10. Before 2006, the calculated crash rate (0.60 crashes/MEV) is close to the statewide average, while after 2006, the calculated crash rate (0.37 crashes/MEV) is below the statewide average and about 38% lower than the crash rate before 2006.

Table 10: Intersection Crashes Before and After 2006

Intersection of Seward Hwy with Alyeska Hwy	Total Crashes	Entering AADT (vpd)	Crash Rate (Crashes/MEV)			Above Average?	Above CAR?
			Calculated	Statewide Average	CAR @ 95.00% Confidence		
1995-2005 (11-Year Period)	19	7,894	0.60	0.52	0.75	Yes	No
2007-2017 (11-Year Period)	12	7,982	0.37	0.52	0.75	No	No

The impact of the Safety Corridor on severity was also considered. Crash severity for the 11-year periods before and after 2006 are shown in Figure 16.

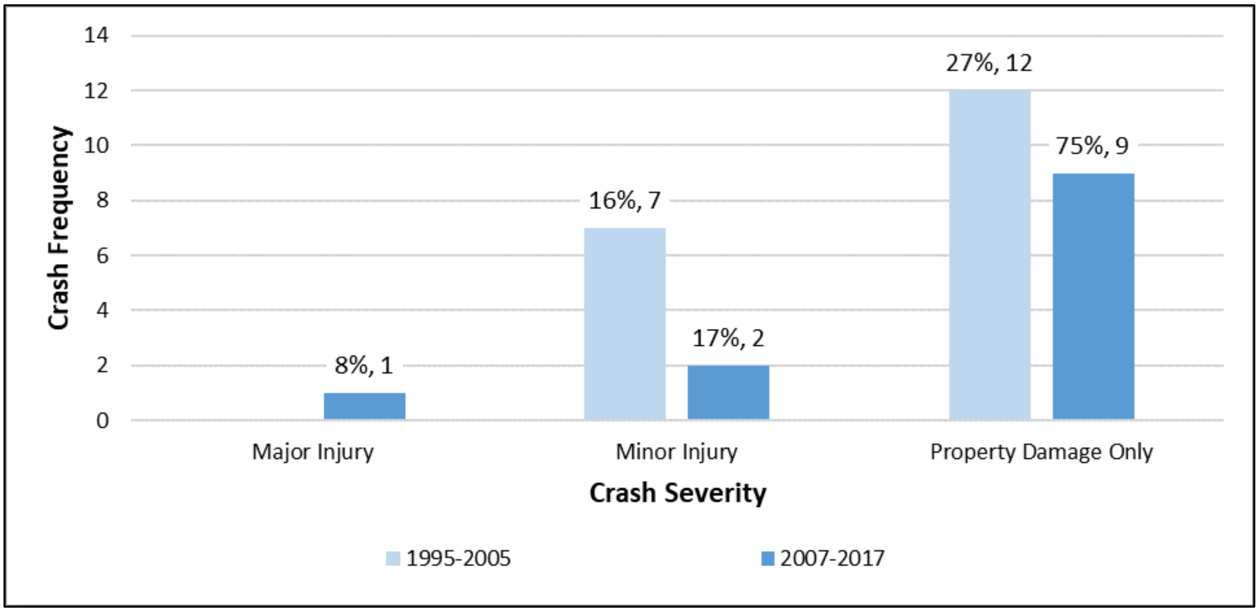

Figure 16: Crash Severity Before and After 2006

3.5 Crash Summary

For the 2013 to 2017 crash period, the intersection and segments studied have crash rates at or below average for similar facilities.

Analysis of crash data from 2008 to 2017 indicates that angle crashes are the primary safety concern for this intersection. Analysis of historical crash data from 1977 to 2007 supports the conclusion that right angle and left turn angle crashes are a safety concern at the intersection. Angle crashes frequently occur between southbound left turn vehicles and westbound vehicles. Crash descriptions available for the more recent years indicate that a common theme for these types of crashes is that westbound vehicles turning right either into the Girdwood Station Mall or onto Alyeska Highway block the sight for southbound drivers turning left from Alyeska Highway onto the Seward Highway. This is corroborated by observations made during sight distance measurements (see Section 2.2).

4 Existing Operations

4.1 Traffic

4.1.1 Historical AADT

Average Annual Daily Traffic (AADT) volumes were collected from the DOT&PF's Central Region Annual Traffic Volume Report(s) and online GIS map. Table 11 summarizes historical AADTs and estimated 2020 AADTs for each road segment in the study area. To develop 2020 base year AADTs, volume data and turning movement data were collected for the study area in September and December 2020 and compared to historical data.

Table 11. Average Annual Daily Traffic (2010-2020)

Segment	Extents (Mileposts)	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020 (est.)
Seward Hwy	Whittier Ferry Train Stop to Alyeska Hwy (MP 79.6 – 89.3)	5,740	5,620	4,778	4,900	4,786	4,977	5,205	4,840	4,276	4,916	4,870
Seward Hwy	Alyeska Hwy to Sawmill Rd (MP 89.3 – 100.0)	8,610	7,909	7,760	8,396	6,771	7,041	7,637	7,101	6,273	7,412	7,130
Alyeska Hwy	Seward Highway to Crow Creek Road (MP 0.0 – 2.0)	2,840	2,760	3,052	2,555	2,621	2,630	2,815	2,922	3,038	2,795	

4.1.2 Data Collection and Data Limitations

KE collected radar data (speed and volume by time of day) and AM, PM, and weekend turning movement counts (TMCs) in August and September 2020.

Radar box and turning movement count locations are shown in Figure 17.

Figure 17: Radar Box Location

The Seward Highway, MP 75 to 90 Road and Bridge Rehabilitation, Phase 1 road construction project was underway during the 2020 construction season. During KE's August and September 2020 data collection period, crews were working from 6:00 am to 6:00 pm, 7 days a week, starting at the Glacier Creek Bridge, less than a ¼ mile from the study intersection. Vehicles going through the construction zone experienced reduced speed limits (45 mph), pilot car and flagging operations, and one-lane traffic. There was an increased number of heavy vehicles due to construction.

KE made every attempt to avoid counting during active construction near the study intersection or when flagging operations were underway at the intersection. KE talked to flaggers and frequented the DOT project website to try to coordinate counts accordingly. However, when KE arrived in the field for AM counts, flagging operations were underway, and during PM and weekend counts, construction vehicles (belly dumpers, sidump'rs, dump trucks etc.) frequently traveled through the intersection. The AM counts were not used for analysis as the PM peak was determined to be the weekday peak hour, based on Continuous Count Station (CCS) data and TMC count data. As discussed in KE's 2020 *Alyeska Seward Assumptions Memo*, 2006 TMCs (DOT&PF) were used as the base for weekday PM peak TMVs used for analysis of the study intersection under the assumption that the distributions in the 2006 counts are more representative of the intersection under normal conditions. These 2006 counts were balanced with the 2020 counts at the other four count locations to bring them to 2020 volumes and to account for construction traffic. Weekend counts from 2006 were not available, so KE used the 2020 counts for weekend peak TMVs, but decreased through movement volumes (on the Seward Highway) when balancing to take construction vehicles into account.

KE also performed PM and weekend TMCs at the intersection of Seward Highway with Alyeska Highway in December 2020 and January 2021. These counts provide data about winter turning movement distributions and provide a snapshot of the intersection under normal, non-construction conditions.

4.1.3 Existing Turning Movement Volumes

Based off data from the Potter Marsh CCS, average weekday traffic volumes on the Seward Highway are higher during the PM peak than during the AM peak, steadily growing from 7 AM until peaking around 5 PM. Meanwhile, average traffic volumes during the weekend follow a smooth bell curve shape, increasing gradually from around 7 AM until about 2 – 3 PM and then decreasing gradually.

To try to capture typical AM, PM and weekend peak traffic, KE performed counts during the count periods shown in Table 12. The winter weekend count times were selected in order to capture traffic to and from the Alyeska Resort.

Table 12: KE 2020 Count Periods

Count Period	**Summer**	**Winter**
Count Location	*All 5 count locations*	*Main study intersection*
AM Peak Hour	7 AM - 9 AM	
PM Peak Hour	4 PM - 6 PM	4 PM - 6 PM
Weekend Peak Hour	2 PM - 3 PM	9:30 AM - 11: 30 AM
		12 Noon - 1 :30 PM
		3 PM - 6 PM

Historical 2006 weekday counts had a volume peak from 5 PM – 6 PM. Based off this historical data and the 2020 counts, the peak hours shown in Table 14 were used for analysis.

Table 13: Peak Hours used for Analysis

Peak Hour	Summer	Winter
PM Peak Hour	5 PM - 6 PM	4:15 PM – 5:15 PM
Weekend Peak Hour	2 PM - 3 PM	3:30 PM – 4:30 PM

The traffic on the Seward Highway at the study intersection experiences different directional distributions by intersection leg, peak hour and time of year. The directional distributions used in analysis are shown in Table 14.

Table 14: Directional Distributions, Westbound (WB) and Eastbound (EB)

Count Period	Base and Summer		Winter	
	West of Intersection	*East of Intersection*	*West of Intersection*	*East of Intersection*
PM	40% WB, 60% EB	55% WB, 45% EB	40% WB, 60% EB	70% WB, 30% EB
Weekend	50% WB, 50% EB	50% WB, 50% EB	50% WB, 50% EB	60% WB, 40% EB

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).

Table 15 shows the intersection PHFs calculated from TMCs in the study area. These PHFs are representative of locations where traffic is evenly spaced throughout the hour, with some periods being slightly higher volume than others.

Table 15: Existing PHFs for Major Peak Periods

Intersection	PM Peak (Weekday)	Weekend Peak
Seward Highway with Alyeska Highway	0.84	0.87
Alyeska Highway with north Girdwood Station Mall driveway	0.90	0.90
Alyeska Highway with south Girdwood Station Mall driveway	0.85	0.97
Seward Highway with Tesoro driveway	0.90	0.83
Seward Highway with Main Street	0.79	0.85

Heavy vehicle (HV) percentages (%) were considered when analyzing intersection capacity. During 2020, there was construction on the Seward Highway through the study intersection for most of the summer and fall. As such, KE’s 2020 TMC and Seward Highway radar data includes a disproportionately high percentage of HVs. Because of this, data from historical class reports from the CCS at Potter Marsh were used to estimate the average daily HV% on the Seward Highway. Since the Alyeska Highway approaching the study intersection was not under construction in 2020, the HV% on the Alyeska Highway were estimated using the 2020 radar data (the radar box was located outside of the construction zone). For both the Seward Highway and the Alyeska Highway, the estimated HV% used for analysis was 7%.

The collected TMCs were balanced to adjust for mathematical inconsistencies, daily variation in traffic, seasonal construction, and traffic reductions due to the Coronavirus Pandemic. See KE’s 2020 *Alyeska Seward Assumptions Memo* for more details. Since the study intersection experiences extreme seasonal traffic peaks, three turning movement volume (TMV) cases were developed:

1) Base Design Hour TMVs → represent average volumes throughout the year
2) Summer TMVs → represent highest hour volumes (high volume case)
3) Winter TMVs → represent typical winter traffic (resort volume case)

Figure 18 through Figure 23 depict existing TMVs for PM and weekend peak hours under base conditions, the summer high volume case, and the winter resort volume case.

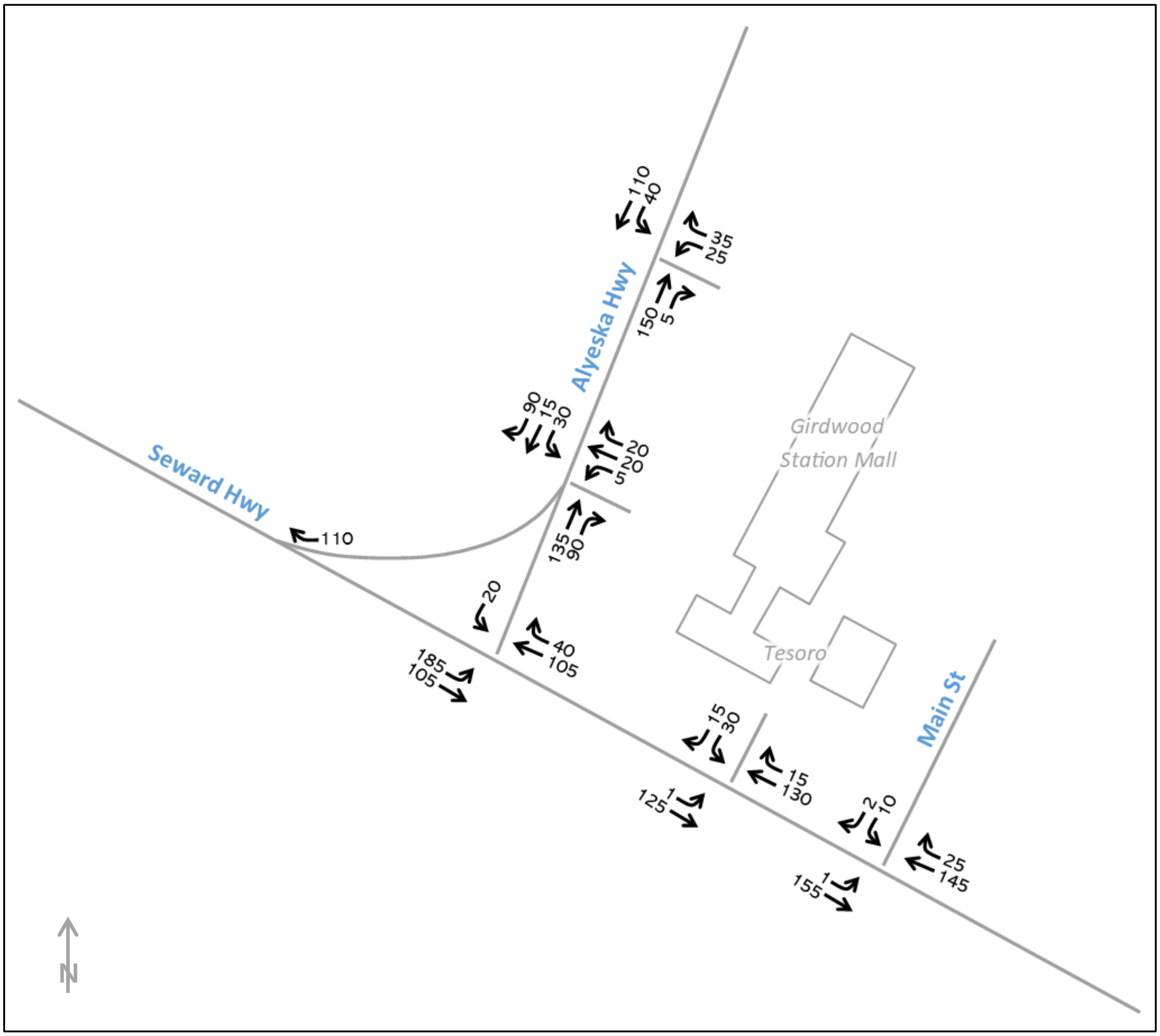

Figure 18: 2020 PM Turning Movement Volumes

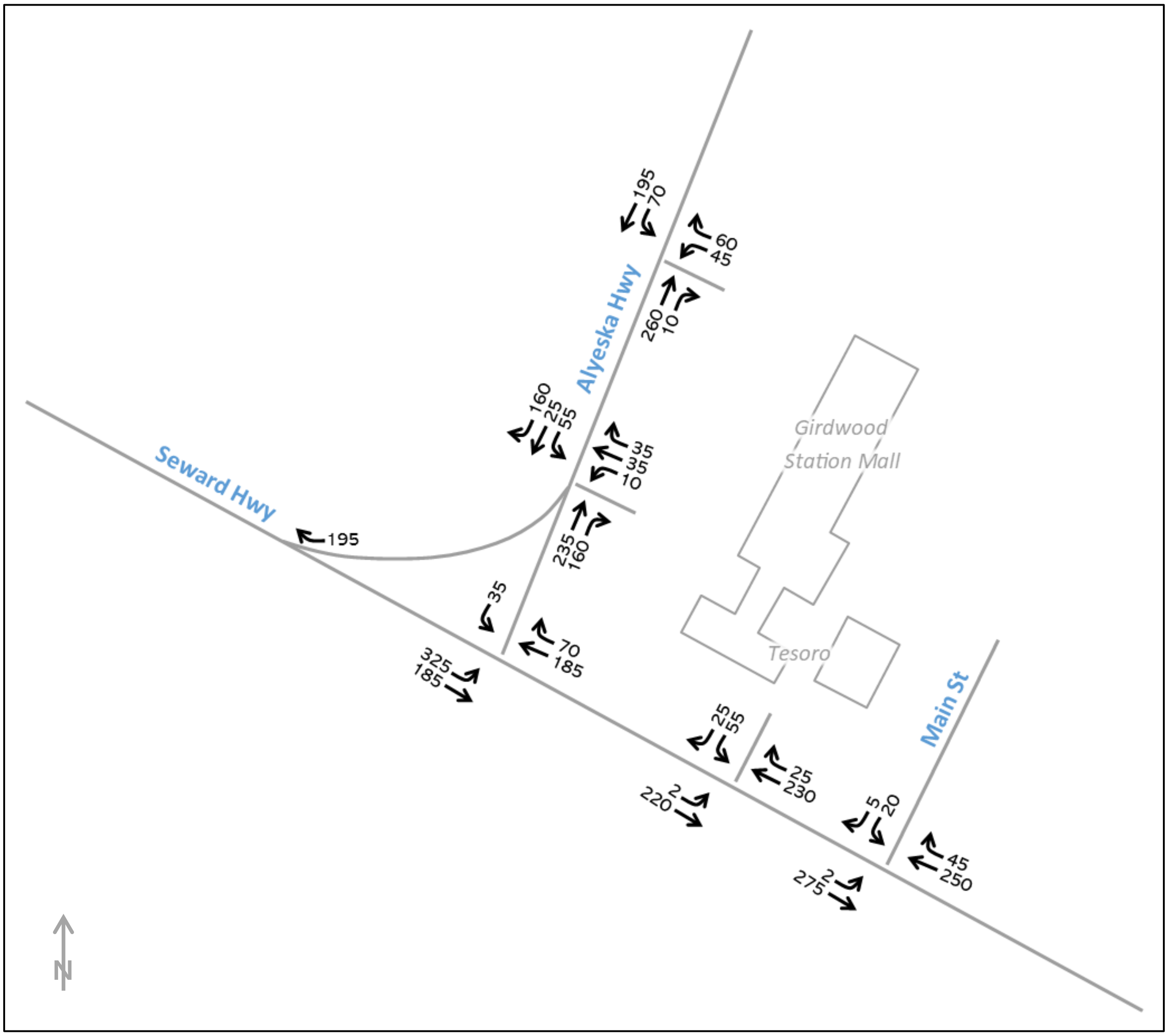

Figure 19: 2020 PM Turning Movement Volumes – Summer

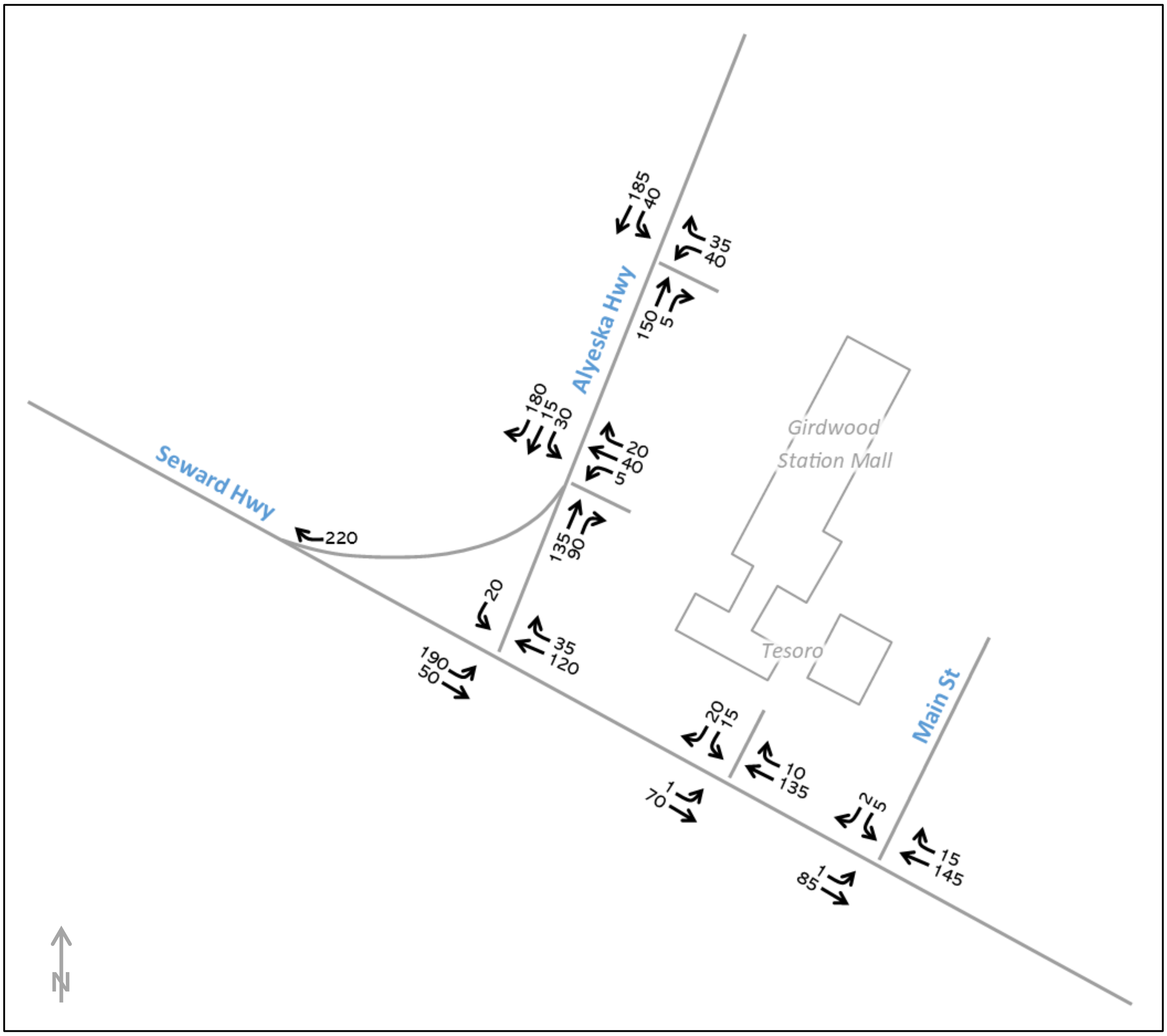

Figure 20: 2020 PM Turning Movement Volumes - Winter

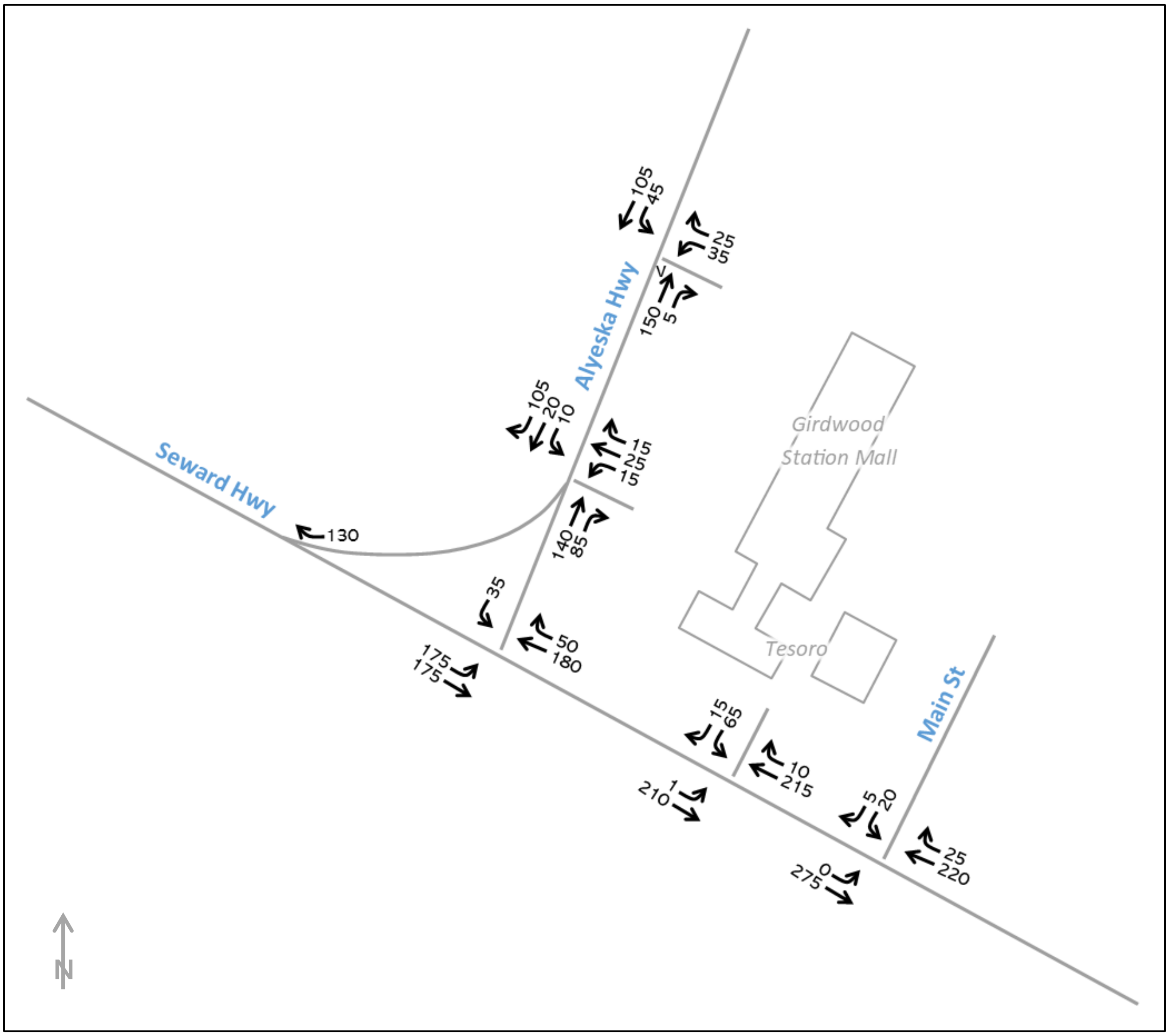

Figure 21: 2020 Weekend Peak Turning Movement Volumes

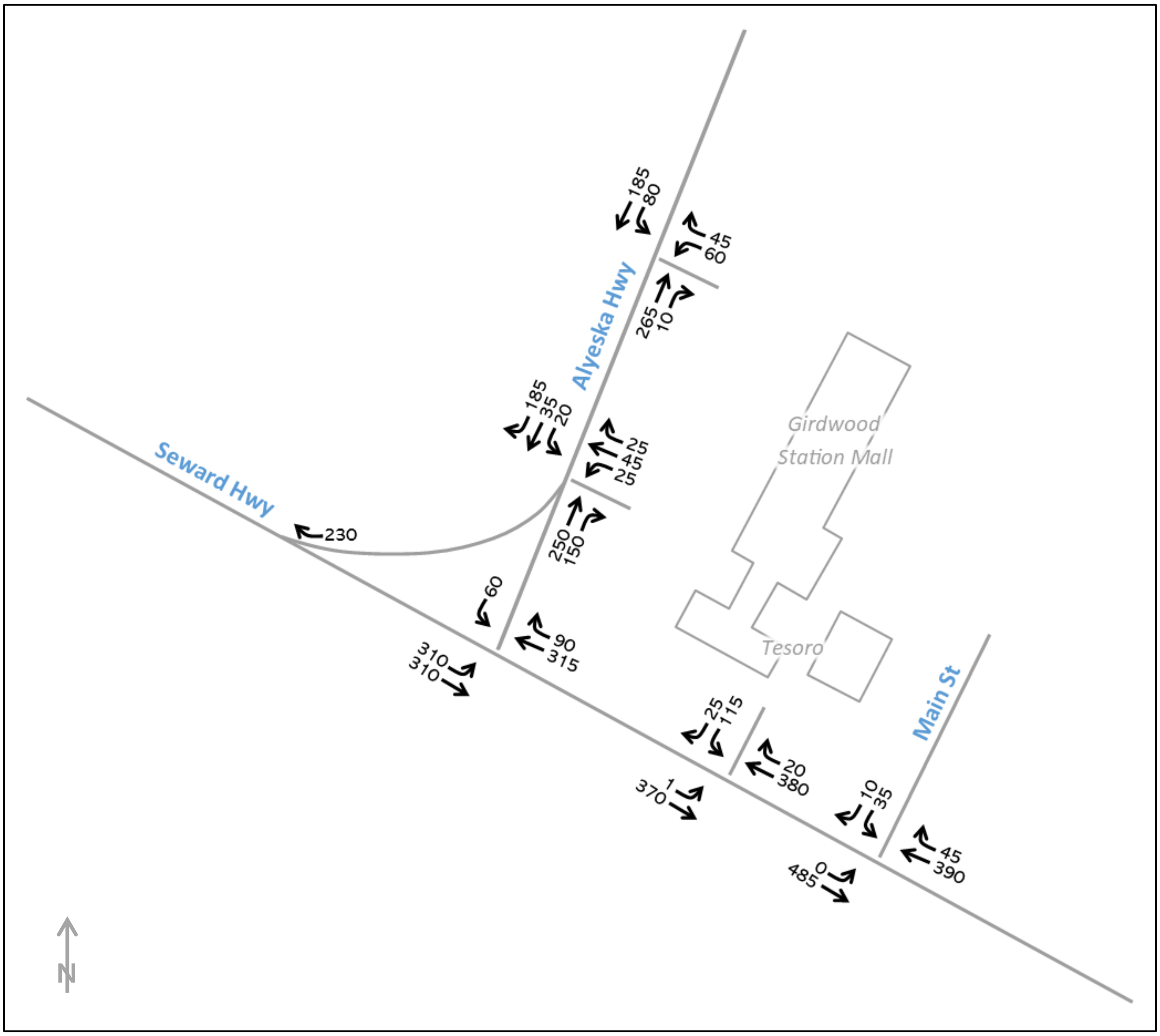

Figure 22: 2020 Weekend Turning Movement Volumes - Summer

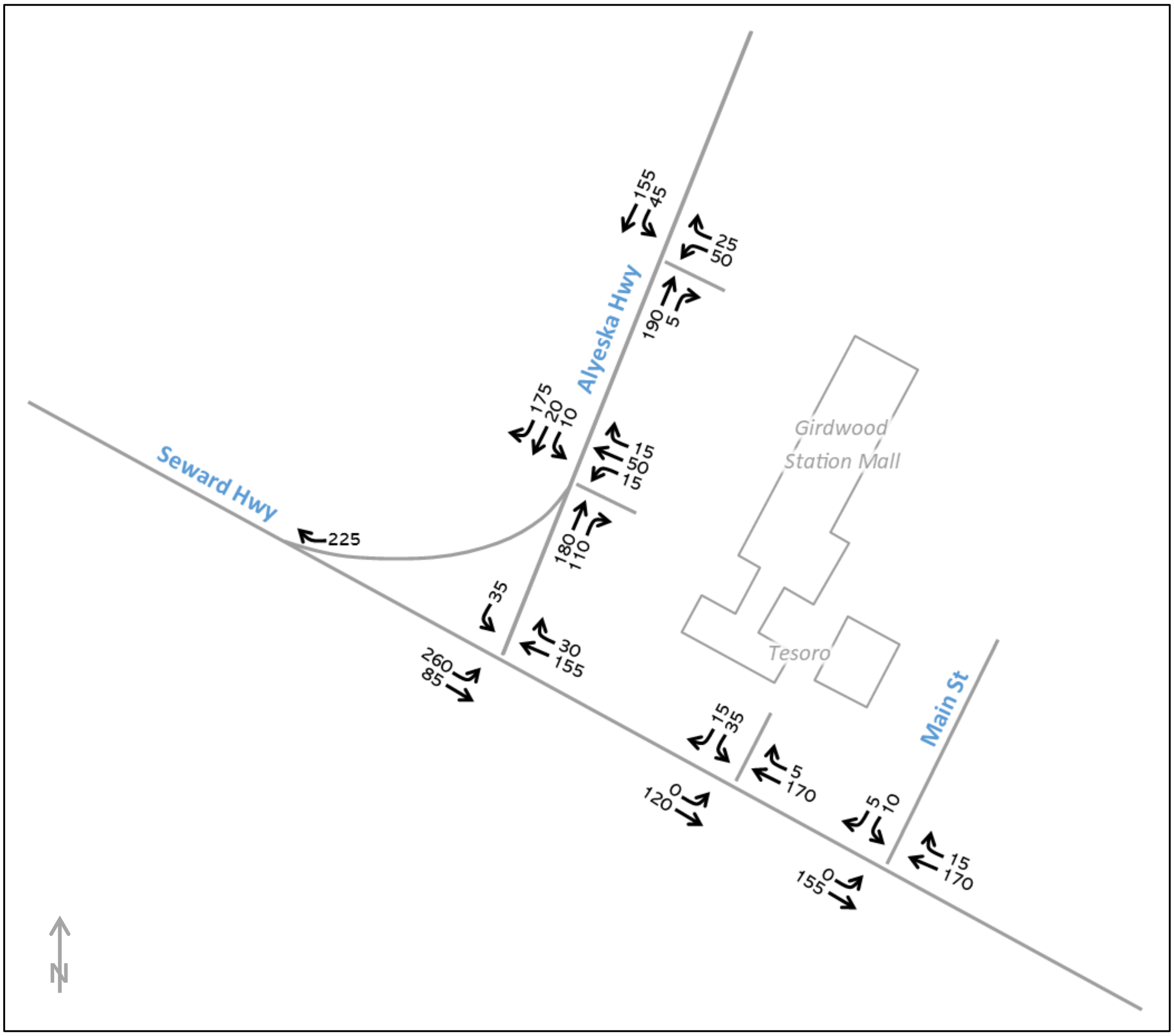

Figure 23: 2020 Weekend Turning Movement Volumes - Winter

4.2 Existing Intersection Capacity

Capacity analyses were conducted using Synchro Trafficware which applies Highway Capacity Manual (HCM) intersection methodologies. The existing PHFs detailed in Table 15 were used to approximate conditions during the highest 15-minute period of each peak hour.

Table 16 through Table 18 summarize existing intersection LOS at peak hours at the intersection of Seward Highway with Alyeska Highway under design hour volumes, under the summer high volume case and under the winter resort volume case.

Table 16. Existing Intersection LOS at Seward Highway with Alyeska Highway

Approach	Movement	PM Peak (Weekday)				Weekend Peak			
		V/C Ratio	95th Percentile Queue (ft)	Delay (sec)	LOS	V/C Ratio	95th Percentile Queue (ft)	Delay (sec)	LOS
Eastbound (Seward)	Left	0.16	<25	8.1	A	0.16	<25	8.3	A
	Through	-	-	-	-	-	-	-	-
Westbound (Seward)	Through	-	-	-	-	-	-	-	-
	Right	-	-	-	-	-	-	-	-
Southbound (Alyeska)	Left	0.07	<25	16.4	C	0.14	<25	19.5	C
	Right	-	-	Free	-	-	-	Free	-
Intersection		n/a		**3.2**	**A**	n/a		**2.9**	**A**

Table 17. Existing Intersection LOS at Seward Highway with Alyeska Highway – Summer

Approach	Movement	PM Peak (Weekday)				Weekend Peak			
		V/C Ratio	95th Percentile Queue (ft)	Delay (sec)	LOS	V/C Ratio	95th Percentile Queue (ft)	Delay (sec)	LOS
Eastbound (Seward)	Left	0.31	50	9.2	A	0.33	50	10	A
	Through	-	-	-	-	-	-	-	-
Westbound (Seward)	Through	-	-	-	-	-	-	-	-
	Right	-	-	-	-	-	-	-	-
Southbound (Alyeska)	Left	0.31	50	43.1	E	0.71	200	104	F
	Right	-	-	Free	-	-	-	Free	-
Intersection		n/a		**4.5**	**A**	n/a		**7.1**	**A**

Table 18. Existing Intersection LOS at Seward Highway with Alyeska Highway – Winter

Approach	Movement	PM Peak (Weekday)				Weekend Peak			
		V/C Ratio	95th Percentile Queue (ft)	Delay (sec)	LOS	V/C Ratio	95th Percentile Queue (ft)	Delay (sec)	LOS
Eastbound (Seward)	Left	0.17	<25	8.2	A	0.23	<25	8.5	A
	Through	-	-	-	-	-	-	-	-
Westbound (Seward)	Through	-	-	-	-	-	-	-	-
	Right	-	-	-	-	-	-	-	-
Southbound (Alyeska)	Left	0.07	<25	15.9	C	0.17	<25	22.7	C
	Right	-	-	Free	-	-	-	Free	-
Intersection		n/a		**3.0**	**A**	n/a		**3.8**	A

The analysis indicates that under average conditions and under winter conditions, the intersection operates well throughout the day (LOS A). However, the southbound left movement experiences significant delay during the summer. Specifically, during the summer PM peak, southbound left turn vehicles (35 vehicles per hour) experience about 43 seconds of delay per vehicle (LOS E), while during the summer weekend peak, the southbound left turn vehicles (60 vehicles per hour) experience about 104 seconds of delay per vehicle (LOS F).

All movements at the Main Street intersection and at the driveways in the study area experience LOS D or better under all existing condition scenarios. At these locations, there are fewer eastbound left turn movements than at the Alyeska Highway intersection, resulting in less delay to enter the Seward Highway.

This report only looks at the operations at the study intersections. Note that under weekend peak hour conditions, it is anecdotally not uncommon for summer traffic to back up on the Seward Highway as recreationists head back to Anchorage after a weekend on the Kenai Peninsula. This is likely more related to the operation and capacity of the highway itself, rather than being specifically related to the study area intersection operations.

4.3 Vehicle Speed Study

In August and September 2020, speed studies were conducted near the intersection of Seward Highway with Alyeska Highway using radar detectors. (The locations where 24-hour radar speeds were collected are shown in Figure 17.) A speed study is conducted to estimate 85th percentile speed and pace. The 85th percentile speed is the speed at which or below which 85 percent of vehicles travel. The "pace" is the 10-mph speed range that more vehicles fall into than any other 10 mph range.

The speed studies were conducted while active construction was occurring east of the study intersection. The study intersection itself was in a reduced speed zone, with the speed limit on the Seward Highway reduced from 55 mph to 45 mph due to construction.

Generally, it is expected that 85th percentile speeds should match the posted speed limit of the roadway and that the 85th percentile speed should fall within the pace. Both speed study locations on the Seward Highway have 85th percentile speeds that are 8 mph or more above the speed limit (55 mph), despite the reduced speed zone due to construction.

The speed study locations on the Alyeska Highway have 85th percentile speeds that are consistent with their speed limits.

Table 19 shows the 2020 85th percentile speeds in the study area calculated from the radar data. Moving away from the intersection, 85th percentile speeds moving are higher than speeds approaching the intersection, indicating that vehicles slow somewhat when nearing the intersection.

Table 19: 85th Percentile Speeds

Segment	Speed Limit	85th % Speed
Southbound Alyeska Highway	45 mph	47 mph
Northbound Alyeska Highway	45 mph	49 mph
Eastbound Seward Highway	55 mph	63 mph
Westbound Seward Highway, Both Lanes Combined	55 mph	66 mph
Westbound Seward Highway, Outer Lane	55 mph	64 mph
Westbound Seward Highway, Inner Lane	55 mph	69 mph

Speed-frequency curves for each location are shown in Figure 24 through Figure 27. These figures present the 85th percentile speed and pace speed range.

The westbound Seward Highway speed-frequency curve (Figure 27) is not as smooth as the other speed-frequency curves. This may be indicative of some drivers heeding reduced speed zones while others ignored them, may reflect vehicles slowing due to frequent police presence in a pullout west of the study intersection, or may be data discrepancy. Although the speed-frequency curve is not smooth, it still yields an 85th percentile speed that is 11 mph above the posted speed, suggesting that it is not uncommon for vehicles speed on this segment of the Seward Highway.

Figure 28 depicts the westbound Seward Highway speed-frequency curve by lane. More vehicles travel in the outer lane, while faster moving vehicles travel in the inner lane, as one would expect.

The speed study indicates that on the Alyeska Highway near the study intersection, most vehicles adhere to the speed limit. However, on the Seward Highway, speeding is commonplace. This trend should be considered when developing alternatives to improve intersection delay and mitigate safety concerns.

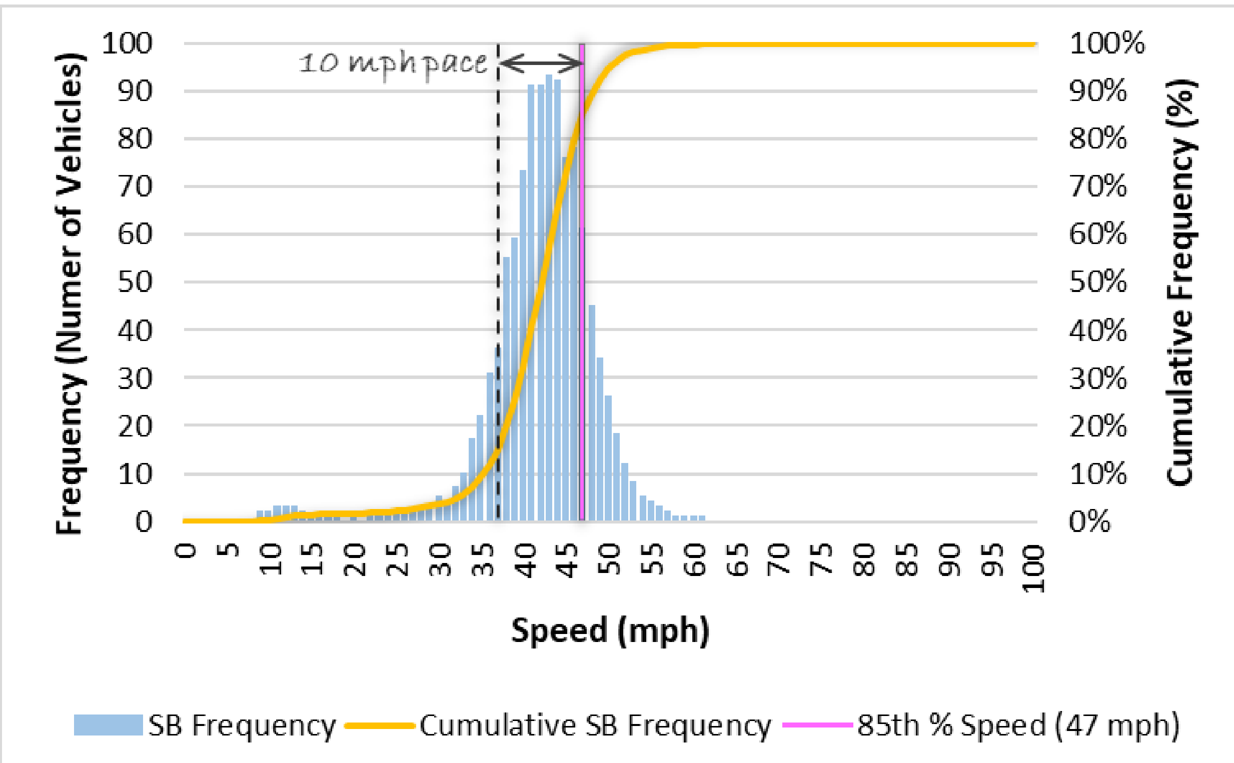

Figure 24: Speeds on Southbound (SB) Alyeska Highway

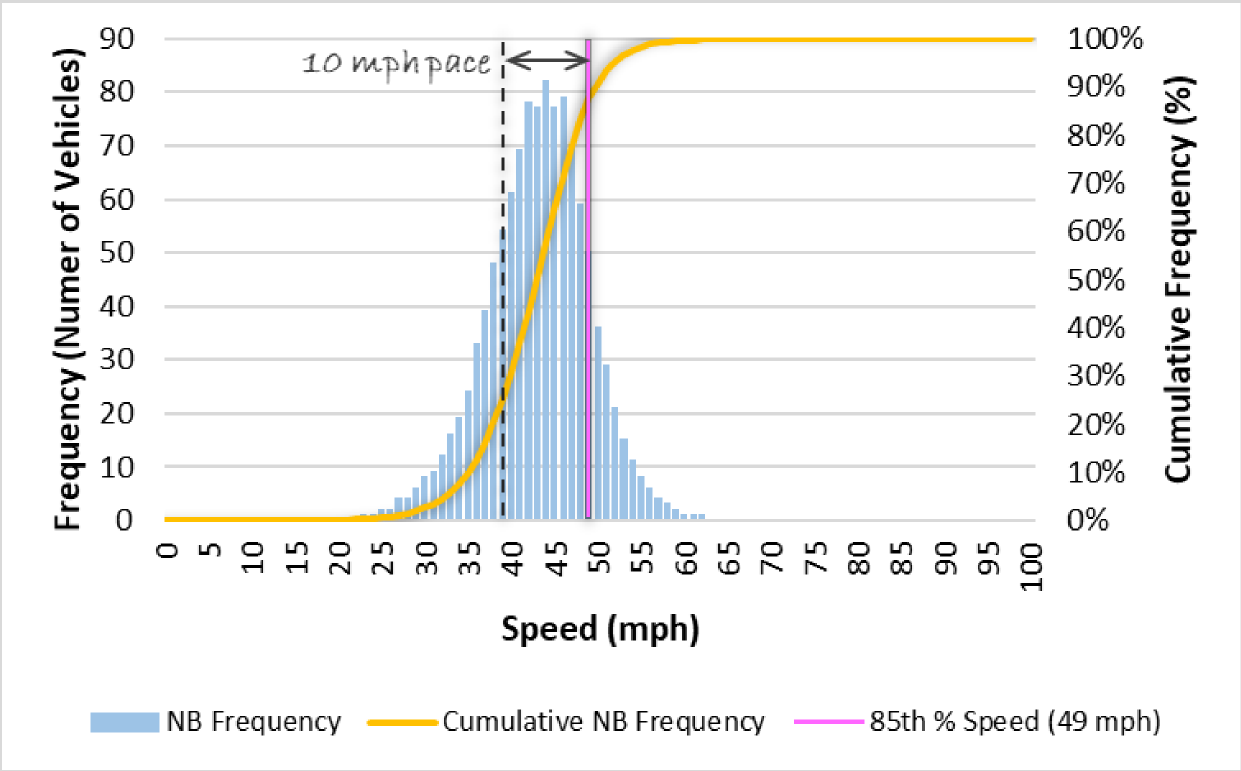

Figure 25: Speeds on Northbound (NB) Alyeska Highway

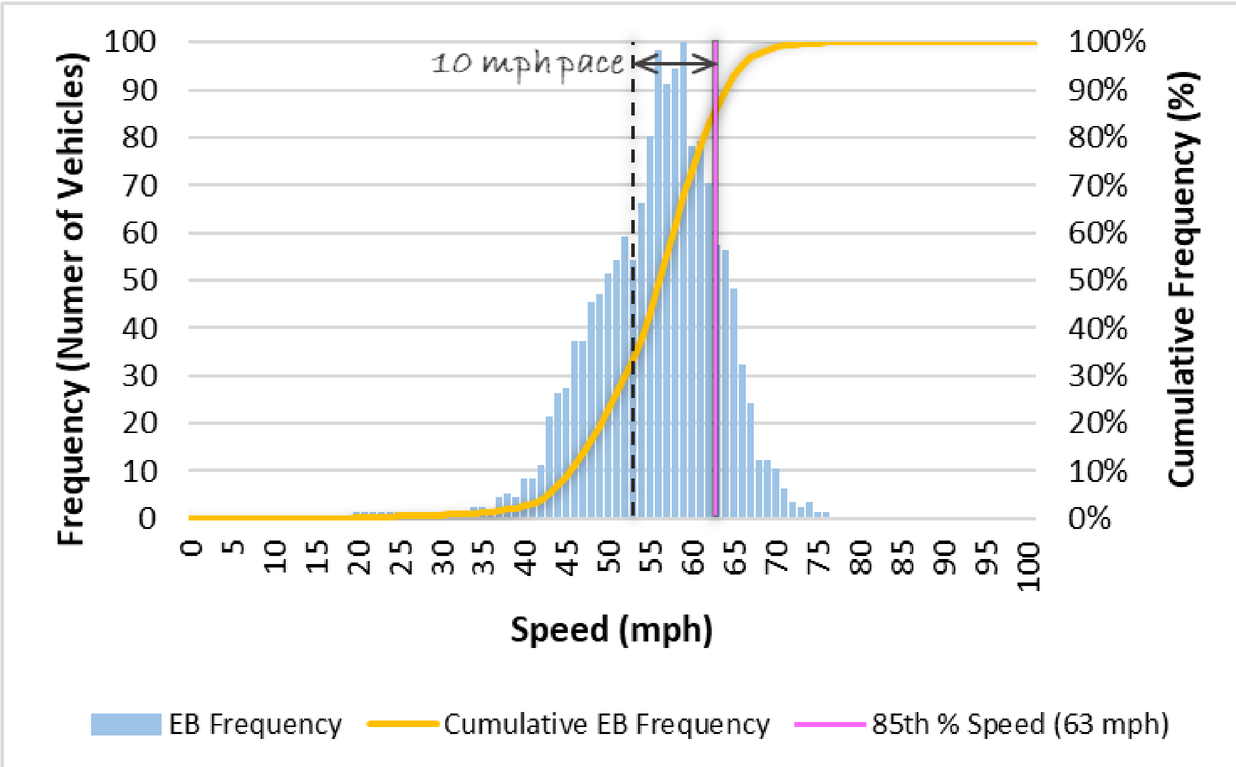

Figure 26: Speeds on Eastbound (EB) Seward Highway

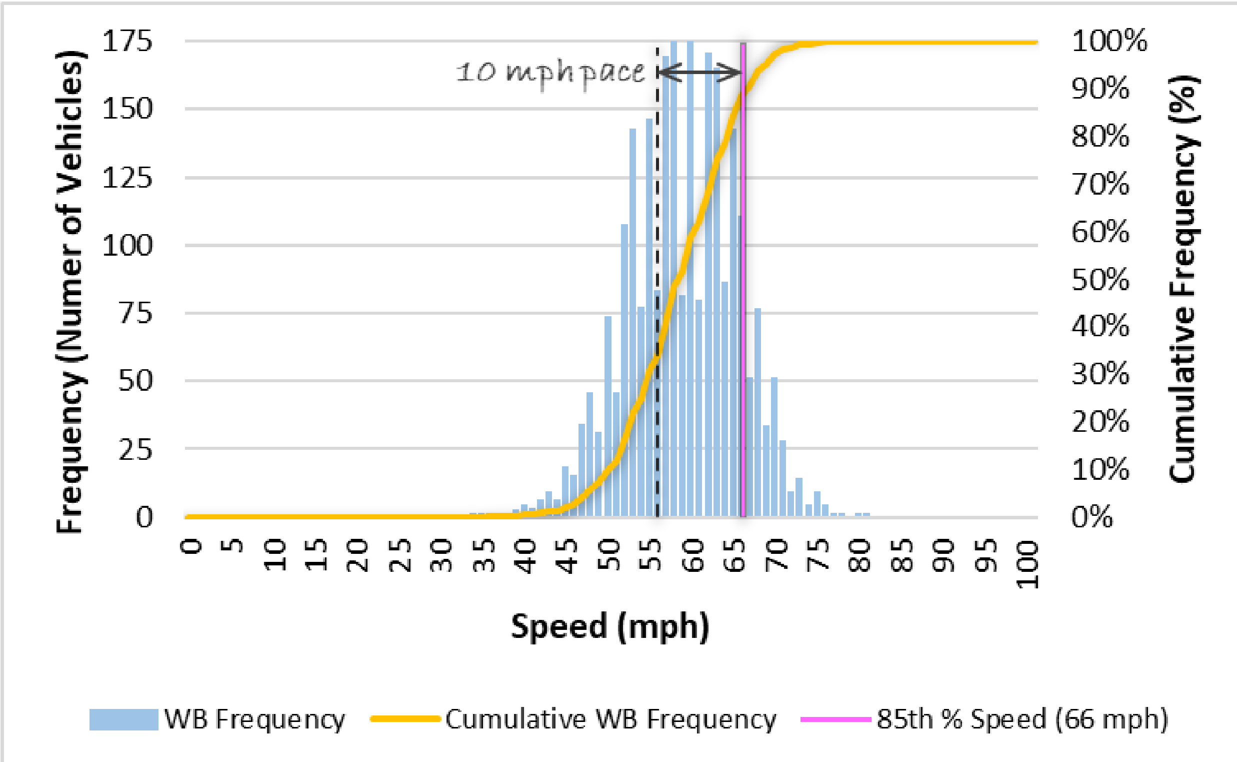

Figure 27: Speeds on Westbound (WB) Seward Highway, Both Lanes Combined

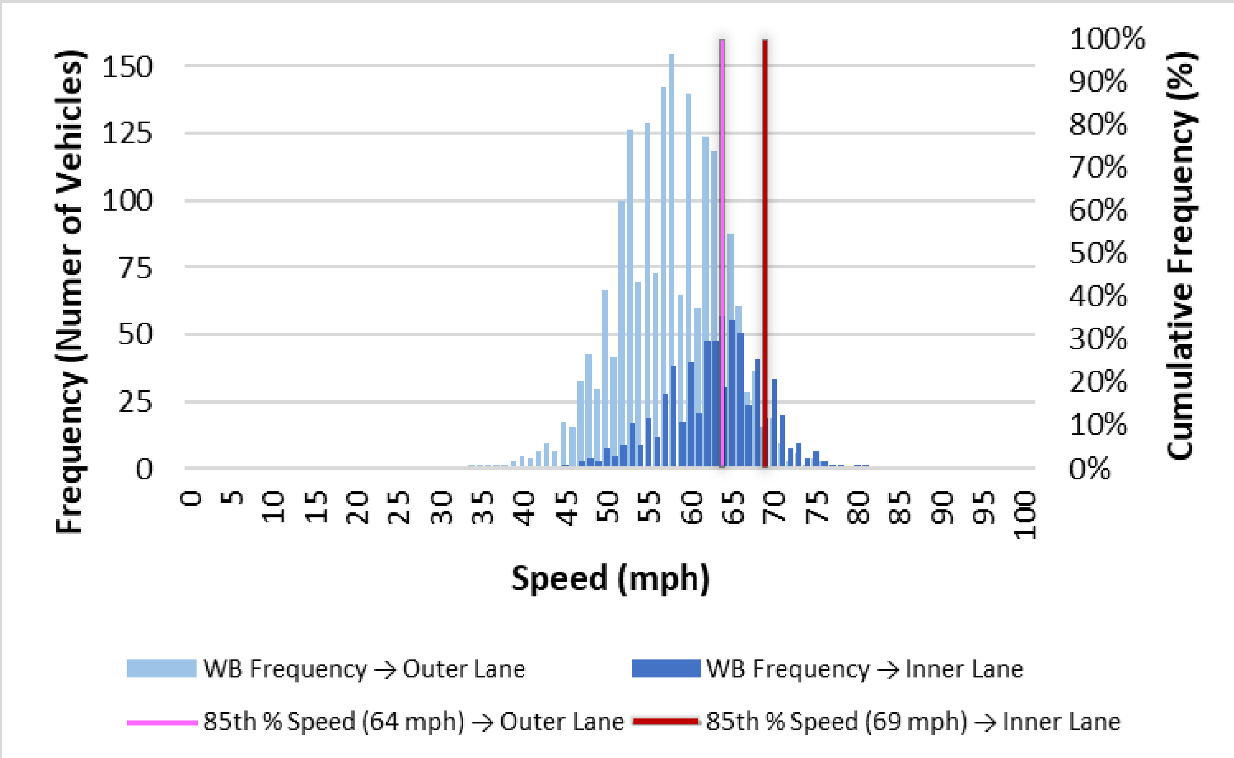

Figure 28: Speeds on Westbound (WB) Seward Highway, by Lane

4.4 Pedestrians and Bicyclists

4.4.1 Pedestrian and Bicyclist Counts

Pedestrian and bicyclist counts were performed simultaneously with turning movement counts in the study area in September and October 2020. No pedestrians were observed during counts at any of the five intersection count locations. However, anecdotal evidence suggests that when the Girdwood Station Mall and Tesoro parking is full, truck drivers park on the south shoulder of the eastbound Seward Highway lanes and cross the study intersection on foot to access the available amenities.

Two bicyclists were observed during weekend counts on August 22, 2020 traveling westbound on the Seward Highway, turning into the Girdwood Station Mall, and then returning eastbound on the Seward Highway, as shown in Figure 29.

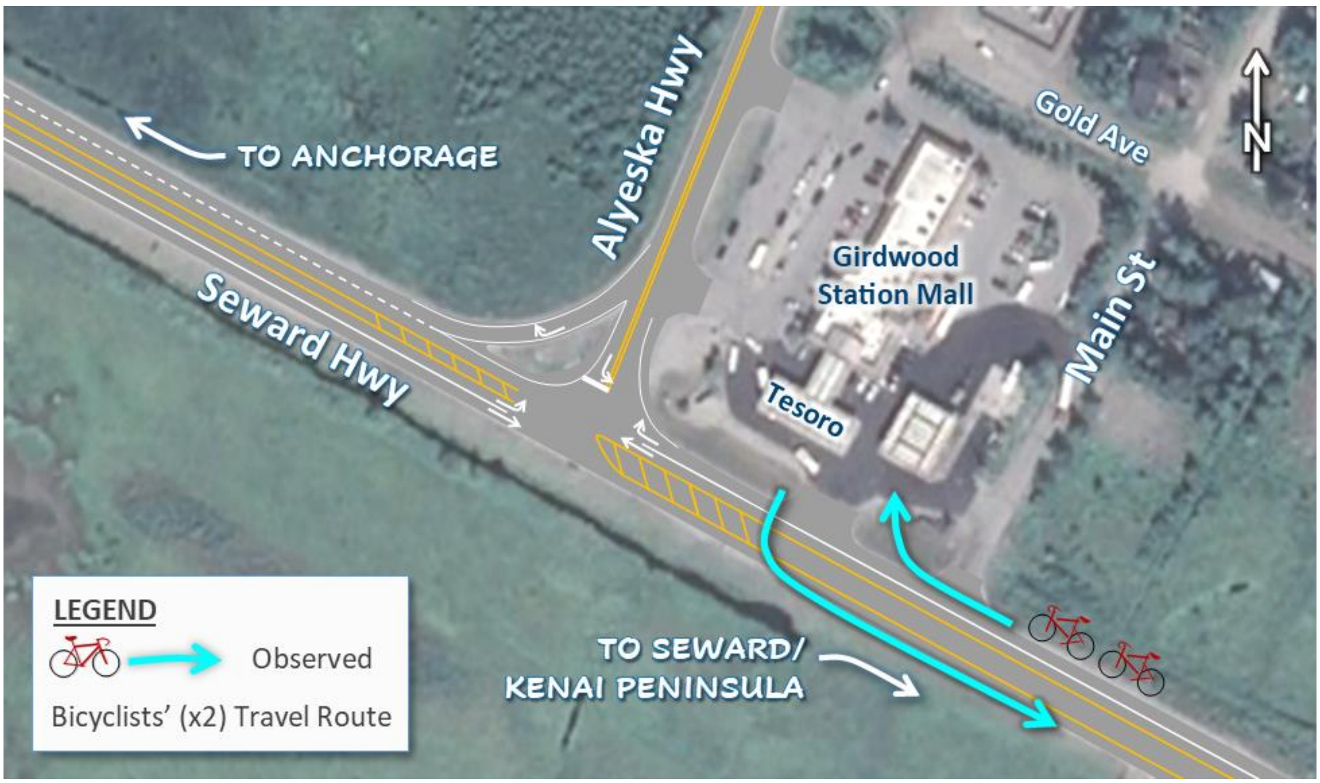

Figure 29: Observed Bicyclists in Study Area

4.4.2 Pedestrian and Bicyclist Crossing Analyses

Pedestrian delay for intersections within the study area was determined using the HCM 2010 methodology. The HCM 2010 methodology to determine LOS for pedestrians crossing at unsignalized intersections (two-way stop controlled) is determined solely based on the length of delay a pedestrian is expected to experience at the crossing and for the most part is unaffected by the number of pedestrians crossing. Table 20, modified from HCM 2010, summarizes the relationship between pedestrian delay and the amount of risk a pedestrian is willing to take to cross a roadway after a given amount of delay.

Table 20. Pedestrian Delay – Unsignalized Intersections

Control Delay (sec/pedestrian)	Comments
0-5	Usually no conflicting traffic
5-10	Occasionally some delay due to conflicting traffic
10-20	Delay noticeable to pedestrians, but not inconveniencing
20-30	Delay noticeable and irritating, increased likelihood of risk taking
30-45	Delay approaches tolerance level, risk-taking behavior likely
>45	Delay exceeds tolerance level, high likelihood of pedestrian risk taking

HCM 2010 describes the average time pedestrians must wait before crossing, or the average pedestrian gap delay, as a function of critical headway and vehicular flow rate. Critical headway is the minimum time needed between conflicting vehicles for a pedestrian to comfortably cross the street. When the gap between vehicles is below the critical headway, a pedestrian crossing opportunity is not available. Pedestrian delay is also affected by the rate at which vehicular traffic yields to pedestrians. For the analysis of uncontrolled crossings, the yield rate was assumed to be zero, meaning cars do not yield to pedestrians. For the stop-controlled approach, pedestrians are assumed to experience no delay, as all vehicles are required to yield to pedestrians.

Table 21 and Table 22 present pedestrian crossing delay at the study intersection during the PM (weekday) and weekend peaks, respectively. During summer traffic peak hours, a pedestrian wishing to cross the Seward Highway at Alyeska Highway would experience significant delay (up to 4.5 minutes) and would be extremely likely to take risks when crossing.

Table 21. Pedestrian Delay at Seward Hwy with Alyeska Hwy – PM Peak Hour

Intersection	Crossing Location	Average Delay (sec)	Likelihood of Risk-Taking Behavior
Average Volume over Year	Northbound (East Leg)	24	Increased likelihood
	Westbound (North Leg)	-	*No delay, stop controlled*
	Southbound (West Leg)	21	Increased likelihood
Summer High Volume Case	Northbound (East Leg)	70	Very High
	Westbound (North Leg)	-	*No delay, stop controlled*
	Southbound (West Leg)	64	Very High
Winter Resort Volume Case	Northbound (East Leg)	18	Low likelihood
	Westbound (North Leg)	-	*No delay, stop controlled*
	Southbound (West Leg)	18	Low likelihood

Table 22. Pedestrian Delay at Seward Hwy with Alyeska Hwy – Weekend Peak Hour

Intersection	Crossing Location	Average Delay (sec)	Likelihood of Risk-Taking Behavior
Average Volume over Year	Northbound (East Leg)	59	Very High
	Westbound (North Leg)	-	*No delay, stop controlled*
	Southbound (West Leg)	36	High
Summer High Volume Case	Northbound (East Leg)	271	Very High
	Westbound (North Leg)	-	*No delay, stop controlled*
	Southbound (West Leg)	145	Very High
Winter Low Volume Case	Northbound (East Leg)	29	Increased likelihood
	Westbound (North Leg)	-	*No delay, stop controlled*
	Southbound (West Leg)	32	High

The HCM 2010 has no specific methodology developed to analyze the performance of bicyclists at TWSC intersections. It is assumed that bicyclists wishing to cross the Seward Highway at the Alyeska Highway would cross as pedestrians.

5 Future Operations

5.1 Projected Traffic

5.1.1 Projected AADT

As presented in the 2020 KE *Alyeska Seward Assumptions Memo*, the base annual traffic volume growth rate for this project is 0.5%. Design year (2045) volumes were projected from the 2020 base year AADTs shown in Section 4.1 using the 0.5% annual growth rate. Table 23 compares 2020 base year AADTs with projected 2045 design year AADTs.

Table 23. Average Annual Daily Traffic, 2020 and 2045

Segment Name	Extents (Mileposts)	2020	2045
Seward Highway	Whittier Ferry Train Stop to Alyeska Hwy (MP 79.6 – 89.3)	4,870	5,515
Seward Highway	Alyeska Hwy to Sawmill Rd (MP 89.3 – 100.0)	7,130	8,075
Alyeska Highway	Seward Highway to Crow Creek Road (MP 0.0 – 2.0)	2,860	3,235

5.1.2 2045 Turning Movement Volumes

Future intersection TMVs were calculated based on AADT projections for the approach roads, existing turning movement proportions, and estimated design hour volume percentages (DHVs). KE's 2020 *Alyeska Seward Assumptions Memo* details how DHVs used in analysis were derived from AADTs, monthly average daily traffic, average hourly volume data, and 2020 volume counts. Table 24 shows the percentages that were used for each peak hour period and volume case.

Table 24. Design Hour Percentages for 2045 Volume Calculations

Time Period	PM Peak Hour (Weekday)	Weekend Peak Hour
Design Hour	10%	13%
Summer (Jun to Aug)	18%	23%
Winter (Dec to Jan)	6%	7%

Figure 30 through Figure 35 depict 2045 TMVs for peak hours under base conditions, for the summer high volume case, and for the winter resort traffic case.

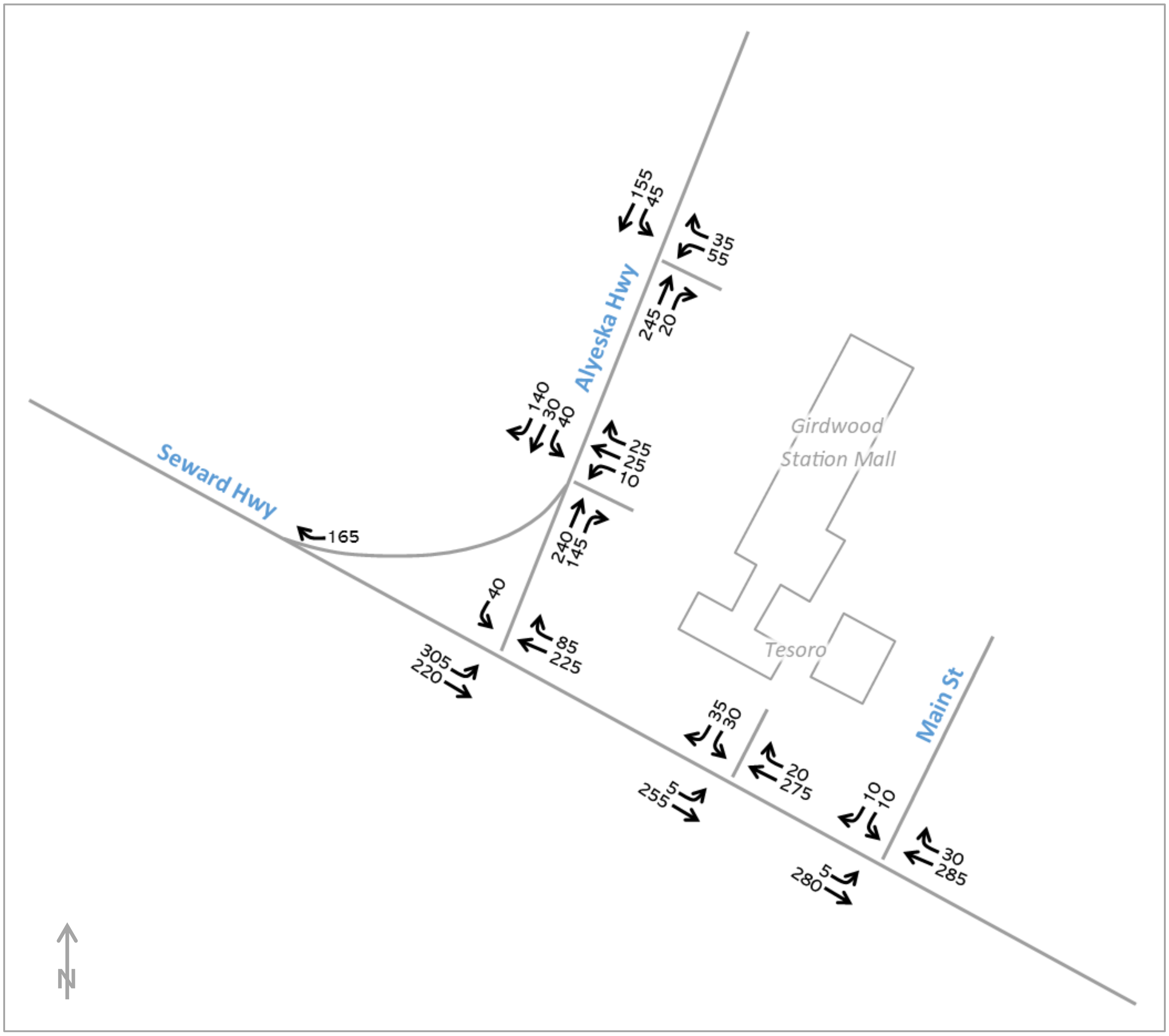

Figure 30: 2045 PM Turning Movement Counts

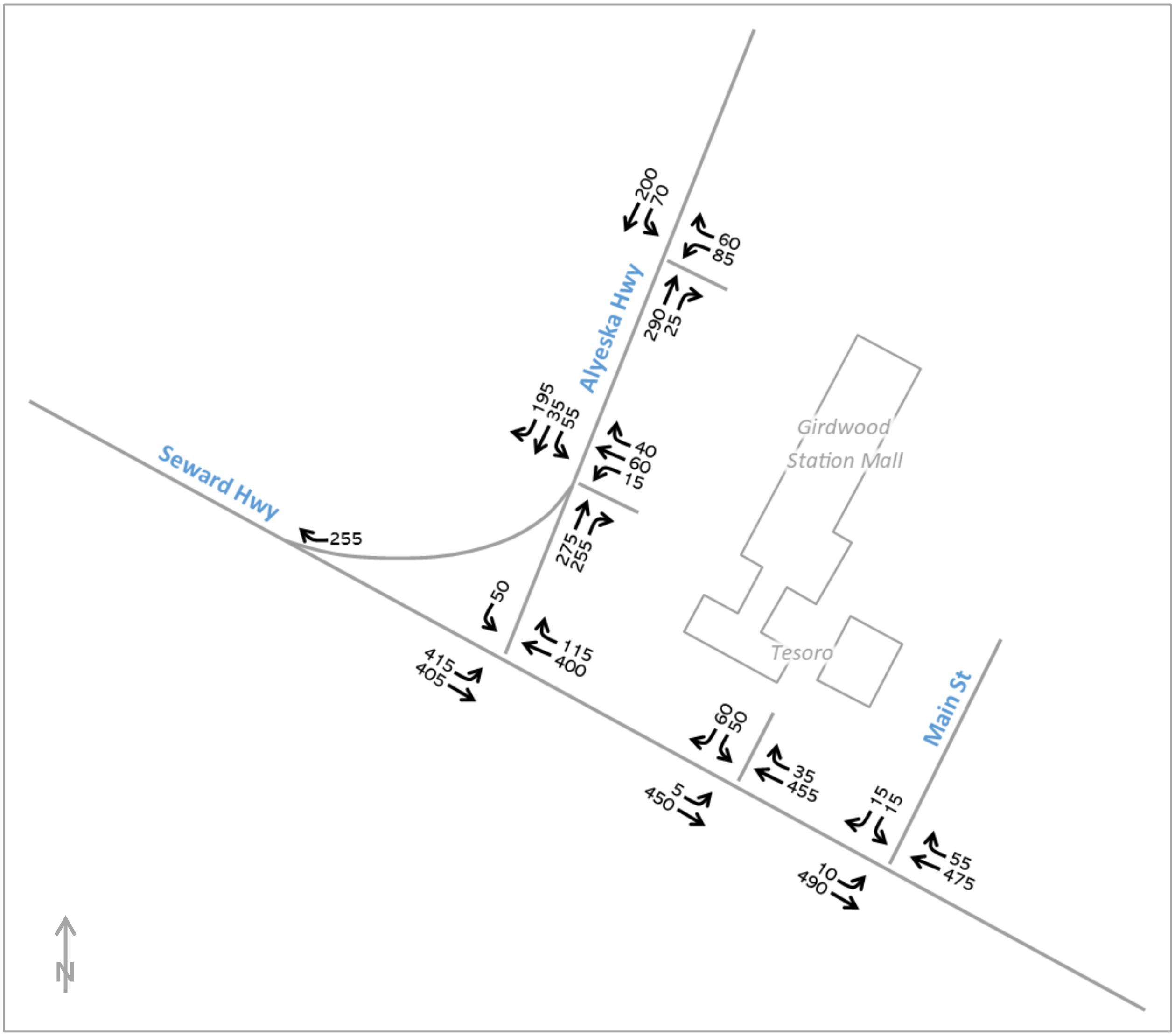

Figure 31: 2045 PM Turning Movement Volumes – Summer

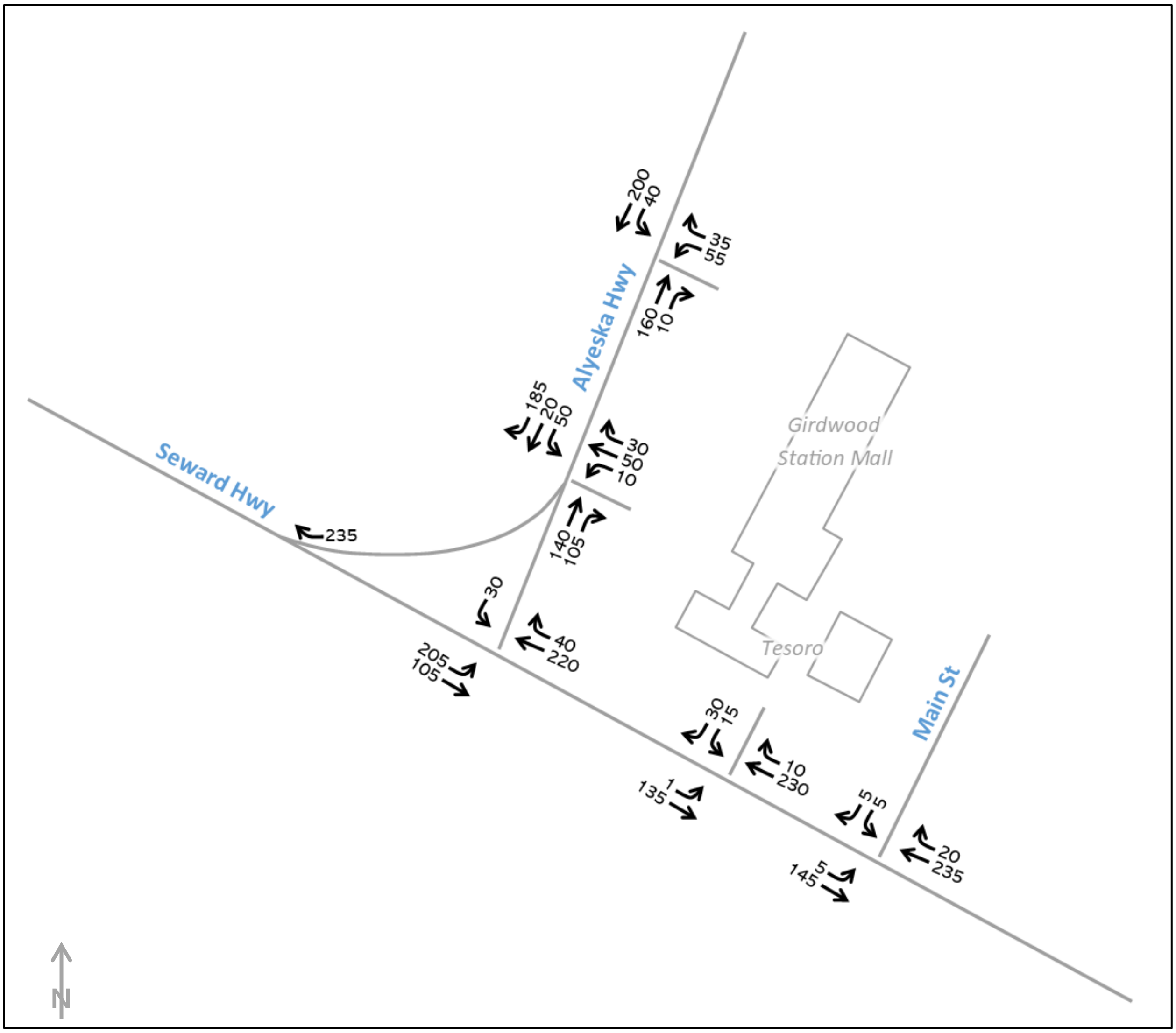

Figure 32: 2045 PM Turning Movement Volumes - Winter

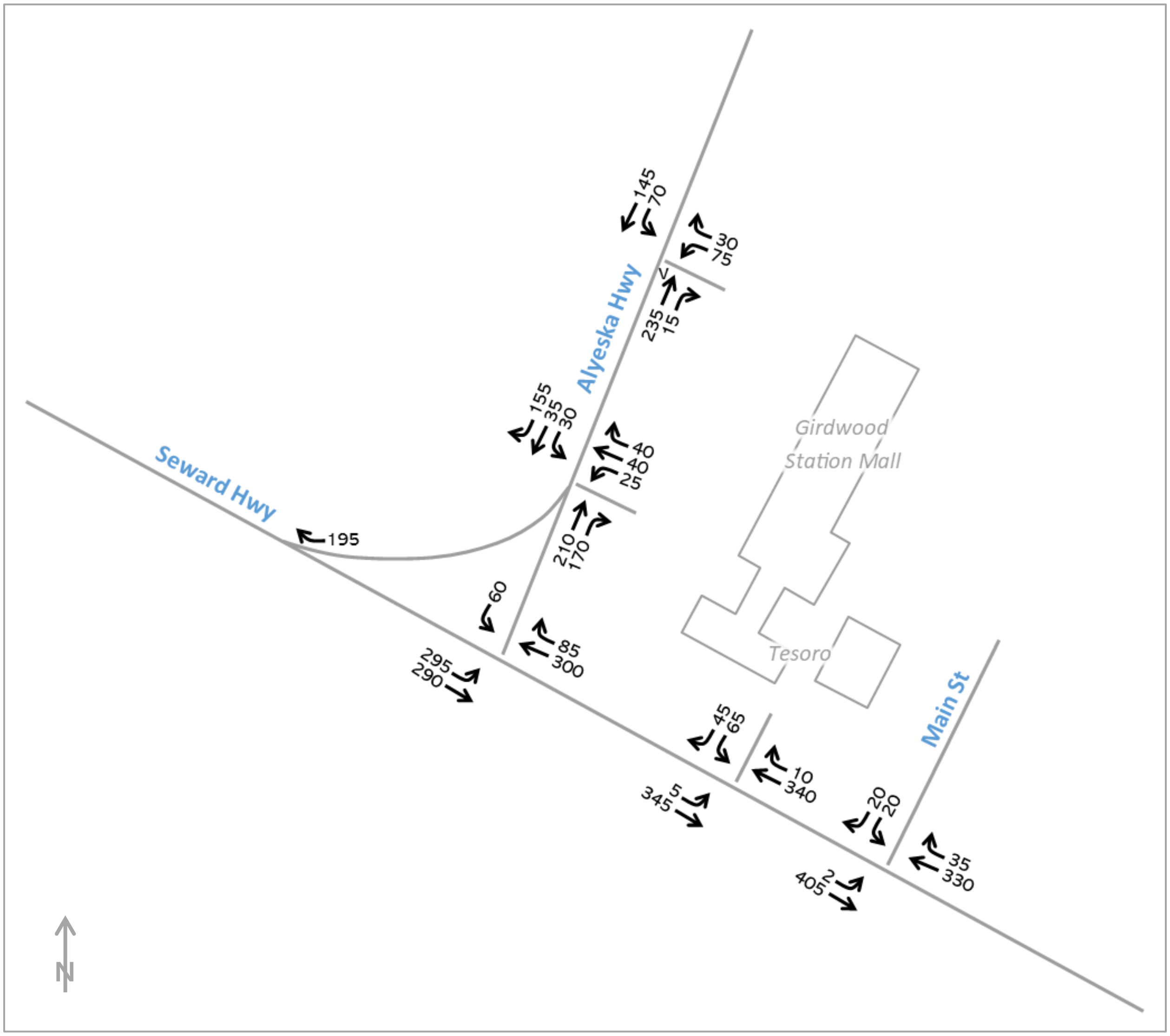

Figure 33: 2045 Weekend Turning Movement Counts

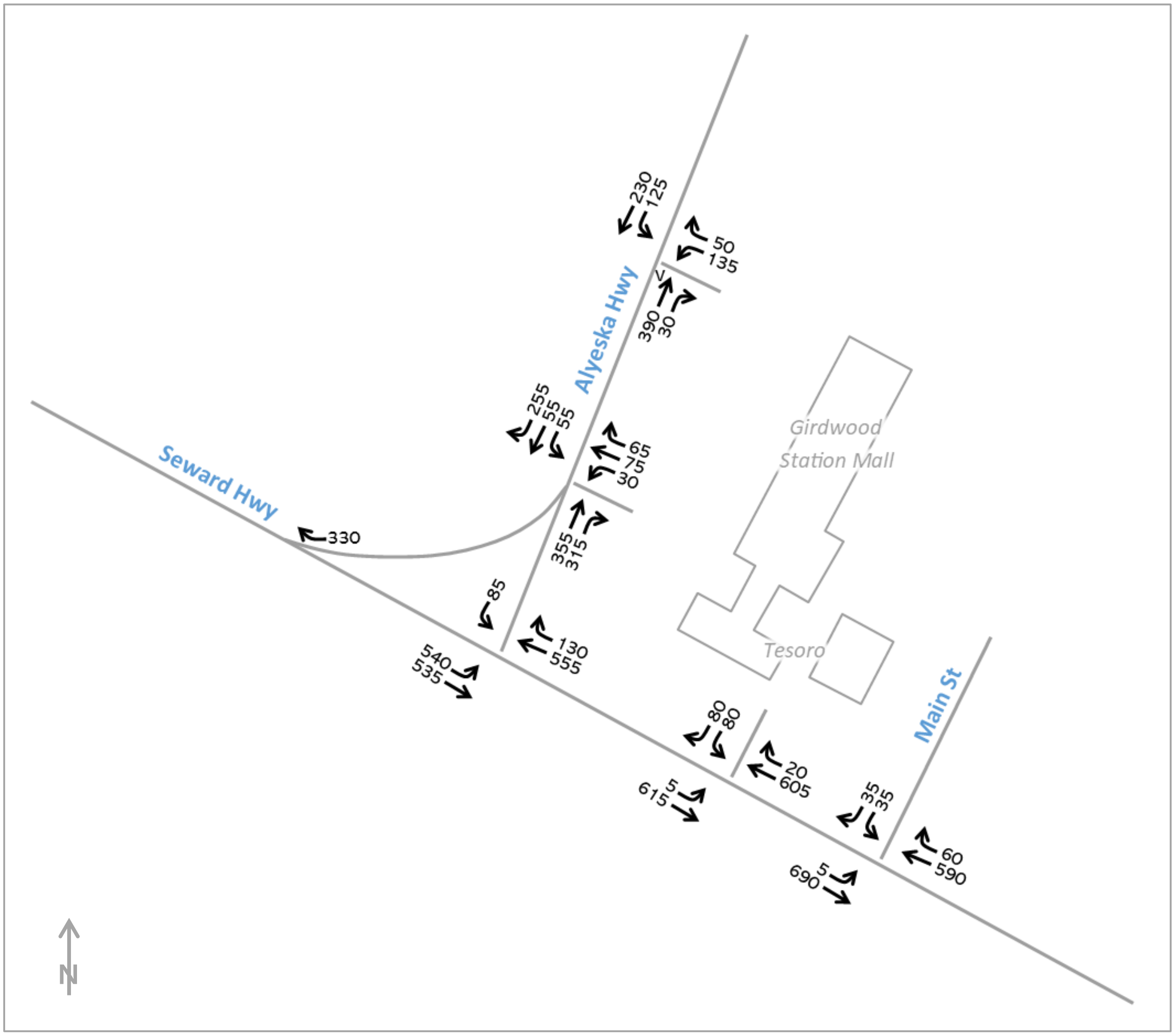

Figure 34: 2045 Weekend Turning Movement Counts – Summer

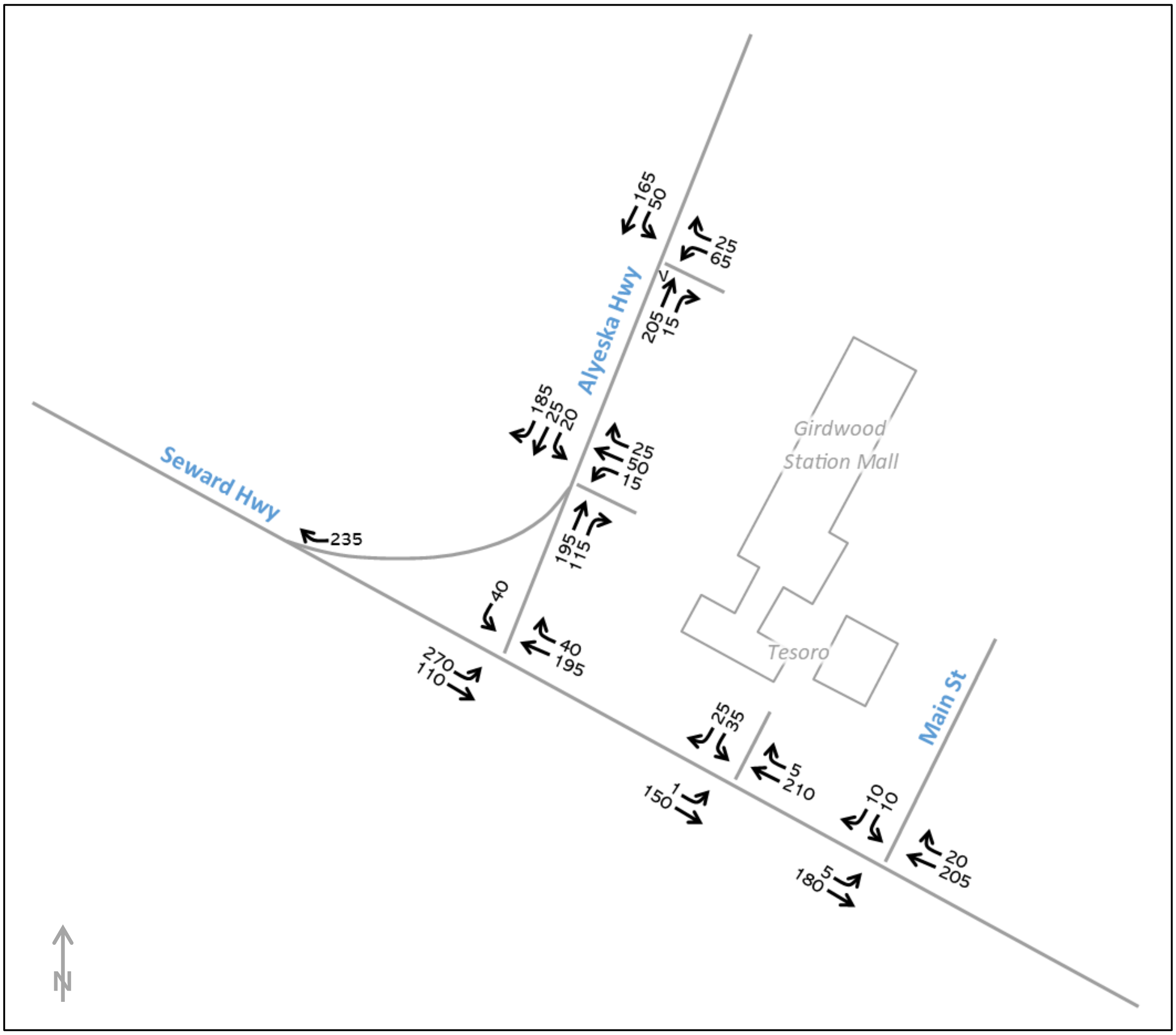

Figure 35: 2045 Weekend Turning Movement Counts - Winter

5.2 Future Intersection Capacity

To determine the future intersection capacity for critical peak hours under the no build condition, the intersection was analyzed using future volumes with existing PHFs and HV%. The analysis was conducted using HCM methodologies in Synchro. Results are shown in Table 25 through Table 27

Table 25. 2045 Intersection LOS at Seward Highway with Alyeska Highway

Approach	Movement	PM Peak (Weekday)				Weekend Peak			
		V/C Ratio	95th Percentile Queue (ft)	Delay (sec)	LOS	V/C Ratio	95th Percentile Queue (ft)	Delay (sec)	LOS
Eastbound (Seward)	Left	0.31	50	9.4	A	0.31	50	9.7	A
	Through	-	-	-	-	-	-	-	-
Westbound (Seward)	Through	-	-	-	-	-	-	-	-
	Right	-	-	-	-	-	-	-	-
Southbound (Alyeska)	Left	0.37	50	48.9	E	0.62	100	80.0	F
	Right	-	-	Free	-	-	-	Free	-
Intersection		n/a		**4.6**	**A**	n/a		**6.3**	**A**

Table 26. 2045 Intersection LOS at Seward Highway with Alyeska Highway – Summer

Approach	Movement	PM Peak (Weekday)				Weekend Peak			
		V/C Ratio	95th Percentile Queue (ft)	Delay (sec)	LOS	V/C Ratio	95th Percentile Queue (ft)	Delay (sec)	LOS
Eastbound (Seward)	Left	0.52	100	13.0	B	0.77	200	22.4	C
	Through	-	-	-	-	-	-	-	-
Westbound (Seward)	Through	-	-	-	-	-	-	-	-
	Right	-	-	-	-	-	-	-	-
Southbound (Alyeska)	Left	1.8	175	>500	F	12.2	350	>1,000	F
	Right	-	-	Free	-	-	-	Free	-
Intersection		n/a		**22.9**	**C**	n/a		**>250**	**F**

Table 27. 2045 Intersection LOS at Seward Highway with Alyeska Highway – Winter

Approach	Movement	PM Peak (Weekday)				Weekend Peak			
		V/C Ratio	95th Percentile Queue (ft)	Delay (sec)	LOS	V/C Ratio	95th Percentile Queue (ft)	Delay (sec)	LOS
Eastbound (Seward)	Left	0.20	<25	8.7	A	0.26	50	8.9	A
	Through	-	-	-	-	-	-	-	-
Westbound (Seward)	Through	-	-	-	-	-	-	-	-
	Right	-	-	-	-	-	-	-	-
Southbound (Alyeska)	Left	0.14	<25	21.8	C	0.24	<25	29.3	D
	Right	-	-	Free	-	-	-	Free	-
Intersection		n/a		**2.9**	**A**	n/a		**4.0**	**A**

Under 2045 base design hour volumes, the intersection operates at LOS A, similar to existing conditions. However, delay for southbound left turning vehicles (40 vehicles per hour) deteriorates from LOS C to LOS E during the PM peak; delay for southbound left turning vehicles (60 vehicles per hour) worsens from LOS C to LOS F during the weekend peak. All movements at the Main Street intersection and at the driveways in the study area experience LOS D or better.

Under the 2045 summer volume case, the intersection LOS drops to LOS C during the PM peak, due to over 500 seconds (8 minutes) of delay experienced by 50 southbound left turning vehicles per hour. During the 2045 summer weekend peak, the intersection operates at LOS F, as 85 southbound left turning vehicles per hour experience over 1,000 seconds (16 minutes) of delay. Not shown in the tables, vehicles wishing to make a southbound left onto the Seward Highway from the Tesoro Station Mall and from Main Street during the 2045 summer weekend peak also experience delays ranging from 0.5 to 1.5 minutes.

Under the 2045 winter volume case, the intersection operates at LOS A, with all movements experiencing LOS of D or better. All movements at the Main Street intersection and at the driveways in the study area experience LOS B or better.

5.3 Future Pedestrian Crossing Analysis

Future pedestrian delay for intersections within the study area was estimated using the HCM 2010 methodology.

Table 28 and Table 29 present pedestrian crossing delay for each analyzed unsignalized crossing location at the 2045 PM and weekend peak periods, respectively. Only the uncontrolled crossings are analyzed. For stop-controlled approaches, pedestrians are assumed to experience no delay, as all vehicles are required to yield to pedestrians.

Under future design hour volumes and summer volumes, a pedestrian would experience a minimum of one minute of delay when wishing to cross the Seward Highway and would be very likely to take risks when crossing.

Table 28. 2045 Pedestrian Delay at Seward Hwy with Alyeska Hwy – PM Peak Hour

Intersection	Crossing Location	Average Delay (sec)	Likelihood of Risk-Taking Behavior
Average Volume over Year	Northbound (East Leg)	>100	High likelihood
	Westbound (North Leg)	-	*No delay, stop controlled*
	Southbound (West Leg)	>60	High likelihood
Summer High Volume Case	Northbound (East Leg)	>500	Very High
	Westbound (North Leg)	-	*No delay, stop controlled*
	Southbound (West Leg)	>100	Very High
Winter Resort Volume Case	Northbound (East Leg)	47	Very High
	Westbound (North Leg)	-	*No delay, stop controlled*
	Southbound (West Leg)	36	High

Table 29. 2045 Pedestrian Delay at Seward Hwy with Alyeska Hwy – Weekend Peak Hour

Intersection	Crossing Location	Average Delay (sec)	Likelihood of Risk-Taking Behavior
Average Volume over Year	Northbound (East Leg)	>200	Very High
	Westbound (North Leg)	-	*No delay, stop controlled*
	Southbound (West Leg)	>100	Very High
Summer High Volume Case	Northbound (East Leg)	>1,000	Very High
	Westbound (North Leg)	-	*No delay, stop controlled*
	Southbound (West Leg)	>1,000	Very High
Winter Resort Volume Case	Northbound (East Leg)	45	Very High
	Westbound (North Leg)	-	*No delay, stop controlled*
	Southbound (West Leg)	42	Very High

6 MUTCD Signal Warrant Analysis

Per the Manual on Uniform Traffic Control Devices (MUTCD), an engineering study of traffic conditions, pedestrian characteristics, and physical characteristics is needed to determine whether installation of a signal at the intersection is justified.

The MUTCD signal warrant analysis uses existing and future traffic conditions at the intersection and compares them with the historical performance for similar intersections in the state to determine whether the location is a favorable candidate for a traffic signal. The warrants include:

- Warrant 1 – 8-Hour Vehicular Volume
- 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 – Intersection Near a Grade Crossing

A signal should be considered only if one or more of the warrants are satisfied. However, satisfying a warrant does not necessarily mean that a signal should be installed. Other factors should be examined as part of an engineering study to determine if a signal will improve the overall safety and/or operation of the intersection. The MUTCD recommends that other treatments or strategies be evaluated and, if feasible, be deployed before signalization.

The study intersection does not meet the criteria for Warrants 3 through 7 and 9. These are not evaluated further. Warrants 1, 2, and 8 are discussed in the following sections.

6.1 Warrants 1 and 2, 8-hour and 4-hour Vehicular Volume

These warrants compare the major road and minor road hourly volumes to thresholds (based on national data) to estimate whether the typical delay experienced by users of the intersection would be decreased by signalizing the intersection cost effectively. Warrant 1 and 2 can be evaluated for the existing condition using actual hourly turning movement volumes; Warrant 1 can also be evaluated for the future condition using projected AADTs.

The warrants were examined for two movement combinations:

1. Southbound approach as “minor road” and combined eastbound and westbound approaches as “major road”
2. Eastbound left turn as “minor road” and westbound approach as “major road”

Table 30 shows that the warrant thresholds were not met for either condition using the existing average daily volumes, adjusted for the traffic volume reduction caused by the pandemic.

Table 30. Evaluation of Warrants 1 and 2 for Weekday Hourly Volumes (2020 adjusted)

Warrant	Minor Road: Southbound Major Road: Combined Eastbound and Westbound	Minor Road: Eastbound Left Major Road: Westbound
Warrant 1 A	Minor Road Threshold: Not Met Major Road Threshold: Met	Minor Road Threshold: Met Major Road Threshold: Not Met
Warrant 1 B	Minor Road Threshold: Not Met Major Road Threshold: Met	Minor Road Threshold: Met Major Road Threshold: Not Met
Warrant 1, Combination A & B	Minor Road Threshold: Not Met Major Road Threshold: Met	Minor Road Threshold: Met Major Road Threshold: Not Met
Warrant 2	Not Met	Not Met

Using 2045 AADTs to evaluate Warrant 1, the warrant is not met for either movement combination; however, Warrant 1 is met for some months of the year, using seasonally adjusted 2045 MADTs, as shown in Table 31.

Table 31. Evaluation of Warrant 1 Using Seasonally Adjusted AADT (2045)

Month	Minor Road: Southbound Major Road: Combined Eastbound and Westbound	Minor Road: Eastbound Left Major Road: Westbound
January	Not Met	Not Met
February	Not Met	Not Met
March	Not Met	Not Met
April	Not Met	Not Met
May	Not Met	Not Met
June	Met	Not Met
July	Met	Not Met
August	Met	Not Met
September	Not Met	Not Met
October	Not Met	Not Met
November	Not Met	Not Met
December	Not Met	Not Met

6.2 Warrant 8, Roadway Network

This warrant considers whether a signal may be justified in order to encourage concentration and organization of traffic flow. This warrant can only be considered for the intersection of two or more "major routes." The Seward Highway and the Alyeska Highway can both be considered "major routes" because they are both "part of the street or highway system that serves as the principal roadway network for through traffic flow."

There are two threshold criteria for this warrant, only one of which must be met:

A. On a typical weekday, there are existing entering volumes of at least 1,000 vehicles per hour in the peak hour and any of Warrants 1 through 3 are projected to be met within 5 years using project volumes.
B. On a non-normal business day (Saturday or Sunday), there are 1,000 entering vehicles per hour for any 5 hours.

Based on KE's turning movement volume forecasts, Warrants 1 through 3 are not projected to be met within 5 years. Thus, the intersection of Seward Highway and Alyeska Highway does not meet part A of this warrant.

However, evidence suggests that part B of this warrant may be met, at least seasonally. KE compared weekend turning movement counts collected on August 29, 2020 and on December 26, 2020 with monthly AADT percentages and average hourly weekend AADT percentages at the Potter Marsh CCS that were provided by DOT&PF and used them to develop hourly average weekend volumes by month. Based on this analysis, it is likely that weekend traffic meets or exceeds 1,000 entering vehicles per hour for at least 5 hours of an average weekend in the months of May through September, as shown in Table 32.

Table 32. Estimated Weekend Hourly Entering Volumes by Month and Time of Day (2020 adjusted)

Time	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
00:00	80	83	101	113	168	247	291	229	160	107	83	81
01:00	49	51	62	69	103	151	178	140	98	65	51	49
02:00	33	34	42	47	69	102	120	95	66	44	34	33
03:00	31	32	39	44	65	95	112	88	62	41	32	31
04:00	33	34	42	47	70	102	120	95	66	44	34	33
05:00	53	55	67	75	111	164	193	152	106	71	55	54
06:00	85	88	107	120	177	261	307	242	169	113	87	85
07:00	143	148	180	202	299	440	518	409	285	191	148	144
08:00	243	251	305	342	508	747	878	693	484	324	250	244
09:00	377	390	474	532	788	1160	1364	1077	751	503	389	379
10:00	546	565	686	770	1142	1680	1976	1560	1088	728	563	**550**
11:00	545	563	684	768	1139	1676	1971	1555	1085	726	561	548
12:00	546	564	686	770	1142	1679	1975	1559	1087	728	563	**549**
13:00	622	642	781	876	1299	1911	2248	1774	1237	829	640	625
14:00	644	666	809	908	1346	1980	2329	1838	1282	858	663	648
15:00	626	647	786	882	1308	1924	2264	1786	1246	834	645	**629**
16:00	637	658	800	898	1332	1959	2304	1818	1268	849	656	**641**
17:00	553	572	695	780	1156	1701	2001	1579	1101	737	570	**556**
18:00	522	540	656	736	1092	1606	1889	1491	1040	696	538	525
19:00	442	457	555	623	924	1360	1599	1262	880	589	456	445
20:00	351	363	441	495	734	1079	1269	1002	699	468	362	353
21:00	271	280	341	382	567	834	981	774	540	362	279	273
22:00	187	194	235	264	391	576	677	534	373	250	193	188
23:00	123	127	155	174	258	379	446	352	245	164	127	124

Note: Hourly volumes above 1,000 vehicles per hour are highlighted in yellow.

6.3 Overall Evaluation of Signal Warrants

No signal warrants are met for this intersection using volumes that represent the average over the year. Using existing volumes (2020, adjusted for the reduction in volumes due to the pandemic), the weekend volume threshold for Warrant 8 appears to be met for the months of May through September. Using 2045 volumes, Warrant 1 is met for the months of June, July, and August.

Public comments and the LOS analysis support the conclusion that signalizing the intersection could be beneficial (reduce overall delay and improve safety) during the summer months. As such, signalized options should be considered in the analysis of alternatives. However, it should be noted that signalization would likely add delay to long-distance travel along Seward Highway, which is undesirable; therefore, the analysis should consider delay to the Seward Highway as a separate measure from overall intersection delay.

7 Summary of Identified Concerns

This Existing Conditions Report has identified three main concerns for the intersection:

- The Girdwood Station Mall in the northeast corner of the study intersection generates a significant number of pass-by trips. While direct access from the Seward Highway (an arterial) to the mall and nearby residences should be restricted, both a driveway intersection and a side street intersection are located within 400’ of the Alyeska Highway.
- Angle crashes between southbound left turn vehicles from the Alyeska Highway and westbound through vehicles on the Seward Highway are a concern (5 of 12 crashes in the last 10 years). Contributing factors to this type of crash are westbound right turn vehicles and large vehicles parked along the Seward Highway blocking the sight lines for the southbound left turning driver and the westbound driver continuing through the intersection.
- Traffic volumes have significant seasonal variation in the study area, with summer daily volumes approximately twice the annual average daily traffic (AADT) and winter volumes approximately half the AADT. The peak traffic volume hours are on the weekends. Southbound left turn drivers from the Alyeska Highway experience very poor level of service (LOS) during the weekend peak period in the summer (LOS F with over a minute and a half of delay per vehicle). Drivers experience less delay if they turn from the Girdwood Station Mall driveway or from Main Street directly onto the Seward Highway (because there are fewer eastbound left turn movements at these intersections). This contributes to the friction that through traffic on Seward Highway experiences in this area.

In addition to these concerns that are specific to the study intersection, the project should address general goals for the Seward Highway, including:

- Maintain a reasonable day’s drive between control cities for the Seward Highway (Homer, Seward, and Anchorage). Note that Girdwood is designated as an intermediate destination for the Seward Highway.
- Support freight mobility for trucks and rail carrying goods throughout Alaska.

8 References

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- *A Policy on Geometric Design of Streets and Highways*, AASHTO, 2011.
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