Glenn Highway: Airport Heights to Parks Highway Rehabilitation

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Ramp Traffic and Safety Analysis Report

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DOT&PF

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Abbreviations

AADT	Annual Average Daily Traffic
CMF	Crash modification factor
DHV	Design Hourly Volume
DOT&PF	Alaska Department of Transportation and Public Facilities
HCM	Highway Capacity Manual
HCS	Highway Capacity Software
HSIP	Highway Safety Improvement Program
IB/C	Incremental benefit-cost ratio
ICM	Integrated Corridor Management
JBER	Joint Base Elmendorf-Richardson
KE	Kinney Engineering
L_A	Acceleration lane length (merge area, measured from nose of painted gore to end of taper)
L_a	Ramp length (measured from slowest point on ramp to start of taper)
LOS	Level of Service
MOA	Municipality of Anchorage
mph	Miles per Hour
M&O	Maintenance and Operations
NPV	Net present value
pc/mi/ln	Passenger Cars per Mile per Lane
PDO	Property Damage Only
PGDHS	A Policy on Geometric Design of Highways and Streets 2011
ROW	Right of Way
vph	Vehicles per Hour

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 sustainable hourly flow rate, considering prevailing roadway, environmental, traffic, and control conditions.

Crash Modification Factor (CMF): Factor used to estimate the effect of a safety treatment. Crashes for the condition without the safety treatment are multiplied by the crash modification factor to estimate the number of crashes expected if the treatment is applied. CMFs are determined using a statistical analysis of sites with and without the treatment.

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 upper control limit for that location, the crash rate is above the average crash rate for similar facilities to a statistically significant level.

Demand: The volume of vehicles desiring to use a facility during a specified period of time, usually measured in vehicles per hour. Under most circumstances, the demand volume is equivalent to the actual volume of vehicles using the facility; however, if the demand volume is greater than the capacity of the facility, the actual volume of vehicles using the facility will be less the demand volume.

Freeway: Divided multi-lane highway without direct access to adjacent land uses. Users must utilize ramps to reach adjacent highway facilities with access to the adjacent land uses.

Highway: General term to describe a public way for vehicular travel.

Integrated Corridor Management (ICM): Management of a transportation corridor to optimize use of available infrastructure by directing travelers to underutilized capacity (for example, shifting travel times, routes, or mode). Multijurisdictional partner agencies manage ICM corridors as collaborative, multimodal systems.

Interchange: Set of ramps and intersections used to allow traffic to travel to and from a freeway facility.

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.

On-ramp: One-directional roadway that is used by traffic entering a freeway facility.

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).

Executive Summary

The Alaska Department of Transportation and Public Facilities (DOT&PF) has retained Kinney Engineering, LLC (KE) to prepare this Ramp Traffic and Safety Analysis Study for the Glenn Highway: Airport Heights to Parks Highway Rehabilitation project. This Ramp Traffic and Safety Analysis Study evaluates the potential benefits of upgrading 15 on-ramps at 9 interchanges along the Glenn Highway from tapered merge entrance design to parallel entrance design. The ramps evaluated were first identified in the Glenn Highway Integrated Corridor Management (ICM) Study (2019), which identified strategies to reduce non-recurring congestion on the Glenn Highway. One of the strategies identified in the report was to convert tapered merge ramps to parallel entrance ramps to ease merge conditions and mitigate the frequency of crashes. Of the 18 ramps initially identified in the ICM study for consideration, 3 ramps are not evaluated in this report because they have already been improved or are expected to be included as part of other projects.

For each of the 15 on-ramps included in this study, this report presents the following operational, safety and public comment analyses:

1. *Merge capacity analysis, which* compares existing ramp lengths with ramp lengths needed to improve the future LOS by one letter grade. If the future operations for a ramp is determined to be at LOS C under existing conditions, then there would be no need for improvements.
2. *Ramp speed analysis, which* calculates the appropriate ramp lengths that will allow drivers to obtain highway speeds prior to merging.
3. *Ramp crash analysis, which* reviews crashes that occurred from 2013 through 2017 and estimates the expected crash cost reductions if the evaluated ramp improvements are implemented
4. *Public response summary, which* reviews survey responses and comments that were collected as part of the 2019 Glenn Highway Integrated Corridor Management (ICM) study and were related to each of the ramps.

Based on these analyses, conceptual designs to convert each on-ramp from a tapered merge ramp to a parallel entrance ramp were prepared. Where appropriate, the conceptual designs include ramp length extensions to ensure drivers can reach highway speeds when merging. Other improvements that could affect ramp LOS (such as converting to a two-lane ramp or installing ramp metering) were outside of the scope of this analysis.

Construction costs were estimated and a benefit-cost ratio was then calculated for each on-ramp, considering the benefits and costs shown in Table 1.

Table 1. Benefits and Costs

Benefits	Costs
• Increased ramp merge area speeds • Reduction in crash costs • Reduction in delay due to crashes	• Construction costs • Yearly maintenance and operations (M&O) costs.

The value of each ramp improvement was calculated for the 20-year design life of the project and brought back to net present value using a 3% discount rate. An incremental benefit-cost analysis was then used to prioritize the ramp improvements, to aid the DOT&PF in determining which ramps to include as part of the Glenn Highway: Airport Heights to Parks Highway Rehabilitation project (expected construction in 2024 through 2026). The ramp priority ranking is presented in Table 2.

Table 2. Prioritized Ranking of Project Ramps

Ramps in Prioritized Order	Estimated Construction Cost
N Birchwood NB	$399,000
S Peters Creek SB	$622,000
JBER SB	$1,209,000
S Birchwood SB	$963,000
JBER NB	$1,217,000
Eklutna SB	$945,000
S Peters Creek NB	$616,000
N Peters Creek SB	$767,000
Mirror Lake SB	$680,000
Eklutna NB	$756,000
N Eagle River SB	$1,416,000
N Peters Creek NB	$900,000
N Birchwood SB	$873,000
Old Glenn SB	$1,032,000
S Birchwood NB	$1,010,000

1 Introduction

The Alaska Department of Transportation and Public Facilities (DOT&PF) has retained Kinney Engineering, LLC (KE) to prepare this Ramp Traffic and Safety Analysis Study for the Glenn Highway: Airport Heights to Parks Highway Rehabilitation project. The segment of the Glenn Highway being analyzed as part of this project is primarily within the Municipality of Anchorage (MOA) and ends in the Matanuska-Susitna Borough (MSB). The study corridor extends from Airport Heights Drive (MP 0) to the Parks Highway Interchange (MP 32.5). The project limits are depicted in Figure 1.

The Glenn Highway is classified as an Interstate Highway, the highest arterial functional classification, by the Federal Highway Administration (FHWA). It is identified as part of the National Highway System (NHS), a network of highways considered integral to the nation's economy, defense, and mobility, and as part of the Strategic Highway Network (STRAHNET), a network of highways which are considered critical to US strategic defense operations. A major thoroughfare for freight, commuter, and tourist travel, the Glenn Highway is the only route that provides northern access to and from Anchorage. There are no continuous parallel routes to the Glenn Highway between Anchorage and the Parks Highway Interchange, and non-recurring congestion due to unplanned events (such as crashes) and planned events (such as road construction) have a significant negative impact on the movement of people and goods.

Under the analysis methodology in the Highway Capacity Manual (HCM), the Glenn Highway within the study area falls into the roadway category of freeway. Freeways are defined by the HCM as separated highways with full access control and two or more lanes in each direction dedicated to the exclusive use of traffic. Throughout the report, the Glenn Highway is referred to as a ***freeway*** when describing measures or analyses specific to the HCM methodology and the general, more comment term ***highway*** is used in all other instances.

The 2019 DOT&PF *Glenn Highway Integrated Corridor Management* (ICM) *Study* developed strategies for improving the resiliency of the Glenn Highway through a range of engineering, technological, and institutional projects. One of the high-priority strategies presented in the ICM was a Freeway On-Ramp Merge Upgrades (Corridor-Wide) project to convert on-ramps with tapered merge entrances to parallel entrances to ease merge conditions and mitigate the frequency of crashes.

The purpose of this Ramp Traffic and Safety Analysis Study is to analyze the benefits of upgrading the on-ramps as suggested by the ICM strategy. The ICM identified 18 on-ramps (at 11 interchanges) with tapered merge entrances onto the Glenn Highway within the project limits. Three of these on-ramps have already been improved or are expected to be improved as part of projects already underway. This study evaluates the benefits of upgrades to the remaining 15 on-ramps and provides a detailed safety and operational analysis for each ramp.

The 15 on-ramps (at 9 interchanges) analyzed in this study include:

- Fort Richardson/JBER Interchange Northbound and Southbound On-Ramps
- N Eagle River Interchange Southbound On-Ramp
- S Birchwood Interchange Northbound and Southbound On-Ramps
- N Birchwood Interchange Northbound and Southbound On-Ramps
- S Peters Creek Interchange Northbound and Southbound On-Ramps
- N Peters Creek Interchange Northbound and Southbound On-Ramps
- Mirror Lake Interchange Southbound On-Ramp
- Eklutna Interchange Northbound and Southbound On-Ramps
- Old Glenn Interchange Southbound On-Ramp

Figure 1 shows the interchanges with on-ramps evaluated for upgrades in the context of the full project area.

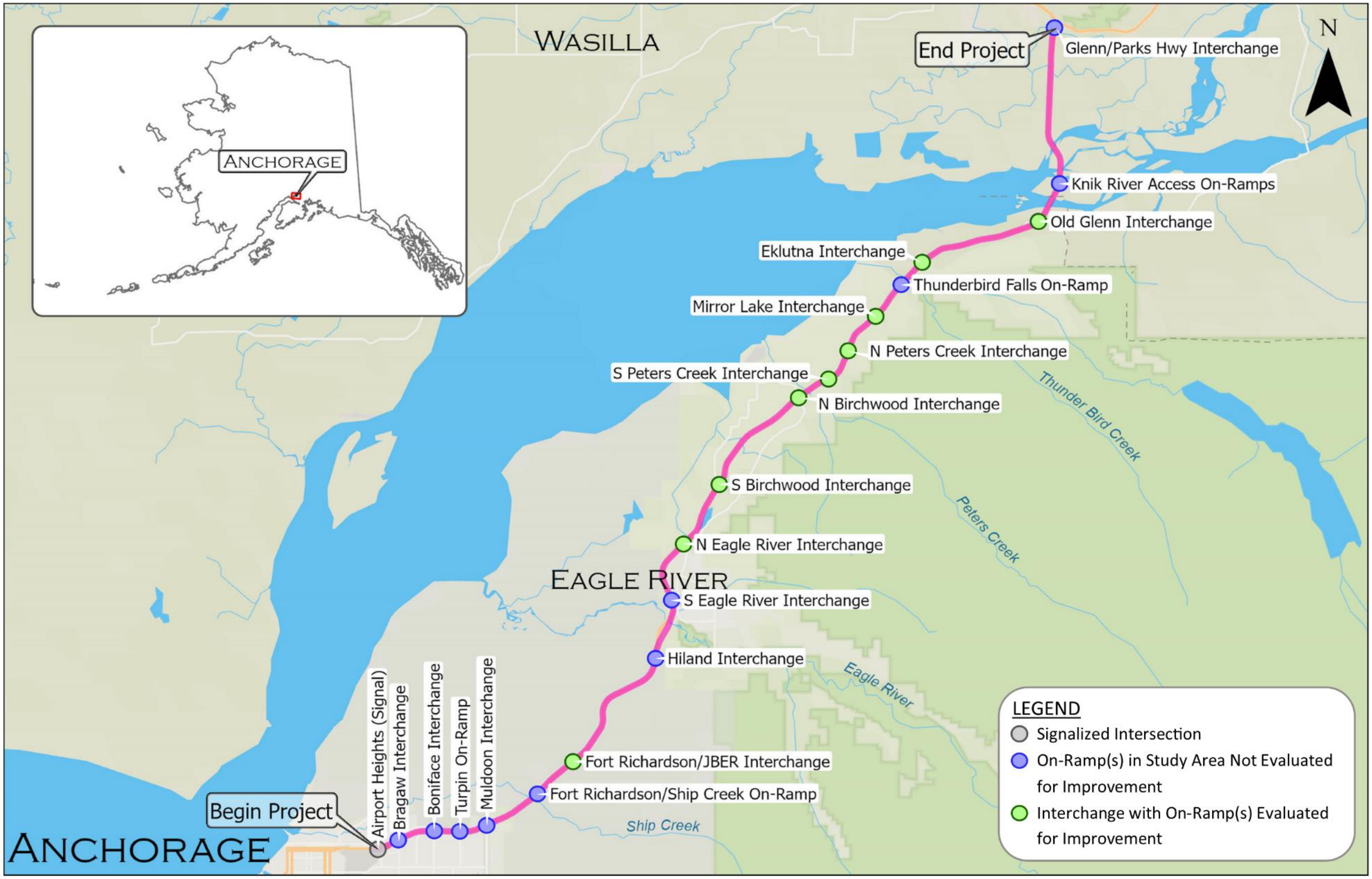


Figure 1. Study Area/Vicinity Map

This study evaluates the performance measures and safety characteristics of the Glenn Highway on-ramps eligible for upgrades and considers potential mitigation improvements. The analyses use the most current standards and methodologies that have been adopted by the DOT&PF as of the submission of this report.

1.1 Existing Conditions

The Glenn Highway has a posted speed limit of 65 mph between the Bragaw Interchange and the Parks Hwy Interchange where this study ends. The existing shoulder widths along the highway are 8 feet and the existing lane widths are 12 feet. As of 2021, the highway configuration transitions from 6-lane to 4-lane at the South Eagle River (Artillery) Interchange. Note that prior to 2015, the transition occurred near the Hiland Interchange. In 2015, an additional northbound lane between Hiland and Artillery was constructed, while in 2020 an additional southbound lane between Artillery and Hiland were completed. The Glenn Highway lane configuration and estimated 2045 AADTs used for analysis are shown in Figure 2. Additional information regarding the present conditions of the highway can be found in the design designation forms, which were provided by DOT&PF and are included in Appendix A Design Designation Forms.

The existing ramp widths range between 20 to over 24 feet, with varying shoulder widths, and the existing acceleration lanes for each ramp are 12 feet wide. The existing ramp lengths are discussed in the following sections of this report. Figure 2 depicts the 15 on-ramps evaluated for improvements and their respective estimated 2045 AADT volumes, FHWA area classification, and order of location relative to the Glenn Highway. The distances between the ramps are not to scale, and ramps that were not evaluated for improvements are not shown.

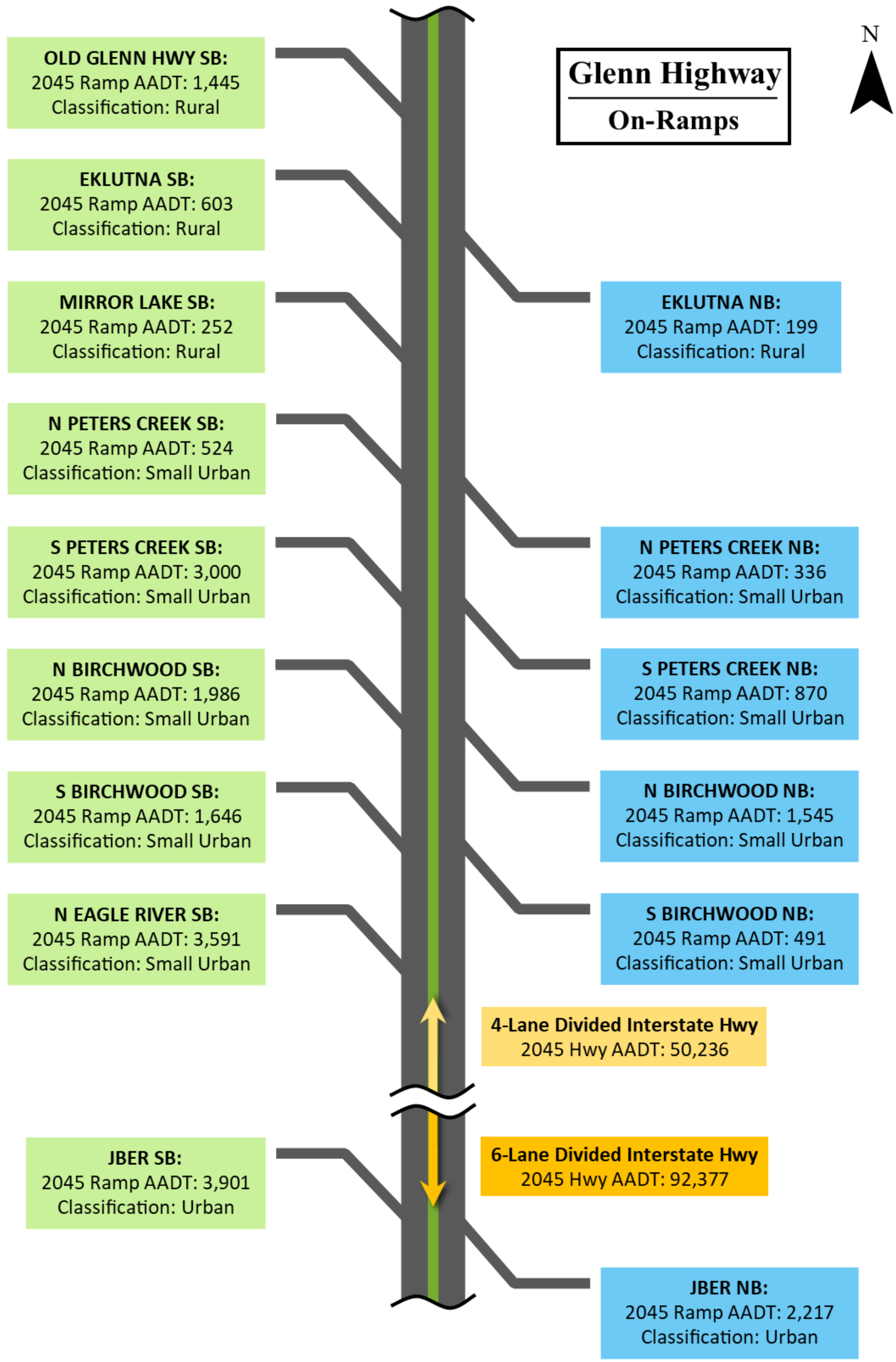


Figure 2. Highway and On-Ramp Existing Conditions

2 Analysis Methodology

Four measures were used to identify operational and safety concerns and to design conceptual ramp improvements and the expected benefit if each improvement were implemented:

1. *Merge capacity analysis.* This merge level of service (LOS) analysis uses the HCM merge methodology in the Highway Capacity Software (HCS7) program. The LOS study considers whether the existing acceleration merge area is long enough to allow ramp traffic to merge efficiently onto the main highway, based on the volume of ramp traffic and the volume of freeway traffic for the existing condition (2020) and for the design year (2045). For each ramp, the merge analysis calculates the LOS and on-ramp influence area average density and speed for the two analysis periods 2020 and 2045. The existing acceleration merge area lengths are compared to the lengths needed in order to potentially improve the LOS by one letter grade.
2. *Ramp speed analysis.* This ramp speed analysis uses a methodology based on factors identified in *A Policy on Geometric Design of Highways and Streets* 2011 (PGDHS). It considers whether the current on-ramp lengths (measured from the point of slowest speed on the ramp to the start of the ramp taper) allow merging vehicles to attain highway speeds on the ramp prior to joining the main stream of highway traffic. For each ramp included in the study, the additional length needed to allow vehicles to achieve highway speeds, improving merge operations is calculated based on the standard ramp lengths defined in the PGDHS.
3. *Ramp crash analysis.* This analysis reviews historical crashes that occurred from 2013 to 2017 on the on-ramps, and on the Glenn Highway but related to on-ramp merging or within the interchange areas. The crash analysis considers the number and type of crashes that occurred during this period, the cost of those crashes, and the expected crash cost reduction if ramp improvements are implemented.
4. *Public response summary*. This summary reviews public comments and survey responses that were collected as part of the Glenn ICM study (collected in an online survey, which was live from February 5th until April 4th, 2018). This summary describes user concerns at each of the ramps, informing the conceptual design of the evaluated improvements.

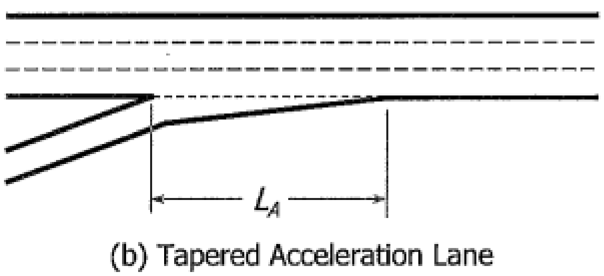
The following sections describe the methodology for each measure in greater detail.

2.1 Merge Capacity Analysis

The HCS7 program offers a multitude of tools for evaluating transportation facilities such as streets, stops, roundabouts, freeways, and other highways. The modules included in the program implement the procedures outlined in the Highway Capacity Manual (HCM) 6th Edition. For this study, an operational merge analysis was performed for each ramp included in the Glenn Highway project. Data in the analysis includes:

- Number of ramp lanes (all ramps have only one lane)

- Number of freeway lanes (the freeway has 3 lanes in each direction at the JBER ramps and 2 lanes in each direction for all of the other ramp analyses)
- Ramp and highway volumes (both 2020 and 2045 demand volumes were used)
- Acceleration lane length L_A (measured using aerial imagery and AutoCAD as the distance between the start of the painted gore and end of the merge lane taper in aerial view, based on guidance from the HCM. See Figure 3)
- Other geometric characteristics (default values of level ramp and highway terrain, ramp free-flow speed of 35 mph, and highway free-flow speed of 70 mph were used; for this analysis, a level grade falls within the range of -3% to +3%)
- Heavy vehicle percentage (ramps were assigned to 5% for urban and small-urban areas or 4% for rural areas; per the design designations, the highway has 6% heavy vehicles)
- Peak hour factor (taken from DOT&PF-provided design designations)



SOURCE: Highway Capacity Manual 6th Edition, Chapter 14 Exhibit 14-5 (b)

Figure 3. Tapered Acceleration Lane

Traffic volumes on the Glenn Highway for 2020 and 2045, directional distribution percentages, and two-way design hour volumes (DHV) were obtained from the design designation forms provided by DOT&PF. Based on the design designations, different freeway demand volumes were used for the JBER ramps than for the other ramps studied. The freeway volumes used for the ramp analyses are presented in the following tables.

Table 3. Freeway Demand Data for JBER Northbound/Southbound On-Ramps

JBER Northbound/Southbound On-Ramps		
Freeway Demand Data	*(2020)*	*(2045)*
2-Way AADT	62429	92377
2-Way DHV (% of AADT)	11	
Directional Distribution (Higher)	0.60	
Freeway Demand Volume	4120	6097

Table 4. Freeway Demand Data for All On-Ramps Excluding JBER

All On-Ramps Except JBER Northbound/Southbound		
Freeway Demand Data	*(2020)*	*(2045)*
2-Way AADT	33950	50236
2-Way DHV (% of AADT)	11	
Directional Distribution (Higher)	0.65	
Freeway Demand Volume	2427	3592

The merge analysis LOS reports provide several analysis metrics, including on-ramp influence area speed (mph), average density (passenger cars per mile per lane, pc/mi/ln), and level of service (LOS). The HCM defines the on-ramp influence area to include the ramp merge area, as well as the two highway lanes closest to the ramp, extending upstream 1,500 feet from the end of the ramp taper. The HCM indicates that the desirable on-ramp influence speed is no less than 5 mph below the posted freeway speed, between 60 and 65 mph for the Glenn Highway. Chapter 13 of the HCM assigns the following LOS criteria to merge (and diverge) freeway segments:

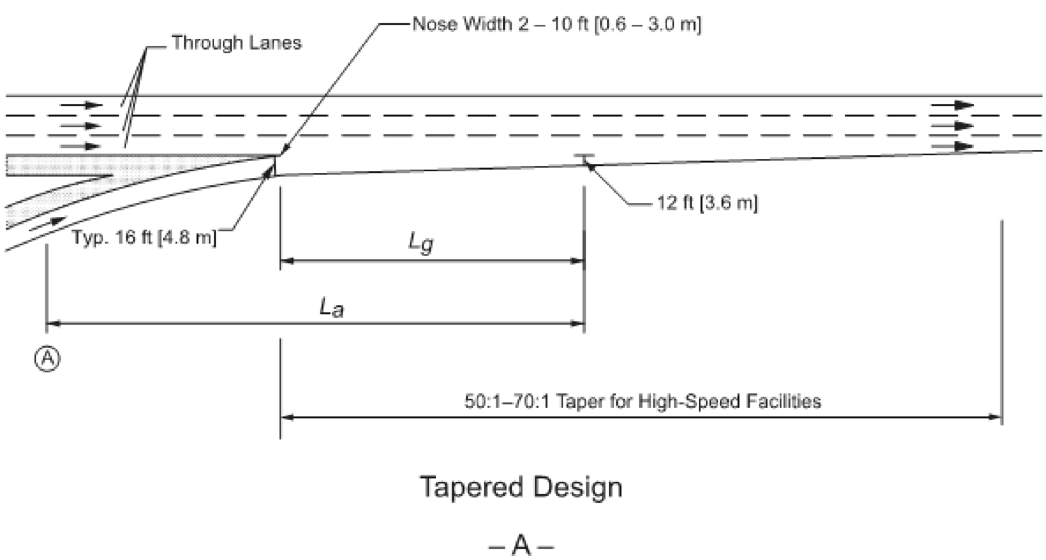
- LOS A: Described as traffic flow with unrestricted operations where "density is low enough to permit smooth merging or diverging with very little turbulence in traffic stream."
- LOS B: Characterized by minimal turbulence, although "merging and diverging maneuvers become noticeable to through drivers."
- LOS C: Described as stable operation in which "speed within the ramp influence area begins to decline as turbulence levels become much more noticeable. Both ramp and freeway vehicles begin to adjust their speeds to accomplish smooth transitions."
- LOS D: Characterized by a level of turbulence in the influence area described as "intrusive", resulting in speed reduction for all vehicles in order to accommodate merging movements.
- LOS E: Defined by operations that are approaching or reaching volume capacity, with a risk of queue formation.
- LOS F: Characterized by the development of both ramp and freeway queues. This unstable condition is present when "the total demand flow rate from the upstream freeway segment and the on-ramp exceeds the capacity of the downstream freeway segment."

The PGDHS indicates that the appropriate LOS for the Glenn Highway is LOS C or D (Urban and Surburban Freeway, from PGDHS Table 2-5). However, the analysis indicated that LOS C or D is not always achievable in 2045 with only the scoped improvements (extension of the ramp merge area length L_A and, or conversion from a tapered entrance to a parallel entrance). For the purposes of this report, an LOS of A through E was considered acceptable for maintaining current conditions, and desirable ramp lengths were calculated by extending the L_A in the HCM calculation until either the LOS was improved to D or C or until the L_A reached 1,500 feet (the maximum length used in the HCM analysis). In general, the evaluated improvements discussed in this report use the "minimum ramp length" (calculated as described in Section 2.2 Ramp Speed Analysis) unless the LOS with this length is calculated as LOS E or F, in which case the desirable ramp length is used (either bringing the LOS to D or maxing out at 1,500 feet of merge area length L_A).

The merge capacity analysis was repeated for each individual ramp under both the 2020 and 2045 volume conditions to determine a conceptual ramp length, and these values were used to calculate a reduction in delay within the 1,500-foot merge area length due to increased ramp influence area speeds. This delay reduction was quantified as part of the benefit-cost analysis presented in Section 5 Benefit-Cost Analysis.

2.2 Ramp Speed Analysis

A speed analysis was performed for each of the study ramps following guidance in the PGDHS Section 10.9.6. The guidance provides criteria for designing a speed-change lane that allows drivers to merge with through traffic at a desirable highway speed. The average ramp grade and length of the speed-change lane, also referred to as the acceleration lane length (L_a), were measured using Lidar surfaces and aerial imagery. The average ramp grades were measured across the L_a length for each ramp, which is adequate for the application of the methodology presented in the PGDHS. Note that most ramps in the study have a sag curve. The acceleration lane length and other geometric variables considered in this design approach for tapered entrances are illustrated in Figure 4.



SOURCE: A Policy on Geometric Design of Highways and Streets 2011, Figure 10-69

Figure 4. Tapered Entrance Ramp Design

According to the PGDHS, the L_a is measured from the speed-controlling feature of the ramp to the point where the outer edge of the taper and closest edge of the adjacent highway through lane are 12 feet apart. This distance is referred to as the point of convergence, at which point a merge speed within 5 mph of the highway operating speed is desirable, allowing the merging driver to join the through traffic by the end of the taper. The PGDHS acceleration lane length L_a is not equivalent to the HCM defined acceleration length (L_A) used in the merge analysis.

The gap acceptance length L_g was also measured for each ramp, from the 10-foot painted nose width to the point of convergence (beginning of existing taper). Both the L_a and L_g segments end at the same location. According to the PGDHS, L_g must be a minimum of 300-500 feet, depending on the painted nose width, in order to support the driver's ability to choose a suitable opening in the through traffic.

For this study, the speed-controlling feature is assumed to be located at the beginning (top) of the ramp where vehicles turn onto the ramp, therefore traveling at their lowest speed. In some cases, the speed-controlling feature would be located at the tightest curve on the ramp. Each case was evaluated under a stop condition with a 0-mph initial speed, which would represent a worst-case-scenario. The ramp grade and existing stop conditions were collected for each ramp and analyzed using Table 5.

Table 5. Acceleration Lane Length Design Criteria
SOURCE: A Policy on Geometric Design of Highways and Streets 2011, Table 10-3

U.S. Customary										
Acceleration Length, *L* (ft) for Entrance Curve Design Speed (mph)										
Highway		Stop Condition	15	20	25	30	35	40	45	50
		and Initial Speed, *V'a* (mph)								
Design Speed, *V* (mph)	Speed Reached, *Va* (mph)	0	14	18	22	26	30	36	40	44
30	23	180	140	—	—	—	—	—	—	—
35	27	280	220	160	—	—	—	—	—	—
40	31	360	300	270	210	120	—	—	—	—
45	35	560	490	440	380	280	160	—	—	—
50	39	720	660	610	550	450	350	130	—	—
55	43	960	900	810	780	670	550	320	150	—
60	47	1200	1140	1100	1020	910	800	550	420	180
65	50	1410	1350	1310	1220	1120	1000	770	600	370
70	53	1620	1560	1520	1420	1350	1230	1000	820	580
Note: Uniform 50:1 to 70:1 tapers are recommended where lengths of acceleration lanes exceed 1,300 ft.										

The Glenn Highway design speed is 70 mph which corresponds to a desirable L_a value of 1,620 feet for a 0 mph stop condition. This value is subject to modification based upon ramp upgrades and downgrades greater than 3% as determined by Table 6.

Table 6. Speed Change Lane Adjustment Factors

SOURCE: A Policy on Geometric Design of Highways and Streets 2011, Table 10-4

U.S. Customary					
Design Speed of Highway (mph)	Deceleration Lanes Ratio of Length on Grade to Length on Level for Design Speed of Turning Curve (mph)				
All Speeds	3 to 4% upgrade 0.9				3 to 4% downgrade 1.2
All Speeds	5 to 6% upgrade 0.8				5 to 6% downgrade 1.35
Design Speed of Highway (mph)	Acceleration Lanes Ratio of Length on Grade to Length on Level for Design Speed of Turning Curve (mph)				
	20	30	40	50	All Speeds
40	1.3	1.3	—	—	0.7
45	1.3	1.35	—	—	0.675
50	1.3	1.4	1.4	—	0.65
55	1.35	1.45	1.45	—	0.625
60	1.4	1.5	1.5	1.6	0.6
65	1.45	1.55	1.6	1.7	0.6
70	1.5	1.6	1.7	1.8	0.6
5 to 6% upgrade 0.8					5 to 6% Downgrade
40	1.5	1.5	—	—	0.6
45	1.5	1.6	—	—	0.575
50	1.5	1.7	1.9	—	0.55
55	1.6	1.8	2.05	—	0.525
60	1.7	1.9	2.2	2.5	0.5
65	1.85	2.05	2.4	2.75	0.5
70	2.0	2.2	2.6	3.0	0.5

Once adjustment factors have been applied, the resulting minimum length for the acceleration lane was compared to the measured existing length to evaluate the potential ramp improvements.

According to PGDHS, passenger cars under free-merge or free-flow conditions are assumed in this methodology. Therefore, the design values in Table 5 are to be regarded as conservative estimates. The design provisions are targeted at minimizing crash potential, reducing interference with freeway traffic, providing an acceptable length for achieving appropriate merge speeds, and offering sufficient gap space for both through and merging traffic.

2.3 Ramp Crash Analysis

Historical crash reports and crash narratives from 2013 to 2017 were provided by DOT&PF for the Glenn Highway. The Alaska Motor Vehicle Collision Report (12-200) Instruction Manual (2016), which specifies how motor vehicle crashes in Alaska are reported and defines how a crash report should be filed, provided insight during analysis of the historical crashes.

For each field in a crash report, there are pre-defined options to choose from. To describe a crash location when filling out a crash report, the crash reporter can choose from 14 location options. Of the 14, the following five crash (first harmful event) locations relate to interchanges:

1. Entrance/Exit Ramp – crash occurred on entrance/exit ramp
2. Entrance/Exit Ramp Related – crash was related to use of or entry onto ramp
3. Acceleration/Deceleration Lane – crash occurred in an interchange area on an auxiliary or speed-change lane that allows vehicles to accelerate to highway speeds before entering highway or decelerate to safe speeds to negotiate a ramp when exiting highway
4. Through Roadway – crash occurred in interchange area but **not** at an intersection, on an Entrance/Exit Ramp or in an Acceleration/Deceleration lane
5. Other Location not Listed Above Within an Interchange Area (Median, Shoulder Roadside) – crash occurred within an interchange area but off the roadway, and was not related to the use of or the entry onto a ramp.

In the historical crash reports, crashes were seldom assigned to Acceleration/Deceleration Lane or Other Location not Listed Above Within an Interchange Area, even if the latitude and longitude placed the crash in these locations. As such, this ramp crash analysis assigned all crashes to one of the following three crash locations at each interchange, also shown in Figure 5:

1. Ramp Crash – crash occurred on a Glenn Highway on-ramp.
2. Ramp Related Crash – crash occurred on the Glenn Highway, but was related to a ramp or ramp merging as per the crash narrative. For example, a vehicle may have lost control on a ramp or may have had difficulty merging.
3. Through Roadway Crash – crash occurred within an interchange area but was not reported to be ramp related and did not occur on a ramp. In each direction, the through roadway area was measured from the beginning of the off-ramp deceleration lane taper to the end of the on-ramp acceleration lane taper.

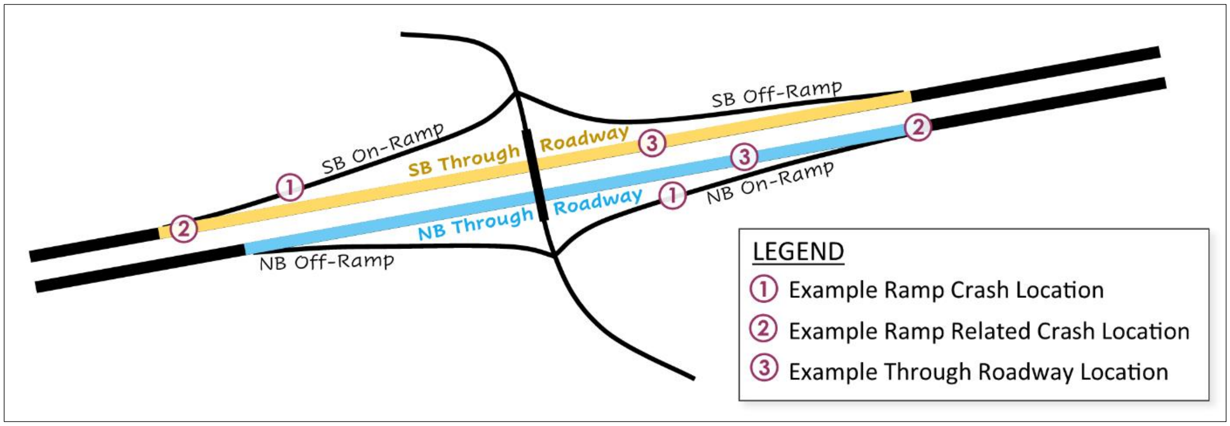


Figure 5. Interchange Crash Locations

Crashes for these three locations were analyzed both separately and together to help identify which ramps should be prioritized for improvements. The analysis considered crash occurrence, crash severity, crash type, and road surface conditions.

The historical crashes received from the DOT&PF were categorized by severity, as shown in Table 7. The crash analysis used these severity ratings.

Table 7. Crash Severity

DOT&PF Severity (used for Analysis)	Alaska Motor Vehicle Collision Report Instruction Manual Severity (Summarized)
Property Damage Only (PDO)	No Apparent Injury – no reason to believe that person received any bodily harm from motor vehicle crash
Minor	Possible Injury – claimed or reported injury that is not fatal, serious, or minor; Suspected Minor Injury – any injury that is evident at the scene of the crash other than fatal or serious
Serious	Suspected Serious Injury – any injury other than fatal that results in severe lacerations, broken bones, crush injuries, significant burns, paralysis etc.
Fatal	Fatal Injury (Killed) – any injury that results in death within 30 days after the crash in which the injury occurred

Each crash was assigned a crash type during analysis, as shown in Table 8.

Table 8. Crash Types

Crash Types used for Analysis	First Harmful Events (Alaska Motor Vehicle Collision Report Instruction Manual)
Animal	Bear, Eagle, Dog, Live Animal *(not Moose)*
Bridge Overhead	Bridge Overhead Structure, *any crash where vehicle passing under bridge strikes bridge*
Guardrail/Barrier	Guardrail End, Guardrail Face, Concrete Traffic Barrier, Crash Cushion, Other Traffic Barrier, Median Barrier, Cable Barrier, Bridge Rail (Includes Parapet)
Moose	Live Animal - Moose
Object (Not Fixed)	Gravel, Debris, Cargo/Equipment Loss or Shift, Boulder, Other Object (Not Fixed), Fell/Jumped from Vehicle, Motor Vehicle In-Transport Strikes or is Struck by Cargo/Persons/Objects Set-In-Motion From/By Another Motor Vehicle In-Transport, Thrown or Falling Object
Other	Backing, Flat Tire, Fire, Jackknife *(Unless sideswipe or angle),* Motor Vehicle in Motion Outside the Trafficway, Mechanical Issue, Non-Motorist on Personal Conveyance, Pedalcycle, Pedestrian
Overturn/Rollover	*Any crash that included or resulted in an* Overturn/Rollover
Ran off Road	Culvert, Ditch, Embankment, Fence, Mailbox, Other Post/Other Pole/Other Support, Parked, Pavement Surface Irregularity (Ruts/Potholes/Grates/etc.), Snow Bank, Snowberm, Traffic Signal Support,Traffic Sign Support, Tree (Standing Only), Utility Pole/Light Support
Rear End	Front-To-Rear
Sideswipe	Sideswipe -Same Direction, Front-To-Side

Detailed analyses specific to each interchange on-ramp that was evaluated for improvements are included under each ramp section in this report. Note that crashes that occurred on off-ramps are not included. Ramps with recent improvements are also not considered in this report, as there is not sufficient crash experience data after their reconstruction.

Crash analyses of on-ramps that were not evaluated for improvements are included in Appendix C Ramps that were not Evaluated for Improvements. Appendix C includes crash analyses for the following on-ramps to the Glenn Highway (that were not identified in the ICM and are therefore not included in this study):

- Turpin Northbound On-Ramp
- JBER/Ship Creek Southbound On-Ramp
- Thunderbird Falls Northbound On-Ramp
- Knik Access Northbound On-Ramp
- Knik Access Southbound On-Ramp

2.3.1 Crash Rates

To identify safety concerns and allow a safety comparison between ramps within the study area, crash rates were calculated for each on-ramp and through roadway area. The crash rate calculation considers number of crashes, crash severity, AADT and segment length. Segment lengths were measured as follows:

- On-Ramp – segment length measured from beginning of ramp to painted gore.
- Through Roadway Area – segment length measured from the beginning of the off-ramp deceleration lane taper to the end of the on-ramp acceleration lane taper. The Through Roadway crash rates includes both Ramp-Related and Through Roadway crashes as described above in Figure 5.

Crash rates for each on-ramp evaluated for improvements are detailed under each ramp section in this report. Crash rates for on-ramps that were not evaluated for improvements are summarized in Appendix C Ramps that were not Evaluated for Improvements.

2.3.2 Estimated 5-Year Crash Cost Reductions Resulting if On-Ramp Improvements are Implemented

When considering the benefits of evaluated improvements from a safety perspective, crash modification factors (CMFs) are used to compute the expected number of crashes after implementing a countermeasure on a road section or intersection. CMFs, published online in the Crash Modification Factors Clearinghouse, are developed via national research studies documenting crash experience before and after improvements are implemented. Ramp improvements evaluated in this report include changing tapered ramp entrances to parallel ramp entrances and lengthening acceleration lanes. A CMF specific to changing a tapered entrance to a parallel entrance has not yet been developed. However, the *Highway Safety Manual*, 1st Edition (2009), presents a CMF (CMFID 5215 in the CMF Clearinghouse) for modifying the length of an acceleration lane. The CMF for total crashes (all severity levels combined) is the ratio of the CMF determined with the existing acceleration lane to the CMF calculated with the conceptual (evaluated) acceleration lane, described by the following formula:

$$CMF = e^{-2.59\,(L_{accelNew} - L_{accelExist})}$$

Where:

$L_{accelNew}$ = new (or conceptual) length of acceleration lane in miles
$L_{accelExist}$ = existing length of acceleration lane in miles

Length of acceleration lane is the distance from the nose of the painted gore to the end of the lane drop taper.

For each on-ramp, the cost of historical crashes was calculated based on average crash costs (by severity) presented by the DOT&PF. These costs are based on the estimated Value of Statistical

Life and are updated annually and published by the DOT&PF's Design and Engineering Services.

For each improved on-ramp conceptual design that lengthens the acceleration lane, a CMF was calculated and then applied to the total crash number in the vicinity of each on-ramp to estimate a 5-year crash cost reduction. All crashes that occurred at the three interchange-related crash locations (Ramp, Ramp Related, and Through Roadway) were counted towards crash cost reductions for each ramp and carried forward into the Benefit-Cost analysis, except for Moose crashes. The HSM presents default base conditions that are assumed to describe crash experience nationwide, and the CMFs were established under similar crash experience conditions. The Moose crashes that occur on the Glenn Highway study segment do not reflect nationwide experience (Glenn Highway Moose + Animal crash occurrence is much higher that nationwide Animal crash occurrence), so Moose crashes were removed before the CMFs were applied under the assumption that these crashes are unlikely to be mitigated by upgrades to ramp design.

2.4 MetroQuest Survey Review

As part of the 2019 ICM Study, efforts were made to gather public input. An online interactive survey run by MetroQuest from February 5th to April 4th of 2018 provided an opportunity for the public to share their concerns and suggest improvements for the Glenn Highway. Out of the approximate 5,400 comments received, 235 comments described concerns specifically regarding the on-ramps included in this study. Responses related to congestion and ramp/merging lane improvements were the most frequently cited among each ramp. Common suggestions included an extension of the ramp or merge lane, as well as additional lanes along the highway. Many respondents shared their ideas and unique experiences as drivers traveling either southbound or northbound on the highway or as merging ramp users. The responses corresponding to each ramp are discussed in their respective public comments section. Markers without comments that were located along the ramps were also reviewed and supplement the completed feedback received.

2.5 Alternatives Development

The evaluated improvements for each on-ramp are based on the merge capacity analysis and, or the ramp speed analysis, as outlined in either the HCM or PGDHS. The conceptual length for the L_a (distance needed for a driver to achieve highway speeds on the ramp) as defined in the PGDHS was considered as the minimum ramp length, while designing the L_A to improve LOS in accordance with the HCM would result in a longer L_a. Thus, the L_A needed to improve the LOS was considered the maximum ramp length.

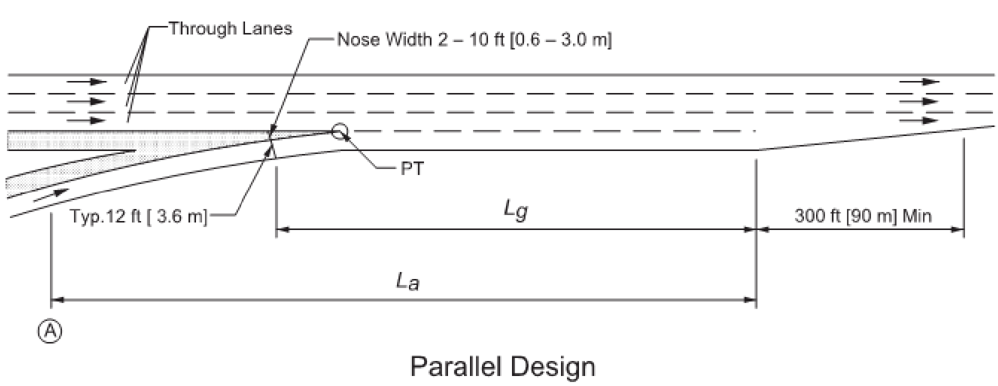
Due to cost concerns, the minimum ramp length was selected as the primary alternative for the conceptual redesign of each ramp except for ramps where the 2045 merge LOS is LOS F without additional improvement. This was the case for both of the JBER on-ramps. The South Birchwood southbound on-ramp also had the highest crash rates and provided no crash reduction upon application of the minimum ramp length. For these three ramps, the maximum ramp length was selected as the primary alternative.

Both the minimum and the maximum ramp lengths provide a ramp extension of a specific length. The extension length needed to produce the desirable merging speeds and ramp operations is applied to the parameters defined by the PGDHS parallel ramp design in Figure 6, which will replace the existing taper entrances. For the minimum ramp lengths, the speed analysis inputs are used to determine the ramp's L_a extension lengths. For the maximum ramp lengths, the merge analysis data determine the ramp's L_A extensions as defined in Figure 7. According to the PGDHS, the minimum curve radius for a typical parallel entrance ramp is 1,000 feet, and the recommended curve length is at least 200 feet in advance of the parallel acceleration lane. Since the minimum and maximum ramp lengths both include a 300-foot taper length, it is incorporated into each ramp concept design.

Design criteria based on the HCM and PGDHS:

1. Taper lengths shall be 300 feet for either minimum or desirable ramp lengths.
2. L_A extensions shall include the 300-foot taper.
3. L_g lengths shall be minimum 300 feet for all minimum ramp lengths. The L_a may be extended past the PGDHS design value to meet this recommendation.
4. The L_g may be extended to match existing.

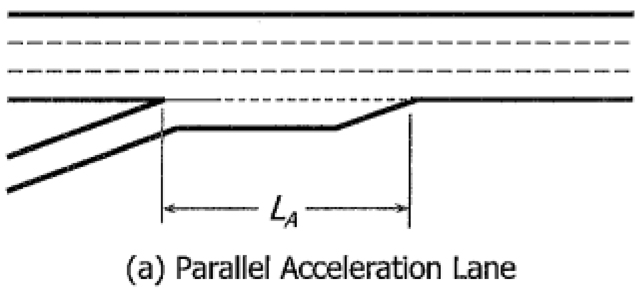
The PGDHS indicates that parallel designs are preferred, as they temporarily provide an auxiliary lane for effective merging movements. This is why the parallel design, which includes the 300-foot L_g and 300-foot taper length, was chosen for the potential redesign of each ramp. The parallel design for a typical single-lane entrance ramp according to the PGDHS is illustrated below.



SOURCE: A Policy on Geometric Design of Highways and Streets 2011, Figure 10-69

Figure 6. Parallel Entrance Ramp Design

Although the desirable ramp length is based on the HCM and merge analysis, it also follows the format of building a parallel acceleration lane with a 300-foot taper (see Figure 7).



SOURCE: Highway Capacity Manual 6th Edition, Chapter 14 Exhibit 14-5 (a)

Figure 7. Parallel Acceleration Lane

A number of the ramp improvements discussed in this report involve conceptual designs that match the existing geometry at the beginning and end of the ramp extensions. Based on as-builts for these individual sites, the conceptual structural section is assumed to match the existing. Additionally, the cost estimates for each potential ramp redesign assume that the work is built as part of a larger project.

Table 9. Impacts of Potential Improvements Summary

Ramp	Potential Right-of-Way Impacts	Potential Wetland Impacts	Other Potential Impacts
JBER Southbound	No	No	Existing Bike Trail on Right
JBER Northbound	No	No	Guardrail on Left Side
N Eagle River Southbound	No	No	-
S Birchwood Southbound	Yes	No	Guardrail on Both Sides, Shims St
S Birchwood Northbound	No	No	Pedestrian Path on Left
N Birchwood Southbound	No	No	Pilots Rd
N Birchwood Northbound	No	No	Guardrail on Right Side
S Peters Creek Southbound	No	No	-
S Peters Creek Northbound	No	No	-
N Peters Creek Southbound	No	No	-
N Peters Creek Northbound	Yes	No	-
Mirror Lake Southbound	No	No	Guardrail on Right Side
Eklutna Southbound	No	No	Fence on Right, Eklutna Village Road
Eklutna Northbound	No	No	-
Old Glenn Southbound	No	No	-

The estimated total cost for reconstruction is listed for each ramp in descending order in Table 10. Cost estimates include direct construction costs, construction administration, and design. Retaining wall costs as mitigation measures for potentially impacted ROW and surrounding features are included in the listed costs for the applicable ramps. Drainage costs are not included. The cost to extend the acceleration lane length of a ramp is approximately $700/LF.

Table 10. Estimated Cost Summary Table

Ramp	Estimated Total Cost
N Eagle River Southbound	$1,416,000
JBER Northbound	$1,217,000
JBER Southbound	$1,209,000
Old Glenn Southbound	$1,032,000
S Birchwood Northbound	$1,010,000
S Birchwood Southbound*	$963,000
Eklutna Southbound	$945,000
N Peters Creek Northbound*	$900,000
N Birchwood Southbound	$873,000
N Peters Creek Southbound	$767,000
Eklutna Northbound	$756,000
Mirror Lake Southbound	$680,000
S Peters Creek Southbound	$622,000
S Peters Creek Northbound	$616,000
N Birchwood Northbound	$399,000

*Cases in which the construction limits for the on-ramp concept designs may intrude on mapped ROW boundaries. For these cases, retaining walls would be considered as the primary alternative for mitigation and are included in the estimated total costs for the applicable ramps.

3 Ramp Analyses

The following sections describe each ramp included in the analysis in terms of current and forecasted demand volumes, geometric data, evaluated acceleration lane lengths, and crash experience. A summary of the public survey responses for each ramp is also included. Finally, potential improvements for each ramp are presented, along with the estimated construction cost and the estimated reduction in crashes.

3.1 Fort Richardson/JBER Interchange

3.1.1 Northbound

The results from the three analyses for the JBER northbound on-ramp are summarized in Figure 8.

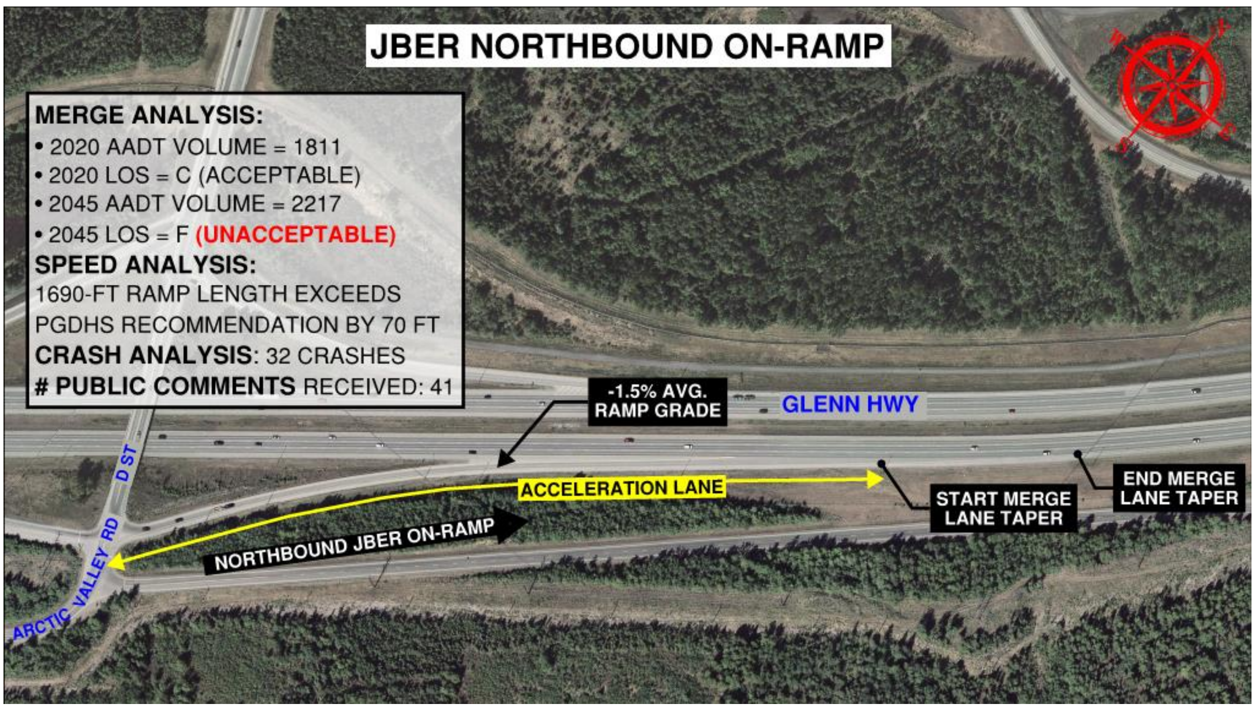


Figure 8. JBER Northbound On-Ramp Location, Characteristics, and Data

3.1.1.1 HCS7 Merge Analysis

The northbound JBER on-ramp operates at an acceptable LOS C under 2020 volumes and an unacceptable LOS F under 2045 volumes. As volumes increase from 2020 to 2045, the on-ramp influence area speed (merge speed) will be reduced from 60 mph to about 48 mph, which is 17 mph under the posted highway speed limit. Table 11 summarizes the merge analysis and results.

Table 11. JBER Northbound On-Ramp Merge Analysis Summary

JBER Northbound On-Ramp Merge Analysis		
Ramp Demand/Geometric Data	***(2020)***	***(2045)***
AADT	1811	2217
Merge Demand Volume, vph	199	244
Measured Length of Acceleration L_A, ft	740	
Classification	URBAN	
Heavy Vehicle %	5	
Analysis Results	***(2020)***	***(2045)***
On-Ramp Influence Area Speed, mph	60	48
Average Density, pc/mi/ln	28	n/a
LOS	C	F

3.1.1.2 Speed Analysis

The northbound JBER on-ramp has sufficient acceleration lane length for drivers to achieve the desirable highway speed prior to merging. The measured L_a beginning at the D Street intersection exceeds the PGDHS-recommended length by about 70 feet. The right turn movement from Arctic Valley Road onto the ramp is stop-controlled, which supports the application of the full stop criterion with an initial speed of 0 mph. The measured L_g length exceeds the minimum recommended 300 feet by about 200 feet, which indicates that drivers have enough space to freely adjust their position as they enter the highway. The following table summarizes the existing ramp conditions.

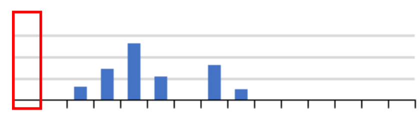
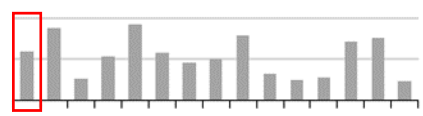
Table 12. JBER Northbound On-Ramp Speed Analysis Data (Existing Conditions)

JBER Northbound On-Ramp Speed Analysis	
Average Ramp Grade, %	-1.5
Measured L_g, ft	500
L_a Based on 0 mph Stop Condition, ft	1620
Measured L_a, ft	1690
Additional L_a per PGDHS, ft	-70

3.1.1.3 Crash Analysis

Table 13 describes the crash experience at this ramp from 2013 through 2017.

Table 13. JBER Northbound On-Ramp Crash Experience 2013 to 2017

Location	Number of Crashes	Segment Length (miles)	Average AADT	Crash Rate	Crash Rate Comparison by Ramp
On-Ramp	0	0.25	2,250	-	
Ramp-Related and Through Roadway	32	0.65	57,440	0.47	

Note: Red rectangle indicates subject ramp.

Figure 9 shows the crash type and severity for the 32 crashes that occurred in the vicinity of this on-ramp.

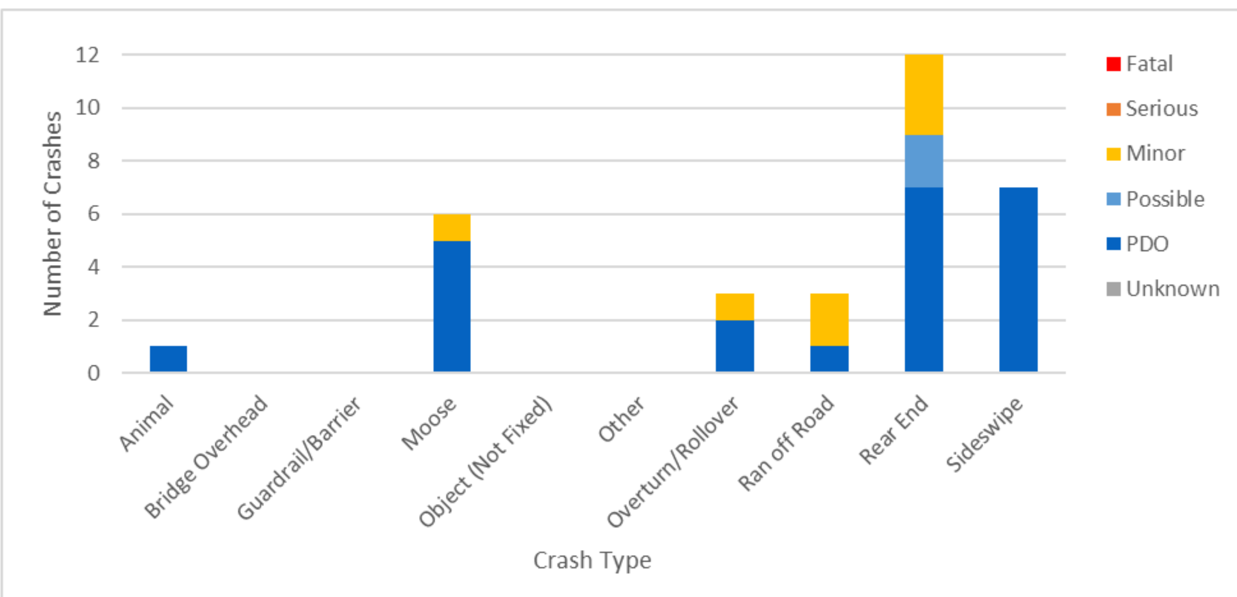


Figure 9. JBER Northbound On-Ramp Crash Type and Severity, 2013 to 2017

A review of the crash data shows:

- Twelve Rear End crashes were recorded in the through roadway area for this ramp. Nine of these crashes occurred during the weekday pm peak (4 pm to 6 pm) with three of them involving three or more vehicles.
- Seven Sideswipe crashes were reported, with two of these crashes involving vehicle merging from the on-ramp.
- Six Moose crashes were also recorded.

The estimated cost of the crashes that occurred in the vicinity of this ramp is $1,392,600. The Moose crashes are unlikely to be reduced by improvements to the on-ramp and were therefore not counted in crash reduction estimations (Section 3.1.1.6).

3.1.1.4 Public Comments

A total of 41 comments from the MetroQuest survey were associated with the northbound JBER on-ramp, 19 of which were related to congestion, 13 related to on-ramp/merging lane improvements, and three related to additional lane suggestions. The most common concern is that merging traffic causes northbound through vehicles to slow down and creates congestion along the highway, "sometimes up to Muldoon". Several survey respondents mentioned experiencing or observing these issues during "rush hour". This concern goes hand-in-hand with the suggestions provided, as most respondents recommended a longer/separate merge lane or an extended ramp length. Other suggestions included additional signage, safe driving education, and lighting.

3.1.1.5 Conceptual Design Improvements

The JBER northbound on-ramp currently provides a ramp length L_a of roughly 1,690 feet, which exceeds the PGDHS-recommended length of 1,620 feet. However, due to vehicle volumes the ramp is projected to operate at LOS F by 2045 without added improvements. The conceptual design for this ramp extends the parallel acceleration lane L_A to 1,500 feet and converts the entrance type from taper to parallel as shown in Figure 7. This would also lengthen the ramp length L_a. While this configuration would not improve the capacity operations by one letter grade, and future operations would remain at LOS F, the concept would meet preferred operational standards, improve merging movements, provide continuity along the study corridor, and possibly address public concerns in the area. The conceptual design improvements are delineated in Table 14, and the conceptual design is shown in Figure 10.

Table 14. Conceptual Design Improvements for JBER Northbound On-Ramp

Ramp Characteristics	Existing	Concept
Ramp Length L_a, ft (measured from stop condition to start of taper, based on PGDHS)	1690	2260
Parallel Acceleration lane L_A, ft (ramp merge area measured from nose of painted gore to end of taper, based on HCM)	740	1500

Note: The existing ramp length L_a is greater than PGDHS-recommended and was increased to accommodate the PGDHS typical parallel entrance ramp design and conceptual L_A length as recommended by the HCM.

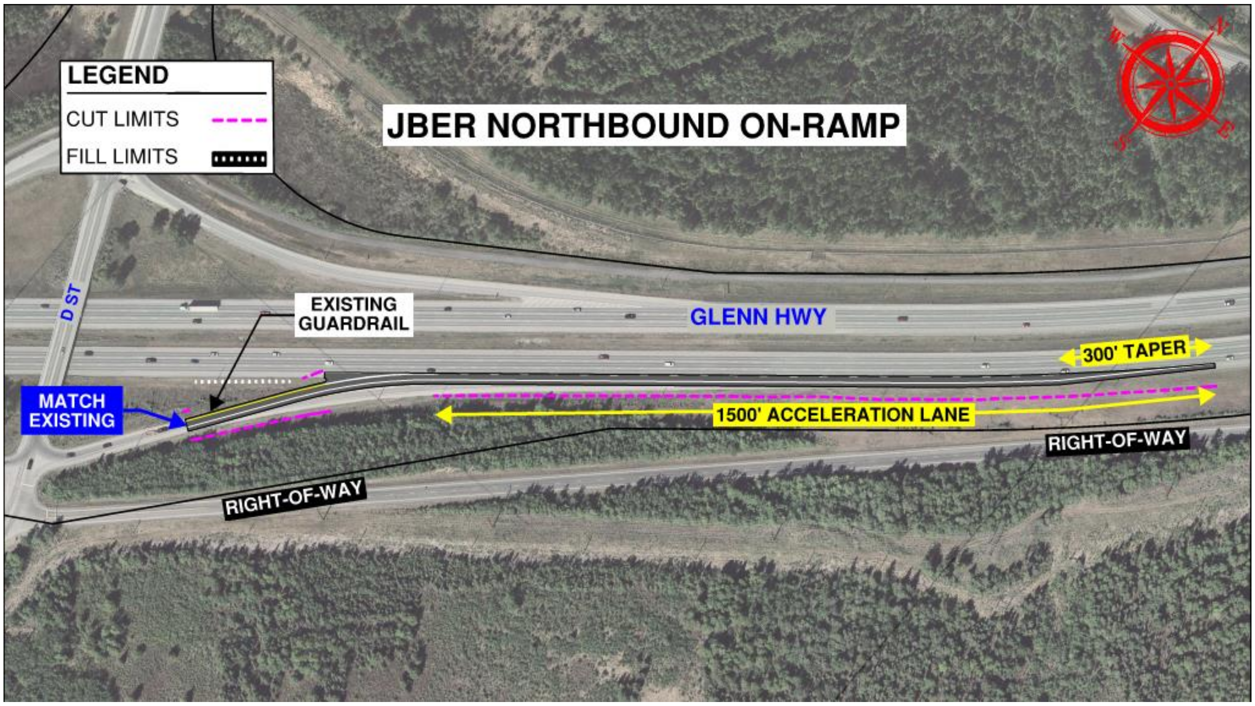


Figure 10. Conceptual Design for JBER Northbound On-Ramp

The area surrounding the conceptual design is free from potential conflicts with Right-of-Way (ROW) boundaries and mapped wetlands. Approximately 480 feet of guardrail on the left side of the ramp would need to be removed and replaced if the ramp were to be reconstructed. Table 15 summarizes the conceptual design impacts on the existing ramp.

Table 15. JBER Northbound On-Ramp: Potential Impacts on Existing Features

	JBER Northbound: Potential Impacts on Existing Features
ROW	None
Wetland	None
Other	Guardrail on Left Side

The construction cost of the conceptual design for the JBER northbound on-ramp is approximately $1,217,000.

3.1.1.6 Crash Reduction

The CMF for lengthening the on-ramp merge area from 740 feet to 1,500 feet long is 0.76. Applying this CMF to all the on-ramp crashes except for Moose crashes would reduce the 5-year cost of crashes by $373,100.

3.1.2 Southbound

Figure 11 shows a summary of the results from the three analyses for the JBER southbound on-ramp.

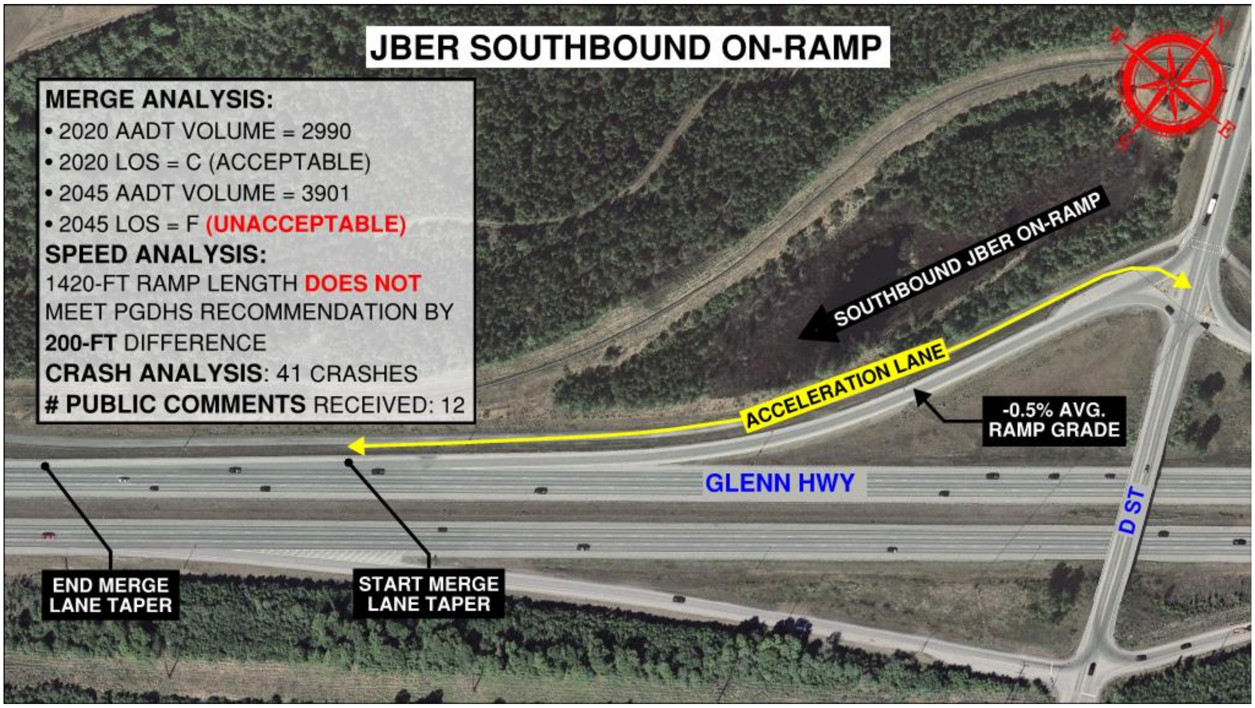


Figure 11. JBER Southbound On-Ramp Location, Characteristics, and Data

3.1.2.1 HCS7 Merge Analysis

The southbound JBER on-ramp operates at an acceptable LOS C under 2020 volumes and an unacceptable LOS F under 2045 volumes. As volumes increase from 2020 to 2045, the on-ramp influence area speed (merge speed) will be reduced from 59 mph to about 44 mph, which is 21 mph less than the posted highway speed limit. The resulting speeds on this ramp, 59 mph (2020) and 44 mph (2045), are the lowest current and forecasted merge speeds among the ramps analyzed. Table 16 summarizes the merge analysis and results.

Table 16. JBER Southbound On-Ramp Merge Analysis Data

JBER Southbound On-Ramp Merge Analysis		
Ramp Demand/Geometric Data	***(2020)***	***(2045)***
AADT	2990	3901
Merge Demand Volume, vph	329	429
Measured Length of Acceleration L_A, ft	660	
Classification	URBAN	
Heavy Vehicle %	5	
Analysis Results	**(2020)**	**(2045)**
On-Ramp Influence Area Speed, mph	59	44
Average Density, pc/mi/ln	29	n/a
LOS	C	F

3.1.2.2 Speed Analysis

The southbound JBER on-ramp may not provide the necessary length for drivers to reach the appropriate speed for merging, because the PGDHS-recommended value of L_a is greater than the existing length. The ramp would need approximately 200 feet in additional length to meet the minimum recommended L_a for a full stop condition. Meanwhile, the measured L_g exceeds the recommended length of 330 feet (due to a larger painted nose measurement, according to the PGDHS) by about 120 feet. The following table summarizes the existing ramp conditions.

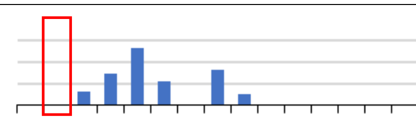
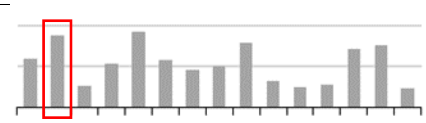
Table 17. JBER Southbound On-Ramp Speed Analysis Data (Existing Conditions)

JBER Southbound On-Ramp Speed Analysis	
Average Ramp Grade, %	-0.5
Measured L_g, ft	450
L_a Based on 0 mph Stop Condition, ft	1620
Measured L_a, ft	1420
Additional L_a per PGDHS, ft	200

3.1.2.3 Crash Analysis

Table 18 describes the crash experience at this ramp from 2013 through 2017.

Table 18. JBER Southbound On-Ramp Crash Experience 2013 to 2017

Location	Number of Crashes	Segment Length (miles)	Average AADT	Crash Rate	Crash Rate Comparison by Ramp
On-Ramp	0	0.23	3,160	-	
Ramp-Related and Through Roadway	41	0.55	57,440	0.71	

Note: Red rectangle indicates subject ramp.

Figure 12 shows the crash type and severity for the 41 crashes that occurred in the vicinity of this on-ramp.

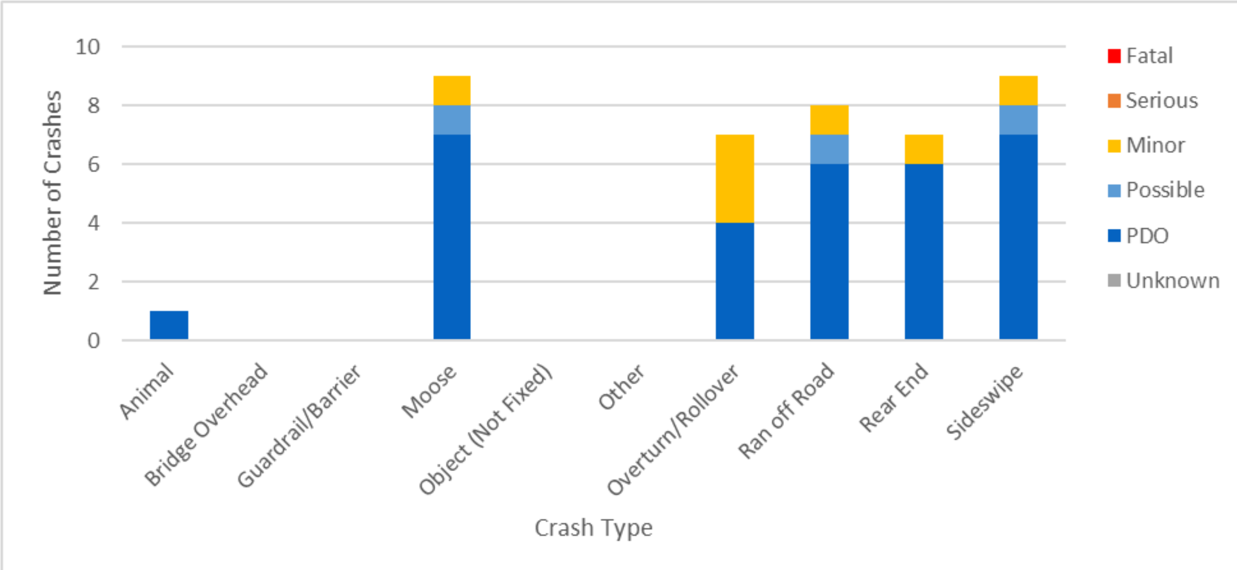


Figure 12. JBER Southbound On-Ramp Crash Type and Severity, 2013 to 2017

A review of the crash data shows:

- Nine Sideswipe crashes were recorded in the through roadway area for this ramp, with three of these crashes involving vehicles merging from the on-ramp.
- Of the eight Ran off Road crashes, four involved vehicles that lost control when merging from the on-ramp; two lost control and struck light poles, one went into a ditch and struck the JBER fence, and one crossed the median and struck a northbound vehicle. The other four crashes that were not related to the on-ramp had similar circumstances, two vehicles struck light poles, one ran into a traffic sign and one crossed the median and struck a northbound vehicle.
- Seven Overturn/Rollovers crashes were reported. One vehicle lost control on the on-ramp, another was changing lanes for a vehicle merging from the on-ramp, one hydroplaned on water in ruts, one overturned after striking a light pole, and the other three lost control on icy/snowy roads.
- Two of the seven rear end crashes involved vehicles braking for moose, and one involved three or more vehicles.
- Seven Sideswipe crashes were reported, with two of these crashes involving vehicle merging from the on ramp.
- Nine Moose crashes were also recorded.

The estimated cost of the crashes that occurred in the vicinity of this ramp is $1,535,200. The Moose crashes are unlikely to be reduced by improvements to the on-ramp and were therefore not counted in crash reduction estimations (Section 3.1.2.6).

3.1.2.4 Public Comments

A total of 12 comments from the MetroQuest survey were associated with the southbound JBER on-ramp, with five congestion-related responses, five on-ramp/merging lane-related, and two driver error-related. A few respondents attributed the congestion as a result of merging traffic and the military exit itself being backed up at times. Four responses shared a need for a longer on-ramp, and two suggested adding signalization for entering traffic.

3.1.2.5 Conceptual Design Improvements

The JBER southbound on-ramp currently provides a ramp length L_a of about 1,420 feet, which does not meet the PGDHS-recommended length of 1,620 feet. Due to vehicle volumes the ramp is projected to operate at an LOS F by the design year 2045 without added improvements. The conceptual design for this ramp extends the ramp length L_a and converts the entrance type from taper to parallel as shown in Figure 7. This would also lengthen the parallel acceleration lane L_A. While this configuration would not improve the capacity operations by one letter grade, and future operations would remain at LOS F, the concept would meet the preferred operational standards, improve merging movements, provide continuity along the study corridor, and possibly address public concerns in the area. The conceptual ramp improvements are delineated in Table 19, and the conceptual design is shown in Figure 7.

Table 19. Conceptual Design Improvements for JBER Southbound On-Ramp

Ramp Characteristics	Existing	Concept
Ramp Length L_a, ft (measured from stop condition to start of taper, based on PGDHS)	1420	1620
Parallel Acceleration lane L_A, ft (ramp merge area measured from nose of painted gore to end of taper, based on HCM)	660	1500

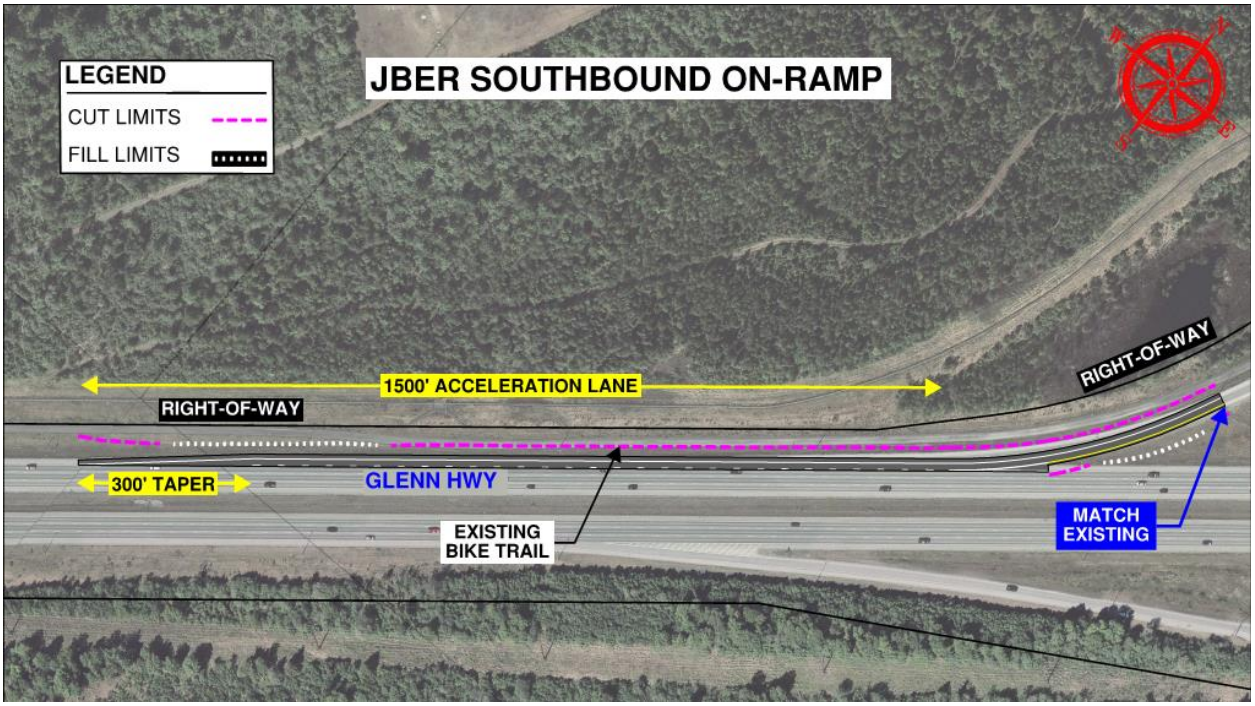


Figure 13. Conceptual Design for JBER Southbound On-Ramp

The area surrounding the conceptual design is free from potential conflicts with ROW boundaries and mapped wetlands The current ramp layout includes a paved bike trail along the right side for the entire ramp length, and it continues southbound past the Muldoon Interchange. Approximately 1,400 feet of pathway would need to be rebuilt if the ramp were to be reconstructed. Table 20 summarizes the conceptual design impacts on the existing ramp.

Table 20. JBER Southbound On-Ramp: Potential Impacts on Existing Features

	JBER Southbound: Potential Impacts on Existing Features
ROW	None
Wetland	None
Other	Existing Bike Trail on Right

The construction cost of the conceptual design for the JBER southbound on-ramp is approximately $1,209,000.

3.1.2.6 Crash Reduction

The CMF for lengthening the on-ramp merge area from 660 feet to 1,500 feet long is 0.66. Applying this CMF to all of the on-ramp crashes except for Moose crashes would reduce the 5-year cost of crashes by $422,400.

3.2 N Eagle River Interchange

3.2.1 Southbound

The results from the three analyses for the North Eagle River southbound on-ramp are summarized in Figure 14.

Figure 14. N Eagle River Southbound On-Ramp Location, Characteristics, and Data

3.2.1.1 HCS7 Merge Analysis

The southbound North Eagle River on-ramp has the longest measured L_A of the ramps in this study and operates at an acceptable LOS C under 2020 volumes and an acceptable LOS D under 2045 volumes. As volumes increase from 2020 to 2045, the on-ramp influence area speed (merge speed) will be reduced from 61 mph to 51 mph, which is 14 mph below the posted highway speed limit. Table 21 summarizes the merge analysis and results.

Table 21. N Eagle River Southbound On-Ramp Merge Analysis Data

N Eagle River Southbound On-Ramp Merge Analysis		
Ramp Demand/Geometric Data	***(2020)***	***(2045)***
AADT	2512	3591
Merge Demand Volume, vph	276	395
Measured Length of Acceleration L_A, ft	1360	
Classification	SMALL URBAN	
Heavy Vehicle %	5	
Report Values	***(2020)***	***(2045)***
On-Ramp Influence Area Speed, mph	61	51
Average Density, pc/mi/ln	27	47
LOS	C	D

3.2.1.2 Speed Analysis

The southbound North Eagle River on-ramp has sufficient acceleration lane length for drivers to achieve the desirable highway speed prior to merging. The measured L_a beginning at the North Eagle River Access Road intersection is approximately 1,020 feet greater than the PGDHS-recommended length. In addition, the measured L_g is more than three times the recommended length of 300 feet, which indicates that merging drivers have enough space to properly locate an opening within the through traffic. Compared to the other ramps in in this study, the southbound North Eagle River on-ramp has the longest measured L_a and L_g lengths. Table 22 summarizes the existing ramp conditions.

Table 22. N Eagle River Southbound On-Ramp Speed Analysis Data (Existing Conditions)

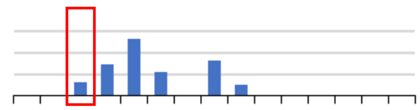
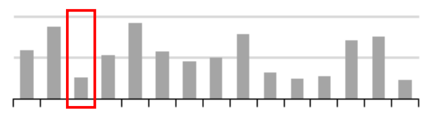
N Eagle River Southbound On-Ramp Speed Analysis	
Average Ramp Grade, %	-0.5
Measured L_g, ft	930
L_a Based on 0 mph Stop Condition, ft	1620
Measured L_a, ft	2640
Additional L_a per PGDHS, ft	-1020

3.2.1.3 Crash Analysis

Twenty-six crashes were reported in the vicinity of this on-ramp from 2013 to 2017, including 17 Rear End crashes recorded in the through roadway area. Eleven of these crashes occurred during the weekday morning peak hour (6 am to 8 am). During the study period, friction and backups due to morning peak hour traffic merging from the southbound South Eagle River on-ramp (upstream of the North Eagle River ramps) were typical. However, in 2020, an additional southbound lane and new bridge over Eagle River between South Eagle River and Hiland were completed, easing merge conditions. Because these morning peak hour rear end crashes were likely already mitigated by the 2020 upgrades, they were removed from the crash analysis, reducing the number of analyzed crashes from 26 to 15.

Table 23 describes the crash experience on and near this ramp from 2013 through 2017.

Table 23. N Eagle River Southbound On-Ramp Crash Experience 2013 to 2017

Location	Number of Crashes	Segment Length (miles)	Average AADT	Crash Rate	Crash Rate Comparison by Ramp
On-Ramp	2	0.37	2,440	1.21	
Ramp-Related and Through Roadway	13	0.93	37,290	0.21	

Note: Red rectangle indicates subject ramp.

Figure 15 shows the crash type and severity for the 15 crashes that occurred in the vicinity of this on-ramp.

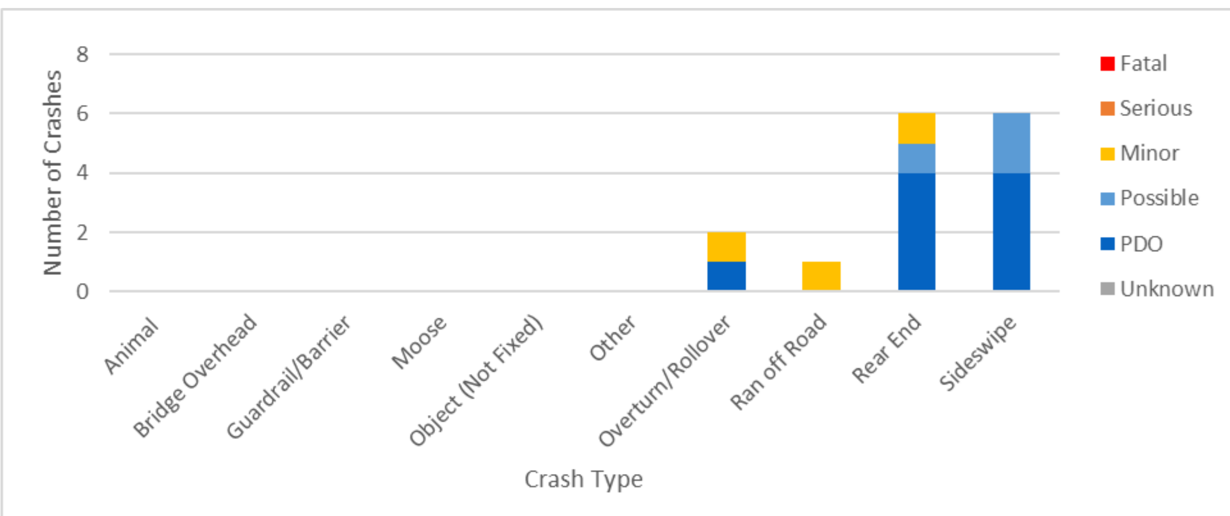


Figure 15. N Eagle River Southbound On-Ramp Crash Type and Severity, 2013 to 2017

A review of the crash data shows:

- Six Rear End crashes were recorded in the through roadway area for this ramp. One of these crashes occurred during the weekday evening peak hour (6 pm to 8 pm), four occurred between the hour from 8 am to 9 am and one occurred between 11 am and noon.
- Of the six Sideswipe crashes, three were attributed to ramp merging.
- Four of the crashes involved three or more vehicles.

The estimated cost of the crashes that occurred in the vicinity of this ramp is $754,800.

3.2.1.4 Public Comments

A total of 65 comments from the MetroQuest survey were associated with the southbound North Eagle River on-ramp, which was the most comments received by a ramp in this study. Note that many of the comments point to backup and delay at North Eagle River resulting from S Eagle River southbound on-ramp deficiencies, which have since been resolved (additional southbound lane added between South Eagle River and Hiland and new bridge over Eagle River completed in 2020).

There were 21 suggestions regarding additional lanes, 33 comments voicing concern for congestion within the area, and 8 responses pertaining to on-ramp/merging lane improvements. The prevailing suggestion for additional lanes is to continue the merge lane as an added lane, as a solution to the heavy congestion. While most respondents support the additional third lane, others also recommended a longer on-ramp, traffic metering lights, and a “dedicated entrance lane no less than 0.5 miles.”

Most respondents trace the congestion to the merging traffic, because drivers seem unable to attain speed on the ramp. The traffic at this point is most frequently described as reaching a “stop and go” condition and moving “25 mph at its best”. Users reported encountering heavy congestion mostly in the morning, specifically between 7 to 8:30 am. The preceding concerns combined with users’ concerns about safety have been attributed to “15-20 minute” delays experienced as well as the many accidents the public reported in this area.

3.2.1.5 Conceptual Design Improvements

The North Eagle River southbound on-ramp currently provides a ramp length L_a of nearly 2,640 feet, which exceeds the PGDHS-recommended length of 1,620 feet. Due to vehicle volumes the ramp is projected to continue operations at an adequate LOS D in 2045 without added improvements. The conceptual design for this ramp converts the entrance type from taper to parallel as shown in Figure 6. This would lengthen both the ramp length L_a and parallel acceleration lane L_A. While this configuration would not improve the capacity operations by one letter grade, and future operations would remain at LOS D, the concept would meet the preferred operational standards, improve merging movements, provide continuity along the study corridor, and possibly address public concerns in the area. The conceptual design improvements are delineated in Table 24, and the conceptual design is shown in Figure 16.

Table 24. Conceptual Design Improvements for N Eagle River Southbound On-Ramp

Ramp Characteristics	Existing	Concept
Ramp Length L_a, ft (measured from stop condition to start of taper, based on PGDHS)	2640	2860
Parallel Acceleration lane L_A, ft (ramp merge area from nose of painted gore to end of taper, based on HCM)	1360	2180

Note: The existing ramp length L_a is greater than PGDHS-recommended and was increased to accommodate the PGDHS typical parallel entrance ramp design.

Figure 16. Conceptual Design for N Eagle River Southbound On-Ramp

The area surrounding the conceptual design is free from potential conflicts with ROW boundaries and mapped wetlands, as well as width constraints. Table 25 summarizes the conceptual design impacts on the existing ramp.

Table 25. N Eagle River Southbound On-Ramp: Potential Impacts on Existing Features

	N Eagle River Southbound: Potential Impacts on Existing Features
ROW	None
Wetland	None
Other	None

The construction cost of the conceptual design for the North Eagle River southbound on-ramp is approximately $1,416,000.

3.2.1.6 Crash Reduction

The CMF for lengthening the on-ramp merge area from 1,360 feet to 2,180 feet long is 0.67. Applying this CMF to all the on-ramp crashes would reduce the 5-year cost of crashes by $371,650.

3.3 S Birchwood Interchange

3.3.1 Northbound

The results from the three analyses for the South Birchwood northbound on-ramp are summarized in Figure 17.

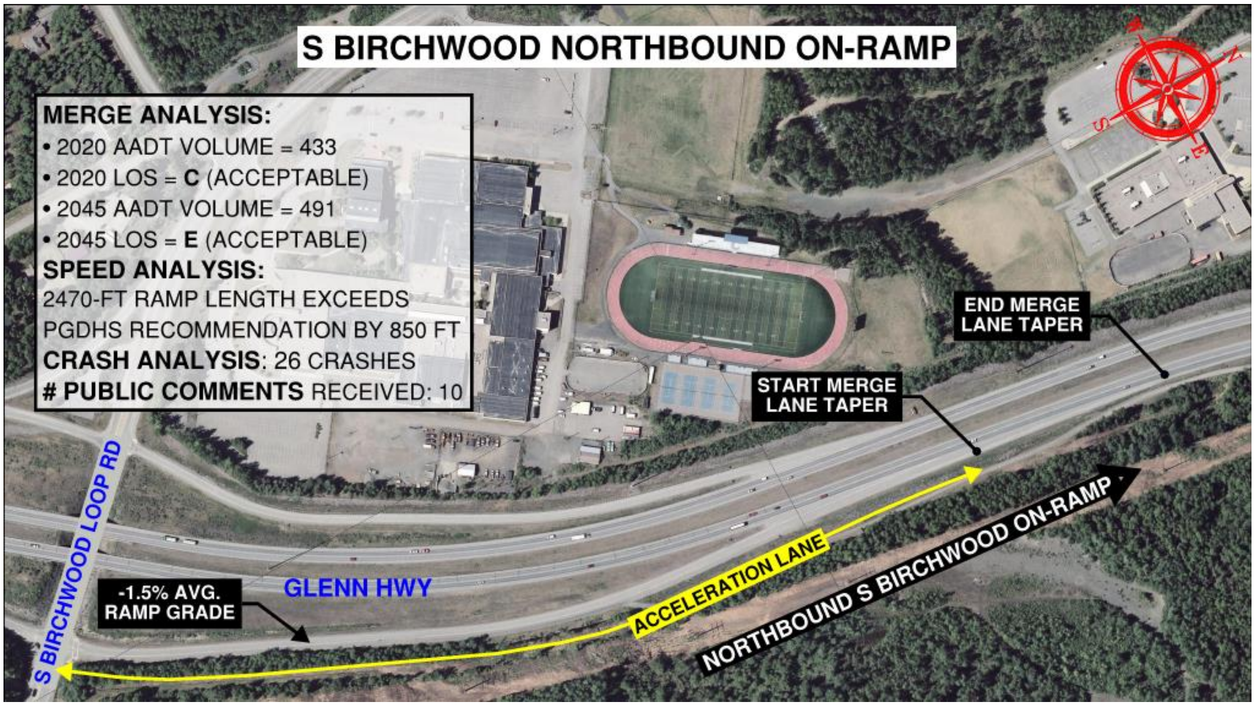


Figure 17. S Birchwood Northbound On-Ramp Location, Characteristics, and Data

3.3.1.1 HCS7 Merge Analysis

The northbound South Birchwood on-ramp operates at an acceptable LOS C and E under the 2020 and 2045 volumes, respectively. As volumes increase from 2020 to 2045, the on-ramp influence area speed (merge speed) will be reduced from 60 mph to roughly 53 mph, which is 12 mph under the posted highway speed limit. Table 26 summarizes the merge analysis and results.

Table 26. S Birchwood Northbound On-Ramp Merge Analysis Data

S Birchwood Northbound On-Ramp Merge Analysis		
Ramp Demand/Geometric Data	***(2020)***	***(2045)***
AADT	433	491
Merge Demand Volume, vph	48	54
Measured Length of Acceleration L_A, ft	605	
Classification	SMALL URBAN	
Heavy Vehicle %	5	
Report Values	***(2020)***	***(2045)***
On-Ramp Influence Area Speed, mph	60	53
Average Density, pc/mi/ln	25	41
LOS	C	E

3.3.1.2 Speed Analysis

The northbound South Birchwood on-ramp has sufficient acceleration lane length for drivers to reach the desirable highway speed prior to merging. The measured L_a beginning at the South

Birchwood Loop Road intersection exceeds the PGDHS-recommended length by about 850 feet. In addition, the measured L_g exceeds the recommended length of 300 feet by about 140 feet, which implies that merging drivers have enough space to properly locate an opening within the through traffic. Table 27 summarizes the existing ramp conditions.

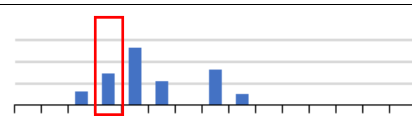
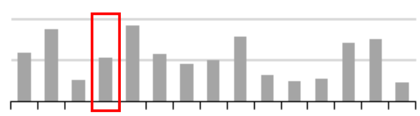
Table 27. S Birchwood Northbound On-Ramp Speed Analysis Data (Existing Conditions)

S Birchwood Northbound On-Ramp Speed Analysis	
Average Ramp Grade, %	-1.5
Measured L_g, ft	440
L_a Based on 0 mph Stop Condition, ft	1620
Measured L_a, ft	2470
Additional L_a per PGDHS, ft	-850

3.3.1.3 Crash Analysis

Table 28 shows the calculated crash rates for crashes that occurred on and near this ramp from 2013 through 2017.

Table 28. S Birchwood Northbound On-Ramp Crash Experience 2013 to 2017

Location	Number of Crashes	Segment Length (miles)	Average AADT	Crash Rate	Crash Rate Comparison by Ramp
On-Ramp	1	0.42	450	2.87	
Ramp-Related and Through Roadway	25	0.85	37,290	0.43	

Note: Red rectangle indicates subject ramp.

Figure 18 shows the crash type and severity for the 26 crashes that occurred in the vicinity of this on-ramp.

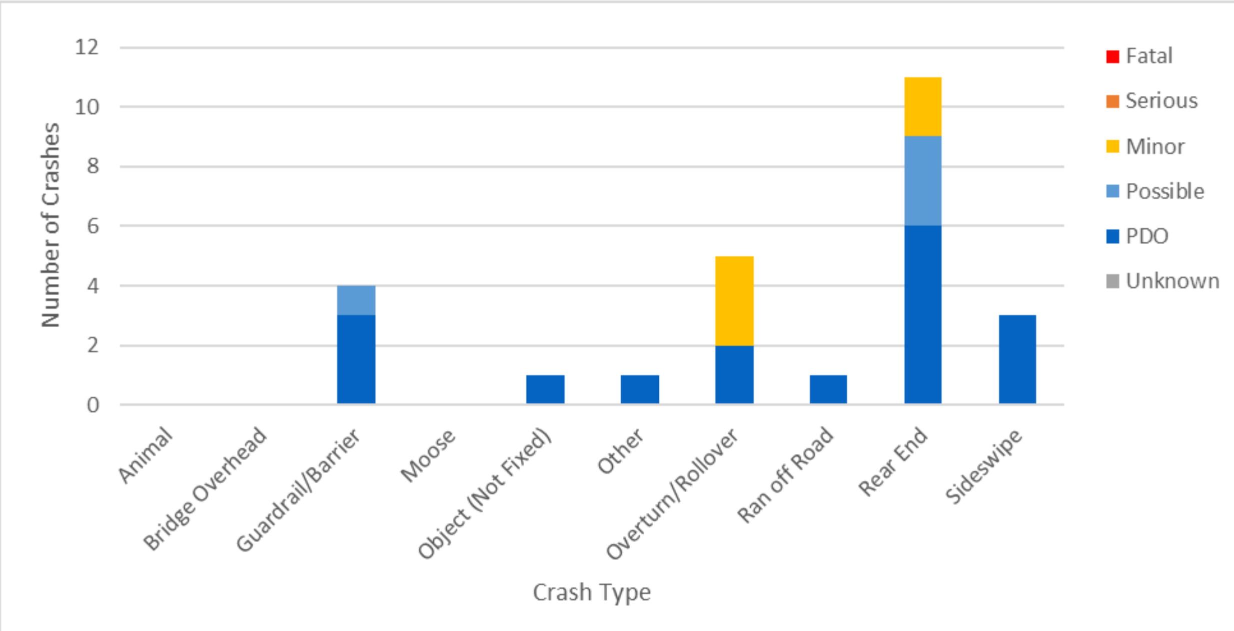


Figure 18. S Birchwood Northbound On-Ramp Crash Type and Severity, 2013 to 2017

A review of the crash data shows eleven Rear End crashes were recorded in the through roadway area for this ramp, with seven of the crashes occurring during the weekday pm peak hour (4 pm – 6 pm), and four crashes involved four vehicles.

The estimated cost of the crashes that occurred in the vicinity of this ramp is $1,197,400.

3.3.1.4 Public Comments

A total of 10 comments from the MetroQuest survey were associated with the northbound South Birchwood on-ramp; 5 comments were related to congestion and three were related to on-ramp/merging lane improvements. Respondents reported experiencing blind spots going up the ramp, as well as the taper causing drivers to feel “too far inside if … not careful.” Suggestions that were submitted consisted of a longer on-ramp and an extra lane for the merging traffic.

3.3.1.5 Conceptual Design Improvements

The South Birchwood northbound on-ramp currently provides a ramp length L_a of approximately 2,470 feet, which exceeds the PGDHS recommendation of 1,620 feet. Due to vehicle volumes the ramp is projected to continue operations at an adequate LOS E in 2045 without added improvements. The conceptual design for this ramp converts the entrance type from taper to parallel as shown in Figure 6. This would lengthen both the ramp length L_a and parallel acceleration lane L_A. While this configuration would not improve the capacity operations by one letter grade, and future operations would remain at LOS E, the concept would meet the preferred operational standards, improve merging movements, provide continuity along the study corridor, and possibly address public concerns in the area. The conceptual design improvements are delineated in Table 32, and the conceptual design is shown in Figure 19.

Table 29. Conceptual Design Improvements for S Birchwood Northbound On-Ramp

Ramp Characteristics	Existing	Concept
Ramp Length L_a, ft (measured from stop condition to start of taper, based on PGDHS)	2470	2540
Parallel Acceleration lane L_A, ft (ramp merge area from nose of painted gore to end of taper, based on HCM)	605	620

Note: The existing ramp length L_a is greater than recommended and was increased to accommodate the PGDHS typical parallel entrance ramp design.

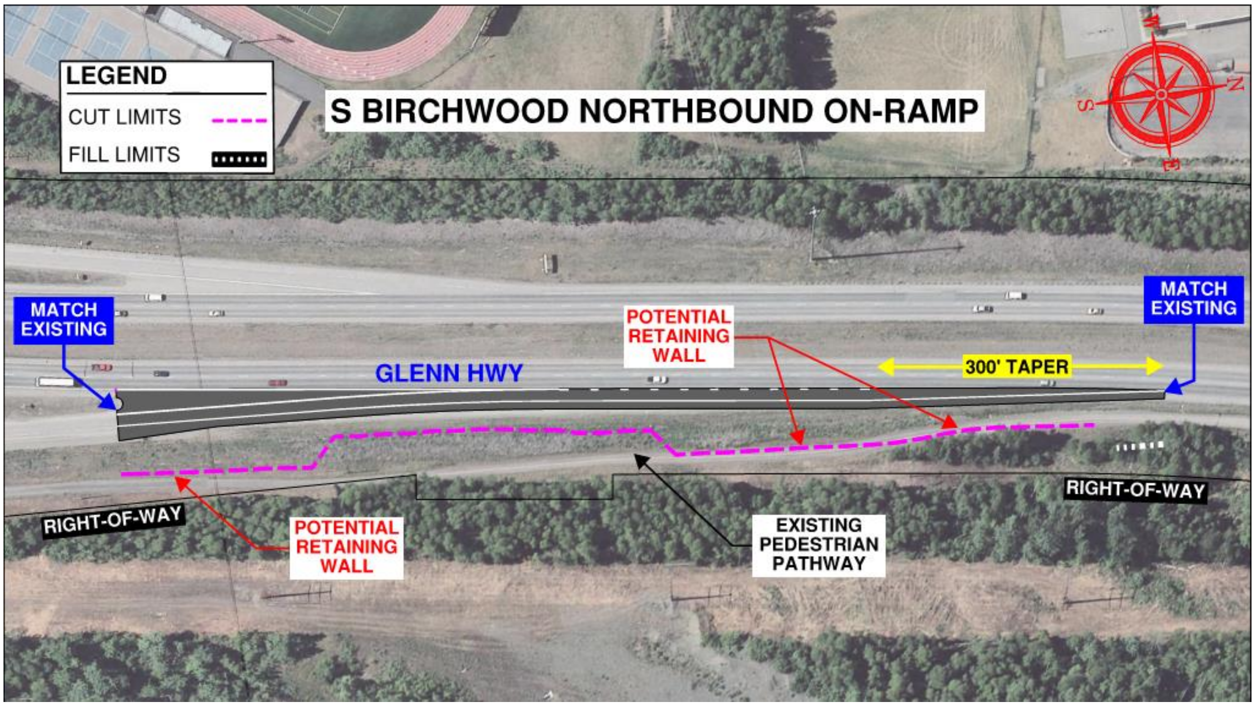


Figure 19. Conceptual Design for S Birchwood Northbound On-Ramp

The area surrounding the conceptual design is free from potential conflicts with ROW boundaries and mapped wetlands. The potential improvements may impact the nearby pedestrian pathway and retaining walls may be needed if the ramp were to be reconstructed. The cost of a total retaining wall length of roughly 590 feet was estimated and included in the total construction cost for this ramp. Table 30 summarizes the conceptual design impacts on the existing ramp.

Table 30. S Birchwood Northbound On-Ramp: Potential Impacts on Existing Features

	S Birchwood Northbound: Potential Impacts on Existing Features
ROW	None
Wetland	None
Other	Pedestrian Path on Left

The construction cost of the conceptual design for the South Birchwood northbound on-ramp is approximately $1,010,000.

3.3.1.6 Crash Reduction

The CMF for lengthening the on-ramp merge area from 605 feet to 620 feet long is 0.99. Applying this CMF to all of the on-ramp crashes would reduce the 5-year cost of crashes by $6,450.

3.3.2 Southbound

The results from the three analyses for the South Birchwood southbound on-ramp are summarized in Figure 20.

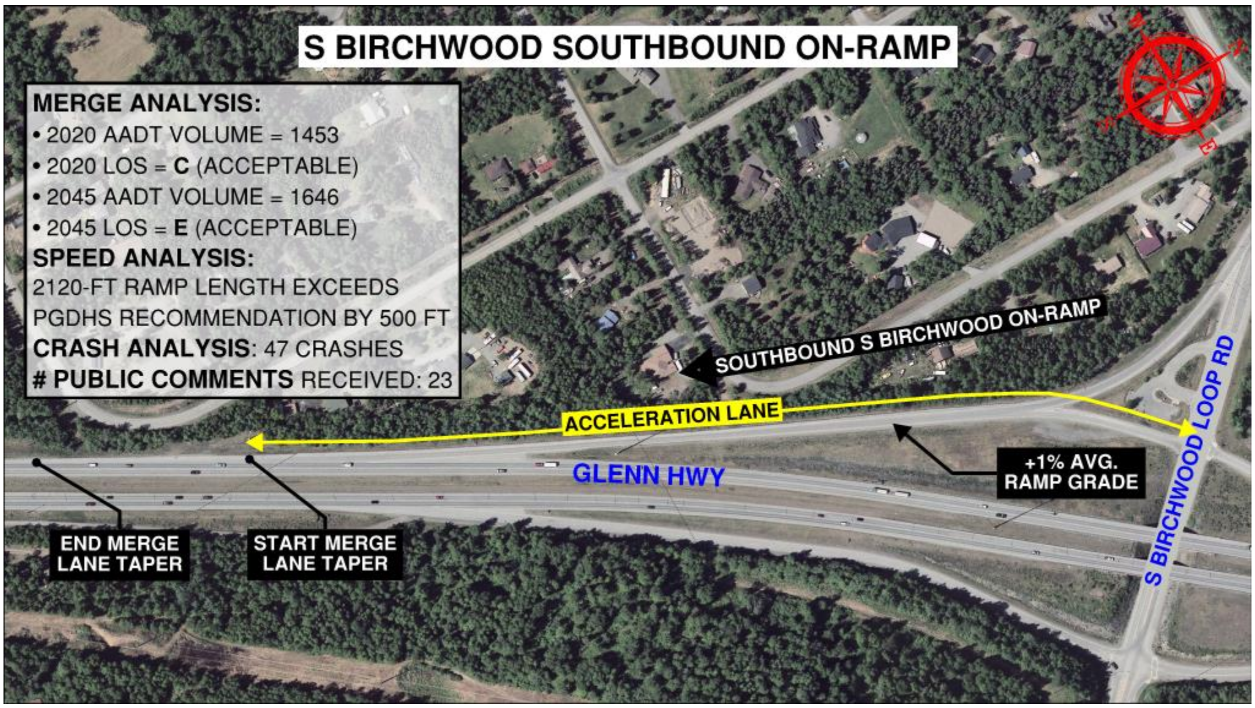


Figure 20. S Birchwood Southbound On-Ramp Location, Characteristics, and Data

3.3.2.1 HCS7 Merge Analysis

The southbound South Birchwood on-ramp operates at an acceptable LOS C under 2020 volumes and an acceptable LOS E under 2045 volumes. As volumes increase from 2020 to 2045, the on-ramp influence area speed (merge speed) will be reduced from 60 mph to 52 mph, which is 13 mph less than the posted highway speed limit. These merge analysis results are similar to those of the northbound South Birchwood on-ramp, despite the 2020 and 2045 volumes being over three times greater. This difference in resulting demand volumes is most likely offset by the longer measured L_A for the southbound on-ramp, thus generating identical LOS criteria. Table 31 summarizes the merge analysis and results.

Table 31. S Birchwood Southbound On-Ramp Merge Analysis Data

S Birchwood Southbound On-Ramp Merge Analysis		
Ramp Demand/Geometric Data	***(2020)***	***(2045)***
AADT	1453	1646
Merge Demand Volume, vph	160	181
Measured Length of Acceleration L_A, ft	800	
Classification	SMALL URBAN	
Heavy Vehicle %	5	
Report Values	***(2020)***	***(2045)***
On-Ramp Influence Area Speed, mph	60	52
Average Density, pc/mi/ln	26	43
LOS	C	E

3.3.2.2 Speed Analysis

The southbound South Birchwood on-ramp has sufficient acceleration lane length for drivers to achieve the desirable highway speed prior to merging. The measured L_a beginning at the South Birchwood Loop Road intersection exceeds the PGDHS-recommended length by about 500 feet. There are no present speed-controlling devices at the right turn onto the ramp, so the 15-mph initial speed condition may be considered for future analysis. However, the full stop condition is still applied in observation of the left-turning vehicles. The measured L_g also exceeds the recommended length of 300 feet by nearly 80 feet, which indicates that merging drivers have enough space to properly locate an opening within the through traffic. The following table summarizes the existing ramp conditions.

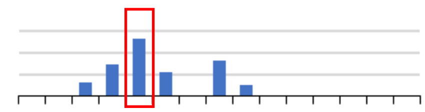
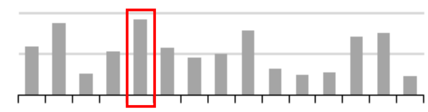
Table 32. S Birchwood Southbound On-Ramp Speed Analysis Data (Existing Conditions)

S Birchwood Southbound On-Ramp Speed Analysis	
Average Ramp Grade, %	+1
Measured L_g, ft	380
L_a Based on 0 mph Stop Condition, ft	1620
Measured L_a, ft	2120
Additional L_a per PGDHS, ft	-500

3.3.2.3 Crash Analysis

Table 33 describes the crash experience on and near this ramp from 2013 through 2017.

Table 33. S Birchwood Southbound On-Ramp Crash Experience 2013 to 2017

Location	Number of Crashes	Segment Length (miles)	Average AADT	Crash Rate	Crash Rate Comparison by Ramp
On-Ramp	5	0.36	1,460	5.22	
Ramp-Related and Through Roadway	42	0.83	37,280	0.74	

Note: Red rectangle indicates subject ramp.

Figure 21 shows the crash type and severity for the 47 crashes that occurred in the vicinity of this on-ramp.

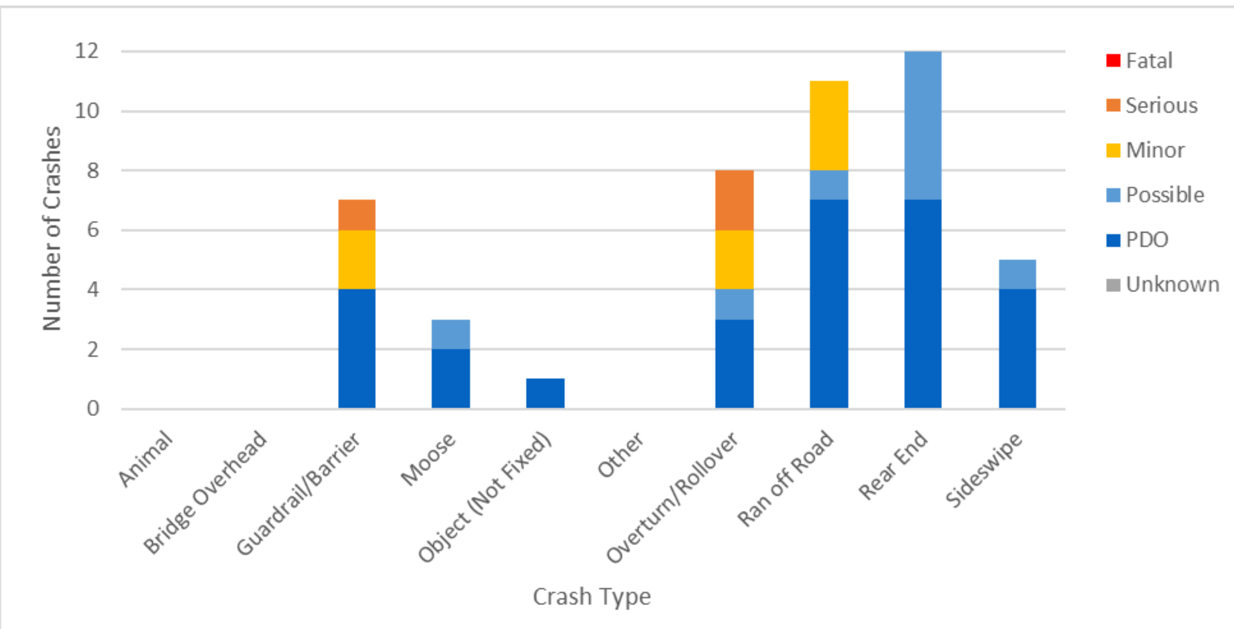


Figure 21. S Birchwood Southbound On-Ramp Crash Type and Severity, 2013 to 2017

A review of the crash data shows:

- Three suspected serious injury crashes were reported. On February 13, 2013 around 9 am, a vehicle overturned in the median after overcorrecting from drifting too far off on the right shoulder. On September 13, 2013 around 11 pm, an Overturn/Rollover occurred, but the driver did not remember the circumstances leading up to the crash. On May 24, 2017 around 10 pm, a driver hydroplaned on water in ruts, struck the guardrail/barrier and careened into the median.

- Twelve Rear End crashes were recorded in the through roadway area for this ramp. Four occurred during the weekday am peak (6 am – 8 am).
- Eleven Ran off Road crashes were reported. Two of these crashes occurred on the on-ramp: a vehicle struck a light pole and knocked it down and a second vehicle swerved to avoid the downed light pole. Three crashes were related to ramp merging; one vehicle lost control and struck trees and a fence, another hydroplaned on standing water when merging and the third lost control on the on-ramp, hit the guardrail, crossed the median and was struck by a vehicle travelling northbound. Of the six other Ran off Road crashes, two involved vehicles parked on the shoulder, two occurred when vehicles lost control and crossed the median, one vehicle hit a traffic sign and another vehicle slid down the embankment and into trees.
- Three Moose crashes were also recorded.

The estimated cost of the crashes that occurred in the vicinity of this ramp is $4,162,600. The Moose crashes are unlikely to be reduced by improvements to the on-ramp and were therefore not counted in crash reduction estimations (Section 3.3.2.6).

3.3.2.4 Public Comments

A total of 23 comments from the MetroQuest survey were associated with the southbound South Birchwood on-ramp, the majority of which were aimed at congestion issues and the need for additional lanes. Most respondents reported congestion as caused by slow merging traffic, with some experiencing traffic jams in the mornings and coinciding with buses and inexperienced drivers (most likely in the early morning and afternoon from Chugiak High School). Many suggest adding a third lane continuing from the on-ramp “for Eagle River traffic to merge onto the Glenn so as not to impede the southbound traffic that’s already on the Glenn.”

In regard to ramp improvements, respondents expressed that there is poor visibility within the merge lane as well as an inadequate ramp length and rise that do not provide enough time for cars to decide if it is safe to merge. To avert any issues with the merging traffic, one respondent shared that moving to the left lane before this juncture helps, especially in the winter. One user reported seeing many accidents in this area, and another suggested the application of informational signs when traffic must be diverted around an obstruction or detoured.

3.3.2.5 Conceptual Design Improvements

The South Birchwood southbound on-ramp currently provides a ramp length L_a of about 2,120 feet, which exceeds the PGDHS-recommended length of 1,620 feet. Due to vehicle volumes the ramp is projected to continue operations at an adequate LOS E in 2045 without added improvements. However, the highest crash rates were reported at this location. The conceptual design for this ramp extends the parallel acceleration lane L_A to 1,000 feet and converts the entrance type from taper to parallel as shown in Figure 7. This would also lengthen the ramp length L_a. While this configuration would not improve the capacity operations by one letter grade, and future operations would remain at LOS E, the concept would meet the preferred operational standards, improve merging movements, provide continuity along the study corridor, and possibly address public concerns in the area. The conceptual ramp improvements are delineated in Table 34, and the conceptual design is shown in Figure 22.

Table 34. Conceptual Design Improvements for S Birchwood Southbound On-Ramp

Ramp Characteristics	Existing	Concept
Ramp Length L_a, ft (measured from stop condition to start of taper, based on PGDHS)	2120	2420
Parallel Acceleration lane L_A, ft (ramp merge area from nose of painted gore to end of taper, based on HCM)	800	1000

Note: The existing ramp length L_a is greater than recommended and was increased to accommodate the PGDHS typical parallel entrance ramp design and conceptual L_A length as recommended by the HCM.

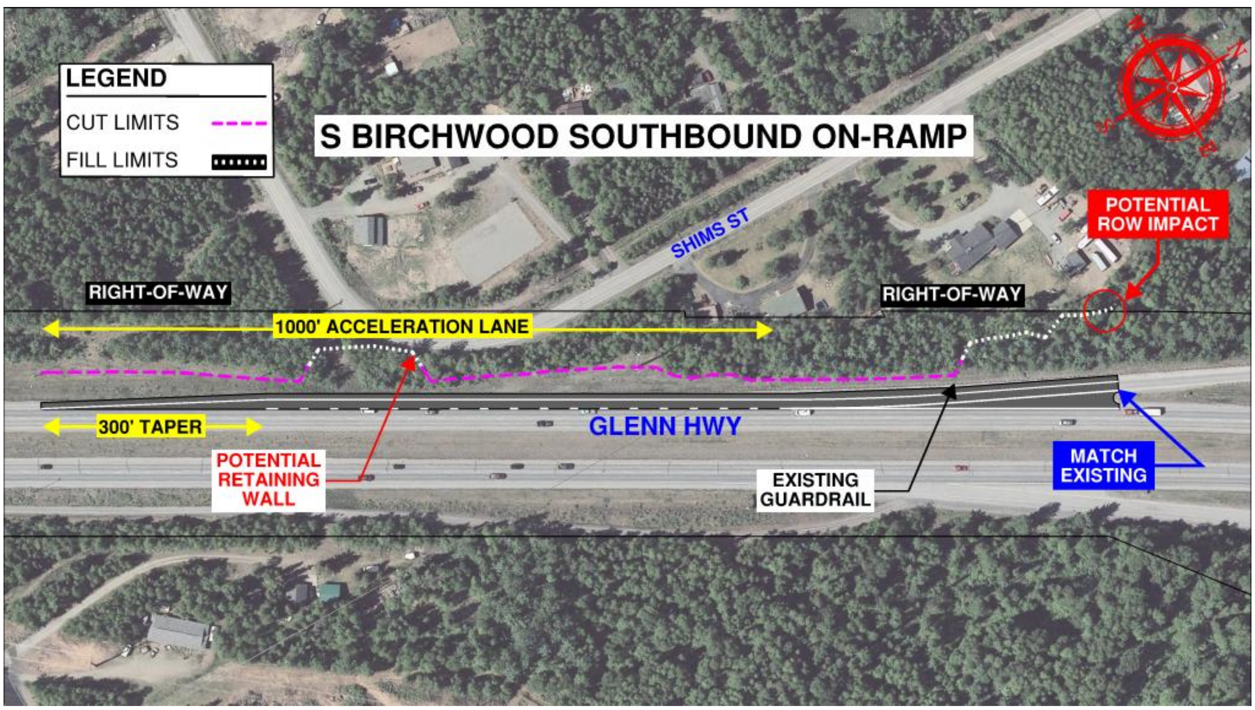


Figure 22. Conceptual Design for S Birchwood Southbound On-Ramp

The area surrounding the conceptual design is free from potential conflicts with mapped wetlands. The design may introduce possible impacts to ROW boundaries, and a retaining wall may be installed to mitigate potential impacts to Shims Street. Retaining walls can be considered as the primary mitigation measure for the potential ROW impacts, and the cost of a total retaining wall length of roughly 120 feet was estimated and included in the total construction cost for this ramp. Approximately 960 feet of guardrail along both sides of the ramp would need to be removed and replaced if the ramp were to be reconstructed. Table 35 summarizes the conceptual design impacts on the existing ramp.

Table 35. S Birchwood Southbound On-Ramp: Potential Impacts on Existing Features

	S Birchwood Southbound: Potential Impacts on Existing Features
ROW	Yes
Wetland	None
Other	Guardrail on Both Sides, Shims St

The construction cost of the conceptual design for the South Birchwood southbound on-ramp is approximately $963,000.

3.3.2.6 Crash Reduction

The CMF for lengthening the on-ramp merge area from 800 feet to 1,000 feet long is 0.91. Applying this CMF to all of the on-ramp crashes except the Moose crashes would reduce the 5-year cost of crashes by $374,800.

3.4 N Birchwood Interchange

3.4.1 Northbound

The results from the three analyses for the North Birchwood northbound on-ramp are summarized in Figure 23.

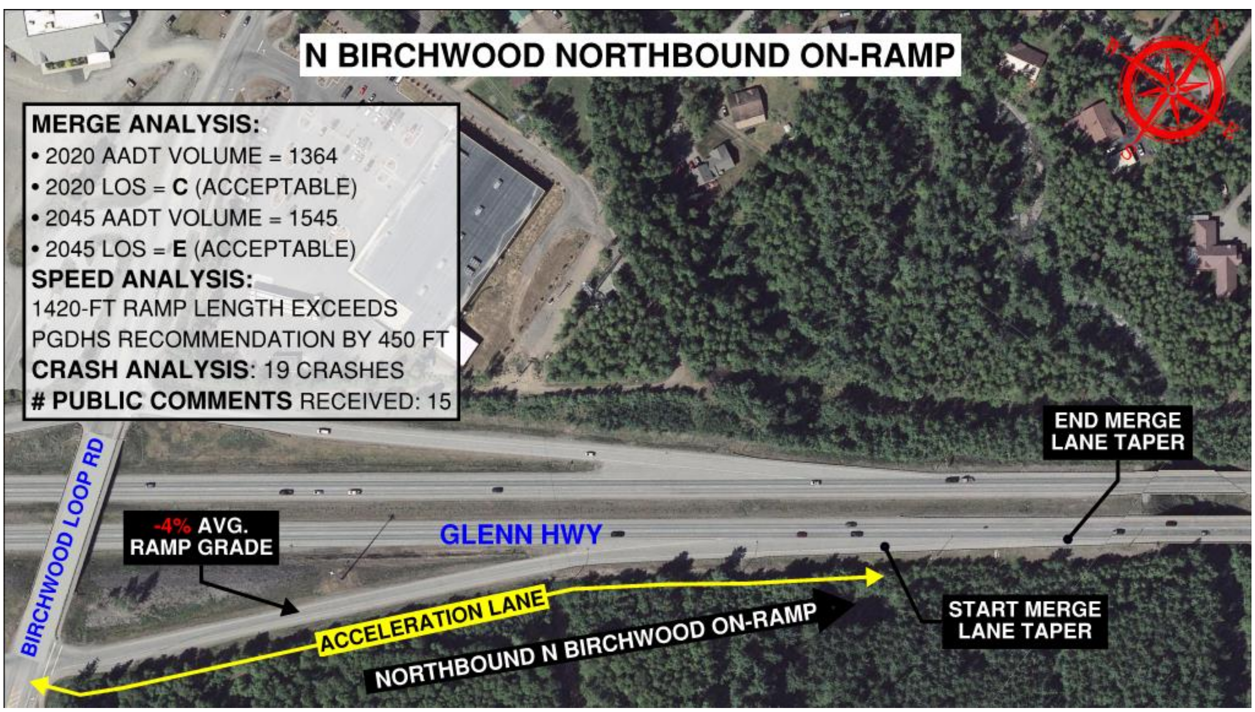


Figure 23. N Birchwood Northbound On-Ramp Location, Characteristics, and Data

3.4.1.1 HCS7 Merge Analysis

The northbound North Birchwood on-ramp operates at an acceptable LOS C under 2020 volumes and an acceptable LOS E under 2045 volumes. As volumes increase from 2020 to 2045, the on-ramp influence area speed (merge speed) will be reduced from 60 mph to 52 mph, which is 13 mph less than the posted highway speed limit. Among the ramps analyzed, this ramp had the shortest measured L_A length. Table 36 summarizes the merge analysis and results.

Table 36. N Birchwood Northbound On-Ramp Merge Analysis Data

N Birchwood Northbound On-Ramp Merge Analysis		
Ramp Demand/Geometric Data	***(2020)***	***(2045)***
AADT	1364	1545
Merge Demand Volume	150	170
Measured Length of Acceleration L_A, ft	520	
Classification	SMALL URBAN	
Heavy Vehicle %	5	
Report Values	***(2020)***	***(2045)***
On-Ramp Influence Area Speed, mph	60	52
Average Density, pc/mi/ln	26	44
LOS	C	E

3.4.1.2 Speed Analysis

The northbound North Birchwood on-ramp has sufficient acceleration lane length for drivers to achieve the desirable highway speed prior to merging. The ramp has an average grade of -4%, which would warrant a speed change lane adjustment factor that modifies the recommended L_a length. The measured L_a beginning at the Birchwood Loop Road intersection exceeds the PGDHS-recommended length by about 450 feet. The existing L_g is also greater than the recommended 300 feet by about 110 feet, which indicates that merging drivers have enough space to properly locate an opening within the through traffic. Table 37 following table summarizes the existing ramp conditions.

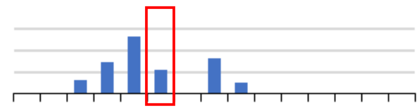
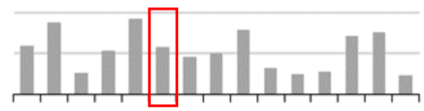
Table 37. N Birchwood Northbound On-Ramp Speed Analysis Data (Existing Conditions)

N Birchwood Northbound On-Ramp Speed Analysis	
Average Ramp Grade, %	- 4
Measured L_g, ft	410
L_a Based on 0 mph Stop Condition, ft	970
Measured L_a, ft	1420
Additional L_a per PGDHS, ft	-450

3.4.1.3 Crash Analysis

Table 38 describes the crash experience on and near this ramp from 2013 through 2017.

Table 38. N Birchwood Northbound On-Ramp Crash Experience 2013 to 2017

Location	Number of Crashes	Segment Length (miles)	Average AADT	Crash Rate	Crash Rate Comparison by Ramp
On-Ramp	1	0.20	1,260	2.17	
Ramp-Related and Through Roadway	18	0.59	36,740	0.46	

Note: Red rectangle indicates subject ramp.

Figure 24 shows the crash type and severity for the 19 crashes that occurred in the vicinity of this on-ramp.

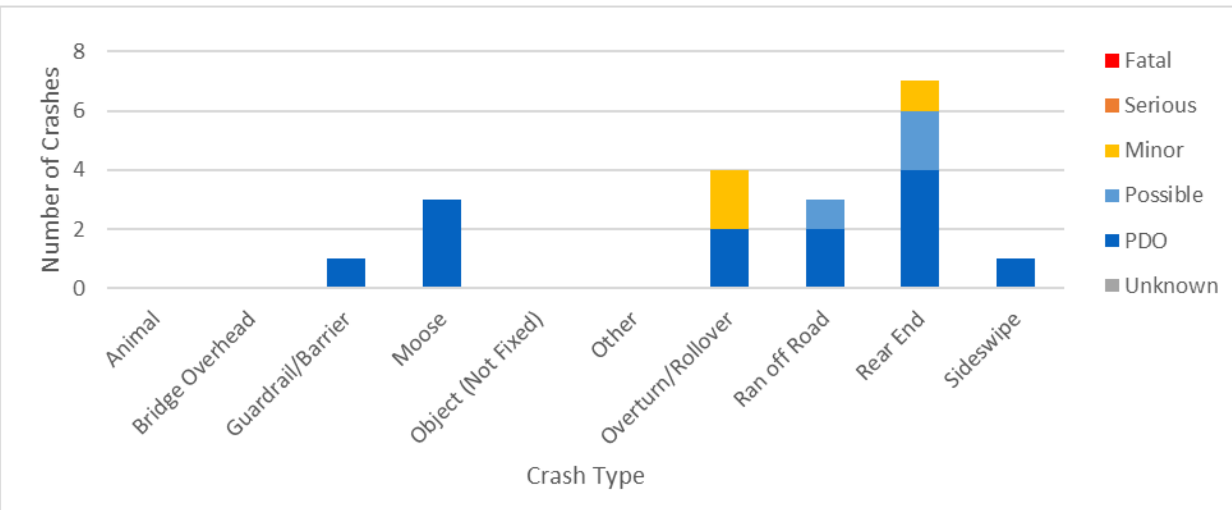


Figure 24. N Birchwood Northbound On-Ramp Crash Type and Severity, 2013 to 2017

Seven Rear End crashes were recorded in the through roadway area for this ramp, with three of the crashes occurring during the weekday evening peak hour (4 pm – 6 pm).

Three Moose crashes were recorded.

The estimated cost of the crashes that occurred in the vicinity of this ramp is $787,600. The Moose crashes are unlikely to be reduced by improvements to the on-ramp and were therefore not counted in crash reduction estimations (Section 3.4.1.6).

3.4.1.4 Public Comments

A total of 15 comments from the MetroQuest survey were associated with the northbound North Birchwood on-ramp, 5 of which were regarding congestion in the area and 7 regarding improvements to the on-ramp/merging lane. Several respondents mentioned not having enough time/distance on the ramp to enter the highway efficiently, as well as a slowdown in speed for both the highway drivers and those merging. Two comments were made about the grade of the ramp hindering the driver's view of the oncoming traffic. A suggestion was made to reconstruct the lanes to be three "all the way to the Wasilla/Palmer interchange."

3.4.1.5 Conceptual Design Improvements

The North Birchwood northbound on-ramp currently provides a ramp length L_a of roughly 1,420 feet, which exceeds the PGDHS-recommended length of 970 feet. Due to vehicle volumes the ramp is projected to continue operations at an adequate LOS E in 2045 without added improvements. The conceptual design for this ramp converts the entrance type from taper to parallel as shown in Figure 6. This would lengthen both the ramp length L_a and parallel acceleration lane L_A. While this configuration would not improve the capacity operations by one letter grade, and future operations would remain at LOS E, the concept would meet the preferred operational standards, improve merging movements, provide continuity along the study corridor, and potentially address public concerns in the area. The conceptual design improvements are delineated in Table 39, and the conceptual design is shown in Figure 25.

Table 39. Conceptual Design Improvements for N Birchwood Northbound On-Ramp

Ramp Characteristics	Existing	Concept
Ramp Length L_a, ft (measured from stop condition to start of taper, based on PGDHS)	1420	1340
Parallel Acceleration lane L_A, ft (ramp merge area from nose of painted gore to end of taper, based on HCM)	520	540

Note: The existing ramp length L_a is greater than PGDHS-recommended and was modified to accommodate the PGDHS typical parallel entrance ramp design. The conceptual L_a is less than the existing due to an existing taper length that is significantly less than 300 feet.

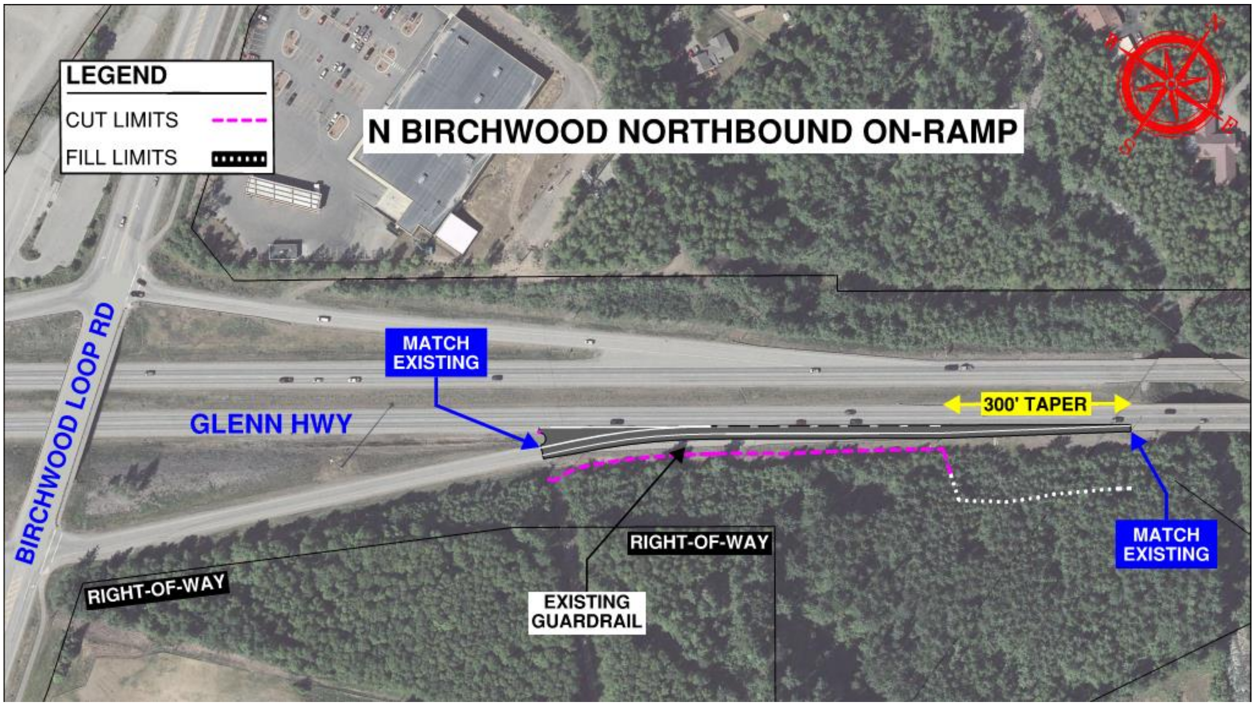


Figure 25. Conceptual Design for N Birchwood Northbound On-Ramp

The area surrounding the conceptual design is free from potential conflicts with ROW boundaries and mapped wetlands. Approximately 570 feet of guardrail on the right side of the ramp would need to be removed and replaced if the ramp were to be reconstructed. Table 40 summarizes the conceptual design impacts on the existing ramp.

Table 40. N Birchwood Northbound On-Ramp: Potential Impacts on Existing Features

	N Birchwood Northbound: Potential Impacts on Existing Features
ROW	None
Wetland	None
Other	Guardrail on Right Side

The construction cost of the conceptual design for the North Birchwood northbound on-ramp is approximately $399,000.

3.4.1.6 Crash Reduction

The CMF for lengthening the on-ramp merge area from 520 feet to 540 feet long is 0.99. Applying this CMF to all of the on-ramp crashes except for Moose crashes would reduce the 5-year cost of crashes by $8,950.

3.4.2 Southbound

Figure 26 displays a summary of the results from the three analyses for the North Birchwood southbound on-ramp.

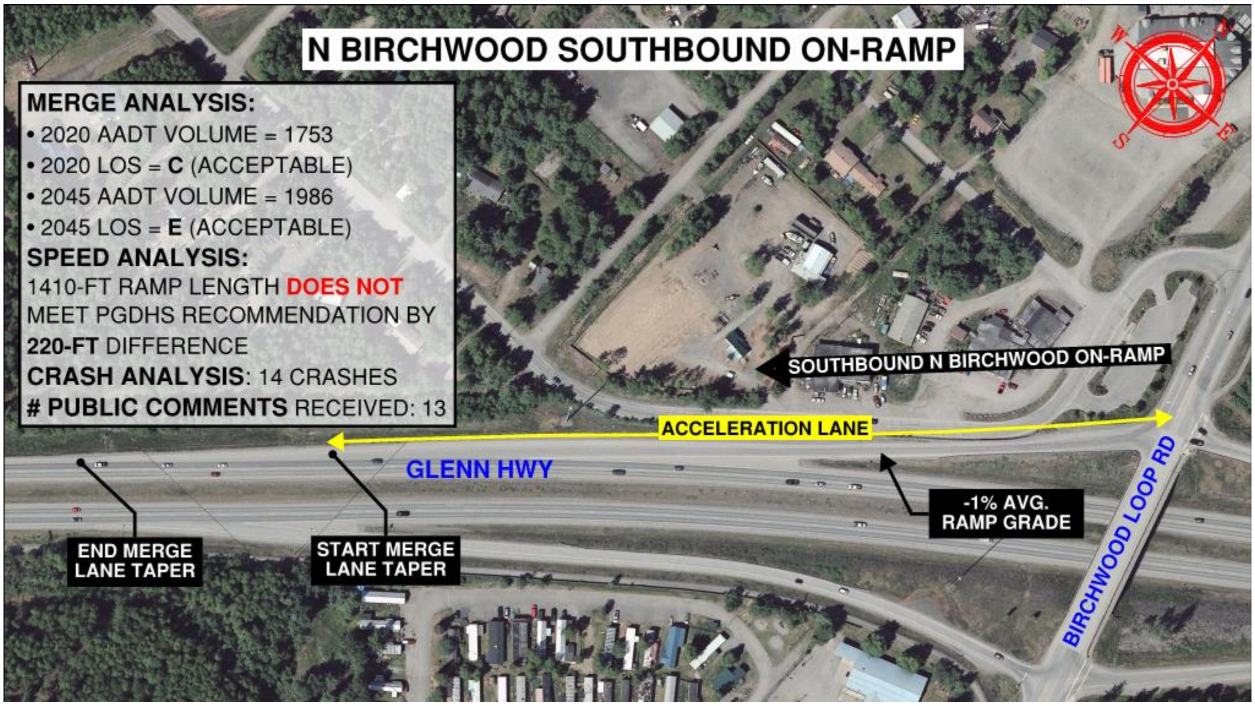


Figure 26. N Birchwood Southbound On-Ramp Location, Characteristics, and Data

3.4.2.1 HCS7 Merge Analysis

The southbound North Birchwood on-ramp operates at an acceptable LOS C under 2020 volumes and an acceptable LOS E under 2045 volumes. As volumes increase from 2020 to 2045, the on-ramp influence area speed (merge speed) will be reduced from 60 mph to 52 mph, which is 13 mph below the posted highway speed limit. Table 41 summarizes the merge analysis and results.

Table 41. N Birchwood Southbound On-Ramp Merge Analysis Data

N Birchwood Southbound On-Ramp Merge Analysis		
Ramp Demand/Geometric Data	***(2020)***	***(2045)***
AADT	1753	1986
Merge Demand Volume, vph	193	218
Measured Length of Acceleration L_A, ft	700	
Classification	SMALL URBAN	
Heavy Vehicle %	5	
Report Values	***(2020)***	***(2045)***
On-Ramp Influence Area Speed, mph	60	52
Average Density, pc/mi/ln	26	44
LOS	C	E

3.4.2.2 Speed Analysis

The southbound North Birchwood on-ramp may not provide the necessary length for drivers to reach the appropriate speed for merging, because the PGDHS-recommended L_a is greater than the existing length. There are no present speed-controlling devices at the right turn onto the ramp, so the 15-mph initial speed condition may be considered for future analysis. However, the full stop condition is still applied in observation of the left-turning vehicles. The ramp would need approximately 220 feet in additional length to meet the minimum recommended L_a. Meanwhile, the measured L_g is about double the recommended 300 feet, which implies that merging drivers have enough space to properly locate an opening within the through traffic. The following table summarizes the existing ramp conditions.

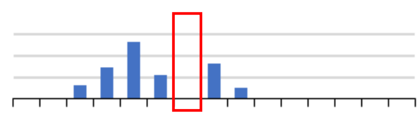
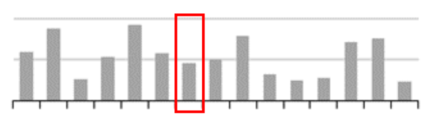
Table 42. N Birchwood Southbound On-Ramp Speed Analysis Data (Existing Conditions)

N Birchwood Southbound On-Ramp Speed Analysis	
Average Ramp Grade, %	-1
Measured L_g, ft	600
L_a Based on 0 mph Stop Condition, ft	1620
Measured L_a, ft	1410
Additional L_a per PGDHS, ft	220

3.4.2.3 Crash Analysis

Table 43 describes the crash experience near this ramp from 2013 through 2017.

Table 43. N Birchwood Southbound On-Ramp Crash Experience 2013 to 2017

Location	Number of Crashes	Segment Length (miles)	Average AADT	Crash Rate	Crash Rate Comparison by Ramp
On-Ramp	0	0.19	1,870	-	
Ramp-Related and Through Roadway	14	0.56	36,740	0.37	

Note: Red rectangle indicates subject ramp.

Figure 27 shows the crash type and severity for the 14 crashes that occurred in the vicinity of this on-ramp.

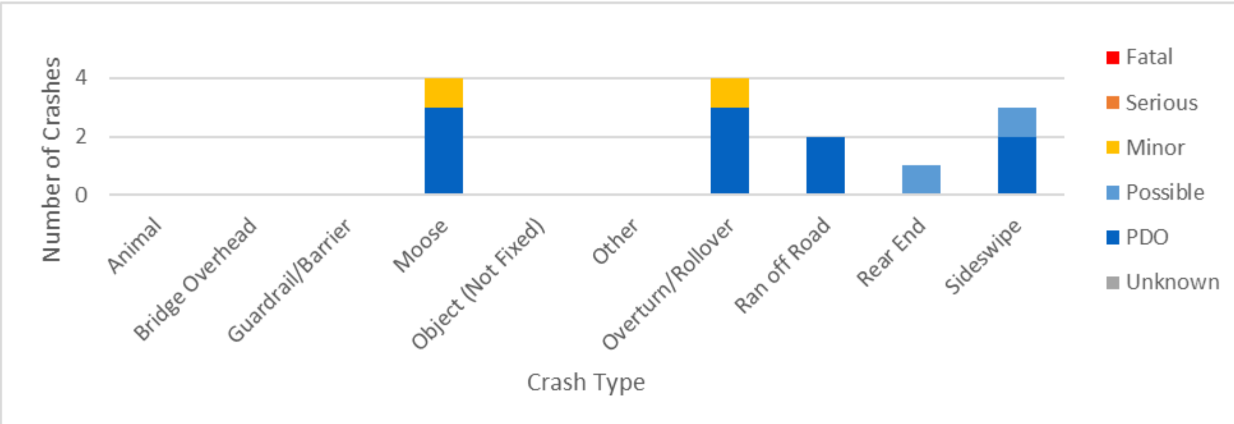


Figure 27. N Birchwood Southbound On-Ramp Crash Type and Severity, 2013 to 2017

Four Overturn/Rollover crashes were reported. Two of these resulted when the driver fell asleep, one occurred when a driver was swerving to avoid a boulder and one occurred when a vehicle's wheel got pulled into the snow berm.

Four Moose crashes were also recorded.

The estimated cost of the crashes that occurred in the vicinity of this ramp is $536,000. The Moose crashes are unlikely to be reduced by improvements to the on-ramp and were therefore not counted in crash reduction estimations (Section 3.4.2.6).

3.4.2.4 Public Comments

A total of 13 comments from the MetroQuest survey were associated with the southbound North Birchwood on-ramp. The majority of comments were related to congestion, and the others covered a variety of categories. The congestion-related responses expressed concern for entering traffic merging at low speeds, thus slowing down highway drivers or motivating them to avoid yielding. One respondent reported experiencing the effects of congestion in the morning, and that it takes "upwards of 35 minutes" to get through the section between Chugiak High School and Hiland. The suggestions were fairly similar to suggestions for other ramps in that they included an extension of the merging lane, a longer on-ramp, or the addition of a third lane from Birchwood through Eagle River. One respondent suggested a frontage road to be installed from North Birchwood to South Eagle River on the right side of the Glenn Highway.

3.4.2.5 Conceptual Design Improvements

The North Birchwood southbound on-ramp currently provides a ramp length L_a of about 1,410 feet, which does not meet the PGDHS-recommended length of 1,620 feet. However, due to vehicle volumes the ramp will continue to operate at an adequate LOS E in 2045 without added improvements. The conceptual design for this ramp extends the ramp length L_a and converts the entrance type from taper to parallel as shown in Figure 6. This would also lengthen the parallel acceleration lane L_A. While this configuration would not improve the capacity operations by one letter grade, and future operations would remain at LOS E, the concept would meet the preferred operational standards, improve merging movements, provide continuity along the study corridor, and possibly resolve public concerns in the area. The conceptual design improvements are delineated in Table 44, and the conceptual design is shown in Figure 28.

Table 44. Conceptual Design Improvements for N Birchwood Southbound On-Ramp

Ramp Characteristics	Existing	Concept
Ramp Length L_a, ft (measured from stop condition to start of taper, based on PGDHS)	1410	1620
Parallel Acceleration lane L_A, ft (ramp merge area from nose of painted gore to end of taper, based on HCM)	700	930

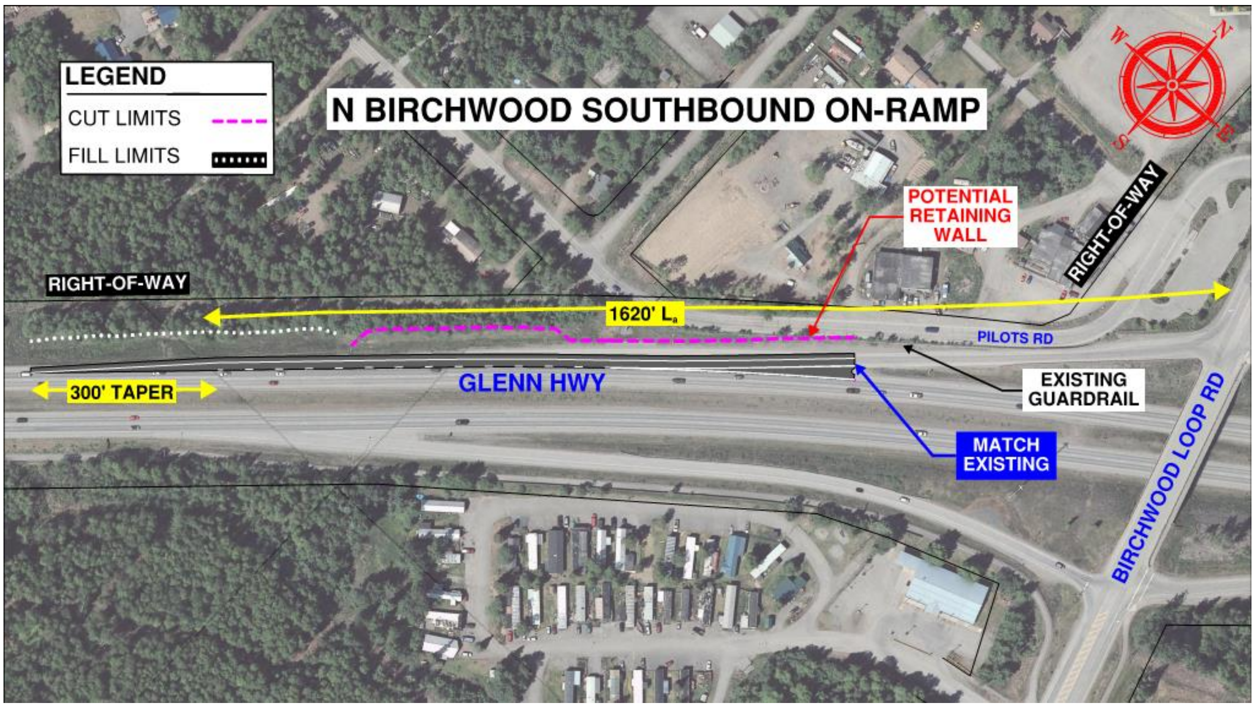


Figure 28. Conceptual Design for N Birchwood Southbound On-Ramp

The area surrounding the conceptual design is free from potential conflicts with ROW boundaries and mapped wetlands. A retaining wall may be installed as a way to mitigate potential impacts on Pilots Road if the ramp were to be reconstructed. The cost of a retaining wall length of roughly 140 feet was estimated and included in the total construction cost for this ramp. The existing guardrail on the left side of the ramp would not be affected by the design. Table 45 summarizes the conceptual design impacts on the existing ramp.

Table 45. N Birchwood Southbound On-Ramp: Potential Impacts on Existing Features

	N Birchwood Southbound: Potential Impacts on Existing Features
ROW	None
Wetland	None
Other	Pilots Rd

The construction cost of the conceptual design for the North Birchwood southbound on-ramp is approximately $873,000.

3.4.2.6 Crash Reduction

The CMF for lengthening the on-ramp merge area from 700 feet to 930 feet long is 0.89. Applying this CMF to all of the on-ramp crashes except for Moose crashes would reduce the 5-year cost of crashes by $38,850.

3.5 S Peters Creek Interchange

3.5.1 Northbound

Figure 29 summarizes the results from the three analyses for the South Peters Creek northbound on-ramp.

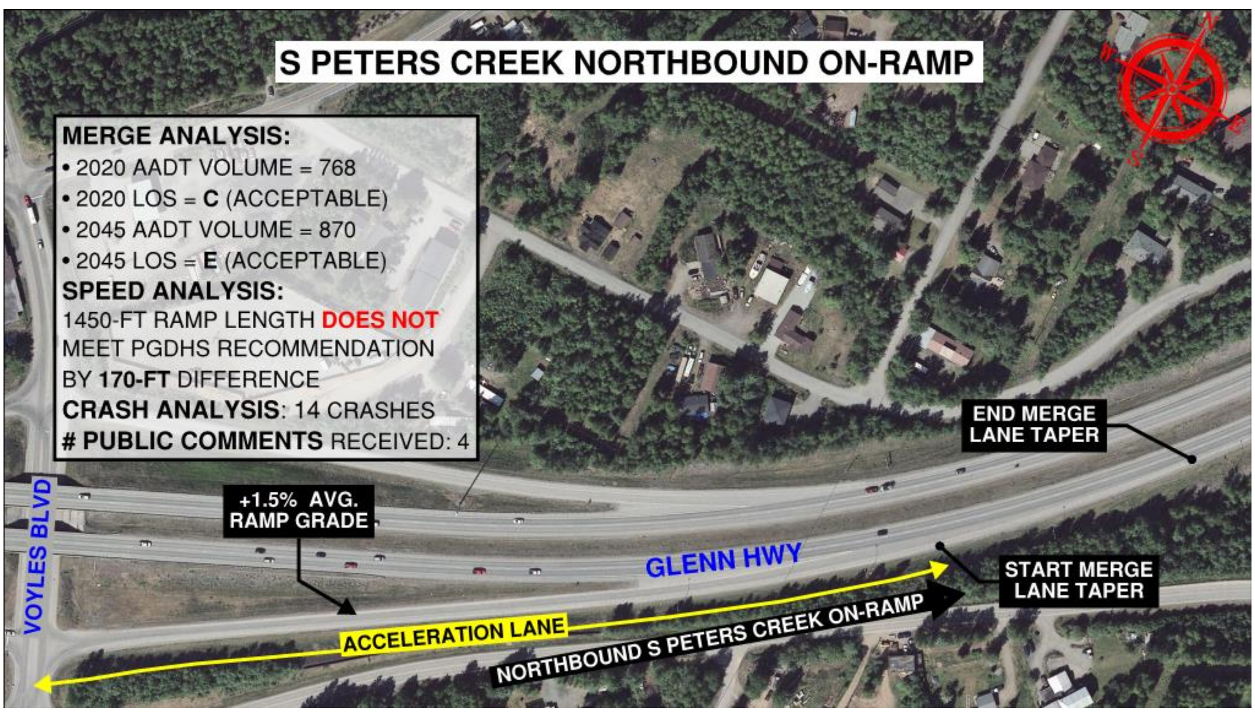


Figure 29. S Peters Creek Northbound On-Ramp Location, Characteristics, and Data

3.5.1.1 HCS7 Merge Analysis

The northbound South Peters Creek on-ramp operates at an acceptable LOS C and E under 2020 and 2045 volumes, respectively. As volumes increase from 2020 to 2045, the on-ramp influence area speed (merge speed) will be reduced from 60 mph to 53 mph, which is 12 mph lower than the posted highway speed limit. Table 46 summarizes the merge analysis and results.

Table 46. S Peters Creek Northbound On-Ramp Merge Analysis Data

S Peters Creek Northbound On-Ramp Merge Analysis		
Ramp Demand/Geometric Data	***(2020)***	***(2045)***
AADT	768	870
Merge Demand Volume, vph	84	96
Measured Length of Acceleration L_A, ft	550	
Classification	SMALL URBAN	
Heavy Vehicle %	5	
Report Values	***(2020)***	***(2045)***
On-Ramp Influence Area Speed, mph	60	53
Average Density, pc/mi/ln	25	42
LOS	C	E

3.5.1.2 Speed Analysis

The northbound South Peters Creek on-ramp may not provide a sufficient length for drivers to achieve the desirable highway speed, because the PGDHS-recommended L_a is greater than the existing length. There are no speed-controlling devices at the right turn onto the ramp, so the 15-mph initial speed condition may be considered for future analysis. However, the full stop condition is still applied in observation of the left-turning vehicles. The ramp would need approximately 270 feet in additional length to meet the minimum recommended L_a. Meanwhile, the measured L_g is about the same as the recommended length, which implies that merging drivers have enough space to properly locate an opening within the through traffic. The following table summarizes the existing ramp conditions.

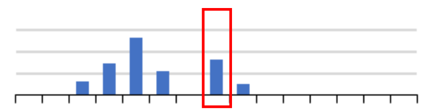
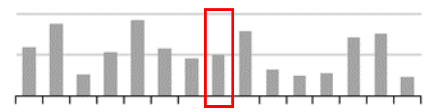
Table 47. S Peters Creek Northbound On-Ramp Speed Analysis Data (Existing Conditions)

S Peters Creek Northbound On-Ramp Speed Analysis	
Average Ramp Grade, %	+1.5
Measured L_g, ft	300
L_a Based on 0 mph Stop Condition, ft	1620
Measured L_a, ft	1450
Additional L_a per PGDHS, ft	170

3.5.1.3 Crash Analysis

Table 48 shows the number and location of crashes that occurred on or near this ramp from 2013 through 2017.

Table 48. S Peters Creek Northbound On-Ramp Crash Experience 2013 to 2017

Location	**Number of Crashes**	**Segment Length (miles)**	**Average AADT**	**Crash Rate**	**Crash Rate Comparison by Ramp**
On-Ramp	1	0.24	700	3.27	
Ramp-Related and Through Roadway	13	0.52	34,460	0.40	

Note: Red rectangle indicates subject ramp.

Figure 30 shows the crash type and severity for the 14 crashes that occurred in the vicinity of this on-ramp.

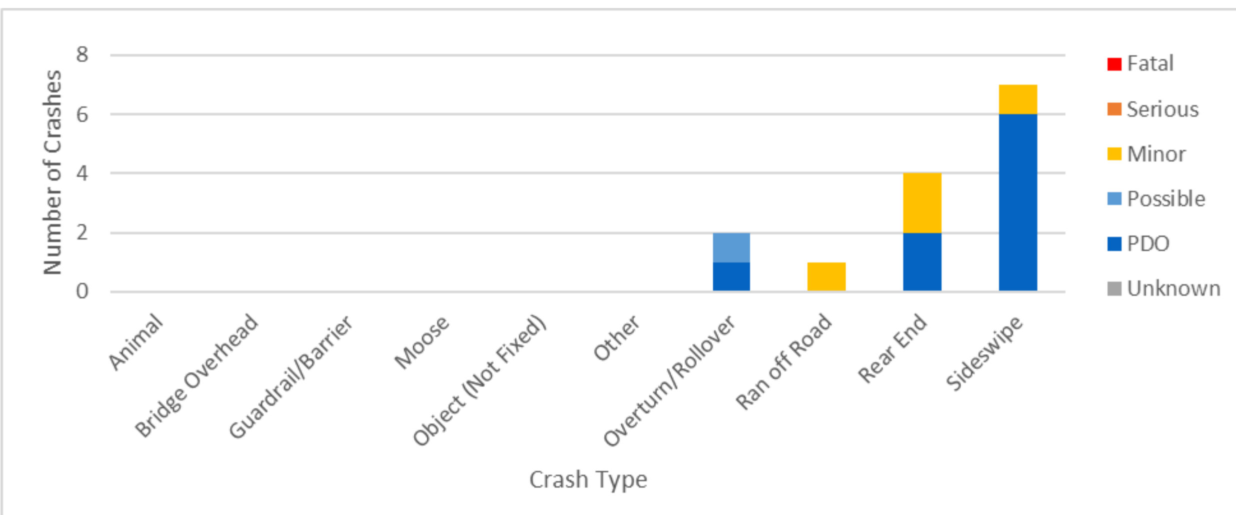


Figure 30. S Peters Creek Northbound On-Ramp Crash Type and Severity, 2013 to 2017

Seven Sideswipe crashes were reported. One of these crashes occurred on the on-ramp and one was related to ramp merging. Four Rear End crashes occurred; one was a motorcycle crash and three occurred during the weekday pm peak hour (4 pm to 6 pm).

The estimated cost of the crashes that occurred in the vicinity of this ramp is $750,800.

3.5.1.4 Public Comments

A total of 4 comments from the MetroQuest survey were associated with the northbound South Peters Creek on-ramp, three of which were concerning congestion and the other being related to on-ramp/merging lane improvements. It has been observed that the congestion lies within the fast lane, as highway drivers change lanes to accommodate entering traffic. Another respondent explained that the combination of congestion and road conditions is the leading cause of accidents in the area. There was expressed dissatisfaction with the ramp being at an uphill grade.

3.5.1.5 Conceptual Design Improvements

The South Peters Creek northbound on-ramp currently provides a ramp length L_a of approximately 1,450 feet, which does not meet the PGDHS recommendation of 1,620 feet. However, due to vehicle volumes the ramp will continue to operate at an adequate LOS E in 2045 without added improvements. The conceptual design for this ramp extends the ramp length L_a and converts the entrance type from taper to parallel as shown in Figure 6. This would also lengthen the parallel acceleration lane L_A. While this configuration would not improve the capacity operations by one letter grade, and future operations would remain at LOS E, the concept would meet the preferred operational standards, improve merging movements, provide continuity along the study corridor and possibly address public concerns in the area. The conceptual design improvements are delineated in Table 49, and the conceptual design is shown in Figure 31.

Table 49. Conceptual Design Improvements for S Peters Creek Northbound On-Ramp

Ramp Characteristics	Existing	Concept
Ramp Length L_a, ft (measured from stop condition to start of taper, based on PGDHS)	1450	1620
Parallel Acceleration lane L_A, ft (ramp merge area from nose of painted gore to end of taper, based on HCM)	550	630

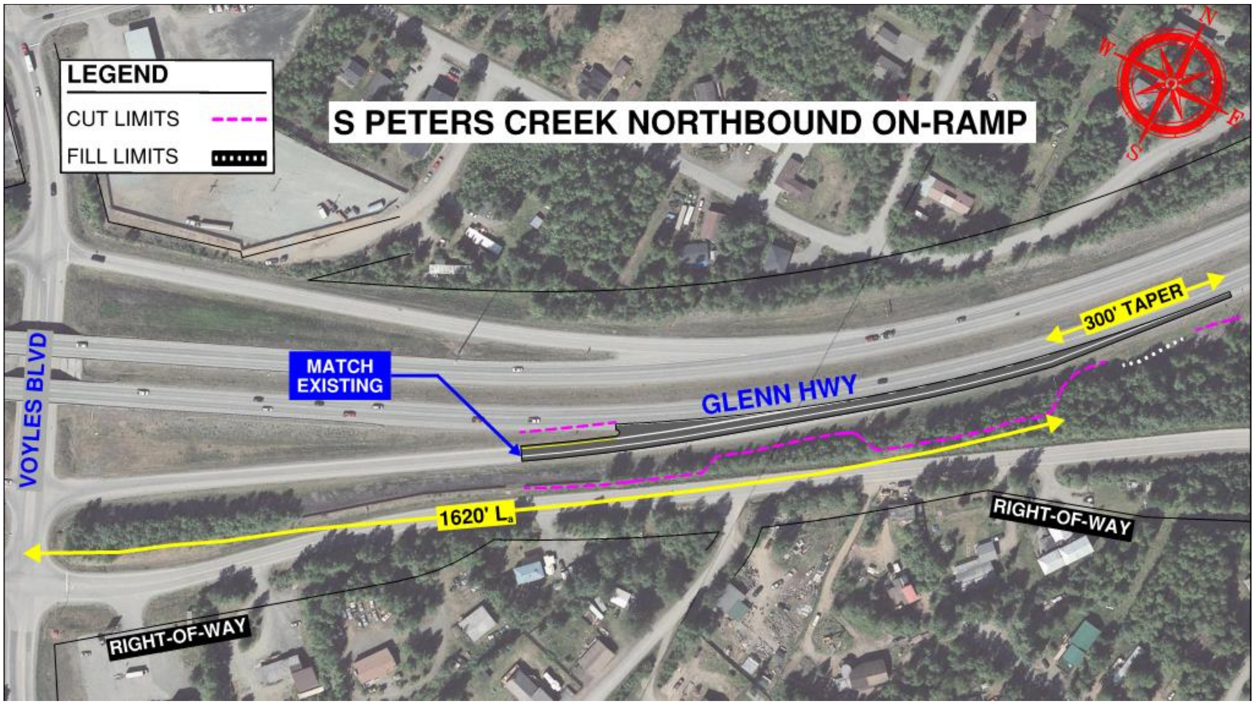


Figure 31. Conceptual Design for S Peters Creek Northbound On-Ramp

The area surrounding the conceptual design is free from potential conflicts with ROW boundaries and mapped wetlands, as well as width constraints. Table 50 summarizes the conceptual design impacts on the existing ramp.

Table 50. S Peters Creek Northbound On-Ramp: Potential Impacts on Existing Features

	S Peters Creek Northbound: Potential Impacts on Existing Features
ROW	None
Wetland	None
Other	None

The construction cost of the conceptual design for the South Peters Creek northbound on-ramp is approximately $616,000.

3.5.1.6 Crash Reduction

The CMF for lengthening the on-ramp merge area from 550 feet to 630 feet long is 0.995. Applying this CMF to all of the on-ramp crashes would reduce the 5-year crash cost by $27,850.

3.5.2 Southbound

A summary of the results from the three analyses for the South Peters Creek southbound on-ramp is displayed in Figure 32.

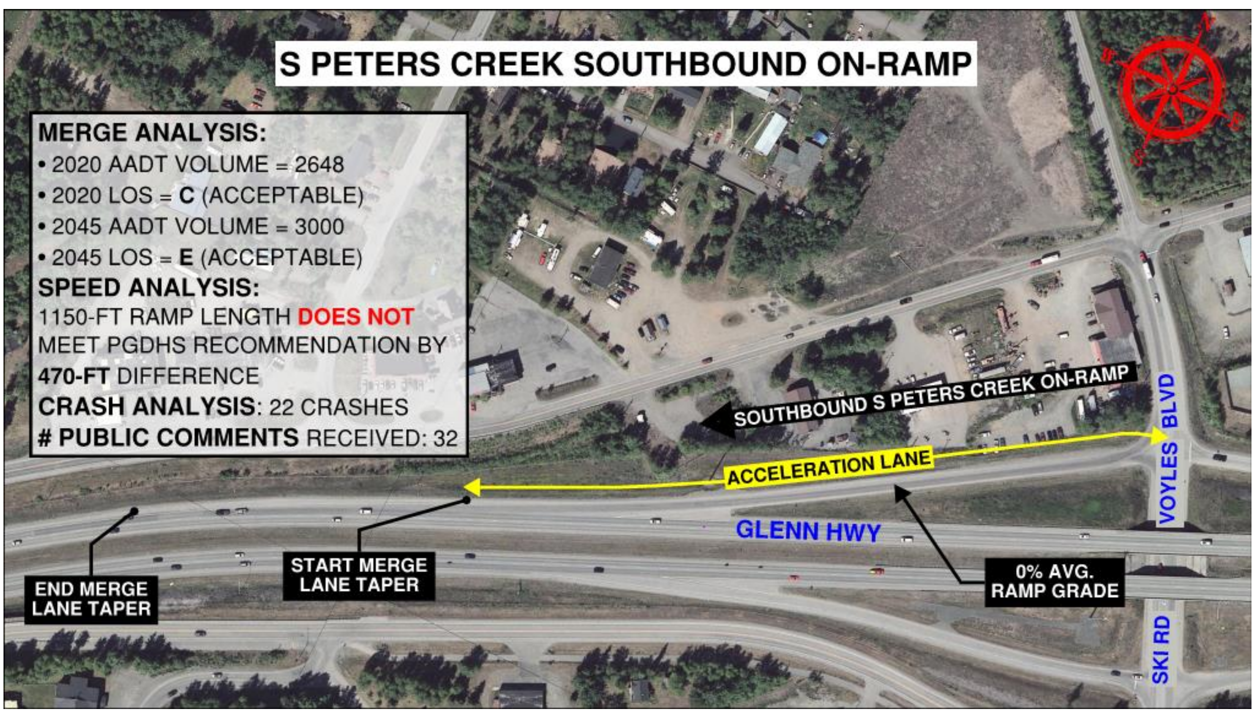


Figure 32. S Peters Creek Southbound On-Ramp Location, Characteristics, and Data

3.5.2.1 HCS7 Merge Analysis

The southbound South Peters Creek on-ramp operates at an acceptable LOS C under 2020 volumes and an acceptable LOS E under 2045 volumes. As volumes increase from 2020 to 2045, the on-ramp influence area speed (merge speed) will be reduced from 60 mph to 51 mph, which is 14 mph under the posted highway speed limit. Table 51 summarizes the merge analysis and results.

Table 51. S Peters Creek Southbound On-Ramp Merge Analysis Data

S Peters Creek Southbound On-Ramp Merge Analysis		
Ramp Demand/Geometric Data	***(2020)***	***(2045)***
AADT	2648	3000
Merge Demand Volume, vph	291	330
Measured Length of Acceleration L_A, ft	780	
Classification	SMALL URBAN	
Heavy Vehicle %	5	
Report Values	***(2020)***	***(2045)***
On-Ramp Influence Area Speed, mph	60	51
Average Density, pc/mi/ln	27	46
LOS	C	E

3.5.2.2 Speed Analysis

The southbound South Peters Creek on-ramp may not provide the necessary length for drivers to achieve the desirable highway speed, because the PGDHS-recommended L_a is greater than the existing length. There is no present speed-controlling device at the right turn onto the ramp, so the 15-mph initial speed condition may be considered for future analysis. However, the full stop condition is still applied in observation of the left-turning vehicles. This ramp has the shortest measured L_a in the study and would need roughly an additional 470 feet to meet the minimum recommended L_a. Meanwhile, the measured L_g exceeds the 300-foot recommendation by about 40 feet, which indicates that merging drivers have enough space to properly locate an opening within the through traffic. The following table summarizes the existing ramp conditions.

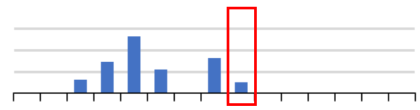
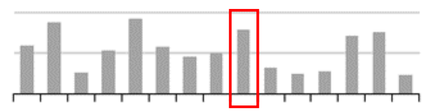
Table 52. S Peters Creek Southbound On-Ramp Speed Analysis Data (Existing Conditions)

S Peters Creek Southbound On-Ramp Speed Analysis	
Average Ramp Grade, %	0
Measured L_g, ft	340
L_a Based on 0 mph Stop Condition, ft	1620
Measured L_a, ft	1150
Additional L_a per PGDHS, ft	470

3.5.2.3 Crash Analysis

Table 53 describes the crash experience on and near this ramp from 2013 through 2017.

Table 53. S Peters Creek Southbound On-Ramp Crash Experience 2013 to 2017

Location	Number of Crashes	Segment Length (miles)	Average AADT	Crash Rate	Crash Rate Comparison by Ramp
On-Ramp	1	0.17	3,170	1.02	
Ramp-Related and Through Roadway	21	0.53	34,460	0.63	

Note: Red rectangle indicates subject ramp.

Figure 33 shows the crash type and severity for the 22 crashes that occurred in the vicinity of this on-ramp.

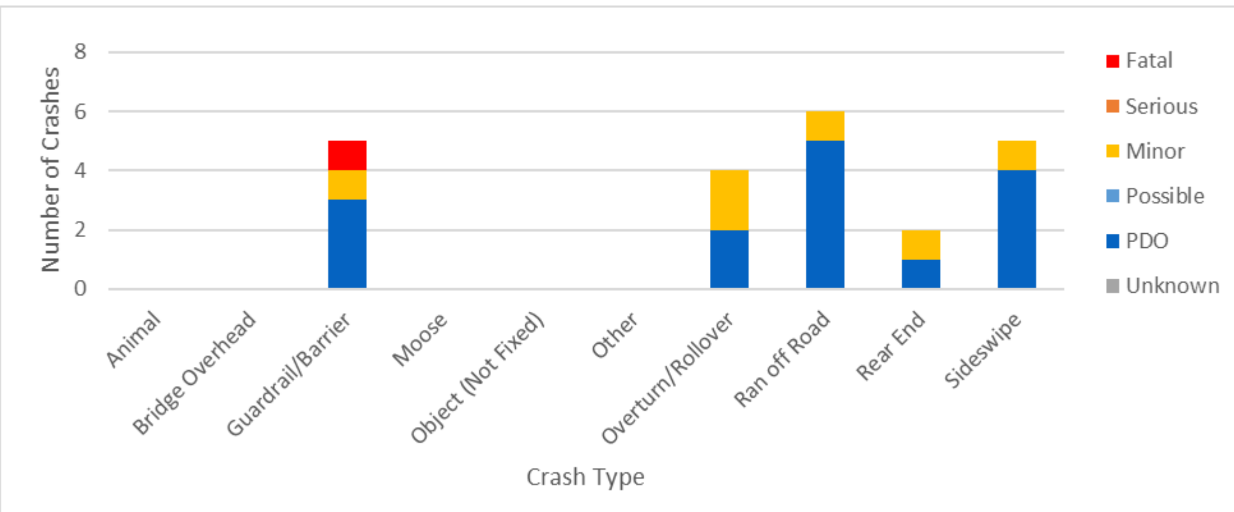


Figure 33. S Peters Creek Southbound On-Ramp Crash Type and Severity, 2013 to 2017

One fatal crash occurred in the through roadway area at this ramp. On September 6, 2015, around midnight, a vehicle left the roadway, entered the median, collided with the guardrail for about 50’, rolled over and ejected the driver.

Six Ran off Road crashes were reported. Five of the six crashes involved vehicles that ran into a fence. Two of the vehicles lost traction on the ramp before colliding with the fence.

The estimated cost of the crashes that occurred in the vicinity of this ramp is $11,623,000.

3.5.2.4 Public Comments

A total of 32 comments from the MetroQuest survey were associated with the southbound South Peters Creek on-ramp, with the majority of comments suggesting ramp or merging lane improvements. Congestion and lighting/visibility issues were frequently mentioned. 23 respondents shared similar opinions about the ramp being too short to allow vehicles to get up to highway speeds and at too steep of an uphill to allow merging drivers to adequately see highway traffic before joining. Several respondents stated that poor visibility is exacerbated by the ramp's guardrail, winter conditions/lack of traction, and morning congestion. One commenter suggested that the curve present at the end or the merging lane catches drivers unaware, and another suggested that the poor visibility caused by the angle of the approach of the ramp combined with the curve leading down the hill (towards N Birchwood) causes vehicles to spin out.

Per the comments, these issues cause people to "unexpectedly change lanes and brake." A respondent observed that merging vehicles are driving "consistently 20 mph under the speed limit." One user recommended a third lane connecting the ramps between North Birchwood and Peters Creek to allow adequate room to merge safely, "similar to the setup on the northbound Glenn/Parks Interchange by Matsu Hospital." The concerns for this ramp that were provided by the public were considered in the development of the concept design.

3.5.2.5 Conceptual Design Improvements

The South Peters Creek southbound on-ramp currently provides a ramp length L_a of about 1,150 feet, which does not meet the PGDHS-recommended length of 1620 feet. However, due to vehicle volumes the ramp will continue to operate at an adequate LOS E in 2045 without added improvements. the conceptual design for this ramp extends the ramp length L_a and converts the entrance type from taper to parallel as shown in Figure 6. This would also lengthen the parallel acceleration lane L_A. While this configuration would not improve the capacity operations by one letter grade, and future operations would remain at LOS E, the concept meets the preferred operational standards, improves merging movements, provide continuity along the study corridor, and possibly resolves public concerns in the area. The conceptual design improvements are delineated in Table 54, and the conceptual design is shown in Figure 34.

Table 54. Conceptual Design Improvements for S Peters Creek Southbound On-Ramp

Ramp Characteristics	Existing	Concept
Ramp Length L_a, ft (measured from stop condition to start of taper, based on PGDHS)	1150	1620
Parallel Acceleration lane L_A, ft (ramp merge area from nose of painted gore to end of taper, based on HCM)	780	960

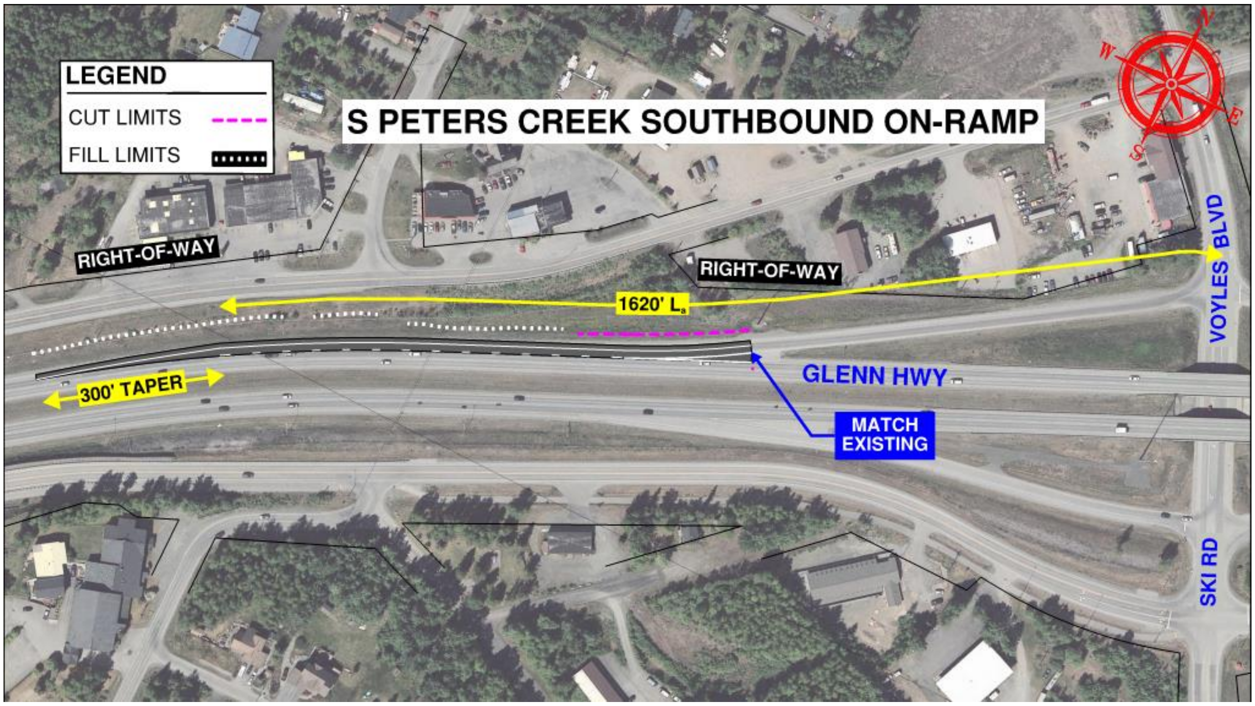


Figure 34. Conceptual Design for S Peters Creek Southbound On-Ramp

The area surrounding the conceptual design is free from potential conflicts with ROW boundaries and mapped wetlands, as well as width constraints. Table 55 summarizes the conceptual design impacts on the existing ramp.

Table 55. S Peters Creek Southbound On-Ramp: Potential Impacts on Existing Features

	S Peters Creek Southbound: Potential Impacts on Existing Features
ROW	None
Wetland	None
Other	None

The construction cost of the conceptual design for the South Peters Creek southbound on-ramp is approximately $622,000.

3.5.2.6 Crash Reduction

The CMF for lengthening the on-ramp merge area from 780 feet to 960 feet long is 0.92. Applying this CMF to all of the on-ramp crashes would reduce the 5-year crash cost by $950,900.

3.6 N Peters Creek Interchange

3.6.1 Northbound

Figure 35 shows a summary of the results from the three analyses for the North Peters Creek northbound on-ramp.

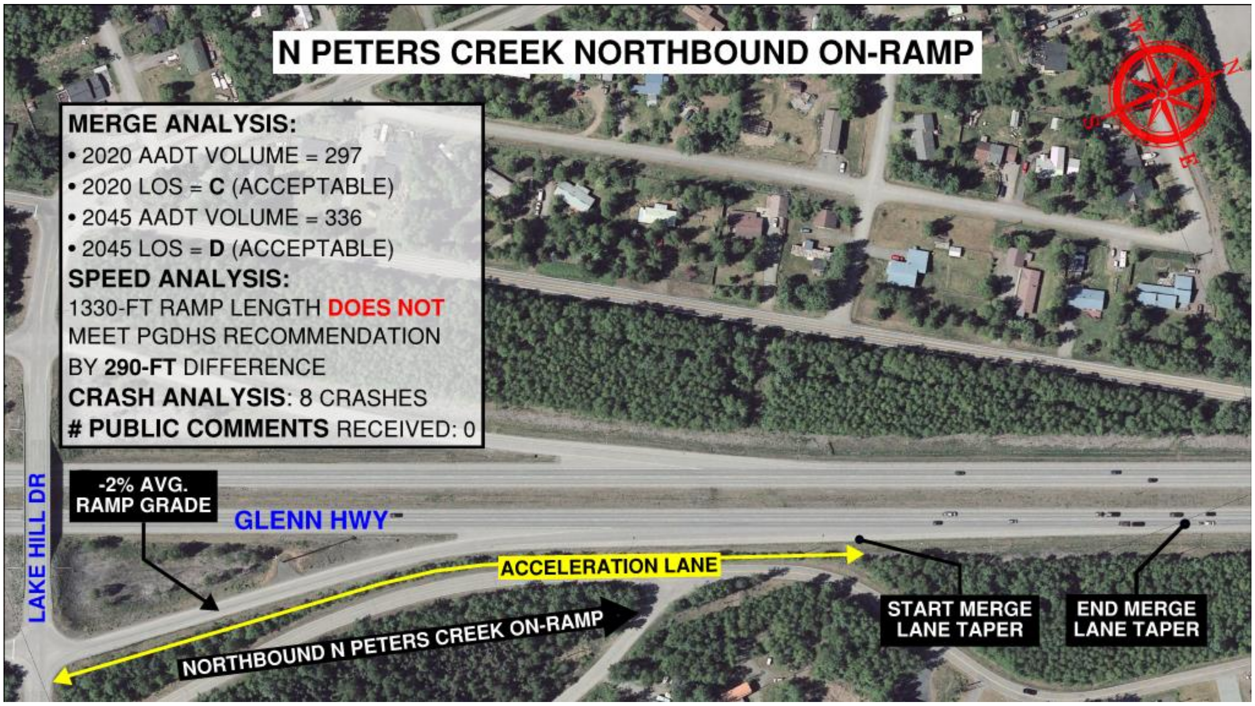


Figure 35. N Peters Creek Northbound On-Ramp Location, Characteristics, and Data

3.6.1.1 HCS7 Merge Analysis

The northbound North Peters Creek on-ramp operates at an acceptable LOS C and D under the respective 2020 and 2045 volumes. As volumes increase from 2020 to 2045, the on-ramp influence area speed (merge speed) will be reduced from 61 mph to 54 mph, which is 11 mph below the posted highway speed limit. Table 56 summarizes the merge analysis and results.

Table 56. N Peters Creek Northbound On-Ramp Merge Analysis Data

N Peters Creek Northbound On-Ramp Merge Analysis		
Ramp Demand/Geometric Data	***(2020)***	***(2045)***
AADT	297	336
Merge Demand Volume	33	37
Measured Length of Acceleration L_A, ft	920	
Classification	SMALL URBAN	
Heavy Vehicle %	5	
Report Values	***(2020)***	***(2045)***
On-Ramp Influence Area Speed, mph	61	54
Average Density, pc/mi/ln	24	41
LOS	C	D

3.6.1.2 Speed Analysis

The northbound North Peters Creek on-ramp may not provide the necessary length for drivers to reach the desirable highway speed, because the PGDHS-recommended L_a is greater than the existing length. Similar to the South Peters Creek on-ramps, there are no present speed-controlling devices at the right turn onto the ramp, so the 15-mph initial speed condition may be considered for future analysis. However, the full stop condition is still applied in observation of the left-turning vehicles. The measured L_a, which began at the Lake Hill Drive intersection, indicates that the ramp would need about 290 additional feet to meet the recommended length. Meanwhile, the measured L_g exceeds the recommended 300-foot length by nearly 200 feet, which implies that merging drivers have enough space to properly locate an opening within the through traffic. Table 57 summarizes the existing ramp conditions.

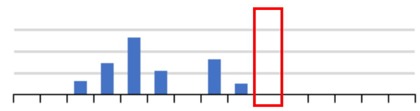
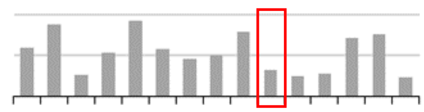
Table 57. N Peters Creek Northbound On-Ramp Speed Analysis Data (Existing Conditions)

N Peters Creek Northbound On-Ramp Speed Analysis	
Average Ramp Grade, %	-2
Measured L_g, ft	500
L_a Based on 0 mph Stop Condition, ft	1620
Measured L_a, ft	1330
Additional L_a per PGDHS, ft	290

3.6.1.3 Crash Analysis

Table 58 describes the crash experience near this ramp from 2013 through 2017.

Table 58. N Peters Creek Northbound On-Ramp Crash Experience 2013 to 2017

Location	Number of Crashes	Segment Length (miles)	Average AADT	Crash Rate	Crash Rate Comparison by Ramp
On-Ramp	0	0.17	270	-	
Ramp-Related and Through Roadway	8	0.52	32,940	0.26	

Note: Red rectangle indicates subject ramp.

Figure 36 shows the crash type and severity for the 8 crashes that occurred in the vicinity of this on-ramp.

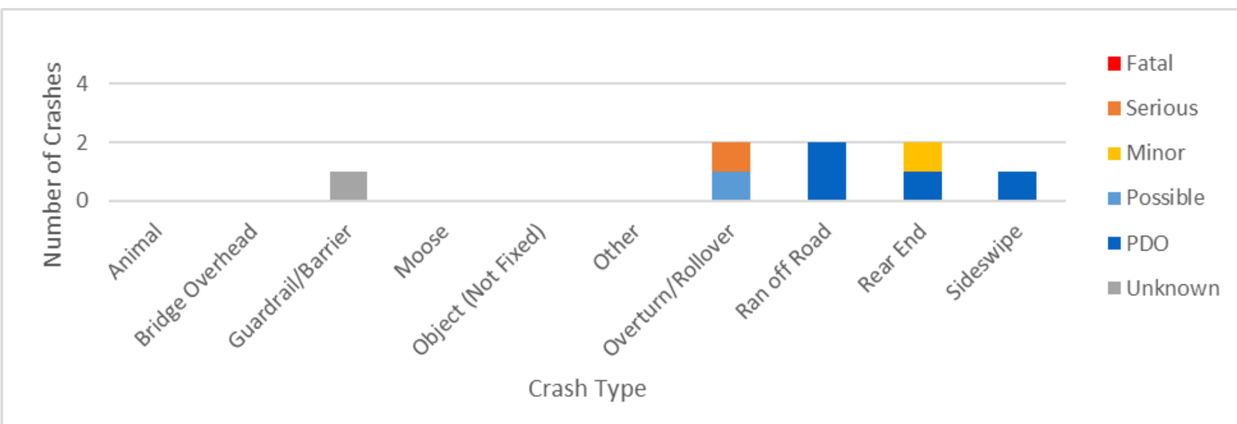


Figure 36. N Peters Creek Northbound On-Ramp Crash Type and Severity, 2013 to 2017

One suspected serious injury occurred around 7 pm on September 25, 2014 in the through roadway area for this ramp, when a vehicle entered the median and rolled several times.

The estimated cost of the crashes that occurred in the vicinity of this ramp is $998,000.

3.6.1.4 Public Comments

No comments related to merging issues for the northbound North Peters Creek on-ramp were found. However, there were several comments under the Ice-Winter Conditions category near the merging point.

3.6.1.5 Conceptual Design Improvements

The North Peters Creek northbound on-ramp currently provides a ramp length L_a of roughly 1,330 feet, which does not meet the PGDHS-recommended length of 1,620 feet. However, due to vehicle volumes the ramp will continue to operate at an adequate LOS D in 2045 without added improvements. The conceptual design for this ramp extends the ramp length L_a and converts the entrance type from taper to parallel as shown in Figure 6. This would also lengthen the parallel acceleration lane L_A. While this configuration would not improve the capacity operations by one letter grade, and future operations would remain at LOS D, the concept would meet the preferred operational standards, improve merging movements, provide continuity along the study corridor, and possibly address public concerns in the area. The conceptual design improvements are delineated in Table 59, and the conceptual design is shown in Figure 37.

Table 59. Conceptual Design Improvements for N Peters Creek Northbound On-Ramp

Ramp Characteristics	Existing	Concept
Ramp Length L_a, ft (measured from stop condition to start of taper, based on PGDHS)	1330	1620
Parallel Acceleration lane L_A, ft (ramp merge area from nose of painted gore to end of taper, based on HCM)	920	1050

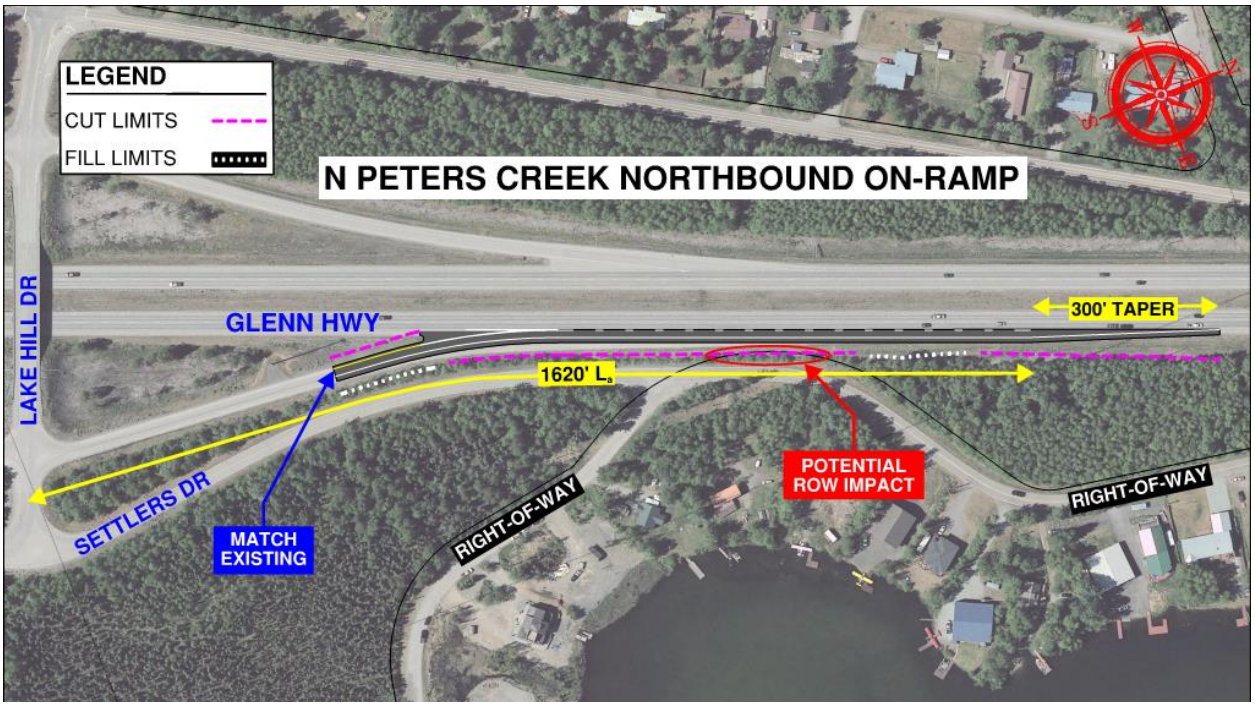


Figure 37. Conceptual Design for N Peters Creek Northbound On-Ramp

The area surrounding the conceptual design is free from potential conflicts with mapped wetlands. The design may introduce possible impacts to ROW boundaries. However, Settlers Drive would not be affected by the potential improvements. Retaining walls can be considered as the primary mitigation measure for the potential ROW impacts, and the cost of a retaining wall length of roughly 150 feet was estimated and included in the total construction cost for this ramp. Table 60 summarizes the conceptual design impacts on the existing ramp.

Table 60. N Peters Creek Northbound On-Ramp: Potential Impacts on Existing Features

	N Peters Creek Northbound: Potential Impacts on Existing Features
ROW	Yes
Wetland	None
Other	None

The construction cost of the conceptual design for the North Peters Creek northbound on-ramp is approximately $900,000.

3.6.1.6 Crash Reduction

The CMF for lengthening the on-ramp merge area from 920 feet to 1,050 feet long is 0.94. Applying this CMF to all of the on-ramp crashes would reduce the 5-year crash cost by $63,950.

3.6.2 Southbound

The results from the three analyses for the North Peters Creek southbound on-ramp are summarized in Figure 38.

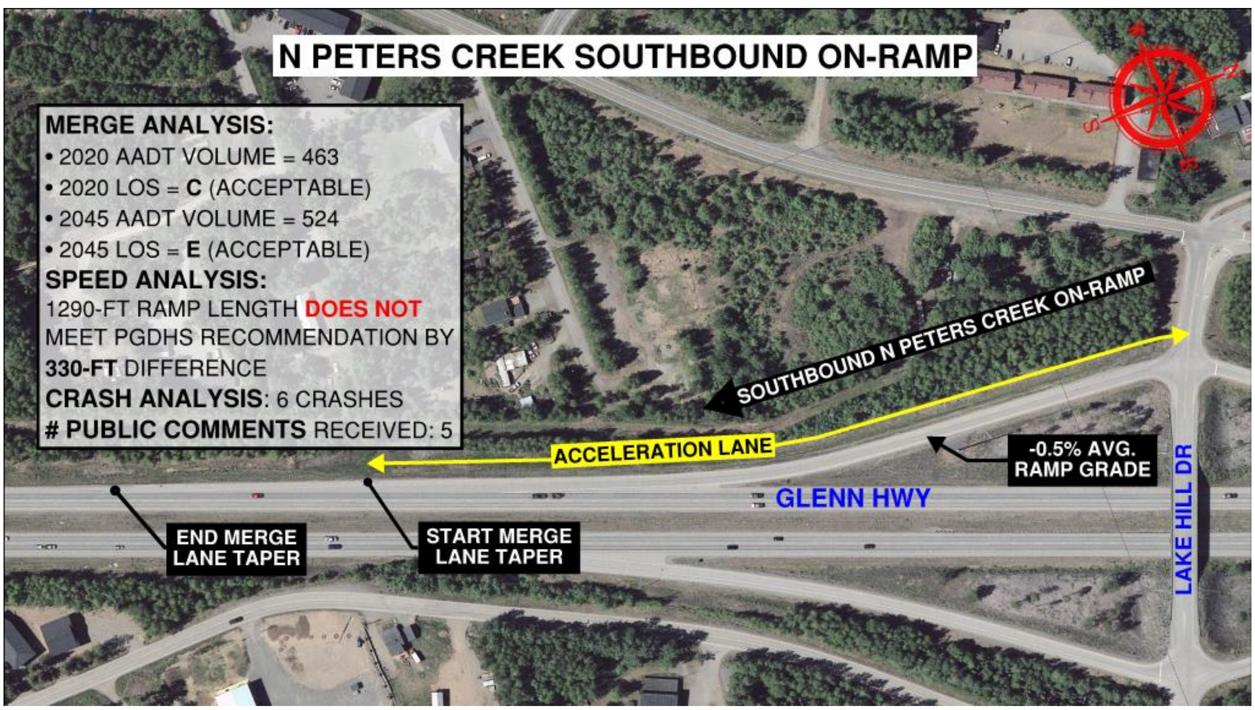


Figure 38. N Peters Creek Southbound On-Ramp Location, Characteristics, and Data

3.6.2.1 HCS7 Merge Analysis

The southbound North Peters Creek on-ramp operates at an acceptable LOS C under 2020 volumes and an acceptable LOS E under 2045 volumes. As volumes increase from 2020 to 2045, the on-ramp influence area speed (merge speed) will be reduced from 60 mph to 53 mph, which is 12 mph less than the posted highway speed limit. Table 61 summarizes the merge analysis and results.

Table 61. N Peters Creek Southbound On-Ramp Merge Analysis Data

N Peters Creek Southbound On-Ramp Merge Analysis		
Ramp Demand/Geometric Data	***(2020)***	***(2045)***
AADT	463	524
Merge Demand Volume, vph	51	58
Measured Length of Acceleration L_A, ft	630	
Classification	SMALL URBAN	
Heavy Vehicle %	5	
Report Values	***(2020)***	***(2045)***
On-Ramp Influence Area Speed, mph	60	53
Average Density, pc/mi/ln	25	41
LOS	C	E

3.6.2.2 Speed Analysis

The southbound North Peters Creek on-ramp may not provide the necessary length for drivers to achieve the desirable highway speed, because the PGDHS-recommended value of L_a is greater than the existing length. There is no present speed-controlling device at the right turn onto the ramp, so the 15-mph initial speed condition may be considered for future analysis. However, the full stop condition is still applied in observation of the left-turning vehicles. Nearly 330 feet of additional length would be needed to meet the minimum recommended length. Meanwhile, the measured L_g surpasses the recommended 300 feet by about 130 feet, which implies that merging drivers have enough space to properly locate an opening within the through traffic. The following table summarizes the existing ramp conditions.

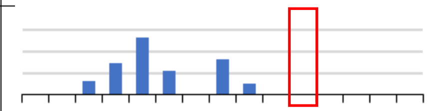
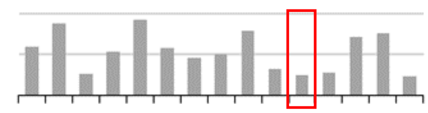
Table 62. N Peters Creek Southbound On-Ramp Speed Analysis Data (Existing Conditions)

N Peters Creek Southbound On-Ramp Speed Analysis	
Average Ramp Grade, %	-0.5
Measured L_g, ft	430
L_a Based on 0 mph Stop Condition, ft	1620
Measured L_a, ft	1290
Additional L_a per PGDHS, ft	330

3.6.2.3 Crash Analysis

Table 63 describes the crash experience at this ramp from 2013 through 2017.

Table 63. N Peters Creek Southbound On-Ramp Crash Experience 2013 to 2017

Location	Number of Crashes	Segment Length (miles)	Average AADT	Crash Rate	Crash Rate Comparison by Ramp
On-Ramp	0	0.21	430	-	
Ramp-Related and Through Roadway	6	0.51	32,940	0.20	

Note: Red rectangle indicates subject ramp.

Figure 39 shows the crash type and severity for the 6 crashes that occurred in the vicinity of this on-ramp.

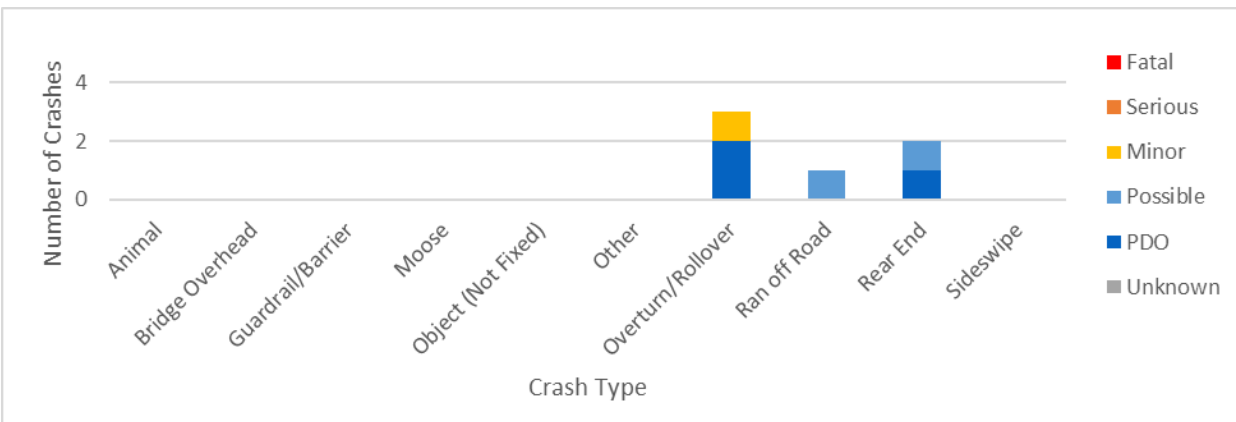


Figure 39. N Peters Creek Southbound On-Ramp Crash Type and Severity, 2013 to 2017

The estimated cost of the crashes that occurred in the vicinity of this ramp is $328,600.

3.6.2.4 Public Comments

A total of 5 comments from the MetroQuest survey were associated with the southbound North Peters Creek on-ramp, with one regarding the congestion due to merging traffic. The rest of the comments described improvements that could be made to the on-ramp. The most common remark was the length and grade of the ramp deterring drivers from reaching highway speeds when merging, especially in the winter. One respondent acknowledged that the length of the ramp provides “great visibility” but agreed with others that the on-ramps should be lengthened. The same respondent observed that it was much easier to safely attain highway speeds before completely merging when the highway was plowed “over the fog line quite a ways past where the actual merge lines are.”

3.6.2.5 Conceptual Design Improvements

The North Peters Creek southbound on-ramp currently provides a ramp length L_a of approximately 1,290 feet, which does not satisfy the PGDHS-recommended length of 1,620 feet. However, due to vehicle volumes the ramp will continue to operate at an adequate LOS E in 2045 without added improvements. The conceptual design for this ramp extends the ramp length L_a to 1,620 feet and converts the entrance type from taper to parallel as shown in Figure 6. This would also lengthen the parallel acceleration lane L_A. The concept would meet the preferred capacity and operational standards, improve merging movements, improve the forecasted LOS from E to D, provide continuity along the study corridor, and possibly address public concerns in the area . The conceptual design improvements are delineated in Table 64, and the conceptual design is shown in Figure 40.

Table 64. Conceptual Design Improvements for N Peters Creek Southbound On-Ramp

Ramp Characteristics	Existing	Concept
Ramp Length L_a, ft (measured from stop condition to start of taper, based on PGDHS)	1290	1620
Parallel Acceleration lane L_A, ft (ramp merge area from nose of painted gore to end of taper, based on HCM)	630	1050

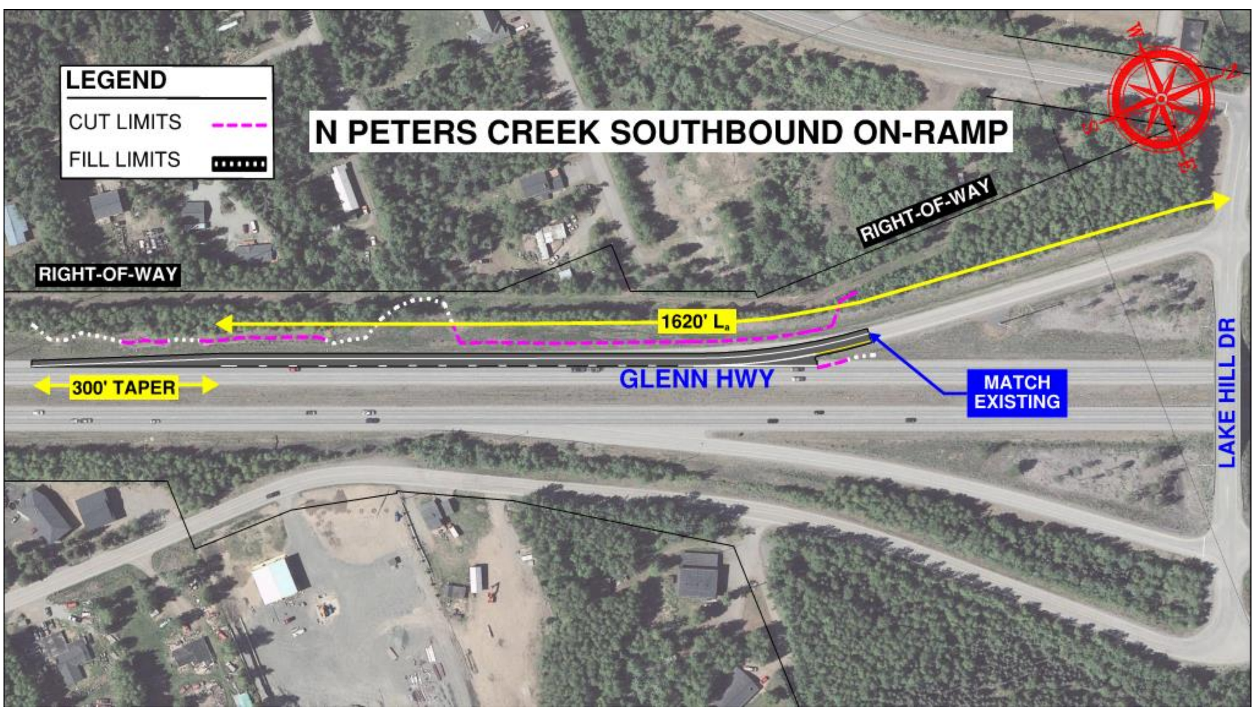


Figure 40. Conceptual Design for N Peters Creek Southbound On-Ramp

The area surrounding the conceptual design is free from potential conflicts with ROW boundaries and mapped wetlands, as well as width constraints. Table 65 summarizes the conceptual design impacts on the existing ramp.

Table 65. N Peters Creek Southbound On-Ramp: Potential Impacts on Existing Features

	N Peters Creek Southbound: Potential Impacts on Existing Features
ROW	None
Wetland	None
Other	None

The construction cost of the conceptual design for the North Peters Creek southbound on-ramp is approximately $767,000.

3.6.2.6 Crash Reduction

The CMF for lengthening the on-ramp merge area from 630 feet to 1,050 feet long is 0.82. Applying this CMF to all of the on-ramp crashes would reduce the 5-year crash cost by $60,800.

3.7 Mirror Lake Interchange

3.7.1 Southbound

Figure 41 displays a summary of the results from the three analyses for the Mirror Lake southbound on-ramp.

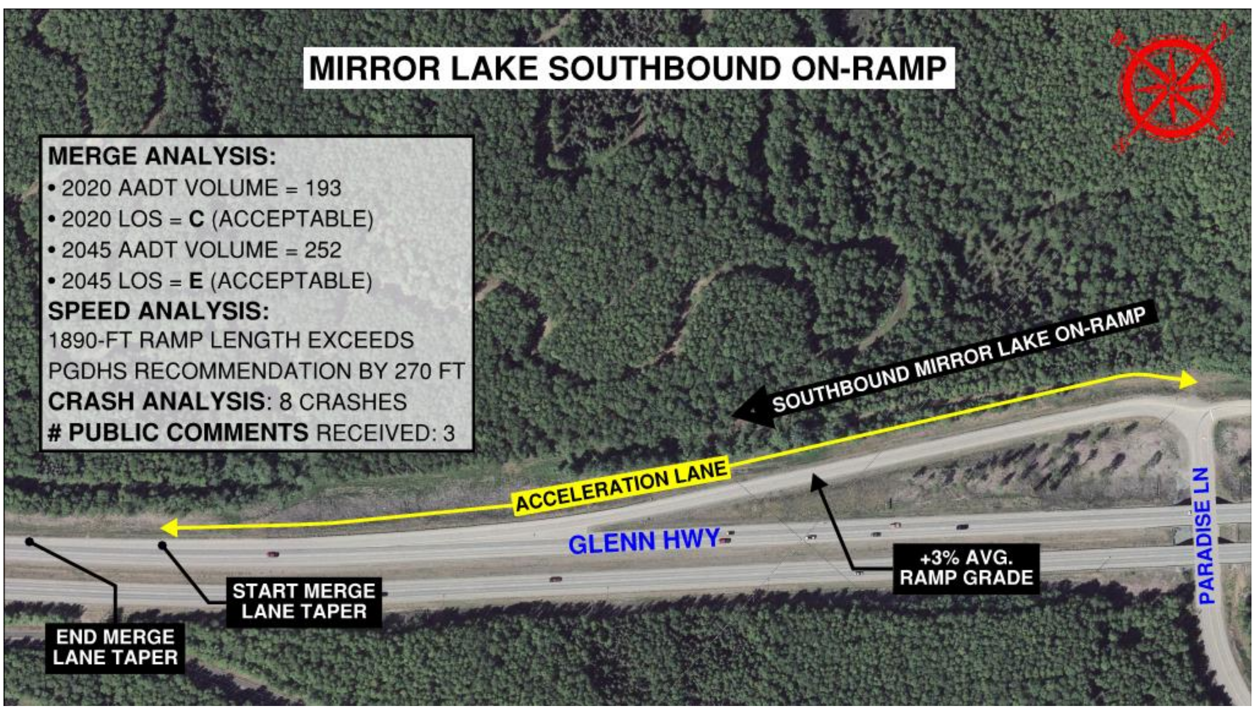


Figure 41. Mirror Lake Southbound On-Ramp Location, Characteristics, and Data

3.7.1.1 HCS7 Merge Analysis

The southbound Mirror Lake on-ramp operates at an acceptable LOS C under 2020 volumes and an acceptable LOS E under 2045 volumes. As volumes increase from 2020 to 2045, the on-ramp influence area speed (merge speed) will be reduced from from 60 mph to 54 mph, which is 11 mph below the posted highway speed limit. The section of the highway past the North Peters

Creek interchange towards Parks Highway transitions from a small urban classification to rural, according to the FHWA area classification definitions. Consequently, the heavy vehicle percentage changes from 5% to 4% for this ramp and the remaining ramps included in the study. Table 66 summarizes the merge analysis and results.

Table 66. Mirror Lake Southbound On-Ramp Merge Analysis Data

Mirror Lake Southbound On-Ramp Merge Analysis		
Ramp Demand/Geometric Data	***(2020)***	***(2045)***
AADT	193	252
Merge Demand Volume	21	28
Measured Length of Acceleration L_A, ft	700	
Classification	RURAL	
Heavy Vehicle %	4	
Report Values	***(2020)***	***(2045)***
On-Ramp Influence Area Speed, mph	60	54
Average Density, pc/mi/ln	24	41
LOS	C	E

3.7.1.2 Speed Analysis

The southbound Mirror Lake off-ramp has sufficient acceleration lane length for drivers to achieve the desirable highway speed prior to merging. There is a stop bar and stop sign combination that prompts drivers to reduce their speeds as they approach the on-ramp, and drivers performing a non-permissive left turn from the adjacent Paradise Lane onto the ramp are also subject to reduced speeds. The 0-mph stop condition is therefore an appropriate evaluation for this ramp, and it was determined that the measured L_a beginning at the Paradise Lane intersection exceeds the PGDHS-recommended length by about 270 feet. Additionally, the measured L_g is more than double the recommended 300-foot length, which indicates that merging drivers have enough space to properly locate an opening within the through traffic. Table 67 summarizes the existing ramp conditions.

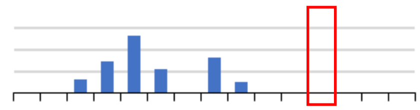
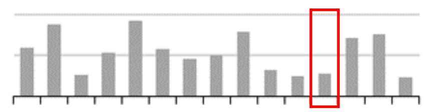
Table 67. Mirror Lake Southbound On-Ramp Speed Analysis Data (Existing Conditions)

Mirror Lake Southbound On-Ramp Speed Analysis	
Average Ramp Grade, %	+3
Measured L_g, ft	630
L_a Based on 0 mph Stop Condition, ft	1620
Measured L_a, ft	1890
Additional L_a per PGDHS, ft	-270

3.7.1.3 Crash Analysis

Table 68 describes the crash experience at this ramp from 2013 through 2017.

Table 68. Mirror Lake Southbound On-Ramp Crash Experience 2013 to 2017

Location	Number of Crashes	Segment Length (miles)	Average AADT	Crash Rate	Crash Rate Comparison by Ramp
On-Ramp	0	0.45	330	-	
Ramp-Related and Through Roadway	8	0.63	32,090	0.22	

Note: Red rectangle indicates subject ramp.

Figure 42 shows the crash type and severity for the 8 crashes that occurred in the vicinity of this on-ramp.

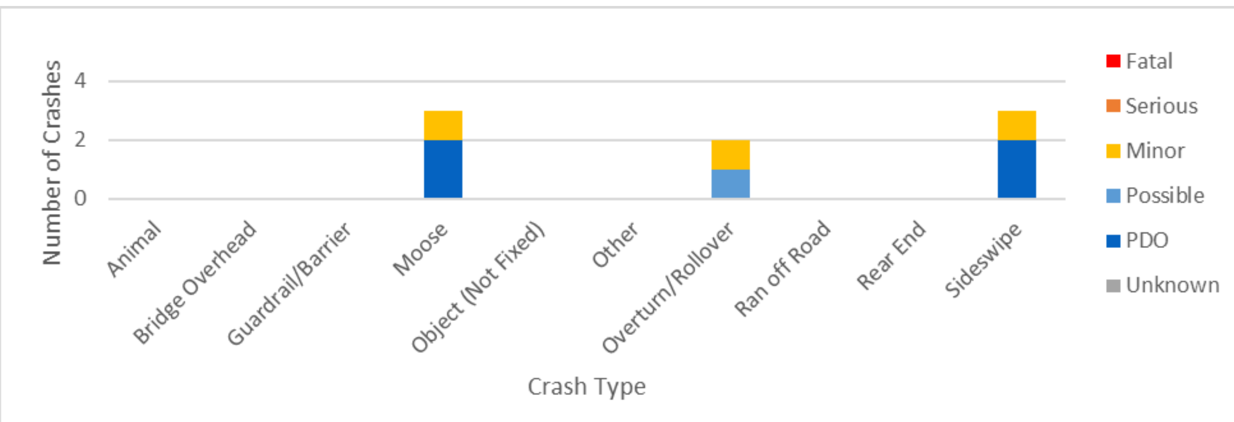


Figure 42. Mirror Lake Southbound On-Ramp Crash Type and Severity, 2013 to 2017

Three Sideswipe crashes were reported in the through roadway area. One crash resulted when a vehicle’s tire got caught in a rut. Both the other two Sideswipe crashes involved three vehicles, and in one of the crashes, the vehicles were slowing for a previous collision.

Three Moose crashes occurred in the vicinity of this ramp.

The estimated cost of the crashes that occurred in the vicinity of this ramp is $559,800. The Moose crashes are unlikely to be reduced by improvements to the on-ramp and were therefore not counted in crash reduction estimations (Section 3.7.1.6).

3.7.1.4 Public Comments

A total of three comments from the MetroQuest survey were associated with the southbound Mirror Lake on-ramp, two of which were concerning the congestion in the area and the other related to merging lane improvements. One respondent voiced that the ramp is “very short and dangerous when merging with traffic.”

3.7.1.5 Conceptual Design Improvements

The Mirror Lake southbound on-ramp currently provides a ramp length L_a of nearly 1,890 feet, which exceeds the PGDHS-recommended length of 1,620 feet. Due to vehicle volumes the ramp will continue to operate at an adequate LOS E in 2045 without added improvements. The conceptual design of the ramp converts the entrance type from taper to parallel as shown in Figure 6. This would lengthen both the ramp length L_a and parallel acceleration lane L_A. The concept would meet the preferred capacity and operational standards, improve merging movements, improve the forecasted LOS from E to D, provide continuity along the study corridor, and possibly address public concerns in the area. The conceptual design improvements are delineated in Table 69, and the conceptual design is shown in Figure 43.

Table 69. Conceptual Design Improvements for Mirror Lake Southbound On-Ramp

Ramp Characteristics	Existing	Concept
Ramp Length L_a, ft (measured from stop condition to start of taper, based on PGDHS)	1890	1920
Parallel Acceleration lane L_A, ft (ramp merge area from nose of painted gore to end of taper, based on HCM)	700	880

Note: The existing ramp length L_a is greater than PGDHS-recommended and was increased to accommodate the PGDHS typical parallel entrance ramp design.

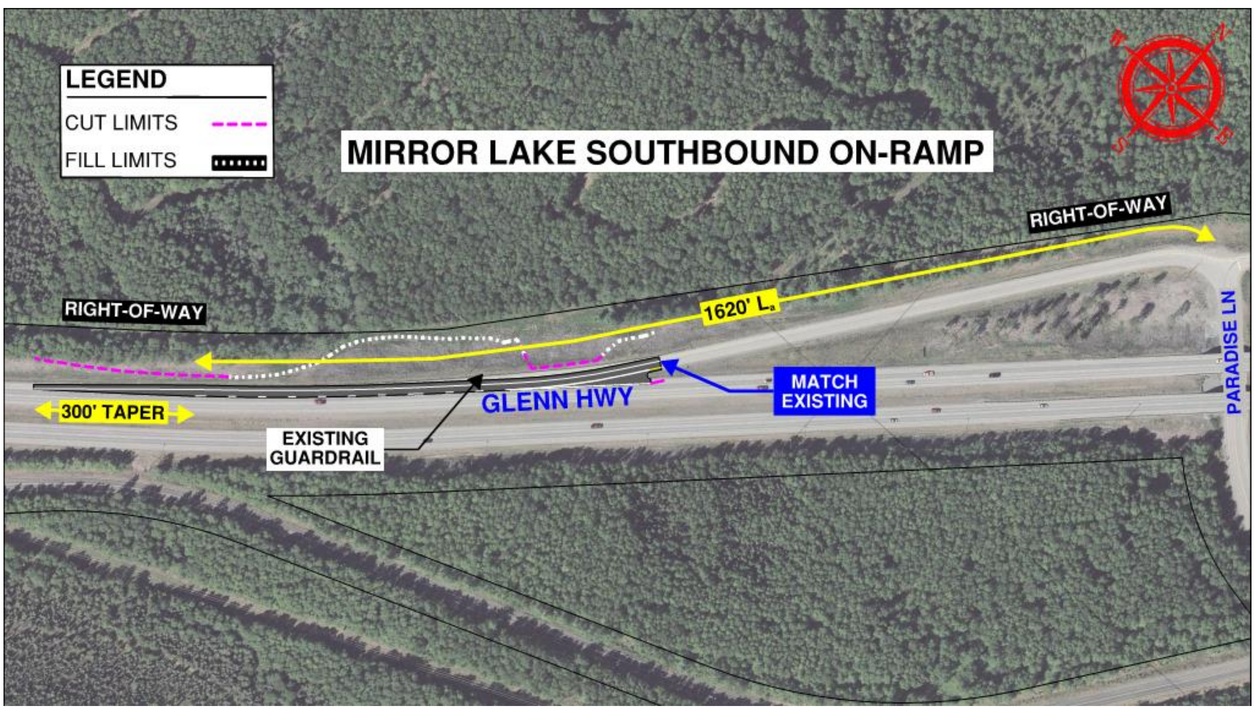


Figure 43. Conceptual Design for Mirror Lake Southbound On-Ramp

The area surrounding the conceptual design is free from potential conflicts with ROW and mapped wetlands. For the Mirror Lake southbound on-ramp concept, excavation limits would be modified as needed to avoid such impacts. Approximately 710 feet of guardrail on the left side of the ramp would need to be removed and replaced if the ramp were to be reconstructed. Table 70 summarizes the conceptual design impacts on the existing ramp.

Table 70. Mirror Lake Southbound On-Ramp: Potential Impacts on Existing Features

	Mirror Lake Southbound: Potential Impacts on Existing Features
ROW	None
Wetland	None
Other	Guardrail on Right Side

The construction cost of the conceptual design for the Mirror Lake southbound on-ramp is approximately $680,000.

3.7.1.6 Crash Reduction

The CMF for lengthening the on-ramp merge area from 700 feet to 880 feet long is 0.91. Applying this CMF to all of the on-ramp crashes except the Moose crashes would reduce the 5-year crash cost by $33,600.

3.8 Eklutna Interchange

3.8.1 Northbound

Figure 44 summarizes the results from the three analyses for the Eklutna northbound on-ramp.

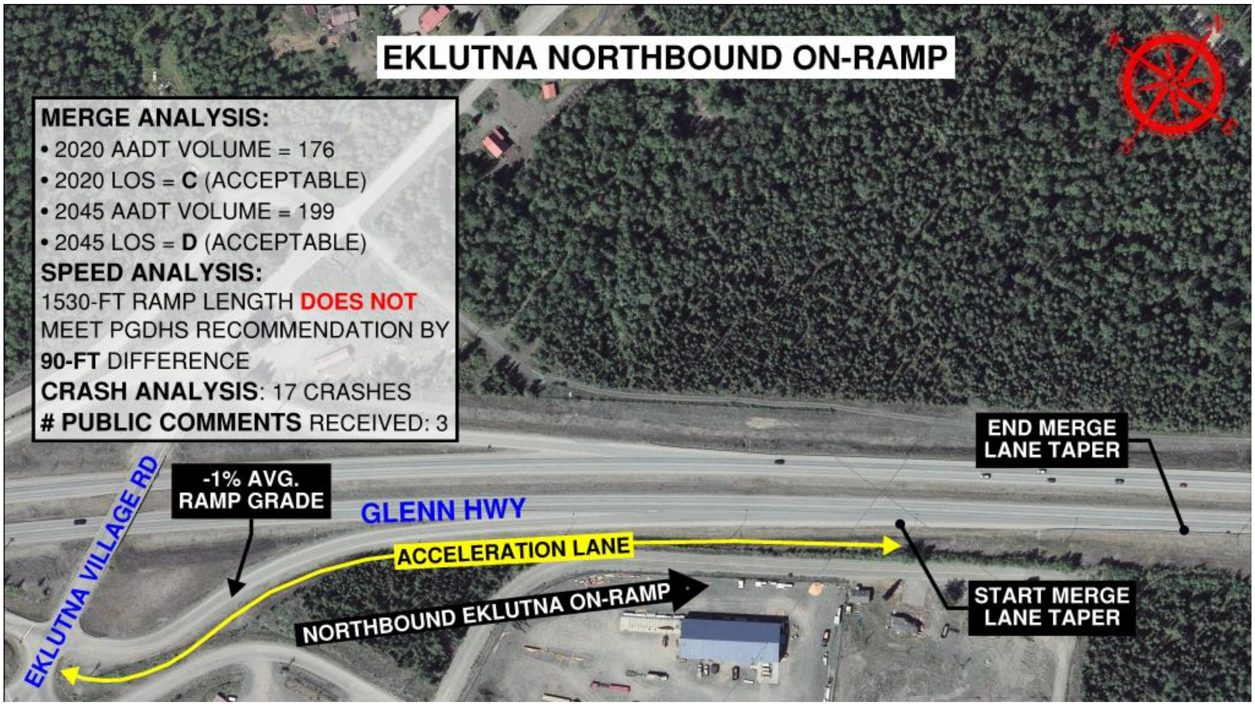


Figure 44. Eklutna Northbound On-Ramp Location, Characteristics, and Data

3.8.1.1 HCS7 Merge Analysis

The northbound Eklutna on-ramp operates at an acceptable LOS C under 2020 volumes and an acceptable LOS D under 2045 volumes. As volumes increase from 2020 to 2045, the on-ramp influence area speed (merge speed) will be reduced from 61 mph to 54 mph, which is 11 mph under the posted highway speed limit. which is Table 71 summarizes the merge analysis and results.

Table 71. Eklutna Northbound On-Ramp Merge Analysis Data

Eklutna Northbound On-Ramp Merge Analysis		
Ramp Demand/Geometric Data	(2020)	(2045)
AADT	176	199
Merge Demand Volume, vph	19	22
Measured Length of Acceleration L_A, ft	870	
Classification	RURAL	
Heavy Vehicle %	4	
Report Values	(2020)	(2045)
On-Ramp Influence Area Speed, mph	61	54
Average Density, pc/mi/ln	24	40
LOS	C	D

3.8.1.2 Speed Analysis

The northbound Eklutna on-ramp may not provide the necessary length for drivers to achieve the desirable highway speed. There are no present speed-controlling devices at the right turn onto the ramp, so the 15-mph initial speed condition may be considered for future analysis. However, the full stop condition is still applied in observation of the left-turning vehicles. The measured L_a length, which began at the Eklutna Village Road intersection, determined that the ramp would need approximately 90 feet in additional length to meet the recommended L_a. Meanwhile, the measured L_g is about double the 300-foot recommendation, which implies that merging drivers have enough space to properly locate an opening within the through traffic. The following table summarizes the existing ramp conditions.

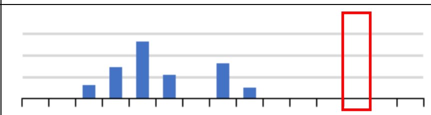
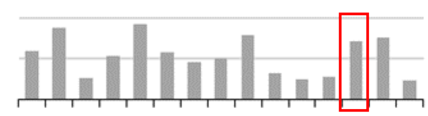
Table 72. Eklutna Northbound On-Ramp Speed Analysis Data (Existing Conditions)

Eklutna Northbound On-Ramp Speed Analysis	
Average Ramp Grade, %	-1
Measured L_g, ft	600
L_a Based on 0 mph Stop Condition, ft	1620
Measured L_a, ft	1530
Additional L_a er PGDHS, ft	90

3.8.1.3 Crash Analysis

Table 73 describes the crash experience at this ramp from 2013 through 2017.

Table 73. Eklutna Northbound On-Ramp Crash Experience 2013 to 2017

Location	Number of Crashes	Segment Length (miles)	Average AADT	Crash Rate	Crash Rate Comparison by Ramp
On-Ramp	0	0.21	220	-	
Ramp-Related and Through Roadway	17	0.51	32,180	0.57	

Note: Red rectangle indicates subject ramp.

Figure 45 shows the crash type and severity for the 17 crashes that occurred in the vicinity of this on-ramp.

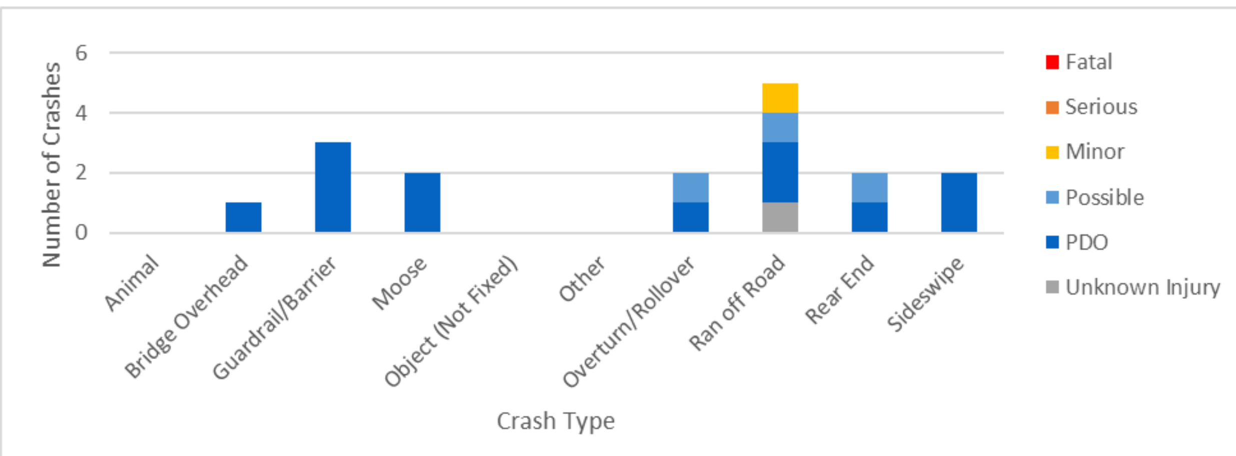


Figure 45. Eklutna Northbound On-Ramp Crash Type and Severity, 2013 to 2017

Five Ran off Road crashes were recorded. Of these five crashes, one vehicle struck the traffic sign in the ramp gore, another struck a light pole, while another had a flat tire.

Two Moose crashes were reported.

The estimated cost of the crashes that occurred in the vicinity of this ramp is $487,600. The Moose crashes are unlikely to be reduced by improvements to the on-ramp and were therefore not counted in crash reduction estimations (Section 3.8.1.6).

3.8.1.4 Public Comments

A total of three comments from the MetroQuest survey were associated with the northbound Eklutna on-ramp, two of which described congestion in the area and the other suggested an additional lane. One respondent recommended that the winter conditions and accidents could be diverted by the addition of a lane, and another respondent indicated that accidents lead to congestion as well.

3.8.1.5 Conceptual Design Improvements

The Eklutna northbound on-ramp currently provides a ramp length L_a of about 1,530 feet, which does not meet the PGDHS recommendation of 1,620 feet. However, due to vehicle volumes the ramp will continue to operate at an adequate LOS D in 2045 without added improvements. The conceptual design for this ramp extends the ramp length L_a and converts the entrance type from taper to parallel as shown in Figure 6. This would also lengthen the parallel acceleration lane L_A. While this configuration would not improve the capacity operations by one letter grade, and future operations would remain at LOS D, the concept would meet the preferred capacity standards, improve merging movements, provide continuity along the study corridor, and possibly address public concerns in the area. The conceptual design improvements are delineated in Table 74, and the conceptual design is shown in Figure 46.

Table 74. Conceptual Design Improvements for Eklutna Northbound On-Ramp

Ramp Characteristics	Existing	Concept
Ramp Length L_a, ft (measured from stop condition to start of taper, based on PGDHS)	1530	1620
Parallel Acceleration lane L_A, ft (ramp merge area from nose of painted gore to end of taper, based on HCM)	870	1090

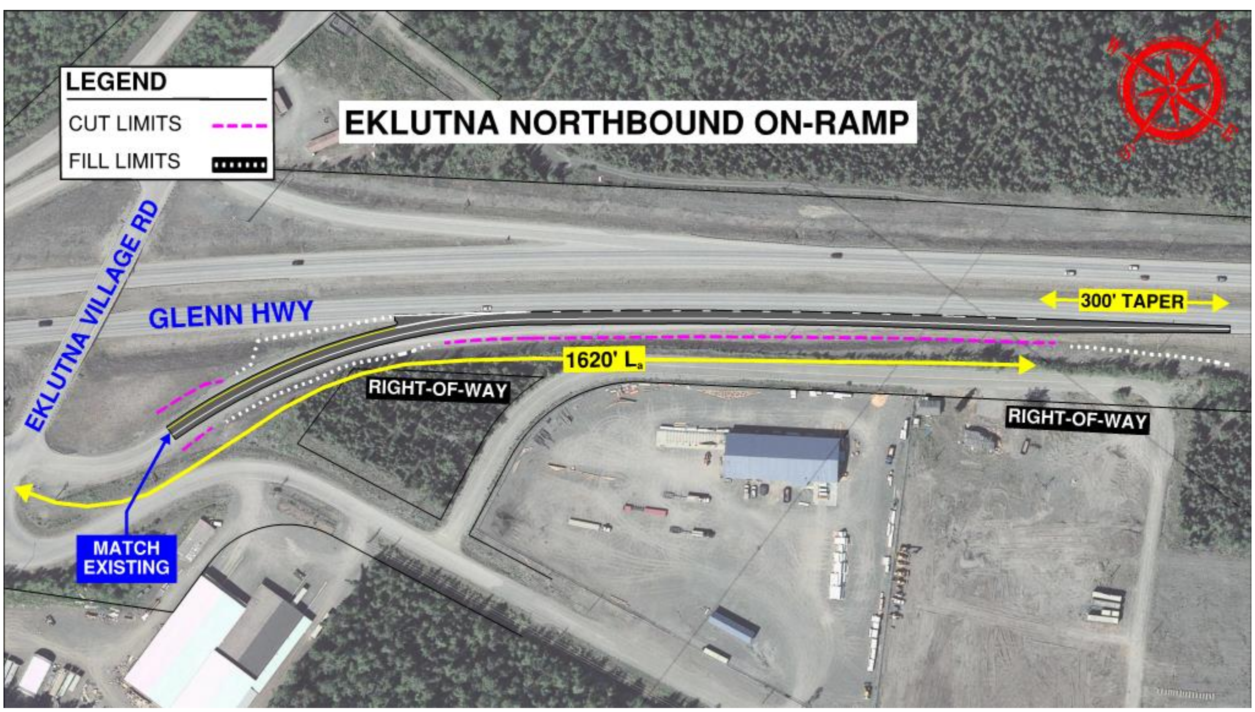


Figure 46. Conceptual Design for Eklutna Northbound On-Ramp

The area surrounding the conceptual design is free from potential conflicts with ROW boundaries and mapped wetlands, as well as width constraints. Table 75 summarizes the conceptual design impacts on the existing ramp.

Table 75. Eklutna Northbound On-Ramp: Potential Impacts on Existing Features

	Eklutna Northbound: Potential Impacts on Existing Features
ROW	None
Wetland	None
Other	None

The construction cost of the conceptual design for the Eklutna northbound on-ramp is approximately $756,000.

3.8.1.6 Crash Reduction

The CMF for lengthening the on-ramp merge area from 870 feet to 1,090 feet long is 0.90. Applying this CMF to all of the on-ramp crashes except the Moose crashes would reduce the 5-year crash cost by $48,600.

3.8.2 Southbound

The results from the three analyses for the Eklutna southbound on-ramp are summarized in Figure 47.

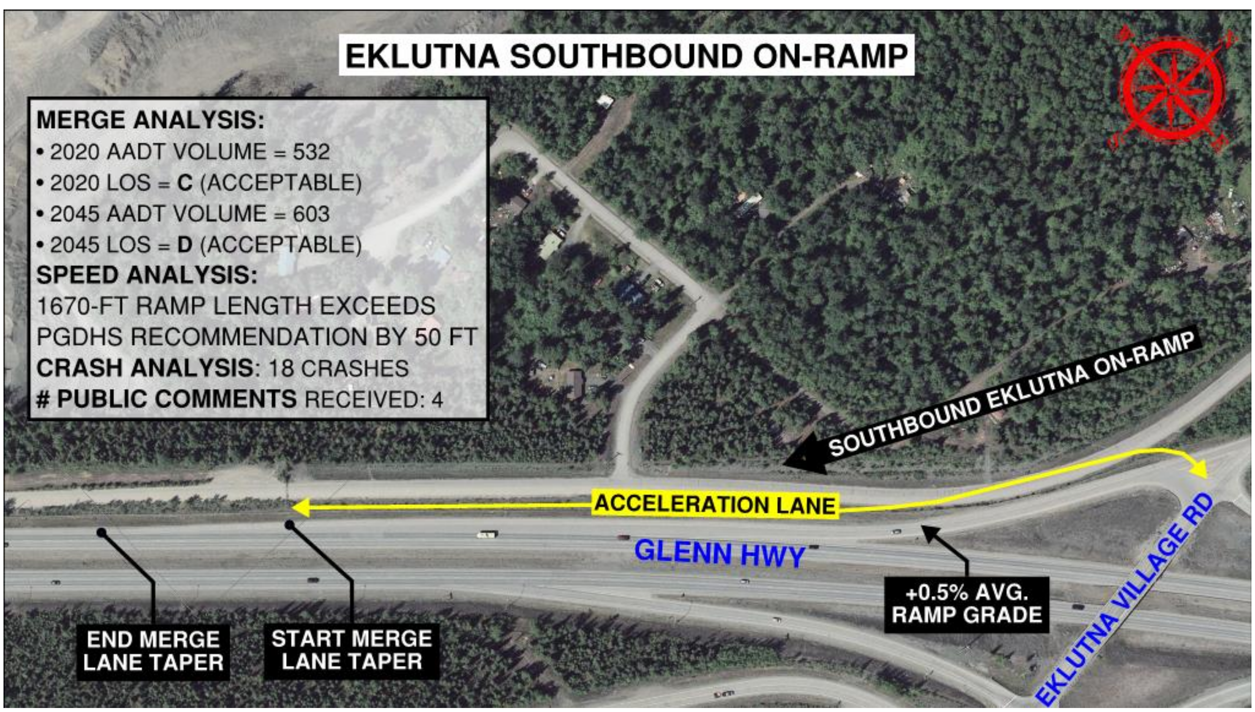


Figure 47. Eklutna Southbound On-Ramp Location, Characteristics, and Data

3.8.2.1 HCS7 Merge Analysis

The southbound Eklutna on-ramp operates at an acceptable LOS C under 2020 volumes and an acceptable LOS D under 2045 volumes. As volumes increase from 2020 to 2045, the on-ramp influence area speed (merge speed) will be reduced from 61 mph to 54 mph, which is 11 mph lower than the posted highway speed limit. Table 76 summarizes the merge analysis and results.

Table 76. Eklutna Southbound On-Ramp Merge Analysis Data

Eklutna Southbound On-Ramp Merge Analysis		
Ramp Demand/Geometric Data	***(2020)***	***(2045)***
AADT	532	603
Merge Demand Volume, vph	59	66
Measured Length of Acceleration L_A, ft	930	
Classification	RURAL	
Heavy Vehicle %	4	
Report Values	***(2020)***	***(2045)***
On-Ramp Influence Area Speed, mph	61	54
Average Density, pc/mi/ln	25	41
LOS	C	D

3.8.2.2 Speed Analysis

The southbound Eklutna on-ramp has sufficient acceleration lane length for drivers to reach the desirable highway speed prior to merging, as the measured L_a exceeds the PGDHS-recommended length by about 50 feet. The yield sign located along Eklutna Village Road prior to the right turn movement onto the ramp voids the need to evaluate a 15-mph initial speed condition, so the full stop condition is an appropriate evaluation. The measured L_g is about triple the recommendation of 300 feet, which implies that merging drivers have enough space to properly locate an opening within the through traffic. The following table summarizes the existing ramp conditions.

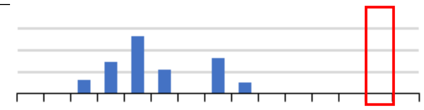
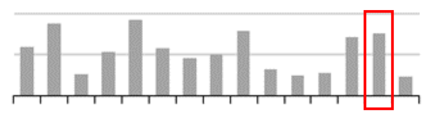
Table 77. Eklutna Southbound On-Ramp Speed Analysis Data (Existing Conditions)

Eklutna Southbound On-Ramp Speed Analysis	
Average Ramp Grade, %	+0.5
Measured L_g, ft	910
L_a Based on 0 mph Stop Condition, ft	1620
Measured L_a, ft	1670
Additional L_a per PGDHS, ft	-50

3.8.2.3 Crash Analysis

Table 78 describes the crash experience at this ramp from 2013 through 2017.

Table 78. Eklutna Southbound On-Ramp Crash Experience 2013 to 2017

Eklutna Southbound	**Number of Crashes**	**Segment Length (miles)**	**Average AADT**	**Crash Rate**	**Crash Rate Comparison by Ramp**
On-Ramp	0	0.21	620	-	
Ramp-Related and Through Roadway	18	0.50	32,180	0.61	

Note: Red rectangle indicates subject ramp.

Figure 48 shows the crash type and severity for the 18 crashes that occurred in the vicinity of this on-ramp.

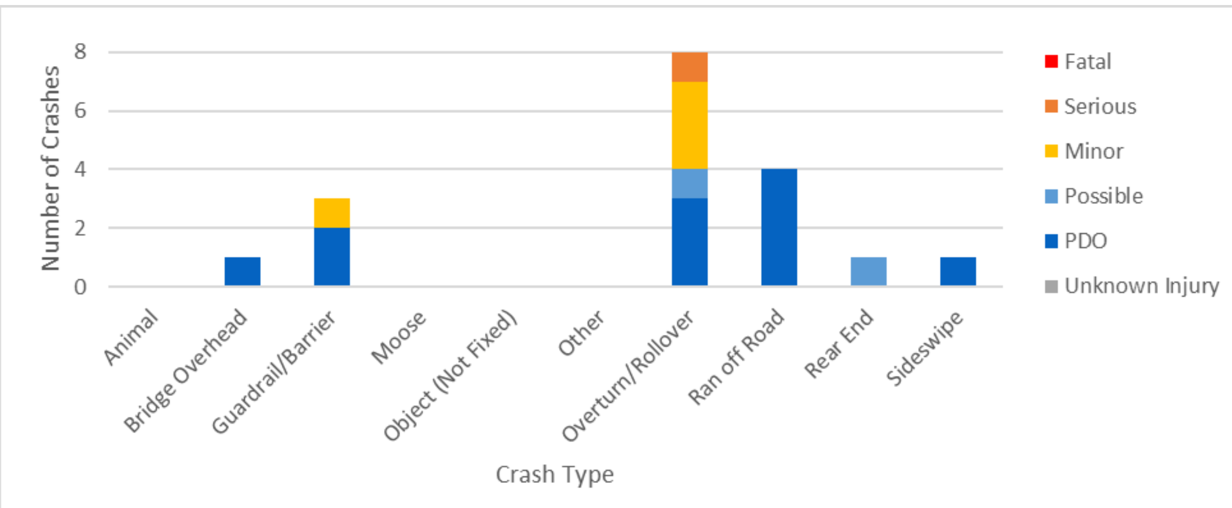


Figure 48. Eklutna Southbound On-Ramp Crash Type and Severity, 2013 to 2017

Eight Overturn/Rollover crashes occurred in the ramp vicinity. One of these crashes occurred when a vehicle was accelerating to merge from the on-ramp and rolled over in the median. Another one of these crashes resulted in suspected serious injuries. On May 25, 2014 around 6:45 pm, a vehicle drove into the ditch, overcorrected, hit a drainage gate, and rolled multiple times.

Four Ran off Road crashes were reported. Of these four, one crashed into a fence. Another vehicle lost control, skidded across the median, and crossed the northbound lanes. There were already several vehicles in the ditch due to icy, unmaintained roads.

The estimated cost of the crashes that occurred in the vicinity of this ramp is $1,574,200.

3.8.2.4 Public Comments

A total of 4 comments from the MetroQuest survey were associated with the southbound Eklutna on-ramp, with two responses regarding curve hazards and the others regarding congestion or the need for additional lanes. One respondent specified a decreased speed limit of 10-15 mph within the congested area. Two comments mutually expressed concern for the frequent crashes at the Eklutna hill, especially during winter.

3.8.2.5 Conceptual Design Improvements

The Eklutna southbound on-ramp currently provides a ramp length L_a of approximately 1,670 feet, which exceeds the PGDHS-recommended length of 1,620 feet. However, due to vehicle volumes the ramp will continue to operate at an adequate LOS D in 2045 without added improvements. The conceptual design for this ramp converts the entrance type from taper to parallel as shown in Figure 6. This would lengthen both the ramp length L_a and parallel acceleration lane L_A. While this configuration would not improve the capacity operations by one letter grade, and future operations would remain at LOS D, the concept would meet the preferred operational standards, improve merging movements, provide continuity along the study corridor, and potentially address public concerns in the area. The conceptual design improvements are delineated in Table 79, and the conceptual design is shown in Figure 49.

Table 79. Conceptual Design Improvements for Eklutna Southbound On-Ramp

Ramp Characteristics	Existing	Concept
Ramp Length L_a, ft (measured from stop condition to start of taper, based on PGDHS)	1670	1980
Parallel Acceleration lane L_A, ft (ramp merge area from nose of painted gore to end of taper, based on HCM)	930	1240

Note: The existing ramp length L_a is greater than PGDHS-recommended and was increased to accommodate the PGDHS typical parallel entrance ramp design.

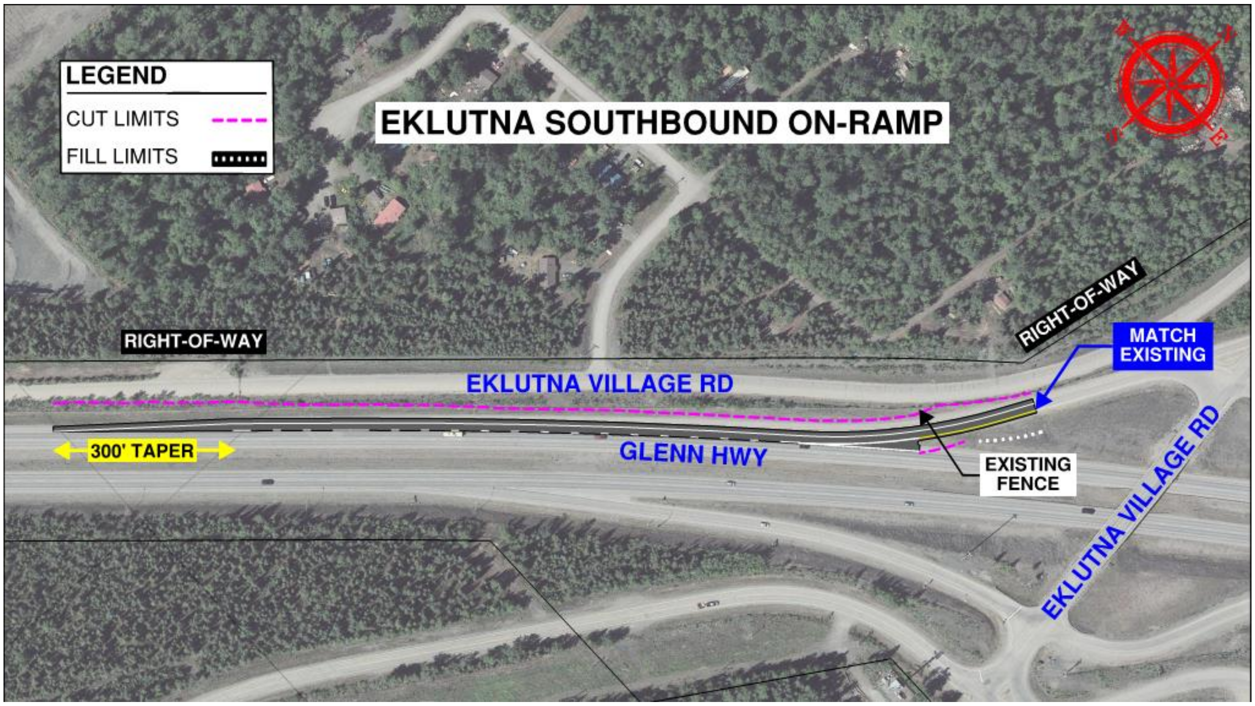


Figure 49. Conceptual Design for Eklutna Southbound On-Ramp

The area surrounding the conceptual design is free from potential conflicts with ROW and mapped wetlands. However, the beginning of the design may introduce possible impacts to Eklutna Village Road, and the excavation limits may be modified as needed to avoid such impacts. Approximately 200 feet of chain link fence on the right side of the ramp would need to be removed and replaced if the ramp were reconstructed. Table 80 summarizes the conceptual design impacts on the existing ramp.

Table 80. Eklutna Southbound On-Ramp: Potential Impacts on Existing Features

	Eklutna Southbound: Potential Impacts on Existing Features
ROW	None
Wetland	None
Other	Fence on Right, Eklutna Village Road

The construction cost of the conceptual design for the Eklutna southbound on-ramp is approximately $945,000.

3.8.2.6 Crash Reduction

The CMF for lengthening the on-ramp merge area from 930 feet to 1,240 feet long is 0.86. Applying this CMF to all of the on-ramp crashes would reduce the 5-year crash cost by $224,050.

3.9 Old Glenn Interchange

3.9.1 Southbound

Figure 50 displays a summary of the results from the three analyses for the Old Glenn Highway southbound on-ramp.

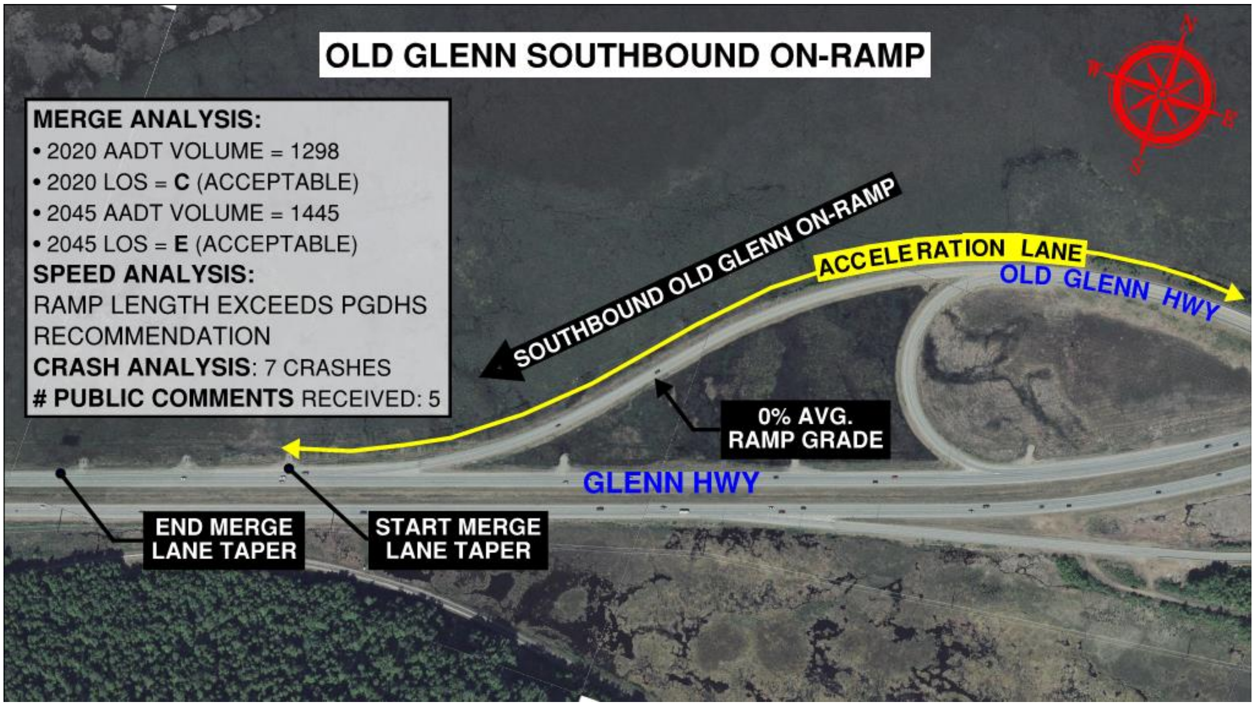


Figure 50. Old Glenn Hwy Southbound On-Ramp Location, Characteristics, and Data

3.9.1.1 HCS7 Merge Analysis

The southbound Old Glenn on-ramp operates at an acceptable LOS C and E under the 2020 and 2045 volumes, respectively. As volumes increase from 2020 to 2045, the on-ramp influence area speed (merge speed) will be reduced from 60 mph to 53 mph, which is 12 mph less than the posted highway speed limit. Table 81 summarizes the merge analysis data and results.

Table 81. Old Glenn Hwy Southbound On-Ramp Merge Analysis Data

Old Glenn Hwy Southbound On-Ramp Merge Analysis		
Ramp Demand/Geometric Data	***(2020)***	***(2045)***
AADT	1298	1445
Merge Demand Volume, vph	143	159
Measured Length of Acceleration L_A, ft	790	
Classification	RURAL	
Heavy Vehicle %	4	
Report Values	***(2020)***	***(2045)***
On-Ramp Influence Area Speed, mph	60	53
Average Density, pc/mi/ln	26	43
LOS	C	E

3.9.1.2 Speed Analysis

The southbound Old Glenn on-ramp was omitted from the speed analysis due to its ramp length, and it is assumed to adequately support appropriate merging speeds. Additionally, the measured L_g exceeds the acceptable length of 300 feet, which indicates that merging drivers have enough space to properly locate an opening within the through traffic. The following table summarizes the existing ramp conditions.

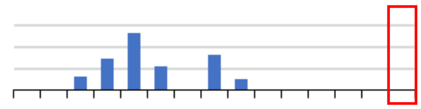
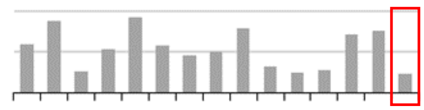
Table 82. Old Glenn Hwy Southbound On-Ramp Speed Analysis Data (Existing Conditions)

Old Glenn Southbound On-Ramp Speed Analysis	
Average Ramp Grade, %	0
Measured L_g, ft	390
L_a Based on 0 mph Stop Condition, ft	1620
Measured L_a, ft	n/a
Additional L_a per PGDHS, ft	n/a

3.9.1.3 Crash Analysis

Table 83 describes the crash experience at this ramp from 2013 through 2017.

Table 83. Old Glenn Southbound On-Ramp Crash Experience 2013 to 2017

Location	Number of Crashes	Segment Length (miles)	Average AADT	Crash Rate	Crash Rate Comparison by Ramp
On-Ramp	0	0.39	1,120	-	
Ramp-Related and Through Roadway	7	0.67	30,600	0.19	

Note: Red rectangle indicates subject ramp.

Figure 51 shows the crash type and severity for the 7 crashes that occurred in the vicinity of this on-ramp.

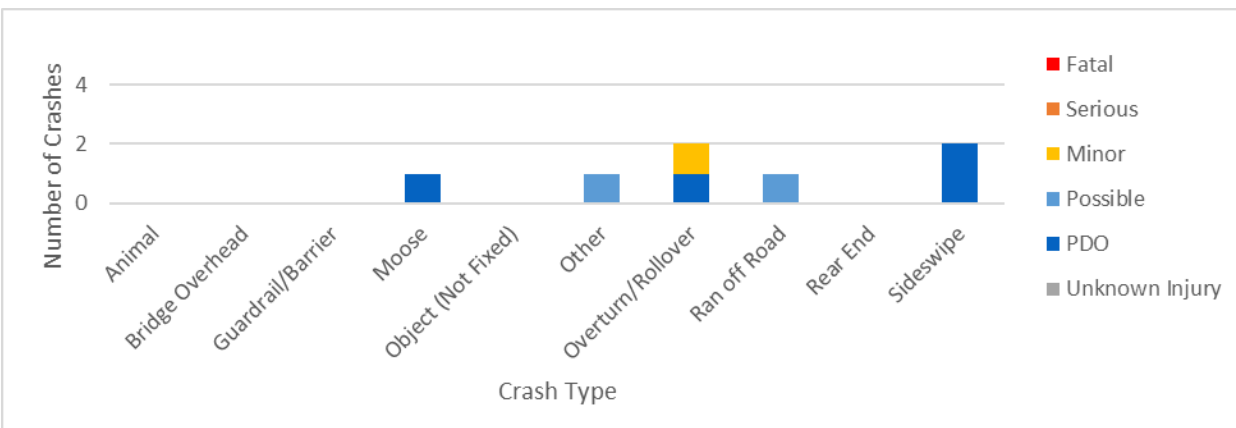


Figure 51. Old Glenn Southbound On-Ramp Crash Type and Severity, 2013 to 2017

Two Overturn/Rollover crashes occurred when vehicles were merging from on-ramp, and two Sideswipe crashes were recorded in through roadway. One Moose crash was reported.

The estimated cost of the crashes that occurred in the vicinity of this ramp is $336,800. The Moose crash is unlikely to be reduced by improvements to the on-ramp and was therefore not counted in crash reduction estimations (Section 3.9.1.6).

3.9.1.4 Public Comments

A total of 5 comments from the MetroQuest survey were associated with the southbound Old Glenn on-ramp, with a few sharing safety concerns for entering traffic. Although respondents approve of the ramp length, they expressed that the narrow width and turn at the end makes it difficult to judge where the vehicles will blend into the traffic flow and becomes even more challenging in wet or icy conditions. One respondent reported congestion being caused by merging traffic, and another observed improper driver use of the merge lane.

3.9.1.5 Conceptual Design Improvements

The Old Glenn southbound on-ramp currently provides a ramp length L_a of roughly 2,490 feet, which exceeds the PGDHS-recommended length of 1,620 feet. However, due to vehicle volumes the ramp will continue to operate at an adequate LOS E in 2045 without added improvements. The conceptual design for this ramp converts the entrance type from taper to parallel as shown in Figure 6. This would lengthen both the ramp length L_a and parallel acceleration lane L_A. The concept would meet the preferred capacity and operational standards, improve merging movements, improve the forecasted LOS from E to D, provide continuity along the study corridor, and possibly resolve public concerns in the area. The conceptual design improvements are delineated in Table 84, and the conceptual design is shown in Figure 52.

Table 84. Conceptual Design Improvements for Old Glenn Southbound On-Ramp

Ramp Characteristics	Existing	Concept
Ramp Length L_a, ft (measured from stop condition to start of taper, based on PGDHS)	2490	2710
Parallel Acceleration lane L_A, ft (ramp merge area from nose of painted gore to end of taper, based on HCM)	790	960

Note: The existing ramp length L_a is greater than PGDHS-recommended and was increased to accommodate the PGDHS typical parallel entrance ramp design.

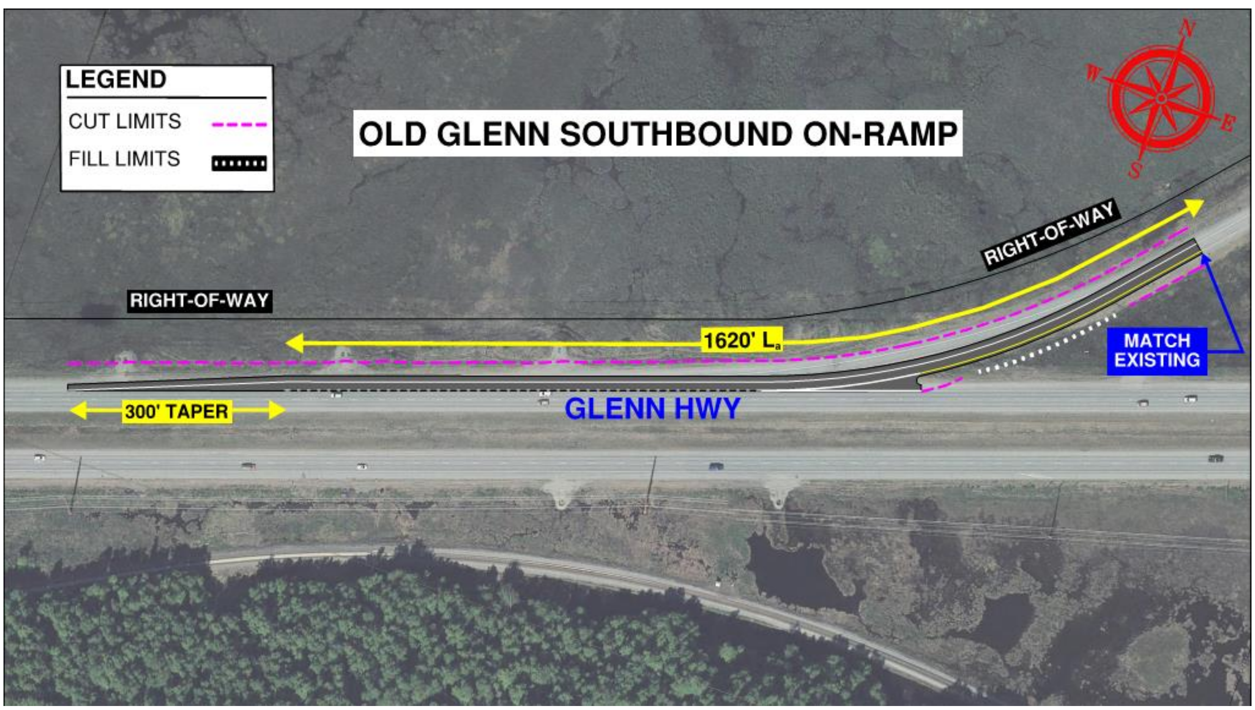


Figure 52. Conceptual Design for Old Glenn Southbound On-Ramp

The area surrounding the conceptual design is free from potential conflicts with ROW boundaries and mapped wetlands. Table 85 summarizes the conceptual design impacts on the existing ramp.

Table 85. Old Glenn Southbound On-Ramp: Potential Impacts on Existing Features

	Old Glenn Southbound: Potential Impacts on Existing Features
ROW	None
Wetland	None
Other	None

The construction cost of the conceptual design for the Old Glenn southbound on-ramp is approximately $1,032,000.

3.9.1.6 Crash Reduction

The CMF for lengthening the on-ramp merge area from 790 feet to 960 feet long is 0.92. Applying this CMF to all of the on-ramp crashes except the Moose crash would reduce the 5-year crash cost by $25,700.

4 Summary of Findings

4.1 Merge Capacity Analysis Summary

The merge analyses are summarized in Tables 84 and 85. Since the LOS is based on average density, the ramps are sorted by that criterion, beginning with the highest reported density (corresponding the ramps with the most need of improvement, per this measure, as a low density allows for stable merge operations). The on-ramp influence area speed, as well as the minimum additional L_A that would improve the LOS by one letter grade are also presented in the tables.

Table 86. 2020 Merge Analysis Summary

On-Ramp	2020 AADT	Current HCM Acceleration Lane L_A, ft	2020 LOS	Average Density, pc/mi/ln	2020 On-Ramp Influence Area Speed, mph	Minimum Additional L_A Length to Achieve LOS B*, ft
JBER Southbound	2990	660	C	29	59.3	More than 840
N Birchwood Northbound	1364	520	C	25.9	59.6	More than 980
JBER Northbound	1811	740	C	28.1	59.8	More than 760
S Peters Creek Southbound	2648	780	C	27.2	59.7	More than 720
N Birchwood Southbound	1753	700	C	26.2	59.9	More than 800
S Birchwood Southbound	1453	800	C	25.8	60.1	More than 700
Old Glenn Southbound	1298	790	C	25.6	60.2	More than 710
S Peters Creek Northbound	768	550	C	25.2	59.9	880
N Eagle River Southbound	2512	1360	C	26.5	60.9	More than 140
S Birchwood Northbound	433	610	C	24.8	60.1	780
N Peters Creek Southbound	463	630	C	24.8	60.1	760
Mirror Lake Southbound	193	700	C	24.4	60.3	650
Eklutna Southbound	532	930	C	24.6	60.7	470
Eklutna Northbound	176	860	C	24.3	60.6	490
N Peters Creek Northbound	297	920	C	24.4	60.7	460

*per HCM

Table 87. Merge Analysis Summary under 2045 AADT Conditions

On-Ramp	2045 AADT	Current HCM Acceleration Lane L_A, ft	2045 LOS	Average Density, pc/mi/ln	2045 On-Ramp Influence Area Speed, mph	Minimum Additional L_A Length to Achieve Higher LOS*, ft
JBER Southbound	3901	660	**F**	n/a	43.9	More than 840
JBER Northbound	2217	740	**F**	n/a	47.5	More than 760
S Peters Creek Southbound	3000	780	E	46.4	50.6	330
N Birchwood Southbound	1986	700	E	44.1	51.8	270
N Birchwood Northbound	1545	520	E	43.5	52	390
N Eagle River Southbound	3591	1360	D	46.9	50.8	More than 140
S Birchwood Southbound	1646	800	E	43.2	52.4	110
S Peters Creek Northbound	870	550	E	41.9	52.9	250
Old Glenn Southbound	1445	790	E	42.7	52.7	90
S Birchwood Northbound	491	610	E	41.1	53.4	150
N Peters Creek Southbound	524	630	E	41.1	53.4	120
Mirror Lake Southbound	252	700	E	40.5	53.8	20
Eklutna Southbound	603	930	D	40.8	53.9	More than 570
Eklutna Northbound	199	860	D	40.2	54.2	More than 640
N Peters Creek Northbound	336	920	D	40.3	54.2	More than 580

* per HCM

4.2 Ramp Speed Analysis Summary

Table 88 presents the results of the ramp speed analysis, in order according to the additional L_a length needed to meet the PGDHS-recommended L_a length. This length allows drivers to reach the desired highway speed prior to merging and is dependent on geometric provisions such as the ramp grade and measured L_a. The table also compares the measured gap acceptance length L_g to the recommended values published in the PGDHS. The desirable gap acceptance length provides the appropriate space for merging.

Table 88. Speed Analysis Summary

On-Ramp	Ramp Grade, %	Measured L_g, ft	Meets Recommended L_g?	Measured PGDHS Acceleration Lane L_a, ft	Additional L_a Length per PGDHS, ft
S Peters Creek Southbound	0	337	YES	1150	470
N Peters Creek Southbound	-0.5	428	YES	1290	330
N Peters Creek Northbound	-2	502	YES	1330	290
N Birchwood Southbound	-1	599	YES	1410	220
JBER Southbound	-0.5	452	YES	1420	200
S Peters Creek Northbound	+1.5	301	YES	1450	170
Eklutna Northbound	-1	604	YES	1530	90
Eklutna Southbound	+0.5	914	YES	1670	-50
JBER Northbound	-1.5	503	YES	1690	-70
Mirror Lake Southbound	+3	627	YES	1890	-270
N Birchwood Northbound	-4	405	YES	1420	-450
S Birchwood Southbound	+1	380	YES	2120	-500
S Birchwood Northbound	-1.5	435	YES	2470	-850
N Eagle River Southbound	-0.5	931	YES	2640	-1020
Old Glenn Southbound	0	392	YES	n/a	0

4.3 Ramp Crash Analysis Summary

Crashes in the vicinity of each on-ramp were analyzed. The ramp crash analysis considered three different crash locations at each interchange:

1. Ramp Crash – crash occurred on a Glenn Highway on-ramp.
2. Ramp Related Crash – crash occurred on the Glenn Highway, but was related to a ramp or ramp merging as described in the crash narrative.
3. Through Roadway Crash – crash occurred within an interchange area but was not reported to be ramp related and did not occur on a ramp.

Table 89 presents the total number of crashes at each interchange with potential on-ramp improvements.

Table 89. Crash Frequency by Interchange Crash Location

Location and Direction	Ramp Crashes	Ramp Related Crashes	Through Roadway Crashes	Total Crashes
JBER Northbound	0	2	30	32
JBER Southbound	0	9	32	41
N Eagle River Southbound	2	3	10	15
S Birchwood Northbound	1	0	25	26
S Birchwood Southbound	5	5	37	47
N Birchwood Northbound	1	0	18	19
N Birchwood Southbound	0	2	12	14
S Peters Creek Northbound	1	1	12	14
S Peters Creek Southbound	1	3	18	22
N Peters Creek Northbound	0	1	7	8
N Peters Creek Southbound	0	1	5	6
Mirror Lake Southbound	0	1	7	8
Eklutna Northbound	0	0	17	17
Eklutna Southbound	0	1	17	18
Old Glenn Southbound	0	3	4	7
TOTAL CRASHES	11	33	261	305

Table 90 delineates the calculated crash rates for crashes that occurred on each on-ramp. The South Birchwood Southbound On-Ramp has the highest on-ramp crash rate, with an average of 1 crash per year over the 5-year analysis period.

Table 91 presents the calculated crash rates for crashes that occurred in the through roadway area, including ramp related crashes. The S Birchwood Southbound On-Ramp through roadway areas experienced the highest number of crashes during the analysis period and has the highest crash rate.

Table 90. On-Ramp Crash Rates

Location and Direction	On-Ramp Length	On-Ramp Crash Frequency	On-Ramp Crash Rate
JBER Northbound	0.25	0	-
JBER Southbound	0.23	0	-
N Eagle River Southbound	0.37	2	1.21
S Birchwood Northbound	0.42	1	2.87
S Birchwood Southbound	0.36	5	5.22
N Birchwood Northbound	0.20	1	2.17
N Birchwood Southbound	0.19	0	-
S Peters Creek Northbound	0.24	1	3.27
S Peters Creek Southbound	0.17	1	1.02
N Peters Creek Northbound	0.17	0	-
N Peters Creek Southbound	0.21	0	-
Mirror Lake Southbound	0.45	0	-
Eklutna Northbound	0.21	0	-
Eklutna Southbound	0.21	0	-
Old Glenn Southbound	0.39	0	-

#.## – Crash rate in the top 10%, #.## – Crash rate in the top 25%

Table 91. Combined Ramp Related and Through Roadway Crash Rates

Location and Direction	Through Roadway Length	Ramp Related and Through Roadway Crash Frequency	Ramp Related and Through Roadway Crash Rate
JBER Northbound	0.65	32	0.47
JBER Southbound	0.55	41	0.71
N Eagle River Southbound	0.93	13	0.21
S Birchwood Northbound	0.85	25	0.43
S Birchwood Southbound	0.83	42	0.74
N Birchwood Northbound	0.59	18	0.46
N Birchwood Southbound	0.56	14	0.37
S Peters Creek Northbound	0.52	13	0.40
S Peters Creek Southbound	0.53	21	0.63
N Peters Creek Northbound	0.52	8	0.26
N Peters Creek Southbound	0.51	6	0.20
Mirror Lake Southbound	0.63	8	0.22
Eklutna Northbound	0.51	17	0.57
Eklutna Southbound	0.50	18	0.61
Old Glenn Southbound	0.67	7	0.19

#.## – Crash rate in the top 10%, #.## – Crash rate in the top 25%

4.4 MetroQuest Survey Summary

Table 92 shows the number of comments received for each ramp in order, from greatest to least.

Table 92. Number of MetroQuest Survey Comments by Ramp

On-Ramp	*# Comments Received*
N Eagle River Southbound	65
JBER Northbound	41
S Peters Creek Southbound	32
S Birchwood Southbound	23
N Birchwood Northbound	15
N Birchwood Southbound	13
JBER Southbound	12
S Birchwood Northbound	10
N Peters Creek Southbound	5
Old Glenn Southbound	5
Eklutna Southbound	4
S Peters Creek Northbound	4
Eklutna Northbound	3
Mirror Lake Southbound	3
N Peters Creek Northbound	0

5 Benefit-Cost Analysis

Three quantifiable benefits of the potential ramp improvements were identified:

1. Speed increase in on-ramp influence area.
2. Crash reduction resulting in reduced total cost of crashes.
3. Crash reduction resulting in reduced delay due to crashes.

The cost value of these benefits was calculated then compared to the construction and Maintenance and Operation (M&O) costs of each benefit, as described in the following sections.

5.1 Speed Increase

Traffic within the influence area of an on-ramp often experiences reduced speeds as vehicles merge onto the highway. The HCM methodology for on-ramp analysis estimates the average speed within the on-ramp influence area based on geometric factors (such as the number of lanes and the length of the acceleration lane), as well as traffic factors (such as the volume and type of vehicles on the ramps and on the mainline). Extending the acceleration lane increases the on-ramp influence area speed because it provides more opportunity for ramp vehicles to find a gap in the mainline traffic without forcing the mainline traffic to slow down.

As described in Section 2.2 Ramp Speed Analysis using the HCM on-ramp methodology, the on-ramp influence area speed was calculated for the existing time period and for 2045 for both the No Build condition (no changes to the on-ramp) and the conceptual design (lengthened acceleration lane and converted parallel ramp) condition. The difference in speed between the No Build and the conceptual design condition was used to calculate the change in travel time for the existing year and for 2045. This was monetized using the method of calculating travel time savings found in the USDOT publication *Benefit-Cost Analysis Guidance for Discretionary Grant Programs*, February 2021 and the DOT&PF interest rate effective January 2021, found at http://dot.alaska.gov/stwddes/dcsprecon/assets/pdf/kabco_costs.pdf.

The pertinent values taken from these publications are shown in Table 93. Table 94 shows the calculated 20-year travel time savings due to the lengthened acceleration lane area for each of the conceptual ramp designs.

Table 93. Values Used in Calculation of Travel Time Savings Due to Speed Change

Value of Time ($/person-hour)	$17.90
Vehicle occupancy (persons per vehicle)	1.48
Discount rate	3%

Table 94. Value of the 20-Year Travel Time Savings Due to Speed Change, by Ramp

On Ramp Location/Direction	Value of Speed Change
JBER Northbound	$199,000
JBER Southbound	$296,000
N Eagle River Southbound	$26,000
S Birchwood Northbound	$0
S Birchwood Southbound	$24,000
N Birchwood Northbound	$6,000
N Birchwood Southbound	$27,000
S Peters Creek Northbound	$5,000
S Peters Creek Southbound	$33,000
N Peters Creek Northbound	$10,000
N Peters Creek Southbound	$36,000
Mirror Lake Southbound	$15,000
Eklutna Northbound	$20,000
Eklutna Southbound	$27,000
Old Glenn Southbound	$17,000

5.2 Crash Reduction Costs

Changes in the number of crashes by severity for the 5-year study period from 2013 to 2017 if the improvements had been implemented were calculated using the CMF, which can be found in the Crash Reduction subsection of the Crash Analysis section for each ramp. This value was then converted into a yearly crash savings value and the net present value (NPV) of this crash savings over a 20-year period was calculated using a 3% discount rate. Table 95 shows the calculated 20-year crash cost savings due to the lengthened acceleration lane area for each of the conceptual ramp designs.

Table 95. Value of the 20-Year Crash Cost Savings, by Ramp

On Ramp Location/Direction	Value of Crash Cost Change
JBER Northbound	$1,110,000
JBER Southbound	$1,257,000
N Eagle River Southbound	$742,000
S Birchwood Northbound	$19,000
S Birchwood Southbound	$1,115,000
N Birchwood Northbound	$27,000
N Birchwood Southbound	$116,000
S Peters Creek Northbound	$83,000
S Peters Creek Southbound	$2,829,000
N Peters Creek Northbound	$190,000
N Peters Creek Southbound	$181,000
Mirror Lake Southbound	$100,000
Eklutna Northbound	$145,000
Eklutna Southbound	$667,000
Old Glenn Southbound	$76,000

5.3 Crash Reduction Delays

The Glenn Highway Integrated Corridor Management (ICM) study calculated delay experienced by other vehicles on the Glenn Highway due to a crash. These values were used to calculate the value of the change in delay due to the reduction in crashes estimated for the potential improvements (lengthening the acceleration lanes), and net present value of this change in delay was calculated over a 20-year design life. Table 96 shows the calculated 20-year delay cost savings due to the lengthened acceleration lane area for each of the conceptual ramp designs.

Table 96. Value of the 20-Year Delay Cost Savings due to Reduction in Crashes, by Ramp

On Ramp Location/Direction	Value of Change in Delay due to Crashes
JBER Northbound	$93,000
JBER Southbound	$124,000
N Eagle River Southbound	$57,000
S Birchwood Northbound	$2,000
S Birchwood Southbound	$48,000
N Birchwood Northbound	$2,000
N Birchwood Southbound	$14,000
S Peters Creek Northbound	$6,000
S Peters Creek Southbound	$23,000
N Peters Creek Northbound	$7,000
N Peters Creek Southbound	$15,000
Mirror Lake Southbound	$6,000
Eklutna Northbound	$21,000
Eklutna Southbound	$34,000
Old Glenn Southbound	$6,000

5.4 Construction and Maintenance and Operations (M&O) Costs

Conceptual drawings of the potential ramp improvements were prepared, as presented in the Conceptual Design Improvements subsection for each ramp. Construction costs based on the conceptual design were estimated for each. M&O costs of the improvement were estimated using the value of $6,000 per lane-mile, as presented in the *Highway Safety Improvement Program (HSIP) Handbook*, 2021. The 20-year net present value of the yearly M&O costs was calculated using the 3% discount rate. Table 97 shows the calculated construction and M&O costs by ramp.

Table 97. Construction and 20-Year M&O Costs, by Ramp

On Ramp Location/Direction	Construction Costs	20-Year M&O Costs
JBER Northbound	$1,217,000	$13,000
JBER Southbound	$1,209,000	$14,000
N Eagle River Southbound	$1,416,000	$14,000
S Birchwood Northbound	$1,010,000	$0
S Birchwood Southbound	$963,000	$3,000
N Birchwood Northbound	$399,000	$0
N Birchwood Southbound	$873,000	$4,000
S Peters Creek Northbound	$616,000	$1,000
S Peters Creek Southbound	$622,000	$3,000
N Peters Creek Northbound	$900,000	$2,000
N Peters Creek Southbound	$767,000	$7,000
Mirror Lake Southbound	$680,000	$3,000
Eklutna Northbound	$756,000	$4,000
Eklutna Southbound	$945,000	$5,000
Old Glenn Southbound	$1,032,000	$3,000

5.1 Summary of Benefit-Cost

Table 98 shows the benefit-cost ratio for the 15 ramps where the potential improvements were evaluated, with the benefit calculated as the sum of the values for speed change, crash cost, and delay due to crashes, and the costs calculated as the cost of construction and M&O.

Table 98. Benefit-Cost Ratio for Conceptual Design Improvements, by Ramp

On Ramp Location/Direction	Benefit	Cost	Benefit-Cost Ratio
JBER Northbound	$1,401,000	$1,230,000	1.1
JBER Southbound	$1,676,000	$1,223,000	1.4
N Eagle River Southbound	$825,000	$1,430,000	0.6
S Birchwood Northbound	$21,000	$1,010,000	0.0
S Birchwood Southbound	$1,187,000	$966,000	1.2
N Birchwood Northbound	$35,000	$399,000	0.1
N Birchwood Southbound	$156,000	$877,000	0.2
S Peters Creek Northbound	$94,000	$617,000	0.2
S Peters Creek Southbound	$2,885,000	$625,000	4.6
N Peters Creek Northbound	$207,000	$902,000	0.2
N Peters Creek Southbound	$232,000	$774,000	0.3
Mirror Lake Southbound	$121,000	$683,000	0.2
Eklutna Northbound	$185,000	$760,000	0.2
Eklutna Southbound	$728,000	$950,000	0.8
Old Glenn Southbound	$100,000	$1,035,000	0.1

6 Prioritization of Ramp Projects

The incremental benefit-cost ratio method was used to place the ramps in the order of preference for improvement. Under this method, the ramps with potential improvements were first ordered by construction cost, from least to greatest. Starting with the two with the lowest construction costs, an incremental benefit-cost ratio (IB/C) was calculated as:

$$\frac{IB}{C}_{2-1} = \frac{\Delta Present\ Value\ (Benefits)}{\Delta Present\ Value\ (Costs)} = \frac{(PV(B)_2 - PV(B)_1)}{(PV(C)_2 - PV(C)_1)}$$

If the $IB/C_{2\text{-}1}$ is equal to or greater than 1, then alternative 1 "wins" the matchup and goes on to be compared with alternative 3. If the $IB/C_{2\text{-}1}$ is less than 1.0, then alternative 2 "wins" and goes on to be paired with alternative 3. The alternative that "wins" the final pairing is the most cost-effective (has the highest incremental benefit compared to the cost). Table 99 presents the ramps in the order of priority, along with the construction cost, the benefit-cost ratio, and a brief description of the identified concerns and potential improvements for each ramp. With the understanding that funding for the improvement of these ramps may be limited, the cumulative cost of ramp improvements (representing the construction cost of each sequential and cumulative ramp) and is also shown.

Table 99. Summary of Ramp Prioritization

Rank	Ramp	Construction Cost	Cumulative Cost	B-C Ratio	Summary of Concerns Addressed	Summary of Potential Ramp Improvements
1	N Birchwood NB	$399,000		0.1	Public comment indicated that merging at this on-ramp causes congestion, resulting in delays. There were 19 crashes, including 2 Moose crashes[i].	Convert to a parallel-type ramp entrance to enhance merging.
2	S Peters Creek SB	$622,000	$1,021,000	4.6	Acceleration lane is too short to allow drivers to reach highway speeds. Public comment described issues with merging due to the short ramp and the incline. There were 24 crashes.	Extend the ramp to allow ramp traffic to achieve highway speeds before merging. Convert to a parallel-type ramp entrance to further enhance merging.
3	JBER SB	$1,209,000	$2,230,000	1.4	Acceleration lane is too short to allow drivers to reach highway speeds. Ramp level of service in 2045 is expected to deteriorate to LOS F. There were 41 crashes, including 9 Moose crashes[i].	Extend the ramp to allow ramp traffic to achieve highway speeds before merging. Convert to a parallel-type ramp entrance to further enhance merging.
4	S Birchwood SB	$963,000	$3,193,000	1.2	Public comment indicated that merging at this on-ramp causes congestion, resulting in delays. Traffic associated with Chugiak High School (buses and inexperienced drivers) was also mentioned. There were 47 crashes, including 3 Moose crashes[i]. This was the highest number of crashes compared to all of the other ramps with potential improvements.	Convert to a parallel-type ramp entrance to enhance merging.
5	JBER NB	$1,217,000	$4,410,000	1.1	Ramp level of service in 2045 is expected to deteriorate to LOS F. Public comment indicated that merging at this on-ramp causes congestion, resulting in delays. There were 32 crashes, including 6 Moose crashes[i].	Convert to a parallel-type ramp entrance to enhance merging.
9	Eklutna SB	$945,000	$5,355,000	0.8	There were 18 crashes.	Convert to a parallel-type ramp entrance to enhance merging.
7	S Peters Creek NB	$616,000	$5,971,000	0.2	Acceleration lane is too short to allow drivers to reach highway speeds. There were 14 crashes.	Extend the ramp to allow ramp traffic to achieve highway speeds before merging. Convert to a parallel-type ramp entrance to enhance merging.
8	N Peters Creek SB	$767,000	$6,738,000	0.3	Acceleration lane is too short to allow drivers to reach highway speeds. There were 6 crashes.	Extend the ramp to allow ramp traffic to achieve highway speeds before merging. Convert to a parallel-type ramp entrance to enhance merging.
9	Mirror Lake SB	$680,000	$7,418,000	0.2	There were 8 crashes, including 3 Moose crashes[i].	Convert to a parallel-type ramp entrance to enhance merging.
10	Eklutna NB	$756,000	$8,174,000	0.2	Acceleration lane is too short to allow drivers to reach highway speeds. There were 17 crashes, including 2 Moose crashes[i].	Extend the ramp to allow ramp traffic to achieve highway speeds before merging. Convert to a parallel-type ramp entrance to enhance merging.
11	N Eagle River SB	$1,416,000	$9,590,000	0.6	This ramp has the second highest ramp volumes of those with potential improvements. Public comment indicated that merging at this on-ramp causes congestion, resulting in delays. There were 15 crashes.	Convert to a parallel-type ramp entrance to enhance merging.
12	N Peters Creek NB	$900,000	$10,490,000	0.2	Acceleration lane is too short to allow drivers to reach highway speeds. There were 8 crashes.	Extend the ramp to allow ramp traffic to achieve highway speeds before merging. Convert to a parallel-type ramp entrance to enhance merging.
13	N Birchwood SB	$873,000	$11,363,000	0.2	Acceleration lane is too short to allow drivers to reach highway speeds. There were 14 crashes, including 4 Moose crashes[i].	Extend the ramp to allow ramp traffic to achieve highway speeds before merging. Convert to a parallel-type ramp entrance to enhance merging.
14	Old Glenn SB	$1,032,000	$12,395,000	0.1	There were 7 crashes, including 1 Moose crash[i].	Convert to a parallel-type ramp entrance to enhance merging.
15	S Birchwood NB	$1,010,000	$13,405,000	0.0	There were 26 crashes.	Convert to a parallel-type ramp entrance to enhance merging.

[i] Moose crashes are unlikely to be reduced by improvements to the on-ramp.

7 References

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Appendix A. Design Designation Forms

DESIGN DESIGNATION

State Route Number: 135000 Route Name: Glenn Highway

Project Limits: Glenn Highway MP 0.0 - 32.5

State Project Number: CFHWY00545 Federal Aid Number: 1656

Project Description: Glenn Highway: Airport Heights to Parks Highway Rehab

Design Functional Classification:
- [X] Freeway
- [ ] Rural Arterial
- [ ] Urban Arterial
- [ ] Other ______
- [ ] Collector, type ______
- [ ] Local Recreational Rd.
- [ ] Local Resource Recovery Rd.
- [ ] Rural Local Rd.
- [ ] Urban Local St.
- [ ] Local Service Rd.

Project Type:
- [ ] New Construction - Reconstruction
- [ ] Preventive Maintenance (PM)
- [X] 3R
- [ ] HSIP

Project Design Life (years): 5 [ ] 10 [ ] 20 [X] 25 [ ] 30 [ ] Other ______

Traffic Projections:

	Current Year	Construction Year	Mid - Life Year	Design Year
	2020	2025	2035	2045
2-Way AADT*	62,429	67,518	78,976	92,377
2-Way DHV	11%	11%	11%	11%
Peak Hour Factor	0.88	0.88	0.88	0.88
Directional Distribution	60/40	60/40	60/40	60/40
Percent Recreational Vehicles	N/A	N/A	N/A	N/A
Percent Commercial Trucks	6%	6%	6%	6%
Growth Rate (%)	1.58%	1.58%	1.58%	1.58%
ESALs				
Pedestrians (Number/Day)	N/A	N/A	N/A	N/A
Bicyclists (Number/Day)	N/A	N/A	N/A	N/A

* Use AFDM Traffic Data Request Form, Figure 6.1 for pavement design. Form 6.1 is available on-line at: http://www.dot.state.ak.us/stwddes/dcsprecon/assets/pdf/other/traffic_data_req_form.pdf

Design Vehicle: WB67

Level of Service (Urban Only): ______

Design Speed: 70 mph

Terrain: [X] Level [X] Rolling [ ] Mountainous

Attach intersection diagrams to this document, when appropriate.

APPROVED ______ Preconstruction Engineer DATE 9/24/2020

Figure 1100-1
Design Designation Form

SOURCE: DOT&PF

Figure A-1. Design Designation form for Glenn Highway Segment Including the JBER Interchange

DESIGN DESIGNATION

State Route Number: 135000 Route Name: Glenn Highway

Project Limits: Glenn Highway MP 0.0 - 32.5

State Project Number: CFHWY00545 Federal Aid Number: 1656

Project Description: Glenn Highway: Airport Heights to Parks Highway Rehab

Design Functional Classification:
- [X] Freeway
- [ ] Rural Arterial
- [ ] Urban Arterial
- [ ] Other ______
- [ ] Collector, type ______
- [ ] Local Recreational Rd.
- [ ] Local Resource Recovery Rd.
- [ ] Rural Local Rd.
- [ ] Urban Local St.
- [ ] Local Service Rd.

Project Type:
- [ ] New Construction - Reconstruction
- [ ] Preventive Maintenance (PM)
- [X] 3R
- [ ] HSIP

Project Design Life (years): 5 [ ] 10 [ ] 20 [X] 25 [ ] 30 [ ] Other ______

Traffic Projections:

	Current Year	Construction Year	Mid - Life Year	Design Year
	2020	2025	2035	2045
2-Way AADT*	33,950	36,718	42,948	50,236
2-Way DHV	11%	11%	11%	11%
Peak Hour Factor	0.88	0.88	0.88	0.88
Directional Distribution	65/35	65/35	65/35	65/35
Percent Recreational Vehicles	N/A	N/A	N/A	N/A
Percent Commercial Trucks	6%	6%	6%	6%
Growth Rate (%)	1.58%	1.58%	1.58%	1.58%
ESALs				
Pedestrians (Number/Day)	N/A	N/A	N/A	N/A
Bicyclists (Number/Day)	N/A	N/A	N/A	N/A

* Use AFDM Traffic Data Request Form, Figure 6.1 for pavement design. Form 6.1 is available on-line at: http://www.dot.state.ak.us/stwddes/dcsprecon/assets/pdf/other/traffic_data_req_form.pdf

Design Vehicle: WB67

Level of Service (Urban Only): ______

Design Speed: 70 mph

Terrain: [X] Level [X] Rolling [ ] Mountainous

Attach intersection diagrams to this document, when appropriate.

APPROVED ______ Preconstruction Engineer DATE 9/24/2020

Figure 1100-1
Design Designation Form

SOURCE: DOT&PF

Figure A-2. Design Designation form for Glenn Highway Segment After the JBER Interchange

Appendix B. Corridor-Wide On-Ramp Crash Analysis

Combined crash data for all on-ramps evaluated for improvements was analyzed. Crash Type and Severity for the three different crash locations (Ramp, Ramp-Related, and Through Roadway) were considered.

Crashes on On-Ramps

Figure B-1 depicts the type and severity of crashes that occurred on on-ramps. A total of eleven crashes occurred on on-ramps evaluated for improvements. Figure B-2 suggests that weather conditions may play a role in the occurrence of on-ramp crashes, with 82% of crashes occurring on roads with winter conditions.

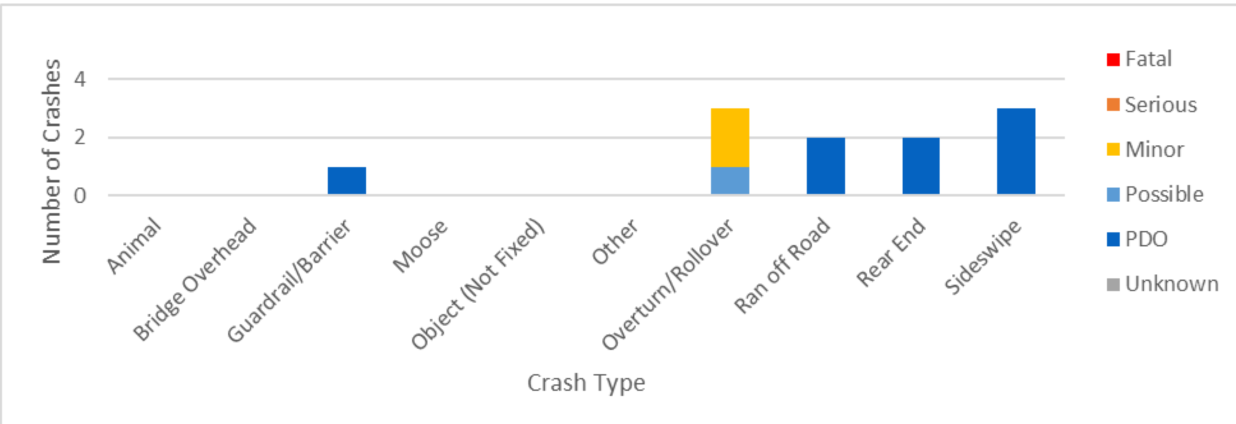

Figure B-1. Crashes on On-Ramps (2013 to 2017)

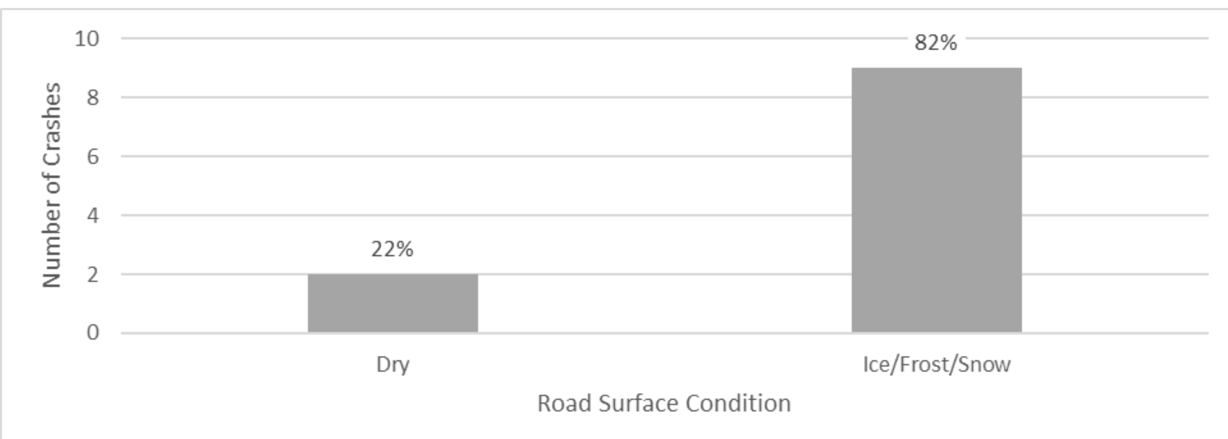

Figure B-2. Crashes on Ramps by Road Surface Condition (2013 to 2017)

Ramp-Related Crashes

Figure B-3 shows the crash type and severity distribution for ramp-related crashes. Sideswipe crashes attributed to merging were the most commonly occurring crash type. Of the nine Ran off Road crashes, four occurred when a vehicle lost control and struck a fence, two vehicles struck a light pole, and two vehicles lost control and crossed the median, colliding with vehicles traveling in the opposite direction. Seven Overturn/Rollover crashes were also reported. About 64% of ramp related crashes occurred under winter road conditions, as shown in Figure B-4.

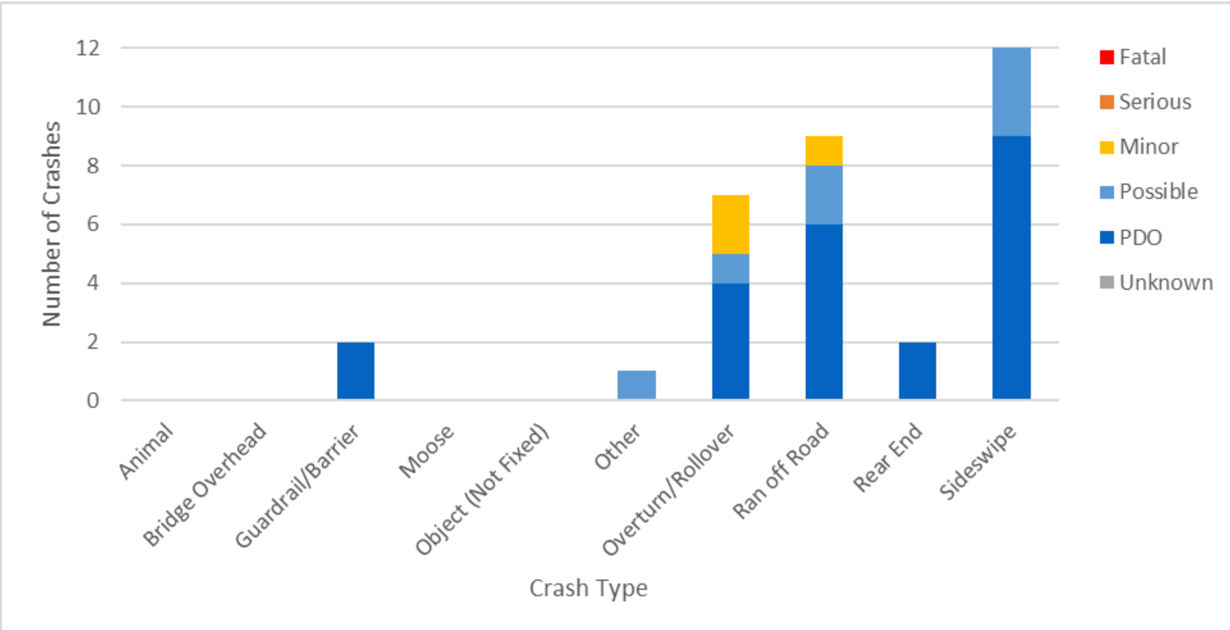

Figure B-3. Ramp Related Crashes (2013 to 2017)

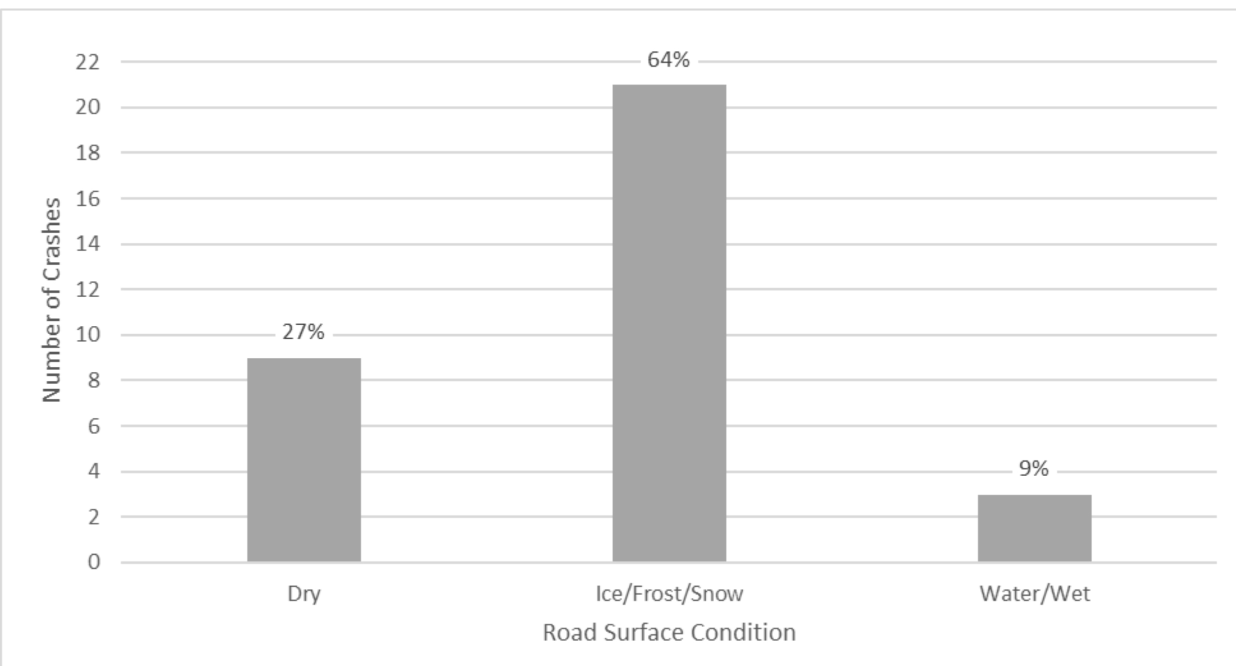

Figure B-4. Ramp Related Crashes by Road Surface Condition(2013 to 2017)

Through Roadway Crashes

Figure B-5 shows the distribution for Through Roadway crashes, with Rear End crashes as the most commonly occurring crash type. Figure B-6 suggests that winter road conditions have little bearing on crash occurrence in through roadway areas.

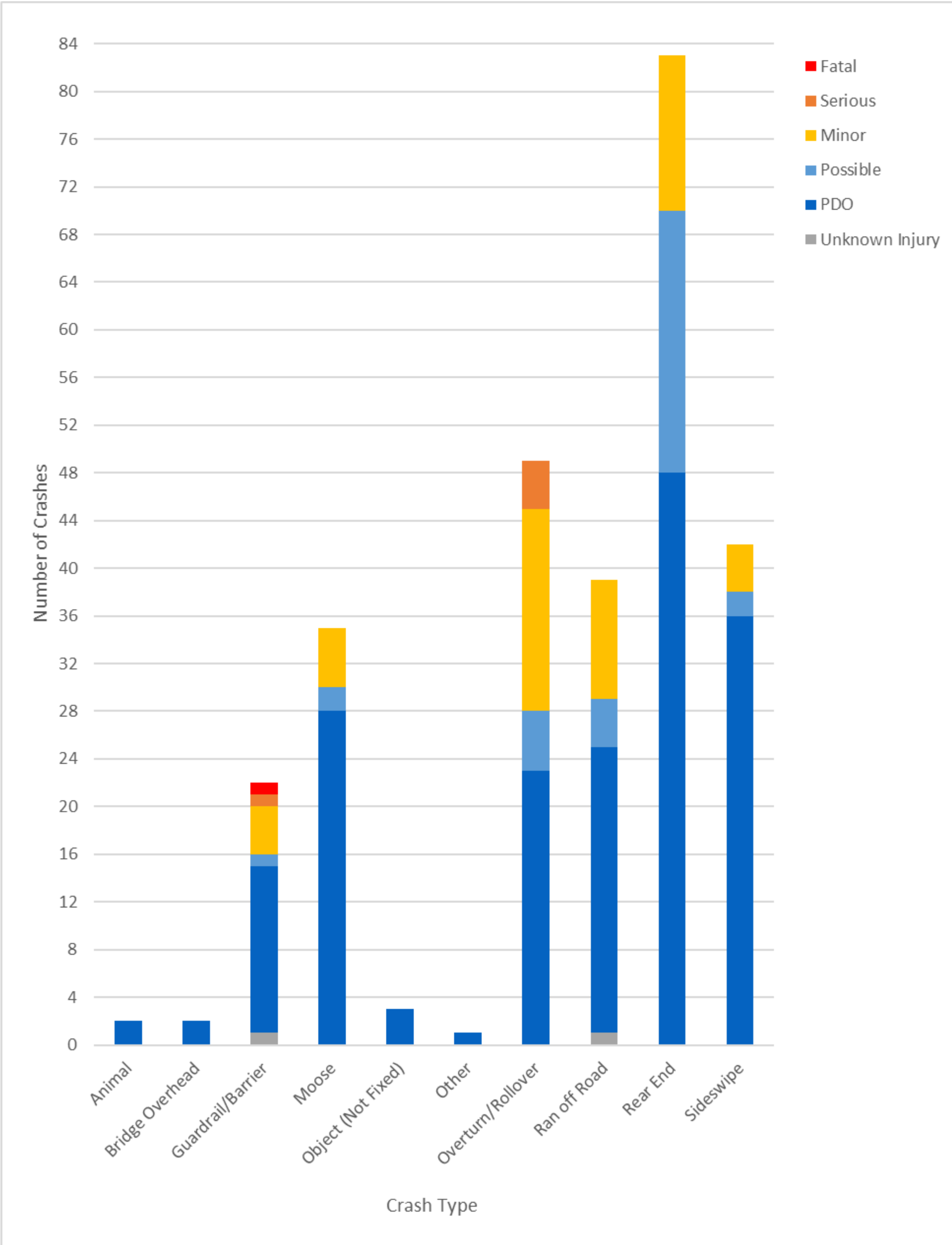

Figure B-5. Through Roadway Crashes (2013 to 2017)

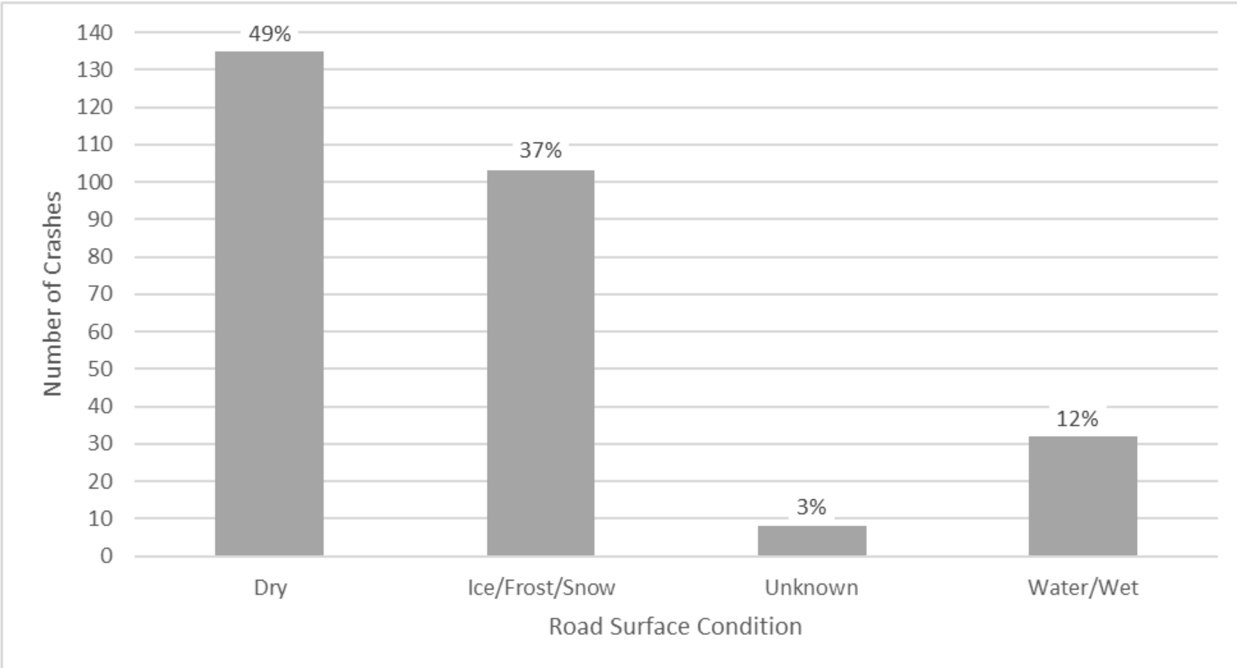

Figure B-6. Through Roadway Crashes by Road Surface

Appendix C. Ramps that were not Evaluated for Improvements

Table C-1 lists the on-ramps that were not evaluated for potential improvements and the reason why they were not evaluated.

Table C-1. On-Ramps with no Improvements

On-Ramp	Comments*
Bragaw Northbound	Not included in scope
Bragaw Southbound	Not included in scope
Boniface Northbound	Not included in scope
Boniface Southbound Clover (On-Ramp)	Not included in scope
Boniface Southbound	Not included in scope
Turpin Northbound	Not included in scope
Muldoon Northbound	Already improved by another project
Muldoon Southbound	Already improved by another project
Ft Rich/Ship Creek Southbound	Not included in scope
Hiland Northbound	In process of being improved by another project
Hiland Southbound	In process of being improved by another project
S Eagle River Northbound	In process of being improved by another project
S Eagle River Southbound	In process of being improved by another project
N Eagle River Northbound	Not included in scope
Thunderbird Falls Northbound	Not included in scope
Old Glenn Northbound	Not included in scope
Knik River Access Northbound	Not included in scope
Knik River Access Southbound	Not included in scope

* The *AMATS: Glenn Highway Integrated Corridor Management Study (ICM)* identified on-ramps that would benefit from merge upgrades (KE, 2019). On-ramps that were not identified in the ICM were not included in the scope for this project.

Crash Rates for Ramps that were not Evaluated for Improvements

Table C-2 lists the number of crashes at each crash location, while Table C-3 and Table C-4 provide on-ramp crash rates and ramp-related and through roadway crash rates, respectively.

Table C-2. Crash Frequency by Interchange Crash Location (Ramps that were not Evaluated for Improvements)

Location and Direction	Ramp Crashes	Ramp Related Crashes	Through Roadway Crashes	Total Crashes
Bragaw Northbound	1	7	9	17
Bragaw Southbound	1	4	23	28
Boniface Northbound	1	2	18	21
Boniface Southbound Clover (On Ramp)	0	1	17	18
Boniface Southbound	0	3	8	11
Turpin Northbound	0	1	3	4
Ft Rich/Ship Creek On-Ramp Southbound	0	1	12	13
N Eagle River Northbound	5	5	12	22
Mirror Lake Northbound	0	0	8	8
Thunderbird Falls Northbound	0	0	8	8
Old Glenn Northbound	0	0	9	9
Knik River Access Northbound	0	1	7	8
Knik River Access Southbound	0	0	7	7
TOTAL CRASHES	8	25	141	174

Table C-3. Crash Rates for On-Ramps that were not Evaluated for Improvements

Location and Direction	On-Ramp Length	On-Ramp Crash Frequency	On-Ramp Crash Rate
Bragaw Northbound	0.21	1	0.46
Bragaw Southbound	0.10	1	3.50
Boniface Northbound	0.18	1	0.43
Boniface Southbound Clover (On Ramp)	0.19	0	-
Boniface Southbound	0.18	0	-
Turpin Northbound	0.16	0	-
Ft Rich/Ship Creek On-Ramp Southbound	0.09	0	-
N Eagle River Northbound	0.45	5	1.32
Mirror Lake Northbound	0.28	0	-
Thunderbird Falls Northbound	0.08	0	-
Old Glenn Northbound	0.27	0	-
Knik River Access Northbound	0.25	0	-
Knik River Access Southbound	0.22	0	-

Table C-4. Combined Ramp Related and Through Roadway Crash Rates (Ramps that were not Evaluated for Improvements)

Location and Direction	Through Roadway Length	Ramp Related and Through Roadway Crash Frequency	Ramp Related and Through Roadway Crash Rate
Bragaw Northbound	0.54	16	0.31
Bragaw Southbound	0.54	27	0.53
Boniface Northbound	0.55	20	0.37
Boniface Southbound Clover (On Ramp)	0.39	18	0.49
Boniface Southbound	0.28	11	0.40
Turpin Northbound	0.37	4	0.11
Ft Rich/Ship Creek On-Ramp Southbound	0.23	13	0.49
N Eagle River Northbound	0.88	17	0.28
Mirror Lake Northbound	0.60	8	0.23
Thunderbird Falls Northbound	0.36	8	0.38
Old Glenn Northbound	0.75	9	0.21
Knik River Access Northbound	0.67	8	0.23
Knik River Access Southbound	0.56	7	0.24

Crash Analysis for Ramps that were not Evaluated for Improvements

Bragaw Northbound Crash Experience (2013 to 2017)

Table C-5 shows the number and location of crashes that occurred on or near this ramp from 2013 through 2017.

Table C-5. Bragaw Northbound On-Ramp Crash Experience 2013 to 2017

	On Ramp	Ramp Related	Through Roadway
Bragaw northbound on-ramp	1	7	9

Figure C-1 shows the crash type and severity for the 17 crashes that occurred in the vicinity of this on-ramp.

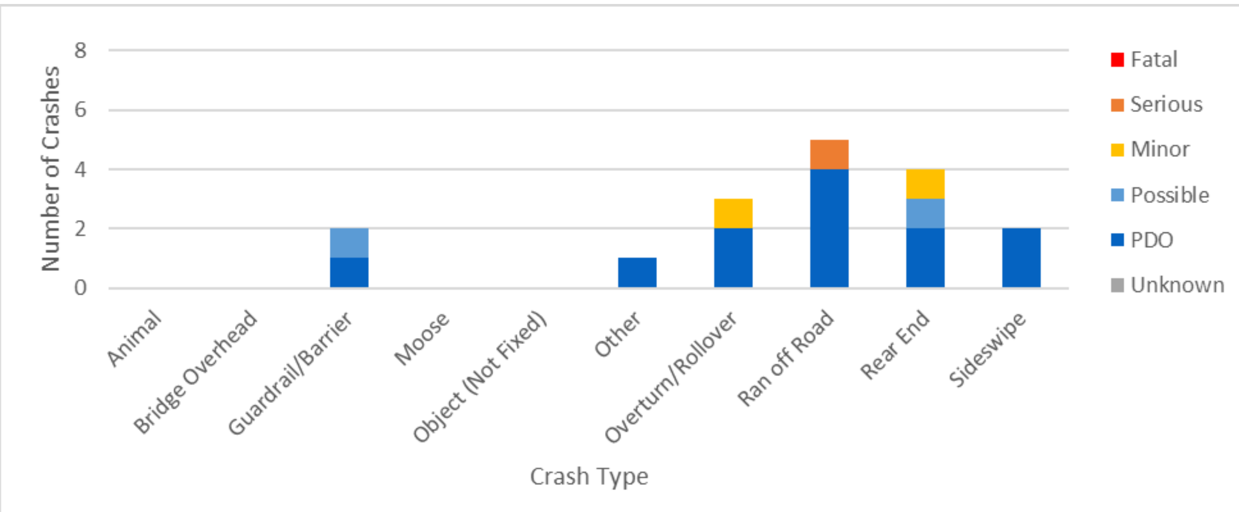

Figure C-1. Bragaw Northbound On-Ramp Crash Type and Severity, 2013 to 2017

Five crashes occurred when vehicles Ran off Road. The vehicle struck a light pole in four of these crashes. The fifth crash, which resulted in suspected serious injuries, occurred just east of the Bragaw overpass early afternoon on January 11, 2016. A vehicle, traveling northbound, crossed the median and collided with a second vehicle, traveling southbound towards Anchorage. A third vehicle then collided with the second vehicle, while a fourth vehicle struck the first vehicle on the right side. Eight people were involved in the crash, with 4 sustaining serious injuries and two sustaining minor injuries.

The estimated cost of the crashes that occurred in the vicinity of this ramp from 2013 through 2017 is $1,282,400.

Bragaw Southbound On-Ramp Crash Experience (2013 to 2017)

Table C-6 shows the number and location of crashes that occurred on or near this ramp from 2013 through 2017.

Table C-6. Bragaw Southbound On-Ramp Crash Experience 2013 to 2017

	On Ramp	Ramp Related	Through Roadway
Bragaw southbound on-ramp	1	4	23

Figure C-2 shows the crash type and severity for the 28 crashes that occurred in the vicinity of this on-ramp.

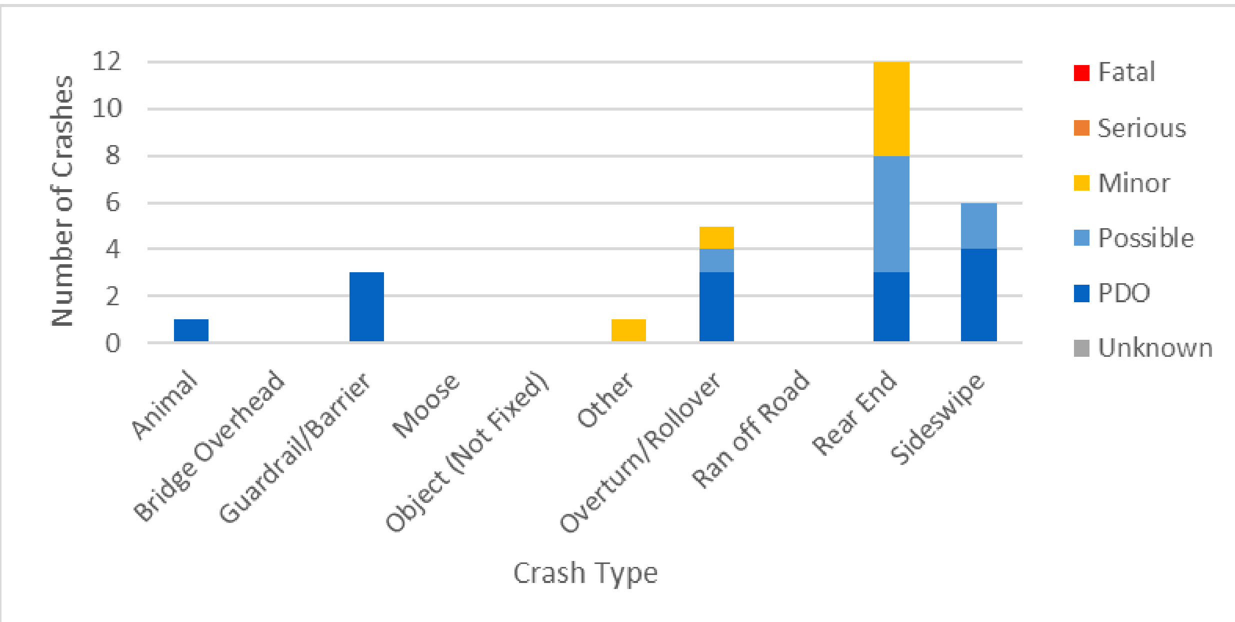

Figure C-2. Bragaw Southbound On-Ramp Crash Type and Severity, 2013 to 2017

A review of the crash data shows:

- Twelve Rear End crashes occurred. One crash, involving four cars, resulted when a vehicle was merging. Six of the crashes involved three or more vehicles; three crashes recorded blowing snow and poor visibility. Six of the crashes occurred during weekday morning rush hour (6 am – 8 am) – one crash narrative stated that it was rush hour and another stated that traffic was backed up from the red light at Airport Heights.
- One collision with a black bear (Animal crash type) was recorded.
- One pedestrian collision (Other crash type) occurred early afternoon in September 2015. A vehicle struck a pedestrian that was walking in the lane of travel. The pedestrian sustained minor injuries.

The estimated cost of the crashes that occurred in the vicinity of this ramp from 2013 through 2017 is $1,630,800.

Boniface Northbound Crash Experience (2013 to 2017)

Table C-7 shows the number and location of crashes that occurred on or near this ramp from 2013 through 2017.

Table C-7. Boniface Northbound On-Ramp Crash Experience 2013 to 2017

	On Ramp	Ramp Related	Through Roadway
Boniface northbound on-ramp	1	2	18

Figure C-3 shows the crash type and severity for the 21 crashes that occurred in the vicinity of this on-ramp.

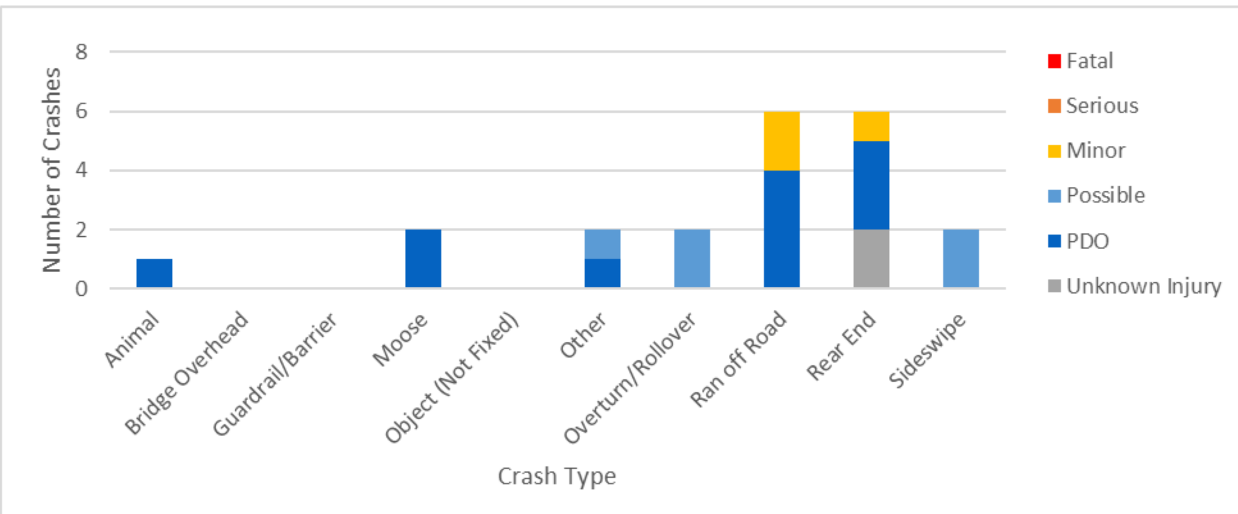

Figure C-3. Boniface Northbound On-Ramp Crash Type and Severity, 2013 to 2017

Six Ran off Road crashes were recorded. Three of these crashes resulted in the vehicle colliding with the underpass wall; one crash involved a vehicle losing control on the on-ramp, crossing the median and striking a northbound vehicle. Six Rear End crashes occurred. One of these crashes, which recorded blowing snow conditions, resulted when a vehicle lost control, causing a 12-car pileup.

One collision with a dog (Animal crash type) and two Moose crashes were recorded.

The estimated cost of the crashes that occurred in the vicinity of this ramp from 2013 through 2017 is $941,600.

Boniface Clover Southbound On-Ramp Crash Experience (2013 to 2017)

Figure C-4 shows the analysis area for crashes in the vicinity of this ramp, and Table C-8 shows the number and location of crashes that occurred on or near this ramp from 2013 through 2017.

Figure C-4. Vicinity Area for Boniface Southbound Clover On-Ramp Crash Analysis

Table C-8. Boniface Clover Southbound On-Ramp Crash Experience 2013 to 2017

	On Ramp	Ramp Related	Through Roadway
Boniface Clover southbound on-ramp	0	1	17

Figure C-5 shows the crash type and severity for the 18 crashes that occurred in the vicinity of this on-ramp.

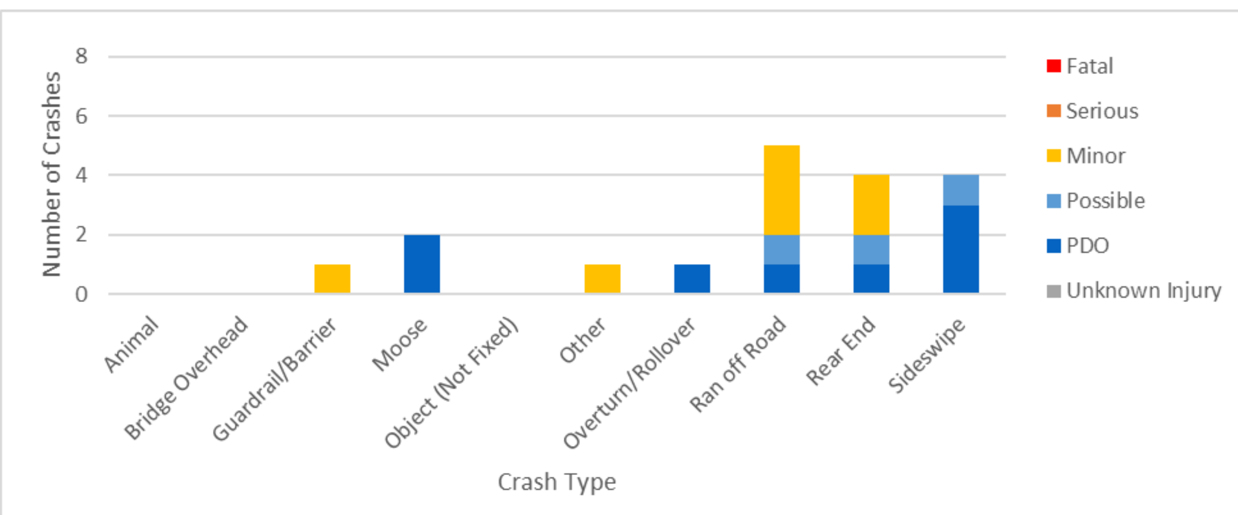

Figure C-5. Boniface Clover Southbound On-Ramp Crash Type and Severity, 2013 to 2017

Five Ran off Road crashes were recorded. One of the crashes occurred when a vehicle hydroplaned on water in ruts, a second crash occurred when a vehicle lost control on the on-ramp and struck the Boniface bridge. A third crash involved two vehicles that ran off the road when breaking for an accident, while the fourth crash resulted when a vehicle ran into a light pole. The fifth crash occurred on March 4, 2016, when a vehicle, breaking for numerous collisions in blowing snow, lost control and crossed the median and the northbound lanes, went into a ditch and struck a fence. Note that eleven crash reports from the Muldoon, Bragaw and Boniface interchanges were filed on March 4, 2016. In addition to the cross median crash, a head on collision (Other crash type) in the Boniface Southbound Clover through roadway area was recorded on March 4, 2016. The crash narrative recounts that a 16-car collision was blocking the highway in blowing snow conditions, when a vehicle was struck and turned around, resulting in a head on collision with a third vehicle.

Two Moose crashes were also recorded.

The estimated cost of the crashes that occurred in the vicinity of this ramp from 2013 through 2017 is $1,346,600.

Boniface Southbound On-Ramp Crash Experience (2013 to 2017)

Figure C-6 shows the analysis area for crashes in the vicinity of this ramp, and Table C-9 the number and location of crashes that occurred on or near this ramp from 2013 through 2017.

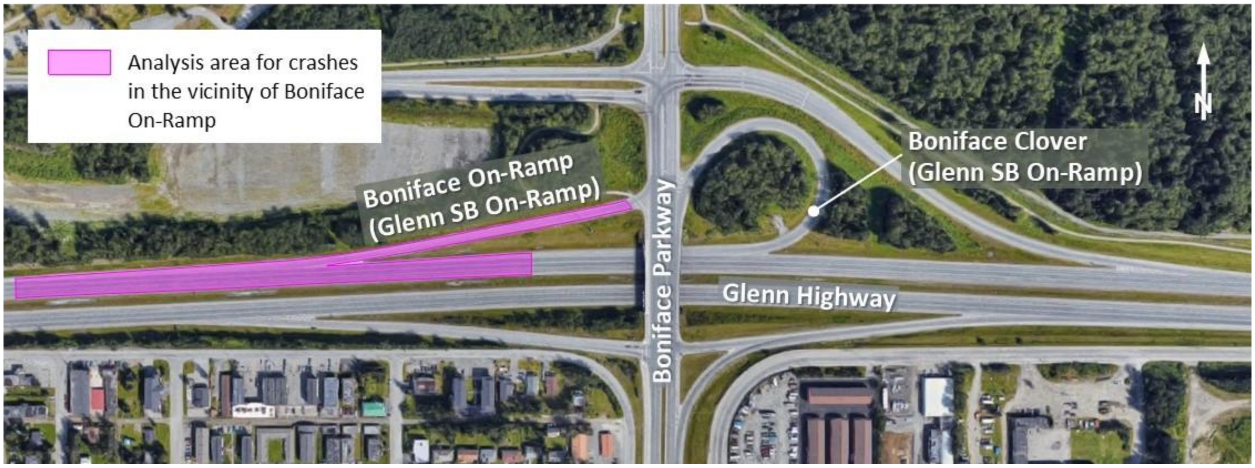

Figure C-6. Vicinity Area for Boniface Southbound Clover On-Ramp Crash Analysis

Table C-9. Boniface Southbound On-Ramp Crash Experience 2013 to 2017

	On Ramp	Ramp Related	Through Roadway
Boniface southbound on-ramp	0	3	8

Figure C-7 shows the crash type and severity for the 11 crashes that occurred in the vicinity of this on-ramp.

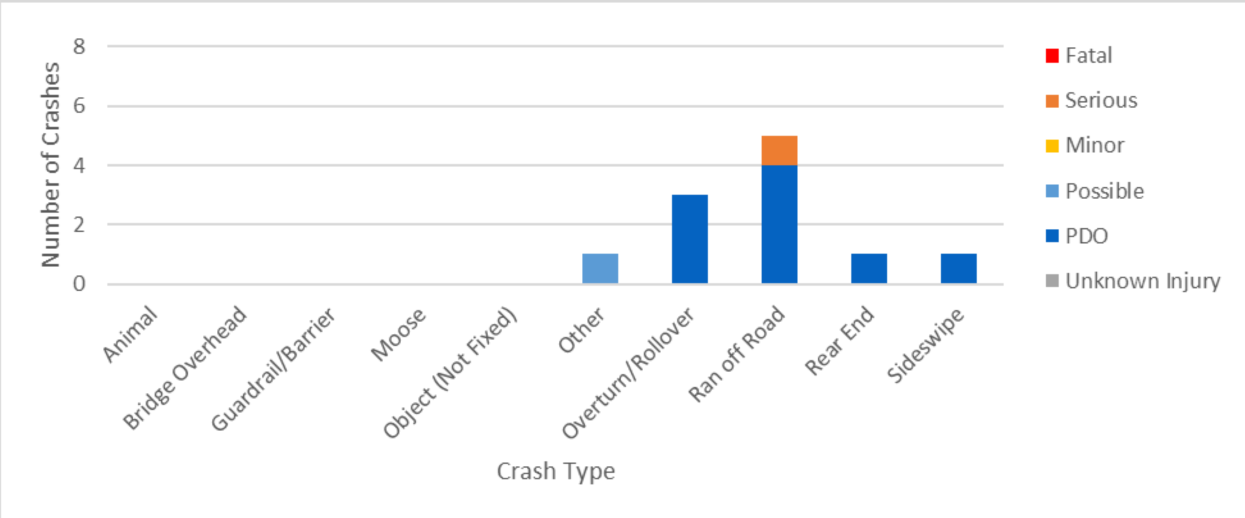

Figure C-7. Boniface Southbound On-Ramp Crash Type and Severity, 2013 to 2017

Five Ran off Road crashes were recorded. One vehicle lost control when merging, another swerved to avoid a vehicle and went through the snowy ramp gore, a third vehicle went into the median when avoiding a vehicle that cut it off, and a fourth vehicle struck a light pole because the driver was having an epileptic seizure. On September 25, 2015 around 4 pm, a vehicle ran off the road, struck a light pole, then rolled up a hill and back onto the roadway. All three occupants were taken to the emergency room, one with suspected serious injuries and two with suspected minor injuries.

The estimated cost of the crashes that occurred in the vicinity of this ramp from 2013 through 2017 is $880,800.

Turpin Northbound On-Ramp Crash Experience (2013 to 2017)

Table C-10 shows the number and location of crashes that occurred on or near this ramp from 2013 through 2017.

Table C-10. Turpin Northbound On-Ramp Crash Experience 2013 to 2017

	On Ramp	Ramp Related	Through Roadway
Turpin northbound on-ramp	0	1	3

Figure C-8 shows the crash type and severity for the 4 crashes that occurred in the vicinity of this on-ramp.

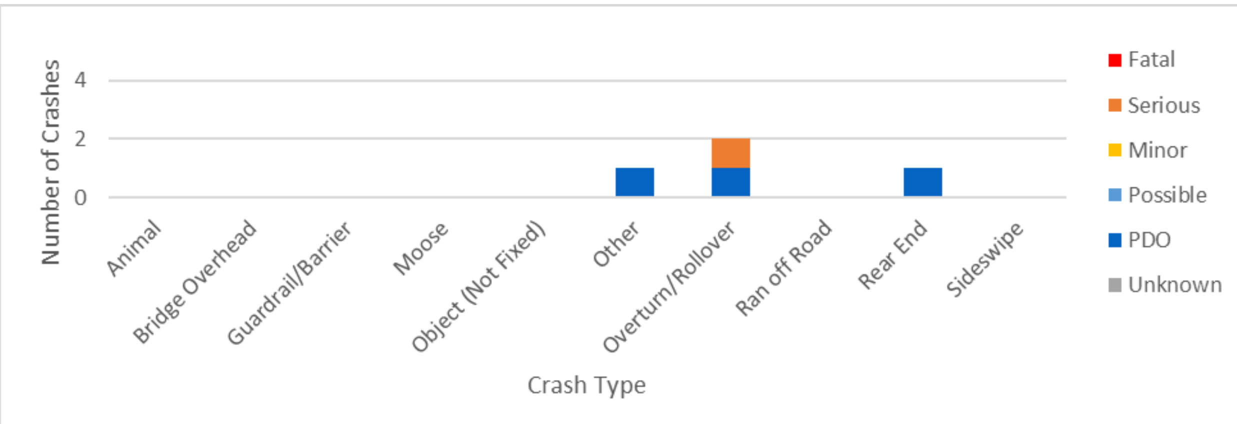

Figure C-8. Turpin Northbound On-Ramp Crash Type and Severity, 2013 to 2017

A crash (Other crash type) occurred when a vehicle entering the Glenn from the Turpin on-ramp skidded, lost control, turned facing oncoming traffic, and was struck head on. Two Overturn/Rollovers were also recorded in the ramp through area. On July 31, 2015 around 5 pm, a motorcycle lost control and overturned; the driver was thrown into the median, sustaining suspected serious injuries. The second rollover resulted when a vehicle tire popped, and the vehicle overturned in the median.

The estimated cost of the crashes that occurred in the vicinity of this ramp from 2013 through 2017 is $754,600.

JBER/Ship Creek Southbound On-Ramp Crash Experience (2013 to 2017)

Table C-11 shows the number and location of crashes that occurred on or near this ramp from 2013 through 2017.

Table C-11. JBER/Ship Creek Southbound On-Ramp Crash Experience 2013 to 2017

	On Ramp	Ramp Related	Through Roadway
JBER/Ship Creek southbound on-ramp	0	1	12

Figure C-9 shows the crash type and severity for the 13 crashes that occurred in the vicinity of this on-ramp.

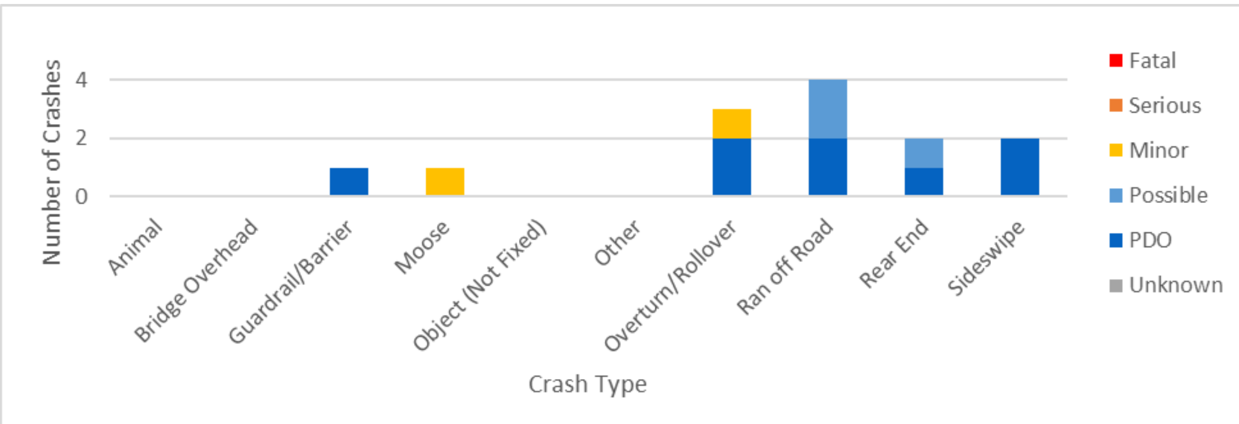

Figure C-9. JBER/Ship Creek Southbound On-Ramp Crash Type and Severity, 2013 to 2017

Four Ran off Road crashes were recorded in the through roadway area for this ramp. Three of these crashes occurred when a vehicle struck a light pole. The fourth crash occurred when a southbound vehicle crossed the median and overturned in the northbound lanes.

One Moose crash was also recorded.

The estimated cost of the crashes that occurred in the vicinity of this ramp from 2013 through 2017 is $596,600.

N Eagle River Northbound On-Ramp Crash Experience (2013 to 2017)

Table C-12 shows the number and location of crashes that occurred on or near this ramp from 2013 through 2017.

Table C-12. N Eagle River Northbound On-Ramp Crash Experience 2013 to 2017

	On Ramp	Ramp Related	Through Roadway
N Eagle River northbound on-ramp	5	5	12

Figure C-10 shows the crash type and severity for the 22 crashes that occurred in the vicinity of this on-ramp.

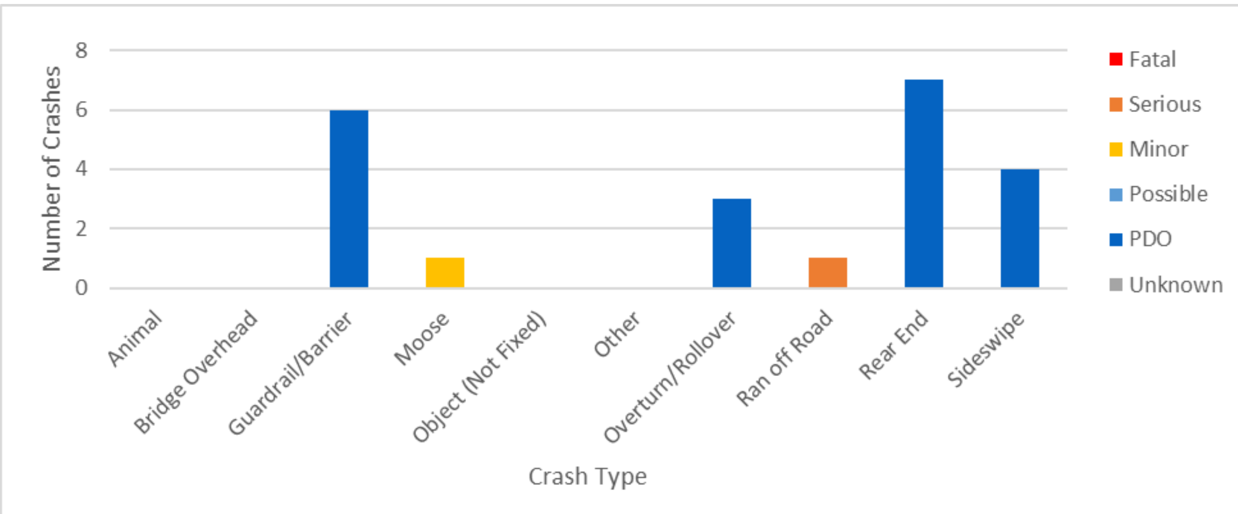

Figure C-10. N Eagle River Northbound On-Ramp Crash Type and Severity, 2013 to 2017

A review of the crash data shows:

- Seven Rear End crashes were reported. One occurred on the on-ramp and another resulted due to a vehicle merging from the on-ramp.
- Of the six Guardrail/Barrier crashes, three occurred on the on-ramp, and two resulted when vehicles were attempting to merge onto the Glenn.
- A Ran off Road crash resulting in a suspected serious injury (possible broken leg) occurred on October 31, 2016 around 3 pm. An northbound vehicle approaching a disabled vehicle parked in the median, belatedly realized that traffic was congested, drove into the median to avoid the traffic, and then continued onto the southbound Glenn Highway lanes where it struck a vehicle head on.
- One Moose crash was also recorded.

The estimated cost of the crashes that occurred in the vicinity of this ramp from 2013 through 2017 is $1,044,000. The Moose crash is unlikely to be reduced by improvements to the on-ramp.

Mirror Lake Northbound On-Ramp Crash Experience (2013 to 2017)

Table C-13 shows the number and location of crashes that occurred on or near this ramp from 2013 through 2017.

Table C-13. Mirror Lake Northbound On-Ramp Crash Experience 2013 to 2017

	On Ramp	Ramp Related	Through Roadway
Mirror Lake northbound on-ramp	0	0	8

Figure C-11 shows the crash type and severity for the 8 crashes that occurred in the vicinity of this on-ramp.

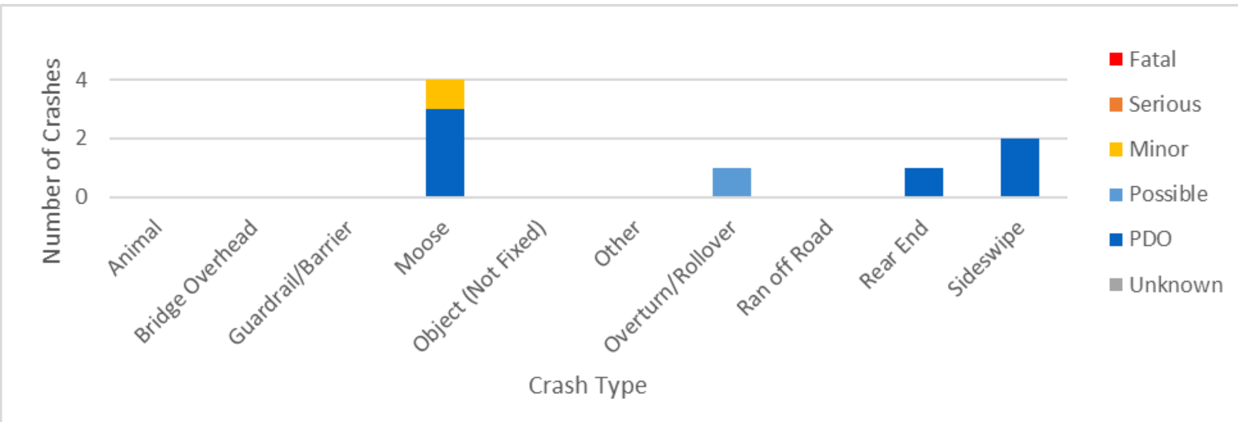

Figure C-11. Mirror Lake Northbound On-Ramp Crash Type and Severity, 2013 to 2017

Four moose crashes occurred in the vicinity of this ramp.

The estimated cost of the crashes that occurred in the vicinity of this ramp from 2013 through 2017 is $276,200. The Moose crashes are unlikely to be reduced by improvements to the on-ramp.

Thunderbird Falls Northbound On-Ramp Crash Experience (2013 to 2017)

Table C-14 shows the number and location of crashes that occurred on or near this ramp from 2013 through 2017.

Table C-14. Thunderbird Falls Northbound On-Ramp Crash Experience 2013 to 2017

	On Ramp	Ramp Related	Through Roadway
Thunderbird Falls northbound on-ramp	0	0	8

Figure C-12 shows the crash type and severity for the 8 crashes that occurred in the vicinity of this on-ramp.

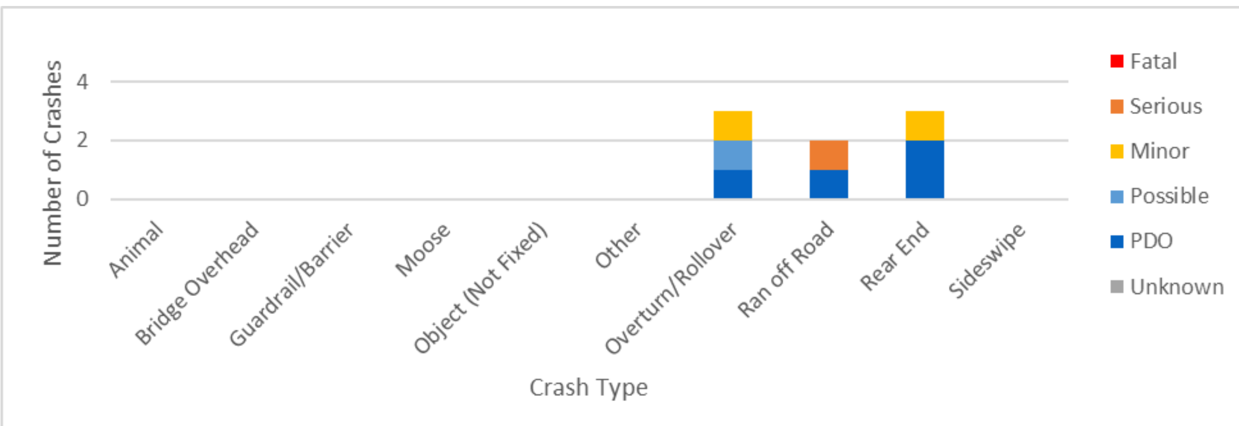

Figure C-12. Thunderbird Falls Northbound On-Ramp Crash Type and Severity, 2013 to 2017

One serious injury crash occurred around 3 pm on November 28, 2017 when a vehicle heading southbound crossed the median and struck an northbound vehicle head on. A third vehicle collided with crash debris, and a fourth vehicle struck the vehicle that had originally been traveling southbound.

The estimated cost of the crashes that occurred in the vicinity of this ramp from 2013 through 2017 is $1,139,800.

Old Glenn Northbound On-Ramp Crash Experience (2013 to 2017)

Table C-15 shows the number and location of crashes that occurred on or near this ramp from 2013 through 2017.

Table C-15. Old Glenn Northbound On-Ramp Crash Experience 2013 to 2017

	On Ramp	Ramp Related	Through Roadway
Old Glenn northbound on-ramp	0	0	9

Figure C-13 shows the crash type and severity for the 9 crashes that occurred in the vicinity of this on-ramp.

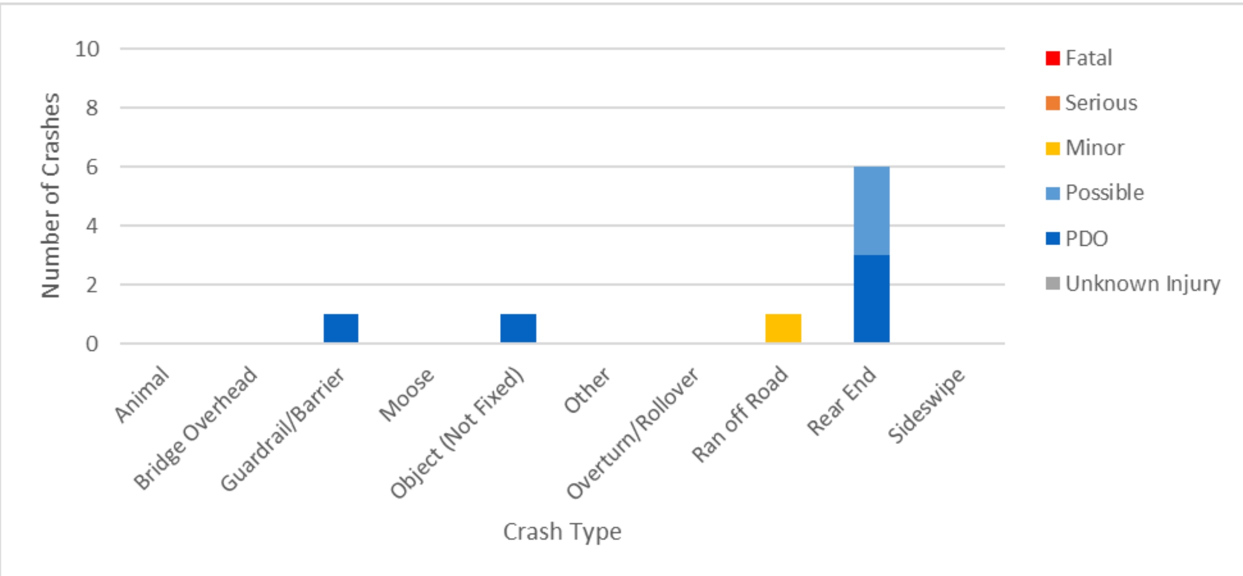

Figure C-13. Old Glenn Northbound On-Ramp Crash Type and Severity, 2013 to 2017

The estimated cost of the crashes that occurred in the vicinity of this ramp from 2013 through 2017 is $422,000.

Knik Access Northbound On-Ramp Crash Experience (2013 to 2017)

Table C-16 shows the number and location of crashes that occurred on or near this ramp from 2013 through 2017.

Table C-16. Knik Access Northbound On-Ramp Crash Experience 2013 to 2017

	On Ramp	Ramp Related	Through Roadway
Knik Access northbound on-ramp	0	1	7

Figure C-14 shows the crash type and severity for the 8 crashes that occurred in the vicinity of this on-ramp.

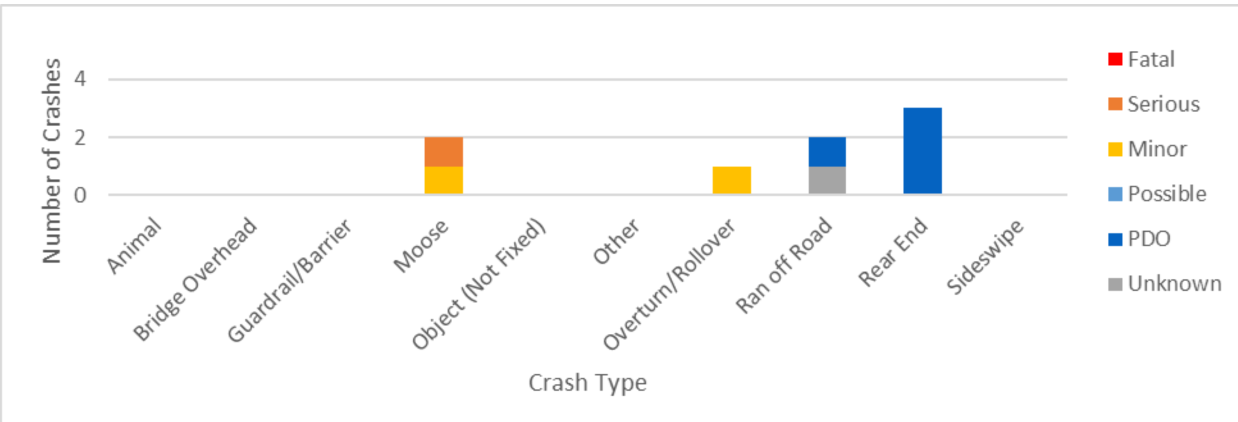

Figure C-14. Knik Access Northbound On-Ramp Crash Type and Severity, 2013 to 2017

Two Moose crashes were reported. One of the Moose crashes resulted in possible serious injuries. On December 24, 2014 at 3:36 pm, an southbound vehicle slowed for a moose in the median, which then jumped out in front of the vehicle. The driver was transported to the hospital for possible neck injuries but was released later that same day.

The estimated cost of the crashes that occurred in the vicinity of this ramp from 2013 through 2017 is $1,071,000. The Moose crashes are unlikely to be reduced by improvements to the on-ramp.

Knik Access Southbound On-Ramp Crash Experience (2013 to 2017)

Table C-17 shows the number and location of crashes that occurred on or near this ramp from 2013 through 2017.

Table C-17. Knik Access Southbound On-Ramp Crash Experience 2013 to 2017

	On Ramp	Ramp Related	Through Roadway
Knik Access southbound on-ramp	0	0	7

Figure C-15 shows the crash type and severity for the 7 crashes that occurred in the vicinity of this on-ramp.

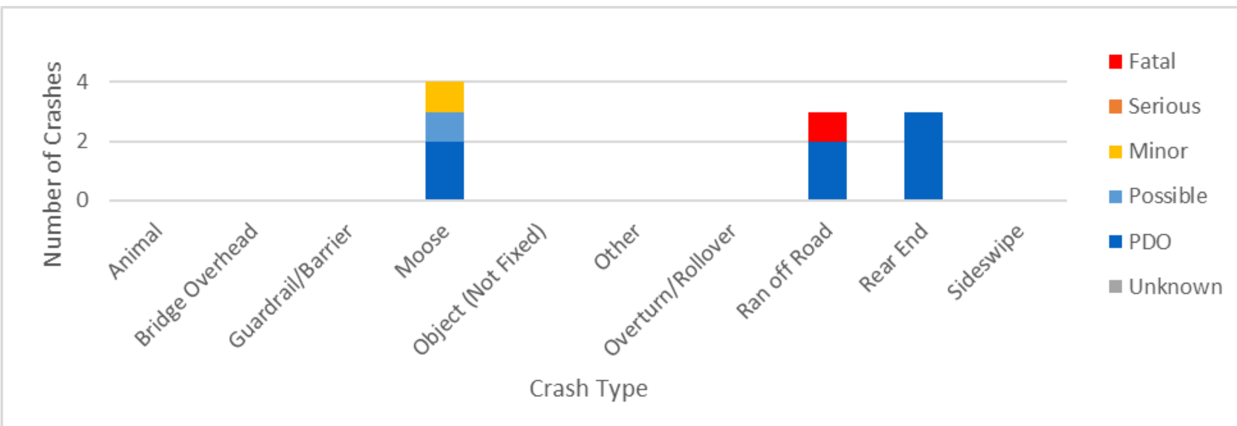

Figure C-15. Knik Access Southbound On-Ramp Crash Type and Severity, 2013 to 2017

On March 12, 2015, around 6 pm, a southbound vehicle crossed the median and crashed successively into two vehicles. It struck the first vehicle on the right front corner, sending it into the median and resulting in the death of one of the vehicle's three passengers. A total of six people were involved in the collision, with one sustaining serious injury, and four sustaining minor injuries.

Four Moose crashes were reported in the vicinity of this ramp.

The estimated cost of the crashes that occurred in the vicinity of this ramp from 2013 through 2017 is $10,859,800. The Moose crashes are unlikely to be reduced by improvements to the on-ramp.