THE STATE of ALASKA
GOVERNOR MIKE DUNLEAVY

Department of Transportation and Public Facilities

NORTHERN REGION
Design, Engineering, & Construction

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November 13, 2025

The Honorable Ashley Carrick
House of Representatives
1292 Sadler Way, Suite 308
Fairbanks, AK 99701

Re: Parks Highway / Sheep Creek Road Extension Traffic Signal (HSIP)
0A45(032)/NFHWY00898
Abbreviated Design Study Report

Dear Representative Carrick:

Enclosed for your file is the approved Abbreviated Design Study Report for the referenced project

Sincerely,

Ivet Hall, P.E.
Engineering Manager

Enclosure
edh
Copy to: Preconstruction/Project
cc: Lauren Little, P.E., Acting Regional Director, Northern Region

MEMORANDUM

State of Alaska
Department of Transportation & Public Facilities
Northern Region Design, Engineering, and Construction

TO: Albert Beck, P.E.
Preconstruction Engineer
Northern Region

THRU: Jason Hill, P.E. Initial
Project Delivery Team Lead
Northern Region

FROM: Ivet Hall, P.E. DS
Engineering Manager
Northern Region

DATE: October 29, 2025

FILE NO:

TELEPHONE NO: 907-451-5386

SUBJECT: Parks Highway / Sheep Creek Road Extension Traffic Signal (HSIP)
NFHWY00898/0A45(032)
Abbreviated Design Study Report

Introduction/History
The Northern Regional Department of Transportation and Public Facilities is working to improve safety at the intersection of the Parks Highway (CDS Route # 2601022X000) and Sheep Creek Road Extension (CDS Route # 1140000D001). The history of crashes at this intersection enabled the Department to nominate this intersection for safety improvements under the federally funded Highway Safety Improvement Program (HSIP). These roadways are classified as an interstate and a major collector, respectively.

This intersection is the primary access from the Parks Highway to residential areas off Sheep Creek Road, including the Ester Dome and Murphy Dome areas. Sheep Creek Road to Goldstream Road is a designated truck route used to bypass Fairbanks to access destinations to the north. It also serves as a primary access point to the University of Alaska Fairbanks for travelers approaching from the south via the Parks Highway. Left and right turn lanes are present on the Parks Highway for turning traffic. Further, the eastbound Parks Highway transitions from 1 to 2 lanes at the intersection. A shared-use pathway parallels the Parks Highway along the north side in this area and crosses Sheep Creek Road Extension at the intersection.

Project Description
The proposed project includes signalizing the intersection of Parks Highway and Sheep Creek Road Extension. The project will install “Signal Ahead” signs and the “Prepare to Stop” overhead flashing sign on Parks Highway east of the intersection. To install the new traffic light, the project will modify the existing roadway geometry by:

- separating the existing westbound right-turn lane onto Sheep Creek Road Extension from the through lane with a median
- constructing new medians between the eastbound acceleration and through lanes
- reducing the superelevation of the westbound Parks Highway through lane
- flattening the Parks Highway profile grade through the intersection
- widening Sheep Creek Road Extension to lengthen the southbound right-turn lane

Land surrounding the intersection is mostly undeveloped. One residential area is adjacent to Sheep Creek Road Extension and Gold Hill Road with the primary access off of Sheep Creek Road Extension. There is also a residential neighborhood south of the Parks Highway separated by a wide tree buffer and accessed by Nash Street off the Parks Highway, about 1,700 feet west of the proposed traffic signal.

Design Standards

- *Alaska Highway Safety Improvement Program Handbook,* State of Alaska, Department of Transportation and Public Facilities (DOT&PF), 2023.
- *Alaska Highway Preconstruction Manual* (HPCM)*,* DOT&PF, January 2025
- *Alaska Traffic Manual, consisting of the Manual on Uniform Traffic Control Devices (MUTCD),* 2016 as amended, United States Department of Transportation (US DOT), Federal Highway Administration (FHWA) and DOT&PF.
- *Highway Capacity Manual, 6th Edition,* Transportation Research Board, 2016
- *Alaska Flexible Pavement Design Manual (PDM),* DOT&PF, 2004
- *Alaska Highway Drainage Manual (HDM),* DOT&PF, 2006
- *A Policy on Geometric Design of Highways and Streets, 6th Edition* (GB)*,* American Association of State Highway and Transportation Officials (AASHTO), 2018
- *Roadside Design Guide, 4th Edition,* AASHTO, 2011
- *ADA Standards for Transportation Facilities,* US DOT, 2006
- *ADA Standards for Accessible Design*, United States Department of Justice, 2010
- *Guide for the Development of Bicycle Facilities* (GDBF)*,* 4th Edition, AASHTO, 2012
- *Guide for the Planning, Design, and Operation of Pedestrian Facilities,* AASHTO, 2004
- National Electrical Safety Code (NESC) C2-2017
- National Electrical Code (NEC), NFPA 70 2020
- NEMA TC 7-2016
- *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*, *with September 2013 Errata and 2015 Interim Revisions*, AASHTO, 2013
- *LRFD Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals,* AASHTO, 2015
- *Recommended Practice for Roadway Lighting (RP-8-14)*, ANSI / IES, 2014

Design Exceptions and Design Waivers

No design exceptions or waivers are required for the project.

Design Alternatives

Trucks accelerating after stopping at the signal in the westbound through lane will not reach 55 miles per hour (MPH) for over one mile (6000-feet) which is exacerbated by the highway profile incline grade. Since trucks account for approximately 25% of the morning peak traffic, there is a high probability of trucks getting stopped by the signal. No passing opportunities are available for 2 miles past the intersection.

The existing configuration of the intersection has a 2.5% profile grade on the Parks Highway and a 5.5% superelevation, both of which are in the direction that increase the likelihood of vehicles losing control while turning left off Sheep Creek Road Extension, causing them to slide through the intersection into the outside through lane of the Parks Highway. This has been identified as one of the contributing crash factors. The new traffic signal will require the vehicles traveling westbound on the

Parks Highway to stop. The combination of the existing longitudinal profile grade and the superelevation will make it difficult for vehicles stopped at the signal to accelerate in icy conditions. Therefore, reducing the Parks Highway profile and superelevation to the extent feasible was deemed necessary. The following profile modifications were considered in various combinations to provide a flat storage queue and acceleration area for stopped vehicles:

- Lowering the Parks Highway profile west of the intersection
- Raising the Parks Highway profile east of the intersection

Lowering the grade west of the intersection would have required lowering grade over 6 feet below the surrounding grade, hence this alternative was deemed not feasible. Portions of the existing embankment already have stability issues in this area and this instability would have been exacerbated by excavating below the original ground line.

Providing a flatter grade on the Parks Highway at the intersection, and shortly past it, requires significant embankment fill east of the intersection which raises the grade of Sheep Creek Road Extension at the intersection. For current conditions, there was no indication from the crash data, or public comments, that vehicles had any issues on Sheep Creek Road Extension when approaching the intersection. This grade will be increased slightly, from existing being near flat to 0.5%-0.75% uphill to the intersection. This grade is still within the maximum landing requirement of 2%.

Flattening the superelevation to 3.6% relies on using e_{max} of 4% for a 1,905-foot radius in the westbound direction which is allowable at signalized intersections per HPCM 1130.1.3. Since the eastbound direction does not stop at the signal, 6% e_{max} is used. A 5.2% superelevation is required for the eastbound through lane which has a series of compounded curves, the smallest radius being 1,810-feet.

Preferred Design Alternative

The signal creates a new situation for drivers heading westbound on the Parks Highway - they will now have to accelerate from a stopped condition. This condition can be analyzed with trigonometry to understand the relationship between the grade of the roadway and the expected friction factor. It demonstrates that when the friction factor is equal to, or greater than, the grade of the roadway then vehicles can accelerate on the slope without wheels spinning. The worst-case friction factor is 0.05 for a wet ice condition per GB Section 3.3.2. In order for the intersection to function properly in this worst-case condition, the compounded grades should not exceed 5%.

The vertical profile of the Parks Highway is flattened at the intersection from 2.5% to a 1.75% grade. The superelevation for the WB through lane is decreased from 5.5% to 3.6%. The resulting combined maximum slope on the vehicle stopped in the westbound through lane is 4% and therefore acceptable. This grade is provided for 250-feet upstream of the stop bar which is the maximum queue length for winter months. Flattening of the Parks Highway profile grade is accomplished by raising the centerline east of intersection approximately 4.5-feet. This increases the uphill grade travelling towards the intersection to about 2.7%, however the grade increase in this area should not create any issues since vehicles will be travelling at, or near, free-flow speed of 55 MPH by the time they reach the steepened 2.7% uphill grade. The flattened 1.75% grade at the intersection continues west for 125-feet and the proposed profile transitions to closely match the existing roadway profile.

The existing Happy Creek fish passage culvert crosses the raised portion of Parks Highway and is anticipated to remain in place. The length and type of culvert is sufficient to allow the embankment to be widened and raised without needing to lengthen, or replace, the culvert. The embankment fill on top of the pipe is increased from 8-feet to approximately 9-feet, measured at the project centerline.

Sheep Creek Road Extension design speed for this project is 40 MPH. The horizontal road alignment will not change. To construct this project, the east limit of the road ends in the middle of a 584-foot radius curve. From GB Table 3-9, this size radius requires a 6% superelevation. The topographic survey shows the superelevation is 5.5% at the match point. Reconstruction of the entire curve would be needed to provide the required superelevation. However because this is an HSIP funded project, and the existing superelevation of Sheep Creek Road is not shown to contribute to any crashes, reconstruction of this curve to increase the existing superelevation is not required per the HPCM. The project will reconstruct and tie into this existing curve with 5.5% maximum superelevation. This slightly raises the side friction factor from 0.1226 for a 6% superelevation to 0.1276 for a 5.5% superelevation which does not exceed the maximum side friction factor of 0.16 for a 40 MPH design speed per GB Table 3-7.

Traffic Analysis
A traffic analysis report was prepared for project. See Attachment A.

Horizontal/Vertical Alignment
The horizontal alignment for the westbound Parks Highway will closely match existing alignment. The outside eastbound through lane is shifted by a maximum of 8-feet south to build the new median. Vertical alignment changes to the Parks Highway are discussed in the Preferred Design Alternative section.

The horizontal alignment of Sheep Creek Road Extension is unchanged. The vertical profile is raised approximately 1.5-feet at the intersection. This is required to match the grade raise of the Parks Highway. The project will smooth the existing drop off between Sheep Creek Road Extension and the superelevated westbound lane of the Parks Highway.

The existing shared-use path on the north side of the Parks Highway will be reconstructed due to the Parks Highway embankment widening and grade raise. The path alignment will maintain the same horizontal location offset 30 feet from the edge of roadway pavement where possible. The path will be brought closer to the Parks Highway edge of pavement at beginning of full width westbound auxiliary turn lane. Along the turn lane the buffer between the edge of highway and edge of shared-use path will be 8.5-feet which is constrained by the existing right-of-way. At the intersection, the pathway grade will be raised upstream of the westbound auxiliary lane crossing so roadway and pathway are at the same elevation to improve the visibility of non-motorized users approaching the crossing. The grade raise of the Parks Highway also requires the pathway reconstruction further than just what was impacted by the slope limits to maintain a gradual uphill grade of the path, similar to existing conditions.

Typical Section(s)
The number of lanes on the Parks Highway changes throughout the project area. The west end of the Parks Highway consists of one 12-foot lane in each direction. East of the project intersection there is an additional eastbound through lane. Outer shoulders are 8-feet wide for both directions except for the 6-foot shoulder along the westbound right-turn lane. No inside shoulders are provided. Typical embankment slopes are 4:1 unless constrained by right-of-way.

The east leg of project intersection has a 12-foot auxiliary westbound right turn lane for vehicles turning onto Sheep Creek Road Extension. The west leg has a 13.5-foot eastbound left-turn lane that continues through the intersection to provide a receiving lane for southbound left-turning traffic from Sheep Creek Road Extension and the lane continues to the end of project where it becomes the second

through lane. The Parks Highway currently has one set of medians on each side of the intersection to separate the two directions of traffic. The project will construct a median, or channelizing island, to separate each lane of traffic on the Parks Highway. The median separating eastbound lanes ends after vehicles have had a chance to accelerate, and then the widening tapers back in to match the existing 2-lane divided highway section.

Sheep Creek Road Extension currently has a single 12-foot through lane in each direction. Outside shoulders are 8-feet wide. At the intersection, the southbound through lane becomes the left-turn lane and an auxiliary 12-foot right-turn lane with adequate storage queue length will be provided. A mailbox pullout will be constructed across from the driveway on Sheep Creek Road Extension to offset the mailboxes that are currently adjacent to the shoulder. Typical embankment slopes are 4:1.

The existing shared-use pathway along the north side of Parks Highway will be reconstructed to provide a 10-foot paved pathway with 5-foot-wide shoulders on both sides (6:1 or flatter). Typical embankment slopes are 4:1. Outside clear zone and where the embankment fill comes close to the right-of-way line, the outside slope of the pathway will be steepened up to 2:1.

A new separated pathway will be constructed by a separate project along the west side of Sheep Creek Road Extension between the Parks Highway and Goldhill Road. The path will have the same cross section as the Parks Highway separated pathway. The pathway will be constructed at an 18-foot offset from the travel way.

Typical section figure is attached. See Attachment B.

Pavement Design
The following pavement design, per the PDM, was approved by the Regional Materials Engineer.

The PDM requires that a project roadway with average annual daily traffic greater than 5,000 vehicles per day with curb and gutter be designed under the requirements of General Policy #7 (GP-7) which requires using:

- 3 inches of Hot Mix Asphalt, Type II; Class B (HMA)
- 3 inches of Asphalt Treated Base (ATB)
- 5 inches of Crushed Asphalt Base Course (CABC)
- Selected Material, Type A, as needed

Project can use Select Material, Type A, instead of Subbase, Grading F. The layer of CABC may be thicker than the minimum 5 inches required by the pavement design analysis.

The approved pavement design is located in Attachment C.

Maintenance Considerations
The new signal will require more maintenance for timing and repair of signal appurtenances than the previous stop control.

The addition of new raised medians and the traffic island will require modifications to the snow plowing operations. The Parks Highway is plowed with equipment that requires at least 16-feet between the faces of curb and gutter to reduce the risk of the blades damaging the medians. The face of expressway curb and gutter is 1.25-feet from the edge of pavement so this equates to a 13.5-foot pavement width.

The shared-use pathway along the Parks Highway and the new shared-use path along Sheep Creek Road Extension will continue to not have snow removal during the winter months.

The shared-use pathway in this area is experiencing settlement issues due to standing water that pools near the pavement edge. The project will add culverts as needed to reduce the standing water.

Utility Relocation & Coordination
The Golden Valley Electric Association (GVEA) facility that crosses the east leg of intersection is a 14.4/24.9 kV distribution line, which may need to be raised with the expected grade change. The change in height may require that four poles be changed.

The Alaska Communications (ACS) facility is both copper telephone and fiber optic cable (FOC) outside plant. The copper telephone cables are used for local distribution, while the FOC is used for long haul transport. The fiber cable may need some adjustment in alignment and the copper telephone will need both alignment adjustment and replacement of existing pedestals, requiring both new excavation and splicing activities.

All of the utilities in the construction area are eligible for relocation benefits, and all of the expected relocation activities can be accomplished in advance of construction, if the construction schedule allows.

Access Control Features
This section of the Parks Highway is access controlled. Pedestrians are prohibited from using the roadway shoulder. Bicycles are allowed on this section of the Parks Highway. This project does not propose to modify any access control features.

Pedestrian/Bicycle (ADA) Provisions
Pedestrians and bicyclists will continue to use the adjacent shared-use path which will be improved with this project. The path will be reconstructed to 10-feet wide with 5-foot wide shoulders no steeper than 6:1 which is recommended by GDBF. Providing the recommended shoulders eliminates the need for constructing a pedestrian barrier along the pathway since the 2:1 slope taller than 4-feet is considered a hazard that would require shielding.

For the signalized pedestrian crossing, audible pedestrian signals (APS) will be installed to ensure compliance with future standards. APS provide a locator tone to assist visually impaired pedestrians with finding the pedestrian push button (PPB). Once the PPB is pressed, an audible “Wait” message will play until the signal indication changes to walk. Some PPB will play an audible “Walk” message and others will play a rapid beeping, or ticking, sound. When the countdown to end of pedestrian phase begins; a different tone or an audible message of the countdown will sound until the “Don’t Walk” indication. The PPB also features a haptic feedback for hearing impaired pedestrians that provides different vibration patterns that are felt by placing their hand on the PPB.

A two-stage crossing with a single channelizing island in the northeast quadrant was chosen as the preferred alternative. The geometry of the island was designed to increase the distance between the pedestrian crossing and the merge onto Sheep Creek Road Extension. First, drivers can focus on yielding to pedestrians, and once past the crossing they can determine if there is a vehicle to yield to before merging onto Sheep Creek Road Extension. A rectangular rapid flashing beacon (RRFB) is planned for the right-turn crossing to aid conspicuity of the crossing non-motorized users.

The RRFB will be actuated by PPBs installed on both sides of crossing. Signage will be provided to clarify that vehicles may not stop and to proceed with caution.

Due to the pedestrian access control, and the lack of a pedestrian facility on the south side of the Parks Highway, the new traffic signal will not provide a pedestrian crossing of the Parks Highway. The only pedestrian crossing at this intersection will remain the crossing of Sheep Creek Road Extension.

Safety Improvements

The following safety improvements are proposed:

- Installation of a traffic signal which addresses contributing crash factors for the left-turn movements off of Sheep Creek Road Extension.
- To address the contributing crash factors for the southbound right-turn movement which will be allowed after vehicles stop on red, the project will offset the westbound right-turn lane with a median. The median will eliminate the current obstructed sight distance of the westbound oncoming vehicles which will help drivers determine lane assignments of vehicles in the two westbound lanes. The median will also eliminate the lane assignment confusion for vehicles turning left from the Parks Highway.
- Raised median channelization between the two eastbound lanes will clearly delineate the receiving lane for southbound left-turn and provide a visual barrier to prevent vehicles from entering the Parks Highway through lane. The raised median will also provide a refuge area in case the left-turning vehicles slides through the receiving lane.
- The raised median between the two eastbound lanes also allows for a grade separation so the eastbound through lane can maintain superelevation and the receiving lane for southbound left-turning vehicles can be banked in the direction of turn which will reduce the possibility of vehicles losing control in icy conditions.
- Lowering the superelevation of the westbound through lane to 3.6% reduces the grade that vehicles turning left from Sheep Creek Road Extension will have to travel across, compared to the previous 5.5% superelevation, reducing the possibility of vehicles losing control while making turning maneuver.
- The signal will remove the need for vehicles entering from Sheep Creek Road Extension to find adequate gaps and to risk making turns when they cannot see oncoming traffic. Right-turning vehicles uncomfortable judging the gaps, or experiencing low-angle sun glare conditions, will be able to wait for the traffic signal to safely enter the Parks Highway.
- Pedestrian safety will be improved by adding a two-stage crossing with a shorter overall crossing distance compared to existing. The channelizing island provides a refuge for pedestrians crossing the westbound right-turn lane. The phasing of the pedestrian signal will be set to wait for the flashing yellow arrow to cycle to red before providing walk signal. RRFB installed for the slip lane crossing will make crossing pedestrians more noticeable to drivers.

Intelligent Transportation System Features

Northern Region utilizes a traffic operations center to monitor signalized intersections using a fiber optic interconnect (FO I/C) in Fairbanks. FO I/C has been installed along Geist Road at both signalized intersections with the Parks Highway interchange. A radio I/C device will link the new signal with the southbound Parks Highway interchange ethernet switch. Direct line of sight is needed for radio I/C, so multiple radios are installed between these intersections to provide signal I/C. Traffic signal poles and light poles will be utilized for mounting radio I/C devices. A pan-tilt-zoom camera is installed on signal pole 4 in the northwest quadrant of intersection.

An active advanced warning flasher (AAWF) will be installed on the Fairbanks side of the intersection to alert drivers to prepare to stop. Because the westbound lane is on an uphill grade, an advance radar detector will be added to the AAWF to monitor for a semi-truck approaching intersection to hold the green light to allow the semi-truck to pass through the intersection without stopping.

Drainage
Existing cross road culverts are impacted by the roadway widening. One crosses the Parks Highway to the west of the intersection and the other crosses Sheep Creek Road Extension north of the intersection.

Drainage improvements will be achieved by:

- New cross road culverts will be installed in the same general location to maintain the existing drainage patterns.
- Inlet boxes connected to 24-inch pipes will be placed along the median curb line in approximately 250-foot intervals that outlet on the south side of the highway.
- A swale will be constructed between the new separated pathway along Sheep Creek Road Extension between existing driveway and the beginning of the turn lane taper. An 18-inch culvert will drain the swale.
- A 24-inch culvert will be installed under the reconstructed driveway on the west side of Sheep Creek Road Extension.
- New culverts across shared-use pathway to reduce standing water

Erosion and Sediment Control
The proposed project will include an Erosion and Sediment Control Plan (ESCP) that will describe Best Management Practices (BMPs). Total disturbed ground exceeds one acre. Storm Water Pollution and Prevention Plan (SWPPP) will be required.

Environmental Commitments
A Categorical Exclusion (CE) has been prepared for this project. The awarded contractor is required to adhere to USFWS' *Timing Recommendations for Land Disturbance & Vegetation Clearing*, dated June 2017. USFWS recommends that for Interior Alaska, vegetative clearing is not to occur from May 1 through July 15.

Work Zone Traffic Control
Two-lane, two-way traffic will be maintained on the Parks Highway during construction.
A road closure memo will be completed, if needed, once a Traffic Control Plan is determined. Temporary closure of Sheep Creek Road Extension will be considered. This would require detours onto Goldhill Road and West Tanana Drive. When the intersection remains open during construction, flagging is anticipated during construction operations and outside of work hours the intersection can be stop controlled.

During reconstruction of the shared-use pathway, non-motorized traffic will be detoured to travel adjacent to the Parks Highway vehicle traffic. The motorized and non-motorized traffic will be separated per the Department’s Standard Plan requirements.

Cost Estimate
The estimated costs for this project are as follows:

Design	$2,090,000.00
Utilities	$300,000.00
Right of Way	$0.00
Construction (Includes 18% Engineering)	$9,125,000.00
Total Cost of Project	$11,515,000.00

Approved: DocuSigned by: 69CC515A62D5404... 10/29/2025
Albert Beck, P.E., Preconstruction Engineer Date

Ih/lmc

Copy to: Preconstruction/Project file
Ron Davis, M&O District Superintendent
Original to: Barbara Tanner, Chief of Contracts
cc: NR Design Directive 20-01 Distribution

Attachment A
Traffic Analysis Report

Parks Highway and Sheep Creek Road Extension Traffic Signal Highway Safety Improvements Project

IRIS Program No. NFHWY00898
Federal Project No. 0A45(032)

Traffic Analysis Report

October 2025

Prepared For:
Alaska Department of Transportation and Public Facilities Northern Region

Prepared By:
Kinney Engineering, LLC
3909 Arctic Blvd, Ste 400
Anchorage, AK 99503
907-346-2373
AECL1102

Table of Contents

Figures

Tables

Abbreviations

AADT	Annual Average Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
DOT&PF	Alaska Department of Transportation and Public Facilities
PGDHS	*A Policy on Geometric Design of Highways and Streets*
KE	Kinney Engineering, LLC
LOS	Level of Service
MUTCD	*Manual on Uniform Traffic Control Devices*
AASHTO	American Association of State Highway and Transportation Officials
HCM	*Highway Capacity Manual*
HPCM	*Highway Preconstruction Manual*
NCHRP	National Cooperative Highway Research Program
%HV	Percent Heavy Vehicles
HSIP	Highway Safety Improvements Project
PGDHS	*A Policy on Geometric Design of Highways and Streets*
PHF	Peak Hour Factor
TMV	Turning Movement Volume

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.

Intersection Sight Distance (ISD): Distance along the main line from the minor street approach at which a driver on the minor street approach (driver eye height of 3.5 feet from the road surface at 15 feet from the travel way) can see an approaching main line street vehicle at object height of 3.5 feet in the center of the main line travel lane. The desirable ISD provides the minor street driver sufficient sight distance to judge and enter main street traffic without significant impact to main line operations.

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.

Monthly Average Daily Traffic (MADT): A measurement of the number of vehicles traveling on a segment of highway each day, averaged over each month.

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).

Stopping Sight Distance (SSD): Distance along the main line at which a driver on the main line (driver eye height of 3.5 feet from the road surface) can see an object on the road ahead. The minimum SSD provides the main line driver sufficient sight distance to judge and slow or stop without striking the object in the road.

Executive Summary

This report summarizes the traffic and safety analysis conducted for the Parks Highway and Sheep Creek Road Extension Traffic Signal Highway Safety Improvements Project. This project proposes installing a traffic signal at the intersection to addresses safety concerns and geometric deficiencies within the intersection functional area.

The project design year is 2050 with construction occurring in 2026. Existing intersection volumes were collected and factored to the summer peak using monthly average daily traffic volumes gathered from nearby continuous count stations. Design volumes were grown from existing counts assuming a 2% annual growth rate determined from the Fairbanks Metropolitan Area Transportation Systems 2045 Travel Demand Model.

To determine if signalization is warranted at the intersection, an analysis was conducted using The Manual on Uniform Traffic Control Devices methodology. Signalization should be considered, but is not necessarily required, if one or more warrants are met. Nine warrants were analyzed for the existing year with the intersection meeting the warrants for 4-hour vehicle volume (Warrant 2) and crash experience (Warrant 7). Warrant 7 requires 5 or more correctable crashes to occur within a single 12-month period. Five correctable angle crashes occurred over 2 separate 12-month periods. Eight-hour capacity (Warrant 1) was also met for the midlife year, 2036, strengthening the case for signalization.

A safety performance analysis was conducted utilizing 11 years of historical crash data. Severity of the crashes are presented in Table 1. No fatal injury, two serious injury, and six minor injury crashes occurred at the project intersection.

Table 1: 2013-2023 Crash Severity at Parks Highway and Sheep Creek Road Intersection

Crash Severity	2013-2023 Crashes
Fatal Injury	0
Serious Injury	2
Minor Injury	6
Property Damage Only	21
Total	29

Table 2 presents the crashes by type, along with a further breakdown of angle crashes by conflicting movement. Angle crashes, the most frequently occurring crash type at the project intersection, are mitigated through signalization by safely separating movements in time. These crashes involved only Parks Highway through vehicles and vehicles making turns from Sheep Creek Road Extension; no crashes occurred between eastbound vehicles turning left and vehicles in the westbound through lane.

Table 2: 2013-2023 Crash Type at Parks Highway and Sheep Creek Road Intersection

Crash Type	2013-2023 Crashes	Conflicting Movement	2013-2023 Crashes
Angle - Left Turning	15	Southbound Left and Westbound Thru	11
		Southbound Left and Eastbound Thru	4
Angle - Right Turning	3	Southbound Right and Westbound Thru	3
Animal	1		
Other	1		
Rear End	3		
Ran Off Road	6		
Total	29		

Crash narratives indicate seasonal trends in angle crashes. In icy conditions, geometric deficiencies created by the Parks Highway superelevation and profile grade make it difficult for left-turning drivers to maintain their lane while accelerating without inadvertently crossing into the eastbound through lane. No crashes occurred making this movement in dry surface conditions. During summer months, some angle crashes were attributed to glare from the sun obstructing turning drivers' view to vehicles on Parks Highway. Westbound right-turning vehicles also blocked sightlines between vehicles in the westbound through lane and the southbound turning traffic. Intersection treatments that would mitigate the observed crashes include:

- Signalizing the intersection to separate conflicts.
- Reducing Parks Highway superelevation (about 5% to 5.5%) and profile grade within the intersection functional area to reduce the likelihood that southbound left-turning vehicles that are turning into the inside eastbound acceleration lane, do not inadvertently cross into the through lane in icy conditions.
- Providing a westbound right-turn acceleration lane to allow turning vehicles to reach highway speed before merging. For right-turning vehicles, this would replace the need for the offset right-turn lane.
- Providing separation between westbound through and right-turn lanes to reduce southbound driver confusion about which lane is occupied, as well as improving sightlines. This is commonly referred to as an "offset right-turn lane."
- Providing a barrier between the eastbound acceleration lane and eastbound through lane to physically keep southbound turning vehicles from crossing into the through lane early.

Design alternatives incorporating the intersection treatments were selected for analysis. Alternative A includes the following intersection treatments:

- Signalized intersection with continuous green given to eastbound Parks Highway vehicles

- Westbound acceleration lane for right-turning Sheep Creek Road Extension vehicles
- Geometry improvements (reduced superelevation and grade) in intersection functional area
- Barrier separating eastbound lanes
- "SIGNAL AHEAD" signs and "PREPARE TO STOP" overhead flashing signs on Parks Highway approaches
- Non-motorized safety improvements including refuge islands and marked crossings

Alternative B includes the following intersection treatments:

- Signalized intersection with continuous green given to eastbound Parks Highway vehicles
- Offset westbound right-turn lane from through lane
- Geometry improvements (reduced superelevation and grade) in intersection functional area
- Barrier separating eastbound lanes
- "SIGNAL AHEAD" signs and "PREPARE TO STOP" overhead flashing signs on Parks Highway approaches
- Non-motorized safety improvements including refuge islands and marked crossings

The public provided feedback on the proposed alternatives and were generally supportive of the project goal to reduce crashes, improve safety for all users, and signalizing the intersection. Common public comment concerns include:

- Raised medians and signal requires additional winter maintenance
- Westbound trucks may have to stop for a signal on an upgrade
- The alternatives do not address Parks Highway speeds or upstream merging issues east of the intersection
- Advanced warning signs and beacons not provided for motorized and unmotorized traffic
- Channelized yield-controlled traffic may not look for or slow down for non-motorists
- Crossing channelized turn lanes is burdensome and inefficient for non-motorized users
- Large turning radius geometry required for truck movements may result in high-speed conflicts with pedestrians crossing channelized lanes
- The alternatives do not address missing pathway connections in the project area

Alternative A improves safety for right-turning Sheep Creek Road Extension vehicles and does not treat left-turn angle crashes. Alternative A was dismissed from consideration because the acceleration lane treatment mitigates the same right-turning angle crash as the signal but introduces a high-speed vehicle-pedestrian conflict due to the large turning radius required for trucks. Alternative A does not reduce confusion for left-turning vehicle Parks Highway as to which westbound lane is occupied. Alternative B improves safety for left- and right-turning vehicles. Alternative B supports configuring the southbound right-turn lane without channelization, allowing the movement to be controlled by the signal that protects non-motorists while maintaining the large radius geometry required for trucks.

Following a public review period, Alternative B was selected for further refinement into the Preferred Alternative. The Preferred Alternative is presented in Figure 1, and includes the following treatments:

- Signalized intersection with continuous green given to eastbound Parks Highway vehicles
- Offset westbound right-turn lane from through lane
- Geometry improvements (reduced superelevation and grade) in intersection functional area
- Barrier separating eastbound lanes
- "SIGNAL AHEAD" signs and "PREPARE TO STOP" overhead flashing signs on Parks Highway approaches
- Non-motorized safety improvements including:
    - Removing southbound right-turn channelization and signalizing the movement
    - Larger westbound channelization island
    - Moving non-motorized crossing over westbound right-turn lane east away from the intersection
    - Compatibility with Rectangular Rapid Flashing Beacon at right-turn crosswalk

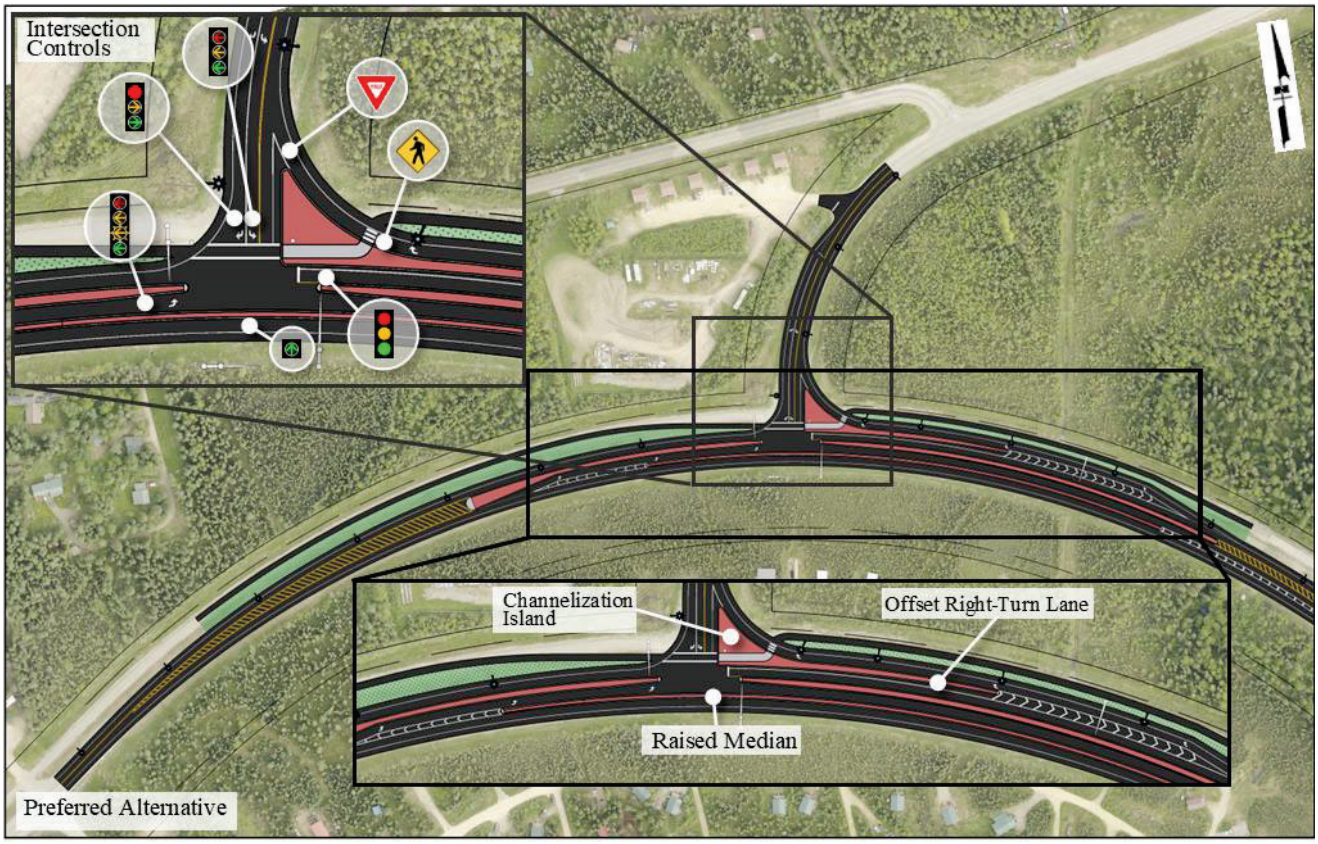

Figure 1: Preferred Alternative Configuration

A capacity analysis conducted on the alternatives show alternatives operate similarly throughout the day for all users. Design year 2050 operations for the alternatives are presented in Table 3.

Table 3: Summary of Parks Highway and Sheep Creek Road Alternatives 2050 Operational Performance

Alternative	Channelized Right-Turn Lanes	Peak Hour		
		Intersection Delay, seconds	Intersection LOS	Pedestrian Delay, seconds
Alternative A	Southbound + Westbound	AM: 19 Midday: 11 PM: 18	AM: B Midday: B PM: B	AM: 24 Midday: 16 PM: 21
Alternative B	Southbound + Westbound	AM: 20 Midday: 12 PM: 20	AM: C Midday: B PM: B	AM: 24 Midday: 17 PM: 22
Preferred Alternative	Westbound	AM: 20 Midday: 12 PM: 22	AM: C Midday: B PM: C	AM: 24 Midday: 17 PM: 22

1 Introduction

1.1 Project Description

The Alaska Department of Transportation and Public Facilities (DOT&PF) has retained Kinney Engineering, LLC (KE) to conduct the traffic and safety analysis for the Parks Highway and Sheep Creek Road Extension Traffic Signal Highway Safety Improvements Project (HSIP). The purpose of this project is to address safety concerns at the intersection through signalization. The inconvenience of adding a signal is reduced by configuring the intersection with a continuous green T allowing through traffic heading northbound on Parks Highway to not stop under normal operating conditions. All roadway users are accommodated by making improvements to the Parks Highway non-motorized pathway approaches and crossings. The project, presented in Figure 2, is located in Fairbanks, Alaska.

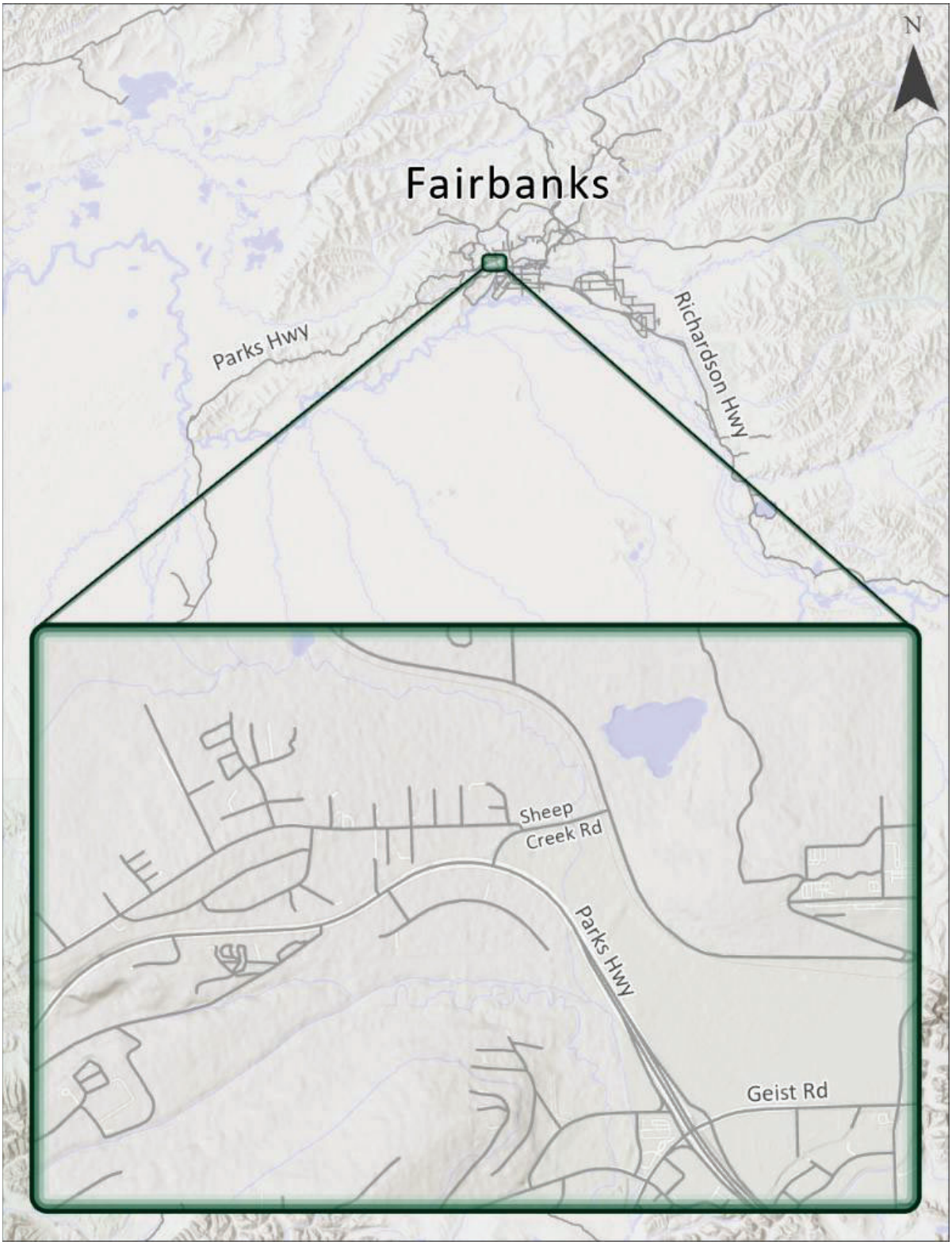

Figure 2: Project Vicinity Map

1.2 Functional Classification

The functional classification of a roadway is an indication of the type of service it is intended to provide, with general safety, speed, capacity, access, and mobility goals. Table 4 presents the functional classification of Parks Highway and Sheep Creek Road Extension. Parks Highway is on the National Highway System.

Table 4: Roadway Functional Classifications

Roadway	Functional Classification
Parks Highway	Interstate Highway
Sheep Creek Road Extension	Major Collector

1.3 Existing Configuration

Parks Highway has a design speed of 55 miles per hour (mph). Sheep Creek Road Extension (hereinafter Sheep Creek Road) has a design speed of 40 mph. Sheep Creek Road intersects Parks Highway on the outside of a 1,910-foot horizontal curve with highway lanes superelevated at 5.5% through the functional area of the intersection.

Figure 3 presents the existing project intersection area and depicts intersection approach and departure lanes and directional references. For the purposes of this report, the stop-controlled 2-lane Sheep Creek Road approach is assigned as the southbound approach. The left-turn auxiliary lane and through-lane inbound (to Fairbanks) Parks Highway approach is assigned as the eastbound approach. The right-turn auxiliary lane and through-lane outbound (to Anchorage) Parks Highway approach is assigned as the westbound approach.

There is one departure lane on both the Parks Highway west leg and Sheep Creek Road north leg. The Parks Highway east leg has two departure lanes; the outside lane is designated to receive eastbound approach through movements and the inside lane is designated to receive southbound approach left-turn movements. A raised median on Parks separates the traffic direction flow (eastbound and westbound) and provides channelization.

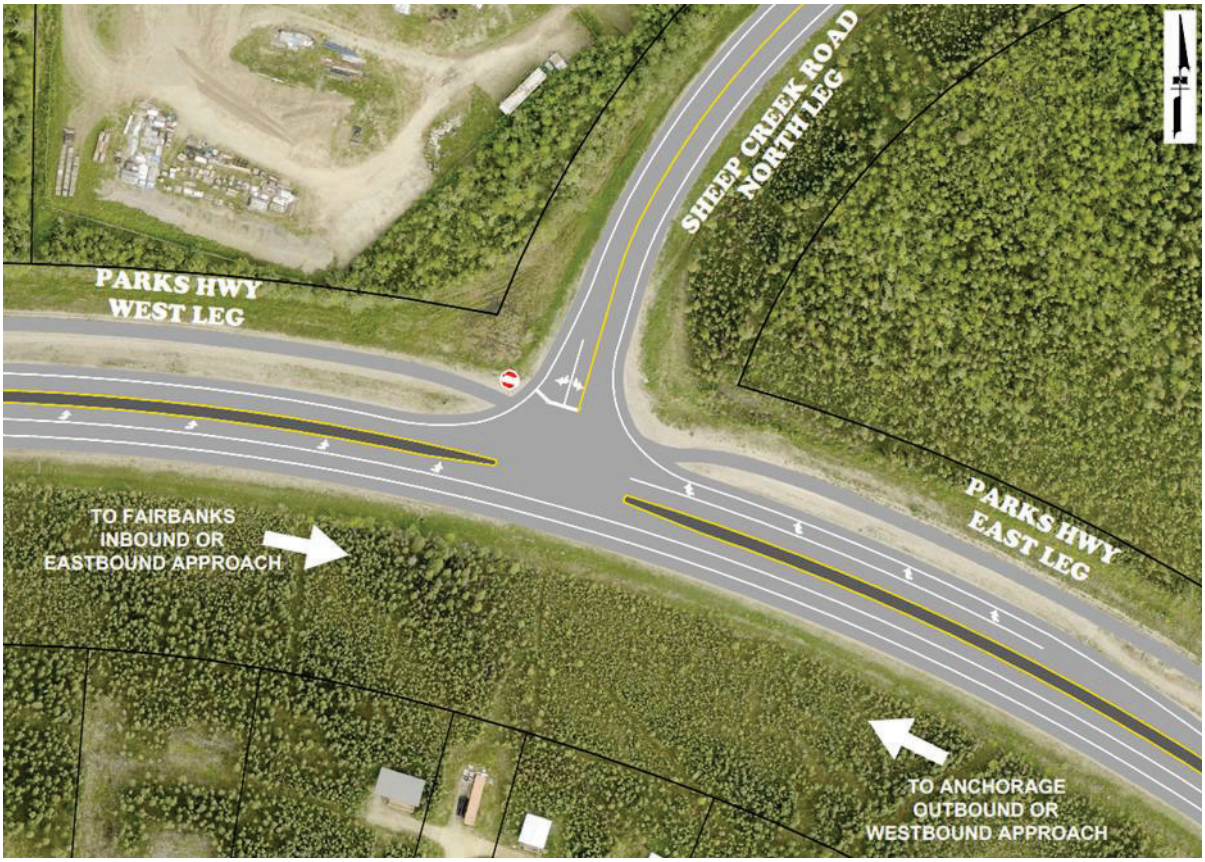

Figure 3: Parks Highway and Sheep Creek Road Intersection Showing Existing Lane Configuration and Report Direction References

2 Data Collection

2.1 Average Annual Daily Traffic

AADT volumes were collected from DOT&PF Traffic Analysis and Data Application website. Table 5 presents the historical AADT volumes, given in vehicles per day (vpd), for Parks Highway and Sheep Creek Road segments in the project area.

Table 5: Average Annual Daily Traffic (2014 - 2023)

Segment Name	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Parks Hwy West Of Sheep Creek Rd	6,006	6,094	7,307	7,294	7,191	7,326	6,460	7,170	6,820	6,950
Parks Hwy East Of Sheep Creek Rd (MP 356)	8,340	8,520	9,442	9,670	10,252	10,444	9,210	10,200	9,980	9,380
Sheep Creek Rd North of Parks Hwy	3,866	4,891	4,300	4,187	4,229	4,293	3,600	2,340	2,340	2,360
Sheep Creek Rd East of Goldhill Rd	3,474	3,519	3,851	3,770	3,808	3,883	3,610	3,860	3,040	3,070

2.2 Turning Movement Volumes

Turning movement volumes (TMVs) for the project intersection were collected by DOT&PF on Wednesday September 11, 2024, and Saturday September 14, 2024. Collected peak hour TMVs are provided in Appendix A. Total volume observed during Wednesday's collection exceeds the volume observed during Saturday's count. Wednesday AM and PM peak hour volumes exceed Saturday's morning and evening peak volumes. During the morning rush hour, vehicles heading eastbound to Fairbanks outnumbered vehicles heading westbound out of the city. The PM peak hour, the highest-volume period recorded in counts, shows the opposite trend; an increase in vehicles heading westbound from Fairbanks during the evening rush hour.

Traffic volumes fluctuate seasonally and peaks during the summer months. DOT&PF Continuous Count Stations (CCS) in the project area located at Parks Highway Milepost 350, Parks Highway Milepost 357, and Geist Road west of Thompson Drive show 2024 Monthly Average Daily Traffic (MADT) peaks from May to September and is shown in Figure 4.

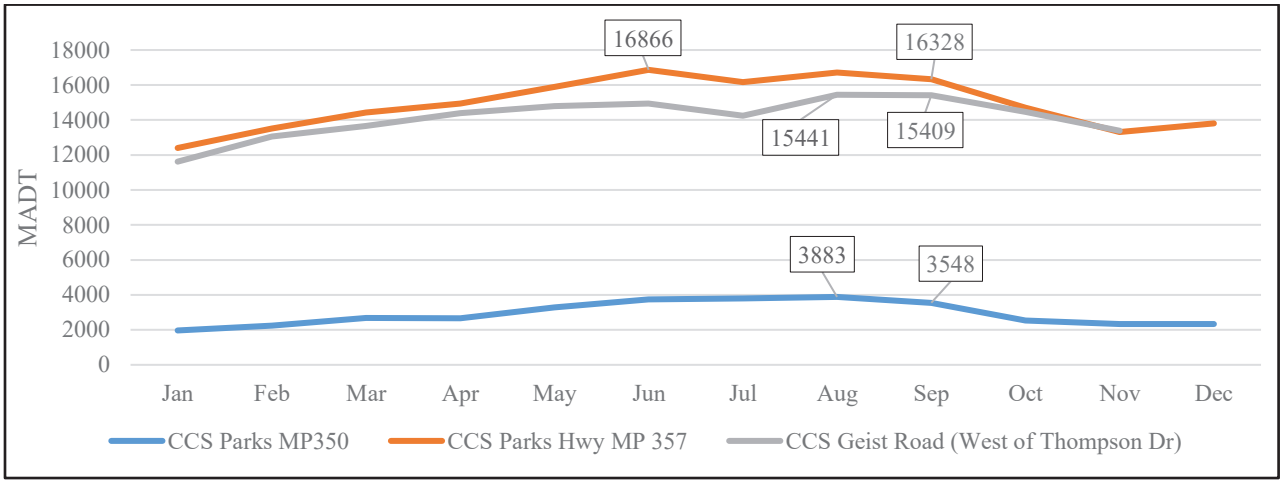

Figure 4: 2024 Monthly Average Daily Traffic at Continuous Count Stations in the Project Area

Table 6 presents the 2024 MADTs used to factor TMVs to the average peak summer month for the three CCS locations. The average factor to convert September counts to a peak condition is 1.043. This factor is applied to the collected September 2024 TMVs (Appendix A) to compute the summer peak TMVs that are presented in Figure 5 through Figure 7.

Table 6: MADT Factors Used to Factor September 2024 TMVs to 2024 Summer Peak

CCS Station	2024 September MADT	2024 Peak MADT	Factor (Peak MADT) / (Sept MADT)
Parks Hwy MP350	3548	3883 (August)	1.094
Parks Hwy MP357	16328	16866 (June)	1.033
Geist Rd West of Thompson Dr	15409	15441 (August)	1.002
Average Factor			1.043

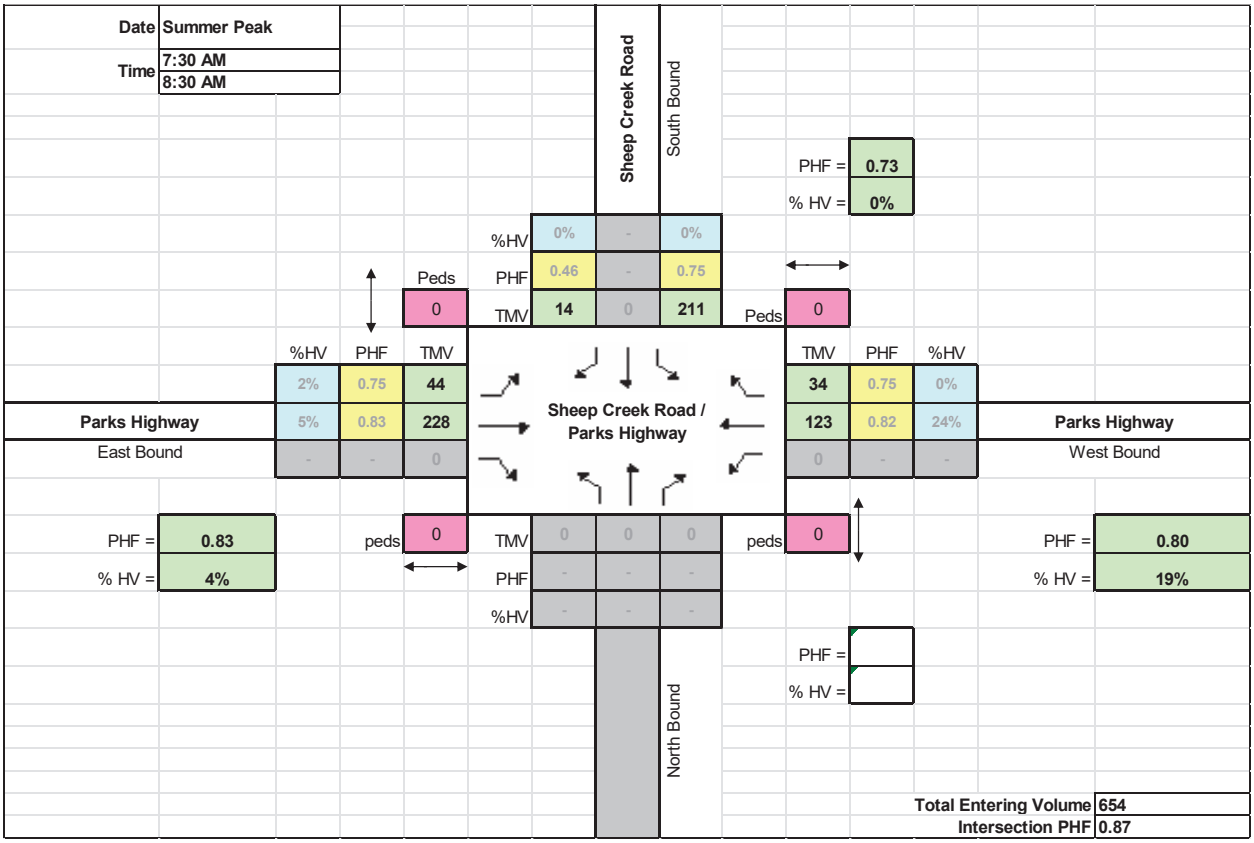

Figure 5: 2024 Summer Turning Movement Volumes, AM Peak

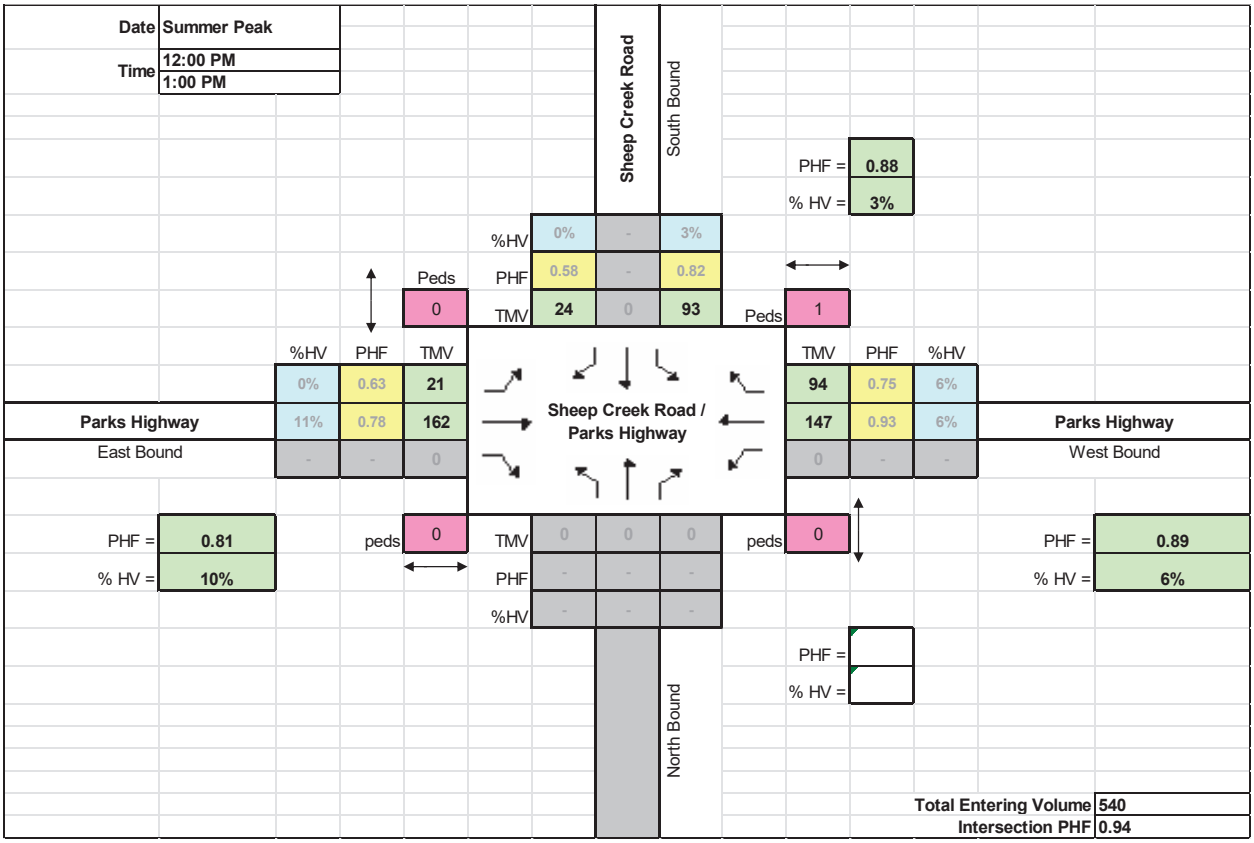

Figure 6: 2024 Summer Turning Movement Volumes, Midday Peak

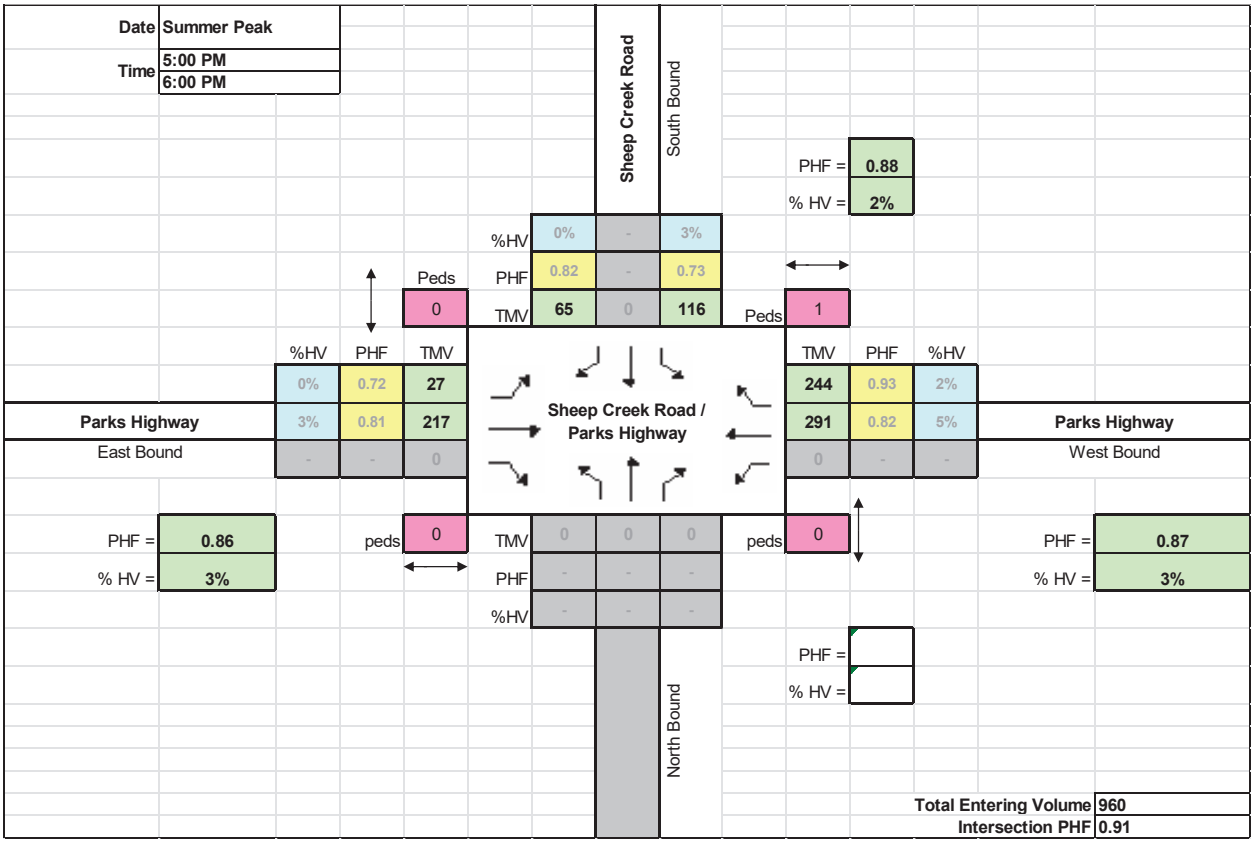

Figure 7: 2024 Summer Turning Movement Volumes, PM Peak

2.3 Peak Hour Factor

Peak Hour Factors (PHFs) convert peak hour volumes to 15-minute design flow rates for use in capacity analysis. They represent the uniformity of traffic volumes over an hourly period and range from 0.25 (all traffic arrives in one 15-minute period and no additional traffic arrives for the rest of the hour) to 1.0 (an equal number of vehicles arrive during each 15-minute period). PHFs are calculated using peak hour 15-minute interval volumes recorded in the TMV counts. Table 7 presents the existing movement and combined PHFs for the study intersection by peak period. The intersection PHFs for all movements show traffic arrives at the intersection evenly through the peak hours. PHFs for individual lane movements indicate volumes arriving throughout the hour will be less evenly spaced. Individual movement PHFs are used in this capacity analysis so individual movements can be removed from the intersection as required for the analysis of the continuous green signal alternative. The uniformity of traffic volumes during the peak hours is assumed to not change so these PHFs are applicable to all analysis conditions: 2024 factored to the summer peak, 2026 construction year, and 2050 forecasted years.

Table 7: 2024 PHFs by Movement

		PHF		
Approach	**Movement**	**AM Peak**	**Midday Peak**	**PM Peak**
Parks Hwy	Eastbound Left	0.75	0.63	0.72
	Eastbound Through	0.83	0.78	0.81
Parks Hwy	Westbound Through	0.82	0.93	0.82
	Westbound Right	0.75	0.75	0.93
Sheep Creek Rd	Southbound Left	0.75	0.82	0.73
	Southbound Right	0.46	0.58	0.82
Intersection	All	0.87	0.94	0.91

2.4 Heavy Vehicle Percentage

DOT&PF turning movement volumes included medium vehicle and articulated truck hourly counts. The percentage of heavy vehicles (%HV) is the total of medium and articulated trucks as a percentage of total vehicle volume. %HV by movement, presented in Table 8, is used in this analysis so specific movements can be removed during the continuous green signal alternative analysis. This capacity analysis assumes the percentage of heavy vehicles will be constant for all for all analysis conditions.

Table 8: 2024 Heavy Vehicle Percentage by Movement

		% Heavy Vehicle		
Approach	**Movement**	**AM Peak**	**Midday Peak**	**PM Peak**
Parks Hwy	Eastbound Left	2%	0%	0%
	Eastbound Through	5%	11%	3%
Parks Hwy	Westbound Through	24%	6%	5%
	Westbound Right	0%	6%	2%
Sheep Creek Rd	Southbound Left	0%	3%	3%
	Southbound Right	0%	0%	0%

2.5 Intersection Sight Distance

Intersection Sight Distance (ISD) was measured by KE on February 26, 2025, for the left- and right-turn sight distance triangles at the stop-controlled Sheep Creek Road approach. ISD is the distance required for minor street driver to judge and enter main street traffic with minimal impact to main street operations. Drivers turning left from Sheep Creek are provided a receiving lane separate from Parks Highway through traffic and as such, must have an adequate gap for only westbound through vehicles. Drivers turning right from Sheep Creek must find a gap in westbound through traffic.

Table 9 presents the minimum, desirable, and measured ISD for the project intersection. Minimum ISD is stopping sight distance, which enables the mainline vehicle to stop in time for a vehicle entering the roadway from the minor approach. Desirable ISD allows the minor street vehicle driver to judge gaps and select those that enable them to enter the roadway with minimal impact to the mainline driver.

The measured 1,090-foot ISD is adequate for vehicles making left and right turns from Sheep Creek Road.

Table 9: Parks Highway and Sheep Creek Road Intersection Sight Distance, Cases B1 and B2

PGDHS Control Case	Design Speed (mph)	Minimum ISD (ft)	Desirable ISD (ft)	Measured ISD (ft)
B1: Left turn from minor road	55	495	610	1090
B2: Right turn from minor road	55	495	530	1090

3 Design Volumes

The project construction year is 2026 and the design year is 2050.

3.1 Forecast Average Annual Daily Traffic

Base forecast volumes from the Fairbanks Metropolitan Area Transportation System (FMATS) 2045 Travel Demand Model (TDM) were used to develop growth rates for the 2050 design year. Table 10 presents the forecast annual growth rates in the project area. A 2% growth rate per year, rounded up from the 1.88% per year on average was applied to 2023 AADTs (the last full year) to determine 2024 current year, 2026 construction year, and 2050 design year projected AADTs, presented in Table 11.

Table 10: 2045 FMATS TDM Forecasted Annual Growth Rate

Segment Name	Forecasted 2024 AADT (vpd)	Forecasted 2045 AADT (vpd)	Annual Growth Rate (%)
Parks Hwy West Of Sheep Creek Rd	6,632	10,862	2.38%
Parks Hwy East Of Sheep Creek Rd (MP 356)	10,625	15,338	1.76%
Sheep Creek Rd North of Parks Hwy	6,043	8,223	1.48%
Combined			1.88%

Table 11: Forecast Volumes Assuming 2% Annual Growth

Segment Name	2023 AADT	2024 AADT	2026 AADT Construction Year	2036 AADT Mid-Life Year	2050 AADT Design Year
Parks Hwy West Of Sheep Creek Rd	6,950	7,089	7,375	8,991	11,863
Parks Hwy East Of Sheep Creek Rd (MP 356)	9,380	9,568	9,954	12,134	16,011
Sheep Creek Rd North of Parks Hwy	2,360	2,407	2,504	3,053	4,028

3.2 2026 Turning Movement Volumes

The 2% annual growth rate was applied to the 2024 summer intersection volumes, shown in Figure 5 through Figure 7, to determine future TMVs for the 2026 construction year. Figure 8 through Figure 10 present the projected 2026 summer TMVs during the AM, Midday, and PM peak hours. PHF and %HV are assumed to remain unchanged from 2024.

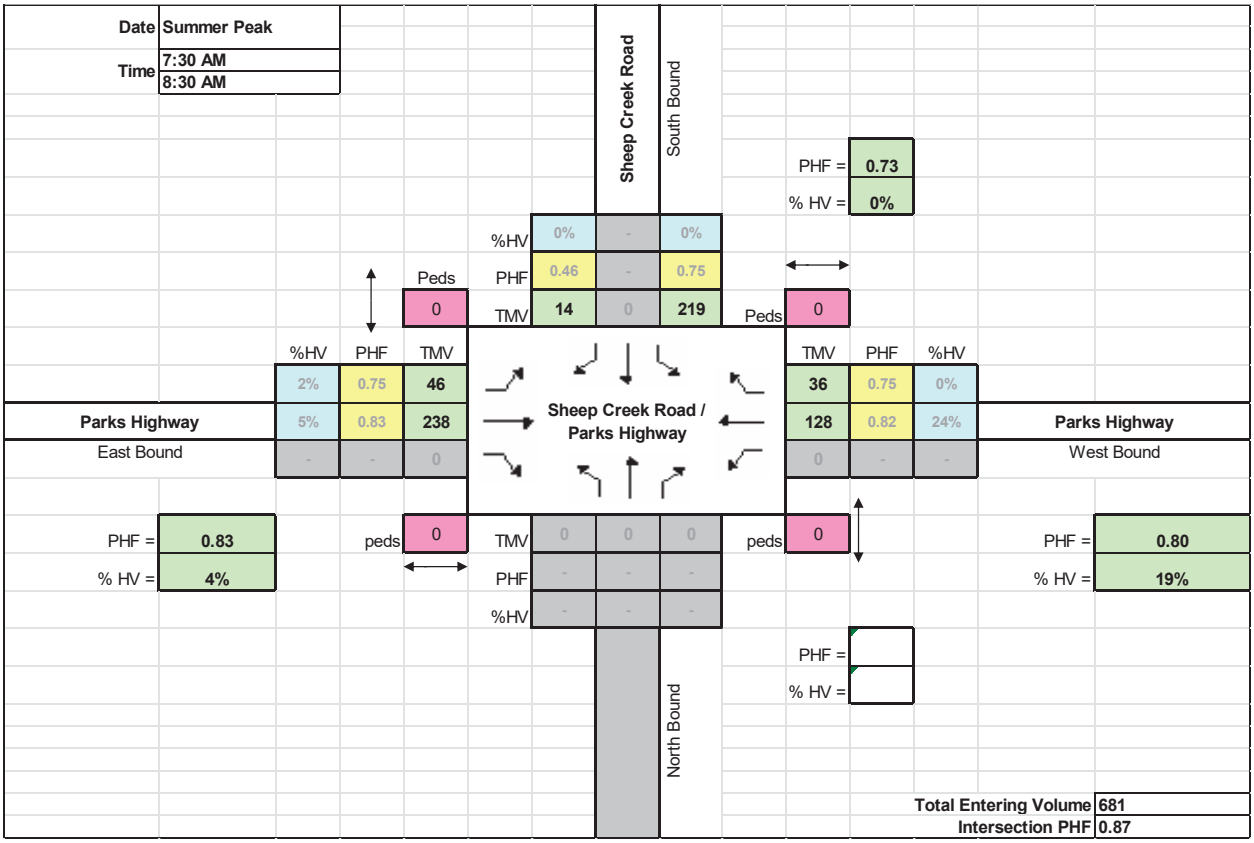

Figure 8: 2026 Summer Turning Movement Volumes, AM Peak

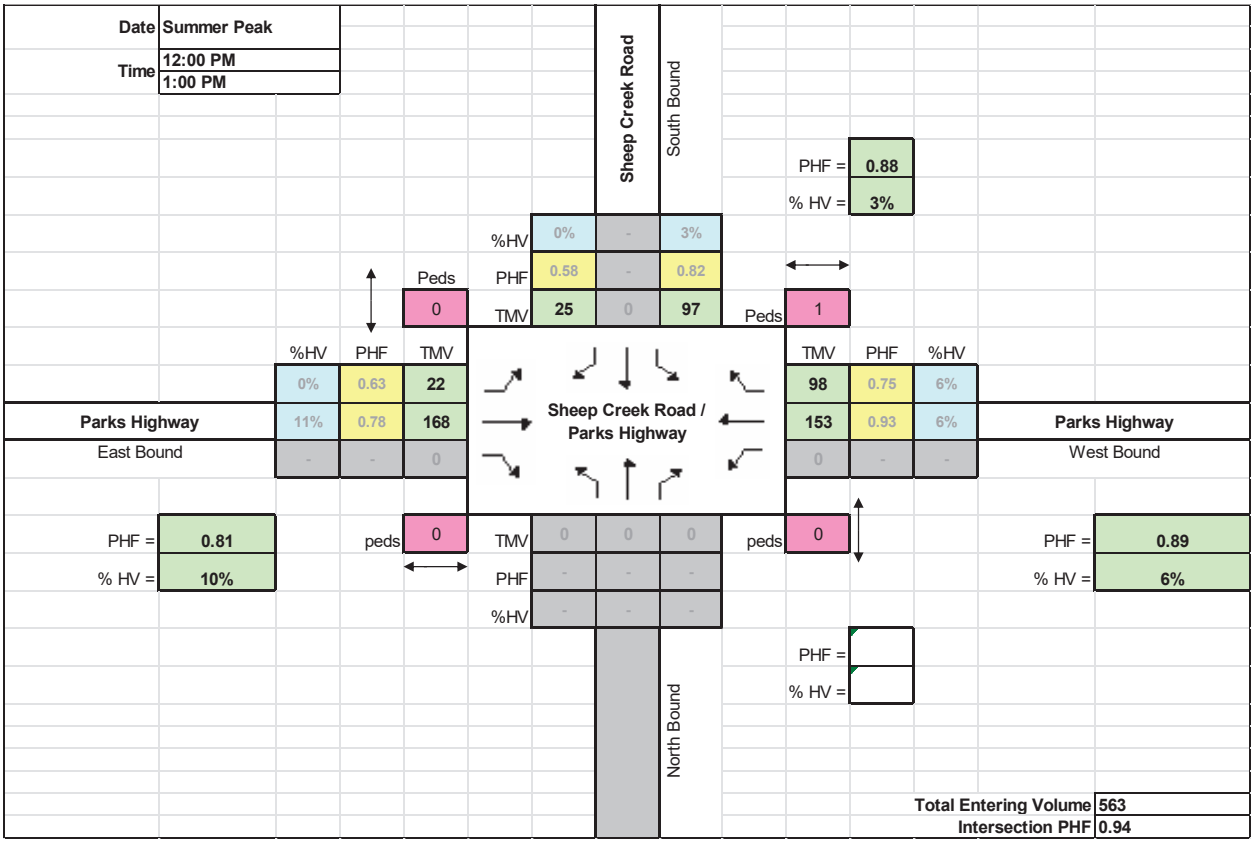

Figure 9: 2026 Summer Turning Movement Volumes, Midday Peak

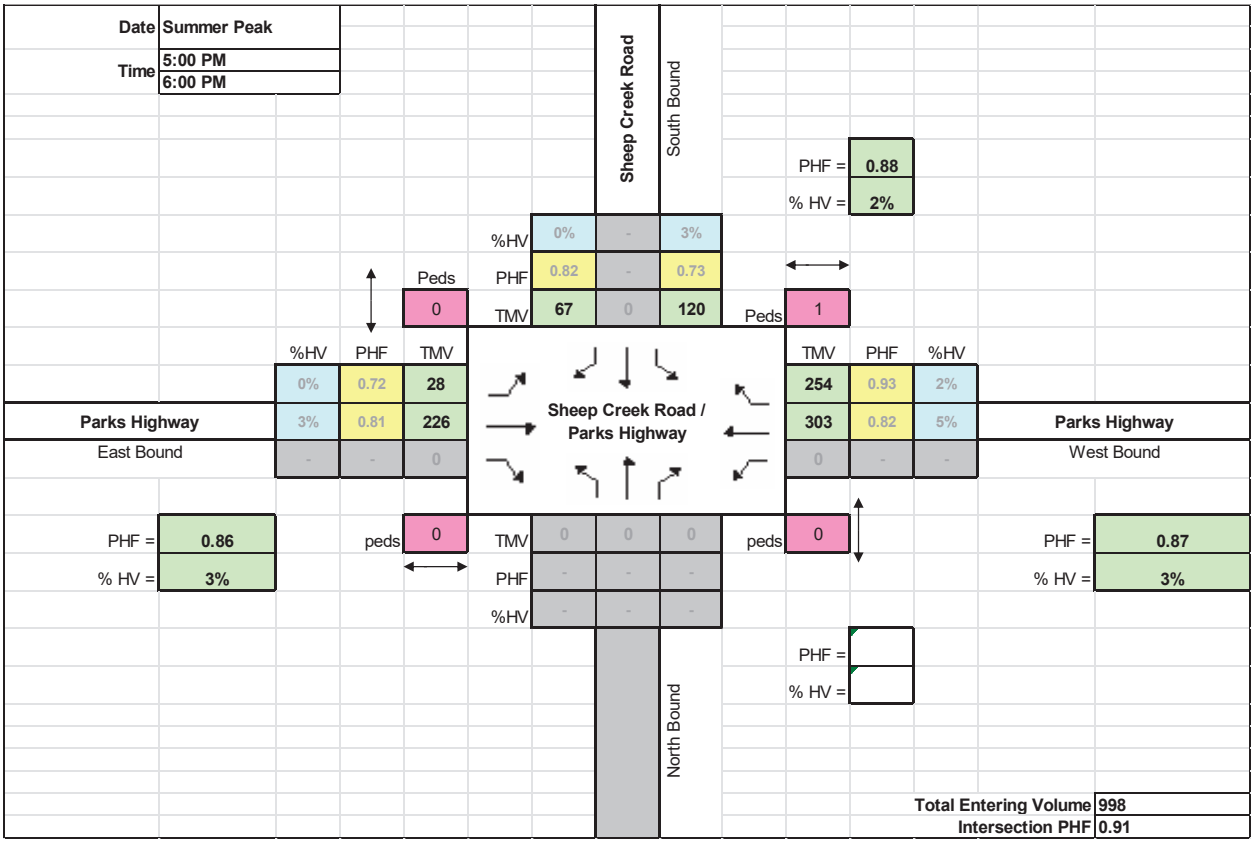

Figure 10: 2026 Summer Turning Movement Volumes, PM Peak

3.3 2050 Turning Movement Volumes

The 2% annual growth rate was applied to the intersection volumes to determine future TMVs for the 2050 design year. Figure 11 through Figure 13 present the projected summer TMVs during the AM, Midday, and PM peak hours. PHF and %HV are assumed to remain unchanged from 2024.

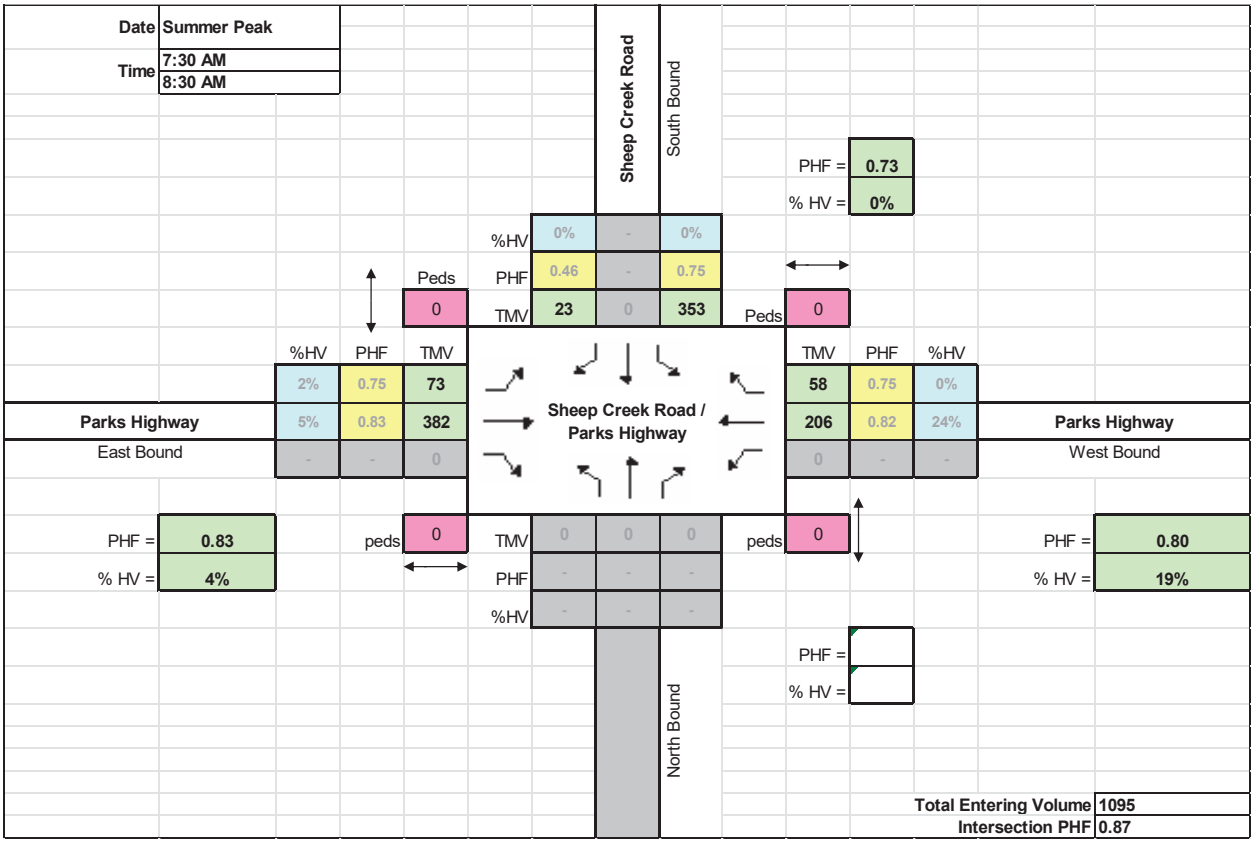

Figure 11: 2050 Summer Turning Movement Volumes, AM Peak

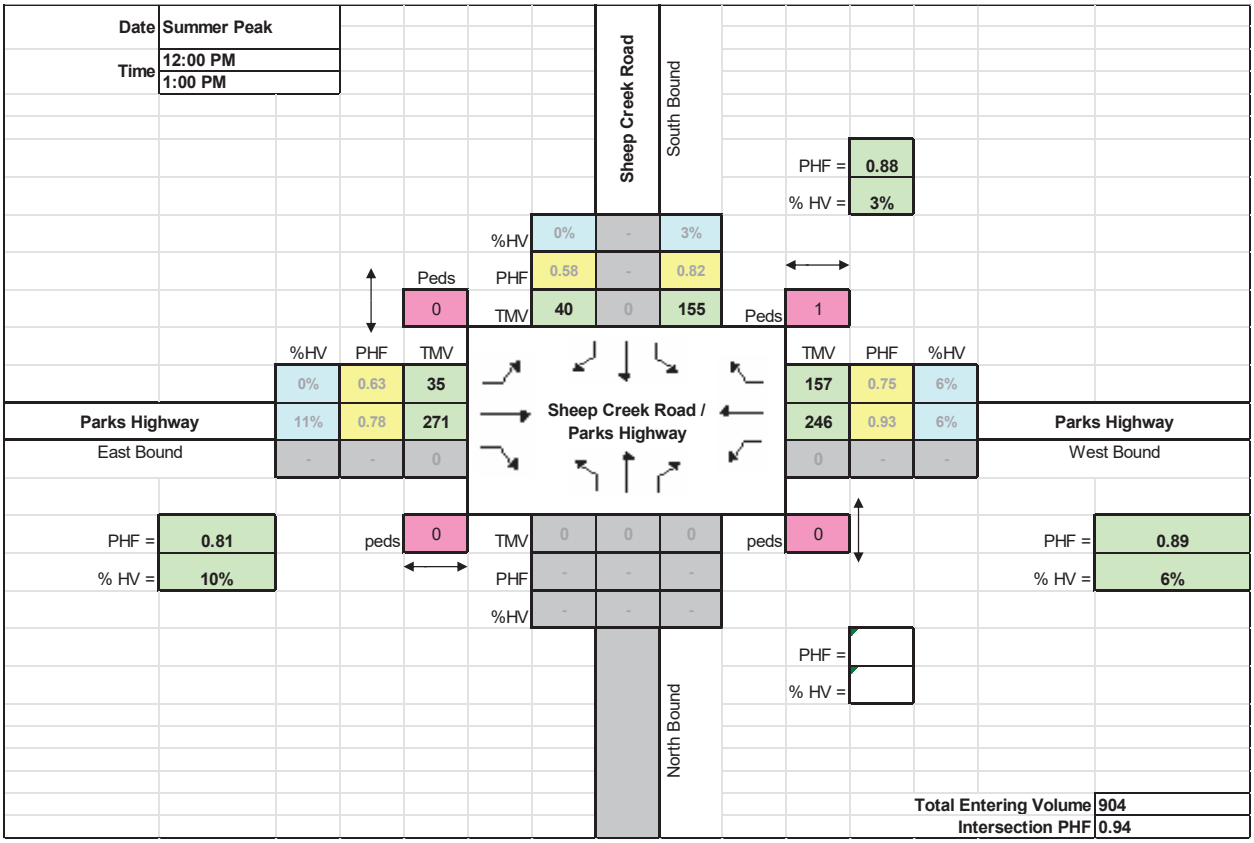

Figure 12: 2050 Summer Turning Movement Volumes, Midday Peak

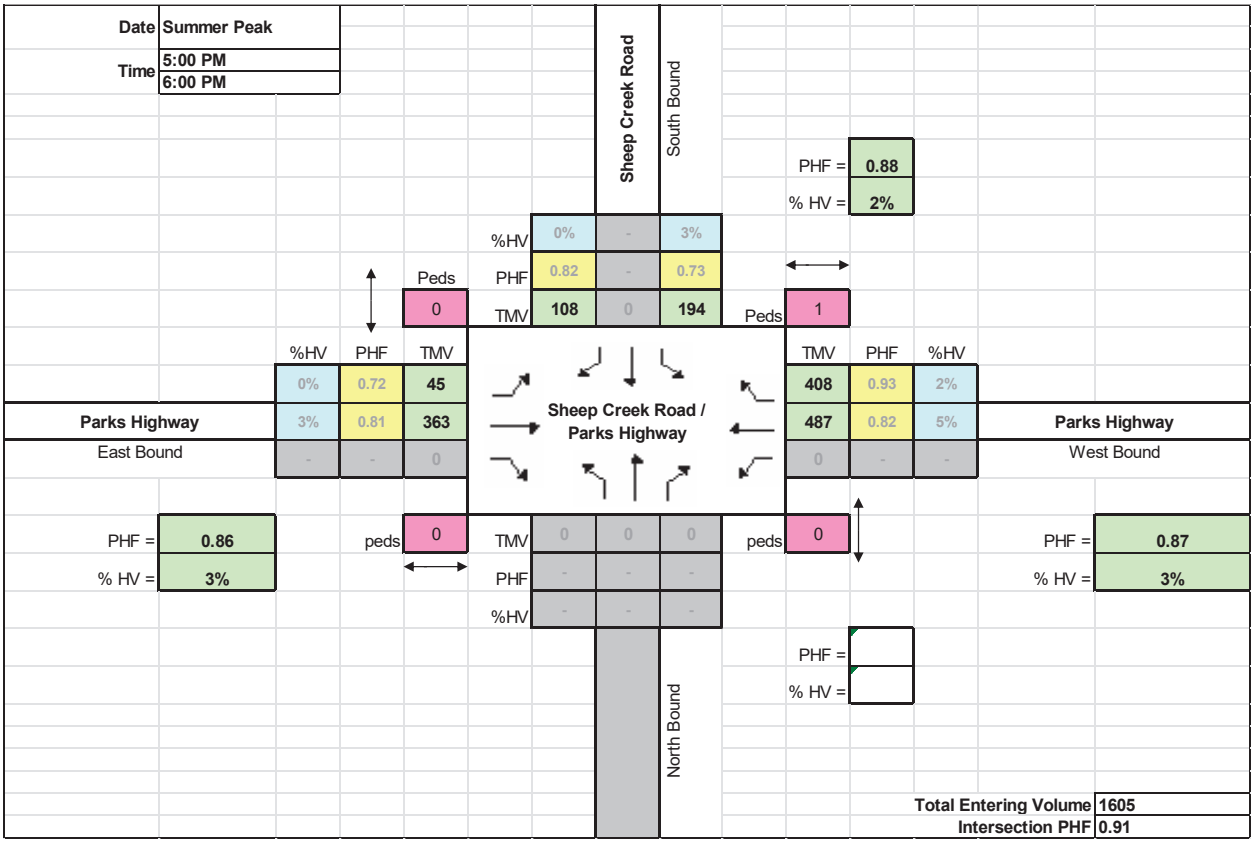

Figure 13: 2050 Summer Turning Movement Volumes, PM Peak

4 Signal Warrant Analysis

The Manual on Uniform Traffic Control Devices (MUTCD) provides methodology to determine whether traffic signals are warranted at an intersection. If one or more warrants are satisfied, then a signal may be considered at the intersection. Satisfying warrants does not necessarily require a signal be installed; the MUTCD recommends other treatments be evaluated prior to implementing signalization.

The MUTCD warrants are:

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

Since Sheep Creek Road is controlled by a stop sign and has less traffic than the Parks Highway, it is considered to be the minor roadway. The posted speed limit of the major road, Parks Highway, is 55 miles per hour (mph). The Parks Highway eastbound and westbound approaches are single through lanes with auxiliary lanes. The Sheep Creek Road southbound approach is a single lane. As such, the intersection is analyzed as having single lane approaches for both major (Parks Highway) and minor (Sheep Creek Road) approaches.

Volumes used in this warrant analysis represent summer peak conditions (factored from September 2024 turning movement counts) and are presented in Appendix B. When analyzing Warrant 1 MUTCD Section 4C.02-05 allows 70% vehicular volumes to be used in evaluating Warrant 1 Condition A and Warrant 1 Condition B warrants when the major road speed limit is greater than 40 mph. Warrant 1 Combination of Condition A and Condition B uses 80% of Condition A and 80% of Condition B.

Table 12 presents the minimum vehicle volume thresholds for single-lane approaches. The 70% volumes are applied to Condition A and Condition B analyses, whereas the 56% volumes apply to the Combination of Warrant 1 Condition A and Warrant 1 Condition B analyses. Consistent with MUTCD supporting discussion, the Sheep Creek Road southbound right-turn traffic is not included the analysis.

Table 12: MUTCD Table 4C-1, Eight-Hour Vehicular Volume

Condition A – Minimum Vehicular Volume									
Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%	80%	70%	56%	100%	80%	70%	56%
1	1	500	400	350	280	150	120	105	84
Condition B – Interruption of Continuous Traffic									
Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%	80%	70%	56%	100%	80%	70%	56%
1	1	750	600	525	420	75	60	53	42

MUTCD section 4C.03-03 allows the 70% factored volume threshold, presented in Figure 14, to be used in Warrant 2 analysis. Section 4C.04-04 allows the 70% volume threshold, presented in Figure 15, to be used in Warrant 3 analysis.

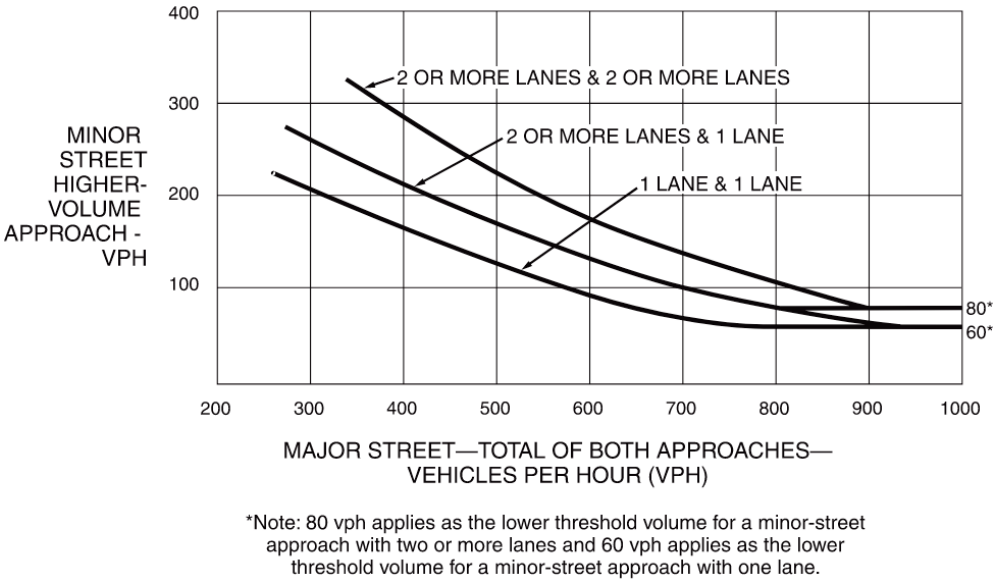

Figure 14: MUTCD Figure 4C-2 Warrant 2, Four-Hour Vehicular Volume (70% Factor)

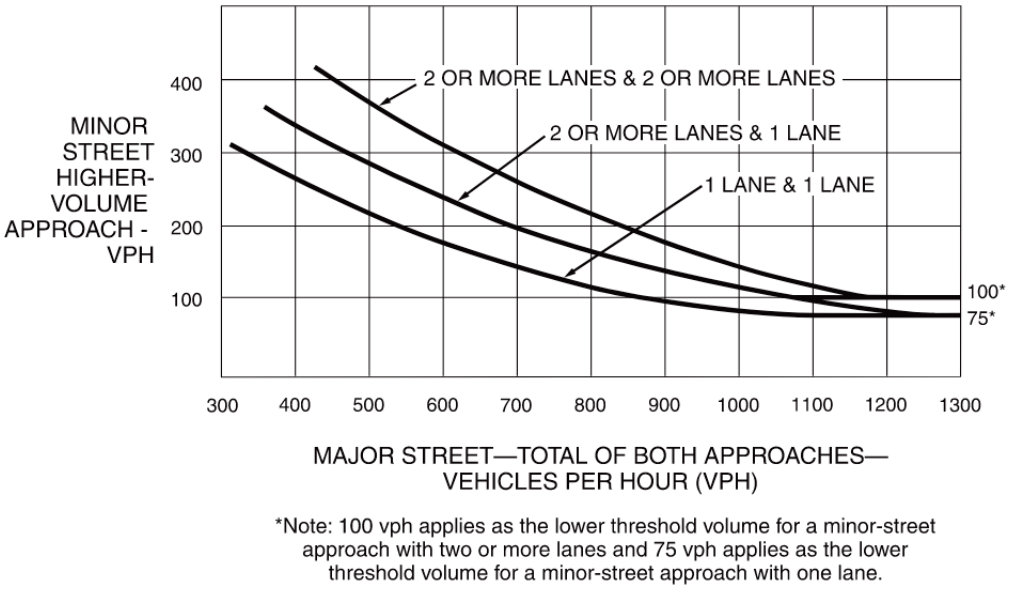

Figure 15: MUTCD Figure 4C-4 Warrant 3, Peak Hour (70% Factor)

Signal warrants applicable to the Sheep Creek intersection are presented in Table 13 and are discussed after. The intersection meets warrant 2 and warrant 7 for signalization.

Table 13: Signal Warrants 1, 2, 3, and 7 for Parks Highway and Sheep Creek Road Intersection, Existing Year 2024

MUTCD Warrant	MUTCD Warrant Description	Criterion Required	Condition Met	Warrant Met?
Warrant 1	8-Hour Vehicular Volume, Condition A- Minimum Vehicular Volume	8 hours	4 hours	No
Warrant 1	8-Hour Vehicular Volume, Condition B- Interruption of Continuous Traffic	8 hours	3 hours	No
Warrant 1	8-Hour Vehicular Volume, Combination of A & B	8 hours	7 hours	No
Warrant 2	4-Hour Vehicular Volume	4 hours	4 hours	Yes
Warrant 3	Peak Hour Volume	1 hour	0 hours	No
Warrant 7	Crash Experience	8 hours	8 hours	Yes
		5 crashes	5 crashes	

4.1 Warrant 1 – 8-Hour Vehicular Volume

(MUTCD Table 4C-1, MUTCD 40.01-08)

Vehicular volumes are presented in Appendix B. Right-turn traffic was removed from the minor street approach following MUTCD discussion on evaluating signal warrants. Minimum vehicular volumes for Warrant 1 Condition A are above the major street 70% threshold of 350 vehicles per

hour for 8 hours and above the minor street threshold of 105 vehicles per hour for 4 hours. Condition B 70% thresholds for major street volume, 525 vehicles per hour, and minor street volume, 53 vehicles per hour, are exceeded for 3 hours. Minimum vehicle volumes exceed 56% of Condition A and Condition B for 7 hours. Warrant 1 criteria are not met.

4.2 Warrant 2 – 4-Hour Vehicle Volume

(MUTCD Figure 4C-2)
Minimum entering vehicle volumes fall above the 70% minor road threshold for 4 hours. Warrant 2 criteria is met.

4.3 Warrant 3 – Peak Hour Volume

(MUTCD Figure 4C-4)
Peak hour minor street vehicular volumes do not exceed the 70% threshold for any hour. Warrant 3 criteria is not met.

4.4 Warrant 4 – Pedestrian Volume

(MUTCD Figure 4C-6, MUTCD Figure 4C-8)
No pedestrians were recorded crossing the major street approaches. Two pedestrians were recorded crossing the minor street over the 8 hours of intersection counts. A minimum of 100 pedestrians in a 4-hour period or 75 pedestrians in a 1-hour period are required to meet this warrant. Warrant 4 criteria is not met.

4.5 Warrant 5 – School Crossing

(MUTCD 4C.06-01)
No pedestrians were counted crossing the major street during the count period. No schools are located in the intersection area. Warrant 5 criteria is not met.

4.6 Warrant 6 – Coordinated Signal System

(MUTCD 4C.07-01)
The intersection is not within 1000 feet of an existing signal and is isolated from other signals by a grade separated interchange. Warrant 6 criteria is not met.

4.7 Warrant 7 – Crash Experience

(MUTCD 4C.08-02)
Eleven years of crash history was provided by DOT&PF. Between 2013 and 2023 29 crashes occurred at the Sheep Creek Rd intersection; 18 of which were correctable by signalization. MUTCD crash experience requires 5 or more correctable crashes within a 12-month period to meet Warrant 7. Five correctable crashes occurred at the intersection over 2 separate 12-month periods. The 5 crashes that occurred between December 2017 and November 2018 are presented in Table 9. Two left-turning crashes involved southbound vehicles colliding with eastbound

vehicles heading toward Fairbanks in icy conditions. Three left-turning crashes involved southbound vehicles failing to yield to westbound vehicles on Parks Highway.

Table 14: Parks Highway and Sheep Creek Road Crashes Occurring During 12 Consecutive Months Between December 2017 and November 2018

Correctable Crash Type	Crashes
Angle - Left-Turn	5

The 5 correctable crashes that occurred between November 2020 and October 2021 are presented in Table 15. The left-turning angle crashes involved vehicles turning left from Sheep Creek failing to yield to vehicles on westbound Parks Highway. The right-turn angle crash involved a vehicle turning from Sheep Creek Road failing to yield to a vehicle on westbound Parks Highway. Signalization separates conflicting movements, reducing the possibility for the observed angle crashes to occur and removes driver judgment from determining appropriate gaps to enter into traffic.

Table 15: Parks Highway and Sheep Creek Road Crashes Occurring During 12 Consecutive Months Between November 2020 and October 2021

Correctable Crash Type	Crashes
Angle - Left-Turn	4
Angle - Right-Turn	1

Vehicle volumes exceed Warrant 1 Conditions A or B for 8 hours. Warrant 7 criteria is met.

4.8 Warrant 8 – Roadway Network

(MUTCD 4C.09-02, MUTCD 4C.09-03)
The existing entering volume does not exceed 1,000 vehicles per hour. Sheep Creek Road does not meet the criteria for being a major route as defined in MUTCD 4C.09-03. Warrant 8 criteria is not met.

4.9 Warrant 9 – Proximity to Grade Crossing

(MUTCD 4C.10-03)
No at-grade railroad crossing is present within 140 feet of the intersection. Warrant 9 criteria is not met.

4.10 Future Signal Warrants

The above analyses shows that Warrant 1, the primary congestion warrant, is not satisfied. The California Department of Transportation (Caltrans) has an accepted methodology which uses forecast AADT approach volumes to estimate if the intersection meets MUTCD Warrant 1

conditions in the future. If Warrant 1 conditions are met by mid-life year, then the case for signalization is strengthened.

Forecast AADT volumes for the 2036 mid-life year are presented in Table 11 above.
Table 16 presents the Caltrans Warrant 1 analysis for the mid-life year, 2036. The major road entering volume threshold is computed as the sum of ½ of each Parks Highway segment AADT. For minor roadway, the entering volume threshold is computed as the ½ of Sheep Creek Road AADT.

Table 16: Signal Warrant 1 for Parks Highway and Sheep Creek Road Intersection, Design Year 2036

Warrant 1 - Minimum Vehicular			
Warrant		Warrant	Forecast
Major Road Threshold (Average of Approach AADT)		5,600	10,562
Minor Road Threshold (Average of Approach AADT)		1,680	1,526
Warrant 1 Satisfied?		No	
Warrant 1 - Interruption of Continuous Traffic			
Warrant		Warrant	Forecast
Major Road Threshold (Average of Approach AADT)		8,400	10,562
Minor Road Threshold (Average of Approach AADT)		850	1,526
Warrant 2 Satisfied?		Yes	
Warrant 1 - Combination			
Warrant	80% W1	80% W2	Forecast
Major Road Threshold (Average of Approach AADT)	4,480	6,720	10,562
Minor Road Threshold (Average of Approach AADT)	1,344	680	1,526
80% Levels of 1 & 2 Satisfied?		Yes	

As the table indicates, Warrant 1 is expected to be satisfied by 2036, joining Warrant 2 (Four-Hour) and Warrant 7 (Crash Experience) as justification for signalizing this intersection.

5 Safety Performance

DOT&PF provided crash data between 2013 and 2023. Crash narratives were also provided for crashes occurring between 2013 and 2022. Twenty-nine crashes occurred at the intersection during this time period. No fatal injury crashes occurred. Two crashes involved serious injuries, and six crashes involved minor injuries. The remaining 21 crashes were non-injury property damage only (PDO).

Table 17 presents the crash severity over the 11-year period. The serious injury crashes, both occurring in daylight on dry roadway surfaces, involved vehicles turning from Sheep Creek Road colliding with westbound Parks Highway traffic. One crash narrative indicated the turning southbound driver misjudged the distance to the westbound vehicle. This is discussed further below.

Table 17: Parks Highway and Sheep Creek Road Intersection Crash Severity by Year (2013 - 2023)

Crash Severity	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2013-2023
Fatal Injury	0	0	0	0	0	0	0	0	0	0	0	0
Serious Injury	0	0	0	0	0	1	0	0	1	0	0	2
Minor Injury	0	1	0	0	0	2	0	0	1	0	2	6
Property Damage Only	1	2	0	2	3	3	0	5	3	0	2	21
Total	1	3	0	2	3	6	0	5	5	0	4	29

Table 18 presents the crash type over the 11-year period. Multi-vehicle angle and rear end crashes outnumber single-vehicle animal, other, and run off road crashes 21 to 8. The high number of left- and right-turning angle crashes involving vehicles turning from Sheep Creek Road indicate a possible problem with intersection geometry. Frequent angle crashes typically indicate ISD may be insufficient for drivers at an intersection, however the available ISD at Sheep Creek Road exceeds the desirable ISD for the intersection. The configuration of the Sheep Creek Road approach to the outside of the Parks Highway horizontal curve creates sight obstructions for left turning vehicles to westbound through vehicles when the westbound right-turn lane is occupied. This curve, when combined with the vertical curve at the project intersection, also creates driver confusion about what westbound lane is occupied. These factors combine to create poor gap judgement for turning vehicles from Sheep Creek Road, resulting in right-angle crashes.

Table 18: Parks Highway and Sheep Creek Road Intersection Crash Type by Year (2013 - 2023)

Crash Type	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2013-2023
Angle - Left Turning	0	1	0	2	0	5	0	3	2	0	2	15
Angle - Right Turning	0	1	0	0	0	0	0	1	1	0	0	3
Animal	0	0	0	0	0	0	0	0	0	0	1	1
Other	0	1	0	0	0	0	0	0	0	0	0	1
Rear End	0	0	0	0	1	0	0	1	1	0	0	3
Ran Off Road	1	0	0	0	2	1	0	0	1	0	1	6
Total	1	3	0	2	3	6	0	5	5	0	4	29

Signalization of an intersection addresses angle crashes by deconflicting movements. Table 19 presents the number of the angle crashes that occurred at the unsignalized project intersection over 11 years. A total of 14 crashes involved southbound vehicles from Sheep Creek Road colliding with westbound Parks Highway vehicles as a result of sight distance restrictions (glare and obstructing vehicles), failure to yield, and confusion as to which westbound lane is occupied. These crashes occurred on both dry and snow/ice road surfaces. Four crashes occurred between southbound Sheep Creek Road vehicles and eastbound Parks Highway vehicles because of icy road conditions, glare, and failure to yield. No left-turning angle crashes involving eastbound vehicles in dry conditions were observed.

Table 19: Parks Highway and Sheep Creek Road Intersection Angle Crashes by Roadway Surface Condition (2013 - 2023)

Crash Type	Conflict	Crashes 2013-2023	Crashes By Surface Conditions
Angle - Left Turning	Southbound LT and Westbound Thru	11	7 Dry 4 Snow/Ice
Angle - Left Turning	Southbound LT and Eastbound Thru	4	0 Dry 4 Snow/Ice
Angle - Right Turning	Southbound RT and Westbound Thru	3	2 Dry 1 Snow/Ice

5.1 Seasonal Variation

During summer months days are long, and temperatures are warm. Road surface conditions are likely to be dry or wet. The winter months feature significant darkness and cold temperatures. Winter road surface conditions are likely to be icy, snowy, or frosty. Spring and Fall months see a combination of conditions depending on the year. Table 20 presents the crash severity and the average crashes per month by season.

Table 20: Parks Highway and Sheep Creek Road Intersection Crash Severity by Season (2013 - 2023)

Season	Summer: June - August	Fall: September - October	Winter: November - March	Spring: April - May
Number of Months in Season (2013 - 2023)	33	22	55	22
Fatal Injury (**frequency/month**)	0 (**0 / month**)	0 (**0 / month**)	0 (**0 / month**)	0 (**0 / month**)
Major Injury (**frequency/month**)	1 (**0.03 / month**)	0 (**0 / month**)	0 (**0 / month**)	1 (**0.05 / month**)
Minor Injury (**frequency/month**)	0 (**0 / month**)	2 (**0.09 / month**)	3 (**0.05 / month**)	1 (**0.05 / month**)
Property Damage Only (**frequency/month**)	2 (**0.06 / month**)	2 (**0.09 / month**)	15 (**0.27 / month**)	2 (**0.09 / month**)
Total Crashes (**frequency/month**)	3 (**0.09 / month**)	4 (**0.18 / month**)	18 (**0.33 / month**)	4 (**0.18 / month**)

Winter had the most observed crashes and the highest frequency of crashes per month; almost double the monthly average of the other seasons. A high proportion of winter crashes were non-injury and likely a result of drivers traveling at lower speeds due to winter road surface conditions. The proportion of non-injury crashes to injury crashes is concerning and suggests injury crashes may be underrepresented during the winter months (or non-injury crashes may be under reported during the spring, summer, and fall months). The higher number of winter crashes may be indicative of inadequate winter maintenance or design deficiencies of the intersection geometry. Crash types on winter road surface conditions are discussed below.

Spring, summer, and fall seasons have similar crash frequencies to each other and occur approximately half as often as winter crashes. The proportion of injury and non-injury crash frequency are similar during these months. Crash types in summer conditions are discussed in more detail below.

5.2 Road Surface Conditions

Table 21 presents the crash type and severity for the roadway surface conditions. Over half the intersection crashes occurred when vehicle traction was limited by ice, snow, or frost on the road surface. No crashes occurred on a wet roadway. Angle crashes occurred with the same frequency in dry and snow/ice/frost (winter) conditions. However, dry-surface angle crashes primarily involved westbound vehicles while eastbound vehicles were more likely to be involved on winter-condition road surfaces.

Table 21: Parks Highway and Sheep Creek Road Intersection Crashes by Roadway Surface Condition (2013 - 2023)

Crash Type	Crash Severity	Surface Conditions		
		Dry	Wet	Ice/Snow/Frost
Angle - Left Turning	Serious Injury	1	0	0
	Minor Injury	3	0	3
	Property Damage Only	3	0	5
Angle - Right Turning	Serious Injury	1	0	0
	Property Damage Only	1	0	1
Animal	Property Damage Only	1	0	0
Other	Property Damage Only	1	0	0
Rear End	Property Damage Only	0	0	3
Ran Off Road	Property Damage Only	2	0	4
	Total	13	0	16

5.2.1 Dry Surface Conditions

Westbound vehicles are provided a through and right-turn lane at the intersection. This turn lane, in conjunction with the minor approach being on the outside of the horizontal curve, frequently creates sight obstructions for vehicles on Sheep Creek Road and results in a higher likelihood of angle crashes with westbound vehicles. A combination of these obstructions, higher travel speeds when roadways are dry, and increased summer traffic result in more severe injury crashes. Providing additional spacing between the westbound turn and through lanes may mitigate some sight obstruction issues. Providing a signal would mitigate these issues by separating movements in time.

Two ran off the road crashes occurred on dry roadway surfaces with both involving westbound Parks Highway vehicles. The ending location for one ran off the road crash was the outside westbound shoulder; the other is not defined in the crash data.

5.2.2 Winter Surface Conditions

The intersection location on a Parks Highway horizontal and vertical curve creates complex roadway geometry with localized grades (a combination of superelevation and longitudinal grade) reaching 12% for southbound left-turning vehicles. The high speed of westbound Parks Highway traffic increases decision-making expediency required for turning vehicles to find suitable gaps to complete the turn. Vehicles have enough traction in dry conditions to find suitable gaps and overcome the high local grades to remain in the acceleration lane. When icy conditions are present, left-turning vehicles do not have the traction to accelerate, turn, and

maintain their position in the acceleration lane resulting in the increased frequency of collisions with eastbound vehicles.

Providing a raised island or barrier to create physical separation between the eastbound acceleration and through lanes could mitigate the high number of winter-condition angle crashes occurring between southbound Sheep Creek Road and eastbound Parks Highway vehicles. In icy conditions single vehicle collisions with the barrier separating eastbound lanes may increase unless superelevation and grade are reduced. Signalization of the intersection could mitigate these winter angle crashes; if all movements were controlled no physical barrier would be needed but if a continuous green were provided for the eastbound through movement a physical barrier would be necessary. Either type of signalization would remove the decision-making expediency required by southbound drivers when finding a gap in westbound traffic, reducing crashes involving vehicles failing to yield because gaps would be provided by the signal phases.

Rear end and single vehicle ran off the road crashes occurred with a higher frequency on winter surfaces than dry, an expected outcome caused by reduced traction winter conditions. Three ran off the road crashes ended with vehicles on the raised center median; a single ran off the road crash ended on the eastbound shoulder. These ran off the road crashes were all non-injury crashes.

5.3 Lighting

Continuous street lighting is provided on each intersection approach, Table 22 presents the intersection crashes by ambient lighting conditions. Crashes occurred during the day and night with similar frequency. However, ¾ of the injury crashes occurred during the day. The high number of daytime injury crashes is partially attributable to Sheep Creek Road drivers contending with glare from the sun while looking east or west at the intersection during the morning or evening hours.

Nighttime crashes tended to be lower in severity although this may be more attributable to the crashes occurring in winter and spring months when drivers are driving slower due to slick road conditions.

Table 22: Parks Highway and Sheep Creek Road Intersection Crashes by Ambient Lighting Condition (2013 - 2023)

Lighting Condition	Dark - Lighted	Dark - Not Lighted or Unknown	Dawn/Dusk	Daylight
Crash Type				
Angle - Left Turning	3	2	1	9
Angle - Right Turning	0	0	0	3
Animal	0	1	0	0
Other	0	0	1	0
Rear End	1	1	0	1
Ran Off Road	2	2	1	1
Total	6	6	3	14
Crash Severity				
Fatal Injury	0	0	0	0
Serious Injury	0	0	0	2
Minor Injury	0	1	1	4
Property Damage Only	6	5	2	8
Total	6	6	3	14

5.4 Safety Performance Summary

No fatal injury crashes occurred at the Parks Highway and Sheep Creek Road intersection between 2013 and 2023. Two major injury crashes and six minor injury crashes occurred over the same period. Twenty-one non-injury property damage only crashes occurred. Left- and right-turning angle crashes were the dominant crash type at the intersection and these crashes share contributing factors:

- Southbound turning vehicles collided with westbound vehicles more during daylight hours in the spring, summer, and fall months. Commonly stated causes were obstructed sight distance (blocked by turning vehicles and glare from the sun) and confusion to which westbound lane is occupied adding to the difficulty in finding acceptable gaps in traffic both for right turning and left turning vehicles.
- Southbound left-turning vehicles collided with eastbound vehicles in icy conditions more during the winter months. Roadway geometry (grades upward of 12% for left turning vehicles) makes it difficult for turning drivers to maintain their turn lane without inadvertently crossing over into the eastbound through lane when the roadway is icy.

Table 23 summarizes the number of crashes by crash type for the identified contributing factors. Crash data does not specify what number of failure-to-yield crashes are a result of insufficient or hard to judge gaps in westbound traffic unless specifically identified in the crash narrative. It can be assumed that some of the eight failure-to-yield crashes a result of drivers misjudging gaps.

Table 23: Observed Crash Type by Contributing Factor

	Crash Type					
Contributing Factor	**Angle-Left Turning**	**Angle-Right Turning**	**Animal**	**Other**	**Rear End**	**Ran Off Road**
Roadway Geometry	4	0	0	0	1	2
Insufficient/hard to judge gaps in westbound traffic	0	1	0	0	0	0
Obstructed by right-turning vehicle	1	0	0	0	0	0
Confusion to what lane is occupied	1	0	0	0	0	0
Glare	2	0	0	0	0	0
Failure to Yield	6	1	0	0	0	1
Other/Unknown	1	1	1	1	2	3

Intersection treatments that would mitigate the causes of the observed crashes include:

- Signalizing the intersection to separate conflicts.
- Reducing Parks Highway superelevation (about 5% to 5.5%) and profile grade within the intersection functional area to reduce the likelihood that southbound left-turning vehicles that are turning into the inside eastbound acceleration lane, do not inadvertently cross into the through lane in icy conditions.
- Providing a westbound right-turn acceleration lane to allow turning vehicles to reach highway speed before merging. For right-turning vehicles, this would replace the need for the offset right-turn lane.
- Providing separation between westbound through and right-turn lanes to reduce southbound driver confusion about which lane is occupied. This is commonly referred to as an “offset right-turn lane.”
- Providing a barrier between the eastbound acceleration and eastbound through lane to physically keep southbound turning vehicles from crossing into the through lane early.

Table 24 summarizes treatment effectiveness at mitigating the observed contributing crash factors. Signalizing the intersection is an effective treatment for all identified contributing factors

except for the roadway geometry. Providing a right-turn acceleration lane for Sheep Creek Road vehicles treats all contributing factors for right-turning vehicles except for roadway geometry; left-turns from both Parks Highway and Sheep Creek Road are not treated. Offsetting the right-turn lane on Parks Highway effectively treats the right-turning vehicle sight obstruction for all vehicles turning from Sheep Creek Road and the westbound occupied lane confusion for Sheep Creek Road vehicles as well as left-turning Parks Highway vehicles. Reducing superelevation and profile grade on Parks Highway effectively treats the crashes caused by existing intersection geometry for all vehicle movements. Installing a barrier between eastbound Parks Highway lanes treats left-turning angle crashes caused by roadway geometry but single vehicle ran of road crashes into the barrier may increase without Parks Highway superelevation and grade reductions.

Table 24: Summary of Intersection Treatment Effectiveness at Mitigating Contributing Crash Factors

	Intersection Treatments				
Contributing Factors	**Signalize Intersection**	**Sheep Creek Rd Right-turn Acceleration Lane**	**Offset Parks Hwy Right-Turn Lane**	**Reduce Parks Hwy Super-elevation and Grade**	**Barrier Between Eastbound Lanes**
Roadway geometry	○ No change	○ No change	○ No change	● Improves in all conditions	◑ May reduce angle crashes and increase ran off road crashes
Insufficient/hard to judge gaps in westbound traffic	● Signal provides protected gaps	◑ Improves for right turn, no change for left turn	○ No change	○ No change	○ No change
Obstructed by right-turning vehicle	● Driver waits for green if vision obstructed	◑ Removes right-turn obstruction, no change to left turn	● Reduces sight obstruction for left and right turns	○ No change	○ No change
Confusion to what lane is occupied	● Protected phases provided	◑ Removes right-turn confusion, no change to left turns	● Reduces confusion for left and right turns	○ No change	○ No change
Glare	● Protected phases provided	◑ Removes right-turn sight obstruction, no change to left turn	○ No change	○ No change	○ No change

● Effective
◑ Improves from existing
○ No impact

6 Alternatives Analysis

6.1 Analysis Methods

6.1.1 Capacity Analysis

Level of service (LOS) is a performance measure used in quantifying operational performance of facilities. The levels range from LOS A, describing the best conditions for users, to LOS F, describing the worst conditions. The conditions described by LOS depend on the facility; a signalized intersection may be measured by delay and volume for motorized operators while non-motorized operations depend on crossing delay and convenience in crossing. Determining a design year LOS target allows facilities to not be over designed for the expected conditions. The American Association of State Highway and Transportation Officials (AASHTO) *A Policy on Geometric Design of Highways and Streets* (PGDHS) presents guidance (Table 25) on the LOS to design facilities to. The project intersection is within an urban area. Urban arterial facilities should operate at LOS C or D in the design year 2050.

Table 25: Guidelines for Selection of Design Levels of Service

	Appropriate Level of Service for Specified Combinations of Area and Terrain Type			
Functional Class	Rural Level	Rural Rolling	Rural Mountainous	Urban and Suburban
Freeway	B	B	C	C or D
Arterial	B	B	C	**C or D**
Collector	C	C	D	D
Local	D	D	D	D

Source: AASHTO PGDHS, Table 2-3

Design year intersection operations are determined using Synchro 11 software utilizing *Highway Capacity Manual* (HCM) 2010 methodology. The phasing required for a continuous green signal, as discussed below in section 6.1.3, is incompatible with HCM 2010 methodology. For motorized operations at the continuous green signal, HCM 2000 methodology is used. Forecasted design year turning movement volumes, peak hour factors, and percent heavy vehicle parameters used in this capacity analysis are discussed in the Data Collection and Design Volumes sections above.

6.1.2 Auxiliary Lane Lengths

Guidance on the configuration of speed change auxiliary lanes is provided in the DOT&PF *Highway Preconstruction Manual* (HPCM) Table 1150-1 and *National Highway Cooperative Highway Research Program* (NCHRP) *Report 279: Intersection Channelization Design Guide*. In general, auxiliary lanes on approaches with speeds less than 40 miles per hour (mph) should provide expected queue storage. Auxiliary lanes on approaches with speeds 40 mph or greater should accommodate expected queues and lane length required for deceleration. Vehicles approaching the T-intersection on Sheep Creek Road will be slowing from the posted 40-mph limit in anticipation of turning left or right and as such, the southbound auxiliary lane does not

need to provide space for deceleration. The auxiliary lanes provided on the 55-mph Parks Highway should provide lane length for deceleration behind the expected queues.

Expected 95th percentile queues are determined in the capacity analysis and set the storage length used in NCHRP 279 calculations. To maximize intersection capacity, queues formed in any lane should not impede entry into adjacent lanes. As such, auxiliary lanes should be long enough for turning traffic to enter unimpeded behind a through-lane queue which then becomes the controlling factor in determining auxiliary lane length.

Auxiliary lane tapers are provided to smoothly transition turning vehicles into the auxiliary lane and to give approaching drivers visual notice of the intersection. Taper rates are based on design speed. AASHTO's PGDHS indicates that auxiliary lane taper rates (longitudinal distance: transverse distance) should be 8:1 for design speeds up to 30 mph, and 15:1 for 50 mph or greater design speeds.

NCHRP 279 presents minimum and desirable auxiliary lane lengths for high-speed (greater than 40 mph) approaches. The minimum auxiliary lane length assumes a vehicle coasts in gear (slowing approximately 10 mph from the approach design speed) while entering the taper before decelerating (6.7 feet/second^2) to a full stop behind the expected vehicle queue. Deceleration is assumed to begin when the taper reaches two-thirds of the fully developed lane width. The desirable auxiliary lane length assumes a vehicle maintains design speed through the taper before decelerating (6.7 feet/second^2) to a full stop entirely within the turn lane behind the expected queue. Table 26 presents the auxiliary turn lane assumptions used in this alternatives analysis.

Table 26: Auxiliary Turn Lane Assumptions

Segment	Movement	Design Speed	HPCM Table 1150-1 Requirements	Taper Rate
Sheep Creek Road	Southbound Right	<40 mph[1]	Storage	8:1
Parks Highway	Westbound Right	55 mph	Storage & Deceleration	15:1
Parks Highway	Eastbound Left	55 mph	Storage & Deceleration	15:1

[1] *The Sheep Creek Road approach to the T-intersection does not allow vehicles to proceed through the intersection at the 40-mph design speed. Approaching vehicles must slow from the design speed to turn right or left, likely at 10 to 15 mph.*

6.1.3 Signal Timing

Signal timing is required for capacity analysis and must be determined as the existing intersection is unsignalized. This alternatives analysis assumes the signal operates with three phases and the eastbound Parks Highway through lane remains continuously green during the cycle. Phase one provides green for westbound Parks Highway. Phase two provides green for eastbound Parks Highway vehicles turning left onto Sheep Creek Road. Phase three provides

green for Sheep Creek Road vehicles turning left into the channelized eastbound Parks Highway acceleration lane. Right turns are either channelized and yield controlled movements or not channelized and permissive movements.

Yellow change and red clearance timing is determined using *NCHRP Report 731: Guidelines for Timing Yellow and All-Red Intervals at Signalized Intersections*. The yellow interval warns approaching drivers of an impending change in in right-of-way assignment at the intersection. When the yellow indication shows, drivers far from the intersection should have sufficient distance to stop comfortably. Drivers closer to the intersection who choose to continue through should be able to. Entry speeds are assumed to be the design speed plus 7 mph for vehicles continuing straight and design speed minus 5 mph for vehicles turning left. The effects of 2% approach grades on Parks Highway on stopping distance and driver perception-reaction time (1 second) are included in the yellow interval.

The red clearance interval provides additional time for vehicles to clear the intersection ahead of any conflicting movements beginning. The left-turning speed is assumed to be 20 mph. Intersection width and traveled path length, the total distance traveled from the stop bar to the outside of the furthest conflicting vehicular movement, is determined for each alternative configuration.

Left-turn phasing mode impacts safety and operations of an intersection. Protected-only phasing should be considered in any case where sight distance is limited, lane configuration does not support permissive phasing, or there is a high number of correctable left-turn crashes (6 crashes in a 1-year period). If protected-only phasing is not required for safety reasons, permissive or protected-permissive phasing should be considered for improved operations. Permissive phasing allows additional green to be given to other movements, reducing delay.

The left-turn phasing mode for eastbound Parks Highway is determined using *NCHRP Web-Only Document 284: Decision-Making for Signal Phasing* methodology. Sight distance, lane configuration, and crash history (only crashes involving eastbound Parks Highway vehicles turning left) do not meet the recommendations for a protected-only left turn. Volumes and vehicle delay do not meet the threshold for protected-permissive phasing (flashing yellow arrow). Although not recommended, a protected-permissive left-turn phase was assumed in this capacity analysis due to the HSIP-status of this project, to reduce westbound Parks Highway delay by providing additional green time, and to remain consistent with other Fairbanks signals.

6.2 Alternatives

Design alternatives were selected based on their ability to address concerns from the public, mitigate safety concerns identified in the safety performance section above, and limit impact to operational performance for motorized and non-motorized users. Treatments considered to mitigate these concerns include:

- Signalizing the intersection

- Posting “SIGNAL AHEAD” signs and “PREPARE TO STOP” overhead flashing signs on Parks Highway approaches
- Modifying roadway geometry by reducing existing superelevation and flattening Parks Highway profile
- Constructing a median separating eastbound through lane from the eastbound receiving lane
- Improving non-motorized safety at the intersection by signalizing the intersection with pavement markings and raised medians or islands separating vehicles from non-motorized users

Two main alternatives were selected for analysis. In addition to the above treatments the proposed alternatives include:

- **Alternative A:** A westbound auxiliary lane departing the intersection is provided to receive southbound right-turning vehicles
- **Alternative B:** The westbound Parks Highway right-turn auxiliary lane is offset from the through lane

6.2.1 Alternative A

Alternative A is presented in Figure 16. This alternative adds a westbound auxiliary lane departing the intersection to allow turning vehicles space outside the through lane to reach highway speed before merging. The signal will provide a continuous green for the channelized eastbound through vehicles and operate similar to a typical signal for the other controlled movements. Westbound right-turning vehicles will yield to pedestrians then vehicles departing the intersection northbound on Sheep Creek Road. Roadway geometry will be modified to reduce the existing superelevation and flatten Parks Highway profile. The existing median separation between westbound and eastbound lanes will be retained. The existing striping separating eastbound turn and through lanes will be modified with a raised median of four to eight feet in width. Right turns are channelized with islands in the northwest and northeast quadrants of the intersection.

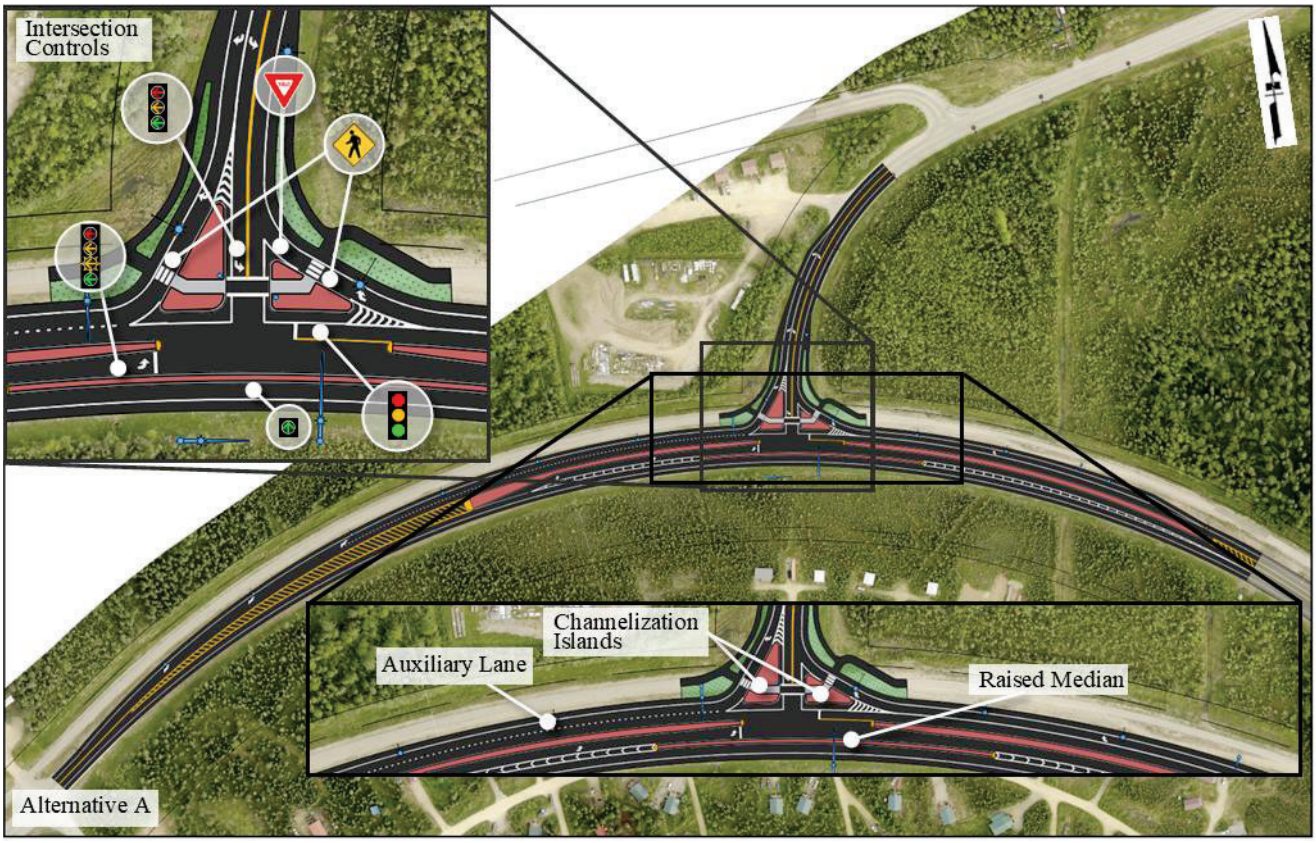

Figure 16: Alternative A Configuration

The auxiliary lane provided in Alternative A treats the gap judgement in westbound traffic, right-turning vehicle obstruction, occupied westbound lane confusion, and glare contributing crash factors for vehicles turning right from Sheep Creek Road by moving the angle conflict point west of the intersection and converting it to a merging conflict; vehicles turning left onto Parks Highway do not benefit from this treatment. Signalizing the intersection mitigates all contributing crash factors except for roadway geometry by separating conflicting movements. Reducing superelevation and profile grade is an effective treatment for crashes caused by roadway geometry. Raising the median to create a barrier between eastbound lanes treats most multiple vehicle crashes but may increase the likelihood of single vehicle ran off road crashes.

6.2.1.1 Signal Timing

Intersection widths and vehicle turning path lengths for Alternative A were determined for the intersection configuration depicted in Figure 16 above. Yellow and red intervals were calculated using methodology discussed in Section 6.1.3 are provided in Table 27.

Table 27: Yellow Change and Red Clearance Intervals – Alternative A

	Parks Highway		Parks Highway	Sheep Creek Road
Phase	**EBL**	**EBT**	**WBT**	**SBL**
Yellow Change Interval, seconds	4.9	-	5.3	3.6
Red Clearance Interval, seconds	3.7	-	3.3	3.0

Protected-permissive phasing is used for the eastbound left turn to remain consistent with Fairbanks area signals and to reduce delay at the signal. A red arrow will be displayed to left-turning drivers when a pedestrian signal is actuated to protect crosswalk occupants. The phasing, yellow change, and red clearance intervals were input, and the signal cycle length was optimized using the Synchro 11 optimizer for all peak periods. Peak period signal timings are presented in Table 28.

Table 28: Synchro Optimized Signal Timings – Alternative A

AM Peak	EBL	EBT	WBT	WBR	SBL	SBR
Movement Type	Protected-Permissive	Free	Protected	Yield	Protected	Yield
Minimum Initial, s	5.0	-	15.0	-	5.0	-
Minimum Split, s	13.6	-	23.6	-	11.6	-
Total Split, s	26.4	-	28.6	-	35.0	-
Yellow Time, s	4.9	-	5.3	-	3.6	-
All-Red Time, s	3.7	-	3.3	-	3.0	-
Cycle Length, s	90					
Midday Peak	**EBL**	**EBT**	**WBT**	**WBR**	**SBL**	**SBR**
Movement Type	Protected-Permissive	Free	Protected	Yield	Protected	Yield
Minimum Initial, s	5.0	-	15.0	-	5.0	-
Minimum Split, s	13.6	-	23.6	-	11.6	-
Total Split, s	14.0	-	26.4	-	24.6	-
Yellow Time, s	4.9	-	5.3	-	3.6	-
All-Red Time, s	3.7	-	3.3	-	3.0	-
Cycle Length, s	65					
PM Peak	**EBL**	**EBT**	**WBT**	**WBR**	**SBL**	**SBR**
Movement Type	Protected-Permissive	Free	Protected	Yield	Protected	Yield
Minimum Initial, s	5.0	-	15.0	-	5.0	-
Minimum Split, s	13.6	-	23.6	-	11.6	-
Total Split, s	26.4	-	39	-	24.6	-
Yellow Time, s	4.9	-	5.3	-	3.6	-
All-Red Time, s	3.7	-	3.3	-	3.0	-
Cycle Length, s	90					

6.2.1.2 Motorized Operations

The 2050 peak hour operations for Alternative A are presented in Table 29. The intersection operates at LOS B during all peak hours. Eastbound drivers heading straight through the signal experience no delay while left-turning drivers will experience up to 37 seconds of delay during the daily peak hours. Signalization introduces up to 30 seconds of delay to westbound traffic during the peak hours. Southbound drivers turning left will experience 23 to 37 seconds of delay and drivers turning right will experience less than 5 seconds of delay during peak hours.

Table 29: 2050 Peak Hour Operations – Alternative A

AM Peak	EBL	EBT	WBT	WBR	SBL	SBR
Volume (vph)	73	382	206	58	353	23
Delay (s/veh)	34	0	29	9	32	<5
LOS	C	A	C	A	C	A
v/c Ratio	0.55	-	0.65	0.10	0.80	0.05
95th Percentile Queue Length (ft)	100	-	200	< 25	275	< 25
Approach Delay	6		25		30	
Approach LOS	A		C		C	
Intersection Delay	19					
Intersection LOS	B					
Midday Peak	**EBL**	**EBT**	**WBT**	**WBR**	**SBL**	**SBR**
Volume (vph)	35	271	246	157	155	40
Delay (s/veh)	37	0	15	10	23	<5
LOS	D	A	B	A	C	A
v/c Ratio	0.60	-	0.45	0.20	0.55	0.10
95th Percentile Queue Length (ft)	50	-	175	25	125	< 25
Approach Delay	5		13		18	
Approach LOS	A		B		B	
Intersection Delay	11					
Intersection LOS	B					
PM Peak	**EBL**	**EBT**	**WBT**	**WBR**	**SBL**	**SBR**
Volume (vph)	45	363	487	408	194	108
Delay (s/veh)	35	0	30	12	37	<5
LOS	C	A	C	B	D	A
v/c Ratio	0.40	-	0.85	0.45	0.75	0.25
95th Percentile Queue Length (ft)	75	-	425	75	175	< 25
Approach Delay	4		22		26	
Approach LOS	A		C		C	
Intersection Delay	18					
Intersection LOS	B					

The signal introduces control to the westbound through movement creating a 425-foot queue during the PM peak hour which extends beyond the 75-foot westbound right-turn queue. During the AM peak hour, the maximum southbound queue is 275 feet for the left-turn lane and less than 25 feet for the right-turn lane. The eastbound left-turn queue extends to 100 feet during the AM peak hour.

Minimum and desirable turn lane lengths are presented in Table 30. Turn lanes should remain unblocked by adjacent queues to maintain unimpeded access to the intersection for turning vehicles. Westbound and southbound auxiliary lane minimum lengths are both controlled by the

queue lengths in adjacent lanes. As such, the NCHRP minimum turn lane lengths are increased to the 95th percentile queue lengths of the westbound through and southbound left turn lanes.

Table 30: Minimum and Desirable Turn Lane Lengths – Alternative A

Segment	Movement	HPCM Table 1150-1 Requirements	Minimum Turn Lane Length	Desirable Turn Lane Length	Taper	Taper Length
Sheep Creek Road	Southbound Right	Storage	275 feet	275 feet	8:1	96 feet
Parks Highway	Westbound Right	Storage & Deceleration	425 feet	550 feet	15:1	180 feet
Parks Highway	Eastbound Left	Storage & Deceleration	350 feet	575 feet	15:1	180 feet

6.2.1.3 Non-Motorized Operations

Under this Alternative A, the non-motorized pathway crossing Sheep Creek Road will be reconfigured into uncontrolled marked crossings for the right turn lanes and a signal-controlled crosswalk crossing the Sheep Creek Road approach and departure lanes. The crossings over the westbound and southbound right-turn lanes are not controlled by a signal and as a result, crossing maneuvers depend on vehicle volumes and vehicle drivers seeing and yielding to pedestrians. A 0% motorist yield rate for marked crossings of any type was assumed for this analysis.

Pedestrians accrue delay at street crossings when vehicular traffic or signal controls keep them from crossing freely. At signals, non-motorists must wait until the pedestrian "WALK" phase occurs. At uncontrolled crosswalks, non-motorists must wait for a suitable gap in traffic provided by either yielding drivers or during periods with low vehicle volumes. The cumulative delay, the sum of delays at the signalized crosswalk and at the uncontrolled right-turn crossings, to non-motorists crossing Sheep Creek Road is presented in Table 31. Pedestrian delay is 24 seconds during the AM peak hour and 21 seconds during the PM peak hour.

Table 31: 2050 Peak Hour Pedestrian Delay – Alternative A

Alternative	Cumulative Pedestrian Delay, seconds per pedestrian		
	AM	Midday	PM
Southbound Right-Turn Auxiliary Lane	24	16	21

The proper reconfiguration of the pathway and its crossings is vital to mitigating non-motorized safety concerns with both yield-controlled right turns. The design of the northwest channelization island in this alternative is of special importance because of the addition of the receiving lane for southbound right-turning vehicles. This lane removes the requirement for turning vehicles to yield to westbound vehicles, increasing the likelihood of drivers treating the movement as an uncontrolled onramp at the expense of non-motorized users wanting to cross the lane.

Intersection geometric design needs to favor pedestrian and bicycle visibility to motorized vehicles to improve yield compliance. Drivers approaching the crosswalks may focus on identifying vehicles to yield to instead of identifying non-motorized users approaching or waiting at the crosswalks. Additional crosswalk signage or lighting should be considered at a minimum, and preferably traffic calming steps should be considered to reduce vehicle approach speeds to these crosswalks.

6.2.2 Alternative B

Alternative B is presented in Figure 17. This alternative signalizes the intersection and offsets the westbound right-turn lane approximately eight feet from the westbound through lane using a raised median. The signal will provide a continuous green for the channelized eastbound through vehicles and operate similar to a typical signal for the other controlled movements. Westbound right-turning vehicles will yield to pedestrians then vehicles departing the intersection northbound on Sheep Creek Road. Roadway geometry will be modified to reduce the existing superelevation and flatten Parks Highway profile. The existing median separation between westbound and eastbound lanes will be retained. The existing striping separating eastbound turn and through lanes will be modified with a raised median of four to eight feet in width. Right turns are channelized with islands in the northwest and northeast quadrants of the intersection.

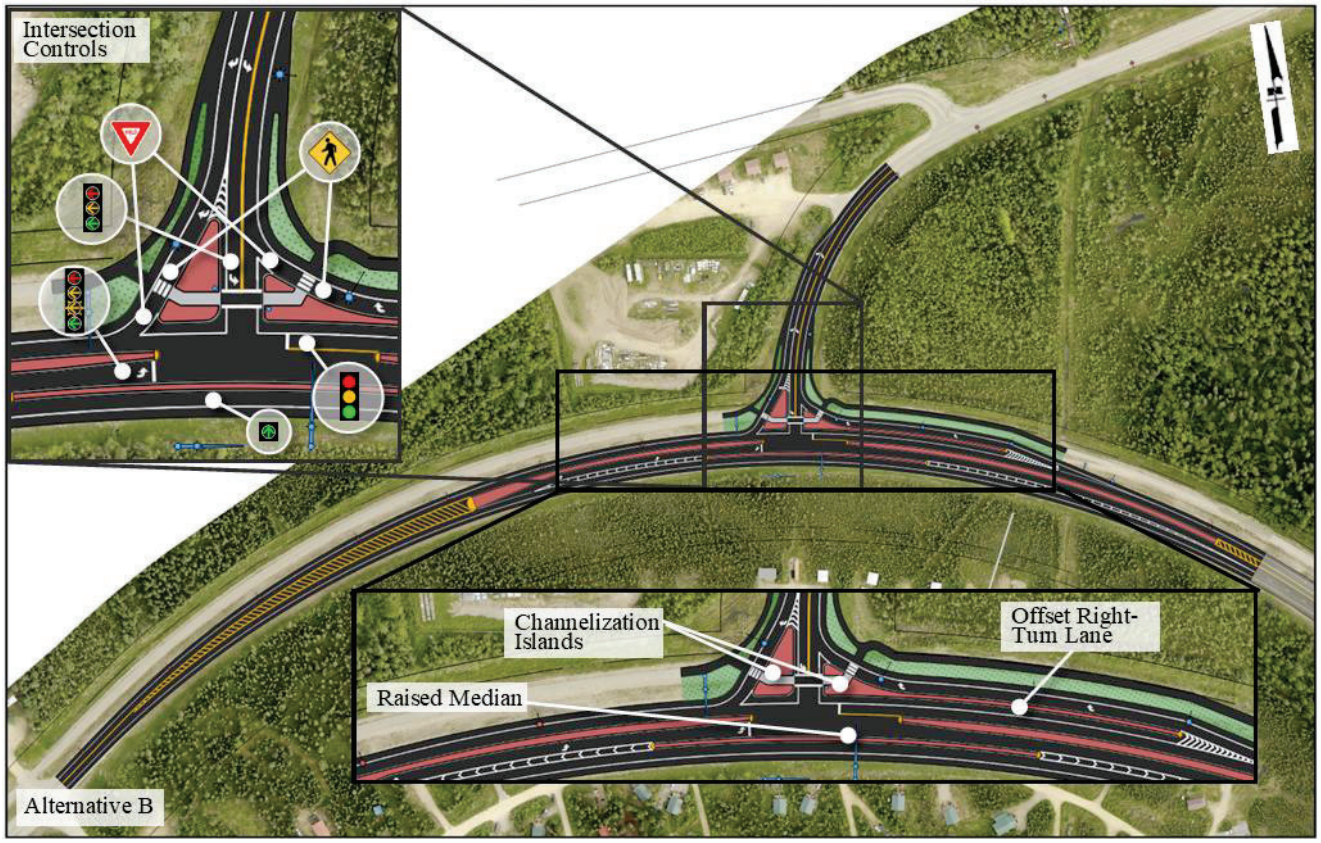

Figure 17: Alternative B Configuration

The offset right-turn lane provided in Alternative B treats the right-turning vehicle obstruction and occupied westbound lane confusion contributing crash factors for all vehicles turning from Sheep Creek Road. Factors contributing to crashes that are not treated by the offset turn lane include roadway geometry, westbound traffic gap judgement difficulties, and glare. Signalizing the intersection mitigates all contributing crash factors except for roadway geometry. Reducing superelevation and profile grade is an effective treatment for crashes caused by roadway geometry. Raising the median to create a barrier between eastbound lanes treats most multiple vehicle crashes but may increase the likelihood of single vehicle ran off road crashes.

6.2.2.1 Signal Timing

Intersection width and vehicle turning path length for Alternative B were determined for the intersection configuration depicted in Figure 17 above. Yellow and red intervals were calculated using methodology discussed in Section 6.1.3 and are provided in Table 32.

Table 32: Yellow Change and Red Clearance Intervals – Alternative B

	Parks Highway		Parks Highway	Sheep Creek Road
Phase	**EBL**	**EBT**	**WBT**	**SBL**
Yellow Change Interval, seconds	4.9	-	5.3	3.6
Red Clearance Interval, seconds	4.1	-	3.7	3.0

Protected-permissive phasing is used for the eastbound left turn to remain consistent with Fairbanks area signals and to reduce delay at the signal. A red arrow will be displayed to left-turning drivers when a pedestrian signal is actuated to protect crosswalk occupants. The phasing, yellow change, and red clearance intervals were input, and the signal cycle length was optimized using the Synchro 11 optimizer for all peak periods. Peak period signal timings are presented in Table 33.

Table 33: Synchro Optimized Signal Timings – Alternative B

AM Peak	EBL	EBT	WBT	WBR	SBL	SBR
Movement Type	Protected-Permissive	Free	Protected	Yield	Protected	Yield
Minimum Initial, s	5.0	-	15.0	-	5.0	-
Minimum Split, s	14.0	-	24.0	-	11.6	-
Total Split, s	27.0	-	28.0	-	35.0	-
Yellow Time, s	4.9	-	5.3	-	3.6	-
All-Red Time, s	4.1	-	3.7	-	3.0	-
Cycle Length, s	90					
Midday Peak	**EBL**	**EBT**	**WBT**	**WBR**	**SBL**	**SBR**
Movement Type	Protected-Permissive	Free	Protected	Yield	Protected	Yield
Minimum Initial, s	5.0	-	15.0	-	5.0	-
Minimum Split, s	14.0	-	24.0	-	11.6	-
Total Split, s	15.0	-	30.0	-	25.0	-
Yellow Time, s	4.9	-	5.3	-	3.6	-
All-Red Time, s	4.1	-	3.7	-	3.0	-
Cycle Length, s	70					
PM Peak	**EBL**	**EBT**	**WBT**	**WBR**	**SBL**	**SBR**
Movement Type	Protected-Permissive	Free	Protected	Yield	Protected	Yield
Minimum Initial, s	5.0	-	15.0	-	5.0	-
Minimum Split, s	14.0	-	24.0	-	11.6	-
Total Split, s	27.0	-	38.4	-	24.6	-
Yellow Time, s	4.9	-	5.3	-	3.6	-
All-Red Time, s	4.1	-	3.7	-	3.0	-
Cycle Length, s	90					

6.2.2.2 Motorized Operations

The 2050 peak hour operations for Alternative B are presented in Table 34. The intersection operates at LOS C during the AM peak hour and LOS B during the midday and PM peak periods. Eastbound drivers heading straight through the signal experience no delay while left-turning drivers will experience up to 36 seconds of delay during peak hours. Signalization introduces 33 seconds of delay or less to westbound traffic during the peak hours. Southbound drivers turning left will experience 24 to 38 seconds of delay and drivers turning right will experience no more than 15 seconds of delay during peak hours.

Table 34: 2050 Peak Hour Operations – Alternative B

AM Peak	EBL	EBT	WBT	WBR	SBL	SBR
Volume (vph)	73	382	206	58	353	23
Delay (s/veh)	35	0	31	9	34	10
LOS	C	A	C	A	C	A
v/c Ratio	0.55	-	0.70	0.10	0.85	0.05
95th Percentile Queue Length (ft)	100	-	225	< 25	275	< 25
Approach Delay	6		26		32	
Approach LOS	A		C		C	
Intersection Delay	20					
Intersection LOS	C					
Midday Peak	**EBL**	**EBT**	**WBT**	**WBR**	**SBL**	**SBR**
Volume (vph)	35	271	246	157	155	40
Delay (s/veh)	36	0	16	10	24	10
LOS	D	A	B	A	C	B
v/c Ratio	0.60	-	0.45	0.20	0.55	0.10
95th Percentile Queue Length (ft)	50	-	175	25	125	< 25
Approach Delay	5		13		20	
Approach LOS	A		B		C	
Intersection Delay	12					
Intersection LOS	B					
PM Peak	**EBL**	**EBT**	**WBT**	**WBR**	**SBL**	**SBR**
Volume (vph)	45	363	487	408	194	108
Delay (s/veh)	35	0	33	12	38	15
LOS	D	A	C	B	D	B
v/c Ratio	0.40	-	0.85	0.45	0.75	0.25
95th Percentile Queue Length (ft)	75	-	450	75	175	50
Approach Delay	4		24		31	
Approach LOS	A		C		C	
Intersection Delay	20					
Intersection LOS	B					

The signal introduces control to the westbound through movement creating a 450-foot queue during the PM peak hour which extends beyond the 75-foot westbound right-turn queue. During the AM peak hour, the maximum southbound queue is 275 feet for the left-turn lane and less than 25 feet for the right-turn lane. The eastbound left queue extends to 100 feet during the AM peak hour.

Minimum and desirable turn lane lengths are presented in Table 35. Turn lanes should remain unblocked by adjacent queues to maintain unimpeded access to the intersection for turning vehicles. Westbound and southbound auxiliary lane minimum lengths are both controlled by the

queue lengths in adjacent lanes. As such, the NCHRP minimum turn lane lengths are increased to the 95th percentile queue lengths of the westbound through and southbound left turn lanes.

Table 35: Minimum and Desirable Turn Lane Lengths – Alternative B

Segment	Movement	HPCM Table 1150-1 Requirements	Minimum Turn Lane Length	Desirable Turn Lane Length	Taper	Taper Length
Sheep Creek Road	Southbound Right	Storage	275 feet	275 feet	8:1	96 feet
Parks Highway	Westbound Right	Storage & Deceleration	450 feet	550 feet	15:1	180 feet
Parks Highway	Eastbound Left	Storage & Deceleration	350 feet	575 feet	15:1	180 feet

6.2.2.3 Non-Motorized Operations

Under Alternative B, the non-motorized pathway crossing Sheep Creek Road will be reconfigured into uncontrolled marked crossings for the right turn lanes and a signal-controlled crosswalk crossing the Sheep Creek Road approach and departure lanes. The crossings over the westbound and southbound right-turn lanes are not controlled by a signal and as a result, crossing maneuvers depend on vehicle volumes and vehicle drivers seeing and yielding to pedestrians. A 0% motorist yield rate for marked crossings of any type was assumed for this analysis. Pedestrian delay at the signalized crossing is controlled by signal timing characteristics instead of pedestrian or vehicle volumes.

Pedestrians accrue delay at street crossings when vehicular traffic or signal controls keep them from crossing freely. At signals, non-motorists must wait until the pedestrian "WALK" phase occurs. At uncontrolled crosswalks, non-motorists must wait for a suitable gap in traffic provided by either yielding drivers or during periods with low vehicle volumes. The cumulative delay, the sum of delays at the signalized crosswalk and at the uncontrolled right-turn crossings, to non-motorists crossing Sheep Creek Road is presented in Table 36. Pedestrian delay is 24 seconds during the AM peak hour and 22 seconds during the PM peak hour.

Table 36: 2050 Peak Hour Pedestrian Delay – Alternative B

Alternative	Cumulative Pedestrian Delay, seconds per pedestrian		
	AM	Midday	PM
Offset Right-Turn Lane	24	17	22

The proper reconfiguration of the pathway and its crossings is vital to mitigating non-motorized safety concerns with both yield-controlled right turns. Intersection geometric design needs to favor pedestrian and bicycle visibility to motorized vehicles to improve yield compliance. Drivers approaching the crosswalks may focus on identifying vehicles to yield to instead of identifying non-motorized users approaching or waiting at the crosswalks. Additional crosswalk

signage or lighting should be considered at a minimum, and preferably traffic calming steps should be considered to reduce vehicle approach speeds to these crosswalks.

6.2.3 Alternative Refinement

Public outreach was conducted through the project website, the April 2, 2025, project Open House, and the April 24, 2025, FAST Planning Walk, Ride & Roll Advisory Committee (formerly Bicycle & Pedestrian Advisory Committee). Eighty-Four public comments were received and overall were supportive of the project's goal to reduce crashes, improve safety for all users, and signalize the intersection. Seven comments explicitly stated support for Alternative A, four comments supported Alternative B, and two comments supported a combination of Alternatives A and B.

Public comments identified the following concerns about the proposed alternatives for motorized users:

- The alternatives do not address the merging- and turning-speed issues created by the westbound lane drop prior to the Sheep Creek Road intersection.
- The alternatives do not reduce vehicle speeds on Parks Highway.
- No advanced warning beacons are provided on Parks Highway approaches.
- Westbound trucks may have to stop for the signal on an upgrade.
- The proposed raised medians are easily obscured by snow, impact snow plowing operations, and may create drainage issues.
- Signalization creates the opportunity for additional ice to build up at the intersection.
- A signal is not needed with the other proposed design features.

Public comments identified the following concerns about the proposed alternatives for non-motorized users:

- Yield-controlled right-turning traffic may fail to look for, yield to, or slow down for non-motorists crossing Sheep Creek Road.
- The channelizing islands and multiple stage crossing create an inefficient, burdensome experience for non-motorized users and reduce the likelihood of timely winter maintenance occurring at the crossing.
- The large turning radii required for truck movements may result in high vehicle speeds in channelized turn lanes.
- Pushbutton actuation and Rectangular Rapid Flashing Beacons at the channelized turn lanes are not provided.
- The alternatives do not address the missing pathway connection along Sheep Creek Road or provide a non-motorized crossing over Parks Highway.

In Alternative A the acceleration lane provided to the channelized Sheep Creek Road turn lane allows turning vehicles to enter Parks Highway without needing to yield or slow down when non-motorists are not present. Drivers frequenting this movement may habitually not look for non-motorists to yield to when present. Reducing the right-turn radius to decrease speeds is not possible because the intersection is on a truck route that must accommodate longer vehicles. Signalizing the intersection mitigates the same right turning vehicle crash concern as providing a right-turn acceleration lane.

The offset right-turn lane provided by Alternative B reduces confusion to which westbound lane is occupied and reduces sight blockages from large vehicles by improving visibility for all vehicles turning from Sheep Creek Road. This is also mitigated by signalization that provides protection for turning vehicles. However, offsetting the right turn lane also benefits non-motorized safety when a larger channelization island is utilized to move the crossing away from the intersection allowing right-turning vehicles to assess each yield separately. Alternative B supports configuring the southbound right-turn without channelization to improve non-motorized safety by controlling the movement with the signal. Additional delay to right turning vehicles is limited by providing a right green arrow signal to clearly indicate when the movement is protected. Non-motorized safety is not impacted as they do not cross when the right green arrow is displayed because it runs concurrently with the Parks Highway left green arrow as well as the Sheep Creek southbound left turn. A red ball is shown to right-turning vehicles when non-motorists cross Sheep Creek Road clearly indicating to drivers that they must stop before proceeding when safe to do so.

Public comments were included in considerations along with user safety, preferences, reported experiences, user needs, and context of the intersection to determine Alternative B should be refined as the Preferred Alternative.

6.2.4 Preferred Alternative

The Preferred Alternative is presented Figure 17. This alternative is a refinement of Alternative B that signalizes the intersection, offsets the westbound right-turn lane, and incorporates changes based on public involvement feedback. The signal will provide a continuous green for the channelized eastbound through vehicles and operate similar to a typical signal for the other controlled movements. Southbound right-turn channelization is removed. Vehicles making this movement will be controlled by the signal and shown a green right-turn arrow during the eastbound left-turn phase and a red ball during the westbound through phase. The existing median separation between westbound and eastbound lanes will be retained. The existing striping separating eastbound turn and through lanes will be modified with a raised median of four to eight feet in width. A larger raised island will separate the offset right-turn lane from the westbound through lane creating a larger pedestrian refuge island size to accommodate larger non-motorized groups.

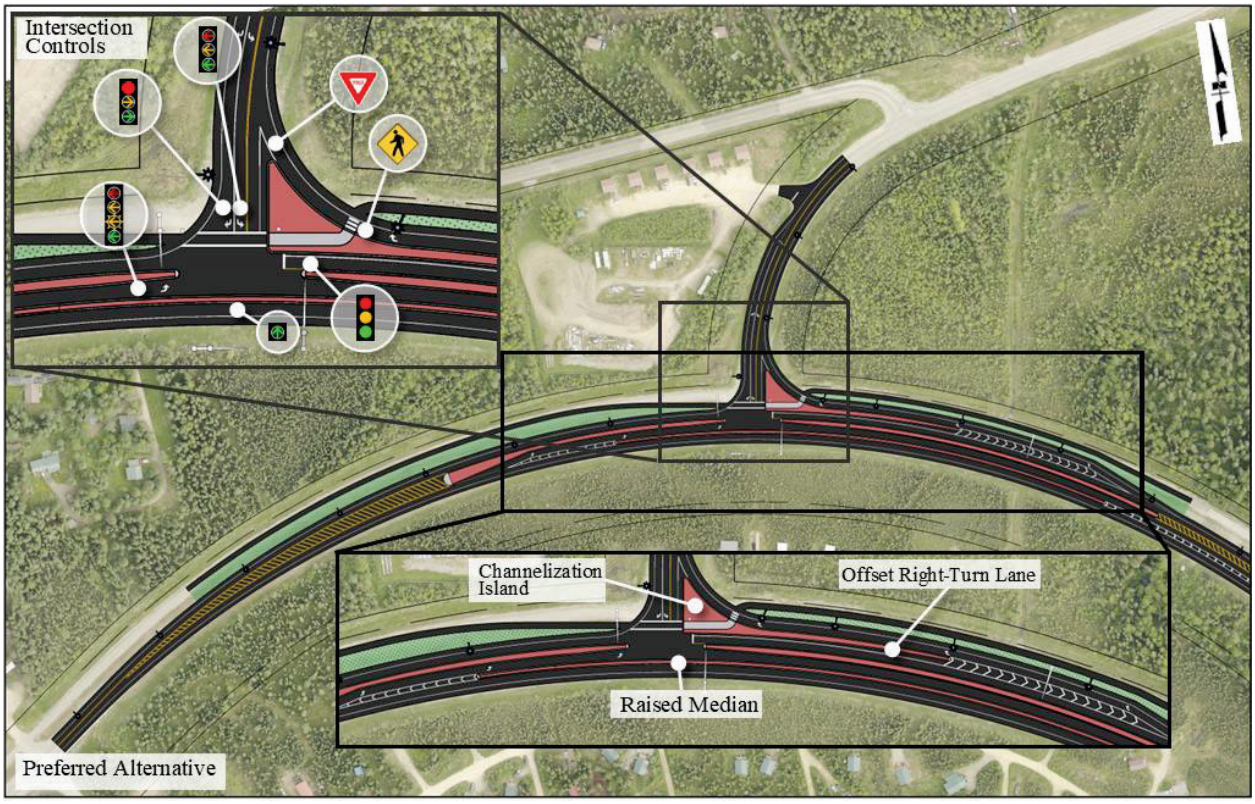

Figure 18: Preferred Alternative Configuration

6.2.4.1 Signal Timing

Intersection width and vehicle turning path length were determined for the Preferred Alternative as depicted in Figure 18. Yellow and red intervals were calculated using methodology discussed in Section 6.1.3 and are provided in Table 37.

Table 37: Yellow Change and Red Clearance Intervals – Preferred Alternative

	Parks Highway		Parks Highway	Sheep Creek Road
Phase	**EBL**	**EBT**	**WBT**	**SBL**
Yellow Change Interval, seconds	4.9	-	5.3	3.6
Red Clearance Interval, seconds	4.1	-	3.7	2.8

Protected-permissive phasing is used for the eastbound left turn to remain consistent with Fairbanks area signals and to reduce delay at the signal. A red left-turn arrow will be displayed to turning drivers when the pedestrian signal is actuated to protect crosswalk occupants. The southbound right-turn will operate with permissive-overlap phasing to protect non-motorized

users crossing during the pedestrian phase while reducing the added delay from removing the channelization. Additional green time is given to southbound right-turning vehicles during the eastbound left-turn phase that creates no additional conflicts with non-motorists. The phasing, yellow change, and red clearance intervals were input, and the signal cycle length was optimized using the Synchro 11 optimizer for all peak periods. Peak period signal timings are presented in Table 38.

Table 38: Synchro Optimized Signal Timings – Preferred Alternative

Approach	**Parks Highway**		**Parks Highway**		**Sheep Creek Road**	
AM Peak	**EBL**	**EBT**	**WBT**	**WBR**	**SBL**	**SBR**
Movement Type	Protected-Permissive	Free	Protected	Yield	Protected	Permissive + Overlap
Minimum Initial, s	5.0	-	15.0	-	5.0	-
Minimum Split, s	14.0	-	24.0	-	11.4	-
Total Split, s	27.0	-	28.0	-	35.0	-
Yellow Time, s	4.9	-	5.3	-	3.6	-
All-Red Time, s	4.1	-	3.7	-	2.8	-
Cycle Length, s	90					
Midday Peak	**EBL**	**EBT**	**WBT**	**WBR**	**SBL**	**SBR**
Movement Type	Protected-Permissive	Free	Protected	Yield	Protected	Permissive + Overlap
Minimum Initial, s	5.0	-	15.0	-	5.0	-
Minimum Split, s	14.0	-	24.0	-	11.4	-
Total Split, s	15.0	-	30.0	-	25.0	-
Yellow Time, s	4.9	-	5.3	-	3.6	-
All-Red Time, s	4.1	-	3.7	-	2.8	-
Cycle Length, s	70					
PM Peak	**EBL**	**EBT**	**WBT**	**WBR**	**SBL**	**SBR**
Movement Type	Protected-Permissive	Free	Protected	Yield	Protected	Permissive + Overlap
Minimum Initial, s	5.0	-	15.0	-	5.0	-
Minimum Split, s	14.0	-	24.0	-	11.4	-
Total Split, s	27.0	-	38.4	-	24.6	-
Yellow Time, s	4.9	-	5.3	-	3.6	-
All-Red Time, s	4.1	-	3.7	-	2.8	-
Cycle Length, s	90					

6.2.4.2 Motorized Operations

The 2050 peak hour operations for the Preferred Alternative are presented in Table 39. The intersection operates at LOS C during the AM and PM peak hours and LOS B during the midday

peak period. Eastbound drivers heading straight through the signal experience no delay while left-turning drivers will experience up to 35 seconds of delay during the daily peak hours. Signalization introduces up to 38 seconds of delay to westbound traffic during the peak hours. Southbound drivers turning left will experience 25 to 38 seconds of delay and drivers turning right will experience 12 to 20 seconds of delay during peak hours.

Table 39: 2050 Peak Hour Operations – Preferred Alternative

AM Peak	EBL	EBT	WBT	WBR	SBL	SBR
Volume (vph)	73	382	206	58	353	23
Delay (s/veh)	35	0	31	9	34	12
LOS	C	A	C	A	C	B
v/c Ratio	0.55	-	0.70	0.10	0.85	0.05
95th Percentile Queue Length (ft)	100	-	225	< 25	275	< 25
Approach Delay	6		26		32	
Approach LOS	A		C		C	
Intersection Delay	20					
Intersection LOS	C					
PM Peak	**EBL**	**EBT**	**WBT**	**WBR**	**SBL**	**SBR**
Volume (vph)	35	271	246	157	155	40
Delay (s/veh)	29	0	17	10	25	16
LOS	C	A	B	A	C	B
v/c Ratio	0.40	-	0.45	0.20	0.55	0.05
95th Percentile Queue Length (ft)	50	-	175	25	125	< 25
Approach Delay	4		14		22	
Approach LOS	A		B		C	
Intersection Delay	12					
Intersection LOS	B					
PM Peak	**EBL**	**EBT**	**WBT**	**WBR**	**SBL**	**SBR**
Volume (vph)	45	363	487	408	194	108
Delay (s/veh)	34	0	38	12	38	20
LOS	C	A	D	B	D	B
v/c Ratio	0.35	-	0.90	0.45	0.75	0.15
95th Percentile Queue Length (ft)	75	-	450	75	175	50
Approach Delay	4		27		32	
Approach LOS	A		C		C	
Intersection Delay	22					
Intersection LOS	C					

The signal introduces westbound through control creating a 450-foot queue during the PM peak hour which extends beyond the 75-foot westbound right-turn queue. During the AM peak hour,

the maximum southbound queue is 275 feet for the left-turn lane and less than 25 feet for the right-turn lane. The eastbound left queue extends to 100 feet during the AM peak hour.

Minimum and desirable turn lane lengths are presented in Table 40. Turn lanes should remain unblocked by adjacent queues to maintain unimpeded access to the intersection for turning vehicles. Westbound and southbound auxiliary lane minimum lengths are both controlled by the queue lengths in adjacent lanes. As such, the NCHRP minimum turn lane lengths are increased to the 95th percentile queue lengths of the westbound through and southbound left turn lanes.

Table 40: Minimum and Desirable Turn Lane Lengths – Preferred Alternative

Segment	Movement	HPCM Table 1150-1 Requirements	Minimum Turn Lane Length	Desirable Turn Lane Length	Taper	Taper Length
Sheep Creek Road	Southbound Right	Storage	275 feet	275 feet	8:1	96 feet
Parks Highway	Westbound Right	Storage & Deceleration	450 feet	550 feet	15:1	180 feet
Parks Highway	Eastbound Left	Storage & Deceleration	350 feet	575 feet	15:1	180 feet

6.2.4.3 Non-Motorized Operations

The Preferred Alternative refines the non-motorized crossing from Alternative B by removing the southbound channelization island and enlarging the westbound channelization island to provide additional protection to non-motorized users. Controlling southbound right-turning vehicles with the signal requires vehicles to stop during the pedestrian signal phase improving yield compliance. Signal control allows speeds to be reduced while maintaining the large turning-radius geometry required by trucks. The crosswalk is moved east on the larger channelization island to create additional separation between the crossing and vehicle yield points. The enlarged channelization island straightens the crossing path for non-motorized users and allows larger groups to cross at the same time. A 0% motorist yield rate for the marked crossing over the channelized right-turn lane was assumed for this analysis. Pedestrian delay at the signalized crossing is controlled by signal timing characteristics instead of pedestrian or vehicle volumes.

Pedestrians accrue delay at street crossings when vehicular traffic or signal controls keep them from crossing freely. At signals, non-motorists must wait until the pedestrian “WALK” phase occurs. At uncontrolled crosswalks, non-motorists must wait for a suitable gap in traffic provided by either yielding drivers or during periods with low vehicle volumes. The cumulative delay, the sum of delays at the signalized crosswalk and at the uncontrolled right-turn crossing, to non-motorists crossing Sheep Creek Road is presented in Table 41. Pedestrian delay is 24 seconds during the AM peak hour and 22 seconds during the PM peak hour.

Table 41: 2050 Peak Hour Pedestrian Delay – Preferred Alternative

Alternative	Cumulative Pedestrian Delay, seconds per pedestrian		
	AM	Midday	PM
Preferred Alternative	24	17	22

Correctly configuring the non-motorized crossing was frequently discussed during the public feedback process to ensure the intersection prioritizes all users. The Preferred Alternative improves driver yielding compliance to non-motorists by removing the southbound channelization and providing additional separation between the westbound crosswalk and the vehicle yield point. This allows approaching drivers time to identify and yield to non-motorists before looking for vehicles to yield to at the intersection. Additional pedestrian signage to warn drivers of the crossing may be supplemented with Rectangular Rapid Flashing Beacons to improve compliance further.

6.3 Alternatives Summary

A summary of the alternative impacts to users are presented in Table 42. Signalization of the alternatives are likely to reduce angle crashes while rear-end crashes may increase. Impacts from delay added to previously uncontrolled westbound movements are minimal with a continuous green signal; no delay is added to the eastbound through movement. The Preferred Alternative provides the most protection to non-motorists by signalizing the Sheep Creek Road crossing, eliminating the high-speed vehicle conflict with pedestrians by not channelizing the southbound right-turn, providing improved visibility at the westbound right-turn crossing. The installation of a Rectangular Rapid Flashing Beacon at the channelized right-turn crosswalk would further increases driver awareness of non-motorists when present.

Table 42: Alternative Impacts Summary

Alternative	Alternative A	Alternative B	Preferred Alternative
Impacts from signalization with Continuous Green T	Delay added to WB drivers	Delay added to WB drivers	Delay added to WB drivers
	No delay for EB through drivers	No delay for EB through drivers	No delay for EB through drivers
	Likely reduction in angle crashes	Likely reduction in angle crashes	Likely reduction in angle crashes
	Likely increase in rear-end crashes	Likely increase in rear-end crashes	Likely increase in rear-end crashes
	Potential high-speed vehicle conflicts at crosswalks	Potential high-speed vehicle conflicts at crosswalks	Reduced potential for high-speed vehicle conflicts at crosswalks
Impacts from geometric configuration	Improves visibility at pathway crossing approaches	Improves visibility at pathway crossing approaches	Improves visibility at pathway crossing approaches
	Moves need for right-turning Sheep Creek Rd sightlines to WB through vehicles to downstream merge location. Right-turning WB vehicles may still block SB left-turning sightlines	Improves sightlines for left- and right-turning Sheep Creek Rd vehicles	Improves sightlines for left- and right-turning Sheep Creek Rd vehicles
		Removes confusion as to which WB lane is occupied	Removes confusion as to which WB lane is occupied
	Signal phase protects pedestrian crossing from left-turning vehicles	Signal phase protects pedestrian crossing from left-turning vehicles	Signal phase protects pedestrian crossing from left-turning vehicles and SB right-turning vehicles
	Likely reduction in angle and ran-off-road crashes from superelevation reduction	Likely reduction in angle and ran-off-road crashes from superelevation reduction	Likely reduction in angle and ran-off-road crashes from superelevation reduction
	Reduction in angle crashes from barrier between lanes	Reduction in angle crashes from barrier between lanes	Reduction in angle crashes from barrier between lanes
	Likely increase in ran off road crashes resulting from barrier between lanes	Likely increase in ran off road crashes resulting from barrier between lanes	Likely increase in ran off road crashes resulting from barrier between lanes

WB = westbound, EB = eastbound, SB = southbound

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NCHRP Report 279: Intersection Channelization Design Guide, Transportation Research Board, 1985

NCHRP Report 731: Guidelines for Timing Yellow and All-Red Intervals at Signalized Intersections, Transportation Research Board, 2012

NCHRP Web-Only Document 284: Decision-Making for Signal Phasing, Transportation Research Board, 2019

Appendix A Existing Peak Hour Turning Movement Volumes (DOT&PF Counts)

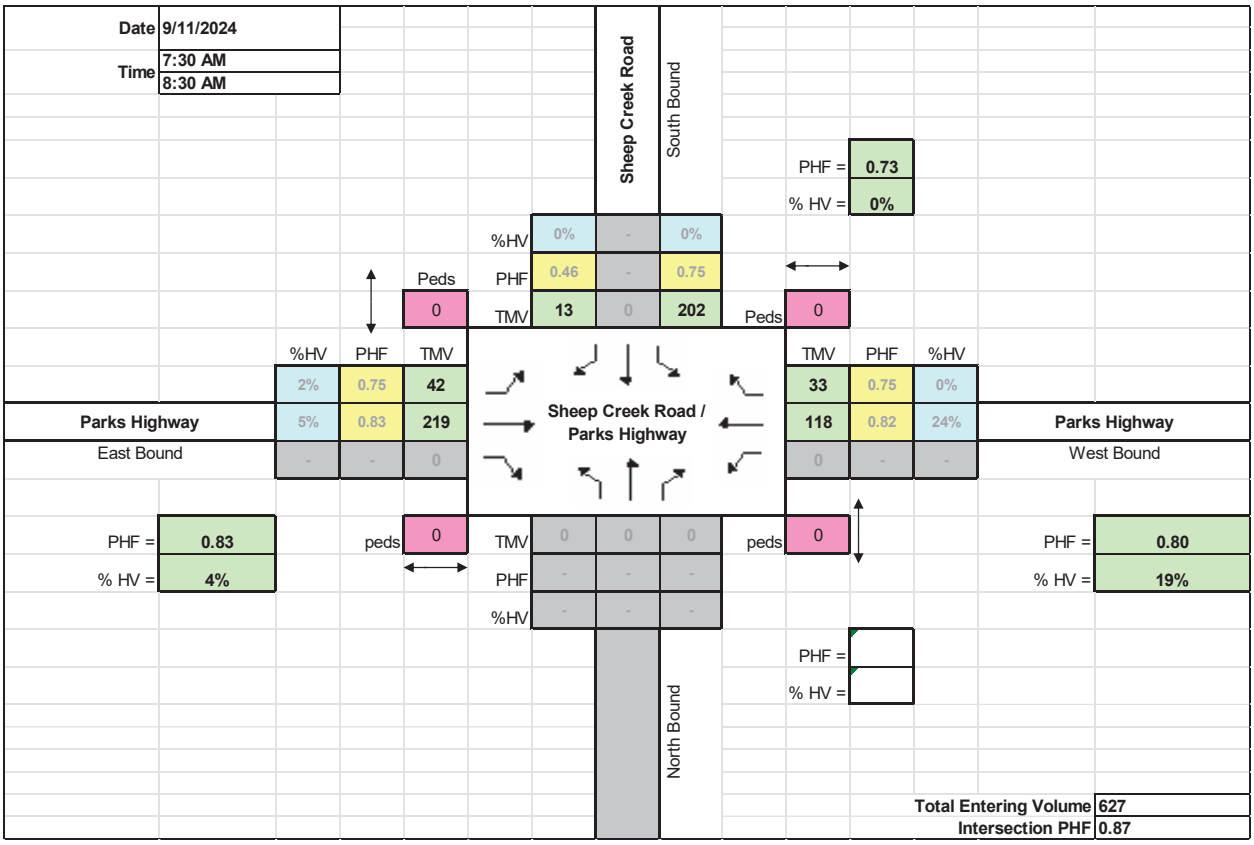

Figure 19: Existing AM Peak Hour Turning Movement Volumes, Wednesday September 11, 2024

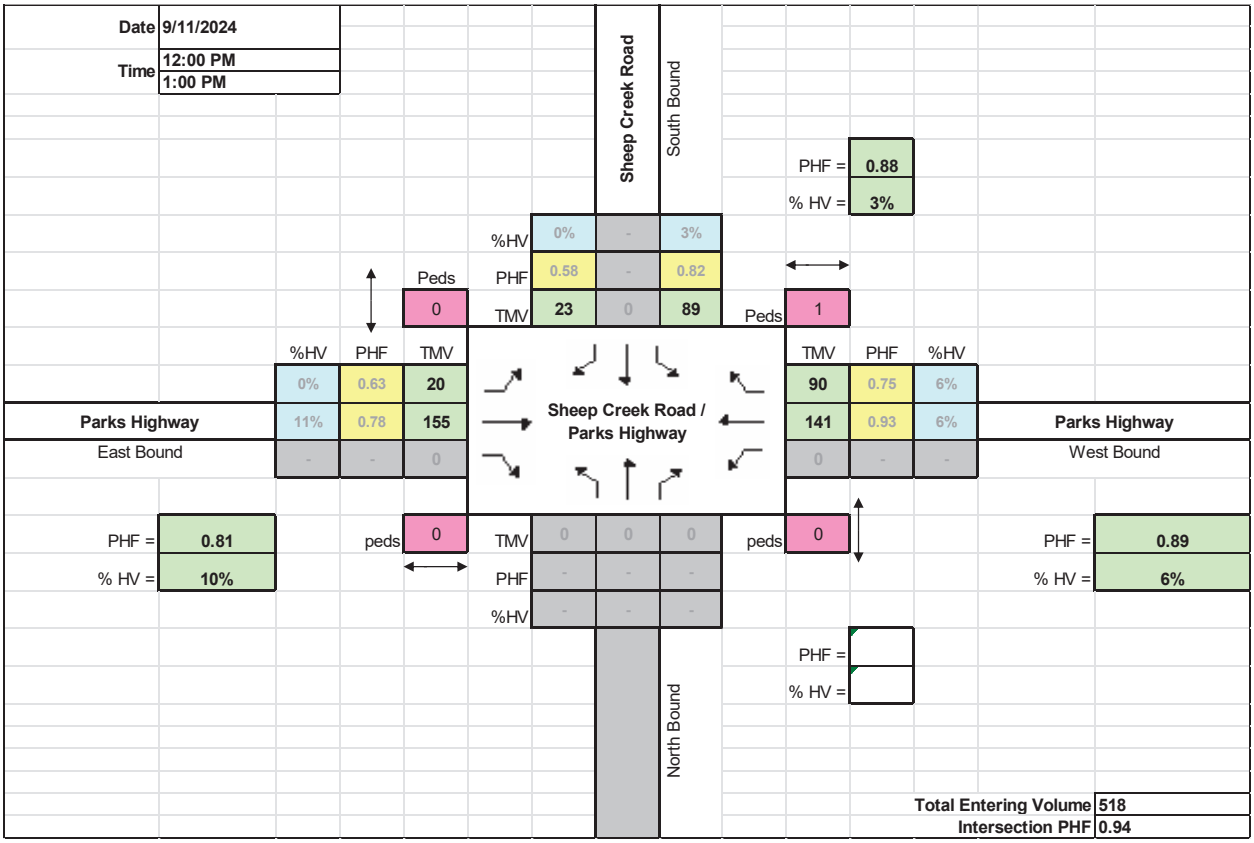

Figure 20: Existing Midday Peak Hour Turning Movement Volumes, Wednesday September 11, 2024

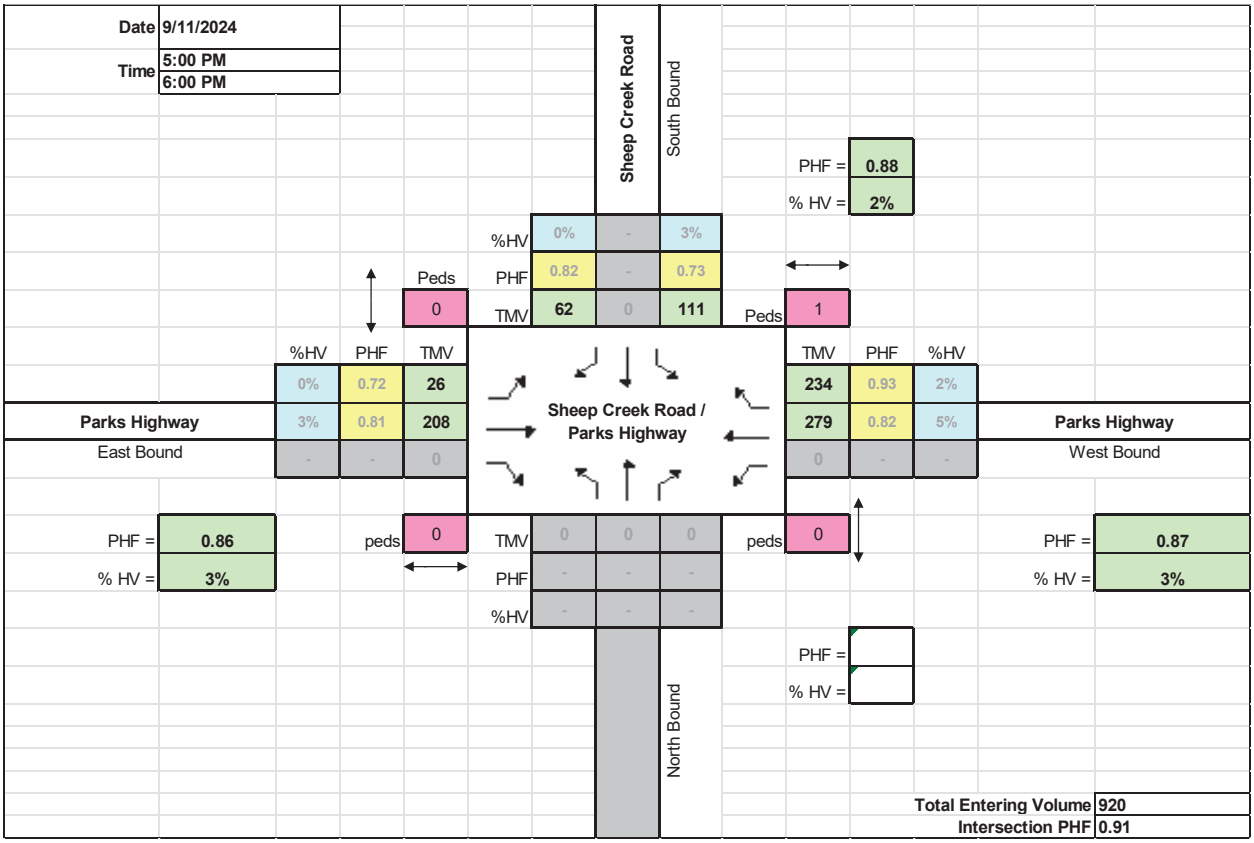

Figure 21: Existing PM Peak Hour Turning Movement Volumes, Wednesday September 11, 2024

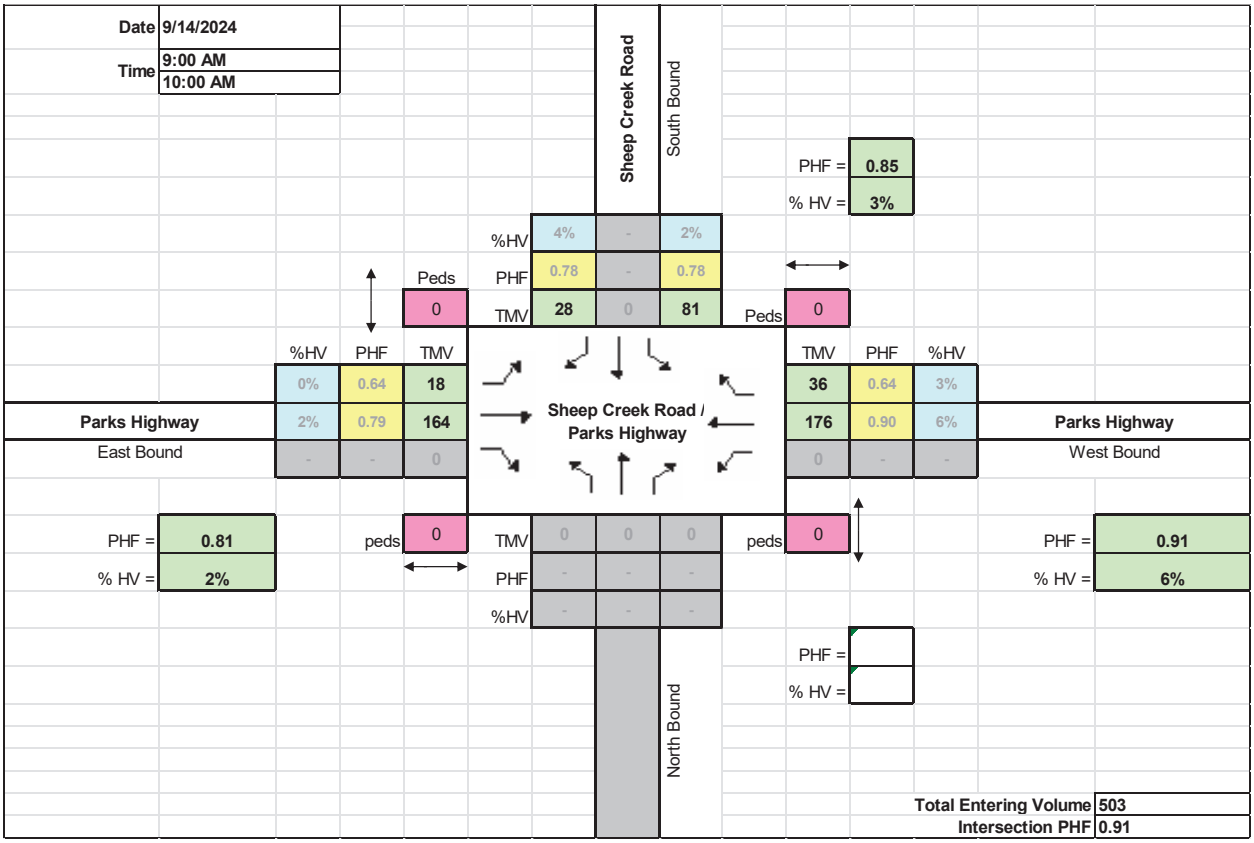

Figure 22: Existing AM Peak Hour Turning Movement Volumes, Saturday September 14, 2024

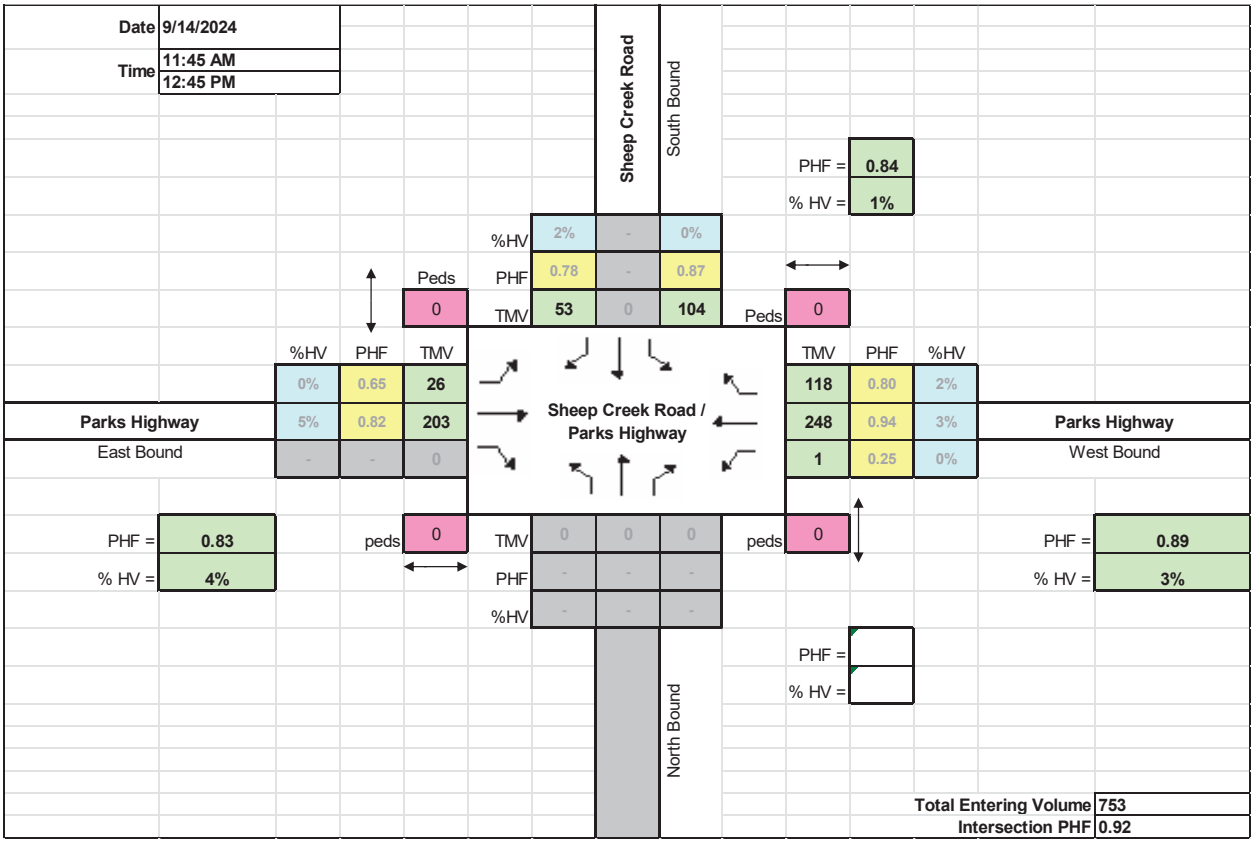

Figure 23: Existing Midday Peak Hour Turning Movement Volumes, Saturday September 14, 2024

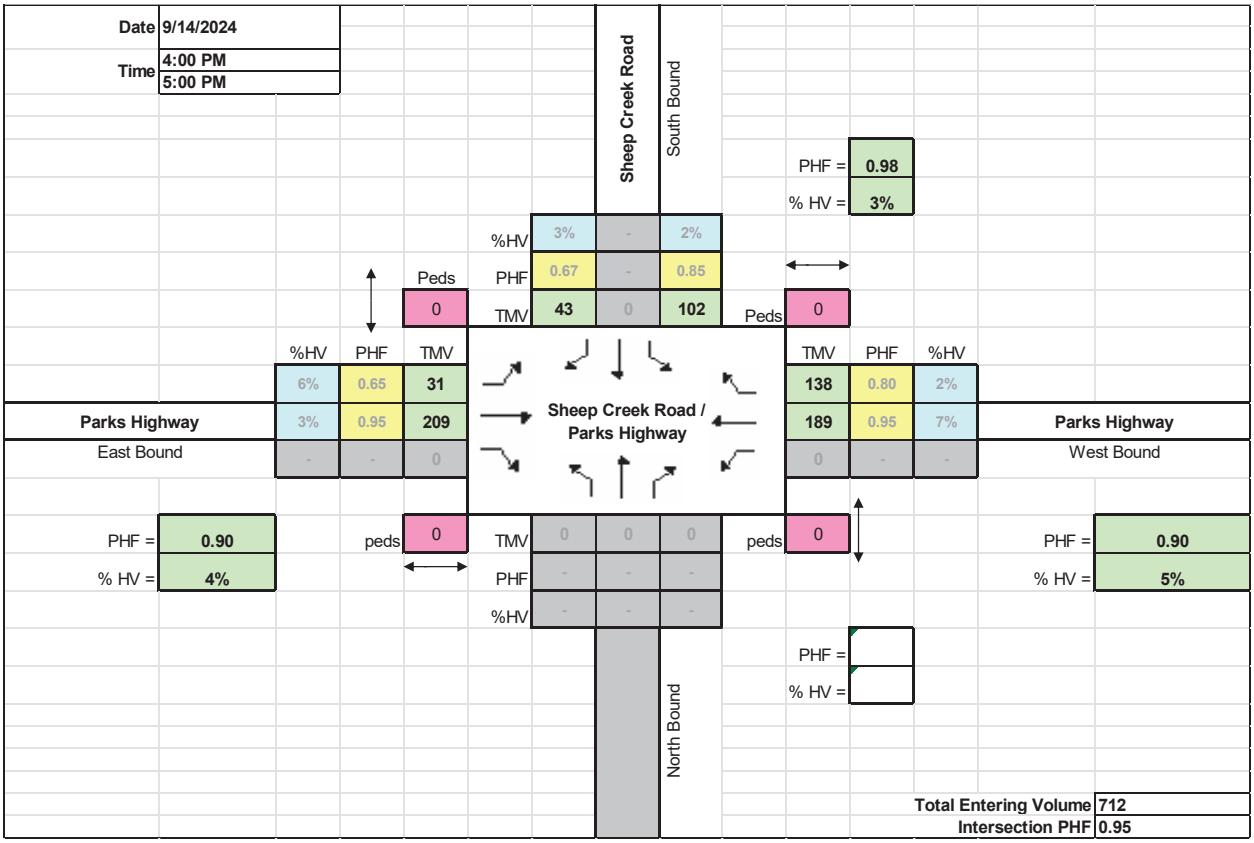

Figure 24: Existing PM Peak Hour Turning Movement Volumes, Saturday September 14, 2024

Appendix B Existing Hourly Weekday Summer Volumes

Table 43: Parks Highway and Sheep Creek Road Intersection Hourly Weekday Summer Volumes (Factored from September 11, 2024, Count)

		Eastbound Parks Highway				Southbound Sheep Creek Road				Westbound Parks Highway				Major Volume	Minor Volume - Right Turns Removed	Total Approach Minor Volume
Start	Stop	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds			
6:00	7:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00	8:00	28	209	0	0	150	0	13	0	0	75	18	0	330	150	163
8:00	9:00	34	161	0	0	136	0	12	0	0	120	45	0	360	136	148
9:00	10:00	26	130	0	0	79	0	16	0	0	128	61	0	345	79	95
10:00	11:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:00	12:00	14	112	0	0	60	0	17	0	0	137	76	0	339	60	77
12:00	13:00	16	130	0	0	75	0	19	0	0	119	76	1	341	75	94
13:00	14:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14:00	15:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15:00	16:00	16	152	0	0	71	0	32	0	0	198	116	0	482	71	103
16:00	17:00	23	162	0	0	87	0	36	0	0	224	155	0	564	87	123
17:00	18:00	21	174	0	0	93	0	52	0	0	234	196	1	625	93	145
18:00	19:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19:00	20:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20:00	21:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21:00	22:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Attachment B
Typical Sections