MENDENHALL LOOP ROAD CAPACITY IMPROVEMENTS

October 2014

Prepared for:

Alaska Department of Transportation and Public Facilities
6860 Glacier Highway
Juneau, AK 99801
(907) 465-1796

Prepared by:

Kittelson & Associates, Inc.
800 H Street, Suite 202
Anchorage, AK 99501
(907) 646-7995

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

MOVING**FORWARD**THINKING™

Final Report

Mendenhall Loop Road Capacity Improvements

Juneau, Alaska

Final

October 2014

Final Report

Mendenhall Loop Road Capacity Improvements

Juneau, Alaska

Prepared For:
Alaska Department of Transportation & Public Facilities
6860 Glacier Highway
Juneau, AK 99801
(907) 465-1796
Project Manager: Keith Karpstein, P.E.

Prepared By:
Kittelson & Associates, Inc.
800 H Street, Suite 202
Anchorage, AK 99501
(907) 646-7995

Project Manager: Lee Rodegerdts, P.E.
Project Principal: Gary Katsion, P.E.
Project Engineer: Andrew Ooms, P.E.

Project No. 13358

October 2014

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Section 1
Executive Summary

EXECUTIVE SUMMARY

INTRODUCTION

The study corridor is approximately 1.75 miles of Mendenhall Loop Road from Nancy Street to Back Loop Road, which serves as the spine to the Mendenhall Valley area. Mendenhall Loop Road serves a blend of local vehicular traffic, transit riders, tourists in tour buses, students, pedestrians, and local and through bicyclists. It is the major commute route to and from Egan Drive as well as the shopping areas along Glacier Highway and Mendenhall Mall Road. Additionally, many residents of Mendenhall Valley use or cross Mendenhall Loop Road by bicycle or on foot to go to school and recreational activities or access public transit services.

Existing Conditions

Currently, the study corridor of Mendenhall Loop Road experiences heavy congestion in the peak hours as well as long queues in the peak directions. The following operational issues were identified:

- Peak hour directional vehicle queuing on Mendenhall Loop Road at the Stephen Richards Drive/Haloff Way and Mendenhall Boulevard/Valley Boulevard intersections.
- High peak hour side street vehicle delay at Nancy Street, Cinema Drive, Dudley Street, McGinnis Drive, and Floyd Dryden Access Road.

The combination of the multiuse path and the shoulder bike lanes along Mendenhall Loop Road provide a range of facilities for bicyclists to choose what best fits their comfort and ability. The multiuse path also provides a comfortable pedestrian path separate from vehicle traffic. However, pedestrian crossings are limited, with three marked and signalized crossings on the 1.75-mile corridor and numerous access points conflict with path users, particularly those bicyclists choosing to use the path.

Crash analysis of the corridor was performed to identify opportunities to reduce segment and/or intersection crashes. Crash histories were reviewed for trends and patterns and used to calculate critical crash rates by intersection. The crash analysis of the corridor revealed the following crash patterns:

- Left-turn angle crashes at the Stephen Richards Drive/Haloff Way intersection;
- Rear-end crashes at the Mendenhall Boulevard/Valley Boulevard intersection; and
- Crashes involving young pedestrians and bicyclists.

Project Goals and Objectives

The primary goals of this project are to provide adequate vehicle capacity and improve pedestrian and bicycle facilities along Mendenhall Loop Road. Objectives were developed to achieve projects goals, which include:

- **Add roadway and intersection capacity** where appropriate to accommodate traffic volume growth;
- **Minimize and manage conflict areas** within the corridor for all modes;
- **Provide safe and effective pedestrian crossings** at logical locations;
- Identify improvements that are **cost effective**;
- Identify improvements that have the **highest likelihood of community acceptance** from affected agencies, residents, and businesses.

Public Involvement

Two open houses were held to give information about the project and receive public comments about the corridor. Comments were received verbally, hand written, and emailed. The first open house was held toward the beginning of the project, November 11th, 2013, to introduce the first round of corridor concepts. The second open house occurred further along in the project timeline, July 8th, 2014, introducing the second and final round of corridor concepts that were developed with consideration of public comment from the previous meeting.

The first open house presented three five-lane corridor concepts, which are referred to in the next section as Concepts A1, A2, and A3. As Mendenhall Loop Road serves as both a commuter route (for vehicles, transit, and bicycles) and as an arterial roadway in a residential area with two schools, many felt adding lanes would decrease the safety along the corridor for all users. Concepts that did not involve expansion of the cross section to five lanes were developed in response to the public comments.

The second open house introduced four new three-lane concepts, referred to in the next section as Concepts B1, B2, B3, and B4, and also presented the original five-lane concepts. The three-lane concepts addressed the concerns expressed in the previous open house. In general, the new three-lane concepts were favored over the five-lane concepts, while suggestions for incorporating treatments from both families of concepts was voiced as well.

RECOMMENDED CORRIDOR ALTERNATIVE

Concept Development

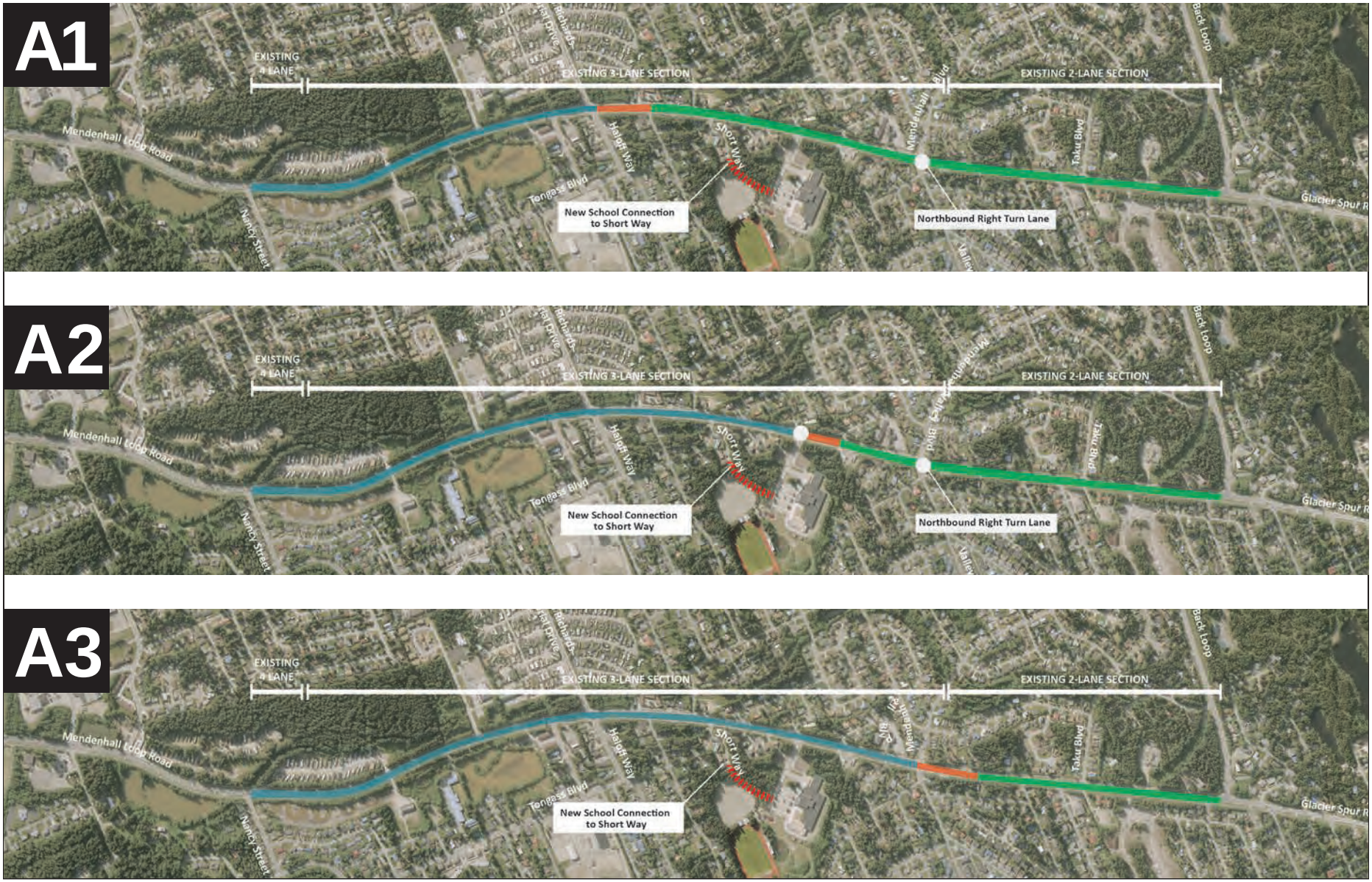
Two families of concepts were developed, A and B. The A family of concepts includes three five-lane concepts; these are designated Concepts A1, A2, and A3. These concepts each include a five-lane cross section, consisting of two travel lanes in each direction and a center turn lane, but they differ in where

the roadway transitions from five lanes to three. Concept A1 consists of a five-lane cross section from Nancy Street to Stephen Richards Drive/Haloff Way. Concept A2 extends the five-lane section north, transitioning to three lanes north of Floyd Dryden Access Road. Concept A3 includes the five-lane section to north of Mendenhall Boulevard/Valley Boulevard. From the transition points, the cross section narrows to three lanes, one travel lane in each direction with a center turn lane, which continues for the remainder of the corridor to Back Loop. Figure 1 shows the basic plan views for A concepts.

The B family is a series of four concepts, B1, B2, B3, and B4, focusing on improvements that would maintain a three-lane cross section for the length of the corridor and expanding the roadway only at the intersections of Stephen Richards Drive/Haloff Way and Floyd Dryden Access Road. Concept B1 maintains the existing signalized traffic control throughout the corridor and expands the Stephen Richards Drive/Haloff Way intersection with auxiliary through lanes to add through capacity and reduce queues. Concepts B2, B3, and B4 introduce roundabouts at key intersections. Concept B2 includes a roundabout at Stephen Richards Drive/Haloff Way; Concept B3 includes roundabouts at Stephen Richards Drive/Haloff Way and Floyd Dryden Access Road; and Concept B4 includes roundabouts at these two intersections plus Mendenhall Boulevard/Valley Boulevard. Figure 2 shows the basic plan views for B concepts.

Both families utilized the same cross sections. Figure 3, 4, and 5, are the cross sections for concepts A1, A2, and A3. Figure 3 is the proposed five-lane section with two-way left-turn lane (TWLTL) which would be implemented from Nancy Street to the transition point of each A concept. Figure 4 depicts the proposed five-lane section with median and dedicated left-turn lane proposed to be implemented at intersections. Figure 5 is the proposed three-lane section with TWLTL which would be applied after the transition and in all the three-lane concepts. The three-lane concepts, B family, will have the same cross section that is depicted in Figure 5.

Detailed conceptual designs for each concept are available in Appendix 4.



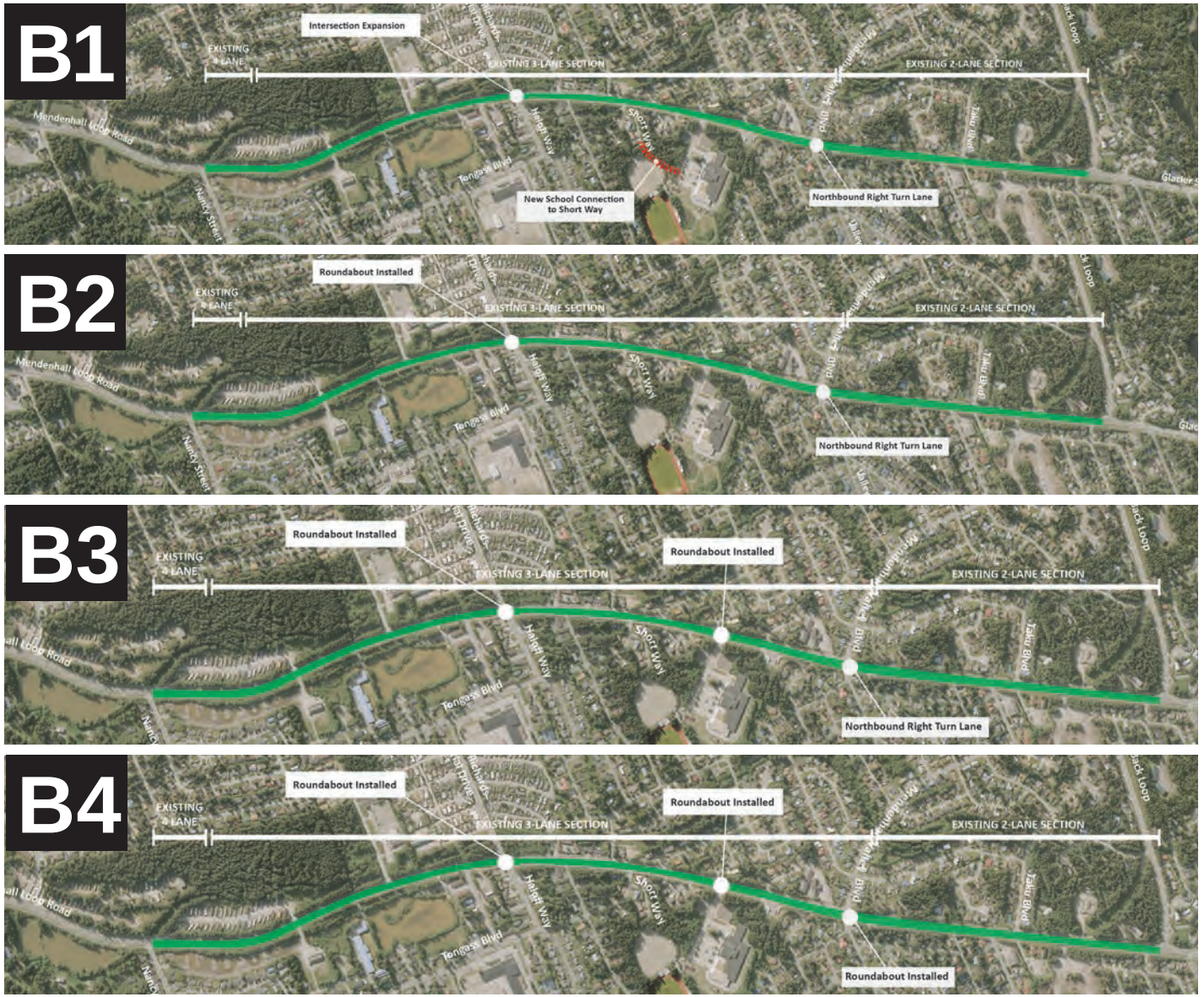
Legend

- Proposed 5-Lane Section
- Proposed 5-Lane to 3-Lane Transition
- Proposed 3-Lane Section

Family A Concepts

Figure **1**

K:\H_Anchorage\projfile\13358 - Mendenhall Loop Road\dwgs\figs



Legend

Proposed 3-Lane Section

Family B Concepts

Figure **2**

K:\H_Anchorage\projfile\13358 - Mendenhall Loop Road\dwgs\figs

Figure 3 Proposed 5-Lane Section with Two-Way Left Turn Lane

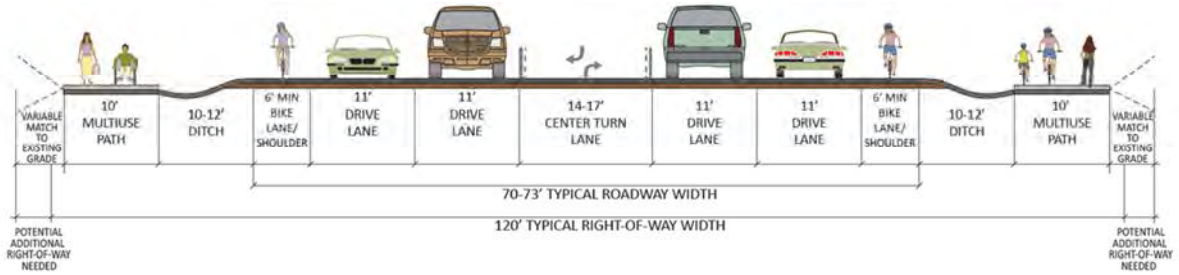


Figure 4 Proposed 5-lane with Median and Dedicated Turn Lane

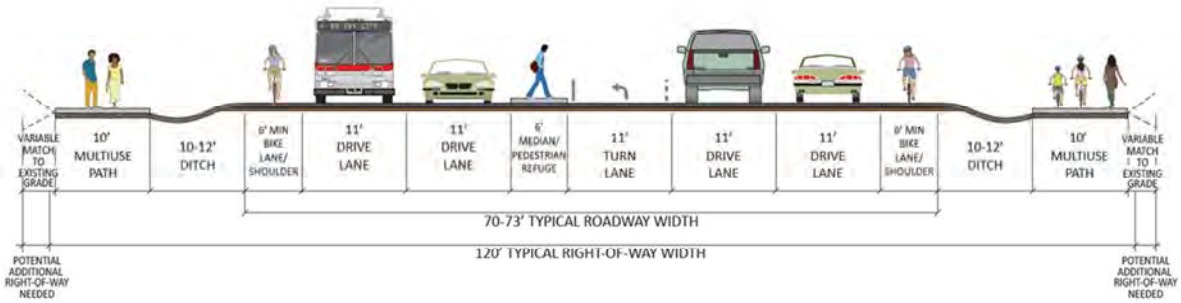
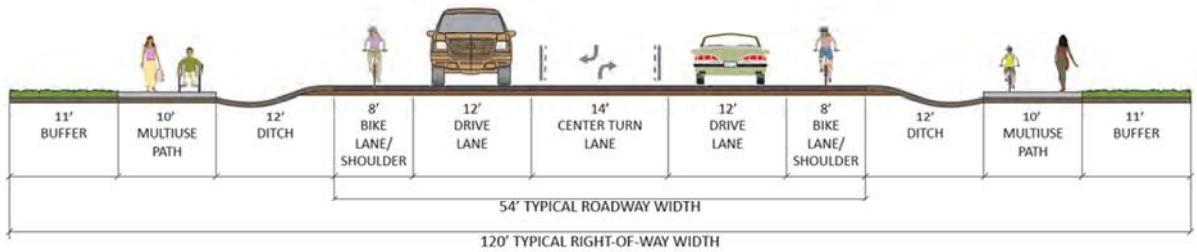


Figure 5 Proposed 3-lane with Two-Way Left Turn Lane



Concept Comparison

The seven developed concepts were evaluated for advantages and disadvantages to facilitate a recommended concept. All seven concepts meet the project objectives to varying degrees. All seven concepts incorporate the following key benefits:

- Vehicle delay and queue lengths are reduced at the Stephen Richards-Haloff Way intersection in both peak hours;
- Vehicle delay and queue lengths are reduced at the Mendenhall Boulevard-Valley Boulevard intersection in both peak hours;
- Vehicle delay is reduced and traffic safety is improved north of the Mendenhall Boulevard-Valley Boulevard intersection.
- Pedestrian and bicycle facilities are maintained and path conflicts are reduced;
- Enhanced transit facilities and a new pedestrian crossing at Cinema Drive; and
- Various proposed treatments are anticipated to yield crash reductions throughout the corridor.

These identified benefits in all seven concepts meet the goal of the project to provide adequate vehicle capacity and improve pedestrian and bicycle facilities along the study corridor. To differentiate and narrow the concepts down to a recommended concept, advantages and disadvantages specific to each concept were identified, first at the family of concept level and then by individual concept.

The A concepts advantages, in addition to the benefits common to all concepts, advantages and disadvantages specific to A concepts include but are not limited to the following:

Family A Concept Benefits

- The lane reduction and associated northbound merge is moved further north where traffic volumes are less than at the existing location;
- Side street operations are improved along the five-lane cross section segments; and
- Bicycle segment level-of-service is improved due to reduced number of vehicles in adjacent travel lane.

Family A Concept Drawbacks

- Pedestrian crossing distances are lengthened, extending pedestrian exposure to vehicles;
- The five-lane sections impact right-of-way and reduce the available buffer to abutting properties;
- Nancy Street experiences increased delay; Floyd Dryden Access Road operates at LOS F during weekday p.m. peak period;
- Opportunities for access management and its associated safety benefits are limited in comparison to B concepts;
- Crashes are predicted to increase when expanded to five lanes; and
- The public and the project advisory group are generally not supportive of five-lane cross section.

Advantages and disadvantages for the B concept family, in addition to the benefits common to all concepts include the following:

Family B Concept Benefits

- The Stephen Richard-Haloff Way intersection operates with lower delay and shorter queues as a roundabout as proposed in Concepts B2, B3, and B4, than as a signalized intersection as proposed in the A family of concepts and Concept B1;
- The Floyd Dryden Access operates at LOS B or better with a roundabout in concepts B3 and B4;
- Pedestrian crossing delay is reduced; and
- Public supports three-lane cross section.

Family B Concept Drawbacks

- The proposed roundabouts in Concepts B2, B3, and B4 create localized right-of-way impacts; and
- The overall capacity of the corridor is somewhat reduced as compared to the five-lane cross section in the A family of concepts.

Due to the generally negative response to the five-lane cross section and the other disadvantages, only the B concepts were moved forward for further evaluation. Individual B concepts were evaluated further in areas of consideration, including intersection operations, pedestrian and bicycle environment, access management, and safety.

While all concepts address vehicle delay and queue lengths at the intersections of Stephen Richards-Haloff Way and Mendenhall Boulevard-Valley Boulevard, only Concepts B3 and B4 also improve Floyd Dryden Access Road with the installation of a roundabout. Moreover, Concepts B3 and B4 improve the side street operations along the corridor with the access management that is facilitated by roundabouts in series. Concept B4 addresses more side street operations over Concept B3 with the additional access management between the intersections at Floyd Dryden Access Road and Mendenhall Boulevard-Valley Boulevard.

The pedestrian and bicycle environment is generally similar throughout the concepts because the multiuse path and bicycle lanes are preserved in addition to implementation of median refuges. Concept B1 has minimal improvement over the no-build scenario compared to the other concepts which propose roundabouts that reduce crossing delay for both modes with the most improvement in Concept B4.

All four concepts are predicted to reduce crashes to various degrees through the use of common crash-reducing treatments such as the addition of a TWLTL, left-turn lane extensions, and installation of pedestrian refuges. Roundabouts are projected to reduce crashes at both signalized and unsignalized intersections, making Concept B4 the most beneficial to intersection safety on the corridor.

As the concepts build sequentially, Concept B4 improves vehicle operations, pedestrian and bicycle environment, and safety the most out of the four B concepts.

Recommended Concept

The concepts recommended for further evaluation are Concepts B3 and B4, shown respectively in Figures B3-1 through B3-6 and Figures B4-1 through B4-6 in Appendix 4. The key driving factors for this recommendation include:

- **Vehicular Operational Improvements:** The corridor currently experiences heavy congestion in the peak hours as well as large queues in the peak directions. Concept B3 addresses these issues with the installation of roundabouts at the intersections at Stephen Richards-Haloff Way and Floyd Dryden Access Road and a northbound right-turn lane at the intersection at Mendenhall Boulevard-Valley Boulevard. Concept B4 replaces the signal at Mendenhall Boulevard-Valley Boulevard with a roundabout. Both of these concepts provide adequate vehicle capacity, reducing peak hour queues and improving peak hour operations.
- **Pedestrian and Bicycle Facilities:** Many residents of Mendenhall Valley use or cross Mendenhall Loop Road by bicycle or on foot to go to work, school, or access public transit services; maintaining and improving existing facilities is a necessity. Concepts B3 and B4 preserve the multiuse path and bicycle lanes and in combination with implementation of roundabouts reduces intersection crossing delay. Additionally, the installation of a marked crosswalk with RRFB at Cinema Drive improves pedestrian crossing facilities along the corridor. Proposed enhanced corridor lighting, focused at intersections and marked crossings, will also help to make pedestrians and bicyclists more visible to vehicles.
- **Corridor Safety:** Improving safety is beneficial to all modes along the corridor. Predicted crash reductions result from many of the treatments in Concepts B3 and B4 including addition of a TWLTL, left-turn lane extensions, and installation of pedestrian refuges. Installation of a roundabout at the intersections at Stephen Richards-Haloff Way and Floyd Dryden Access Road are projected to reduce total crashes by 3.35 and 0.27 crashes per year, respectively. Both concepts are projected to improve safety performance at Mendenhall Boulevard-Valley Boulevard, with greater reduction in Concept B4. For Concept B3, the installation of a northbound right turn lane is projected to reduce rear ends and sideswipe crashes by 0.2 crashes per year. For Concept B4, the installation of a roundabout at this location is projected to reduce total crashes by 4.3 crashes per year.

While Concept B4 provides access management and safety benefits beyond Concept B3, it is unclear whether the costs associated with the additional treatments in Concept B4 will yield enough benefit to justify the cost. Further determination is recommended after additional engineering and cost estimating can be completed. In addition, the estimation of costs for all alternatives (design, construction, utilities, and right-of-way) were not part of the scope of this evaluation and should be considered when making a final recommendation.

Section 2
Introduction

INTRODUCTION

This report presents analysis and recommendations for proposed improvement concepts for Mendenhall Loop Road between Nancy Street and Back Loop Road in Juneau, Alaska. This important arterial street serves a blend of local vehicular traffic, transit riders, tourists in tour buses, students, pedestrians, and local and through bicyclists. Today the study corridor experiences heavy congestion in the peak hours as well as large queues in the peak directions. In addition, pedestrians and bicyclists experience challenges traveling along and crossing Mendenhall Loop Road throughout this section.

The primary goal of this project is to provide adequate vehicle capacity and improve pedestrian and bicycle facilities along this section of Mendenhall Loop Road. Through collaboration with Department of Transportation & Public Facilities (DOT&PF) staff and City and Borough of Juneau (CBJ) staff, along with public input, the project team developed infrastructure improvement concepts that accomplish the primary project goal, improving the operations and safety of the corridor for all modes. A recommendation was formed based on operational benefits, public comment, and cost effectiveness. This report presents analysis and recommendations of the study corridor and the corridor concepts.

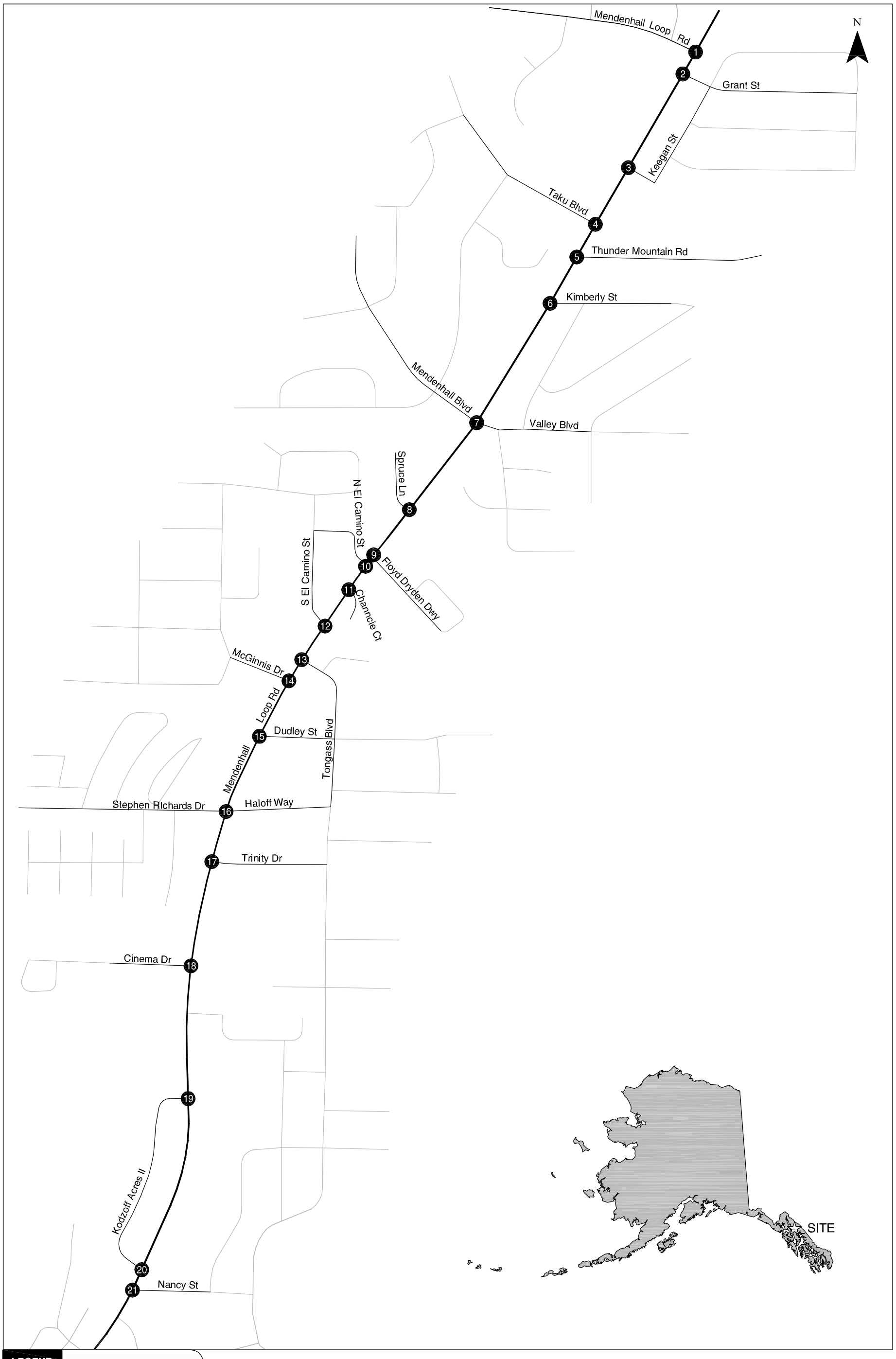
EXISTING CONDITIONS

STUDY AREA CHARACTERISTICS

The following sections analyze the existing conditions of Mendenhall Loop Road with respect to configuration, traffic volumes, existing and future no-build traffic conditions, safety, non-motorized facilities, transit operations, and access management. A description of the configuration of Mendenhall Loop Road sets up the discussion followed by the analysis of each aforementioned topic. Figure 6 shows the project area.

The corridor study area is approximately 1.75 miles of Mendenhall Loop Road, which serves as the spine to the Mendenhall Valley area. It is the major commute route to and from Egan Drive as well as the shopping areas along Glacier Highway and Mendenhall Mall Road. Mendenhall Loop Road is the gateway to the Mendenhall Glacier, one of the most popular tourist attractions in Southeast Alaska. In the peak tourist season, visitors travel to the glacier most commonly by tour bus along Mendenhall Loop Road. Additionally, many residents of Mendenhall Valley use or cross Mendenhall Loop Road by bicycle or on foot to go to school or access public transit services. Mendenhall Loop Road has a posted speed of 40 miles per hour through the study area, with a speed adjustment during school arrival and departure times.

Mendenhall Loop Road has three distinct cross sections, illustrated in Figure 7, 8, and 9. The roadway cross section reflects the traffic demand pattern, with heaviest traffic volumes on the southern end of the study section. In the northbound direction, Mendenhall Loop Road changes at Nancy Street from the four-lane cross section shown in Figure 7 to the three-lane section shown in Figure 8. This configuration continues until just north of the intersection with Mendenhall Boulevard/Valley Boulevard, where the center turn lane is eliminated and the roadway has a two-lane cross section as shown in Figure 9.



Site Vicinity Map
Juneau, Alaska

Figure
6

Figure 7 Existing Mendenhall Loop Road Cross Section: Vicinity of Nancy Street

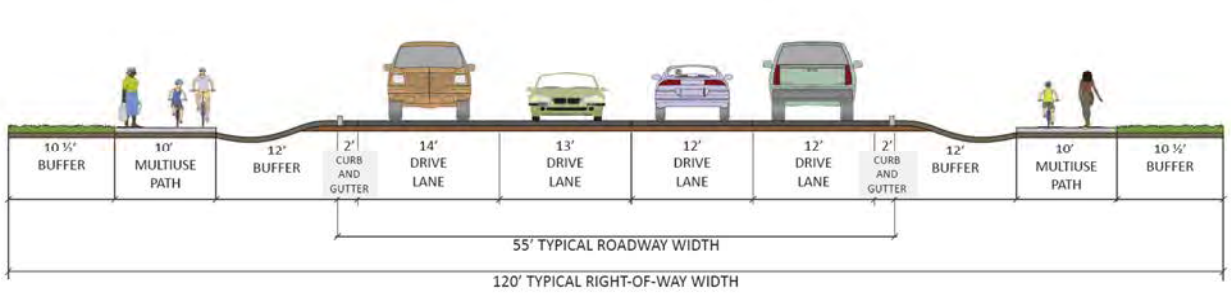


Figure 8 Existing Mendenhall Loop Road Cross Section: Vicinity of Stephen Richards/Haloff Way

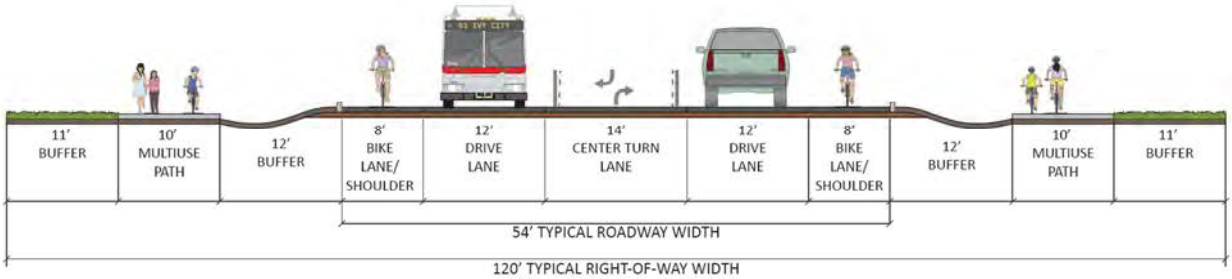


Figure 9 Existing Mendenhall Loop Road Cross Section: Vicinity of Back Loop

All three cross sections are located in a 120-foot-wide right-of-way. A continuous ditch, multiuse path, and buffer with trees run along each side of the roadway between the edge of the roadway and the right-of-way line. While the topography of the corridor varies, the elevation of the multiuse path is generally lower than the roadway as indicated in the previous figures.

Another element to the corridor is the number of access points onto Mendenhall Loop Road. A review of access points along the corridor revealed there are several parcels and subdivisions along the corridor with unused or redundant access points. Closures or modifications of the accesses were considered in upcoming sections of this report.

Street lighting is present along the length of the corridor. The spacing of luminaires appears to be generally consistent along the corridor and does not emphasize intersections or pedestrian crossings.

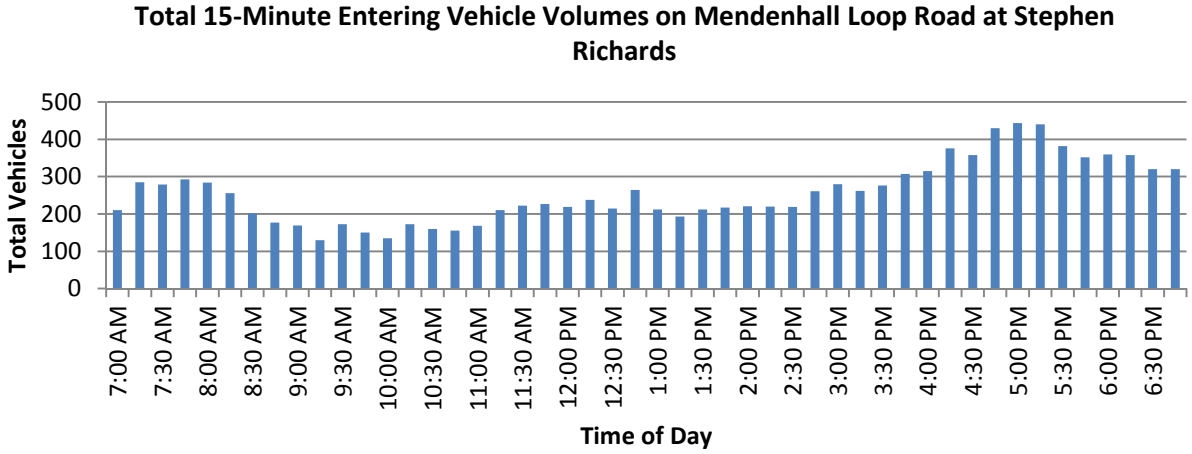
TRAFFIC VOLUMES

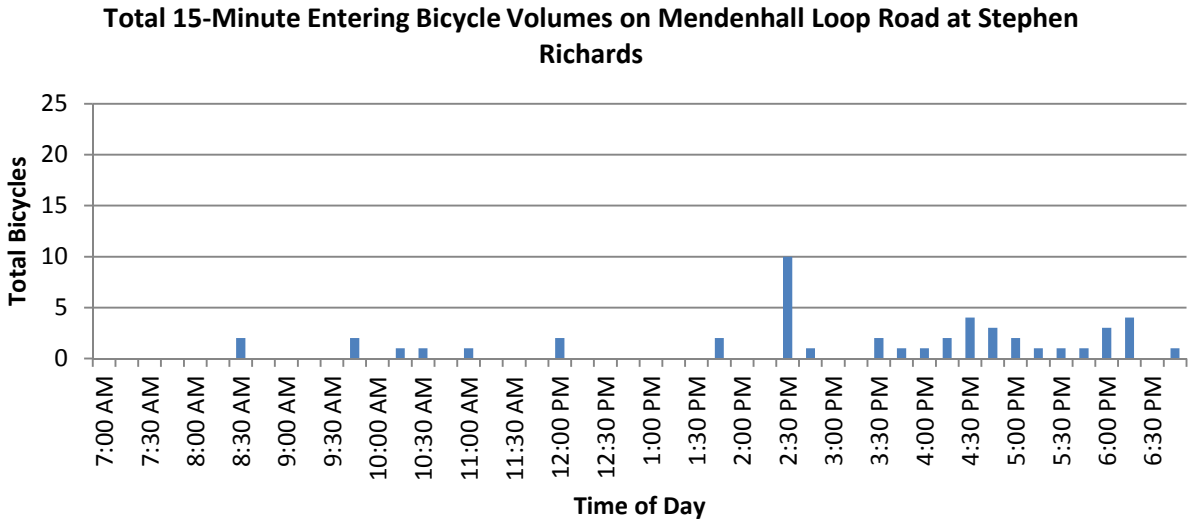
Vehicular turning movement volumes and bicycle and pedestrian crossing volumes were provided by DOT&PF staff for the period from 7:00 a.m. to 7:00 p.m. on typical weekdays during August 2012, when school was not in session, and in September 2012, with school in session, at the following study intersections:

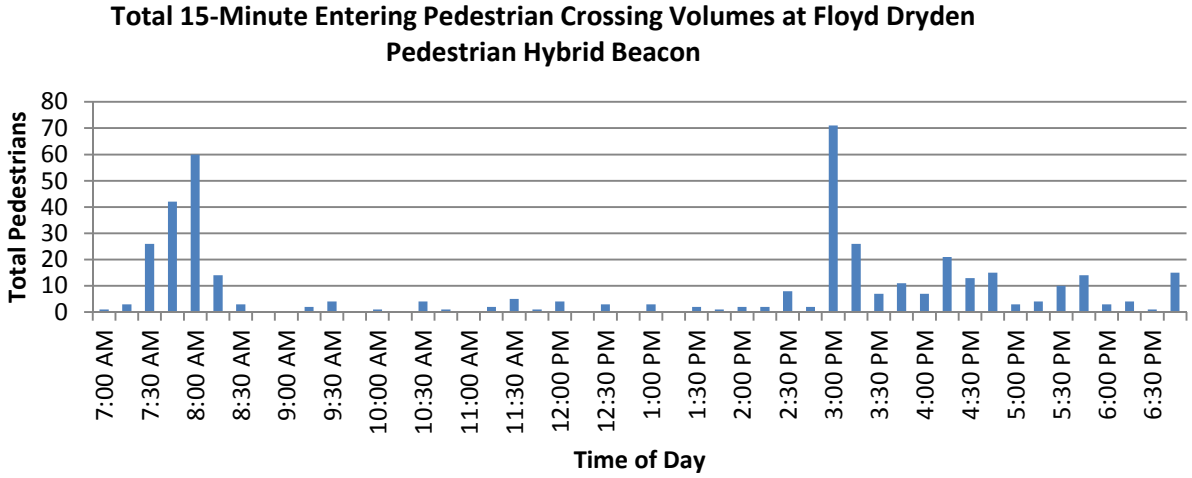
- Mendenhall Loop Road/Mendenhall Loop Road (Back Loop)
- Mendenhall Loop Road/Floyd Dryden Access Road-El Camino Street
- Mendenhall Loop Road/Stephen Richards Memorial Drive-Haloff Way
- Mendenhall Loop Road/Valley Boulevard-Mendenhall Boulevard
- Mendenhall Loop Road/Nancy Street
- Mendenhall Loop Road/Kodzoff Acres II Driveways
- Mendenhall Loop Road/Cinema Drive
- Mendenhall Loop Road/Trinity Drive
- Mendenhall Loop Road/Dudley Street
- Mendenhall Loop Road/McGinnis Street
- Mendenhall Loop Road/Tongass Boulevard
- Mendenhall Loop Road/El Camino Street
- Mendenhall Loop Road/Channcie Court
- Mendenhall Loop Road/Spruce Lane
- Mendenhall Loop Road/Kimberly Street
- Mendenhall Loop Road/Thunder Mountain Road
- Mendenhall Loop Road/Taku Boulevard
- Mendenhall Loop Road/Keegan Street
- Mendenhall Loop Road/Grant Street

Summary volume profiles on Mendenhall Loop Road are shown in Exhibit 1 to provide a representative sampling of the motorized and non-motorized through volumes on Mendenhall Loop Road. The traffic volumes collected while school was in session were used for this study, as this period is more representative of the yearly traffic on the corridor. Pedestrians crossing Mendenhall Loop Road at the Floyd Dryden pedestrian hybrid beacon are concentrated during the school arrival and dismissal times.

Exhibit 1: Weekday Fifteen-Minute Volume Profiles (7AM to 7PM)





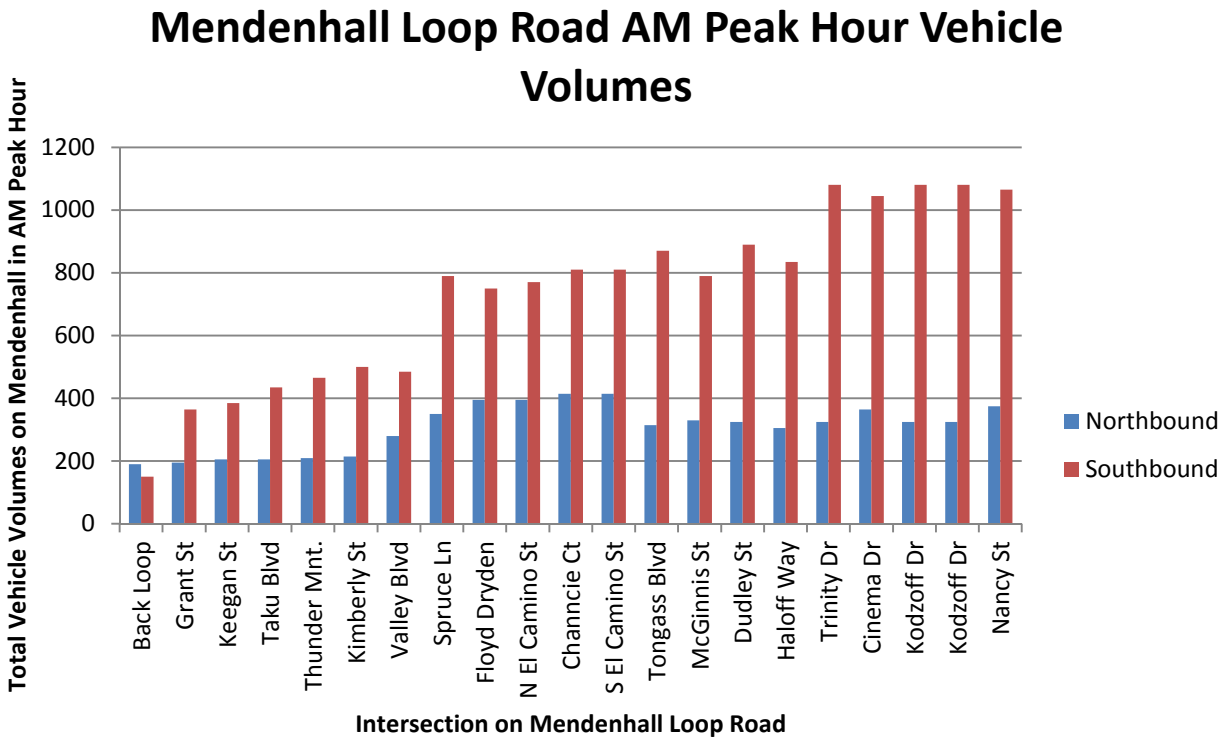


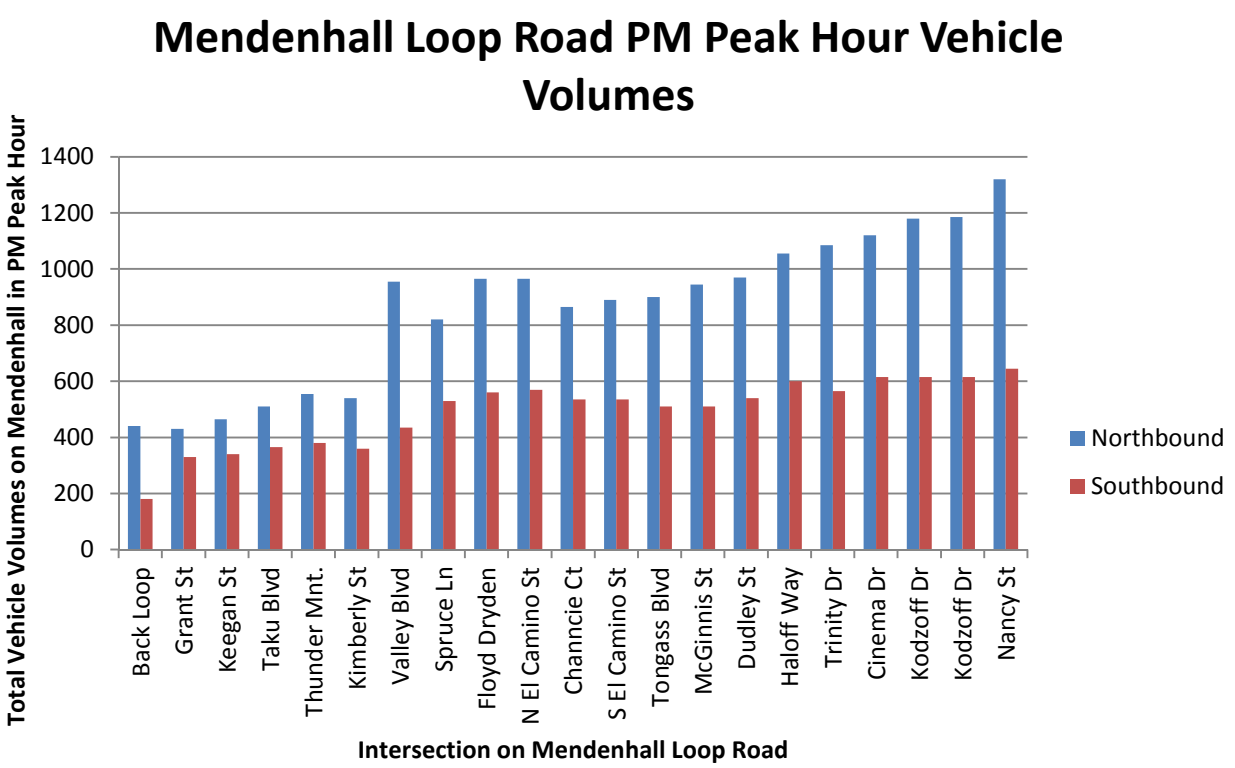
Vehicle Volumes Summary

The existing weekday a.m. and p.m. peak hour traffic volumes are shown in Figure 10 and 11. The intersection peak hours were determined individually and were generally 7:15 to 8:15 a.m. and 4:45 to 5:45 p.m., respectively, as shown in Exhibit 1.

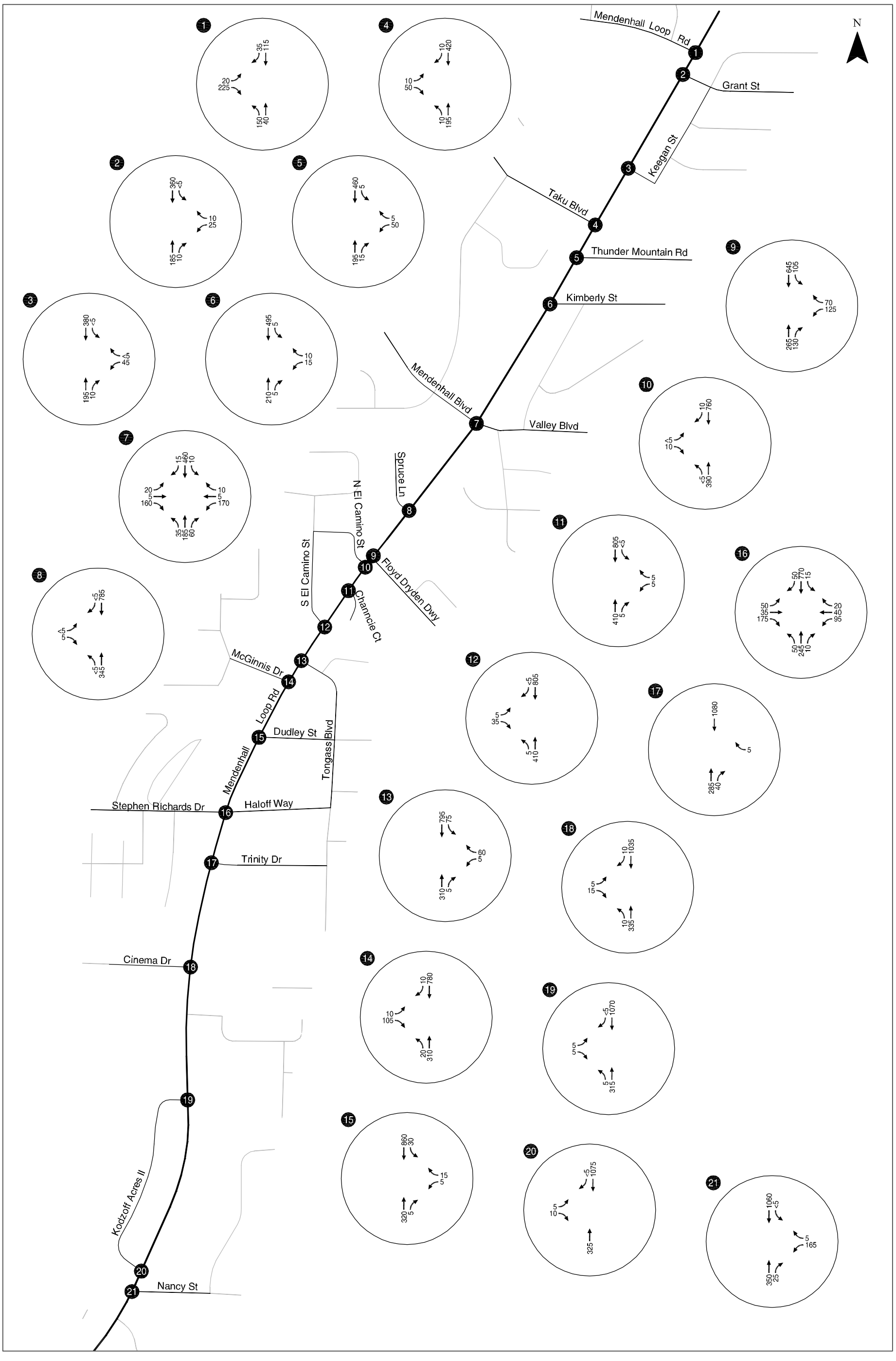
Traffic volumes on Mendenhall Loop Road are highly directional with peaks in the southbound direction in the weekday a.m. peak hour and northbound in the weekday p.m. peak hour, as highlighted in Exhibit 2. Peak direction traffic volumes are highest at the southern end of the study corridor and generally decline to the north. Traffic volumes in the non-peak direction are generally steady with reduced volumes north of Floyd Dryden Access Road.

Exhibit 2: Weekday Peak Hour Volume Profiles



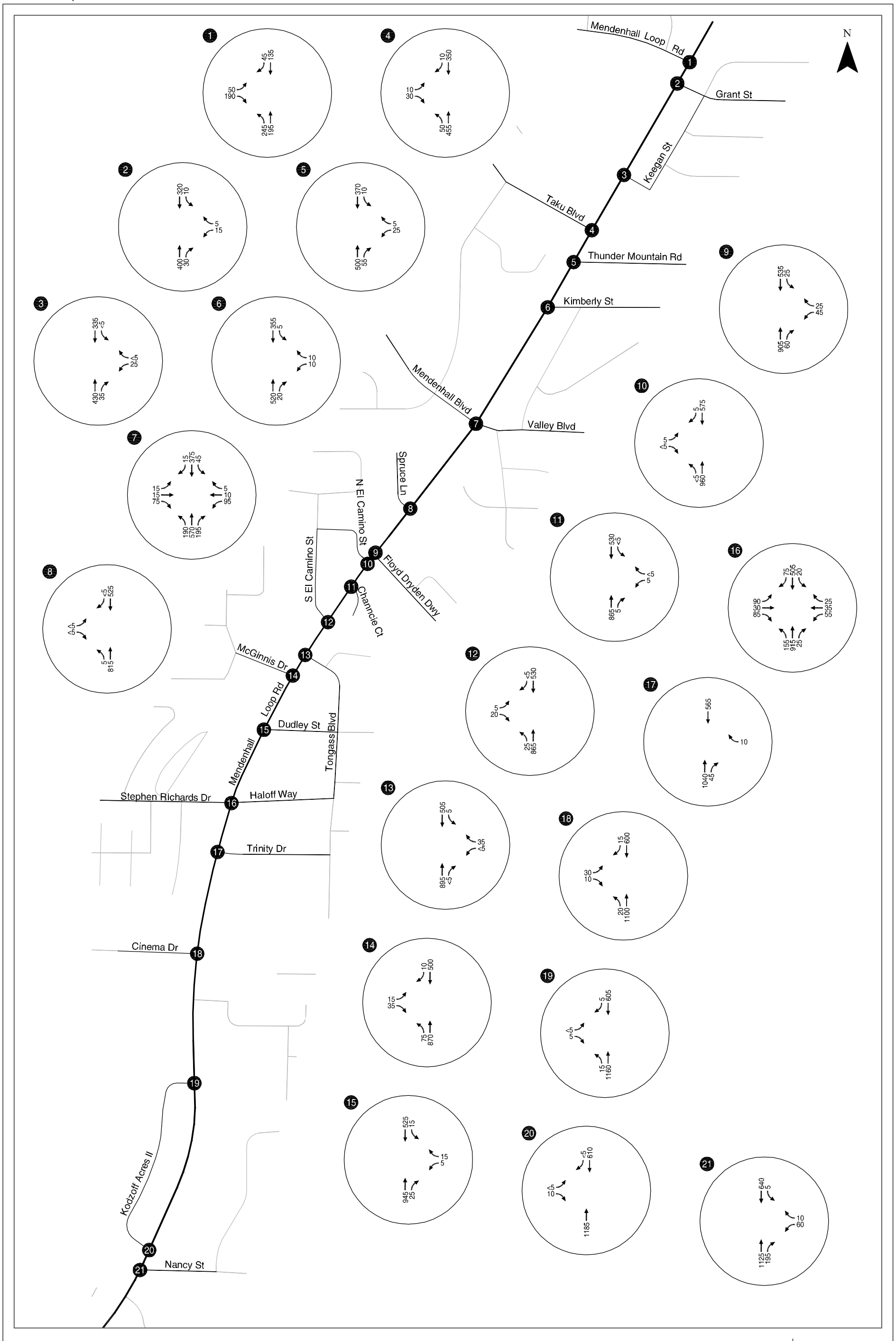


In addition to the typical peak hour conditions, sporting events at the Floyd Dryden Middle School draw large crowds. Attendees reportedly experience long delays during event egress which reportedly leads to attendees parking along Mendenhall Loop Road to avoid the congestion. This study will consider the operations of Mendenhall Loop Road during Floyd Dryden Middle School event conditions.



Existing AM Peak Hour Traffic Volumes
Juneau, Alaska

Figure
10



Existing PM Peak Hour Traffic Volumes
Juneau, Alaska

Figure
11

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

Future Traffic Volumes

Vehicular traffic growth estimates were developed using an annual background growth rate. Through conversations with CBJ staff, no planned developments were considered to have a significant impact on the number of vehicles on the corridor. Population growth in Juneau has been very minimal over the past decade, averaging approximately 0.2% from 2000 to 2010.

A 2009 DOT&PF study used a 1 percent annual growth rate on the corridor to generate a conservatively high estimate as historical counts on the corridor have grown more slowly.

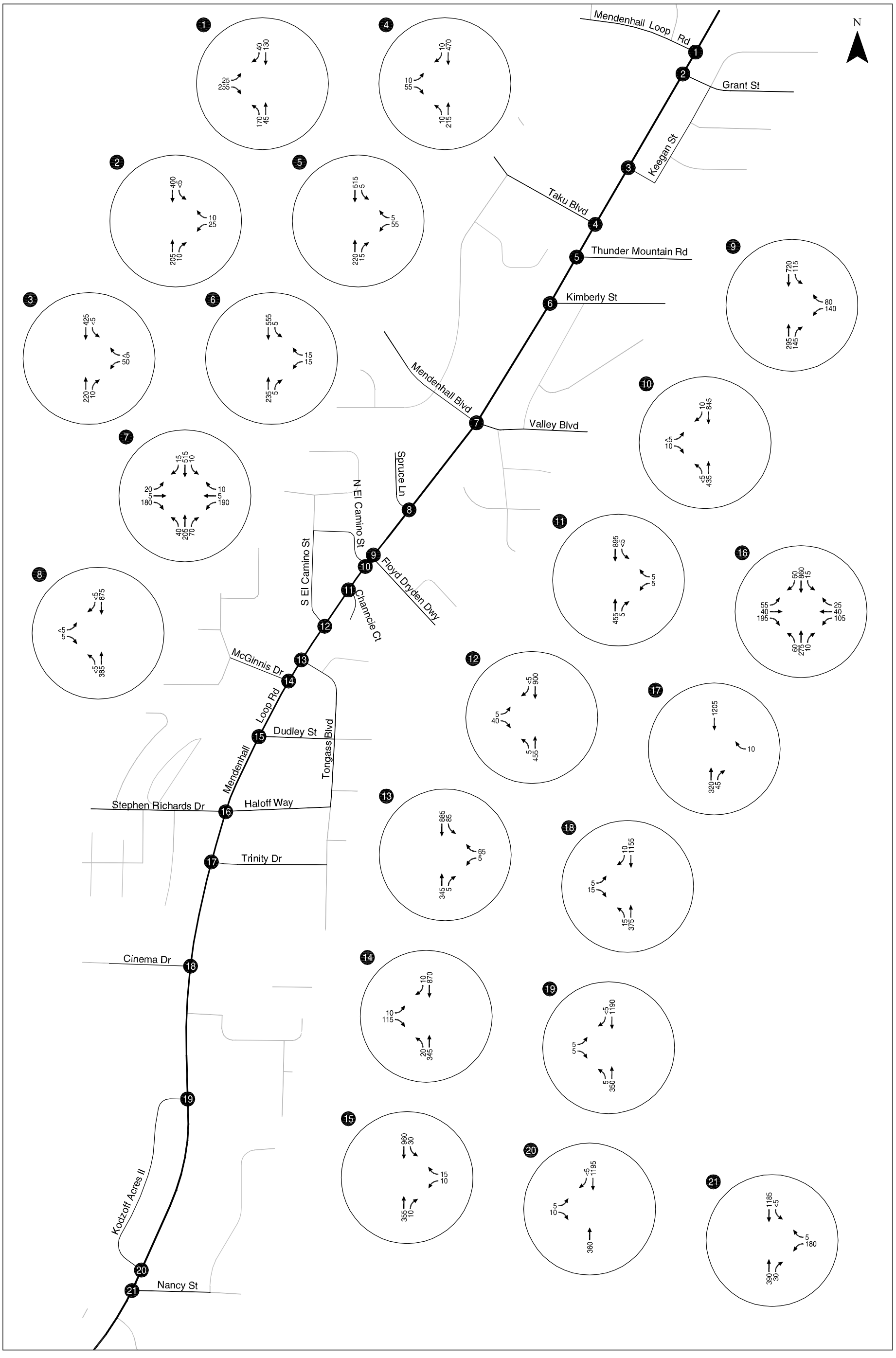
Based on historical vehicular volume growth rates and discussions with CBJ staff, a 0.5-percent compound annual growth rate was used to develop future vehicular volumes. These volumes show the 22-year projected vehicular turning movement volumes shown in Figure 12 and 13.

Pedestrian Volumes Summary

The existing pedestrian crossing volumes from the DOT&PF data are shown in Figure 14. The counts taken from 7:00 a.m. to 7:00 p.m. were assumed to be representative of daily trips (i.e., the overnight pedestrian volumes between 7:00 p.m. and 7:00 a.m. were assumed to be negligible). The intersection crossing volumes do not include bicyclists using the crosswalk. The pedestrian crossing volumes are reported as the total volume crossing each leg of the intersection, regardless of direction of travel.

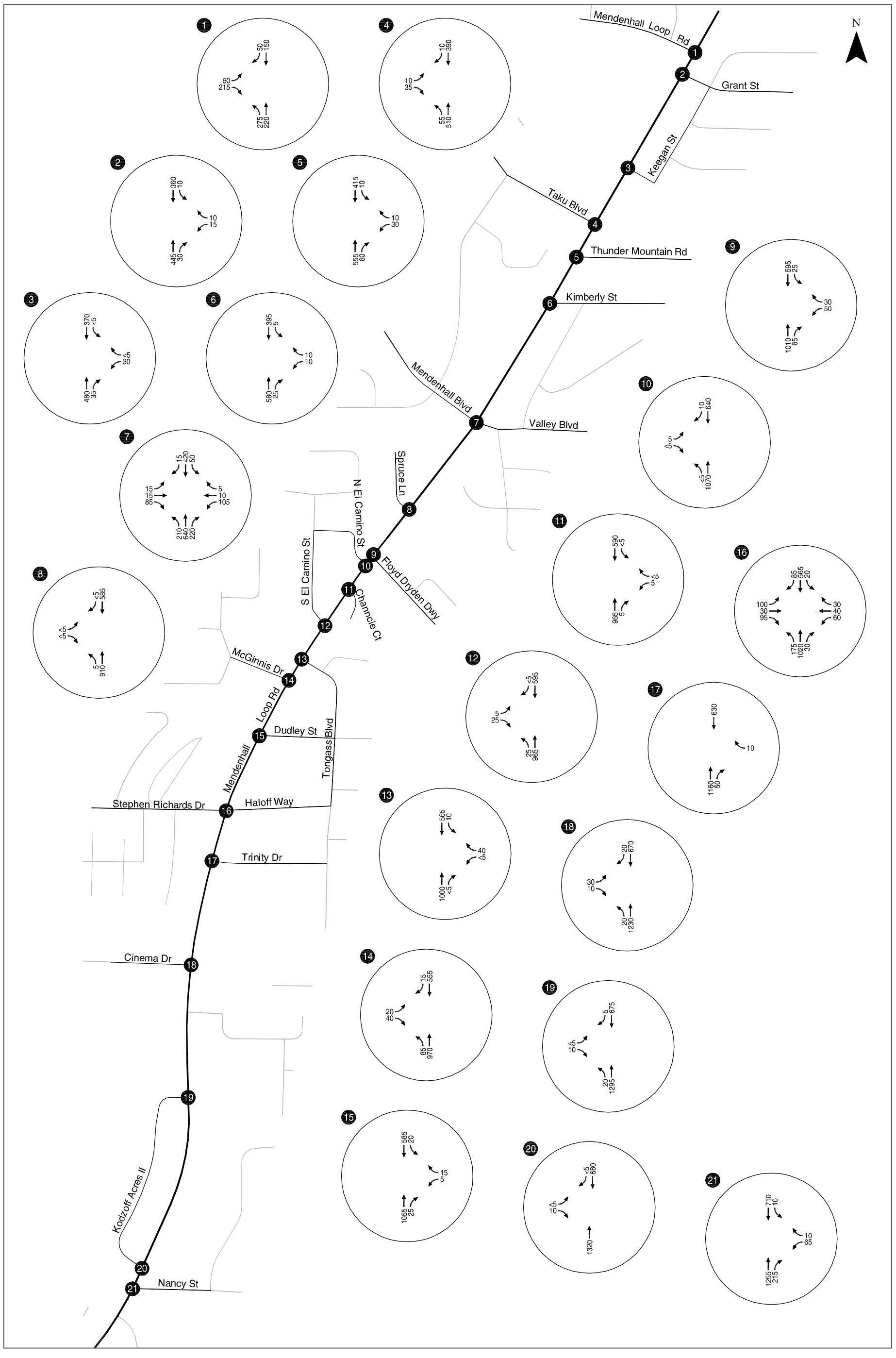
Transit service on Mendenhall Loop Road is provided by Capital Transit Lemon Creek/Mendenhall Valley routes #3 and #4, with several bus stops along the corridor contributing to pedestrian volumes. The signed bus stops on Mendenhall Loop Road are located near the following locations on both sides of the roadway:

- Nancy Street
- Stephen Richards Memorial Drive/Haloff Way
- Mendenhall Boulevard/Valley Boulevard
- Thunder Mountain Road



2035 No Build AM Peak Hour Traffic Volumes
Juneau, Alaska

Figure
12



2035 No Build PM Peak Hour Traffic Volumes
Juneau, Alaska

Figure
13

Existing 12-Hour Pedestrian Crossing Volumes
Juneau, Alaska

Figure
14

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

Forecast Future Pedestrian Volumes

Future, 20-year projected pedestrian volumes were developed for use in the forthcoming future conditions analysis. Travel mode splits for commute trips in Juneau were captured in the 2000 U.S. Census and again in 2007 to 2009 in the American Community Survey (data provided by CBJ). In 2000, walking accounted for 8 percent of commute trips in Juneau; this number increased to 8.8 percent in the 2007-2009 survey, indicating a small amount of growth in the pedestrian mode split. It was assumed that this commute trend would apply to all walking trip types. Walking will have an increasing share of all trips in addition to a portion of any new trips due to growth in the area and any new transit trips. Therefore, the pedestrian link and crossing volumes were estimated to grow by 1 percent per year from the existing volumes to the 22-year projected volumes.

Bicycle Volumes Summary

The existing bicycle crossing volumes from the DOT&PF data are shown in Figure 15. As with the pedestrian volumes, the 7:00 a.m. to 7:00 p.m. counts were assumed to constitute daily trips (i.e., the overnight bicycle volumes between 7:00 p.m. and 7:00 a.m. were assumed to be negligible). Bicycle counts were only available for bicyclists using the crosswalks; bicyclists riding on the roadway shoulder were not included in the traffic counts.

Forecast Future Bicycle Volumes

Similar to the pedestrian volumes, the 2000 US Census and the 2007-2009 American Community Survey were used to assess bicycle growth in Juneau. The proportion of commute trips completed by bicyclists in Juneau in the 2000 Census was reported as 2 percent and increased to 4.4 percent in according to the 2007-2009 survey. This increase in bicycle mode share indicates substantial future growth in bicycling within Juneau over the past decade and this trend is expected to continue for the foreseeable future with continued emphasis on non-motorized transportation in the community. Due to the intra-city distances and weather conditions in Juneau, it is unlikely with the existing infrastructure that the bicycle mode share would exceed 8 to 10 percent of the total commute volumes. Therefore, the 2035 projected bicycle volumes on Mendenhall Loop Road were assumed to double from the existing volumes, which is equates to a 5 percent annual increase in bicycle travel over the timeframe. This amount of growth would roughly correspond to an 8 percent bicycle mode share split in 22 years.

Existing 12-Hour Bicycle Crossing Volumes
Juneau, Alaska

Figure
15

TRAFFIC CONDITIONS

An analysis of the existing traffic conditions was undertaken to identify operational issues that should be addressed by proposed corridor concepts. Traffic operations including level-of-service, delay, volume-to-capacity ratio, and queuing were evaluated during the weekday peak a.m. and p.m. peak hours to understand how the corridor is performing under existing conditions. Crash history was also examined and is discussed in a following section.

Traffic volumes from the previous section were used to evaluate existing facilities on Mendenhall Loop Road. The assembled weekday a.m. and p.m. hour traffic volumes, existing lane configurations, and traffic control devices for the study intersections were analyzed using the implementation of the Highway Capacity Manual (HCM) methodology implemented in Synchro 7.

Vehicle operations at intersections are chiefly assessed by volume-to-capacity ratio and average vehicle delay, which is assigned a Level of Service (LOS). Traffic operations for a signalized intersection are reported for the intersection as a whole, while unsignalized intersection operations are reported for the critical movement, typically a minor street turning movement. The DOT&PF intersection operation standard for urban areas is LOS D. Figure 16, 17, and 18 report the existing lane configuration and traffic control devices, existing traffic conditions for the weekday a.m. peak hour, and the existing traffic conditions for the weekday p.m. peak hour, respectively.

Most of the existing study intersections were found to operate at or better than the DOT&PF standard during the weekday a.m. and p.m. peak hours with the exception of the intersections at Floyd Dryden Access Road, Cinema Drive, and Nancy Street in both peak hours and McGinnis Drive and Dudley Street in the weekday p.m. peak hour. The side-street left turns at these intersections experience long delays, resulting in poor LOS.

Floyd Dryden Access Road westbound left-turn movement operates at LOS F for both the a.m. and p.m. peak hours. The left-turn movements experience high delay due to the heavy through volume and lack of acceptable gaps on Mendenhall Loop Road during the peak hours. However, activation of the pedestrian hybrid beacon on the north leg of the intersection would create gaps allowing for the Floyd Dryden left turns to make their maneuver. The beacon was not accounted for in this analysis methodology; as a result, the actual left-turn delay is likely less than the delay reported in Figure 17 and 18. Sporting and other events are scheduled throughout the year at Floyd Dryden Middle School with similar difficulty for vehicles exiting from Floyd Dryden Access Road. Public comments indicate that vehicles park along the Mendenhall Loop Road during these events due to difficulty exiting Floyd Dryden Access Road when the event ends.

Cinema Drive's eastbound left-turn movement operates at LOS E and F for a.m. and p.m. peak hours, respectively. Public comments indicate similar delay occurs following showings at the theater, though this occurs outside the roadway peak periods. Nancy Street's westbound left-turn movement operates at LOS F for both the a.m. and p.m. peak hours.

Mendenhall Loop Rd
Grant St
Keegan St
Taku Blvd
Thunder Mountain Rd
Kimberly St
Mendenhall Blvd
Valley Blvd
Spruce Ln
N El Camino St
S El Camino St
Floyd Dryden Dwy
Channcie Ct
McGinnis Dr
Loop Rd
Dudley St
Mendenhall
Tongass Blvd
Stephen Richards Dr
Haloff Way
Trinity Dr
Cinema Dr
Kodzoff Acres II
Nancy St

LEGEND

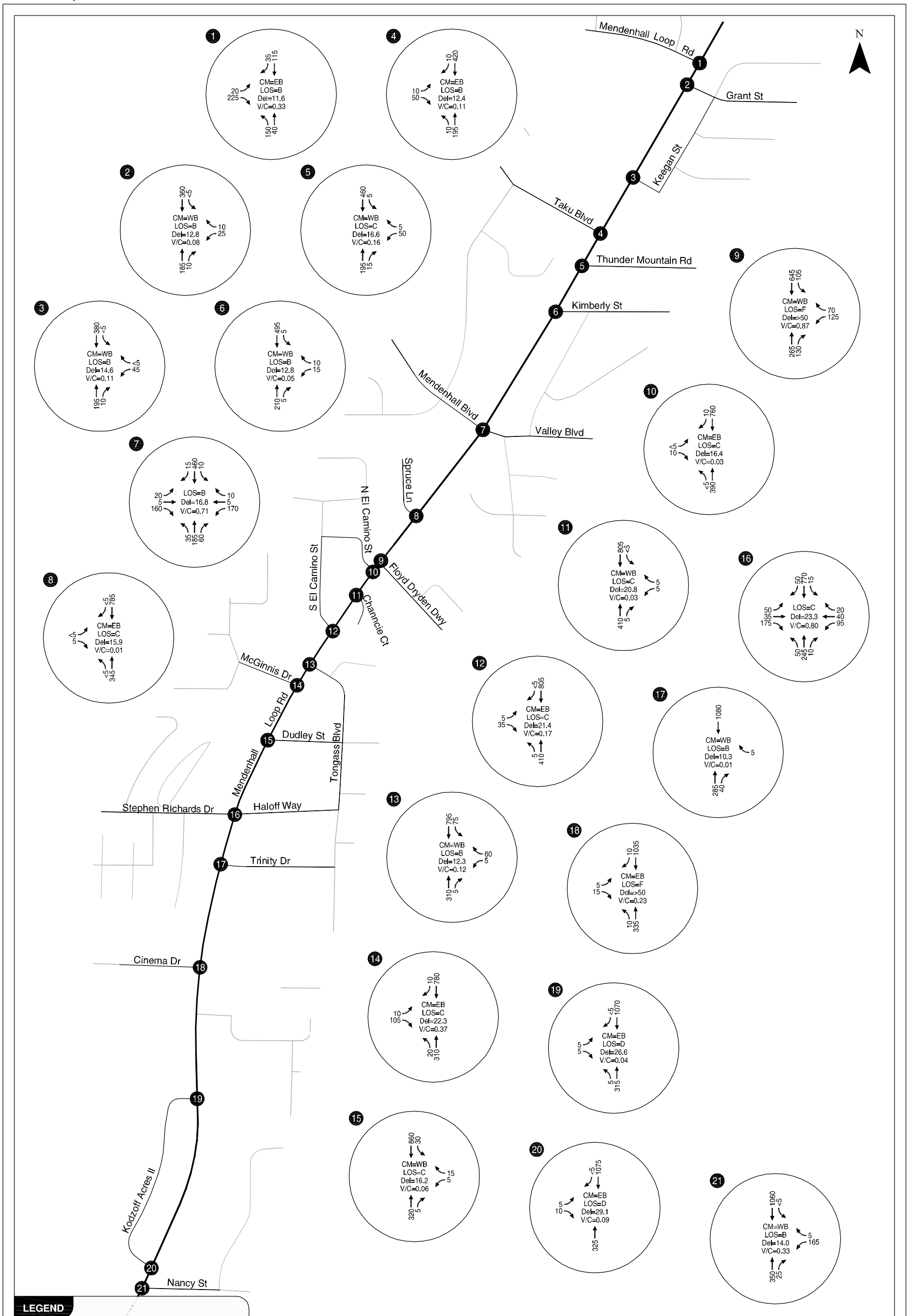
- STOP SIGN
- TRAFFIC SIGNAL

Existing Lane Configurations and Traffic Control Devices
Juneau, Alaska

Figure **16**

C:\Users\boullimore\appdata\local\temp\AcPublish_17056\13358_Fig.dwg Oct 27, 2014 - 11:21am - boullimore Layout Tab: 16

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING/PLANNING

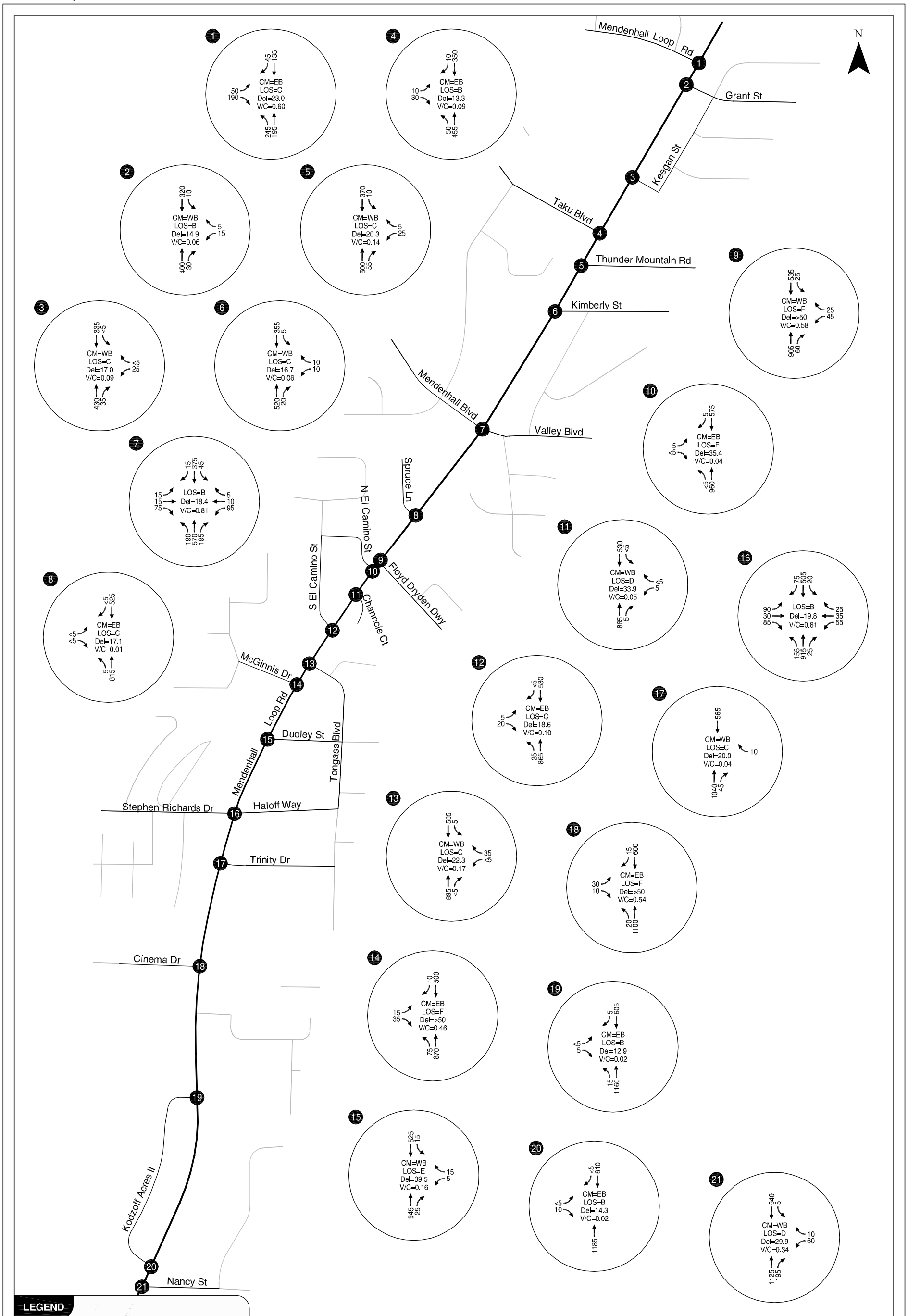


LEGEND

CM = CRITICAL MOVEMENT (UNSIGNALIZED)
LOS = INTERSECTION LEVEL OF SERVICE (SIGNALIZED)/CRITICAL MOVEMENT LEVEL OF SERVICE (UNSIGNALIZED)
Del = INTERSECTION AVERAGE CONTROL DELAY (SIGNALIZED)/CRITICAL MOVEMENT CONTROL DELAY (UNSIGNALIZED)
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

Existing AM Peak Hour Traffic Conditions
Juneau, Alaska

Figure **17**



LEGEND

CM = CRITICAL MOVEMENT (UNSIGNALIZED)
LOS = INTERSECTION LEVEL OF SERVICE (SIGNALIZED)/CRITICAL MOVEMENT LEVEL OF SERVICE (UNSIGNALIZED)
Del = INTERSECTION AVERAGE CONTROL DELAY (SIGNALIZED)/CRITICAL MOVEMENT CONTROL DELAY (UNSIGNALIZED)
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

Existing PM Peak Hour Traffic Conditions
Juneau, Alaska

Figure **18**

Field observation and operations analysis indicates that vehicle queuing is an issue in the peak hours. Peak direction queues along Mendenhall Loop Road form in the southbound and northbound directions in the a.m. and p.m. peak hours, respectively. Southbound queues build at both signalized intersections, Stephen Richards Drive/Haloff Way and Mendenhall Boulevard/Valley Boulevard, in the a.m. peak. In the p.m. peak hour, northbound queues form at both signalized intersections. The northbound queue at Stephen Richards Drive was calculated to extend nearly 1000 feet during the weekday p.m. peak hour, blocking side street access points. While peak direction queuing is an issue for both peak periods, the northbound queue at Stephen Richards Drive is particularly notable. Table 1 reports the calculated queues at the signalized intersections.

Table 1 Existing 95th Percentile Queues on Mendenhall Loop Road

Mendenhall Loop Road Intersection	Weekday AM Peak Hour		Weekday PM Peak Hour	
	Northbound Queue (ft)	Southbound Queue (ft)	Northbound Queue (ft)	Southbound Queue (ft)
Stephen Richards/Haloff Way	150	750	950*	425
Mendenhall Blvd/Valley Blvd	150	325	650*	250

*95th percentile volume exceeds capacity, queue may be longer

In summary, the following operational issues were identified:

- High peak hour side street vehicle delay at Nancy Street, Cinema Drive, Dudley Street, McGinnis Drive, and Floyd Dryden Access Road.
- Peak hour directional vehicle queuing on Mendenhall Loop Road at the Stephen Richards Drive/Haloff Way and Mendenhall Boulevard/Valley Boulevard intersections.

Appendix 1 contains the Synchro worksheets.

SAFETY ANALYSIS

Crash analysis of the corridor was performed to identify opportunities to reduce segment and/or intersection crashes. Crash histories were reviewed for trends and patterns and used to calculate critical crash rates by intersection. Any identified issues were noted and were considered through the concept development.

Crash records were obtained from DOT&PF for the five-year period from January 1, 2007 through December 31, 2011. Intersection crash data was reviewed at the intersections along Mendenhall Loop Road from Nancy Street to Back Loop. A summary of the available crash data over the five-year period is provided in Table 2. Appendix 2 contains the crash data worksheets.

Table 2 Study Area Crash Summary (2007-2011)

Intersection	Collision Type								Severity			Total Crashes
	Angle	Turning	Side-swipe	Rear End	Head On	Fixed Object	Ped / Bike	Other	PDO	Injury	Fatality	
Nancy St.	3	0	0	1	1	0	1	0	5	1	0	6
Kodzoff St.	1	0	0	0	0	0	0	0	1	0	0	1
Lakeside Condos Dr.	0	0	0	0	0	1	0	0	1	0	0	1
Cinema Dr.	1	0	1	3	0	1	1	1	5	3	0	8
Trinity Dr.	0	0	0	4	0	0	0	1	4	1	0	5
Stephen Richards Dr./Haloff Way	14	0	0	5	0	0	1	0	14	6	0	20
Dudley St.	0	0	0	0	0	0	0	0	0	0	0	0
McGinnis Dr.	0	0	0	0	0	0	0	0	0	0	0	0
Tongass Blvd.	0	0	0	0	0	0	0	0	0	0	0	0
El Camino St.	0	0	0	0	0	0	0	0	0	0	0	0
Channcie Ct.	0	0	0	0	0	0	0	0	0	0	0	0
Floyd Dryden Access Rd.	0	0	0	4	0	0	1	1	2	4	0	6
Spruce Ln.	0	0	0	0	0	0	0	0	0	0	0	0
Mendenhall Blvd./Valley Blvd.	9	0	1	12	0	0	1	0	12	11	0	23
Kimberly Rd.	1	0	0	1	0	0	0	0	1	1	0	2
Thunder Mtn. Rd.	0	0	1	1	0	1	0	0	2	1	0	3
Taku Blvd.	1	0	0	0	0	0	0	0	0	1	0	1
Keegan St.	0	0	0	0	0	0	0	0	0	0	0	0
Grant St.	0	0	0	2	0	0	0	0	1	1	0	2
Back Loop	1	0	0	1	0	1	1	0	1	3	0	4

A review of the above crash data found that the intersections at Stephen Richards Drive/Haloff Way and Mendenhall Boulevard/Valley Boulevard on Mendenhall Loop Road have the two highest crash occurrences with 20 and 23, respectively.

Of the 20 crashes at Stephen Richards Drive/Haloff Way, 14 were angle crashes. Six of the angle crashes involved left turning vehicles. The Stephen Richards Drive and Haloff Way meet at a skew. In addition, the intersection is located on a curve such that the sight distance for northbound vehicle turning left can be blocked by a vehicle in the opposing left-turn lane. Public comments mentioned the alignment of the intersection needs to be improved and turning is difficult from all directions. The intersection at Stephen Richards Drive/Haloff Way currently has a Highway Safety Improvement Program (HSIP) project in process to help mitigate the safety issues experienced there. This project will reconfigure the lanes of the Stephen Richard Drive and Haloff Way approaches.

The intersection of Mendenhall Boulevard/Valley Boulevard and Mendenhall Loop Road experienced 23 crashes over the 5-year period. Of the 23 crashes, 12 were rear end collisions and of the 12 rear ends, 8 reported injuries. Six of the rear end crashes occurred during the peak traffic hours. All of the rear end crashes were between vehicles heading north and south on Mendenhall Loop Road.

Two pedestrian-related and four bicycle-related crashes were reported across six corridor intersections, as shown in Table 2. Four of the crashes occurred during the peak traffic hours with three being in the morning peak and the other in the evening peak. Five of the crashes resulted in injuries, one of which was a classified as a major injury. In the five crashes where the ages were reported, the bicyclists or pedestrians were between 10 and 13 years old.

DOT&PF provided statewide average crash rates at a variety of intersection configurations based on number of approaches and traffic control types. The average crash rate represents the approximate number of crashes that are “expected” at a study intersection. However, this average crash rate was used to calculate the critical crash rate for each study intersection, based on the DOT&PF HSIP Manual methodology.

Per the DOT&PF HSIP Manual, intersections are flagged for further review when the safety index, calculated by the observed crash rate over the critical crash rate, is greater than or equal to 0.9, or if the intersection has experienced one fatal crash or two major injury crashes in the past five years.

The summary crash data in Table 3 reports the observed crashes, million entering vehicles (MEV), the observed crash rate per MEV, the statewide average crash rate, critical crash rate, and safety index for all study intersections.

Table 3 Intersection Crash Rate Analysis (2007-2011)

Intersection	Total Crashes	Total Million Entering Vehicles (MEVs)	Crash Rate (per MEV)	ADOT Average Crash Rate (per MEV)	Critical Crash Rate	Safety Index
Nancy St.	6	37.1	0.16	0.47	0.67	0.24
Kodzoff St.	2	32.9	0.03	0.47	0.68	0.04
Lakeside Condos Dr.	1	32.6	0.03	0.47	0.68	0.04
Cinema Dr.	8	32.6	0.25	0.47	0.68	0.36
Trinity Dr.	5	30.3	0.16	0.47	0.69	0.24
Stephen Richards Blvd./Haloff Blvd.	20	36.8	0.54	1.36	1.69	0.32
Dudley St.	0	27.9	0.00	0.47	0.70	0.00
McGinnis Dr.	0	27.5	0.00	0.47	0.70	0.00
Tongass Blvd.	0	26.4	0.00	0.47	0.71	0.00
El Camino St.	0	26.4	0.00	0.47	0.71	0.00
Channcie Ct.	0	25.6	0.00	0.47	0.71	0.00
Floyd Dryden Rd.	6	29.2	0.21	0.47	0.70	0.29
Spruce Ln.	0	24.6	0.00	0.47	0.72	0.00
Mendenhall Blvd./Valley Blvd.	23	29.2	0.79	1.36	1.73	0.45
Kimberly Rd.	2	16.7	0.12	0.47	0.78	0.15
Thunder Mtn. Rd.	3	17.6	0.17	0.47	0.77	0.22
Taku Blvd.	1	16.6	0.06	0.58	0.92	0.07
Keegan St.	0	15.1	0.00	0.47	0.79	0.00
Grant St.	2	14.2	0.14	0.47	0.80	0.18
Back Loop	4	15.8	0.25	0.47	0.78	0.32

Table 3 shows the safety indices of all study intersections are below the 0.90 DOT&PF threshold. All crash rates are below the statewide average. The review of the crash data also revealed only the intersection at Mendenhall Boulevard/Valley Boulevard met the severity threshold with two major injury crashes in the past five years. One of the injury crashes was between a bicyclist and a vehicle when the bicyclist disregarded a traffic control device. The other crash, an angle crash, was between two vehicles due to a red light violation.

The 2010 Southeast Region Traffic and Safety Report lists several of the intersections along the study corridor, including the Mendenhall Loop Road/Mendenhall Boulevard/Valley Boulevard intersection, which was reported to have the highest crash rate in the region. Other intersections on the list are Mendenhall Loop Road/Stephen Richards Drive/Haloff Way and Mendenhall Loop Road/Nancy Street, ranked 10th and 28th, respectively. This 2010 study utilized an older data set than the 2007-2011 crash data analyzed in this memorandum.

In summary, the crash analysis of the corridor revealed the following crash patterns:

- Left-turn angle crashes at the Stephen Richards Drive/Haloff Way intersection;
- Rear-end crashes at the Mendenhall Boulevard/Valley Boulevard intersection; and
- Crashes involving young pedestrians and bicyclists.

NON-MOTORIZED CONDITIONS

Non-motorized travel is popular along Mendenhall Loop Road as a bicycle commuter route as well as for pedestrian travel along and across to surrounding schools and transit stops as documented in the *Traffic and Non-Motorized Volume Summary* technical memorandum. To facilitate this travel, Mendenhall Loop Road currently has longitudinal and crossing treatments for bicyclists and pedestrians. These facilities have been assessed to identify any non-motorized transportation needs.

Longitudinally, Mendenhall Loop Road has facilities for both pedestrians and bicyclists for the length of the study corridor. Ten-foot-wide, separated, multiuse paths are on both sides of the corridor and are used by pedestrians and some bicyclists. An 8-to-10-foot shoulder on either side is present starting north of the Kodzoff Acres south entrance and is used as a bike lane by some bicyclists.

There are three intersections with marked crosswalks across Mendenhall Loop Road: Stephen Richards Drive/Haloff Way, Floyd Dryden Access Road, and Mendenhall Boulevard/Valley Boulevard. The signalized intersections at Stephen Richards Drive/Haloff Way and Mendenhall Boulevard/Valley Boulevard have standard crosswalk markings on all approaches and pedestrian countdown signal heads. The high-visibility (“zebra-style”) crosswalk on the north side of the Floyd Dryden Access Road is supplemented by an actuated pedestrian hybrid beacon, also known as a HAWK signal. Per Alaska statute, pedestrians are allowed to cross at all intersections, regardless of whether they are marked or not (13 AAC 02.160 – Reference 1), unless pedestrians are specifically prohibited from crossing.

Facilities provided on Mendenhall Loop Road supply adequate routes for bicycle and pedestrian use. The combination of the multiuse path and the shoulder bike lanes provide a range of facilities for bicyclists to choose what best fits their comfort and ability. The multiuse path also provides a comfortable pedestrian path separate from vehicle traffic. However, pedestrian crossings are limited, with three marked and signalized crossings on the 1.75-mile corridor. Though having both bike lanes and a multiuse path is typical in Alaska, the American Association of State Highway Officials (AASHTO) *Guide to Bicycle Facilities* discourages their use in combination due to conflicts with vehicles at access points, higher bicycle speeds on a sidewalk than expected by drivers, and conflicts with pedestrians.

TRANSIT FACILITIES

Along with the other modes of travel, transit has a presence with stops along the corridor at Nancy Street, Cinema Drive, Stephen Richards Drive, Floyd Dryden Access Road, Mendenhall Boulevard/Valley Boulevard, and Taku Boulevard-Thunder Mountain (inbound-outbound). Half of the transit stops have bus pullouts; the stops at Cinema Drive, Floyd Dryden Access Road, and Taku Boulevard-Thunder Mountain are lacking bus pullouts. Three of the six transit stops are located at or near marked crosswalks.

ACCESS MANAGEMENT

Access along Mendenhall Loop Road was evaluated to confirm the function of those that are necessary and appropriate and to identify opportunities for consolidation or possible closure. There are a number of parcels and subdivisions having multiple or redundant access points along the corridor, with some serving backyards and fenced areas. Accesses create conflicts between vehicles, bicyclists, and pedestrians, affecting non-motorized comfort and safety.

There are two sections, just north of each signalized intersection on the southbound side, that have a number of residential driveways with access to Mendenhall Loop Road. These residences have no other access points. The driveways are in the conflict zone for the left-turn lanes of the nearby signalized intersections, with left-turn movements into and out of the driveways impeded during peak periods. Other residences along the corridor have alternate accesses to side streets as well as access to Mendenhall Loop Road.

FUTURE TRAFFIC OPERATIONS

Future no-build traffic operations were evaluated to establish a vehicle operations baseline and to identify operations issues that may arise under future conditions. The future no-build scenario maintains existing lane configurations and signal operations while increasing traffic volumes to match projected growth in the area.

Future year 2035 traffic volumes were developed using an annual background growth rate. Based on historical vehicular volume growth rates and discussions with CBJ staff, a 0.5-percent annual growth

rate was used to develop future vehicular volumes. The development is documented in the previous sections. Figure 19 and 20 show the 22-year projected vehicular turning movement volumes.

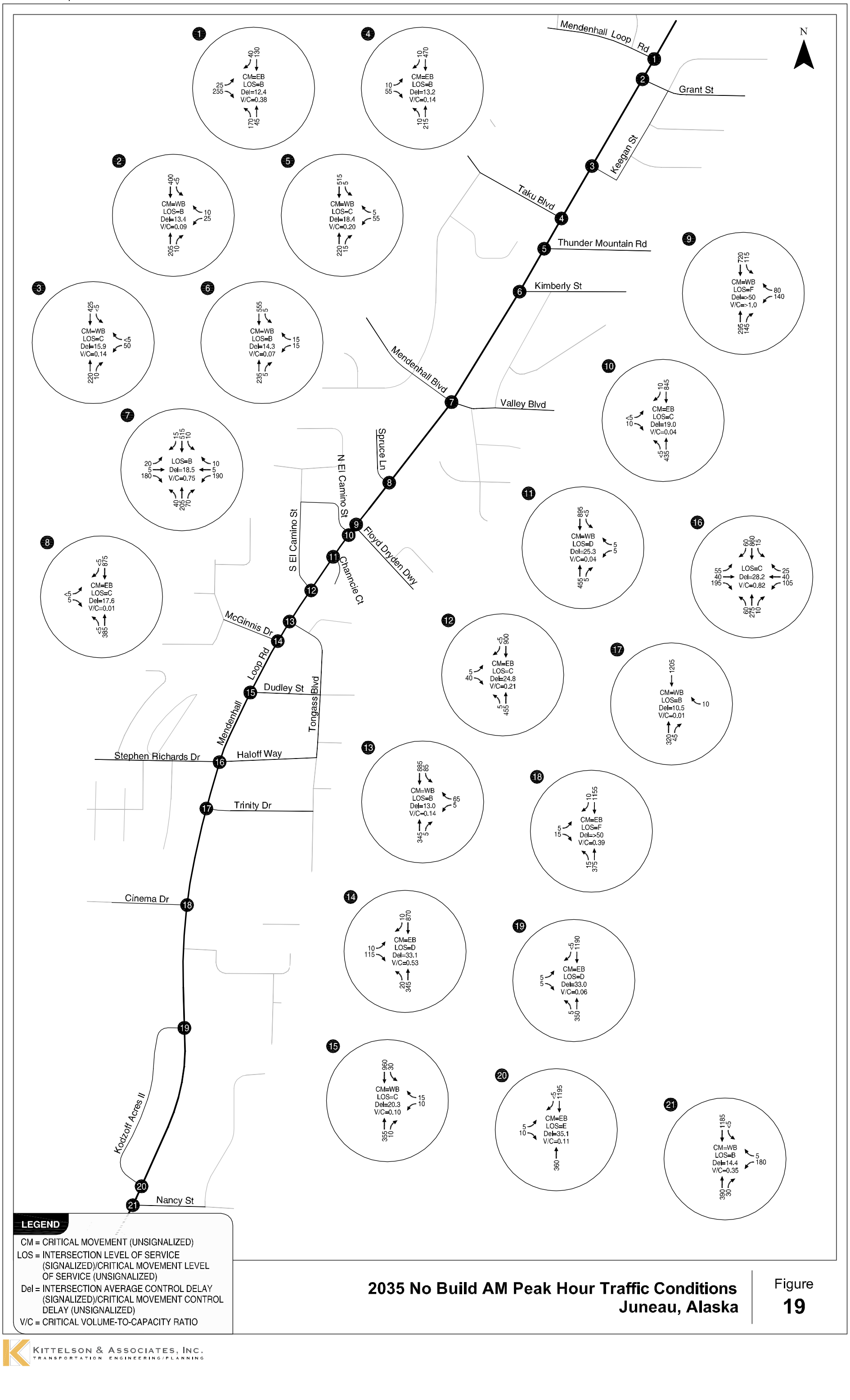
The projected vehicle volumes were used to analyze the study intersections under future no-build conditions. Results are reported in Figure 19 and 20. As shown in the figures, the same intersections (Floyd Dryden Access Road, McGinnis Drive, Dudley Street, Cinema Drive, and Nancy Street) that operate below LOS D under existing conditions continue to operate the same or worse due to the increase in volumes. In addition to those intersections, the operations of El Camino Street (north access) and Channcie Court drop to LOS E during the weekday p.m. peak hour.

Queuing continues to be an issue in the future model year of 2035 at the intersections of Stephen Richards Drive/Haloff Way and Mendenhall Boulevard/Valley Boulevard. Table 4 summarizes the queues at these intersections.

Table 4 2035 No-Build 95th Percentile Queues on Mendenhall Loop Road

Mendenhall Loop Road Intersection	Weekday AM Peak Hour		Weekday PM Peak Hour	
	Northbound Queue (ft)	Southbound Queue (ft)	Northbound Queue (ft)	Southbound Queue (ft)
Stephen Richards/Haloff Way	175	1000*	1150*	525
Mendenhall Blvd/Valley Blvd	175	400	775*	300

*95th percentile volume exceeds capacity, queue may be longer

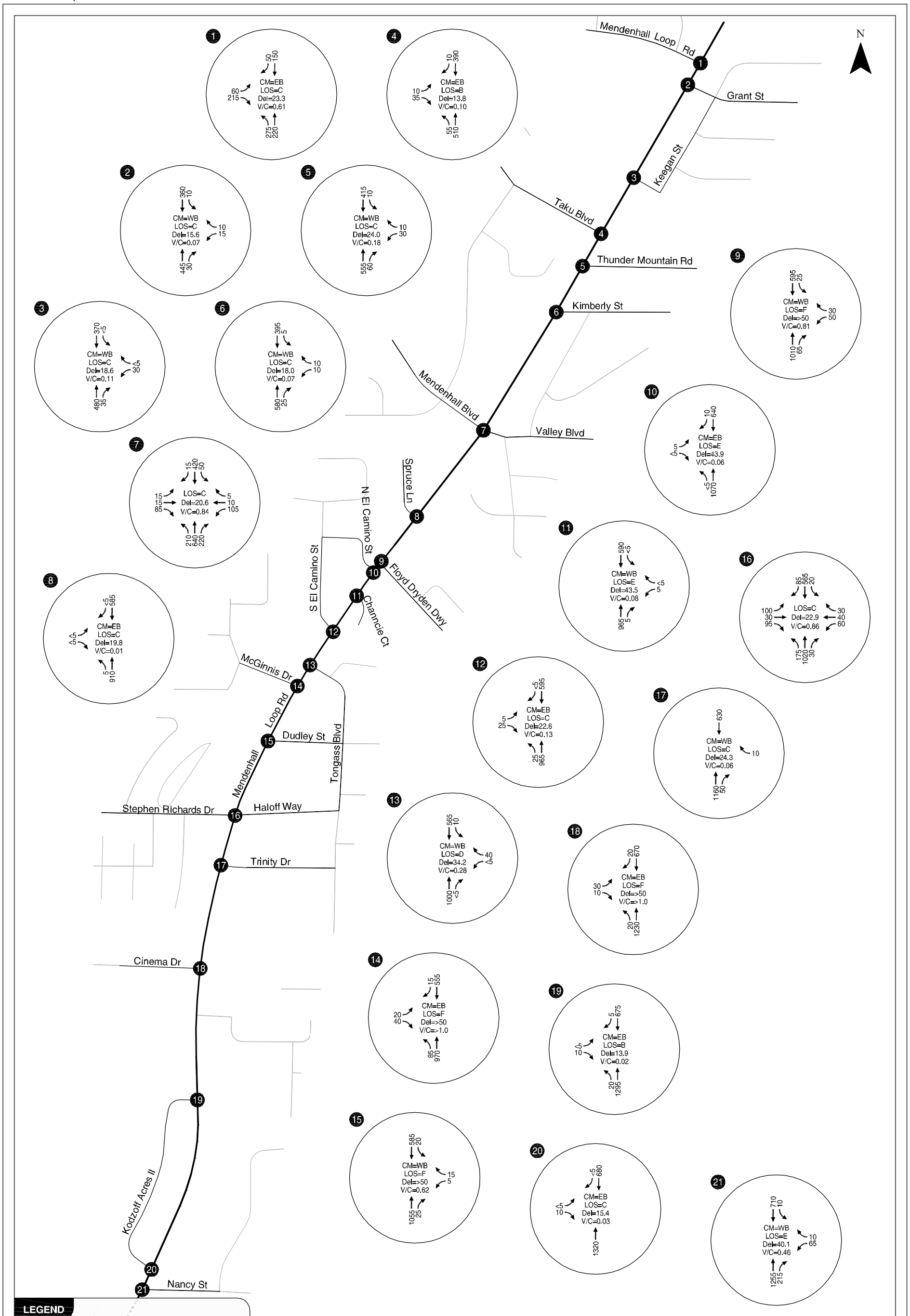


LEGEND

CM = CRITICAL MOVEMENT (UNSIGNALIZED)
LOS = INTERSECTION LEVEL OF SERVICE (SIGNALIZED)/CRITICAL MOVEMENT LEVEL OF SERVICE (UNSIGNALIZED)
Del = INTERSECTION AVERAGE CONTROL DELAY (SIGNALIZED)/CRITICAL MOVEMENT CONTROL DELAY (UNSIGNALIZED)
V/C = CRITICAL VOLUME-TO-CAPACITY RATIO

2035 No Build AM Peak Hour Traffic Conditions
Juneau, Alaska

Figure **19**



2035 No Build PM Peak Hour Traffic Conditions
Juneau, Alaska

Figure **20**

Section 3
Public Comment Summary

PUBLIC COMMENT SUMMARY

Two open houses were held to give information about the project and receive public comments and concerns about the corridor. Comments were received verbally, hand written, and emailed. The first open house was held toward the beginning of the project, November 11th, 2013, to introduce the first round of corridor concepts. The second open house occurred further along in the project timeline, July 8th, 2014, introducing the second and final round of corridor concepts that were developed with consideration of public comment from the previous meeting. The first meeting was held at Floyd Dryden Middle School, and the second meeting was held at Thunder Mountain High School.

The first open house presented three five-lane corridor concepts, which are referred to the next section as Concepts A1, A2, and A3. The most common issues centered around operational issues at four intersections (Nancy Street, Stephen Richards Drive/Haloff Way, Floyd Dryden Access Road, and Mendenhall Boulevard/Valley Boulevard), bicycle and pedestrian facilities, corridor wide treatments, and concerns over corridor widening. Public comments were not in favor of widening the roadway to five lanes, except for where critically necessary. As Mendenhall Loop Road is a commuter route (for vehicles, transit, and bicycles) as well as primarily a residential area with two schools, many felt adding lanes would decrease the safety along the corridor for all users. Widening at specific locations such as at the intersections at Stephen Richards Drive/Haloff Way, Floyd Dryden Access Road, and Mendenhall Boulevard/Valley Boulevard did have support from the public. Concepts that did not involve expansion of the cross section to five lanes were developed in response to the public comments.

The second open house introduced four new three-lane concepts, referred to the next section as Concepts B1, B2, B3, and B4, and also presented the original five-lane concepts. The three-lane concepts addressed the concerns expressed in the previous open house. In general, the new three-lane concepts were favored over the five-lane concepts, while suggestions for incorporating treatments from both families of concepts was voiced as well. Public comments indicated a desire for education on treatments proposed in the concepts including roundabouts and pedestrian crossing aids, e.g. pedestrian hybrid beacon.

A full summary of public comments received is provided in Appendix 3.

Section 4
Corridor Concept Development and Evaluation

CORRIDOR CONCEPT DEVELOPMENT AND EVALUATION

Concepts were developed to address the operations and safety issues identified through initial evaluation of the corridor. Peak-direction vehicle operations and queues, particularly at the Stephen Richards Drive/Haloff Way intersection, led to a series of concepts where Mendenhall Loop Road is widened to a combination of three- and five-lane cross sections. Additional vehicle travel lanes on Mendenhall Loop Road would add capacity needed to effectively move the peak hour traffic through the corridor reducing the queues and improving operations. The southern end of the study section has the heaviest traffic volumes and would benefit the most from a five-lane cross section. Three five-lane concepts were developed and were presented to the public in the open house. As noted previously, public comments were largely opposed to expanding the roadway to five lanes due to the impacts of widening the roadway, including the following:

- Increased pedestrian crossing length, exposure and time;
- Potential overbuilding of the corridor when the problem is primarily the Stephens Richards/Haloff intersection;
- Potential reduced winter snow storage; and
- Decreased vegetation and sound buffer.

As the capacity constraints on the corridor are primarily caused by the signalized intersections—the Stephen Richards Drive/Haloff Way intersection in particular—additional three-lane concepts with widening limited to the intersections were developed. The following sections discuss the development and details of the concepts.

Two families of concepts were developed. The first family of concepts includes the original three five-lane concepts presented to the public in November 2013; these are designated Concepts A1, A2, and A3. These concepts each include a five-lane cross section, consisting of two travel lanes in each direction and a center turn lane, but they differ in where the roadway transitions from five lanes to three. Concept A1 consists of a five-lane cross section from Nancy Street to Stephen Richards Drive/Haloff Way. Concept A2 extends the five-lane section north, transitioning to three lanes north of Floyd Dryden Access Road. Concept A3 includes the five-lane section to north of Mendenhall Boulevard/Valley Boulevard. From the transition points, the cross section narrows to three lanes, one travel lane in each direction with a center turn lane, which continues for the remainder of the corridor to Back Loop.

The B family is a series of four concepts, B1, B2, B3, and B4, focusing on improvements that would maintain a three-lane cross section for the length of the corridor and expanding the roadway only at the intersections of Stephen Richards Drive/Haloff Way and Floyd Dryden Access Road. Concept B1 maintains the existing signalized traffic control throughout the corridor and expands the Stephen Richards Drive/Haloff Way intersection with auxiliary through lanes to add through capacity and reduce queues. Concepts B2, B3, and B4 introduce roundabouts at key intersections. Concept B2 includes a roundabout at Stephen Richards Drive/Haloff Way; Concept B3 includes roundabouts at Stephen

Richards Drive/Haloff Way and Floyd Dryden Access Road; and Concept B4 includes roundabouts at these two intersections plus Mendenhall Boulevard/Valley Boulevard.

Roundabouts can provide a range of benefits for the Mendenhall Loop Road corridor. At individual intersections, they can improve side-street capacity and can provide a substantial reduction in crash severity. Along the main street corridor, a roundabout can reduce vehicle speeds through vehicle path deflection accomplished via raised medians and curbs. Where roundabouts are implemented in a series along a corridor, as done in Concepts B3 and B4, they provide an opportunity for access management. Left-turns from driveways can be restricted with minimal impact if the left-turn movement can be accommodated indirectly via a right-turn and a U-turn at a nearby roundabout.

CORRIDOR CONCEPT DEVELOPMENT

Seven concepts (three five-lane and four three-lane concepts) were developed to address operational and safety issues on Mendenhall Loop Road. All concepts maintain the shoulder bike lane (6 foot width minimum), buffer/ditch (10 to 12 feet in width), multiuse path (10 feet in width), and treed buffer (variable width) on both sides. Travel lane widths vary with the availability of right-of-way (ROW), as does the treed buffer. The treed buffer will be maintained to the extent possible. Though the five-lane cross sections are as narrow as feasible and fit within the existing right-of-way, portions of the proposed five-lane sections may require additional right-of-way to match the existing grade beyond the path. These areas will be affected the most by the reduced treed buffer. Identifying those locations and the scale of their impacts is beyond the scope of this study.

Access management is suggested in all concepts as well. Redundant and unused accesses are recommended to be closed. Access management within the transition zones of concepts A1, A2, and A3 and the roundabout area in B2, B3, and B4 and proposed access closures are discussed by concept in the following sections.

Concepts A1, A2, and A3 are five-lane concepts. Each of the three concepts have five-lane and three-lane cross sections varying by where the cross section transition occurs. Figure 21, 22, and 23, are the cross sections for concepts A1, A2, and A3. Figure 21 is the proposed five-lane section with two-way left-turn lane (TWLTL) which would be implemented from Nancy Street to the transition point of each A concept. Figure 22 depicts the proposed five-lane section with median and dedicated left-turn lane proposed to be implemented at intersections. Figure 23 is the proposed three-lane section with TWLTL that would be applied after the transition and in all the three-lane concepts to Back Loop Road.

Concepts B1, B2, B3, and B4 are a three-lane concept with intersection expansions or conversion to roundabout at key intersections on the corridor to serve projected peak traffic demand. The three-lane concepts will have the same cross section that is depicted in Figure 23; this cross section would also extend to Back Loop Road.

Each concept is described in further detail in the following sections and conceptual drawings are included in Appendix 4. Detailed evaluation of each corridor for vehicle operations, non-motorized facilities, and safety were performed and are described in the following the concept descriptions.

Figure 21 Proposed 5-Lane Section with Two-Way Left Turn Lane

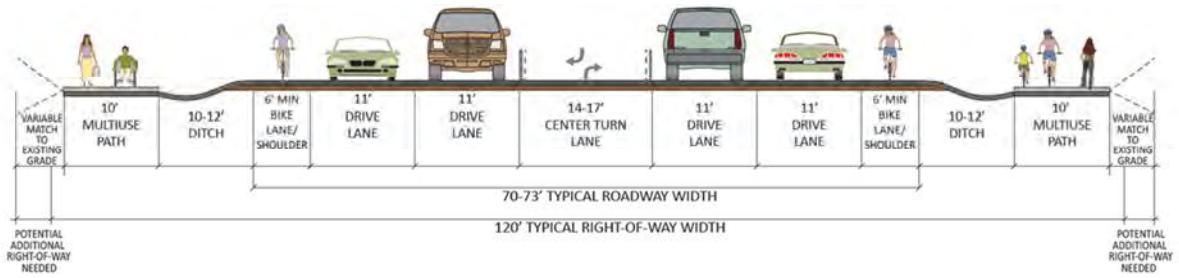
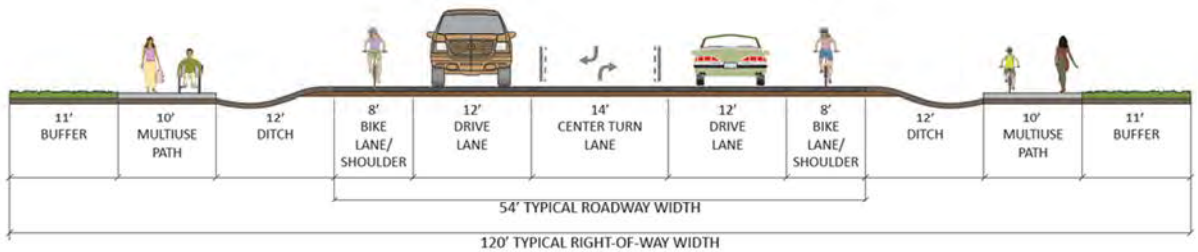


Figure 22 Proposed 5-lane with Median and Dedicated Turn Lane

Figure 23 Proposed 3-lane with Two-Way Left Turn Lane



Concept A1 – Five-Lane Cross Section with Transition North of Stephen Richards Drive/Haloff Way

Concept A1, presented in figures A1-1 through A1-6, found in Appendix 4, consists of widening the roadway to a five-lane cross section, transitioning to a three-lane section north of the Stephen Richards/Haloff Way intersection. Treatments to the corridor are described in more detail specific to concept A1 in the following:

Longitudinal Treatments

- Widen to five-lane cross section with TWLTL from Nancy Street through the Stephen Richards Drive/Haloff Way intersection.
- Transition from five-lane to three-lane cross section north of Stephen Richards Drive/Haloff Way intersection.
- Maintain three-lane cross section with TWLTL from north of Stephen Richards/Haloff intersection to Mendenhall Boulevard/Valley Boulevard intersection and widen to three-lane cross section with TWLTL to Back Loop.
- Enhance existing lighting at pedestrian crossings and intersections (common to all A concepts).

Access Management

- Limit Kodzoff Acres (south access) to right in/right out.
- Limit Lake Side Condos access to right in/right out.
- Limit Trinity Drive to right in/right out.
- Close private access:
    - On west side of the street north of McGinnis Drive, two access points.
    - On east side of the street north of Tongass Boulevard.
    - On west side of the street between Mendenhall Boulevard/Valley Boulevard and Kimberly Street: it is a redundant access point.
    - On the east side of the street between Mendenhall Boulevard/Valley Boulevard and Kimberly Street.
- Limit Thunder Mountain Road to right in/right out.

Bus Stop Improvements

- Relocate bus stops at Cinema Drive to north leg and add pullouts and shelters.
- Relocate existing bus stops and add pullouts with shelters at Floyd Dryden Access Road stops.

Intersection Treatments

- Nancy Street
    - Remove receiving and acceleration lane on Mendenhall Loop Road. Left-turning vehicles use the TWLTL for two-stage gap acceptance.

  - Install raised median for southbound left-turn lane.
- Cinema Drive
  - Add marked pedestrian crossing with raised median on north leg.
  - Add raised median for northbound left-turn lane.
- Stephen Richards Drive/Haloff Way
  - Modify signal to convert northbound and southbound left turn phasing to protected left turn only and side streets left turn phasing to protected-permitted with flashing yellow arrow indication.
  - Realign side street approaches and change lane configuration to exclusive left-turn lane and through-right.
  - Install raised median for northbound left-turn lane.
- Floyd Dryden Access Road
  - Modify pedestrian hybrid beacon (PHB) for two-stage crossing.
- Mendenhall Boulevard/Valley Boulevard
  - Adjust signal timing as needed to match demand patterns.
  - Add northbound right-turn lane.
  - Add bicycle detection in bike lane.
  - Paint conflict zone green.
- Floyd Dryden Access Road and Short Way connection
  - Add a new school connection to Short Way.
- Taku Boulevard
  - Add raised median for northbound left-turn lane.
- Keegan Street
  - Align church access with Keegan Street.

Concept A2 – Five-Lane Cross Section with Transition North of Floyd Dryden Access Road

Concept A2 uses the same cross sections and treatments as Concept A1 but continues the five-lane section further north, transitioning from five lanes to three lanes north of the Floyd Dryden Access Road. Figures A2-1 through A2-6, found in Appendix 4, show Concept A2 for the length of the corridor with callouts for specific treatments. Concept A2 is identical to Concept A1 for the corridor south of Stephen Richards Drive/Haloff Way and north of Floyd Dryden Access Road. The differences between Concepts A1 and A2 are as follows:

Longitudinal Treatments

- Widen to five-lane cross section with TWLTL from Nancy Street through Floyd Dryden Access Road intersection.
- Transition from five-lane to three-lane cross section north of Floyd Dryden Access Road intersection.

- Maintain three-lane cross section with TWLTL from north of Floyd Dryden Access Road intersection to Mendenhall Boulevard/Valley Boulevard intersection and widen to three-lane cross section with TWLTL to Back Loop.

Access Management

- No additional access management treatments in the proposed A2 concept.

Bus Stop Improvements

- No additional bus stop changes in the proposed A2 concept.

Intersection Treatments

- No additional intersection treatments in the A2 concept.

Concept A3 – Five-Lane Cross Section with Transition North of Mendenhall Boulevard/Valley Boulevard

Concept A3 is largely similar to Concepts A1 and A2 but extends the five-lane section further north to the Mendenhall Boulevard/Valley Boulevard intersection. Figures A3-1 through A3-6, found in Appendix 4, show the concept with callouts for specific treatments. The following presents the treatments that are different from the treatments presented in the A1 and A2 concepts.

Longitudinal Treatments

- Widen to five-lane cross section with TWLTL from Nancy Street through Mendenhall Boulevard/Valley Boulevard intersection.
- Transition from five-lane to three-lane cross section north of Mendenhall Boulevard/Valley Boulevard intersection.
- Widen to three-lane cross section with TWLTL from north of Mendenhall Boulevard/Valley Boulevard intersection to Back Loop.

Access Management

- No additional access management treatments in the proposed A3 concept.

Bus Stop Improvements

- No additional bus stop changes in the proposed A3 concept.

Intersection Treatments

- No additional intersection treatments in the proposed A3 concept.

Concept B1 – Three-Lane Concept with Expanded Stephen Richards Signal

Concept B1 consists of a three-lane cross section for the length of the corridor, except for the addition of auxiliary through lanes at the Stephen Richards Drive/Haloff Way traffic signal. These lanes, shown in Figure B1-3, increase the capacity of the signal and provide additional vehicle queue storage. Figures B1-1 through B1-6, found in Appendix 4, show the concept for the length of the corridor with callouts for specific treatments. Details of B1 are discussed further in the following sections.

Longitudinal Treatments

- Maintain existing three-lane cross section between Nancy Street and Mendenhall Boulevard/Valley Boulevard.
- Add TWLTL to existing two-lane cross section north of Mendenhall Boulevard/Valley Boulevard.
- Enhance existing lighting at pedestrian crossings and intersections (common to all B concepts).

Access Management

- Restrict Kodzoff Acres (south access) to right in/right out.
- Restrict Lake Side Condos access to right in/right out.
- Restrict Trinity Drive to right in/right out.
- Close private access points as shown on the figures:
    - On west side of the street north of McGinnis Drive, two access points.
    - On east side of the street north of Tongass Boulevard.
    - On west side of the street between Mendenhall Boulevard/Valley Boulevard and Kimberly Street (the access point is redundant).
    - On the east side of the street between Mendenhall Boulevard/Valley Boulevard and Kimberly Street.
- Restrict Thunder Mountain Road to right-in/right-out.

Bus Stop Improvements

- Relocate bus stops at Cinema Drive to north leg and add pullouts with shelters.
- Relocate existing bus stops and add pullouts with shelters at Floyd Dryden Access Road stops.

Intersection Treatments

- Cinema Drive
    - Add marked pedestrian crossing with RRFB and raised median refuge on north leg.
- Stephen Richard Drive/Haloff Way expansion

  - Add auxiliary through lanes in the northbound and southbound directions.
  - Modify signal to convert northbound and southbound left turn phasing to protected left turn only and side streets left turn phasing to protected/permitted with flashing yellow arrow indication.
  - Realign side street approaches and change lane configuration to exclusive left-turn lane and through-right.
- Floyd Dryden Access Road
  - Modify PHB for two-stage crossing.
- Mendenhall Boulevard/Valley Boulevard
  - Add northbound right turn lane.
  - Add bicycle detection in bike lane.
  - Paint conflict zone green.
- Floyd Dryden Access Road and Short Way connection
  - Add a new school connection to Short Way.
- Taku Boulevard
  - Install raised median for northbound left-turn lane.
- Keegan Street
  - Align church access with Keegan Street.

Concept B2 – Three-Lane Concept with Roundabout at Stephen Richards Drive/Haloff Way

Concept B2 consists of the same three-lane cross section as Concept B1 but implements a roundabout at the intersection of Stephen Richards Drive/Haloff Way. Figures B2-1 through B2-6, found in Appendix 4, show the concept for the length of the corridor with callouts for specific treatments. As with the A family of concepts, the B family concepts are identical for the majority of the corridor. Concept B2 differs from Concept B1 as follows:

Longitudinal Treatments

- No additional longitudinal treatments in the proposed B2 concept

Access Management

- Limited access to driveways and side streets within roundabout approaches

Bus Stop Improvements

- The Stephen Richards Drive/Haloff Way bus stops are relocated further downstream of the intersection due to the roundabout configuration.

Intersection Treatments

- Stephen Richards Drive/Haloff Way

- Install a multilane roundabout with two circulating lanes for the northbound and southbound through movements.
- Install offset pedestrian crossings with RRFBs and pedestrian refuges on the north, south, and west legs.

Concept B3 – Three-Lane Concept with Roundabouts at Stephen Richards Drive/Haloff Way and Floyd Dryden Access Road

Concept B3 adds an additional roundabout at the intersection of Floyd Dryden Access Road, creating a roundabout pair. This configuration both improves access in and out of Floyd Dryden Middle School and provides an indirect left turn for the intersections and driveways between the two roundabouts. Figures B3-1 through B3-6, found in Appendix 4, show the concept for the length of the corridor with callouts for specific treatments. The differences between Concept B3 and Concept B2 are as follows:

Longitudinal Treatments

- Install raised median from the roundabout at Stephen Richards Drive/Haloff Way to the roundabout at Floyd Dryden Access Road.

Access Management

- Limit access to private driveways and side streets between the two roundabouts to right in/right out. Left turn movements are served via indirect left turns at downstream roundabouts.

Bus Stop Improvements

- No additional bus stop changes in the proposed B3 concept.

Intersection Treatments

- Floyd Dryden Access Road
  - Install a multilane roundabout with two circulating lanes to serve northbound and southbound through traffic.
  - Install offset pedestrian crossings with RRFBs and pedestrian refuges on the north and south legs.

Concept B4 – Three-Lane Concept with Roundabouts at Stephen Richards Drive/Haloff Way, Floyd Dryden Access Road, and Mendenhall Boulevard/Valley Boulevard

Concept B4 builds on Concept B3, adding an additional roundabout at the intersection of Mendenhall Boulevard/Valley Boulevard and extending the access management opportunities on the corridor. Figures B4-1 through B4-6, found in Appendix 4, show the concept for the length of the corridor with callouts for specific treatments. Additional changes from B3 are as follows:

Longitudinal Treatments

- Install raised median from the roundabout at Floyd Dryden Access Road to the roundabout at Mendenhall Boulevard/Valley Boulevard.

Access Management

- Limited access to private driveways and side streets between the three roundabouts to right in/right out. Left turn movements are served via indirect left turns at downstream roundabouts.

Bus Stop Improvements

- No additional bus stop changes in the proposed B4 concept

Intersection Treatments

- Mendenhall Boulevard/Valley Boulevard
    - Install a single-lane roundabout with a northbound right-turn lane.

Short Way-Floyd Dryden Connection

Left-turning vehicles from Floyd Dryden experience long delays during peak periods and special events. A new roadway connection from Floyd Dryden Access Road to Short Way would provide a second vehicular access point to the school, helping to relieve the demand at the current sole access point. This connection would allow vehicles to access the signalized intersection of Stephen Richards Drive/Haloff Way via Tongass Boulevard. The connection also provides neighborhood access to Floyd Dryden Middle School without having to use Mendenhall Loop Road, reducing the volumes on Mendenhall Loop Road during peak hours and augmenting the current bicycle and pedestrian trail system between Short Way and Floyd Dryden Access Road. This connection would be particularly useful for Concepts A1, B1 and B2, which include a three-lane section adjacent to Floyd Dryden Middle School with two-stop control at the access point. The roundabout proposed at Mendenhall Loop Road/Floyd Dryden Access Road in Concepts B3 and B4 reduces the need for this connection.

Students and parents currently use the existing trail from Floyd Dryden Access Road to Short Way, accessing the school and the sports fields frequently. Efforts to maintain facilities for pedestrians and bicycles along this route will be considered.

To evaluate this connection, traffic volumes were developed by rerouting traffic that would use the Short Way connection. An estimated 50 percent of left turns from Floyd Dryden Access Road would use the new Short Way connection. Rerouting the westbound left turns using Short Way to the intersection of Stephen Richards Drive/Haloff Way improves the operations at Floyd Dryden Access Road. The intersection at Stephen Richards Drive/Haloff Way can accommodate the additional left-turning traffic from Floyd Dryden Access Road during both the weekday a.m. and p.m. peak hours, maintaining LOS C and increasing the delay by four seconds and two seconds, respectively.

DETAILED CONCEPT EVALUATION

The following sections present a comparison of each concept.

Vehicle Operations

The intersection vehicle operations were calculated under 2035 traffic volumes for all study intersections. This evaluation establishes how each concept meets the stated goal of providing vehicle capacity. A vehicular level-of-service (LOS) D or higher is considered acceptable for DOT&PF.

Some treatments result in similar improvement throughout all concepts including the following:

- **Nancy Street**: The three-lane concepts maintain the existing receiving lane for the westbound left turn out of Nancy Street, effectively eliminating the conflicts with southbound through vehicles. The five-lane segment provides two-stage gap acceptance via a two-way left-turn lane (TWLTL), though this configuration reduces capacity for the movement compared to the existing configuration, as left-turning vehicles must find gaps in the southbound traffic stream. Neither configuration operates at an acceptable LOS in the p.m. peak hour. Other alternatives were examined at this location including westbound left-turn prohibition with alternate route to Stephen Richard Drive/Haloff Way, a traffic signal, and a roundabout. Table 5 summarizes the operations of the Nancy Street intersection under the 2035 conditions for the five intersection configurations examined.

Table 5 2035 Nancy Street Operations

Configuration	AM			PM		
	V/C	LOS	Delay	V/C	LOS	Delay
Existing/3-Lane	0.35	B (WB)	14.4	0.46	E (WB)	40.1
5-Lane	0.50	C (WB)	22.3	0.49	E (WB)	44.9
Left-Turn Prohibition	0.01	A (WB)	9.8	0.03	C (WB)	16.8
Signal	0.93	C*	26.8	0.56	A	4.3
Roundabout	0.66	C (SB)	16.6	0.79	C (WB)	19.7

*Southbound queues in the a.m. peak hour exceed 1100 feet

As shown in the table, the three-lane configuration operates better in the weekday a.m. peak hour and has more capacity and less delay in the weekday p.m. peak hour than the five-lane configuration. Westbound left-turn prohibition produces the best operations, volume-to-capacity ratio, LOS, and delay, in both the a.m. and p.m. peak hours, but this is not recommended for network connectivity reasons. Both a traffic signal and a roundabout operate acceptably at this location, but the intersection does not meet traffic signal warrants and thus installation of a traffic signal is not recommended.

- **Stephen Richards Drive/Haloff Way:** Peak hour, peak direction queues are reduced and intersection operations are improved in all concepts with either the expansion of the intersection or conversion to a roundabout. A roundabout at this intersection produces better

operations over the expanded traffic signal, improving a.m. peak hour operations from LOS C as a signal to LOS B and maintaining LOS C in the p.m. peak hour.

- **Mendenhall Boulevard/Valley Boulevard:** Peak hour, northbound queues are reduced and intersection operations are improved with the addition of the right-turn lane or implementation of a roundabout.

The five-lane concepts improve the corridor in other ways. All five-lane concepts produce slightly better side street operations compared to the three-lane cross section for the five-lane segments, although pedestrian crossings are impacted negatively as discussed below. The five-lane concepts differ in the operations of the intersections between Stephen Richards Drive/Haloff Way and Floyd Dryden Access Road, specifically Dudley Street and McGinnis Drive and including Floyd Dryden Access Road. Concept A1 does not address the operational issues through the segment as the five-lane cross section is not proposed past Stephen Richards Drive/Haloff Way. Concepts A2 and A3 both implement a five-lane cross section through that segment, improving operations to acceptable levels for this section.

Concepts B1 and B2 improve the intersections of Stephen Richards Drive/Haloff Way and Mendenhall Boulevard/Valley Boulevard but, like Concept A1, do not address the vehicle capacity issues in the segment between Stephen Richards Drive/Haloff Way and Floyd Dryden Access Road including the intersection at Floyd Dryden Access Road. Under Concepts B3 and B4, operations at Dudley Street and McGinnis Drive improve by restricting left-turns onto Mendenhall Loop Road accommodating them indirectly via a U-turn at adjacent roundabouts. The Floyd Dryden Access Road operations are improved by a multilane roundabout.

Non-Motorized Level of Service Evaluation

The project team used the Highway Capacity Manual 2010 (HCM) level of service analysis methodology for evaluating the bicycle and pedestrian modes of travel on Mendenhall Loop Road. The HCM provides a scientific basis for evaluating multimodal level of service (MMLOS) on urban streets for autos, bicyclists using the roadway, pedestrians, and transit riders. The MMLOS analysis method for urban streets consists of a set of recommended procedures for predicting traveler perceptions of quality of service and performance measures for urban streets. The HCM method calculates a level of service (LOS) for each mode based on several inputs related to conditions along the corridor. The types of inputs considered by this analysis for bicyclists and pedestrians include peak hour traffic volumes, presence and width of sidewalks and bicycle lanes, crossing delay, and driveway and unsignalized intersection density.

The following is a list of parameters that influence the bicycle, pedestrian, and transit LOS scores.

Bicycle

- Vehicle volume in outside (right) lane
- Heavy vehicle percentage
- Vehicle speeds
- Travel lane and bicycle lane widths
- Pavement quality
- Unsignalized intersections/driveway density

Pedestrian

- Vehicle volume in outside (right) lane
- Vehicle speeds
- Presence and with of sidewalk and buffer
- Lateral separation between vehicles and pedestrians
- Crossing delay (signalized and uncontrolled)

Transit

- Number of transit stops
- Presence of stop amenities
- Frequency of buses
- On-time performance
- Number of passengers per bus
- Pedestrian link LOS

Because most of the intersections along the study corridor have stop-controlled side streets, intersection delays for pedestrians and bicycles traveling along the corridor are negligible for these intersections. Therefore, this analysis mostly focused on the LOS for each mode along each segment between signalized intersections, with delay focused at the intersections of Stephen Richards Drive/Haloff Way, Floyd Dryden Access Road, and Mendenhall Boulevard/Valley Boulevard. The MMLOS for the following scenarios was evaluated for existing conditions, 2035 no-build, and all seven concepts.

The LOS for bicycles using the roadway varied across the proposed concepts, but because all the cross sections included shoulder bike lanes, these variations were minor. The five-lane concepts produce better segment results by maintaining a bike lane/shoulder (though narrowed by the lane widening) and reducing the number of vehicles in the adjacent travel lane to the bicycle lane. The three-lane concepts maintain acceptable LOS along each segment but are slightly lower than the existing and 2035 no-build scenarios because the bicycle lane/shoulder is narrowed slightly by the additional center lane. However, the intersection LOS at the key intersections is improved. The removal of access points benefits cyclists as well.

All concepts improve either the pedestrian segment or intersection LOS. The expansion to five-lane cross section improves the pedestrian segment LOS for the five-lane concepts over the no-build scenario due to the distribution of the volume in the adjacent travel lane, but the five-lane concepts lengthen the crossing distance. Increased crossing distances increases pedestrian crossing time and exposure to vehicles. Roundabouts in the three-lane concepts improve the pedestrian intersection LOS over the no-build by reducing crossing delay. Median refuges also provide benefits for pedestrians.

The transit LOS does not substantially change under the proposed concepts. Reduced intersection delay improved transit LOS slightly. The MMLOS worksheets are included in Appendix 5.

Safety Evaluation

The elements of each corridor vision were evaluated based on their safety impacts. First, the AASHTO *Highway Safety Manual* (HSM) crash prediction methodologies were applied to compare the traffic volume, intersection, and cross-section changes between the existing, no build, and corridor vision alternatives. This analysis indicated the growth in volume between the existing and future analysis years is predicted to increase crash frequency on the corridor by approximately 5.5 percent. The

prediction model outputs indicate that the driveway consolidations proposed in the corridor visions would reduce crashes between 0.5 and 1.5 percent. However, these models do not account for all proposed corridor and intersection treatments, as not all treatments are measurable under HSM procedures. Therefore, the crash prediction models were supplemented with documented crash reduction factors in the DOT&PF HSIP Handbook (Reference 4) or are based on national research assembled in the FHWA CMF Clearinghouse (Reference 5).

The following sections detail the predicted crash reductions of various proposed treatments contained in the HSM. As with the limitations of the HSM crash prediction models, crash reduction factors are not available to all proposed treatments due to lack of research, so the safety benefit could not be established quantitatively for all treatments. The safety performance of some treatments, such as in the case of access management features, are highly dependent on local factors, such as volumes, driveway configurations, and traffic control, that the specific crash reduction cannot be estimated.

Two-Way Left-Turn Lanes

Crash reduction factors for installation of a two-way left-turn lane (TWLTL) is determined based on the number of accesses along the given segment. Mendenhall Boulevard/Valley Boulevard to Back Loop is the only two-lane roadway segment without a TWLTL in the study corridor. A crash reduction factor of 26% was calculated for this segment yielding a reduction of 0.3 crashes per year.

Roundabouts

Research has established that converting two-way stop-controlled and signalized intersections to single-lane roundabouts reduce intersection crashes, particularly injury and fatality crashes. The HSIP Handbook reports that converting three-leg and four-leg intersections to single-lane roundabouts may reduce crashes by 30 percent and 75 percent respectively, independent of intersection traffic control type. NCHRP Report 572 *Roundabouts in the United States* reports converting signalized intersections and two-way stop intersections to multilane roundabouts results in a total crash reduction of approximately 67 percent and 18 percent, respectively. Regardless of intersection traffic control type before, conversion to a roundabout results in a projected 70 to 80 percent reduction in injury and fatal crashes.

Concepts B2, B3, and B4 propose two-lane roundabouts at Stephen Richards Drive/Haloff Way and Floyd Dryden Access Road and a single-lane roundabout at Mendenhall Boulevard/Valley Boulevard. The predicted crash reductions calculated using the DOT&PF HSIP estimates and NCHRP Report 572 are shown in Table 6. The last two columns predict the reduced number of total crashes and injury and fatal crashes per year, respectively (in other words, the number of crashes that are predicted to no longer occur).

Table 6 Estimated Roundabout Crash Reduction per Year per DOT&PF HSIP Handbook

Intersection	Crash Reduction Factor	Existing Affected Crashes/Year	Reduced Total Crashes/Year	Reduced Injury and Fatal Crashes/Year
Stephen Richards Dr/Haloff Way	-67% intersection crashes	5.0	3.35	3.5-4.0
Floyd Dryden Access Rd	-18% intersection crashes	1.5	0.27	1.05-1.2
Mendenhall Blvd/Valley Blvd	-75% intersection crashes	5.75	4.3	4.03-4.6

Raised Median

Raised medians reduce crossover and access-related crashes by 15 percent per the HSIP Handbook. The CMF Clearinghouse reports medians reduce fatal and injury crashes by 39 percent. Concepts B2, B3, and B4 implement raised medians on the approaches to the roundabouts, as well as between roundabouts for Concepts B3 and B4. No applicable crashes were reported in the sections where raised medians are proposed.

Install Right-Turn Lane

Installation of a northbound right-turn lane is proposed at the Mendenhall Blvd/Valley Blvd intersection. The HSIP Handbook reports a reduction of 10% of rear ends and side swipes involving turning cars making the target movement. Two crashes were reported in the target movement resulting in a reduction of 0.2 crashes per year.

Extend Turn Lane Length

An extension of the northbound left-turn lane is proposed at the intersection of Stephen Richards Drive/Haloff Way. The HSIP Handbook reports a 15% reduction in rear-end accidents involving vehicles waiting to enter the turn lane. No qualifying crashes were reported at Stephen Richards Drive/Haloff Way intersection.

Enhanced Illumination

The HSIP handbook reports a 50% crash reduction at unlit intersections when illumination is installed. All study intersections have at least minimal lighting. The concepts propose enhancing the sparse existing lighting throughout the corridor therefore the expected benefit is less than the estimated 50% crash reduction.

Left-Turn Traffic Signal Phasing

Changing left-turn traffic signal phasing can reduce left-turn angle crashes by up to 60 percent depending on the treatment. Adjustment of left-turn phasing from permissive to protected/permissive flashing yellow arrow (FYA) reduces left-turn crashes by 40 percent per the HSIP Handbook. A reduction

of 60 percent is reported from changing the left-turn phasing from doghouse protected/permissive to protected only. The predicted crash reductions calculated using the DOT&PF HSIP estimates are shown in Table 7.

Table 7 Estimated Left-Turn Traffic Signal Phasing Crash Reduction per DOT&PF HSIP Handbook at Intersection of Stephen Richards Dr/Haloff Way

Intersection	Treatment	Crash Reduction Factor	Existing Affected Crashes/Year	Reduced Crashes/Year
EB/WB Approaches	Permissive to protected/permissive FYA	-40% left-turn crashes	0.25	0.1
NB/SB Approaches	Doghouse protected/permissive to protected only	-60% left-turn crashes	1.0	0.6

Pedestrian Refuges

The HSIP Handbook estimates pedestrian refuges providing two-stage pedestrian and bicycle crossing reduces the associated crashes by 45 percent. Based on the crash data supplied by ADOT&PF and CBJ for the corridor from 2007 to 2011, an average of 1.2 pedestrian crossing crashes per year occurred at locations proposed to be treated by pedestrian refuges. Therefore, the installation of the proposed pedestrian refuges is expected to reduce 0.5 crashes per year. All concepts propose pedestrian refuges at four locations.

Three-Lane to Five-Lane Conversion

Future no-build scenario, three-lane cross section, and five-lane cross sections crash predictions were compared as another evaluation criterion. Predicted changes in segment crashes are as follows:

- **2035 No Build** – 14% increase over existing conditions due to traffic growth on the corridor.
- **Concept A1** – an additional 16% increase over 2035 No Build for the segment from Nancy Street to Stephen Richards Drive/Haloff Way.
- **Concept A2** – an additional 10% increase over Concept A1 for the segment from Stephen Richards Drive/Haloff Way to Floyd Dryden Access Road.
- **Concept A3** – an additional 4% increase over Concept A2 for the segment from Floyd Dryden Access Road to Mendenhall Boulevard/Valley Boulevard.
- **B Concepts** – Same as 2035 No Build, as there is not a lane conversion.

As shown, conversion to five-lane cross section results in an increase of the predicted crashes with the increase being larger based on the length of the converted segment.

Section 5
Recommendations

RECOMMENDATIONS

The development of the recommended concept was shaped by the goals and objectives of the project and comments from the public. As mentioned previously, the primary goal of this project is to provide adequate vehicle capacity and improve pedestrian and bicycle facilities along Mendenhall Loop Road.

FINDINGS

Two families of concepts were developed to address the operational issues of the corridor and public concerns. Family A consists of three five-lane concepts and Family B of four three-lane concepts for a total of seven concepts. All seven concepts meet the project objectives to varying degrees. All seven concepts incorporate the following key benefits:

- Vehicle delay and queue lengths are reduced at the Stephen Richards-Haloff Way intersection in both peak hours;
- Vehicle delay and queue lengths are reduced at the Mendenhall Boulevard-Valley Boulevard intersection in both peak hours;
- Vehicle delay is reduced and traffic safety is improved north of the Mendenhall Boulevard-Valley Boulevard intersection.
- Pedestrian and bicycle facilities are maintained and path conflicts are reduced;
- Enhanced transit facilities and a new pedestrian crossing is provided at Cinema Drive; and
- Various proposed treatments are anticipated to yield crash reductions throughout the corridor.

These identified benefits in all seven concepts meet the goal of the project to provide adequate vehicle capacity and improve pedestrian and bicycle facilities along the study corridor. To differentiate and narrow the concepts down to a recommended concept, advantages and disadvantages specific to each concept were identified, first at the family of concept level and then by individual concept.

Family A Concepts

The A family of concepts, as described in previous sections, implements a five-lane cross section for differing lengths of the corridor starting at Nancy Street moving north. In addition to the benefits common to all concepts, advantages and disadvantages specific to A concepts include but are not limited to the following:

Family A Concept Advantages

- The lane reduction and associated northbound merge is moved further north where traffic volumes are less than at the existing location;
- Side street operations are improved along the five-lane cross section segments; and
- Bicycle segment level-of-service is improved due to reduced number of vehicles in adjacent travel lane.

Family A Concept Disadvantages

- Pedestrian crossing distances are lengthened, extending pedestrian exposure to vehicles;
- The five-lane sections impact right-of-way and reduce the available buffer to abutting properties;
- Nancy Street experiences increased delay;
- Floyd Dryden Access Road operates at LOS F during weekday p.m. peak period;
- Opportunities for access management and its associated safety benefits are limited in comparison to B concepts;
- Crashes are predicted to increase when expanded to five lanes; and
- The public and the project advisory group are generally not supportive of five-lane cross section.

Family B Concepts

The B family of concepts implements a three-lane cross section with localized widening at signalized intersections and/or roundabouts, as described in previous sections. Advantages and disadvantages for this concept family, in addition to the benefits common to all concepts include the following:

Family B Concept Advantages

- The Stephen Richard-Haloff Way intersection operates with lower delay and shorter queues as a roundabout as proposed in Concepts B2, B3, and B4, than as a signalized intersection as proposed in the A family of concepts and Concept B1;
- The Floyd Dryden Access operates at LOS B or better with a roundabout in Concepts B3 and B4;
- Pedestrian crossing delay is reduced; and
- The public supports three-lane cross section.

Family B Concept Disadvantages

- The proposed roundabouts in Concepts B2, B3, and B4 create localized right-of-way impacts; and
- The overall capacity of the corridor is somewhat reduced as compared to the five-lane cross section in the A family of concepts.

Due to the generally negative response to the five-lane cross section and the other disadvantages, only the B concepts were moved forward for further evaluation. Individual B concepts were evaluated further in areas of consideration, including intersection operations, pedestrian and bicycle environment, access management, and safety. Table 8 reports the differences between the concepts.

Table 8 B Concept Evaluation Summary

Areas of Consideration	Concept			
	B1	B2	B3	B4
Intersection Operations	• Stephen Richard-Haloff Way queues are reduced by nearly 50% in peak hours • Mendenhall Boulevard-Valley Boulevard queues are reduced by nearly 30% in peak hours • Floyd Dryden Access Road operates at LOS F in both peak hour	• Stephen Richard-Haloff Way queues are reduced by **over** 50% in peak hours • Mendenhall Boulevard-Valley Boulevard queues are reduced by nearly 30% in peak hours • Floyd Dryden Access Road operates at LOS F in both peak hour	• Stephen Richard-Haloff Way queues are reduced by **over** 50% in peak hours • Mendenhall Boulevard-Valley Boulevard queues are reduced by nearly 30% in peak hours • Floyd Dryden Access Road operates at LOS C and LOS B in the a.m. and p.m. peak hours, respectively	• Stephen Richard-Haloff Way queues are reduced by **over** 50% in peak hours • Mendenhall Boulevard-Valley Boulevard queues are reduced by nearly **50%** in peak hours • Floyd Dryden Access Road operates at LOS C and LOS B in the a.m. and p.m. peak hours, respectively
Access Management	• Limited access management	• Limited access management	• Allows for restricted access to side streets between Stephen Richards-Haloff Way and Floyd Dryden Access Road, increasing side street operations, and accommodating left-turns via U-turns at the roundabouts	• Allows for additional restricted access to side streets from Floyd Dryden Access Road to Mendenhall Boulevard-Valley Boulevard, increasing side street operations, and accommodating left-turns via U-turns at the roundabouts
Pedestrian and Bicycle Environment	• Improved bicycle intersection LOS at Stephen-Richards-Haloff Way	• Improved pedestrian intersection LOS at roundabout at Stephen Richards-Haloff Way • Improved bicycle intersection LOS at Stephen-Richards-Haloff Way	• Improved pedestrian intersection LOS at roundabouts at Stephen Richards-Haloff Way and Floyd Dryden Access Road • Improved bicycle intersection LOS at Stephen-Richards-Haloff Way	• Improved pedestrian intersection LOS at roundabouts at Stephen Richards-Haloff Way, Floyd Dryden Access Road, and Mendenhall Boulevard-Valley Boulevard • Improved bicycle intersection LOS at Stephen-Richards-Haloff Way and Mendenhall Boulevard-Valley Boulevard
Safety	• Addition of protected left-turn signal phasing at Stephen Richards Dr/Haloff Way is projected to reduce 0.7 left-turn crashes/per year • Installation of the northbound right-turn lane at Mendenhall Blvd/Valley Blvd is projected to reduce rear ends and sideswipe crashes by 0.2 crashes/year	• Roundabout is projected to reduce total crashes at Stephen Richards Dr/Haloff Way by 3.35 crashes/year • Installation of the northbound right-turn lane at Mendenhall Blvd/Valley Blvd is projected to reduce rear ends and sideswipe crashes by 0.2 crashes/year • Raised medians are projected to reduce crossover and access-related crashes by 15%; raised medians are used leading up to and between roundabouts	• Roundabouts are projected to reduce total crashes at Stephen Richards Dr/Haloff Way by 3.35 crashes/year and Floyd Dryden Access Rd by 0.27 crashes/year • Installation of the northbound right-turn lane at Mendenhall Blvd/Valley Blvd is projected to reduce rear ends and sideswipe crashes by 0.2 crashes/year • Raised medians are projected to reduce crossover and access-related crashes by 15%; raised medians are used leading up to and between roundabouts	• Roundabouts are projected to reduce total crashes at Stephen Richards Dr/Haloff Way by 3.35 crashes/year, Floyd Dryden Access Rd by 0.27 crashes/year, and Mendenhall Blvd/Valley Blvd by 4.3 crashes/year • Raised medians are projected to reduce crossover and access-related crashes by 15%; raised medians are used leading up to and between roundabouts
	Common to All Concepts			
	• Adding a TWLTL from Mendenhall Boulevard-Valley Boulevard to Back Loop Road is projected to reduce left-turn related crashes by 0.3 crashes/year • Extending the left-turn lane length is projected to reduce rear end crashes involving vehicles waiting to enter the lane by 15% • Installation of pedestrian refuges is projected to reduce pedestrian and bicycle crashes by 0.5 crashes/year along the corridor			

Note: NB = northbound; SB = southbound, LOS = Level-of-Service, TWLTL = two-way left-turn lane

While all concepts address vehicle delay and queue lengths at the intersections of Stephen Richards-Haloff Way and Mendenhall Boulevard-Valley Boulevard, only Concepts B3 and B4 also improve Floyd Dryden Access Road with the installation of a roundabout. Moreover, Concepts B3 and B4 improve the side street operations along the corridor with the access management that is facilitated by roundabouts in series. Concept B4 addresses more side street operations over Concept B3 with the additional access management between the intersections at Floyd Dryden Access Road and Mendenhall Boulevard-Valley Boulevard.

The pedestrian and bicycle environment is generally similar throughout the concepts because the multiuse path and bicycle lanes are preserved in addition to implementation of median refuges. Concept B1 has minimal improvement over the no-build scenario compared to the other concepts which propose roundabouts that reduce crossing delay for both modes with the most improvement in Concept B4.

All four concepts are predicted to reduce crashes to various degrees through the use of common crash-reducing treatments such as the addition of a TWLTL, left-turn lane extensions, and installation of pedestrian refuges. Roundabouts are projected to reduce crashes at both signalized and unsignalized intersections, making Concept B4 the most beneficial to intersection safety on the corridor.

As the concepts build sequentially, Concept B4 improves vehicle operations, pedestrian and bicycle environment, and safety the most out of the four B concepts.

Short Way-Floyd Dryden Connection

The proposed Short Way extension can be constructed independently of the Mendenhall Loop Road corridor concepts. While the new connection would benefit all concepts by providing secondary access to Floyd Dryden Middle School, this improvement is particularly beneficial to the concepts without intersection improvements at Floyd Dryden Access Road, namely the A family and Concept B1.

The advantages of this concept are reduced delay at the Floyd Dryden Access Road intersection and providing flexibility in school and event traffic management. Disadvantages included increased traffic volumes on Short Way and impacts to the character of the current path connection (which would be maintained).

RECOMMENDATIONS

The primary goals of this project are to provide adequate vehicle capacity and improve pedestrian and bicycle facilities along Mendenhall Loop Road. In consideration of these project goals, Concepts B3 and B4 provide the greatest benefit and are recommended. The key driving factors for this recommendation include:

- **Vehicular Operational Improvements:** The corridor currently experiences heavy congestion in the peak hours as well as large queues in the peak directions. Concept B3 addresses these issues with the installation of roundabouts at the intersections at Stephen Richards-Haloff Way and Floyd Dryden Access Road and a northbound right-turn lane at the intersection at Mendenhall Boulevard-Valley Boulevard. Concept B4 replaces the signal at Mendenhall Boulevard-Valley Boulevard with a roundabout. Both of these concepts provide adequate vehicle capacity, reducing peak hour queues and improving peak hour operations.
- **Pedestrian and Bicycle Facilities:** Many residents of Mendenhall Valley use or cross Mendenhall Loop Road by bicycle or on foot to go to work, school, or access public transit services; maintaining and improving existing facilities is a necessity. Concepts B3 and B4 preserve the multiuse path and bicycle lanes and in combination with implementation of roundabouts reduce intersection crossing delay. Additionally, the installation of a marked crosswalk with RRFB at Cinema Drive improves pedestrian crossing facilities along the corridor. Proposed enhanced corridor lighting, focused at intersections and marked crossings, will also help to make pedestrians and bicyclists more visible to vehicles.
- **Corridor Safety:** Improving safety is beneficial to all modes along the corridor. Predicted crash reductions result from many of the treatments in Concepts B3 and B4 including addition of a TWLTL, left-turn lane extensions, and installation of pedestrian refuges. Installation of a roundabout at the intersections at Stephen Richards-Haloff Way and Floyd Dryden Access Road are projected to reduce total crashes by 3.35 and 0.27 crashes per year, respectively. Both concepts are projected to improve safety performance at Mendenhall Boulevard-Valley Boulevard, with greater reduction in Concept B4. For Concept B3, the installation of a northbound right turn lane is projected to reduce rear ends and sideswipe crashes by 0.2 crashes per year. For Concept B4, the installation of a roundabout at this location is projected to reduce total crashes by 4.3 crashes per year.

While Concept B4 provides access management and safety benefits beyond Concept B3, it is unclear whether the costs associated with the additional treatments in Concept B4 will yield enough benefit to justify the cost. Further determination is recommended after additional engineering and cost estimating can be completed. In addition, the estimation of costs for all alternatives (design, construction, utilities, and right-of-way) were not part of the scope of this evaluation and should be considered when making a final recommendation.

NEXT STEPS

This report recommends carrying Concepts B3 and B4 into further engineering evaluation to refine the designs and establish anticipated costs. This will help both with the selection of the final recommended concept and possible phased implementation to match funding streams.