Traffic Study Report

6th Avenue/US12 & Main Street Intersection

City of Aberdeen, SD

January 23, 2023

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Executive Summary

In early 2022, the City of Aberdeen and South Dakota Department of Transportation (SDDOT) initiated a study to evaluate feasibility of a potential one-way to two-way conversion of Main Street between 6th Avenue/US12 and Railroad Avenue. Currently, Main Street is two lanes in the northbound direction, starting at 6th Avenue/US12 and terminating at the Railroad Avenue intersection.

The study focuses on the potential operational impacts to the 6th Avenue/US12 corridor, from 2nd Street to Washington Street, and construction-related impacts to Main Street between 5th Avenue and 6th Avenue/US12. Analysis intersections include:

- 6th Avenue/US12 & 1st Street
- 6th Avenue/US12 & Main Street
- 6th Avenue/US12 & Lincoln Street
- 5th Avenue & Main Street

Two 'Build condition' alternatives were developed, and reviewed in detail, for the 6th Avenue/US12 & Main Street intersection. A supplemental analysis was also conducted to assess potential impacts to analysis intersections if traffic signals were removed at the 6th Avenue/US12 & 1st Street and/or Lincoln Street intersections.

The primary differences between the two were number of southbound Main Street approach lanes to the 6th Avenue/US12 & Main Street intersection.

Alternative A: see **Figure ES-1**

- Southbound Main Street approach: shared left/through/right turn lane (LT/T/RT)

Alternative B: see **Figure ES-2**

- Southbound Main Street approach: exclusive left turn and shared through/right turn lanes (LT, T/RT)

Overarching conclusions from the analysis include:

- **Alternatives A and B** are both feasible options for a one-way to two-way conversion, but exhibit tradeoffs regarding side-street traffic operations, pedestrian crossing distances, construction and parking impacts, and cost

- **Alternative A** exhibits the least impact with a shared southbound Main Street approach lane at the 6th Avenue/US12 & Main Street intersection

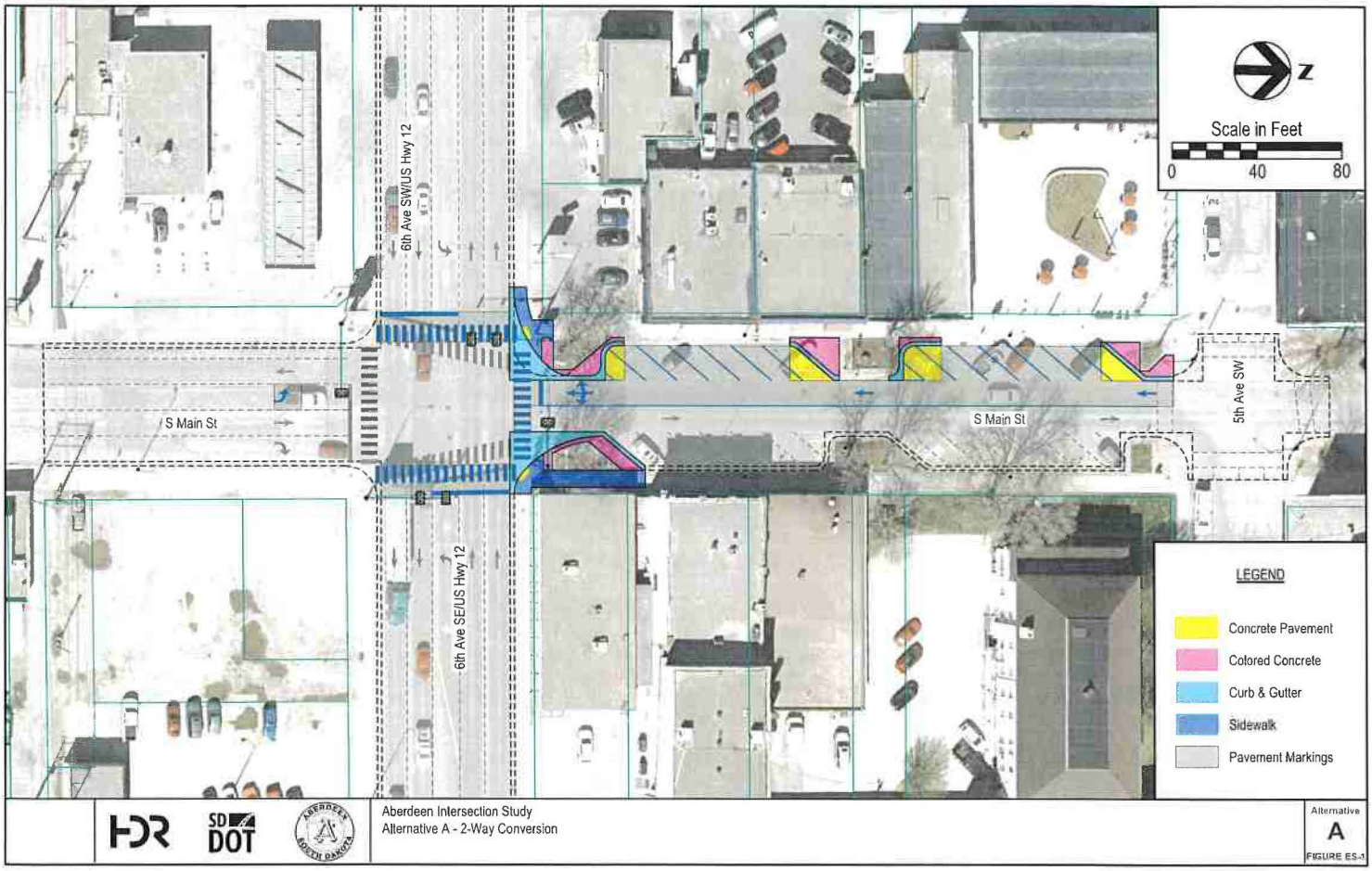
- **Alternative B** best manages side-street delay and queues, but exhibits more impacts than Alternative A due to the two southbound Main Street approach lanes at the 6th Avenue/US12 & Main Street intersection

If a one-way to two-way conversion is desired, the study recommends the following:

- **Alternative A** is recommended if a one-way to two-way conversion is desired with goals of minimizing construction impacts and maintaining angle parking on the west side of Main Street. This recommendation accepts longer, but managed, southbound Main Street queues and higher levels of approach delay at the 6th Avenue/US12 & Main Street intersection.

- **Alternative B** is recommended if a one-way to two-way conversion is desired with goals of providing highest level of operations, in terms of lowest delay and shortest queues, for the southbound Main Street approach through separate left turn and shared through/right turn lanes at the 6th Avenue/US12 & Main Street intersection. This recommendation accepts higher construction costs and impacts and removes parking from the west side of Main Street.

- **Alternative B** is recommended if traffic signals are desired to be removed at the 6th Avenue/US12 intersections with 1st Street and/or Lincoln Street.



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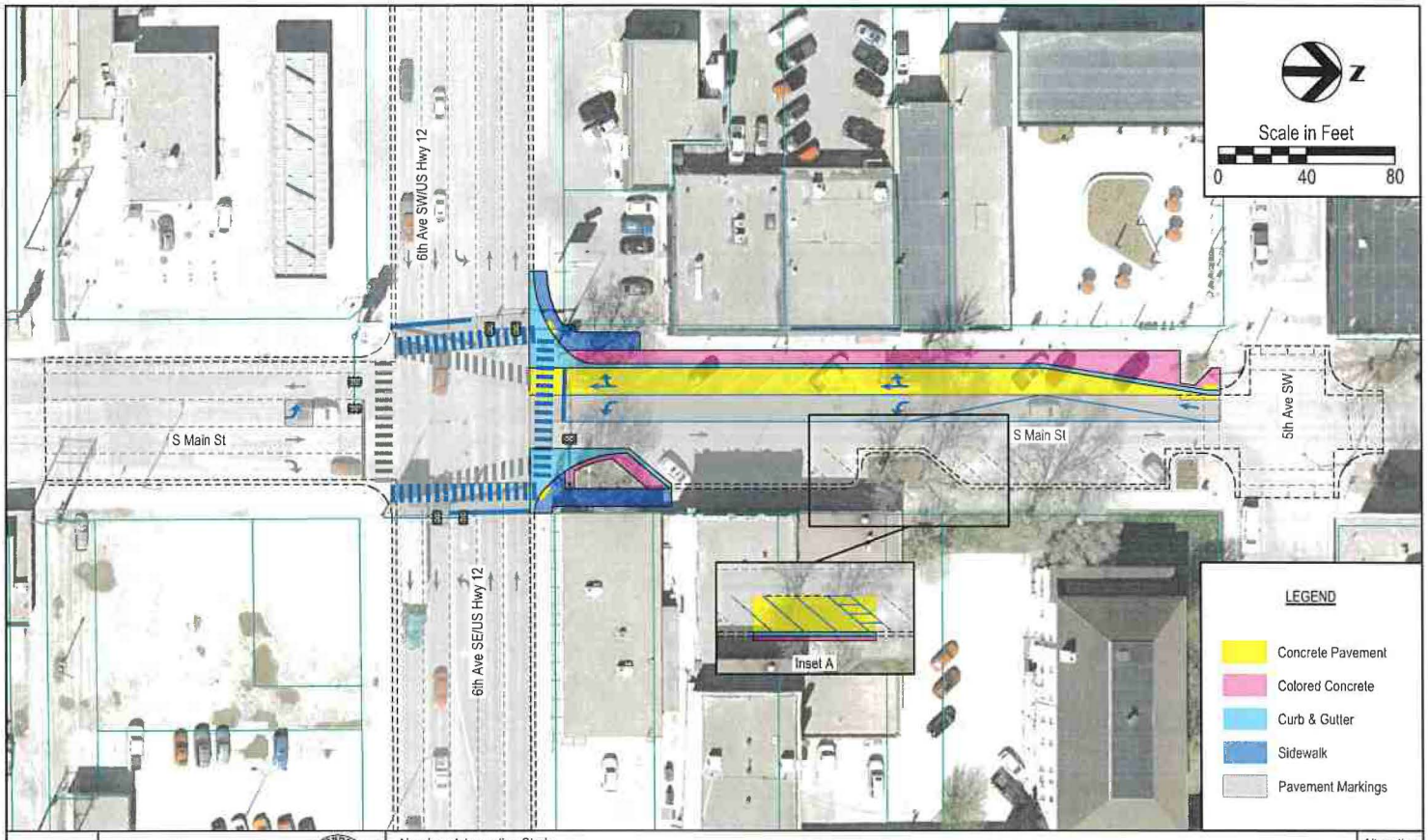
Aberdeen Intersection Study
Alternative A - 2-Way Conversion

Alternative
A
FIGURE ES-1



Aberdeen Intersection Study
Alternative B - 2-Way Conversion w/ Added Turn Lane

Alternative
B

FIGURE ES-2

Introduction

In early 2022, the City of Aberdeen and South Dakota Department of Transportation (SDDOT) initiated a study to evaluate the feasibility of a potential one-way to two-way conversion of Main Street between 6th Avenue/US12 and Railroad Avenue. Currently, Main Street is one-way with two lanes in the northbound direction, starting at 6th Avenue/US12 and terminating at the Railroad Avenue intersection. The study focuses on the potential operational impacts to the 6th Avenue/US12 corridor and construction-related impacts to Main Street between 5th Avenue and 6th Avenue/US12.

Study Area

The study's analysis corridors include (also see **Figure 1**):

- 6th Avenue, from 2nd Street to Washington Street
- Main Street, from 6th Avenue to 5th Avenue

Figure 1: Study (Analysis) Area

Analysis intersections include:

- 6th Avenue/US12 & 1st Street
- 6th Avenue/US12 & Main Street
- 6th Avenue/US12 & Lincoln Street
- 5th Avenue & Main Street

The 6th Avenue/US12 intersections with 2nd Street and Washington Street were also included in the analysis, with the primary purpose of developing coordinated traffic flows entering the three analysis intersections.

Traffic volumes were also developed for other downtown intersections beyond the analysis area to aid in the development of future-year two-way traffic on Main Street, with peak hour turning movement count locations shown in **Figure 2**.

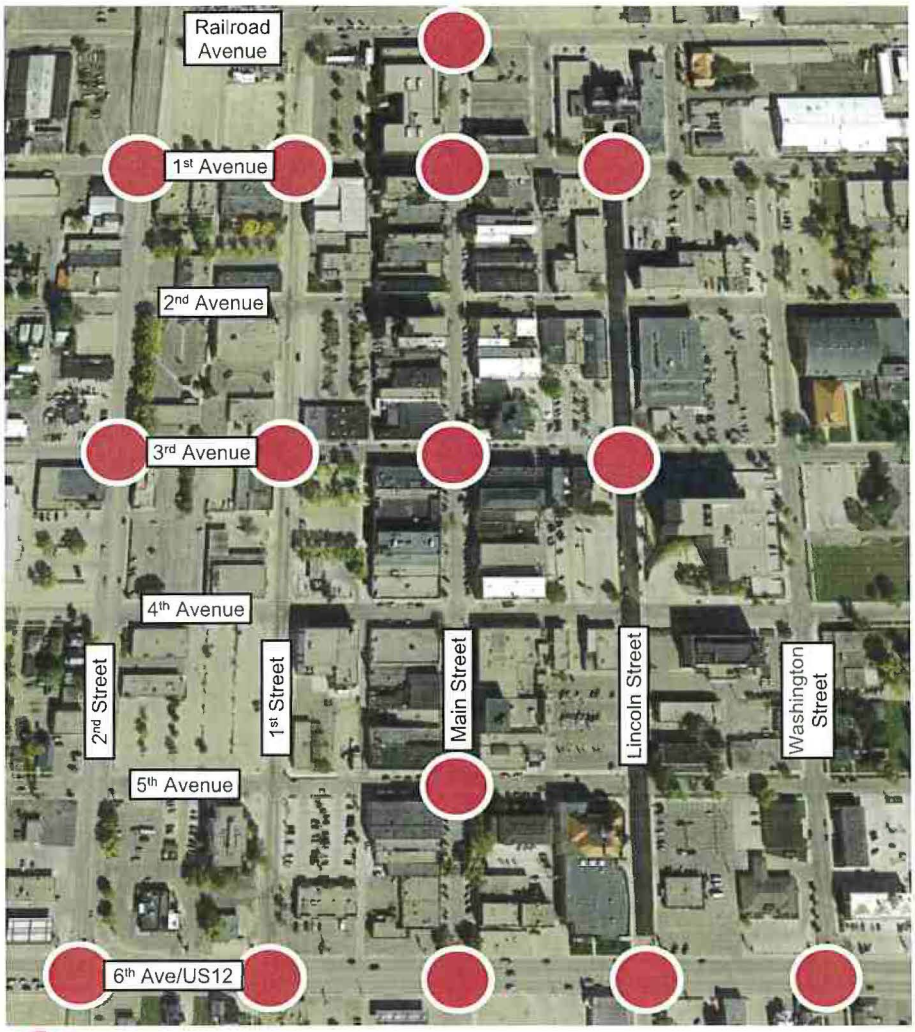


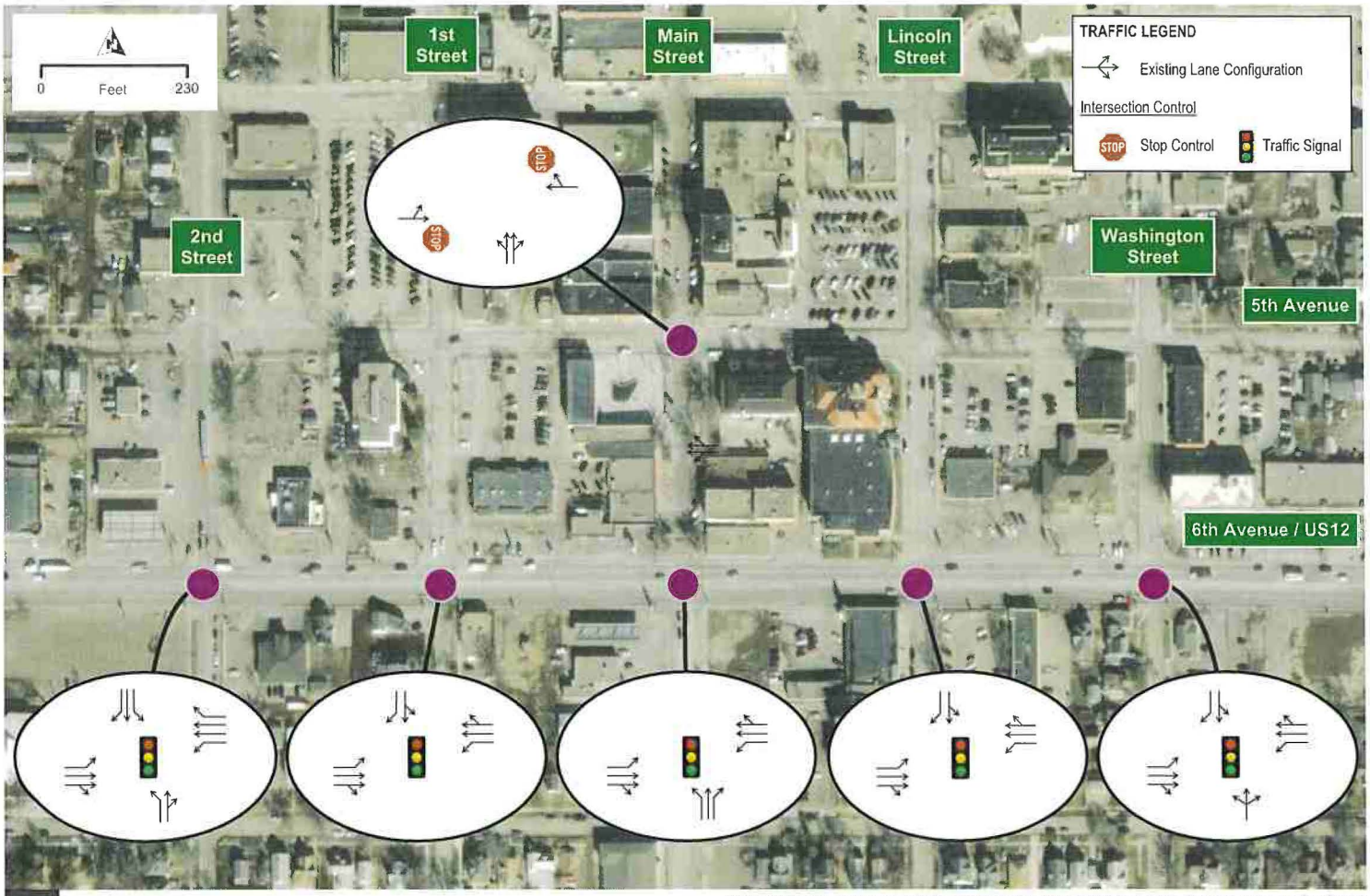
Figure 2: Intersection Turning Movement Count Locations

Methods and Assumptions

A *Methods and Assumptions Document* (M&A document) was prepared at the onset of the study to serve as a historical record of the study process, methodologies, dates, and decisions made by the study team. The most recent version of the M&A document is provided in **Appendix A**.

Existing Conditions

Existing analysis intersection lane configurations and traffic control are shown **Figure 3**.



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EXISTING ANALYSIS INTERSECTION LANE CONFIGURATION AND TRAFFIC CONTROL

FIGURE 3

Crash History Review

Crash history was reviewed at the four analysis intersections to identify trends and patterns that may benefit from a Main Street one-way to two-way conversion. Crash data was obtained through the SDDOT's Interactive Crash Mapping Tool and reflects all reported crashes in the State of South Dakota crash database for years 2017-2021 (most recent five complete years).

Table 1 provides a summary of intersection crash frequency and rates. Additional details are provided in the *Crash History Review* memo in **Appendix B**. Intersection crash rates are based on crashes per million entering vehicles (crashes/MEV).

Table 1: Intersection Crash History (2017-2021)

Intersection	Total Crashes	Injury Crashes	Crash Rate *(crashes/MEV)*	Manner of Collision		
				Angle	Rear-end	Other
6th Avenue/US12 & 1st Street	**11**	2	0.32	6	4	1
6th Avenue/US12 & Main Street	**22**	4	0.56	10	6	5
6th Avenue/US12 & Lincoln Street	**9**	0	0.24	6	3	0
5th Avenue & Main Street	**1**	0	0.15	1	0	0

Key findings include:

- 6th Avenue/US12 & Main Street intersection exhibited highest crash frequency and rate
- 11 of the 12 eastbound or westbound 6th Avenue/US12 corridor rear-end crashes occurred prior to 2019
- Angle crashes with 'wrong-way travel' occurred at 6th Avenue/US12 intersections with Main Street (2) and Lincoln Street (1)
- Higher propensity for afternoon crashes at 6th Avenue/US12 intersections with 1st Street and Lincoln Street compared to the Main Street intersection

In discussion with the study team, SDDOT indicated no intersections within the study area exhibit a high crash rate when compared to similar intersections elsewhere in Aberdeen or the SDDOT Aberdeen Region. A conversion of Main Street to a two-way street would aid in addressing the 'wrong-way travel' types of crashes through improving driver expectancy.

Traffic Volumes

Traffic volumes were developed for the following years:

- Existing conditions: 2022
- Opening Year: 2025
- Planning Horizon Year: 2045

The traffic volume development process is summarized in the following section with additional details in the *Traffic Forecast* memo in **Appendix C.**

Data Collection

Traffic data used in developing existing condition traffic volumes were collected over the following dates/years:

- Intersection peak hour turning movement counts: February and March 2022
- Daily segment counts: 2018 through 2021 as part of SDDOT annual count programs

Morning and afternoon/evening peak hours were similar across the study area intersections and within the following windows:

- Morning: 7:15 and 8:30 AM
- Afternoon/evening: 4:15 and 6:00 PM

All volumes were factored to a July design season.

Traffic Growth Factors

The following data sources were reviewed to determine applicable growth factors to estimate future-year traffic volumes:

1. SDDOT countywide growth factors
2. Historical traffic counts
3. Population history
4. Previous studies

A summary of 20-year growth factors, and the associated annual straight-line growth rates, from this review is shown in **Table 2.**

Table 2: Growth Factor Summary

Source	20-Year Factor	Annual Growth Rate (Straight-Line)
SDDOT Countywide Growth Factor	1.537	2.69%
US12 Historical Counts: *West of 2nd Street* *2nd Street to Main Street* *East of Main Street*	 1.75 0.84 0.69	 3.75% -0.81% -1.55%
Aberdeen Population History (1990-2020)	1.10	0.50%
Brown County Population History (1990-2020)	1.05	0.26%
City of Aberdeen 2045 Comprehensive Plan: *Target Population growth rate (approximate)*	1.3	1.5%
Aberdeen Master Transportation Plan: *6th Avenue/US12 segment in study area*	1.22	1.11%

It was concluded that the SDDOT countywide 20-year growth factor of 1.537 (2.69% annual growth) be used for the eastbound/westbound state highway through movements on the 6th Avenue/US12 corridor. This growth aligns with SDDOT internal traffic forecasts for the state highway network in Aberdeen and provides a conservative volume estimate for analysis of the key east/west arterial through the community.

For the remainder of the downtown area, including turning movements to/from the 6th Avenue/US12 corridor, it is recommended that a 20-year growth factor of 1.30 (1.5% annual growth rate) be used. While this growth factor is higher than the 30-year trend in Aberdeen population growth, it accounts for the increasing desirability of the downtown area and the subsequent anticipated increases to downtown building occupancy and development/redevelopment. Further, this growth factor aligns with the 1.5% annual growth rate representative the City of Aberdeen's 2045 comprehensive plan's 'Target Population'.

Traffic Forecasting Process

The following methodology was used to develop 2025 (Opening Day) and 2045 (Planning Horizon) traffic forecasts.

1. Identify 20-year growth factor and annual growth rate
2. Develop future-year traffic volumes for base case
3. Consider over/under representation of volumes
4. Reroute volumes based on one-way to two-way conversion for Opening Day and Planning Horizon scenarios

The 62 residential apartment units planned for the downtown area were incorporated into the forecasts using ITE Trip Generation rates in Step 3. This development equates to approximately 473 daily, 42 morning peak hour, and 47 afternoon peak hour trips being added to the downtown roadway network.

The one-way to two-way conversion process in Step 4 encompassed four main phases:

1. Adjust northbound Main Street traffic entering at 6th Avenue/US12 intersection
2. Adjust southbound Main Street traffic entering study area at Railroad Avenue intersection
3. Adjust for reduction in 'around the block' turns with current one-way travel
    a. Nominal adjustment for eastbound/westbound turns at Main Street with two-way traffic
4. Adjust travel 'leaving the parking areas and heading south' to account for shift in parking lot traffic to southbound Main Street

The study team identified the following overarching, targeted volume shifts to/from Main Street based on before/after comparisons of one-way to two-way conversion traffic in a Louisville, Kentucky case study (**Figure 4**):

- **Main Street northbound:** approximately 30% of northbound through traffic will shift to adjacent parallel corridors due to increased friction with a 2-way street

- **Main Street southbound:** approximately 40% of southbound through traffic on adjacent parallel corridors will shift to Main Street with the new two-way street
    - At the north end of Main Street, the percentage of southbound through traffic continuing south through the Railroad Avenue intersection was adjusted to 45-50% based on feedback from the study team and historical traffic patterns when Main Street was a 2-way street

During the conversion process, four important considerations emerged regarding traffic patterns throughout the downtown area:

1. **Parking areas** are generally located along the 1st Street and Lincoln Street north/south corridors and thus will maintain north/south travel demand along these corridors

2. **North/south traffic** is funneled to Main Street at the northern and southern limits of the study area:
    a. At north end: Main Street provides an at-grade railroad crossing
    b. At south end: Main Street is the lone roadway accommodating northbound travel, south of 6th Avenue/US12, amongst 1st Street, Main Street, and Lincoln Street
    c. While Main Street provides the most direct north/south route between these two termini, there will be considerable points of friction when evaluating route desirability for traffic traveling through downtown
        i. Angle parking and limited right-of-way leads to slow parking maneuvers, particularly when backing out of the angle parking
        ii. Low speeds
        iii. Increased pedestrian traffic
        iv. Implementation of all-way stop-control intersection traffic control at multiple Main Street intersections
        v. Increase in downtown destination traffic volumes (live/work/play area)

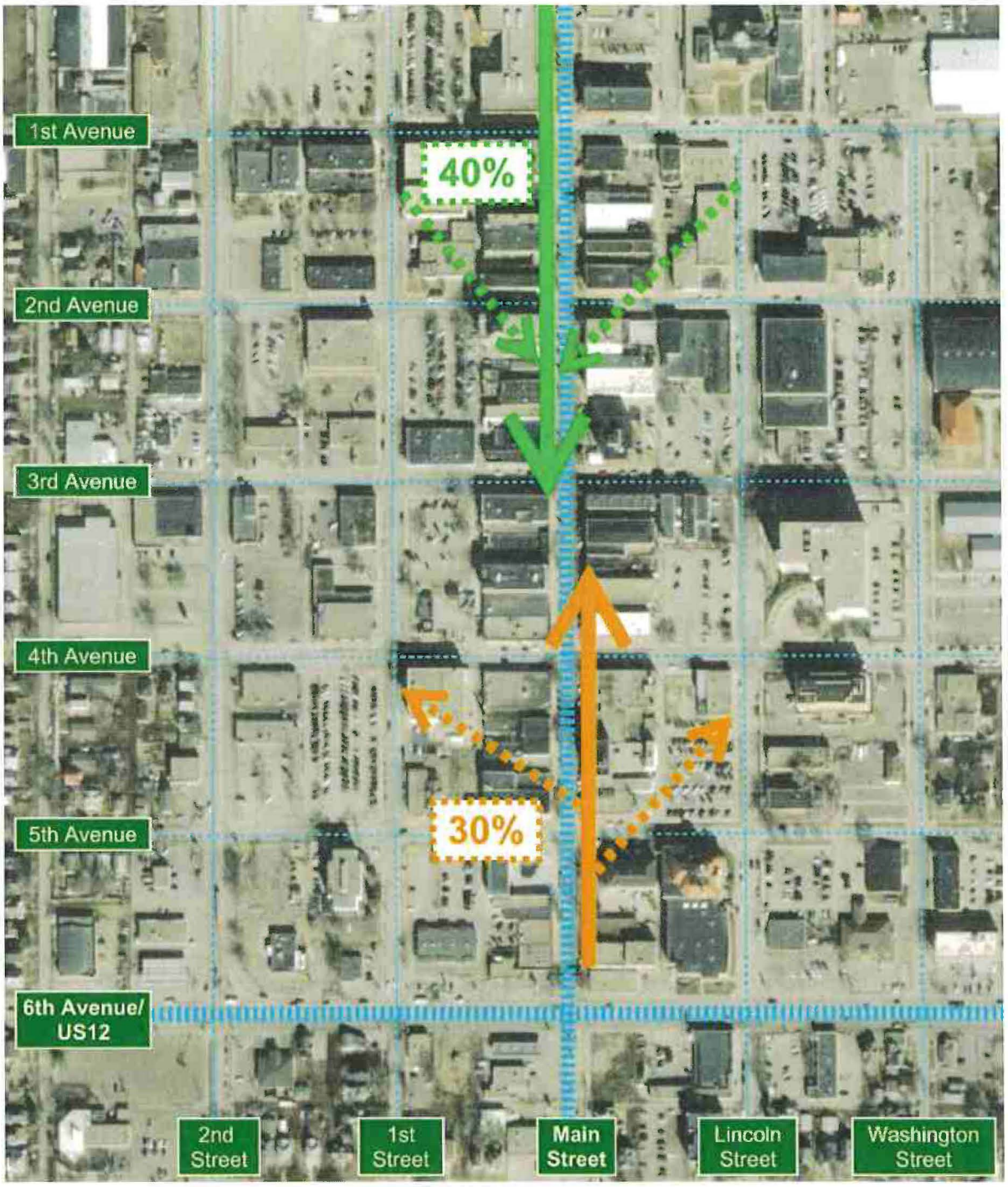
3. **East/west traffic** entering/exiting the downtown area on 1st Avenue, 3rd Avenue, and Railroad Avenue will likely incur negligible impact or influence from the Main Street one-way to two-way conversion

Traffic Volumes

A comparison of existing daily segment traffic volumes (at SDDOT count locations) and 2045 Planning Horizon No Build volumes throughout the downtown area is provided in **Figure 5**. A summary of the anticipated shift in 2045 Planning Horizon daily volumes due to the Main Street one-way to two-way conversion is provided in **Figure 6**.

Analysis intersection peak hour volumes are provided in the following figures:

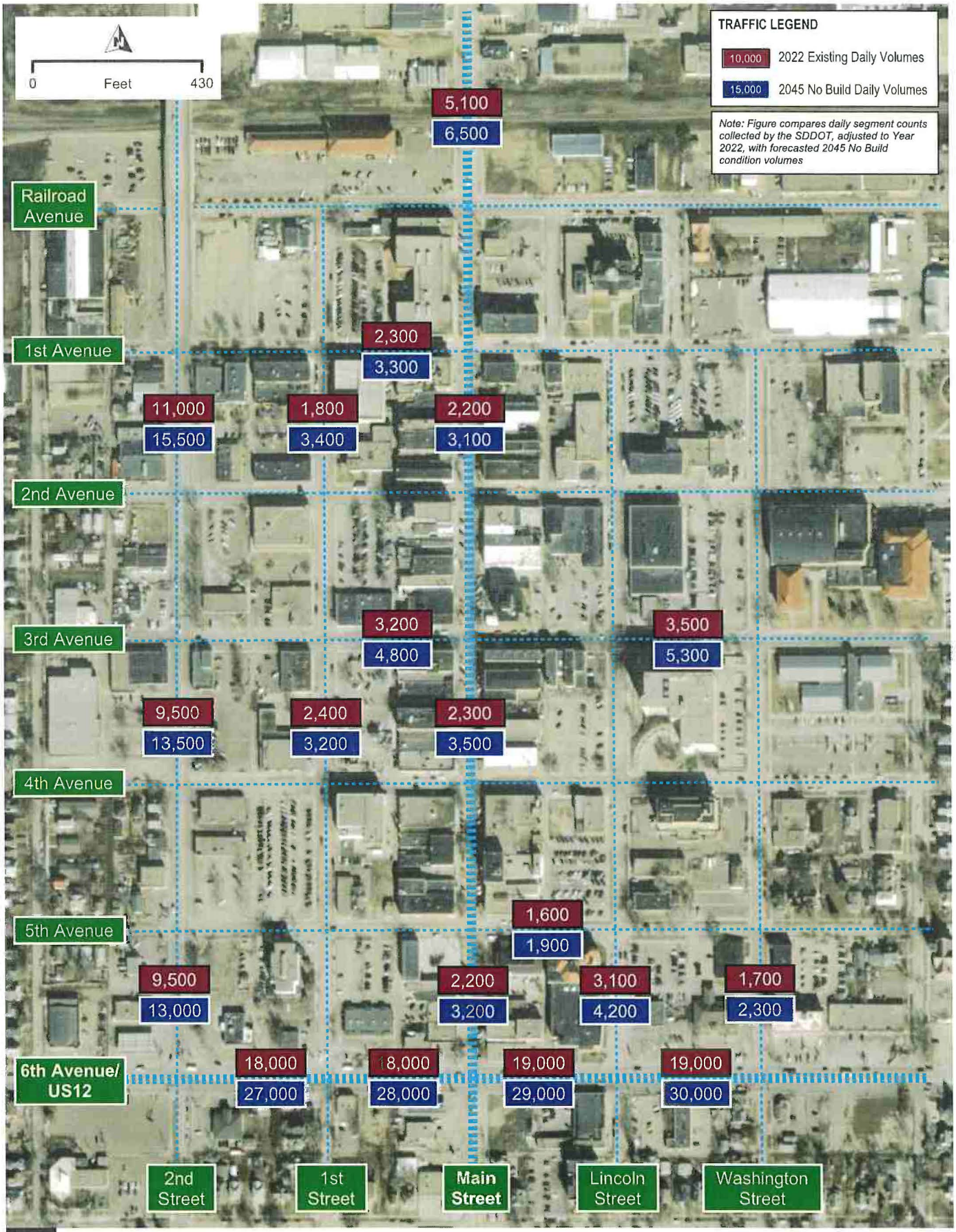
- **Figure 7:** Existing Condition Traffic Volumes
- **Figure 8:** 2025 Opening Day Build Condition Traffic Volumes
- **Figure 9:** 2045 Planning Horizon No Build Condition Traffic Volumes
- **Figure 10:** 2045 Planning Horizon Build Condition Traffic Volumes



Main Street northbound (orange): approximately 30% of northbound through traffic shifts to adjacent parallel corridors due to increased friction with a 2-way street

Main Street southbound (green): approximately 40% of southbound through traffic on adjacent parallel corridors shifts to Main Street with the new two-way street

Figure 4: Targeted One-Way to Two-Way Volume Shifts To/From Main Street



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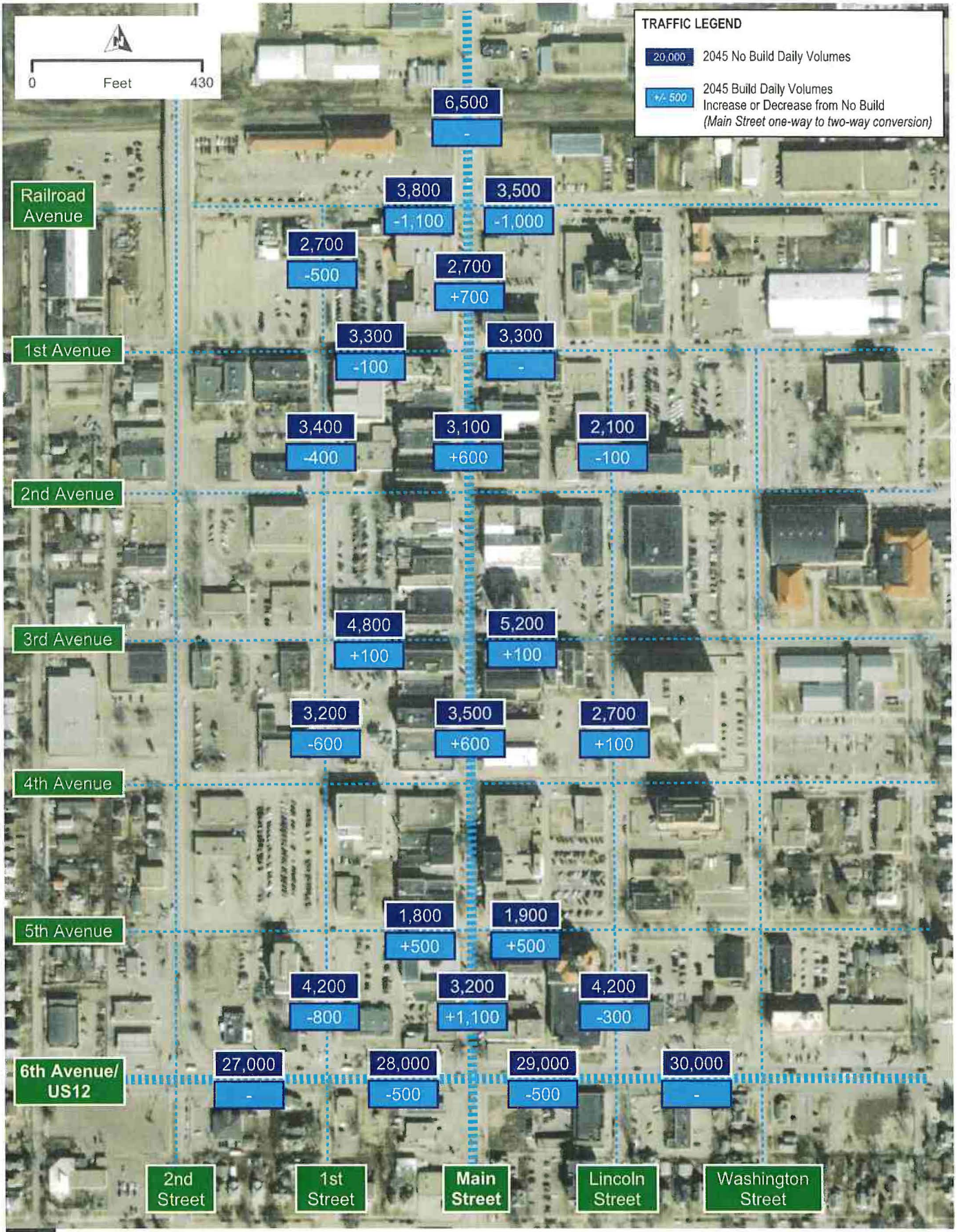
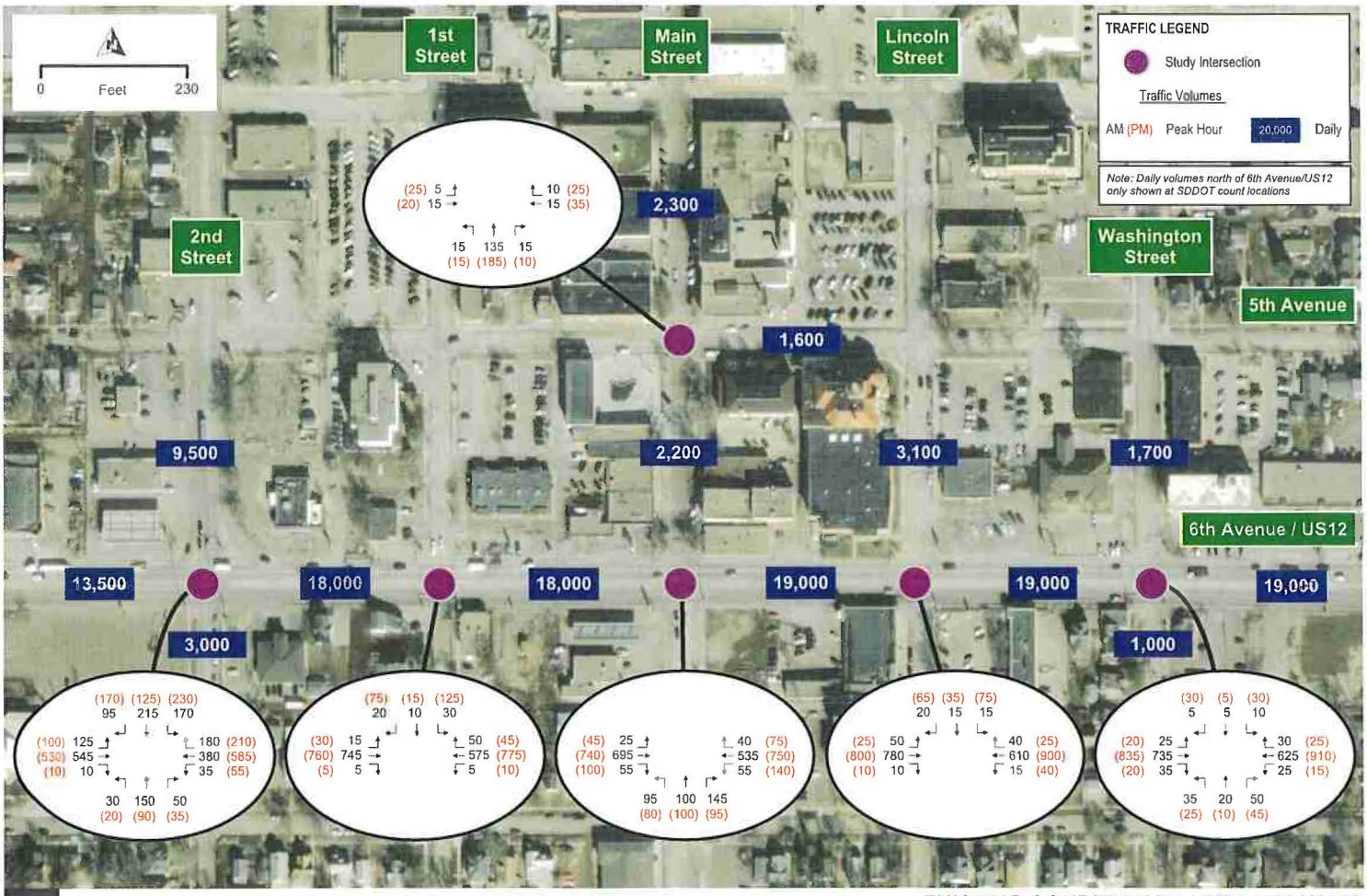
EXISTING AND 2045 NO BUILD DOWNTOWN AREA DAILY TRAFFIC COMPARISON

FIGURE 5



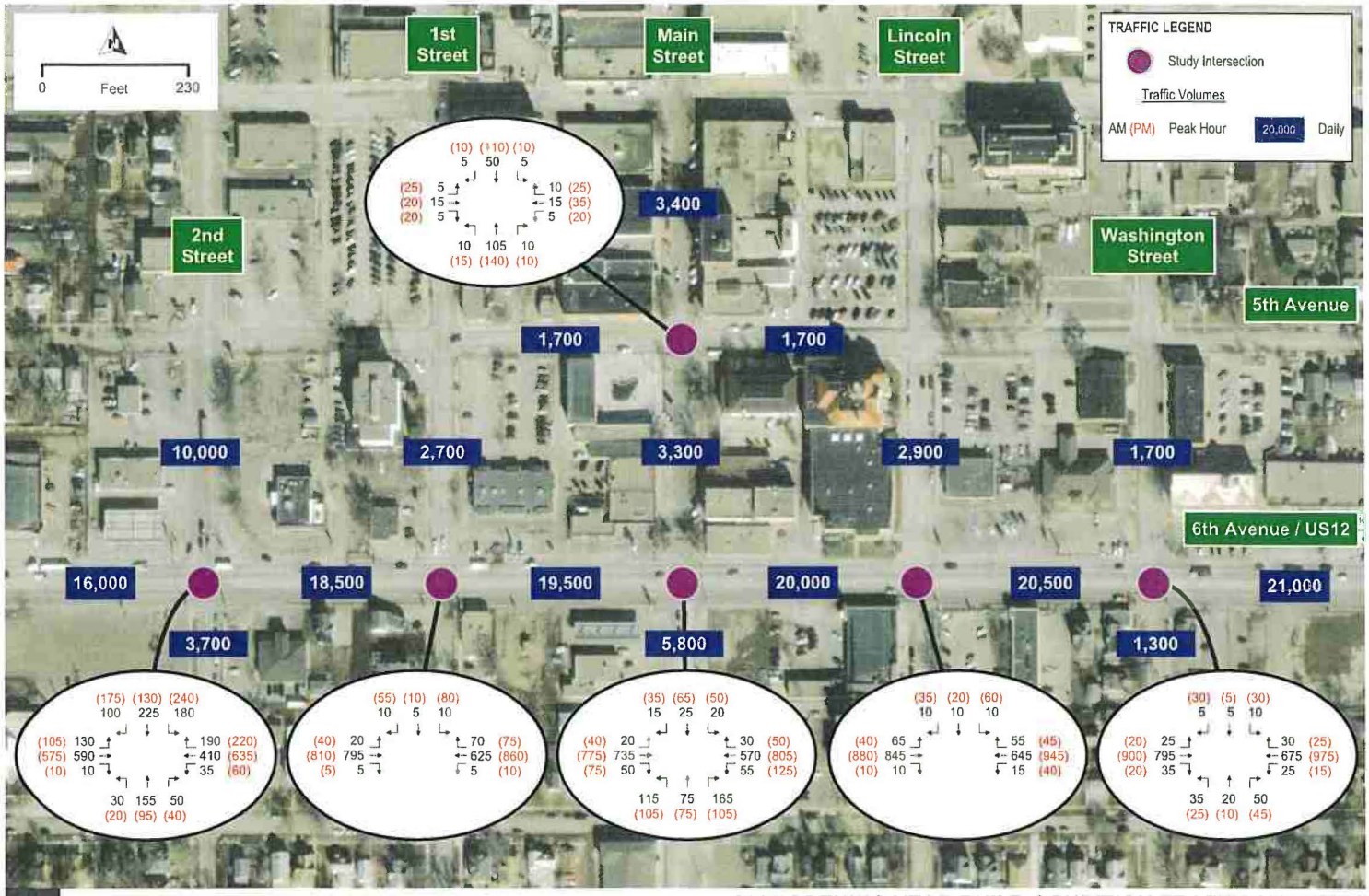
2045 PLANNING HORIZON (NO BUILD AND BUILD) DOWNTOWN AREA DAILY TRAFFIC VOLUMES

FIGURE 6



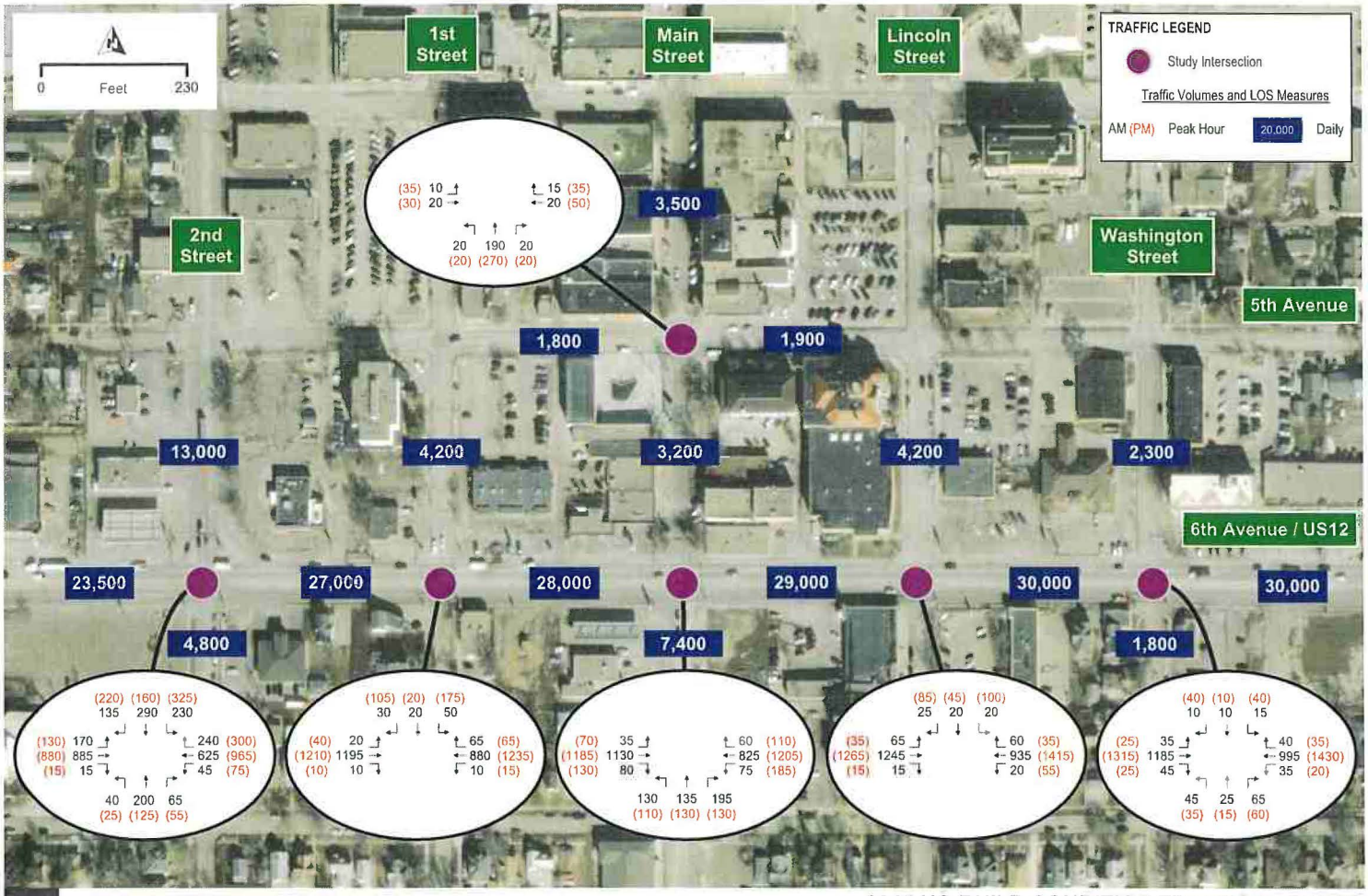
EXISTING CONDITION TRAFFIC VOLUMES

FIGURE 7



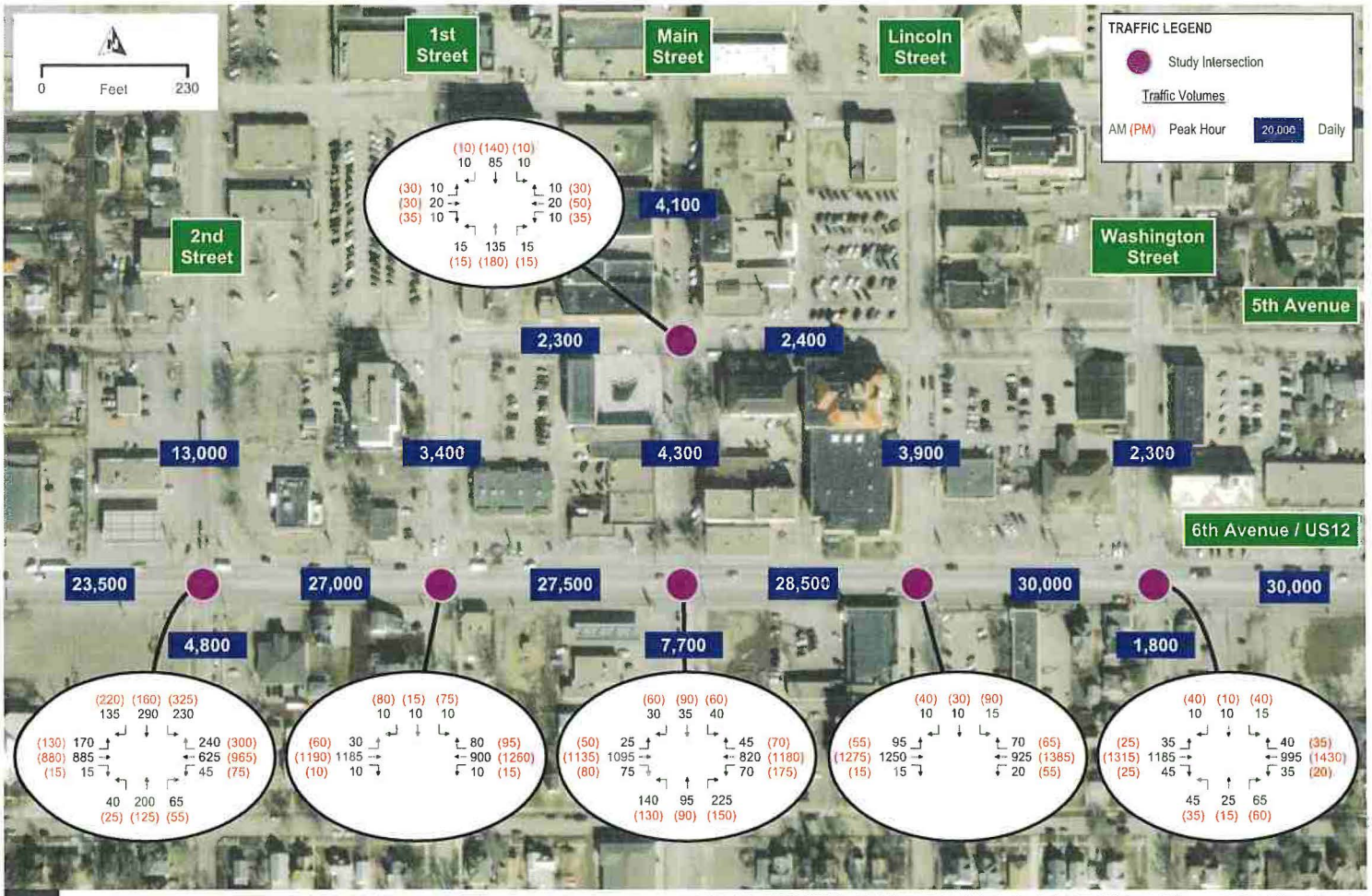
2025 OPENING YEAR BUILD CONDITION TRAFFIC VOLUMES

FIGURE 8



2045 NO BUILD CONDITION TRAFFIC VOLUMES

FIGURE 9



2045 PLANNING HORIZON BUILD CONDITION TRAFFIC VOLUMES

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FIGURE 10

Build Condition Traffic Operations Analysis

Traffic analysis was conducted at study intersections to identify required traffic signal modifications and timings, intersection level of service (LOS) and queue lengths, and roadway segment travel time related to the potential Main Street one-way to two-way conversion.

AM and PM peak hour Build conditions (one-way to two-way conversion) were analyzed for the 2025 Opening Year and 2045 Planning Horizon.

Analysis Scenarios

Three one-way to two-way conversion scenarios were developed for analysis, varying only by southbound Main Street approach lane configuration:

- **Option A:** shared left turn/through/right turn lane (LT/T/RT)
- **Option B:** exclusive left turn and shared through/right turn lane (LT, T/RT)
- **Option C:** shared left turn/through lane and right turn lane (LT/T, RT)

These configurations were analyzed to determine the possible improvements to operations and queue lengths at 6th Avenue/US12 & Main Street intersection.

Analysis Methodology

Operational performance of highways is evaluated in terms of quality of service, which describes how well a transportation facility operates from a traveler's perspective. Quality of service is typically measured with 'Level of Service' (LOS), which is presented by a letter grade similar to those used in school. A summary of LOS measures for different roadway facilities pertinent to this study are provided **Table 3**.

Table 3: Level of Service Definitions

Level of Service	Signalized Intersection Control Delay (seconds/vehicle)	All-Way and Two-Way Stop*, Intersection Control Delay (seconds/vehicle)
A	≤ 10	≤ 10
B	> 10 – 20	> 10 – 15
C	> 20 – 35	> 15 – 25
D	> 35 – 55	> 25 – 35
E	> 55 – 80	> 35 – 50
F	> 80; volume exceeds capacity	> 50; volume exceeds capacity

* TWSC LOS based on worst-case stop-controlled approach LOS

Source: Highway Capacity Manual 6th Edition

Intersection capacity analyses were completed with Synchro 11 software. LOS values are reported using the Highway Capacity Manual 6th Edition (HCM6) reporting module. Additional details and analysis reports are provided in the *Traffic Analysis* memo in **Appendix D**.

LOS 'C' is the study goal for signalized and unsignalized intersections.

One-Way to Two-Way Conversion Scenario Analysis

The intersection operations analysis focused on the 6th Avenue/US12 intersections with 1st Street, Main Street, and Lincoln Street. 6th Avenue/US12 intersections with 2nd Street and Washington Street were incorporated in the analysis models to develop platoons, reflective of progression within a coordinated corridor, entering the interior three intersections. The following tables summarize intersection LOS for the 2025 and 2045 Build conditions.

Table 4: Intersection Operations - 2025 Build Conditions

Intersection	Control	AM LOS	PM LOS
6th Avenue/US12 & 1st Street	Signal	A	A
6th Avenue/US12 & Main Street	Signal *(Option A)*	A (8.7)	A (8.1)
	Signal *(Option B)*	A (8.9)	A (7.9)
	Signal *(Option C)*	A (8.7)	A (7.8)
6th Avenue/US12 & Lincoln Street	Signal	A	A
Main Street & 5th Avenue	AWSC	A	A

Option A, B, and C intersection delay measure (sec/veh) provided to illustrate differences at 6th Avenue/US12 & Main Street intersection

Table 5: Intersection Operations - 2045 Build Conditions

Intersection	Control	AM LOS	PM LOS
6th Avenue/US12 & 1st Street	Signal	A	A
6th Avenue/US12 & Main Street	Signal *(Option A)*	B (12.3)	B (10.2)
	Signal *(Option B)*	B (12.4)	B (10.1)
	Signal *(Option C)*	B (12.7)	B (10.5)
6th Avenue/US12 & Lincoln Street	Signal	A	A
Main Street & 5th Avenue	AWSC	A	A

Option A, B, and C intersection delay measure (sec/veh) provided to illustrate differences at 6th Avenue/US12 & Main Street intersection

There was minimal difference in overall intersection delay across the three options as volumes were managed within the existing traffic signal timings used to facilitate coordinated progression along the 6th Avenue/US12 corridor. Option C exhibited the highest overall intersection delay due to the higher side-street (Main Street) approach delay from blocked through traffic within the shared southbound left/through lane.

95th percentile queue lengths were also measured at the analysis intersections. Focusing on the 6th Avenue/US12 & Main Street intersection southbound approach, lane configuration played a notable role in managing southbound queues between 6th Avenue/US12 and 5th Avenue. The longest measured queues, and respective lane/movement, for each of the three options are shown in **Table 6**. Approximately 285 feet is available for queued traffic between the southbound stop bar and the south leg 5th Avenue & Main Street intersection crosswalk.

Table 6: 6th Avenue/US12 & Main Street Intersection Southbound Approach 95th Percentile Queue Lengths - 2045 Build Conditions

Intersection Option	Southbound Main Street Lane with Longest Queue		Other Southbound Main Street Lane Queue	
	Lane	Queue (ft)	Lane	Queue (ft)
Option A	Shared LT/T/RT	231	-	-
Option B	Shared T/RT	147	LT	58
Option C	Shared LT/T	150	RT	53

Traffic Signal Removal Scenarios Analysis

Option B was carried forward to the traffic signal removal scenarios based on its ability to best accommodate additional traffic and manage queues on the southbound Main Street approach, particularly when compared to Option A that exhibited longer southbound queues extending back towards 5th Avenue.

Table 7 through **Table 9** present the traffic signal removal scenarios using Option B (LT, T/RT) southbound Main Street lane configuration.

The analysis included a redistribution of traffic, from the signal removal intersections to adjacent signalized intersections, to reflect the natural shift in traffic patterns to shorter delay and travel time routes. It is anticipated that side-street (1st Street and Lincoln Street) left turn and through movements from a stop-controlled approach will have difficulties finding available gaps in traffic during peak hours, and thus traffic will find alternate routes via other downtown signalized intersections. This analysis gauges the potential impacts from increased traffic at the adjacent signalized intersections.

Table 7: Intersection Operations - 2045 Build Conditions (Signal Removal at 1st Street)

Intersection	Control	Measure	AM LOS	PM LOS
6th Avenue/US12 & 1st Street	TWSC	Overall: (WCSC):	A (B)	A (E)
6th Avenue/US12 & Main Street	Signal *(Option B)*	Overall:	B (12.7)	B (10.7)
6th Avenue/US12 & Lincoln Street	Signal	Overall:	A	A
Main Street & 5th Avenue	AWSC	Overall:	A	A

Option B intersection delay measure (sec/veh) provided to illustrate differences at 6th Avenue/US12 & Main Street intersection

Table 8: Intersection Operations - 2045 Build Conditions (Signal Removal at Lincoln Street)

Intersection	Control	Measure	AM LOS	PM LOS
6th Avenue/US12 & 1st Street	Signal	Overall:	A	A
6th Avenue/US12 & Main Street	Signal *(Option B)*	Overall:	B (12.2)	B (11.6)
6th Avenue/US12 & Lincoln Street	TWSC	Overall: (WCSC):	A (B)	A (C)
Main Street & 5th Avenue	AWSC	Overall:	A	A

Option B intersection delay measure (sec/veh) provided to illustrate differences at 6th Avenue/US12 & Main Street intersection

Table 9: Intersection Operations - 2045 Build Conditions (Signal Removals at 1st Street and Lincoln Street)

Intersection	Control	Measure	AM LOS	PM LOS
6th Avenue/US12 & 1st Street	TWSC	Overall: (WCSC):	A (B)	A (E)
6th Avenue/US12 & Main Street	Signal *(Option B)*	Overall:	B (13.0)	B (12.4)
6th Avenue/US12 & Lincoln Street	TWSC	Overall: (WCSC):	A (B)	A (C)
Main Street & 5th Avenue	AWSC	Overall:	A	B

Option B intersection delay measure (sec/veh) provided to illustrate differences at 6th Avenue/US12 & Main Street intersection

6th Avenue/US12 Corridor Travel Time

6th Avenue/US12 eastbound/westbound analysis travel times were measured for 2045 Build condition scenarios shown in **Table 10**. Option A and B, both maintaining all existing 6th Avenue/US12 corridor traffic signals, exhibit similar travel times in the eastbound and westbound directions. Greatest improvement to corridor travel times occurs when signals are removed at 1st Street and/or Lincoln Street.

Table 10: 6th Avenue/US12 Travel Time Comparison - 2045 Build Condition

Scenario	AM		PM	
	Eastbound *+/- sec from Base condition*	**Westbound** *+/- sec from Base condition*	**Eastbound** *+/- sec from Base condition*	**Westbound** *+/- sec from Base condition*
Option A	Base	Base	Base	Base
Option B	-1	-4	-5	0
Option B w/ Signal Removal at 1st Street	-14	-14	-27	-23
Option B w/ Signal Removal at Lincoln Street	-16	-14	-13	-21
Option B w/ Signal Removals at 1st Street and Lincoln Street	-34	-26	-34	-38

Traffic Operations Analysis Conclusions

Overarching conclusions from this analysis include:

- **Options A, B, and C** all meet operational goals of LOS C or better
  - Permissive phasing for all Main Street movements, incorporated within the existing coordinated signal timings
  - Implementing a protected left turn phase would impact 6th Avenue/US12 progression and require corridor-wide timing adjustments

- **Options A, B, and C** manage 95th percentile queues
  - Measured queues do not spill back into the next adjacent intersections

- **Option A** benefits from traffic signals being maintained at the adjacent 6th Avenue/US12 intersections of 1st Avenue and Lincoln Avenue to spread traffic demand across multiple intersections

- **Option B** best manages queues on Main Street and exhibits the least risk to blocking traffic and not clearing queues in a phase (cycle failure)

- **Option B** best accommodates additional traffic if 6th Avenue/US12 signals are removed at 1st Street and/or Lincoln Street

- **Option C** exhibits operational concerns (signal phasing, queues, and blocking) and is not recommended for further consideration
    - If split phasing is desired, which is common with this configuration at higher volumes, it would have notable impact to 6th Avenue/US12 corridor operations by reducing available east/west green time

- **5th Avenue & Main Street intersection** queues are well-managed with all-way stop-control, generally less than two vehicles

- **It is feasible to remove one or both 6th Avenue/US12 traffic signals** at 1st Street and Lincoln Street intersections
    - Removing two traffic signals results in the highest side-street queue lengths and intersection delay at the remaining signalized intersections
    - Removing one traffic signal exhibits some increases to queue lengths and delay at the remaining signalized intersections, but less pronounced than with two signals removed
    - Traffic signal removal is a benefit to eastbound/westbound 6th Avenue/US12 corridor travel time
    - Any signal removal should be coordinated with Aberdeen Fire & Rescue as the department currently uses Lincoln Street as a primary route to/from 6th Avenue/US12

6th Avenue & US12 Intersection Alternatives

Based on the traffic operations analysis, 6th Avenue/US12 & Main Street intersection Option A and Option B were carried forward to conceptual design.

Alternative A: see **Figure 11**

- Southbound Main Street approach: shared left/through/right turn lane (LT/T/RT)

Alternative B: see **Figure 12**

- Southbound Main Street approach: exclusive left turn and shared through/right turn lanes (LT, T/RT)

Intersection and Main Street Modification Needs

A summary of 6th Avenue/US12 & Main Street intersection modifications required to facilitate a Main Street one-way to two-way conversion are summarized below.

Intersection Turning Movements

Intersection turning movements to/from Main Street were reviewed using a WB-40 intermediate semitrailer delivery truck and SDDOT Road Design Manual intersection turn path guidelines. Alternative A and B turning movements are shown in **Figure 13** and **Figure 14**, respectively.

For Alternative A, the northwest and northeast quadrants would need to be modified to accommodate WB-40 vehicles completing a right turn. The northwest quadrant needs to be modified to allow for a WB-40 vehicle to turn into the nearest lane (westbound outside lane). In the northeast quadrant, the available receiving width is reduced to a single lane with two-way traffic and thus the quadrant needs modified to mitigate potential westbound to northbound right turn conflicts with the southbound lane.

For Alternative B, the northwest quadrant is impacted with the second southbound lane (shared through/right turn lane) and would need to be modified. The northeast quadrant exhibits the same impacts as Alternative A and needs modified.

Modifications to the northeast and northwest quadrants are expected to impact the existing landscaping and gateway features.

Intersection Sight Distance

The existing building in the northeast quadrant is anticipated to restrict sight distance for southbound traffic, as shown in **Figure 15**. This will likely prohibit southbound right turns on red and require the traffic signal to remain fully functional in the overnight hours (no red/yellow flash operation).

Traffic Signal Modifications

6th Avenue/US12 & Main Street intersection traffic signal modifications are anticipated to include the following items. Additional details are provided in the *6th Avenue/US12 & Main Street Traffic Signal Adjustments* memo in **Appendix E**.

Signal Poles and Signal Heads

- Northwest quadrant:
  - Relocate existing signal pole
  - Relocate pedestrian push button poles
  - Maintain controller cabinet in existing location
- Northeast quadrant:
  - Relocate existing signal pole
  - Relocate pedestrian push button poles
- Southwest quadrant:
  - New signal pole with luminaire extension
  - New signal heads (3 or 4 heads)
  - Relocate existing pedestrian push button poles

Vehicle Detection

- Detection not required with coordinated timing plan, but would provide reliability and response benefits to both 6th Avenue/US12 and Main Street traffic
- Camera detection with future adaptive system

Underground

- Junction box adjustments in northwest, northeast, and southwest quadrants
- New conduit and cable across north, west, and south intersection legs likely

Cabinet Items

- Additions
  - Load switch for southbound phase
  - Jumper for MMU board
  - Detector amplifier for southbound movements
- Updates
  - Vehicle preemption for southbound movements

Temporary Traffic Signals During Construction

- Recommended for Alternative A and B due to extent of anticipated impacts in northeast and northwest quadrants

Main Street Corridor Modifications

Main Street corridor modifications are associated with the change in direction of the western lane, from northbound to southbound travel.

Alternative A Parking on West Side

Angle parking can be maintained in Alternative A through adjustments to pavement markings and, if desired, mid-segment and intersection bump outs. However, parking spots at the south end (near 6th Avenue/US12) may be unusable or have a negative impact to intersection operations for certain periods of the day when southbound queued vehicles consistently back up through the parking and block vehicles from backing out of the spot.

Alternative B Parking on West Side

Alternative B will likely require full removal of angle parking on the west side due to the southbound left turn and shared through/right turn lanes. Because of the analysis queues measured in the 2045 Build condition analysis, the full block is needed to develop the left turn lane and minimize risk of a queue blocking the other lane. Adding roadway pavement width for parallel parking is not an option due to limited width between Main Street buildings. A few parking spots could be reclaimed on the east side by removing the mid-segment bump-out and replacing the area with parking spots.

Truck Parking

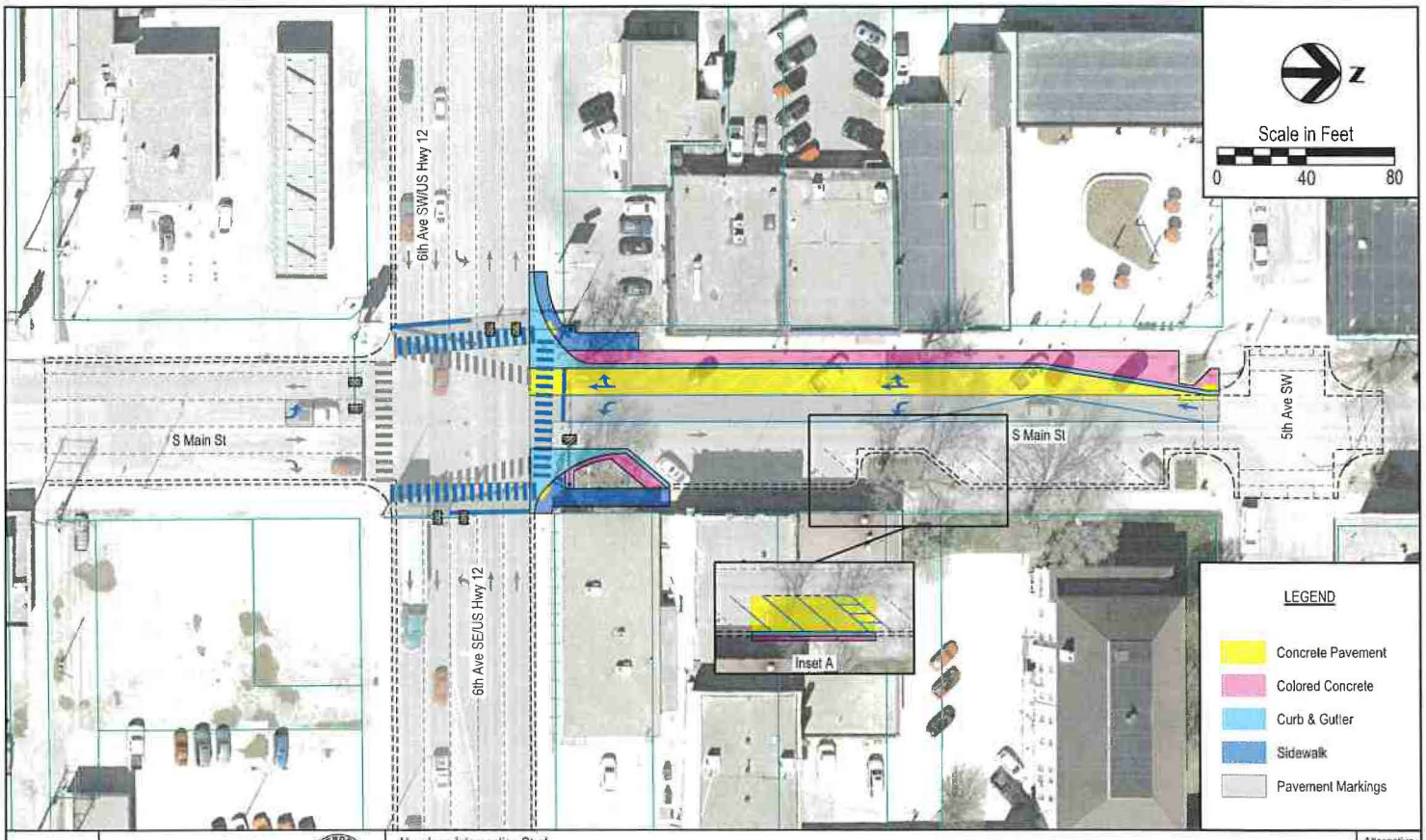
Currently, trucks will temporarily park in one of the through lanes for deliveries while the other through lane is unimpeded for northbound traffic flow. With a conversion to two-way traffic, trucks will not be able to park in a through lane and will need to find alternative areas to make deliveries. Examples of what other communities have implemented to address this need include:

- Provide designated delivery or drop-off locations on Main Street
- Provide designated delivery or drop-off locations on the crossroads (i.e., 5th Avenue, 4th Avenue, 3rd Avenue) where destinations would generally be within a ½ of a block
- Encourage or restrict deliveries to occur during a certain time of day, typically when there is low demand for on-street parking
- Encourage the use of alleys or improve alleys to support use

Pedestrian

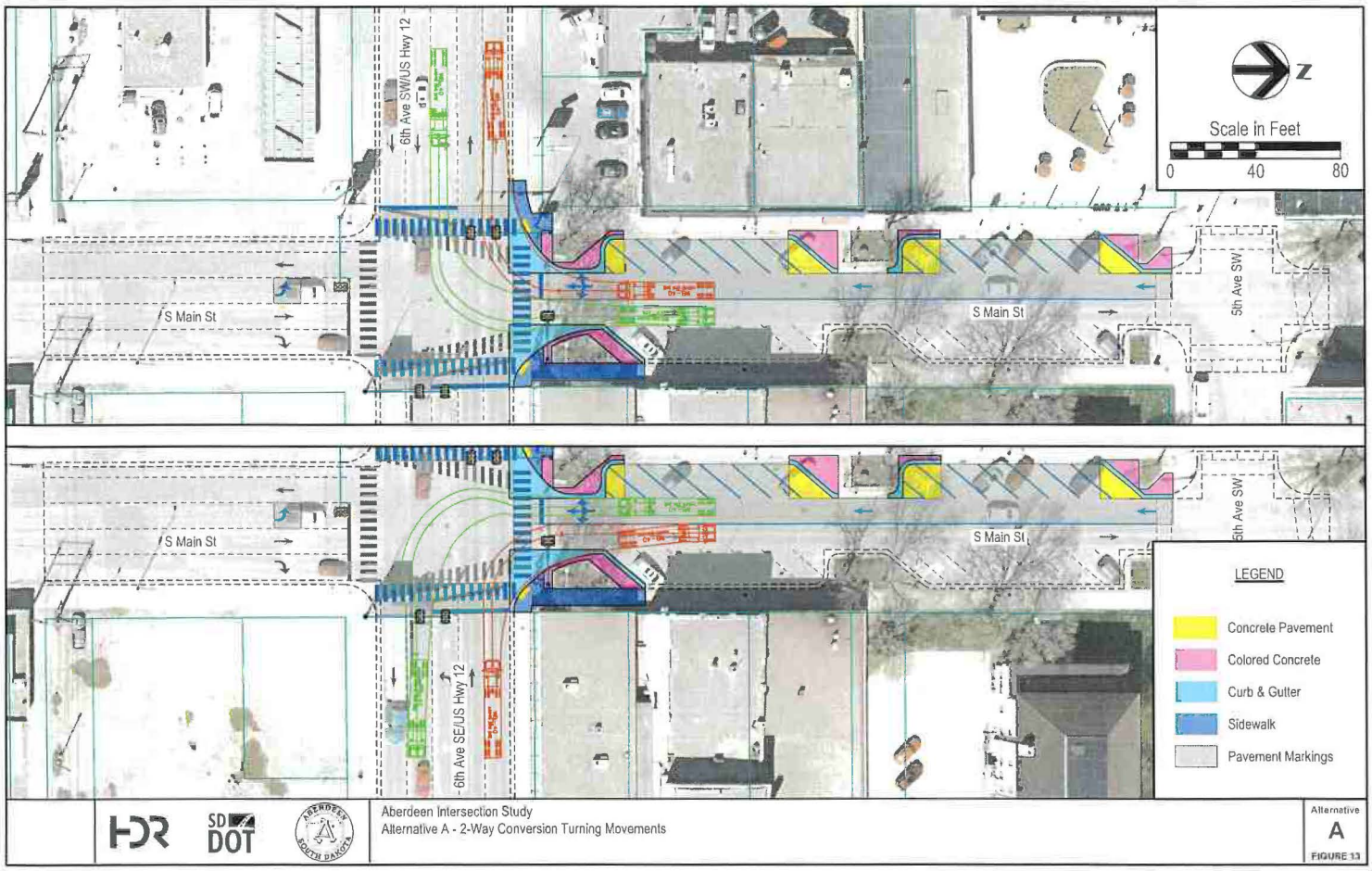
Potential pedestrian impacts associated with both alternatives include:

- Mid-block crosswalk removal due to southbound queued traffic
- 6th Avenue/US12 & Main Street intersection
    - Northeast quadrant reconstruction
        - Provides a more perpendicular crosswalk across east leg of intersection
        - Lengthens crossing distance across north leg of intersection
    - Longer pedestrian crossing distance across north leg
        - Provides a more perpendicular crosswalk across west leg of intersection
        - Lengthens crossing distance due to quadrant modifications



Aberdeen Intersection Study
Alternative B - 2-Way Conversion w/ Added Turn Lane

Alternative B
FIGURE 12

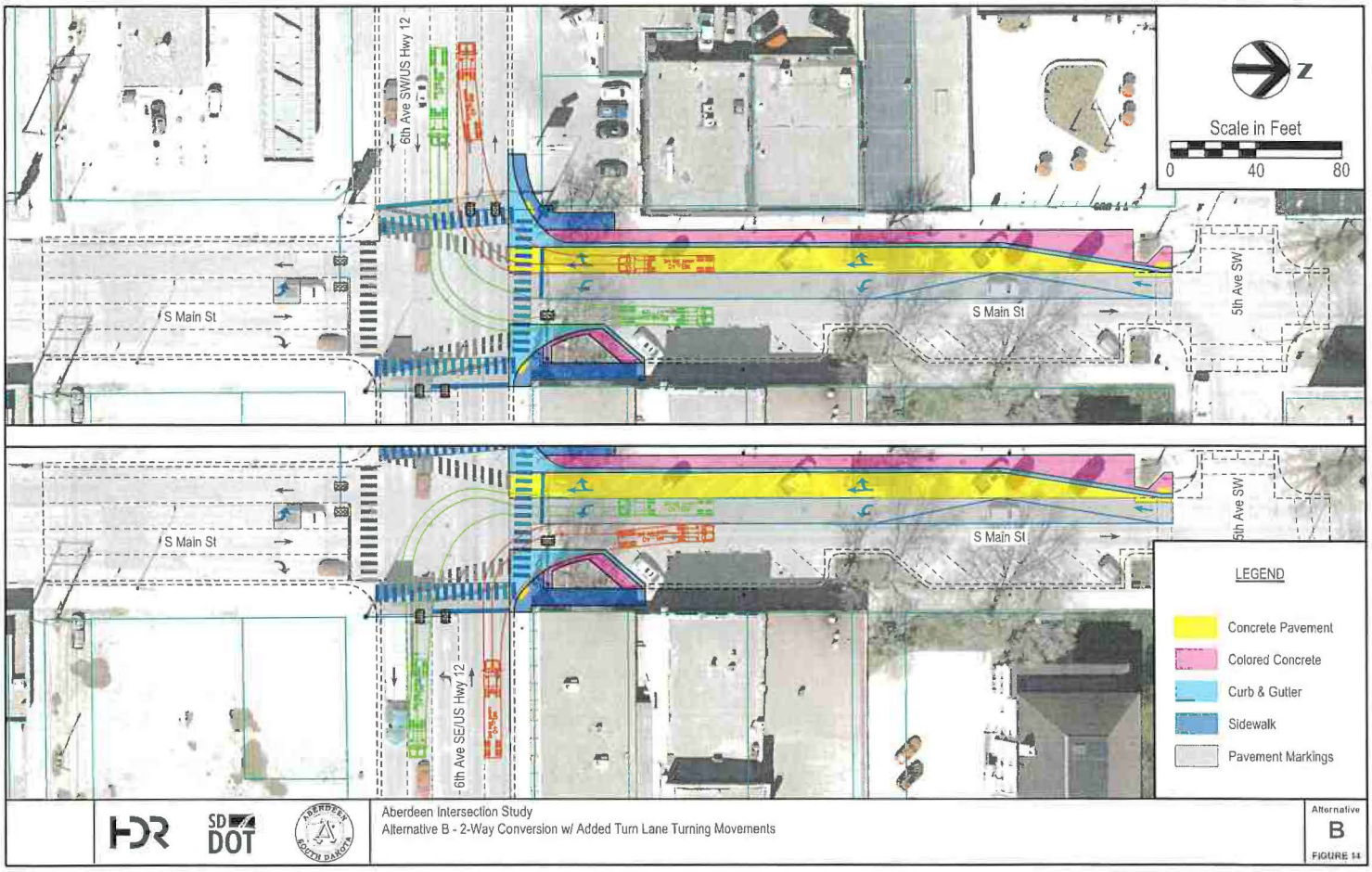


HDR SD DOT ABERDEEN SOUTH DAKOTA

Aberdeen Intersection Study
Alternative A - 2-Way Conversion Turning Movements

Alternative A

FIGURE 13

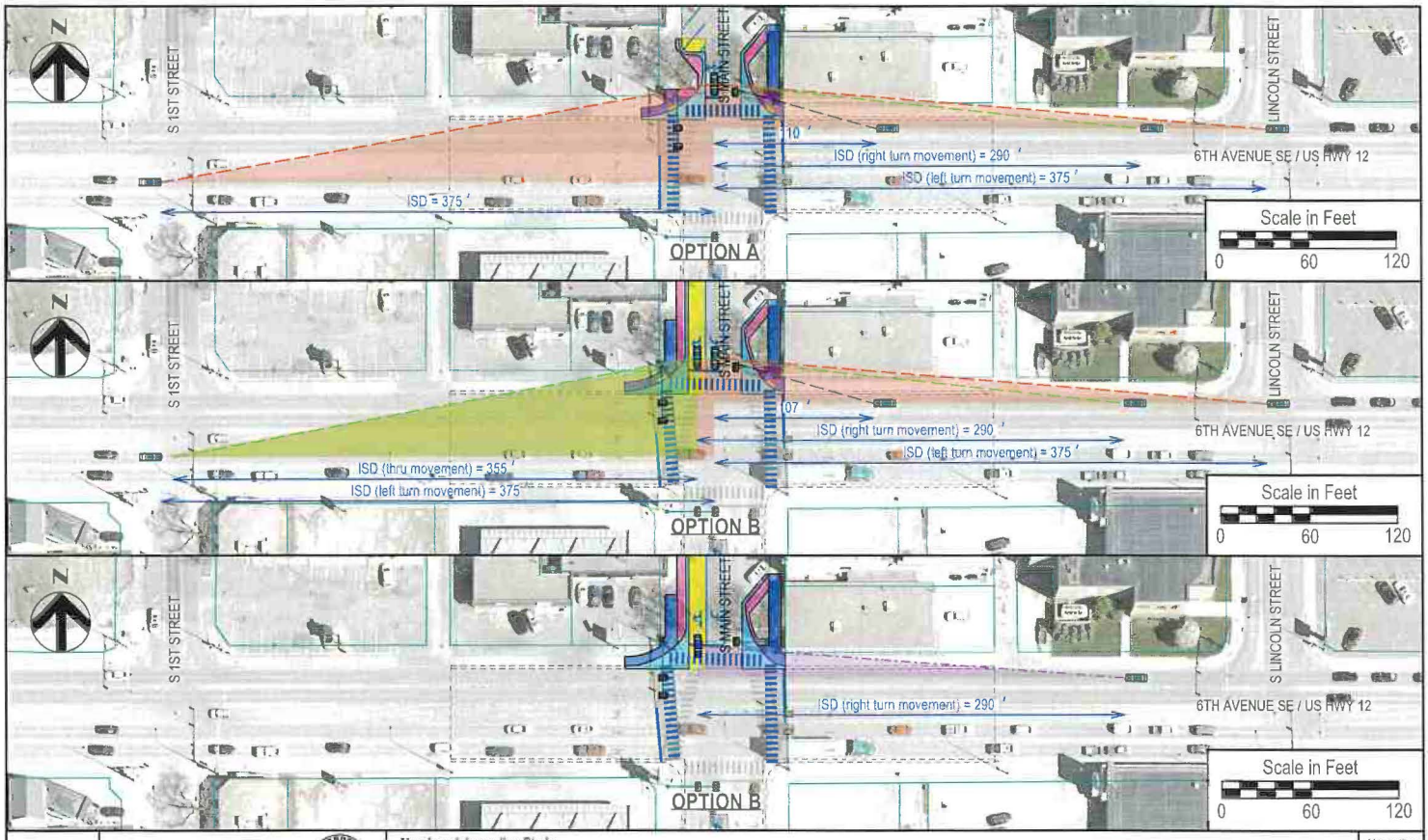


HDR SD DOT ABERDEEN SOUTH DAKOTA

Aberdeen Intersection Study
Alternative B - 2-Way Conversion w/ Added Turn Lane Turning Movements

Alternative B

FIGURE 11



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Aberdeen Intersection Study
Intersection Site Distances

Alternative
A / B

FIGURE 15

Conceptual Costs

Conceptual costs for Alternative A and B are shown in **Table 11**. Unit costs are based on overserved 2022 construction and 2023 bid costs.

Additional details are provided in **Appendix E**.

Table 11: Conceptual Costs

Item	Alternative A	Alternative B
Pavement Marking	$35,000	$45,000
Concrete Work	$85,000	$210,000
Removals	$125,000	$260,000
Signal System	$550,000	$550,000
Utilities	$45,000	$55,000
Subtotal	*$840,000*	*$1,120,000*
Contingency	*$420,000*	*$560,000*
Engineering	*$189,000*	*$252,000*
Concept Total (2023$):	**$1,449,000**	**$1,932,000**

If the mid-block bump out on the east side is removed and replaced with parking, it would result in an increase of approximately $137,000.

Evaluation

An evaluation matrix summarizing benefits and drawbacks of the No Build condition and two one-way to two-way conversion options is shown in **Table 12**.

Table 12: Evaluation Matrix

Measure	No Build	Option A	Option B
6th Avenue/US12 & Main Street Intersection *Traffic Operations*			
Overall intersection	●	●	●
6th Avenue/US12 approaches	●	●	●
Main Street approaches	●	◑	●
Adjacent 6th Avenue/US12 Intersections *Traffic Operations*	●	●	●
6th Avenue/US12 Corridor *Traffic Operations*	●	●	●
Adjacent 6th Avenue/US12 Intersections *Traffic Signal Removal Feasibility*	◑	◑	●
Main Street Parking *6th Avenue to 5th Avenue*			
On-street vehicular parking	●	●	◑
Delivery truck parking	●	◑	◑
Geometrics			
Southbound Main Street intersection sight distance	●	◑	◑
Main Street corridor traffic calming	○	●	●
Main Street corridor pedestrian crossings	◑	●	●
Downtown Traffic Flow			
Unfamiliar driver expectancy	◑	●	●
Business access	◑	●	●
Constructability	●	◑	◑
Construction Cost (2023$)	$0	$1,449,000	$1,932,000

Evaluation Matrix Legend

Traffic Operations (Vehicular Delay and Queues)

Intersection Operations	Meets or Exceeds Existing Condition	Meets Study Goals	Degrades Operations
	●	◑	○

Corridor Operations (Travel Time)

Corridor Operations	Meets or Exceeds Existing Condition	Meets Study Goals	Degrades Operations
	●	◑	○

Adjacent Intersection Traffic Signal Removal Feasibility

Intersection and Corridor Operations	Greatest Feasibility *(negligible impact to adjacent intersections and overall corridor)*	Feasible *(some impact to adjacent intersections)*	Least Feasibility *(notable impact to adjacent intersections)*
	●	◑	○

Main Street Parking Impacts (6th Avenue to 5th Avenue)

Parking Spots Lost	No or Minor Parking Impact	Some Parking Impact	Notable Parking Impact
	●	◑	○

Geometrics and Downton Traffic Flow

Measure	Improves Existing or No Impact	Minor or Mitigated Impact	Notable Impact or Drawback
	●	◑	○

Constructability

Construction Impacts and Extent of Reconstruction	No Impact	Minor or Mitigated Impact	Notable Impact or Drawback
	●	◑	○

Additional Resources

Additional guidance and discussion on the benefits and drawbacks of one-way to two-way street conversions is provided through the following nationally recognized resources:

National Association of City Transportation Officials (NACTO)

- Urban Street Design Guide
  - Downtown 1-Way Street design: https://nacto.org/publication/urban-street-design-guide/streets/downtown-1-way-street/
  - Downtown 2-Way Street design: https://nacto.org/publication/urban-street-design-guide/streets/downtown-2-way-street/

Federal Highway Administration (FHWA)

- Pedestrian Safety Guide and Countermeasure Selection System (PEDSAFE)
  - One-way/Two-way Street Conversions: http://www.pedbikesafe.org/pedsafe/countermeasures_detail.cfm?CM_NUM=23

Conclusions and Recommendations

Overarching conclusions from the analysis include:

- **Alternatives A and B** are both feasible options for a one-way to two-way conversion, but exhibit tradeoffs regarding side-street traffic operations, pedestrian crossing distances, construction and parking impacts, and cost

- **Alternative A** exhibits the least impact with a shared southbound Main Street approach lane at the 6th Avenue/US12 & Main Street intersection

- **Alternative B** best manages side-street delay and queues, but exhibits more impacts than Alternative A due to the two southbound Main Street approach lanes at the 6th Avenue/US12 & Main Street intersection

If a one-way to tow-way conversion is desired, the study recommends the following:

- **Alternative A** is recommended if a one-way to two-way conversion is desired with goals of minimizing construction impacts and maintaining angle parking on the west side of Main Street. This recommendation accepts longer, but managed, southbound Main Street queues and higher levels of approach delay at the 6th Avenue/US12 & Main Street intersection.

- **Alternative B** is recommended if a one-way to two-way conversion is desired with goals of providing highest level of operations, in terms of lowest delay and shortest queues, for the southbound Main Street approach through separate left turn and shared through/right turn lanes at the 6th Avenue/US12 & Main Street intersection. This

recommendation accepts higher construction costs and impacts and removes parking from the west side of Main Street.

- **Alternative B** is recommended if traffic signals are desired to be removed at the 6th Avenue/US12 intersections with 1st Street and/or Lincoln Street. The southbound Main Street approach lane configuration, separated left turn and shared through/right turn lanes, provide the highest level of capacity to accommodate increased traffic volumes and peak volume fluctuations.