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Memorandum

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Minnesota Department of Transportation - District 1

FROM: Mike Anderson, PE, PTOE
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DATE: January 14, 2022

SUBJECT: TH 169 at US 2 Intersection Study

Introduction

Alliant Engineering has developed and evaluated potential alternatives that would improve the efficiency of TH 169 at the US 2 intersection in Grand Rapids, MN. The need for this analysis was initially identified during the Grand Rapids Traffic Signal Optimization Project in the summer of 2019 when concerns were raised over the existing split phasing, left turn lane utilization, and pedestrian signal phasing at this location. Historically this intersection has experienced significant delays and congestion during afternoon peak periods, specifically during summer months and Friday recreational travel.

Project Description and Purpose

TH 169 and US 2 are major commercial corridors in Grand Rapids and provide regional connectivity to north central Minnesota. The corridors feature an array of land uses, namely a combination of commercial, residential, and tourism/hospitality. During summer months, traffic is largely dictated by heavy recreational traffic patterns. The majority of northbound TH 169 traffic turns left at US 2. However, the left-most northbound left turn lane is not used as much as the right northbound left turn lane. This results in essentially single traffic lane operation, with left turn queues that occasionally spill back south along TH 169 through the TH 169 and 3rd Street and TH 169 and 2nd Street intersections to the Mississippi river bridge. This queueing issue worsens when a pedestrian call is placed on the west leg of TH 2, as it shortens the northbound left turn split.

The objective of the project was to develop alternatives that remove split phasing, improve the northbound left turn lane utilization and improve the overall efficiency of the TH 169 and US 2 intersection. The evaluation also explores opportunity to improve the efficiency of the pedestrian signal phasing and safety of the pedestrian crosswalks.

Existing Conditions

Existing lane configurations are shown in **Figure 1** and the PM Peak (average summer weekday) turning movement volumes are shown in **Figure 2** for both intersections. Volumes used for this analysis were collected January/February 2019 and factored up by 1.25 (25%) to reflect summer traffic conditions based on MnDOT automatic recorder station (ATR) 219 historical data. A single track at-grade railroad crossing is on TH 169 between US 2 and 3rd Street and is an active rail line. North/south TH 169 left turn vehicle paths overlap, and the northbound right left turn lane is shared with the northbound through lane, which currently require the approaches to be split phased.

An origin-destination analysis was completed using StreetLight data for all 12 months of 2019 to determine the portion of northbound TH 169 left-turning vehicles continuing west on US 2, as opposed to turning to the north at TH 38. The analysis found that 76% of northbound TH 169 left turn traffic continues to head west on US 2 past TH 38.

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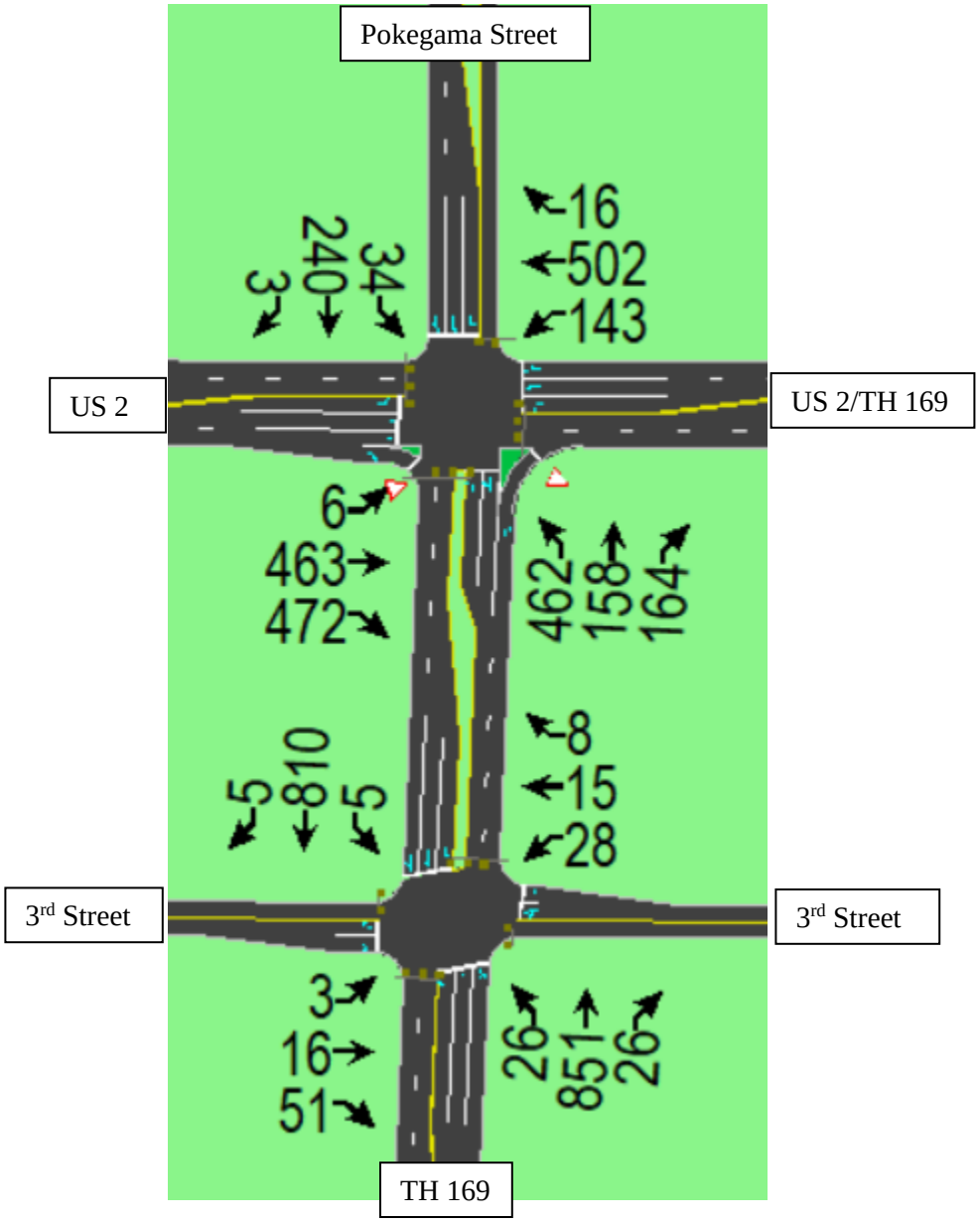
FIGURE 1
EXISTING LANE CONFIGURATIONS

Figure 2. Existing Lane Configurations and PM Peak Volumes



High-Level Preliminary Alternatives Analysis

To address the identified deficiencies, numerous improvement alternatives were identified and analyzed. The set of alternatives includes variations that maintain two southbound lanes (on the south leg) and some alternatives with one southbound lane. Due to the close proximity of the two intersections and extent of improvements, some alternatives impact the TH 169 and 3rd Street intersection. The results of the Alternatives Analysis including high level geometric sketches, key benefits, pros/cons, and operations analysis results are provided in **Appendix A**.

Preliminary Alternatives Development

A total of ten preliminary alternatives were developed to address the identified deficiencies. All alternatives developed remove the north/south TH 169 left turn vehicle path overlap which removes the need for signal split phasing.

The alternatives were split into two main groups: Group A with two southbound TH 169 lanes between US 2 and 3rd Street and Group B with one southbound TH 169 lane. Sub alternatives were created based on the level of impact to the TH 169 and 3rd Street. A summary of the alternative naming convention is as follows:

TH 169 and US 2 Intersection	TH 169 and 3rd Street
A = 2 Southbound TH 169 Lanes B = 1 Southbound TH 169 Lane	A = Full Access with TH 169 lane configuration adjustments B = Restricted Access with short median at intersection only C = Restricted Access with extended median

The ten alternatives developed include a combination of improvement strategies including:

- Lane shifts and reconfiguration to improve lane utilization.
- Increased northbound TH 169 left turn queue storage capacity through the use of medians at TH 169/3rd Street.
- Signal phasing adjustments at TH 169/US 2 including removal of split phasing to improve operational efficiency, flashing yellow arrows for variable left and right turn phasing (by time of day), pedestrian omit on flashing yellow arrow (POOFYA) for concurrent vehicle/pedestrian phasing, shortened crosswalks (removal of channelized islands) and leading pedestrian intervals for pedestrian safety.
- Modified access at TH 169/US 2 and corresponding removal of signal phases to improve operational efficiency.
- Curb extensions for improved pedestrian safety and lane shifts to improve lane utilization.
- Removal of TH 169/US 2 channelized right turns for improved pedestrian safety.

While the alternatives developed offer various benefits and improvements, there are tradeoffs that will require local acceptance by local leaders, business owners, and residents. These include:

- Potential loss of on street parking spaces on east side of Pokegama Avenue.
- Restricted access at TH 169/US 2 requiring rerouting of traffic to 1st Street NW and NE.
- Restricted access at TH 169/3rd Street requiring rerouting of traffic to 1st Street NW and NE.
- Restricted access south of 3rd Street resulting in southbound TH 169 access only.

The following summarizes the alternatives developed and the key benefits of each. A list of specific alternative pros and cons can be found in **Appendix A**.

- Alternative A1: Lane Shift for 2 Northbound Left Turn Lanes, 2 southbound Lanes. The key benefit of this alternative is the minimal impact to existing configuration with the northbound lane shift.
- Alternative A2: Lane Shift for 2 Northbound Left Turn Lanes with Ped Enhancement, 2 Southbound Lanes. The key benefits of this alternative are the minimal impact to existing configuration listed in A1 and the pedestrian-friendly design of the SE corner.
- Alternative A3-B: Northbound Left Turn Lane Extension to 3rd St, 2 Southbound Lanes. The key benefit of this alternative is that the northbound left turn lane queue storage extends to 3rd Street.
- Alternative A3-C2: Northbound Left Turn Lanes Max Extension, 2 Southbound Lanes. The key benefit of this alternative is that the northbound left turn lane queue storage extends south of 3rd Street.
- Alternative B1-C1: Northbound Left Turn Lanes Max Extension w/northbound Thru Lane, 1 Southbound Lane. The key benefits of this alternative are that the northbound left turn lane queue storage extends south of 3rd Street and that there is a separate northbound through lane.
- Alternative B2-A2: Northbound Left Turn Lanes Max Extension w/northbound Thru Lane and LT Lanes at 3rd, 1 Southbound Lane. The key benefits of this alternative are that the northbound left turn lane has the maximum queue storage south of 3rd Street and that 3rd Street is full-access with left turn lanes.
- Alternative B3-C1: Pokegama St Northbound Only, 1 Southbound Lane. The key benefits of this alternative are that the northbound left turn lane has the maximum queue storage south of 3rd Street and the reduction of two signal phases at TH 169 and US 2.
- Alternative B4-C1: Pokegama Southbound Left Only, 1 Southbound Lane. The key benefits of this alternative are that the northbound left turn lane has the maximum queue storage south of 3rd Street and the reduction of one signal phase at TH 169 and US 2.
- Alternative B5-A2: Pokegama RIRO, 1 Southbound Lane. The key benefits of this alternative are that the northbound left turn lane has the maximum queue storage south of 3rd Street and the reduction of one signal phase at TH 169 and US 2.
- Alternative B6-A1: Close North Leg, 1 Southbound Lane. The key benefits of this alternative are the reduction of four signal phases at TH 169 and US 2 and the pedestrian-friendly design of the SW and SE corners.

Design Considerations

It should be noted that all alternatives developed will have an impact on the railroad crossing with existing gate arms that may need to be adjusted in length for each alternative's lane configurations. According to the *Highway-Rail Crossing Handbook* (FHWA, 2019), railroad crossing gate arms have a maximum standard length of 32-38 feet, depending on the railroad. Locations of existing trunk storm sewers have not been investigated. Median widths and lane dimensions shown are from face of curb to center of lane line. Lane widths were designed at 11' or greater where possible.

Operations Analysis

A traffic operations analysis was completed using Synchro/SimTraffic software. The key measures of effectiveness (MOE) evaluated include intersection delay, specific movement delay, and 95th percentile queue lengths. An existing conditions traffic operations analysis was completed using 2019 weekday p.m. peak period turning movement counts to establish baseline conditions. Separate traffic operations analysis was completed using the 2019 weekday p.m. peak period turning movement counts for each alternative developed. For comparison purposes, the northbound left-turn delay and queueing impacts at TH 169 and US 2, as well as the southbound delay impacts for applicable alternatives were documented as a percentage change from existing. Each alternative led to a decrease in northbound left-turn delay and queueing. Some alternatives led to increases in southbound delay. These comparison percentages are documented in **Appendix A**. Detailed traffic operations analysis results can be found in **Appendix B**.

Key Conclusions

The alternatives analysis revealed some key conclusions including:

- Removal of split phasing and installation of FYA at TH 169 and US 2 provides opportunity to increase operational flexibility and efficiency through variable left turn phasing by time of day.
- Lengthening the northbound TH 169 left turn lanes or providing lane continuity of the northbound thru lanes into the left turn lanes provide the best lane utilizations.
- 1st Street NW and 1st Street NE have sufficient capacity and signal green time to accommodate traffic diversions as a result of access modifications at 3rd Street and/or Pokegama Street.

Refined Alternatives

The ten preliminary alternatives developed and analyzed were discussed with MnDOT District 1 and the City of Grand Rapids on May 22, 2020. Three alternatives were selected for further refinement and cost analysis.

- Alternative 1 (Preliminary Alternative A1)
- Alternative 2 (modified Preliminary Alternative A3-C2)
- Alternative 3 (new Alternative)

The new Alternative 3 is based on preliminary alternative B3-C1 and added in the removal of the channelized right turn in the southeast quadrant and created a free westbound right turn lane. The median and lane transition between 3rd Street and 2nd Street was modified for Alternative 2 and Alternative 3. Conceptual layouts were prepared for the selected alternatives, as shown in **Figures 3-5**.

High planning-level construction cost estimates were developed for each refined alternative. The estimates do not include modifications to the railroad gate arms and cantilever warning system. Storm sewer costs are estimated since existing locations of trunk storm sewers have not been investigated. A partial temporary signal system was assumed for TH 169 and US 2 for alternatives with construction in the intersection. No temporary signal was assumed at the 3rd Street intersection. The estimate does not include mill and overlay to mitigate against pavement marking

removal scarring and/or cross slope corrections. A 30% overall contingency was factored into the estimated costs for each alternative. Detailed cost estimates can be found in **Appendix C**. Detailed traffic operations analysis results for the refined Alternatives can be found in **Appendix D**.

The refined alternatives, key benefits, and estimated costs are as follows:

- Alternative 1 (**Figure 3**)
  - Includes: Lane shift for 2 northbound left turn lanes and 2 southbound lanes.
  - Key benefit: minimal impact to existing configuration with the northbound lane shift resulting in low capital cost.
  - Cost: $174,800
- Alternative 2 (**Figure 4**)
  - Includes: Northbound left turn lanes maximum queue storage, 2 southbound lanes. 3rd Street traffic signal to be revised as a pedestrian signal for crossing TH 169.
  - Key benefits: northbound left turn lane queue storage extends south of 3rd Street.
  - Cost: $191,300
- Alternative 3 (**Figure 5**)
  - Includes: Northbound left turn lanes maximum queue storage, 2 southbound lanes with free westbound right turn lane, Pokegama Street northbound only, and non-channelized northbound right turn lane in southeast quadrant. 3rd Street traffic signal to be revised as a pedestrian signal for crossing TH 169.
  - Key benefits: the reduction of two signal phases at TH 169 and US 2, northbound left turn lane has the maximum queue storage south of 3rd Street, and the southeast quadrant is more pedestrian friendly.
  - Cost: $485,600

60

SCALE IN FEET

TH 169

3RD ST

TH 2

13' THRU LANE
11' THRU LANE
11' LEFT TURN LANE
12' THRU LANE
13' THRU LANE

13' THRU LANE
11' THRU LANE
11' LEFT TURN LANE
11' LEFT TURN LANE
11' THRU/RT LANE

RIGHT TURN LANE

13' THRU LANE
12' THRU LANE
13' LEFT TURN LANE
11' THRU LANE
14' THRU LANE

14' THRU LANE
11' THRU LANE
13' LEFT TURN LANE
12' THRU LANE
14' THRU LANE

13' THRU/RT LANE
12' THRU LANE
12' LEFT TURN LANE
13' THRU LANE
PARKING

LOSS OF PARKING SPACES (5)

LEGEND

- CURB & GUTTER/MEDIAN
- SIDEWALK
- SOD/LANDSCAPING

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FIGURE 3
CONCEPT ALTERNATIVE 1

60

SCALE IN FEET

MEDIAN LENGTH TO BE DETERMINED IN COORDINATION WITH LOCAL PROPERTY OWNERS

TH 169

RIGHT ONLY

2' MEDIAN F-F

13' THRU
12' THRU
13' LEFT TURN LANE
11' THRU LANE
13' THRU LANE

12' THRU LANE
12' THRU LANE
12' THRU LANE
11' THRU LANE
13' THRU LANE

13' THRU LANE
12' THRU LANE
12' THRU LANE
11' THRU LANE
13' THRU LANE

13' THRU LANE
13' THRU LANE
11' LEFT TURN LANE
11' LEFT TURN LANE
13' THRU/RT TURN LANE

RIGHT TURN LANE

14' THRU LANE
12' THRU LANE
13' LEFT TURN LANE
11' THRU LANE
14' THRU LANE

13' THRU/RT LANE
12' THRU LANE
12' LEFT TURN LANE
13' THRU LANE

PARKING

LOSS OF PARKING SPACES (5)

2ND ST

3RD ST

RIGHT ONLY

13' THRU LANE
12' THRU LANE
13' LEFT TURN LANE
11' THRU LANE
14' THRU LANE

TH 2

LEGEND

- CURB & GUTTER/MEDIAN
- SIDEWALK
- SOD/LANDSCAPING

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FIGURE 4
CONCEPT ALTERNATIVE 2

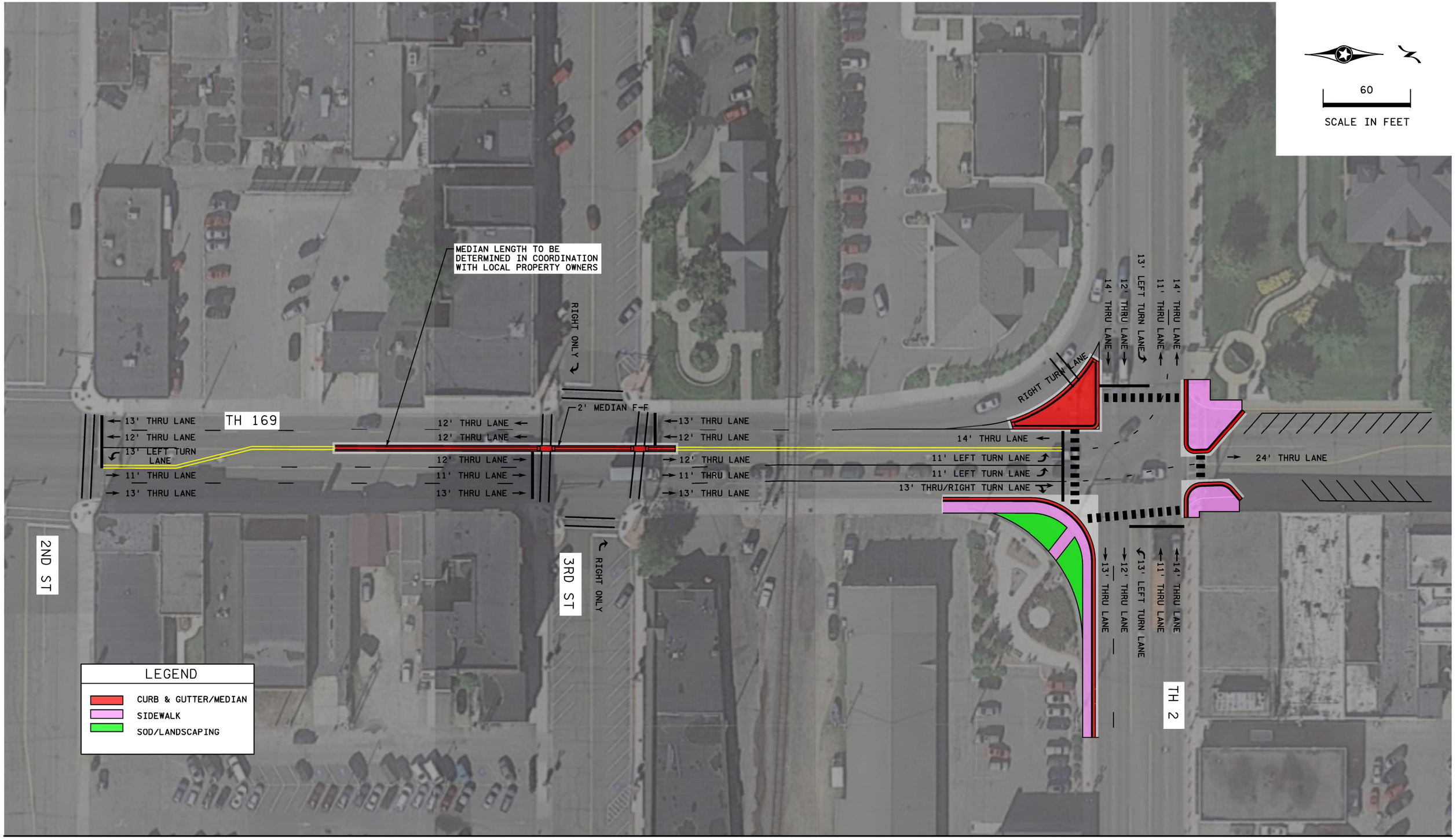

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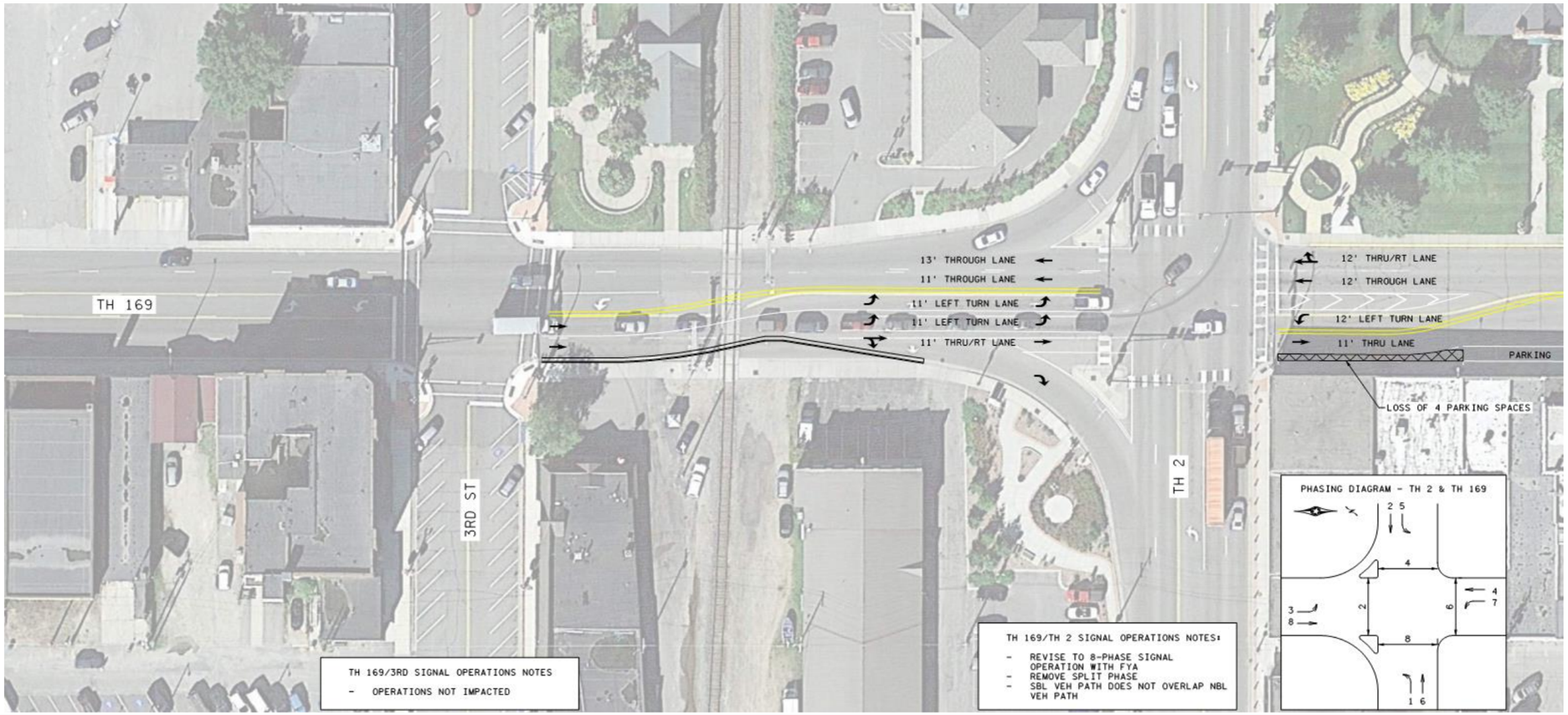
FIGURE 5
CONCEPT ALTERNATIVE 3

Appendix A

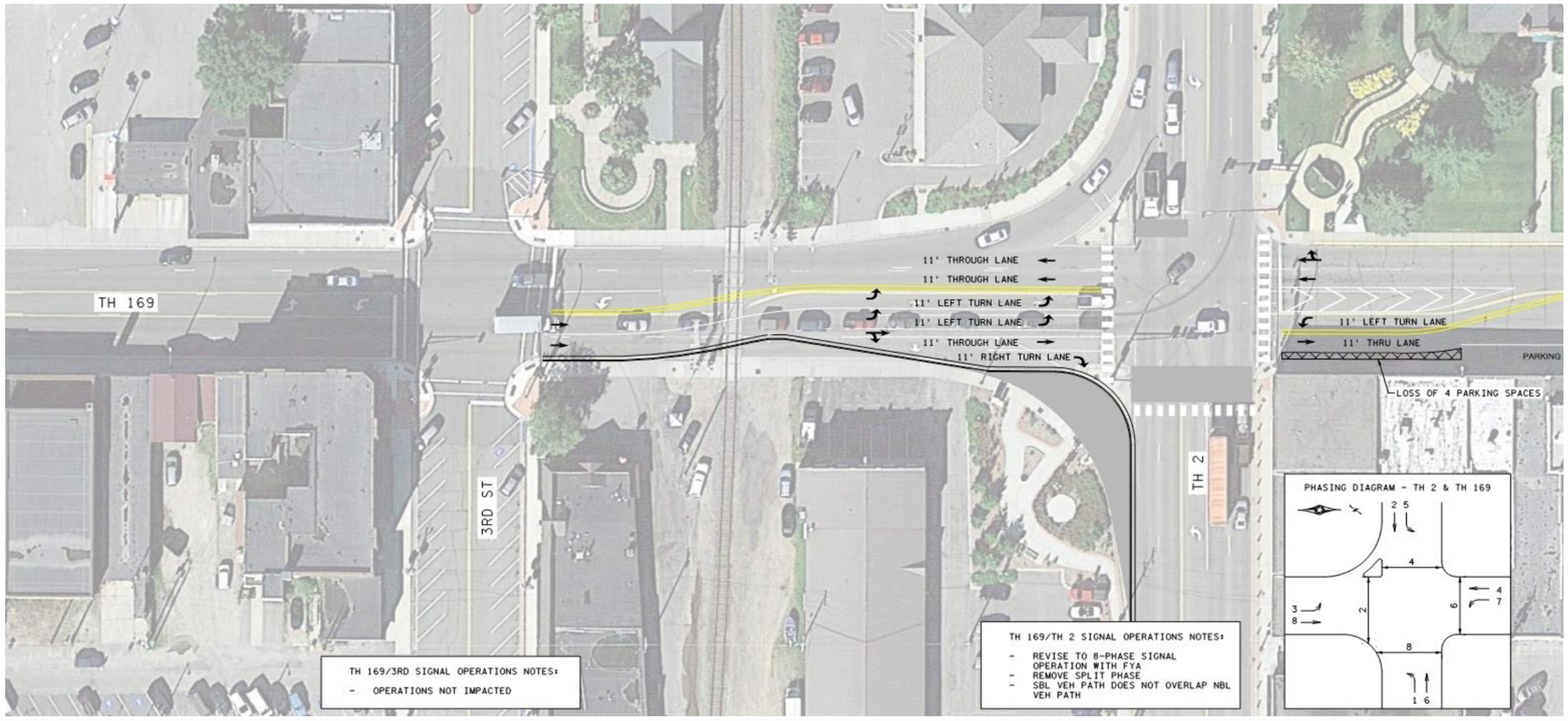
Preliminary Alternatives Analysis Screening Matrix

Alternative A1: Lane Shift for 2 NB Left Turn Lanes (2 SB Lanes)

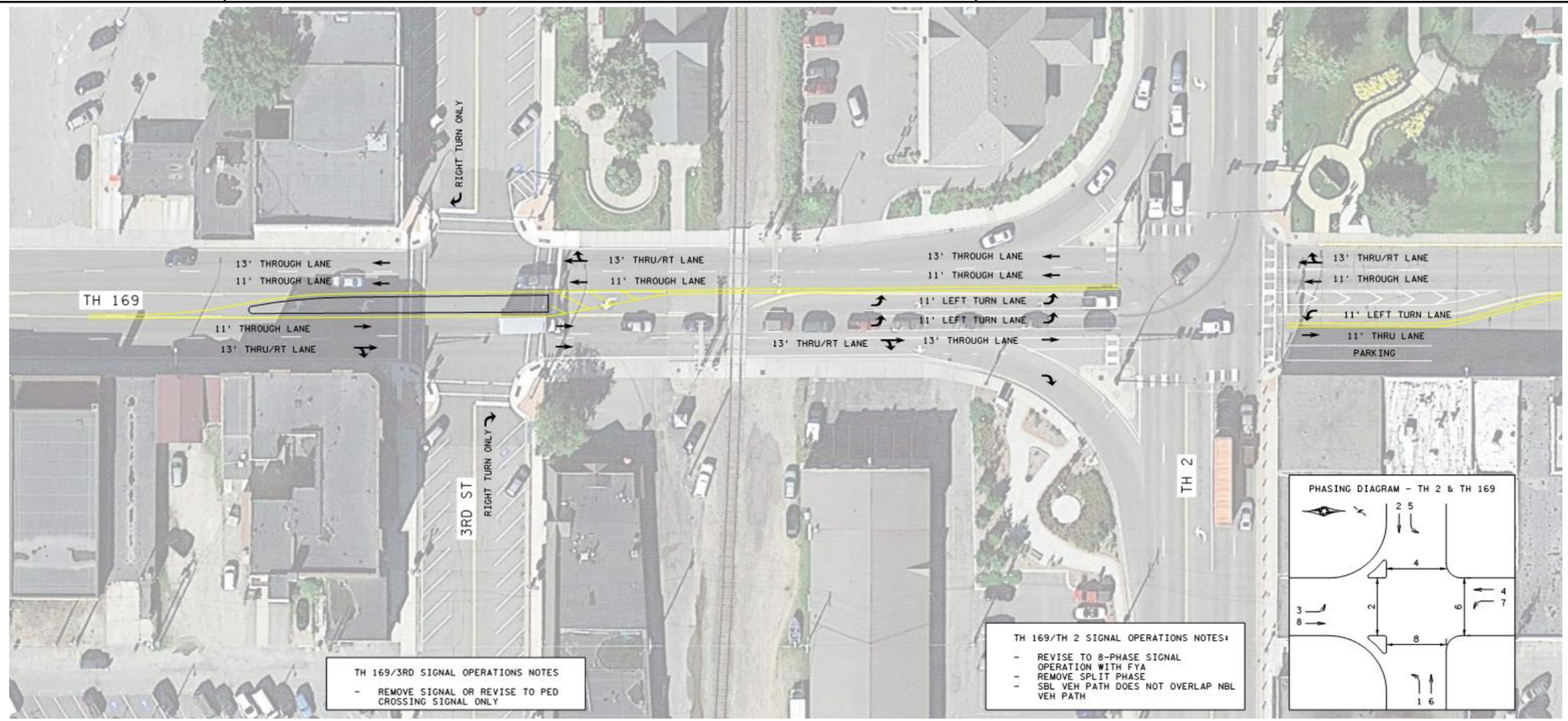
Key Benefits	Pros/Cons	Operations Evaluation
-Minimal impact to existing configuration with NB lane shift	**Pros:** 1. Additional storage for northbound left turn lanes. 2. Lowest cost. 3. No imact to 3rd Street. 4. Balanced lane utilization **Cons:** 1. Loss of 4 on-street parking spaces. 2. Northbound thru and right turn vehicles mixed into left turn queue. 3. Does not mitigate West pedestrian approach operational conflict.	NBL Delay Reduction - 6% NBL Queue Reduction - 27%



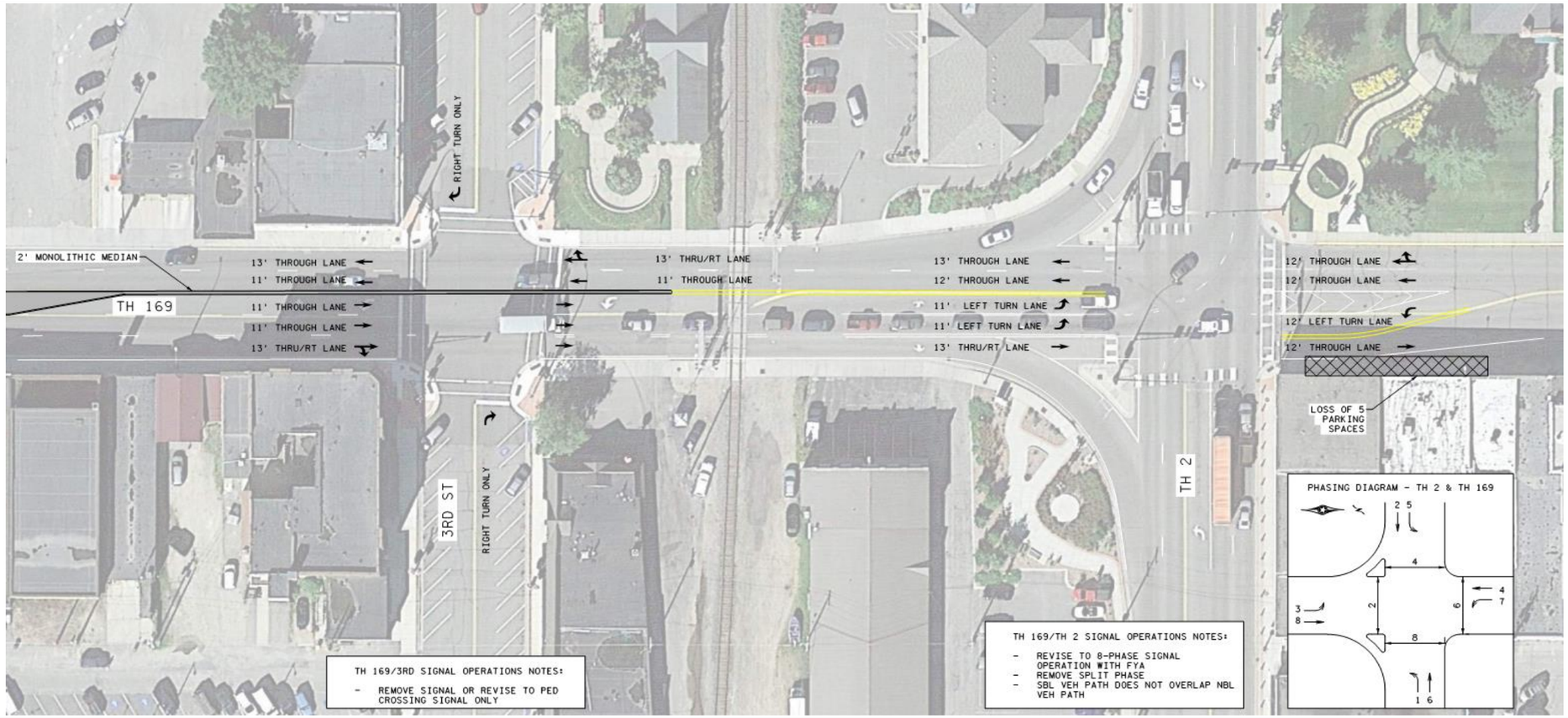
Alternative A2: Lane Shift for 2 NB Left Turn Lanes with Ped Enhancement (2 SB Lanes)		
Key Benefits	**Pros/Cons**	**Operations Evaluation**
-Alt A1 **-Includes pedestrian friendly design of SE corner**	**Pros:** 1. Additional storage for northbound left turn lanes. 2. Low cost. 3. No imact to 3rd Street. 4. Balanced lane utilization. 5. Removal of channelized right turn may provide safer east leg pedestrian crossing. **Cons:** 1. Loss of 4 on-street parking spaces. 2. Northbound thru and right turn vehicles mixed into left turn queue. 3. Does not mitigate West pedestrian approach operational conflict.	NBL Delay Reduction - 3% NBL Queue Reduction - 35%



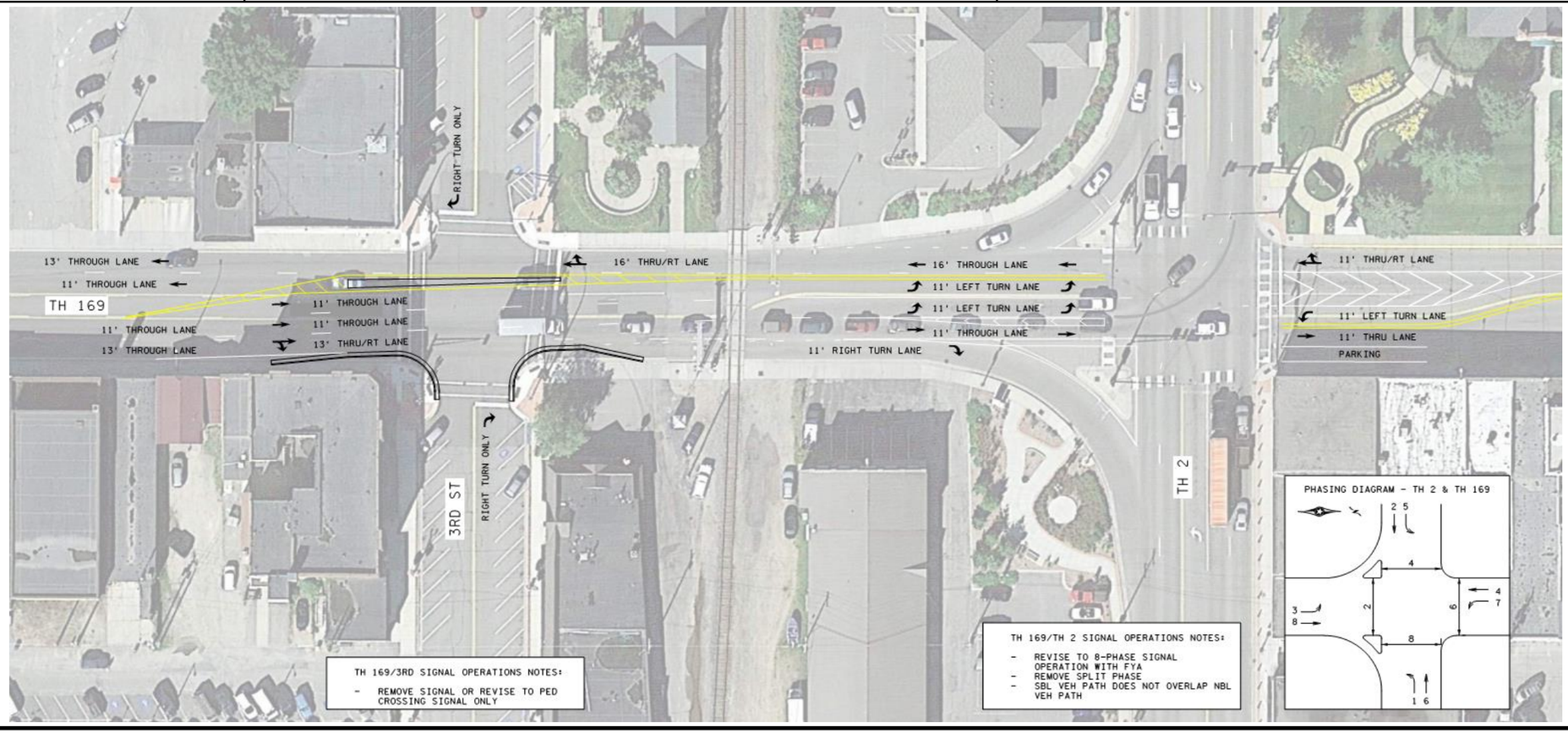
Alternative A3-B: NB Left Turn Lane Extension to 3rd St (2 SB Lanes)		
Key Benefits	**Pros/Cons**	**Operations Evaluation**
-NB Left Turn Lane queue storage extends to 3rd St	**Pros:** 1. Additional storage to 3rd Street for northbound left turn lanes with thru/right in separate lane. 2. Removal of 3rd St signal can provide better northbound traffic progression. **Cons:** 1. No change to existing lane utilization. 2. 3rd Street access is impacted with little advantage to operations. 3. Does not mitigate West pedestrian approach operational conflict.	NBL Delay Reduction - 10% NBL Queue Reduction - 20% Negligible impacts at 1st Ave NW and NE



Alternative A3-C2: NB Left Turn Lanes Max Extension (2 SB Lanes)		
Key Benefits	**Pros/Cons**	**Operations Evaluation**
-NB Left Turn Lane queue storage extends south of 3rd St	**Pros:** 1. Additional storage south of 3rd for northbound left turn lanes with thru/right in separate lane. 2. Balanced lane utilization. 3. Removal of 3rd St signal can provide better northbound traffic progression. **Cons:** 1. 3rd Street access. 2. Loss of 5 parking spaces. 3. Does not mitigate West pedestrian approach operational conflict.	NBL Delay Reduction - 8% NBL Queue Reduction - 51% Negligible impacts at 1st Ave NW and NE

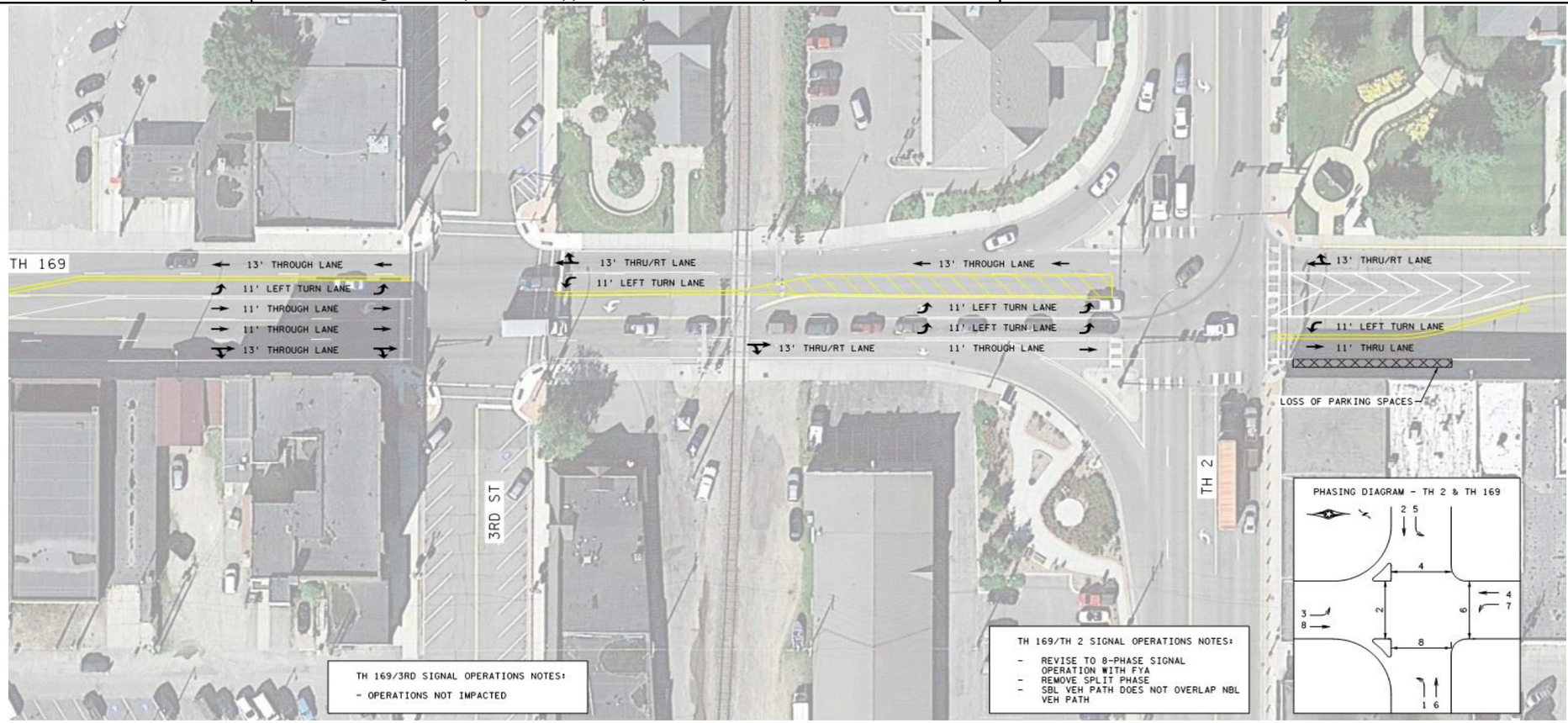


Alternative B1-C1: NB Left Turn Lanes Max Extension w/NB Thru Lane (1 SB Lane)		
Key Benefits	**Pros/Cons**	**Operations Evaluation**
-Maximum NB Left Turn Lane queue storage south of 3rd St **-Separate NB Thru Lane**	**Pros:** 1. Additional storage south of 3rd for northbound left turn lanes with thru/right in separate lane. 2. Balanced lane utilization. 3. Removal of 3rd St signal can provide better northbound traffic progression. 4. Curb extensions on east side at 3rd Street. **Cons:** 1. 3rd Street access. 2. Increase in SB delay. 3. Does not mitigate West pedestrian approach operational conflict.	NBL Delay Reduction - 9% NBL Queue Reduction - 53% SB Delay Increase - 38% Negligible impacts at 1st Ave NW and NE

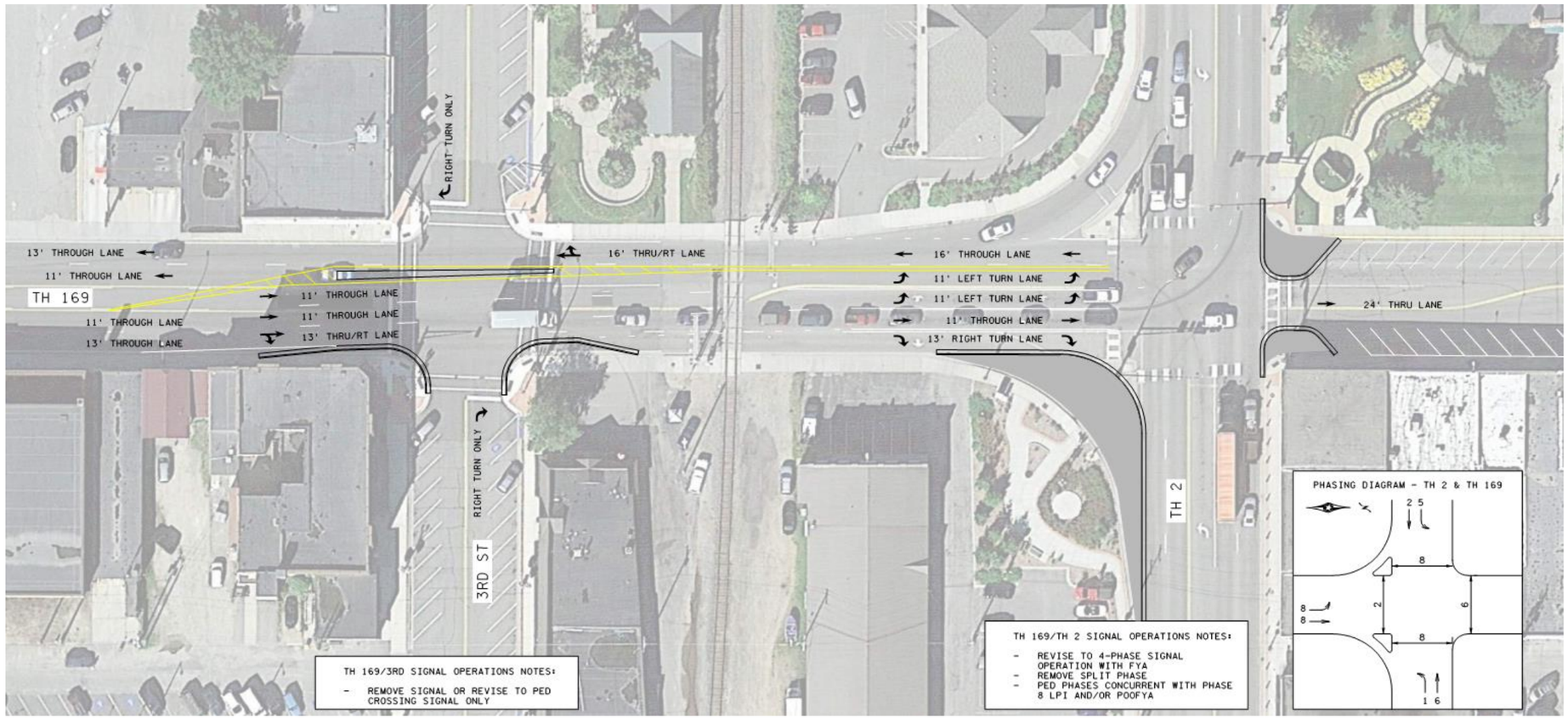


Alternative B2-A2: NB Left Turn Lanes Max Extension w/NB Thru Lane and LT Lanes at 3rd (1 SB Lane)

Key Benefits	Pros/Cons	Operations Evaluation
-Full access at 3rd St with Left Turn Lanes **-Maximum NB Left Turn Lane queue storage south of 3rd St**	**Pros:** 1. Additional storage south of 3rd for northbound left turn lanes with thru/right in separate lane. 2. Balanced lane utilization. 3. Full access at 3rd with NB/SB left turn lanes. **Cons:** 1. Loss of 5 parking spaces. 2. Significant increase in SB delay. 3. Does not mitigate West pedestrian approach operational conflict.	NBL Delay Reduction - 4% NBL Queue Reduction - 48% SB Delay Increase - 110%

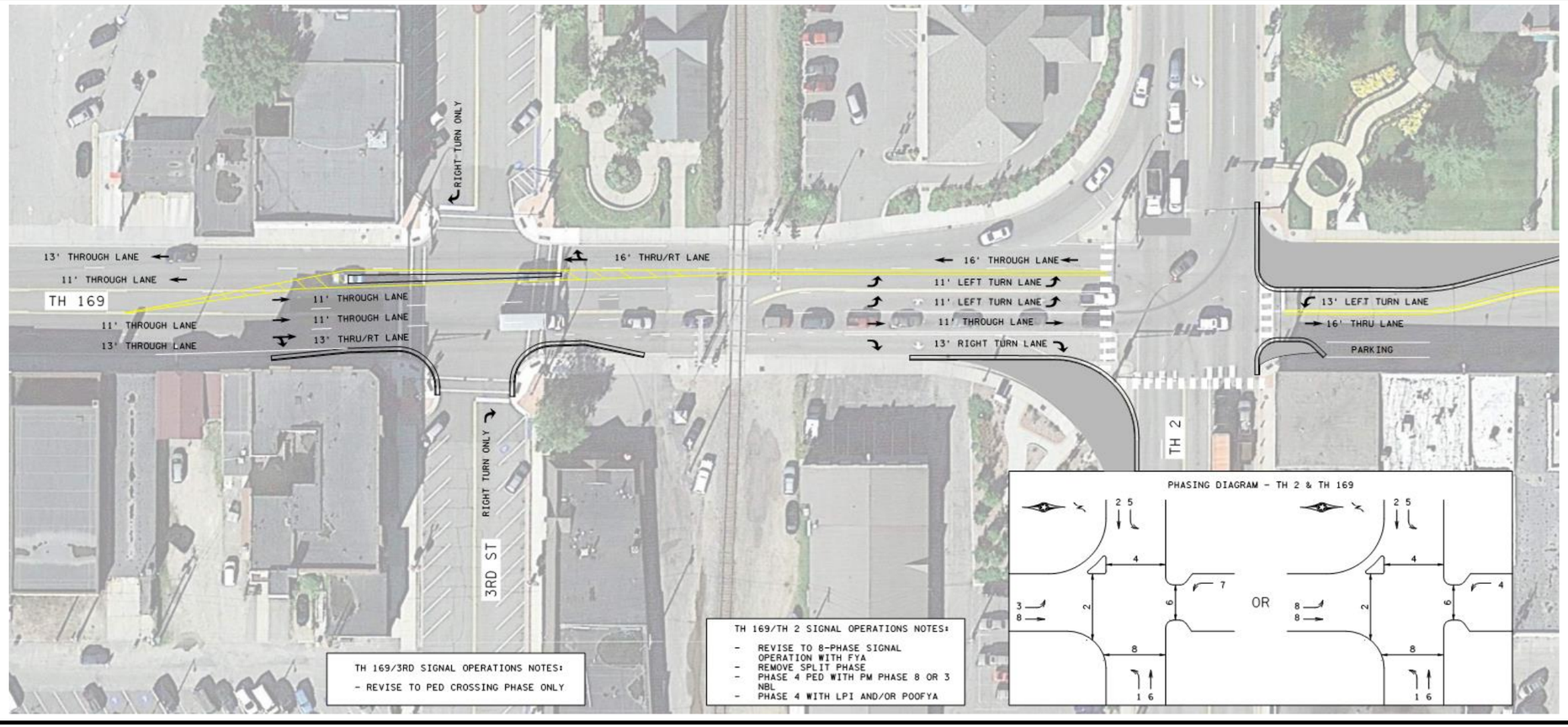


Alternative B3-C1: Pokegama St NB Only (1 SB Lane)		
Key Benefits	**Pros/Cons**	**Operations Evaluation**
-Reduction of 2 signal phases at TH 169/TH 2 with Pokegama St NB Only **-Maximum NB Left Turn Lane queue storage south of 3rd St**	**Pros:** 1. Additional storage south of 3rd for northbound left turn lanes with thru/right in separate lane. 2. Balanced lane utilization. 3. Removal of 3rd St signal can provide better northbound traffic progression. 4. Curb extensions on east side at 3rd Street. 5. Reduction of 2 signal phases at 169/2. 6. Additional parking provided. 7. Curb extensions on north leg of 169/2. 8. Removal of channelized right turn may provide safer east leg pedestrian crossing. **Cons:** 1. 3rd St access restrictions. 2. Pokegama St change in access. 3. Increase in delay at 1st St NW and NE	NBL Delay Reduction - 9% NBL Queue Reduction - 49% SB Approach Delay Increase at 1st Ave NW and NE - ~25%

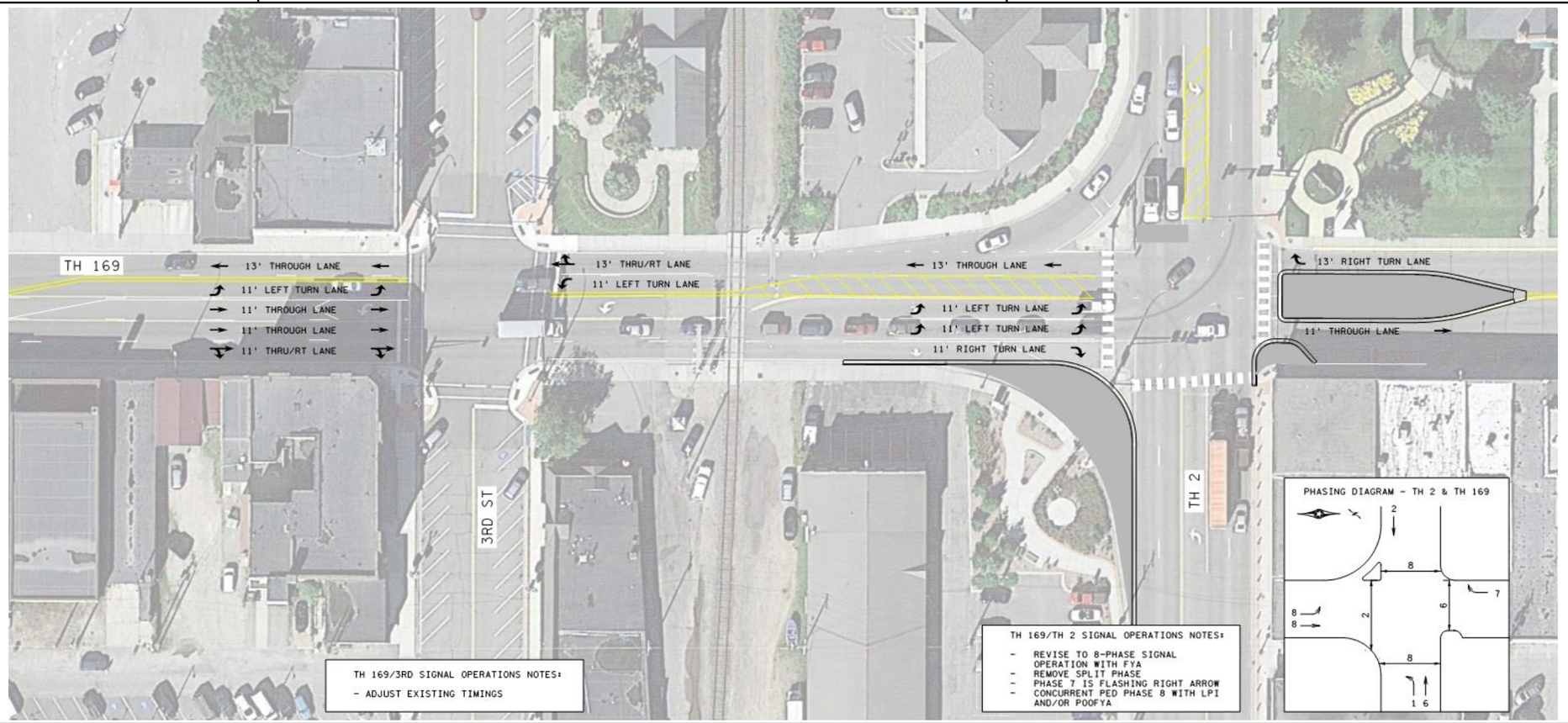


Alternative B4-C1: Pokegama SB Left Only (1 SB Lane)

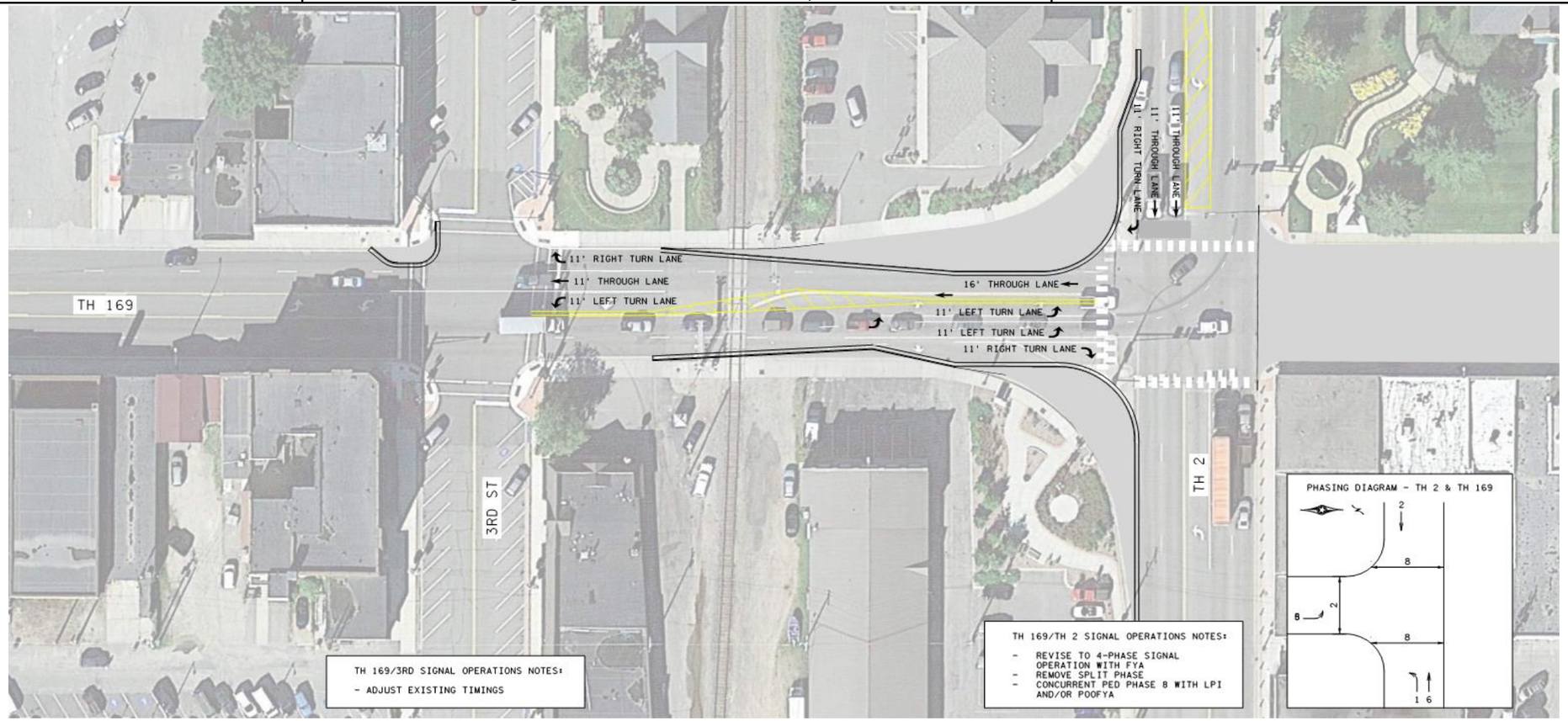
Key Benefits	Pros/Cons	Operations Evaluation
-Reduction of 1 signal phase at TH 169/TH 2 with Pokegama St SBL Only **-NB Left Turn Lane queue storage extends south of 3rd St**	**Pros:** 1. Additional storage south of 3rd for northbound left turn lanes with thru/right in separate lane. 2. Balanced lane utilization. 3. Removal of 3rd St signal can provide better northbound traffic progression. 4. Curb extensions on east side at 3rd Street. 5. Reduction of 1 signal phase at 169/2. 6. Curb extensions on north leg of 169/2. 7. Removal of channelized right turn may provide safer east leg pedestrian crossing. **Cons:** 1. 3rd St access restrictions. 2. Pokegama St change in access. 3. Increase in delay at 1st St NW and NE.	NBL Delay Reduction - 23% NBL Queue Reduction - 54% SB Approach Delay Increase at 1st Ave NW and NE - ~25%



Alternative B5-A2: Pokegama RIRO (1 SB Lane)		
Key Benefits	**Pros/Cons**	**Operations Evaluation**
-Reduction of 1 signal phase at TH 169/TH 2 with Pokegama St SBR Only **-NB Left Turn Lane queue storage extends south of 3rd St**	**Pros:** 1. Additional storage south of 3rd for northbound left turn lanes with thru/right in separate lane. 2. Balanced lane utilization. 3. Full access at 3rd with NB/SB left turn lanes. 4. Removal of channelized right turn may provide safer east leg pedestrian crossing. 5. Reduction of 1 signal phase at 169/2. **Cons:** 1. Pokegama St access. 2. Increase in delay at 1st St NE and NW.	NBL Delay Reduction - 3% NBL Queue Reduction - 41% SB Approach Delay Increase at 1st Ave NW and NE - ~25%



Alternative B6-A1: Close North Leg (1 SB Lane)		
Key Benefits	**Pros/Cons**	**Operations Evaluation**
-Reduction of 4 signal phases at TH 169/TH 2 **-Pedestrian friendly design at SW and SE corner**	**Pros:** 1. Balanced lane utilization. 2. Removal of channelized right turns may provide safer pedestrian crossings. 3. Reduction of 4 signal phases at 169/2. **Cons:** 1. Pokegama St access. 2. High cost. 3. Increase in delay at 1st St NE and NW. 4. Northbound thru and right turn vehicles mixed into left turn queue.	NBL Delay Reduction - 8% NBL Queue Reduction - 30% SB Approach Delay Increase at 1st Ave NW and NE - ~25%



Appendix B

Preliminary Alternatives Traffic Operations Analysis

2020 Existing - PM Peak Hour

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
803	Traffic Signal	TH 2 and 1st Ave W	Movement Delay (sec/veh)	15.1	6.7	6.6	11.0	2.4	1.6	48.3	51.6	12.1	49.3	50.9	9.7	7.3
			Total Delay (hr)	0.1	1.8	0.1	0.0	0.7	0.0	0.8	0.4	0.1	0.3	0.3	0.1	4.7
			Movement LOS	B	A	A	B	A	A	D	D	B	D	D	A	A
			Movement Volume	13	983	49	15	1034	25	60	27	26	21	21	35	2309
			Movement 95th Queue (ft)	30	166	226	28	51	55	140	140	54	86	86	53	
			Storage Bay Distance (ft)	130	0	0	110	0	0	0	0	0	0	0	0	
			Approach Delay (sec/veh)	6.8			2.5			40.8			31.7			
			Approach LOS	A			A			D			C			

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
804	Traffic Signal	TH 2 and TH 169	Movement Delay (sec/veh)	18.4	27.8	11.0	26.8	20.2	18.0	39.5	28.0	1.8	56.0	53.1	18.4	26.3
			Total Delay (hr)	0.0	4.1	1.4	1.0	3.2	0.1	5.1	2.0	0.1	0.5	3.5	0.0	21.0
			Movement LOS	B	C	B	C	C	B	D	C	A	E	D	B	C
			Movement Volume	6	525	456	138	562	18	453	254	164	35	234	4	2849
			Movement 95th Queue (ft)	50	297	173	162	246	248	515	631	38	97	178	161	
			Storage Bay Distance (ft)	110	0	25	100	0	0	40	0	0	100	0	0	
			Approach Delay (sec/veh)	20.0			21.4			29.0			53.0			
			Approach LOS	B			C			C			D			

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
806	Traffic Signal	TH 2 and 1st Ave E	Movement Delay (sec/veh)	7.8	4.4	3.6	8.9	4.5	4.1	54.9	53.0	7.8	50.4	50.8	6.0	7.9
			Total Delay (hr)	0.1	0.9	0.0	0.1	0.9	0.0	0.5	0.5	0.1	0.1	0.5	0.0	3.7
			Movement LOS	A	A	A	A	A	A	D	D	A	D	D	A	A
			Movement Volume	41	689	25	21	686	17	33	35	26	8	36	20	1637
			Movement 95th Queue (ft)	43	70	79	31	71	76	125	125	69	95	95	45	
			Storage Bay Distance (ft)	100	0	0	100	0	0	0	0	30	0	0	30	
			Approach Delay (sec/veh)	4.6			4.6			41.2			36.8			
			Approach LOS	A			A			D			D			

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
818	Traffic Signal	TH 169 and 3rd St N	Movement Delay (sec/veh)	59.0	56.6	9.7	56.2	51.8	21.7	15.1	10.4	1.6	6.9	3.7	3.3	8.9
			Total Delay (hr)	0.1	0.2	0.1	0.4	0.2	0.1	0.1	2.7	0.0	0.0	0.9	0.0	4.8
			Movement LOS	E	E	A	E	D	C	B	B	A	A	A	A	A
			Movement Volume	4	14	50	27	17	9	23	931	27	4	837	3	1946
			Movement 95th Queue (ft)	51	51	63	90	90	31	79	268	208	9	98	110	
			Storage Bay Distance (ft)	0	0	30	0	0	10	100	0	0	85	0	0	
			Approach Delay (sec/veh)	22.3			48.9			10.3			3.7			
			Approach LOS	C			D			B			A			

2020 Alternative A1 - PM Peak Hour

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
803	Traffic Signal	TH 2 and 1st Ave W	Movement Delay (sec/veh)	14.2	5.5	4.8	11.7	2.9	1.9	49.8	49.4	11.7	47.6	53.5	9.2	6.8
			Total Delay (hr)	0.1	1.5	0.1	0.1	0.8	0.0	0.7	0.3	0.1	0.4	0.3	0.1	4.5
			Movement LOS	B	A	A	B	A	A	D	D	B	D	D	A	A
			Movement Volume	13	971	48	17	1047	19	51	23	29	26	19	33	2296
			Movement 95th Queue (ft)	31	146	192	30	81	86	124	124	52	87	87	51	
			Storage Bay Distance (ft)	130	0	0	110	0	0	0	0	0	0	0	0	
			Approach Delay (sec/veh)		5.6			3.0			39.0			32.8		
			Approach LOS		A			A			D			C		

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
804	Traffic Signal	TH 2 and TH 169	Movement Delay (sec/veh)	7.2	15.6	6.7	19.1	12.8	8.3	37.3	24.4	14.9	59.4	70.3	33.1	23.0
			Total Delay (hr)	0.0	2.3	0.9	0.7	2.0	0.0	5.0	1.6	0.7	0.5	4.7	0.0	18.4
			Movement LOS	A	B	A	B	B	A	D	C	B	E	E	C	C
			Movement Volume	4	520	466	136	552	16	468	239	174	30	237	5	2847
			Movement 95th Queue (ft)	13	214	155	109	167	174	377	327	253	110	219	202	
			Storage Bay Distance (ft)	110	0	25	100	0	0	0	100	100	100	0	0	
			Approach Delay (sec/veh)		11.4			13.9			29.4			68.4		
			Approach LOS		B			B			C			E		

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
806	Traffic Signal	TH 2 and 1st Ave E	Movement Delay (sec/veh)	8.0	4.6	3.2	8.2	4.1	3.3	55.8	54.0	8.8	54.8	45.0	6.1	7.8
			Total Delay (hr)	0.1	0.9	0.0	0.1	0.8	0.0	0.6	0.5	0.1	0.1	0.4	0.0	3.6
			Movement LOS	A	A	A	A	A	A	E	D	A	D	D	A	A
			Movement Volume	42	680	25	25	678	19	35	35	27	6	33	15	1620
			Movement 95th Queue (ft)	45	73	85	32	59	67	129	129	62	84	84	32	
			Storage Bay Distance (ft)	100	0	0	100	0	0	0	0	30	0	0	30	
			Approach Delay (sec/veh)		4.7			4.2			42.1			35.3		
			Approach LOS		A			A			D			D		

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
818	Traffic Signal	TH 169 and 3rd St N	Movement Delay (sec/veh)	54.9	48.1	8.0	52.5	48.7	17.6	6.5	2.3	1.5	8.6	3.8	2.9	4.8
			Total Delay (hr)	0.1	0.2	0.1	0.5	0.2	0.0	0.0	0.6	0.0	0.0	0.9	0.0	2.6
			Movement LOS	D	D	A	D	D	B	A	A	A	A	A	A	A
			Movement Volume	4	13	53	32	15	9	21	936	29	4	845	5	1966
			Movement 95th Queue (ft)	44	44	58	89	89	30	29	74	94	13	100	106	
			Storage Bay Distance (ft)	0	0	30	0	0	10	100	0	0	70	0	0	
			Approach Delay (sec/veh)		18.1			45.9			2.4			3.8		
			Approach LOS		B			D			A			A		

2020 Alternative A2 - PM Peak Hour

Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
		EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
TH 2 and 1st Ave W	Movement Delay (sec/veh)	10.1	6.1	5.1	13.2	2.9	2.4	45.5	54.6	11.3	45.6	46.5	10.2	7.3
	Total Delay (hr)	0.0	1.7	0.1	0.1	0.8	0.0	0.8	0.4	0.1	0.3	0.3	0.1	4.7
	Movement LOS	B	A	A	B	A	A	D	D	B	D	D	B	A
	Movement Volume	13	1005	50	18	1040	24	66	28	32	24	20	33	2353
	Movement 95th Queue (ft)	26	155	206	37	83	84	139	139	57	92	92	51	
	Storage Bay Distance (ft)	130	0	0	110	0	0	0	0	0	0	0	0	
	Approach Delay (sec/veh)	6.1			3.1			38.8			30.7			
	Approach LOS	A			A			D			C			

Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
		EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
TH 2 and TH 169	Movement Delay (sec/veh)	16.1	15.5	7.3	17.6	12.0	11.0	38.4	21.0	10.8	63.6	70.7	32.7	22.5
	Total Delay (hr)	0.0	2.3	1.0	0.7	1.9	0.0	5.0	1.5	0.5	0.5	4.9	0.0	18.3
	Movement LOS	B	B	A	B	B	B	D	C	B	E	E	C	C
	Movement Volume	4	536	478	145	563	16	453	251	162	31	242	3	2884
	Movement 95th Queue (ft)	15	218	160	127	159	167	333	286	137	91	229	214	
	Storage Bay Distance (ft)	110	0	25	100	0	0	0	100	100	100	0	0	
	Approach Delay (sec/veh)	11.7			13.1			28.2			69.5			
	Approach LOS	B			B			C			E			

Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
		EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
TH 2 and 1st Ave E	Movement Delay (sec/veh)	7.6	3.5	2.6	9.4	4.0	3.3	49.4	51.1	6.7	38.6	45.6	5.3	7.1
	Total Delay (hr)	0.1	0.7	0.0	0.1	0.8	0.0	0.5	0.5	0.0	0.1	0.4	0.0	3.2
	Movement LOS	A	A	A	A	A	A	D	D	A	D	D	A	A
	Movement Volume	43	680	26	21	697	18	38	35	26	11	31	14	1640
	Movement 95th Queue (ft)	48	73	85	31	56	61	133	133	64	93	93	35	
	Storage Bay Distance (ft)	100	0	0	100	0	0	0	0	30	0	0	30	
	Approach Delay (sec/veh)	3.7			4.1			38.8			34.2			
	Approach LOS	A			A			D			C			

Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
		EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
TH 169 and 3rd St N	Movement Delay (sec/veh)	46.8	57.6	9.1	56.0	52.8	9.1	9.8	2.1	1.4	8.8	4.1	5.1	5.0
	Total Delay (hr)	0.1	0.3	0.1	0.4	0.2	0.0	0.1	0.5	0.0	0.0	1.0	0.0	2.7
	Movement LOS	D	E	A	E	D	A	A	A	A	A	A	A	A
	Movement Volume	4	19	54	25	16	8	23	921	25	5	872	6	1978
	Movement 95th Queue (ft)	57	57	54	92	92	27	30	59	77	16	118	125	
	Storage Bay Distance (ft)	0	0	30	0	0	10	100	0	0	70	0	0	
	Approach Delay (sec/veh)	23.0			47.3			2.3			4.1			
	Approach LOS	C			D			A			A			

2020 Alternative A3B - PM Peak Hour

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
803	Traffic Signal	TH 2 and 1st Ave W	Movement Delay (sec/veh)	10.5	5.4	4.4	10.2	2.7	2.4	49.1	54.5	9.4	59.1	49.5	7.8	6.7
			Total Delay (hr)	0.0	1.5	0.1	0.0	0.8	0.0	0.8	0.3	0.1	0.4	0.3	0.1	4.4
			Movement LOS	B	A	A	B	A	A	D	D	A	E	D	A	A
			Movement Volume	15	983	44	13	1031	21	55	22	34	22	20	34	2294
			Movement 95th Queue (ft)	28	141	181	29	71	77	131	131	51	95	95	50	
			Storage Bay Distance (ft)	130	0	0	110	0	0	0	0	0	0	0	0	
			Approach Delay (sec/veh)	5.4			2.8			38.0			33.6			
			Approach LOS	A			A			D			C			

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
804	Traffic Signal	TH 2 and TH 169	Movement Delay (sec/veh)	17.9	20.0	8.2	20.9	13.5	11.9	34.9	21.9	10.5	63.2	60.2	31.3	23.0
			Total Delay (hr)	0.0	3.0	1.1	1.1	2.0	0.1	4.8	1.5	0.5	0.6	4.3	0.0	19.0
			Movement LOS	B	B	A	C	B	B	C	C	B	E	E	C	C
			Movement Volume	6	531	467	185	520	20	479	238	162	32	255	4	2899
			Movement 95th Queue (ft)	20	254	170	160	172	178	281	320	298	92	202	187	
			Storage Bay Distance (ft)	110	0	25	100	0	0	125	0	0	100	0	0	
			Approach Delay (sec/veh)	14.5			15.3			26.9			60.1			
			Approach LOS	B			B			C			E			

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
806	Traffic Signal	TH 2 and 1st Ave E	Movement Delay (sec/veh)	7.5	3.9	3.2	9.7	3.9	3.3	51.9	50.1	7.6	52.7	47.1	6.1	7.2
			Total Delay (hr)	0.1	0.8	0.0	0.1	0.7	0.0	0.5	0.5	0.1	0.1	0.4	0.0	3.3
			Movement LOS	A	A	A	A	A	A	D	D	A	D	D	A	A
			Movement Volume	42	687	22	22	683	12	34	33	26	9	31	15	1616
			Movement 95th Queue (ft)	43	72	84	29	57	54	122	122	54	87	87	41	
			Storage Bay Distance (ft)	100	0	0	100	0	0	0	0	30	0	0	30	
			Approach Delay (sec/veh)	4.1			4.1			38.9			36.8			
			Approach LOS	A			A			D			D			

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
818	Traffic Signal	TH 169 and 3rd St N	Movement Delay (sec/veh)	0.0	0.0	4.8	0.0	0.0	4.4	0.0	1.3	0.9	0.0	1.9	1.4	1.7
			Total Delay (hr)	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.5	0.0	0.9
			Movement LOS	A	A	A	A	A	A	A	A	A	A	A	A	A
			Movement Volume	0	0	52	0	0	9	0	933	29	0	899	21	1943
			Movement 95th Queue (ft)	0	0	48	0	0	28	0	22	34	0	0	0	
			Storage Bay Distance (ft)	0	0	0	0	0	0	0	0	0	0	0	0	
			Approach Delay (sec/veh)	4.8			4.4			1.3			1.9			
			Approach LOS	A			A			A			A			

2020 Alternative A3C2 - PM Peak Hour

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
803	Traffic Signal	TH 2 and 1st Ave W	Movement Delay (sec/veh)	11.6	6.1	5.1	10.6	2.8	2.5	49.9	46.6	12.3	47.7	51.9	9.3	7.3
			Total Delay (hr)	0.0	1.7	0.1	0.1	0.8	0.0	0.9	0.4	0.1	0.3	0.3	0.1	4.8
			Movement LOS	B	A	A	B	A	A	D	D	B	D	D	A	A
			Movement Volume	13	997	45	19	1023	26	64	28	32	25	18	32	2322
			Movement 95th Queue (ft)	29	137	187	34	74	77	129	129	55	81	81	54	
			Storage Bay Distance (ft)	130	0	0	110	0	0	0	0	0	0	0	0	
			Approach Delay (sec/veh)		6.1			2.9			39.5			32.3		
			Approach LOS		A			A			D			C		

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
804	Traffic Signal	TH 2 and TH 169	Movement Delay (sec/veh)	19.0	19.3	8.8	18.9	13.8	9.1	36.2	19.1	7.4	56.3	59.3	33.6	22.2
			Total Delay (hr)	0.0	2.8	1.2	1.0	2.0	0.1	4.9	1.2	0.3	0.5	4.0	0.0	18.0
			Movement LOS	B	B	A	B	B	A	D	B	A	E	E	C	C
			Movement Volume	7	521	489	180	527	22	484	229	166	32	235	4	2896
			Movement 95th Queue (ft)	39	268	170	139	174	180	254	271	259	97	188	174	
			Storage Bay Distance (ft)	110	0	25	100	0	0	0	0	0	100	0	0	
			Approach Delay (sec/veh)		14.2			14.9			26.3			58.6		
			Approach LOS		B			B			C			E		

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
806	Traffic Signal	TH 2 and 1st Ave E	Movement Delay (sec/veh)	8.3	3.9	3.0	11.1	4.1	3.8	48.0	51.1	8.0	55.5	53.7	6.8	7.6
			Total Delay (hr)	0.1	0.7	0.0	0.1	0.8	0.0	0.5	0.4	0.1	0.2	0.6	0.0	3.5
			Movement LOS	A	A	A	B	A	A	D	D	A	E	D	A	A
			Movement Volume	39	686	24	22	680	13	35	29	29	10	39	15	1621
			Movement 95th Queue (ft)	49	66	77	38	76	71	114	114	51	105	105	36	
			Storage Bay Distance (ft)	100	0	0	100	0	0	0	0	30	0	0	30	
			Approach Delay (sec/veh)		4.1			4.3			36.5			43.0		
			Approach LOS		A			A			D			D		

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
818	Traffic Signal	TH 169 and 3rd St N	Movement Delay (sec/veh)	0.0	0.0	4.6	0.0	0.0	4.5	0.0	1.1	0.7	0.0	1.9	1.8	1.6
			Total Delay (hr)	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.5	0.0	0.9
			Movement LOS	A	A	A	A	A	A	A	A	A	A	A	A	A
			Movement Volume	0	0	51	0	0	8	0	940	23	0	894	20	1936
			Movement 95th Queue (ft)	0	0	48	0	0	18	0	12	16	0	9	9	
			Storage Bay Distance (ft)	0	0	0	0	0	0	0	0	0	0	0	0	
			Approach Delay (sec/veh)		4.6			4.5			1.1			1.9		
			Approach LOS		A			A			A			A		

2020 Alternative B1C1 - PM Peak Hour

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
803	Traffic Signal	TH 2 and 1st Ave W	Movement Delay (sec/veh)	11.8	5.9	6.0	12.1	2.8	2.6	48.3	53.0	13.6	50.6	49.0	9.6	7.2
			Total Delay (hr)	0.0	1.6	0.1	0.1	0.8	0.0	0.8	0.4	0.1	0.4	0.3	0.1	4.7
			Movement LOS	B	A	A	B	A	A	D	D	B	D	D	A	A
			Movement Volume	15	984	46	18	1039	20	58	26	31	25	19	33	2314
			Movement 95th Queue (ft)	31	145	199	31	80	76	132	132	55	84	84	50	
			Storage Bay Distance (ft)	130	0	0	110	0	0	0	0	0	0	0	0	
			Approach Delay (sec/veh)		6.0			3.0			40.0			32.6		
			Approach LOS		A			A			D			C		

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
804	Traffic Signal	TH 2 and TH 169	Movement Delay (sec/veh)	13.6	22.5	17.5	22.0	16.4	15.5	36.0	14.3	1.5	67.3	74.1	71.9	25.7
			Total Delay (hr)	0.0	3.3	2.3	1.0	2.4	0.1	5.0	1.0	0.1	0.6	5.1	0.1	21.0
			Movement LOS	B	C	B	C	B	B	D	B	A	E	E	E	C
			Movement Volume	4	525	474	171	524	18	491	242	165	30	237	3	2884
			Movement 95th Queue (ft)	15	289	147	141	178	182	240	156	0	156	428	428	
			Storage Bay Distance (ft)	110	0	25	100	0	0	0	0	0	150	0	0	
			Approach Delay (sec/veh)		20.1			17.7			23.8			73.3		
			Approach LOS		C			B			C			E		

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
806	Traffic Signal	TH 2 and 1st Ave E	Movement Delay (sec/veh)	9.1	3.8	3.2	9.2	4.1	3.4	52.6	49.4	6.6	50.2	51.9	6.9	7.5
			Total Delay (hr)	0.1	0.7	0.0	0.1	0.8	0.0	0.5	0.5	0.0	0.2	0.5	0.0	3.4
			Movement LOS	A	A	A	A	A	A	D	D	A	D	D	A	A
			Movement Volume	38	678	27	27	676	15	33	35	22	11	35	14	1611
			Movement 95th Queue (ft)	42	64	72	36	66	67	128	128	57	103	103	34	
			Storage Bay Distance (ft)	100	0	0	100	0	0	0	0	30	0	0	30	
			Approach Delay (sec/veh)		4.0			4.3			40.1			41.1		
			Approach LOS		A			A			D			D		

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
818	Traffic Signal	TH 169 and 3rd St N	Movement Delay (sec/veh)	0.0	0.0	13.5	0.0	0.0	3.2	0.0	1.2	0.7	0.0	3.5	2.4	2.6
			Total Delay (hr)	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.9	0.0	1.4
			Movement LOS	A	A	B	A	A	A	A	A	A	A	A	A	A
			Movement Volume	0	0	49	0	0	10	0	961	27	0	873	22	1942
			Movement 95th Queue (ft)	0	0	64	0	0	21	0	0	0	0	0	0	
			Storage Bay Distance (ft)	0	0	0	0	0	0	0	0	0	0	0	0	
			Approach Delay (sec/veh)		13.5			3.2			1.2			3.5		
			Approach LOS		B			A			A			A		

2020 Alternative B2A2 - PM Peak Hour

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
803	Traffic Signal	TH 2 and 1st Ave W	Movement Delay (sec/veh)	12.3	5.9	5.2	13.2	2.4	1.9	44.7	53.1	13.2	49.9	43.3	9.3	6.6
			Total Delay (hr)	0.0	1.6	0.1	0.1	0.7	0.0	0.7	0.4	0.1	0.2	0.2	0.1	4.2
			Movement LOS	B	A	A	B	A	A	D	D	B	D	D	A	A
			Movement Volume	11	974	48	17	1026	27	54	26	32	18	18	33	2284
			Movement 95th Queue (ft)	24	149	202	31	54	54	122	122	55	72	72	51	
			Storage Bay Distance (ft)	130	0	0	110	0	0	0	0	0	0	0	0	
			Approach Delay (sec/veh)	5.9			2.6			37.7			28.8			
			Approach LOS	A			A			D			C			

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
804	Traffic Signal	TH 2 and TH 169	Movement Delay (sec/veh)	16.8	20.0	17.7	20.9	14.9	12.2	38.1	17.3	7.7	98.3	113.3	100.0	29.4
			Total Delay (hr)	0.0	2.9	2.3	0.8	2.3	0.1	4.9	1.2	0.3	0.9	8.2	0.1	24.0
			Movement LOS	B	B	B	C	B	B	D	B	A	F	F	F	C
			Movement Volume	5	512	464	139	563	18	452	242	158	31	238	2	2824
			Movement 95th Queue (ft)	19	276	156	119	176	186	277	294	255	141	666	666	
			Storage Bay Distance (ft)	110	0	25	100	0	0	0	0	0	100	0	0	
			Approach Delay (sec/veh)	18.9			16.0			26.6			111.5			
			Approach LOS	B			B			C			F			

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
806	Traffic Signal	TH 2 and 1st Ave E	Movement Delay (sec/veh)	7.7	3.9	3.7	9.2	4.1	3.3	51.5	52.7	7.3	46.9	48.3	7.0	7.5
			Total Delay (hr)	0.1	0.7	0.0	0.1	0.8	0.0	0.6	0.5	0.0	0.1	0.5	0.0	3.4
			Movement LOS	A	A	A	A	A	A	D	D	A	D	D	A	A
			Movement Volume	41	664	22	24	691	12	38	33	23	10	33	14	1605
			Movement 95th Queue (ft)	43	62	75	32	59	61	125	125	55	85	85	37	
			Storage Bay Distance (ft)	100	0	0	100	0	0	0	0	30	0	0	30	
			Approach Delay (sec/veh)	4.1			4.3			41.1			37.9			
			Approach LOS	A			A			D			D			

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
818	Traffic Signal	TH 169 and 3rd St N	Movement Delay (sec/veh)	50.9	55.5	14.6	59.3	52.3	9.4	15.9	1.7	1.0	9.6	5.6	2.8	5.6
			Total Delay (hr)	0.0	0.2	0.2	0.4	0.3	0.0	0.1	0.4	0.0	0.0	1.4	0.0	3.0
			Movement LOS	D	E	B	E	D	A	B	A	A	A	A	A	A
			Movement Volume	2	15	49	24	19	7	25	909	26	3	859	5	1943
			Movement 95th Queue (ft)	48	48	60	91	91	34	41	39	51	11	186	186	
			Storage Bay Distance (ft)	0	0	30	0	0	10	100	33	0	70	0	0	
			Approach Delay (sec/veh)	25.0			49.7			2.1			5.6			
			Approach LOS	C			D			A			A			

2020 Alternative B3C1 - PM Peak Hour

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
803	Traffic Signal	TH 2 and 1st Ave W	Movement Delay (sec/veh)	14.1	15.1	13.5	14.0	10.0	8.8	41.5	44.5	17.1	47.5	46.4	9.8	15.9
			Total Delay (hr)	0.1	4.1	0.2	0.1	2.9	0.0	0.6	0.4	0.2	2.0	0.2	0.1	10.9
			Movement LOS	B	B	B	B	A	A	D	D	B	D	D	A	B
			Movement Volume	18	964	43	16	1047	19	54	30	35	149	19	34	2428
			Movement 95th Queue (ft)	36	328	410	56	303	321	125	125	62	198	198	54	
			Storage Bay Distance (ft)	130	0	0	110	0	0	0	0	0	0	0	0	
			Approach Delay (sec/veh)	15.0			10.0			35.1			41.1			
			Approach LOS	B			B			D			D			

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
804	Traffic Signal	TH 2 and TH 169	Movement Delay (sec/veh)	11.8	14.3	25.3	14.8	6.0	5.2	36.1	24.2	1.7	0.0	0.0	0.0	18.7
			Total Delay (hr)	0.0	2.1	4.0	1.3	0.9	0.0	5.0	1.6	0.1	0.0	0.0	0.0	15.0
			Movement LOS	B	B	C	B	A	A	D	C	A	A	A	A	B
			Movement Volume	5	528	571	308	547	15	482	229	166	0	0	0	2851
			Movement 95th Queue (ft)	15	331	145	162	130	130	262	191	0	0	0	0	
			Storage Bay Distance (ft)	110	0	25	100	0	0	0	0	0	0	0	0	
			Approach Delay (sec/veh)	20.0			9.1			26.5			0.0			
			Approach LOS	B			A			C			A			

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
806	Traffic Signal	TH 2 and 1st Ave E	Movement Delay (sec/veh)	8.6	4.2	4.2	11.1	4.9	3.2	48.9	46.7	6.6	50.2	43.1	9.6	8.6
			Total Delay (hr)	0.1	0.8	0.0	0.1	1.0	0.0	0.5	0.4	0.1	0.6	0.5	0.4	4.5
			Movement LOS	A	A	A	B	A	A	D	D	A	D	D	A	A
			Movement Volume	38	685	23	21	691	16	34	33	28	43	37	146	1795
			Movement 95th Queue (ft)	47	78	90	33	87	82	118	118	57	165	165	114	
			Storage Bay Distance (ft)	100	0	0	100	0	0	0	0	30	0	0	30	
			Approach Delay (sec/veh)	4.4			5.0			35.7			22.8			
			Approach LOS	A			A			D			C			

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
818	Traffic Signal	TH 169 and 3rd St N	Movement Delay (sec/veh)	0.0	0.0	10.1	0.0	0.0	3.1	0.0	1.1	0.8	0.0	3.4	3.3	2.4
			Total Delay (hr)	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.8	0.0	1.2
			Movement LOS	A	A	B	A	A	A	A	A	A	A	A	A	A
			Movement Volume	0	0	51	0	0	7	0	941	28	0	875	21	1923
			Movement 95th Queue (ft)	0	0	60	0	0	18	0	8	0	0	0	0	
			Storage Bay Distance (ft)	0	0	0	0	0	0	0	0	0	0	0	0	
			Approach Delay (sec/veh)	10.1			3.1			1.1			3.4			
			Approach LOS	B			A			A			A			

2020 Alternative B4C1 - PM Peak Hour

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
803	Traffic Signal	TH 2 and 1st Ave W	Movement Delay (sec/veh)	12.1	13.2	14.2	12.5	8.9	8.3	37.4	37.5	15.0	46.0	46.9	8.8	14.4
			Total Delay (hr)	0.0	3.6	0.2	0.1	2.5	0.0	0.6	0.3	0.1	1.9	0.3	0.1	9.7
			Movement LOS	B	B	B	B	A	A	D	D	B	D	D	A	B
			Movement Volume	10	961	50	16	1008	19	56	24	28	145	20	38	2375
			Movement 95th Queue (ft)	24	258	359	64	273	281	119	119	55	207	207	50	
			Storage Bay Distance (ft)	130	0	0	110	0	0	0	0	0	0	0	0	
			Approach Delay (sec/veh)	13.2			8.9			31.6			39.1			
			Approach LOS	B			A			C			D			

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
804	Traffic Signal	TH 2 and TH 169	Movement Delay (sec/veh)	18.4	17.4	24.3	14.4	7.2	4.1	30.5	25.4	1.7	66.7	0.0	0.0	19.1
			Total Delay (hr)	0.0	2.5	3.9	1.2	1.0	0.0	4.0	1.8	0.1	0.6	0.0	0.0	15.1
			Movement LOS	B	B	C	B	A	A	C	C	A	E	A	A	B
			Movement Volume	5	513	576	303	523	19	461	247	158	34	0	0	2839
			Movement 95th Queue (ft)	38	330	141	155	135	132	238	209	41	99	0	0	
			Storage Bay Distance (ft)	110	0	25	100	0	0	0	0	250	0	0	0	
			Approach Delay (sec/veh)	21.0			9.7			23.8			66.7			
			Approach LOS	C			A			C			E			

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
806	Traffic Signal	TH 2 and 1st Ave E	Movement Delay (sec/veh)	8.4	4.5	3.8	9.5	4.5	4.0	52.0	48.4	6.7	44.4	50.3	8.1	7.8
			Total Delay (hr)	0.1	0.8	0.0	0.1	0.9	0.0	0.5	0.4	0.1	0.1	0.4	0.3	3.7
			Movement LOS	A	A	A	A	A	A	D	D	A	D	D	A	A
			Movement Volume	42	665	24	26	688	11	35	31	29	9	31	133	1724
			Movement 95th Queue (ft)	47	80	90	34	67	71	113	113	58	100	100	87	
			Storage Bay Distance (ft)	100	0	0	100	0	0	0	0	30	0	0	30	
			Approach Delay (sec/veh)	4.7			4.7			37.0			17.6			
			Approach LOS	A			A			D			B			

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
818	Traffic Signal	TH 169 and 3rd St N	Movement Delay (sec/veh)	0.0	0.0	10.4	0.0	0.0	3.3	0.0	1.1	0.7	0.0	3.4	2.8	2.4
			Total Delay (hr)	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.8	0.0	1.2
			Movement LOS	A	A	B	A	A	A	A	A	A	A	A	A	A
			Movement Volume	0	0	50	0	0	8	0	916	28	0	869	21	1892
			Movement 95th Queue (ft)	0	0	57	0	0	20	0	16	16	0	0	0	
			Storage Bay Distance (ft)	0	0	0	0	0	0	0	0	0	0	0	0	
			Approach Delay (sec/veh)	10.4			3.3			1.1			3.4			
			Approach LOS	B			A			A			A			

2020 Alternative B5A2 - PM Peak Hour

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
803	Traffic Signal	TH 2 and 1st Ave W	Movement Delay (sec/veh)	12.6	10.0	9.4	14.1	14.5	12.7	41.3	40.1	13.9	46.1	46.9	10.0	15.5
			Total Delay (hr)	0.1	2.7	0.1	0.1	4.2	0.3	0.7	0.3	0.1	1.9	0.2	0.1	10.8
			Movement LOS	B	A	A	B	B	B	D	D	B	D	D	A	B
			Movement Volume	18	982	45	17	1035	97	61	27	32	145	17	30	2506
			Movement 95th Queue (ft)	38	203	280	104	339	347	130	130	55	207	207	51	
			Storage Bay Distance (ft)	130	0	0	110	0	0	0	0	0	0	0	0	
			Approach Delay (sec/veh)	10.0			14.3			33.7			40.5			
			Approach LOS	B			B			C			D			

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
804	Traffic Signal	TH 2 and TH 169	Movement Delay (sec/veh)	0.0	15.3	19.1	17.2	7.6	5.5	38.2	2.2	6.8	0.0	0.0	11.3	18.1
			Total Delay (hr)	0.0	2.3	3.1	1.3	1.2	0.0	5.9	0.0	0.5	0.0	0.0	0.0	14.3
			Movement LOS	A	B	B	B	A	A	D	A	A	A	A	B	B
			Movement Volume	0	538	583	261	563	17	550	72	240	0	0	3	2827
			Movement 95th Queue (ft)	0	314	151	146	127	123	302	0	104	0	0	18	
			Storage Bay Distance (ft)	0	0	25	100	0	0	0	0	0	0	0	0	
			Approach Delay (sec/veh)	17.3			10.5			26.5			11.3			
			Approach LOS	B			B			C			B			

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
806	Traffic Signal	TH 2 and 1st Ave E	Movement Delay (sec/veh)	10.2	3.9	2.9	10.6	6.6	4.3	44.4	49.0	6.6	48.6	46.9	8.1	9.0
			Total Delay (hr)	0.5	0.7	0.0	0.1	1.3	0.0	0.4	0.4	0.0	0.6	0.4	0.3	4.7
			Movement LOS	B	A	A	B	A	A	D	D	A	D	D	A	A
			Movement Volume	171	685	24	25	693	14	34	29	26	46	30	137	1914
			Movement 95th Queue (ft)	109	88	101	35	124	123	114	114	65	146	146	104	
			Storage Bay Distance (ft)	100	0	0	100	0	0	0	0	30	0	0	30	
			Approach Delay (sec/veh)	5.1			6.7			34.9			22.3			
			Approach LOS	A			A			C			C			

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
818	Traffic Signal	TH 169 and 3rd St N	Movement Delay (sec/veh)	52.9	55.0	14.0	56.0	52.5	10.7	14.0	2.2	1.1	16.9	6.2	3.8	6.2
			Total Delay (hr)	0.1	0.2	0.2	0.5	0.2	0.0	0.1	0.5	0.0	0.0	1.5	0.0	3.3
			Movement LOS	D	D	B	E	D	B	B	A	A	B	A	A	A
			Movement Volume	4	16	53	28	15	8	22	898	24	5	856	6	1935
			Movement 95th Queue (ft)	52	52	62	93	93	26	41	40	26	15	233	233	
			Storage Bay Distance (ft)	0	0	30	0	0	10	100	33	0	70	0	0	
			Approach Delay (sec/veh)	25.1			47.9			2.4			6.2			
			Approach LOS	C			D			A			A			

2020 Alternative B6A1 - PM Peak Hour

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
803	Traffic Signal	TH 2 and 1st Ave W	Movement Delay (sec/veh)	18.3	8.5	6.5	17.1	10.4	8.6	38.0	49.7	15.0	44.2	45.1	7.2	12.9
			Total Delay (hr)	0.1	2.3	0.1	0.1	3.0	0.3	0.6	0.3	0.1	1.8	0.3	0.1	9.1
			Movement LOS	B	A	A	B	B	A	D	D	B	D	D	A	B
			Movement Volume	15	974	45	14	1024	111	61	25	29	140	21	36	2495
			Movement 95th Queue (ft)	37	190	245	87	316	326	126	126	53	204	204	50	
			Storage Bay Distance (ft)	130	0	0	110	0	0	0	0	0	0	0	0	
			Approach Delay (sec/veh)	8.6			10.3			34.7			37.5			
			Approach LOS	A			B			C			D			

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
804	Traffic Signal	TH 2 and TH 169	Movement Delay (sec/veh)	0.0	15.1	11.3	35.1	7.6	0.0	36.2	4.4	11.0	0.0	0.0	0.0	18.2
			Total Delay (hr)	0.0	2.2	1.8	2.7	1.2	0.0	5.6	0.1	0.8	0.0	0.0	0.0	14.4
			Movement LOS	A	B	B	D	A	A	D	A	B	A	A	A	B
			Movement Volume	0	530	577	272	568	0	545	76	247	0	0	0	2815
			Movement 95th Queue (ft)	0	268	150	208	175	0	358	0	222	0	0	0	
			Storage Bay Distance (ft)	0	0	25	100	0	0	0	0	75	0	0	0	
			Approach Delay (sec/veh)	13.1			16.5			26.2			0.0			
			Approach LOS	B			B			C			A			

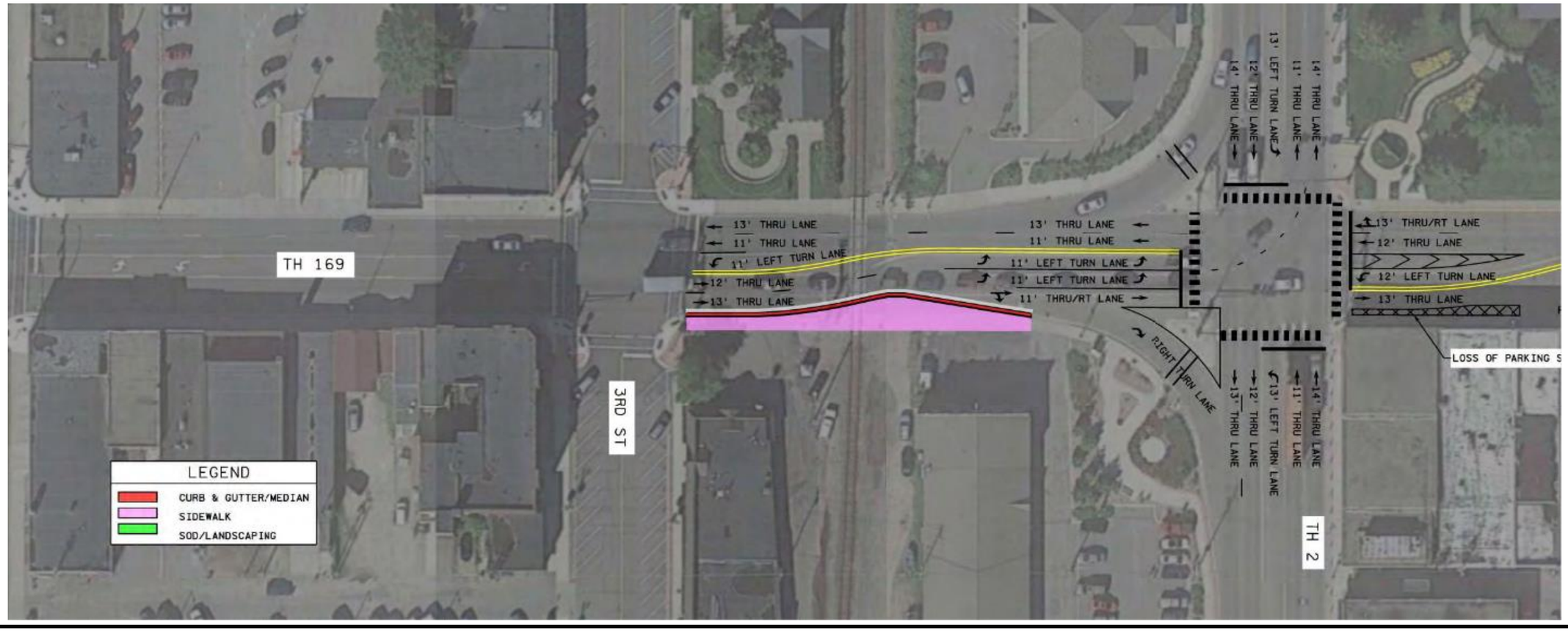
Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
806	Traffic Signal	TH 2 and 1st Ave E	Movement Delay (sec/veh)	9.6	3.9	2.5	9.8	7.0	6.5	48.4	46.2	7.1	47.6	45.4	8.8	9.5
			Total Delay (hr)	0.5	0.7	0.0	0.1	1.4	0.0	0.4	0.5	0.1	0.7	0.5	0.3	5.2
			Movement LOS	A	A	A	A	A	A	D	D	A	D	D	A	A
			Movement Volume	181	673	21	24	688	15	32	36	27	50	35	141	1923
			Movement 95th Queue (ft)	101	84	92	33	122	120	123	123	64	162	162	117	
			Storage Bay Distance (ft)	100	0	0	100	0	0	0	0	30	0	0	30	
			Approach Delay (sec/veh)	5.0			7.1			35.8			23.1			
			Approach LOS	A			A			D			C			

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
818	Traffic Signal	TH 169 and 3rd St N	Movement Delay (sec/veh)	46.0	48.0	14.2	55.4	54.0	9.9	11.4	2.5	1.9	13.7	6.3	0.9	6.2
			Total Delay (hr)	0.0	0.2	0.2	0.4	0.3	0.0	0.1	0.6	0.0	0.0	1.5	0.0	3.3
			Movement LOS	D	D	B	E	D	A	B	A	A	B	A	A	A
			Movement Volume	2	16	52	24	17	9	24	910	22	6	861	7	1950
			Movement 95th Queue (ft)	44	44	52	93	93	35	40	70	91	19	311	81	
			Storage Bay Distance (ft)	0	0	30	0	0	10	100	0	0	70	0	0	
			Approach Delay (sec/veh)	22.8			46.7			2.7			6.3			
			Approach LOS	C			D			A			A			

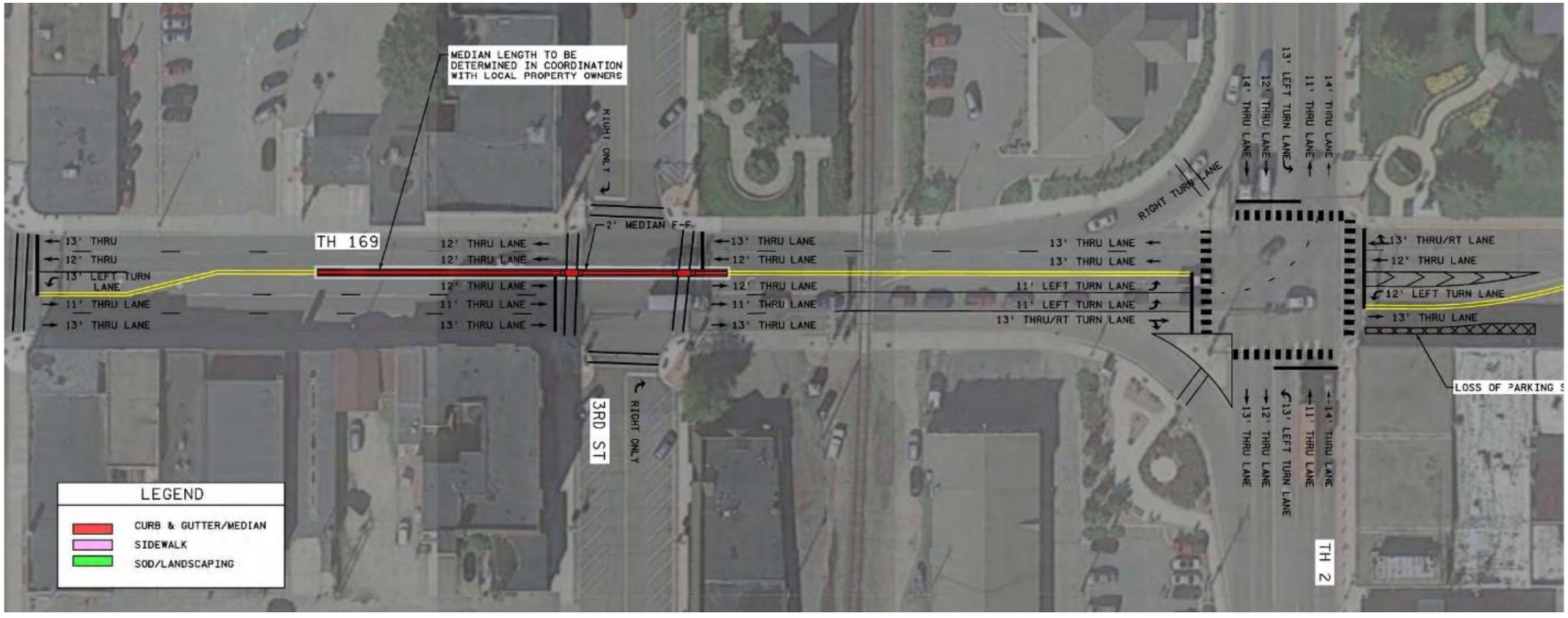
Appendix C

Refined Alternatives Analysis Comparison Matrix and Cost Estimates

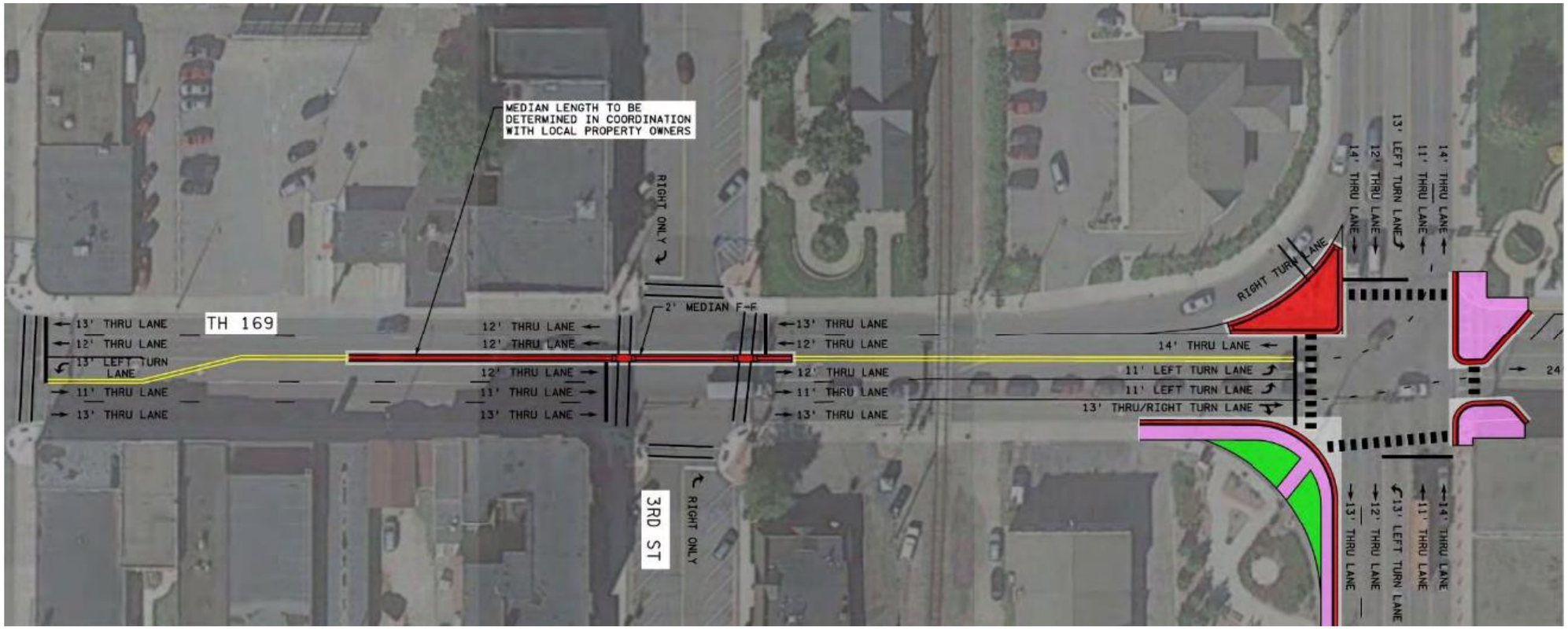
Alternative 1: Lane Shift for 2 NB Left Turn Lanes (2 SB Lanes)		
Key Benefits	**Pros/Cons**	**Operations Evaluation**
-Minimal impact to existing configuration with NB lane shift	**Pros:** 1. Additional storage for northbound left turn lanes. 2. Lowest cost. 3. No imact to 3rd Street. 4. Balanced lane utilization **Cons:** 1. Loss of 4 on-street parking spaces. 2. Northbound thru and right turn vehicles mixed into left turn queue. 3. Does not mitigate West pedestrian approach operational conflict.	NBL Delay Reduction - 6% NBL Queue Reduction - 27%



Alternative 2: NB Left Turn Lanes Max Extension (2 SB Lanes)		
Key Benefits	**Pros/Cons**	**Operations Evaluation**
-Maximum NB Left Turn Lane queue storage south of 3rd St	**Pros:** 1. Additional storage south of 3rd for northbound left turn lanes with thru/right in separate lane. 2. Balanced lane utilization. 3. Removal of 3rd St signal can provide better northbound traffic progression. **Cons:** 1. 3rd Street access. 2. Loss of 5 parking spaces. 3. Does not mitigate West pedestrian approach operational conflict.	NBL Delay Reduction - 8% NBL Queue Reduction - 51% Negligible impacts at 1st Ave NW and NE



Alternative 3: Pokegama St NB Only (1 SB Lane)		
Key Benefits	**Pros/Cons**	**Operations Evaluation**
-Reduction of 2 signal phases at TH 169/TH 2 with Pokegama St NB Only **-Maximum NB Left Turn Lane queue storage south of 3rd St** **-Removal of NB channelized Right Turn** **-Addition of EB free right turn**	**Pros:** 1. Additional storage south of 3rd for northbound left turn lanes with thru/right in separate lane. 2. Balanced lane utilization. 3. Removal of 3rd St signal can provide better northbound traffic progression. 4. Curb extensions on east side at 3rd Street. 5. Reduction of 2 signal phases at 169/2. 6. Additional parking provided. 7. Curb extensions on north leg of 169/2. 8. Removal of channelized right turn may provide safer east leg pedestrian crossing. 9. Added efficiency for EB right turn traffic with free right. **Cons:** 1. 3rd St access restrictions. 2. Pokegama St change in access. 3. Increase in delay at 1st St NW	NBL Delay Reduction - 18% NBL Queue Reduction - 44% SB Approach Delay Increase at 1st Ave NW - ~25%



US 169/2

Engineers Estimate

Assumptions

1) Construction costs do not include modifications to the gate arms and cantilever warning system at the RR crossing. Some alternatives will require modifications to the warning systems.
2) Striping is assumed to be multi-component.
3) Storm sewer costs are estimated. Locations of existing trunk storm sewers have not been investigated.
4) Partial temporary signal system assumed at US 169/2 intersection for alternatives with construction in the intersection. No temporary signal is assumed at the 3rd Street intersection.
5) Estimate does not include mill and overlay to mitigate against pavement marking removal scarring and/or cross slope corrections.
6) Estimate does not include landscaping improvements or modifications in the SE corner of the US 169/2 intersection.
7) Estimate does not include decorative concrete sidewalks.

ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST
TH 2 & TH 169 CONCEPTUAL DESIGN
Alliant Project No. 180223

Date Prepared:
June 11, 2020

ALLIANT ENGINEERING

				Alternative 1		Alternative 2		Alternative 3	
Item #	**Description**	**Unit**	**Unit Price**	**Quantity**	**Total**	**Quantity**	**Total**	**Quantity**	**Total**
Paving and Grading Costs									
1.	Removals - Curb & Gutter	LIN FT	$6.00	200	$1,200	-	-	420	$2,520
2.	Removals - Sidewalk*	SQ FT	$3.00	1,590	$4,770	-	-	1,580	$4,740
3.	Removals - Bituminous Pavement*	SQ YD	$18.00	160	$2,880	220	$3,960	690	$12,420
4.	Bituminous Pavement*	SQ YD	$65.00	50	$3,250	110	$7,150	310	$20,150
5.	Concrete Walk/Median*	SQ YD	$50.00	290	$14,500	60	$3,000	560	$28,000
6.	Concrete Curb and Gutter*	LIN FT	$30.00	210	$6,300	480	$14,400	1,060	$31,800
7.	ADA Ramp	EACH	$3,000.00	2	$6,000	2	$6,000	11	$33,000
Subtotal Paving and Grading Costs					**$38,900**		**$34,510**		**$132,630**
Drainage and Restoration Costs									
8.	Drainage	LUMP SUM	Variable	1	$14,000	-	-	1	$66,000
9.	Sod and Topsoil	SQ YD	$20.00	-	-	-	-	120	$2,400
Subtotal Drainage and Restoration Costs					**$14,000**		**$0**		**$68,400**
Signing, Striping, Signal and Lighting Costs									
10.	Signing	EACH	$5,000.00	1	$5,000	1	$5,000	1	$5,000
11.	Striping (4")(Multi-Component)	LIN FT	$1.00	3,000	$3,000	5,660	$5,660	5,390	$5,390
12.	Crosswalks (Multi-Component)	SQ FT	$10.00	750	$7,500	760	$7,600	590	$5,900
13.	Pavement Marking Removal	LIN FT	$1.00	2,400	$2,400	4,530	$4,530	4,320	$4,320
14.	Temporary Traffic Signal System (Partial at US 169/2)	LUMP SUM	Variable	-	-	-	-	1	$30,000
15.	Traffic Signal Modifications	LUMP SUM	Variable	1	$38,000	1	$60,000	1	$52,000
Subtotal Signing, Striping, Signal and Lighting Costs					**$55,900**		**$82,790**		**$102,610**
Miscellaneous Costs									
16.	Mobilization	10%			$11,000		$12,000		$30,000
17.	Traffic Control	LUMP SUM		1	$10,000	1	$15,000	1	$30,000
18.	Erosion Control	LUMP SUM		1	$5,000	1	$3,000	1	$10,000
Subtotal Miscellaneous Costs					**$26,000**		**$30,000**		**$70,000**
Construction Subtotal					$134,800		$147,300		$373,640
Contingency			30%		$40,000		$44,000		$112,000
Total Opinion of Project Construction Cost					**$174,800**		**$191,300**		**$485,640**

Note: Right-of-way and easement costs not included in estimate. Survey needed in pre-design phase to confirm necessary right-of-way acquisition.

*includes aggregate base

Appendix D

Refined Alternatives Traffic Operations Analysis

2020 Alternative 1 - PM Peak Hour

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
803	Traffic Signal	TH 2 and 1st Ave W	Movement Delay (sec/veh)	14.2	5.5	4.8	11.7	2.9	1.9	49.8	49.4	11.7	47.6	53.5	9.2	6.8
			Total Delay (hr)	0.1	1.5	0.1	0.1	0.8	0.0	0.7	0.3	0.1	0.4	0.3	0.1	4.5
			Movement LOS	B	A	A	B	A	A	D	D	B	D	D	A	A
			Movement Volume	13	971	48	17	1047	19	51	23	29	26	19	33	2296
			Movement 95th Queue (ft)	31	146	192	30	81	86	124	124	52	87	87	51	
			Storage Bay Distance (ft)	130	0	0	110	0	0	0	0	0	0	0	0	
			Approach Delay (sec/veh)		5.6			3.0			39.0			32.8		
			Approach LOS		A			A			D			C		

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
804	Traffic Signal	TH 2 and TH 169	Movement Delay (sec/veh)	7.2	15.6	6.7	19.1	12.8	8.3	37.3	24.4	14.9	59.4	70.3	33.1	23.0
			Total Delay (hr)	0.0	2.3	0.9	0.7	2.0	0.0	5.0	1.6	0.7	0.5	4.7	0.0	18.4
			Movement LOS	A	B	A	B	B	A	D	C	B	E	E	C	C
			Movement Volume	4	520	466	136	552	16	468	239	174	30	237	5	2847
			Movement 95th Queue (ft)	13	214	155	109	167	174	377	327	253	110	219	202	
			Storage Bay Distance (ft)	110	0	25	100	0	0	0	100	100	100	0	0	
			Approach Delay (sec/veh)		11.4			13.9			29.4			68.4		
			Approach LOS		B			B			C			E		

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
806	Traffic Signal	TH 2 and 1st Ave E	Movement Delay (sec/veh)	8.0	4.6	3.2	8.2	4.1	3.3	55.8	54.0	8.8	54.8	45.0	6.1	7.8
			Total Delay (hr)	0.1	0.9	0.0	0.1	0.8	0.0	0.6	0.5	0.1	0.1	0.4	0.0	3.6
			Movement LOS	A	A	A	A	A	A	E	D	A	D	D	A	A
			Movement Volume	42	680	25	25	678	19	35	35	27	6	33	15	1620
			Movement 95th Queue (ft)	45	73	85	32	59	67	129	129	62	84	84	32	
			Storage Bay Distance (ft)	100	0	0	100	0	0	0	0	30	0	0	30	
			Approach Delay (sec/veh)		4.7			4.2			42.1			35.3		
			Approach LOS		A			A			D			D		

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
818	Traffic Signal	TH 169 and 3rd St N	Movement Delay (sec/veh)	54.9	48.1	8.0	52.5	48.7	17.6	6.5	2.3	1.5	8.6	3.8	2.9	4.8
			Total Delay (hr)	0.1	0.2	0.1	0.5	0.2	0.0	0.0	0.6	0.0	0.0	0.9	0.0	2.6
			Movement LOS	D	D	A	D	D	B	A	A	A	A	A	A	A
			Movement Volume	4	13	53	32	15	9	21	936	29	4	845	5	1966
			Movement 95th Queue (ft)	44	44	58	89	89	30	29	74	94	13	100	106	
			Storage Bay Distance (ft)	0	0	30	0	0	10	100	0	0	70	0	0	
			Approach Delay (sec/veh)		18.1			45.9			2.4			3.8		
			Approach LOS		B			D			A			A		

2020 Alternative 2 - PM Peak Hour

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
803	Traffic Signal	TH 2 and 1st Ave W	Movement Delay (sec/veh)	11.6	6.1	5.1	10.6	2.8	2.5	49.9	46.6	12.3	47.7	51.9	9.3	7.3
			Total Delay (hr)	0.0	1.7	0.1	0.1	0.8	0.0	0.9	0.4	0.1	0.3	0.3	0.1	4.8
			Movement LOS	B	A	A	B	A	A	D	D	B	D	D	A	A
			Movement Volume	13	997	45	19	1023	26	64	28	32	25	18	32	2322
			Movement 95th Queue (ft)	29	137	187	34	74	77	129	129	55	81	81	54	
			Storage Bay Distance (ft)	130	0	0	110	0	0	0	0	0	0	0	0	
			Approach Delay (sec/veh)		6.1			2.9			39.5			32.3		
			Approach LOS		A			A			D			C		

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
804	Traffic Signal	TH 2 and TH 169	Movement Delay (sec/veh)	19.0	19.3	8.8	18.9	13.8	9.1	36.2	19.1	7.4	56.3	59.3	33.6	22.2
			Total Delay (hr)	0.0	2.8	1.2	1.0	2.0	0.1	4.9	1.2	0.3	0.5	4.0	0.0	18.0
			Movement LOS	B	B	A	B	B	A	D	B	A	E	E	C	C
			Movement Volume	7	521	489	180	527	22	484	229	166	32	235	4	2896
			Movement 95th Queue (ft)	39	268	170	139	174	180	254	271	259	97	188	174	
			Storage Bay Distance (ft)	110	0	25	100	0	0	0	0	0	100	0	0	
			Approach Delay (sec/veh)		14.2			14.9			26.3			58.6		
			Approach LOS		B			B			C			E		

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
806	Traffic Signal	TH 2 and 1st Ave E	Movement Delay (sec/veh)	8.3	3.9	3.0	11.1	4.1	3.8	48.0	51.1	8.0	55.5	53.7	6.8	7.6
			Total Delay (hr)	0.1	0.7	0.0	0.1	0.8	0.0	0.5	0.4	0.1	0.2	0.6	0.0	3.5
			Movement LOS	A	A	A	B	A	A	D	D	A	E	D	A	A
			Movement Volume	39	686	24	22	680	13	35	29	29	10	39	15	1621
			Movement 95th Queue (ft)	49	66	77	38	76	71	114	114	51	105	105	36	
			Storage Bay Distance (ft)	100	0	0	100	0	0	0	0	30	0	0	30	
			Approach Delay (sec/veh)		4.1			4.3			36.5			43.0		
			Approach LOS		A			A			D			D		

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
818	Traffic Signal	TH 169 and 3rd St N	Movement Delay (sec/veh)	0.0	0.0	4.6	0.0	0.0	4.5	0.0	1.1	0.7	0.0	1.9	1.8	1.6
			Total Delay (hr)	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.5	0.0	0.9
			Movement LOS	A	A	A	A	A	A	A	A	A	A	A	A	A
			Movement Volume	0	0	51	0	0	8	0	940	23	0	894	20	1936
			Movement 95th Queue (ft)	0	0	48	0	0	18	0	12	16	0	9	9	
			Storage Bay Distance (ft)	0	0	0	0	0	0	0	0	0	0	0	0	
			Approach Delay (sec/veh)		4.6			4.5			1.1			1.9		
			Approach LOS		A			A			A			A		

2020 Alternative 3 - PM Peak Hour

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
803	Traffic Signal	TH 2 and 1st Ave W	Movement Delay (sec/veh)	14.5	9.2	8.8	12.9	9.2	7.8	42.1	42.1	12.1	46.0	46.7	9.7	13.0
			Total Delay (hr)	0.1	2.4	0.1	0.1	2.6	0.1	0.6	0.3	0.1	2.0	0.2	0.1	8.7
			Movement LOS	B	A	A	B	A	A	D	D	B	D	D	A	B
			Movement Volume	16	951	47	17	1028	24	53	25	30	153	19	38	2401
			Movement 95th Queue (ft)	30	206	281	52	284	295	117	117	54	214	214	56	
			Storage Bay Distance (ft)	130	0	0	110	0	0	0	0	0	0	0	0	
			Approach Delay (sec/veh)		9.3			9.2			33.8			39.5		
			Approach LOS		A			A			C			D		

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
804	Traffic Signal	TH 2 and TH 169	Movement Delay (sec/veh)	10.8	16.1	4.9	16.4	8.4	6.2	32.6	22.2	21.1	0.0	0.0	0.0	16.0
			Total Delay (hr)	0.0	2.3	0.8	1.4	1.2	0.0	4.4	1.5	1.0	0.0	0.0	0.0	12.6
			Movement LOS	B	B	A	B	A	A	C	C	C	A	A	A	B
			Movement Volume	5	513	582	303	504	15	474	246	164	0	0	0	2806
			Movement 95th Queue (ft)	8	230	166	176	161	156	288	300	300	0	0	0	
			Storage Bay Distance (ft)	110	0	25	100	0	0	0	0	0	0	0	0	
			Approach Delay (sec/veh)		10.2			11.3			27.6			0.0		
			Approach LOS		B			B			C			A		

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
806	Traffic Signal	TH 2 and 1st Ave E	Movement Delay (sec/veh)	0.0	2.7	1.9	7.9	3.2	0.0	59.0	0.0	6.3	0.0	0.0	0.0	4.5
			Total Delay (hr)	0.0	0.5	0.0	0.1	0.6	0.0	0.6	0.0	0.0	0.0	0.0	0.0	1.8
			Movement LOS	A	A	A	A	A	A	E	A	A	A	A	A	A
			Movement Volume	0	674	21	23	687	0	38	0	27	0	0	0	1470
			Movement 95th Queue (ft)	0	72	91	40	48	0	87	0	46	0	0	0	
			Storage Bay Distance (ft)	0	0	0	100	0	0	0	0	0	0	0	0	
			Approach Delay (sec/veh)		2.7			3.4			37.1			0.0		
			Approach LOS		A			A			D			A		

Node	Traffic Control	Intersection	MOE	Eastbound Approach			Westbound Approach			Northbound Approach			Southbound Approach			Intersection Total
				EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
818	Traffic Signal	TH 169 and 3rd St N	Movement Delay (sec/veh)	0.0	0.0	4.8	0.0	0.0	4.2	0.0	1.4	1.1	0.0	1.0	1.1	1.3
			Total Delay (hr)	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.3	0.0	0.8
			Movement LOS	A	A	A	A	A	A	A	A	A	A	A	A	A
			Movement Volume	0	0	51	0	0	7	0	947	26	0	879	22	1932
			Movement 95th Queue (ft)	0	0	49	0	0	19	0	43	43	0	6	3	
			Storage Bay Distance (ft)	0	0	0	0	0	0	0	0	0	0	0	0	
			Approach Delay (sec/veh)		4.8			4.2			1.4			1.0		
			Approach LOS		A			A			A			A		