



ENGINEERING ■ ARCHITECTURE ■ SURVEYING ■ PLANNING

Lincoln Street Corridor Study, 5th Street to 22nd Street

Beatrice, NE

JEO Project No. 211224.00

**Prepared for:
The City of Beatrice**

*Prepared by:
JEO Consulting Group*

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1.0 Introduction and Background

This report documents the results of the Lincoln Street corridor study conducted for the City of Beatrice. More specifically, the study was focused on the section of Lincoln Street between N 5th Street and N 22nd Street. The scope and methodology of this study was developed by JEO Consulting Group in coordination with the City of Beatrice.

1.1 Objective

The primary objective of this corridor study was to evaluate Lincoln Street and, through both public involvement and technical evaluation, identify preferred alternatives for the street that could be implemented when paving rehabilitation and reconstruction occurs. Several specific locations along the corridor were reviewed in additional detail including:

- Intersection geometrics and traffic control for the intersection of N 6th Street & Lincoln Street
- Intersection geometrics and traffic control for the intersection of N 19th Street & Lincoln Street
- Pedestrian crossings including, but not limited to, the existing mid-block crossing between N 6th Street and N 7th Street.
- Typical cross-section for Lincoln Street, when considering the following items:
 - Vehicular operations
 - Multi-modal accommodations
 - Adjacent Property Impacts
 - On-Street Parking

1.2 Corridor Description

Lincoln Street is an arterial street with an estimated average daily volume of 4,775 vehicles per day and the surface has declined despite cyclical maintenance activity. Parking is allowed on the south side of the street, resulting in an offset lane and a significant horizontal shift in the street alignment near 13th Street. A few key intersections (as noted above) have also been identified for potential phased improvements. To determine the preferred intersection geometrics and traffic control at both Lincoln Street intersections with N 6th Street and N 19th Street, three traffic volume analysis scenarios were developed for the project and include:

1. Existing Conditions
2. Buildout Conditions (Year 2027)
3. Horizon Conditions (Year 2040)

1.3 Report Organization

The remainder of this report is organized to briefly summarize the process utilized during the study of Lincoln Street:

- 2.0 Existing Conditions
- 3.0 Year 2027 – Build Out Conditions
- 4.0 Year 2040 – Horizon Year Conditions
- 5.0 Intersection Configuration Options
- 6.0 Lincoln Street Corridor Alternatives
- 7.0 Public Engagement
- 8.0 Recommendations and Next Steps

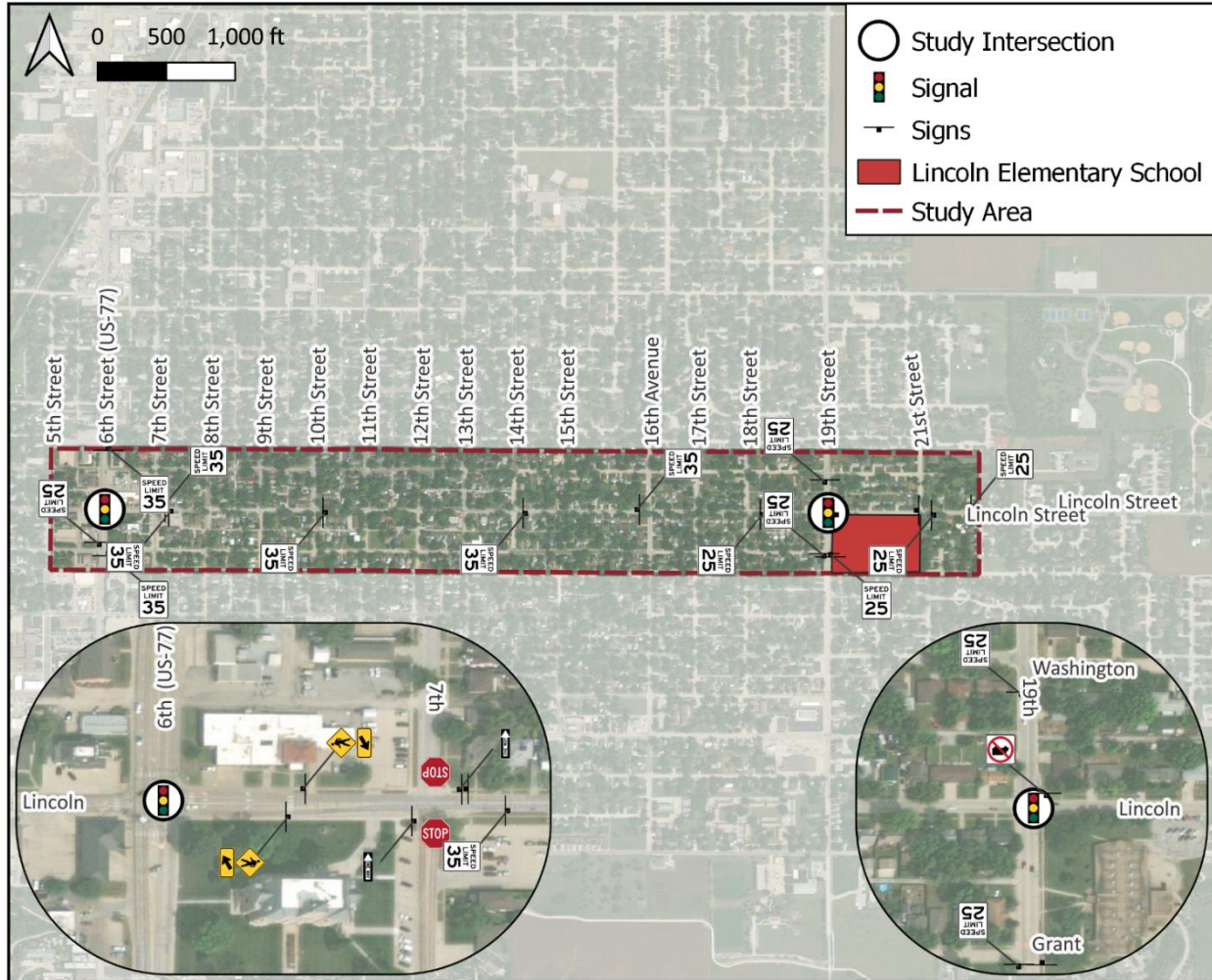


Figure 1: Vicinity Map

2.0 Existing Conditions

This section of the report summarizes the existing study area conditions.

2.1 Existing Roadway Geometry and Intersection Characteristics

The descriptions below summarize primary streets and intersections that were included in capacity analysis and intersection evaluations as part of the study.

2.1.1 Lincoln Street

Lincoln Street is an east/west, two-lane, two-way undivided street classified as an “Other Arterial” east of N 6th Street and “Local” west of N 6th Street according to the Nebraska Department of Transportation’s (NDOT) State Functional Classification map. For eastbound vehicles, the speed limit is posted at 35 mph until 18th Street, where it drops to 25 mph. For westbound vehicles, the speed limit is posted at 25 mph until 16th Avenue where it increases to 35 mph (this overlap/gap in the speed limit variation should be aligned with signing adjustments). Although the total right-of-way (ROW) width does vary throughout the study area (from 80 feet near the west end of the corridor to 60 feet near the east end of the corridor), the back-of-curb to back-of-curb (BOC to BOC) width is fairly consistent at 30 feet, with a few exceptions. On-street parking is allowed between N 5th Street and N 6th Street within a 150-foot section adjacent to the Christ Church Episcopal, where parallel parking is only permitted on Sundays. No on-street parking is allowed between N 6th Street and N 7th Street, however between N 7th Street and N 19th Street on-street parallel parking is permitted on the south side of the street. From N 19th Street to N 21st Street, on-street parallel parking is permitted on the north side, while between N 21st Street and N 22nd Street, on-street parallel parking is provided on both sides of the street. Pedestrian accommodations are provided in the form of sidewalks on both the north and south sides of the street. Sidewalk varies between having setbacks and being on back of curb, and there exists several opportunities for improvements to both midblock segments and also curb ramps at intersections.

2.1.2 N 6th Street (U.S. Highway 77)

N 6th Street (U.S. Highway 77) is a north/south, four-lane, two-way, undivided roadway that is classified as a “Major Arterial” according to NDOT’s State Functional Classification map. N 6th Street is currently posted at 35 MPH in the vicinity of the Lincoln Street intersection. N 6th Street has an existing BOC to BOC width of 50 feet, although the street does widen as it approaches the intersection with Lincoln Street to account for northbound and southbound left-turn lanes. On-street parking is prohibited throughout the study area along N 6th Street. Pedestrian accommodations are provided in the form of sidewalks on both the east and west sides of the street. Although it is acknowledged that N 6th Street is also U.S. Highway 77, for the purposes of this study, it will be referred to as N 6th Street.

2.1.3 N 19th Street

N 19th Street is a north/south, two-lane, two-way, undivided “Minor Arterial”, as defined by NDOT’s State Functional Classification map. N 19th Street has a posted speed limit of 25 mph and a BOC to BOC width of 44 feet; however, this does immediately reduce to 30 feet directly north of the study area. Pedestrian accommodations are provided in the form of sidewalks on both the east and west sides of the street. North of Lincoln Street, on-street parallel parking is provided on both sides of the street however, south of Lincoln Street, on-street parallel parking is restricted near the adjacent Lincoln Elementary School.

2.1.4 The Intersection of N 6th Street and Lincoln Street

The full access intersection of N 6th Street with Lincoln Street is signal controlled with N 6th Street forming the north and south legs and Lincoln Street forming the east and west legs. Both northbound and southbound N 6th Street approaches consist of one shared through and right-turn lane, one exclusive through lane, and one exclusive left-turn lane. The eastbound Lincoln Street approach consists of an exclusive left-turn lane and shared through and right-turn lane. The westbound Lincoln Street approach consists of one exclusive left-turn lane, one exclusive through lane, and one exclusive right-turn lane. Pedestrian accommodation is provided by marked crosswalks, curb ramps, and pedestrian signals across all four legs of the intersection. However, pedestrian push buttons are only provided for crossing the north and south legs of the intersection. This intersection is currently illuminated via luminaires on all corners.

2.1.5 The Intersection of 13th Street & Lincoln Street

The full access intersection of N 13th Street & Lincoln Street is a two-way stop controlled (TWSC) intersection with N 13th Street forming the stop-controlled north and south legs and Lincoln Street forming the uncontrolled east and west legs. All approaches consist of single shared left-, through, and right-turn lanes. It should be noted that there is an approximate eight-foot offset between the east and west legs, which results in a skewed intersection and vehicle travel patterns that are aligned with head-on vehicles in the opposing direction.

2.1.6 The Intersection of 19th Street & Lincoln Street

The full access intersection of 19th Street & Lincoln Street is span-wire signal controlled with 19th Street forming the north and south legs and Lincoln Street forming the west and east legs. The southbound 19th Street approach consists of one shared through and left-turn lane and one exclusive right-turn lane. The northbound 19th Street approach, as well as both Lincoln Street approaches, consist of one shared left-, through, and right-turn lane. Right turn on red is prohibited on all approaches 7:30AM – 4:30PM, Monday through Friday. The intersection provides pedestrian accommodation through pedestrian signal heads, crosswalks, and curb ramps across all legs of the intersection. The intersection is lighted via a luminaire in the northwest corner of the intersection.

Further details of the existing geometrics and traffic control at the existing signalized intersections on each end of the corridor are illustrated in Figure 2.

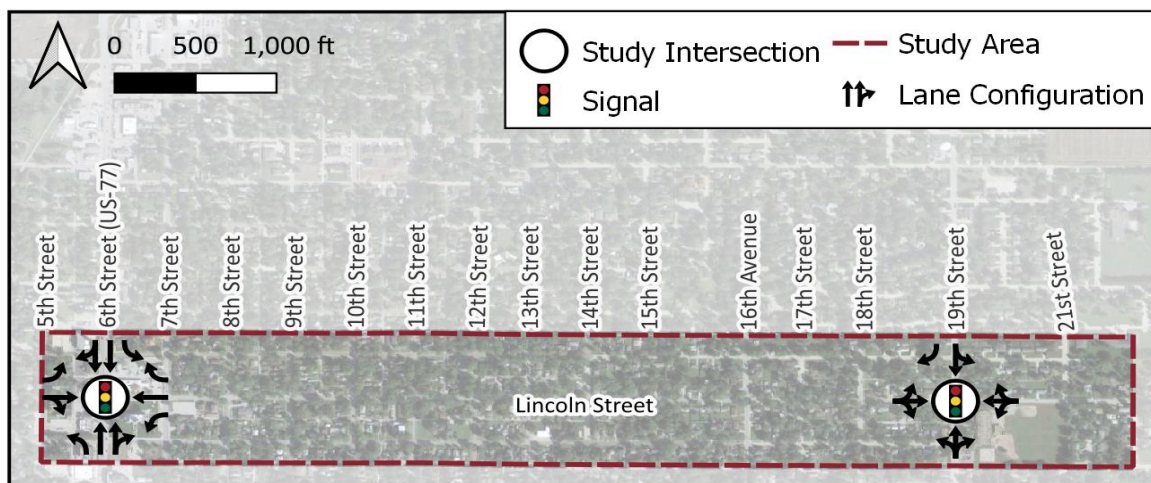


Figure 2: Existing Street Geometrics and Traffic Control

2.2 Existing Traffic Volumes

Existing turning movement volumes were collected on Tuesday, February 8, 2022, at both Lincoln Street intersections with 6th Street and 19th Street using Miovision Scout Cameras. Additional analysis of existing traffic patterns was performed using StreetLight Data. A summary of this analysis is provided in Appendix A.

2.2.1 N 6th Street and Lincoln Street

At the intersection of N 6th Street & Lincoln Street, the observed AM peak hour was between 7:30 am and 8:30 am while the PM peak hour occurred between 3:15 pm and 4:15 pm. The 2022 volumes are shown in Figure 3 and were considered the baseline volumes for this intersection.

2.2.2 N 19th Street & Lincoln Street

In addition to the data gathered on 2022, there was additional data gathered on April 16, 2019, as part of a previous study at the intersection of N 19th Street & Lincoln Street. These 2019 volumes show higher volumes than the 2022 counts. To produce a conservative analysis and to avoid any potential impacts from COVID-19, the 2019 counts were utilized and considered as the baseline volumes for this intersection. The observed AM peak hour was between 7:30 am and 8:30 am while the PM peak hour occurred between 4:30 pm and 5:30 pm. The 2019 volumes at this intersection are shown in Figure 3.

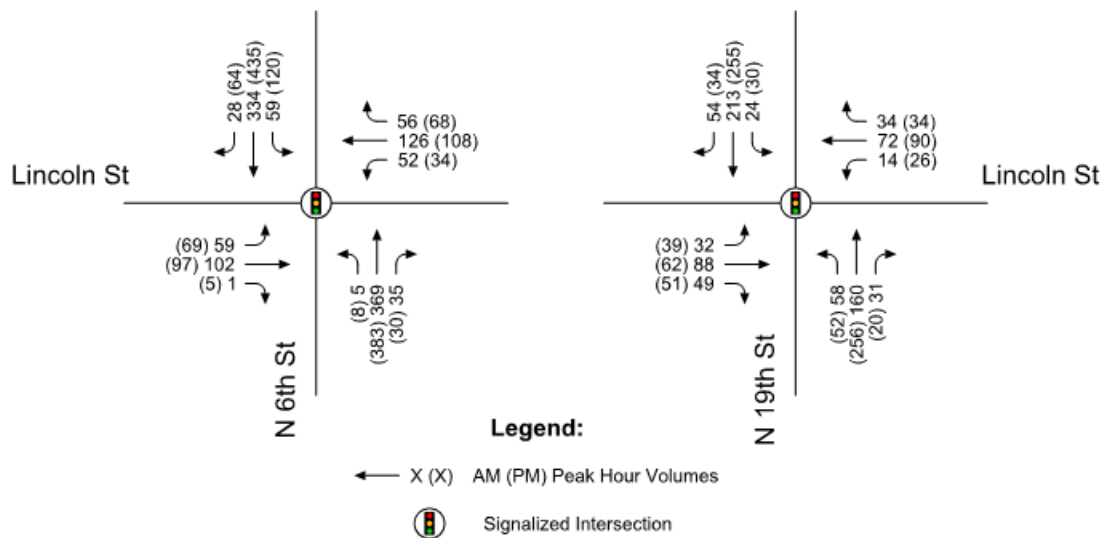


Figure 3: Existing Peak Hour Volumes

2.3 Study Methodology

The peak hour volumes for the study area intersections were analyzed using the signalized intersection capacity analysis procedures outlined in the Highway Capacity Manual, 6th Edition (HCM). Per the HCM, Level of Service (LOS) is presented as a letter grade (A through F) based on the calculated average delay for an intersection or movement during a specific time (such as the AM and PM peak hours). LOS A represents free flow movement with very little to no delay, while LOS F represents congested flow at or exceeding the capacity of the roadway. Further explanations and detail about the LOS methodology can be found in Table 1.

Table 1: Level of Service Interpretation

Level of Service	Description	Signalized Intersection Delay (seconds per vehicle)	Stop-Controlled Intersection & Roundabout Delay (seconds per vehicle)
A	Free-flow operations. Vehicles are almost completely unimpeded in their ability to maneuver within the traffic stream.	< 10	< 10
B	Reasonably free flow. The ability to maneuver within the traffic stream is only slightly restricted.	>10 and < 20	>10 and < 15
C	At or near free flow. Freedom to maneuver within the traffic stream is noticeably restricted.	>20 and < 35	>15 and < 25
D	Speeds begin to decline slightly. Freedom to maneuver within the traffic stream is noticeably limited.	>35 and < 55	>25 and < 35
E	At capacity. Maneuverability within the traffic stream is extremely limited.	>55 and < 80	>35 and < 50
F	Breakdown. Vehicles are jammed. Generally, queues form behind the breakdown condition.	> 80	> 50

Source: Highway Capacity Manual, 6th Edition, A Guide for Multimodal Mobility Analysis, Transportation Research Board, Washington, D.C.

2.4 Existing Conditions Traffic Operations Analysis

The existing weekday AM and PM peak hour traffic conditions were analyzed using the existing traffic volumes and intersection geometrics described previously using Synchro 11, a software that uses HCM methodology. As shown in Figure 4, all lanes currently operate at LOS B or better, except for the northbound through lanes at the intersection of N 6th Street and Lincoln Street which were shown to operate at LOS C during the AM peak hour. Additional details of the analysis can be found in the Synchro output sheets in Appendix B.

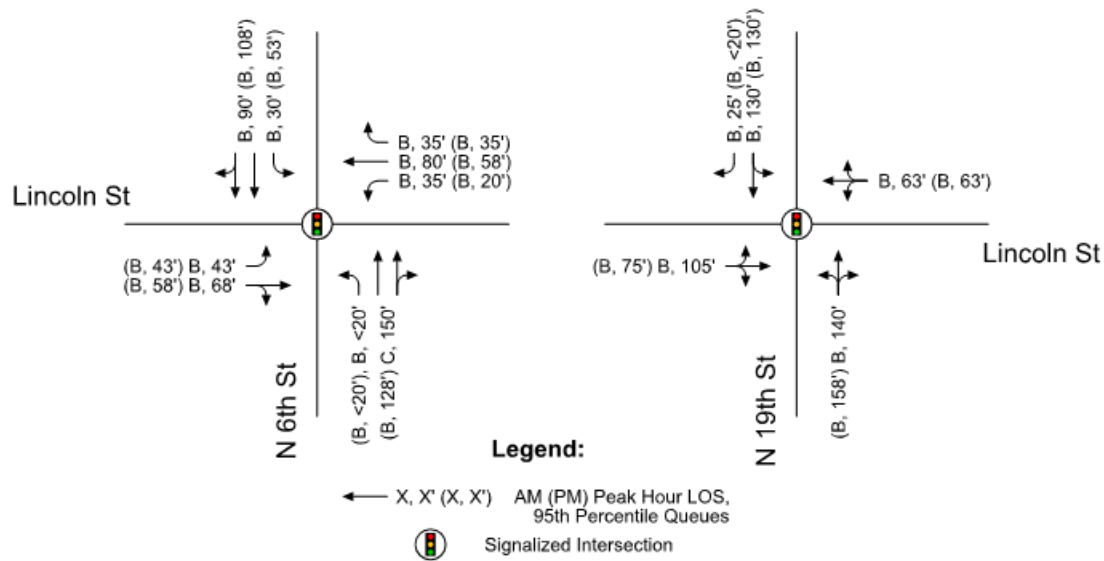


Figure 4: Existing Peak Hour Level of Service

2.5 Safety Analysis Summary of Lincoln Street Corridor

Crash data for the corridor area was obtained from NDOT for the most recent available five years (2016 to 2020), with raw data sheets provided in Appendix C. A map of all crashes recorded within the study area has been included as Figure 5. Crash rates at all study intersections, as well as corridor segments, have been calculated in terms of vehicle crashes per million entering vehicles (MEV) and million vehicle miles (MVM), respectively. These crash rates can be found in Tables 2 and 3, respectively. Along Lincoln Street, the most common type of crash was property damage only (PDO), which accounted for 41% of all crashes. The second most common type was non-reportable crash (classified as vehicle crash damages equal to or less than \$1,000) accounting for 40% of all crashes along Lincoln Street.

For the short segment west of 6th Street, there were two severe crashes noted at the intersection of 5th & Lincoln Street during the five-year analysis period from 2016 to 2020. The remainder of the crashes were PDO. Observed segment crash rates west of 6th Street were insignificantly near the threshold of the average Gage County crash rates and significantly below the critical crash rates along this segment between 5th Street and 6th Street. The calculated rate for this portion of the corridor is largely influenced by the short length of this segment.

The segment between 6th Street and 19th Street had the highest crash rate of any of the study segments. Also, it was higher than the critical crash rate for this classification of segment with a segment crash rate of 7.31 MVM as illustrated in Table 3.

The segment from 19th Street to 22nd Street experienced no crashes during the study period. With traffic patterns changing within the study area, crash occurrences may change as well and therefore crash history should be continually monitored to detect patterns and identify countermeasures.

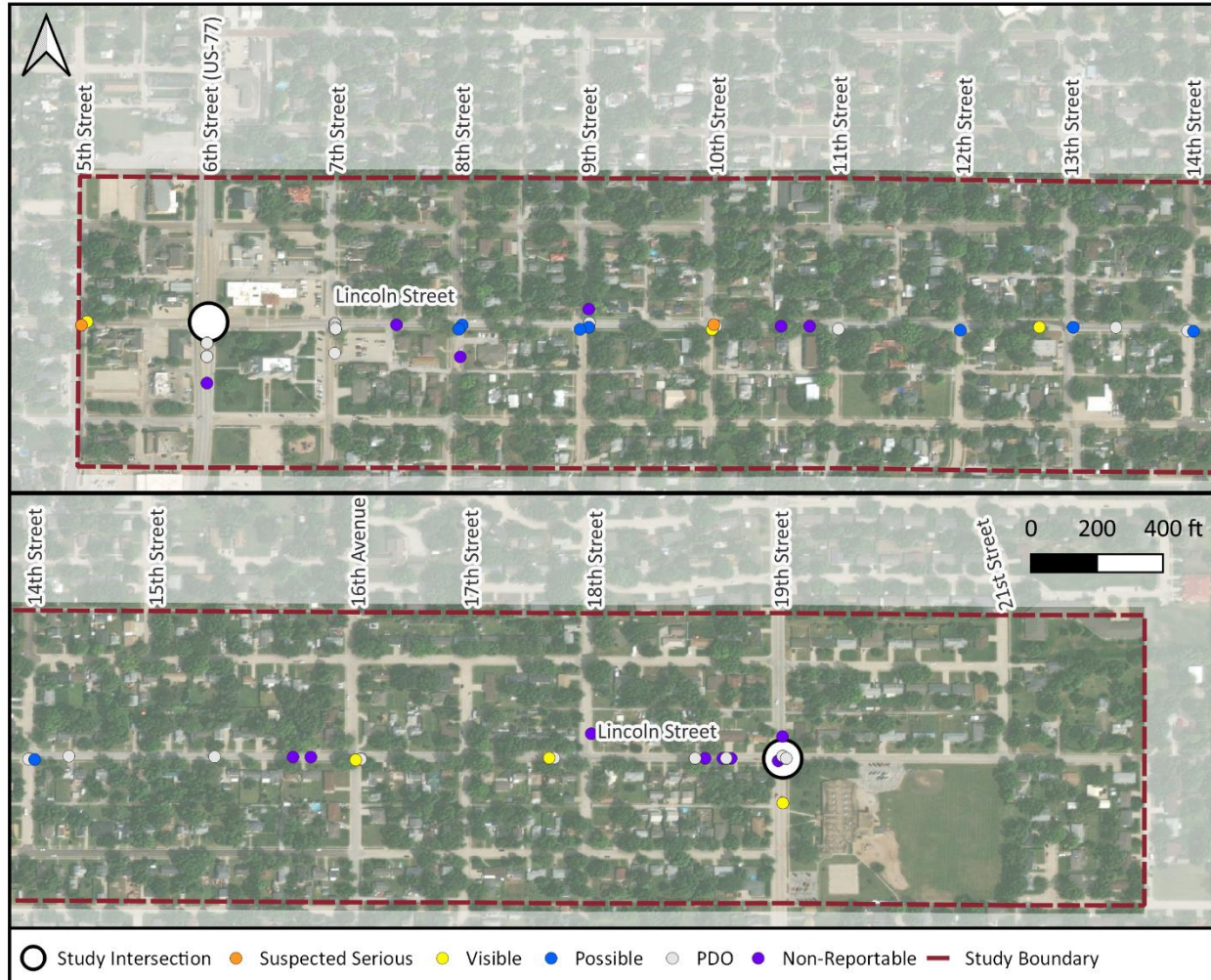


Figure 5: Crashes within the Lincoln Street Corridor Study Area (2016-2020)

Table 2: Intersection Crash Rates

<i>Intersection</i>	Vehicle Crashes (per MEV)
<i>N 6th Street & Lincoln Street</i>	0.58
<i>N 19th Street & Lincoln Street</i>	0.91

Table 3: Segment Crash Rates

<i>Corridor Segment</i>	Segment Length (mi)	Average Crash Rate*	Crash Rate Along Segment (MVM)	Critical Crash Rate Along Segment (MVM)
<i>Lincoln Street (5th Street to 6th Street)</i>	0.07	6.36	6.36	13.67
<i>Lincoln Street (6th Street to 19th Street)</i>	1.00	2.07	7.31	3.01
<i>Lincoln Street (19th Street to 22nd Street)</i>	0.21	2.07	0.00	4.92

* Average crash rates based on 2019 Gage County crash data and facility type.

2.6 Pedestrian Crossings

Pedestrian and bicyclist crossing information was collected at two different locations along the corridor: the mid-block crossing between N 6th Street and N 7th Street and at the intersection of N 19th Street and Lincoln Street.

2.6.1 Lincoln Street Mid-Block Crossing

The mid-block crossing across Lincoln Street between N 6th Street and N 7th Street was counted for a 24-hour period on February 8th, 2022, and the resulting data is presented in Table 4. In total, there were seven pedestrian crossings and no bicycle crossings during this study period. It should also be noted that while no crashes were experienced at this crossing during the study period, the distance from the signalized intersection at N 6th Street to the mid-block crossing is only 162 feet which is insufficient to provide adequate stopping sight distance for pedestrians to cross safely. There is also no direct destination located on the south side of the mid-block crossing. This indicates that relocating the crosswalk would have limited impact on pedestrian level of service while increasing safety.

Therefore, it is recommended to locate the existing mid-block crossing to the currently unmarked crosswalk across the west leg of the intersection of 7th Street & Lincoln Street. This relocation also has the added benefit of providing the necessary stopping sight distance from the signalized intersection of N 6th Street & Lincoln Street. This visual depiction of this improvement is provided in Figure 6. Enhancements such as lane narrowing in conjunction with corridor improvements are also recommended to decrease pedestrian exposure to vehicle traffic. A Rectangular Rapid Flashing Beacon (RRFB) could also be installed together with the crosswalk to ensure greater driver awareness of crossing pedestrians and bicyclists.

Table 4: Daily Pedestrian and Bicyclists Counts at 6th /7th Street Mid-block Pedestrian Crossing

Location	Northbound	Southbound	Total
6 th /7 th Street Mid-block Pedestrian Crossing	2	5	7



Figure 6: Proposed Relocation of the Lincoln Street Mid-Block Crossing

2.6.2 The Intersection of N 19th Street & Lincoln Street

Two different pedestrian and bicyclists crossing counts have been conducted at the intersection of N 19th Street & Lincoln Street. A 6-hour count was conducted in April of 2019 and a 24-hour count was conducted in February of 2022. Details on both counts is provided below in Table 5.

Table 5: Pedestrian and Bicyclists Counts at the 19th Street and Lincoln Street Intersection

Date and Time of Count	Type of Crossing	N 19 th Street & Lincoln Street				Total
		North Leg	South Leg	East Leg	West Leg	
Tuesday, April 16, 2019 6-Hours (7-9AM, 2-6PM)	Pedestrian	7	25	6	14	52
	Bicyclist on Crosswalk	1	7	0	5	13
Tuesday, February 8, 2022 24-Hour	Pedestrian	3	15	8	8	34
	Bicyclist on Crosswalk	0	2	1	3	6

It is recognized that the 6-hour count collected a greater amount of crosswalk users than the 24-hour count. This is assumed to have been the case mainly due to two considerations. The first of these being the weather. The 6-hour count happened in mid spring, while the 24-hour count took place in late winter. There could have also been COVID impacts on the 24-hour count that would not have been present in the 2019 count. However, it should be noted that the intensity of pedestrians at this intersection is expected to decrease as the Lincoln Elementary School relocates away from this intersection.

2.7 Vehicular Speeds Along the Lincoln Street Corridor

Speed data was not collected as part of this study, however, speeding concerns have been reported by the public. Along much of the corridor, the roadway cross-section consists of two twelve-foot lanes and a six-foot parking lane. In addition, there are also no traffic control devices impeding drivers along Lincoln Street between N 6th Street and N 19th Street. Unutilized parking spaces along this corridor could also give drivers the impression that they have a wider driving lane which is likely to decrease their perception of their own speeds. This may encourage drivers to exceed the posted speed limit. There are several traffic calming strategies that promote slower speeds and could be included with the various alternatives as appropriate. For example, narrower travel lanes with widths of ten to eleven feet are one countermeasure. Other speed reduction mechanisms as recommended in the *NACTO Urban Street Design Guide* are pinch points or bulb-outs which narrow the lane width for short roadway segments at the mid-block or intersections, respectively. These would accompany design alternatives, including adjustments to the availability of on-street parallel parking.

2.8 Access Management Discussion

As shown in Figure 7, there are numerous driveways and access points along the Lincoln Street corridor. The term 'driveway spacing distance' is defined as the minimum separation needed between a driveway from any adjacent driveways or intersections. According to the *City of Beatrice Access Management Policy*, the driveway spacing distance for "Local" road with a posted speed limit of 35 MPH is 50 feet, while for "Other Arterial" under the same conditions, the driveway spacing distance is 330 feet. It is recommended that this policy be adhered to on any (re)development along the Lincoln Street corridor. Fewer driveways helps to reduce turning vehicle overlaps within the functional area of adjacent intersections and driveways. Additionally, removing unnecessary driveways reduces conflict points for pedestrians and bicyclists.

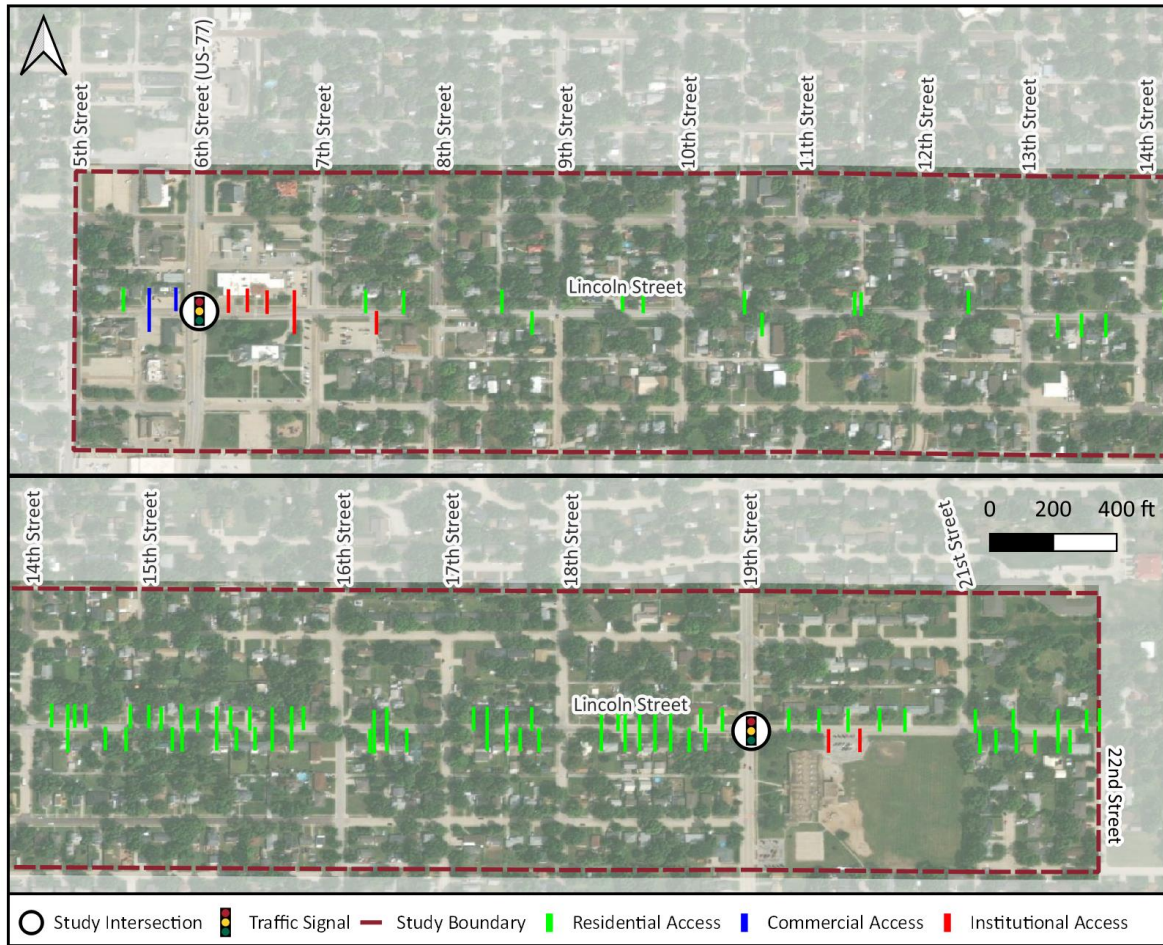


Figure 7: Existing Access Locations Along the Lincoln Street Corridor

3.0 Year 2027 – Build Out Conditions

This section of the report summarizes the development of year 2027 peak hour traffic volumes and analysis of the corridor under Year 2027 Build Out Conditions. The year 2027 was chosen as it is anticipated that several projects in the area will be completed and plan to open in 2027.

3.1 Year 2027 Projected Background Traffic Volumes

NDOT provided historical average daily traffic volumes (ADT) for several area roadways. In accordance with these historical ADTs, a 1% growth rate was selected to be consistent with the calculated growth rates that included both relatively low and, in a couple of cases, negative growth trends on several area streets. These resultant Year 2027 Background AM and PM peak hour volumes are shown in Figure 8.

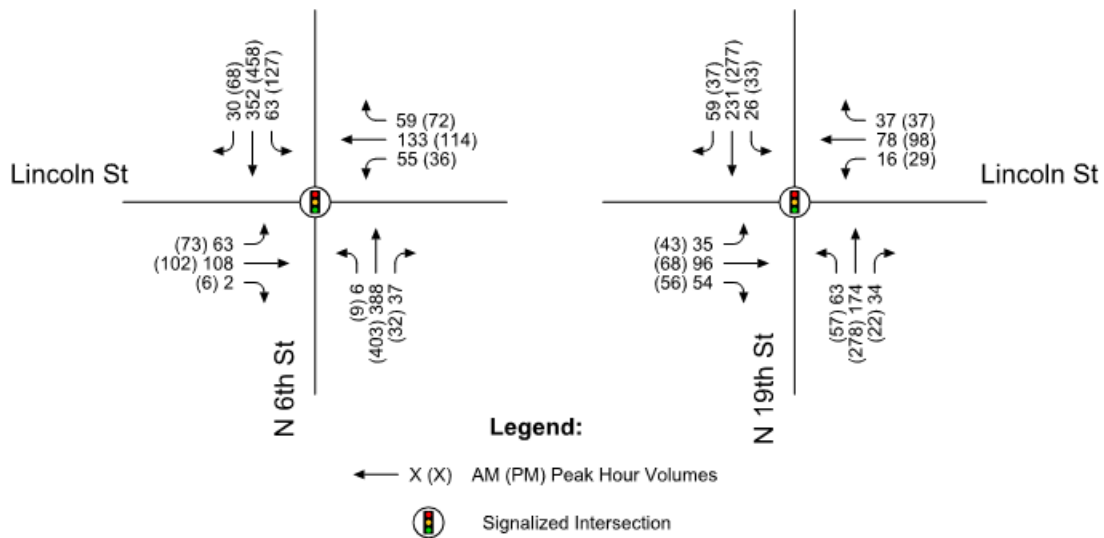


Figure 8: Year 2027 Background AM and PM Peak Hour Volumes

3.2 Year 2027 Projected Trip Generation and Assignment

According to the City of Beatrice, three local projects that would impact the Lincoln Street corridor’s adjacent land uses could be in various phases of completion by the year 2027. These projects include the removal of the current Lincoln Elementary School, the construction of single-family housing on the existing school site, and the construction of new Elementary and Middle Schools on the southwest corner of the N 33rd Street & Lincoln Street intersection. Further information regarding the exact location of these projects is shown in Figure 9.



Figure 9: Trip Generation Areas

According to the Beatrice School District, a nearly 200 students will be relocated as the Lincoln Elementary School is removed. It is also estimated that, based on the size of the current Lincoln Elementary School property, approximately 25 single-family detached homes could be constructed. The trip generation characteristics for these first two projects were provided by the Institute of Transportation Engineers' (ITE) Trip Generation Manual, 11th Edition and are shown in Table 6.

In addition, additional trips were added to account for the proposed Elementary and Middle Schools located east of the study area. These trips came from the Beatrice Public School Traffic Impact Study provided by the City of Beatrice.

These site trips were distributed to study area roadways based on existing traffic patterns and predicted route convenience. Current directional distribution percentages are summarized in Appendix D. These average AM and PM distribution percentages were then applied to distribute future trip demands resulting from the trip generations onto the street network. These distributed site trips are shown in Figure 10.

These site trips were then added to the Year 2027 Background AM and PM Peak Hour Volumes to produce Year 2027 Background plus Site AM and PM Peak Hour Volumes and are shown in Figure 11.

Table 6: Trip Generation Summary

Daily Trip Generation											
							Trip Distribution		Total Daily Trips		
ITE	Lane Use	Size		Trip Gen. Avg. Rate/	Daily Trips	Mixed-Use Reduction	Net Daily Trips	Enter	Exit	Enter	Exit
520	Elementary School	196	Students	2.27	-445	0	-445	50%	50%	-223	-222
210	Single-Family Detached Housing	25	Dwelling Units	9.43	235.75	0	235.75	50%	50%	118	117
Total										-105	-105

AM Peak Hour Trips											
							Trip Distribution		Total AM Trips		
ITE	Lane Use	Size		Trip Gen. Avg. Rate/	AM Trips	Mixed-Use Reduction	Net AM Trips	Enter	Exit	Enter	Exit
520	Elementary School	196	Students	0.74	-145	0	-145	54%	46%	-78	-67
210	Single-Family Detached Housing	25	Dwelling Units	0.70	18	0	18	26%	74%	5	13
Total										-73	-54

PM Peak Hour Trips											
							Trip Distribution		Total PM Trips		
ITE	Lane Use	Size		Trip Gen. Avg. Rate/	PM Trips	Mixed-Use Reduction	Net PM Trips	Enter	Exit	Enter	Exit
520	Elementary School	196	Students	0.16	-31	0	-31	46%	54%	-14	-17
210	Single-Family Detached Housing	25	Dwelling Units	0.94	24	0	24	63%	37%	15	9
Total										1	-8

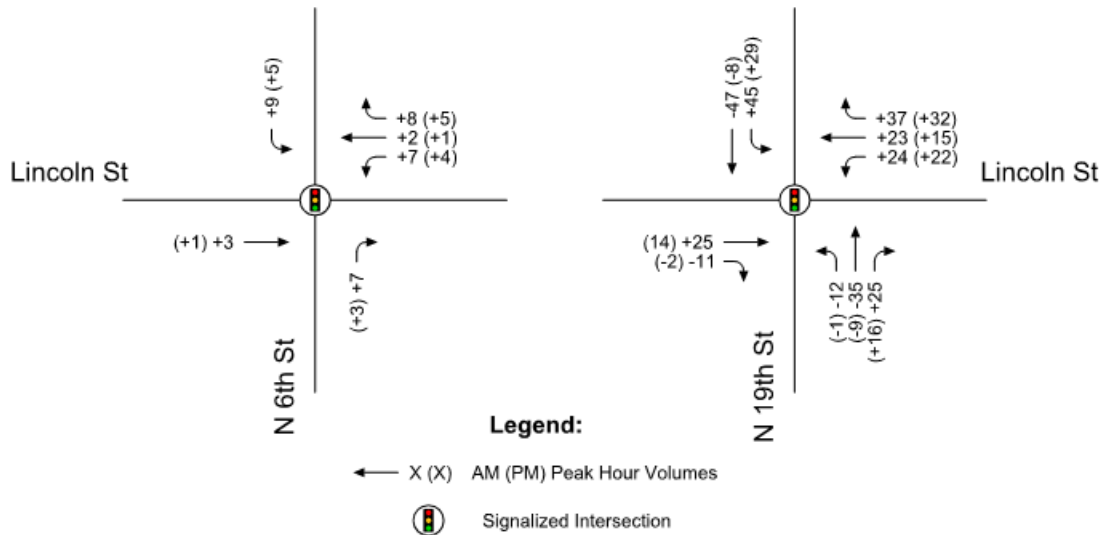


Figure 10: Distributed Site Trips

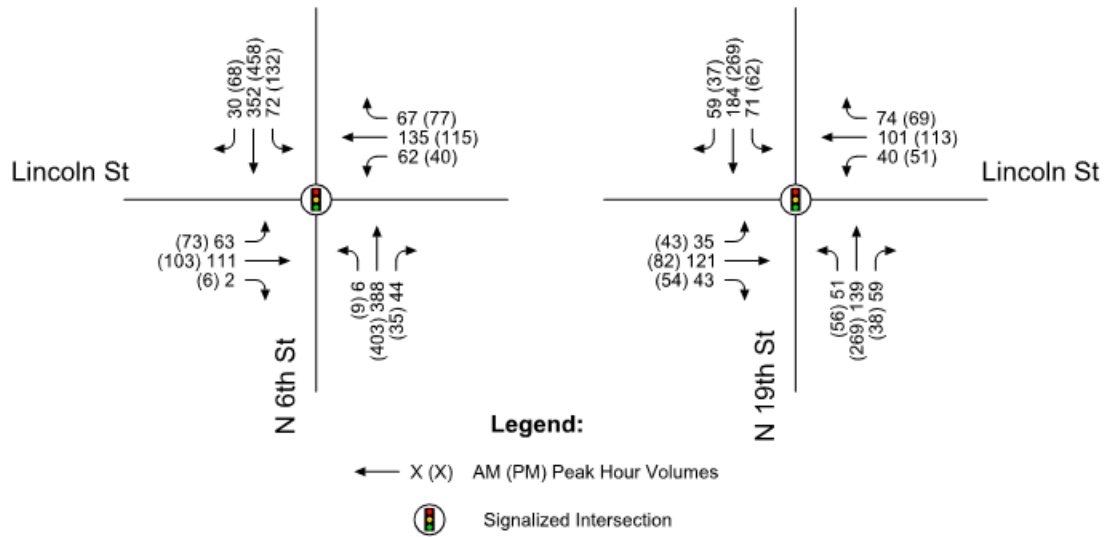


Figure 11: Year 2027 Background Plus Site AM and PM Peak Hour Volumes

3.3 Year 2027 Projected Background Plus Site Capacity Analysis

Year 2027 background plus site AM and PM peak hour volumes were analyzed using the procedure described previously. As shown in Figure 12 below, both intersections continue to operate at acceptable LOS through the year 2027. Additional details of the analysis can be found in the Synchro output sheets in Appendix E.

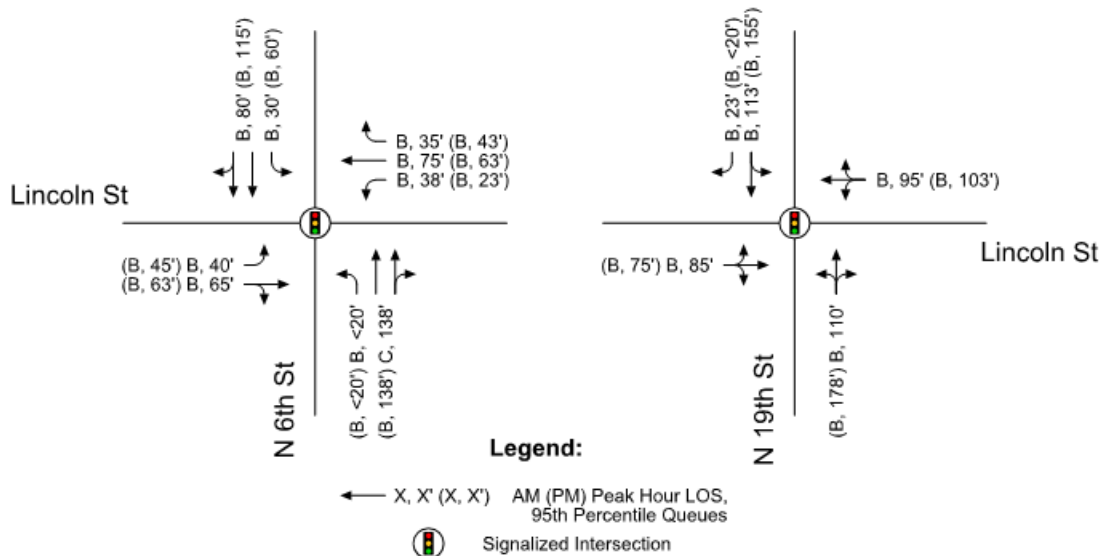


Figure 12: Year 2027 Background Plus Site AM and PM Peak Hour LOS

4.0 Year 2040 – Horizon Year Conditions

This section of the report summarizes the development of year 2040 peak hour traffic volumes and analysis of the corridor under Year 2040 Horizon Year Conditions. The year 2040 was selected to model the corridor after the developments have been complete for several years.

4.1 Year 2040 Projected Traffic Volumes

The same growth rate discussed previously was used to develop the Year 2040 Projected Background Traffic Volumes. These can be found in Figure 13. These were then combined with the previously discussed site trips to generate Year 2040 Background Plus Site AM and PM Peak Hour Volumes and are provided in Figure 14.

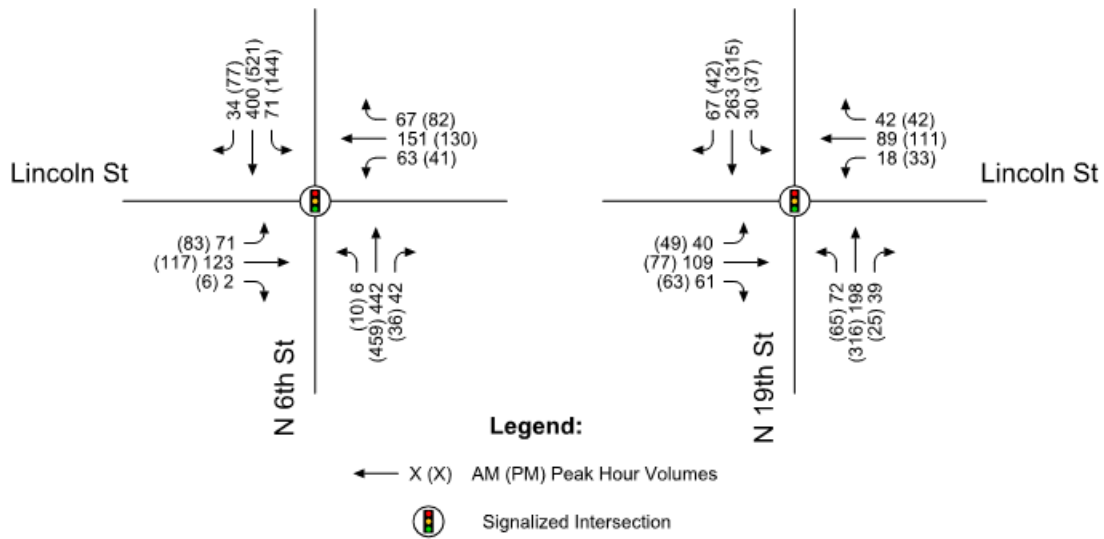


Figure 13: Year 2040 AM and PM Peak Hour Volumes

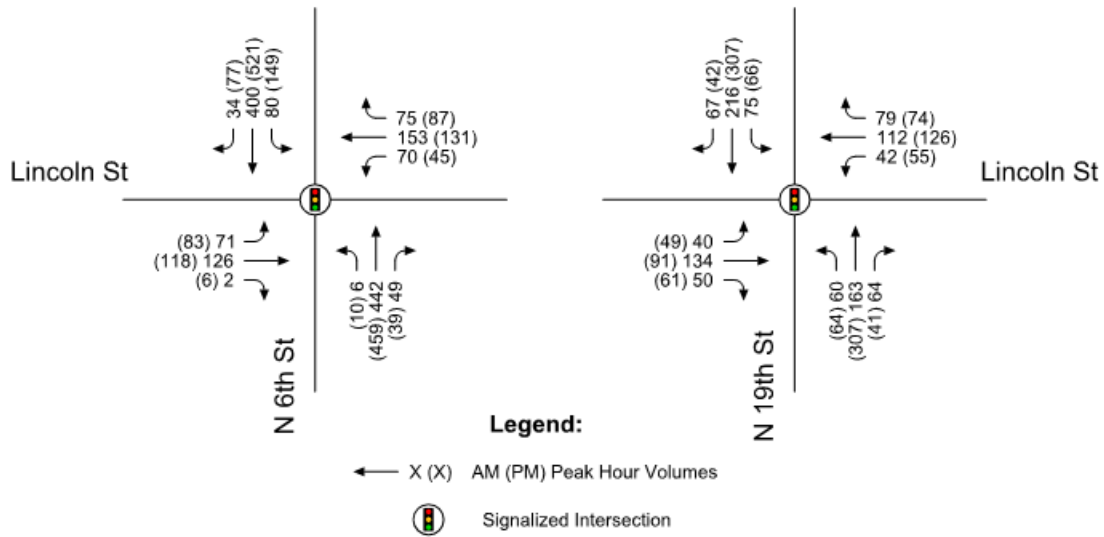


Figure 14: Year 2040 Background Plus Site AM and PM Peak Hour Volumes

4.2 Year 2040 Projected Background Plus Site Capacity Analysis

Year 2040 background plus site AM and PM peak hour volumes were analyzed using the procedure described previously. As shown in Figure 15 below, all movements at both intersections continue to operate very similarly to Year 2027 conditions, with 95%-tile queue lengths only marginally increasing. It is noted that, while the northbound movement at the intersection of 6th Street & Lincoln Street during the PM peak hour did deteriorate to LOS C, this was only an increase of 1.4 seconds of average delay per vehicle. Additional details of the analysis can be found in the Synchro output sheets in Appendix F.

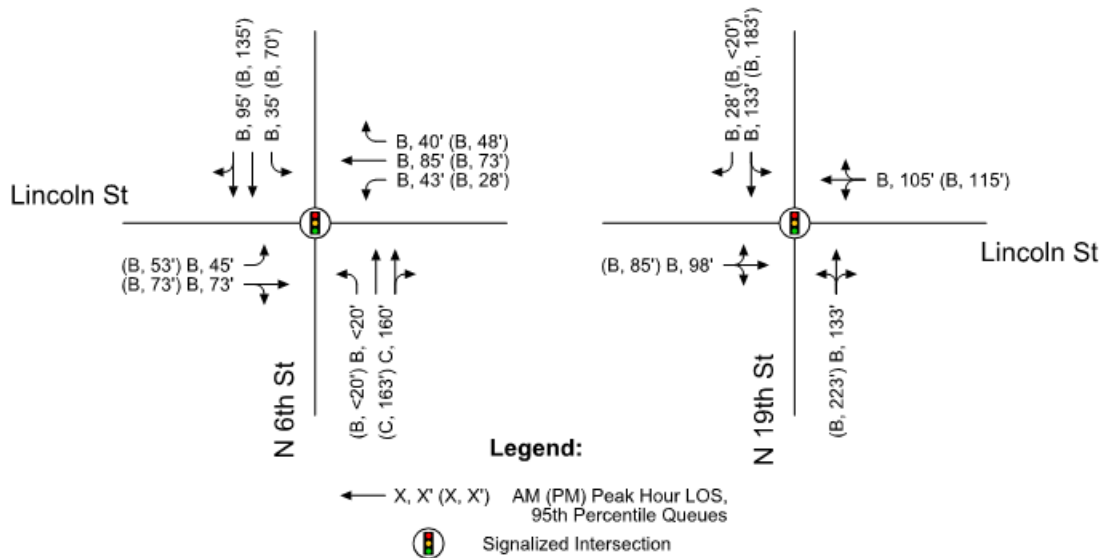


Figure 15: Year 2040 Background Plus Site AM and PM Peak Hour LOS

5.0 Intersection Configuration Options

This section of the report summarizes the alternatives that were evaluated at both signalized intersections on the project corridor.

5.1 The Intersection of N 6th Street & Lincoln Street

The following sections discuss the potential improvements at the intersection of N 6th Street & Lincoln Street.

5.1.1 East/West Through Lane Alignment

One safety concern at the intersection of N 6th Street & Lincoln Street is the approximate 5-foot offset between the eastbound/westbound approach lanes and their receiving lanes across the intersection. One way to address this could be to remove the westbound right-turn lane. However, it is also recognized that this may impact the favorable westbound left-turn offset which permits turning vehicles to see eastbound through vehicles without being blocked by the eastbound left-turning vehicles. According to the Crash Modification Factor (CMF) Clearinghouse, this positive left-turn offset results in a 20% reduction in angle crashes at urban signalized intersections, when compared to intersections without this positive offset.

To ensure that the removal of the westbound right-turn lane would not cause a significant impact on the operations of the intersection, operations both with and without this turn lane were compared. As shown in Table 7 below, the removal of the westbound right-turn lane, and the potential of better alignment across the intersection does not have any significant impact on the overall operations of the intersection. Additional details of the analysis without the westbound left-turn lane can be found in the Synchro output sheets in Appendix G.

Table 7: N 6th Street & Lincoln Street Operations - With and Without the WB Left-Turn Lane

Intersection Approach		Build Out Conditions (Year 2027)				Horizon Year Conditions (Year 2040)			
		EB	WB	NB	SB	EB	WB	NB	SB
With WB Right-Turn Lane	AM LOS	B	B	B	B	B	B	C	B
	PM LOS	B	B	B	B	B	B	C	B
WithOUT WB Right-Turn Lane	AM LOS	B	B	B	B	B	B	C	B
	PM LOS	B	B	B	B	B	B	C	B

5.1.2 Auxiliary Turn-Lane Analysis

To determine if any turn-lane length adjustments were needed at the intersection of N 6th Street & Lincoln Street, comparisons were made between the 95th percentile queue lengths and the available storage length provided at the intersection. As shown in Table 8 below, under all scenarios evaluated, all provided storage lengths can contain the 95th percentile queues and no lengthening of turn lanes is required.

Table 8: Auxiliary Turn-Lane Analysis at N 6th Street & Lincoln Street

Year	2022		2027 Buildout Year				2040 Horizon Year			
Alternative	Existing		With WBR		W/O WBR		With WBR		W/O WBR	
Movement	Avail.	Req.	Avail.	Req.	Avail.	Req.	Avail.	Req.	Avail.	Req.
NBL	75'	<20'	75'	<20'	75'	<20'	75'	<20'	75'	<20'
SBL	170'	58'	170'	60'	170'	60'	170'	70'	170'	70'
EBL	105'	63'	105'	45'	105'	50'	105'	53'	105'	60'
WBL	130'	40'	130'	38'	130'	38'	130'	43'	130'	43'
WBR	80'	43'	80'	43'	N/A		80'	48'	N/A	

Avail. = Existing Queue Storage Length

Req. = Required Turn Lane Length Derived From 95th Percentile Queuing

Given these considerations, it is recommended at the intersection of N 6th Street & Lincoln Street that the westbound right-turn lane be removed. However, a positive or neutral left-turn offset should be maintained, as much as possible.

5.2 The Intersection of N 13th Street & Lincoln Street

The eastbound and westbound approaches to the intersection of N 13th Street & Lincoln Street are offset by approximately 8 feet. As the corridor is reconstructed, realigning these two approaches would greatly improve safety and driver consistency at this intersection. An example of how this could be accomplished is included in the conceptual drawings located in Figure 19 later in the report.

5.3 The Intersection of N 19th Street & Lincoln Street

The following sections discuss the potential improvements at the intersection of N 19th Street & Lincoln Street.

5.3.1 Signal Warrant Analysis

To determine if the existing signal is appropriate at the intersection of N 19th Street & Lincoln Street, a signal warrant analysis was conducted to determine if existing, 2027, and/or 2040 traffic demands would satisfy 2009 MUTCD signal warrant criteria. The following warrants were considered in the analysis:

- Warrant 1 (Eight Hour Warrant)
- Warrant 2 (Four Hour Warrant)
- Warrant 8 (Roadway Network)

Signal warrant sheets are provided in Appendix H. MUTCD warrant analysis results are summarized in Table 9.

Table 9: MUTCD Signal Warrant Summary

<i>Lincoln Street Intersection with</i>	Traffic Demand Year	2009 MUTCD Warrants Satisfied		
		Warrant 1 (8 Hour)	Warrant 2 (4 Hour)	Warrant 8 (Roadway Network)
<i>N 19th Street</i>	Existing	No	No	No
	2027	No*	No*	N/A
	2040	No*	No*	N/A

**While future peak hours do, in some cases, satisfy the warrant individually, it is unlikely that the required number of other hours will also satisfy the warrant. For this reason, the warrant is not considered to be satisfied.*

As shown, the intersection does not satisfy the signal warrants under existing or future conditions. For this reason, traffic signal control is not recommended to continue at the intersection of N 19th Street & Lincoln Street.

5.3.2 Alternative Traffic Control

To determine the appropriate traffic control at the intersection of N 19th Street & Lincoln Street, the intersection's operation was analyzed under TWSC, all-way stop control (AWSC), and as a roundabout. Operations during both the build-out year and the horizon year under the above listed traffic control is summarized in Table 10. Additional details of the analysis can be found in the Synchro and SIDRA output sheets in Appendix J.

Table 10: N 19th Street & Lincoln Street Operational Alternatives Analysis

Intersection Approach		Build-Out Conditions (Year 2027)				Horizon Year Conditions (Year 2040)			
		EB	WB	NB	SB	EB	WB	NB	SB
Existing (Traffic Signal)	AM LOS	B	B	B	B	B	B	B	B
	PM LOS	B	B	B	B	B	B	B	B
TWSC	AM LOS	D	E	*	*	F	F	*	*
	PM LOS	F	F	*	*	F	F	*	*
AWSC	AM LOS	B	B	B	B	C	C	C	C
	PM LOS	B	C	C	C	C	C	E	E
Roundabout	AM LOS	A	A	B	A	B	B	B	B
	PM LOS	A	B	B	B	B	B	B	B

** LOS not provided for uncontrolled intersection approaches*

As shown in the table above, installation of TWSC would create significant delay on the stop-controlled approaches with LOS F present under both Build-out and Horizon year conditions. However, while installation of AWSC does operate better than TWSC, the northbound and southbound approaches are expected to operate at LOS E during the PM peak hour in the year 2040. The roundabout operates the best with operations matching, and in some cases exceeding, the operations present at the intersection today. The following discussions provide additional considerations on each of the alternatives at the intersection of N 19th Street & Lincoln Street.

5.3.2.1 Two-Way Stop Control

Because the northbound and southbound approaches combined carry a higher volume of vehicles than the eastbound and westbound approaches, it was assumed that the eastbound and

westbound approaches would be the stop-controlled approaches. However, as discussed previously, this leads to significant delay on these approaches. Also, when comparing a TWSC intersection to a signalized intersection, the TWSC intersection could result in a higher crash pattern. Drivers would have more opportunities to misjudge headways when entering traffic, resulting in relatively severe head-on, angle-oncoming and broadside collisions. In contrast, there would likely be fewer rear-end collisions compared to traffic signals as not all vehicles approaching the intersection would have to stop. In general, TWSC intersections can have worse safety performance than a roundabout or AWSC due to the speed and angle of collisions.

5.3.2.2 All-Way Stop Control

No CMF was available for converting a signalized intersection to an AWSC intersection. However, the National Cooperative Highway Research Program (NCHRP) Report 17-70 indicates that conversion from AWSC to a roundabout found “no apparent safety benefit.” Given the relatively low speed of drivers in this intersection and the residential environment, the AWSC is expected to have similar low speed safety performance of the roundabout alternative.

5.3.2.3 Roundabout Control

The CMF Clearinghouse indicates that converting a traffic signal to a roundabout could result in a 66% reduction in serious, minor, and possible injury crashes with a 21% reduction in total crashes. If a mini-roundabout were to be constructed, research in the U.K. shows an approximate 30% crash reduction when converting from a traffic signal to a mini-roundabout.

Because of the desirable operations and safety characteristics anticipated with roundabout control at the intersection of N 19th Street and Lincoln Street, it is recommended that this intersection configuration be implemented long term and phased with adjacent project construction. In the interim, AWSC would provide favorable operations at the intersection.

6.0 Lincoln Street Corridor Alternatives

Based upon the traffic analysis and overall corridor evaluation completed for the project, several improvement alternatives were initially developed. Based upon continued discussion and public input (described in Section 7.0) further refinement of these alternatives were conducted. This section provides a brief description of the alternatives developed. Further illustrations of improvement options are included in the Public Engagement Summary and appendices. In addition, a final concept of the selected improvements is illustrated at the end of Section 8.0 in this report.

6.1 Segment Design Alternatives

To address the overall mobility of Lincoln Street and improve lane alignment issues at specific locations, four different street cross-sections were developed for the corridor. These included the following:

- Two-lane (one lane in each direction) with sidewalk and side path;
- Two-lane (one lane in each direction), plus on-street parking on one side of Lincoln Street with sidewalk and side path;
- Two-lane (one lane in each direction), plus on-street bike lanes and sidewalks; and
- Three-lane (one lane in each direction plus center two-way left-turn lane) with sidewalk or side path.

These four alternatives were then presented at a public meeting for consideration. Feedback on the various intersections and street segment widths was collected. The different impacts to adjacent ROW including sidewalk setbacks and parkway areas were also compared. One primary difference on within the improvement options included the presence of bicycle facilities “on” versus “off” the street. Further discussion of the on-street bike lane facilities is included in Section 6.2 below.

6.2 Segment Bicycle Lane Configuration

The *National Association of City Transportation Officials (NACTO) Urban Bikeway Design Guide* contains guidance for selecting bikeways based on street characteristics. Given the existing and future volumes along Lincoln Street, the guide recommends buffered or protected bike lanes with a 25 MPH speed limit or protected bike lanes with a speed limit greater than 25 MPH. A fully protected bike lane results in physical separation (median or other) between the vehicle lanes and the bike lanes. For several areas along segments the Lincoln Street corridor contains insufficient width to accommodate a separate, protected bike lane. For this reason, bike lanes were not recommended as a desired improvement. Despite this, a bike lane was still provided in one of the alternatives at the public meeting to gather additional feedback. This gave the public an opportunity to comment on the presence of a bike lanes and their associated characteristics along the Lincoln Street Corridor.

7.0 Public Engagement

The Lincoln Street Corridor Study included a community engagement effort that provided residents and users of Lincoln Street opportunities to learn about and provide comments on the project. The community engagement effort included targeted postcard mailers, news releases, social media posts, digital message boards, a project website, and two public open house meetings, each with a comment period.

The first public meeting was held March 21, 2022, toward the end of the team’s information gathering stage. The purpose of the meeting was to create awareness about the study and have the public verify the team’s understanding of existing conditions. The second public meeting was held May 9, 2022, following the development of improvement alternatives. The purpose of the meeting was to share and collect public input on these alternatives.

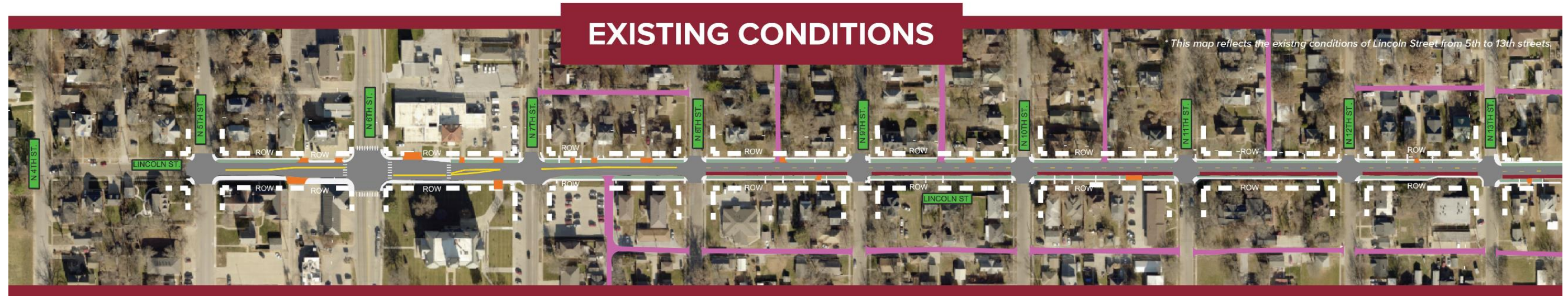
Summaries of the two public meetings are provide in Appendix K; however, key conclusions of the input received include:

- “Driver and pedestrian safety” and “lane alignment” are primary concerns of the existing conditions.
- Based on previously stated city priorities, respondents agreed that “enhance safety” and “cost-effective solutions” are top priorities for the corridor.
- There is mixed public opinion on traffic signal control at the Lincoln & 19th Street intersection.
- On-street parking is needed only in locations where there is no driveway or alley access for corridor residents.
- In general, there is less interest in on-street bike lanes versus options to ride along a trail or down adjacent neighborhood streets.

An example of the visuals used during the second public meeting is provided in Figure 16. This graphic illustrates several of the various typical sections evaluated for the corridor.

5th-13th Streets

From 5th to 13th streets, where the existing ROW is **80-feet**, the project team is considering different lane configurations that would provide consistent street and sidewalk conditions.



POTENTIAL ALTERNATIVES



Two-lane with limited parking



Three lane (with center turn lane) with limited parking



Two-lane



Three lane (with center turn lane)

Figure 16: Corridor Potential Design Alternatives

13th-22nd Streets

From 13th to 22nd streets, where the existing ROW is **66-feet**, the project team is considering different lane configurations that would provide consistent street and sidewalk conditions.



POTENTIAL ALTERNATIVES



Two-lane with parking (14th - 16th streets only)



Three lane (with center turn lane) with parking (14th - 16th streets only)



Two-lane



Three lane (with center turn lane)

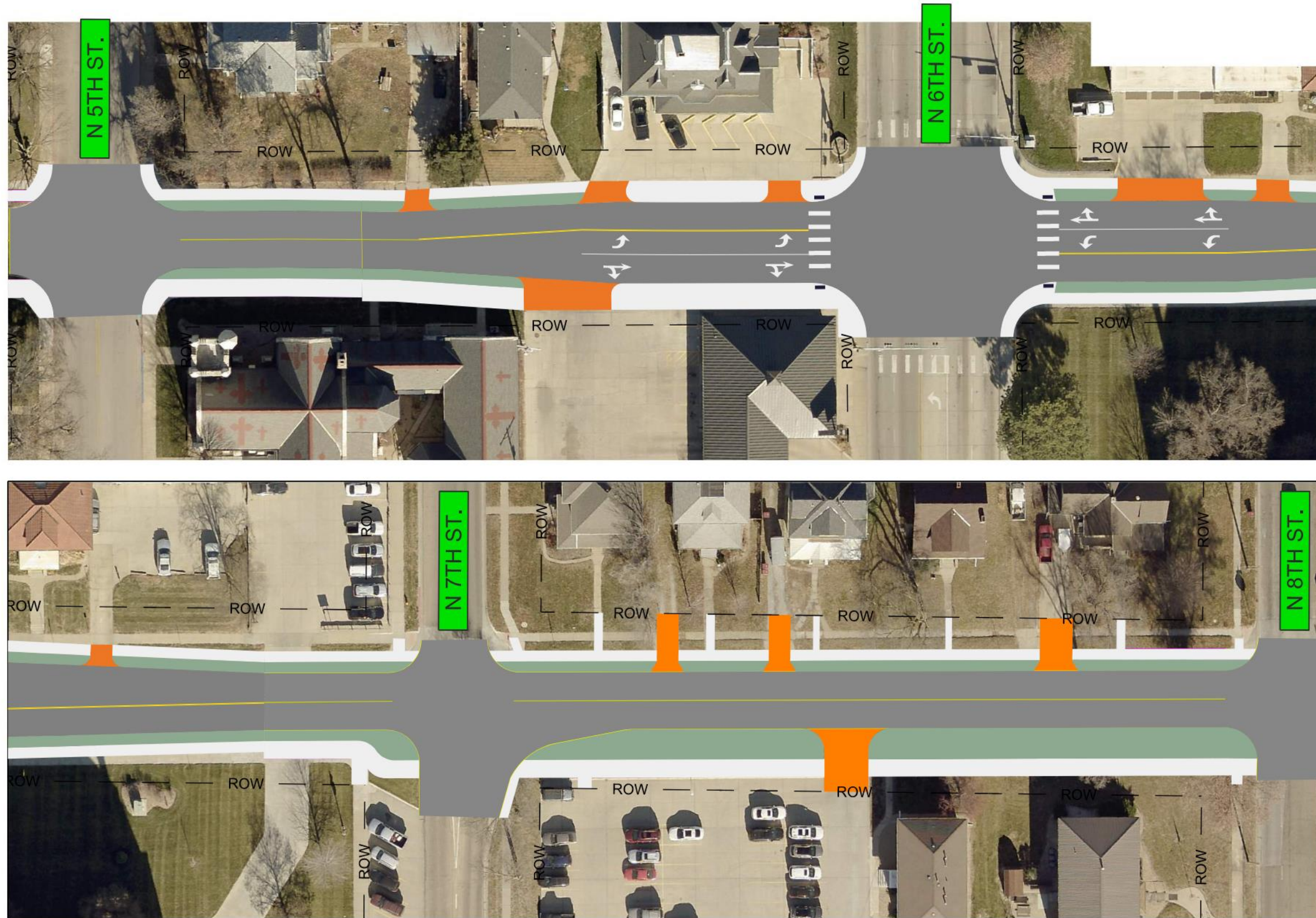
Figure 16: Corridor Potential Design Alternatives

8.0 Recommendations and Next Steps

Based on the above analysis and community input, the following recommendations are provided to improve the Lincoln Street corridor in a phased approach, as the City looks to program improvements:

- A two-lane cross-section with on-street parking on the south side in select locations is recommended. In addition, a sidewalk on both sides of the street and/or trail on one side is also recommended for improved multi-modal opportunities. The overall footprint of a trail along the south side of the street would have a similar ROW impact in terms of width due to the varying setback distance between back of street curb and near edge of trail or sidewalk. A conceptual drawing of the street alternative is provided in Figures 17 – 22 which follow at the end of this report.
- The westbound right-turn lane at the intersection of N 6th Street & Lincoln Street should be removed. However, care should be taken to preserve neutral or positive offset for the eastbound/westbound left-turns. This lane geometry improvement will also result in traffic signal modifications (construction) and improvements to signal displays and pedestrian accommodations.
- The mid-block crossing located between N 6th Street and N 7th Street should be relocated to the current unmarked crosswalk across the west leg of the intersection of N 7th Street & Lincoln Street.
- The eastbound and westbound skew through the intersection of N 13th Street & Lincoln Street should be improved and realigned as the corridor is reconstructed.
- The traffic signal at the intersection of N 19th Street & Lincoln Street should be removed and replaced with a roundabout. To reduce impacts, this roundabout could also be designed as a mini roundabout. In the interim, an AWSC implementation is expected to provide favorable operations.

A project phasing plan and associated opinion of probable costs table have been developed for the recommended design alternative. Table 11 shows the proposed phasing plan and the associated project costs for each potential phase of the project. These project costs reflect current year dollars and construction unit costs and do not consider increasing construction, operation, and maintenance costs. The next steps for the City of Beatrice are to begin programming funds in the current capital program, evaluate other funding opportunities (i.e. grants), and begin next phases of design for initial phases of the corridor.



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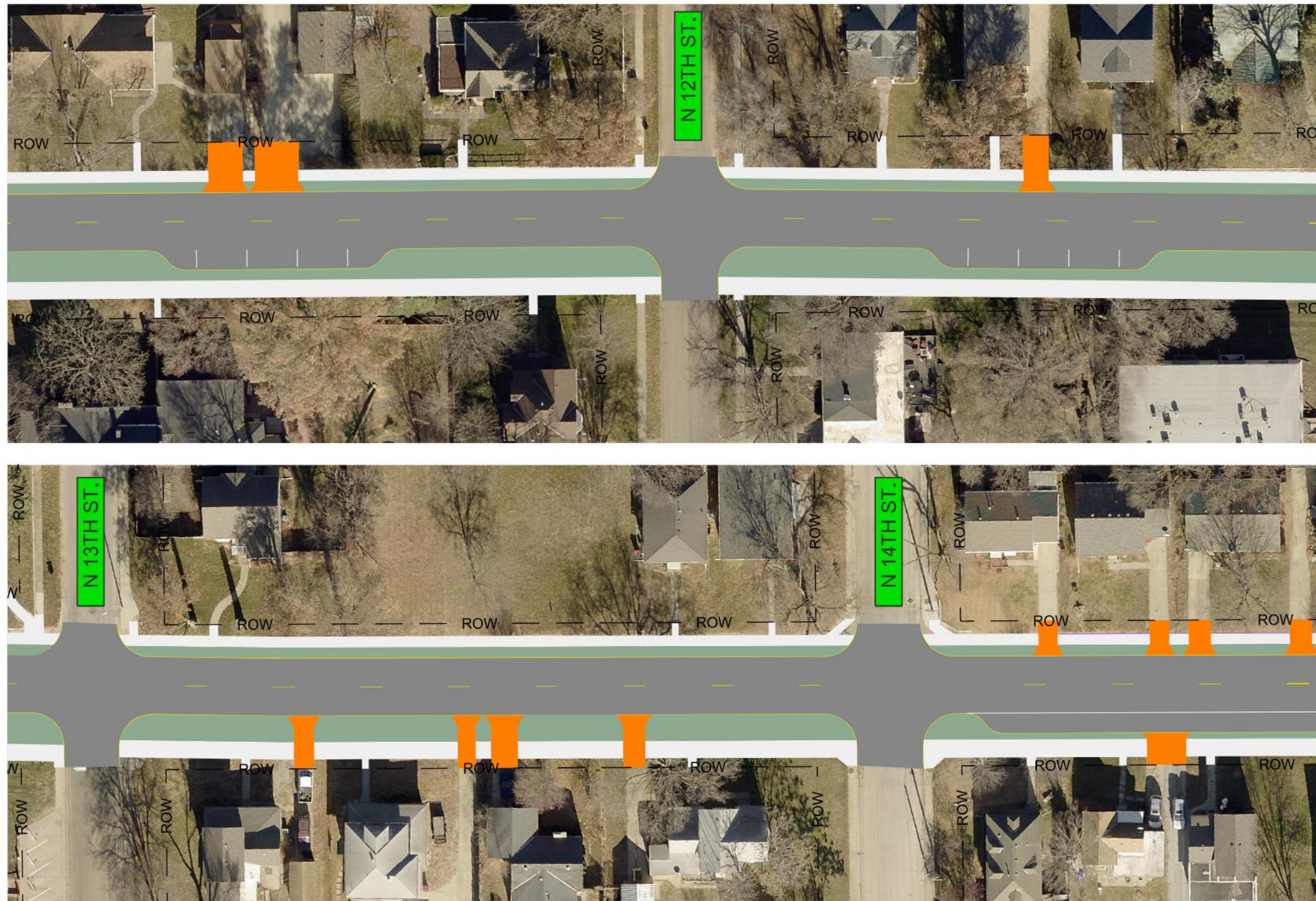
2022
BEATRICE, NE
LINCOLN STREET CORRIDOR STUDY

Figure 17: Recommended Lincoln Street Design Alternative (5th Street to 8th Street)



2022
BEATRICE, NE
LINCOLN STREET CORRIDOR STUDY

Figure 18: Recommended Lincoln Street Design Alternative (8th Street to 11th Street)



2022
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LINCOLN STREET CORRIDOR STUDY

Figure 19: Recommended Lincoln Street Design Alternative (11th Street to 14th Street)

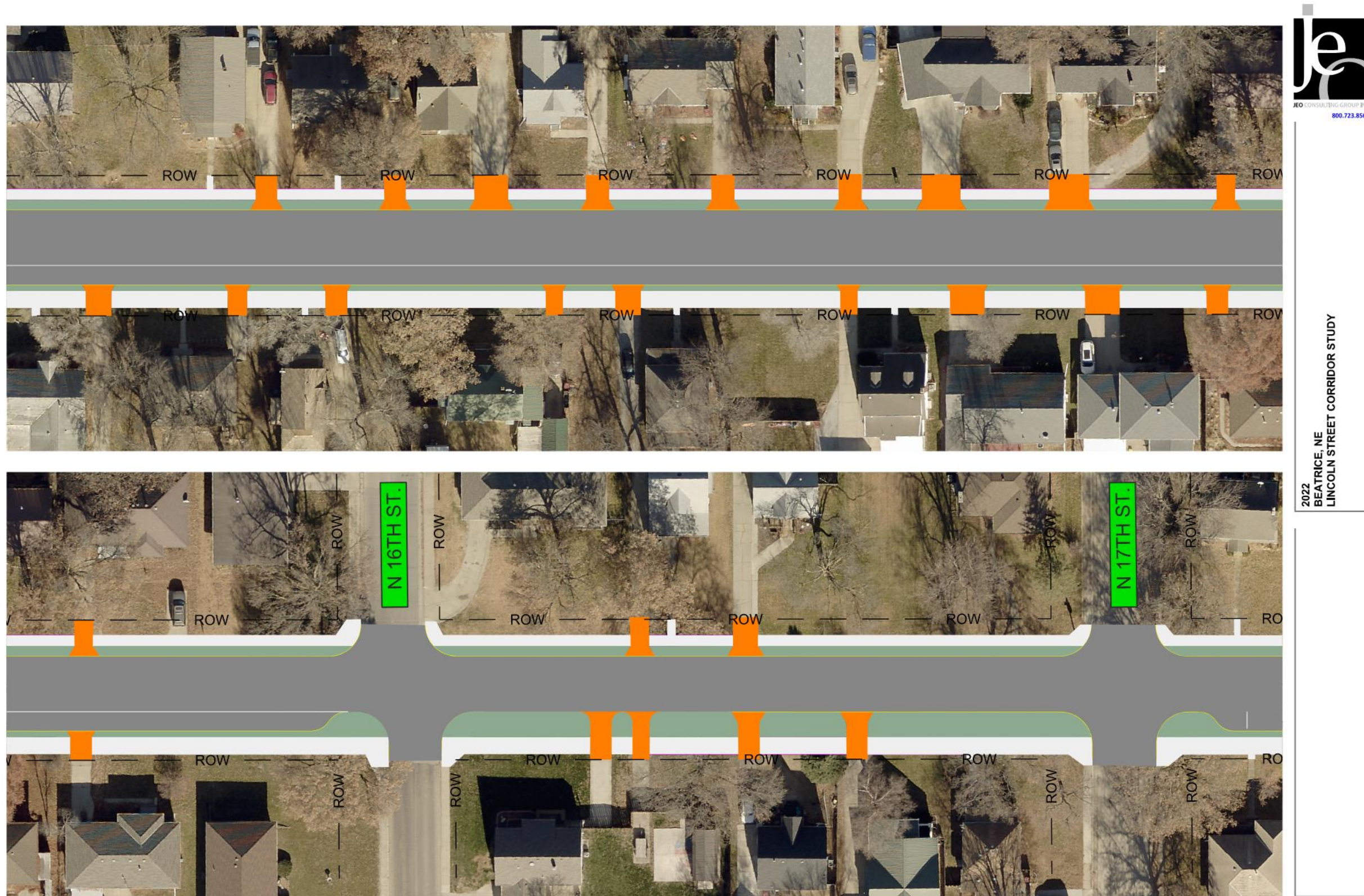
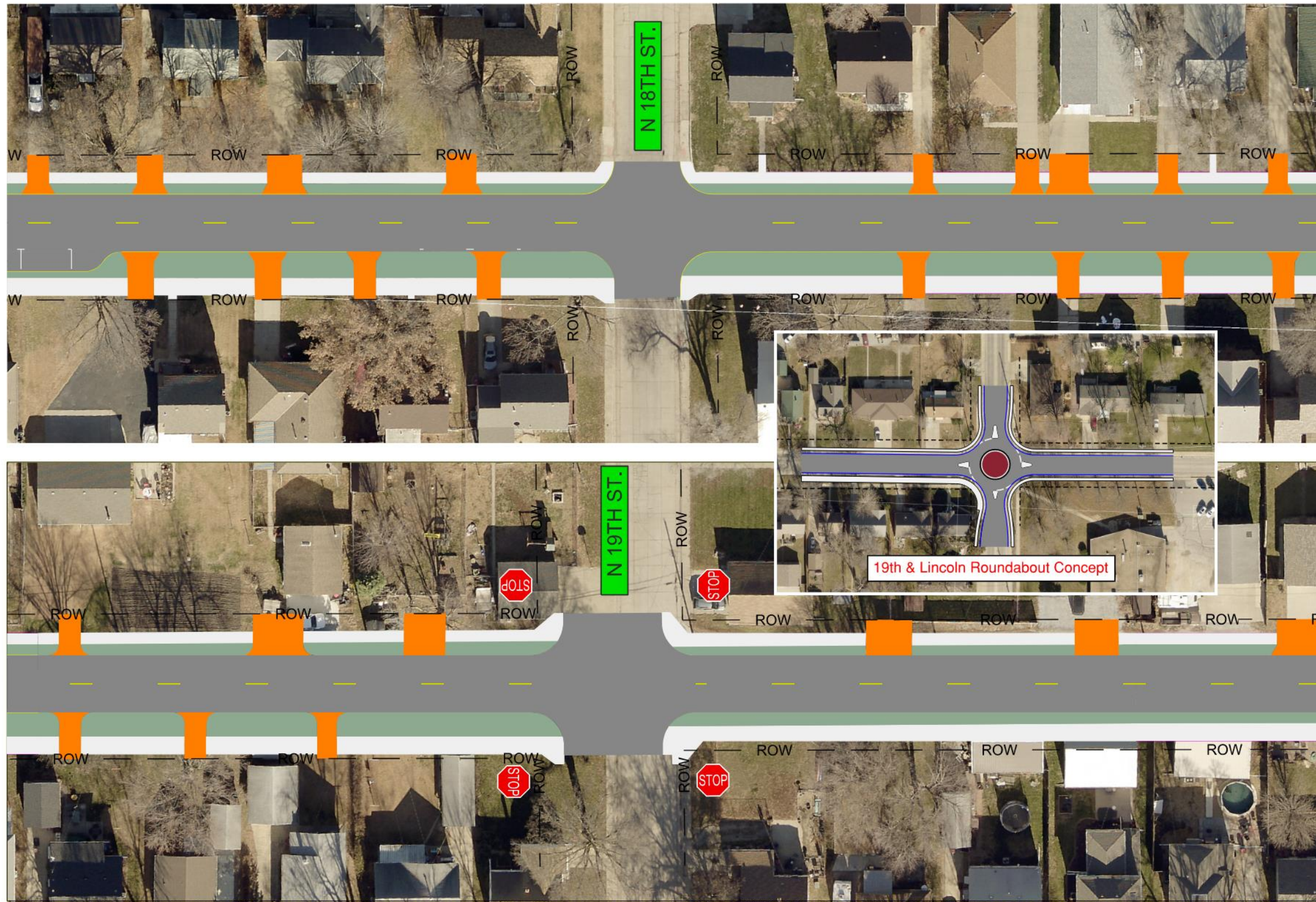
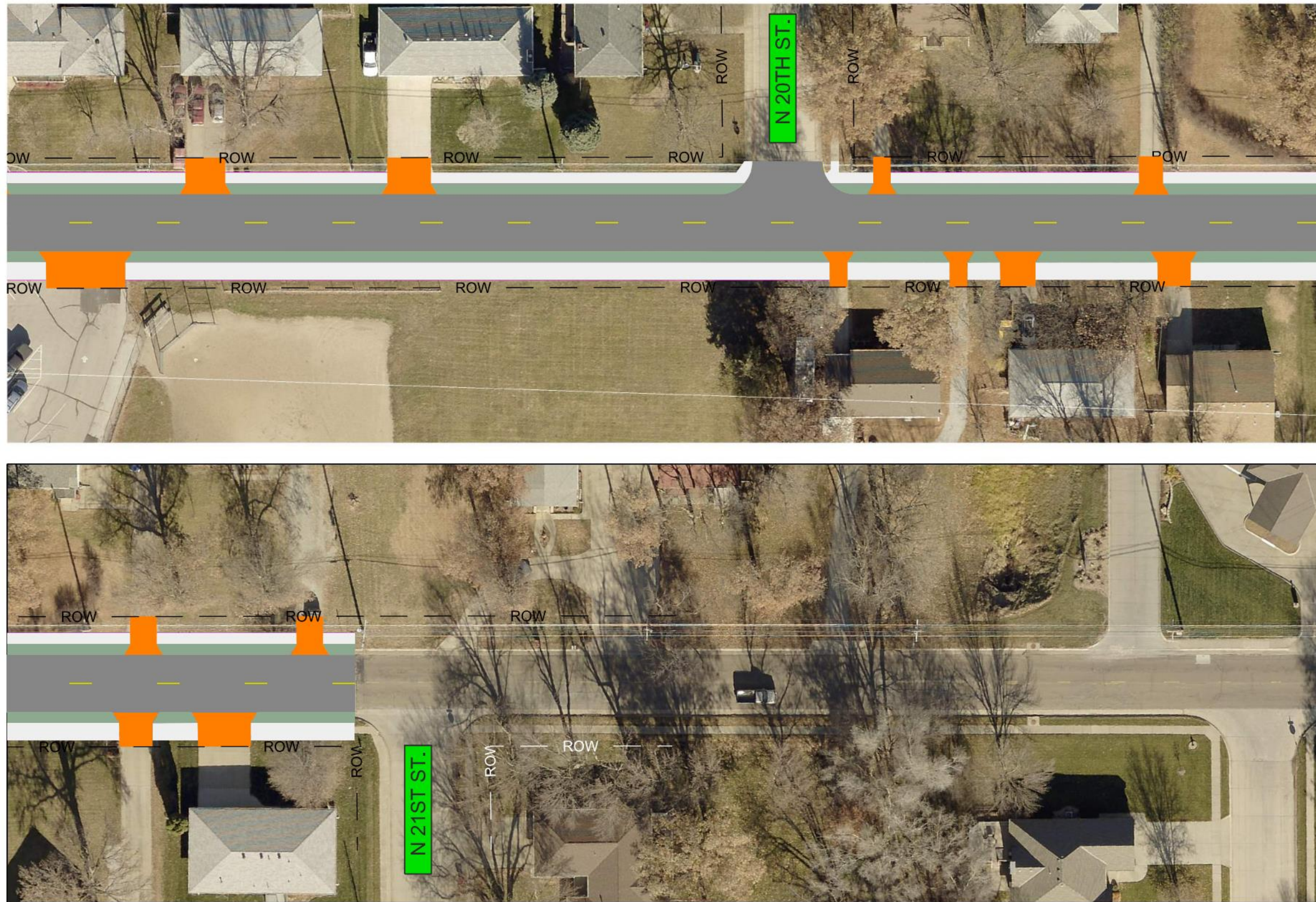


Figure 20: Recommended Lincoln Street Design Alternative (14th Street to 17th Street)



2022
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Figure 21: Recommended Lincoln Street Design Alternative (17th Street to 19th Street)



2022
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Figure 22: Recommended Lincoln Street Design Alternative (19th Street to 21st Street)

Table 11: Proposed Project Phasing Plan and Cost Estimate

Project Phase	Lincoln Street Corridor Project Phasing Plan	Opinion of Costs*
1	5th St. to 8th St. -Realign 6 th & Lincoln intersection to address existing safety issues -Improve traffic signal at 6 th & Lincoln -Sidewalk and streetscape improvements	\$1,700,000
2	11th St. to 14th St. -Realign Lincoln St. between 12 th and 13 th to address existing safety issues -Rebuild two lane section of street with limited parking -Sidewalk and streetscape improvements	\$1,425,000
3	8th St. to 11th St. -Rebuild two lane section of street with limited parking -Sidewalk and streetscape improvements	\$1,650,000
4	14th St. to 17th St. -Rebuild two lane section of street with limited parking -Sidewalk and streetscape improvements	\$1,900,000
5A	17th St. to 19th St. (All-Way stop at 19th) -Reconstruction of 19 th & Lincoln intersection as an all-way stop -Rebuild two lane section of street with limited parking -Sidewalk and streetscape improvements	\$1,750,000
5B	17th St. to 19th St. (Roundabout at 19th) -Construction of Roundabout at intersection of 19 th & Lincoln -Rebuild two lane section of street with limited parking -Sidewalk and streetscape improvements	\$2,075,000
6	19th St. to 21st St. -Rebuild two lane section of street with limited parking -Sidewalk and streetscape improvements	\$1,050,000

**Opinion of Probable Project Cost estimates reflect current year dollars and construction unit costs and do not consider increasing construction or operation and maintenance costs.*