Traffic Impact Study

ISD No. 624 Proposed Hugo Elementary School

Hugo, Minnesota

ISDWB 156183 | January 28, 2021

SEH

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January 28, 2021

RE: ISD No. 624 Proposed Hugo Elementary School Traffic Impact Study
Hugo, Minnesota
SEH No. ISDWB 156183 4.00

Mr. Tim Wald
Superintendent for Finance and Operations
Independent School District No. 624
4855 Bloom Avenue
White Bear Lake, MN 55110

Dear Mr. Wald

The attached Traffic Impact Study and Intersection Control Evaluation Report was prepared for the planned new Hugo Elementary School located near the intersection of US Highway 61 and 152nd Street. The scope of this traffic study was discussed with City of Hugo, Washington County, and Minnesota Department of Transportation (MnDOT) staff prior to initiation of the work to ensure the study met all project stakeholder expectations and the appropriate level of effort was completed.

Respectfully submitted,

Chad Jorgenson, PE, PTOE
Senior Traffic Engineer/Project Manager
(Lic. IA, MN, SD)

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Traffic Impact Study

ISD No. 624 Proposed Hugo Elementary School
Hugo, Minnesota

SEH No. ISDWB 156183

January 28, 2021

I hereby certify that this report was prepared by me or under my direct supervision, and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Chad Jorgenson, PE, PTOE

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Traffic Impact Study

ISD No. 624 Proposed Hugo Elementary School

Prepared for Independent School District No. 624

1 Background and Purpose

With the passing of the recent White Bear Lake Area School's bond referendum, a new elementary school is now being proposed in Hugo, Minnesota. The elementary school is expected to be located just west of the intersection of Highway 61 and 152nd Street. The proposed elementary school will have direct access onto Highway 61 with the construction of a west leg at the intersection of Highway 61 and 152nd Street.

The proposed elementary school is expected to open during the Fall of 2022 and will serve approximately 500 students, 50 staff members, and 7 buses at the time of opening. It is anticipated that the school will be at maximum capacity by the year 2026. Under the maximum capacity conditions the school is expected to serve 720 students, 70 staff members, and 11 buses.

This study will analyze the year of opening 2022 school conditions, 2026 full school build out conditions and five years after the full build out in the year 2031.

Based upon the above analysis scenarios, the purpose of this study is to analyze traffic operations at the three study intersections noted below and to determine any appropriate intersection improvements at the Highway 61 and 152nd Street intersection:

- Highway 61 at 159th Street
- Highway 61 at 152nd Street
- Highway 61 at 147th Street

Figure 1 represents the study intersections within the project area.

2 Existing Conditions

Currently, through the City of Hugo, Highway 61 is considered an "A" Minor Arterial in the City's 2040 Comprehensive Plan. Highway 61 is currently under the jurisdiction of the Minnesota Department of Transportation, however in the future this section of Highway 61 through the project area may be turned back to Washington County. In 2019, through the project area, Highway 61 carried an Annual Average Daily Traffic (AADT) total of 11,453 vehicles per day.

The intersection of Highway 61 at 159th Street is currently a stop-controlled intersection. The west leg of the intersection is owned by the City of Hugo and generally serves a residential neighborhood to the west. The east leg serves the private business of Industrial Utilities.

The speed limit of Highway 61 through this area is 55 miles per hour (mph) and the speed limit of 159th Street is 30 mph.

The northbound Highway 61 approach to 159th Street currently has two approach lanes, a single thru/left lane, and a by-pass lane for traffic to pass vehicles waiting to make a northbound left turn onto 159th Street. The southbound Highway 61 approach has two approach lanes a dedicated right turn lane and a shared through/left turn lane. Both the eastbound and westbound approaches have a single approach lane.

The intersection of Highway 61 at 152nd Street is currently a stop-controlled T-intersection. 152nd Street is a City owned street that generally serves an industrial area located east of Highway 61 on both the north and south sides of 152nd Street.

The speed limit of Highway 61 through the 152nd Street intersection is 55 mph. However, approximately 350' south of the intersection Highway 61 transitions into a 45-mph speed zone. The speed limit on 152nd Street is 30 mph.

The northbound Highway 61 approach to 152nd Street includes a dedicated right turn lane and a through lane. Southbound Highway 61 is a two-lane approach with a shared thru/left turn lane and a by-pass lane for traffic to pass vehicles waiting to make a southbound left turn onto 152nd Street.

The intersection of Highway 61 and 147th Street is currently a signalized intersection with the west leg of 147th Street generally serving residential housing as well as provides access to Lions Park. The east leg of 147th Street serves as a local street providing access to residential neighborhoods located east of Highway 61. 147th Street is a City of Hugo owned street.

The speed limit of Highway 61 through the 147th Street intersection is 35 mph. The speed limit on 147th Street is 30 mph.

The northbound and southbound Highway 61 approaches to 147th Street have a geometric section that includes a dedicated left, thru and right turn lanes. Both eastbound and westbound 147th Street approaches to 152nd Street have dedicated left turn lanes and shared thru/right turn lanes.

2.1 Existing Traffic Volumes and the Health Pandemic

The current health pandemic surrounding COVID-19 has impacts on the project data collection; both commuter and school traffic has been impacted by the situation.

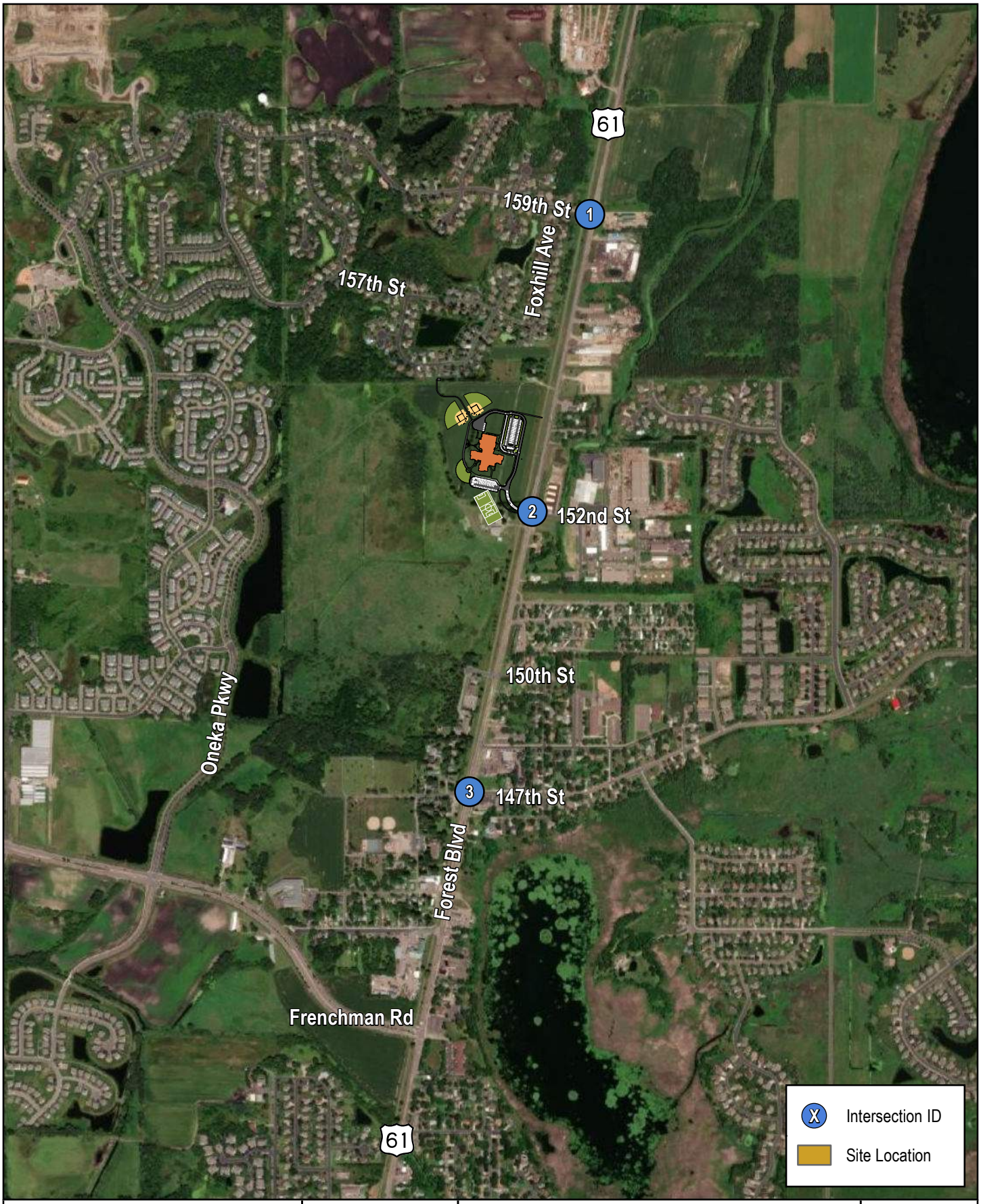
Traffic counts for this project were taken at all three study intersections in June of 2020. Due to school not being in session and the impacts to traffic volumes caused by the coronavirus, adjustments were made to factor up the traffic counts to more "normal" conditions.

Traffic counts were obtained from MnDOT that were taken in November of 2019 as part of a larger signal re-timing effort. A count at the intersection of Highway 61 and 147th Street was compared to the traffic count obtained at this intersection in June of 2020.

When comparing these two counts it was determined that the AM peak hour of the roadway was approximately 28% lower than the previous count's AM peak hour during the school arrival period. Throughout the rest of the day the June 2020 traffic count was approximately 20% lower. Therefore, the AM peak hour traffic counts at each of the study intersections were increased by 28% and the school dismissal and PM peak hour counts were increased by 20%.

Figure 2 shows the existing June 2020 traffic counts at each of the study intersections.

Figure 3 shows the coronavirus adjusted traffic counts at each of the study intersections.



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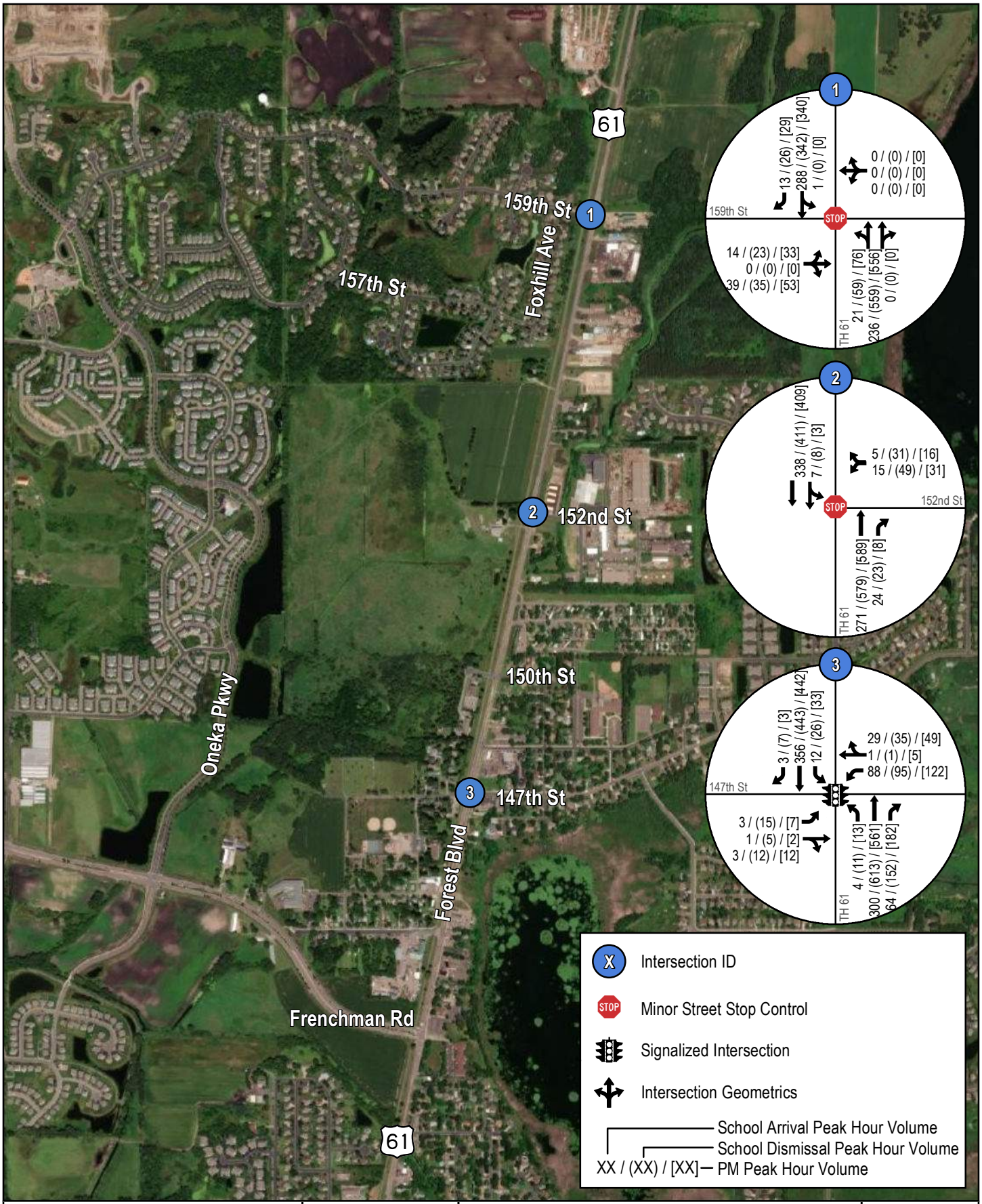
Project: ISDWB 156183
Print Date: 12/8/2020

Map by: jdanibas
Projection: NAD 1983 HARN MN Washington
Source: ESRI

Project Location

White Bear Lake Elementary School
Hugo, MN

Figure 1



Path: X:\F\I\ISDWB\156183\15-final-dsgn\51-drawings\90-GIS\Figure 2 - Existing 2020 Traffic.mxd

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Project: ISDWB 156183
Print Date: 10/31/2020

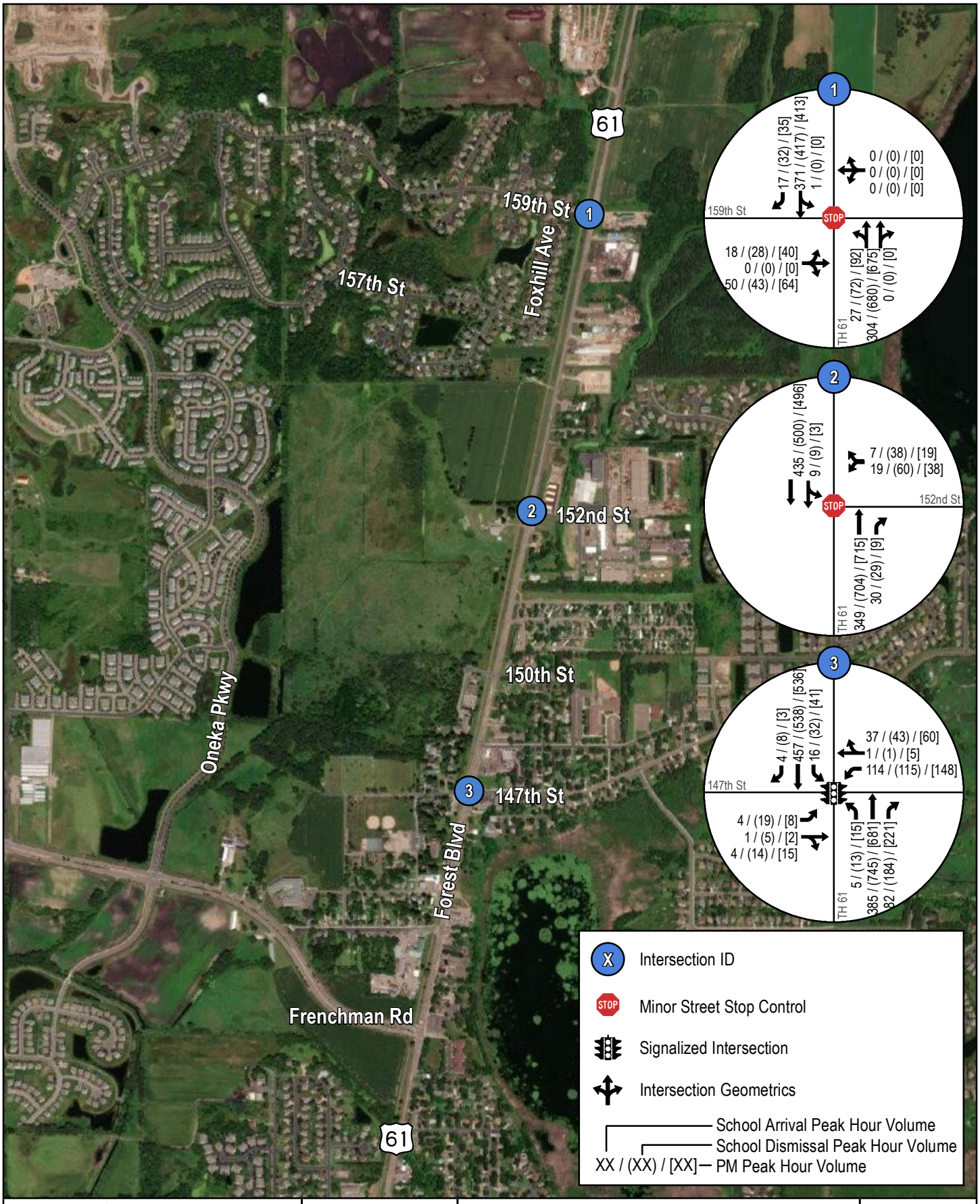
Map by: jdanibas
Projection: NAD 1983 HARN MN Washington
Source: ESRI

Existing 2020 Traffic

White Bear Lake Elementary School

Hugo, MN

Figure 2



Path: X:\FJ\I\ISDWB\156183\15-final-dsgn\51-drawings\90-GIS\Figure 3 - COVID-19 Adjusted 2020 Traffic Counts.mxd

SEH

Project: ISDWB 156183
Print Date: 10/31/2020

Map by: jdanibas
Projection: NAD 1983 HARN MN Washington
Source: ESRI

COVID-19 Adjusted 2020 Traffic Counts
White Bear Lake Elementary School
Hugo, MN

Figure 3

2.2 Historical Crash Analysis

Crash data from January 1st, 2009 through December 31st, 2019 was collected from the Minnesota Crash Mapping Analysis Tool (MnCMAT2). The type and severity of the crashes were reviewed, and crash rates and critical rates were calculated for the study intersections.

Crash rates are expressed as the number of crashes per million entering vehicles at an intersection or along a segment. Crash severity is comprised of 5 separate types including fatal, an incapacitating injury (Severity A), a non-incapacitating injury (Severity B), a possible injury (Severity C), or a property damage crash.

The critical crash rate is a statistical value that is unique to each intersection based on vehicular exposure and the statewide average crash rate for similar intersections; an intersection with a crash or severity rate higher than the critical rates indicates a sustained crash problem at the intersection.

At the intersection of Highway 61 at 159th Street there have been a total of 24 crashes from 2009 to 2019. One of these crashes resulted in a fatality, six crashes resulted in non-incapacitating injuries, six crashes resulted in possible injury, and 11 were property damage only crashes. Of the 24 crashes, 11 were rear ends, 5 were right angle, 3 were sideswipe, 1 was a head-on, 1 was a single vehicle, and 3 were designated as “Other”. The predominant crash type at this intersection is rear end crashes, with 9 of the 11 rear end crashes involving northbound vehicles. The calculated crash rate at this intersection is 0.53 crashes per million entering vehicles (MEV). The calculated crash rate is higher than the MnDOT statewide average crash rate for this type of intersection (Urban Thru/stop-controlled intersection) and the crash rate is above the calculated critical crash rate. This indicates that there is a sustained crash problem at this intersection.

At the intersection of Highway 61 and 152nd, there have been a total of two crashes from 2009 through 2019. One crash was a rear end accident that resulted in a possible injury crash. The other crash occurred during construction operations along Highway 61, in which a left turning vehicle struck the trailer of a construction vehicle hauling asphalt mix during a flagging operation that was taking place. The crash rate at this intersection is 0.05 crashes per MEV. This calculated crash rate is lower than the MnDOT statewide average crash rate for intersections with similar characteristics and is also lower than the calculated critical crash rate. A calculated crash rate lower than the critical crash rate indicates that there does not appear to be a sustained crash problem at this intersection.

At the intersection of Highway 61 and 147th Street there have been a total of 18 crashes from 2009 to 2019. One crash resulted in an incapacitating injury, two crashes resulted in non-incapacitating injuries, five resulted in possible injuries, and ten crashes resulted in property damage only. The calculated crash rate at this intersection is 0.33 crashes per MEV. This calculated crash rate is lower than the MnDOT statewide average crash rate for intersections with similar characteristics and is also lower than the calculated critical crash rate. A calculated crash rate lower than the critical crash rate indicates that there does not appear to be a sustained crash problem at this intersection.

The crash information is summarized in **Table 1**. More detailed crash information is shown in **Tables A1 & A2** in **Appendix A**.

Table 1 – Crash History 2009 - 2019

Intersection:	Crash Severity						Crash Rates	
	Fatal	Sev A	Sev B	Sev C	Property Damage	Total	Int. Rate	Critical Rate
Highway 61 at 159th Street	1	0	6	6	11	24	0.53	0.37
Highway 61 at 152nd Street	0	0	0	1	1	2	0.05	0.48
Highway 61 at 147th Street	0	1	2	5	10	18	0.33	0.80

3 Future Conditions

As previously mentioned, this study includes evaluation of the study intersections in future year conditions to determine the impacts of increased growth along the surrounding roadways.

3.1 Trip Generation and Trip Distribution

The Institute of Transportation Engineers (ITE) Trip Generation Manual 10th Edition was used to estimate new development trips for the proposed elementary school. ITE Land Use Code 520-Elementary School was used to generate trips for the elementary school for both the year of opening 2022 and expected full build out year 2026.

Trip generation rates vary for the elementary school based upon the different time periods throughout the day. For instance, the trips that are generated for an elementary school are lower during the AM peak hour of the roadway since elementary schools typically start later in the morning compared to the morning rush hour.

Due to the current start and end times of the District's elementary school, 9:30 AM to 3:30 PM, trip rates assigned to the elementary school were based upon the peak hour of the generator for the AM and school dismissal peak time periods. Trips were generated for the PM peak hour by using the rate associated with the peak hour of adjacent street traffic.

Table 2 – ITE Trip Generation

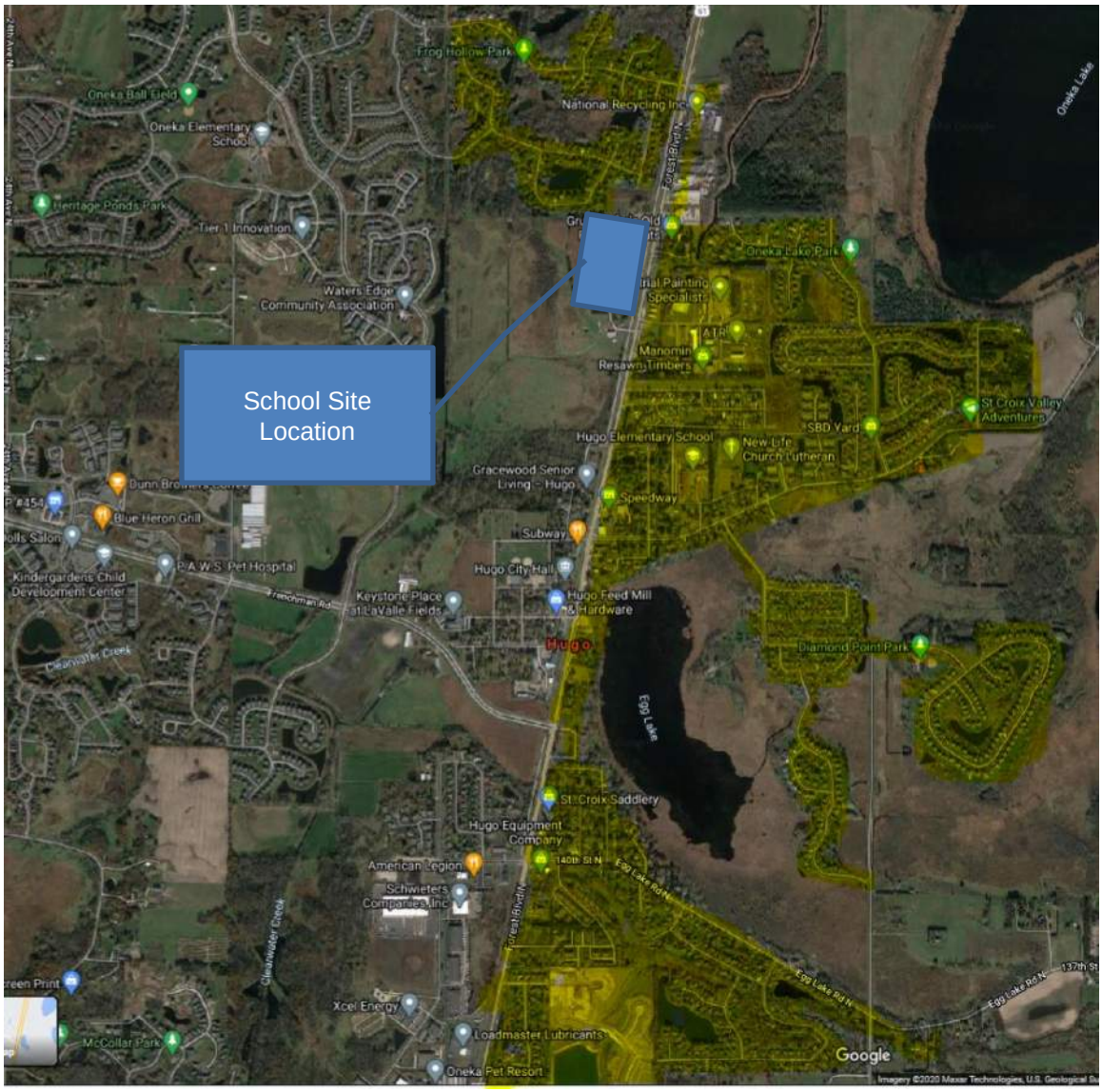
ITE Code	Students	Daily			AM Peak			SD Peak			PM Peak		
		Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total
520 – Elem. School	500	472	473	945	176	149	325	77	93	170	41	44	85
520 – Elem. School	720	680	681	1361	253	215	468	110	135	245	59	63	122

At the time of opening in 2022, the elementary school is expected to have 500 students. Enrollment is expected to increase to a full build out of 720 students by the year 2026.

Trips were distributed to the roadway based upon conversations with the White Bear Lake School District and the City of Hugo. Based upon these conversations a preliminary school boundary

was developed and used to assign traffic to the surrounding roadway network. **Exhibit 1** shows the approximate school boundary.

Exhibit 1: Proposed School Boundary



From this proposed boundary it was determined that approximately 90% of school traffic would travel from the site to the south and the remaining 10% to the north. This school distribution was used for both the year of opening and 2026 analysis scenarios.

Based on conversations with the City of Hugo, there is a possibility of more housing developments to occur north of the school site, approximately 200 homes west of Oneka Lake. Therefore, based on this information, the trip distribution was modified for the future 2031 analysis scenario. With the possible construction of the homes to the north, the trip distribution was adjusted to 75% of traffic traveling to and from the south and 25% of the traffic to and from the north.

Figures 4, 5 and **6** show the proposed trip generation for the year of opening, full build out and future year school traffic, respectively.

3.2 Traffic Forecasts

Historical AADT data in the project area along with previous traffic study information was reviewed to determine background growth rates for the surrounding roadway network.

Based on this information a straight-line linear growth rate of 2.0% per year was selected and utilized to develop traffic forecasts along Highway 61 for all future year analyses.

All side streets in the study area utilized a straight-line linear growth rate of 0.5% per year to develop traffic forecasts for future year scenarios.

Currently, Hugo Elementary and Oneka Elementary School serves the proposed attendance boundary shown in **Exhibit 1**. As part of the School District's Bond referendum that passed, the current Hugo Elementary School will be converted into a Northern Early Childhood location while Oneka Elementary School and the new proposed elementary school will serve the existing K-5 student demand. This change in operations will likely result in reduced traffic volumes on the roadways surrounding the current Hugo Elementary School as well as some neighborhoods being served currently by Oneka Elementary School.

Figures 7, 9, and **11** show the No Build conditions for the 2022 year of opening, 2026 Full Build, and 2031 future year conditions respectively.

4 Capacity Analysis

An existing and future intersection capacity analysis was completed using Synchro/SimTraffic software (Version 9). To address possible traffic control changes at Highway 61 and 152nd Street, an intersection control warrant analysis was also conducted.

4.1 Warrant Analysis

The Minnesota Manual of Uniform Traffic Control Devices (MnMUTCD) provides guidance on when it may be appropriate to use all-way stop or signal control at an intersection. This MnMUTCD guidance is provided in the form of "warrants", or criteria, for when all-way stop or signal control may be justified. Though all-way stop or signal control should not be installed at an intersection unless a MnMUTCD warrant is met, meeting a warrant at an intersection does not in itself require the installation of that particular type of control. Roundabouts are typically considered to be warranted if traffic volumes meet the criteria for either all-way stops or traffic signals. Along with traffic volumes, warrants also consider vehicle crash history and school crossings.

For traffic signal installation, MnDOT typically requires volume thresholds for Warrant 1 to be satisfied, which requires 8-hours of combined major approach volumes and the highest minor street approach volume to meet MnMUTCD thresholds. These thresholds vary with the number of approach lanes on the major and minor street. Other warrants may be used as indicators of a need to consider traffic control change; an engineering study that considers factors, including warrants, should be performed to determine the optimum type of control at an intersection.

4.1.1 Warrant Analysis Assumptions

MnDOT guidelines for the traffic signal warrant suggests removing 100% of right turning traffic from the minor leg since this movement typically can enter the traffic stream with minimal conflict. This suggestion is not applicable with the all-way stop warrant. Therefore, a traffic signal would not be needed to reduce delay or improve safety for this right turn movement. In certain circumstances (i.e. high right turn volume, minimum mainline gaps etc.), MnDOT allows for the inclusion of 50% of the minor street right turning traffic in the analysis. Based upon MnDOT's ICE Report Manual (http://www.dot.state.mn.us/trafficeng/signals/worksheets/ICE.pdf) if "right turning volume exceeds 70% of its potential capacity for any hour for each approach, 50% of the right turning volume for all hours should be added back in."

Based upon MnDOT guidance, the analysis for this study intersection includes the removal of 100% of the right turning traffic from the minor approaches for the signal warrant analysis.

MnMUTCD guidelines suggest that the warrant thresholds may also be reduced based on the roadway speeds and population of the city the intersection is within. If either major approach to the intersection has a posted speed, or 85th percentile speed, that exceeds 40 mph, then a reduction to 70% threshold volumes is allowed in both all way stop warrant and traffic signal warrant. If the population of the city is less than 10,000 people, a reduction to 70% threshold volumes is allowed in the traffic signal warrant, but not the all way stop warrants.

Based upon MnMUTCD guidance, the analysis of the study intersection does include a reduction to 70% thresholds based upon the speed limit of Highway 61 being above 40 mph through the 152nd Street intersection.

4.1.2 Warrant Analysis Summary

The existing 2020 traffic volumes, both the raw and increased base counts, at the study intersection currently do not meet either the All-Way Stop warrant or the traffic signal volume thresholds for Warrants 1A, 1B, 1A & 1B, Warrant 2 – Four Hour, Warrant 3 – Peak Hour, or Warrant 7 – Crash Experience (see Section 2.2 for crash history).

During the future year conditions with the elementary school present, the school is expected to directly access Highway 61 from a newly constructed west leg of 152nd Street.

To conduct a warrant analysis for the future conditions with the elementary school present, the ITE Trip Generation Handbook was used to distribute generated trips throughout the day. The Trip Generation Handbook provides guidance for the distribution of the daily elementary school traffic throughout an average day.

For the purposes of this warrant analysis, it was assumed that the geometry for the new eastbound approach would include a dedicated left, through and right turn lane approach. Based on this geometry, the volume thresholds change for the traffic signal warrants due to the minor street approach now having more than one lane of approach. If the geometry were to change to a dedicated left turn and a shared thru-right approach lane, the minor street approaches would still be considered a multi-lane approach.

Under the 2022 year of opening traffic volumes, the study intersection of Highway 61 at 152nd Street does not meet either the All-Way Stop warrant or the traffic signal volume thresholds for Warrants 1A, 1B, 1A & 1B, Warrant 2 – Four Hour, Warrant 3 – Peak Hour, or Warrant 7 – Crash Experience (see Section 4.2 for crash estimates). Due to the change of adding additional lanes

on the minor street approaches, the volume thresholds are modified for the year of opening and full build out years. Due to this threshold change, Warrant 1 – 8 hour does not meet the volume requirements for any hours of the day. When compared to the year 2020 with a single lane minor street approach, the intersection met for 2 of the 8 required hours.

Under the 2026 Full Build condition traffic volumes, the study intersection of Highway 61 at 12nd Street still does not meet either the All-Way Stop warrant or the traffic signal volume thresholds for Warrants 1A, 1B, 1A & 1B, Warrant 2 – Four Hour, Warrant 3 – Peak Hour, or Warrant 7 – Crash Experience (see Section 4.2 for crash estimates).

Table 3 provides both the all-way stop warrant and the traffic signal warrant summary for the existing 2020 COVID-19 Adjusted volumes, 2022 year of opening conditions and 2026 Full Build out conditions. The full all-way stop warrant analysis and the traffic signal warrant analysis can be found in **Appendix B**.

Table 3 – Warrant Analysis Results

Traffic Year	Description	All Way Stop Warrant	Traffic Signal Warrants		
			8-Hour Warrant	4-Hour Warrant	Peak Hour Warrant
2020	Existing (raw count)	Not Met 0/8 Hours	Not Met 2/8 Hours	Not Met 0/4 Hours	Not Met 0/1 Hours
2022	Year of Opening	Not Met 2/8 Hours	Not Met 0/8 Hours	Not Met 0/4 Hours	Not Met 0/1 Hours
2026	Full Build	Not Met 2/8 Hours	Not Met 0/8 Hours	Not Met 0/4 Hours	Not Met 0/1 Hours
Notes: X/Y infers X hours met / Y hours required.					

While the intersection of Highway 61 at 152nd Street does not meet Warrant 1, 2, 3, or 7 there are other warrants outlined in the MnMUTCD that need to be considered.

Given the current proposal of constructing an elementary school at this intersection, emphasis should be given to Warrant 5 – School Crossing. This warrant is intended for application where the fact that school children cross the major street is the principal reason to consider installing a traffic control signal. This warrant states that there should be approximately 20 school children crossing the major roadway during the highest crossing hour. This would equate to approximately 4% of the students attempting to cross Highway 61 during the year of opening either in the hour before school starts or in the hour after school concludes.

Based upon the location of the school and the residential housing located across Highway 61 from the school site, the School District plans to provide busing to students living across Highway 61. Even with the School District providing busing, there will still be students attempting to cross Highway 61 both during school times as well as outside of the normal school day. The amenities that the new elementary school provides (fields, playgrounds, trails, etc.) serve as a pedestrian generator outside of the normal school day as well as during the summer months when school is not in session. Having traffic control installed whether it be traffic signal control or roundabout control at this intersection will help pedestrians cross this intersection in a more controlled environment when compared to the current side street stop-controlled intersection.

The current approximate intersection width is 60' and would be proposed to be increased due to the addition of dedicated left and right turn lanes for northbound and southbound Highway 61. A pedestrian crossing Highway 61 in its current state, at 3.5 feet per second, would need a gap in traffic of approximately 18 seconds to cross safely. Two-way traffic volumes along Highway 61 in this area are approximately 1,000 vehicles in the AM peak hour and 1,300 vehicles during school dismissal. This equates to approximately one vehicle every 4 seconds in the AM peak hour and one vehicle every 3 seconds in the school dismissal peak hour.

The unique characteristics surrounding this intersection, including serving as access to an elementary school, the site being a pedestrian generator outside of school hours, high speed roadway, limited gaps in traffic, and poor future traffic operations (shown in Section 4.9), justify the installation of traffic signal control.

4.2 Safety

Future crash estimates were developed for reference information on various traffic control options. Estimates were developed by applying existing and MnDOT statewide average (10-year) crash rates to the future projected traffic volumes for the study intersection of Highway 61 at 152nd Street. Intersection control can be warranted if there are five or more crashes in a 12-month period that are susceptible to correction through that control.

The following crash rates were utilized in this analysis:

- The existing crash rate is lower than the MnDOT average for urban thru/stop-controlled intersections with a crash rate of 0.05 crashes per million vehicles entering the intersection.
- The MnDOT statewide average crash rate for all-way stop controlled intersections is 0.35 crashes per million vehicles entering the intersection.
- Signalized intersection rates are based on the MnDOT statewide average crash rates for a high speed (>45 mph), low volume (<15,000 vph on highest volume leg) signalized intersections; the average crash rate is 0.45 crashes per million vehicles entering the intersection.
- Roundabout crash estimation was done using MnDOT's *A Study of the Traffic Safety at Roundabouts in Minnesota*. This study concluded that single lane roundabouts have a crash rate of 0.32 crashes per million vehicles entering the intersection.

Table 4 shows the projected number of total yearly crashes for each traffic control type analyzed for the projected 2022 and 2026 traffic conditions.

Table 4 – Projected 2022 and 2026 Annual Crash Frequency Estimates for Highway 61 and 152nd Street

Year		Annual Crash Estimates by Control Type			
	Urban Thru/ Stop[1]	Urban Thru/Stop[2]	All-Way Stop[2]	Traffic Signal[2]	Single Lane Roundabout[3]
2022	0.2	1.3	1.7	2.2	1.5
2026	0.3	1.4	1.8	2.4	1.7
	Notes:1: Based on Existing intersection crash rate. 2. Based on MnDOT Statewide average crash rates for control type (2005-2015 Data). 3: Based on MnDOT's A Study of the Traffic Safety at Roundabouts in Minnesota.				

The existing thru/stop-controlled intersection, with no changes to the intersection would have the lowest number of projected crashes among the different control alternatives. However, with the addition of another leg to this intersection, it can be expected that the thru/stop-controlled intersection would align more closely with MnDOT's statewide average rate.

A signalized intersection would have more projected crashes than all other conditions using MnDOT statewide average rates. A traffic signal typically has an increase in the number of rear end collisions as the major through traffic must stop when the minor approach has the green phase.

A roundabout controlled intersection would incur the second lowest number of crashes at the study intersection due to the single circulating lane. These crashes would typically be less severe than the other control types due to the reduced speeds approaching and departing the intersection. Roundabouts require a low travel speed through the intersection and eliminate left turn and crossing crashes. The vehicle trajectory through roundabouts helps soften the angle of potential collisions between vehicles.

In all cases the estimated number of future crashes do not warrant intersection control.

4.3 Traffic Operations

Traffic operations analyses were conducted to determine the level of service (LOS), delay, and queueing information for the AM, school dismissal, and PM peak hour conditions.

LOS is a qualitative rating system used to describe the efficiency of traffic operations at an intersection. Six LOS are defined, designated by letters A through F. LOS A represents the best operating conditions (no congestion), and LOS F represents the worst operating conditions (severe congestion). For the study intersection it was assumed that a LOS C or better, for all approaches and the overall intersection, represents acceptable operating conditions.

LOS for intersections is determined by the average control delay per vehicle. The range of control delay for each LOS is different for signalized and unsignalized intersections. The expectation is that a signalized intersection is designed to carry higher traffic volumes and will experience greater delays than an unsignalized intersection; driver tolerance for delay is greater at a signal than at a stop sign. Therefore, the LOS thresholds for each LOS category are lower for unsignalized intersections than for signalized intersections

Traffic operations analyses were performed using Synchro/SimTraffic software at the three study intersections. To evaluate roundabout control, additional analysis was conducted using the Highway Capacity Software (HCS 7); which is a faithful implementation of the Highway Capacity Manual calculations.

Based on the traffic data and field observations, the following three peak periods were evaluated:

- School AM Peak Hour: 8:30 to 9:30 AM
- School Dismissal (SD) Peak Hour: 3:15 to 4:15 PM
- PM Peak Hour: 4:30 to 5:30 PM

School traffic typically peaks in a short amount of time, 15 to 20 minutes. As this study was directed towards intersection improvements, a peak hour (60 minutes) was conducted to ensure improvements are not overbuilt based on short bursts of traffic. Hourly traffic was distributed over

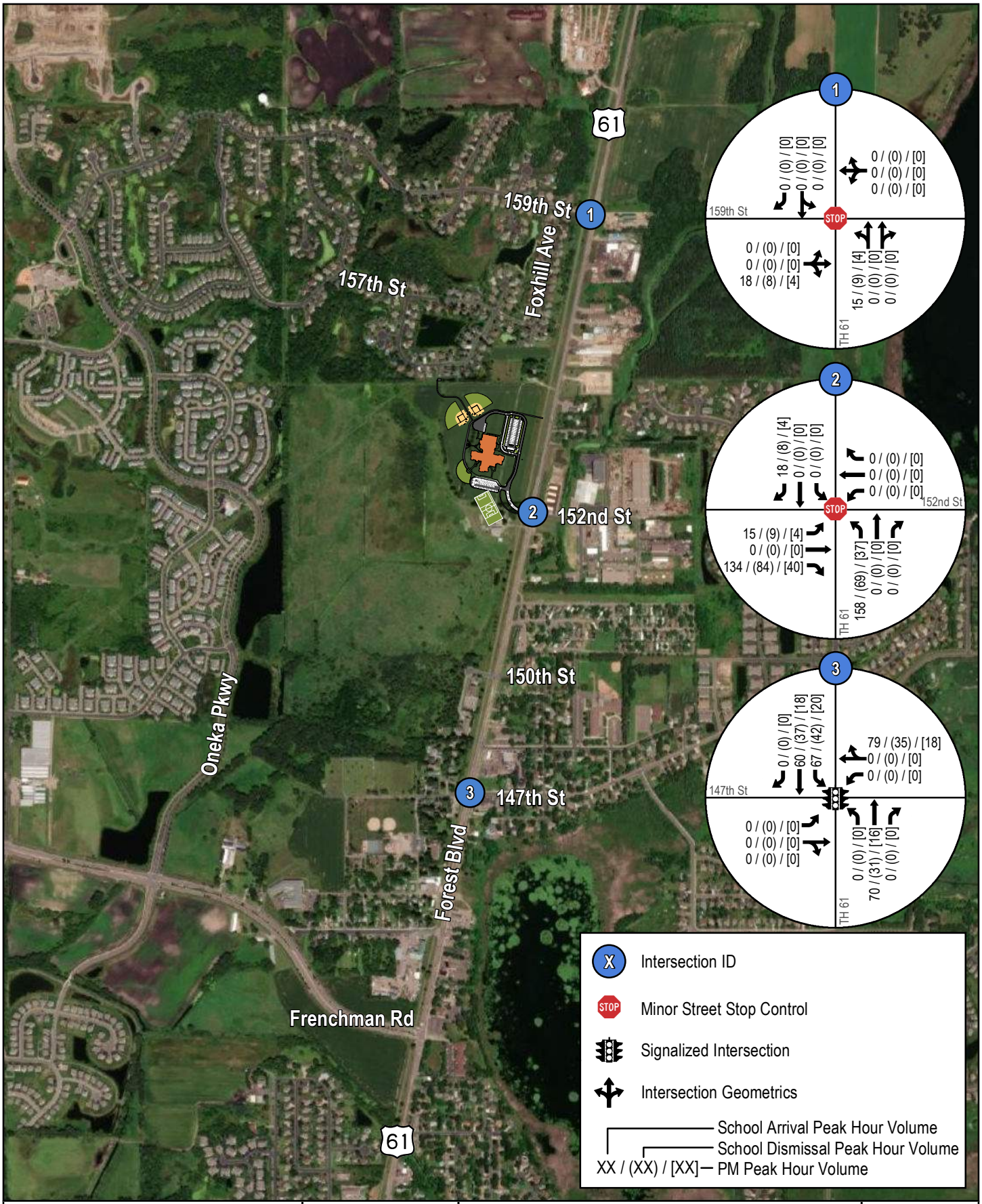
the school arrival and dismissal hour based upon previously collected turning movement count data from another school Traffic Impact Study completed in Minnesota.

As part of the bond referendum, White Bear Lake School District is also expanding its current North Campus High School and Central Middle School site located in White Bear Lake. The new high school is expected to serve all high school students grades 9 through 12 once it is complete. This will remove the two campus high school operations that the District currently utilizes. As part of this project, the District will be taking a closer look into modified start and end times for high school, middle school, and elementary school students. If the start times for the elementary school are modified and shifted to be more in line with either the AM or PM peak roadway hours, modifications will need to be made to the traffic signal timing in order to accommodate the change in traffic volumes if a traffic signal is chosen to be the traffic control alternative.

As is shown in the following sections, the roundabout operates acceptably throughout the future design year conditions and has additional capacity in order to accommodate additional traffic volumes should the start and end times change for the elementary school.

Figures 8, 10, and **12** show the 2022, 2026 and 2031 Build scenario traffic volumes, respectively.

The attached **Appendix C** includes all relevant operational tables and results for the existing, 2020, 2026 and 2031 scenarios that follow.



Path: X:\F:\N\SDWB\156183\5-final-dsgn\51-drawings\90-GIS\Figure 4 - 2022 Year of Opening School Traffic Distribution.mxd

SEH

Project: ISDWB 156183
Print Date: 10/31/2020

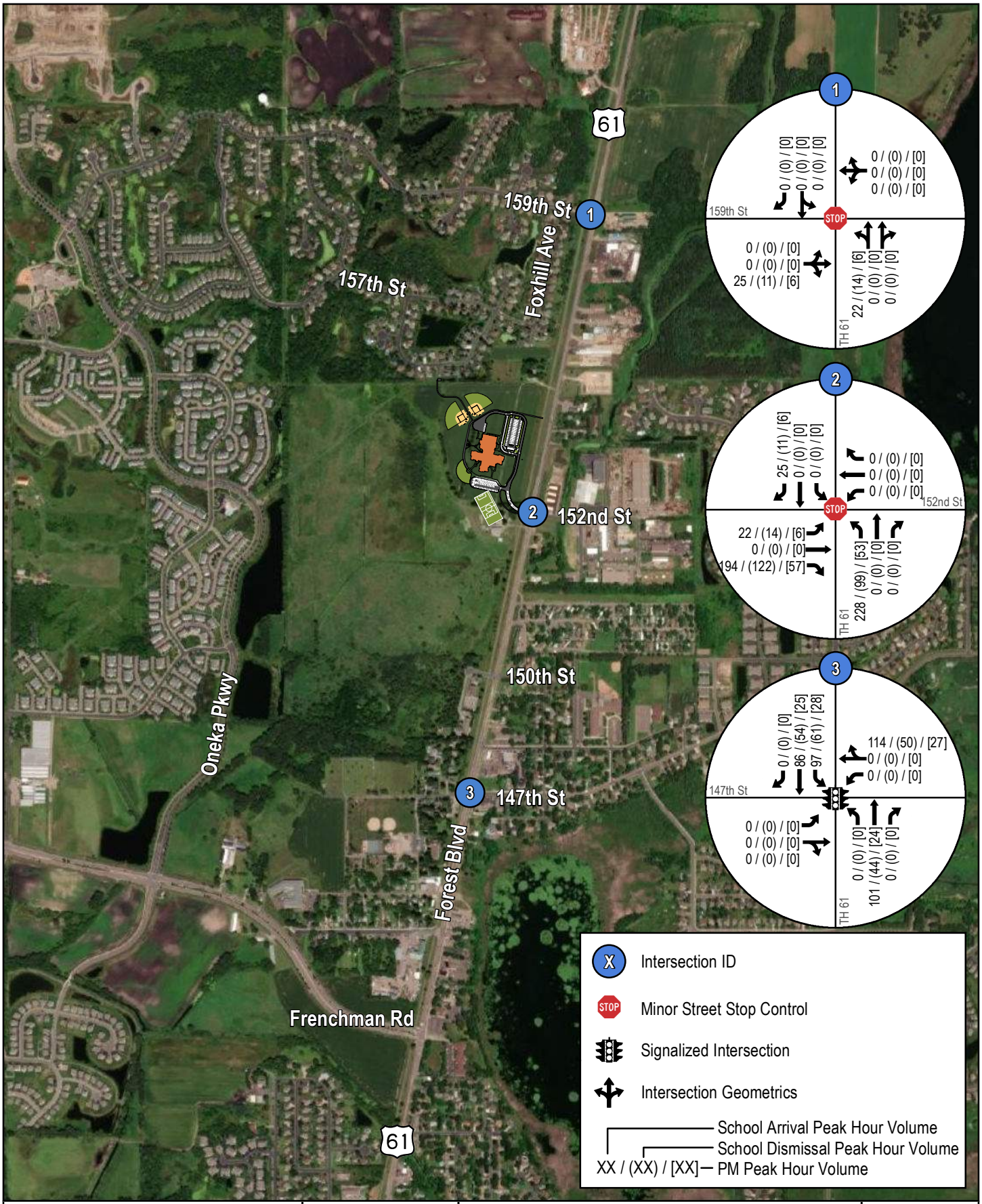
Map by: jdanibas
Projection: NAD 1983 HARN MN Washington
Source: ESRI

2022 Year of Opening School Traffic Distibution

White Bear Lake Elementary School

Hugo, MN

Figure 4



Path: X:\F:\N\SDWB\156183\5-final-dsgn\51-drawings\90-GIS\Figure 5 - 2026 Full Build School Traffic Distribution.mxd

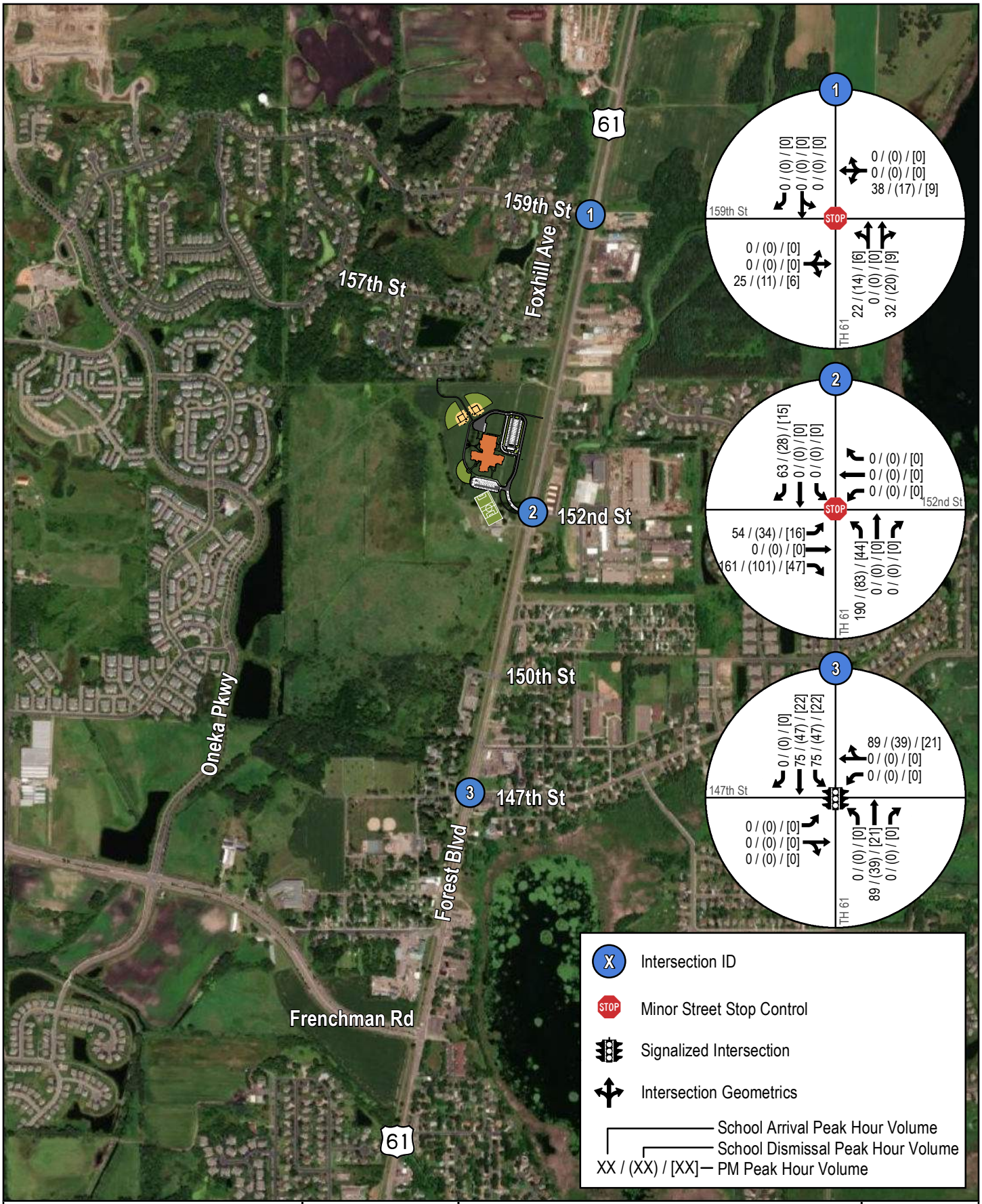
SEH

Project: ISDWB 156183
Print Date: 10/31/2020

Map by: jdanibas
Projection: NAD 1983 HARN MN Washington
Source: ESRI

2026 Full Build
School Traffic Distibution
White Bear Lake Elementary School
Hugo, MN

Figure 5



Path: X:\F:\N\SDWB\156183\5-final-dsgn\51-drawings\90-GIS\Figure 6 - 2031 Future Build School Traffic Distribution.mxd

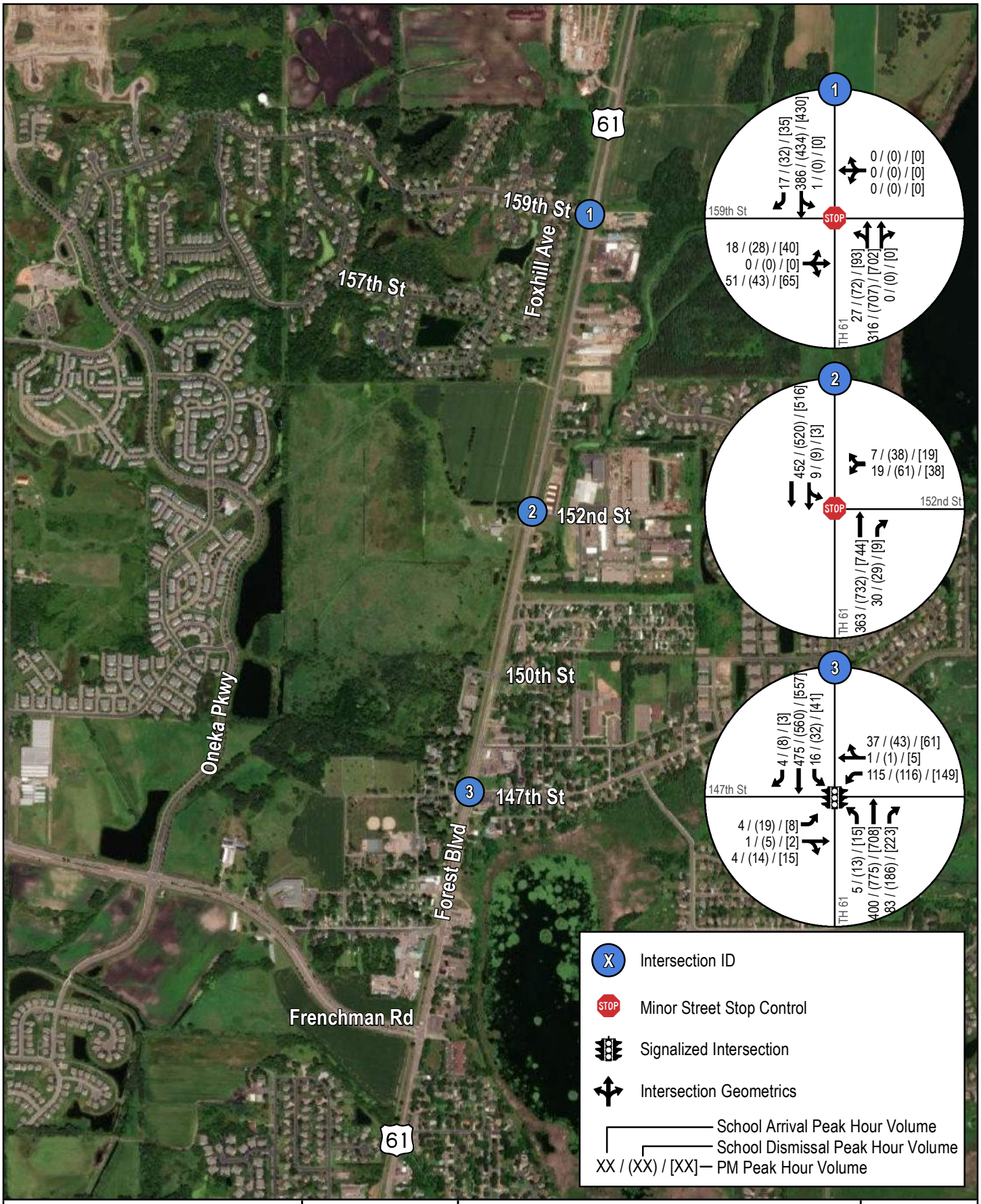
SEH

Project: ISDWB 156183
Print Date: 10/31/2020

Map by: jdanibas
Projection: NAD 1983 HARN MN Washington
Source: ESRI

2031 Future Build
School Traffic Distibution
White Bear Lake Elementary School
Hugo, MN

Figure 6



Path: X:\F\I\ISDWB\156183\5-final-dsgn\51-drawings\90-GIS\Figure 7 - 2022 No Build Conditions.mxd

SEH

Project: ISDWB 156183
Print Date: 10/31/2020

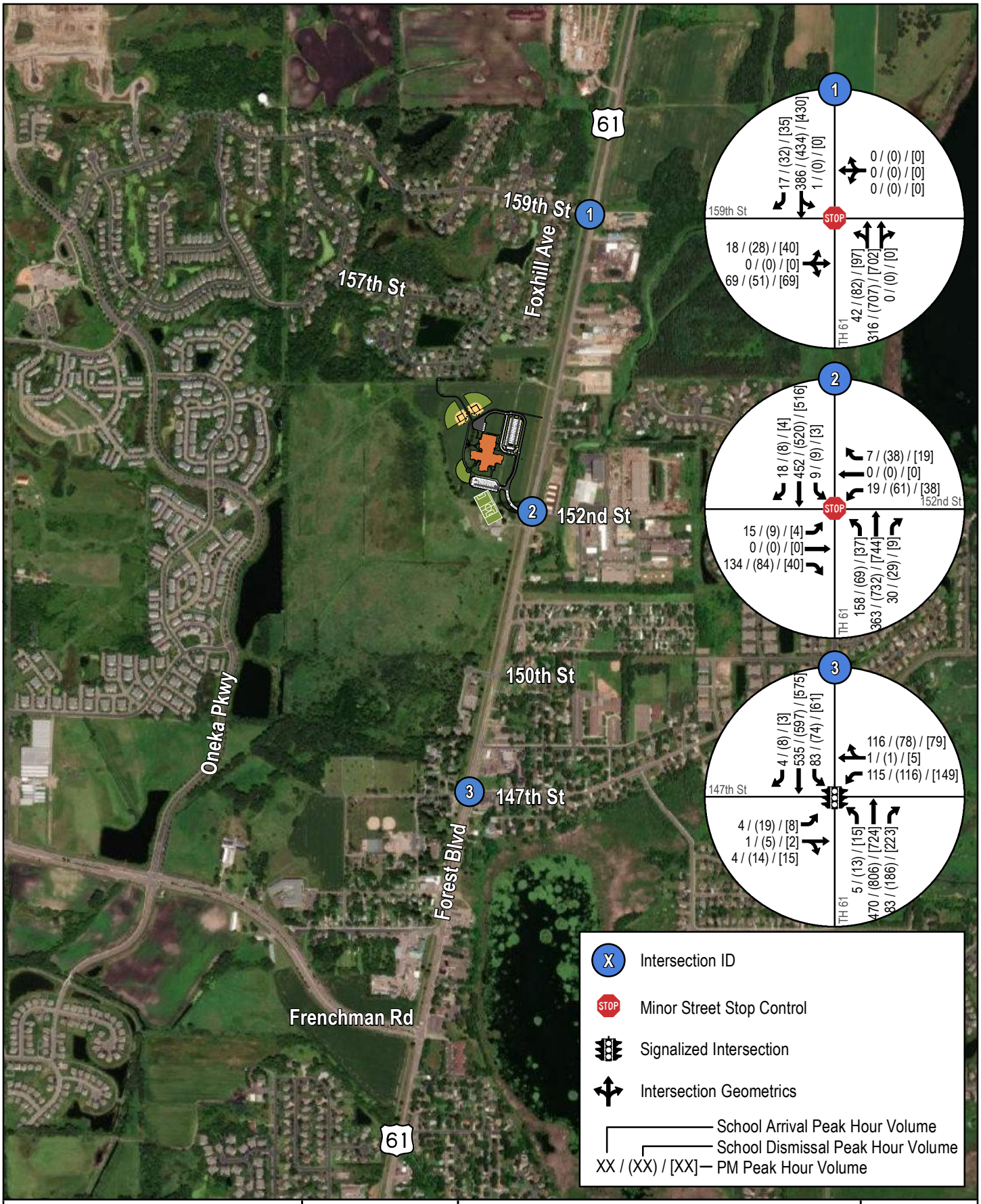
Map by: jdanibas
Projection: NAD 1983 HARN MN Washington
Source: ESRI

2022 No Build Conditions

White Bear Lake Elementary School

Hugo, MN

Figure 7



Path: X:\F:\IN\SDWB\156183\15-final-dsgn\51-drawings\90-GIS\Figure 8 - 2022 Build Conditions.mxd

SEH

Project: ISDWB 156183
Print Date: 12/8/2020

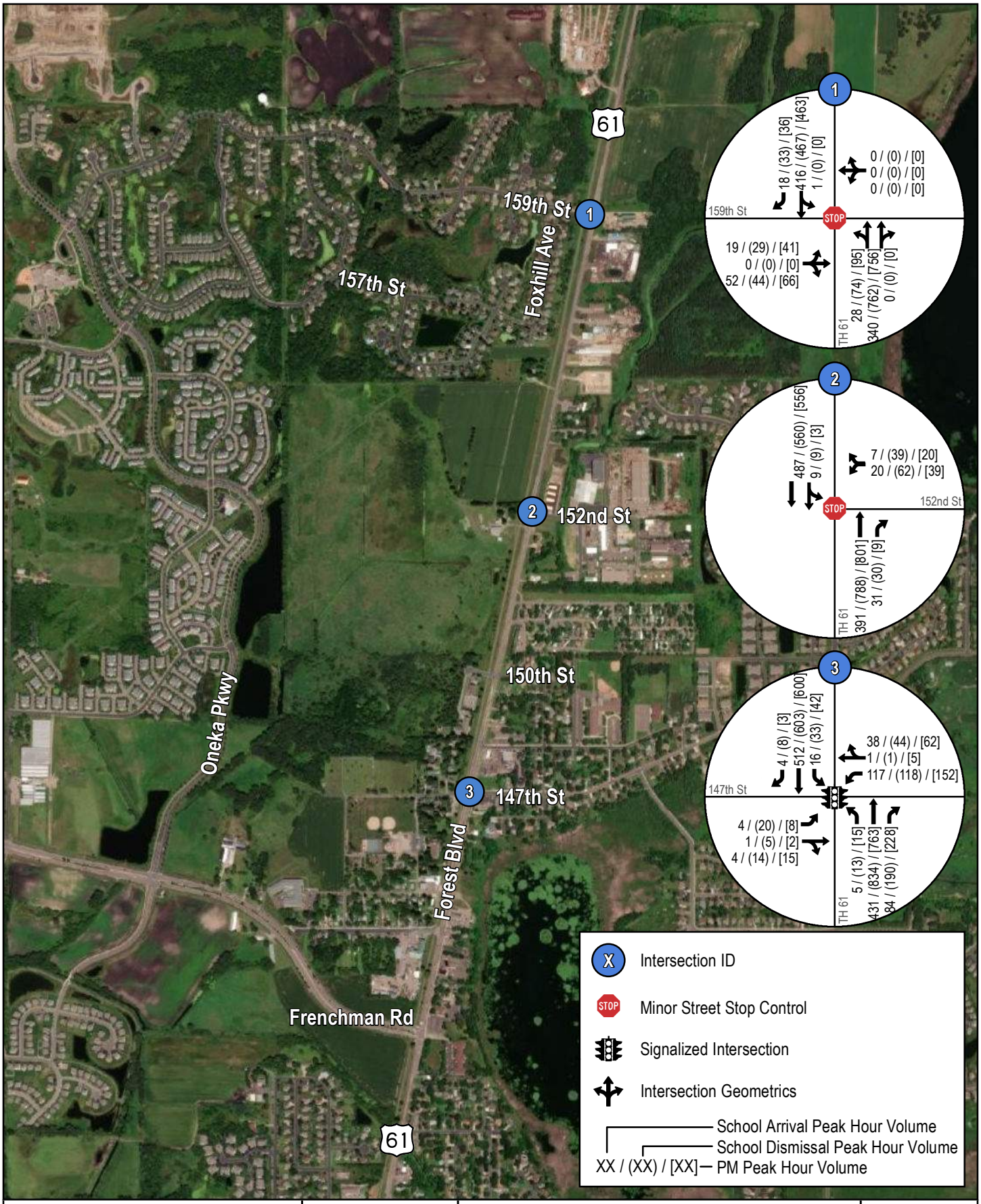
Map by: jdanibas
Projection: NAD 1983 HARN MN Washington
Source: ESRI

2022 Build Conditions

White Bear Lake Elementary School

Hugo, MN

Figure 8



Path: X:\F:\I\ISDWB\156183\15-final-dsgn\51-drawings\90-GIS\Figure 9 - 2026 No Build Conditions.mxd

SEH

Project: ISDWB 156183
Print Date: 10/31/2020

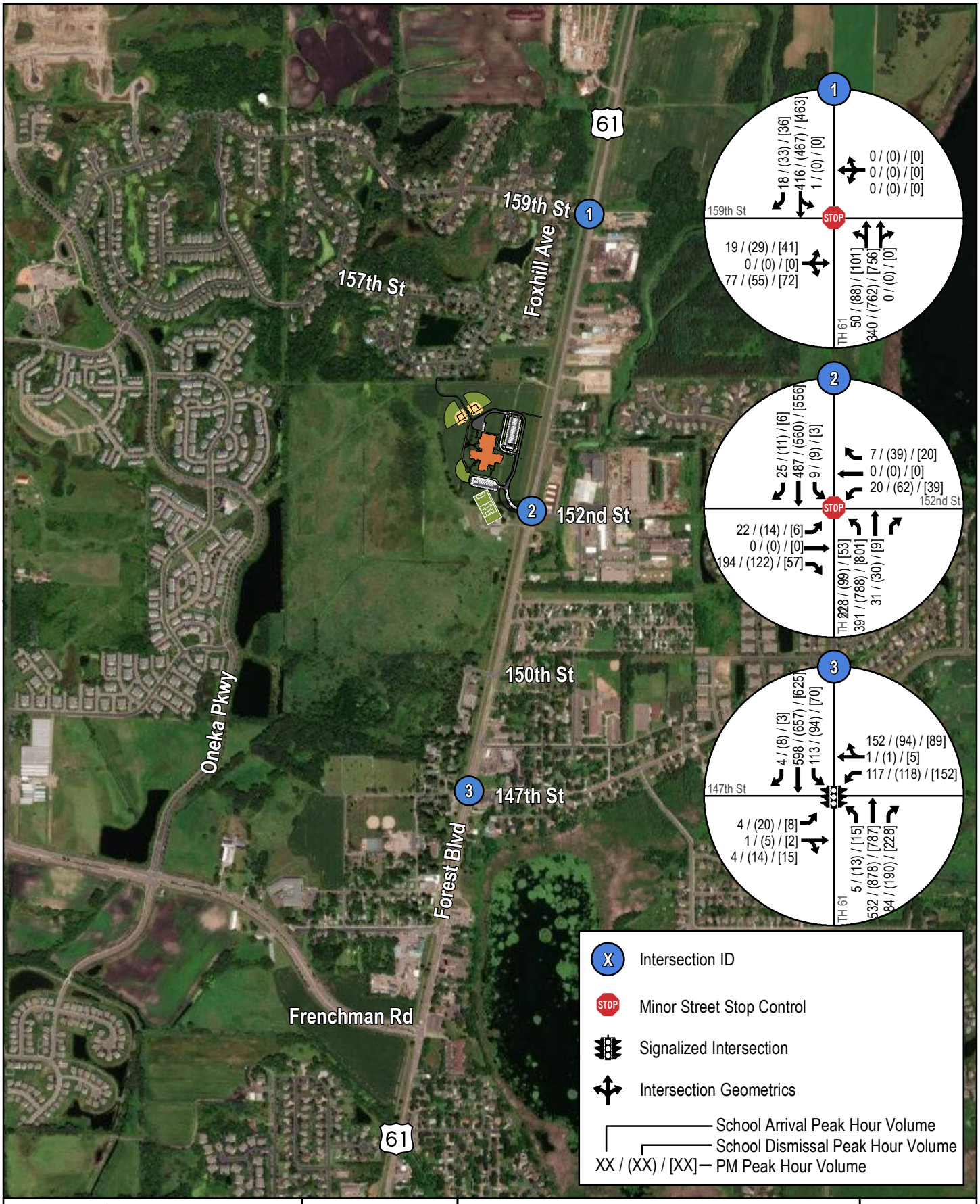
Map by: jdanibas
Projection: NAD 1983 HARN MN Washington
Source: ESRI

2026 No Build Conditions

White Bear Lake Elementary School

Hugo, MN

Figure 9



Path: X:\F:\IN\SDWB\156183\15-final-dsgn\51-drawings\90-GIS\Figure 10 - 2026 Build Conditions.mxd

SEH

Project: ISDWB 156183
Print Date: 10/31/2020

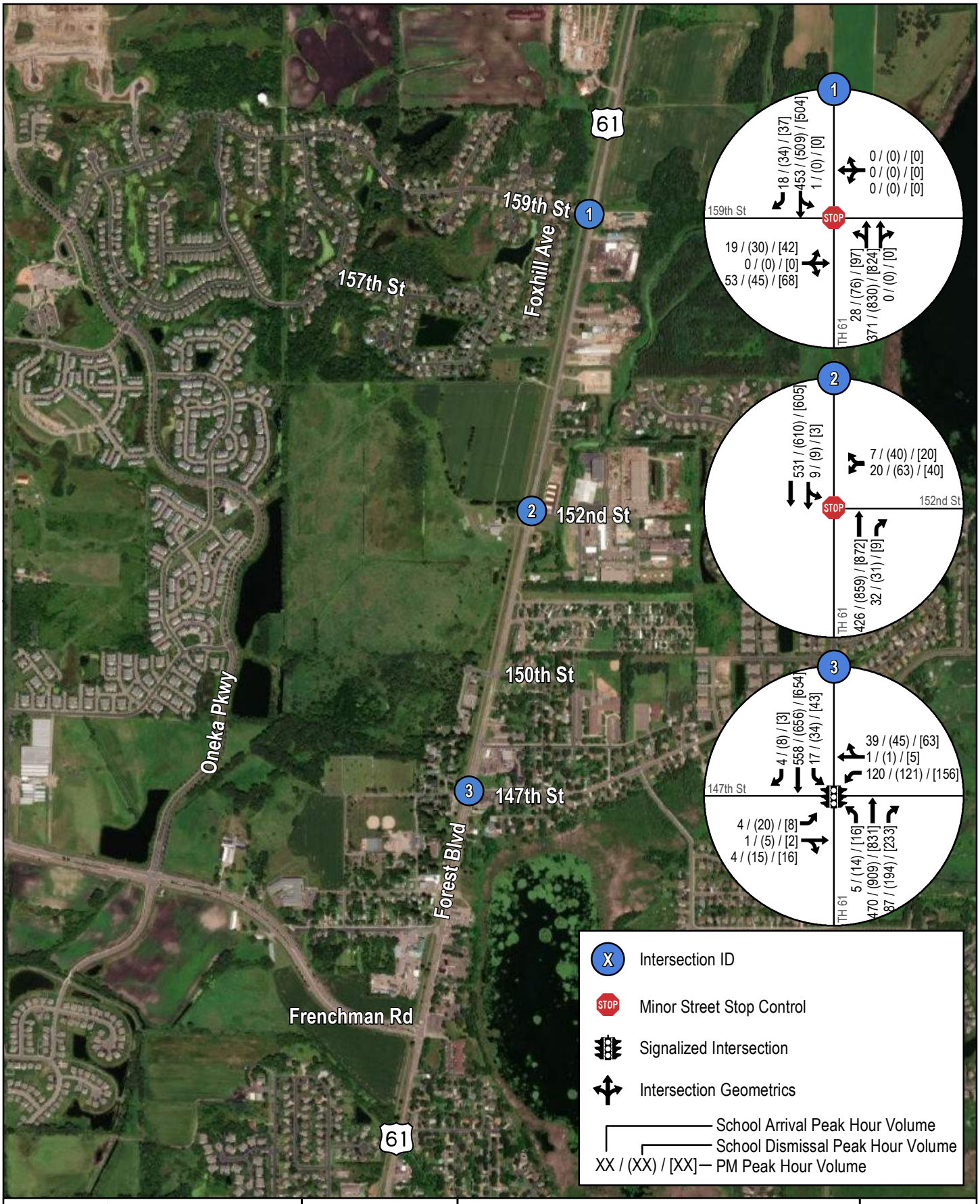
Map by: jdanibas
Projection: NAD 1983 HARN MN Washington
Source: ESRI

2026 Build Conditions

White Bear Lake Elementary School

Hugo, MN

Figure 10



Path: X:\F:\I\ISDWB\156183\15-final-dsgn\51-drawings\90-GIS\Figure 11 - 2031 No Build Conditions.mxd

SEH

Project: ISDWB 156183
Print Date: 10/31/2020

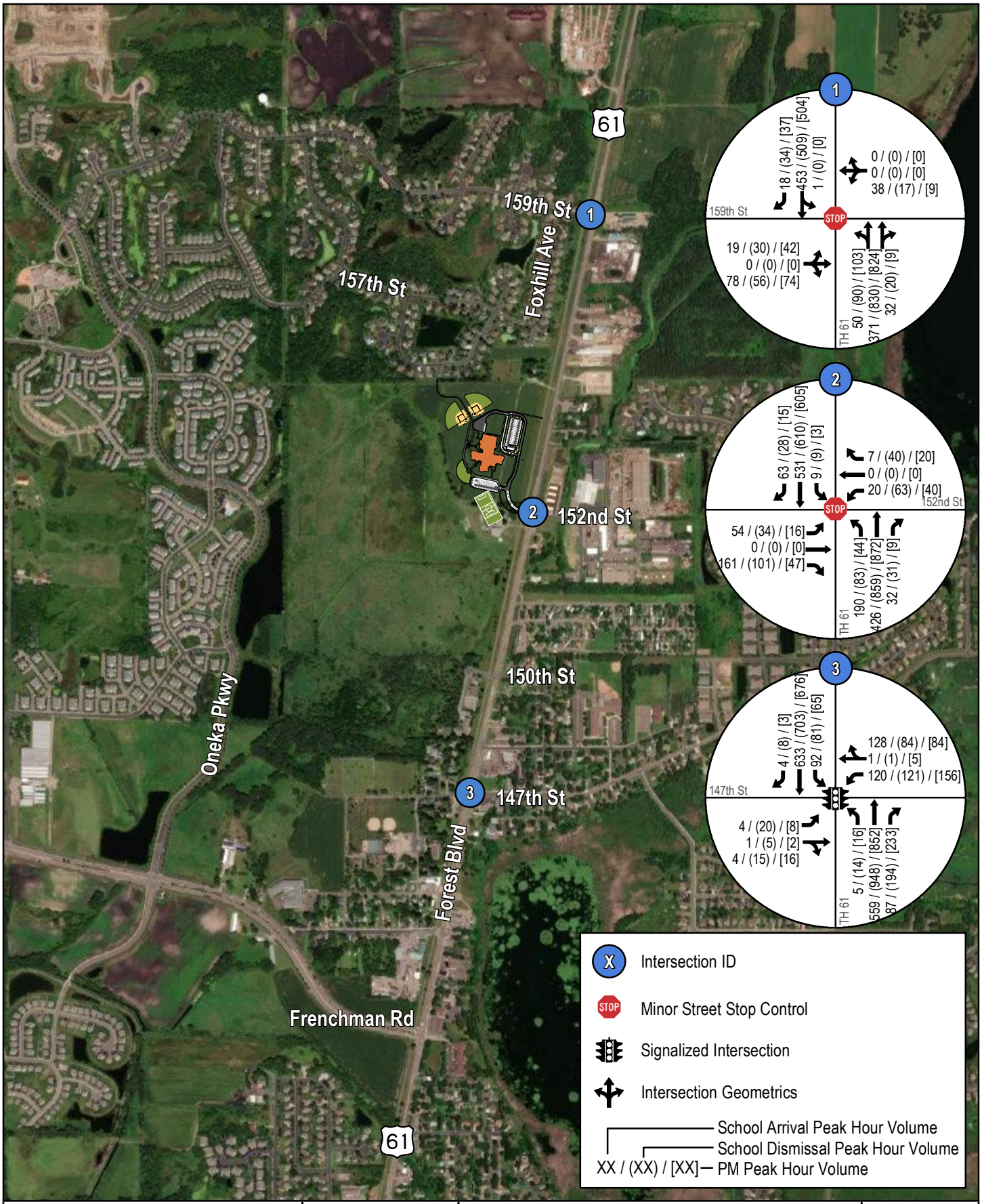
Map by: jdanibas
Projection: NAD 1983 HARN MN Washington
Source: ESRI

2031 No Build Conditions

White Bear Lake Elementary School

Hugo, MN

Figure 11



Path: X:\F:\IN\SDWB\156183\5-final-dsgn\51-drawings\90-GIS\Figure 12 - 2031 Build Conditions.mxd

SEH

Project: ISDWB 156183
Print Date: 10/31/2020

Map by: jdanibas
Projection: NAD 1983 HARN MN Washington
Source: ESRI

2031 Build Conditions

White Bear Lake Elementary School

Hugo, MN

Figure 12

4.4 Existing 2020 Conditions

The existing conditions traffic model was developed based on the existing base volumes that have been adjusted for impacts due to school not being in session when traffic counts were taken, and impacts caused by the coronavirus.

Overall, most intersections operate under acceptable conditions in each peak hour. In all three peak periods all study intersections operate at a LOS B or better with no queuing issues that present themselves. During the school dismissal and PM peak hours, longer delays are present for the 147th Street approaches to Highway 61. This is a function of the longer cycle times that are currently in place during this time of day and not caused by the current traffic demands on those approaches.

Table 5 shows the approach LOS and total intersection LOS for all study intersections during the 2020 AM peak, school dismissal peak, and PM peak hours. More detailed results are shown in **Table A1** in **Appendix C.**

Table 5 – Existing 2020 Traffic Operations (Synchro)

Peak Hour	Intersection:	Approach	Delay (s/veh)				
			Left	Thru	Right	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)
School Arrival Peak Hour	Highway 61 at 159th Street	EB	8.6 / A		4.1 / A	5.4 / A	1.2 / A
		NB	1.7 / A	1.0 / A		1.1 / A	
		SB	1.4 / A	0.6 / A	0.0 / A	0.6 / A	
	Highway 61 at 152nd Street	WB	8.4 / A		2.8 / A	6.8 / A	0.6 / A
		NB		0.5 / A	0.0 / A	0.5 / A	
		SB	1.6 / A	0.4 / A		0.4 / A	
	Highway 61 at 147th Street (Signal)	EB	35.5 / D	38.6 / D	5.0 / A	20.6 / C	7.7 / A
		WB	33.3 / C	50.2 / D	5.5 / A	26.4 / C	
		NB	6.6 / A	5.7 / A	1.8 / A	5.0 / A	
		SB	5.6 / A	4.2 / A	0.9 / A	4.2 / A	
School Dismissal Peak Hour	Highway 61 at 159th Street	EB	16.0 / C		6.5 / A	10.4 / B	2.2 / A
		NB	2.9 / A	2.4 / A		2.4 / A	
		SB		0.7 / A	0.0 / A	0.6 / A	
	Highway 61 at 152nd Street	WB	21.2 / C		11.5 / B	17.3 / C	2.2 / A
		NB		1.0 / A	0.1 / A	1.0 / A	
		SB	3.9 / A	0.8 / A		0.9 / A	
	Highway 61 at 147th Street (Signal)	EB	**56.1 / E**	54.6 / D	8.5 / A	40.4 / D	9.1 / A
		WB	**64.1 / E**	46.7 / D	11.3 / B	49.1 / D	
		NB	6.3 / A	4.4 / A	2.2 / A	4.0 / A	
		SB	12.0 / B	3.8 / A	0.8 / A	4.1 / A	
PM Peak Hour	Highway 61 at 159th Street	EB	21.7 / C		9.3 / A	14.0 / B	3.2 / A
		NB	3.2 / A	3.1 / A		3.1 / A	
		SB		0.8 / A	0.0 / A	0.7 / A	
	Highway 61 at 152nd Street	WB	15.1 / C		8.4 / A	12.9 / B	1.2 / A
		NB		0.8 / A	0.0 / A	0.8 / A	
		SB	4.0 / A	0.5 / A		0.5 / A	
	Highway 61 at 147th Street (Signal)	EB	**70.0 / E**	52.9 / D	8.2 / A	28.4 / C	11.3 / B
		WB	**72.0 / E**	51.1 / D	13.4 / B	**55.1 / E**	
		NB	6.9 / A	4.6 / A	2.3 / A	4.1 / A	
		SB	12.1 / B	5 / A	1.3 / A	5.5 / A	

4.5 2022 No Build Conditions

The 2022 No Build Conditions scenario includes the existing 2020 traffic counts with background growth applied to the turning movement counts.

Under this scenario, all intersections operate like the existing conditions with all study intersections operating at a LOS B or better. No queuing issues present themselves during this

scenario. Longer delays are present for the side streets at the intersection of Highway 61 and 147th Street during the school dismissal and PM peak hours.

Table 6 shows the approach LOS and total intersection LOS for all study intersections during the 2022 No build AM peak, school dismissal peak, and PM peak hours. More detailed results are shown in **Table A2** in **Appendix C.**

Table 6 – 2022 No Build Traffic Operations (Synchro)

Peak Hour	Intersection:	Approach	Delay (s/veh)				
			Left	Thru	Right	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)
School Arrival Peak Hour	Highway 61 at 159th Street	EB	8.0 / A		3.9 / A	4.9 / A	1.2 / A
		NB	1.7 / A	1.0 / A		1.1 / A	
		SB	1.1 / A	0.6 / A	0.0 / A	0.6 / A	
	Highway 61 at 152nd Street	WB	9.1 / A		3.9 / A	7.6 / A	0.7 / A
		NB		0.5 / A	0.0 / A	0.5 / A	
		SB	1.8 / A	0.5 / A		0.5 / A	
	Highway 61 at 147th Street (Signal)	EB	29.8 / C	21.8 / C	6.4 / A	18.5 / B	7.8 / A
		WB	34.5 / C	18.7 / B	5.4 / A	27.2 / C	
		NB	6.3 / A	5.6 / A	1.7 / A	4.9 / A	
		SB	6.9 / A	4.3 / A	0.7 / A	4.4 / A	
School Dismissal Peak Hour	Highway 61 at 159th Street	EB	16.5 / C		6.3 / A	10.4 / B	2.2 / A
		NB	2.9 / A	2.3 / A		2.4 / A	
		SB		0.7 / A	0.0 / A	0.7 / A	
	Highway 61 at 152nd Street	WB	23.9 / C		13 / B	20.0 / C	2.3 / A
		NB		1.0 / A	0.0 / A	1.0 / A	
		SB	5.2 / A	0.8 / A		0.9 / A	
	Highway 61 at 147th Street (Signal)	EB	**59.0 / E**	47.8 / D	10.7 / B	38.7 / D	9.1 / A
		WB	**64.6 / E**	**79.1 / E**	12.2 / B	50.3 / D	
		NB	6.7 / A	4.6 / A	2.2 / A	4.2 / A	
		SB	10.3 / B	4.3 / A	0.5 / A	4.6 / A	
PM Peak Hour	Highway 61 at 159th Street	EB	28.7 / D		14.0 / B	19.4 / C	3.7 / A
		NB	3.7 / A	3.5 / A		3.5 / A	
		SB		0.8 / A	0.1 / A	0.7 / A	
	Highway 61 at 152nd Street	WB	18.0 / C		9.8 / A	15.3 / C	1.4 / A
		NB		0.9 / A	0.0 / A	0.9 / A	
		SB	2.7 / A	0.5 / A		0.5 / A	
	Highway 61 at 147th Street (Signal)	EB	**58.9 / E**	53.6 / D	5.7 / A	25.2 / C	11.8 / B
		WB	**73.2 / E**	**61.1 / E**	13.4 / B	**55.9 / E**	
		NB	5.8 / A	5.1 / A	2.3 / A	4.5 / A	
		SB	13.6 / B	6.3 / A	1.0 / A	6.8 / A	

4.6 2022 Year of Opening Conditions

Under this scenario, the elementary school is present and accesses Highway 61 at 152nd Street from the west leg of the intersection. As part of this scenario, geometric improvements to the intersection of Highway 61 and 152nd Street were implemented. These improvements include the following:

- Northbound and southbound dedicated left and right turn lanes
- Dedicated left, through and right turn lanes for the school driveway
- Dedicated left, through and right turn lanes lane for the westbound 152nd Street approach

Overall, during the AM peak hour all intersections operate acceptably with all study intersections operating at a LOS A. Longer delays are present for the eastbound and westbound left turning movements at 152nd Street with both movements having approximately 30 seconds of delay per vehicle.

During the school dismissal time period, operations degrade at the intersection of Highway 61 and 152nd for the minor street approaches. Longer delays are present for the eastbound and westbound left turning movements, with the westbound left movement operating at a LOS F with 109.4 seconds of delay per vehicle and the eastbound left movement operating at LOS E with 37.3 seconds of delay. As delays increase on the side streets, motorists may start to select riskier gaps in order to enter the mainline traffic stream. This results in a possible decrease in safety at this intersection.

The PM Peak hour has operations that improve at the intersection of Highway 61 and 152nd Street. With less demand on the side streets during this time period, the eastbound left turning movement operates at a LOS C and the westbound left turning movement operates at a LOS D.

Table 7 shows the approach LOS and total intersection LOS for all study intersections during the 2022 Year of Opening AM peak, school dismissal peak, and PM peak hours. More detailed results are shown in **Table A3** in **Appendix C.**

Table 7 – 2022 Year of Opening Traffic Operations (Synchro)

Peak Hour	Intersection:	Approach	Delay (s/veh)				
			Left	Thru	Right	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)
School Arrival Peak Hour	Highway 61 at 159th Street	EB	8.7 / A		4.1 / A	4.9 / A	1.3 / A
		NB	2.0 / A	1.0 / A		1.1 / A	
		SB	0.7 / A	0.7 / A	0.0 / A	0.7 / A	
	Highway 61 at 152nd Street	EB	32.8 / D		8.2 / A	10.7 / B	3.9 / A
		WB	26.2 / D		4.2 / A	19.4 / C	
		NB	7.2 / A	1.0 / A	0.2 / A	2.7 / A	
		SB	2.8 / A	2.4 / A	0.7 / A	2.3 / A	
	Highway 61 at 147th Street (Signal)	EB	25.7 / C	28.1 / C	6.1 / A	17.2 / B	8.3 / A
		WB	31.9 / C	19.1 / B	8.2 / A	20.4 / C	
		NB	6.9 / A	6.0 / A	1.9 / A	5.4 / A	
		SB	9.3 / A	5.9 / A	2.1 / A	6.3 / A	
School Dismissal Peak Hour	Highway 61 at 159th Street	EB	18.7 / C		7.1 / A	11.5 / B	2.5 / A
		NB	3.0 / A	2.6 / A		2.6 / A	
		SB		0.8 / A	0.1 / A	0.7 / A	
	Highway 61 at 152nd Street	EB	**37.3 / E**		14.4 / B	16.2 / C	7.4 / A
		WB	**109.4 / F**		20.7 / C	**74.5 / F**	
		NB	4.6 / A	1.6 / A	0.4 / A	1.8 / A	
		SB	5.6 / A	2.6 / A	0.4 / A	2.6 / A	
	Highway 61 at 147th Street (Signal)	EB	**55.9 / E**	45.2 / D	11.5 / B	38.1 / D	10.6 / B
		WB	**69.0 / E**	**71.9 / E**	14.1 / B	46.8 / D	
		NB	6.4 / A	5.8 / A	2.5 / A	5.2 / A	
		SB	15.3 / B	5.8 / A	1.8 / A	6.8 / A	
PM Peak Hour	Highway 61 at 159th Street	EB	21.2 / C		7.9 / A	12.9 / B	3.3 / A
		NB	4.0 / A	3.4 / A		3.5 / A	
		SB		0.9 / A	0.0 / A	0.8 / A	
	Highway 61 at 152nd Street	EB	24.8 / C		5.9 / A	6.8 / A	2.7 / A
		WB	30.2 / D		7.2 / A	21.5 / C	
		NB	3.3 / A	1.4 / A	0.3 / A	1.5 / A	
		SB	4.3 / A	2.0 / A	0.8 / A	2.0 / A	
	Highway 61 at 147th Street (Signal)	EB	**59.7 / E**	**89.4 / F**	7.6 / A	27.9 / C	11.6 / B
		WB	**66.7 / E**	**51.8 / D**	16.0 / B	48.9 / D	
		NB	8.2 / A	4.8 / A	2.4 / A	4.3 / A	
		SB	15.1 / B	6.9 / A	2.9 / A	7.7 / A	

4.7 2022 Year of Opening Conditions with Mitigations

Based upon the warrant analysis results for a school crossing at the intersection of Highway 61 at 152nd Street, further investigation of intersection improvements was needed in addition to the geometric improvements made in the previous scenario. The following are different traffic control alternatives that were analyzed.

4.7.1 Traffic Signal Control at Highway 61 and 152nd Street

Traffic signal control was added at the intersection of Highway 61 and 152nd Street. As part of this improvement, a dedicated left, thru, and right turn lane was provided for the westbound 152nd approach.

The cycle lengths for each peak period were matched to the existing signal timing that is in place today at adjacent intersections. Based upon MnDOT guidance for flashing yellow arrow operation, northbound protected only phasing was recommended during the school arrival time period based upon the number of northbound left turns entering the site versus the number of opposing southbound through vehicles and the speed limit of Highway 61. Therefore, both northbound and southbound left turning movements were modeled with protected only left turn phasing during the School Arrival time period.

During the School Dismissal peak hour, MnDOT guidance recommends protected-permissive phasing for northbound Highway 61 and therefore both northbound and southbound approaches were modeled with this phasing.

During all peak hours permissive (flashing yellow arrow) phasing was used for the eastbound and westbound approaches.

Traffic signal control at this intersection fits in the context of the larger Highway 61 corridor and would be able to be coordinated with other surrounding signals in the area.

With Highway 61 under traffic signal control, operations for the side streets improve and delays decrease during the peak school dismissal time period and slightly increase during the AM and PM peak hours. As was previously mentioned, although delays may be slightly higher during the AM and PM peak hours, driver tolerance for delay is greater at a traffic signal than at a stop-controlled intersection. Left turning movements at each of the two signalized study intersections during this scenario experience longer delays which are ultimately as a result of longer cycle lengths and more green time allocated to the mainline.

Table 8 shows the approach LOS and total intersection LOS for all study intersections during the 2022 Year of Opening AM peak, school dismissal peak, and PM peak hours with traffic signal control at 152nd Street. More detailed results are shown in **Table A4** in **Appendix C.**

Table 8 – 2022 Year of Opening Traffic Operations with Traffic Signal Control at 152nd Street (Synchro)

Peak Hour	Intersection:	Approach	Delay (s/veh)				
			Left	Thru	Right	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)
School Arrival Peak Hour	Highway 61 at 159th Street	EB	8.4 / A		4.1 / A	4.8 / A	1.4 / A
		NB	2.1 / A	1.1 / A		1.2 / A	
		SB	0.7 / A	0.8 / A	0.0 / A	0.8 / A	
	Highway 61 at 152nd Street (Signal)	EB	34.7 / C		9.3 / A	11.7 / B	11.6 / B
		WB	36.9 / D		4.5 / A	26.8 / C	
		NB	39.6 / D	2.6 / A	0.6 / A	12.8 / B	
		SB	7.6 / A	9.5 / A	2.7 / A	9.2 / A	
	Highway 61 at 147th Street (Signal)	EB	34.3 / C	32.1 / C	5.9 / A	21.0 / C	7.7 / A
		WB	32.5 / C	21.8 / C	8.5 / A	20.8 / C	
		NB	8.5 / A	5.4 / A	2.0 / A	4.9 / A	
		SB	9.7 / A	4.6 / A	2.3 / A	5.2 / A	
School Dismissal Peak Hour	Highway 61 at 159th Street	EB	16.8 / C		6.6 / A	10.2 / B	2.4 / A
		NB	3.2 / A	2.5 / A		2.6 / A	
		SB		0.8 / A	0.0 / A	0.7 / A	
	Highway 61 at 152nd Street (Signal)	EB	48.9 / D		8.9 / A	13.0 / B	8.1 / A
		WB	**77.5 / E**		13.3 / B	52.1 / D	
		NB	7.5 / A	4.2 / A	0.8 / A	4.3 / A	
		SB	9.6 / A	5.3 / A	1.5 / A	5.3 / A	
	Highway 61 at 147th Street (Signal)	EB	**55.5 / E**	48.1 / D	8.3 / A	36.1 / D	10.5 / B
		WB	**64.0 / E**	46.4 / D	13.7 / B	43.4 / D	
		NB	7.7 / A	6.2 / A	2.5 / A	5.6 / A	
		SB	15.7 / B	6.1 / A	2.7 / A	7.1 / A	
PM Peak Hour	Highway 61 at 159th Street	EB	22.2 / C		8.9 / A	14.0 / B	3.4 / A
		NB	3.7 / A	3.4 / A		3.4 / A	
		SB		0.9 / A	0.0 / A	0.8 / A	
	Highway 61 at 152nd Street (Signal)	EB	**60.3 / E**		6.3 / A	10.1 / B	4.7 / A
		WB	**67.8 / E**		8.9 / A	49.5 / D	
		NB	4.2 / A	1.7 / A	0.4 / A	1.8 / A	
		SB	5.8 / A	3.4 / A	0.7 / A	3.4 / A	
	Highway 61 at 147th Street (Signal)	EB	**63.9 / E**	**58.6 / E**	10.2 / B	31.7 / C	14.5 / B
		WB	**80.4 / F**	**61.3 / E**	15.5 / B	**57.4 / E**	
		NB	7.7 / A	5.2 / A	2.5 / A	4.6 / A	
		SB	15.5 / B	12.8 / B	5.6 / A	13.0 / B	

4.7.1.1 Modified Traffic Signal Control Highway 61 and 152nd Street

In order to understand the traffic signal operations under the most restrictive conditions, traffic signal operational adjustments were analyzed. These adjustments, summarized below, may help improve pedestrian and bicycle safety at the intersection.

The eastbound and westbound 152nd Street approaches were modified to include a dedicated left turn lane and a shared through-right turn lane. This geometric modification shortens the pedestrian crossing distance for non-motorized users along the Hardwood Creek Trail and in addition there is anticipated to be little to no through traffic traveling across Highway 61.

Protected only left turns for all approaches at the intersection of Highway 61 and 152nd Street as well as prohibiting all right turns on red were modeled in order to see the impacts they may have on traffic operations should they be implemented at this intersection.

During the school arrival peak hour, all intersections operate at a LOS C or better. The intersection of Highway 61 and 152nd has longer delays for all protected left turn movements. In addition, the eastbound right turn exiting the school site now operates at a LOS E due to the restriction of right turning vehicles on a red indication. The maximum queue reported for this movement is 276 feet.

Similar operations were reported for the school dismissal peak hour. All left turning movements at the intersection of Highway 61 and 152nd Street operate at a LOS E and the eastbound right turning movement exiting the school also operates at a LOS E. The maximum reported eastbound queue length is 210 feet.

During the PM peak hour, left turning movements at the intersection of Highway 61 and 152nd Street operate with longer delays. The eastbound left turn, serving 4 vehicles, operates at a LOS F during this peak hour. This is primarily due to the longer cycle lengths that are in place along Highway 61. The eastbound right turning movement serving 40 vehicles operates at a LOS E and has a maximum queue length of 104 feet.

Table 9 shows the approach LOS and total intersection LOS for all study intersections during the 2022 Year of Opening AM peak, school dismissal peak, and PM peak hours with traffic signal control modifications at 152nd Street. More detailed results are shown in **Table A11** in **Appendix C.**

Table 9 – 2022 Year of Opening Traffic Operations with Modified Traffic Signal Control at 152nd Street (Synchro)

Peak Hour	Intersection:	Approach	Delay (s/veh)				
			Left	Thru	Right	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)
School Arrival Peak Hour	Highway 61 at 159th Street	EB	8.4 / A		4.1 / A	4.9 / A	1.4 / A
		NB	2.4 / A	1.1 / A		1.2 / A	
		SB	1.0 / A	0.8 / A	0.0 / A	0.8 / A	
	Highway 61 at 152nd Street (Signal)	EB	**59.2 / E**		**66.1 / E**	**65.4 / E**	20.1 / C
		WB	40.5 / D		29.6 / C	37.1 / D	
		NB	32.5 / C	6.1 / A	4.3 / A	13.2 / B	
		SB	38.8 / D	13.2 / B	9.7 / A	13.4 / B	
	Highway 61 at 147th Street (Signal)	EB	24.4 / C	30.7 / C	7.1 / A	17.7 / B	9.7 / A
		WB	31.9 / C	21.4 / C	8.1 / A	20.3 / C	
		NB	10.1 / B	10.1 / B	2.5 / A	8.9 / A	
		SB	9.7 / A	5.8 / A	3.0 / A	6.3 / A	
School Dismissal Peak Hour	Highway 61 at 159th Street	EB	24.2 / C		11.1 / B	15.6 / C	2.8 / A
		NB	3.3 / A	2.9 / A		2.9 / A	
		SB		0.7 / A	0.0 / A	0.7 / A	
	Highway 61 at 152nd Street (Signal)	EB	**67.0 / E**		**57.9 / E**	**58.6 / E**	17.9 / B
		WB	**67.5 / E**		47.0 / D	**59.5 / E**	
		NB	**69.6 / E**	7.1 / A	3.3 / A	12.1 / B	
		SB	**55.3 / E**	11.7 / B	7.1 / A	12.3 / B	
	Highway 61 at 147th Street (Signal)	EB	**55.4 / E**	45.1 / D	9.3 / A	36.8 / D	10.6 / B
		WB	**63.6 / E**	40.0 / D	13.3 / B	42.9 / D	
		NB	5.5 / A	6.4 / A	2.6 / A	5.7 / A	
		SB	15.3 / B	6.0 / A	2.7 / A	7.0 / A	
PM Peak Hour	Highway 61 at 159th Street	EB	22.3 / C		9.7 / A	14.4 / B	3.4 / A
		NB	3.8 / A	3.2 / A		3.3 / A	
		SB		0.9 / A	0.0 / A	0.8 / A	
	Highway 61 at 152nd Street (Signal)	EB	**100.9 / F**		**74.1 / E**	**75.9 / E**	12.0 / B
		WB	**71.2 / E**		**62.1 / E**	**68.0 / E**	
		NB	**64.9 / E**	4.0 / A	1.1 / A	7.0 / A	
		SB	**63.2 / E**	7.2 / A	2.7 / A	7.5 / A	
	Highway 61 at 147th Street (Signal)	EB	**59.9 / E**	**137.7 / F**	7.9 / A	29.7 / C	11.9 / B
		WB	**69.8 / E**	54.8 / D	14.3 / B	50.4 / D	
		NB	8.7 / A	5.0 / A	2.5 / A	4.5 / A	
		SB	13.4 / B	7.4 / A	2.8 / A	8.0 / A	

4.7.2 Roundabout Control at Highway 61 and 152nd Street

A single lane roundabout was modeled at the intersection of Highway 61 and 152nd Street in the Highway Capacity Software (HCS) to ensure the operations would be acceptable, HCS is typically a more conservative evaluation when compared to Synchro. Generally, roundabouts have the following pros and cons:

Advantages	Disadvantages
- Provides orderly flow for all traffic - Reduced crash severity - Performs acceptably long term - Pedestrians cross one lane of traffic at a time	- Construction costs - Longer delays for mainline traffic outside of peak school time periods

One of the large benefits to roundabouts in terms of pedestrian safety is that vehicle speeds are lower for the vehicles entering and exiting the roundabout. Lower vehicle speeds results in a lower potential for a severe pedestrian crash. In addition, another advantage is pedestrians only cross one direction of traffic at a time and may use the splitter islands as refuge to complete their crossing.

A single lane roundabout at this intersection will operate acceptably under the 2022 Year of Opening conditions. The 95th percentile queue in the AM peak hour is approximately 66' for southbound Highway 61. The 95th percentile queue in the school dismissal peak hour is approximately 142' for the northbound Highway 61 approach. The 95th percentile queue in the PM peak hour is approximately 98' for northbound Highway 61.

Table 10 shows the approach LOS and total intersection LOS during the 2022 Year of Opening AM peak, school dismissal peak, and PM peak hours with roundabout control at 152nd Street. More detailed analysis, including queueing information is provided in **Appendix G.**

Table 10 – Future 2022– Roundabout Control (HCS)

Intersection:	Approach	AM Peak		SD Peak		PM Peak	
		Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)
Highway 61 at 152nd Street	NB	8.1 / A	8.7 / A	13.5 / B	11.6 / B	10.5 / B	9.2 / A
	SB	9.8 / A		9.5/ A		7.6 / A	
	EB	7.9 / A		7.8 / A		5.7 / A	
	WB	5.7 / A		10.3 / B		7.8 / A	

Notes: HCS – Highway Capacity Software.

4.8 2026 No Build Conditions

The 2026 No Build scenario includes the existing 2020 traffic counts with background growth applied to the turning movement counts.

Under this scenario, all intersections operate similar to the existing conditions with all study intersections operating at a LOS B or better. Longer delays are present for the side streets at the intersection of Highway 61 and 147th Street during the school dismissal and PM peak hours. During the PM peak hour, the westbound left turn at 147th Street operates at a LOS F with 96.1 seconds of delay. This delay is due to the amount of green time this movement receives compared to the mainline Highway 61 green time.

Table 11 shows the approach LOS and total intersection LOS for all study intersections during the 2026 No build AM peak, school dismissal peak, and PM peak hours. More detailed results are shown in **Table A5** in **Appendix C.**

Table 11 – 2026 No Build Traffic Operations (Synchro)

Peak Hour	Intersection:	Approach	Delay (s/veh)				
			Left	Thru	Right	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)
School Arrival Peak Hour	Highway 61 at 159th Street	EB	9.0 / A		3.9 / A	5.3 / A	1.2 / A
		NB	1.8 / A	1.0 / A		1.1 / A	
		SB	1.0 / A	0.6 / A	0.0 / A	0.6 / A	
	Highway 61 at 152nd Street	WB	9.3 / A		3.9 / A	7.6 / A	0.6 / A
		NB		0.5 / A	0.0 / A	0.5 / A	
		SB	1.5 / A	0.4 / A		0.4 / A	
	Highway 61 at 147th Street (Signal)	EB	28.9 / C	34.4 / C	6.7 / A	19.6 / B	7.9 / A
		WB	35.7 / D	31.8 / C	6.3 / A	28.5 / C	
		NB	6.2 / A	5.7 / A	1.8 / A	5.1 / A	
		SB	7.0 / A	4.1 / A	1.2 / A	4.2 / A	
School Dismissal Peak Hour	Highway 61 at 159th Street	EB	19.4 / C		7.9 / A	12.2 / B	2.5 / A
		NB	3.6 / A	2.7 / A		2.8 / A	
		SB		0.7 / A	0.0 / A	0.7 / A	
	Highway 61 at 152nd Street	WB	28.7 / D		19.3 / C	25.1 / D	2.6 / A
		NB		1.0 / A	0.0 / A	1.0 / A	
		SB	5.9 / A	0.9 / A		1.0 / A	
	Highway 61 at 147th Street (Signal)	EB	**62.5 / E**	**66.8 / E**	11.8 / B	42.7 / D	9.1 / A
		WB	**63.6 / E**	34.2 / C	13.3 / B	49.2 / D	
		NB	7.3 / A	4.9 / A	2.5 / A	4.5 / A	
		SB	12.2 / B	4.4 / A	0.7 / A	4.8 / A	
PM Peak Hour	Highway 61 at 159th Street	EB	29.2 / D		12.8 / B	19.3 / C	3.6 / A
		NB	3.6 / A	3.4 / A		3.4 / A	
		SB		0.8 / A	0.0 / A	0.7 / A	
	Highway 61 at 152nd Street	WB	17.1 / C		11.1 / B	15.2 / C	1.3 / A
		NB		0.8 / A	0.0 / A	0.8 / A	
		SB	5.2 / A	0.5 / A		0.5 / A	
	Highway 61 at 147th Street (Signal)	EB	**67.3 / E**	**69.6 / E**	11.0 / B	33.7 / C	13.6 / B
		WB	**96.1 / F**	**64.6 / E**	17.2 / B	**71.8 / E**	
		NB	6.6 / A	4.9 / A	2.3 / A	4.3 / A	
		SB	14.0 / B	7.3 / A	1.2 / A	7.7 / A	

4.9 2026 Full Build Conditions

Under this scenario, the elementary school is fully built out and is expected to serve 720 students. The site continues to access Highway 61 at 152nd Street from the west leg of the intersection. Similar to the 2022 Build Conditions, geometric improvements to the intersection of Highway 61 and 152nd Street were implemented. These improvements include the following:

- Northbound and southbound dedicated left and right turn lanes
- Dedicated left, through and right turn lanes for the school driveway
- Dedicated left, through and right turn lanes lane for the westbound 152nd Street approach

During the AM peak hour all intersections with the exception of Highway 61 at 152nd Street operate acceptably. At the intersection of 152nd Street, the eastbound and westbound left turning traffic onto Highway 61 has long wait times to find acceptable gaps to complete their movement. Both eastbound and westbound left turning movement operate at a LOS F with 83.9 and 53.6 seconds of delay per vehicle, respectively.

The School Dismissal and PM Peak hour also share similar operations at 152nd Street with the eastbound left turning movements operating poorly.

Table 12 shows the approach LOS and total intersection LOS for all study intersections during the 2026 Full Build AM peak, school dismissal peak, and PM peak hours. More detailed results are shown in **Table A6** in **Appendix C.**

Table 12 – 2026 Full Build Traffic Operations (Synchro)

Peak Hour	Intersection:	Approach	Delay (s/veh)				
			Left	Thru	Right	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)
School Arrival Peak Hour	Highway 61 at 159th Street	EB	10.1 / B		4.8 / A	5.8 / A	1.6 / A
		NB	2.4 / A	1.3 / A		1.4 / A	
		SB	0.0 / A	0.8 / A	0.0 / A	0.8 / A	
	Highway 61 at 152nd Street	EB	**83.9 / F**		22.8 / C	28.6 / D	8.7 / A
		WB	**53.6 / F**		4.6 / A	**40.1 / E**	
		NB	13.1 / B	1.5 / A	0.5 / A	5.4 / A	
		SB	2.1 / A	3.0 / A	0.9 / A	2.9 / A	
	Highway 61 at 147th Street (Signal)	EB	26.6 / C	38.8 / D	7.5 / A	21.6 / C	9.5 / A
		WB	32.5 / C	11.7 / B	11.1 / B	20.3 / C	
		NB	7.1 / A	7.5 / A	2.1 / A	6.7 / A	
		SB	11.1 / B	6.9 / A	2.3 / A	7.5 / A	
School Dismissal Peak Hour	Highway 61 at 159th Street	EB	26.9 / D		11.1 / B	16.4 / C	3.1 / A
		NB	3.7 / A	3.1 / A		3.2 / A	
		SB		0.8 / A	0.0 / A	0.8 / A	
	Highway 61 at 152nd Street	EB	**63.1 / F**		**50.4 / F**	**51.7 / F**	22.8 / C
		WB	**382.9 / F**		**201.7 / F**	**312.4 / F**	
		NB	6.3 / A	1.8 / A	0.5 / A	2.2 / A	
		SB	6.8 / A	3.1 / A	0.7 / A	3.1 / A	
	Highway 61 at 147th Street (Signal)	EB	**62.1 / E**	48.5 / D	10.5 / B	39.3 / D	11.5 / B
		WB	**61.7 / E**	32.9 / C	17.0 / B	40.3 / D	
		NB	6.2 / A	8.4 / A	3.1 / A	7.5 / A	
		SB	23.5 / C	6.2 / A	2.2 / A	8.4 / A	
PM Peak Hour	Highway 61 at 159th Street	EB	31.6 / D		13.4 / B	20.5 / C	4.3 / A
		NB	3.9 / A	4.0 / A		4.0 / A	
		SB		1.0 / A	0.0 / A	0.9 / A	
	Highway 61 at 152nd Street	EB	**36.8 / E**		6.9 / A	10.0 / B	3.6 / A
		WB	**52.6 / F**		8.9 / A	**37.8 / E**	
		NB	4.4 / A	1.5 / A	0.4 / A	1.7 / A	
		SB	4.8 / A	2.2 / A	0.8 / A	2.2 / A	
	Highway 61 at 147th Street (Signal)	EB	**64.7 / E**	**58.6 / E**	16.1 / B	31.9 / C	28.8 / C
		WB	**132.9 / F**	**58.8 / E**	21.2 / C	**88.6 / F**	
		NB	9.7 / A	6.7 / A	2.6 / A	5.8 / A	
		SB	37.2 / D	43.3 / D	2.1 / A	42.6 / D	

4.10 2026 Full Build Conditions with Mitigations

Based upon the poor operational results at the intersection of Highway 61 at 152nd Street, further investigation of intersection improvements was needed in addition to the geometric improvements made in the previous scenario. The following are different traffic control alternatives that were analyzed.

4.10.1 Traffic Signal Control at Highway 61 and 152nd Street

Similar to the 2022 Build Mitigations, traffic signal control was added at the intersection of Highway 61 and 152nd Street. As part of this improvement, a dedicated left, thru, and right turn lane was provided for the westbound 152nd approach.

Similar phasing and cycle lengths were used for this analysis as was used during the year of opening analysis. However, during the school dismissal time period the eastbound and westbound left turn phasing was modified from permissive only to protected-permissive phasing at the intersection of Highway 61 and 152nd Street.

During the AM peak hour, all study intersections operate acceptably with all intersections operating at a LOS B or better. During this time period the maximum northbound left turn queue is 276' at the intersection of Highway 61 and 152nd Street.

During the school dismissal time period, with the addition of the traffic signal at 152nd Street, delays for the eastbound and westbound approaches are greatly reduced compared to side street stop control. Both the eastbound and westbound left turning movements operate at a LOS E.

During the PM peak hour, operations improve, however the westbound 147th Street left turning movement still operates at a LOS F with almost 100 seconds of delay per vehicle. This movement is not impacted by school traffic and the delay is a function of how much of the cycle is being allocated to that movement during the PM peak hour.

Table 13 shows the approach LOS and total intersection LOS for all study intersections during the 2026 Full Build Conditions AM peak, school dismissal peak, and PM peak hours with traffic signal control at 152nd Street. More detailed results are shown in **Table A7** in **Appendix C.**

Table 13 – 2026 Full Build Traffic Operations with Traffic Signal Control at 152nd Street (Synchro)

Peak Hour	Intersection:	Approach	Delay (s/veh)				
			Left	Thru	Right	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)
School Arrival Peak Hour	Highway 61 at 159th Street	EB	10.1 / B		4.5 / A	5.6 / A	1.7 / A
		NB	2.7 / A	1.3 / A		1.5 / A	
		SB	0.5 / A	0.9 / A	0 / A	0.9 / A	
	Highway 61 at 152nd Street (Signal)	EB	30.5 / C		15.3 / B	16.9 / B	15.3 / B
		WB	45.3 / D		3.6 / A	35.2 / D	
		NB	32.6 / C	4.8 / A	0.9 / A	13.9 / B	
		SB	36.9 / D	15.3 / B	4.4 / A	15.1 / B	
	Highway 61 at 147th Street (Signal)	EB	23.1 / C	26.4 / C	8.4 / A	16.9 / B	8.2 / A
		WB	30.7 / C	19.9 / B	10.3 / B	19.1 / B	
		NB	5.2 / A	6.1 / A	1.7 / A	5.5 / A	
		SB	10.8 / B	5.5 / A	2.1 / A	6.3 / A	
School Dismissal Peak Hour	Highway 61 at 159th Street	EB	21.1 / C		8.0 / A	12.3 / B	2.7 / A
		NB	3.6 / A	2.9 / A		3.0 / A	
		SB		0.9 / A	0.0 / A	0.8 / A	
	Highway 61 at 152nd Street (Signal)	EB	**59.5 / E**		18.9 / B	21.9 / C	9.6 / A
		WB	**58.6 / E**		11.7 / B	40.4 / D	
		NB	13.2 / B	5.1 / A	0.7 / A	5.8 / A	
		SB	10.6 / B	7.8 / A	1.7 / A	7.7 / A	
	Highway 61 at 147th Street (Signal)	EB	**56.4 / E**	42.5 / D	11.0 / B	36.2 / D	13.4 / B
		WB	**63.4 / E**	41.6 / D	15.7 / B	40.7 / D	
		NB	9.5 / A	12.0 / B	3.7 / A	10.5 / B	
		SB	19.8 / B	7.4 / A	2.3 / A	8.8 / A	
PM Peak Hour	Highway 61 at 159th Street	EB	**36.0 / E**		18.7 / C	25.2 / D	4.6 / A
		NB	4.2 / A	4.1 / A		4.1 / A	
		SB		1.0 / A	0.1 / A	0.9 / A	
	Highway 61 at 152nd Street (Signal)	EB	**65.1 / E**		7.2 / A	14.4 / B	5.1 / A
		WB	**66.6 / E**		10.6 / B	47.6 / D	
		NB	5.1 / A	1.9 / A	0.5 / A	2.1 / A	
		SB	6.2 / A	4.1 / A	0.9 / A	4.1 / A	
	Highway 61 at 147th Street (Signal)	EB	**59.9 / E**	**66.1 / E**	15.3 / B	33.9 / C	20.8 / C
		WB	**99.4 / F**	52.4 / D	19.2 / B	**68.3 / E**	
		NB	10.2 / B	6.9 / A	2.7 / A	6.0 / A	
		SB	27.2 / C	25.5 / C	6.3 / A	25.6 / C	

4.10.1.1 Modified Traffic Signal Control Highway 61 and 152nd Street

Similar to traffic signal modifications outlined in section 4.7.1.1, the following changes were analyzed to determine how the traffic signal at Highway 61 and 152nd Street would operate under the most restrictive operations:

- The eastbound and westbound 152nd Street approaches were modified to include a dedicated left turn lane and a shared through-right turn lane.
- Protected only left turns phasing was added for all approaches at the intersection of Highway 61 and 152nd Street
- No right turns on red indications were applied to all movements at the intersection

During the school arrival peak hour, all intersections operate at a LOS C or better. The intersection of Highway 61 and 152nd has longer delays for all protected left turn movements, all of which operate at a LOS D. In addition, the eastbound right turn exiting the school site operates at a LOS C, this is an improvement from the 2022 scenario, and is due to more phase time being allocated for the eastbound approach due to the increase in volume under full build conditions. The maximum queue reported for this movement is 283 feet.

Similar operations were reported for the school dismissal peak hour. All left turning movements at the intersection of Highway 61 and 152nd Street operate with longer delays. The eastbound left turn operates at a LOS F to serve 14 vehicles over the peak hour. The eastbound right turning movement exiting the school operates at a LOS E. The maximum reported eastbound queue length is 374 feet.

During the PM peak hour, left turning movements at the intersection of Highway 61 and 152nd Street operate with longer delays. The southbound left turn, serving 3 vehicles operates at a LOS F during this peak hour. This is primarily due to the longer cycle lengths that are in place along Highway 61. The eastbound right turning movement serving 72 vehicles operates at a LOS E and has a maximum queue length of 50 feet.

Table 14 shows the approach LOS and total intersection LOS for all study intersections during the 2026 Full Build AM peak, school dismissal peak, and PM peak hours with traffic signal control modifications at 152nd Street. More detailed results are shown in **Table A12** in **Appendix C.**

Table 14 – 2026 Full Build Traffic Operations with Modified Traffic Signal Control at 152nd Street (Synchro)

Peak Hour	Intersection:	Approach	Delay (s/veh)				
			Left	Thru	Right	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)
School Arrival Peak Hour	Highway 61 at 159th Street	EB	9.8 / A		4.4 / A	5.5 / A	1.7 / A
		NB	2.7 / A	1.5 / A		1.6 / A	
		SB	0.0 / A	0.9 / A	0.1 / A	0.9 / A	
	Highway 61 at 152nd Street (Signal)	EB	36.1 / D		32.8 / C	33.1 / C	33.2 / C
		WB	38.9 / D		29.0 / C	36.2 / D	
		NB	38.3 / D	11.0 / B	6.1 / A	20.1 / C	
		SB	44.5 / D	49.9 / D	28.5 / C	48.7 / D	
	Highway 61 at 147th Street (Signal)	EB	30.9 / C	52.8 / D	6.4 / A	25.2 / C	9.1 / A
		WB	30.9 / C	12.9 / B	11.4 / B	19.8 / B	
		NB	7.0 / A	7.0 / A	1.9 / A	6.3 / A	
		SB	11.3 / B	6.5 / A	3.4 / A	7.2 / A	
School Dismissal Peak Hour	Highway 61 at 159th Street	EB	24.4 / C		10.7 / B	15.5 / C	3.2 / A
		NB	3.7 / A	3.4 / A		3.4 / A	
		SB		0.8 / A	0 / A	0.7 / A	
	Highway 61 at 152nd Street (Signal)	EB	**95.1 / F**		**65.5 / E**	**68.8 / E**	23.1 / C
		WB	**73.4 / E**		53.3 / D	**65.0 / E**	
		NB	**67.1 / E**	9.7 / A	4.2 / A	15.3 / B	
		SB	54.6 / D	16.6 / B	8.3 / A	16.9 / B	
	Highway 61 at 147th Street (Signal)	EB	**62.2 / E**	59.6 / E	11.1 / B	38.6 / D	13.8 / B
		WB	**64.5 / E**	49.1 / D	15.8 / B	42.5 / D	
		NB	9.2 / A	11.6 / B	3.7 / A	10.2 / B	
		SB	21.1 / C	7.5 / A	2.8 / A	9.2 / A	
PM Peak Hour	Highway 61 at 159th Street	EB	**43.5 / E**		22.3 / C	30.1 / D	5.1 / A
		NB	4.4 / A	4.0 / A		4.0 / A	
		SB		1.0 / A	0.1 / A	0.9 / A	
	Highway 61 at 152nd Street (Signal)	EB	**76.1 / E**		7.1 / A	14.8 / B	10.0 / B
		WB	**71.0 / E**		9.4 / A	48.9 / D	
		NB	**77.0 / E**	4.3 / A	1.4 / A	8.9 / A	
		SB	**99.5 / F**	6.2 / A	1.3 / A	6.6 / A	
	Highway 61 at 147th Street (Signal)	EB	52.5 / D	**70.4 / E**	20.3 / C	33.6 / C	23.8 / C
		WB	**106.3 / F**	**55.5 / E**	16.7 / B	**70.1 / E**	
		NB	8.7 / A	6.1 / A	2.5 / A	5.3 / A	
		SB	35.3 / D	35.9 / D	3.2 / A	35.7 / D	

4.10.2 Roundabout Control at Highway 61 and 152nd Street

A single lane roundabout was modeled at the intersection of Highway 61 and 152nd Street in the Highway Capacity Software (HCS) to ensure the operations would be acceptable under the 2026 Full Build Conditions.

A single lane roundabout at this intersection will operate acceptably under the 2026 Full Build Conditions. The 95th percentile queue in the AM peak hour is approximately 112' for southbound Highway 61. The 95th percentile queue in the school dismissal peak hour is approximately 218' for the northbound Highway 61 approach. The 95th percentile queue in the PM peak hour is approximately 124' for northbound Highway 61.

Table 15 shows the approach LOS and total intersection LOS during the 2026 Full Build AM peak, school dismissal peak, and PM peak hours with roundabout control at 152nd Street. More detailed analysis, including queueing information is provided in **Appendix G.**

Table 15 – Future 2026– Roundabout Control (HCS)

Intersection:	Approach	AM Peak		SD Peak		PM Peak	
		Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)
Highway 61 at 152nd Street	NB	10.8 / B	12.2 / B	19.1 / C	15.6 / C	12.2 / B	10.5 / B
	SB	14.6 / B		11.8 / B		8.4 / A	
	EB	11.2 / B		9.8 / A		6.3 / A	
	WB	6.9 / A		12.6 / B		8.7 / A	

Notes: HCS – Highway Capacity Software.

4.11 2031 Future No Build Conditions

The 2031 No Build scenario includes the existing 2020 traffic counts with background growth applied to the turning movement counts.

Under this scenario, all intersections operate similar to the 2026 No Build Conditions with all study intersections operating at LOS A in the AM peak hour.

During the peak school dismissal time period, some delay is present for the side street approaches of 147th to Highway 61 with both approaches operating at a LOS D.

During the PM peak hour delays increase at the Highway 61 and 147th Street intersection for the eastbound and westbound side street approaches. During this peak hour the westbound approach operates at LOS F with approximately 102.9 seconds of delay per vehicle.

Table 16 shows the approach LOS and total intersection LOS for all study intersections during the 2031 No Build AM peak, school dismissal peak, and PM peak hours. More detailed results are shown in **Table A8** in **Appendix C.**

Table 16 – 2031 Future No Build Traffic Operations (Synchro)

Peak Hour	Intersection:	Approach	Delay (s/veh)				
			Left	Thru	Right	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)
School Arrival Peak Hour	Highway 61 at 159th Street	EB	10.4 / B		5.0 / A	6.4 / A	1.4 / A
		NB	2.1 / A	1.1 / A		1.2 / A	
		SB	1.8 / A	0.7 / A	0.0 / A	0.7 / A	
	Highway 61 at 152nd Street	WB	9.9 / A		4.6 / A	8.4 / A	0.7 / A
		NB		0.5 / A	0.0 / A	0.5 / A	
		SB	2.0 / A	0.5 / A		0.5 / A	
	Highway 61 at 147th Street (Signal)	EB	23.6 / C	**59.5 / E**	6.7 / A	20.1 / C	7.8 / A
		WB	34.0 / C	0.0 / A	6.3 / A	27.3 / C	
		NB	7.0 / A	5.7 / A	1.9 / A	5.1 / A	
		SB	7.7 / A	4.7 / A	0.8 / A	4.8 / A	
School Dismissal Peak Hour	Highway 61 at 159th Street	EB	21.4 / C		8.9 / A	13.5 / B	2.6 / A
		NB	3.6 / A	2.7 / A		2.8 / A	
		SB		0.8 / A	0.0 / A	0.7 / A	
	Highway 61 at 152nd Street	WB	33.1 / D		22.3 / C	29.3 / D	2.7 / A
		NB		1.0 / A	0.0 / A	1.0 / A	
		SB	4.5 / A	0.8 / A		0.9 / A	
	Highway 61 at 147th Street (Signal)	EB	54.9 / D	**55.9 / E**	11.0 / B	38.4 / D	9.0 / A
		WB	**66.1 / E**	**59.4 / E**	14.9 / B	51.0 / D	
		NB	7.4 / A	6.1 / A	2.8 / A	5.5 / A	
		SB	14.5 / B	4.4 / A	1.0 / A	4.8 / A	
PM Peak Hour	Highway 61 at 159th Street	EB	**44.0 / E**		20.8 / C	30.2 / D	4.8 / A
		NB	4.2 / A	4.0 / A		4.0 / A	
		SB		1.0 / A	0.1 / A	0.9 / A	
	Highway 61 at 152nd Street	WB	27.9 / D		16.9 / C	24.1 / C	1.7 / A
		NB		0.9 / A	0.0 / A	0.9 / A	
		SB	5.6 / A	0.5 / A		0.5 / A	
	Highway 61 at 147th Street (Signal)	EB	**57.6 / E**	**68.6 / E**	22.8 / C	37.0 / D	24.3 / C
		WB	**139.8 / F**	**74.4 / E**	21.3 / C	**102.9 / F**	
		NB	9.7 / A	6.8 / A	2.8 / A	6.0 / A	
		SB	17.9 / B	30.3 / C	2.8 / A	29.4 / C	

4.12 2031 Future Build Conditions

This scenario includes analysis of five years after the expected full build out of the elementary school site. As previously mentioned, in this scenario, additional housing development just east of Highway 61 and 159th Street is expected to be constructed. Therefore, it was expected that 15% of the school traffic would travel to and from the 200 expected homes at this location. The

overall trip distribution for the elementary school changes for this scenario in that 25% of the school traffic travels to and from the school site from the north and 75% to and from the south.

Similar to the 2026 Build Conditions, geometric improvements to the intersection of Highway 61 and 152nd Street were implemented. These improvements include the following:

- Northbound and southbound dedicated left and right turn lanes
- Dedicated left, through and right turn lanes for the school driveway
- Dedicated left, through and right turn lanes lane for the westbound 152nd Street approach

During the AM peak hour all intersections except for Highway 61 at 152nd Street, operate acceptably. At the intersection of 152nd Street, the eastbound and westbound left turning traffic onto Highway 61 have long wait times to find acceptable gaps to complete their movement. Both eastbound and westbound left turning movements operate at a LOS F and LOS E with 261.5 and 45.8 seconds of delay per vehicle, respectively.

During the school dismissal peak hour all study intersections operate acceptably except for the intersection of Highway 61 and 152nd Street. At the 152nd Street intersection the westbound approach operates at LOS F with long delays and queue lengths.

The PM Peak hour also shares similar operations at 152nd Street with the eastbound left turning movement operating at a LOS E and the westbound left turning movement operating at LOS F. In addition, similar to the No Build conditions, the westbound approach at Highway 61 and 147th Street continues to operate at a LOS F.

Table 17 shows the approach LOS and total intersection LOS for all study intersections during the 2031 Future Build AM peak, school dismissal peak, and PM peak hours. More detailed results are shown in **Table A9** in **Appendix C.**

Table 17 – 2031 Future Build Traffic Operations (Synchro)

Peak Hour	Intersection:	Approach	Delay (s/veh)				
			Left	Thru	Right	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)
School Arrival Peak Hour	Highway 61 at 159th Street	EB	10.4 / B		5.3 / A	6.3 / A	2.1 / A
		WB	13.2 / B			13.2 / B	
		NB	2.7 / A	1.3 / A		1.4 / A	
		SB	3.1 / A	1.0 / A	0.0 / A	1.0 / A	
	Highway 61 at 152nd Street	EB	**261.5 / F**		**118.6 / F**	**157.0 / F**	24.7 / C
		WB	**45.8 / E**		5.5 / A	32.8 / C	
		NB	11.7 / B	1.5 / A	0.4 / A	4.4 / A	
		SB	3.1 / A	2.9 / A	1.1 / A	2.7 / A	
	Highway 61 at 147th Street (Signal)	EB	28.8 / C	35.6 / D	4.4 / A	21.4 / C	9.1 / A
		WB	33.6 / C	29.3 / C	10.6 / B	21.9 / C	
		NB	6.5 / A	6.8 / A	1.9 / A	6.2 / A	
		SB	11.3 / B	6.5 / A	1.5 / A	7.0 / A	
School Dismissal Peak Hour	Highway 61 at 159th Street	EB	32.1 / D		14.7 / B	20.4 / C	3.7 / A
		WB	26.0 / D			26.0 / D	
		NB	4.4 / A	3.5 / A		3.5 / A	
		SB		1.0 / A	0.1 / A	0.9 / A	
	Highway 61 at 152nd Street	EB	**127.6 / F**		32.7 / D	54.3 / D	27.6 / C
		WB	**528.2 / F**		**319.3 / F**	**449.0 / F**	
		NB	6.5 / A	1.9 / A	0.5 / A	2.2 / A	
		SB	7.8 / A	3.0 / A	0.8 / A	3.0 / A	
	Highway 61 at 147th Street (Signal)	EB	**63.4 / E**	**71.7 / E**	13.2 / B	47.9 / D	12.4 / B
		WB	**63.5 / E**	44.7 / D	21.8 / C	45.1 / D	
		NB	8.0 / A	9.2 / A	3.3 / A	8.2 / A	
		SB	24.3 / C	6.5 / A	2.5 / A	8.3 / A	
PM Peak Hour	Highway 61 at 159th Street	EB	**36.0 / E**		17.6 / C	24.0 / C	4.5 / A
		WB	32.3 / D			32.3 / D	
		NB	4.1 / A	3.9 / A		3.9 / A	
		SB		1.1 / A	0.1 / A	1.0 / A	
	Highway 61 at 152nd Street	EB	**38.6 / E**		11.6 / B	19.2 / B	5.9 / A
		WB	**69.9 / F**		14.0 / B	49.3 / D	
		NB	4.4 / A	1.7 / A	0.3 / A	1.8 / A	
		SB	4.3 / A	5.8 / A	3.2 / A	5.7 / A	
	Highway 61 at 147th Street (Signal)	EB	**61.0 / E**	**77.0 / E**	22.2 / C	36.9 / D	39.0 / D
		WB	**147.1 / F**	**60.7 / E**	26.0 / C	**100.7 / F**	
		NB	9.3 / A	6.8 / A	2.9 / A	6.0 / A	
		SB	**62.7 / E**	**74.0 / E**	42.0 / D	**72.8 / E**	

4.13 2031 Future Build Conditions with Mitigations

Similar to the previous scenarios further investigation of intersection improvements were analyzed or the future 2031 Build scenario. The following are different traffic control alternatives that were analyzed.

4.13.1 Traffic Signal Control at Highway 61 and 152nd Street

Similar to the 2026 Build Mitigations, traffic signal control was added at the intersection of Highway 61 and 152nd Street. As part of this improvement, a dedicated left, thru, and right turn lane was provided for the westbound 152nd approach.

Similar phasing and cycle lengths were used for this analysis as was used during the 2026 Full Build Analysis.

During the AM peak hour, all study intersections operate acceptably with all intersections operating at a LOS B or better. The northbound left turn at the intersection of Highway 61 and 152nd Street has a maximum reported queue length of 313'.

During the school dismissal time period, with the addition of the traffic signal at 152nd Street, delays for the eastbound and westbound approaches are greatly reduced. Both the eastbound and westbound left turning movements operate at a LOS D and LOS E, respectively.

During the PM peak hour, operations improve, however the westbound 147th Street left turning movement still operates at a LOS F with almost 150 seconds of delay per vehicle. This movement is not impacted by school traffic and the delay is a function of how much of the cycle is being allocated to that movement during the PM peak hour. Longer delays are also present for left turning traffic from 159th Street onto Highway 61. The eastbound left turn operates at a LOS F with 51.3 seconds of delay per vehicle.

Table 18 shows the approach LOS and total intersection LOS for all study intersections during the 2031 Future Build Conditions AM peak, school dismissal peak, and PM peak hours with traffic signal control at 152nd Street. More detailed results are shown in **Table A10** in **Appendix C.**

Table 18 – 2031 Future Build Traffic Operations with Traffic Signal Control at 152nd Street (Synchro)

Peak Hour	Intersection:	Approach	Delay (s/veh)				
			Left	Thru	Right	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)
School Arrival Peak Hour	Highway 61 at 159th Street	EB	11.0 / B		5.4 / A	6.4 / A	2.1 / A
		WB	12.8 / B			12.8 / B	
		NB	2.5 / A	1.4 / A		1.4 / A	
		SB	0.0 / A	1.1 / A	0.0 / A	1.1 / A	
	Highway 61 at 152nd Street (Signal)	EB	36.7 / D		13.0 / B	18.9 / B	9.6 / A
		WB	40.1 / D		3.8 / A	28.4 / C	
		NB	13.7 / B	2.7 / A	0.9 / A	5.7 / A	
		SB	5.7 / A	9.9 / A	3.7 / A	9.2 / A	
	Highway 61 at 147th Street (Signal)	EB	31.8 / C	31.3 / C	6.5 / A	20.5 / C	9.1 / A
		WB	33.9 / C	23.9 / C	9.6 / A	21.8 / C	
		NB	7.7 / A	6.9 / A	1.9 / A	6.2 / A	
		SB	11.2 / B	6.6 / A	1.9 / A	7.1 / A	
School Dismissal Peak Hour	Highway 61 at 159th Street	EB	26.8 / D		13.5 / B	18.1 / C	3.6 / A
		WB	25.7 / D			25.7 / D	
		NB	4.5 / A	3.3 / A		3.3 / A	
		SB		1.0 / A	0.1 / A	0.9 / A	
	Highway 61 at 152nd Street (Signal)	EB	49.9 / D		16.4 / B	23.4 / C	10.0 / A
		WB	**59.9 / E**		11.9 / B	40.9 / D	
		NB	11.6 / B	5.6 / A	1.5 / A	6.0 / A	
		SB	13.8 / B	8.2 / A	2.0 / A	8.0 / A	
	Highway 61 at 147th Street (Signal)	EB	54.1 / D	**56.7 / E**	13.4 / B	39.1 / D	14.8 / B
		WB	**66.4 / E**	**63.9 / E**	18.6 / B	46.8 / D	
		NB	12.0 / B	13.2 / B	4.0 / A	11.8 / B	
		SB	19.9 / B	8.0 / A	2.5 / A	9.1 / A	
PM Peak Hour	Highway 61 at 159th Street	EB	**51.3 / F**		28.0 / D	**36.3 / E**	5.8 / A
		WB	**40.9 / E**			**40.9 / E**	
		NB	4.7 / A	4.2 / A		4.2 / A	
		SB		1.1 / A	0.0 / A	1.0 / A	
	Highway 61 at 152nd Street (Signal)	EB	**60.3 / E**		7.8 / A	19.1 / B	5.4 / A
		WB	**66.0 / E**		11.8 / B	46.8 / D	
		NB	5.6 / A	2.1 / A	0.6 / A	2.3 / A	
		SB	10.9 / B	4.2 / A	1.2 / A	4.1 / A	
	Highway 61 at 147th Street (Signal)	EB	**67.3 / E**	47.0 / D	26.3 / C	39.4 / D	41.3 / D
		WB	**149.4 / F**	52.6 / D	28.1 / C	**101.3 / F**	
		NB	11.9 / B	7.2 / A	3.0 / A	6.3 / A	
		SB	**64.0 / E**	**78.4 / E**	**82.6 / F**	**77.1 / E**	

4.13.1.1 Modified Traffic Signal Control Highway 61 and 152nd Street

Similar to traffic signal modifications outlined in section 4.10.1.1, the following changes were analyzed to determine how the traffic signal at Highway 61 and 152nd Street would operate under the most restrictive operations:

- The eastbound and westbound 152nd Street approaches were modified to include a dedicated left turn lane and a shared through-right turn lane.
- Protected only left turns phasing was added for all approaches at the intersection of Highway 61 and 152nd Street
- No right turns on red indications were applied to all movements at the intersection

During the school arrival peak hour, all intersections operate at a LOS C or better. The intersection of Highway 61 and 152nd has longer delays for all protected left turn movements. In addition, the eastbound right turn exiting the school site operates at a LOS C. The maximum queue reported for this movement is 297 feet.

Similar operations were reported for the school dismissal peak hour. All left turning movements at the intersection of Highway 61 and 152nd Street operate with longer delays. The eastbound right turning movement exiting the school operates at a LOS E. The maximum reported eastbound queue length is 294feet.

During the PM peak hour, left turning movements at the intersection of Highway 61 and 152nd Street operate with longer delays. The southbound left turn, serving 3 vehicles operates at a LOS F during this peak hour. This is primarily due to the longer cycle lengths that are in place along Highway 61. The eastbound right turning movement serving 47 vehicles operates at a LOS E and has a maximum queue length of 103 feet.

Table 19 shows the approach LOS and total intersection LOS for all study intersections during the 2031 Future Build AM peak, school dismissal peak, and PM peak hours with traffic signal control modifications at 152nd Street. More detailed results are shown in **Table A13** in **Appendix C.**

Table 19 – 2031 Future Build Traffic Operations with Modified Traffic Signal Control at 152nd Street (Synchro)

Peak Hour	Intersection:	Approach	Delay (s/veh)				
			Left	Thru	Right	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)
School Arrival Peak Hour	Highway 61 at 159th Street	EB	11.2 / B		5.6 / A	6.5 / A	2.4 / A
		WB	15.0 / C			15.0 / C	
		NB	3.0 / A	1.7 / A		1.7 / A	
		SB	0.0 / A	1.1 / A	0.0 / A	1.1 / A	
	Highway 61 at 152nd Street (Signal)	EB	33.4 / C		32.2 / C	32.5 / C	32.6 / C
		WB	38.8 / D		34.0 / C	37.1 / D	
		NB	38.6 / D	13.0 / B	7.6 / A	20.1 / C	
		SB	44.5 / D	46.9 / D	31.1 / C	45.1 / D	
	Highway 61 at 147th Street (Signal)	EB	32.5 / C	25.3 / C	4.4 / A	22.3 / C	8.8 / A
		WB	32.5 / C	26.3 / C	10.4 / B	21.2 / C	
		NB	7.8 / A	6.0 / A	1.8 / A	5.5 / A	
		SB	11.7 / B	6.7 / A	1.8 / A	7.2 / A	
School Dismissal Peak Hour	Highway 61 at 159th Street	EB	**35.1 / E**		19.3 / C	24.7 / C	4.0 / A
		WB	20.4 / C			20.4 / C	
		NB	4.0 / A	3.5 / A		3.5 / A	
		SB		1.0 / A	0.0 / A	0.9 / A	
	Highway 61 at 152nd Street (Signal)	EB	**70.6 / E**		**58.7 / E**	**61.4 / E**	21.1 / C
		WB	**63.2 / E**		53.4 / D	**59.3 / E**	
		NB	**62.4 / E**	10.1 / B	5.2 / A	14.7 / B	
		SB	**64.6 / E**	15.3 / B	11.1 / B	15.8 / B	
	Highway 61 at 147th Street (Signal)	EB	53.5 / D	**60.1 / E**	12.2 / B	37.6 / D	14.4 / B
		WB	**63.2 / E**	**73.7 / E**	19.0 / B	44.2 / D	
		NB	14.1 / B	12.4 / B	4.0 / A	11.0 / B	
		SB	20.6 / C	9.0 / A	3.2 / A	10.2 / B	
PM Peak Hour	Highway 61 at 159th Street	EB	**45.6 / E**		28.7 / D	34.6 / D	5.4 / A
		WB	**36.8 / E**			**36.8 / E**	
		NB	4.5 / A	3.9 / A		3.9 / A	
		SB		1.1 / A	0.1 / A	1.0 / A	
	Highway 61 at 152nd Street (Signal)	EB	**72.9 / E**		**70.5 / E**	**71.1 / E**	15.2 / B
		WB	**75.3 / E**		**63.2 / E**	**71.7 / E**	
		NB	**67.1 / E**	8.4 / A	2.7 / A	11.1 / B	
		SB	**86.5 / F**	10.0 / B	6.0 / A	10.1 / B	
	Highway 61 at 147th Street (Signal)	EB	**73.3 / E**	**65.2 / E**	24.5 / C	38.4 / D	37.4 / D
		WB	**169.3 / F**	**73.9 / E**	29.7 / C	**112.1 / F**	
		NB	10.4 / B	7.0 / A	2.9 / A	6.1 / A	
		SB	53.8 / D	**63.1 / E**	**92.1 / F**	62.3 / E	

4.13.2 Roundabout Control at Highway 61 and 152nd Street

A single lane roundabout was modeled at the intersection of Highway 61 and 152nd Street in the Highway Capacity Software (HCS) to ensure the operations would be acceptable under the 2031 Future Build Conditions.

A single lane roundabout at this intersection will operate acceptably under the 2031 Future Build conditions. The 95th percentile queue in the AM peak hour is approximately 140' for southbound Highway 61. The 95th percentile queue in the school dismissal peak hour is approximately 282' for the northbound Highway 61 approach. The 95th percentile queue in the PM peak hour is approximately 158' for northbound Highway 61.

Table 20 shows the approach LOS and total intersection LOS during the 2031 Future Build AM peak, school dismissal peak, and PM peak hours with roundabout control at 152nd Street.

Table 20 – Future 2031– Roundabout Control (HCS)

Intersection:	Approach	AM Peak		MD Peak		PM Peak	
		Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)
Highway 61 at 152nd Street	NB	11.6 / B	13.5 / B	25.3 / D	19.4 / C	14.5 / B	12.1 / B
	SB	16.4 / C		13.3 / B		9.2 / A	
	EB	12.1 / B		10.5 / B		6.7 / A	
	WB	7.1 / A		14.1 / B		9.5 / A	

Notes: HCS – Highway Capacity Software.

5 Additional Considerations

The project area experiences high volumes of traffic along Highway 61 throughout the day. However, the west leg of the 152nd Street intersections will likely experience congestion in short bursts that are directly related to school traffic. The following considerations address issues off the roadway network, turn lane warrants, construction staging, and estimated construction costs.

5.1 Pedestrian Access

Given the proposed location of the new elementary school and its proximity to surrounding neighborhoods, emphasis should be given to providing safe pedestrian connections to the school site. It is recommended that a direct connection be made to the neighborhood immediately to the north of the school site. Based upon conversations with the White Bear Lake School District students in grades K-2 will not be provided busing if they are located within a half mile of the school. Schoolchildren in grades 3-5 will not be provided busing if they live within ¾ of a mile from the elementary school site. This provision does not apply to students who live on the east side of Highway 61. The School District will provide busing to students, regardless of proximity to the school site, if they live on the east side of Highway 61.

Located on the west side of Highway 61, the Hardwood Creek Regional Trail runs parallel to Highway 61 and will provide a space for pedestrians and bicyclists to access the elementary school from both north and south of the school site.

Students located on the east side of Highway 61 will be provided busing to the school site. However, consideration should be given to providing pedestrian facilities along 152nd Street as well as providing pedestrians a means to access Hugo Estates, a mobile home park located just southeast of the school site on the east side of Highway 61.

As part of the City of Hugo's 2040 Comprehensive Plan, a sidewalk/trail has been identified to be built parallel to Highway 61 on the east side of the roadway. This connection would travel from 147th Street to 152nd Street helping to provide pedestrian connectivity to the neighborhoods on the east side of Highway 61 that the school is serving. Additionally, another pedestrian connection is planned to connect Oneka Parkway to the Hardwood Creek Trail by traveling along 147th Street just north of Lions Park. A pedestrian routing map showing the official pedestrian crossing routes, unofficial crossing routes, as well as future pedestrian connections is shown in **Figure 13.**

It should be noted that unofficial crossing routes are routes that pedestrians may choose to take to get to the school site. These routes will not be maintained or encouraged as a means to access the school site.

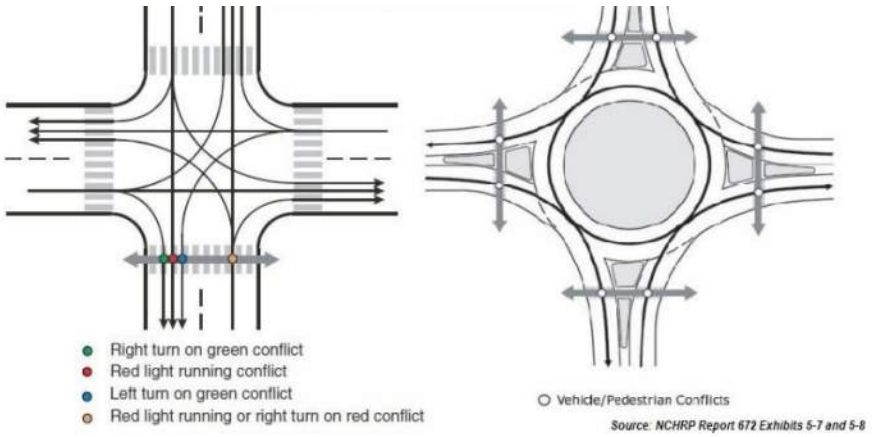
5.1.1 Pedestrian/Bicycle Safety at Roundabouts

As additional roundabouts are constructed in Minnesota and across the country, historical data on pedestrian/bicycle safety at roundabouts continues to accumulate. Many studies suggest that additional information is desired to draw stronger conclusions. However, there is commonality in the findings of several studies in Minnesota and nationally that supports that roundabouts are safe for pedestrians and bicyclists.

One significant factor in pedestrian and bicycle crossing safety at single-lane roundabouts is the reduced number of pedestrian-vehicle conflict points when compared to a traditional signalized

intersection. A signalized intersection has 16 pedestrian-vehicle conflict points with 4 on each intersection leg; right turn on red from a different intersection leg, red light running from a different intersection leg, left turn on green from a different intersection leg, and red light running/right turn on red on the crossing leg. A single-lane roundabout has only 8 pedestrian-vehicle conflict points with one at each entrance and exit to the roundabout. **Exhibit 2**, from the National Cooperative High Research Program (NCHRP) Report 672, shows a comparison of pedestrian-vehicle conflict points at traditional signalized intersections and single-lane roundabouts. In addition to the reduced pedestrian-vehicle conflicts at a single-lane roundabouts, pedestrians/bicyclists only cross one conflict point at a time due to the pedestrian refuge area on the splitter island of each roundabout leg; pedestrian/bicyclists at signalized intersection often must cross all four conflict points on an intersection leg at once. The pedestrian refuge in the splitter island also allows for pedestrians at roundabouts to look for a gap in traffic in only one direction at a time.

Exhibit 2 – Pedestrian- Vehicle Conflict Point Comparison (NCHRP Report 672)



Several studies have been completed both in Minnesota and nationally on the safety of drivers, pedestrians, and bicyclists at roundabouts.

- A study completed by the Insurance Institute for Highway Safety (IIHS) and Federal Highway Administration (FHWA) concluded that **roundabouts typically achieve a reduction of 40% of pedestrian crashes when converted from a conventional intersection**.
- A 2018 report from MnDOT called *An Addendum to "A Study of the Traffic Safety at Roundabouts in Minnesota"* compared pedestrian and bicycle crashes at 126 roundabouts to 126 comparable non-roundabout intersections in order to study the safety of roundabouts in Minnesota. This study concluded that **Minnesota roundabouts saw a reduction of over 60% in pedestrian crashes and a little over 15% reduction in bicycle crashes compared to conventional intersections in their before and after study.**
- MnDOT's *Pedestrian and Bicyclist Safety in Minnesota Roundabout Crossings,* completed in 2013, conducted observations at two Minnesota roundabouts to look for pedestrian and bicyclist safety concerns. This research **"strongly suggests that roundabout crossings are safe for pedestrians and bicyclists"**

In addition to the many local and nationwide studies on roundabout and pedestrian safety, many agencies have made statements about pedestrian and roundabout safety.

- MnDOT's *Minnesota Best Practices for Pedestrian/Bicycle Safety*, completed in 2013 says: "The characteristics of Roundabouts present a number of advantages for pedestrians and bicyclists – reduced vehicle operating speeds, reduced delays, and median refuge islands on all approach results in only having to cross a single direction of traffic at one time.
- The IIHS webpage on roundabouts says the following about the safety of pedestrians in a roundabout: "In addition to having fewer serious conflicts between vehicles than traditional intersections, roundabouts are generally safer for pedestrians as well. In a roundabout, pedestrians walk on sidewalks around the perimeter of the circular roadway. If they need to cross the roadway, they cross only one direction of traffic at a time. In addition, crossing distances are relatively short, and vehicle speeds tend to be low."
- The FHWA webpage on Roundabouts and Mini Roundabouts said the following: "Roundabouts are designed to improve safety for all users, including pedestrians and bicycles"

The Safe Routes to School Guidebook (http://guide.saferoutesinfo.org/engineering/roundabouts.cfm) provides the following excerpt regarding children and the use of roundabouts

> *"While roundabouts offer the general pedestrian population certain crossing and safety benefits, there is a dearth of research about the ability of child and elderly pedestrians, and those with mobility impairments to cross safely at roundabouts [Rodergerdts et al., 2010]. Children face special challenges to safely crossing a street. Factors include: impulsiveness, slower walking speeds; small body size that limits their visibility; less experience with traffic; still-developing cognitive abilities that make it difficult to accurately judge vehicle speed and traffic stream gaps; and a general perception drivers will be able to stop instantly [Rodergerdts et al., 2010; Fitpatrick et al., 2006]. These factors lend support for considering the need for adult supervision such as parents, caregivers or crossing guards at roundabout and other street crossing locations near elementary schools during arrival and dismissal times."*

Based upon this information, it is recommended that crossing guards be present during peak school arrival and dismissal time periods to help facilitate pedestrian crossings during the school year under either roundabout or traffic signal control.

In conclusion, roundabouts are beneficial for pedestrians and bicyclists compared to conventional intersections because they have fewer pedestrian-vehicle conflict points, have lower pedestrian delays, lower vehicle speeds, and pedestrians only need to cross one direction of traffic at a time, all of which result in increased pedestrian and bicycle safety. There is limited research however, regarding the pedestrian safety benefits of roundabouts in regard to younger children attempting to cross an intersection. If a roundabout were to be the preferred traffic control alternative, it is recommended that crossing guards be present during peak school arrival and dismissal time periods to help facilitate pedestrian crossings across Highway 61.

5.1.2 Pedestrian and Bicycle Safety at Traffic Signals

When looking at pedestrian and bicycle safety at traffic signals there are several treatments that can be implemented that influence the potential safety benefits of providing signalized crosswalks at intersections. Some of the treatments that should be considered are the following:

- Signal Phasing and timing
- Accessible Pedestrian Signals and pedestrian push buttons
- Countdown Pedestrian Timers
- Crossing Guards

5.1.2.1 Signal Phasing and Timing

There are several different strategies that can be implemented with signal phasing and timing changes. The first strategy would be to implement leading pedestrian intervals (LPI), leading pedestrian intervals allow the crosswalk/pedestrian movement to begin crossing 3-6 seconds before the green signal indication is given to motor vehicle traffic in the same direction. This gives pedestrians more time to get out into the roadway and make it more likely that motorists will see them before making a turn. Based upon guidance in the MnMUTCD, if an LPI is used, consideration should be given to prohibiting turns across the crosswalk during the interval.

Another strategy with signal timing that can be implemented is “No Right Turn on Red” signing. Motorists making a right turn on a red signal indication often are looking to the left to judge a gap in oncoming traffic and do not always look for pedestrians who may be crossing on their right side. Having a right turn on red restriction is another way to help reduce conflicts between motorists and non-motorized users at a traffic signal. Based upon guidance in the MnMUTCD, a No Turn on Red sign should be considered when there is an unacceptable number of pedestrian conflicts with right turn on red maneuvers, especially involving children, older pedestrians, or persons with disabilities. It should be noted that when right turn on red is prohibited, there may more right turn on green conflicts between vehicles and pedestrians at the adjacent crosswalk. The use of a leading pedestrian interval in conjunction with a prohibited right turn on red can help reduce this concern, however, this may lead to signal cycles changing more frequently, which can increase delay for mainline vehicles and presents the potential for an increased rear-end crash risk.

One of the drawbacks of a traffic signal at this location is the longer cycle lengths that are needed to accommodate large volumes of Highway 61 traffic both southbound in the morning and northbound in the afternoon. Due to these longer cycle times, pedestrian wait times will likely be longer to cross Highway 61. Additionally, increased pedestrian clearance intervals may also be needed to accommodate groups of children or slower walkers than the standards walk time of 3.5 feet per second. However, these increased walk times should be balanced against the potential of increased wait times between “Walk” indications.

One advantage the elementary school has is the current start and end times of the elementary school occur after the AM Peak hour of Highway 61 and before the afternoon PM peak hour therefore creating the possibility of having shortened cycle lengths during school arrival and dismissal time periods.

If a traffic signal is the chosen alternative, MnDOT's Signal Operations Group and Bicycle and Pedestrian Planning Group will make final determination on the operation of the traffic signal.

5.1.2.2 Accessible Pedestrian Signals and Pedestrian Push Buttons

Accessible Pedestrian Signals (APS) are audible signals that indicate when it is or is not appropriate to cross the street. APS signals are used when accommodating pedestrians with visual impairments. According to the Safe Routes to School Guide, these types of signals help increase the awareness of all pedestrians and may lead to fewer pedestrian crashes, as well as possibly reducing the amount of time it takes pedestrians to cross be reducing start up delay.

Additionally, pedestrian push buttons will be provided at the intersection as standard practice per MnDOT requirements should a traffic signal be the chosen alternative. These buttons help reduce delay to vehicular traffic when pedestrians are not present at the intersection and place a call to the signal of a need to complete a crossing.

5.1.2.3 Countdown Pedestrian Timers

Countdown pedestrian timers are timer displays that are used to inform pedestrians how much time is remaining to complete a crossing movement. These timers help reduce the number of pedestrians that may be caught in the crosswalk when the crossing cycle ends. Pedestrian Countdown Timers should be provided at the intersection should traffic signal control be installed.

5.1.2.4 Crossing Guards

Crossing guards should be considered at the intersection in order to help assist children in crossing Highway 61.

5.2 Turn Lane Warrants

MnDOT provides intersection turn lane warrant criteria in their access management manual. While these are not mandatory criteria to install turn lanes, they provide guidance on when a decision about turn lanes should be considered. There are nine warrant criteria in total; however, only two apply to this project area, Warrant 6 and Warrant 9.

- Warrant 6: School Entrances – At public and private school driveways on high-speed highways (posted speed ≥ 45 mph) used by school traffic
- Warrant 9: Vehicular Volume Warrant – At high-volume driveways (>100 trips per day) and all public street connections on high-speed highways (posted speed ≥ 45 mph) that satisfy the criteria in Figures 3.40 and 3.41 below. (**See Exhibit 3**)

Based on Warrant 6, turn lanes should be provided on Highway 61 at 152nd Street. The intersection is located on a high speed (posted at 55 mph) road that intersects with a school entrance; both left and right turn lanes on Highway 61 are warranted.

Highway 61 at 152nd Street also meets the volume Warrant 9 for both left and right turn lanes. The AADT on Highway 61 is currently 11,453, and the 152nd Street elementary school approach is expected to generate 1,361 trips per day at Full Build in 2026. Based on these volumes both a left and right turn lane are warranted on Highway 61.

While the turn lane warrants do not apply to the eastbound and westbound 152nd Street approaches, it is recommended that a dedicated left turn lane and a shared through right turn lane be provided at this intersection. This recommendation stems from the very limited number

of vehicles going straight through the intersection. Additionally, a two-lane approach on the minor street approaches provides a shorter crossing distance for pedestrians crossing 152nd Street. Given the higher volume of pedestrians and bicyclists using the Hardwood Creek Trail, this shorter crossing distance provides safety benefits to those non-motorized users.

Exhibit 3: MnDOT Turn Lane Warrant Thresholds

Figure 3.40: Warrant 9 for Left-Turn Lanes

2-Lane Highway AADT	4-Lane Highway AADT	Cross Street or Driveway ADT	Turn Lane Requirement
1500 to 2999	3000 to 5999	> 1500	Left-turn lane warranted
3000 to 3999	6000 to 7999	> 1200	Left-turn lane warranted
4000 to 4999	8000 to 9999	> 1000	Left-turn lane warranted
5000 to 6499	10,000 to 12,999	> 800	Left-turn lane warranted
≥ 6500 AADT	≥ 13,000 AADT	101 to 400 > 400	Left-turn lane or bypass lane Left-turn lane warranted

Highway AADT one year after opening
Posted speed 45 mph or greater

Figure 3.41: Warrant 9 for Right-Turn Lanes

2-Lane Highway AADT	4-Lane Highway AADT	Cross Street or Driveway ADT	Turn Lane Requirement
≥ 1500 AADT	≥ 3000 AADT	> 100	Right-turn lane warranted

Highway AADT one year after opening
Posted speed 45 mph or greater

5.3 Internal Site Circulation

The proposed elementary school site plan is attached in **Appendix H**. The site is also shown on all build figures. The site plan features a separated bus drop off location as well as a longer entrance roadway to accommodate pick-up and drop off queues that are typically present with school operations. As is shown in the site plan, the bus access point includes a dedicated left turn lane for buses to wait for a gap in departing traffic in order to complete their movement. This allows through traffic to continue into the site without backing up towards Highway 61.

Vehicle queues from the traffic signal and roundabout options do not have significant queueing for the eastbound approach and are not anticipated to impact the bus entrance even under the traffic signal No Right Turn on Red scenario.

Pedestrians and bicyclists will have direct access to the Hardwood Creek Trail and will access the school site by only having to interact with vehicles at the school bus site driveway before entering the school. The pedestrian and bicycle connection can be seen in the attached Site Plan.

5.4 Hardwood Creek Trail

The Hardwood Creek Trail is a regional trail currently running parallel to Highway 61 on the west side of the roadway. The trail is currently owned by the Washington County Regional Rail

Authority. With improvements to the 152nd Street intersection, improvements will also be needed for the trail crossing.

Under the signalized control option, the trail crossing should be realigned closer to the intersection. This will allow trail users cross the intersection where a typical non-motorized user would cross and will prevent vehicles queues from obstructing the trail crossing.

Under the roundabout control option, the splitter island on the west leg of the intersection should be large enough to accommodate a bicycle with a baby trailer as well as sufficient boulevard width in order to prevent any quick bicycle turns towards the crosswalk. The concept drawings included in Section 5.5 show each of these recommendations for each alternative.

5.5 Construction Staging Considerations

Conversations with MnDOT's work zone group were had to discuss construction methods, impacts, and requirements of the traffic control alternatives at the intersection of Highway 61 and 152nd Street. Through these discussions, MnDOT stated that typically it is advantageous to construct a roundabout under a complete roadway closure.

To construct a roundabout at Highway 61 and 152nd Street, MnDOT would likely allow a full roadway closure while providing a main roadway detour as well as a secondary detour option for local traffic. The main roadway detour would direct motorists to use CSAH 8 to Interstate 35E and travel north to Highway 97. Motorists would travel east on Highway 97 and then once again enter Highway 61 and travel southbound back toward the roadway closure. This detour is approximately 15 miles in length.

A secondary detour would also be signed for local traffic. This detour would direct motorists east on 147th Street (Oneka Lake Blvd N) to Harrow Avenue N. Motorists would travel north on Harrow Avenue up to 165th Street N and then back west to Highway 61. This detour route is approximately 4 miles in length and would serve primarily the local traffic in the area.

If Highway 61 is closed during construction, one of the biggest challenges will be maintaining access to the east leg of 152nd Street as well as construction traffic on the west leg to construct the school. Due to the limited street network in this location, surrounding wetlands, and the need to accommodate heavy vehicles, there is no efficient way to maintain access at this location at a different access location. This challenge then requires the roundabout to be built under traffic, which will likely include construction of a by-pass lane to maintain traffic on Highway 61 as well as access to 152nd Street. This requirement will increase construction costs as well as add additional delay to the project.

Based upon conversations with MnDOT work zone staff, construction of the traffic signal will also likely require some minor widening as well as a temporary traffic signal system during construction. There will be less motorist impacts under this option when compared to the roundabout control option.

5.6 Concept Drawings and Construction Costs

Concept alternatives were generated for each of the alternatives that were modeled in the Capacity Analysis section of this report. A concept was generated for the geometric modifications and traffic control change to traffic signal control as well as a concept showing a single lane roundabout. Multiple traffic signal alternatives were drawn and analyzed as part of this project. These concepts are shown in **Drawing No. 1, 2, and 3** and **Drawing No. 4.**

Construction costs were developed and refined after conversations and input from project stakeholders for each traffic control alternative. Based on these conversations the following costs were developed:

- Traffic Signal Control with three lanes of approach on the minor street approaches: approximately $2,400,000 (**Drawing No. 1**)
- Traffic Signal Control with two lanes of approach on the minor street approaches: approximately $2,300,000
- Traffic Signal Control with three lanes of approach on the minor street approaches and a center median along Highway 61: approximately $2,950,000 (**Drawing No. 2)**
- Traffic Signal Control with two lanes of approach on the minor street approaches and a center median along Highway 61: approximately $2,850,000 (**Drawing No. 3)**
- Roundabout Control: between $2,300,000 and $2,500,000 based largely on construction staging and traffic control costs (**Drawing No. 4)**

It should be noted the following drawings are preliminary concepts and will be refined as design of the intersection continues, which will require for adjustments to the cost estimates. The current cost estimates do not include costs for right-of-way that may be needed. During preliminary design efforts will be made to minimize right-of-way impacts associated with the chosen alternative.

Detailed cost estimates are attached in **Appendix F**.

Path: X:\FJ\N\SDWB\156183\5-final-dsgn\51-drawings\90-GIS\Figure 13 - Pedestrian Routes.mxd

SEH

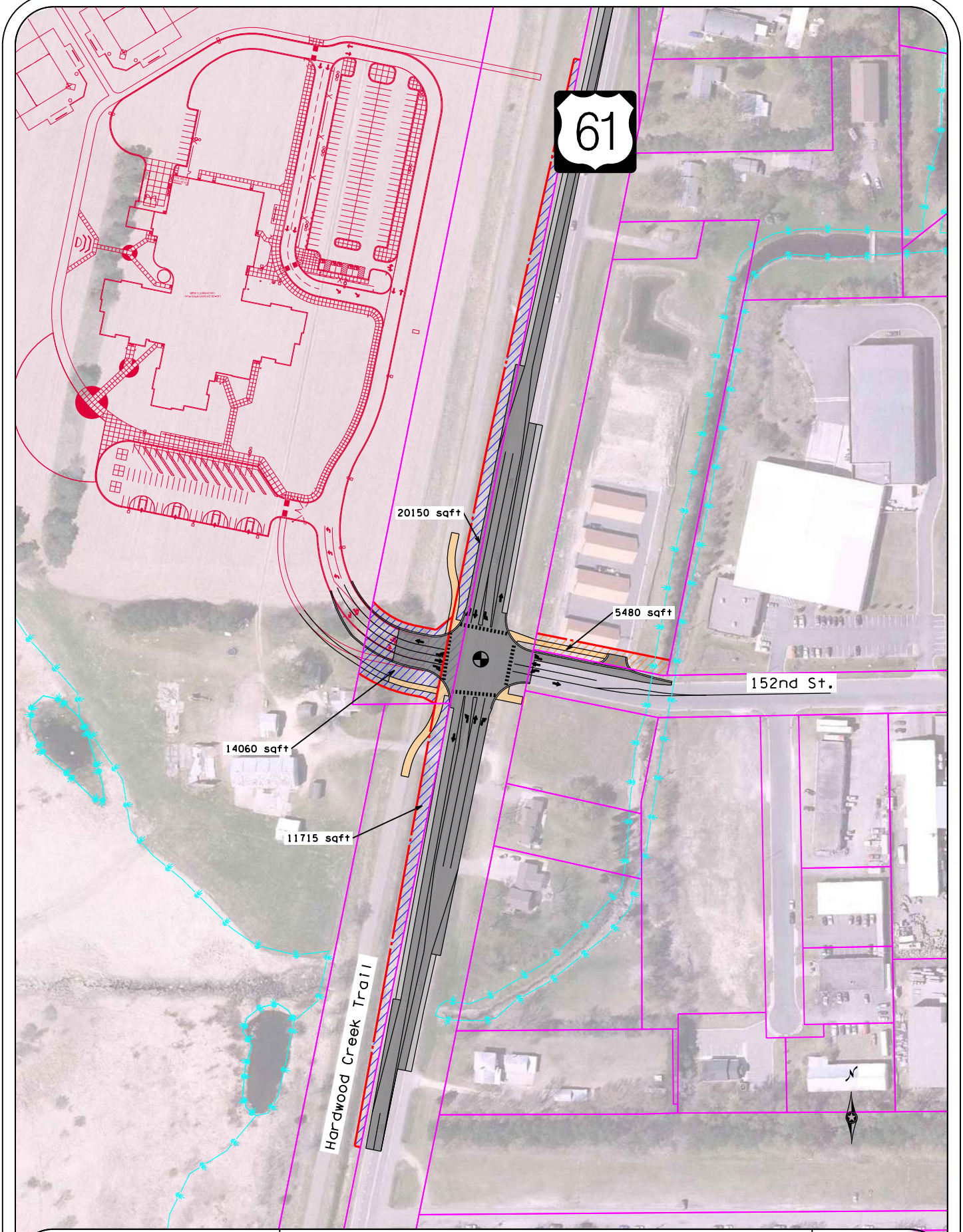
Project: ISDWB 156183
Print Date: 12/8/2020

Map by: jdanibas
Projection: NAD 1983 HARN MN Washington
Source: ESRI

Pedestrian Routes

White Bear Lake Elementary School
Hugo, MN

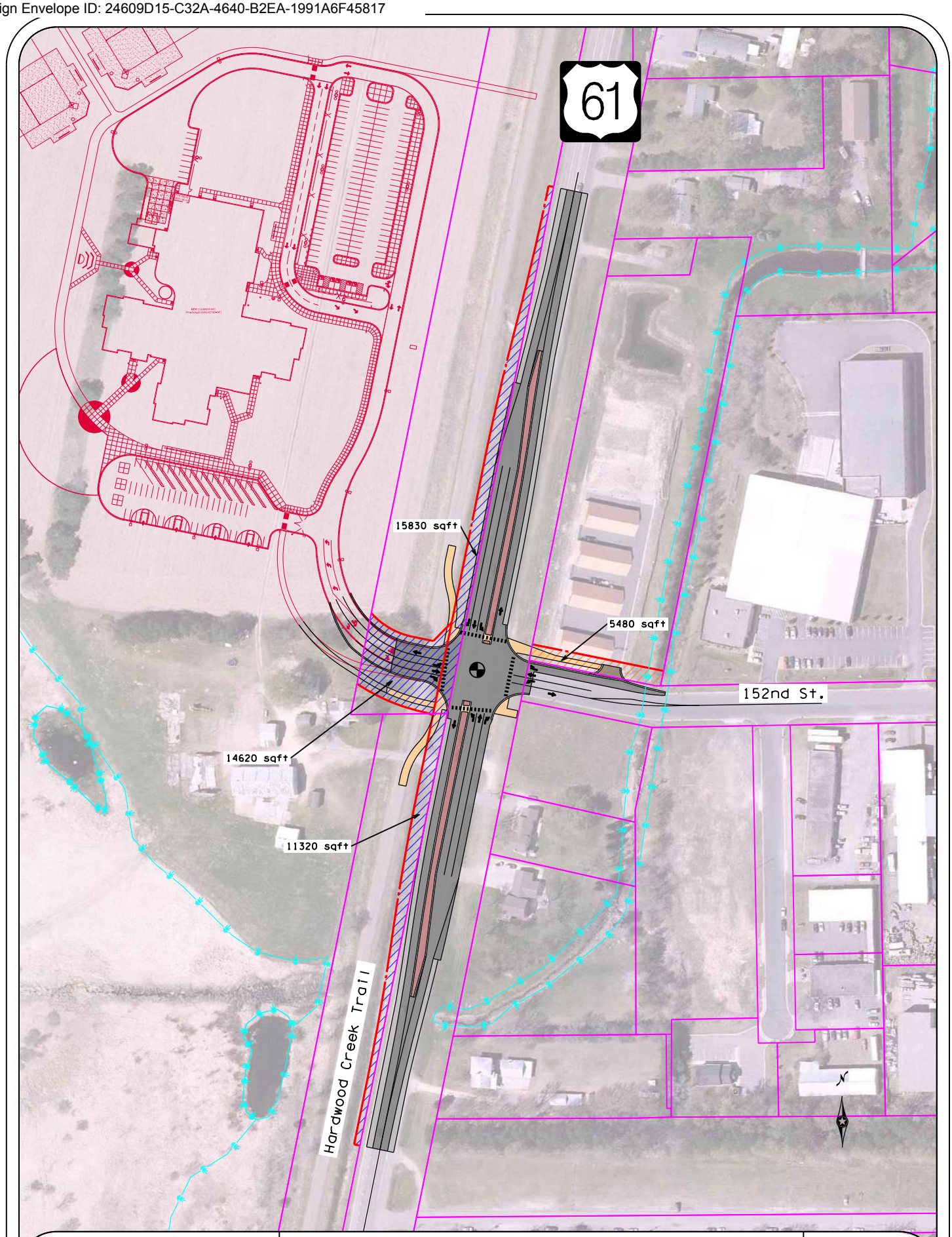
Figure 13



SEH
PHONE: (651) 490-2000
3535 VADNAIS CENTER DR.
ST. PAUL, MN 55110

ISD NO. 624
NEW ELEMENTARY SCHOOL ACCESS
ALTERNATIVE 1a

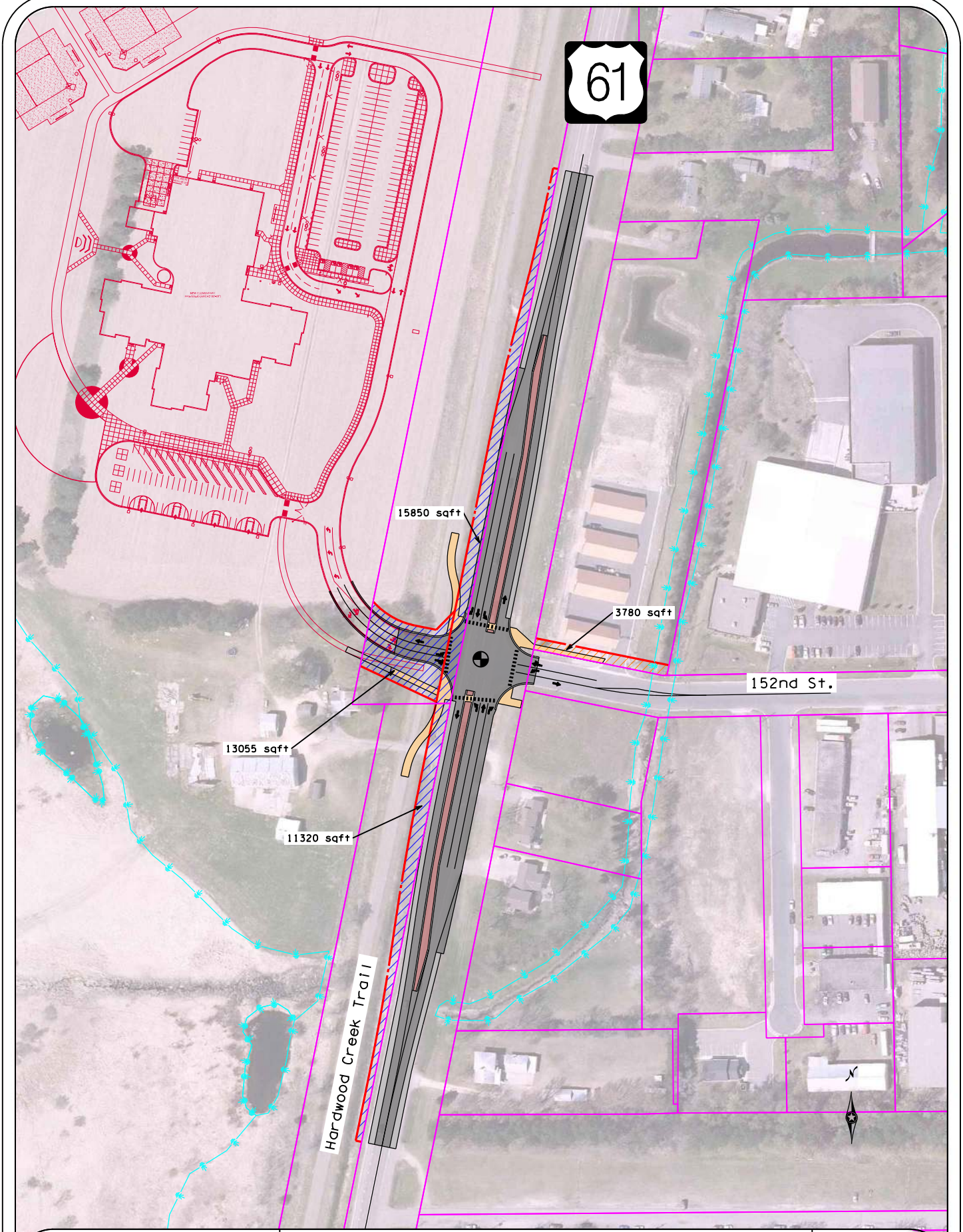
DRAWING NO. 1



SEH
PHONE: (651) 490-2000
3535 VADNAIS CENTER DR.
ST. PAUL, MN 55110

ISD NO. 624
NEW ELEMENTARY SCHOOL ACCESS
ALTERNATIVE 1b

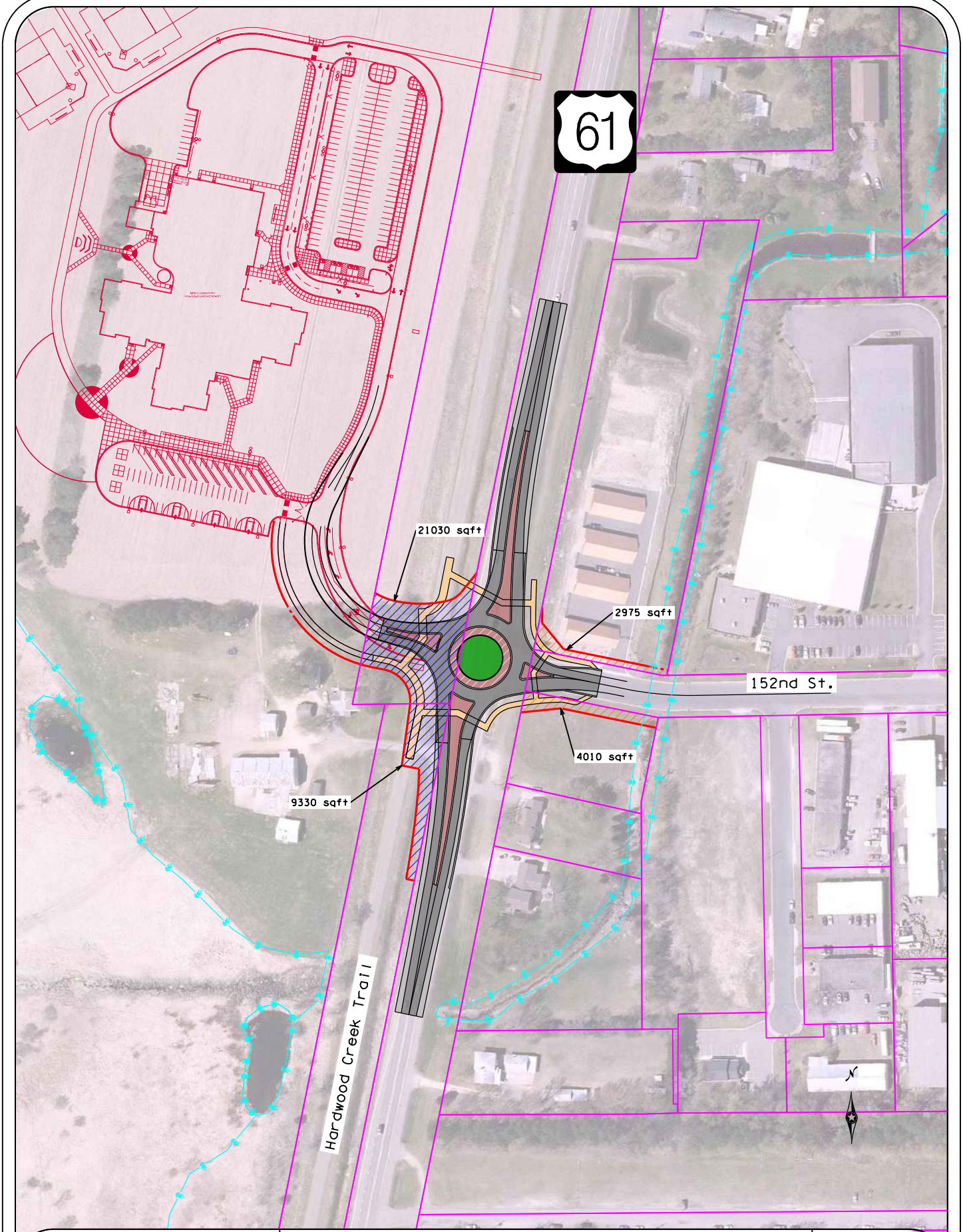
DRAWING NO. 2



SEH
PHONE: (651) 490-2000
3535 VADNAIS CENTER DR.
ST. PAUL, MN 55110

ISD NO. 624
NEW ELEMENTARY SCHOOL ACCESS
ALTERNATIVE 1c

DRAWING NO. 3



SEH
PHONE: (651) 490-2000
3535 VADNAIS CENTER DR.
ST. PAUL, MN 55110

ISD NO. 624
NEW ELEMENTARY SCHOOL ACCESS
ALTERNATIVE 2

DRAWING NO. 4

6 Summary of Findings and Recommendation

This study's purpose is to document the impacts of a proposed elementary school that is to be built at the intersection of Highway 61 and 152nd Street. The analysis included traffic counts that were taken while school was not in session and impacts from COVID-19 were impacting traffic patterns through the study intersections. Traffic counts were adjusted based on previous counts in the area to account for these abnormalities and to develop a sound base volume dataset.

A historical crash analysis was conducted on the three study intersections. This analysis indicated that there was not a sustained crash problem at the intersections of Highway 61 and 147th Street and Highway 61 and 152nd Street. The analysis did however indicate a sustained crash problem at the intersection of Highway 61 and 159th Street. The predominant crash type at this intersection is rear end crashes with almost 50% of all crashes in the last ten years being rear ends. Nine of the eleven rear end crashes in the last ten years involved northbound Highway 61 vehicles.

Trips were generated for the school site for both the expected 2022 year of opening as well as expected full enrollment of the school in year 2026. Trips were assigned to the roadway network based upon conversations with the project team and a draft school attendance boundary.

A future crash analysis was conducted for the intersection of Highway 61 and 152nd Street and based on this analysis the existing side street stop-controlled intersection is expected to have the lowest number of crashes in both the year of opening and full build out year. A single lane roundabout had the next highest number of expected crashes at 1.5 crashes per year during the year of opening and 1.7 crashes per year during the 2026 full build out year. As expected, the traffic signal alternative is expected to have the highest number of expected crashes with 2.2 expected crashes during the year of opening and 2.4 crashes during the 2026 full build out year.

A traffic operations analysis was conducted to evaluate traffic control alternatives at the intersection of Highway 61 and 152nd Street. Operational analysis was conducted for the 2022 year of opening, 2026 full enrollment of the school, and 2031 five years after the full build out of the site. Based on the analysis, a traffic signal operates acceptably through the 2031 design year, even under capacity constraints that were analyzed such as "No Right Turn on Red". The roundabout alternative also operates acceptably through the 2031 design year.

A review of pedestrian and bicycle safety at both traffic signals and roundabouts was conducted. Based on this review, it was determined that roundabouts are beneficial for pedestrians and bicyclists compared to conventional intersections because they have fewer pedestrian-vehicle conflict points, have lower pedestrian delays, lower vehicle speeds, and pedestrians only need to cross one direction of traffic at a time, all of which result in increased pedestrian and bicycle safety. There is limited research however, regarding the pedestrian safety benefits of roundabouts in regard to younger children attempting to cross an intersection. It is recommended that crossing guards be present during peak school arrival and dismissal time periods to help facilitate pedestrian crossings across Highway 61 under roundabout control. Non-motorized safety at traffic signals was also reviewed. Based on our research it was determined that generally, providing signalized crosswalks may help create a safer route to the school for children when compared to the No Build thru-stop condition. There are treatments that should be considered in order to improve pedestrian safety at signalized locations. These treatments can be in the form of timing improvements, equipment improvements, as well as signing changes to limit vehicle movements at the intersection during certain signal phases and crossing guards.

Construction costs were developed and refined after conversations and input from project stakeholders for each traffic control alternative. Based on these conversations the following costs were developed:

- Traffic Signal Control with three lanes of approach on the minor street approaches: approximately $2,400,000 (**Drawing No. 1**)
- Traffic Signal Control with two lanes of approach on the minor street approaches: approximately $2,300,000
- Traffic Signal Control with three lanes of approach on the minor street approaches and a center median along Highway 61: approximately $2,950,000 (**Drawing No. 2)**
- Traffic Signal Control with two lanes of approach on the minor street approaches and a center median along Highway 61: approximately $2,850,000 (**Drawing No. 3)**
- Roundabout Control: between $2,300,000 and $2,500,000 based largely on construction staging and traffic control costs (**Drawing No. 4)**

Due to the very limited number of through movements from the side street approaches at the intersection of Highway 61 and 152nd Street, it is recommended that a dedicated left turn lane and a shared through-right turn lane be provided for both eastbound and westbound 152nd Street. This lane configuration provides a shorter crossing distance for pedestrians and bicyclists using the Hardwood Creek Regional Trail crossing the west leg of the intersection as well as still allowing protected left turn phasing to be utilized for eastbound and westbound left turning traffic.

6.1 Advantages and Disadvantages of Traffic Signal Control and Roundabout Control

There are many advantages and disadvantages of each traffic control alternative analyzed as part of this study. The following sections provide the pros and cons of each traffic control alternative. It should be noted that the advantages and disadvantages of each traffic control alternative is not considered to be an exhaustive list.

6.1.1 Traffic Signal Control

6.1.1.1 Advantages

- Ability for the signal to be coordinated with other adjacent signal systems providing added efficiency during off-peak school times when side street traffic volumes are low.
- Control the flow of traffic at the intersection and provide sufficient time for safe and efficient pedestrian crossings.
- Ability to reduce motor vehicle and pedestrian conflicts through the use of leading pedestrian intervals.
- Can provide audible signals for the visually impaired that indicate when it is appropriate to cross the street.
- Minimized construction impacts when compared to roundabout alternative

- Emergency vehicle priority can be established through the use of emergency vehicle preemption

6.1.1.2 Disadvantages

- Possible increase in motor vehicle crashes compared to the No Build and roundabout control options
    - Rear end crashes are expected to increase at signalized intersections
- Increased number of pedestrian-vehicle conflict points when compared to a roundabout (16 vs. 8)
- Possible increased pedestrian wait times compared to minor street stop or roundabout control
    - The longer pedestrians must wait to cross the street, the more likely they will decide to cross against the signal.
- Higher vehicle speeds crossing through the intersection when compared to roundabout control
- Possible sight line restrictions with the addition of center medians along Highway 61
    - If center medians are provided along Highway 61, sight lines should be evaluated to make sure that left turning vehicles on Highway 61 are able to see oncoming traffic if a left turning queue exists for the opposing left turn movement. Positively offsetting left turns will help increase sight distance, however, will also increase costs.

6.1.2 Roundabout Control

6.1.2.1 Advantages

- Ability to control speeds entering the intersection.
- Increased pedestrian safety
    - Lower vehicle speeds through the intersection
    - Pedestrians only have to cross one direction of traffic at a time, and typically have shorter crossing distances when compared to traffic signals
- Reduced crash severity due to the softening of the angle of potential collisions between vehicles
- Reduced number of pedestrian-vehicle conflict points when compared to a traffic signal (8 vs. 16)
- Reduced pedestrian wait times to cross Highway 61

6.1.2.2 Disadvantages

- Requires a temporary 2-lane bypass required during construction
    - More complex staging, increased construction costs, longer construction duration

- Limited research regarding the pedestrian safety benefits of roundabouts as they pertain to younger children and their ability to safely cross the roadway unassisted.
- Traffic flow along Highway 61 is slowed as all vehicles must slow for the roundabout, however, limited stops when conflicting movements are not present.
- Difficult crossing for visually impaired pedestrians.
- No priority given to emergency vehicles, as roundabouts assign right of way equally throughout the intersection

6.2 Recommendations

A traffic signal without center medians and two lanes of approach on the minor street approaches is recommended at the intersection of Highway 61 and 152nd Street. This traffic control is recommended because it operates acceptably through the 2031 design year, provides efficiency for northbound and southbound Highway 61 during off-peak times, has the ability to provide sufficient crossing times across Highway 61 during peak times, and has minimized construction impacts when compared to the roundabout alternative.

As a consideration, crossing safety at the signalized intersection can be further improved through the use of crossing guards to help aid in children crossing the roadway during school arrival and dismissal time periods.

CMJ

Appendix A

Crash History Analysis Tables

Table A1
ISD No. 624 Hugo Elementary School Traffic Study
Jan 2009 to Dec 2019 Crash Data
MnDOT Crash Mapping Software Information

Study Intersections			Crash Severity						INTERSECTION CRASH RATE INFORMATION				FATAL AND SEV A RATE INFORMATION		
									Crash Rate	Critical Rates	Critical Index	MnDOT Average	FAR Rate	Critical Rates	MnDOT Average
Intersection	Control Type	Entering ADT	Fatal	A	B	C	Property	Total	Crash Rate	Crash Rate	Critical Index	Crash Rate	FAR Rate	FAR Rate	FAR Rate
Highway 61 at 159th Street	Thru/Stop (U)	12,380	1	0	6	6	11	24	**0.53**	**0.37**	**1.43**	**0.19**	2.21	2.58	**0.35**
Highway 61 at 152nd Street	Thru/Stop (U)	12,050	0	0	0	1	1	2	0.05	0.48	0.10	0.19	0.00	4.35	0.57
Highway 61 at 147th Street**	Signal (1)	15,080	0	1	2	5	10	18	0.33	0.80	0.41	0.54	1.82	2.89	**0.62**
TOTAL			**1**	**1**	**8**	**12**	**22**	**44**							
			2%	**2%**	**18%**	**27%**	**50%**	**100%**							

Critical Rate Exceeded | Critical Index ≥ 1 | Critical Index ≥ 0.85 | Average Rate Exceeded

Critical FAR Rate Exceeded | Average FAR Rate Exceeded

NOTES:

**Signalized Intersections

Crash Rates - Number of crashes per million entering vehicles

FAR Rates - Number of Fatal and Severity A crashes per 100 million entering vehicles

Exceeding the Calculated Critical Rates indicated a sustained crash problem.

Control Type - Thru/Sop (U) - Urban

Control Type - Thru/Sop (R) - Rural

MnDOT Statewide Average Rates (2015 Data; 10-Year)*

Intersection Type	Crash Rate
Signal (1) - Low Volume, Low Speed	0.54
Signal (2) -Low Volume, High Speed	0.45
Thru/Stop - Urban	0.19

Table A2
ISD No. 624 Hugo Elementary School Traffic Study
Jan 2009 to Dec 2019 Crash Data
MnDOT Crash Mapping Software Information

Study Intersections	Diagram - Crash Type							Pedestrian / Bicycle Crashes	
Intersection	Rear End	Right Angle	Sideswipe	Head On	Single Vehicle	Other	Total	Pedestrian	Bicycle
Highway 61 at 159th Street	11	5	3	1	1	3	24	0	0
Highway 61 at 152nd Street	1	1	0	0	0	0	2	0	0
Highway 61 at 147th Street**	9	3	0	2	1	4	19	0	0
TOTAL	**21**	**9**	**3**	**3**	**2**	**7**	**45**	**0**	**0**

NOTES:
**Signalized Intersections

Appendix B

Warrant Analyses

SHORT ELLIOTT HENDRICKSON INC.

10901 Red Circle Drive, Suite 200
Minnetonka, MN 55343

COVID Adjusted Existing 2020 - TH 61 at 152nd St
ALL WAY STOP
WARRANT ANALYSIS

LOCATION: TH 61 at 152nd St
COUNTY: Washington
REF. POINT: 0
DATE: 11/2/2020

OPERATOR: LJ

85th% Speed	Approach Description		Lanes	Approach Total
55	Major App1:	TH 61 NB	2	6148
55	Major App3:	TH 61 SB	2	6622
30	Minor App2:	152nd St EB	0	0
30	Minor App4:	152nd St WB	1	612

0.70 SPEED FACTOR USED? **Yes**

Minimum Volume Requirement
210 **140**

HOUR	MAJOR APP. 1	MAJOR APP. 3	MINOR APP. 2	MINOR APP. 4	MAJOR APPROACH TOTAL Σ (APP.1 + APP. 3)	MINOR APPROACH TOTAL Σ (APP.2 + APP. 4)	WARRANT MET MAJOR / MINOR
0:00 - 1:00	0	0	0	0	0	0	NO / NO
1:00 - 2:00	0	0	0	0	0	0	NO / NO
2:00 - 3:00	0	0	0	0	0	0	NO / NO
3:00 - 4:00	0	0	0	0	0	0	NO / NO
4:00 - 5:00	0	0	0	0	0	0	NO / NO
5:00 - 6:00	0	0	0	0	0	0	NO / NO
6:00 - 7:00	193	955	0	18	1148	18	YES / NO
7:00 - 8:00	268	920	0	17	1188	17	YES / NO
8:00 - 9:00	343	599	0	28	942	28	YES / NO
9:00 - 10:00	300	489	0	20	789	20	YES / NO
10:00 - 11:00	358	377	0	28	735	28	YES / NO
11:00 - 12:00	350	397	0	71	747	71	YES / NO
12:00 - 13:00	492	392	0	74	884	74	YES / NO
13:00 - 14:00	424	372	0	49	796	49	YES / NO
14:00 - 15:00	502	406	0	58	908	58	YES / NO
15:00 - 16:00	721	426	0	93	1147	93	YES / NO
16:00 - 17:00	825	456	0	67	1281	67	YES / NO
17:00 - 18:00	735	409	0	63	1144	63	YES / NO
18:00 - 19:00	637	424	0	26	1061	26	YES / NO
19:00 - 20:00	0	0	0	0	0	0	NO / NO
20:00 - 21:00	0	0	0	0	0	0	NO / NO
21:00 - 22:00	0	0	0	0	0	0	NO / NO
22:00 - 23:00	0	0	0	0	0	0	NO / NO
23:00 - 24:00	0	0	0	0	0	0	NO / NO
Daily	**6148**	**6622**	**0**	**612**			

	Met (Hr)	Required (Hr)
Hours met for warrant:	**0**	**8**

All-way Stop Warrant: **Not satisfied**

REMARKS:

SHORT ELLIOTT HENDRICKSON INC.

10901 Red Circle Drive, Suite 200
Minnetonka, MN 55343

Future Build 2022 - TH 61 at 152nd St
ALL WAY STOP
WARRANT ANALYSIS

LOCATION: TH 61 at 152nd St
COUNTY: Washington
REF. POINT: 0
DATE: 11/2/2020

OPERATOR: LJ

85th% Speed	Approach Description		Lanes	Approach Total
55	Major App1:	TH 61 NB	2	6807
55	Major App3:	TH 61 SB	2	6936
30	Minor App2:	152nd St EB	2	450
30	Minor App4:	152nd St WB	1	612

0.70 SPEED FACTOR USED? **Yes**

Minimum Volume Requirement
210 **140**

HOUR	MAJOR APP. 1	MAJOR APP. 3	MINOR APP. 2	MINOR APP. 4	MAJOR APPROACH TOTAL Σ (APP.1 + APP. 3)	MINOR APPROACH TOTAL Σ (APP.2 + APP. 4)	WARRANT MET MAJOR / MINOR
0:00 - 1:00	0	0	0	0	0	0	NO / NO
1:00 - 2:00	0	0	0	0	0	0	NO / NO
2:00 - 3:00	0	0	0	0	0	0	NO / NO
3:00 - 4:00	0	0	0	0	0	0	NO / NO
4:00 - 5:00	0	0	0	0	0	0	NO / NO
5:00 - 6:00	0	0	0	0	0	0	NO / NO
6:00 - 7:00	214	996	4	18	1210	22	YES / NO
7:00 - 8:00	293	960	4	17	1253	21	YES / NO
8:00 - 9:00	418	629	50	28	1047	78	YES / NO
9:00 - 10:00	455	525	159	20	980	179	**YES / YES**
10:00 - 11:00	379	391	8	28	770	36	YES / NO
11:00 - 12:00	369	412	8	71	781	79	YES / NO
12:00 - 13:00	521	408	12	74	929	86	YES / NO
13:00 - 14:00	451	391	8	49	842	57	YES / NO
14:00 - 15:00	537	426	20	58	963	78	YES / NO
15:00 - 16:00	817	451	90	93	1268	183	**YES / YES**
16:00 - 17:00	892	478	47	67	1370	114	YES / NO
17:00 - 18:00	794	429	36	63	1223	99	YES / NO
18:00 - 19:00	667	440	4	26	1107	30	YES / NO
19:00 - 20:00	0	0	0	0	0	0	NO / NO
20:00 - 21:00	0	0	0	0	0	0	NO / NO
21:00 - 22:00	0	0	0	0	0	0	NO / NO
22:00 - 23:00	0	0	0	0	0	0	NO / NO
23:00 - 24:00	0	0	0	0	0	0	NO / NO
Daily	**6807**	**6936**	**450**	**612**			

	Met (Hr)	Required (Hr)
Hours met for warrant:	**2**	**8**

All-way Stop Warrant: **Not satisfied**

REMARKS:

SHORT ELLIOTT HENDRICKSON INC.

10901 Red Circle Drive, Suite 200
Minnetonka, MN 55343

Future Build 2026 - TH 61 at 152nd St
ALL WAY STOP
WARRANT ANALYSIS

LOCATION: TH 61 at 152nd St
COUNTY: Washington
REF. POINT: 0
DATE: 11/2/2020

OPERATOR: LJ

85th% Speed	Approach Description		Lanes	Approach Total
55	Major App1:	TH 61 NB	2	7449
55	Major App3:	TH 61 SB	2	7479
30	Minor App2:	152nd St EB	2	651
30	Minor App4:	152nd St WB	1	616

0.70 SPEED FACTOR USED? **Yes**

Minimum Volume Requirement
210 **140**

HOUR	MAJOR APP. 1	MAJOR APP. 3	MINOR APP. 2	MINOR APP. 4	MAJOR APPROACH TOTAL Σ (APP.1 + APP. 3)	MINOR APPROACH TOTAL Σ (APP.2 + APP. 4)	WARRANT MET MAJOR / MINOR
0:00 - 1:00	0	0	0	0	0	0	NO / NO
1:00 - 2:00	0	0	0	0	0	0	NO / NO
2:00 - 3:00	0	0	0	0	0	0	NO / NO
3:00 - 4:00	0	0	0	0	0	0	NO / NO
4:00 - 5:00	0	0	0	0	0	0	NO / NO
5:00 - 6:00	0	0	0	0	0	0	NO / NO
6:00 - 7:00	230	1068	8	18	1298	26	YES / NO
7:00 - 8:00	316	1032	8	17	1348	25	YES / NO
8:00 - 9:00	469	679	72	28	1148	100	YES / NO
9:00 - 10:00	540	570	229	20	1110	249	**YES / YES**
10:00 - 11:00	409	421	12	28	830	40	YES / NO
11:00 - 12:00	400	447	8	72	847	80	YES / NO
12:00 - 13:00	561	441	20	75	1002	95	YES / NO
13:00 - 14:00	486	420	12	49	906	61	YES / NO
14:00 - 15:00	583	458	28	58	1041	86	YES / NO
15:00 - 16:00	904	487	131	95	1391	226	**YES / YES**
16:00 - 17:00	971	517	69	67	1488	136	YES / NO
17:00 - 18:00	864	464	50	63	1328	113	YES / NO
18:00 - 19:00	716	475	4	26	1191	30	YES / NO
19:00 - 20:00	0	0	0	0	0	0	NO / NO
20:00 - 21:00	0	0	0	0	0	0	NO / NO
21:00 - 22:00	0	0	0	0	0	0	NO / NO
22:00 - 23:00	0	0	0	0	0	0	NO / NO
23:00 - 24:00	0	0	0	0	0	0	NO / NO
Daily	**7449**	**7479**	**651**	**616**			

	Met (Hr)	Required (Hr)
Hours met for warrant:	**2**	**8**

All-way Stop Warrant: **Not satisfied**

REMARKS:

SHORT ELLIOTT HENDRICKSON INC.
10901 Red Circle Drive, Suite 200
Minnetonka, MN 55343

COVID Adjusted Existing 2020 - TH 61 at 152nd St
SIGNAL WARRANT
ANALYSIS

LOCATION: TH 61 at 152nd St
COUNTY: Washington
REF. POINT: 0
DATE: 11/2/2020

OPERATOR: LJ

85th% Speed	Approach Description		Lanes	Approach
55	Major App1:	TH 61 NB	2	6148
55	Major App3:	TH 61 SB	2	6622
30	Minor App2:	152nd St EB	0	0
30	Minor App4:	152nd St WB	1	415

40 MPH OR FASTER?	YES
POPULATION < 10,000?	NO
VOLUME REQ. AT 70%?	**YES**
CORRECTABLE CRASHES: (12-month period)	0

	Minimum Volume Requirement		
	1A	1B	1A&B (80%)
Major Total	420	630	504
Minor Approach	105	53	84

HOUR	MAJOR APP. 1	MAJOR APP. 3	MINOR APP. 2	MINOR APP. 4	MAJOR APPROACH TOTAL Σ (APP.1 + APP. 3)	MAX MINOR APPROACH (APP. 2 or 4)	WARRANT 1A - 8 hr MAJOR/MINOR	WARRANT 1B - 8 hr MAJOR/MINOR	WARRANT 1A & B MAJOR/MINOR
0:00 - 1:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
1:00 - 2:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
2:00 - 3:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
3:00 - 4:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
4:00 - 5:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
5:00 - 6:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
6:00 - 7:00	193	955	0	17	1148	17	YES / NO	YES / NO	YES / NO
7:00 - 8:00	268	920	0	14	1188	14	YES / NO	YES / NO	YES / NO
8:00 - 9:00	343	599	0	21	942	21	YES / NO	YES / NO	YES / NO
9:00 - 10:00	300	489	0	16	789	16	YES / NO	YES / NO	YES / NO
10:00 - 11:00	358	377	0	21	735	21	YES / NO	YES / NO	YES / NO
11:00 - 12:00	350	397	0	49	747	49	YES / NO	YES / NO	YES / NO
12:00 - 13:00	492	392	0	53	884	53	YES / NO	**YES / YES**	YES / NO
13:00 - 14:00	424	372	0	30	796	30	YES / NO	YES / NO	YES / NO
14:00 - 15:00	502	406	0	41	908	41	YES / NO	YES / NO	YES / NO
15:00 - 16:00	721	426	0	60	1147	60	YES / NO	**YES / YES**	YES / NO
16:00 - 17:00	825	456	0	38	1281	38	YES / NO	YES / NO	YES / NO
17:00 - 18:00	735	409	0	39	1144	39	YES / NO	YES / NO	YES / NO
18:00 - 19:00	637	424	0	16	1061	16	YES / NO	YES / NO	YES / NO
19:00 - 20:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
20:00 - 21:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
21:00 - 22:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
22:00 - 23:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
23:00 - 24:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
Daily	**6148**	**6622**	**0**	**415**					

		Met (Hr)	Required (Hr)	WARRANT MET:
Warrant 1	**Eight Hour Volumes**	2	8	Not satisfied
Warrant 1A	Minimum Vehicular Volume	0	8	Not satisfied
Warrant 1B	Interruption of Continuous Flow	2	8	Not satisfied
1A & 1B	Combination of Warrants	0	8	Not satisfied
Warrant 2	**Four Hour Volumes**	0	4	Not satisfied
Warrant 3	**Peak Hour Volumes**	0	1	Not satisfied
Warrant 7	**Crash Experience**	1	8	Not satisfied

COMMENTS:

SHORT ELLIOTT HENDRICKSON INC.
10901 Red Circle Drive, Suite 200
Minnetonka, MN 55343

COVID Adjusted Existing 2020 - TH 61 at 152nd St
SIGNAL WARRANT
ANALYSIS

LOCATION: TH 61 at 152nd St
COUNTY: Washington
REF. POINT: 0
DATE: 11/2/2020

OPERATOR: LJ

40 MPH OR FASTER?	YES
POPULATION < 10,000?	NO
VOLUME REQ. AT 70%?	**YES**

85th% Speed	Approach Description		Lanes	Approach
55	Major App1:	TH 61 NB	2	6148
55	Major App3:	TH 61 SB	2	6622
30	Minor App2:	152nd St EB	0	0
30	Minor App4:	152nd St WB	1	415

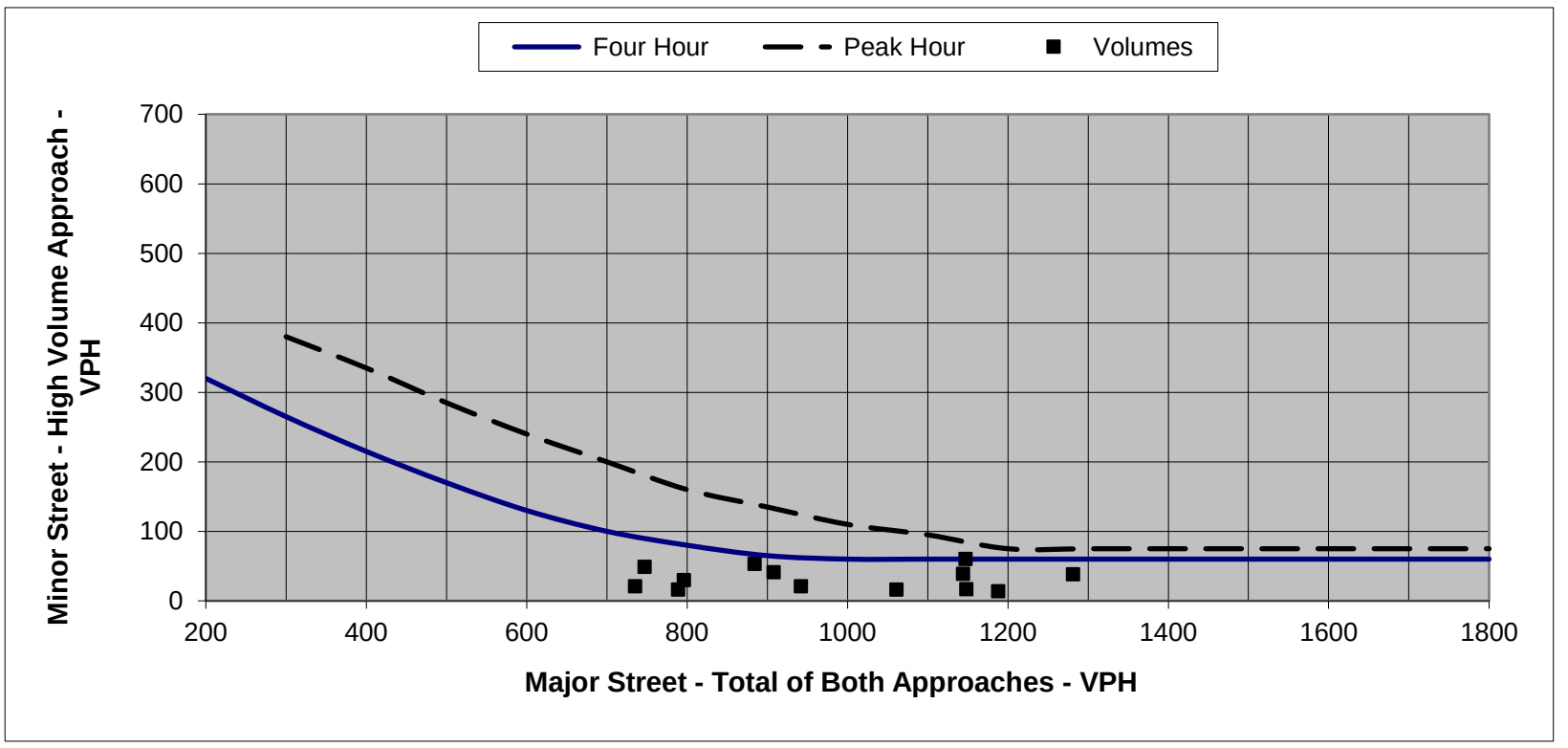


Figure 1. Four Hour and Peak Hour Warrant Analysis

Note: For data points outside the graph range, check the minor street volume against the lower thresholds

Warrant Criteria (Graph)		
Major Approach	Minor App. Four Hour	Minor App. Peak Hour
200	320	
300	265	380
400	215	335
500	170	285
600	130	240
700	100	200
800	80	160
900	65	135
1000	60	110
1100	60	95
1200	60	75
1300	60	75
1400	60	75
1500	60	75
1600	60	75
1700	60	75
1800	60	75

Actual Hourly Count			Warrants Met:	
			Warrant 2	Warrant 3
HOUR	Sum Major App.	Max Minor App.	Four Hour	Peak Hour
0:00 - 1:00	0	0	NO	NO
1:00 - 2:00	0	0	NO	NO
2:00 - 3:00	0	0	NO	NO
3:00 - 4:00	0	0	NO	NO
4:00 - 5:00	0	0	NO	NO
5:00 - 6:00	0	0	NO	NO
6:00 - 7:00	1148	17	NO	NO
7:00 - 8:00	1188	14	NO	NO
8:00 - 9:00	942	21	NO	NO
9:00 - 10:00	789	16	NO	NO
10:00 - 11:00	735	21	NO	NO
11:00 - 12:00	747	49	NO	NO
12:00 - 13:00	884	53	NO	NO
13:00 - 14:00	796	30	NO	NO
14:00 - 15:00	908	41	NO	NO
15:00 - 16:00	1147	60	NO	NO
16:00 - 17:00	1281	38	NO	NO
17:00 - 18:00	1144	39	NO	NO
18:00 - 19:00	1061	16	NO	NO
19:00 - 20:00	0	0	NO	NO
20:00 - 21:00	0	0	NO	NO
21:00 - 22:00	0	0	NO	NO
22:00 - 23:00	0	0	NO	NO
23:00 - 24:00	0	0	NO	NO

S:\KO\M\Mntmd\153052\8-planning\87-rpt-stud\FYA & TOD Forms\Faribault\[FYA TOD TH 60 and 2nd Avenue - 03-25-2020.xlsx]Ø5 Eastbound

SHORT ELLIOTT HENDRICKSON INC.

10901 Red Circle Drive, Suite 200
Minnetonka, MN 55343

Future Build 2022 - TH 61 at 152nd St
SIGNAL WARRANT
ANALYSIS

LOCATION: TH 61 at 152nd St
COUNTY: Washington
REF. POINT: 0
DATE: 11/2/2020

OPERATOR: LJ

85th% Speed	Approach	Description	Lanes	Approach
55	Major App1:	TH 61 NB	2	6807
55	Major App3:	TH 61 SB	2	6936
30	Minor App2:	152nd St EB	2	46
30	Minor App4:	152nd St WB	1	415

40 MPH OR FASTER?	YES
POPULATION < 10,000?	NO
VOLUME REQ. AT 70%?	**YES**
CORRECTABLE CRASHES: (12-month period)	0

	Minimum Volume Requirement		
	1A	1B	1A&B (80%)
Major Total	420	630	504
Minor Approach	140	70	112

HOUR	MAJOR APP. 1	MAJOR APP. 3	MINOR APP. 2	MINOR APP. 4	MAJOR APPROACH TOTAL Σ (APP.1 + APP. 3)	MAX MINOR APPROACH (APP. 2 or 4)	WARRANT 1A - 8 hr MAJOR/MINOR	WARRANT 1B - 8 hr MAJOR/MINOR	WARRANT 1A & B MAJOR/MINOR
0:00 - 1:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
1:00 - 2:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
2:00 - 3:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
3:00 - 4:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
4:00 - 5:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
5:00 - 6:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
6:00 - 7:00	214	996	0	17	1210	17	YES / NO	YES / NO	YES / NO
7:00 - 8:00	293	960	0	14	1253	14	YES / NO	YES / NO	YES / NO
8:00 - 9:00	418	629	6	21	1047	21	YES / NO	YES / NO	YES / NO
9:00 - 10:00	455	525	17	16	980	17	YES / NO	YES / NO	YES / NO
10:00 - 11:00	379	391	0	21	770	21	YES / NO	YES / NO	YES / NO
11:00 - 12:00	369	412	0	49	781	49	YES / NO	YES / NO	YES / NO
12:00 - 13:00	521	408	0	53	929	53	YES / NO	YES / NO	YES / NO
13:00 - 14:00	451	391	0	30	842	30	YES / NO	YES / NO	YES / NO
14:00 - 15:00	537	426	4	41	963	41	YES / NO	YES / NO	YES / NO
15:00 - 16:00	817	451	10	60	1268	60	YES / NO	YES / NO	YES / NO
16:00 - 17:00	892	478	5	38	1370	38	YES / NO	YES / NO	YES / NO
17:00 - 18:00	794	429	4	39	1223	39	YES / NO	YES / NO	YES / NO
18:00 - 19:00	667	440	0	16	1107	16	YES / NO	YES / NO	YES / NO
19:00 - 20:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
20:00 - 21:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
21:00 - 22:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
22:00 - 23:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
23:00 - 24:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
Daily	**6807**	**6936**	**46**	**415**					

		Met (Hr)	Required (Hr)	WARRANT MET:
Warrant 1	**Eight Hour Volumes**	0	8	Not satisfied
Warrant 1A	Minimum Vehicular Volume	0	8	Not satisfied
Warrant 1B	Interruption of Continuous Flow	0	8	Not satisfied
1A & 1B	Combination of Warrants	0	8	Not satisfied
Warrant 2	**Four Hour Volumes**	0	4	Not satisfied
Warrant 3	**Peak Hour Volumes**	0	1	Not satisfied
Warrant 7	**Crash Experience**	0	8	Not satisfied

COMMENTS:

SHORT ELLIOTT HENDRICKSON INC.
10901 Red Circle Drive, Suite 200
Minnetonka, MN 55343

Future Build 2022 - TH 61 at 152nd St
SIGNAL WARRANT
ANALYSIS

LOCATION: TH 61 at 152nd St
COUNTY: Washington
REF. POINT: 0
DATE: 11/2/2020

OPERATOR: LJ

40 MPH OR FASTER?	YES
POPULATION < 10,000?	NO
VOLUME REQ. AT 70%?	**YES**

85th% Speed	Approach	Description	Lanes	Approach
55	Major App1:	TH 61 NB	2	6807
55	Major App3:	TH 61 SB	2	6936
30	Minor App2:	152nd St EB	2	46
30	Minor App4:	152nd St WB	1	415

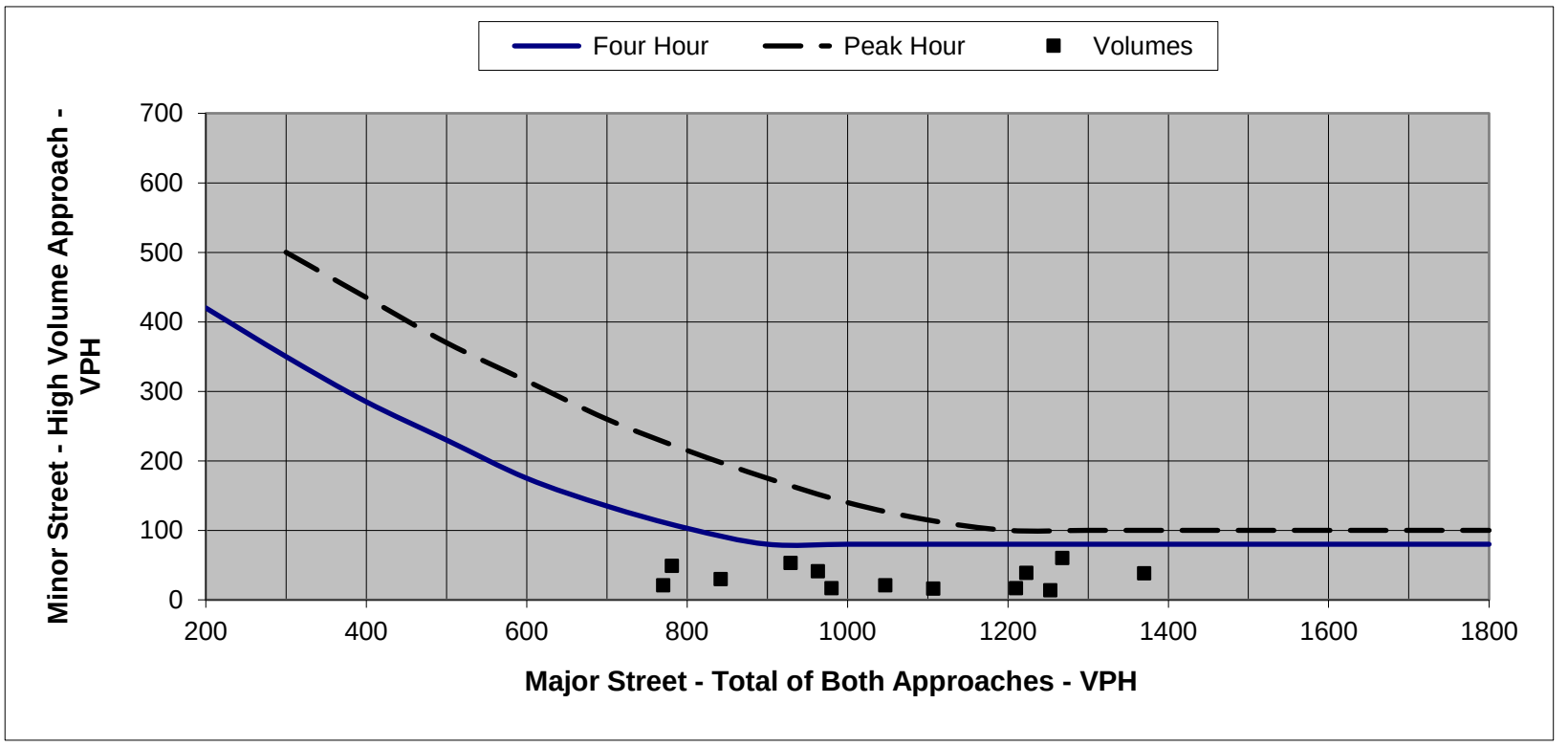


Figure 1. Four Hour and Peak Hour Warrant Analysis
Note: For data points outside the graph range, check the minor street volume against the lower thresholds

Warrant Criteria (Graph)		
Major Approach	Minor App. Four Hour	Minor App. Peak Hour
200	420	
300	350	500
400	285	435
500	230	370
600	175	315
700	135	260
800	103	215
900	80	175
1000	80	140
1100	80	115
1200	80	100
1300	80	100
1400	80	100
1500	80	100
1600	80	100
1700	80	100
1800	80	100

Actual Hourly Count			Warrants Met:	
			Warrant 2	Warrant 3
HOUR	Sum Major App.	Max Minor App.	Four Hour	Peak Hour
0:00 - 1:00	0	0	NO	NO
1:00 - 2:00	0	0	NO	NO
2:00 - 3:00	0	0	NO	NO
3:00 - 4:00	0	0	NO	NO
4:00 - 5:00	0	0	NO	NO
5:00 - 6:00	0	0	NO	NO
6:00 - 7:00	1210	17	NO	NO
7:00 - 8:00	1253	14	NO	NO
8:00 - 9:00	1047	21	NO	NO
9:00 - 10:00	980	17	NO	NO
10:00 - 11:00	770	21	NO	NO
11:00 - 12:00	781	49	NO	NO
12:00 - 13:00	929	53	NO	NO
13:00 - 14:00	842	30	NO	NO
14:00 - 15:00	963	41	NO	NO
15:00 - 16:00	1268	60	NO	NO
16:00 - 17:00	1370	38	NO	NO
17:00 - 18:00	1223	39	NO	NO
18:00 - 19:00	1107	16	NO	NO
19:00 - 20:00	0	0	NO	NO
20:00 - 21:00	0	0	NO	NO
21:00 - 22:00	0	0	NO	NO
22:00 - 23:00	0	0	NO	NO
23:00 - 24:00	0	0	NO	NO

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SHORT ELLIOTT HENDRICKSON INC.

10901 Red Circle Drive, Suite 200
Minnetonka, MN 55343

Future Build 2026 - TH 61 at 152nd St
SIGNAL WARRANT
ANALYSIS

LOCATION: TH 61 at 152nd St
COUNTY: Washington
REF. POINT: 0
DATE: 11/2/2020

OPERATOR: LJ

85th% Speed	Approach	Description	Lanes	Approach
55	Major App1:	TH 61 NB	2	7449
55	Major App3:	TH 61 SB	2	7479
30	Minor App2:	152nd St EB	2	66
30	Minor App4:	152nd St WB	1	418

40 MPH OR FASTER?	YES
POPULATION < 10,000?	NO
VOLUME REQ. AT 70%?	**YES**
CORRECTABLE CRASHES: (12-month period)	0

	Minimum Volume Requirement		
	1A	1B	1A&B (80%)
Major Total	420	630	504
Minor Approach	140	70	112

HOUR	MAJOR APP. 1	MAJOR APP. 3	MINOR APP. 2	MINOR APP. 4	MAJOR APPROACH TOTAL Σ (APP.1 + APP. 3)	MAX MINOR APPROACH (APP. 2 or 4)	WARRANT 1A - 8 hr MAJOR/MINOR	WARRANT 1B - 8 hr MAJOR/MINOR	WARRANT 1A & B MAJOR/MINOR
0:00 - 1:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
1:00 - 2:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
2:00 - 3:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
3:00 - 4:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
4:00 - 5:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
5:00 - 6:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
6:00 - 7:00	230	1068	0	17	1298	17	YES / NO	YES / NO	YES / NO
7:00 - 8:00	316	1032	0	14	1348	14	YES / NO	YES / NO	YES / NO
8:00 - 9:00	469	679	7	21	1148	21	YES / NO	YES / NO	YES / NO
9:00 - 10:00	540	570	23	16	1110	23	YES / NO	YES / NO	YES / NO
10:00 - 11:00	409	421	0	21	830	21	YES / NO	YES / NO	YES / NO
11:00 - 12:00	400	447	0	50	847	50	YES / NO	YES / NO	YES / NO
12:00 - 13:00	561	441	4	54	1002	54	YES / NO	YES / NO	YES / NO
13:00 - 14:00	486	420	0	30	906	30	YES / NO	YES / NO	YES / NO
14:00 - 15:00	583	458	4	41	1041	41	YES / NO	YES / NO	YES / NO
15:00 - 16:00	904	487	14	61	1391	61	YES / NO	YES / NO	YES / NO
16:00 - 17:00	971	517	8	38	1488	38	YES / NO	YES / NO	YES / NO
17:00 - 18:00	864	464	6	39	1328	39	YES / NO	YES / NO	YES / NO
18:00 - 19:00	716	475	0	16	1191	16	YES / NO	YES / NO	YES / NO
19:00 - 20:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
20:00 - 21:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
21:00 - 22:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
22:00 - 23:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
23:00 - 24:00	0	0	0	0	0	0	NO / NO	NO / NO	NO / NO
Daily	**7449**	**7479**	**66**	**418**					

		Met (Hr)	Required (Hr)	WARRANT MET:
Warrant 1	**Eight Hour Volumes**	0	8	Not satisfied
Warrant 1A	Minimum Vehicular Volume	0	8	Not satisfied
Warrant 1B	Interruption of Continuous Flow	0	8	Not satisfied
1A & 1B	Combination of Warrants	0	8	Not satisfied
Warrant 2	**Four Hour Volumes**	0	4	Not satisfied
Warrant 3	**Peak Hour Volumes**	0	1	Not satisfied
Warrant 7	**Crash Experience**	0	8	Not satisfied

COMMENTS:

SHORT ELLIOTT HENDRICKSON INC.
10901 Red Circle Drive, Suite 200
Minnetonka, MN 55343

Future Build 2026 - TH 61 at 152nd St
SIGNAL WARRANT
ANALYSIS

LOCATION: TH 61 at 152nd St
COUNTY: Washington
REF. POINT: 0
DATE: 11/2/2020

OPERATOR: LJ

40 MPH OR FASTER?	YES
POPULATION < 10,000?	NO
VOLUME REQ. AT 70%?	**YES**

85th% Speed	Approach Description		Lanes	Approach
55	Major App1:	TH 61 NB	2	7449
55	Major App3:	TH 61 SB	2	7479
30	Minor App2:	152nd St EB	2	66
30	Minor App4:	152nd St WB	1	418

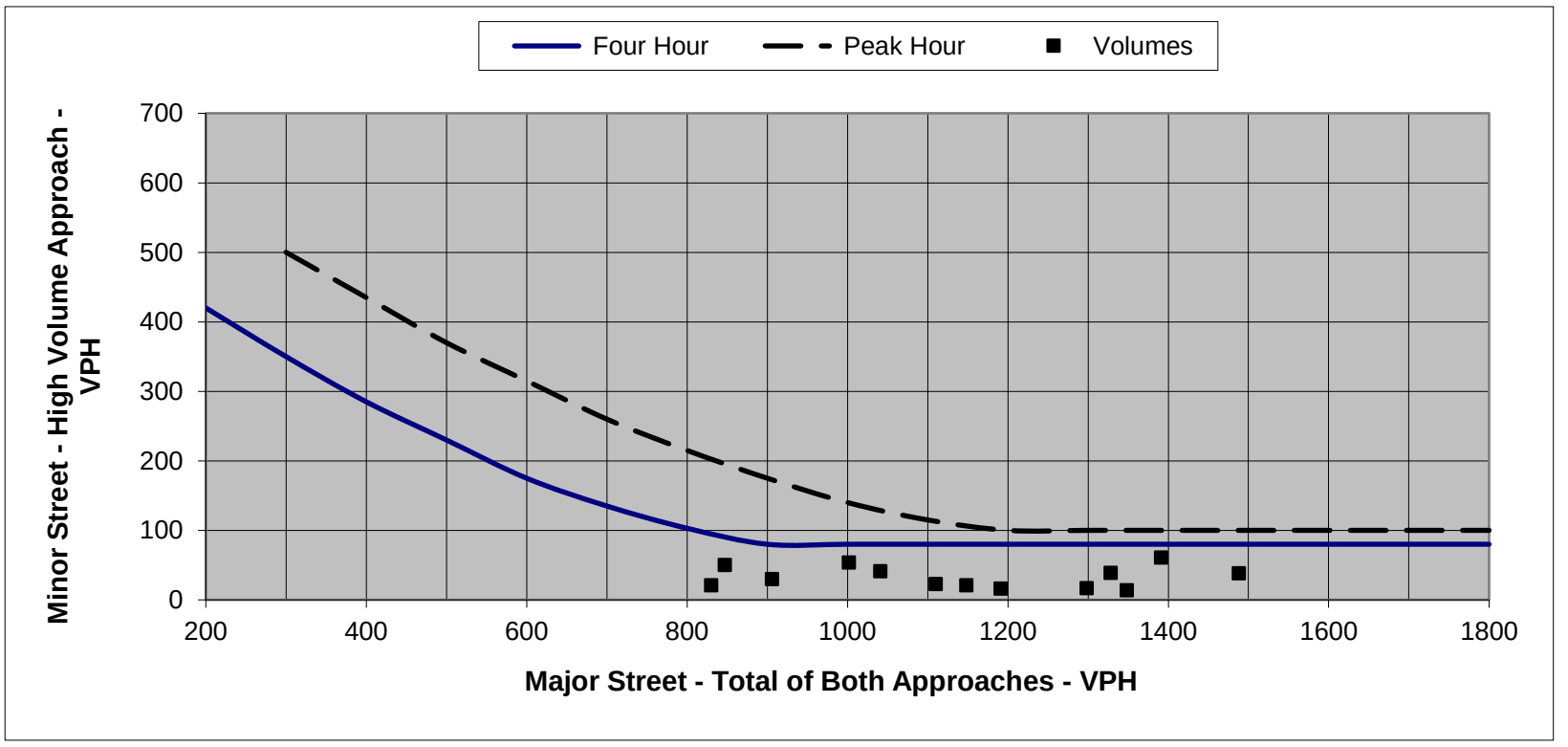

Figure 1. Four Hour and Peak Hour Warrant Analysis

Note: For data points outside the graph range, check the minor street volume against the lower thresholds

Warrant Criteria (Graph)		
Major Approach	Minor App. Four Hour	Minor App. Peak Hour
200	420	
300	350	500
400	285	435
500	230	370
600	175	315
700	135	260
800	103	215
900	80	175
1000	80	140
1100	80	115
1200	80	100
1300	80	100
1400	80	100
1500	80	100
1600	80	100
1700	80	100
1800	80	100

Actual Hourly Count			Warrants Met:	
			Warrant 2	Warrant 3
HOUR	Sum Major App.	Max Minor App.	Four Hour	Peak Hour
0:00 - 1:00	0	0	NO	NO
1:00 - 2:00	0	0	NO	NO
2:00 - 3:00	0	0	NO	NO
3:00 - 4:00	0	0	NO	NO
4:00 - 5:00	0	0	NO	NO
5:00 - 6:00	0	0	NO	NO
6:00 - 7:00	1298	17	NO	NO
7:00 - 8:00	1348	14	NO	NO
8:00 - 9:00	1148	21	NO	NO
9:00 - 10:00	1110	23	NO	NO
10:00 - 11:00	830	21	NO	NO
11:00 - 12:00	847	50	NO	NO
12:00 - 13:00	1002	54	NO	NO
13:00 - 14:00	906	30	NO	NO
14:00 - 15:00	1041	41	NO	NO
15:00 - 16:00	1391	61	NO	NO
16:00 - 17:00	1488	38	NO	NO
17:00 - 18:00	1328	39	NO	NO
18:00 - 19:00	1191	16	NO	NO
19:00 - 20:00	0	0	NO	NO
20:00 - 21:00	0	0	NO	NO
21:00 - 22:00	0	0	NO	NO
22:00 - 23:00	0	0	NO	NO
23:00 - 24:00	0	0	NO	NO

X:\FJ\I\ISDWB\156183\8-planning\81 - Analysis\Warrants\[Build 2022 Warrant Worksheet - Signal and All Way.xlsx]AllWayStop

Appendix C

SimTraffic MOE Tables

Table A1

ISD No. 624 Hugo Elementary Traffic Impact Study
Existing Conditions (2020)
AM, School Dismissal & PM Peak Hours

	Intersection	Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Vehicle Queing Information (feet)													
																	Left Turn Lane				Through Lane (s)					Right Turn Lane				
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Storage (feet) [3]	Avg. Queue (feet) [1]	Max Queue (feet) [1]	% Block Thru [2] ---->	% Block Left [2] <----	Link Length (feet)	Avg. Queue (feet) [1]	Max Queue (feet) [1]	% Block Right [2] ---->	% Block Thru [2] <----	Storage (feet) [3]	Avg. Queue (feet) [1]	Max Queue (feet) [1]
SA Peak Hour	TH 61 at 159th St	EB	18		50	68	8.6	A			4.1	A	5.4	A	1.2	A						901	23	60					
		NB	27	304		331	1.7	A	1.0	A			1.1	A								344	20	56					
		SB	1	371	17	389	1.4	A	0.6	A		A	0.6	A								432		20					
	TH61 at 152nd St	WB	19		7	26	8.4	A			2.8	A	6.8	A	0.6	A						665	20	29					
		NB		349	30	379			0.5	A		A	0.5	A															
		SB	9	435		444	1.6	A	0.4	A			0.4	A								263	20	26					
	TH 61 at 147th St (Signal)	EB	4	1	4	9	35.5	D	38.6	D	5.0	A	20.6	C	7.7	A	170	20	34			1106	20	32					
		WB	114	1	37	152	33.3	C	50.2	D	5.5	A	26.4	C			275	70	149			1025	21	64					
		NB	5	385	82	472	6.6	A	5.7	A	1.8	A	5.0	A			315	20	23			902	58	168			315	20	41
		SB	16	457	4	477	5.6	A	4.2	A	0.9	A	4.2	A			300	20	34			397	57	148			300		20
SD Peak Hour	TH 61 at 159th St	EB	28		43	71	16.0	C			6.5	A	10.4	B	2.2	A						901	24	76					
		NB	72	680		752	2.9	A	2.4	A			2.4	A								344	26	107					
		SB		417	32	449			0.7	A		A	0.6	A															
	TH61 at 152nd St	WB	60		38	98	21.2	C			11.5	B	17.3	C	2.2	A						665	38	132					
		NB		704	29	733			1.0	A	0.1	A	1.0	A															
		SB	9	500		509	3.9	A	0.8	A			0.9	A								263	20	68					
	TH 61 at 147th St (Signal)	EB	19	5	14	38	56.1	E	54.6	D	8.5	A	40.4	D	9.1	A	170	20	70			1106	20	65					
		WB	115	1	43	159	64.1	E	46.7	D	11.3	B	49.1	D			275	111	212			1025	30	112					
		NB	13	745	184	942	6.3	A	4.4	A	2.2	A	4.0	A			315	20	30			902	65	186			315	20	49
		SB	32	538	8	578	12.0	B	3.8	A	0.8	A	4.1	A			300	20	51			397	61	182			300	20	20
PM Peak Hour	TH 61 at 159th St	EB	40		64	104	21.7	C			9.3	A	14.0	B	3.2	A						901	38	109					
		NB	92	675		767	3.2	A	3.1	A			3.1	A								344	35	167					
		SB		413	35	448			0.8	A		A	0.7	A															
	TH61 at 152nd St	WB	38		19	57	15.1	C			8.4	A	12.9	B	1.2	A						665	23	71					
		NB		715	9	724			0.8	A		A	0.8	A															
		SB	3	496		499	4.0	A	0.5	A			0.5	A								263	20	39					
	TH 61 at 147th St (Signal)	EB	8	2	15	25	70.0	E	52.9	D	8.2	A	28.4	C	11.3	B	170	20	40			1106	20	52					
		WB	148	5	60	213	72.0	E	51.1	D	13.4	B	55.1	E			275	139	**243**			1025	37	136					
		NB	15	681	221	917	6.9	A	4.6	A	2.3	A	4.1	A			315	20	30			902	56	199			315	20	52
		SB	41	536	3	580	12.1	B	5.0	A	1.3	A	5.5	A			300	21	56			397	69	216			300		20

NOTES

1. If the reported queue is greater than zero (0), but less than 20 ft, a minimum of 20 ft is reported.
2. Block Percentage is proportion of analysis time (1 hour) the storage lane or through lane is blocked or blocking.
3. Multiple storage lanes of different length are averaged together to show the "Effective Storage Length" per lane.

Table A2

ISD No. 624 Hugo Elementary Traffic Impact Study
No Build Conditions (2022)
AM, School Dismissal & PM Peak Hours

	Intersection	Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Vehicle Queing Information (feet)													
																	Left Turn Lane				Through Lane (s)					Right Turn Lane				
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Storage (feet) [3]	Avg. Queue (feet) [1]	Max Queue (feet) [1]	% Block Thru [2] ---->	% Block Left [2] <----	Link Length (feet)	Avg. Queue (feet) [1]	Max Queue (feet) [1]	% Block Right [2] ---->	% Block Thru [2] <----	Storage (feet) [3]	Avg. Queue (feet) [1]	Max Queue (feet) [1]
SA Peak Hour	TH 61 at 159th St	EB	18		51	69	8.0	A			3.9	A	4.9	A	1.2	A						901	24	56					
		NB	27	316		343	1.7	A	1.0	A			1.1	A								344	20	52					
		SB	1	386	17	404	1.1	A	0.6	A	0.0	A	0.6	A								432		20					
	TH61 at 152nd St	WB	19		7	26	9.1	A			3.9	A	7.6	A	0.7	A						665	20	39					
		NB		363	30	393			0.5	A	0.0	A	0.5	A															
		SB	9	452		461	1.8	A	0.5	A			0.5	A								263	20	42					
	TH 61 at 147th St (Signal)	EB	4	1	4	9	29.8	C	21.8	C	6.4	A	18.5	B	7.8	A	170	20	38			1106	20	34					
		WB	115	1	37	153	34.5	C	18.7	B	5.4	A	27.2	C			275	74	150			1025	22	66					
		NB	5	400	83	488	6.3	A	5.6	A	1.7	A	4.9	A			315	20	25			902	61	157			315	20	39
		SB	16	475	4	495	6.9	A	4.3	A	0.7	A	4.4	A			300	20	30			397	57	173			300		20
SD Peak Hour	TH 61 at 159th St	EB	28		43	71	16.5	C			6.3	A	10.4	B	2.2	A						901	24	85					
		NB	73	707		780	2.9	A	2.3	A			2.4	A								344	27	116					
		SB		434	32	466			0.7	A	0.0	A	0.7	A															
	TH61 at 152nd St	WB	61		38	99	23.9	C			13.0	B	20.0	C	2.3	A						665	42	152					
		NB		732	29	761			1.0	A	0.0	A	1.0	A															
		SB	9	520		529	5.2	A	0.8	A			0.9	A								263	20	89					
	TH 61 at 147th St (Signal)	EB	19	5	14	38	59.0	**E**	47.8	D	10.7	B	38.7	D	9.1	A	170	20	77			1106	20	65					
		WB	116	1	43	160	64.6	**E**	79.1	**E**	12.2	B	50.3	D			275	104	210			1025	27	102					
		NB	13	775	186	974	6.7	A	4.6	A	2.2	A	4.2	A			315	20	30			902	69	218			315	20	43
		SB	32	560	8	600	10.3	B	4.3	A	0.5	A	4.6	A			300	20	48			397	73	236			300		20
PM Peak Hour	TH 61 at 159th St	EB	40		65	105	28.7	D			14.0	B	19.4	C	3.7	A						901	43	143					
		NB	93	702		795	3.7	A	3.5	A			3.5	A								344	40	134					
		SB		430	35	465			0.8	A	0.1	A	0.7	A													275		20
	TH61 at 152nd St	WB	38		19	57	18.0	C			9.8	A	15.3	C	1.4	A						665	25	79					
		NB		744	9	753			0.9	A	0.0	A	0.9	A															
		SB	3	516		519	2.7	A	0.5	A			0.5	A								263	20	29					
	TH 61 at 147th St (Signal)	EB	8	2	15	25	58.9	**E**	53.6	D	5.7	A	25.2	C	11.8	B	170	20	48			1106	20	52					
		WB	149	5	61	215	73.2	**E**	61.1	**E**	13.4	B	55.9	**E**			275	143	**262**			1025	39	156					
		NB	15	708	223	946	5.8	A	5.1	A	2.3	A	4.5	A			315	20	26			902	64	218			315	20	52
		SB	41	557	3	601	13.6	B	6.3	A	1.0	A	6.8	A			300	20	57		1 %	397	79	258	1 %		300		20

NOTES

1. If the reported queue is greater than zero (0), but less than 20 ft, a minimum of 20 ft is reported.
2. Block Percentage is proportion of analysis time (1 hour) the storage lane or through lane is blocked or blocking.
3. Multiple storage lanes of different length are averaged together to show the "Effective Storage Length" per lane.

Table A3

ISD No. 624 Hugo Elementary Traffic Impact Study
Build Conditions (2022)
AM, School Dismissal & PM Peak Hours

	Intersection	Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Vehicle Queing Information (feet)													
																	Left Turn Lane				Through Lane (s)					Right Turn Lane			
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Storage (feet) [3]	Avg. Queue (feet) [1]	Max Queue (feet) [1]	% Block Thru [2] ---->	% Block Left [2] <----	Link Length (feet)	Avg. Queue (feet) [1]	Max Queue (feet) [1]	% Block Right [2] ---->	% Block Thru [2] <----	Storage (feet) [3]	Avg. Queue (feet) [1]	Max Queue (feet) [1]
SA Peak Hour	TH 61 at 159th St	EB	18		69	87	8.7	A			4.1	A	4.9	A	1.3	A						901	26	50					
		NB	42	316		358	2.0	A	1.0	A			1.1	A								344	20	58					
		SB	1	386	17	404	0.7	A	0.7	A	0.0	A	0.7	A								432		20					
	TH61 at 152nd St	EB	15		134	149	32.8	D			8.2	A	10.7	B	3.9	A	100	20	68								100	34	**91**
		WB	19		7	26	26.2	D			4.2	A	19.4	C								660	20	55			100	20	21
		NB	158	363	30	551	7.2	A	1.0	A	0.2	A	2.7	A			265	31	118										
		SB	9	452	18	479	2.8	A	2.4	A	0.7	A	2.3	A			265	20	20								265		20
	TH 61 at 147th St (Signal)	EB	4	1	4	9	25.7	C	28.1	C	6.1	A	17.2	B	8.3	A	170	20	30			1106	20	30					
		WB	115	1	116	232	31.9	C	19.1	B	8.2	A	20.4	C			275	71	144			1025	42	92					
		NB	5	470	83	558	6.9	A	6.0	A	1.9	A	5.4	A			315	20	26			844	59	189			315	20	51
		SB	83	535	4	622	9.3	A	5.9	A	2.1	A	6.3	A			300	25	80			1798	67	155			300		20
SD Peak Hour	TH 61 at 159th St	EB	28		51	79	18.7	C			7.1	A	11.5	B	2.5	A						901	29	78					
		NB	82	707		789	3.0	A	2.6	A			2.6	A								344	27	138					
		SB		434	32	466			0.8	A	0.1	A	0.7	A															
	TH61 at 152nd St	EB	9		84	93	37.3	**E**			14.4	B	16.2	C	7.4	A	100	20	52			400	20	38		1 %	100	32	**99**
		WB	61		38	99	109.4	**F**			20.7	C	74.5	**F**								660	66	230	14 %		100	25	**104**
		NB	69	732	29	830	4.6	A	1.6	A	0.4	A	1.8	A			265	20	65										
		SB	9	520	8	537	5.6	A	2.6	A	0.4	A	2.6	A			265	20	22			1380		20					
	TH 61 at 147th St (Signal)	EB	19	5	14	38	55.9	**E**	45.2	D	11.5	B	38.1	D	10.6	B	170	20	95			1106	20	69					
		WB	116	1	78	195	69.0	**E**	71.9	**E**	14.1	B	46.8	D			275	106	221			1025	42	90					
		NB	13	806	186	1,005	6.4	A	5.8	A	2.5	A	5.2	A			315	20	26			902	85	251			315	20	52
		SB	74	597	8	679	15.3	B	5.8	A	1.8	A	6.8	A			300	31	82			1701	73	202			300		20
PM Peak Hour	TH 61 at 159th St	EB	40		69	109	21.2	C			7.9	A	12.9	B	3.3	A						901	38	95					
		NB	97	702		799	4.0	A	3.4	A			3.5	A								344	41	170					
		SB		430	35	465			0.9	A	0.0	A	0.8	A															
	TH61 at 152nd St	EB	4		40	44	24.8	C			5.9	A	6.8	A	2.7	A	100	20	28								100	20	55
		WB	38		19	57	30.2	D			7.2	A	21.5	C								660	22	87			100	20	42
		NB	37	744	9	790	3.3	A	1.4	A	0.3	A	1.5	A			265	20	42										
		SB	3	516	4	523	4.3	A	2.0	A	0.8	A	2.0	A			265	20	20										
	TH 61 at 147th St (Signal)	EB	8	2	15	25	59.7	**E**	89.4	**F**	7.6	A	27.9	C	11.6	B	170	20	39			1106	20	47					
		WB	149	5	79	233	66.7	**E**	51.8	D	16.0	B	48.9	D			275	132	**240**			1025	46	160					
		NB	15	724	223	962	8.2	A	4.8	A	2.4	A	4.3	A			315	20	34			902	56	174			315	20	59
		SB	61	575	3	639	15.1	B	6.9	A	2.9	A	7.7	A			300	29	82			1701	77	237			300		20

NOTES

1. If the reported queue is greater than zero (0), but less than 20 ft, a minimum of 20 ft is reported.
2. Block Percentage is proportion of analysis time (1 hour) the storage lane or through lane is blocked or blocking.
3. Multiple storage lanes of different length are averaged together to show the "Effective Storage Length" per lane.

Table A4

ISD No. 624 Hugo Elementary Traffic Impact Study
Build Conditions with Mitigations (2022)
AM, School Dismissal & PM Peak Hours

	Intersection	Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Vehicle Queing Information (feet)													
																	Left Turn Lane				Through Lane (s)					Right Turn Lane				
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Storage (feet) [3]	Avg. Queue (feet) [1]	Max Queue (feet) [1]	% Block Thru [2] ---->	% Block Left [2] <----	Link Length (feet)	Avg. Queue (feet) [1]	Max Queue (feet) [1]	% Block Right [2] ---->	% Block Thru [2] <----	Storage (feet) [3]	Avg. Queue (feet) [1]	Max Queue (feet) [1]
SA Peak Hour	TH 61 at 159th St	EB	18		69	87	8.4	A			4.1	A	4.8	A	1.4	A						901	25	54					
		NB	42	316		358	2.1	A	1.1	A			1.2	A								344	20	66					
		SB	1	386	17	404	0.7	A	0.8	A	0.0	A	0.8	A								432		20					
	TH61 at 152nd St (Signal)	EB	15		134	149	34.7	C			9.3	A	11.7	B	11.6	B	100	20	59								100	36	103
		WB	19		7	26	36.9	D			4.5	A	26.8	C			100	20	58								100	20	21
		NB	158	363	30	551	39.6	D	2.6	A	0.6	A	12.8	B			265	89	246			789	20	120			265	20	20
		SB	9	452	18	479	7.6	A	9.5	A	2.7	A	9.2	A			265	20	27			1460	67	180			265	20	28
	TH 61 at 147th St (Signal)	EB	4	1	4	9	34.3	C	32.1	C	5.9	A	21.0	C	7.7	A	170	20	35			1106	20	30					
		WB	115	1	116	232	32.5	C	21.8	C	8.5	A	20.8	C			275	70	143			1025	44	103					
		NB	5	470	83	558	8.5	A	5.4	A	2.0	A	4.9	A			315	20	26			844	52	193			315	20	51
		SB	83	535	4	622	9.7	A	4.6	A	2.3	A	5.2	A			300	26	102			1798	43	119			300		20
SD Peak Hour	TH 61 at 159th St	EB	28		51	79	16.8	C			6.6	A	10.2	B	2.4	A						901	26	83					
		NB	82	707		789	3.2	A	2.5	A			2.6	A								344	28	101					
		SB		434	32	466			0.8	A	0.0	A	0.7	A															
	TH61 at 152nd St (Signal)	EB	9		84	93	48.9	D			8.9	A	13.0	B	8.1	A	100	20	62			400		20			100	29	93
		WB	61		38	99	77.5	E			13.3	B	52.1	D			100	52	123			660	20	227			100	20	71
		NB	69	732	29	830	7.5	A	4.2	A	0.8	A	4.3	A			265	21	89			913	56	204			265	20	20
		SB	9	520	8	537	9.6	A	5.3	A	1.5	A	5.3	A			265	20	30			1380	43	178			265	20	20
	TH 61 at 147th St (Signal)	EB	19	5	14	38	55.5	E	48.1	D	8.3	A	36.1	D	10.5	B	170	20	80			1106	20	53					
		WB	116	1	78	195	64.0	E	46.4	D	13.7	B	43.4	D			275	104	190			1025	40	96					
		NB	13	806	186	1,005	7.7	A	6.2	A	2.5	A	5.6	A			315	20	30			902	96	220			315	20	49
		SB	74	597	8	679	15.7	B	6.1	A	2.7	A	7.1	A			300	32	74			1701	77	233			300	20	20
PM Peak Hour	TH 61 at 159th St	EB	40		69	109	22.2	C			8.9	A	14.0	B	3.4	A						901	39	112					
		NB	97	702		799	3.7	A	3.4	A			3.4	A								344	39	176					
		SB		430	35	465			0.9	A	0.0	A	0.8	A													275		20
	TH61 at 152nd St (Signal)	EB	4		40	44	60.3	E			6.3	A	10.1	B	4.7	A	100	20	28								100	20	51
		WB	38		19	57	67.8	E			8.9	A	49.5	D			100	40	112			660	20	20			100	20	47
		NB	37	744	9	790	4.2	A	1.7	A	0.4	A	1.8	A			265	20	46			913	20	49			265		20
		SB	3	516	4	523	5.8	A	3.4	A	0.7	A	3.4	A			265	20	20			1380	24	109			265		20
	TH 61 at 147th St (Signal)	EB	8	2	15	25	63.9	E	58.6	E	10.2	B	31.7	C	14.5	B	170	20	49			1106	20	46					
		WB	149	5	79	233	80.4	F	61.3	E	15.5	B	57.4	E			275	144	276			1025	47	151					
		NB	15	724	223	962	7.7	A	5.2	A	2.5	A	4.6	A			315	20	32			902	63	193			315	20	54
		SB	61	575	3	639	15.5	B	12.8	B	5.6	A	13.0	B			300	30	140		4 %	1701	104	363	4 %		300		20

NOTES

1. If the reported queue is greater than zero (0), but less than 20 ft, a minimum of 20 ft is reported.
2. Block Percentage is proportion of analysis time (1 hour) the storage lane or through lane is blocked or blocking.
3. Multiple storage lanes of different length are averaged together to show the "Effective Storage Length" per lane.

Table A5

ISD No. 624 Hugo Elementary Traffic Impact Study
No Build Conditions (2026)
AM, School Dismissal & PM Peak Hours

	Intersection	Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Vehicle Queing Information (feet)													
																	Left Turn Lane				Through Lane (s)					Right Turn Lane				
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Storage (feet) [3]	Avg. Queue (feet) [1]	Max Queue (feet) [1]	% Block Thru [2] ---->	% Block Left [2] <----	Link Length (feet)	Avg. Queue (feet) [1]	Max Queue (feet) [1]	% Block Right [2] ---->	% Block Thru [2] <----	Storage (feet) [3]	Avg. Queue (feet) [1]	Max Queue (feet) [1]
SA Peak Hour	TH 61 at 159th St	EB	19		52	71	9.0	A			3.9	A	5.3	A	1.2	A						901	23	63					
		NB	28	340		368	1.8	A	1.0	A			1.1	A								344	20	60					
		SB	1	416	18	435	1.0	A	0.6	A	0.0	A	0.6	A								432		20					
	TH61 at 152nd St	WB	20		7	27	9.3	A			3.9	A	7.6	A	0.6	A						665	20	39					
		NB		391	31	422			0.5	A	0.0	A	0.5	A															
		SB	9	487		496	1.5	A	0.4	A			0.4	A								263	20	30					
	TH 61 at 147th St (Signal)	EB	4	1	4	9	28.9	C	34.4	C	6.7	A	19.6	B	7.9	A	170	20	37			1106	20	30					
		WB	117	1	38	156	35.7	D	31.8	C	6.3	A	28.5	C			275	75	175			1025	21	62					
		NB	5	431	84	520	6.2	A	5.7	A	1.8	A	5.1	A			315	20	33			902	62	176			315	20	41
		SB	16	512	4	532	7.0	A	4.1	A	1.2	A	4.2	A			300	20	28			397	57	168			300		20
SD Peak Hour	TH 61 at 159th St	EB	29		44	73	19.4	C			7.9	A	12.2	B	2.5	A						901	26	82					
		NB	74	762		836	3.6	A	2.7	A			2.8	A								344	33	141					
		SB		467	33	500			0.7	A	0.0	A	0.7	A													275		20
	TH61 at 152nd St	WB	62		39	101	28.7	D			19.3	C	25.1	D	2.6	A						665	45	174					
		NB		788	30	818			1.0	A	0.0	A	1.0	A															
		SB	9	560		569	5.9	A	0.9	A			1.0	A								263	20	93					
	TH 61 at 147th St (Signal)	EB	20	5	14	39	62.5	E	66.8	E	11.8	B	42.7	D	9.1	A	170	20	67			1106	20	62					
		WB	118	1	44	163	63.6	E	34.2	C	13.3	B	49.2	D			275	103	201			1025	29	80					
		NB	13	834	190	1,037	7.3	A	4.9	A	2.5	A	4.5	A			315	20	28			902	78	255			315	20	61
		SB	33	603	8	644	12.2	B	4.4	A	0.7	A	4.8	A			300	20	51			397	74	226			300	20	20
PM Peak Hour	TH 61 at 159th St	EB	41		66	107	29.2	D			12.8	B	19.3	C	3.6	A						901	43	121					
		NB	95	756		851	3.6	A	3.4	A			3.4	A								344	39	145					
		SB		463	36	499			0.8	A	0.0	A	0.7	A															
	TH61 at 152nd St	WB	39		20	59	17.1	C			11.1	B	15.2	C	1.3	A						665	25	79					
		NB		801	9	810			0.8	A	0.0	A	0.8	A															
		SB	3	556		559	5.2	A	0.5	A			0.5	A								263	20	41					
	TH 61 at 147th St (Signal)	EB	8	2	15	25	67.3	E	69.6	E	11.0	B	33.7	C	13.6	B	170	20	51			1106	20	48					
		WB	152	5	62	219	96.1	F	64.6	E	17.2	B	71.8	E			275	154	**296**			1025	64	256					
		NB	15	763	228	1,006	6.6	A	4.9	A	2.3	A	4.3	A			315	20	33			902	63	208			315	20	45
		SB	42	600	3	645	14.0	B	7.3	A	1.2	A	7.7	A			300	20	60		1 %	397	88	276	1 %		300		20

NOTES
1. If the reported queue is greater than zero (0), but less than 20 ft, a minimum of 20 ft is reported.
2. Block Percentage is proportion of analysis time (1 hour) the storage lane or through lane is blocked or blocking.
3. Multiple storage lanes of different length are averaged together to show the "Effective Storage Length" per lane.

Table A6

ISD No. 624 Hugo Elementary Traffic Impact Study
Build Conditions (2026)
AM, School Dismissal & PM Peak Hours

	Intersection	Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Vehicle Queing Information (feet)													
																	Left Turn Lane				Through Lane (s)					Right Turn Lane			
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Storage (feet) [3]	Avg. Queue (feet) [1]	Max Queue (feet) [1]	% Block Thru [2] ---->	% Block Left [2] <----	Link Length (feet)	Avg. Queue (feet) [1]	Max Queue (feet) [1]	% Block Right [2] ---->	% Block Thru [2] <----	Storage (feet) [3]	Avg. Queue (feet) [1]	Max Queue (feet) [1]
SA Peak Hour	TH 61 at 159th St	EB	19		77	96	10.1	B			4.8	A	5.8	A	1.6	A						901	30	78					
		NB	50	340		390	2.4	A	1.3	A			1.4	A								344	20	57					
		SB	1	416	18	435	0.0	A	0.8	A	0.0	A	0.8	A								432		20					
	TH61 at 152nd St	EB	22		194	216	83.9	F			22.8	C	28.6	D	8.7	A	100	24	107			565	35	260		10 %	100	55	124
		WB	20		7	27	53.6	F			4.6	A	40.1	E								660	20	71			100	20	21
		NB	228	391	31	650	13.1	B	1.5	A	0.5	A	5.4	A			265	54	214			789	20	40			265		20
		SB	9	487	25	521	2.1	A	3.0	A	0.9	A	2.9	A			265	20	21								265	20	22
	TH 61 at 147th St (Signal)	EB	4	1	4	9	26.6	C	38.8	D	7.5	A	21.6	C	9.5	A	170	20	34			1106	20	30					
		WB	117	1	152	270	32.5	C	11.7	B	11.1	B	20.3	C			275	74	151			1025	54	154					
		NB	5	532	84	621	7.1	A	7.5	A	2.1	A	6.7	A			315	20	29			844	77	204			315	20	37
		SB	113	598	4	715	11.1	B	6.9	A	2.3	A	7.5	A			300	33	99			1798	80	214			300		20
SD Peak Hour	TH 61 at 159th St	EB	29		55	84	26.9	D			11.1	B	16.4	C	3.1	A						901	34	95					
		NB	88	762		850	3.7	A	3.1	A			3.2	A								344	38	137					
		SB		467	33	500			0.8	A	0.0	A	0.8	A															
	TH61 at 152nd St	EB	14		122	136	63.1	F			50.4	F	51.7	F	22.8	C	100	20	69			400	46	245		14 %	100	53	125
		WB	62		39	101	382.9	F			201.7	F	312.4	F								660	206	532	46 %	1 %	100	48	125
		NB	99	788	30	917	6.3	A	1.8	A	0.5	A	2.2	A			265	28	86								265		20
		SB	9	560	11	580	6.8	A	3.1	A	0.7	A	3.1	A			265	20	37										
	TH 61 at 147th St (Signal)	EB	20	5	14	39	62.1	E	48.5	D	10.5	B	39.3	D	11.5	B	170	20	86			1106	20	55					
		WB	118	1	94	213	61.7	E	32.9	C	17.0	B	40.3	D			275	102	186			1025	48	112					
		NB	13	878	190	1,081	6.2	A	8.4	A	3.1	A	7.5	A			315	20	30		1 %	902	124	380	1 %		315	20	52
		SB	94	657	8	759	23.5	C	6.2	A	2.2	A	8.4	A			300	46	131			1701	82	245			300	20	20
PM Peak Hour	TH 61 at 159th St	EB	41		72	113	31.6	D			13.4	B	20.5	C	4.3	A						901	46	138					
		NB	101	756		857	3.9	A	4.0	A			4.0	A								344	48	196					
		SB		463	36	499			1.0	A	0.0	A	0.9	A													275		20
	TH61 at 152nd St	EB	6		57	63	36.8	E			6.9	A	10.0	B	3.6	A	100	20	36								100	23	63
		WB	39		20	59	52.6	F			8.9	A	37.8	E								660	29	114	2 %		100	20	71
		NB	53	801	9	863	4.4	A	1.5	A	0.4	A	1.7	A			265	20	42										
		SB	3	556	6	565	4.8	A	2.2	A	0.8	A	2.2	A			265	20	20										
	TH 61 at 147th St (Signal)	EB	8	2	15	25	64.7	E	58.6	E	16.1	B	31.9	C	28.8	C	170	20	71			1106	20	52					
		WB	152	5	89	246	132.9	F	58.8	E	21.2	C	88.6	F			275	184	343			1025	105	447					
		NB	15	787	228	1,030	9.7	A	6.7	A	2.6	A	5.8	A			315	20	38			902	90	236			315	20	46
		SB	70	625	3	698	37.2	D	43.3	D	2.1	A	42.6	D			300	84	338		18 %	1701	263	977	18 %		300	20	99

NOTES

1. If the reported queue is greater than zero (0), but less than 20 ft, a minimum of 20 ft is reported.
2. Block Percentage is proportion of analysis time (1 hour) the storage lane or through lane is blocked or blocking.
3. Multiple storage lanes of different length are averaged together to show the "Effective Storage Length" per lane.

Table A7

ISD No. 624 Hugo Elementary Traffic Impact Study
Build Conditions with Mitigations (2026)
AM, School Dismissal & PM Peak Hours

	Intersection	Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Vehicle Queing Information (feet)													
																	Left Turn Lane				Through Lane (s)					Right Turn Lane				
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Storage (feet) [3]	Avg. Queue (feet) [1]	Max Queue (feet) [1]	% Block Thru [2] ---->	% Block Left [2] <----	Link Length (feet)	Avg. Queue (feet) [1]	Max Queue (feet) [1]	% Block Right [2] ---->	% Block Thru [2] <----	Storage (feet) [3]	Avg. Queue (feet) [1]	Max Queue (feet) [1]
SA Peak Hour	TH 61 at 159th St	EB	19		77	96	10.1	B			4.5	A	5.6	A	1.7	A						901	29	77					
		NB	50	340		390	2.7	A	1.3	A			1.5	A								344	20	69					
		SB	1	416	18	435	0.5	A	0.9	A	0.0	A	0.9	A								432		20					
	TH61 at 152nd St (Signal)	EB	22		194	216	30.5	C			15.3	B	16.9	B	15.3	B	100	20	**95**			565	21	236		5 %	100	57	**125**
		WB	20		7	27	45.3	D			3.6	A	35.2	D			100	20	58								100	20	21
		NB	228	391	31	650	32.6	C	4.8	A	0.9	A	13.9	B			265	107	**276**			789	37	153			265	20	20
		SB	9	487	25	521	36.9	D	15.3	B	4.4	A	15.1	B			265	20	47			1460	112	282			265	20	34
	TH 61 at 147th St (Signal)	EB	4	1	4	9	23.1	C	26.4	C	8.4	A	16.9	B	8.2	A	170	20	34			1106	20	34					
		WB	117	1	152	270	30.7	C	19.9	B	10.3	B	19.1	B			275	70	141			1025	51	122					
		NB	5	532	84	621	5.2	A	6.1	A	1.7	A	5.5	A			315	20	20			844	62	180			315	20	28
		SB	113	598	4	715	10.8	B	5.5	A	2.1	A	6.3	A			300	33	90			1798	57	178			300		20
SD Peak Hour	TH 61 at 159th St	EB	29		55	84	21.1	C			8.0	A	12.3	B	2.7	A						901	28	87					
		NB	88	762		850	3.6	A	2.9	A			3.0	A								344	36	123					
		SB		467	33	500			0.9	A	0.0	A	0.8	A															
	TH61 at 152nd St (Signal)	EB	14		122	136	59.5	**E**			18.9	B	21.9	C	9.6	A	100	20	49			454	20	202		4 %	100	46	**122**
		WB	62		39	101	58.6	**E**			11.7	B	40.4	D			100	46	**122**			660	20	151			100	20	62
		NB	99	788	30	917	13.2	B	5.1	A	0.7	A	5.8	A			265	33	120			913	69	214			265	20	20
		SB	9	560	11	580	10.6	B	7.8	A	1.7	A	7.7	A			265	20	28			1380	64	247			265	20	26
	TH 61 at 147th St (Signal)	EB	20	5	14	39	56.4	**E**	42.5	D	11.0	B	36.2	D	13.4	B	170	20	77			1106	20	51					
		WB	118	1	94	213	63.4	**E**	41.6	D	15.7	B	40.7	D			275	103	188			1025	46	123					
		NB	13	878	190	1,081	9.5	A	12.0	B	3.7	A	10.5	B			315	20	117		2 %	902	202	431	2 %		315	25	153
		SB	94	657	8	759	19.8	B	7.4	A	2.3	A	8.8	A			300	39	104			1701	101	275			300	20	20
PM Peak Hour	TH 61 at 159th St	EB	41		72	113	36.0	**E**			18.7	C	25.2	D	4.6	A						901	49	160					
		NB	101	756		857	4.2	A	4.1	A			4.1	A								344	49	179					
		SB		463	36	499			1.0	A	0.1	A	0.9	A															
	TH61 at 152nd St (Signal)	EB	6		57	63	65.1	**E**			7.2	A	14.4	B	5.1	A	100	20	43								100	24	58
		WB	39		20	59	66.6	**E**			10.6	B	47.6	D			100	35	**107**			660	20	35			100	20	42
		NB	53	801	9	863	5.1	A	1.9	A	0.5	A	2.1	A			265	20	49			913	20	67			265		20
		SB	3	556	6	565	6.2	A	4.1	A	0.9	A	4.1	A			265	20	21			1380	33	131			265		20
	TH 61 at 147th St (Signal)	EB	8	2	15	25	59.9	**E**	66.1	**E**	15.3	B	33.9	C	20.8	C	170	20	55			1106	20	51					
		WB	152	5	89	246	99.4	**F**	52.4	D	19.2	B	68.3	**E**			275	164	**322**			1025	63	262					
		NB	15	787	228	1,030	10.2	B	6.9	A	2.7	A	6.0	A			315	20	36			902	94	272			315	20	62
		SB	70	625	3	698	27.2	C	25.5	C	6.3	A	25.6	C			300	54	242		9 %	1701	190	679	9 %		300		20

NOTES

1. If the reported queue is greater than zero (0), but less than 20 ft, a minimum of 20 ft is reported.
2. Block Percentage is proportion of analysis time (1 hour) the storage lane or through lane is blocked or blocking.
3. Multiple storage lanes of different length are averaged together to show the "Effective Storage Length" per lane.

Table A8

ISD No. 624 Hugo Elementary Traffic Impact Study
No Build Conditions (2031)
AM, School Dismissal & PM Peak Hours

	Intersection	Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Vehicle Queing Information (feet)													
																	Left Turn Lane				Through Lane (s)						Right Turn Lane			
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Storage (feet) [3]	Avg. Queue (feet) [1]	Max Queue (feet) [1]	% Block Thru [(2)] <----	% Block Left [(2)] <----	Link Length (feet)	Avg. Queue (feet) [1]	Max Queue (feet) [1]	% Block Right [(2)] ---->	% Block Thru [(2)] <----	Storage (feet) [3]	Avg. Queue (feet) [1]	Max Queue (feet) [1]
SA Peak Hour	TH 61 at 159th St	EB	19		53	72	10.4	B			5.0	A	6.4	A	1.4	A						901	25	73					
		NB	28	371		399	2.1	A	1.1	A			1.2	A								344	20	66					
		SB	1	453	18	472	1.8	A	0.7	A	0.0	A	0.7	A								432		20					
	TH61 at 152nd St	WB	20		7	27	9.9	A			4.6	A	8.4	A	0.7	A						665	20	37					
		NB		426	32	458			0.5	A	0.0	A	0.5	A															
		SB	9	531		540	2.0	A	0.5	A			0.5	A								263	20	49					
	TH 61 at 147th St (Signal)	EB	4	1	4	9	23.6	C	59.5	E	6.7	A	20.1	C	7.8	A	170	20	37			1106	20	30					
		WB	120	1	39	160	34.0	C	0.0	A	6.3	A	27.3	C			275	74	163			1025	22	56					
		NB	5	470	87	562	7.0	A	5.7	A	1.9	A	5.1	A			315	20	23			902	64	162			315	20	38
		SB	17	558	4	579	7.7	A	4.7	A	0.8	A	4.8	A			300	20	39			397	69	180			300		20
SD Peak Hour	TH 61 at 159th St	EB	30		45	75	21.4	C			8.9	A	13.5	B	2.6	A						901	29	93					
		NB	76	830		906	3.6	A	2.7	A			2.8	A								344	34	138					
		SB		509	34	543			0.8	A	0.0	A	0.7	A															
	TH61 at 152nd St	WB	63		40	103	33.1	D			22.3	C	29.3	D	2.7	A						665	47	169					
		NB		859	31	890			1.0	A	0.0	A	1.0	A															
		SB	9	610		619	4.5	A	0.8	A			0.9	A								263	20	87					
	TH 61 at 147th St (Signal)	EB	20	5	15	40	54.9	D	55.9	E	11.0	B	38.4	D	9.7	A	170	20	71			1106	20	50					
		WB	121	1	45	167	66.1	E	59.4	E	14.9	B	51.0	D			275	113	222			1025	31	77					
		NB	14	909	194	1,117	7.4	A	6.1	A	2.8	A	5.5	A			315	20	26			902	100	317			315	20	58
		SB	34	656	8	698	14.5	B	4.4	A	1.0	A	4.8	A			300	20	59			397	80	230			300	20	20
PM Peak Hour	TH 61 at 159th St	EB	42		68	110	44.0	E			20.8	C	30.2	D	4.8	A						901	54	174					
		NB	97	824		921	4.2	A	4.0	A			4.0	A								344	47	162					
		SB		504	37	541			1.0	A	0.1	A	0.9	A								432		20					
	TH61 at 152nd St	WB	40		20	60	27.9	D			16.9	C	24.1	C	1.7	A						665	31	115					
		NB		872	9	881			0.9	A	0.0	A	0.9	A															
		SB	3	605		608	5.6	A	0.5	A			0.5	A								263	20	38					
	TH 61 at 147th St (Signal)	EB	8	2	16	26	57.6	E	68.6	E	22.8	C	37.0	D	24.3	C	170	20	39			1106	20	54					
		WB	156	5	63	224	139.8	F	74.4	E	21.3	C	102.9	F			275	186	397			1025	81	489					
		NB	16	831	233	1,080	9.7	A	6.8	A	2.8	A	6.0	A			315	20	35			902	91	274			315	20	59
		SB	43	654	3	700	17.9	B	30.3	C	2.8	A	29.4	C			300	35	300		22 %	397	193	406	22 %		300	20	81

NOTES
1. If the reported queue is greater than zero (0), but less than 20 ft, a minimum of 20 ft is reported.
2. Block Percentage is proportion of analysis time (1 hour) the storage lane or through lane is blocked or blocking.
3. Multiple storage lanes of different length are averaged together to show the "Effective Storage Length" per lane.

Table A9

ISD No. 624 Hugo Elementary Traffic Impact Study
Build Conditions (2031)
AM, School Dismissal & PM Peak Hours

	Intersection	Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Vehicle Queing Information (feet)													
																	Left Turn Lane				Through Lane (s)					Right Turn Lane				
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Storage (feet) [3]	Avg. Queue (feet) [1]	Max Queue (feet) [1]	% Block Thru [2] ---->	% Block Left [2] <----	Link Length (feet)	Avg. Queue (feet) [1]	Max Queue (feet) [1]	% Block Right [2] ---->	% Block Thru [2] <----	Storage (feet) [3]	Avg. Queue (feet) [1]	Max Queue (feet) [1]
SA Peak Hour	TH 61 at 159th St	EB	19		78	97	10.4	B			5.3	A	6.3	A	2.1	A						901	30	72					
		WB	38		38		13.2	B					13.2	B								1292	24	70					
		NB	50	371	32	453	2.7	A	1.3	A	0.1	A	1.4	A								344	20	66					
		SB	1	453	18	472	3.1	A	1.0	A	0.0	A	1.0	A								432	20	20					
	TH61 at 152nd St	EB	54		161	215	261.5	F			118.6	F	157.0	F	24.7	C	100	63	125			565	225	612		11 %	100	55	125
		WB	20		7	27	45.8	E			5.5	A	32.8	D								660	20	54			100	20	21
		NB	190	426	32	648	11.7	B	1.5	A	0.4	A	4.4	A			265	49	172										
		SB	9	531	63	603	3.1	A	2.9	A	1.1	A	2.7	A			265	20	22								265	20	35
	TH 61 at 147th St (Signal)	EB	4	1	4	9	28.8	C	35.6	D	4.4	A	21.4	C	9.1	A	170	20	34			1106	20	30					
		WB	120	1	128	249	33.6	C	29.3	C	10.6	B	21.9	C			275	75	155			1025	47	142					
		NB	5	559	87	651	6.5	A	6.8	A	1.9	A	6.2	A			315	20	20			844	70	220			315	20	36
		SB	92	633	4	729	11.3	B	6.5	A	1.5	A	7.0	A			300	25	82			1798	78	174			300	20	20
SD Peak Hour	TH 61 at 159th St	EB	30		56	86	32.1	D			14.7	B	20.4	C	3.7	A						901	35	122					
		WB	17			17	26.0	D					26.0	D								1292	20	57					
		NB	90	830	20	940	4.4	A	3.5	A	0.2	A	3.5	A								344	49	168					
		SB		509	34	543			1.0	A	0.1	A	0.9	A															
	TH61 at 152nd St	EB	34		101	135	127.6	F			32.7	D	54.3	F	27.6	D	100	39	117			400	40	359		6 %	100	47	124
		WB	63		40	103	528.2	F			319.3	F	449.0	F								660	311	590	63 %		100	56	125
		NB	83	859	31	973	6.5	A	1.9	A	0.5	A	2.2	A			265	23	69								265		20
		SB	9	610	28	647	7.8	A	3.0	A	0.8	A	3.0	A			265	20	32			1380		20			265		20
	TH 61 at 147th St (Signal)	EB	20	5	15	40	63.4	E	71.7	E	13.2	B	47.9	D	12.4	B	170	22	72			1106	20	61					
		WB	121	1	84	206	63.5	E	44.7	D	21.8	C	45.1	D			275	103	206			1025	53	138					
		NB	14	948	194	1,156	8.0	A	9.2	A	3.3	A	8.2	A			315	20	30		1 %	902	146	340	1 %		315	20	57
		SB	81	703	8	792	24.3	C	6.5	A	2.5	A	8.3	A			300	39	115			1701	94	209			300	20	20
PM Peak Hour	TH 61 at 159th St	EB	42		74	116	36.0	E			17.6	C	24.0	C	4.5	A						901	50	164					
		WB	9			9	32.3	D					32.3	D								1292	20	48					
		NB	103	824	9	936	4.1	A	3.9	A	0.1	A	3.9	A								344	47	191					
		SB		504	37	541			1.1	A	0.1	A	1.0	A													275		20
	TH61 at 152nd St	EB	16		47	63	38.6	E			11.6	B	19.2	C	5.9	A	100	20	60								100	23	58
		WB	40		20	60	69.9	F			14.0	B	49.3	E								660	38	127	4 %		100	20	104
		NB	44	872	9	925	4.4	A	1.7	A	0.3	A	1.8	A			265	20	38										
		SB	3	605	15	623	4.3	A	5.8	A	3.2	A	5.7	A			265	20	20		2 %	1380	20	195	2 %		265	20	90
	TH 61 at 147th St (Signal)	EB	8	2	16	26	61.0	E	77.0	E	22.2	C	36.9	D	39.0	D	170	20	59			1106	20	50					
		WB	156	5	84	245	147.1	F	60.7	E	26.0	C	100.7	F			275	190	388			1025	103	526					
		NB	16	852	233	1,101	9.3	A	6.8	A	2.9	A	6.0	A			315	20	31			902	96	294			315	20	57
		SB	65	676	3	744	62.7	E	74.0	E	42.0	D	72.8	E			300	83	400		25 %	1701	435	1528	25 %		300	20	96

NOTES

1. If the reported queue is greater than zero (0), but less than 20 ft, a minimum of 20 ft is reported.
2. Block Percentage is proportion of analysis time (1 hour) the storage lane or through lane is blocked or blocking.
3. Multiple storage lanes of different length are averaged together to show the "Effective Storage Length" per lane.

Table A10

ISD No. 624 Hugo Elementary Traffic Impact Study
Future Build Conditions (2031)
AM, School Dismissal & PM Peak Hours

	Intersection	Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Vehicle Queing Information (feet)													
																	Left Turn Lane				Through Lane (s)					Right Turn Lane				
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Storage (feet) [3]	Avg. Queue (feet) [1]	Max Queue (feet) [1]	% Block Thru [2] ---->	% Block Left [2] <----	Link Length (feet)	Avg. Queue (feet) [1]	Max Queue (feet) [1]	% Block Right [2] ---->	% Block Thru [2] <----	Storage (feet) [3]	Avg. Queue (feet) [1]	Max Queue (feet) [1]
SA Peak Hour	TH 61 at 159th St	EB	19		78	97	10.4	B			5.2	A	6.1	A	2.0	A						901	30	78					
		WB	38			38	11.9	B					11.9	B								1292	22	61					
		NB	50	371	32	453	2.4	A	1.3	A	0.0	A	1.3	A								344	20	65					
		SB	1	453	18	472	0.0	A	1.0	A	0.0	A	1.0	A								432		20					
	TH61 at 152nd St (Signal)	EB	54		161	215	33.0	C			12.8	B	17.8	B	14.3	B	100	37	**115**			565	20	134		3 %	100	52	**120**
		WB	20		7	27	45.5	D			4.3	A	29.9	C			100	20	53								100	20	21
		NB	190	426	32	648	40.5	D	3.5	A	1.2	A	14.0	B			265	103	**313**			789	30	137			265	20	20
		SB	9	531	63	603	43.7	D	13.0	B	5.3	A	12.5	B			265	20	36			1460	99	229			265	20	69
	TH 61 at 147th St (Signal)	EB	4	1	4	9	27.1	C	25.3	C	5.9	A	19.8	B	8.7	A	170	20	34			1106	20	34					
		WB	120	1	128	249	32.9	C	26.0	C	9.3	A	20.9	C			275	73	152			1025	43	112					
		NB	5	559	87	651	7.5	A	6.6	A	1.9	A	6.0	A			315	20	25			844	66	195			315	20	37
		SB	92	633	4	729	11.4	B	6.3	A	1.7	A	6.8	A			300	26	89			1798	77	188			300		20
SD Peak Hour	TH 61 at 159th St	EB	30		56	86	26.8	D			13.5	B	18.1	C	3.6	A						901	35	129					
		WB	17			17	25.7	D					25.7	D								1292	20	56					
		NB	90	830	20	940	4.5	A	3.3	A	0.1	A	3.3	A								344	41	172					
		SB		509	34	543			1.0	A	0.1	A	0.9	A															
	TH61 at 152nd St (Signal)	EB	34		101	135	49.9	D			16.4	B	23.4	C	10.0	B	100	27	**110**			400	20	138		3 %	100	43	**109**
		WB	63		40	103	59.9	**E**			11.9	B	40.9	D			100	50	**122**			660	20	113			100	20	61
		NB	83	859	31	973	11.6	B	5.6	A	1.5	A	6.0	A			265	28	92			913	65	233			265	20	20
		SB	9	610	28	647	13.8	B	8.2	A	2.0	A	8.0	A			265	20	28			1380	77	249			265	20	26
	TH 61 at 147th St (Signal)	EB	20	5	15	40	54.1	D	56.7	**E**	13.4	B	39.1	D	14.8	B	170	20	80			1106	20	60					
		WB	121	1	84	206	66.4	**E**	63.9	**E**	18.6	B	46.8	D			275	110	216			1025	48	127					
		NB	14	948	194	1,156	12.0	B	13.2	B	4.0	A	11.8	B			315	20	31		3 %	902	215	448	3 %		315	30	**288**
		SB	81	703	8	792	19.9	B	8.0	A	2.5	A	9.1	A			300	33	107			1701	115	312			300	20	20
PM Peak Hour	TH 61 at 159th St	EB	42		74	116	51.3	**F**			28.0	D	36.3	**E**	5.8	A						901	64	210					
		WB	9			9	40.9	**E**					40.9	**E**								1292	20	38					
		NB	103	824	9	936	4.7	A	4.2	A	0.0	A	4.2	A								344	51	186					
		SB		504	37	541			1.1	A	0.0	A	1.0	A													275		20
	TH61 at 152nd St (Signal)	EB	16		47	63	60.3	**E**			7.8	A	19.1	B	5.4	A	100	20	51								100	22	58
		WB	40		20	60	66.0	**E**			11.8	B	46.8	D			100	39	**104**			660	20	24			100	20	54
		NB	44	872	9	925	5.6	A	2.1	A	0.6	A	2.3	A			265	20	44			913	20	95			265		20
		SB	3	605	15	623	10.9	B	4.2	A	1.2	A	4.1	A			265	20	20			1380	32	145			265	20	20
	TH 61 at 147th St (Signal)	EB	8	2	16	26	67.3	**E**	47.0	D	26.3	C	39.4	D	41.3	D	170	20	50			1106	20	56					
		WB	156	5	84	245	149.4	**F**	52.6	D	28.1	C	101.3	**F**			275	190	**403**			1025	120	540					
		NB	16	852	233	1,101	11.9	B	7.2	A	3.0	A	6.3	A			315	20	41		28 %	902	100	293			315	20	67
		SB	65	676	3	744	64.0	**E**	78.4	**E**	82.6	**F**	77.1	**E**			300	95	**400**		28 %	1701	484	**1570**	28 %		300	20	**286**

NOTES

1. If the reported queue is greater than zero (0), but less than 20 ft, a minimum of 20 ft is reported.
2. Block Percentage is proportion of analysis time (1 hour) the storage lane or through lane is blocked or blocking.
3. Multiple storage lanes of different length are averaged together to show the "Effective Storage Length" per lane.

Table A11

ISD No. 624 Hugo Elementary Traffic Impact Study
Build Conditions with Mitigations including Signal Modifications at 152nd Street (2022)
AM, School Dismissal & PM Peak Hours

Intersection		Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Vehicle Queing Information (feet)													
																	Left Turn Lane				Through Lane (s)						Right Turn Lane			
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Storage (feet) [3]	Avg. Queue (feet) [1]	Max Queue (feet) [1]	% Block Thru [2] ---->	% Block Left [2] <----	Link Length (feet)	Avg. Queue (feet) [1]	Max Queue (feet) [1]	% Block Right [2] ---->	% Block Thru [2] <----	Storage (feet) [3]	Avg. Queue (feet) [1]	Max Queue (feet) [1]
SA Peak Hour	TH 61 at 159th St	EB	18		69	87	8.4	A			4.1	A	4.9	A	1.4	A						901	25	64					
		NB	42	316		358	2.4	A	1.1	A			1.2	A								344	20	62					
		SB	1	386	17	404	1.0	A	0.8	A	0.0	A	0.8	A								432		20					
	TH 61 at 152nd St (Signal)	EB	15		134	149	59.2	**E**			66.1	**E**	65.4	**E**	20.1	C	100	22	**124**		20 %	564	99	276					
		WB	19		7	26	40.5	D			29.6	C	37.1	D			100	20	53			660	20	35					
		NB	158	363	30	551	32.5	C	6.1	A	4.3	A	13.2	B			265	82	**231**			802	54	180			265	20	37
		SB	9	452	18	479	38.8	D	13.2	B	9.7	A	13.4	B			265	20	36			1472	100	244			265	20	55
	TH 61 at 147th St (Signal)	EB	4	1	4	9	24.4	C	30.7	C	7.1	A	17.7	B	9.7	A	170	20	31			1106	20	30					
		WB	115	1	116	232	31.9	C	21.4	C	8.1	A	20.3	C			275	70	143			1025	42	105					
		NB	5	470	83	558	10.1	B	10.1	B	2.5	A	8.9	A			315	20	29			844	108	250			315	20	52
		SB	83	535	4	622	9.7	A	5.8	A	3.0	A	6.3	A			300	24	73			1798	58	160			300	20	20
SD Peak Hour	TH 61 at 159th St	EB	28		51	79	24.2	C			11.1	B	15.6	C	2.8	A						901	29	103					
		NB	82	707		789	3.3	A	2.9	A			2.9	A								344	31	129					
		SB		434	32	466			0.7	A	0.0	A	0.7	A													275		20
	TH 61 at 152nd St (Signal)	EB	9		84	93	67.0	**E**			57.9	**E**	58.6	**E**	17.9	B	100	20	58		8 %	400	66	210					
		WB	61		38	99	67.5	**E**			47.0	D	59.5	**E**			100	46	**120**		1 %	660	35	196					
		NB	69	732	29	830	69.6	**E**	7.1	A	3.3	A	12.1	B			265	58	188			926	74	281			265	20	39
		SB	9	520	8	537	55.3	**E**	11.7	B	7.1	A	12.3	B			265	20	47			1393	107	269			265	20	24
	TH 61 at 147th St (Signal)	EB	19	5	14	38	55.4	**E**	45.1	D	9.3	A	36.8	D	10.6	B	170	20	80			1106	20	59					
		WB	116	1	78	195	63.6	**E**	40.0	D	13.3	B	42.9	D			275	102	208			1025	39	91					
		NB	13	806	186	1,005	5.5	A	6.4	A	2.6	A	5.7	A			315	20	26			902	99	306			315	20	58
		SB	74	597	8	679	15.3	B	6.0	A	2.7	A	7.0	A			300	31	81			1701	69	199			300	20	20
PM Peak Hour	TH 61 at 159th St	EB	40		69	109	22.3	C			9.7	A	14.4	B	3.4	A						901	42	131					
		NB	97	702		799	3.8	A	3.2	A			3.3	A								344	41	131					
		SB		430	35	465			0.9	A	0.0	A	0.8	A															
	TH 61 at 152nd St (Signal)	EB	4		40	44	100.9	**F**			74.1	**E**	75.9	**E**	12.0	B	100	20	31		1 %	400	38	104					
		WB	38		19	57	71.2	**E**			62.1	**E**	68.0	**E**			100	34	**104**			660	20	80					
		NB	37	744	9	790	64.9	**E**	4.0	A	1.1	A	7.0	A			265	40	101			926	64	210			265	20	20
		SB	3	516	4	523	63.2	**E**	7.2	A	2.7	A	7.5	A			265	20	35			1393	76	223			265		20
	TH 61 at 147th St (Signal)	EB	8	2	15	25	59.9	**E**	137.7	**F**	7.9	A	29.7	C	11.9	B	170	20	55			1106	20	46					
		WB	149	5	79	233	69.8	**E**	54.8	D	14.3	B	50.4	D			275	137	**263**			1025	44	108					
		NB	15	724	223	962	8.7	A	5.0	A	2.5	A	4.5	A			315	20	35			902	62	187			315	20	57
		SB	61	575	3	639	13.4	B	7.4	A	2.8	A	8.0	A			300	27	64			1701	83	292			300		20

NOTES

1. If the reported queue is greater than zero (0), but less than 20 ft, a minimum of 20 ft is reported.
2. Block Percentage is proportion of analysis time (1 hour) the storage lane or through lane is blocked or blocking.
3. Multiple storage lanes of different length are averaged together to show the "Effective Storage Length" per lane.

Table A12

ISD No. 624 Hugo Elementary Traffic Impact Study
Build Conditions with Mitigations including Signal Modifications at 152nd Street (2026)
AM, School Dismissal & PM Peak Hours

	Intersection	Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Vehicle Queing Information (feet)													
																	Left Turn Lane				Through Lane (s)					Right Turn Lane				
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Storage (feet) [3]	Avg. Queue (feet) [1]	Max Queue (feet) [1]	% Block Thru [2] <----	% Block Left [2] <----	Link Length (feet)	Avg. Queue (feet) [1]	Max Queue (feet) [1]	% Block Right [2] ---->	% Block Thru [2] <----	Storage (feet) [3]	Avg. Queue (feet) [1]	Max Queue (feet) [1]
SA Peak Hour	TH 61 at 159th St	EB	19		77	96	9.8	A			4.4	A	5.5	A	1.7	A						901	29	77					
		NB	50	340		390	2.7	A	1.5	A			1.6	A								344	20	75					
		SB	1	416	18	435	0.0	A	0.9	A	0.1	A	0.9	A								432		20			275		20
	TH61 at 152nd St (Signal)	EB	22		194	216	36.1	D			32.8	C	33.1	C	33.2	C	100	21	117		14 %	564	104	283					
		WB	20		7	27	38.9	D			29.0	C	36.2	D			100	20	66			660	20	30					
		NB	228	391	31	650	38.3	D	11.0	B	6.1	A	20.1	C			265	119	344			802	86	297			265	20	48
		SB	9	487	25	521	44.5	D	49.9	D	28.5	C	48.7	D			265	20	47		21 %	1472	243	623	21 %		265	40	370
	TH 61 at 147th St (Signal)	EB	4	1	4	9	30.9	C	52.8	D	6.4	A	25.2	C	9.1	A	170	20	38			1106	20	29					
		WB	117	1	152	270	30.9	C	12.9	B	11.4	B	19.8	B			275	71	142			1025	55	145					
		NB	5	532	84	621	7.0	A	7.0	A	1.9	A	6.3	A			315	20	35			844	72	209			315	20	41
		SB	113	598	4	715	11.3	B	6.5	A	3.4	A	7.2	A			300	32	90			1798	70	192			300		20
SD Peak Hour	TH 61 at 159th St	EB	29		55	84	24.4	C			10.7	B	15.5	C	3.2	A						901	29	96					
		NB	88	762		850	3.7	A	3.4	A			3.4	A								344	36	140					
		SB		467	33	500			0.8	A	0.0	A	0.7	A															
	TH61 at 152nd St (Signal)	EB	14		122	136	95.1	F			65.5	E	68.8	E	23.1	C	100	23	113		17 %	453	112	374					
		WB	62		39	101	73.4	E			53.3	D	65.0	E			100	47	122		1 %	660	43	239					
		NB	99	788	30	917	67.1	E	9.7	A	4.2	A	15.3	B			265	83	236		1 %	926	113	326	1 %		265	20	30
		SB	9	560	11	580	54.6	D	16.6	B	8.3	A	16.9	B			265	20	60		2 %	1393	157	398	2 %		265	20	37
	TH 61 at 147th St (Signal)	EB	20	5	14	39	62.2	E	59.6	E	11.1	B	38.6	D	13.8	B	170	20	73			1106	20	60					
		WB	118	1	94	213	64.5	E	49.1	D	15.8	B	42.5	D			275	112	207			1025	46	108					
		NB	13	878	190	1,081	9.2	A	11.6	B	3.7	A	10.2	B			315	20	35		1 %	902	196	401	1 %		315	20	56
		SB	94	657	8	759	21.1	C	7.5	A	2.8	A	9.2	A			300	42	119			1701	92	260			300	20	20
PM Peak Hour	TH 61 at 159th St	EB	41		72	113	43.5	E			22.3	C	30.1	D	5.1	A						901	55	199					
		NB	101	756		857	4.4	A	4.0	A			4.0	A								344	46	155					
		SB		463	36	499			1.0	A	0.1	A	0.9	A															
	TH61 at 152nd St (Signal)	EB	6		57	63	76.1	E			7.1	A	14.8	B	10.0	B	100	20	36			400	25	50					
		WB	39		20	59	71.0	E			9.4	A	48.9	D			100	34	108			660	20	98					
		NB	53	801	9	863	77.0	E	4.3	A	1.4	A	8.9	A			265	54	131			926	45	170			265		20
		SB	3	556	6	565	99.5	F	6.2	A	1.3	A	6.6	A			265	20	40			1393	67	170			265	20	20
	TH 61 at 147th St (Signal)	EB	8	2	15	25	52.5	D	70.4	E	20.3	C	33.6	C	23.8	C	170	20	50			1106	20	53					
		WB	152	5	89	246	106.3	F	55.5	E	16.7	B	70.1	E			275	156	294			1025	60	244					
		NB	15	787	228	1,030	8.7	A	6.1	A	2.5	A	5.3	A			315	20	38			902	86	203			315	20	44
		SB	70	625	3	698	35.3	D	35.9	D	3.2	A	35.7	D			300	61	271		12 %	1701	233	758	12 %		300		20

NOTES

1. If the reported queue is greater than zero (0), but less than 20 ft, a minimum of 20 ft is reported.
2. Block Percentage is proportion of analysis time (1 hour) the storage lane or through lane is blocked or blocking.
3. Multiple storage lanes of different length are averaged together to show the "Effective Storage Length" per lane.

Table A13

ISD No. 624 Hugo Elementary Traffic Impact Study
Future Build Conditions with Mitigations including Signal Modifications at 152nd Street (2031)
AM, School Dismissal & PM Peak Hours

	Intersection	Approach	Demand Volumes				Delay (s/veh)						LOS By Approach		LOS By Intersection		Vehicle Queing Information (feet)											
																	Left Turn Lane				Through Lane (s)					Right Turn Lane			
			L	T	R	Total	L	LOS	T	LOS	R	LOS	Delay (S/Veh)	LOS	Delay (S/Veh)	LOS	Storage (feet) [3]	Avg. Queue (feet) [1]	Max Queue (feet) [1]	% Block Thru [(2)] ---->	% Block Left [(2)] <----	Link Length (feet)	Avg. Queue (feet) [1]	Max Queue (feet) [1]	% Block Right [(2)] ---->	% Block Thru [(2)] <----	Storage (feet) [3]	Avg. Queue (feet) [1]	Max Queue (feet) [1]
SA Peak Hour	TH 61 at 159th St	EB	19		78	97	11.2	B			5.6	A	6.5	A	2.4	A						901	30	78					
		WB	38			38	15.0	C					15.0	C								1292	26	82					
		NB	50	371	32	453	3.0	A	1.7	A	0.0	A	1.7	A								344	20	82					
		SB	1	453	18	472	0.0	A	1.1	A	0.0	A	1.1	A														
	TH61 at 152nd St (Signal)	EB	54		161	215	33.4	C			32.2	C	32.5	C	32.6	C	100	40	124		12 %	564	95	297					
		WB	20		7	27	38.8	D			34.0	C	37.1	D			100	20	48			660	20	39					
		NB	190	426	32	648	38.6	D	13.0	B	7.6	A	20.1	C			265	105	318			802	104	300			265	20	43
		SB	9	531	63	603	44.5	D	46.9	D	31.1	C	45.1	D			265	20	34		20 %	1472	253	726	20 %		265	92	450
	TH 61 at 147th St (Signal)	EB	4	1	4	9	32.5	C	25.3	C	4.4	A	22.3	C	8.8	A	170	20	34			1106	20	30					
		WB	120	1	128	249	32.5	C	26.3	C	10.4	B	21.2	C			275	73	147			1025	46	122					
		NB	5	559	87	651	7.8	A	6.0	A	1.8	A	5.5	A			315	20	26			844	64	179			315	20	33
		SB	92	633	4	729	11.7	B	6.7	A	1.8	A	7.2	A			300	30	99			1798	72	236			300		20
SD Peak Hour	TH 61 at 159th St	EB	30		56	86	35.1	E			19.3	C	24.7	C	4.0	A						901	40	165					
		WB	17			17	20.4	C					20.4	C								1292	20	57					
		NB	90	830	20	940	4.0	A	3.5	A	0.1	A	3.5	A								344	37	143					
		SB		509	34	543			1.0	A	0.0	A	0.9	A														
	TH61 at 152nd St (Signal)	EB	34		101	135	70.6	E			58.7	E	61.4	E	21.1	C	100	38	124		14 %	400	96	294					
		WB	63		40	103	63.2	E			53.4	D	59.3	E			100	47	123		1 %	660	40	242					
		NB	83	859	31	973	62.4	E	10.1	B	5.2	A	14.7	B			265	74	186			926	123	320			265	20	40
		SB	9	610	28	647	64.6	E	15.3	B	11.1	B	15.8	B			265	20	51		1 %	1393	144	337	1 %		265	20	58
	TH 61 at 147th St (Signal)	EB	20	5	15	40	53.5	D	60.1	E	12.2	B	37.6	D	14.4	B	170	20	81			1106	20	56					
		WB	121	1	84	206	63.2	E	73.7	E	19.0	B	44.2	D			275	103	206			1025	48	123					
		NB	14	948	194	1,156	14.1	B	12.4	B	4.0	A	11.0	B			315	20	35		2 %	902	205	409	2 %		315	20	58
		SB	81	703	8	792	20.6	C	9.0	A	3.2	A	10.2	B			300	38	108			1701	111	303			300	20	20
PM Peak Hour	TH 61 at 159th St	EB	42		74	116	45.6	E			28.7	D	34.6	D	5.4	A						901	61	185					
		WB	9			9	36.8	E					36.8	E								1292	20	31					
		NB	103	824	9	936	4.5	A	3.9	A	0.1	A	3.9	A								344	50	162					
		SB		504	37	541			1.1	A	0.1	A	1.0	A														
	TH61 at 152nd St (Signal)	EB	16		47	63	72.9	E			70.5	E	71.1	E	15.2	B	100	20	72		1 %	400	44	103					
		WB	40		20	60	75.3	E			63.2	E	71.7	E			100	38	118		1 %	660	20	100					
		NB	44	872	9	925	67.1	E	8.4	A	2.7	A	11.1	B			265	42	112		1 %	926	117	326	1 %		265	20	24
		SB	3	605	15	623	86.5	F	10.0	B	6.0	A	10.1	B			265	20	25		1 %	1393	118	301	1 %		265	20	30
	TH 61 at 147th St (Signal)	EB	8	2	16	26	73.3	E	65.2	E	24.5	C	38.4	D	37.4	D	170	20	50			1106	20	68					
		WB	156	5	84	245	169.3	F	73.9	E	29.7	C	112.1	F			275	209	412			1025	128	536					
		NB	16	852	233	1,101	10.4	B	7.0	A	2.9	A	6.1	A			315	20	30			902	94	264			315	20	71
		SB	65	676	3	744	53.8	D	63.1	E	92.1	F	62.3	E			300	91	400		24 %	1701	398	1546	24 %		300	20	288

NOTES

1. If the reported queue is greater than zero (0), but less than 20 ft, a minimum of 20 ft is reported.
2. Block Percentage is proportion of analysis time (1 hour) the storage lane or through lane is blocked or blocking.
3. Multiple storage lanes of different length are averaged together to show the "Effective Storage Length" per lane.

Appendix D

Traffic Counts

Location: TH 61 at 147th St
Count Date: 6/23/2020
Counted By: KP

TURNING MOVEMENT COUNT DATA

All Vehicles

	TH61				147th St				TH61				147th St				
	Southbound				Westbound				Northbound				Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
6:00	1	91	0	0	27	0	3	0	0	31	5	0	1	0	0	1	159
6:15	1	80	0	0	36	0	2	0	0	40	3	0	0	0	2	2	164
6:30	1	116	0	0	31	0	5	0	0	52	8	0	0	0	1	1	214
6:45	5	97	0	0	33	0	5	0	0	81	8	0	0	0	0	0	229
7:00	4	79	2	0	36	0	5	0	0	56	12	0	3	0	1	2	198
7:15	1	89	0	0	35	0	8	0	1	60	13	0	0	0	1	2	208
7:30	4	103	1	0	32	0	9	0	0	68	19	0	0	0	2	1	238
7:45	3	94	0	1	28	2	6	0	0	80	8	0	0	0	0	1	221
8:00	6	77	0	0	32	0	9	0	0	64	11	0	2	0	0	4	201
8:15	3	85	0	0	25	0	9	0	1	55	11	1	1	0	1	1	191
8:30	3	95	0	0	13	0	6	0	1	73	11	0	0	1	0	0	203
8:45	4	85	0	0	28	0	5	0	2	77	17	0	0	0	0	1	218
9:00	2	99	2	0	23	1	12	0	0	68	17	0	1	0	2	2	227
9:15	3	77	1	0	24	0	6	0	1	82	19	0	2	0	1	1	216
9:30	3	80	2	0	32	1	12	0	1	76	21	0	1	0	0	1	229
9:45	9	101	2	0	25	1	9	1	2	93	15	0	1	1	2	5	261
10:00	4	87	1	0	22	0	9	2	0	81	21	5	1	0	1	8	227
10:15	6	88	1	0	17	0	4	8	3	77	20	5	0	0	0	3	216
10:30	5	68	1	0	17	1	12	0	3	84	18	1	1	0	4	2	214
10:45	4	107	5	0	19	2	5	0	4	68	19	3	2	1	8	9	244
11:00	2	101	4	0	24	1	6	0	5	98	19	5	5	2	3	2	270
11:15	4	81	3	3	21	1	10	3	6	72	22	7	7	1	6	5	234
11:30	3	83	6	1	27	3	8	0	5	117	25	2	6	0	4	5	287
11:45	4	83	0	0	26	1	6	0	8	90	30	4	7	2	8	2	265
12:00	3	89	3	0	24	2	5	0	7	104	14	0	6	2	3	1	262
12:15	7	94	2	1	24	1	9	0	5	87	20	1	7	3	2	6	261
12:30	2	96	2	0	28	1	9	0	5	112	24	4	3	0	5	0	287
12:45	4	80	4	3	18	1	9	7	3	91	27	8	5	1	6	1	249
13:00	3	99	4	0	23	2	9	0	3	101	27	0	2	1	8	2	282
13:15	3	101	5	2	19	1	9	3	6	92	22	4	3	2	9	1	272
13:30	7	104	3	0	26	1	13	0	5	88	25	5	5	0	3	5	280
13:45	9	102	5	0	27	2	2	0	7	112	23	0	4	2	5	2	300
14:00	3	91	3	0	21	1	3	2	1	124	34	2	5	1	1	1	288
14:15	3	134	0	0	26	0	8	2	3	119	18	2	5	1	4	2	321
14:30	3	107	1	0	25	0	4	2	3	133	30	6	3	1	3	4	313
14:45	6	107	4	0	22	1	7	0	4	115	26	2	2	1	2	1	297
15:00	5	83	3	0	19	0	4	0	5	135	39	1	3	0	1	0	297
15:15	9	80	1	0	19	1	8	1	3	139	37	1	2	2	6	7	307
15:30	6	120	3	1	27	0	6	1	2	145	25	0	7	2	4	5	347
15:45	4	121	1	0	25	0	8	2	4	187	42	6	3	0	0	1	395
16:00	7	122	2	1	24	0	13	0	2	142	48	0	3	1	2	4	366
16:15	9	89	2	1	34	3	7	0	2	168	39	4	4	0	3	6	360
16:30	12	122	0	0	29	0	12	0	3	148	41	1	1	1	2	5	371
16:45	8	107	1	0	31	2	18	2	2	155	45	2	4	1	3	6	377
17:00	4	114	1	0	32	2	11	1	2	127	52	1	2	0	4	1	351
17:15	9	99	1	6	30	1	8	0	6	131	44	3	0	0	3	1	332
17:30	6	74	7	0	24	2	7	4	5	122	45	0	4	1	4	4	301
17:45	2	75	3	0	25	1	9	5	2	94	33	6	4	2	1	5	251
18:00	6	78	3	2	23	1	4	0	6	89	32	0	3	1	4	6	250
18:15	2	81	3	0	20	2	7	1	2	101	33	5	7	2	3	5	263
18:30	5	69	1	0	19	0	10	0	2	98	34	0	2	0	2	1	242
18:45	8	62	1	0	15	0	5	0	5	86	25	4	2	0	2	2	211
Total	240	4846	100	22	1312	42	395	47	148	5088	1276	101	142	36	142	146	13767
Cars+	233	4451	100	10	1299	40	388	17	146	4742	1261	48	142	36	142	33	12980
Trucks	7	395	0	12	13	2	7	30	2	346	15	53	0	0	0	113	787
% Trucks	2.9	8.2	0.0	54.5	1.0	4.8	1.8	63.8	1.4	6.8	1.2	52.5	0.0	0.0	0.0	77.4	
	7.8				1.3				5.6				0.0				5.7

Location: TH 61 at 152nd St
Count Date: 6/23/2020
Counted By: KP

TURNING MOVEMENT COUNT DATA

All Vehicles

	TH61				152nd St				TH61				152nd St				
	Southbound				Westbound				Northbound				Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
6:00	7	70	0	0	8	0	0	0	0	24	6	0	0	0	0	0	115
6:15	10	84	0	0	0	0	0	0	0	32	8	0	0	0	0	0	134
6:30	6	104	0	0	1	0	1	0	0	46	10	0	0	0	0	0	168
6:45	13	89	0	0	5	0	0	0	0	47	19	0	0	0	0	0	173
7:00	4	81	0	0	3	0	1	0	0	48	13	0	0	0	0	0	150
7:15	6	78	0	0	3	0	1	0	0	48	4	0	0	0	0	0	140
7:30	2	92	0	0	1	0	1	0	0	61	8	0	0	0	0	0	165
7:45	2	103	0	0	4	0	0	0	0	68	6	0	0	0	0	0	183
8:00	5	68	0	0	3	0	0	0	0	65	10	0	0	0	0	0	151
8:15	1	80	0	0	4	0	2	0	0	57	7	0	0	0	0	0	151
8:30	1	87	0	0	5	0	2	0	0	60	5	0	0	0	0	0	160
8:45	4	87	0	0	5	0	1	0	0	76	7	0	0	0	0	0	180
9:00	2	85	0	0	3	0	0	0	0	63	8	0	0	0	0	0	161
9:15	0	79	0	0	2	0	2	0	0	72	4	0	0	0	0	0	159
9:30	3	76	0	0	3	0	0	0	0	78	3	0	0	0	0	0	163
9:45	1	106	0	0	4	0	1	0	0	87	4	0	0	0	0	0	203
10:00	2	83	0	0	2	0	1	0	0	75	12	0	0	0	0	0	175
10:15	1	93	0	0	8	0	3	0	0	62	9	0	0	0	0	0	176
10:30	2	60	0	0	3	0	1	0	0	85	4	0	0	0	0	0	155
10:45	2	101	0	0	3	0	1	0	0	86	4	0	0	0	0	0	197
11:00	3	85	0	0	15	0	5	0	0	85	8	0	0	0	0	0	201
11:15	2	81	0	0	11	0	5	0	0	72	5	0	0	0	0	0	176
11:30	1	87	0	0	9	0	5	0	0	114	5	0	0	0	0	0	221
11:45	4	78	0	0	4	0	3	0	0	80	14	0	0	0	0	0	183
12:00	3	80	0	0	21	0	4	0	0	119	11	0	0	0	0	0	238
12:15	5	98	0	0	6	0	6	0	0	93	8	0	0	0	0	0	216
12:30	3	88	0	0	7	0	3	0	0	121	12	0	0	0	0	0	234
12:45	3	76	0	0	8	0	3	0	0	115	9	0	0	0	0	0	214
13:00	2	96	0	0	6	0	2	0	0	100	4	0	0	0	0	0	210
13:15	0	111	0	0	3	0	3	0	0	84	11	0	0	0	0	0	212
13:30	3	93	0	0	7	0	2	0	0	102	7	0	0	0	0	0	214
13:45	1	101	0	0	7	0	7	0	0	102	5	0	0	0	0	0	223
14:00	1	77	0	0	7	0	1	0	0	112	10	1	0	0	0	0	208
14:15	1	128	0	0	11	0	7	0	0	114	3	0	0	0	0	0	264
14:30	0	93	0	0	7	0	3	0	0	124	3	0	0	0	0	0	230
14:45	2	107	0	0	7	0	2	0	0	111	3	0	0	0	0	0	232
15:00	3	78	0	0	8	0	1	0	0	134	5	0	0	0	0	0	229
15:15	1	83	0	0	3	0	3	0	0	130	7	0	0	0	0	0	227
15:30	1	98	0	0	28	0	15	0	0	147	4	0	0	0	0	0	293
15:45	5	115	0	0	9	0	7	0	0	157	5	0	0	0	0	0	298
16:00	1	115	0	0	9	0	6	0	0	145	7	0	0	0	0	0	283
16:15	3	101	0	0	5	0	9	0	0	167	2	0	0	0	0	0	287
16:30	0	115	0	0	13	0	7	0	0	148	7	0	0	0	0	0	290
16:45	2	109	0	0	4	0	1	0	0	159	0	0	0	0	0	0	275
17:00	0	91	0	0	12	0	8	0	0	145	0	0	0	0	0	0	256
17:15	1	94	0	0	2	0	0	0	0	137	1	0	0	0	0	0	235
17:30	0	89	0	0	9	0	7	0	0	125	5	0	0	0	0	0	235
17:45	0	81	0	0	8	0	4	0	0	106	2	0	0	0	0	0	201
18:00	0	72	0	0	5	0	2	0	0	84	3	0	0	0	0	0	166
18:15	0	82	0	0	6	0	2	0	0	98	6	0	0	0	0	0	194
18:30	1	79	0	0	1	0	2	0	0	104	2	0	0	0	0	0	189
18:45	0	80	0	0	1	0	1	0	0	84	0	0	0	0	0	0	166
Total	126	4667	0	0	329	0	154	0	0	4958	325	1	0	0	0	0	10559
Cars+	113	4322	0	0	285	0	140	0	0	4639	282	1	0	0	0	0	9781
Trucks	13	345	0	0	44	0	14	0	0	319	43	0	0	0	0	0	778
% Trucks	10.3	7.4	0.0	0.0	13.4	0.0	9.1	0.0	0.0	6.4	13.2	0.0	0.0	0.0	0.0	0.0	
	7.5				12.0				6.9				0.0				7.4

Location: TH 61 at 159th St
Count Date: 6/23/2020
Counted By: KP

TURNING MOVEMENT COUNT DATA

All Vehicles

	TH61				Private Driveway				TH61				159th St				
	Southbound				Westbound				Northbound				Eastbound				
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Int. Total
6:00	0	72	1	0	0	0	0	0	1	22	0	0	6	0	3	0	105
6:15	1	85	0	0	0	0	0	0	1	28	0	0	3	0	14	0	132
6:30	2	97	0	0	0	0	1	0	5	40	0	0	4	0	10	0	159
6:45	0	92	4	0	0	0	0	0	1	42	0	0	2	0	6	0	147
7:00	0	70	6	0	0	0	0	0	5	43	0	0	2	0	20	0	146
7:15	0	82	7	0	0	0	0	0	3	42	0	0	4	0	4	0	142
7:30	0	75	2	0	0	0	0	0	3	55	0	0	2	0	19	0	156
7:45	0	91	5	0	0	0	0	0	8	54	0	0	3	0	11	0	172
8:00	0	66	5	0	0	0	0	0	7	56	0	0	0	0	9	0	143
8:15	0	79	3	0	0	0	0	0	4	49	0	0	5	0	8	0	148
8:30	0	69	2	0	0	0	0	0	5	52	0	0	4	0	12	0	144
8:45	1	73	2	0	0	0	0	0	3	68	0	0	7	0	10	0	164
9:00	0	74	4	0	0	0	0	0	4	58	0	0	1	0	11	0	152
9:15	0	72	5	0	0	0	0	0	9	58	0	0	2	0	6	0	152
9:30	0	71	3	0	0	0	0	0	5	71	0	0	5	0	5	0	160
9:45	0	91	3	0	1	0	0	0	2	78	1	0	8	0	12	0	196
10:00	0	72	3	0	0	0	0	0	1	67	0	0	3	0	10	0	156
10:15	0	91	5	0	0	0	0	0	7	57	0	0	6	0	4	0	170
10:30	0	51	3	0	0	0	0	0	10	69	0	0	1	0	5	0	139
10:45	0	89	4	0	0	0	0	0	13	71	0	0	9	0	14	0	200
11:00	0	79	4	0	0	0	0	0	6	80	0	0	3	0	13	0	185
11:15	0	63	5	0	0	0	0	0	8	65	0	0	5	0	7	0	153
11:30	0	85	9	0	0	0	0	0	8	116	0	0	5	0	6	0	229
11:45	0	73	1	0	0	0	0	0	8	75	0	0	9	0	9	0	175
12:00	0	77	4	0	0	0	0	0	6	108	0	0	5	0	11	0	211
12:15	0	93	6	0	0	0	0	0	12	87	0	0	5	0	7	0	210
12:30	0	68	3	0	0	0	0	0	15	105	0	0	8	0	6	0	205
12:45	0	71	6	0	0	0	0	0	13	109	0	0	5	0	14	0	218
13:00	0	86	4	0	0	0	0	0	5	92	0	0	1	0	8	0	196
13:15	0	100	6	0	0	0	0	0	11	78	0	0	5	0	7	0	207
13:30	0	84	2	0	0	0	0	0	7	90	0	0	5	0	12	0	200
13:45	0	94	5	0	0	0	0	0	7	99	0	0	3	0	4	0	212
14:00	0	79	6	0	0	0	0	0	6	106	0	0	2	0	5	0	204
14:15	0	108	8	0	0	0	0	0	5	108	0	0	8	0	12	0	249
14:30	0	82	6	0	0	0	0	0	8	118	0	0	5	0	9	0	228
14:45	0	102	4	0	0	0	0	0	11	98	0	0	5	0	9	0	229
15:00	0	70	6	0	0	0	0	0	6	116	0	0	6	0	5	0	209
15:15	0	72	7	0	0	0	0	0	10	126	0	0	8	0	8	0	231
15:30	0	91	9	0	0	0	0	0	10	142	0	0	6	0	13	0	271
15:45	0	97	6	0	0	0	0	0	18	149	0	0	8	0	13	0	291
16:00	0	82	4	0	0	0	0	0	21	142	0	0	1	0	1	0	251
16:15	0	83	6	0	0	0	0	0	25	149	0	0	9	0	14	0	286
16:30	0	89	8	0	0	0	0	0	22	150	0	0	9	0	22	0	300
16:45	0	88	6	0	0	0	0	0	20	150	0	0	14	0	10	0	288
17:00	0	75	11	0	0	0	0	0	15	138	0	0	2	0	11	0	252
17:15	0	88	4	0	0	0	0	0	19	118	0	0	8	0	10	0	247
17:30	0	66	13	0	0	0	0	0	9	123	0	0	4	0	15	0	230
17:45	0	68	3	0	0	0	0	0	10	103	0	0	5	0	13	0	202
18:00	0	63	7	0	0	0	0	0	9	74	0	0	14	0	7	0	174
18:15	0	67	9	0	0	0	0	0	15	85	0	0	7	0	6	0	189
18:30	0	72	9	0	0	0	1	0	14	89	0	0	4	0	5	0	194
18:45	0	64	3	0	0	0	0	0	4	81	0	0	5	0	9	0	166
Total	4	4141	257	0	1	0	2	0	460	4549	1	0	266	0	494	0	10175
Cars+	4	3811	248	0	0	0	1	0	451	4229	0	0	258	0	489	0	9491
Trucks	0	330	9	0	1	0	1	0	9	320	1	0	8	0	5	0	684
% Trucks	0.0	8.0	3.5	0.0	100.0	0.0	50.0	0.0	2.0	7.0	100.0	0.0	3.0	0.0	1.0	0.0	
	7.7				66.7				6.6				1.7				6.7

Appendix E

ICE Report

Intersection Control Evaluation Report

US Highway 61 and 152nd Street

Hugo, Minnesota

ISDWB 156183 | January 27, 2021

SEH

Building a Better World for All of Us®

Engineers | Architects | Planners | Scientists

Intersection Control Evaluation Report

US Highway 61 and 152nd Street

Hugo, Minnesota

SEH No. ISDWB 156183

January 27, 2021

I hereby certify that this report was prepared by me or under my direct supervision, and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Chad M. Jorgenson, PE, PTOE

Date: January 27, 2021 License No.: 55528

Approved By:

Lars Impola Digitally signed by Lars Impola
Date: 2021.01.28 14:37:09 -06'00'

Lars Impola, PE
MnDOT Metro Program Support Date

Reviewed By:

DocuSigned by:
Mark Erichson 2/1/2021
C2276C98595D45F...

March Erichson, PE
City of Hugo Engineer Date

DocuSigned by:
Rachel Juba 2/1/2021
CBEB84B4EB114D9...

Rachel Juba
City of Hugo Community Development Director Date

DocuSigned by:
Wayne Sandberg 2/1/2021
F7EE927E26B24F3...

Wayne Sandberg, PE
Washington County Regional Rail Authority Date

Short Elliott Hendrickson Inc.
3535 Vadnais Center Drive
St. Paul, MN 55110-3507
651.490.2000

SEH

Building a Better World for All of Us®

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Intersection Control Evaluation Report

US Highway 61 and 152nd Street

Prepared by Short Elliott Hendrickson Inc. for Independent School District No. 624.

1 Background and Purpose

With the passing of the recent White Bear Lake Area School's bond referendum, a new elementary school is now being proposed in Hugo, Minnesota. The elementary school is expected to be located just west of the intersection of Highway 61 and 152nd Street. The proposed elementary school will have direct access onto Highway 61 with the construction of a west leg at the intersection of Highway 61 and 152nd Street.

The proposed elementary school is expected to open during the Fall of 2022 and will serve approximately 500 students, 50 staff members, and 7 buses at the time of opening. It is anticipated that the school will be at maximum capacity by the year 2026. Under the maximum capacity conditions the school is expected to serve 720 students, 70 staff members, and 11 buses.

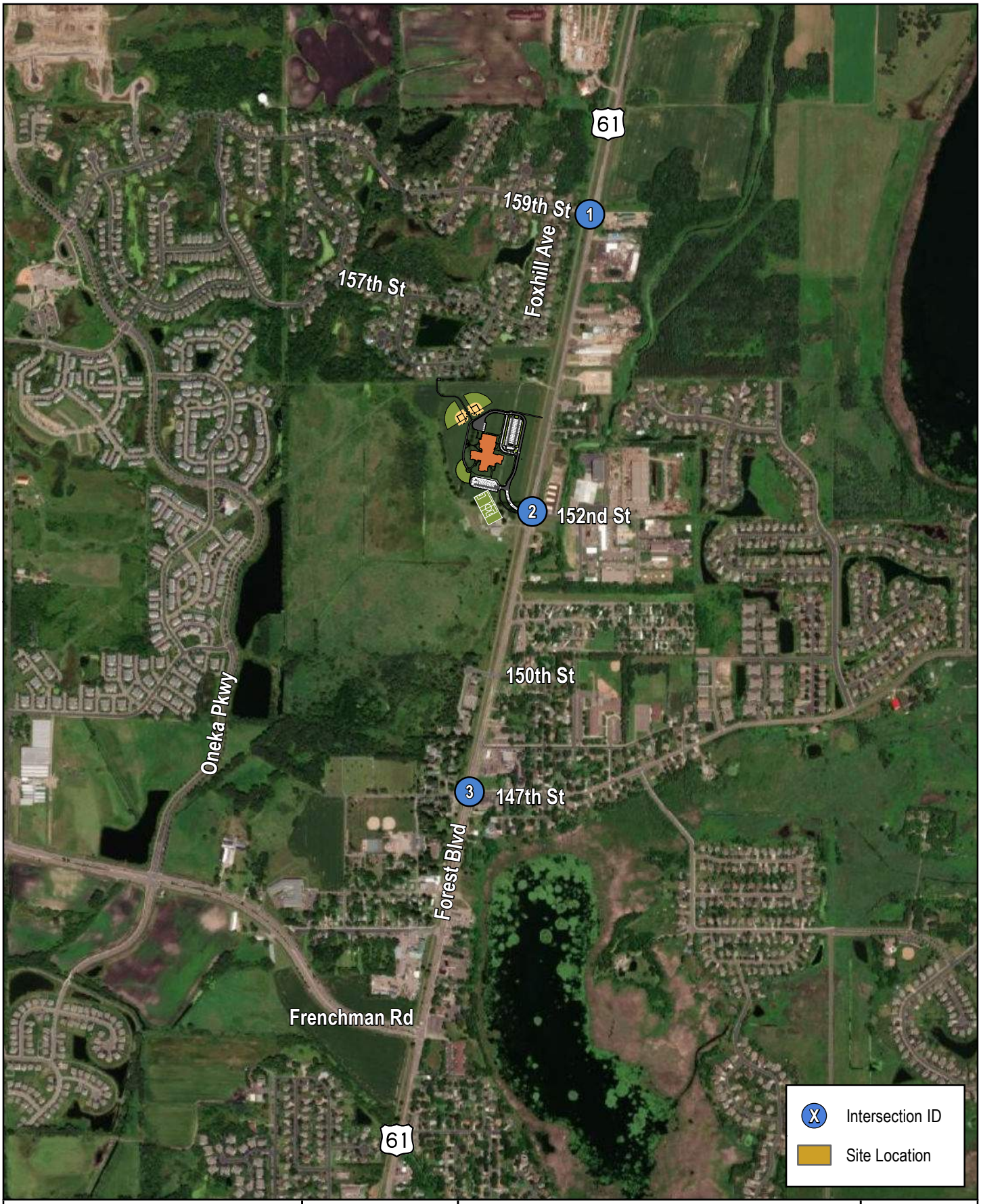
The Minnesota Department of Transportation (MnDOT) has defined the Intersection Control Evaluation (ICE) process used in this study. The process is used to objectively investigate and determine the optimal type of traffic control that should be provided to serve the existing conditions and future needs. The evaluation includes analyzing the AM, school dismissal, and PM peak hours for the existing year (2020), forecast year of opening 2022 school conditions, 2026 full school build out conditions and five years after the full build out in the year 2031. The evaluations include assessing traffic control volume warrants, intersection and roadway safety, traffic operations and other factors such as cost and right of way impacts.

The range of traffic control options includes a No Build scenario, with no change to the existing control conditions, and viable traffic control changes for the study intersection, including traffic signal control and roundabout control.

A traffic study was completed as part of this project and analyzed the following three study intersections noted below:

- Highway 61 at 159th Street
- Highway 61 at 152nd Street
- Highway 61 at 147th Street

Figure 1 represents the study intersections within the project area.



Path: X:\F:\I\ISDWB\156183\5-final-dsgn\51-drawings\90-GIS\Figure 1- Project Location.mxd

SEH

Project: ISDWB 156183
Print Date: 12/8/2020

Map by: jdanibas
Projection: NAD 1983 HARN MN Washington
Source: ESRI

Project Location

White Bear Lake Elementary School
Hugo, MN

Figure 1

2 Existing Conditions

Currently, through the City of Hugo, Highway 61 is considered an "A" Minor Arterial in the City's 2040 Comprehensive Plan. Highway 61 is currently under the jurisdiction of the Minnesota Department of Transportation, however in the future this section of Highway 61 through the project area may be turned back to Washington County. In 2019, through the project area, Highway 61 carried an Annual Average Daily Traffic (AADT) total of 11,453 vehicles per day.

The intersection of Highway 61 at 152nd Street is currently a stop-controlled T-intersection. 152nd Street is a City owned street that generally serves an industrial area located east of Highway 61 on both the north and south sides of 152nd Street.

The speed limit of Highway 61 through the 152nd Street intersection is 55 mph. However, approximately 350' south of the intersection Highway 61 transitions into a 45-mph speed zone. The speed limit on 152nd Street is 30 mph.

The northbound Highway 61 approach to 152nd Street includes a dedicated right turn lane and a through lane. Southbound Highway 61 is a two-lane approach with a shared thru/left turn lane and a by-pass lane for traffic to pass vehicles waiting to make a southbound left turn onto 152nd Street.

The Hardwood Creek, currently under the jurisdiction of the Washington County Regional Rail Authority, is a multi-use trail that currently runs parallel to Highway 61 on the west side of the highway. No marked crosswalks are currently present at the intersection of Highway 61 and 152nd Street.

2.1 Existing Traffic Volumes and the Health Pandemic

The current health pandemic surrounding COVID-19 has impacts on the project data collection; both commuter and school traffic has been impacted by the situation.

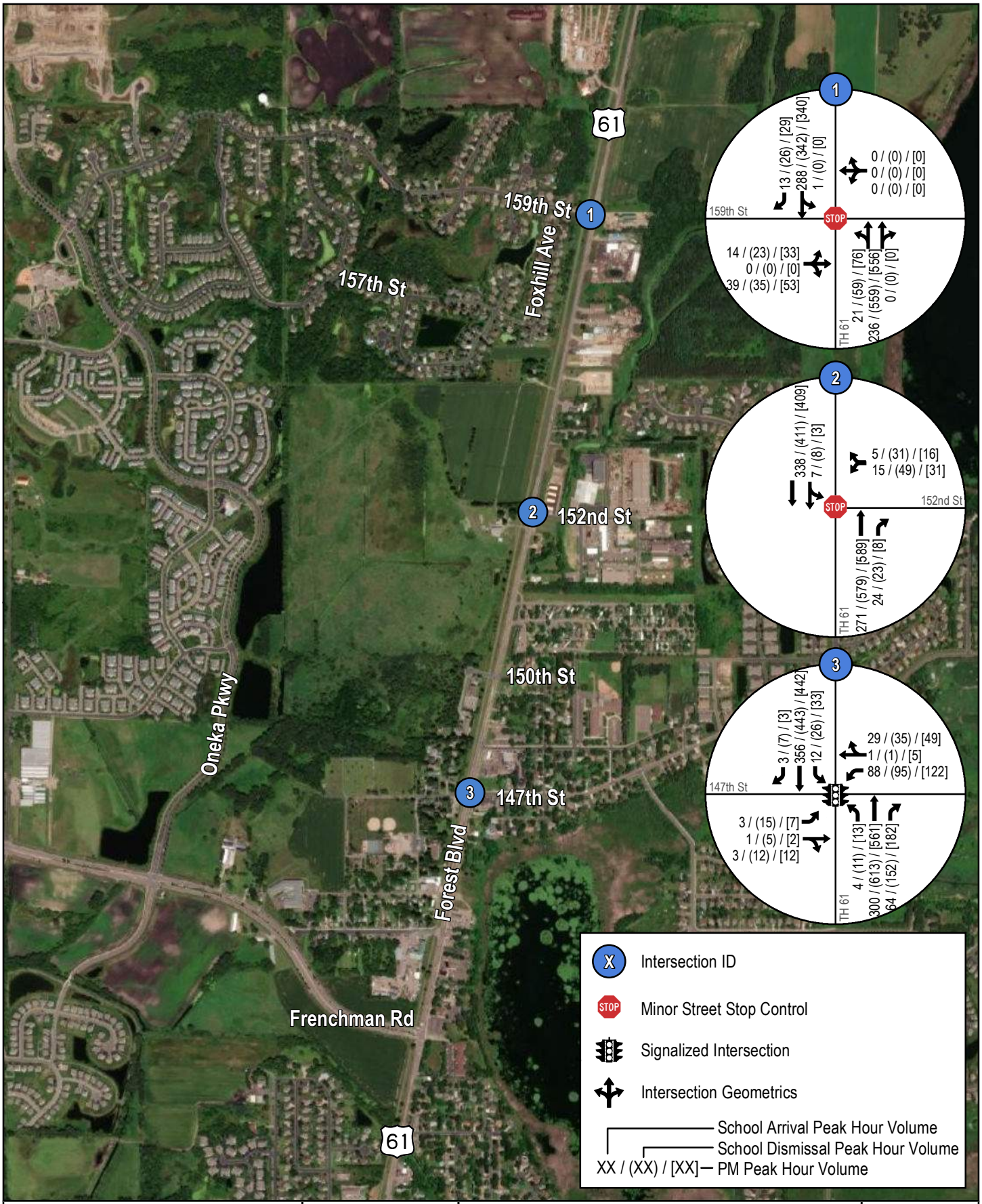
Traffic counts for this project were taken at all three study intersections in June of 2020. Due to school not being in session and the impacts to traffic volumes caused by the coronavirus, adjustments were made to factor up the traffic counts to more "normal" conditions.

Traffic counts were obtained from MnDOT that were taken in November of 2019 as part of a larger signal re-timing effort. A count at the intersection of Highway 61 and 147th Street was compared to the traffic count obtained at this intersection in June of 2020.

When comparing these two counts it was determined that the AM peak hour was approximately 28% lower than the previous count's AM peak hour. Throughout the rest of the day the June 2020 traffic count was approximately 20% lower. Therefore, the AM peak hour traffic counts at each of the study intersections were increased by 28% and the school dismissal and PM peak hour counts were increased by 20%.

Figure 2 shows the existing June 2020 traffic counts at each of the study intersections.

Figure 3 shows the coronavirus adjusted traffic counts at each of the study intersections.



Path: X:\F:\IN\SDWB\156183\15-final-dsgn\51-drawings\90-GIS\Figure 2 - Existing 2020 Traffic.mxd

SEH

Project: ISDWB 156183
Print Date: 10/31/2020

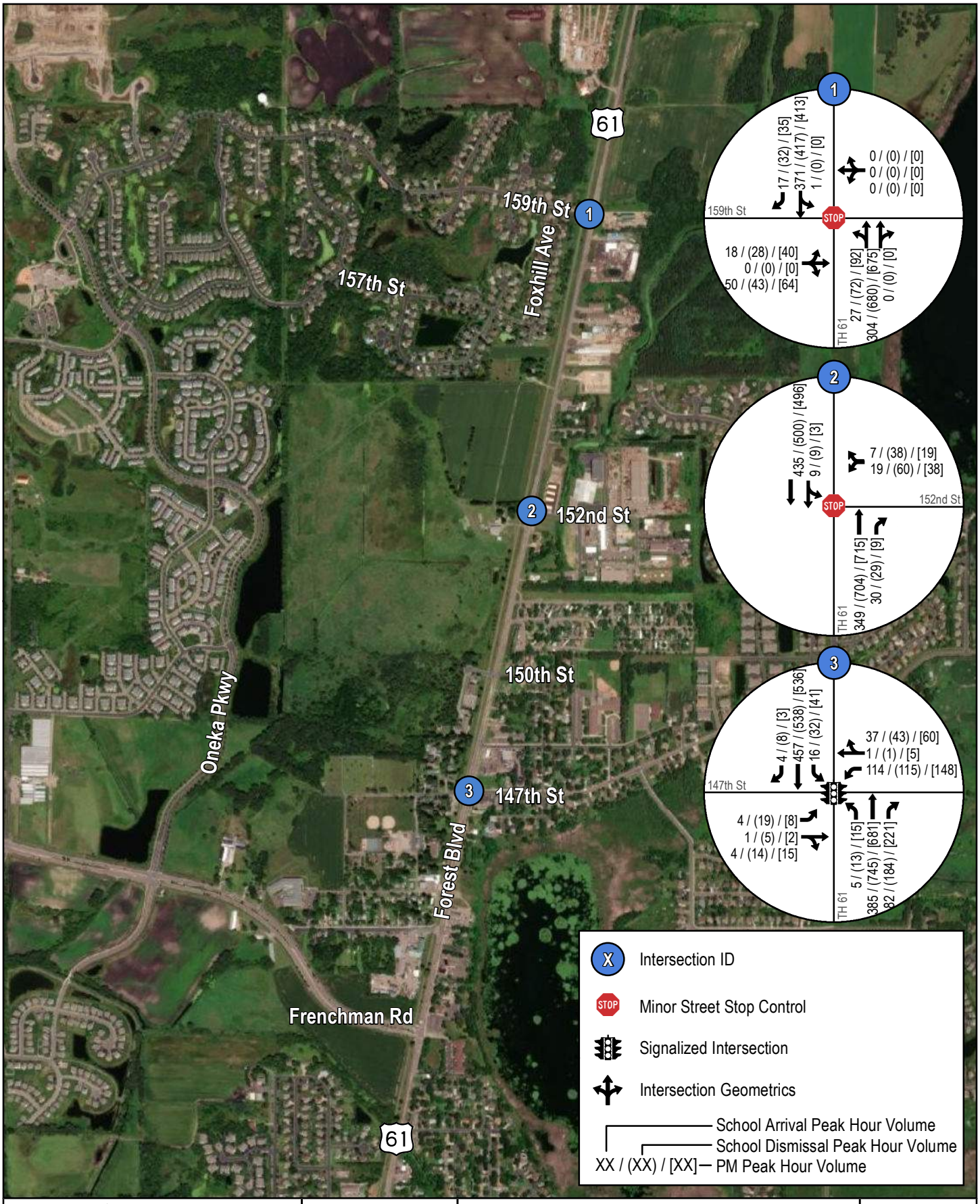
Map by: jdanibas
Projection: NAD 1983 HARN MN Washington
Source: ESRI

Existing 2020 Traffic

White Bear Lake Elementary School

Hugo, MN

Figure 2



Path: X:\FJ\I\ISDWB\156183\15-final-dsgn\51-drawings\90-GIS\Figure 3 - COVID-19 Adjusted 2020 Traffic Counts.mxd

SEH

Project: ISDWB 156183
Print Date: 10/31/2020

Map by: jdanibas
Projection: NAD 1983 HARN MN Washington
Source: ESRI

COVID-19 Adjusted 2020 Traffic Counts
White Bear Lake Elementary School
Hugo, MN

Figure 3

2.2 Historical Crash Analysis

Crash data from January 1st, 2009 through December 31st, 2019 was collected from the Minnesota Crash Mapping Analysis Tool (MnCMAT2). The type and severity of the crashes were reviewed, and crash rates and critical rates were calculated for the study intersection.

Crash rates are expressed as the number of crashes per million entering vehicles at an intersection or along a segment. Crash severity is comprised of 5 separate types including fatal, an incapacitating injury (Severity A), a non-incapacitating injury (Severity B), a possible injury (Severity C), or a property damage crash.

The critical crash rate is a statistical value that is unique to each intersection based on vehicular exposure and the statewide average crash rate for similar intersections; an intersection with a crash or severity rate higher than the critical rates indicates a sustained crash problem at the intersection.

At the intersection of Highway 61 and 152nd, there have been a total of two crashes from 2010 through 2019. One crash was a rear end accident that resulted in a possible injury crash. The other crash occurred during construction operations, in which a left turning vehicle struck the trailer of a construction vehicle hauling asphalt mix during a flagging operation that was taking place on Highway 61. The crash rate at this intersection is 0.05 crashes per MEV. This calculated crash rate is lower than the MnDOT statewide average crash rate for intersections with similar characteristics and is also lower than the calculated critical crash rate. As was previously stated, having a calculated crash rate lower than the critical crash rate indicates that there does not appear to be a sustained crash problem at this intersection.

The crash information is summarized in Table 1. More detailed crash information is shown in **Tables A1** & **A2** in the **Appendix A.**

Table 1 – Crash History 2009 - 2019

Intersection:	Crash Severity						Crash Rates	
	Fatal	Sev A	Sev B	Sev C	Property Damage	Total	Int. Rate	Critical Rate
Highway 61 at 152nd Street	0	0	0	1	1	2	0.05	0.48

3 Future Conditions

As previously mentioned, this study includes evaluation of the study intersections in future year conditions to determine the impacts of increased growth along the surrounding roadways.

3.1 Trip Generation and Trip Distribution

The Institute of Transportation Engineers (ITE) Trip Generation Manual 10th Edition was used to estimate new development trips for the proposed elementary school. ITE Land Use Code 520-Elementary School was used to generate trips for the elementary school for both the year of opening 2022 and expected full build out year 2026.

Trip generation rates vary for the elementary school based upon the different time periods throughout the day. For instance, the trips that are generated for an elementary school are lower during the AM peak hour of the roadway since elementary schools typically start later in the morning compared to the morning rush hour.

Due to the proposed start and end times of the elementary school, 9:30 AM to 3:30 PM, trip rates assigned to the elementary school were based upon the peak hour of the generator for the AM and school dismissal peak time periods. Trips were generated for the PM peak hour by using the rate associated with the peak hour of adjacent street traffic.

Table 2 – Trip Generation

ITE Code	Students	Daily			AM Peak			SD Peak			PM Peak		
		Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total	Enter	Exit	Total
520 – Elem. School	500	472	473	945	176	149	325	77	93	170	41	44	85
520 – Elem. School	720	680	681	1361	253	215	468	110	135	245	59	63	122

As previously stated, at the time of opening in 2022, the elementary school is expected to have 500 students. Enrollment is expected to increase to a full build out of 720 students by the year 2026.

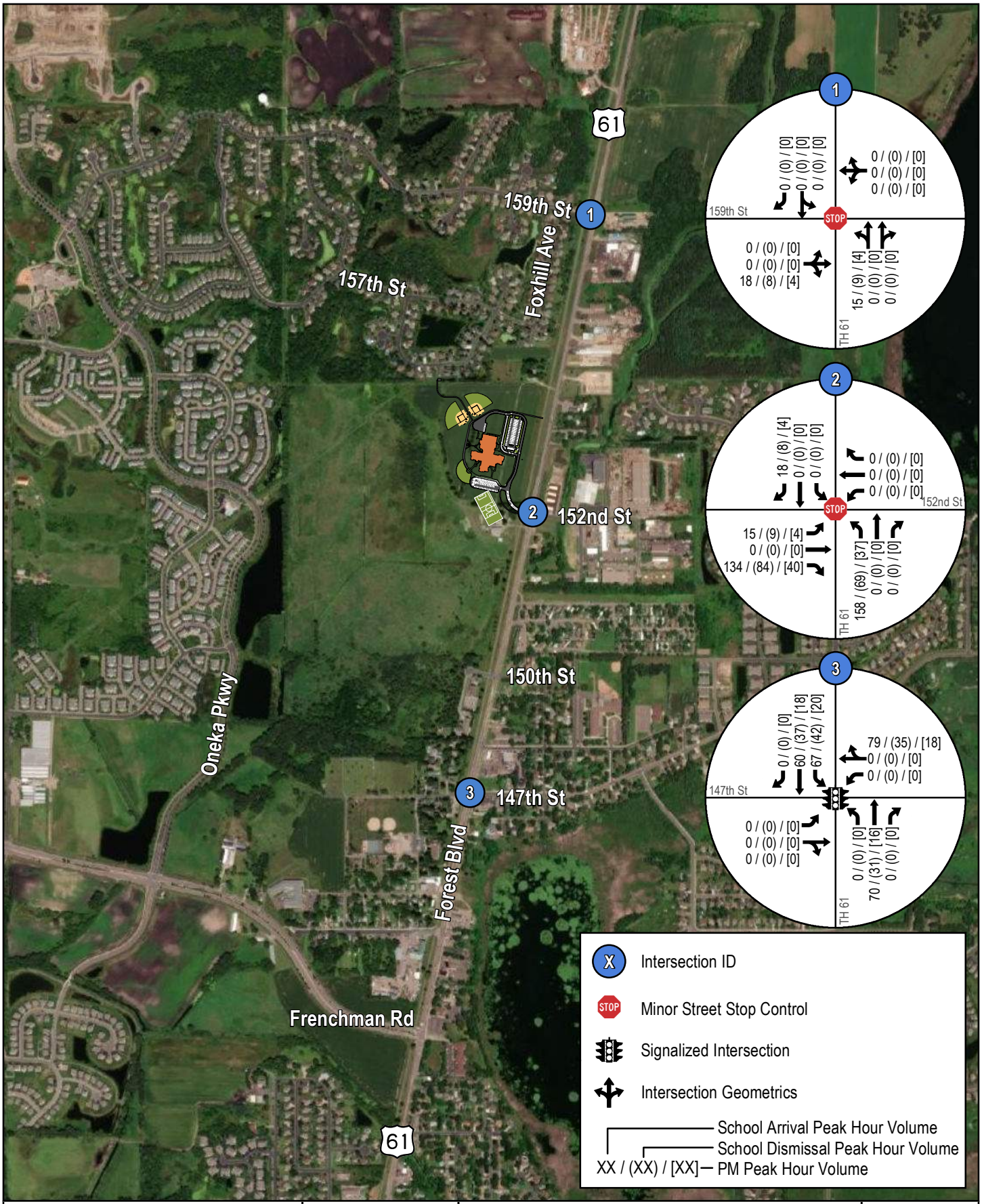
Trips were distributed to the roadway based upon conversations with the White Bear Lake School District and the City of Hugo. Based upon these conversations a preliminary school boundary was developed and used to assign traffic to the surrounding roadway network. **Exhibit 1** shows the approximate school boundary.

Exhibit 1: Proposed School Boundary

From this proposed boundary it was determined that approximately 90% of school traffic would travel from the site to the south and the remaining 10% to the north. This school distribution was used for both the year of opening and 2026 analysis scenarios.

Based on conversations with the City of Hugo, there is a possibility of more housing developments to occur north of the school site, approximately 200 homes west of Oneka Lake. Therefore, based on this information, the trip distribution was modified for the future 2031 analysis scenario. With the possible construction of the homes to the north the trip distribution was adjusted to 75% of traffic traveling to and from the south and 25% of the traffic to and from the north.

Figures 4, 5 and **6** show the proposed trip generation for the year of opening, full build out and future year school traffic, respectively.



Path: X:\F:\N\SDWB\156183\5-final-dsgn\51-drawings\90-GIS\Figure 4 - 2022 Year of Opening School Traffic Distribution.mxd

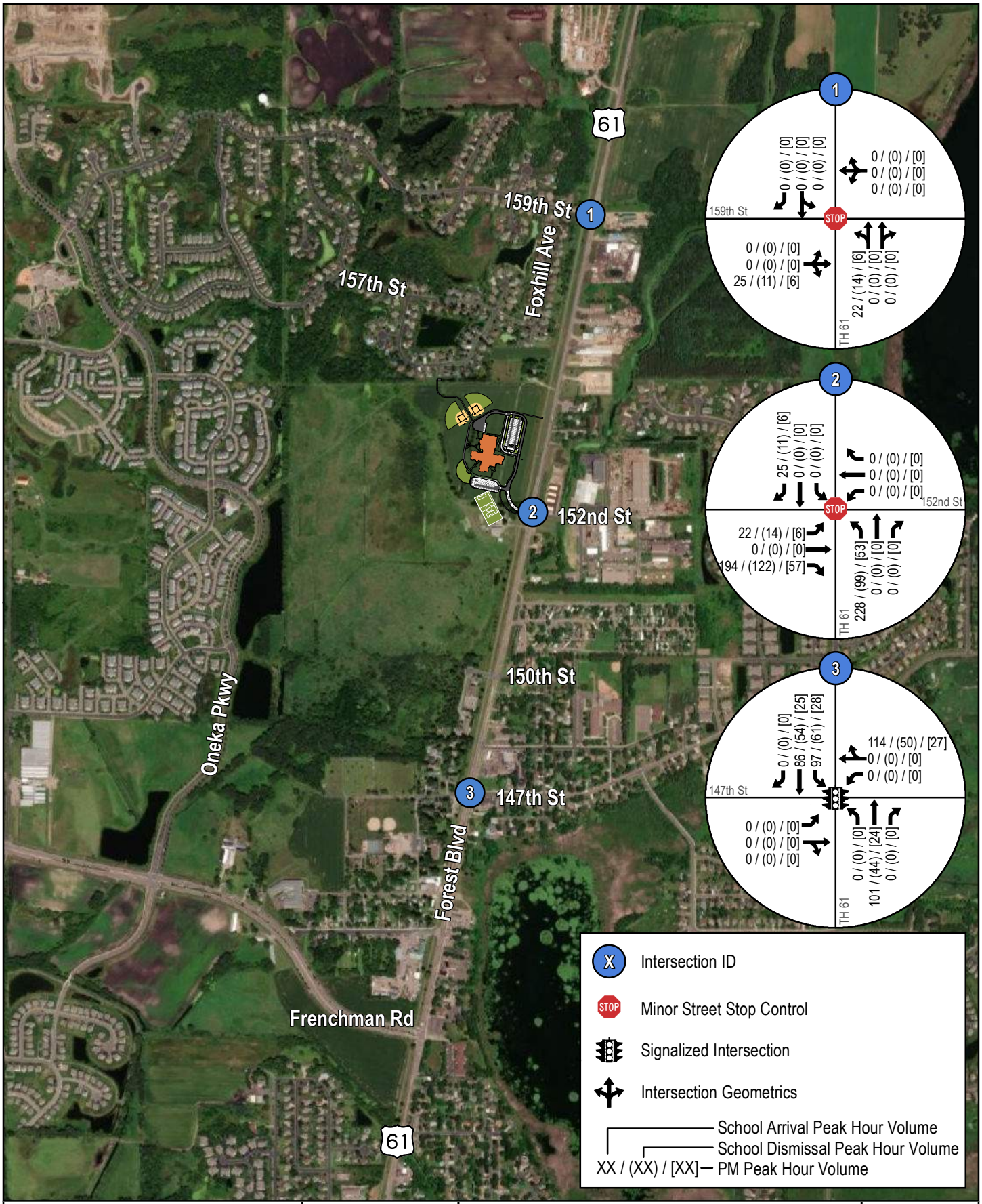
SEH

Project: ISDWB 156183
Print Date: 10/31/2020

Map by: jdanibas
Projection: NAD 1983 HARN MN Washington
Source: ESRI

2022 Year of Opening School Traffic Distibution
White Bear Lake Elementary School
Hugo, MN

Figure 4



Path: X:\F:\N\SDWB\156183\5-final-dsgn\51-drawings\90-GIS\Figure 5 - 2026 Full Build School Traffic Distribution.mxd

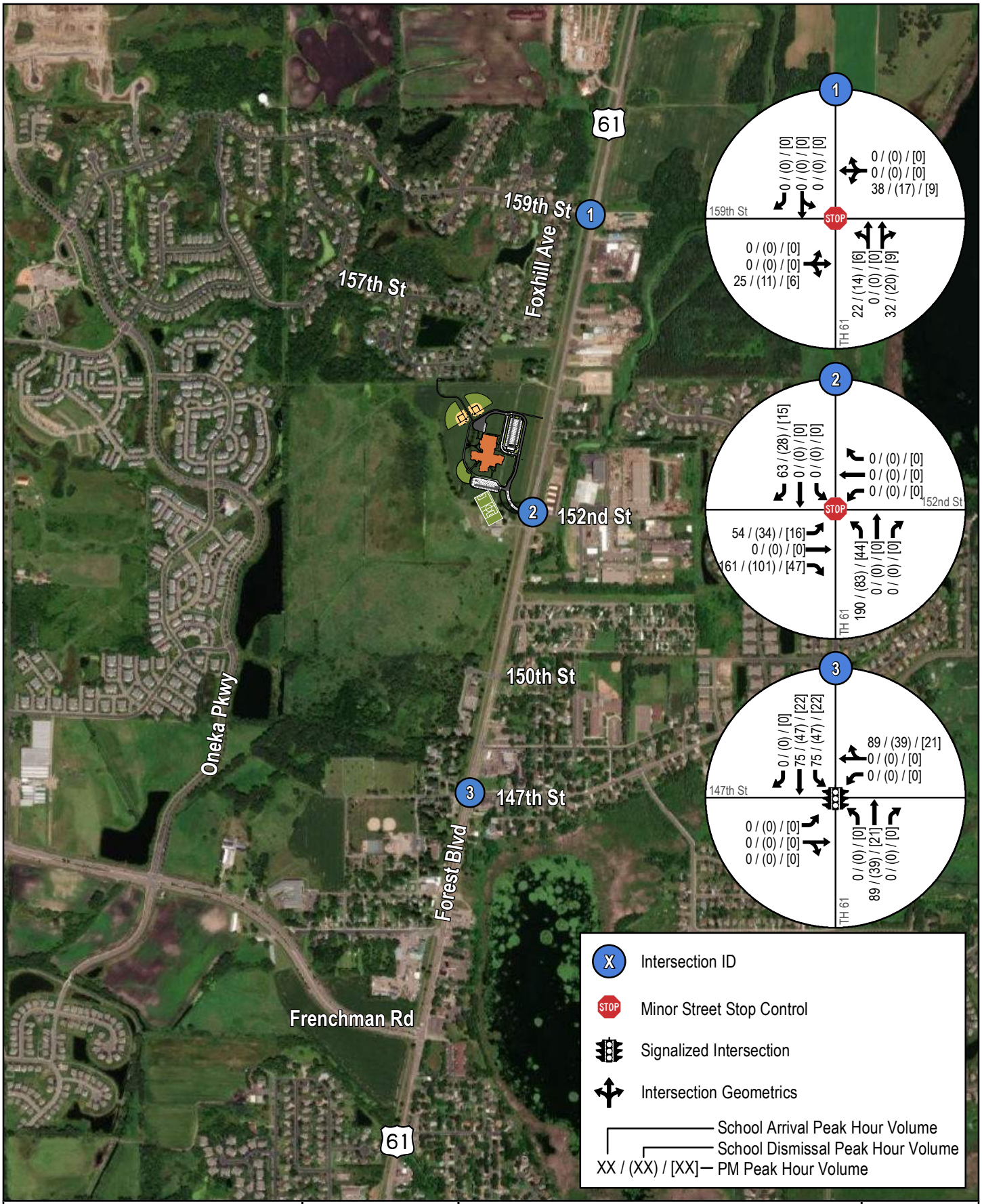
SEH

Project: ISDWB 156183
Print Date: 10/31/2020

Map by: jdanibas
Projection: NAD 1983 HARN MN Washington
Source: ESRI

2026 Full Build
School Traffic Distibution
White Bear Lake Elementary School
Hugo, MN

Figure 5



Path: X:\FJ\IN\SDWB\156183\5-final-dsgn\51-drawings\90-GIS\Figure 6 - 2031 Future Build School Traffic Distribution.mxd

SEH

Project: ISDWB 156183
Print Date: 10/31/2020

Map by: jdanibas
Projection: NAD 1983 HARN MN Washington
Source: ESRI

2031 Future Build
School Traffic Distibution
White Bear Lake Elementary School
Hugo, MN

Figure 6

3.2 Traffic Forecasts

Historical AADT data in the project area along with previous traffic study information was reviewed to determine background growth rates for the surrounding roadway network.

Based on this information a straight-line linear growth rate of 2.0% per year was selected and utilized to develop traffic forecasts along Highway 61 for all future year analyses.

All side streets in the study area utilized a straight-line linear growth rate of 0.5% per year to develop traffic forecasts for future year scenarios.

Currently, Hugo Elementary and Oneka Elementary School serves the proposed attendance boundary shown in **Exhibit 1**. As part of the School District's Bond referendum that passed, the current Hugo Elementary School will be converted into a Northern Early Childhood location while Oneka Elementary School and the new proposed elementary school will serve the existing K-5 student demand. This change in operations will likely result in reduced traffic volumes on the roadways surrounding the current Hugo Elementary School as well as some neighborhoods being served currently by Oneka Elementary School.

Figures 7, 9, and **11** show the No Build conditions for the 2022 year of opening, 2026 Full Build, and 2031 future year conditions respectively.

4 Analysis of Alternatives

Intersection control evaluations rely on traffic control warrants to assess the different options available at any intersection. To determine the control options, warrants are evaluated to assess where control changes can be made based on volumes. The results are used to aid in the evaluation of traffic safety and traffic operations at the study intersection.

4.1 Warrant Analysis

The Minnesota Manual of Uniform Traffic Control Devices (MnMUTCD) provides guidance on when it may be appropriate to use all-way stop or signal control at an intersection. This MnMUTCD guidance is provided in the form of "warrants", or criteria, for when all-way stop or signal control may be justified. Though all-way stop or signal control should not be installed at an intersection unless a MnMUTCD warrant is met, meeting a warrant at an intersection does not in itself require the installation of that particular type of control. Roundabouts are typically considered to be warranted if traffic volumes meet the criteria for either all-way stops or traffic signals. Along with traffic volumes, warrants also consider vehicle crash history and school crossings.

For traffic signal installation, MnDOT typically requires volume thresholds for Warrant 1 to be satisfied, which requires 8-hours of combined major approach volumes and the highest minor street approach volume to meet MnMUTCD thresholds. These thresholds vary with the number of approach lanes on the major and minor street. Other warrants may be used as indicators of a need to consider traffic control change; an engineering study that considers factors, including warrants, should be performed to determine the optimum type of control at an intersection.

4.1.1 Requirements for Installation of an All-Way Stop

For an all-way stop control installation, the study reviewed the minimum volume criteria outlined in the MnMUTCD (Chapter 2B.7). This criteria states that for any 8 hours of the day, the combined major approach volumes and combined minor approach volumes should be at or greater than the volume thresholds. An engineering study that considers factors, including warrants, should be performed to determine the “best” type of control at an intersection.

4.1.2 Requirements for Installation of a Traffic Signal

For traffic signal installation, MnDOT typically requires volume thresholds for Warrant 1 to be satisfied, which requires 8-hours of combined major approach volumes and the highest minor street approach volume to meet MnMUTCD thresholds (Chapter 4C). These thresholds vary with the number of approach lanes on the major and minor street. However, other warrants may be used as indicators of a need to consider traffic control change. In this analysis, Warrant 2 (4-hour volumes) and Warrant 3 (peak hour volumes), Warrant 5 – School Crossing, as well as Warrant 7 – Crash Experience were also reviewed for the intersection. An engineering study that considers factors, including warrants, should be performed to determine the “best” type of control at an intersection.

4.1.3 Warrant Analysis Assumptions

MnDOT guidelines for the traffic signal warrant suggests removing 100% of right turning traffic from the minor leg since this movement typically can enter the traffic stream with minimal conflict. This suggestion is not applicable with the all-way stop warrant. Therefore, a traffic signal would not be needed to reduce delay or improve safety for this right turn movement. In certain circumstances (i.e. high right turn volume, minimum mainline gaps etc.), MnDOT allows for the inclusion of 50% of the minor street right turning traffic in the analysis. Based upon MnDOT’s ICE Report Manual (http://www.dot.state.mn.us/trafficeng/signals/worksheets/ICE.pdf) if “right turning volume exceeds 70% of its potential capacity for any hour for each approach, 50% of the right turning volume for all hours should be added back in.”

Based upon MnDOT guidance, the analysis for this study intersection includes the removal of 100% of the right turning traffic from the minor approaches for the signal warrant analysis.

MnMUTCD guidelines suggest that the warrant thresholds may also be reduced based on the roadway speeds and population of the city the intersection is within. If either major approach to the intersection has a posted speed, or 85th percentile speed, that exceeds 40 mph, then a reduction to 70% threshold volumes is allowed in both all way stop warrant and traffic signal warrant. If the population of the city is less than 10,000 people, a reduction to 70% threshold volumes is allowed in the traffic signal warrant, but not the all way stop warrants.

Based upon MnMUTCD guidance, the analysis of the study intersection does include a reduction to 70% thresholds based upon the speed limit of Highway 61 being above 40 mph through the 152nd Street intersection.

4.1.4 Warrant Results Summary

The existing 2020 traffic volumes, both the raw and increased base counts, at the study intersection currently do not meet either the All-Way Stop warrant or the traffic signal volume

thresholds for Warrants 1A, 1B, 1A & 1B, Warrant 2 – Four Hour, Warrant 3 – Peak Hour, or Warrant 7 – Crash Experience (see Section 2.2 for crash history).

During the future year conditions with the elementary school present, the school is expected to directly access Highway 61 from a newly constructed west leg of 152nd Street.

To conduct a warrant analysis for the future conditions with the elementary school present, the ITE Trip Generation Handbook was used to distribute generated trips throughout the day. The Trip Generation Handbook provides guidance for the distribution of the daily elementary school traffic throughout an average day.

For the purposes of this warrant analysis, it was assumed that the geometry for the new eastbound approach would include a dedicated left, through and right turn lane approach. Based on this geometry, the volume thresholds change for the traffic signal warrants due to the minor street approach now having more than one lane of approach. If the geometry were to change to a dedicated left turn and a shared thru-right approach lane, the minor street approaches would still be considered a multi-lane approach.

Under the 2022 year of opening traffic volumes, the study intersection of Highway 61 at 152nd Street does not meet either the All-Way Stop warrant or the traffic signal volume thresholds for Warrants 1A, 1B, 1A & 1B, Warrant 2 – Four Hour, Warrant 3 – Peak Hour, or Warrant 7 – Crash Experience (see Section 4.2 for crash estimates). Due to the change of adding additional lanes on the minor street approaches, the volume thresholds are modified for the year of opening and full build out years. Due to this threshold change, Warrant 1 – 8 hour does not meet the volume requirements for any hours of the day. When compared to the year 2020 with a single lane minor street approach, the intersection met for 2 of the 8 required hours.

Under the 2026 Full Build condition traffic volumes, the study intersection of Highway 61 at 12nd Street still does not meet either the All-Way Stop warrant or the traffic signal volume thresholds for Warrants 1A, 1B, 1A & 1B, Warrant 2 – Four Hour, Warrant 3 – Peak Hour, or Warrant 7 – Crash Experience (see Section 4.2 for crash estimates).

Table 3 provides both the all-way stop warrant and the traffic signal warrant summary for the existing 2020 COVID-19 Adjusted volumes, 2022 year of opening conditions and 2026 Full Build out conditions. The full all-way stop warrant analysis and the traffic signal warrant analysis can be found in **Appendix B**.

Table 3 – Warrant Analysis Results

Traffic Year	Description	All Way Stop Warrant	Traffic Signal Warrants		
			8-Hour Warrant	4-Hour Warrant	Peak Hour Warrant
2020	Existing (raw count)	Not Met 0/8 Hours	Not Met 2/8 Hours	Not Met 0/4 Hours	Not Met 0/1 Hours
2022	Year of Opening	Not Met 2/8 Hours	Not Met 0/8 Hours	Not Met 0/4 Hours	Not Met 0/1 Hours
2026	Full Build	Not Met 2/8 Hours	Not Met 0/8 Hours	Not Met 0/4 Hours	Not Met 0/1 Hours

Notes: X/Y infers X hours met / Y hours required.

While the intersection of Highway 61 at 152nd Street does not meet Warrant 1, 2, 3, or 7 there are other warrants outlined in the MnMUTCD that need to be considered.

Given the current proposal of constructing an elementary school at this intersection, emphasis should be given to Warrant 5 – School Crossing. This warrant is intended for application where the fact that school children cross the major street is the principal reason to consider installing a traffic control signal. This warrant states that there should be approximately 20 school children crossing the major roadway during the highest crossing hour. This would equate to approximately 4% of the students attempting to cross Highway 61 during the year of opening either in the hour before school starts or in the hour after school concludes.

Based upon the location of the school and the residential housing located across Highway 61 from the school site, the School District plans to provide busing to students living across Highway 61. Even with the School District providing busing, there will still be students attempting to cross Highway 61 both during school times as well as outside of the normal school day. The amenities that the new elementary school provides (fields, playgrounds, trails, etc.) serve as a pedestrian generator outside of the normal school day as well as during the summer months when school is not in session. Having traffic control installed whether it be traffic signal control or roundabout control at this intersection will help pedestrians cross this intersection in a more controlled environment when compared to the current side street stop-controlled intersection.

The current approximate intersection width is 60’ and would be proposed to be increased due to the addition of dedicated left and right turn lanes for northbound and southbound Highway 61. A pedestrian crossing Highway 61 in its current state, at 3.5 feet per second, would need a gap in traffic of approximately 18 seconds to cross safely. Two-way traffic volumes along Highway 61 in this area are approximately 1,000 vehicles in the AM peak hour and 1,300 vehicles during school dismissal. This equates to approximately one vehicle every 4 seconds in the AM peak hour and one vehicle every 3 seconds in the school dismissal peak hour.

The unique characteristics surrounding this intersection, including serving as access to an elementary school, the site being a pedestrian generator outside of school hours, high speed roadway, limited gaps in traffic, and poor future traffic operations (shown in Section 4.9), justify the installation of traffic signal control.

4.2 Safety Analysis

Future crash estimates were developed for reference information on various traffic control options. Estimates were developed by applying existing and MnDOT statewide average (10-year) crash rates to the future projected traffic volumes for the study intersection of Highway 61 at 152nd Street. Intersection control can be warranted if there are five or more crashes in a 12-month period that are susceptible to correction through that control.

The following crash rates were utilized in this analysis:

- The existing crash rate is lower than the MnDOT average for urban thru/stop-controlled intersections with a crash rate of 0.05 crashes per million vehicles entering the intersection.
- The MnDOT statewide average crash rate for all-way stop controlled intersections is 0.35 crashes per million vehicles entering the intersection.
- Signalized intersection rates are based on the MnDOT statewide average crash rates for a high speed (>45 mph), low volume (<15,000 vph on highest volume leg) signalized

intersections; the average crash rate is 0.45 crashes per million vehicles entering the intersection.

- Roundabout crash estimation was done using MnDOT's *A Study of the Traffic Safety at Roundabouts in Minnesota*. This study concluded that single lane roundabouts have a crash rate of 0.32 crashes per million vehicles entering the intersection.

Table 4 shows the projected number of total yearly crashes for each traffic control type analyzed for the projected 2022 and 2026 traffic conditions.

Table 4 – Projected 2022 and 2026 Annual Crash Frequency Estimates for Highway 61 and 152nd Street

Year		Annual Crash Estimates by Control Type			
	Urban Thru/ Stop[1]	Urban Thru/Stop[2]	All-Way Stop[2]	Traffic Signal[2]	Single Lane Roundabout[3]
2022	0.2	1.3	1.7	2.2	1.5
2026	0.3	1.4	1.8	2.4	1.7
	Notes:1: Based on Existing intersection crash rate. 2. Based on MnDOT Statewide average crash rates for control type (2011-2015 Data). 3: Based on MnDOT's A Study of the Traffic Safety at Roundabouts in Minnesota.				

The existing thru/stop-controlled intersection, with no changes to the intersection would have the lowest number of projected crashes among the different control alternatives. However, with the addition of another leg to this intersection, it can be expected that the thru/stop-controlled intersection would align more closely with MnDOT's statewide average rate.

A signalized intersection would have more projected crashes than all other conditions using MnDOT statewide average rates. A traffic signal typically has an increase in the number of rear end collisions as the major through traffic must stop when the minor approach has the green phase.

A roundabout controlled intersection would incur the second lowest number of crashes at the study intersection due to the single circulating lane. These crashes would typically be less severe than the other control types due to the reduced speeds approaching and departing the intersection. Roundabouts require a low travel speed through the intersection and eliminate left turn and crossing crashes. The vehicle trajectory through roundabouts helps soften the angle of potential collisions between vehicles.

In all cases the estimated number of future crashes do not warrant intersection control.

4.3 Traffic Operations

Traffic operations analyses were conducted to determine the level of service (LOS), delay, and queueing information for the AM, school dismissal, and PM peak hour conditions.

LOS is a qualitative rating system used to describe the efficiency of traffic operations at an intersection. Six LOS are defined, designated by letters A through F. LOS A represents the best operating conditions (no congestion), and LOS F represents the worst operating conditions (severe congestion). For the study intersection it was assumed that a LOS C or better, for all approaches and the overall intersection, represents acceptable operating conditions.

LOS for intersections is determined by the average control delay per vehicle. The range of control delay for each LOS is different for signalized and unsignalized intersections. The expectation is that a signalized intersection is designed to carry higher traffic volumes and will experience greater delays than an unsignalized intersection; driver tolerance for delay is greater at a signal than at a stop sign. Therefore, the LOS thresholds for each LOS category are lower for unsignalized intersections than for signalized intersections

Traffic operations analyses were performed using Synchro/SimTraffic software at the three study intersections. To evaluate roundabout control, additional analysis was conducted using the Highway Capacity Software (HCS 7); which is a faithful implementation of the Highway Capacity Manual calculations.

Based on the traffic data and field observations, the following three peak periods were evaluated:

- School AM Peak Hour: 8:30 to 9:30 AM
- School Dismissal (SD) Peak Hour: 3:15 to 4:15 PM
- PM Peak Hour: 4:30 to 5:30 PM

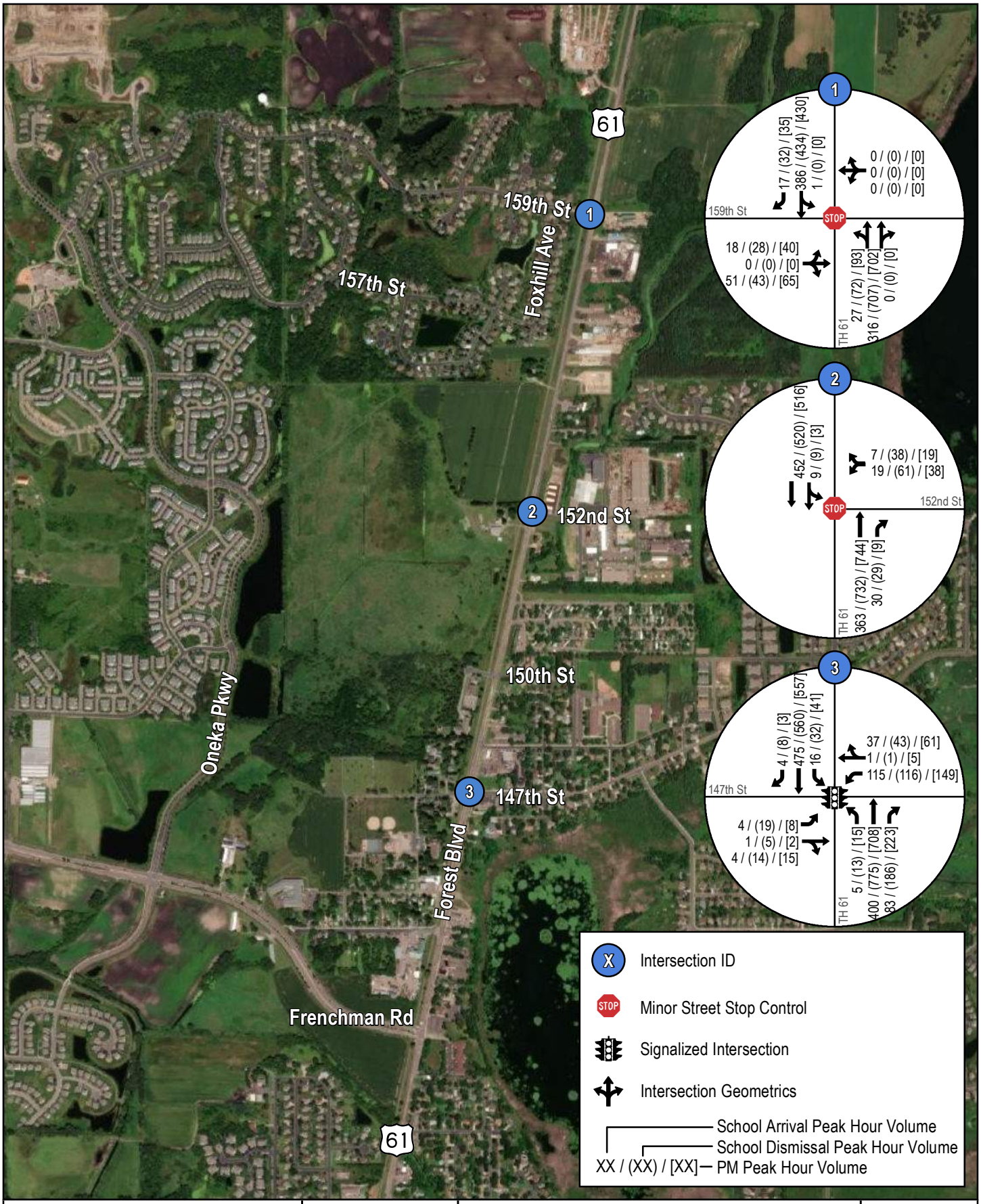
School traffic typically peaks in a short amount of time, 15 to 20 minutes. As this study was directed towards intersection improvements, a peak hour (60 minutes) was conducted to ensure improvements are not overbuilt based on short bursts of traffic. Hourly traffic was distributed over the school arrival and dismissal hour based upon previously collected turning movement count data from another school Traffic Impact Study completed in Minnesota.

As part of the bond referendum, White Bear Lake School District is also expanding its current North Campus High School and Central Middle School site located in White Bear Lake. The new high school is expected to serve all high school students grades 9 through 12 once it is complete. This will remove the two campus high school operations that the District currently utilizes. As part of this project, the District will be taking a closer look into modified start and end times for high school, middle school, and elementary school students. If the start times for the elementary school are modified and shifted to be more in line with either the AM or PM peak roadway hours, modifications will need to be made to the traffic signal timing in order to accommodate the change in traffic volumes if a traffic signal is chosen to be the traffic control alternative.

As is shown in the following sections, the roundabout operates acceptably throughout the future design year conditions and has additional capacity in order to accommodate additional traffic volumes should the start and end times change for the elementary school.

Figures 8, 10, and **12** show the 2022, 2026 and 2031 Build scenario traffic volumes, respectively.

The attached **Appendix C** includes all relevant operational tables and results for the existing, 2020, 2026 and 2031 scenarios that follow.



Path: X:\F:\I\ISDWB\156183\15-final-dsgn\51-drawings\90-GIS\Figure 7 - 2022 No Build Conditions.mxd

SEH

Project: ISDWB 156183
Print Date: 10/31/2020

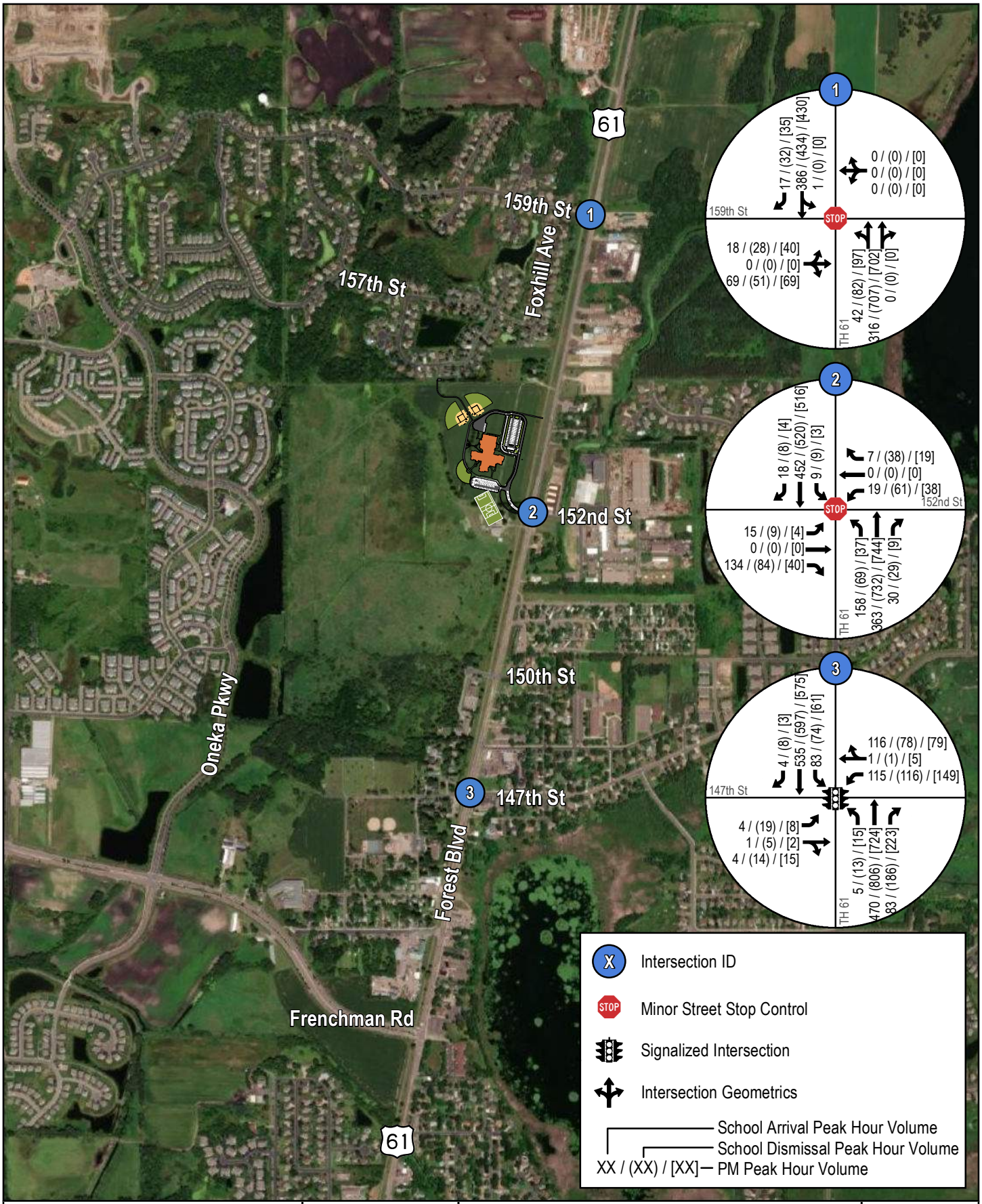
Map by: jdanibas
Projection: NAD 1983 HARN MN Washington
Source: ESRI

2022 No Build Conditions

White Bear Lake Elementary School

Hugo, MN

Figure 7



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SEH

Project: ISDWB 156183
Print Date: 12/8/2020

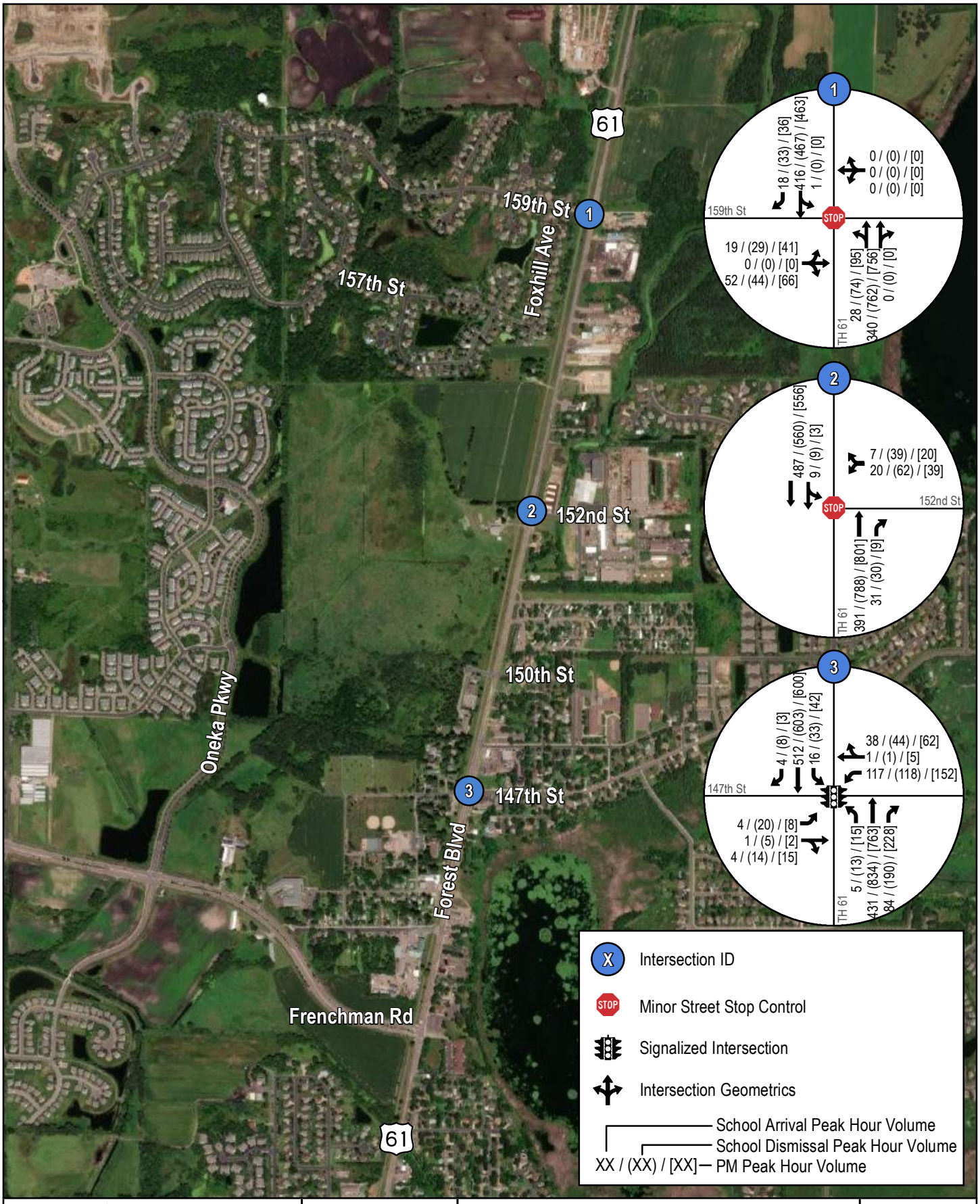
Map by: jdanibas
Projection: NAD 1983 HARN MN Washington
Source: ESRI

2022 Build Conditions

White Bear Lake Elementary School

Hugo, MN

Figure 8



Path: X:\F:\I\ISDWB\156183\15-final-dsgn\51-drawings\90-GIS\Figure 9 - 2026 No Build Conditions.mxd

SEH

Project: ISDWB 156183
Print Date: 10/31/2020

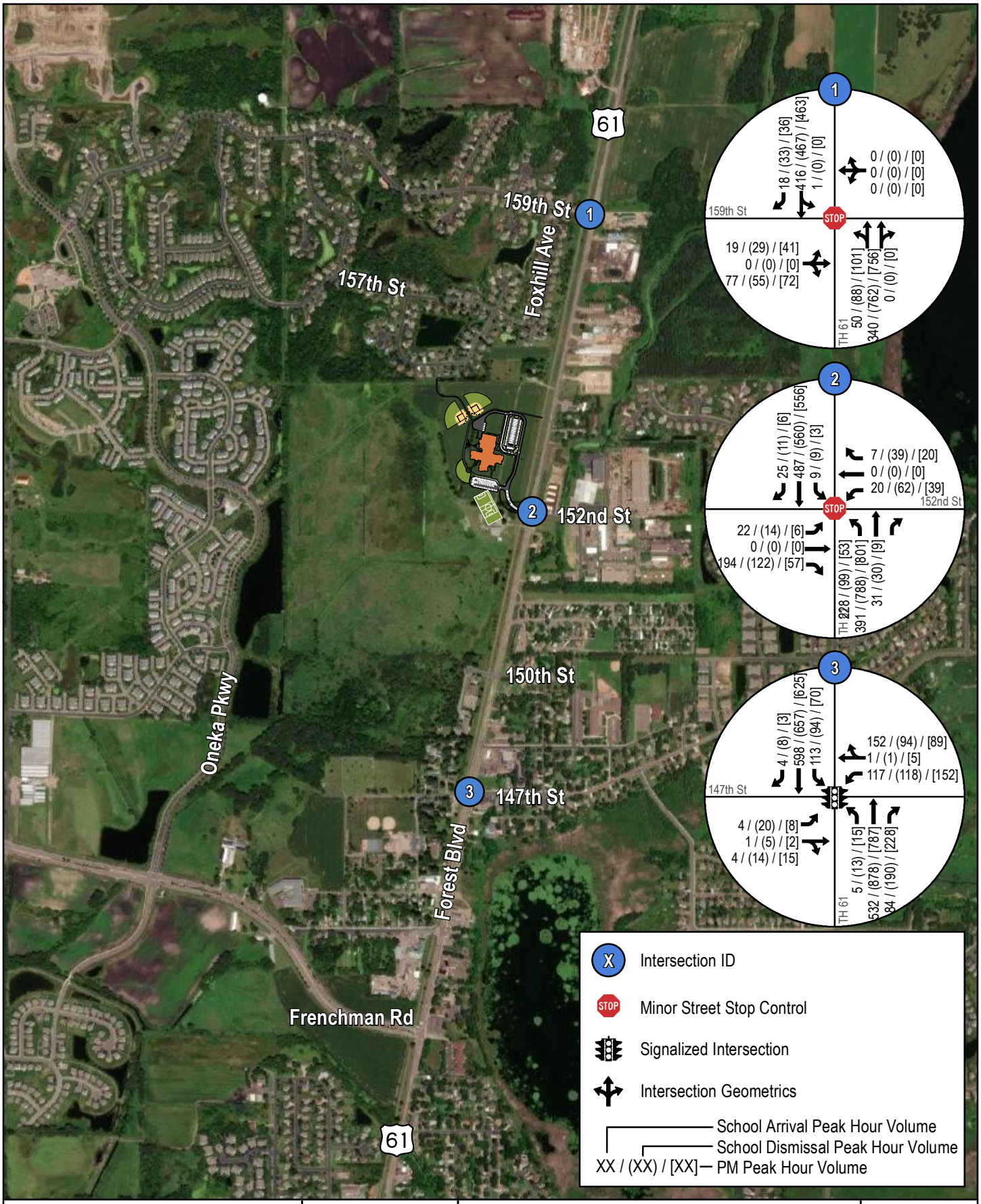
Map by: jdanibas
Projection: NAD 1983 HARN MN Washington
Source: ESRI

2026 No Build Conditions

White Bear Lake Elementary School

Hugo, MN

Figure 9



Path: X:\F\IN\SDWB\156183\15-final-dsgn\51-drawings\90-GIS\Figure 10 - 2026 Build Conditions.mxd

SEH

Project: ISDWB 156183
Print Date: 10/31/2020

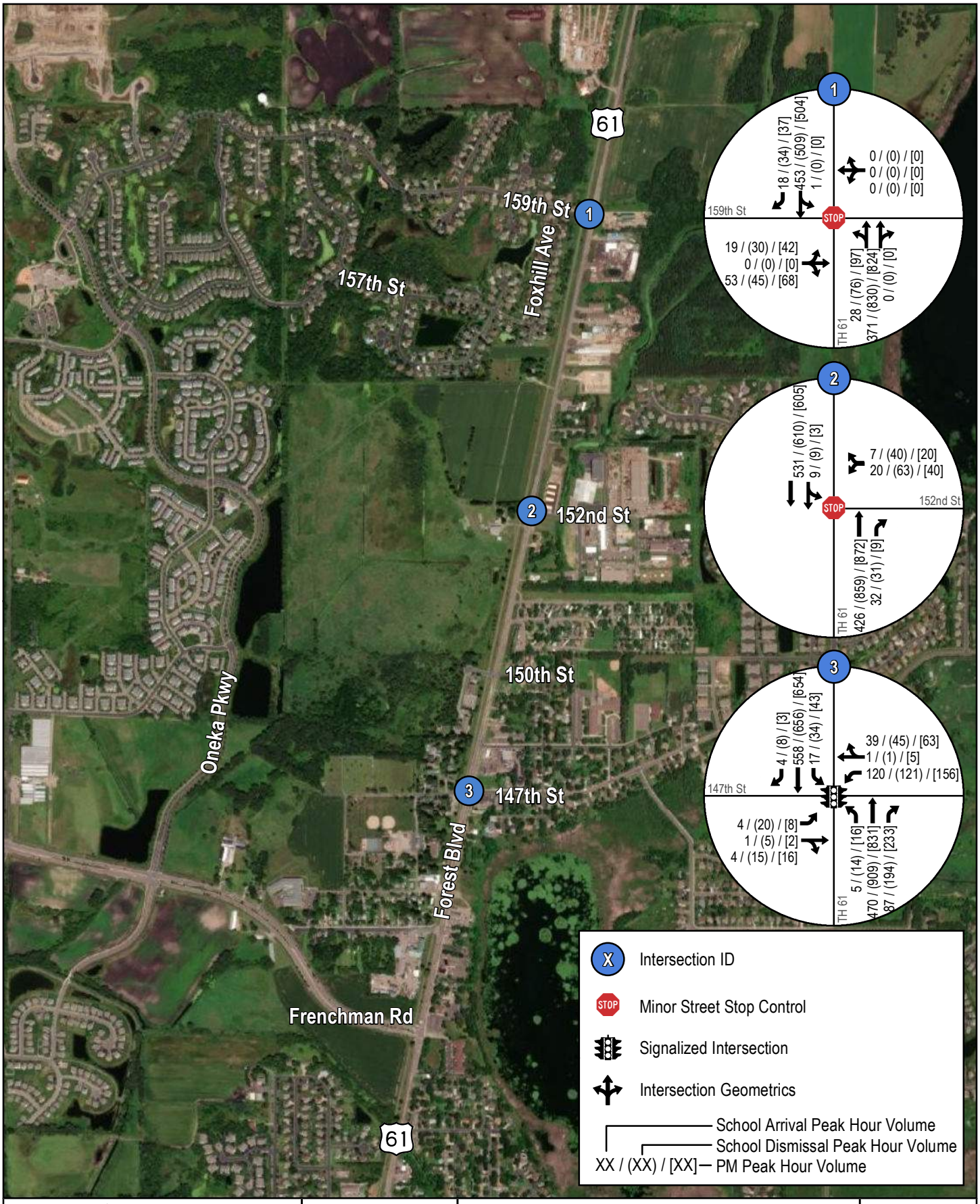
Map by: jdanibas
Projection: NAD 1983 HARN MN Washington
Source: ESRI

2026 Build Conditions

White Bear Lake Elementary School

Hugo, MN

Figure 10



Path: X:\F:\I\ISDWB\156183\5-final-dsgn\51-drawings\90-GIS\Figure 11 - 2031 No Build Conditions.mxd

SEH

Project: ISDWB 156183
Print Date: 10/31/2020

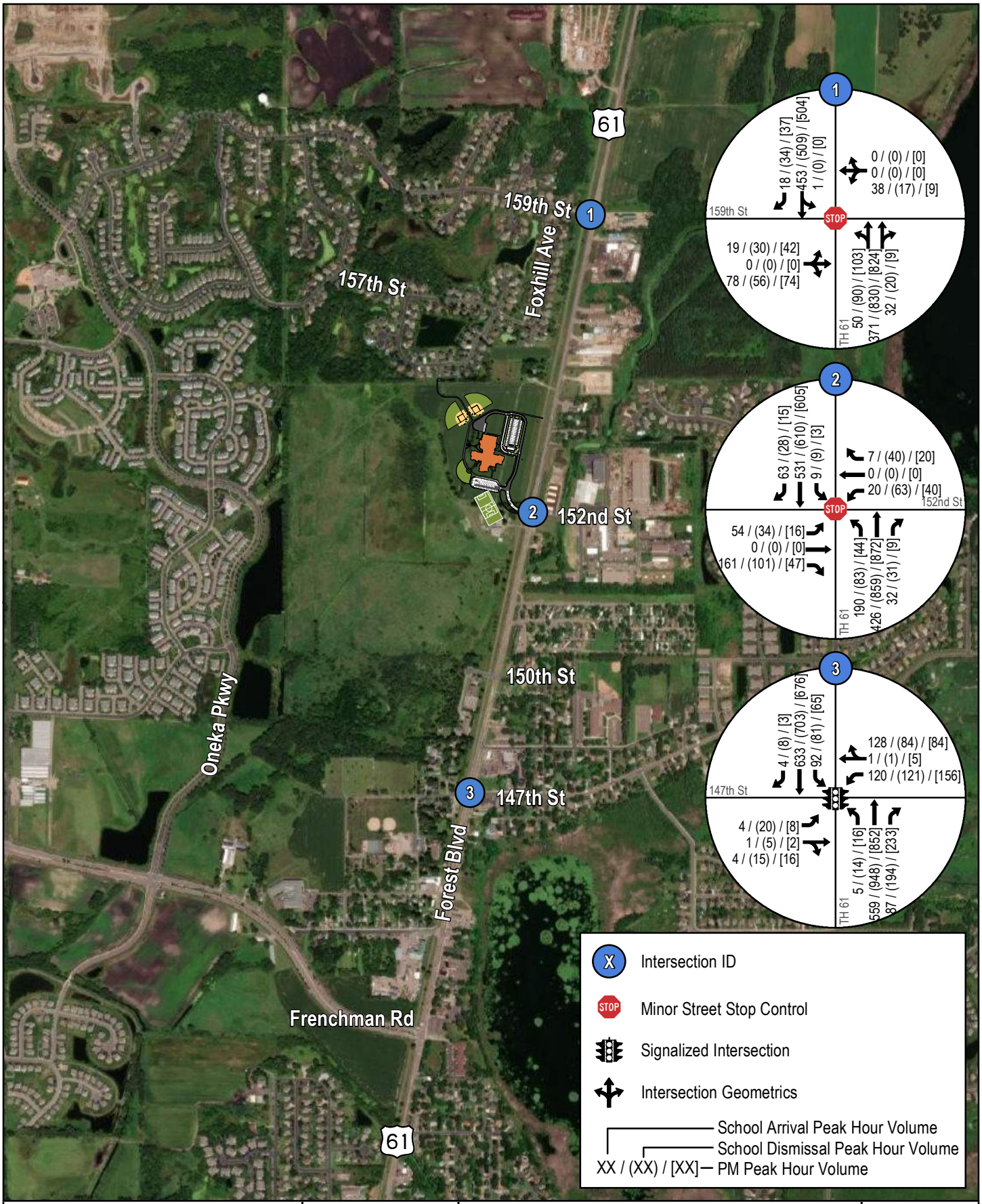
Map by: jdanibas
Projection: NAD 1983 HARN MN Washington
Source: ESRI

2031 No Build Conditions

White Bear Lake Elementary School

Hugo, MN

Figure 11



Path: X:\F:\IN\SDWB\156183\15-final-dsgn\51-drawings\90-GIS\Figure 12 - 2031 Build Conditions.mxd

SEH

Project: ISDWB 156183
Print Date: 10/31/2020

Map by: jdanibas
Projection: NAD 1983 HARN MN Washington
Source: ESRI

2031 Build Conditions

White Bear Lake Elementary School

Hugo, MN

Figure 12

4.4 Existing 2020 Traffic Operations

The existing conditions traffic model was developed based on the existing base volumes that have been adjusted for impacts due to school not being in session when traffic counts were taken, and impacts caused by the coronavirus.

Overall, the study intersection operates acceptably in each peak hour. During the school dismissal peak period, the westbound 152nd Approach to Highway 61 operates at LOS C.

Table 5 shows the approach LOS and total intersection LOS for the study intersection during the 2020 AM peak, school dismissal peak, and PM peak hours. More detailed results are shown in **Table A1** in **Appendix C.**

Table 5 – Existing 2020 Traffic Operations (Synchro)

Peak Hour	Intersection:	Approach	Delay (s/veh)				
			Left	Thru	Right	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)
School Arrival Peak Hour	Highway 61 at 152nd Street	WB	8.4 / A		2.8 / A	6.8 / A	0.6 / A
		NB		0.5 / A	0.0 / A	0.5 / A	
		SB	1.6 / A	0.4 / A		0.4 / A	
School Dismissal Peak Hour	Highway 61 at 152nd Street	WB	21.2 / C		11.5 / B	17.3 / C	2.2 / A
		NB		1.0 / A	0.1 / A	1.0 / A	
		SB	3.9 / A	0.8 / A		0.9 / A	
PM Peak Hour	Highway 61 at 152nd Street	WB	15.1 / C		8.4 / A	12.9 / B	1.2 / A
		NB		0.8 / A	0.0 / A	0.8 / A	
		SB	4.0 / A	0.5 / A		0.5 / A	

4.5 2022 No Build Traffic Operations

The 2022 No Build Conditions scenario includes the existing 2020 traffic counts with background growth applied to the turning movement counts.

Under this scenario, the study intersection operates similar to the 2020 conditions. During the school dismissal time period, the westbound 152nd Street approach continues to operate at a LOS C.

Table 6 shows the approach LOS and total intersection LOS for the study intersection during the 2022 No build AM peak, school dismissal peak, and PM peak hours. More detailed results are shown in **Table A2** in **Appendix C.**

Table 6 – 2022 No Build Traffic Operations (Synchro)

Peak Hour	Intersection:	Approach	Delay (s/veh)				
			Left	Thru	Right	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)
School Arrival Peak Hour	Highway 61 at 152nd Street	WB	9.1 / A		3.9 / A	7.6 / A	0.7 / A
		NB		0.5 / A	0.0 / A	0.5 / A	
		SB	1.8 / A	0.5 / A		0.5 / A	
School Dismissal Peak Hour	Highway 61 at 152nd Street	WB	23.9 / C		13 / B	20.0 / C	2.3 / A
		NB		1.0 / A	0.0 / A	1.0 / A	
		SB	5.2 / A	0.8 / A		0.9 / A	
PM Peak Hour	Highway 61 at 152nd Street	WB	18.0 / C		9.8 / A	15.3 / C	1.4 / A
		NB		0.9 / A	0.0 / A	0.9 / A	
		SB	2.7 / A	0.5 / A		0.5 / A	

4.6 2022 Year of Opening Conditions

Under this scenario, the elementary school is present and accesses Highway 61 at 152nd Street from the west leg of the intersection. As part of this scenario, geometric improvements to the intersection of Highway 61 and 152nd Street were implemented. These improvements include the following:

- Northbound and southbound dedicated left and right turn lanes
- Dedicated left, through and right turn lanes for the school driveway
- Dedicated left, through and right turn lanes lane for the westbound 152nd Street approach

Overall, during the AM peak hour the study intersection operates at a LOS A. Longer delays are present for the eastbound and westbound left turning movements at 152nd Street with both movements having approximately 30 seconds of delay per vehicle.

During the school dismissal time period, operations degrade at the intersection of Highway 61 and 152nd for the minor street approaches. Longer delays are present for the eastbound and westbound left turning movements, with the westbound left movement operating at a LOS F with 109.4 seconds of delay per vehicle and the eastbound left movement operating at LOS E with 37.3 seconds of delay. As delays increase on the side streets, motorists may start to select riskier gaps in order to enter the mainline traffic stream. This results in a possible decrease in safety at this intersection.

The PM Peak hour has operations that improve at the intersection of Highway 61 and 152nd Street. With less demand on the side streets during this time period, the eastbound left turning movement operates at a LOS C and the westbound left turning movement operates at a LOS D.

Table 7 shows the approach LOS and total intersection LOS for the study intersection during the 2022 Year of Opening AM peak, school dismissal peak, and PM peak hours. More detailed results are shown in **Table A3** in **Appendix C.**

Table 7 – 2022 Year of Opening Traffic Operations (Synchro)

Peak Hour	Intersection:	Approach	Delay (s/veh)				
			Left	Thru	Right	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)
School Arrival Peak Hour	Highway 61 at 152nd Street	EB	32.8 / D		8.2 / A	10.7 / B	3.9 / A
		WB	26.2 / D		4.2 / A	19.4 / C	
		NB	7.2 / A	1.0 / A	0.2 / A	2.7 / A	
		SB	2.8 / A	2.4 / A	0.7 / A	2.3 / A	
School Dismissal Peak Hour	Highway 61 at 152nd Street	EB	**37.3 / E**		14.4 / B	16.2 / C	7.4 / A
		WB	**109.4 / F**		20.7 / C	**74.5 / F**	
		NB	4.6 / A	1.6 / A	0.4 / A	1.8 / A	
		SB	5.6 / A	2.6 / A	0.4 / A	2.6 / A	
PM Peak Hour	Highway 61 at 152nd Street	EB	24.8 / C		5.9 / A	6.8 / A	2.7 / A
		WB	30.2 / D		7.2 / A	21.5 / C	
		NB	3.3 / A	1.4 / A	0.3 / A	1.5 / A	
		SB	4.3 / A	2.0 / A	0.8 / A	2.0 / A	

4.7 2022 Year of Opening Conditions with Mitigations

Based upon the warrant analysis results for a school crossing at the intersection of Highway 61 at 152nd Street, further investigation of intersection improvements was needed in addition to the geometric improvements made in the previous scenario. The following are different traffic control alternatives that were analyzed.

4.7.1 Traffic Signal Control at Highway 61 and 152nd Street

Traffic signal control was added at the intersection of Highway 61 and 152nd Street. As part of this improvement, a dedicated left, thru, and right turn lane was provided for the westbound 152nd approach.

The cycle lengths for each peak period were matched to the existing signal timing that is in place today at adjacent intersections. Based upon MnDOT guidance for flashing yellow arrow operation, northbound protected only phasing was recommended during the school arrival time period based upon the number of northbound left turns entering the site versus the number of opposing southbound through vehicles and the speed limit of Highway 61. Therefore, both

northbound and southbound left turning movements were modeled with protected only left turn phasing during the School Arrival time period.

During the School Dismissal peak hour, MnDOT guidance recommends protected-permissive phasing for northbound Highway 61 and therefore both northbound and southbound approaches were modeled with this phasing.

During all peak hours permissive (flashing yellow arrow) phasing was used for the eastbound and westbound approaches.

Traffic signal control at this intersection fits in the context of the larger Highway 61 corridor and would be able to be coordinated with other surrounding signals in the area.

With Highway 61 under traffic signal control, operations for the side streets improve and delays decrease during the peak school dismissal time period and slightly increase during the AM and PM peak hours. As was previously mentioned, although delays may be slightly higher during the AM and PM peak hours, driver tolerance for delay is greater at a traffic signal than at a stop-controlled intersection. Left turning movements at each of the two signalized study intersections during this scenario experience longer delays which are ultimately as a result of longer cycle lengths and more green time allocated to the mainline.

Table 8 shows the approach LOS and total intersection LOS for all study intersections during the 2022 Year of Opening AM peak, school dismissal peak, and PM peak hours with traffic signal control at 152nd Street. More detailed results are shown in **Table A4** in **Appendix C.**

Table 8 – 2022 Year of Opening Traffic Operations with Traffic Signal Control at 152nd Street (Synchro)

Peak Hour	Intersection:	Approach	Delay (s/veh)				
			Left	Thru	Right	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)
School Arrival Peak Hour	Highway 61 at 152nd Street (Signal)	EB	34.7 / C		9.3 / A	11.7 / B	11.6 / B
		WB	36.9 / D		4.5 / A	26.8 / C	
		NB	39.6 / D	2.6 / A	0.6 / A	12.8 / B	
		SB	7.6 / A	9.5 / A	2.7 / A	9.2 / A	
School Dismissal Peak Hour	Highway 61 at 152nd Street (Signal)	EB	48.9 / D		8.9 / A	13.0 / B	8.1 / A
		WB	**77.5 / E**		13.3 / B	52.1 / D	
		NB	7.5 / A	4.2 / A	0.8 / A	4.3 / A	
		SB	9.6 / A	5.3 / A	1.5 / A	5.3 / A	
PM Peak Hour	Highway 61 at 152nd Street (Signal)	EB	**60.3 / E**		6.3 / A	10.1 / B	4.7 / A
		WB	**67.8 / E**		8.9 / A	49.5 / D	
		NB	4.2 / A	1.7 / A	0.4 / A	1.8 / A	
		SB	5.8 / A	3.4 / A	0.7 / A	3.4 / A	

4.7.1.1 Modified Traffic Signal Control Highway 61 and 152nd Street

In order to understand the traffic signal operations under the most restrictive conditions, traffic signal operational adjustments were analyzed. These adjustments, summarized below, may help improve pedestrian and bicycle safety at the intersection.

The eastbound and westbound 152nd Street approaches were modified to include a dedicated left turn lane and a shared through-right turn lane. This geometric modification shortens the pedestrian crossing distance for non-motorized users along the Hardwood Creek Trail and in addition there is anticipated to be little to no through traffic traveling across Highway 61.

Protected only left turns for all approaches at the intersection of Highway 61 and 152nd Street as well as prohibiting all right turns on red were modeled in order to see the impacts they may have on traffic operations should they be implemented at this intersection.

During the school arrival peak hour, all intersections operate at a LOS C or better. The intersection of Highway 61 and 152nd has longer delays for all protected left turn movements. In addition, the eastbound right turn exiting the school site now operates at a LOS E due to the restriction of right turning vehicles on a red indication. The maximum queue reported for this movement is 276 feet.

Similar operations were reported for the school dismissal peak hour. All left turning movements at the intersection of Highway 61 and 152nd Street operate at a LOS E and the eastbound right turning movement exiting the school also operates at a LOS E. The maximum reported eastbound queue length is 210 feet.

During the PM peak hour, left turning movements at the intersection of Highway 61 and 152nd Street operate with longer delays. The eastbound left turn, serving 4 vehicles, operates at a LOS F during this peak hour. This is primarily due to the longer cycle lengths that are in place along Highway 61. The eastbound right turning movement serving 40 vehicles operates at a LOS E and has a maximum queue length of 104 feet.

Table 9 shows the approach LOS and total intersection LOS for all study intersections during the 2022 Year of Opening AM peak, school dismissal peak, and PM peak hours with traffic signal control modifications at 152nd Street. More detailed results are shown in **Table A11** in **Appendix C.**

Table 9 – 2022 Year of Opening Traffic Operations with Modified Traffic Signal Control at 152nd Street (Synchro)

Peak Hour	Intersection:	Approach	Delay (s/veh)				
			Left	Thru	Right	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)
School Arrival Peak Hour	Highway 61 at 152nd Street (Signal)	EB	**59.2 / E**		**66.1 / E**	**65.4 / E**	20.1 / C
		WB	40.5 / D		29.6 / C	37.1 / D	
		NB	32.5 / C	6.1 / A	4.3 / A	13.2 / B	
		SB	38.8 / D	13.2 / B	9.7 / A	13.4 / B	
School Dismissal Peak Hour	Highway 61 at 152nd Street (Signal)	EB	**67.0 / E**		**57.9 / E**	**58.6 / E**	17.9 / B
		WB	**67.5 / E**		47.0 / D	**59.5 / E**	
		NB	**69.6 / E**	7.1 / A	3.3 / A	12.1 / B	
		SB	**55.3 / E**	11.7 / B	7.1 / A	12.3 / B	
PM Peak Hour	Highway 61 at 152nd Street (Signal)	EB	**100.9 / F**		**74.1 / E**	**75.9 / E**	12.0 / B
		WB	**71.2 / E**		**62.1 / E**	**68.0 / E**	
		NB	**64.9 / E**	4.0 / A	1.1 / A	7.0 / A	
		SB	**63.2 / E**	7.2 / A	2.7 / A	7.5 / A	

4.7.2 Roundabout Control at Highway 61 and 152nd Street

A single lane roundabout was modeled at the intersection of Highway 61 and 152nd Street in the Highway Capacity Software (HCS) to ensure the operations would be acceptable, HCS is typically a more conservative evaluation when compared to Synchro. Generally, roundabouts have the following pros and cons:

Advantages	Disadvantages
- Provides orderly flow for all traffic - Reduced crash severity - Performs acceptably long term - Pedestrians cross one lane of traffic at a time	- Construction costs - Longer delays for mainline traffic outside of peak school time periods

One of the large benefits to roundabouts in terms of pedestrian safety is that vehicle speeds are lower for the vehicles entering and exiting the roundabout. Lower vehicle speeds results in a lower potential for a severe pedestrian crash. In addition, another advantage is pedestrians only cross one direction of traffic at a time and may use the splitter islands as refuge to complete their crossing.

A single lane roundabout at this intersection will operate acceptably under the 2022 Year of Opening conditions. The 95th percentile queue in the AM peak hour is approximately 66' for southbound Highway 61. The 95th percentile queue in the school dismissal peak hour is approximately 142' for the northbound Highway 61 approach. The 95th percentile queue in the PM peak hour is approximately 98' for northbound Highway 61.

Table 10 shows the approach LOS and total intersection LOS during the 2022 Year of Opening AM peak, school dismissal peak, and PM peak hours with roundabout control at 152nd Street. More detailed analysis, including queueing information is provided in **Appendix G.**

Table 10 – Future 2022– Roundabout Control (HCS)

Intersection:	Approach	AM Peak		SD Peak		PM Peak	
		Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)
Highway 61 at 152nd Street	NB	8.1 / A	8.7 / A	13.5 / B	11.6 / B	10.5 / B	9.2 / A
	SB	9.8 / A		9.5/ A		7.6 / A	
	EB	7.9 / A		7.8 / A		5.7 / A	
	WB	5.7 / A		10.3 / B		7.8 / A	
Notes: HCS – Highway Capacity Software.							

4.8 2026 No Build Conditions

The 2026 No Build scenario includes the existing 2020 traffic counts with background growth applied to the turning movement counts.

Under this scenario, all intersections operate similar to the existing conditions scenario. Longer delays are present for the side streets at the intersection of Highway 61 and 152nd Street during the school dismissal and PM peak hours.

Table 11 shows the approach LOS and total intersection LOS for the study intersection during the 2026 No build AM peak, school dismissal peak, and PM peak hours. More detailed results are shown in **Table A5** in **Appendix C.**

Table 11 – 2026 No Build Traffic Operations (Synchro)

Peak Hour	Intersection:	Approach	Delay (s/veh)				
			Left	Thru	Right	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)
School Arrival Peak Hour	Highway 61 at 152nd Street	WB	9.3 / A		3.9 / A	7.6 / A	0.6 / A
		NB		0.5 / A	0.0 / A	0.5 / A	
		SB	1.5 / A	0.4 / A		0.4 / A	
School Dismissal Peak Hour	Highway 61 at 152nd Street	WB	28.7 / D		19.3 / C	25.1 / D	2.6 / A
		NB		1.0 / A	0.0 / A	1.0 / A	
		SB	5.9 / A	0.9 / A		1.0 / A	
PM Peak Hour	Highway 61 at 152nd Street	WB	17.1 / C		11.1 / B	15.2 / C	1.3 / A
		NB		0.8 / A	0.0 / A	0.8 / A	
		SB	5.2 / A	0.5 / A		0.5 / A	

4.9 2026 Full Build Conditions

Under this scenario, the elementary school is fully built out and is expected to serve 720 students. The site continues to access Highway 61 at 152nd Street from the west leg of the intersection. Similar to the 2022 Build Conditions, geometric improvements to the intersection of Highway 61 and 152nd Street were implemented. These improvements include the following:

- Northbound and southbound dedicated left and right turn lanes
- Dedicated left, through and right turn lanes for the school driveway
- Dedicated left, through and right turn lanes lane for the westbound 152nd Street approach

During the AM peak hour the eastbound and westbound left turning traffic onto Highway 61 has long wait times to find acceptable gaps to complete their movement. Both eastbound and

westbound left turning movement operate at a LOS F with 83.9 and 53.6 seconds of delay per vehicle, respectively.

The School Dismissal and PM Peak hour also share similar operations at 152nd Street with the eastbound left turning movements operating poorly.

Table 12 shows the approach LOS and total intersection LOS for all study intersections during the 2026 Full Build AM peak, school dismissal peak, and PM peak hours. More detailed results are shown in **Table A6** in **Appendix C.**

Table 12 – 2026 Full Build Traffic Operations (Synchro)

Peak Hour	Intersection:	Approach	Delay (s/veh)				
			Left	Thru	Right	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)
School Arrival Peak Hour	Highway 61 at 152nd Street	EB	**83.9 / F**		22.8 / C	28.6 / D	8.7 / A
		WB	**53.6 / F**		4.6 / A	**40.1 / E**	
		NB	13.1 / B	1.5 / A	0.5 / A	5.4 / A	
		SB	2.1 / A	3.0 / A	0.9 / A	2.9 / A	
School Dismissal Peak Hour	Highway 61 at 152nd Street	EB	**63.1 / F**		**50.4 / F**	**51.7 / F**	22.8 / C
		WB	**382.9 / F**		**201.7 / F**	**312.4 / F**	
		NB	6.3 / A	1.8 / A	0.5 / A	2.2 / A	
		SB	6.8 / A	3.1 / A	0.7 / A	3.1 / A	
PM Peak Hour	Highway 61 at 152nd Street	EB	**36.8 / E**		6.9 / A	10.0 / B	3.6 / A
		WB			8.9 / A	**37.8 / E**	
		NB	4.4 / A	1.5 / A	0.4 / A	1.7 / A	
		SB	4.8 / A	2.2 / A	0.8 / A	2.2 / A	

4.10 2026 Full Build Conditions with Mitigations

Based upon the poor operational results at the intersection of Highway 61 at 152nd Street, further investigation of intersection improvements was needed in addition to the geometric improvements made in the previous scenario. The following are different traffic control alternatives that were analyzed.

4.10.1 Traffic Signal Control at Highway 61 and 152nd Street

Similar to the 2022 Build Mitigations, traffic signal control was added at the intersection of Highway 61 and 152nd Street. As part of this improvement, a dedicated left, thru, and right turn lane was provided for the westbound 152nd approach.

Similar phasing and cycle lengths were used for this analysis as was used during the year of opening analysis. However, during the school dismissal time period the eastbound and westbound left turn phasing was modified from permissive only to protected-permissive phasing at the intersection of Highway 61 and 152nd Street.

During the AM peak hour, the intersection operates at a LOS B. During this peak hour the westbound approach operates at LOS D. During this time period the maximum northbound left turn queue is 276' at the study intersection.

During the school dismissal time period, with the addition of the traffic signal at 152nd Street, delays for the eastbound and westbound approaches are greatly reduced. Both the eastbound and westbound left turning movements operate at a LOS E.

During the PM peak hour, operations improve for the side street approaches compared to the side street stop control.

Table 13 shows the approach LOS and total intersection LOS for the study intersection during the 2026 Full Build Conditions AM peak, school dismissal peak, and PM peak hours with traffic signal control at 152nd Street. More detailed results are shown in **Table A7** in **Appendix C.**

Table 13 – 2026 Full Build Traffic Operations with Traffic Signal Control at 152nd Street (Synchro)

Peak Hour	Intersection:	Approach	Delay (s/veh)				
			Left	Thru	Right	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)
School Arrival Peak Hour	Highway 61 at 152nd Street (Signal)	EB	30.5 / C		15.3 / B	16.9 / B	15.3 / B
		WB	45.3 / D		3.6 / A	35.2 / D	
		NB	32.6 / C	4.8 / A	0.9 / A	13.9 / B	
		SB	36.9 / D	15.3 / B	4.4 / A	15.1 / B	
School Dismissal Peak Hour	Highway 61 at 152nd Street (Signal)	EB	**59.5 / E**		18.9 / B	21.9 / C	9.6 / A
		WB	**58.6 / E**		11.7 / B	40.4 / D	
		NB	13.2 / B	5.1 / A	0.7 / A	5.8 / A	
		SB	10.6 / B	7.8 / A	1.7 / A	7.7 / A	
PM Peak Hour	Highway 61 at 152nd Street (Signal)	EB	**65.1 / E**		7.2 / A	14.4 / B	5.1 / A
		WB	**66.6 / E**		10.6 / B	47.6 / D	
		NB	5.1 / A	1.9 / A	0.5 / A	2.1 / A	
		SB	6.2 / A	4.1 / A	0.9 / A	4.1 / A	

4.10.1.1 Modified Traffic Signal Control Highway 61 and 152nd Street

Similar to traffic signal modifications outlined in section 4.7.1.1, the following changes were analyzed to determine how the traffic signal at Highway 61 and 152nd Street would operate under the most restrictive operations:

- The eastbound and westbound 152nd Street approaches were modified to include a dedicated left turn lane and a shared through-right turn lane.
- Protected only left turns phasing was added for all approaches at the intersection of Highway 61 and 152nd Street
- No right turns on red indications were applied to all movements at the intersection

During the school arrival peak hour, the study intersection operates at a LOS C. The intersection has longer delays for all protected left turn movements, all of which operate at a LOS D. In addition, the eastbound right turn exiting the school site operates at a LOS C, this is an improvement from the 2022 scenario, and is due to more phase time being allocated for the eastbound approach due to the increase in volume under full build conditions. The maximum queue reported for this movement is 283 feet.

Similar operations were reported for the school dismissal peak hour. All left turning movements at the intersection of Highway 61 and 152nd Street operate with longer delays. The eastbound left turn operates at a LOS F to serve 14 vehicles over the peak hour. The eastbound right turning movement exiting the school operates at a LOS E. The maximum reported eastbound queue length is 374 feet.

During the PM peak hour, left turning movements at the intersection of Highway 61 and 152nd Street operate with longer delays. The southbound left turn, serving 3 vehicles operates at a LOS F during this peak hour. This is primarily due to the longer cycle lengths that are in place along Highway 61. The eastbound right turning movement serving 72 vehicles operates at a LOS E and has a maximum queue length of 50 feet.

Table 14 shows the approach LOS and total intersection LOS for all study intersections during the 2026 Full Build AM peak, school dismissal peak, and PM peak hours with traffic signal control modifications at 152nd Street. More detailed results are shown in **Table A12** in **Appendix C.**

Table 14 – 2026 Full Build Traffic Operations with Modified Traffic Signal Control at 152nd Street (Synchro)

Peak Hour	Intersection:	Approach	Delay (s/veh)				
			Left	Thru	Right	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)
School Arrival Peak Hour	Highway 61 at 152nd Street (Signal)	EB	36.1 / D		32.8 / C	33.1 / C	33.2 / C
		WB	38.9 / D		29.0 / C	36.2 / D	
		NB	38.3 / D	11.0 / B	6.1 / A	20.1 / C	
		SB	44.5 / D	49.9 / D	28.5 / C	48.7 / D	
School Dismissal Peak Hour	Highway 61 at 152nd Street (Signal)	EB	**95.1 / F**		**65.5 / E**	**68.8 / E**	23.1 / C
		WB	**73.4 / E**		53.3 / D	**65.0 / E**	
		NB	**67.1 / E**	9.7 / A	4.2 / A	15.3 / B	
		SB	54.6 / D	16.6 / B	8.3 / A	16.9 / B	
PM Peak Hour	Highway 61 at 152nd Street (Signal)	EB	**76.1 / E**		7.1 / A	14.8 / B	10.0 / B
		WB	**71.0 / E**		9.4 / A	48.9 / D	
		NB	**77.0 / E**	4.3 / A	1.4 / A	8.9 / A	
		SB	**99.5 / F**	6.2 / A	1.3 / A	6.6 / A	

4.10.2 Roundabout Control at Highway 61 and 152nd Street

A single lane roundabout was modeled at the intersection of Highway 61 and 152nd Street in the Highway Capacity Software (HCS) to ensure the operations would be acceptable under the 2026 Full Build Conditions.

A single lane roundabout at this intersection will operate acceptably under the 2026 Full Build Conditions. The 95th percentile queue in the AM peak hour is approximately 112' for southbound Highway 61. The 95th percentile queue in the school dismissal peak hour is approximately 218' for the northbound Highway 61 approach. The 95th percentile queue in the PM peak hour is approximately 124' for northbound Highway 61.

Table 15 shows the approach LOS and total intersection LOS during the 2026 Full Build AM peak, school dismissal peak, and PM peak hours with roundabout control at 152nd Street. More detailed analysis, including queueing information is provided in **Appendix G.**

Table 15 – Future 2026– Roundabout Control (HCS)

Intersection:	Approach	AM Peak		SD Peak		PM Peak	
		Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)
Highway 61 at 152nd Street	NB	10.8 / B	12.2 / B	19.1 / C	15.6 / C	12.2 / B	10.5 / B
	SB	14.6 / B		11.8 / B		8.4 / A	
	EB	11.2 / B		9.8 / A		6.3 / A	
	WB	6.9 / A		12.6 / B		8.7 / A	
Notes: HCS – Highway Capacity Software.							

4.11 2031 Future No Build Conditions

The 2031 No Build scenario includes the existing 2020 traffic counts with background growth applied to the turning movement counts.

Under this scenario, the study intersection operates similar to the 2026 No Build Conditions, operating at LOS A during all peak hours.

Table 16 shows the approach LOS and total intersection LOS the study intersection during the 2031 No build AM peak, school dismissal peak, and PM peak hours. More detailed results are shown in **Table A8** in **Appendix C.**

Table 16 – 2031 No Build Traffic Operations (Synchro)

Peak Hour	Intersection:	Approach	Delay (s/veh)				
			Left	Thru	Right	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)
School Arrival Peak Hour	Highway 61 at 152nd Street	WB	9.9 / A		4.6 / A	8.4 / A	0.7 / A
		NB		0.5 / A	0.0 / A	0.5 / A	
		SB	2.0 / A	0.5 / A		0.5 / A	
School Dismissal Peak Hour	Highway 61 at 152nd Street	WB	33.1 / D		22.3 / C	29.3 / D	2.7 / A
		NB		1.0 / A	0.0 / A	1.0 / A	
		SB	4.5 / A	0.8 / A		0.9 / A	
PM Peak Hour	Highway 61 at 152nd Street	WB	27.9 / D		16.9 / C	24.1 / C	1.7 / A
		NB		0.9 / A	0.0 / A	0.9 / A	
		SB	5.6 / A	0.5 / A		0.5 / A	

4.12 2031 Future Build Conditions

This scenario includes analysis of five years after the expected full build out of the elementary school site. As previously mentioned, in this scenario, additional housing development just east of Highway 61 and 159th Street is expected to be constructed. Therefore, it was expected that 15% of the school traffic would travel to and from the 200 expected homes at this location. The overall trip distribution for the elementary school changes for this scenario in that 25% of the school traffic travels to and from the school site from the north and 75% to and from the south.

Similar to the 2026 Build Conditions, geometric improvements to the intersection of Highway 61 and 152nd Street were implemented. These improvements include the following:

- Northbound and southbound dedicated left and right turn lanes
- Dedicated left, through and right turn lanes for the school driveway
- Dedicated left, through and right turn lanes lane for the westbound 152nd Street approach

During the AM peak hour, the eastbound and westbound left turning traffic onto Highway 61 have long wait times to find acceptable gaps to complete their movement. Both eastbound and westbound left turning movements operate at a LOS F and LOS E with 261.5 and 45.8 seconds of delay per vehicle, respectively.

During the school dismissal peak hour, the westbound approach operates at LOS F with long delays and queue lengths

The PM Peak hour also shares similar operations at 152nd Street with the eastbound left turning movement operating at a LOS E and the westbound left turning movement operating at LOS F.

Table 17 shows the approach LOS and total intersection LOS for the study intersection during the 2031 Full Build AM peak, school dismissal peak, and PM peak hours. More detailed results are shown in **Table A9** in **Appendix C.**

Table 17 – 2031 Future Build Traffic Operations (Synchro)

Peak Hour	Intersection:	Approach	Delay (s/veh)				
			Left	Thru	Right	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)
School Arrival Peak Hour	Highway 61 at 152nd Street	EB	**261.5 / F**		**118.6 / F**	**157.0 / F**	24.7 / C
		WB	**45.8 / E**		5.5 / A	32.8 / C	
		NB	11.7 / B	1.5 / A	0.4 / A	4.4 / A	
		SB	3.1 / A	2.9 / A	1.1 / A	2.7 / A	
School Dismissal Peak Hour	Highway 61 at 152nd Street	EB	**127.6 / F**		32.7 / D	54.3 / D	27.6 / C
		WB	**528.2 / F**		**319.3 / F**	**449.0 / F**	
		NB	6.5 / A	1.9 / A	0.5 / A	2.2 / A	
		SB	7.8 / A	3.0 / A	0.8 / A	3.0 / A	
PM Peak Hour	Highway 61 at 152nd Street	EB	**38.6 / E**		11.6 / B	19.2 / B	5.9 / A
		WB	**69.9 / F**		14.0 / B	49.3 / D	
		NB	4.4 / A	1.7 / A	0.3 / A	1.8 / A	
		SB	4.3 / A	5.8 / A	3.2 / A	5.7 / A	

4.13 2031 Future Build Conditions with Mitigations

Similar to the previous scenarios further investigation of intersection improvements were analyzed or the future 2031 Build scenario. The following are different traffic control alternatives that were analyzed.

4.13.1 Traffic Signal Control at Highway 61 and 152nd Street

Similar to the 2026 Build Mitigations, traffic signal control was added at the intersection of Highway 61 and 152nd Street. As part of this improvement, a dedicated left, thru, and right turn lane was provided for the westbound 152nd approach.

Similar phasing and cycle lengths were used for this analysis as was used during the 2026 Full Build Analysis.

The intersection operates acceptably during the AM peak hour. The northbound left turn at the intersection of Highway 61 and 152nd Street has a maximum reported queue length of 313'.

During the school dismissal time period, with the addition of the traffic signal at 152nd Street, delays for the eastbound and westbound approaches are greatly reduced. Both the eastbound and westbound left turning movements operate at a LOS D and LOS E, respectively.

Table 18 shows the approach LOS and total intersection LOS for the study intersection during the 2031 Full Build Conditions AM peak, school dismissal peak, and PM peak hours with traffic signal control at 152nd Street. More detailed results are shown in **Table A10** in **Appendix C.**

Table 18 – 2031 Full Build Traffic Operations with Traffic Signal Control at 152nd Street (Synchro)

Peak Hour	Intersection:	Approach	Delay (s/veh)				
			Left	Thru	Right	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)
School Arrival Peak Hour	Highway 61 at 152nd Street (Signal)	EB	36.7 / D		13.0 / B	18.9 / B	9.6 / A
		WB	40.1 / D		3.8 / A	28.4 / C	
		NB	13.7 / B	2.7 / A	0.9 / A	5.7 / A	
		SB	5.7 / A	9.9 / A	3.7 / A	9.2 / A	
School Dismissal Peak Hour	Highway 61 at 152nd Street (Signal)	EB	49.9 / D		16.4 / B	23.4 / C	10.0 / A
		WB	**59.9 / E**		11.9 / B	40.9 / D	
		NB	11.6 / B	5.6 / A	1.5 / A	6.0 / A	
		SB	13.8 / B	8.2 / A	2.0 / A	8.0 / A	
PM Peak Hour	Highway 61 at 152nd Street (Signal)	EB	**60.3 / E**		7.8 / A	19.1 / B	5.4 / A
		WB	**66.0 / E**		11.8 / B	46.8 / D	
		NB	5.6 / A	2.1 / A	0.6 / A	2.3 / A	
		SB	10.9 / B	4.2 / A	1.2 / A	4.1 / A	

4.13.1.1 Modified Traffic Signal Control Highway 61 and 152nd Street

Similar to traffic signal modifications outlined in section 4.10.1.1, the following changes were analyzed to determine how the traffic signal at Highway 61 and 152nd Street would operate under the most restrictive operations:

- The eastbound and westbound 152nd Street approaches were modified to include a dedicated left turn lane and a shared through-right turn lane.
- Protected only left turns phasing was added for all approaches at the intersection of Highway 61 and 152nd Street
- No right turns on red indications were applied to all movements at the intersection

During the school arrival peak hour, all intersections operate at a LOS C or better. The intersection of Highway 61 and 152nd has longer delays for all protected left turn movements. In addition, the eastbound right turn exiting the school site operates at a LOS C. The maximum queue reported for this movement is 297 feet.

Similar operations were reported for the school dismissal peak hour. All left turning movements at the intersection of Highway 61 and 152nd Street operate with longer delays. The eastbound right turning movement exiting the school operates at a LOS E. The maximum reported eastbound queue length is 294feet.

During the PM peak hour, left turning movements at the intersection of Highway 61 and 152nd Street operate with longer delays. The southbound left turn, serving 3 vehicles operates at a LOS F during this peak hour. This is primarily due to the longer cycle lengths that are in place along Highway 61. The eastbound right turning movement serving 47 vehicles operates at a LOS E and has a maximum queue length of 103 feet.

Table 19 shows the approach LOS and total intersection LOS for all study intersections during the 2031 Future Build AM peak, school dismissal peak, and PM peak hours with traffic signal control modifications at 152nd Street. More detailed results are shown in **Table A13** in **Appendix C.**

Table 19 – 2031 Full Build Traffic Operations with Modified Traffic Signal Control at 152nd Street (Synchro)

Peak Hour	Intersection:	Approach	Delay (s/veh)				
			Left	Thru	Right	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)
School Arrival Peak Hour	Highway 61 at 152nd Street (Signal)	EB	33.4 / C		32.2 / C	32.5 / C	32.6 / C
		WB	38.8 / D		34.0 / C	37.1 / D	
		NB	38.6 / D	13.0 / B	7.6 / A	20.1 / C	
		SB	44.5 / D	46.9 / D	31.1 / C	45.1 / D	
School Dismissal Peak Hour	Highway 61 at 152nd Street (Signal)	EB	**70.6 / E**		**58.7 / E**	**61.4 / E**	21.1 / C
		WB	**63.2 / E**		53.4 / D	**59.3 / E**	
		NB	**62.4 / E**	10.1 / B	5.2 / A	14.7 / B	
		SB	**64.6 / E**	15.3 / B	11.1 / B	15.8 / B	
PM Peak Hour	Highway 61 at 152nd Street (Signal)	EB	**72.9 / E**		**70.5 / E**	**71.1 / E**	15.2 / B
		WB	**75.3 / E**		**63.2 / E**	**71.7 / E**	
		NB	**67.1 / E**	8.4 / A	2.7 / A	11.1 / B	
		SB	**86.5 / F**	10.0 / B	6.0 / A	10.1 / B	

4.13.2 Roundabout Control at Highway 61 and 152nd Street

A single lane roundabout was modeled at the intersection of Highway 61 and 152nd Street in the Highway Capacity Software (HCS) to ensure the operations would be acceptable under the 2031 Future Build Conditions.

A single lane roundabout at this intersection will operate acceptably under the 2031 Future Build Conditions. A single lane roundabout at this intersection will operate acceptably under the 2031 Future Build conditions. The 95th percentile queue in the AM peak hour is approximately 140' for southbound Highway 61. The 95th percentile queue in the school dismissal peak hour is approximately 282' for the northbound Highway 61 approach. The 95th percentile queue in the PM peak hour is approximately 158' for northbound Highway 61.

Table 20 shows the approach LOS and total intersection LOS during the 2031 Future Build AM peak, school dismissal peak, and PM peak hours with roundabout control at 152nd Street.

Table 20 – Future 2031– Roundabout Control (HCS)

Intersection:	Approach	AM Peak		MD Peak		PM Peak	
		Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)	Approach Delay (sec/veh / LOS)	Intersection Delay (sec/veh / LOS)
Highway 61 at 152nd Street	NB	11.6 / B	13.5 / B	25.3 / D	19.4 / C	14.5 / B	12.1 / B
	SB	16.4 / C		13.3 / B		9.2 / A	
	EB	12.1 / B		10.5 / B		6.7 / A	
	WB	7.1 / A		14.1 / B		9.5 / A	

Notes: HCS – Highway Capacity Software.

5 Other Considerations

The project area experiences high volumes of traffic along Highway 61 throughout the day. However, the west leg of the 152nd Street intersections will likely experience congestion in short bursts that are directly related to school traffic. The following considerations address issues off the roadway network, turn lane warrants, and estimated construction costs.

5.1 Pedestrian Access

Given the proposed location of the new elementary school and its proximity to surrounding neighborhoods, emphasis should be given to providing safe pedestrian connections to the school site. It is recommended that a direct connection be made to the neighborhood immediately to the north of the school site. Based upon conversations with the White Bear Lake School District students in grades K-2 will not be provided busing if they are located within a half mile of the school. Schoolchildren in grades 3-5 will not be provided busing if they live within ¾ of a mile from the elementary school site. This provision does not apply to students who live on the east side of Highway 61. The School District will provide busing to students, regardless of proximity to the school site, if they live on the east side of Highway 61.

Located on the west side of Highway 61, the Hardwood Creek Regional Trail runs parallel to Highway 61 and will provide a space for pedestrians and bicyclists to access the elementary school from both north and south of the school site.

Students located on the east side of Highway 61 will be provided busing to the school site. However, consideration should be given to providing pedestrian facilities along 152nd Street as well as providing pedestrians a means to access Hugo Estates, a mobile home park located just southeast of the school site on the east side of Highway 61.

As part of the City of Hugo's 2040 Comprehensive Plan, a sidewalk/trail has been identified to be built parallel to Highway 61 on the east side of the roadway. This connection would travel from 147th Street to 152nd Street helping to provide pedestrian connectivity to the neighborhoods on the east side of Highway 61 that the school is serving. Additionally, another pedestrian connection is planned to connect Oneka Parkway to the Hardwood Creek Trail by traveling along 147th Street just north of Lions Park. A pedestrian routing map showing the official pedestrian crossing routes, unofficial crossing routes, as well as future pedestrian connections is shown in **Figure 13.**

It should be noted that unofficial crossing routes are routes that pedestrians may choose to take to get to the school site. These routes will not be maintained or encouraged as a means to access the school site.

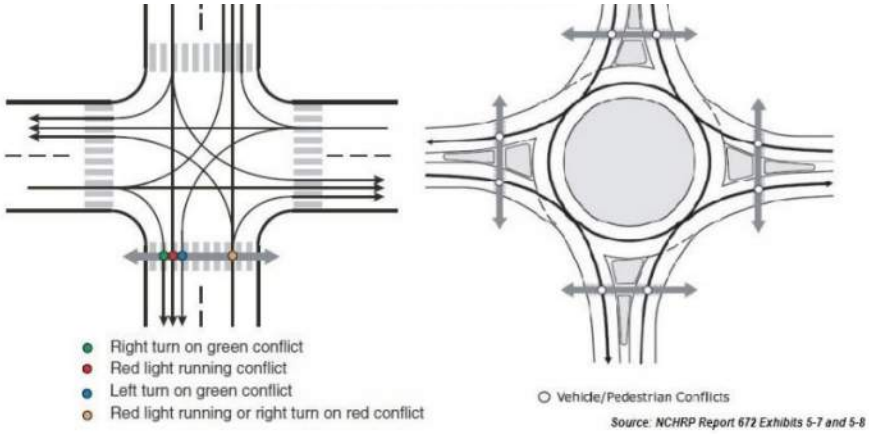
5.1.1 Pedestrian/Bicycle Safety at Roundabouts

As additional roundabouts are constructed in Minnesota and across the country, historical data on pedestrian/bicycle safety at roundabouts continues to accumulate. Many studies suggest that additional information is desired to draw stronger conclusions. However, there is commonality in the findings of several studies in Minnesota and nationally that supports that roundabouts are safe for pedestrians and bicyclists.

One significant factor in pedestrian and bicycle crossing safety at single-lane roundabouts is the reduced number of pedestrian-vehicle conflict points when compared to a traditional signalized

intersection. A signalized intersection has 16 pedestrian-vehicle conflict points with 4 on each intersection leg; right turn on red from a different intersection leg, red light running from a different intersection leg, left turn on green from a different intersection leg, and red light running/right turn on red on the crossing leg. A single-lane roundabout has only 8 pedestrian-vehicle conflict points with one at each entrance and exit to the roundabout. **Exhibit 2**, from the National Cooperative High Research Program (NCHRP) Report 672, shows a comparison of pedestrian-vehicle conflict points at traditional signalized intersections and single-lane roundabouts. In addition to the reduced pedestrian-vehicle conflicts at a single-lane roundabouts, pedestrians/bicyclists only cross one conflict point at a time due to the pedestrian refuge area on the splitter island of each roundabout leg; pedestrian/bicyclists at signalized intersection often must cross all four conflict points on an intersection leg at once. The pedestrian refuge in the splitter island also allows for pedestrians at roundabouts to look for a gap in traffic in only one direction at a time.

Exhibit 2 – Pedestrian- Vehicle Conflict Point Comparison (NCHRP Report 672)



Several studies have been completed both in Minnesota and nationally on the safety of drivers, pedestrians, and bicyclists at roundabouts.

- A study completed by the Insurance Institute for Highway Safety (IIHS) and Federal Highway Administration (FHWA) concluded that **roundabouts typically achieve a reduction of 40% of pedestrian crashes when converted from a conventional intersection**.
- A 2018 report from MnDOT called *An Addendum to "A Study of the Traffic Safety at Roundabouts in Minnesota"* compared pedestrian and bicycle crashes at 126 roundabouts to 126 comparable non-roundabout intersections in order to study the safety of roundabouts in Minnesota. This study concluded that **Minnesota roundabouts saw a reduction of over 60% in pedestrian crashes and a little over 15% reduction in bicycle crashes compared to conventional intersections in their before and after study.**
- MnDOT's *Pedestrian and Bicyclist Safety in Minnesota Roundabout Crossings,* completed in 2013, conducted observations at two Minnesota roundabouts to look for pedestrian and bicyclist safety concerns. This research **"strongly suggests that roundabout crossings are safe for pedestrians and bicyclists"**

In addition to the many local and nationwide studies on roundabout and pedestrian safety, many agencies have made statements about pedestrian and roundabout safety.

- MnDOT's *Minnesota Best Practices for Pedestrian/Bicycle Safety*, completed in 2013 says: "The characteristics of Roundabouts present a number of advantages for pedestrians and bicyclists – reduced vehicle operating speeds, reduced delays, and median refuge islands on all approach results in only having to cross a single direction of traffic at one time.
- The IIHS webpage on roundabouts says the following about the safety of pedestrians in a roundabout: "In addition to having fewer serious conflicts between vehicles than traditional intersections, roundabouts are generally safer for pedestrians as well. In a roundabout, pedestrians walk on sidewalks around the perimeter of the circular roadway. If they need to cross the roadway, they cross only one direction of traffic at a time. In addition, crossing distances are relatively short, and vehicle speeds tend to be low."
- The FHWA webpage on Roundabouts and Mini Roundabouts said the following: "Roundabouts are designed to improve safety for all users, including pedestrians and bicycles"

The Safe Routes to School Guidebook (http://guide.saferoutesinfo.org/engineering/roundabouts.cfm) provides the following excerpt regarding children and the use of roundabouts

> *"While roundabouts offer the general pedestrian population certain crossing and safety benefits, there is a dearth of research about the ability of child and elderly pedestrians, and those with mobility impairments to cross safely at roundabouts [Rodergerdts et al., 2010]. Children face special challenges to safely crossing a street. Factors include: impulsiveness, slower walking speeds; small body size that limits their visibility; less experience with traffic; still-developing cognitive abilities that make it difficult to accurately judge vehicle speed and traffic stream gaps; and a general perception drivers will be able to stop instantly [Rodergerdts et al., 2010; Fitpatrick et al., 2006]. These factors lend support for considering the need for adult supervision such as parents, caregivers or crossing guards at roundabout and other street crossing locations near elementary schools during arrival and dismissal times."*

Based upon this information, it is recommended that crossing guards be present during peak school arrival and dismissal time periods to help facilitate pedestrian crossings during the school year under either roundabout or traffic signal control.

In conclusion, roundabouts are beneficial for pedestrians and bicyclists compared to conventional intersections because they have fewer pedestrian-vehicle conflict points, have lower pedestrian delays, lower vehicle speeds, and pedestrians only need to cross one direction of traffic at a time, all of which result in increased pedestrian and bicycle safety. There is limited research however, regarding the pedestrian safety benefits of roundabouts in regard to younger children attempting to cross an intersection. If a roundabout were to be the preferred traffic control alternative, it is recommended that crossing guards be present during peak school arrival and dismissal time periods to help facilitate pedestrian crossings across Highway 61.

5.1.2 Pedestrian and Bicycle Safety at Traffic Signals

When looking at pedestrian and bicycle safety at traffic signals there are several treatments that can be implemented that influence the potential safety benefits of providing signalized crosswalks at intersections. Some of the treatments that should be considered are the following:

- Signal Phasing and timing
- Accessible Pedestrian Signals and pedestrian push buttons
- Countdown Pedestrian Timers
- Crossing Guards

5.1.2.1 Signal Phasing and Timing

There are several different strategies that can be implemented with signal phasing and timing changes. The first strategy would be to implement leading pedestrian intervals (LPI), leading pedestrian intervals allow the crosswalk/pedestrian movement to begin crossing 3-6 seconds before the green signal indication is given to motor vehicle traffic in the same direction. This gives pedestrians more time to get out into the roadway and make it more likely that motorists will see them before making a turn. Based upon guidance in the MnMUTCD, if an LPI is used, consideration should be given to prohibiting turns across the crosswalk during the interval.

Another strategy with signal timing that can be implemented is “No Right Turn on Red” signing. Motorists making a right turn on a red signal indication often are looking to the left to judge a gap in oncoming traffic and do not always look for pedestrians who may be crossing on their right side. Having a right turn on red restriction is another way to help reduce conflicts between motorists and non-motorized users at a traffic signal. Based upon guidance in the MnMUTCD, a No Turn on Red sign should be considered when there is an unacceptable number of pedestrian conflicts with right turn on red maneuvers, especially involving children, older pedestrians, or persons with disabilities. It should be noted that when right turn on red is prohibited, there may more right turn on green conflicts between vehicles and pedestrians at the adjacent crosswalk. The use of a leading pedestrian interval in conjunction with a prohibited right turn on red can help reduce this concern, however, this may lead to signal cycles changing more frequently, which can increase delay for mainline vehicles and presents the potential for an increased rear-end crash risk.

One of the drawbacks of a traffic signal at this location is the longer cycle lengths that are needed to accommodate large volumes of Highway 61 traffic both southbound in the morning and northbound in the afternoon. Due to these longer cycle times, pedestrian wait times will likely be longer to cross Highway 61. Additionally, increased pedestrian clearance intervals may also be needed to accommodate groups of children or slower walkers than the standards walk time of 3.5 feet per second. However, these increased walk times should be balanced against the potential of increased wait times between “Walk” indications.

One advantage the elementary school has is the current start and end times of the elementary school occur after the AM Peak hour of Highway 61 and before the afternoon PM peak hour therefore creating the possibility of having shortened cycle lengths during school arrival and dismissal time periods.

5.1.2.2 Accessible Pedestrian Signals and Pedestrian Push Buttons

Accessible Pedestrian Signals (APS) are audible signals that indicate when it is or is not appropriate to cross the street. APS signals are used when accommodating pedestrians with visual impairments. According to the Safe Routes to School Guide, these types of signals help increase the awareness of all pedestrians and may lead to fewer pedestrian crashes, as well as possibly reducing the amount of time it takes pedestrians to cross be reducing start up delay.

Additionally, pedestrian push buttons will be provided at the intersection as standard practice per MnDOT requirements should a traffic signal be the chosen alternative. These buttons help reduce delay to vehicular traffic when pedestrians are not present at the intersection and place a call to the signal of a need to complete a crossing.

5.1.2.3 Countdown Pedestrian Timers

Countdown pedestrian timers are timer displays that are used to inform pedestrians how much time is remaining to complete a crossing movement. These timers help reduce the number of pedestrians that may be caught in the crosswalk when the crossing cycle ends. Pedestrian Countdown Timers should be provided at the intersection should traffic signal control be installed.

5.1.2.4 Crossing Guards

Crossing guards should be considered at the intersection in order to help assist children in crossing Highway 61.

5.2 Turn Lane Warrants

MnDOT provides intersection turn lane warrant criteria in their access management manual. While these are not mandatory criteria to install turn lanes, they provide guidance on when a decision about turn lanes should be considered. There are nine warrant criteria in total; however, only two apply to this project area, Warrant 6 and Warrant 9.

- Warrant 6: School Entrances – At public and private school driveways on high-speed highways (posted speed ≥ 45 mph) used by school traffic
- Warrant 9: Vehicular Volume Warrant – At high-volume driveways (>100 trips per day) and all public street connections on high-speed highways (posted speed ≥ 45 mph) that satisfy the criteria in Figures 3.40 and 3.41 below. (**See Exhibit 3**)

Based on Warrant 6, turn lanes should be provided on Highway 61 at 152nd Street. The intersection is located on a high speed (posted at 55 mph) road that intersects with a school entrance; both left and right turn lanes on Highway 61 are warranted.

Highway 61 at 152nd Street also meets the volume Warrant 9 for both left and right turn lanes. The AADT on Highway 61 is currently 11,453, and the 152nd Street elementary school approach is expected to generate 1,361 trips per day at Full Build in 2026. Based on these volumes both a left and right turn lane are warranted on Highway 61.

While the turn lane warrants do not apply to the eastbound and westbound 152nd Street approaches, it is recommended that a dedicated left turn lane and a shared through right turn lane be provided at this intersection. This recommendation stems from the very limited number of vehicles going straight through the intersection. Additionally, a two-lane approach on the minor street approaches provides a shorter crossing distance for pedestrians crossing 152nd

Street. Given the higher volume of pedestrians and bicyclists using the Hardwood Creek Trail, this shorter crossing distance provides safety benefits to those non-motorized users.

Exhibit 3: MnDOT Turn Lane Warrant Thresholds

Figure 3.40: Warrant 9 for Left-Turn Lanes

2-Lane Highway AADT	4-Lane Highway AADT	Cross Street or Driveway ADT	Turn Lane Requirement
1500 to 2999	3000 to 5999	> 1500	Left-turn lane warranted
3000 to 3999	6000 to 7999	> 1200	Left-turn lane warranted
4000 to 4999	8000 to 9999	> 1000	Left-turn lane warranted
5000 to 6499	10,000 to 12,999	> 800	Left-turn lane warranted
≥ 6500 AADT	≥ 13,000 AADT	101 to 400 > 400	Left-turn lane or bypass lane Left-turn lane warranted

Highway AADT one year after opening
Posted speed 45 mph or greater

Figure 3.41: Warrant 9 for Right-Turn Lanes

2-Lane Highway AADT	4-Lane Highway AADT	Cross Street or Driveway ADT	Turn Lane Requirement
≥ 1500 AADT	≥ 3000 AADT	> 100	Right-turn lane warranted

Highway AADT one year after opening
Posted speed 45 mph or greater

5.3 Internal Site Circulation

The proposed elementary school site plan is attached in **Appendix H**. The site is also shown on all build figures. The site plan features a separated bus drop off location as well as a longer entrance roadway to accommodate pick-up and drop off queues that are typically present with school operations. As is shown in the site plan, the bus access point includes a dedicated left turn lane for buses to wait for a gap in departing traffic in order to complete their movement. This allows through traffic to continue into the site without backing up towards Highway 61.

Vehicle queues from the traffic signal and roundabout options do not have significant queueing for the eastbound approach and are not anticipated to impact the bus entrance even under the traffic signal No Right Turn on Red scenario.

Pedestrians and bicyclists will have direct access to the Hardwood Creek Trail and will access the school site by only having to interact with vehicles at the school bus site driveway before entering the school. The pedestrian and bicycle connection can be seen in the attached Site Plan.

5.4 Hardwood Creek Trail

The Hardwood Creek Trail is a regional trail currently running parallel to Highway 61 on the west side of the roadway. The trail is currently owned by the Washington County Regional Rail Authority. With improvements to the 152nd Street intersection, improvements will also be needed for the trail crossing.

Under the signalized control option, the trail crossing should be realigned closer to the intersection. This will allow trail users cross the intersection where a typical non-motorized user would cross and will prevent vehicles queues from obstructing the trail crossing.

Under the roundabout control option, the splitter island on the west leg of the intersection should be large enough to accommodate a bicycle with a baby trailer as well as sufficient boulevard width in order to prevent any quick bicycle turns towards the crosswalk. The concept drawings included in Section 5.5 show each of these recommendations for each alternative.

5.5 Construction Staging Considerations

Conversations with MnDOT's work zone group were had to discuss construction methods, impacts, and requirements of the traffic control alternatives at the intersection of Highway 61 and 152nd Street. Through these discussions, MnDOT stated that typically it is advantageous to construct a roundabout under a complete roadway closure.

To construct a roundabout at Highway 61 and 152nd Street, MnDOT would likely allow a full roadway closure while providing a main roadway detour as well as a secondary detour option for local traffic. The main roadway detour would direct motorists to use CSAH 8 to Interstate 35E and travel north to Highway 97. Motorists would travel east on Highway 97 and then once again enter Highway 61 and travel southbound back toward the roadway closure. This detour is approximately 15 miles in length.

A secondary detour would also be signed for local traffic. This detour would direct motorists east on 147th Street (Oneka Lake Blvd N) to Harrow Avenue N. Motorists would travel north on Harrow Avenue up to 165th Street N and then back west to Highway 61. This detour route is approximately 4 miles in length and would serve primarily the local traffic in the area.

If Highway 61 is closed during construction, one of the biggest challenges will be maintaining access to the east leg of 152nd Street as well as construction traffic on the west leg to construct the school. Due to the limited street network in this location, surrounding wetlands, and the need to accommodate heavy vehicles, there is no efficient way to maintain access at this location at a different access location. This challenge then requires the roundabout to be built under traffic, which will likely include construction of a by-pass lane to maintain traffic on Highway 61 as well as access to 152nd Street. This requirement will increase construction costs as well as add additional delay to the project.

Based upon conversations with MnDOT work zone staff, construction of the traffic signal will also likely require some minor widening as well as a temporary traffic signal system during construction. There will be less motorist impacts under this option when compared to the roundabout control option.

5.6 Concept Drawings and Construction Costs

Concept alternatives were generated for each of the alternatives that were modeled in the Capacity Analysis section of this report. A concept was generated for the geometric modifications and traffic control change to traffic signal control as well as a concept showing a single lane roundabout. Multiple traffic signal alternatives were drawn and analyzed as part of this project. These concepts are shown in **Drawing No. 1, 2, and 3** and **Drawing No. 4.**

Construction costs were developed and refined after conversations and input from project stakeholders for each traffic control alternative. Based on these conversations the following costs were developed:

- Traffic Signal Control with three lanes of approach on the minor street approaches: approximately $2,400,000 (**Drawing No. 1**)
- Traffic Signal Control with two lanes of approach on the minor street approaches: approximately $2,300,000
- Traffic Signal Control with three lanes of approach on the minor street approaches and a center median along Highway 61: approximately $2,950,000 (**Drawing No. 2)**
- Traffic Signal Control with two lanes of approach on the minor street approaches and a center median along Highway 61: approximately $2,850,000 (**Drawing No. 3)**
- Roundabout Control: between $2,300,000 and $2,500,000 based largely on construction staging and traffic control costs (**Drawing No. 4)**

It should be noted the following drawings are preliminary concepts and will be refined as design of the intersection continues, which will require for adjustments to the cost estimates. The current cost estimates do not include costs for right-of-way that may be needed. During preliminary design efforts will be made to minimize right-of-way impacts associated with the chosen alternative.

Detailed cost estimates are attached in **Appendix F**.

Path: X:\FJ\N\SDWB\156183\5-final-dsgn\51-drawings\90-GIS\Figure 13 - Pedestrian Routes.mxd

SEH

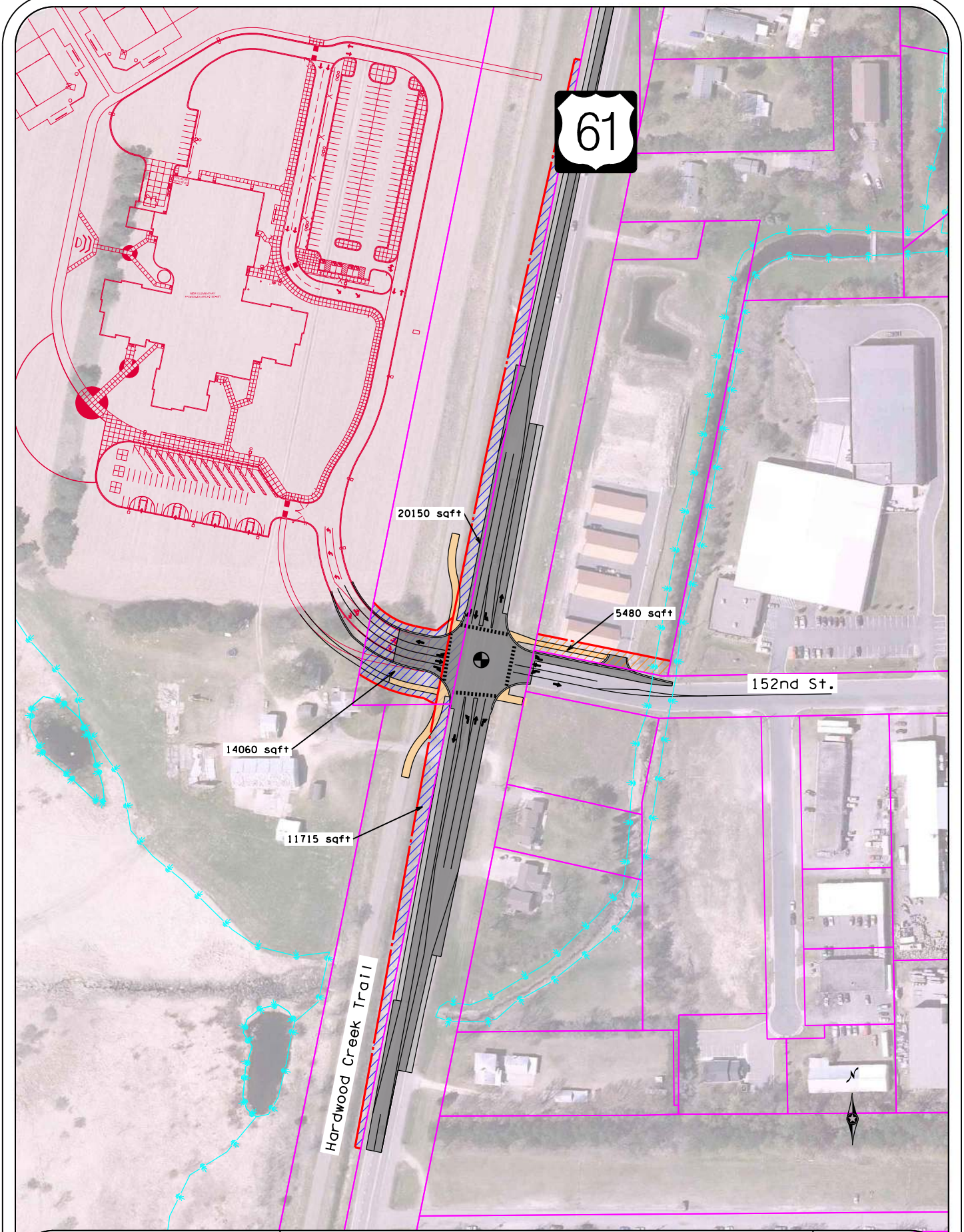
Project: ISDWB 156183
Print Date: 12/8/2020

Map by: jdanibas
Projection: NAD 1983 HARN MN Washington
Source: ESRI

Pedestrian Routes

White Bear Lake Elementary School
Hugo, MN

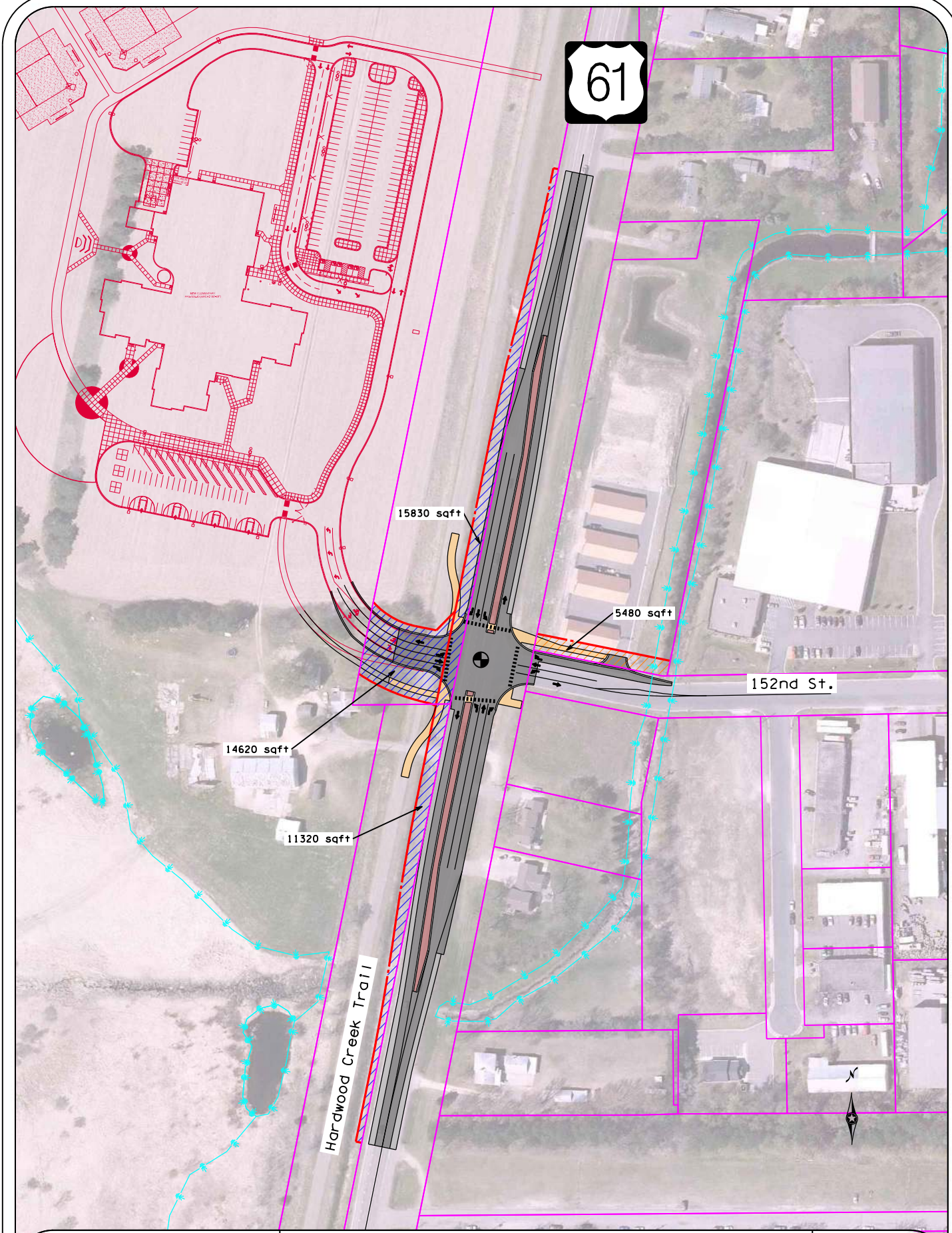
Figure 13



PHONE: (651) 490-2000

ISD NO. 624

DRAWING



PHONE: (651) 490-2000

ISD NO. 624

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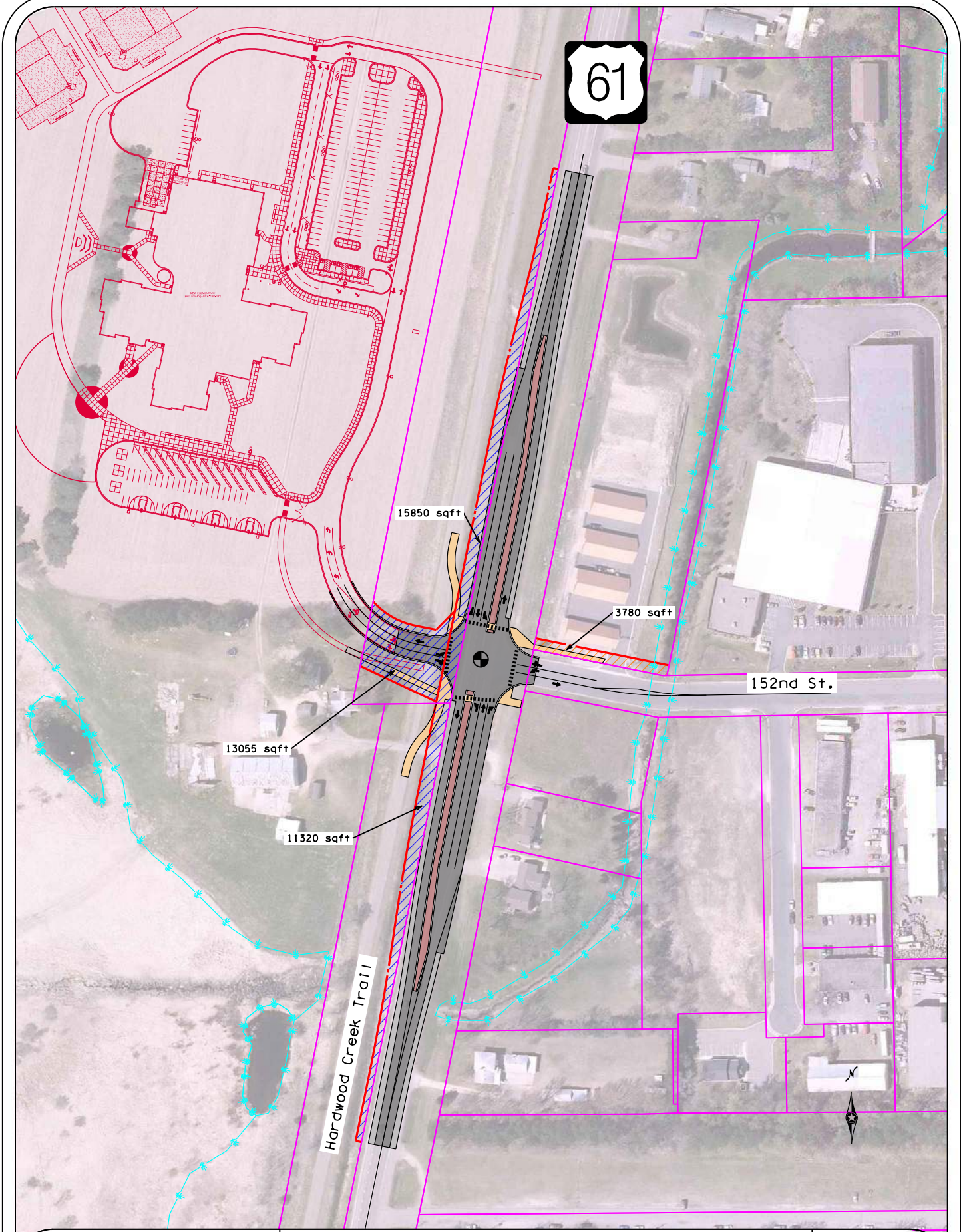

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ST. PAUL, MN 55110

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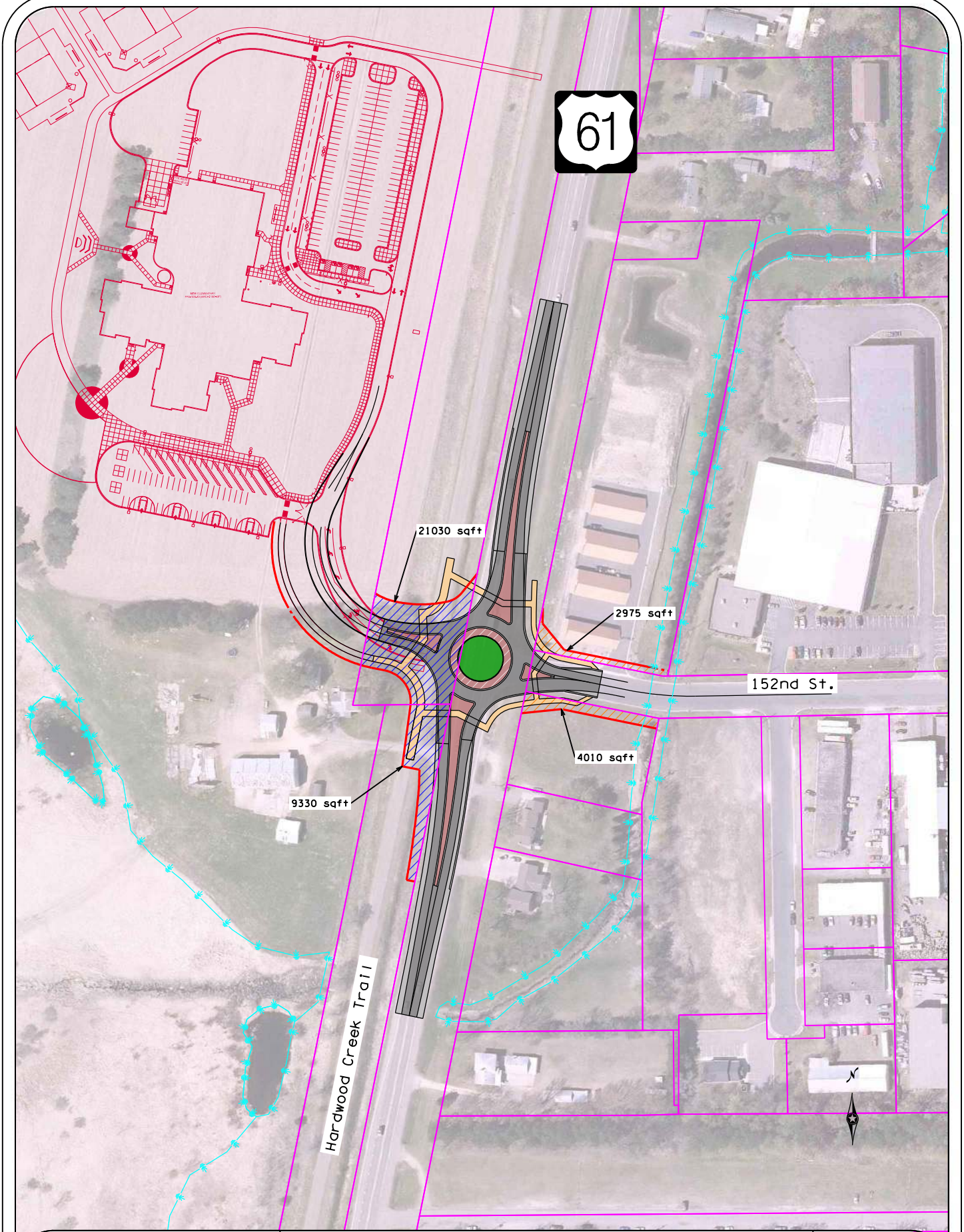
ALTERNATIVE 1c

DRAWING NO. 3



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3535 VADNAIS CENTER DR.
ST. PAUL, MN 55110

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NEW ELEMENTARY SCHOOL ACCESS
ALTERNATIVE 2

DRAWING NO. 4

6 Summary of Findings and Recommendation

This study's purpose is to document the "best" type of intersection control at Highway 61 and 152nd Street. The analysis included traffic counts that were taken while school was not in session and impacts from COVID-19 were impacting traffic patterns through the study intersections. Traffic counts were adjusted based on previous counts in the area to account for these abnormalities and to develop a sound base volume dataset.

A historical crash analysis was conducted for the main study intersection. This analysis indicated that there was not a sustained crash problem at the intersections of Highway 61 and 152nd Street.

Trips were generated for the school site for both the expected 2022 year of opening as well as expected full enrollment of the school in year 2026. Trips were assigned to the roadway network based upon conversations with the project team and a draft school attendance boundary.

A future crash analysis was conducted and based on this analysis the existing side street stop-controlled intersection is expected to have the lowest number of crashes in both the year of opening and full build out year. A single lane roundabout had the next highest number of expected crashes at 1.5 crashes per year during the year of opening and 1.7 crashes per year during the 2026 full build out year. As expected, the traffic signal alternative is expected to have the highest number of expected crashes with 2.2 expected crashes during the year of opening and 2.4 crashes during the 2026 full build out year.

A traffic operations analysis was conducted to evaluate traffic control alternatives at the intersection of Highway 61 and 152nd Street. Operational analysis was conducted for the 2022 year of opening, 2026 full enrollment of the school, and 2031 five years after the full build out of the site. Based on the analysis, a traffic signal operates acceptably through the 2031 design year, even under capacity constraints that were analyzed such as "No Right Turn on Red". The roundabout alternative also operates acceptably through the 2031 design year.

A review of pedestrian and bicycle safety at both traffic signals and roundabouts was conducted. Based on this review, it was determined that roundabouts are beneficial for pedestrians and bicyclists compared to conventional intersections because they have fewer pedestrian-vehicle conflict points, have lower pedestrian delays, lower vehicle speeds, and pedestrians only need to cross one direction of traffic at a time, all of which result in increased pedestrian and bicycle safety. There is limited research however, regarding the pedestrian safety benefits of roundabouts in regard to younger children attempting to cross an intersection. It is recommended that crossing guards be present during peak school arrival and dismissal time periods to help facilitate pedestrian crossings across Highway 61 under roundabout control. Non-motorized safety at traffic signals was also reviewed. Based on our research it was determined that generally, providing signalized crosswalks may help create a safer route to the school for children when compared to the No Build thru-stop condition. There are treatments that should be considered in order to improve pedestrian safety at signalized locations. These treatments can be in the form of timing improvements, equipment improvements, as well as signing changes to limit vehicle movements at the intersection during certain signal phases and crossing guards.

Construction costs were developed and refined after conversations and input from project stakeholders for each traffic control alternative. Based on these conversations the following costs were developed:

- Traffic Signal Control with three lanes of approach on the minor street approaches: approximately $2,400,000 (**Drawing No. 1**)
- Traffic Signal Control with two lanes of approach on the minor street approaches: approximately $2,300,000
- Traffic Signal Control with three lanes of approach on the minor street approaches and a center median along Highway 61: approximately $2,950,000 (**Drawing No. 2)**
- Traffic Signal Control with two lanes of approach on the minor street approaches and a center median along Highway 61: approximately $2,850,000 (**Drawing No. 3)**
- Roundabout Control: between $2,300,000 and $2,500,000 based largely on construction staging and traffic control costs (**Drawing No. 4)**

Due to the very limited number of through movements from the side street approaches at the intersection of Highway 61 and 152nd Street, it is recommended that a dedicated left turn lane and a shared through-right turn lane be provided for both eastbound and westbound 152nd Street. This lane configuration provides a shorter crossing distance for pedestrians and bicyclists using the Hardwood Creek Regional Trail crossing the west leg of the intersection as well as still allowing protected left turn phasing to be utilized for eastbound and westbound left turning traffic.

The preliminary cost estimates do not include costs for right-of-way that may be needed, however during the preliminary design phase, efforts will be made to minimize right-of-way impacts associated with the chosen alternative.

6.1 Advantages and Disadvantages of Traffic Signal Control and Roundabout Control

There are many advantages and disadvantages of each traffic control alternative analyzed as part of this study. The following sections provide the pros and cons of each traffic control alternative. It should be noted that the advantages and disadvantages of each traffic control alternative is not considered to be an exhaustive list.

6.1.1 Traffic Signal Control

6.1.1.1 Advantages

- Ability for the signal to be coordinated with other adjacent signal systems providing added efficiency during off-peak school times when side street traffic volumes are low.
- Control the flow of traffic at the intersection and provide sufficient time for safe and efficient pedestrian crossings.
- Ability to reduce motor vehicle and pedestrian conflicts through the use of leading pedestrian intervals.
- Can provide audible signals for the visually impaired that indicate when it is appropriate to cross the street.
- Minimized construction impacts when compared to roundabout alternative

- Emergency vehicle priority can be established through the use of emergency vehicle preemption

6.1.1.2 Disadvantages

- Possible increase in motor vehicle crashes compared to the No Build and roundabout control options
    - Rear end crashes are expected to increase at signalized intersections
- Increased number of pedestrian-vehicle conflict points when compared to a roundabout (16 vs. 8)
- Possible increased pedestrian wait times compared to minor street stop or roundabout control
    - The longer pedestrians must wait to cross the street, the more likely they will decide to cross against the signal.
- Higher vehicle speeds crossing through the intersection when compared to roundabout control
- Possible sight line restrictions with the addition of center medians along Highway 61
    - If center medians are provided along Highway 61, sight lines should be evaluated to make sure that left turning vehicles on Highway 61 are able to see oncoming traffic if a left turning queue exists for the opposing left turn movement. Positively offsetting left turns will help increase sight distance, however, will also increase costs.

6.1.2 Roundabout Control

6.1.2.1 Advantages

- Ability to control speeds entering the intersection.
- Increased pedestrian safety
    - Lower vehicle speeds through the intersection
    - Pedestrians only have to cross one direction of traffic at a time, and typically have shorter crossing distances when compared to traffic signals
- Reduced crash severity due to the softening of the angle of potential collisions between vehicles
- Reduced number of pedestrian-vehicle conflict points when compared to a traffic signal (8 vs. 16)
- Reduced pedestrian wait times to cross Highway 61

6.1.2.2 Disadvantages

- Requires a temporary 2-lane bypass required during construction
    - More complex staging, increased construction costs, longer construction duration

- Limited research regarding the pedestrian safety benefits of roundabouts as they pertain to younger children and their ability to safely cross the roadway unassisted.
- Traffic flow along Highway 61 is slowed as all vehicles must slow for the roundabout, however, limited stops when conflicting movements are not present.
- Difficult crossing for visually impaired pedestrians.
- No priority given to emergency vehicles, as roundabouts assign right of way equally throughout the intersection

6.2 Recommendations

A traffic signal without center medians and two lanes of approach on the minor street approaches is recommended at the intersection of Highway 61 and 152nd Street. This traffic control is recommended because it operates acceptably through the 2031 design year, provides efficiency for northbound and southbound Highway 61 during off-peak times, has the ability to provide sufficient crossing times across Highway 61 during peak times, and has minimized construction impacts when compared to the roundabout alternative.

Based upon requirements from the Minnesota Department of Transportation, 300’ turn lanes with a 1:15 taper shall be provided for turn lanes on Highway 61.

Based upon capacity analysis results, 150’ eastbound left turn lane with a 1:5 taper and a 150’ westbound left turn lane with a 1:10 taper should be provided.

As a consideration, crossing safety at the signalized intersection can be further improved through the use of crossing guards to help aid in children crossing the roadway during school arrival and dismissal time periods.

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Appendix F

Preliminary Construction Cost Estimates

Construction Cost Estimate

Signal 1a

Item Description	Units	Unit Cost	Quantity	Total
PAVING AND GRADING (P & G) COSTS				
Bituminous Pavement (1)	ton	$75.00	4,343	$ 325,703
4" Concrete Walk	sq ft	$6.00	6,698	$ 40,188
8" Concrete pavement	sq yd	$70.00	0	$ -
Concrete pavement	sq yd	$70.00	0	$ -
Class 2 Aggregate Shoulder (1)	cu yd	$45.00	0	$ -
Class 6 Aggregate Base (1)	cu yd	$40.00	3,185	$ 127,382
Subgrade Excavation (1)	cu yd	$10.00	4,591	$ 45,908
Common Excavation	cu yd	$10.00	3,860	$ 38,600
Common Borrow	cu yd	$8.00	5,790	$ 46,320
Select Granular Borrow	cu yd	$20.00	4,591	$ 91,816
Mill Pavement	sq yd	$1.50	1,705	$ 2,557
Curb and Gutter Design B624	lin ft	$20.00	970	$ 19,400
(a) Subtotal Paving and Grading				**$ 737,874**
UTILITIES, REMOVALS, DRAINAGE, ETC.				
Removals/Clear and Grub		5.0%		$ 36,894
Minor City Utilities		5.0%		$ 36,894
Signing, Striping, Traffic Control		5.0%		$ 36,894
Erosion Control and Turf Establishment		5.0%		$ 36,894
(b) Subtotal Utilities, Removals, Drainage, Etc.				**$ 147,575**
DRAINAGE				
Storm Sewer		30.0%		$ 221,362
(c) Subtotal Drainage				**$ 221,362**
STRUCTURES/SIGNALS/MISC. COST				
Bridge removal	sqft	$15		$ -
Bridge rehab	lump sum	$1,100,000		$ -
Bridge	sqft	$140		$ -
Retaining Wall	sqft	$100		$ -
Retaining Block Wall	sqft	$60		$ -
Lighting	each	$7,000	5	$ 35,000
Interchange Lighting		$480,000		$ -
Landscaping		$20,000		$ -
Intersection ADA	each	$ 6,000.00	8	$ 48,000
Signal System	each	$ 250,000.00	1	$ 250,000
				$ -
(d) Subtotal Structural				**$ 333,000**
(a+b+c+d) Subtotal Construction				**$ 1,439,811**
Risk & Contingency		20.0%		$ 287,962
TMP		5.0%		$ 71,991
Mobilization		5.0%		$ 71,991
(e) Subtotal Miscellaneous				**$ 431,943**
(a+b+c+d+e) Total Construction				**$ 1,871,754**
Inflation Adjusted Construction Cost for 2021 (1.09 factor)				**$ 2,040,212**
Design & Construction Engineering		20.0%		$ 374,351
RW Cost				
Total RW		$10,100,000		$ -
Total RW				**$ -**

Total Estimated Cost	**$ 2,414,563**

Construction Cost Estimate

Signal 1b

Item Description	Units	Unit Cost	Quantity	Total
PAVING AND GRADING (P & G) COSTS				
Bituminous Pavement (1)	ton	$75.00	4,395	$ 329,658
4" Concrete Walk	sq ft	$6.00	19,731	$ 118,386
8" Concrete pavement	sq yd	$70.00	0	$ -
Concrete pavement	sq yd	$70.00	0	$ -
Class 2 Aggregate Shoulder (1)	cu yd	$45.00	0	$ -
Class 6 Aggregate Base (1)	cu yd	$40.00	4,005	$ 160,219
Subgrade Excavation (1)	cu yd	$10.00	5,817	$ 58,169
Common Excavation	cu yd	$10.00	4,822	$ 48,218
Common Borrow	cu yd	$8.00	7,233	$ 57,861
Select Granular Borrow	cu yd	$20.00	5,817	$ 116,339
Mill Pavement	sq yd	$1.50	0	$ -
Curb and Gutter Design B624	lin ft	$20.00	2,855	$ 57,100
(a) Subtotal Paving and Grading				**$ 945,950**
UTILITIES, REMOVALS, DRAINAGE, ETC.				
Removals/Clear and Grub		5.0%		$ 47,297
Minor City Utilities		5.0%		$ 47,297
Signing, Striping, Traffic Control		5.0%		$ 47,297
Erosion Control and Turf Establishment		5.0%		$ 47,297
(b) Subtotal Utilities, Removals, Drainage, Etc.				**$ 189,190**
DRAINAGE				
Storm Sewer		30.0%		$ 283,785
(c) Subtotal Drainage				**$ 283,785**
STRUCTURES/SIGNALS/MISC. COST				
Bridge removal	sqft	$15		$ -
Bridge rehab	lump sum	$1,100,000		$ -
Bridge	sqft	$140		$ -
Retaining Wall	sqft	$100		$ -
Retaining Block Wall	sqft	$60		$ -
Lighting	each	$7,000	5	$ 35,000
Interchange Lighting		$480,000		$ -
Landscaping		$20,000		$ -
Intersection ADA	each	$ 6,000.00	8	$ 48,000
Signal System	each	$ 250,000.00	1	$ 250,000
				$ -
(d) Subtotal Structural				**$ 333,000**
(a+b+c+d) Subtotal Construction				**$ 1,751,925**
Risk & Contingency		20.0%		$ 350,385
TMP		5.0%		$ 87,596
Mobilization		5.0%		$ 87,596
(e) Subtotal Miscellaneous				**$ 525,577**
(a+b+c+d+e) Total Construction				**$ 2,277,502**
Inflation Adjusted Construction Cost for 2021 (1.09 factor)				**$ 2,482,478**
Design & Construction Engineering		20.0%		$ 455,500
RW Cost				
Total RW		$10,100,000		$ -
Total RW				**$ -**

Total Estimated Cost	**$ 2,937,978**

Construction Cost Estimate

Signal 1c

Item Description	Units	Unit Cost	Quantity	Total
PAVING AND GRADING (P & G) COSTS				
Bituminous Pavement (1)	ton	$75.00	4,193	$ 314,445
4" Concrete Walk	sq ft	$6.00	19,960	$ 119,760
8" Concrete pavement	sq yd	$70.00	0	$ -
Concrete pavement	sq yd	$70.00	0	$ -
Class 2 Aggregate Shoulder (1)	cu yd	$45.00	0	$ -
Class 6 Aggregate Base (1)	cu yd	$40.00	3,862	$ 154,464
Subgrade Excavation (1)	cu yd	$10.00	5,595	$ 55,948
Common Excavation	cu yd	$10.00	4,659	$ 46,589
Common Borrow	cu yd	$8.00	6,988	$ 55,907
Select Granular Borrow	cu yd	$20.00	5,595	$ 111,896
Mill Pavement	sq yd	$1.50	0	$ -
Curb and Gutter Design B624	lin ft	$20.00	2,573	$ 51,460
(a) Subtotal Paving and Grading				**$ 910,468**
UTILITIES, REMOVALS, DRAINAGE, ETC.				
Removals/Clear and Grub		5.0%		$ 45,523
Minor City Utilities		5.0%		$ 45,523
Signing, Striping, Traffic Control		5.0%		$ 45,523
Erosion Control and Turf Establishment		5.0%		$ 45,523
(b) Subtotal Utilities, Removals, Drainage, Etc.				**$ 182,094**
DRAINAGE				
Storm Sewer		30.0%		$ 273,140
(c) Subtotal Drainage				**$ 273,140**
STRUCTURES/SIGNALS/MISC. COST				
Bridge removal	sqft	$15		$ -
Bridge rehab	lump sum	$1,100,000		$ -
Bridge	sqft	$140		$ -
Retaining Wall	sqft	$100		$ -
Retaining Block Wall	sqft	$60		$ -
Lighting	each	$7,000	5	$ 35,000
Interchange Lighting		$480,000		$ -
Landscaping		$20,000		$ -
Intersection ADA	each	$ 6,000.00	8	$ 48,000
Signal System	each	$ 250,000.00	1	$ 250,000
				$ -
(d) Subtotal Structural				**$ 333,000**
(a+b+c+d) Subtotal Construction				**$ 1,698,702**
Risk & Contingency		20.0%		$ 339,740
TMP		5.0%		$ 84,935
Mobilization		5.0%		$ 84,935
(e) Subtotal Miscellaneous				**$ 509,610**
(a+b+c+d+e) Total Construction				**$ 2,208,312**
Inflation Adjusted Construction Cost for 2021 (1.09 factor)				**$ 2,407,060**
Design & Construction Engineering		20.0%		$ 441,662
RW Cost				
Total RW		$10,100,000		$ -
Total RW				**$ -**

Total Estimated Cost	**$ 2,848,722**

Construction Cost Estimate

Roundabout

Item Description	Units	Unit Cost	Quantity	Total
PAVING AND GRADING (P & G) COSTS				
Bituminous Pavement (1)	ton	$75.00	1,738	$ 130,379
4" Concrete Walk	sq ft	$6.00	16,940	$ 101,640
8" Concrete pavement	sq yd	$70.00	352	$ 24,632
Concrete pavement	sq yd	$70.00	2,511	$ 175,770
Class 2 Aggregate Shoulder (1)	cu yd	$45.00	0	$ -
Class 6 Aggregate Base (1)	cu yd	$40.00	2,271	$ 90,843
Subgrade Excavation (1)	cu yd	$10.00	3,619	$ 36,191
Common Excavation	cu yd	$10.00	3,341	$ 33,410
Common Borrow	cu yd	$8.00	5,011	$ 40,092
Select Granular Borrow	cu yd	$20.00	3,619	$ 72,381
Mill Pavement	sq yd		0	$ -
Curb and Gutter Design B624	lin ft	$20.00	3,515	$ 70,300
(a) Subtotal Paving and Grading				**$ 775,638**
UTILITIES, REMOVALS, DRAINAGE, ETC.				
Removals/Clear and Grub		5.0%		$ 38,782
Minor City Utilities		5.0%		$ 38,782
Signing, Striping, Traffic Control		5.0%		$ 38,782
Erosion Control and Turf Establishment		5.0%		$ 38,782
(b) Subtotal Utilities, Removals, Drainage, Etc.				**$ 155,128**
DRAINAGE				
Storm Sewer		15.0%		$ 116,346
(c) Subtotal Drainage				**$ 116,346**
STRUCTURES/SIGNALS/MISC. COST				
Bridge removal	sqft	$15		$ -
Bridge rehab	lump sum	$1,100,000		$ -
Bridge	sqft	$140		$ -
Retaining Wall	sqft	$100		$ -
Retaining Block Wall	sqft	$60		$ -
Lighting	each	$7,000	8	$ 56,000
Interchange Lighting		$480,000		$ -
Landscaping		$20,000	1	$ 20,000
Intersection ADA	each	$ 6,000.00	16	$ 96,000
Signal System	each	$ 250,000.00	0	$ -
				$ -
(d) Subtotal Structural				**$ 172,000**
(a+b+c+d) Subtotal Construction				**$ 1,219,111**
Risk & Contingency		20.0%		$ 243,822
TMP		5.0%		$ 60,956
Mobilization		5.0%		$ 60,956
(e) Subtotal Miscellaneous				**$ 365,733**
(a+b+c+d+e) Total Construction				**$ 1,584,845**
Inflation Adjusted Construction Cost for 2021 (1.09 factor)				**$ 1,727,481**
Design & Construction Engineering		20.0%		$ 316,969
RW Cost				
Total RW		$10,100,000		$ -
Total RW				**$ -**

Total Estimated Cost	**$ 2,044,450**

Appendix G

Highway Capacity Software MOEs

HCS7 Roundabouts Report

General Information

Analyst	JDA
Agency or Co.	SEH
Date Performed	11/2/2020
Analysis Year	2022
Time Analyzed	Build AM Peak Hour
Project Description	White Bear Lake Area Elementary School TIS

Site Information

Intersection	TH 61 at 152nd St
E/W Street Name	152nd St
N/S Street Name	TH 61
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.83
Jurisdiction	White Bear Lake Schools

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment			LTR				LTR				LTR				LTR	
Volume (V), veh/h	0	15	0	134	0	19	0	7	0	158	363	30	0	9	452	18
Percent Heavy Vehicles, %	2	13	2	4	2	2	2	2	2	3	2	2	2	2	2	11
Flow Rate (v_{PCE}), pc/h	0	20	0	168	0	23	0	9	0	196	446	37	0	11	555	24
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes	1				1				1				1			
Pedestrians Crossing, p/h	0				0				0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)		4.9763			4.9763			4.9763			4.9763	
Follow-Up Headway (s)		2.6087			2.6087			2.6087			2.6087	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h		188			32			679			590	
Entry Volume veh/h		179			31			664			577	
Circulating Flow (v_c), pc/h		589			662			31			219	
Exiting Flow (v_{ex}), pc/h		48			220			475			746	
Capacity (c_{pce}), pc/h		757			702			1337			1104	
Capacity (c), veh/h		722			689			1307			1079	
v/c Ratio (x)		0.25			0.05			0.51			0.53	

Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		7.9			5.7			8.1			9.8	
Lane LOS		A			A			A			A	
95% Queue, veh		1.0			0.1			3.0			3.3	
Approach Delay, s/veh	7.9			5.7			8.1			9.8		
Approach LOS	A			A			A			A		
Intersection Delay, s/veh | LOS	8.7						A					

HCS7 Roundabouts Report

General Information

Analyst	JDA
Agency or Co.	SEH
Date Performed	11/2/2020
Analysis Year	2022
Time Analyzed	Build PM Peak Hour
Project Description	White Bear Lake Area Elementary School TIS

Site Information

Intersection	TH 61 at 152nd St
E/W Street Name	152nd St
N/S Street Name	TH 61
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.92
Jurisdiction	White Bear Lake Schools

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment			LTR				LTR				LTR				LTR	
Volume (V), veh/h	0	4	0	40	0	38	0	19	0	37	744	9	0	4	516	3
Percent Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Flow Rate (v_{PCE}), pc/h	0	4	0	44	0	42	0	21	0	41	825	10	0	4	572	3
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes	1				1				1				1			
Pedestrians Crossing, p/h	0				0				0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)		4.9763			4.9763			4.9763			4.9763	
Follow-Up Headway (s)		2.6087			2.6087			2.6087			2.6087	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h		48			63			876			579	
Entry Volume veh/h		47			62			859			568	
Circulating Flow (v_c), pc/h	618			870			8			83		
Exiting Flow (v_{ex}), pc/h	14			44			850			658		
Capacity (c_{pce}), pc/h		735			568			1369			1268	
Capacity (c), veh/h		720			557			1342			1243	
v/c Ratio (x)		0.07			0.11			0.64			0.46	

Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		5.7			7.8			10.5			7.6	
Lane LOS		A			A			B			A	
95% Queue, veh		0.2			0.4			4.9			2.5	
Approach Delay, s/veh	5.7			7.8			10.5			7.6		
Approach LOS	A			A			B			A		
Intersection Delay, s/veh | LOS	9.2						A					

HCS7 Roundabouts Report

General Information

Analyst	JDA
Agency or Co.	SEH
Date Performed	11/2/2020
Analysis Year	2022
Time Analyzed	Build SD Peak Hour
Project Description	White Bear Lake Area Elementary School TIS

Site Information

Intersection	TH 61 at 152nd St
E/W Street Name	152nd St
N/S Street Name	TH 61
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.86
Jurisdiction	White Bear Lake Schools

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment			LTR				LTR				LTR				LTR	
Volume (V), veh/h	0	10	0	83	0	60	0	38	0	68	732	29	0	9	521	7
Percent Heavy Vehicles, %	2	20	2	6	2	2	2	2	2	7	2	2	2	2	2	29
Flow Rate (v_{PCE}), pc/h	0	14	0	102	0	71	0	45	0	85	868	34	0	11	618	11
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes	1				1				1				1			
Pedestrians Crossing, p/h	0				0				0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)		4.9763			4.9763			4.9763			4.9763	
Follow-Up Headway (s)		2.6087			2.6087			2.6087			2.6087	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h		116			116			987			640	
Entry Volume veh/h		108			114			964			625	
Circulating Flow (v_c), pc/h	700			967			25			156		
Exiting Flow (v_{ex}), pc/h	45			96			927			791		
Capacity (c_{pce}), pc/h		676			515			1345			1177	
Capacity (c), veh/h		629			505			1314			1150	
v/c Ratio (x)		0.17			0.23			0.73			0.54	

Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		7.8			10.3			13.5			9.5	
Lane LOS		A			B			B			A	
95% Queue, veh		0.6			0.9			7.1			3.4	
Approach Delay, s/veh	7.8			10.3			13.5			9.5		
Approach LOS	A			B			B			A		
Intersection Delay, s/veh | LOS	11.6						B					

HCS7 Roundabouts Report

General Information

Analyst	JDA
Agency or Co.	SEH
Date Performed	11/2/2020
Analysis Year	2026
Time Analyzed	Build AM Peak Hour
Project Description	White Bear Lake Area Elementary School TIS

Site Information

Intersection	TH 61 at 152nd St
E/W Street Name	152nd St
N/S Street Name	TH 61
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.79
Jurisdiction	White Bear Lake Schools

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment			LTR				LTR				LTR				LTR	
Volume (V), veh/h	0	22	0	195	0	19	0	7	0	228	391	30	0	9	486	25
Percent Heavy Vehicles, %	2	9	2	5	2	2	2	2	2	4	2	2	2	2	2	8
Flow Rate (v_{PCE}), pc/h	0	30	0	259	0	25	0	9	0	300	505	39	0	12	627	34
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes	1				1				1				1			
Pedestrians Crossing, p/h	0				0				0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)		4.9763			4.9763			4.9763			4.9763	
Follow-Up Headway (s)		2.6087			2.6087			2.6087			2.6087	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h		289			34			844			673	
Entry Volume veh/h		274			33			822			658	
Circulating Flow (v_c), pc/h		664			835			42			325	
Exiting Flow (v_{ex}), pc/h		51			334			544			911	
Capacity (c_{pce}), pc/h		701			589			1322			991	
Capacity (c), veh/h		665			577			1287			968	
v/c Ratio (x)		0.41			0.06			0.64			0.68	

Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		11.2			6.9			10.8			14.6	
Lane LOS		B			A			B			B	
95% Queue, veh		2.0			0.2			4.9			5.6	
Approach Delay, s/veh	11.2			6.9			10.8			14.6		
Approach LOS	B			A			B			B		
Intersection Delay, s/veh | LOS	12.2						B					

HCS7 Roundabouts Report

General Information

Analyst	JDA
Agency or Co.	SEH
Date Performed	11/2/2020
Analysis Year	2026
Time Analyzed	Build PM Peak Hour
Project Description	White Bear Lake Area Elementary School TIS

Site Information

Intersection	TH 61 at 152nd St
E/W Street Name	152nd St
N/S Street Name	TH 61
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.92
Jurisdiction	White Bear Lake Schools

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment			LTR				LTR				LTR				LTR	
Volume (V), veh/h	0	6	0	57	0	39	0	20	0	53	801	9	0	3	556	6
Percent Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Flow Rate (v_{PCE}), pc/h	0	7	0	63	0	43	0	22	0	59	888	10	0	3	616	7
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes	1				1				1				1			
Pedestrians Crossing, p/h	0				0				0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)		4.9763			4.9763			4.9763			4.9763	
Follow-Up Headway (s)		2.6087			2.6087			2.6087			2.6087	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h		70			65			957			626	
Entry Volume veh/h		69			64			938			614	
Circulating Flow (v_c), pc/h	662			954			10			102		
Exiting Flow (v_{ex}), pc/h	13			66			917			722		
Capacity (c_{pce}), pc/h		702			522			1366			1244	
Capacity (c), veh/h		689			511			1339			1219	
v/c Ratio (x)		0.10			0.12			0.70			0.50	

Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		6.3			8.7			12.2			8.4	
Lane LOS		A			A			B			A	
95% Queue, veh		0.3			0.4			6.2			2.9	
Approach Delay, s/veh	6.3			8.7			12.2			8.4		
Approach LOS	A			A			B			A		
Intersection Delay, s/veh | LOS	10.5						B					

HCS7 Roundabouts Report

General Information

Analyst	JDA
Agency or Co.	SEH
Date Performed	11/2/2020
Analysis Year	2026
Time Analyzed	Build SD Peak Hour
Project Description	White Bear Lake Area Elementary School TIS

Site Information

Intersection	TH 61 at 152nd St
E/W Street Name	152nd St
N/S Street Name	TH 61
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.84
Jurisdiction	White Bear Lake Schools

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment			LTR				LTR				LTR				LTR	
Volume (V), veh/h	0	14	0	122	0	61	0	39	0	99	788	29	0	9	560	11
Percent Heavy Vehicles, %	2	14	2	7	2	2	2	2	2	9	2	2	2	2	2	18
Flow Rate (v_{PCE}), pc/h	0	19	0	155	0	74	0	47	0	128	957	35	0	11	680	15
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes	1				1				1				1			
Pedestrians Crossing, p/h	0				0				0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)		4.9763			4.9763			4.9763			4.9763	
Follow-Up Headway (s)		2.6087			2.6087			2.6087			2.6087	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h		174			121			1120			706	
Entry Volume veh/h		162			119			1090			690	
Circulating Flow (v_c), pc/h		765			1104			30			202	
Exiting Flow (v_{ex}), pc/h		46			143			1023			909	
Capacity (c_{pce}), pc/h		632			448			1338			1123	
Capacity (c), veh/h		587			439			1303			1098	
v/c Ratio (x)		0.28			0.27			0.84			0.63	

Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		9.8			12.6			19.1			11.8	
Lane LOS		A			B			C			B	
95% Queue, veh		1.1			1.1			10.9			4.7	
Approach Delay, s/veh	9.8			12.6			19.1			11.8		
Approach LOS	A			B			C			B		
Intersection Delay, s/veh | LOS	15.6						C					

HCS7 Roundabouts Report

General Information

Analyst	JDA
Agency or Co.	SEH
Date Performed	11/2/2020
Analysis Year	2031
Time Analyzed	Build AM Peak Hour
Project Description	White Bear Lake Area Elementary School TIS

Site Information

Intersection	TH 61 at 152nd St
E/W Street Name	152nd St
N/S Street Name	TH 61
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.80
Jurisdiction	White Bear Lake Schools

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment			LTR				LTR				LTR				LTR	
Volume (V), veh/h	0	54	0	162	0	19	0	7	0	190	426	31	0	9	531	62
Percent Heavy Vehicles, %	2	9	2	5	2	2	2	2	2	4	2	2	2	2	2	8
Flow Rate (v_{PCE}), pc/h	0	74	0	213	0	24	0	9	0	247	543	40	0	11	677	84
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes	1				1				1				1			
Pedestrians Crossing, p/h	0				0				0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)		4.9763			4.9763			4.9763			4.9763	
Follow-Up Headway (s)		2.6087			2.6087			2.6087			2.6087	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h		287			33			830			772	
Entry Volume veh/h		271			32			809			752	
Circulating Flow (v_c), pc/h		712			864			85			271	
Exiting Flow (v_{ex}), pc/h		51			331			626			914	
Capacity (c_{pce}), pc/h		668			572			1265			1047	
Capacity (c), veh/h		630			560			1233			1020	
v/c Ratio (x)		0.43			0.06			0.66			0.74	

Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		12.1			7.1			11.6			16.4	
Lane LOS		B			A			B			C	
95% Queue, veh		2.2			0.2			5.2			7.0	
Approach Delay, s/veh	12.1			7.1			11.6			16.4		
Approach LOS	B			A			B			C		
Intersection Delay, s/veh | LOS	13.5						B					

HCS7 Roundabouts Report

General Information

Analyst	JDA
Agency or Co.	SEH
Date Performed	11/2/2020
Analysis Year	2031
Time Analyzed	Build PM Peak Hour
Project Description	White Bear Lake Area Elementary School TIS

Site Information

Intersection	TH 61 at 152nd St
E/W Street Name	152nd St
N/S Street Name	TH 61
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.92
Jurisdiction	White Bear Lake Schools

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment			LTR				LTR				LTR				LTR	
Volume (V), veh/h	0	16	0	47	0	40	0	20	0	44	872	9	0	3	605	15
Percent Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Flow Rate (v_{PCE}), pc/h	0	18	0	52	0	44	0	22	0	49	967	10	0	3	671	17
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes	1				1				1				1			
Pedestrians Crossing, p/h	0				0				0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)		4.9763			4.9763			4.9763			4.9763	
Follow-Up Headway (s)		2.6087			2.6087			2.6087			2.6087	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h		70			66			1026			691	
Entry Volume veh/h		69			65			1006			677	
Circulating Flow (v_c), pc/h	718			1034			21			93		
Exiting Flow (v_{ex}), pc/h	13			66			1007			767		
Capacity (c_{pce}), pc/h		663			481			1351			1255	
Capacity (c), veh/h		650			471			1324			1230	
v/c Ratio (x)		0.11			0.14			0.76			0.55	

Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		6.7			9.5			14.5			9.2	
Lane LOS		A			A			B			A	
95% Queue, veh		0.4			0.5			7.9			3.5	
Approach Delay, s/veh	6.7			9.5			14.5			9.2		
Approach LOS	A			A			B			A		
Intersection Delay, s/veh | LOS	12.1						B					

HCS7 Roundabouts Report

General Information

Analyst	JDA
Agency or Co.	SEH
Date Performed	11/2/2020
Analysis Year	2031
Time Analyzed	Build SD Peak Hour
Project Description	White Bear Lake Area Elementary School TIS

Site Information

Intersection	TH 61 at 152nd St
E/W Street Name	152nd St
N/S Street Name	TH 61
Analysis Time Period (hrs)	0.25
Peak Hour Factor	0.85
Jurisdiction	White Bear Lake Schools

Volume Adjustments and Site Characteristics

Approach	EB				WB				NB				SB			
Movement	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment			LTR				LTR				LTR				LTR	
Volume (V), veh/h	0	33	0	100	0	64	0	39	0	83	859	29	0	9	610	28
Percent Heavy Vehicles, %	2	14	2	7	2	2	2	2	2	9	2	2	2	2	2	18
Flow Rate (v_{PCE}), pc/h	0	44	0	126	0	77	0	47	0	106	1031	35	0	11	732	39
Right-Turn Bypass	None				None				None				None			
Conflicting Lanes	1				1				1				1			
Pedestrians Crossing, p/h	0				0				0				0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway (s)		4.9763			4.9763			4.9763			4.9763	
Follow-Up Headway (s)		2.6087			2.6087			2.6087			2.6087	

Flow Computations, Capacity and v/c Ratios

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Entry Flow (v_e), pc/h		170			124			1172			782	
Entry Volume veh/h		156			122			1142			761	
Circulating Flow (v_c), pc/h		820			1181			55			183	
Exiting Flow (v_{ex}), pc/h		46			145			1122			935	
Capacity (c_{pce}), pc/h		598			414			1305			1145	
Capacity (c), veh/h		550			406			1272			1115	
v/c Ratio (x)		0.28			0.30			0.90			0.68	

Delay and Level of Service

Approach	EB			WB			NB			SB		
Lane	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Lane Control Delay (d), s/veh		10.5			14.1			25.3			13.3	
Lane LOS		B			B			D			B	
95% Queue, veh		1.2			1.2			14.1			5.7	
Approach Delay, s/veh	10.5			14.1			25.3			13.3		
Approach LOS	B			B			D			B		
Intersection Delay, s/veh | LOS	19.4						C					

Appendix H

Site Plan

INDEPENDENT SCHOOL DISTRICT #624

NEW ELEMENTARY SCHOOL
APRIL 8, 2020

1 SITE DIAGRAM

1" = 160'-0"

0 120' 240'

5/1/2020 4:50:17 PM
C:\Users\tertl\Documents\ES_NEW ELEMENTARY BASE 2019_tertl@woldae.com.rvt
\\Wae-srv-mn.woldae.com\StPaul\ISD624\ES_NEW\ES_NEW ELEMENTARY BASE 2019.rvt

20200408_SITE DIAGRAM

Comm No: 192237

Building a Better World for All of Us®

Sustainable buildings, sound infrastructure, safe transportation systems, clean water, renewable energy and a balanced environment. Building a Better World for All of Us communicates a company-wide commitment to act in the best interests of our clients and the world around us.

We're confident in our ability to balance these requirements.

Join Our Social Communities