Proposed Industrial/Warehouse Building
600 Griffin Brook Drive

Methuen, MA

April 30, 2022

Prepared by:

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Prepared for:

RJ Kelly Co., Inc.

TRAFFIC IMPACT AND ACCESS STUDY

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SECTION 1: EXECUTIVE SUMMARY

Bayside Engineering has prepared this study to assess the traffic impact and to evaluate the access requirements of the industrial development to be located at 501 & 600 Griffin Brook Drive in Methuen, Massachusetts.

This report identifies existing traffic operating parameters on key roadways and intersections within the study area, evaluates the anticipated traffic volume increases as a result of the proposed project, analyzes the project's traffic-related impacts, determines the projects access/egress requirements and identifies appropriate mitigating measures designed to minimize the traffic-related impacts created by the project. The following provides a brief summary of the study findings.

PROJECT DESCRIPTION

The proposed building site is located at the end of Griffin Brook Drive, north of the existing building at No. 501 Griffin Brook Drive. The project site encompasses both buildings. The site is abutted by 401 Griffin Brook Drive to the south and wooded land to the north, east and west, with the Hickory Hill golf course slightly further north and east. Currently, the site consists of wooded land.

The project consists of the construction of a 101,250 square foot (sf) industrial/warehouse building. Approximately 55,000 sf would be used as light-industrial space and the remaining 46,250 sf would be warehouse space. Access to the site will be provided by way the driveway that serves 501 Griffin Brook Drive (at the end of Griffin Brook Drive) and then provides two access ways that circumvent 501 Griffin Brook Drive. Figure 1 shows the site location in relation to the surrounding area.

STUDY METHODOLOGY

This study has been prepared in three stages. The first stage involved an assessment of existing conditions within the study area and included an inventory of roadway geometrics,

Figure 1
Site Location Map

pedestrian and bicycle facilities and public transportation services. Existing traffic counts were performed at the study area intersections.

In the second stage of the study, future traffic conditions were projected and analyzed. Specific travel demand forecasts for the project were assessed along with future traffic demands due to expected traffic growth independent of the proposed project. In accordance with Massachusetts Department of Transportation (MassDOT) guidelines, the year 2029 was selected as the basis for modeling future transportation impacts of the proposed development to reflect the opening year conditions and a seven-year planning horizon.

The third stage of the study presents and evaluates measures to address traffic issues, if any, and necessary improvements to accommodate the development.

STUDY AREA

Roadway geometry and traffic control information was collected for the following locations:

- Lowell Street (Route 110) and Griffin Brook Drive
- Lowell Boulevard (Route 110) and Wheeler Street
- Griffin Brook Drive and Driveway to 400 Griffin Brook Drive

EXISTING CONDITIONS

Evaluation of existing conditions within the study area includes a description of roadway geometrics, traffic constraints, land uses at the intersections, and quantification of traffic volumes.

Existing Traffic Volumes

To establish base traffic conditions within the study area, manual turning movement and vehicle classification counts were obtained in March and April 2022. Data from MassDOT was reviewed to determine the monthly variations of the traffic volumes. Based upon available data, both March and April volumes were found to be slightly lower than average month conditions. To be conservative, the March volumes were adjusted upward by a factor of 1.065 and the April volumes by a factor of 1.044 to reflect average month conditions.

Due to the Covid-19 pandemic, traffic volumes are currently lower than normal. To account for this, data from MassDOT was reviewed. The 2022 volumes were increased by a factor of 1.0513 to represent pre-COVID conditions.

Lowell Street, north of Griffin Brook Drive was recorded to carry approximately 15,750 vehicles per day (vpd) on a weekday. During the weekday morning peak hour, approximately 1,294 vehicles per hour (vph) were recorded and during the weekday evening peak hour, 1,416 vph were recorded.

Griffin Brook Drive, west of Lowell Street was recorded to carry approximately 1,200 vpd on a weekday. During the weekday morning peak hour, approximately 141 vph were recorded and during the weekday evening peak hour, 152 vph were recorded.

Motor Vehicle Crash Data

Motor vehicle crash data for the study area intersections were obtained from the MassDOT Crash Portal for 2015 through the end of 2021. The motor vehicle crash data was reviewed to determine crash trends in the study area. Nineteen (19) crashes were reported at the study area intersections. Of the nineteen (19) crashes, thirteen (13) crashes were reported at the intersection of Lowell Street and Griffin Brook Drive and six (6) crashes were reported at the intersection of Lowell Boulevard and Wheeler Street. No crashes were reported at the intersection of Griffin Brook Drive and the 401 Griffin Brook Drive driveway, nor were any reported at the entrance to 501 Griffin Brook Drive. No fatalities were reported.

PROBABLE IMPACTS OF THE PROJECT

No-Build Traffic Volumes

To determine the impact of site-generated traffic volumes on the roadway network under future conditions, baseline traffic volumes in the study area were projected to the year 2029. Traffic volumes on the roadway network at that time, in the absence of the proposed project, would include existing traffic, new traffic due to general background traffic growth, and traffic related to specific developments by others expected to be completed by 2029. A one-half (0.5) percent compounded growth rate was used to develop future No-Build conditions based on communications with the Central Transportation Planning Staff (CTPS) at the Metropolitan Planning Organization (MPO).

Conversations with the City of Methuen indicated that there is one (1) other potential project identified in the area. This is the vacant Building 501 within Griffin Brook Park (former 3M building). This building is approximately 59,650 sf and designed for research and development space and was most recently fully occupied as research and development space up until October 2021. Trips for this project were obtained from the ITE *Trip Generation* manual[1].

Build Traffic Volumes

Site generated traffic was based on trip-generation data published by the ITE *Trip Generation* manual[2]. The project consists of the construction of a 101,250 sf industrial/warehouse building. Approximately 55,000 sf would be used as light-industrial space and the remaining 46,250 sf would be warehouse space.

On a typical weekday, the proposed development is expected to generate 370 daily vehicle trips. During the weekday morning peak hour, 70 vehicle trips (58 vehicles entering and 12 vehicles exiting) are expected. During the weekday evening peak hour, 59 vehicle trips (13 vehicles entering and 46 vehicles exiting) are expected. .

TRAFFIC OPERATIONS ANALYSIS

To assess the impacts of the proposed project on the roadway network, traffic operations analyses were performed at the study area intersections under 2022 Existing, 2029 No-Build and 2029 Build conditions. These analyses indicate that the proposed project will not result in a significant impact on traffic operations at the study area intersections over No-Build conditions.

[1] *Trip Generation,* Tenth Edition; Institute of Transportation Engineers; Washington, DC; 2017.
[2] *Ibid*.

SITE CIRCULATION

Access to the site will be separated from the parking for the existing building (501 Griffin Brook Drive). South of the building, an existing access way, separated from the parking field provides access to the rear loading area for Building 501 and will provide access to the east side of the new building, 600 Griffin Brook Drive.

Along the western boundary of the site, a new access roadway will be provided that does not go through the parking field for Building 501 Griffin Brook Drive, and provide access to the main parking field for the new building (600 Griffin Brook Drive) as well as the loading dock area on the south side of the building.

The proposed site has been designed such that turnaround areas are included in the vicinity of the loading docks on the east side and south side of the building such that tractor trailers can maneuver and back into the loading dock area. These maneuvers will not impact any existing parking or any proposed parking on the site.

The Morin-Cameron group has performed AutoTURN runs for emergency equipment as well as a WB-65 tractor trailer truck. These drawings are included in the appendix and show that emergency vehicles have full access around the building.

RECOMMENDATIONS

Project Related Measures

Project Access

The site access is shared with 501 Griffin Brook Drive. Access to the site will be provided by way the driveway that serves 501 Griffin Brook Drive (at the end of Griffin Brook Drive) and then provides two access ways that circumvent 501 Griffin Brook Drive. It is recommended that the two access way approaches to Griffin Brook Drive be under STOP-sign control. To maintain sight distances, it is recommended that, any proposed vegetation at the site access should be designed to be low growth plantings to not impede sight lines.

Transportation Demand Management

A Transportation Demand Management (TDM) plan should be implemented. The goal of a TDM plan is to reduce the project's overall traffic impact by implementing measures geared toward affecting a change in driver behavior, and to be successful, they must rely on incentives or disincentives to cause drivers to shift travel patterns. TDM programs are designed to maximize the capability of the existing transportation infrastructure by increasing the number of persons in a vehicle, providing alternate modes of travel, or influencing the time of, or need to, travel.

TDM measures are generally directed at commuter travel. The day-to-day regularity of this type of trip and conditions at the workplace, in terms of employer practices such as on-site services, bicycle storage, and shuttle services, affect commuter choices and make this

market the most suitable for identifying alternatives. TDM encompasses both alternatives to driving alone and the techniques or supporting strategies that encourage the use of these alternatives. TDM alternatives to driving alone include carpools and vanpools, public and private transit, and non-motorized travel, including bicycling and walking. TDM alternatives can also influence when trips are made. For example, alternative work hours (compressed work weeks, flex-time, and telecommuting) can affect what time of day trips are made, or if trips occur at all on certain days. TDM strategies are the supporting measures that encourage the use of alternatives to driving alone. TDM strategies typically include financial incentives, time incentives, provision of new or enhanced commuter services, dissemination of information, and marketing alternative services. TDM strategies include all the incentives and disincentives that increase the likelihood for people to change their travel behavior.

The project proponent is committed to promoting several measures that contribute toward the reduction of vehicular traffic to and from the site. The following describes the TDM program:

A TDM plan will be implemented. The project proponent is committed to promoting several measures that contribute toward the reduction of vehicular traffic to and from the site. The following describes the components of TDM program:

- A Transportation Coordinator (TC) will be assigned the responsibilities of coordinating the TDM program.

- The TC will also promote alternative transportation modes by posting local commuter rail and bus schedules and encouraging employees to use public transportation.

- The TC will also promote ridesharing via carpools for employees. The project proponent will recommend that employees interested in car-pooling provide their contact information.

- Designate two (2) carpool/vanpool parking spaces as close as possible to the front.

- Site amenities should also be provided to discourage off-site trips. These measures may include providing a break room, direct deposit of paychecks, allowing for telecommuting or flex work opportunities.

- Bicycle racks will also be located throughout the site to encourage the use of bicycles.

CONCLUSION

Review of the proposed project and the access plan shows that in relation to roadway capacity, traffic safety, and traffic impacts upon the surrounding roadway network, the proposed project will meet safety standards and have a minimal impact on existing traffic

conditions. Project-related increases are in the range of 13 to 55 bi-directional vehicles during the peak hours at the study area boundaries. This is approximately equivalent to one (1) additional vehicle every minute or less per direction on average during the peak hours. With the proposed access, safe and efficient access can be provided to the tenants of the proposed development and to the motoring public in the area.

SECTION 2: EXISTING TRAFFIC CONDITIONS

STUDY AREA

Roadway geometry and traffic control information was collected for the following locations:

- Lowell Street (Route 110) and Griffin Brook Drive
- Lowell Boulevard (Route 110) and Wheeler Street
- Griffin Brook Drive and Driveway to 400 Griffin Brook Drive

FIELD SURVEY

A comprehensive field inventory of the proposed site was conducted in March 2022. The inventory included collection of existing roadway geometrics, traffic volumes, and safety data for the existing study area intersections and site access driveway locations. Traffic volumes were measured by means of automatic traffic recorder (ATR) counts and substantiated by manual turning movement counts (TMCs) conducted at the study area intersections.

GEOMETRICS

Primary study area roadways are described below.

Roadways

Lowell Street/Lowell Boulevard (Route 110)

Lowell Street (Route 110) is classified as an Urban Principal Arterial extending in a generally north/south direction within the study area. About 1,500 feet south of Griffin Brook Drive, the Route 110 roadway changes name to Lowell Boulevard into Dracut where Route 110 continues as Merrimack Avenue. Route 110 is under the jurisdiction of the

Massachusetts Department of Transportation (MassDOT). Near Griffin Brook Drive, Route 110 provides one travel lane in each direction separated by a double-yellow centerline. The posted speed limit on Route 110 near Griffin Brook Drive is 45 miles per hour (mph). Illumination is provided by luminaires mounted on telephone poles within the study area. Sidewalks are provided on the west side of the road in the study area. Land use along Route 110 in the study area consists of commercial properties.

Griffin Brook Drive

Griffin Brook Drive is classified as a local road extending in a generally easterly direction from Lowell Street. Griffin Brook Drive is under the jurisdiction of the City of Methuen. Griffin Brook Drive provides one travel lane in each direction. Travel lanes are separated by a median or a double-yellow centerline. There is no posted speed limit on Griffin Brook Drive. Sidewalks are provided on the north side of Griffin Brook Drive. Land use along Griffin Brook Drive in the study area consists of commercial properties.

Intersections

Lowell Street and Griffin Brook Drive

Lowell Street forms the north and south legs of this three-legged intersection with Griffin Brook Drive forming the west leg. The Lowell Street northbound approach consists of an exclusive left-turn lane and a two through lanes. The Lowell Street southbound approach consists of an exclusive right-turn lane and two (2) through lanes. The Griffin Brook Drive eastbound approach consists of an exclusive left-turn lane and an exclusive right-turn lane. The entering and exiting traffic on Griffin Brook Drive is separated by a landscaped median. Existing pavement markings at the intersection are faded and in some cases, worn away completely. Sidewalks exist along the north side of Griffin Brook Drive and the west side of Lowell Street. Land use at the intersection consists of commercial properties and wooded land.

Lowell Boulevard and Wheeler Street

Lowell Boulevard forms the north and south legs of this three-legged intersection with Wheeler Street forming the west leg. The Boulevard approaches each consist of a single lane permitting left- or right-turn movements. The Wheeler Street eastbound approach consists of a single lane permitting left- or right-turn movements. Wheeler Street is under STOP sign control. No sidewalks or crosswalks are provided on Wheeler Street. Sidewalks are present on the west side of Lowell Boulevard. Land use at the intersection consists of commercial properties and wooded land.

Griffin Brook Drive and Driveway to 401 Griffin Brook Drive

Griffin Brook Drive forms the north and south legs and the driveway to 401 Griffin Brook Drive forms the east leg of this unsignalized T-intersection. All approaches to the intersection consist of a single lane permitting left or right-turn movements. The north leg

is currently the driveway into 501 Griffin Brook Drive, which will also serve the proposed site. The driveway approach operates under STOP control. No sidewalks or crosswalks are provided at the intersection. Land use at the intersection consists of commercial properties, wooded land, and the project site.

TRAFFIC VOLUMES

Existing Traffic Volumes

To establish base traffic conditions within the study area, manual turning movement and vehicle classification counts were obtained in March 2022. Peak-period turning movement counts were conducted on Thursday, March 4, 2022 and Thursday April 14, 2022 during the weekday morning and evening peak periods (7:00 to 9:00 AM and 4:00 to 6:30 PM). Counts were performed at the following intersections:

- Lowell Street (Route 110) and Griffin Brook Drive
- Lowell Boulevard (Route 110) and Wheeler Street
- Griffin Brook Drive and Driveway to 400 Griffin Brook Drive

Daily traffic counts were conducted on Lowell Street and Griffin Brook Drive for a two day period using automatic traffic recorders (ATR) on Wednesday, March 3, 2022 and Thursday, March 4, 2022.

Analysis of the peak-period traffic counts indicated that the weekday morning commuter peak hour generally occurs between 7:30 AM and 8:30 AM and the weekday evening commuter peak hour generally occurs between 4:30 PM and 5:30 PM. The traffic count worksheets are provided in the Appendix.

Seasonal Adjustment

The traffic-volume data gathered as part of this study was collected during the months of March and April 2022. Data from the MassDOT was reviewed to determine the monthly variations of the traffic volumes. Based upon available data, March and April volumes were found to be slightly lower than average month conditions. To be conservative, the March volumes were adjusted upward by a factor of 1.065 and the April volumes by a factor of 1.044 to reflect average month conditions.

Due to the Covid-19 pandemic, traffic volumes are currently lower than normal. To account for this, data from MassDOT Mobility Dashboard was reviewed. Data from the count station on Interstate 93 (I-93) was reviewed and showed that volumes continue to be below average and fluctuate weekly. Based on the data, volumes are approximately five (5) percent below average. Therefore, the 2022 peak hour volumes were increased by a factor of 1.0513 to represent pre-COVID conditions.

The 2022 existing weekday daily and peak-hour traffic volumes for average-month

conditions are summarized below in Table 1. The 2022 Existing weekday morning and weekday evening peak hour traffic flow networks are shown graphically on Figures 2 and 3, respectively. The seasonal worksheets are provided in the Appendix.

TABLE 1
EXISTING WEEKDAY TRAFFIC-VOLUME SUMMARY[a]

Location	Daily Traffic Volume[b]	Weekday Morning Peak Hour			Weekday Evening Peak Hour		
		Traffic Volume[c]	K Factor[d]	Directional Distribution[e]	Traffic Volume	K Factor	Directional Distribution
Lowell Street, north of Griffin Brook Drive	15,750	1,294	8.2	55.8% SB	1,416	9.0	55.8% NB
Griffin Brook Drive, west of Lowell Street	1,200	141	11.8	88.7% WB	152	12.7	86.2% EB

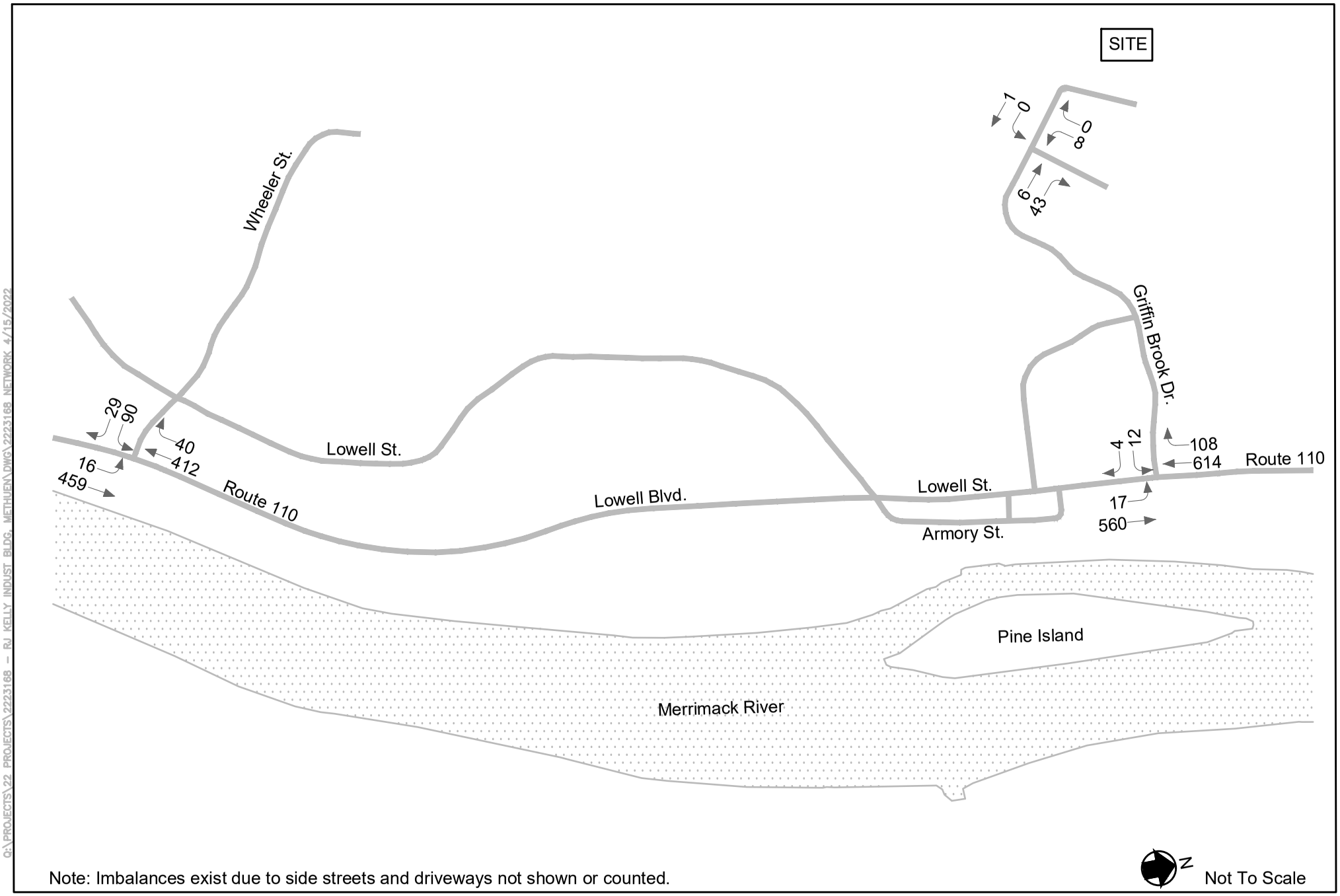
[a]Two-way traffic volume.
[b]Daily traffic expressed in vehicles per day.
[c]Expressed in vehicles per hour.
[d]Percent of daily traffic volumes which occurs during the peak hour.
[e]Percent of peak-hour volume in the predominant direction of travel.
NB = northbound; SB = southbound; EB = eastbound; WB = westbound.

Lowell Street, north of Griffin Brook Drive was recorded to carry approximately 15,750 vehicles per day (vpd) on a weekday. During the weekday morning peak hour, approximately 1,294 vehicles per hour (vph) were recorded and during the weekday evening peak hour, 1,416 vph were recorded.

Griffin Brook Drive, west of Lowell Street was recorded to carry approximately 1,200 vpd on a weekday. During the weekday morning peak hour, approximately 141 vph were recorded and during the weekday evening peak hour, 152 vph were recorded.

MOTOR VEHICLE CRASH DATA

Motor vehicle crash data for the study area intersections were obtained from the MassDOT Crash Portal for 2015 through the end of 2021. The motor vehicle crash data was reviewed to determine crash trends in the study area. Nineteen (19) crashes were reported at the study area intersections. Of the nineteen (19) crashes, thirteen (13) crashes were reported at the intersection of Lowell Street and Griffin Brook Drive and six (6) crashes were reported at the intersection of Lowell Boulevard and Wheeler Street. No crashes were reported at the intersection of Griffin Brook Drive and the 401 Griffin Brook Drive driveway nor the entrance to 501 Griffin Brook Drive. No fatalities were reported. The crash data is summarized in Table 2 and included in the Appendix.



Note: Imbalances exist due to side streets and driveways not shown or counted.

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Figure 2

2022 Existing
Weekday Morning
Peak Hour Traffic Volumes

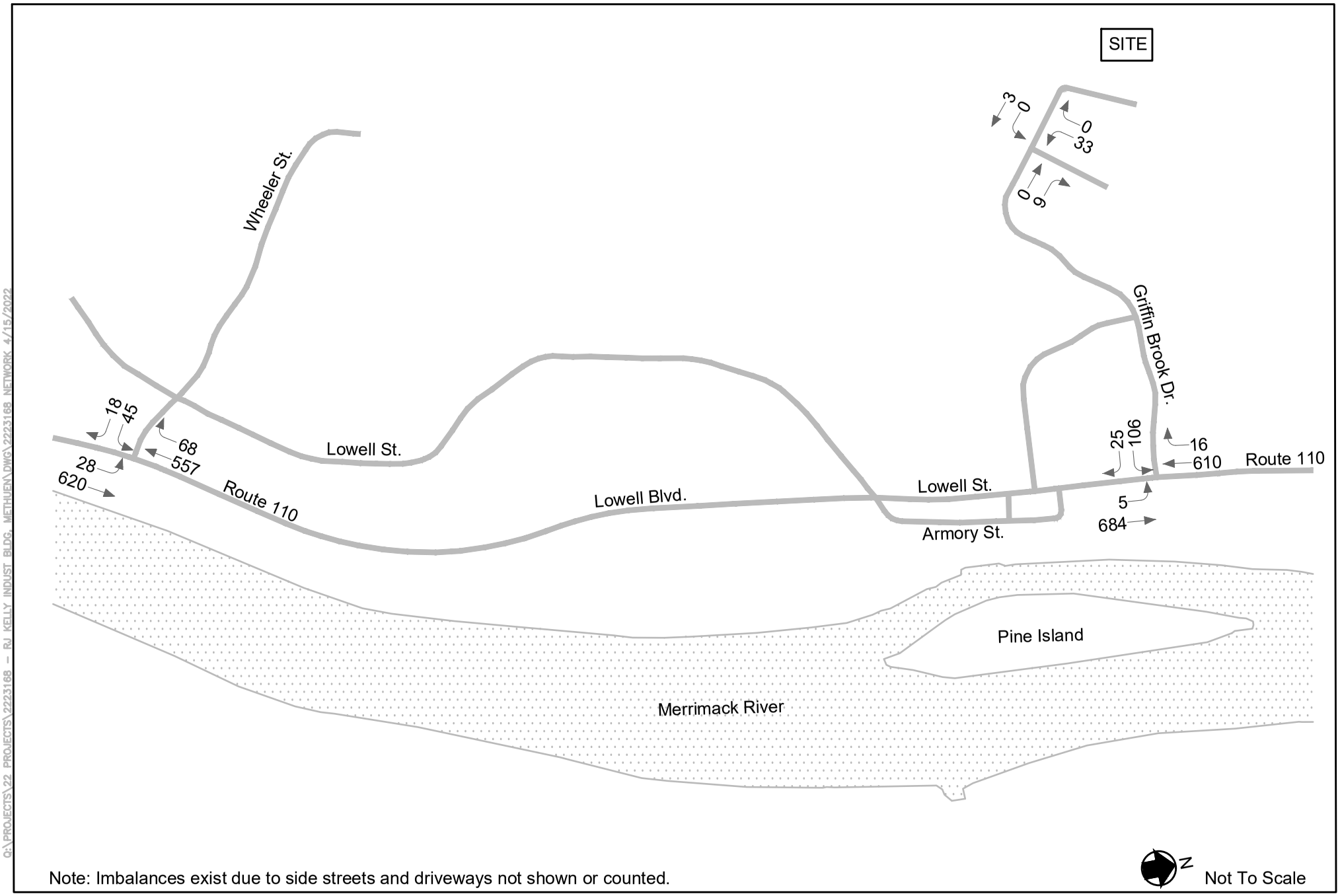

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Figure 3

2022 Existing
Weekday Evening
Peak Hour Traffic Volumes

TABLE 2
MOTOR VEHICLE CRASH DATA SUMMARY[a]

Scenario	Griffin Brook Drive and #401 Driveway	Lowell Street and Griffin Brook Drive	Lowell Boulevard and Wheeler Street
Year:			
2015	0	3	1
2016	0	1	2
2017	0	5	1
2018	0	3	1
2019	0	0	1
2020	0	1	0
2021	0	0	0
Total	0	13	6
Average:	0	1.86	0.86
Crash Rate:	0.00	0.32	0.16
Significance:	No	No	No
Type:			
Angle	0	3	1
Rear-End	0	7	3
Head-On	0	1	0
Sideswipe	0	2	0
Single Vehicle Crash	0	0	2
Unknown	0	0	0
Total	0	13	6
Time of Day:			
Weekday (7:00 to 9:00 AM)	0	2	2
Weekday (4:00 to 6:00 PM)	0	2	0
Remainder of Day	0	9	4
Total	0	13	6
Pavement Conditions:			
Dry	0	7	5
Wet	0	4	0
Snow/Ice	0	1	1
Other	0	0	0
Unknown	0	1	0
Total	0	13	6
Severity:			
Property Damage Only	0	11	5
Personal Injury	0	2	1
Fatal Accident	0	0	0
Unknown	0	0	0
Total	0	13	6

[a]Source: MassDOT Impact Crash Portal.
[b]Average crashes over analysis period.
[c]Crash rate per million entering vehicles (mev).
[d]Signalized intersections are significant if rate >0.73 crashes per million vehicles, and unsignalized intersections are significant if rate >0.57 crashes per million vehicles.

PUBLIC TRANSPORTATION

The Merrimack Valley Regional Transportation Authority (MVRTA) was reviewed for available public transportation services. Bus Route 41 provides service along Lowell Street from Lawrence to Lowell. The route runs between the Robert B. Kennedy bus transfer center and the Buckley Transportation Center in Lawrence. Currently, this bus route has stops near Griffin Brook Drive. Route 41 bus service is provided Monday through Friday from 5:00 AM to 7:40 PM. Saturday service is provided from 7:00 AM to 6:40 PM. No Sunday service is provided. Available route data is provided in the Appendix.

PLANNED ROADWAY IMPROVEMENTS

Officials for the City of Methuen were contacted regarding roadway improvements planned for the study area intersections. No roadway improvements are currently planned.

SECTION 3:
FUTURE NO-BUILD AND BUILD TRAFFIC CONDITIONS

To determine the impact of site-generated traffic volumes on the roadway network under future conditions, baseline traffic volumes in the study area were projected to the year 2029. Traffic volumes on the roadway network at that time, in the absence of the proposed project, would include existing traffic, new traffic due to general background traffic growth, and traffic related to specific developments by others expected to be completed by 2029. Consideration of these factors resulted in the development of 2029 No-Build traffic volumes. Anticipated site-generated traffic volumes were then superimposed upon these No-Build traffic flow networks to develop the 2029 Build conditions.

FUTURE 2029 NO-BUILD TRAFFIC VOLUMES

Traffic growth on area roadways is a function of the expected land development in the immediate area as well as the surrounding region. Several methods can be used to estimate this growth. A procedure frequently employed estimates an annual percentage increase in traffic growth and applies that percentage to all traffic volumes under study. The drawback to such a procedure is that some turning volumes may actually grow at either a higher or a lower rate at particular intersections.

An alternative procedure identifies the location and type of planned development, estimates the traffic to be generated, and assigns it to the area roadway network. This produces a more realistic estimate of growth for local traffic. However, the drawback of this procedure is that the potential growth in population and development external to the study area would not be accounted for in the traffic projections.

To provide a conservative analysis framework, both procedures were used.

Background Traffic Growth

To determine the impact of site-generated traffic volumes generated by the project on the

roadway network, under future conditions, baseline traffic volumes in the study area were projected to the year 2029. Traffic volumes on the roadway network at that time, in absence of the proposed project, would include existing traffic, new traffic due to general background traffic growth, and traffic related to specific developments by others expected to be completed by 2029. A one-half (0.5) percent compounded growth rate was used to develop future No-Build conditions based on communications with the Central Transportation Planning Staff (CTPS) at the Metropolitan Planning Organization (MPO).

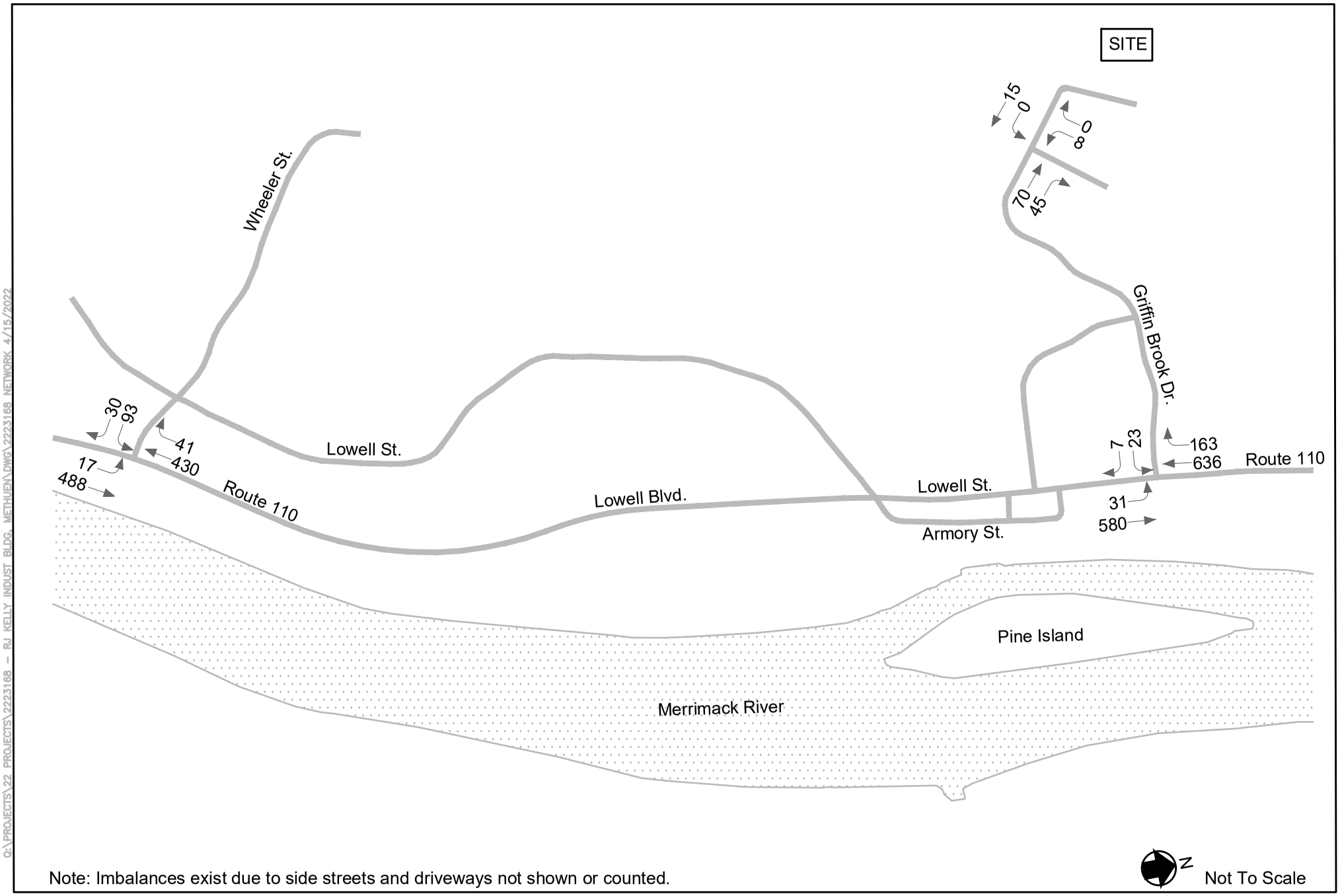
Specific Development by Others

Traffic volumes generated by the specific local developments by others were included in the 2029 No-Build condition. The City of Methuen was contacted to identify specific planned developments. Based on these discussions, there is one potential project identified in the area. This is the vacant Building 501 within Griffin Brook Park (former 3M building). This building is approximately 59,650 sf and designed for research and development space. Trip generation for the space was developed using data from the Institute of Transportation *(ITE) Trip Generation* manual[3] and included in the background projections.

No-Build Condition Traffic Volumes

The 2029 No-Build weekday morning and weekday evening peak-hour traffic volumes were developed by applying a compounded one-half (0.5) percent annual growth rate to the 2022 Existing peak-hour traffic volumes and adding traffic from the identified background project. Figures 4 and 5 show the projected 2029 No-Build peak hour traffic volumes for the respective weekday morning and weekday evening peak-hours.

[3] *Trip Generation,* Eleventh Edition; Institute of Transportation Engineers; Washington, DC; 2021.



Note: Imbalances exist due to side streets and driveways not shown or counted.

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Figure 4

2029 No-Build
Weekday Morning
Peak Hour Traffic Volumes

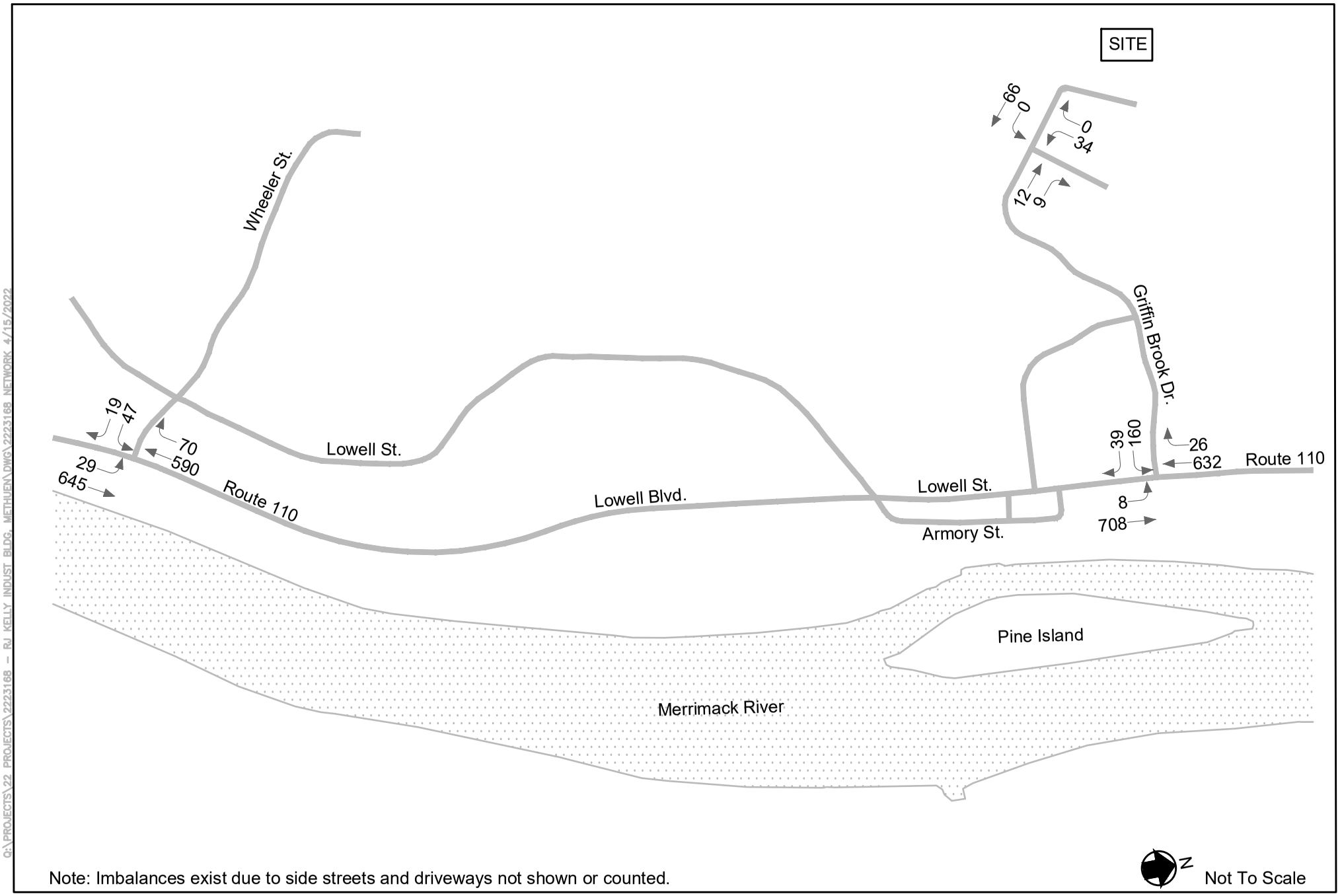

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Figure 5

2029 No-Build
Weekday Evening
Peak Hour Traffic Volumes

FUTURE 2029 BUILD CONDITIONS

Project Description

The project consists of the construction of a 101,250 square foot (sf) industrial/warehouse building. Approximately 55,000 sf would be used as light-industrial space and the remaining 46,250 sf would be warehouse space. . Access to the site will be provided by way the driveway that serves 501 Griffin Brook Drive and then provides two access ways that circumvent 501 Griffin Brook Drive.

Site Traffic Generation

Site generated traffic was based on trip-generation data published by the ITE *Trip Generation* manual[4]. Trip generation data for Land Use Code (LUC) 150 – Warehousing was reviewed. The trip generation for the project is summarized in Table 3. The trip generation worksheets are included in the Appendix.

TABLE 3
TRIP-GENERATION SUMMARY

	Industrial Trips[a]	Warehouse Trips[a]	Total Trips[a]
Average Weekday Daily Traffic	258	112	370
Weekday Morning Peak Hour:			
Entering	36	22	58
Exiting	5	7	12
Total	41	29	70
Weekday Evening Peak Hour:			
Entering	4	9	13
Exiting	22	24	46
Total	26	33	59

[a]Based on ITE LUC 110 – General Light Industrial; 55,000 sf.
[b]Based on ITE LUC 150 – Warehousing; 46,250 sf.

On a typical weekday, the proposed development is expected to generate 370 daily vehicle trips. During the weekday morning peak hour, 70 vehicle trips (58 vehicles entering and 12 vehicles exiting) are expected. During the weekday evening peak hour, 59 vehicle trips (13 vehicles entering and 46 vehicles exiting) are expected.

[4] Ibid.

The volumes presented in Table 3 represent total trips generated by the project on a daily and peak hour basis. Of these vehicles, some are expected to be trucks. At this time, no tenants have been identified. ITE data from the Trip Generation Manual was used to estimate the number of truck trips and are summarized in Table 4.

TABLE 4
TRUCK TRIP-GENERATION SUMMARY

	Industrial Trips[a]	Warehouse Trips[a]	Total Trips[a]
Average Weekday Daily Traffic	14	32	46
Weekday Morning Peak Hour:			
Entering	0	0	0
Exiting	1	1	2
Total	1	1	2
Weekday Evening Peak Hour:			
Entering	0	0	0
Exiting	1	1	0
Total	1	1	2

[a]Based on ITE LUC 110 – General Light Industrial; 55,000 sf.
[b]Based on ITE LUC 150 – Warehousing; 46,250 sf.

Trip Distribution

The directional distribution of the vehicular traffic approaching and departing the site is a function of population densities, the location of employment, existing travel patterns, similar uses, and the efficiency of the existing roadway system. The volume of traffic entering and exiting Griffin Brook Park from Lowell Street were reviewed to develop the expected trip patterns. Table 5 summarizes the expected trip distribution.

Future Traffic Volumes - Build Condition

The site-generated traffic was distributed within the study area according to the percentages summarized in Table 5. The weekday peak hour site generated trips are shown on Figures 6 and 7. The site generated volumes were then superimposed onto the 2029 No-Build traffic volumes to represent the 2029 Build traffic-volume conditions. The anticipated 2029 Build weekday morning and weekday evening peak-hour traffic volumes are graphically presented in Figures 8 and 9. These volumes were used as the basis for all analysis as well as to identify potential mitigation measures to ameliorate the project's impacts.

TABLE 5
PROPOSED TRIP DISTRIBUTION

Route	Direction	Percent of Warehouse Trips
Lowell Street	North	79
Lowell Street	South	21
TOTAL		100

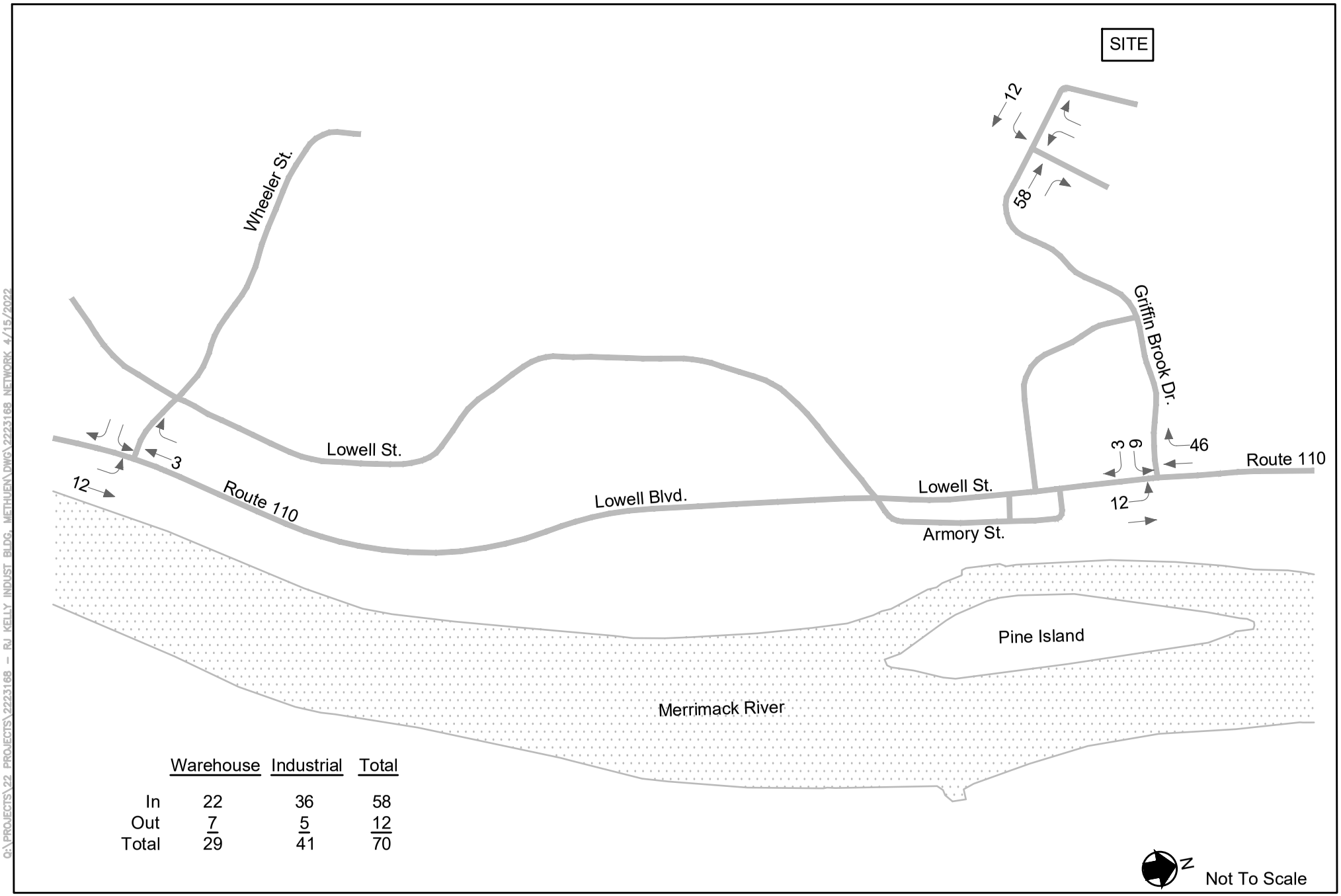
A summary of 2029 peak-hour projected traffic-volume changes in the site vicinity are shown in Table 6. These volumes are based on the expected increases from the site traffic generation.

TABLE 6
TRAFFIC-VOLUME INCREASES[a]

Location/Peak Hour	2029 No-Build	2029 Build	Volume Increase over No-Build
Lowell Street, north of Griffin Brook Drive			
Weekday Morning	1,402	1,457	55
Weekday Evening	1,526	1,572	46
Lowell Street, south of Wheeler Street			
Weekday Morning	965	980	15
Weekday Evening	1,283	1,296	13

[a]All volumes are vehicles per hour, total of both directions.

As shown in Table 6, project-related increases are in the range of 13 to 55 bi-directional vehicles during the peak hours entering or exiting the study area. This is approximately equivalent to one additional vehicle every minute or less per direction on average during the peak hours.



	Warehouse	Industrial	Total
In	22	36	58
Out	7	5	12
Total	29	41	70

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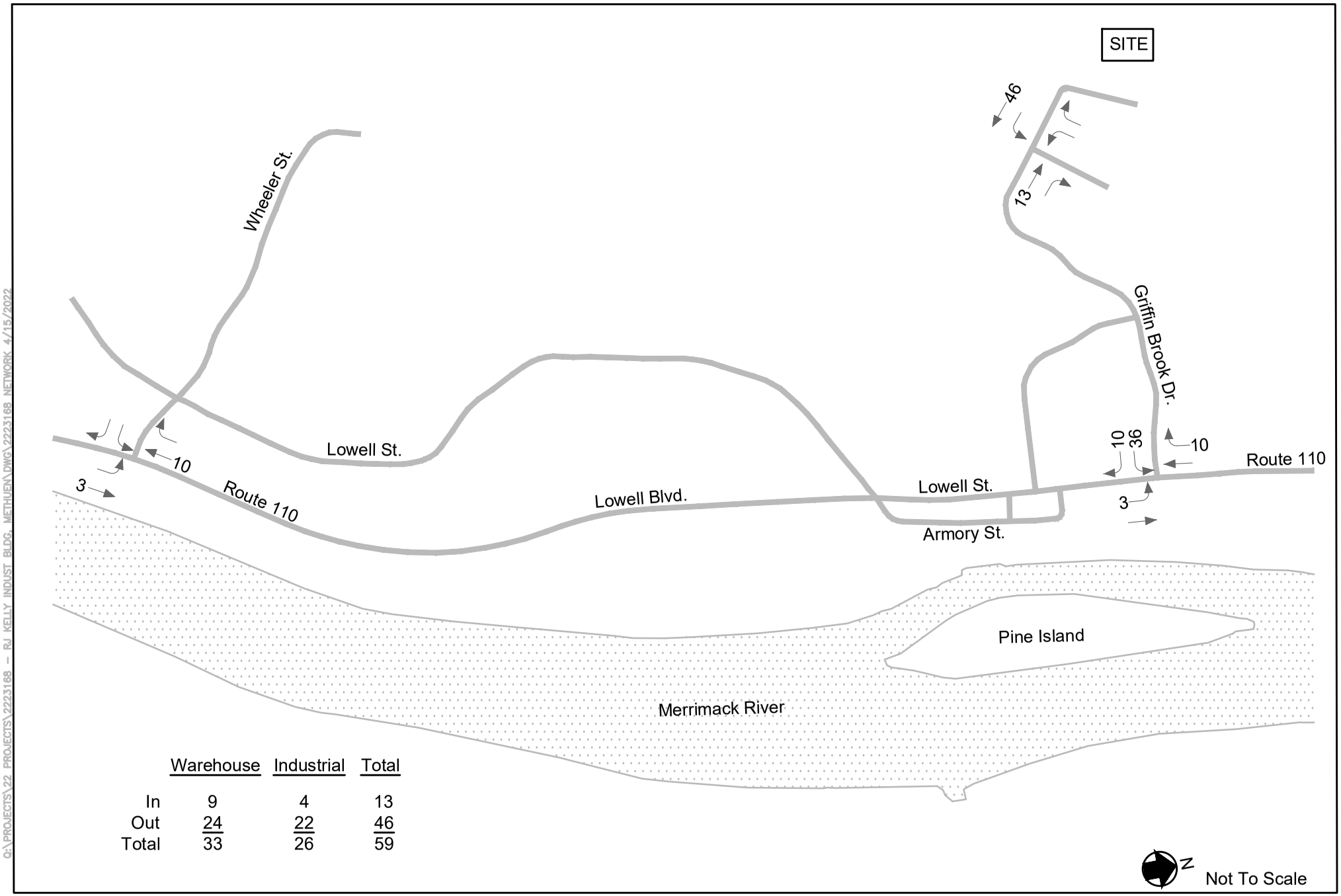
Figure 6

Site Generated
Weekday Morning
Peak Hour Traffic Volumes



	Warehouse	Industrial	Total
In	9	4	13
Out	24	22	46
Total	33	26	59

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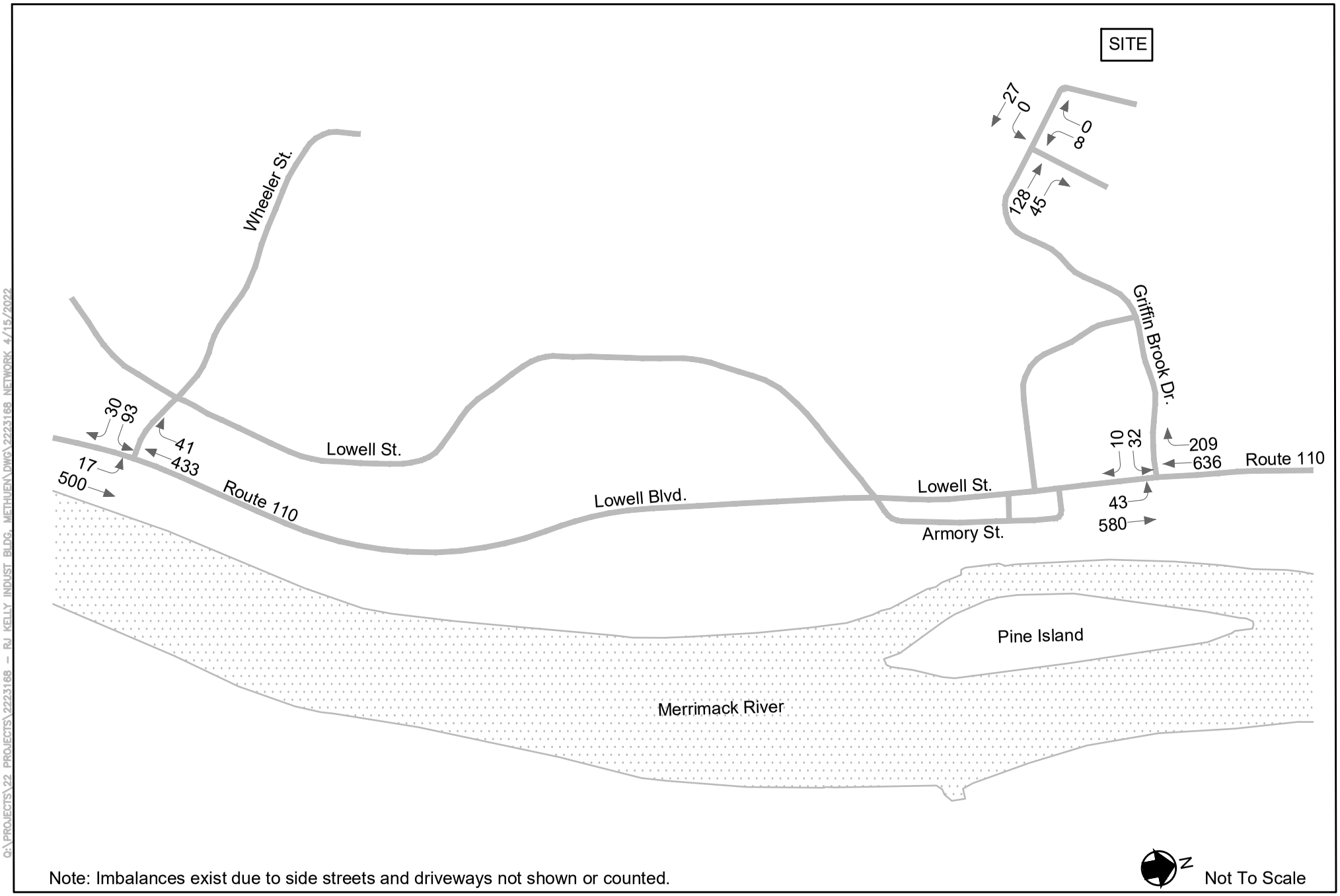
Figure 7

Site Generated
Weekday Evening
Peak Hour Traffic Volumes



Note: Imbalances exist due to side streets and driveways not shown or counted.

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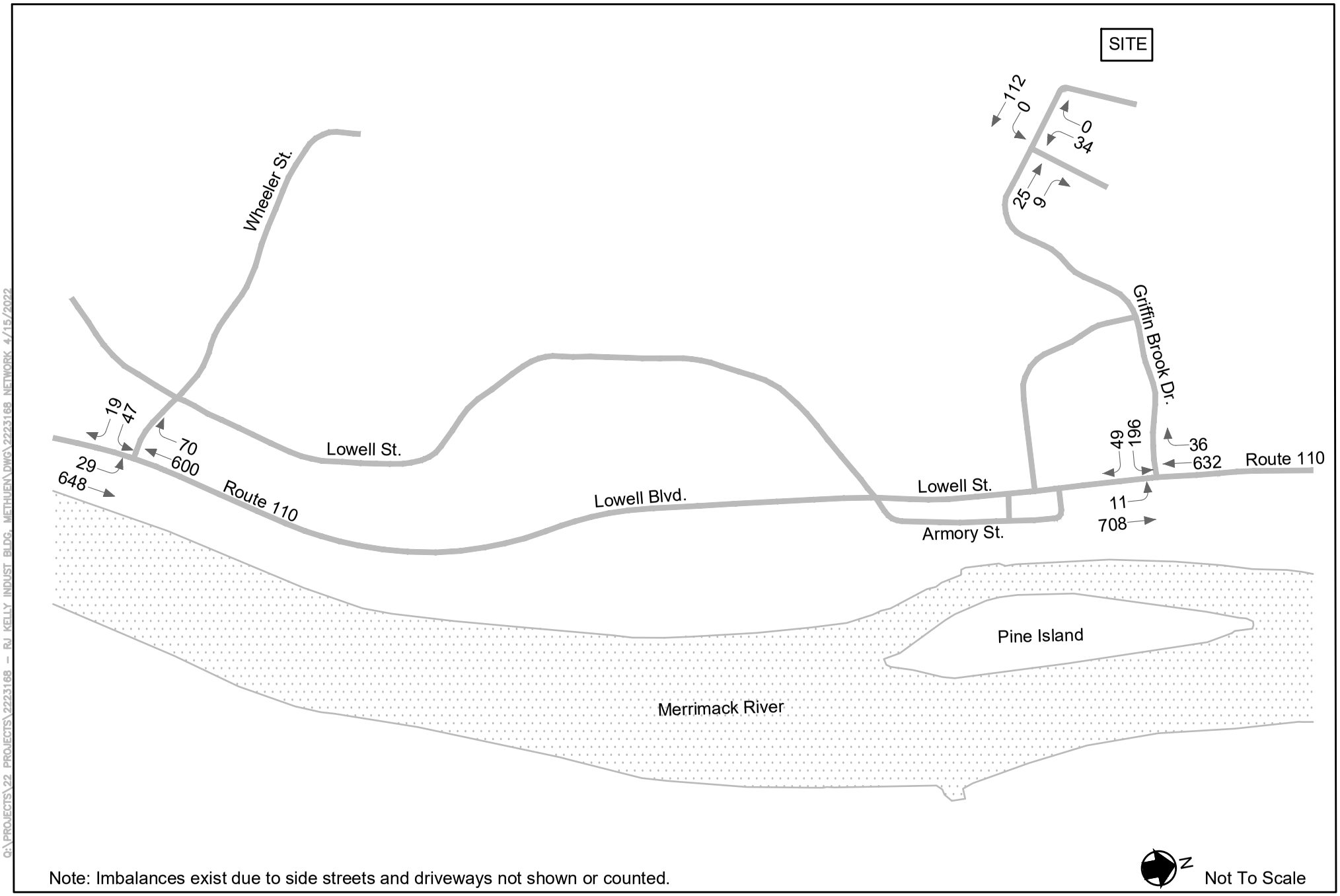
Figure 8

2029 Build
Weekday Morning
Peak Hour Traffic Volumes



Note: Imbalances exist due to side streets and driveways not shown or counted.

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Figure 9

2029 Build
Weekday Evening
Peak Hour Traffic Volumes

SECTION 4: ANALYSIS

To assess intersection operations, capacity analyses were conducted for Existing, No-Build, and Build traffic-volume conditions. Capacity analyses provide an indication of how well the study area intersections serve existing and projected traffic volumes. Vehicle queue analyses provide a secondary measure of the operational characteristics of an intersection or section of roadway under study in terms of lane use and demand.

METHODOLOGY

Levels of Service

Level of service (LOS) is a quantitative measure used to describe the operation of an intersection or roadway segment. The level of service definition is described by the quality of traffic flow and is primarily defined in terms of traffic delays. The primary result of capacity analyses[1] is the assignment of a level of service to traffic intersections or roadway segments under various traffic-flow conditions. Six levels of service are defined for traffic intersections and roadway segments. Levels of service range from LOS A to LOS F. LOS A represents very good operating conditions and LOS F represents very poor operating conditions.

Signalized Intersections

Levels of service for signalized intersections are calculated using the methodology and procedures described in the 2010 *Highway Capacity Manual*[2] *(HCM)*. The methodology assesses the intersection based on type of signal operation, signal timing and phasing, progression, vehicle mix, and intersection geometrics. Level-of-service designations are service and delay. The calculated delay values result in level-of-service designations which

[1]The capacity analysis methodology is based on procedures presented in the *Highway Capacity Manual;* Transportation Research Board; Washington, DC; 2010.

[2]*Highway Capacity Manual*; Transportation Research Board; Washington, DC; 2010.

are applied to individual lane groups, to individual intersection approaches, and to the entire intersection. In the 2010 HCM methodology, the critical lane group volume to capacity ratio is reported.

TABLE 7
LEVEL-OF-SERVICE CRITERIA FOR SIGNALIZED INTERSECTIONS[a]

Delay per Vehicle (Seconds)	Resulting Level of Service v/c[b] < 1.0	Resulting Level of Service v/c[b] > 1.0
≤10.0	A	F
10.1 to 20.0	B	F
20.1 to 35.0	C	F
35.1 to 55.0	D	F
55.1 to 80.0	E	F
>80.0	F	F

[a]*Highway Capacity Manual*; Transportation Research Board; Broad, DC; 2010; page 18-6.
[b]Volume to capacity ratio.

Unsignalized Intersections

The level of service for an unsignalized intersection is determined by the methodology and procedures described in the 2010 HCM. The level of service for unsignalized intersections is measured in terms of average delay for the critical movements (typically side street turning movements or mainline turning movements). The delay for the critical movements is a function of the available capacity for the movement and the degree of saturation of the lane group containing the critical movement. The delay calculation includes the effects of initial deceleration delay approaching a STOP sign, stopped delay, queue move-up time, and final acceleration delay from a stopped condition. The definitions for level of service at unsignalized intersections are also provided in the 2010 *Highway Capacity Manual*. Table 8 summarizes the relationship between level of service and average control delay for the critical movements at unsignalized intersections.

TABLE 8
LEVEL-OF-SERVICE CRITERIA FOR UNSIGNALIZED INTERSECTIONS[a]

Average Delay (seconds per vehicle)	Resulting Level of Service v/c[b] < 1.0	Resulting Level of Service v/c > 1.0
≤ 10.0	A	F
10.1 to 15.0	B	F
15.1 to 25.0	C	F
25.1 to 35.0	D	F
35.1 to 50.0	E	F
>50.0	F	F

[a]*Highway Capacity Manual*; Transportation Research Board; Broad, DC; 2010; page 19-2
[b]Volume to capacity ratio.

The analytical methodologies used for the analysis of unsignalized intersections use conservative analysis parameters, such as high critical gaps. The critical gap is defined as the minimum time between successive main line vehicles for a side street vehicle to execute the appropriate turning maneuver. Actual field observations indicate that drivers at the study area intersections accept smaller gaps in traffic than those used in the analysis procedures and therefore experience less delay than calculated by the HCM methodology. **The analysis results from the HCM model overstate the actual delays experienced in the field.** It should be noted that the unsignalized intersections along heavily trafficked roadways operate at constrained levels and the resulting calculated results of the unsignalized intersection analyses should be considered highly conservative.

CAPACITY ANALYSIS RESULTS

Level-of-service analyses were conducted for 2022 Existing, 2029 No-Build, and 2029 Build conditions for the intersections within the study area. The results of the signalized analyses are summarized in Table 9. The results of the unsignalized analyses are summarized in Table 10. Detailed analysis sheets are presented in the Appendix.

Lowell Street and Griffin Brook Drive

Under 2022 Existing conditions, this signalized intersection is modeled to operate at LOS A during the weekday morning peak hour and LOS A during the weekday evening peak hour. Under future 2029 No-Build conditions, the intersection is projected to operate at LOS A during the weekday morning peak hour and at LOS B during the weekday evening peak hour. Under 2029 Build conditions, the intersection is projected to continue to operate at LOS A during the weekday morning peak hour and at LOS B during the weekday evening peak hour.

TABLE 9
SIGNALIZED LEVEL-OF-SERVICE SUMMARY
LOWELL STREET AND GRIFFIN BROOK DRIVE

Peak Hour/Lane Group	2022 Existing				2029 No-Build				2029 Build			
	V/C[a]	Delay[b]	LOS[c]	Queue[d]	V/C	Delay	LOS	Queue	V/C	Delay	LOS	Queue
Weekday Morning												
Eastbound Lt	0.44	38.4	D	12/17	0.58	39.4	D	23/27	0.70	42.0	D	31/34
Eastbound Rt	0.16	34.3	C	0/5	0.19	33.7	C	0/5	0.22	33.7	C	0/6
Northbound Lt	0.04	3.0	A	1/6	0.08	3.4	A	4/10	0.11	3.7	A	6/14
Northbound Th	0.26	2.1	A	0/55	0.28	2.4	A	47/64	0.28	2.6	A	50/70
Southbound Th	0.31	4.8	A	0/110	0.33	5.7	A	87/123	0.34	6.2	A	91/132
Southbound Rt	0.12	4.0	A	0/16	0.18	5.1	A	0/20	0.24	5.9	A	0/24
Overall	--	**4.2**	**A**	--	--	**5.4**	**A**	--	--	**6.3**	**A**	--
Weekday Evening												
Eastbound Lt	0.75	39.1	D	65/99	0.81	38.9	D	100/142	0.84	42.3	D	126/172
Eastbound Rt	0.19	31.7	C	0/18	0.22	30.6	C	0/21	0.23	29.9	C	0/23
Northbound Lt	0.01	4.1	A	1/4	0.02	5.3	A	1/6	0.02	6.0	A	2/8
Northbound Th	0.27	3.5	A	57/98	0.29	4.6	A	71/119	0.30	5.4	A	79/119
Southbound Th	0.28	5.9	A	48/132	0.31	7.4	A	60/153	0.32	8.6	A	67/153
Southbound Rt	0.02	4.6	A	0/9	0.03	5.9	A	0/13	0.05	6.9	A	0/15
Overall	--	**8.2**	**A**	--	--	**10.6**	**B**	--	--	**12.7**	**B**	--

[a]Maximum volume-to-capacity ratio.
[b]Delay in seconds per vehicle.
[c]Level of service.
[d]Average Queue (ft)/95th %tile Queue (ft)
Lt = Left; Th = Through; Rt = Right.

Lowell Boulevard and Wheeler Street

Under 2022 Existing conditions, the critical movements at this unsignalized intersection (all movements from Wheeler Street) are modeled to operate at LOS D during the weekday morning peak hour and at LOS D during the weekday evening peak hour. Under future 2029 No-Build conditions, the critical movements are projected to operate at LOS D during the weekday morning peak hour and at LOS E during the weekday evening peak hour. Under 2029 Build conditions, the critical movements are projected to continue to operate at LOS D during the weekday morning peak hour and at LOS E during the weekday evening peak hour. The volume to capacity ratio (v/c) for the critical movement is well below 1.0 (theoretical capacity) and no significant queuing is projected.

Griffin Brook Drive and Driveway to 401 Griffin Brook Drive

Under 2022 Existing conditions, the critical movements at this unsignalized intersection (all movements from the driveway) are modeled to operate at LOS A during the weekday morning peak hour and at LOS A during the weekday evening peak hour. Under future 2029 No-Build conditions, the critical movements are projected to operate at LOS A during the weekday morning peak hour and at LOS A during the weekday evening peak hour. Under 2029 Build conditions, the critical movements are projected to operate at LOS B during the weekday morning peak hour and at LOS A during the weekday evening peak hour.

TABLE 10
UNSIGNALIZED LEVEL-OF-SERVICE ANALYSIS SUMMARY

Critical Movement/ Peak Hour	2022 Existing					2029 No-Build					2029 Build				
	Demand[a]	V/C[b]	Delay[c]	LOS[d]	Queue[e]	Demand	V/C	Delay	LOS	Queue	Demand	V/C	Delay	LOS	Queue
Lowell Boulevard and Wheeler Street															
All movements from Wheeler Street:															
Weekday Morning	119	0.49	29.2	D	62.5	123	0.55	33.8	D	75.0	123	0.56	34.9	D	77.5
Weekday Evening	63	0.35	32.5	D	37.5	66	0.41	37.8	E	45.0	66	0.41	38.3	E	45.0
Griffin Brook Drive and 401 Griffin Brook Drive Driveway															
All movements from driveway:															
Weekday Morning	8	0.01	8.8	A	0.0	8	0.02	9.6	A	0.0	8	0.02	10.5	B	2.5
Weekday Evening	33	0.05	8.7	A	5.0	34	0.06	9.2	A	5.0	34	0.07	9.6	A	5.0

[a]Demand of critical movements in vehicles per hour.
[b]Volume-to-capacity ratio.
[c]Delay in seconds per vehicle.
[d]Level of service.
[e]95th percentile queue in feet.
Calculated delay and v/c not representative of actual conditions when v/c exceeds 1.0.

SITE CIRCULATION

Access to the site will be separated from the parking for the existing building (501 Griffin Brook Drive). South of the building, an existing access way, separated from the parking field provides access to the rear loading area for Building 501 and will provide access to the east side of the new building, 600 Griffin Brook Drive.

Along the western boundary of the site, a new access roadway will be provided that does not go through the parking field for Building 501 Griffin Brook Drive, and provide access to the main parking field for the new building (600 Griffin Brook Drive) as well as the loading dock area on the south side of the building.

The proposed site has been designed such that turnaround areas are included in the vicinity of the loading docks on the east side and south side of the building such that tractor trailers can maneuver and back into the loading dock area. These maneuvers will not impact any existing parking or any proposed parking on the site.

The Morin-Cameron group has performed AutoTURN runs for emergency equipment as well as a WB-65 tractor trailer truck. These drawings are included in the appendix and show that emergency vehicles have full access around the building.

SECTION 5: RECOMMENDATIONS AND CONCLUSION

RECOMMENDATIONS

The final phase of the analysis process is to identify the mitigation measures necessary to minimize the impact of the project on the transportation system. The analyses performed for 2022 Existing and 2029 future No-Build and Build conditions indicate that the proposed project will not result in a significant impact on the traffic operations at the study area intersections. The addition of the site generated traffic will marginally increase projected delays.

Project Related Measures

Project Access

The site access is shared with 501 Griffin Brook Drive. Access to the site will be provided by way the driveway that serves 501 Griffin Brook Drive (at the end of Griffin Brook Drive) and then provides two access ways that circumvent 501 Griffin Brook Drive. It is recommended that the two access way approaches to Griffin Brook Drive be under STOP-sign control. To maintain sight distances, it is recommended that, any proposed vegetation at the site access should be designed to be low growth plantings to not impede sight lines.

Transportation Demand Management

A Transportation Demand Management (TDM) plan should be implemented. The goal of a TDM plan is to reduce the project's overall traffic impact by implementing measures geared toward affecting a change in driver behavior, and to be successful, they must rely on incentives or disincentives to cause drivers to shift travel patterns. TDM programs are designed to maximize the capability of the existing transportation infrastructure by increasing the number of persons in a vehicle, providing alternate modes of travel, or influencing the time of, or need to, travel.

TDM measures are generally directed at commuter travel. The day-to-day regularity of this type of trip and conditions at the workplace, in terms of employer practices such as on-site services, bicycle storage, and shuttle services, affect commuter choices and make this market the most suitable for identifying alternatives. TDM encompasses both alternatives to driving alone and the techniques or supporting strategies that encourage the use of these alternatives. TDM alternatives to driving alone include carpools and vanpools, public and private transit, and non-motorized travel, including bicycling and walking. TDM alternatives can also influence when trips are made. For example, alternative work hours (compressed work weeks, flex-time, and telecommuting) can affect what time of day trips are made, or if trips occur at all on certain days. TDM strategies are the supporting measures that encourage the use of alternatives to driving alone. TDM strategies typically include financial incentives, time incentives, provision of new or enhanced commuter services, dissemination of information, and marketing alternative services. TDM strategies include all the incentives and disincentives that increase the likelihood for people to change their travel behavior.

The project proponent is committed to promoting several measures that contribute toward the reduction of vehicular traffic to and from the site. The following describes the TDM program:

A TDM plan will be implemented. The project proponent is committed to promoting several measures that contribute toward the reduction of vehicular traffic to and from the site. The following describes the components of TDM program:

- A Transportation Coordinator (TC) will be assigned the responsibilities of coordinating the TDM program.

- The TC will also promote alternative transportation modes by posting local commuter rail and bus schedules and encouraging employees to use public transportation.

- The TC will also promote ridesharing via carpools for employees. The project proponent will recommend that employees interested in car-pooling provide their contact information.

- Designate two (2) carpool/vanpool parking spaces as close as possible to the front.

- Site amenities should also be provided to discourage off-site trips. These measures may include providing a break room, direct deposit of paychecks, allowing for telecommuting or flex work opportunities.

- Bicycle racks will also be located throughout the site to encourage the use of bicycles.

CONCLUSION

Review of the proposed project and the access plan shows that in relation to roadway capacity, traffic safety, and traffic impacts upon the surrounding roadway network, the proposed project will meet safety standards and have a minimal impact on existing traffic conditions. Project-related increases are in the range of 13 to 55 bi-directional vehicles during the peak hours at the study area boundaries. This is approximately equivalent to one (1) additional vehicle every minute or less per direction on average during the peak hours.