Proposed Residential
1180 Great Plain Avenue

Needham, MA
May 10, 2019

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TRAFFIC IMPACT AND ACCESS STUDY

PROPOSED RESIDENTIAL

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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 proposed residential development to be located at 1180 Great Plain Avenue in Needham, 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 residential development is to be located on the south side of Great Plain Avenue, west of Linden Street. Currently, the site consists of a vacant one story building. A circular driveway is provided in front of the site providing access/egress to/from Great Plain Avenue. To the rear, a twenty (20) foot wide right-of-way provides access to Walnut Street.

The project will consist of the renovation (existing building footprint will be made smaller) and expansion (adding one story to the building) of the existing building to include sixteen (16) residential apartment units. Parking for a total of 28 vehicles will be provided across the site. Four (4) visitor parking spaces will be provided in the circular driveway in the front, seven (7) parking spaces along the driveway side of the building, and seventeen (17) parking spaces in the rear of the building. Access to the site is proposed to be provided by way of the existing circular driveway at the end of Great Plain Avenue. The circular driveway provides access to the rear of the site by way of a twelve (12) foot wide accessway. This accessway will be controlled and allow safe two-way flow through an on-site signal system to allow vehicles to safely enter and exit the rear of the site where the parking will occur. With this access scenario, the twenty (20) foot wide right-of-way to Walnut Street would be discontinued.

A second access scenario was also reviewed for the proposed residential apartment units. With this scenario, all access would be from Walnut Street and all egress would be to Great Plain Avenue.

Finally, for comparison, a second development scenario was reviewed. The site was most recently used as a day care center. Therefore, for comparison purposes, the potential impact of a 10,000 square foot (sf) day care center was evaluated, with all access from Great Plain Avenue and all egress to Walnut Street.

Figure 1 shows the site location in relation to the surrounding area.

Figure 1
Site Location Map

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, 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 2026 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:

- Great Plain Avenue, Marked Tree Road and Gage Street
- Great Plain Avenue, Marshall Street and Site Driveway
- Great Plain Avenue, Linden Street and Washburn Avenue
- Walnut Street, Willow Street and Walnut Place

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 May 2019. Peak-period turning movement counts were conducted during the weekday morning period (7:00 to 9:00 AM) and the weekday evening peak period (4:00 to 6:30 PM). Daily traffic counts were conducted on Great Plain Avenue and Walnut Street for a two (2) day period using automatic traffic recorders (ATR). The weekday morning commuter peak hour generally occurs between 7:45 AM and 8:45 AM and the weekday evening commuter peak hour generally occurs between 5:15 PM and 6:15 PM.

The traffic-volume data gathered as part of this study was collected during the month of May. Data from MassDOT was reviewed to determine the monthly variations of the traffic volumes. Based upon available data, May volumes were found to be slightly higher than average month conditions. To be conservative, the May volumes were used to reflect average month conditions.

Great Plain Avenue, west of Marshall Street, was recorded to carry approximately 12,450 vehicles per day (vpd) on a weekday. During the weekday morning peak hour, approximately 1,006 vehicles per hour (vph) were recorded and during the weekday evening peak hour, 1,221 vph were recorded.

Walnut Street, west of Willow Street, was recorded to carry approximately 385 vpd on a weekday. During the weekday morning peak hour, approximately 25 vph were recorded on Walnut Street and during the weekday evening peak hour, 35 vph were recorded.

Vehicle Speeds

Existing speed data for Great Plain Avenue and Walnut Street was also collected. The average speed of vehicles travelling eastbound or westbound on Great Plain Avenue, west of Marshall Street, was found to be 30 or 32 mph. The 85th percentile speed was found to be 35 or 36 mph for eastbound or westbound vehicles, respectively.

The average speed of vehicles travelling eastbound or westbound on Walnut Street, west of Willow Street was found to be 21 or 18 mph. The 85th percentile speed was found to be 27 or 24 mph for eastbound or westbound vehicles, respectively.

Motor Vehicle Crash Data

Motor vehicle crash data for the study area intersections and roadways were obtained from MassDOT from 2012 to 2016. The motor vehicle crash data was reviewed to determine crash trends in the study area. Eighteen (18) crashes were reported at the study area intersections. Nine (9) crashes occurred at the Great Plain Avenue intersection with Marked Tree Road/Gage Street, two (2) at the Great Plain Avenue intersection with Marshall Street and seven (7) crashes occurred at the Great Plain Avenue intersection with Linden Street/Washburn Avenue. None of the study area intersections experienced a significant crash rate and 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 2026. 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 2026. A review of available MassDOT traffic volume data shows that growth in the area has been approximately one (1.0) percent per year.

The Needham Town Planning Department was also contacted to determine if there are any other projects that could affect study area traffic volumes. No background projects were identified in the area.

Build Traffic Volumes

Site generated traffic was based on trip-generation data published by the ITE *Trip Generation* manual[1]. The proposed site redevelopment is expected to consist of sixteen (16) apartment units. Trip generation data for Land Use Code (LUC) 220 – Multifamily Housing (Low-Rise) was reviewed.

On a typical weekday, the proposed residential development is expected to generate 80 daily vehicle trips. During the weekday morning peak hour, 8 vehicle trips (2 vehicles entering and 6 vehicles exiting) are expected. During the weekday evening peak hour, 12 vehicle trips (8 vehicles entering and 4 vehicles exiting) are expected.

Previously, the site was used as a day care facility. Utilizing the ITE data, ITE LUC 565 – Day Care Center, the site would have generated 476 daily vehicle trips. During the weekday morning peak hour, 110 vehicle trips (58 vehicles entering and 52 vehicles exiting) would be expected. During the weekday evening peak hour, 111 vehicle trips (52 vehicles entering and 59 vehicles exiting) would be expected.

As can be seen, based on the ITE data, the Day Care Center would have generated more daily and more peak hour trips than the current residential proposal.

TRAFFIC OPERATIONS ANALYSIS

In order to assess the impacts of the proposed project on the roadway network, traffic operations analyses were performed at the study area intersections under 2019 Existing, 2026 No-Build and 2026 Build conditions. These analyses indicate that the proposed project (16 residential apartments) will not result in a significant impact on traffic operations at the study area intersections over No-Build conditions.

The proposed residential development traffic will have very little, if any impact at the study area intersections. This would be true for either access scenario. A review of the impacts associated with a day care center indicate that delays would be increased for the side-streets, and vehicle queues increase by four (4) to five (5) vehicles during peak periods.

The analysis results of the day care center scenario show that the existing volume of traffic on Walnut Street would double.

RECOMMENDATIONS

The final phase of the analysis process will be to identify the mitigation measures necessary to minimize the impact of the project on the transportation system.

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

Project Related Mitigation

It is recommended that the exit to Great Plain Avenue be under STOP sign control. It is recommended that any signage or landscaping that would occur along the Great Plain Avenue frontage be set back and designed to not impact sight lines.

Transportation Demand Management

The goal of a Transportation Demand Management (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 showers, 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, flextime, and telecommuting) can affect what time of day trips are made, or if trips occur at all on certain days. On an area-wide basis, the provision of park-and-ride facilities and transit services can also provide a competitive alternative to drive-alone commuting. TDM strategies are the supporting measures that encourage the use of alternatives to driving alone. TDM strategies 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 a number of measures that contribute toward the reduction of vehicular traffic to and from the site. The following describes the TDM program:

- The management company responsible for the renting of the apartments will responsible for coordinating the TDM program.

- The management company will promote alternative transportation modes by posting local bus schedules and encouraging tenants to provide incentives to employees using public transportation. The MBTA currently has a bus route that runs along Great Plain Avenue, as well as the nearby commuter rail stations.

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

SUMMARY

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 0 to 9 bi-directional vehicles during the peak hours at the study area boundaries. This is approximately equivalent to one additional vehicle every twelve (12) minutes or less per direction on average during the peak hours.

With the proposed access, in conjunction with the mitigation measures described above and maintaining sight distances from the driveway (clear sight lines along frontage), safe and efficient access can be provided to the residents of the proposed project 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:

- Great Plain Avenue, Marked Tree Road and Gage Street
- Great Plain Avenue, Marshall Street and Site Driveway
- Great Plain Avenue, Linden Street and Washburn Avenue
- Walnut Street, Willow Street and Walnut Place

FIELD SURVEY

A comprehensive field inventory of the proposed site was conducted in May 2019. 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

Great Plain Avenue

Great Plain Avenue is an Urban Principle Arterial roadway extending in a generally east/west direction through the Town of Needham. The roadway is under the jurisdiction

of the Town of Needham. In the study area, Great Plain Avenue provides one travel lane in each direction separated by a double-yellow centerline. The posted speed limit in the site vicinity is 35 miles per hour (mph) and transitions to 25 mph just west of Linden Street. Land use along Great Plain Avenue in the study area consists of residential properties, a church and commercial properties. Illumination is provided by luminaires mounted on telephone poles within the study area. Sidewalks are provided on both sides Great Plain Avenue within the study area.

Intersections

Great Plain Avenue, Marked Tree Road and Gage Street

This unsignalized intersection is under the jurisdiction of the Town of Needham. Great Plain Avenue forms the east and west legs of the intersection, Marked Tree Road forms the south leg and Gage Street forms the north leg. The Great Plain Avenue approaches each consist of single lanes permitting left or right turns. The Marked Tree Road northbound approach consists of a single lane that permits all movements. The Gage Street southbound approach consists of a single lane that permits all movements. Sidewalks are present on all approaches to the intersection. Marked Tree Road is under STOP sign control. Crosswalks exist across the Marked Tree Road and Gage Street approaches. Land use at the intersection consists of residential homes.

Great Plain Avenue, Marshall Street and Existing Site Driveway

This unsignalized intersection is under the jurisdiction of the Town of Needham. Great Plain Avenue forms the east and west legs of the intersection, Marshall Street forms the north leg and the existing site driveway forms the south leg. The Great Plain Avenue approaches each consist of single lanes permitting left or right turns. The Marshall Street southbound approach consists of a single lane that permits all movements. The site driveway is a circular driveway with the entrance opposite Marshall Street and the exit approximately 70 feet to the east. Sidewalks are present on the Great Plain Avenue and Marshall Street approaches to the intersection. Marshall Street operates under STOP control. A crosswalk exists across the Marshall Street approach. Land use at the intersection consists of residential homes, the site and a church.

Great Plain Avenue, Linden Street and Washburn Avenue

This unsignalized intersection is under the jurisdiction of the Town of Needham. Great Plain Avenue forms the east and west legs of the intersection, Linden Street forms the south leg and Washburn Avenue forms the north leg. Linden Street and Washburn Avenue are offset by approximately 50 feet. The Great Plain Avenue approaches each consist of single lanes permitting left or right turns. The Linden Street northbound approach consists of a single lane that permits all movements. The Washburn Avenue southbound approach consists of a single lane that permits all movements. Sidewalks are present on all approaches to the intersection. Linden Street is under STOP sign control. Crosswalks exist across the Linden Street and Washburn Avenue approaches, as

well as across Great Plain Avenue in between Linden Street and Washburn Avenue. Land use at the intersection consists of residential homes along the north side of Great Plain Avenue and a church and commercial properties along the south side of Great Plain Avenue.

Walnut Street, Willow Street and Walnut Place

This unsignalized intersection is under the jurisdiction of the Town of Needham. Walnut Street forms the east and west legs of the intersection, Willow Street forms the south leg and Walnut Place forms the north leg. Willow Street and Walnut Place are slightly offset. The Walnut Street approaches each consist of single lanes permitting left or right turns. The Willow Street northbound approach consists of a single lane that permits all movements. The Walnut Place southbound approach consists of a single lane that permits all movements. Walnut Place allows southbound traffic flow only. Sidewalks are present on all approaches to the intersection except Walnut Place (no sidewalks). Willow Street is under STOP control. Land use at the intersection consists of residential homes.

TRAFFIC VOLUMES

Existing Traffic Volumes

To establish base traffic conditions within the study area, manual turning movement and vehicle classification counts were obtained in May 2019. Peak-period turning movement counts were conducted on Thursday, May 2, 2019 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:

- Great Plain Avenue, Marked Tree Road and Gage Street
- Great Plain Avenue, Marshall Street and Site Driveway
- Great Plain Avenue, Linden Street and Washburn Avenue
- Walnut Street, Willow Street and Walnut Place

Daily traffic counts were conducted on Great Plain Avenue and Walnut Street for a two (2) day period using automatic traffic recorders (ATR) on Wednesday, May 1, 2019 and Thursday, May 2, 2019.

On Thursday, May 2, 2019, a temporary detour on Walnut Street was in affect and had a minor impact on traffic flows. Supplemental counts were conducted at the intersections of Great Plain Avenue, Marked Tree Road and Gage Street and Walnut Street, Willow Street and Walnut Place on Tuesday, May 7, 2019.

Analysis of the peak-period traffic counts indicated that the weekday morning commuter peak hour generally occurs between 7:45 AM and 8:45 AM and the weekday evening commuter peak generally hour occurs between 5:15 PM and 6:15 PM. The traffic count

worksheets are provided in the Appendix.

Observations of traffic flow in the study area during peak periods shows that there are long vehicle queues on Great Plain Avenue eastbound. This is a result of the at-grade railroad crossing of the MBTA's commuter rail. As trains pull into or out of the Needham Center Station, traffic on Great Plain Avenue is forced to stop. The vehicle queues generally clear in a reasonable time-frame.

Seasonal Adjustment

The traffic-volume data gathered as part of this study was collected during the month of May 2019. Data from the MassDOT was reviewed to determine the monthly variations of the traffic volumes. The traffic data showed May volumes to be slightly higher than average month conditions. Therefore, the May traffic volumes were used to represent average month conditions. The 2019 existing weekday daily and peak-hour traffic volumes for average-month conditions are summarized in Table 1. The 2019 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
Great Plain Avenue, west of Marshall Street	12,450	1,006	8.1	51.5% EB	1,221	9.8	57.4% WB
Walnut Street, west of Willow Street	385	25	6.4	60% EB	35	9.1	68.6% WB

[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.

Great Plain Avenue, west of Marshall Street was recorded to carry approximately 12,450 vehicles per day (vpd) on a weekday. During the weekday morning peak hour, approximately 1,006 vehicles per hour (vph) were recorded and during the weekday evening peak hour, 1,221 vph were recorded.

Walnut Street, west of Willow Street was recorded to carry approximately 385 vpd on a weekday. During the weekday morning peak hour, approximately 25 vph were recorded on Great Plain Avenue and during the weekday evening peak hour, 35 vph were recorded.

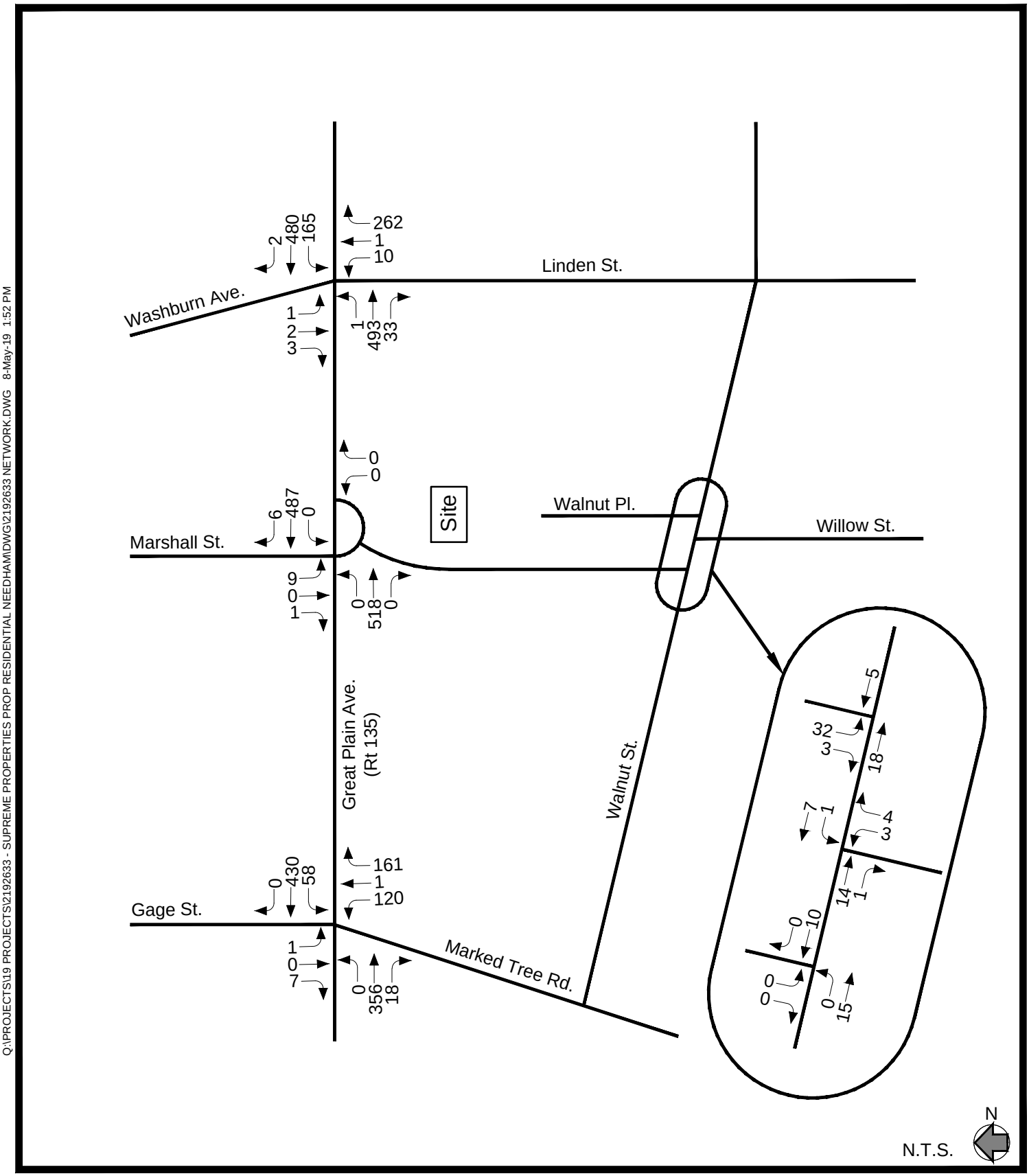

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Figure 2

2019 Existing
Weekday Morning
Peak Hour Traffic Volumes

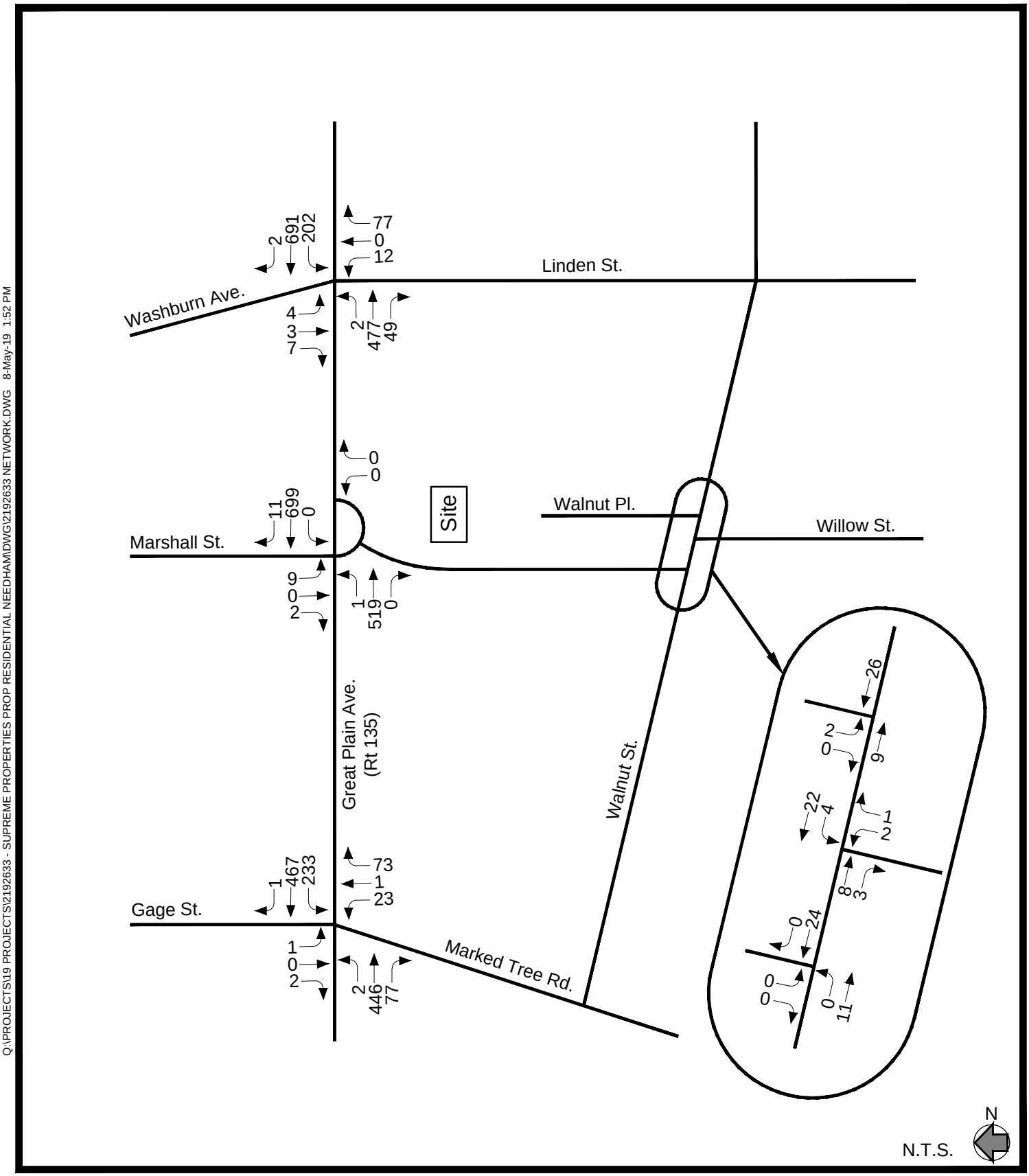

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Figure 3

2019 Existing
Weekday Evening
Peak Hour Traffic Volumes

VEHICLE SPEEDS

Existing speed data for Great Plain Avenue west of Marshall Street was also collected using the ATR. The posted speed limit on Great Plain Avenue is 35 mph at the site driveway. The speed data is summarized in Table 2.

TABLE 2
OBSERVED VEHICLE SPEEDS

Direction	Posted Speed Limit (mph)	Direction	Average Observed Speed[a] (mph)	85th Percentile Speed (mph)
Great Plain Avenue, west of Marshall Street	35	EB	30	35
	35	WB	32	36
Walnut Street, west of Willow Street	NP	EB	21	27
	NP	WB	18	24

[a]Based on speed data compiled on May 1 and 2, 2019.
NP = Not Posted

As shown in Table 2, the average speed of vehicles travelling eastbound or westbound on Great Plain Avenue, west of Marshall Street, was found to be 30 or 32 mph. The 85th percentile speed was found to be 35 or 36 mph for eastbound or westbound vehicles, respectively.

The average speed of vehicles travelling eastbound or westbound on Walnut Street, west of Willow Street was found to be 21 or 18 mph. The 85th percentile speed was found to be 27 or 24 mph for eastbound or westbound vehicles, respectively. The 85th percentile speed is the speed at which sight distances are typically evaluated.

MOTOR VEHICLE CRASH DATA

Motor vehicle crash data for the study area intersections and roadways were obtained from the MassDOT for 2012 through 2016. The motor vehicle crash data was reviewed to determine crash trends in the study area. A total of eighteen (18) crashes were reported during the five-year interval at the study area intersections. The crash data is included in the Appendix. The crash data is summarized in Table 3.

TABLE 3
MOTOR VEHICLE CRASH DATA SUMMARY[a]

Scenario	Location: Great Plain Avenue/Marked Tree Road/Gage Street	Great Plain Avenue/Marshall Street/Site Driveway	Great Plain Avenue/Linden Street/Washburn Avenue	Walnut Street/Willow Street/Walnut Place
Year[b]:				
2012	3	0	1	0
2013	1	1	2	0
2014	0	1	2	0
2015	0	0	1	0
2016	5	0	1	0
Total	9	2	7	0
Average[b]	1.8	0.4	1.4	0.0
Crash Rate[c]	0.36	0.09	0.25	0.0
Significant[d]	No	No	No	No
Type:				
Angle	5	1	2	0
Rear-End	3	1	1	0
Sideswipe	0	0	1	0
Head-On	0	0	0	0
Bicycle	0	0	0	0
Single Vehicle Crash	1	0	3	0
Unknown	0	0	0	0
Total	9	2	7	0
Time of Day:				
Morning (7:00 to 9:00 AM)	2	0	2	0
Evening (4:00 to 6:00 PM)	3	1	1	0
Remainder of Day	4	1	4	0
Total	9	2	7	0
Pavement Conditions:				
Dry	6	1	5	0
Wet	2	1	2	0
Snow/Ice/Slush	1	0	0	0
Unknown	0	0	0	0
Total	9	2	7	0
Severity:				
Property Damage Only	5	2	3	0
Personal Injury	3	0	4	0
Fatal Accident	0	0	0	0
Unknown	1	0	0	0
Total	9	2	7	0

[a]Source: MassDOT.
[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 >0.56 crashes per million vehicles.

PUBLIC TRANSPORTATION

Public transportation services are provided within the study area by the Massachusetts Bay Transportation Authority (MBTA). The MBTA operates the Needham Line Commuter Rail and Bus Route 59 in the vicinity of the site.

The Needham Line Commuter Rail runs from Needham Heights to South Station. Service is provided Monday through Friday from 6:05 AM to 12:00 (midnight). On Saturdays, service is provided from 7:10 AM to 12:00 (midnight). There is no Sunday service. The closest stops from the site are Needham Center and Needham Junction with both being less than one (1) mile from the site.

Bus Route 59 runs from the Watertown Square Terminal to Needham Junction at the Commuter Rail Station. Service is provided Monday through Friday from 6:05 AM to 8:21 PM. On Saturdays, service is provided from 6:20 AM to 7:35 PM and on Sundays, service is provided from 7:05 AM to 6:51 PM. The closest stops from the site are at the corner of Chestnut Street at Great Plain Avenue and Chestnut Street at Oak Street with both being less than one-half (0.5) mile from the site.

Schedules and maps for the Needham Line Commuter Rail and Bus Route 59 are included in the Appendix.

PLANNED ROADWAY IMPROVEMENTS

Officials for the Town of Needham were contacted regarding roadway improvements planned for the study area intersections. No capacity related 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 2026. 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 2026. Consideration of these factors resulted in the development of 2026 No-Build traffic volumes. Anticipated site-generated traffic volumes were then superimposed upon these No-Build traffic flow networks to develop the 2026 Build conditions.

FUTURE 2026 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

Review of available MassDOT traffic count data indicates that there has been little growth over the past several years. Traffic count data from MassDOT was reviewed. Specifically, permanent count station data was reviewed. Based on this data, growth is expected to occur at a rate of approximately one (1.0) percent per year. To provide a conservative analysis, a background growth rate of one (1.0) percent per year was applied.

Specific Development by Others

Traffic volumes generated by the specific local developments by others were included in the 2025 No-Build condition. The Town of Needham was contacted to identify specific planned developments. Based on these discussions, there are no projects that are currently planned, approved or under construction in the immediate area that would impact future traffic volumes beyond the general background traffic growth rate.

No-Build Condition Traffic Volumes

The 2026 No-Build weekday morning and weekday evening peak-hour traffic volumes were developed by applying a compounded one (1.0) percent annual growth rate to the 2019 Existing peak-hour traffic volumes. Figures 4 and 5 show the projected 2026 No-Build peak hour traffic volumes for the respective weekday morning and weekday evening peak-hours.

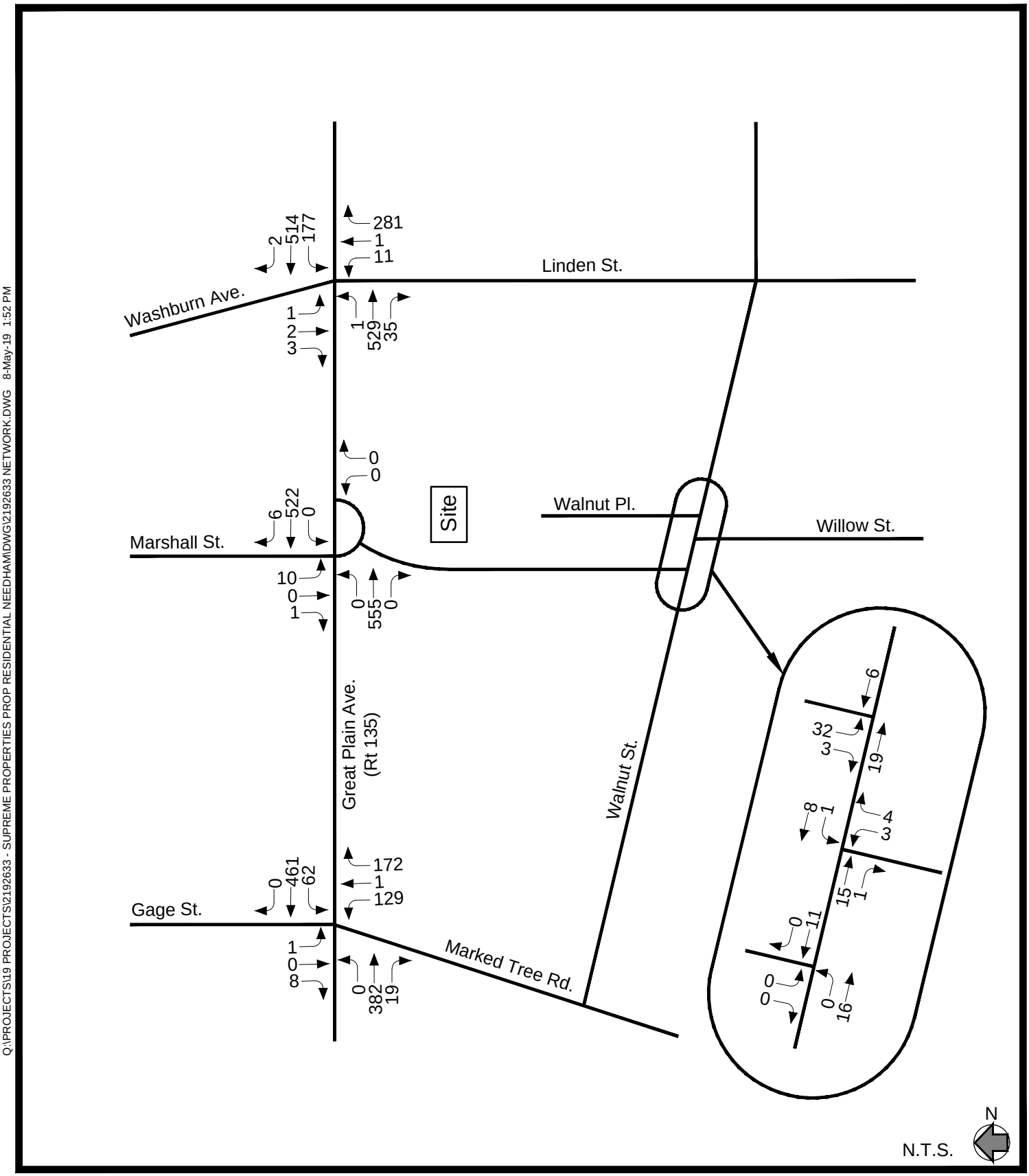

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Figure 4

2026 No-Build
Weekday Morning
Peak Hour Traffic Volumes

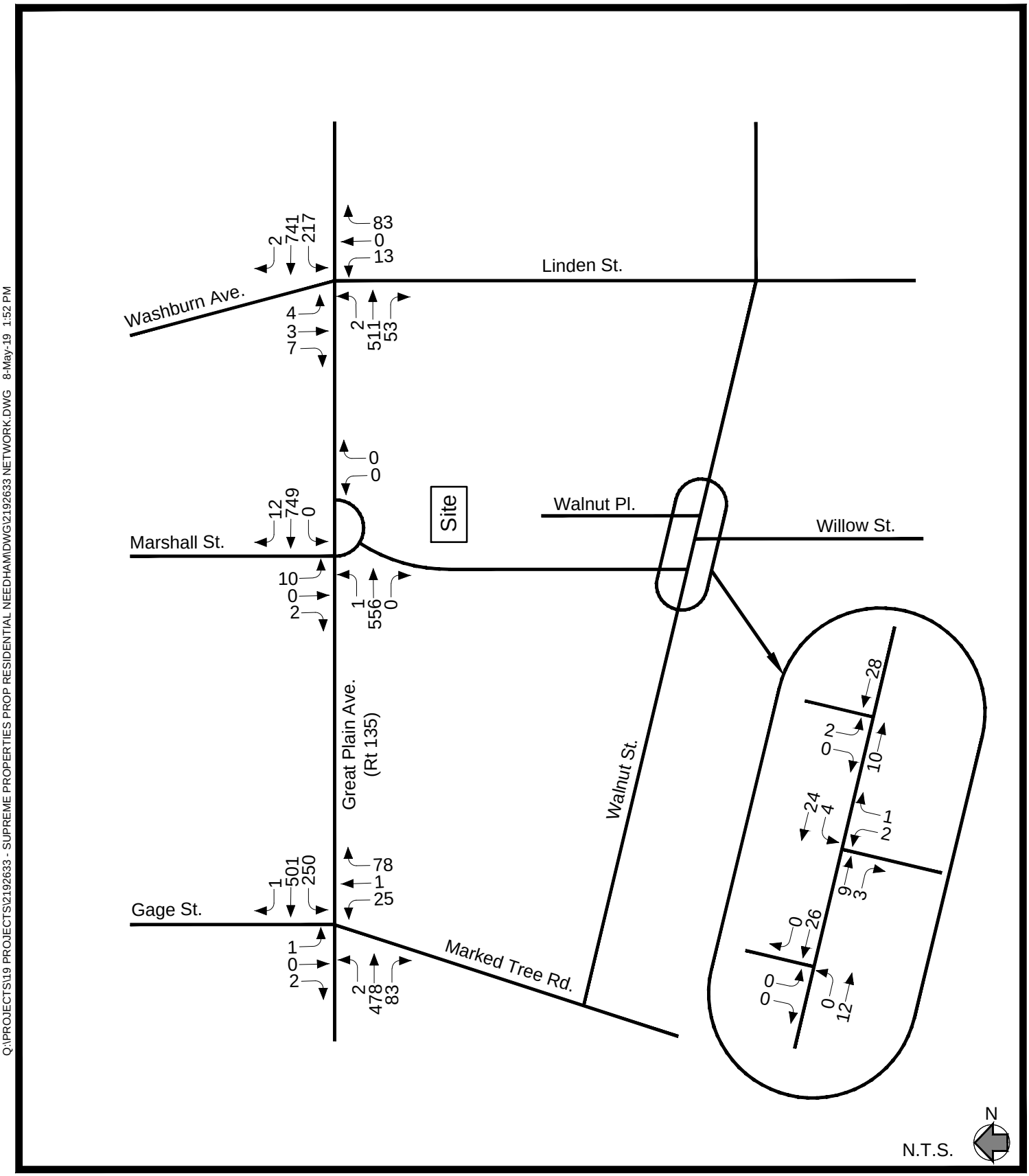

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Figure 5

2026 No-Build
Weekday Evening
Peak Hour Traffic Volumes

FUTURE 2026 BUILD CONDITIONS

Project Description

The project will consist of the renovation and expansion of the existing building to include sixteen (16) apartment units. Parking for a total of 28 vehicles will be provided across the site. Four (4) visitor parking spaces will be provided in the circular driveway in the front, seven (7) parking spaces along the driveway side of the building, and seventeen (17) parking spaces in the rear of the building. Access to the site will continue to be provided by way of the existing circular driveway at the end of Great Plain Avenue.

Site Traffic Generation

Site generated traffic for the redevelopment was based on trip-generation data published by the Institute of Transportation Engineers (ITE) in the *Trip Generation* manual[2]. Trip generation data for Land Use Codes (LUC) 220 – Multifamily Housing (Low-Rise) was reviewed. The trip generation for the project is summarized in Table 4.

TABLE 4
PROPOSED RESIDENTIAL
TRIP-GENERATION SUMMARY

	Total Trips[a]
Average Weekday Daily Traffic	80
Weekday Morning Peak Hour:	
Entering	2
Exiting	6
Total	8
Weekday Evening Peak Hour:	
Entering	8
Exiting	4
Total	12

[a]Based on ITE LUC 220 – Multifamily Housing (Low-Rise); 16 units.

On a typical weekday, the proposed residential development is expected to generate 80 daily vehicle trips. During the weekday morning peak hour, 8 vehicle trips (2 vehicles entering and 6 vehicles exiting) are expected. During the weekday evening peak hour, 12 vehicle trips (8 vehicles entering and 4 vehicles exiting) are expected.

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

As part of the analysis, the impacts of the prior use of the building as a day care center were also evaluated. The trip generation characteristics of a day care are summarized in Table 5.

TABLE 5
DAY CARE CENTER
TRIP-GENERATION SUMMARY

	Total Trips[a]
Average Weekday Daily Traffic	476
Weekday Morning Peak Hour:	
Entering	58
Exiting	52
Total	110
Weekday Evening Peak Hour:	
Entering	52
Exiting	59
Total	111

[a]Based on ITE LUC 565 – Day Care Center; 10,000 sf.

On a typical weekday, the day care center would be expected to generate 476 daily vehicle trips. During the weekday morning peak hour, 110 vehicle trips (58 vehicles entering and 52 vehicles exiting) would be expected. During the weekday evening peak hour, 111 vehicle trips (52 vehicles entering and 59 vehicles exiting) would be expected.

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. For the proposed residences, locations of employment from the recent 2010 census was reviewed. Table 6 summarizes the expected trip distribution for the residences, which is also shown graphically on Figure 6.

The trip distribution pattern for the prior use as a day care center was developed based on a review of existing traffic flows and is also shown in Table 6.

TABLE 6
PROPOSED TRIP DISTRIBUTION

Route	Direction	Percent of Residential Trips	Percent of Day Care Center Trips
Great Plain Avenue	East	74	40
Great Plain Avenue	West	16	40
Marked Tree Road	South	6	10
Linden Street	South	4	10
TOTAL		100	100

Future Traffic Volumes - Build Condition

The site-generated traffic was distributed within the study area according to the percentages summarized in Table 6 and are shown on Figure 7. The site generated volumes shown on Figure 7 were then superimposed onto the 2026 No-Build traffic volumes to represent the 2026 Build traffic-volume conditions. The anticipated 2026 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.

A summary of 2026 peak-hour projected traffic-volume changes in the site vicinity are shown in Table 7. These volumes are based on the expected increases from the site traffic generation.

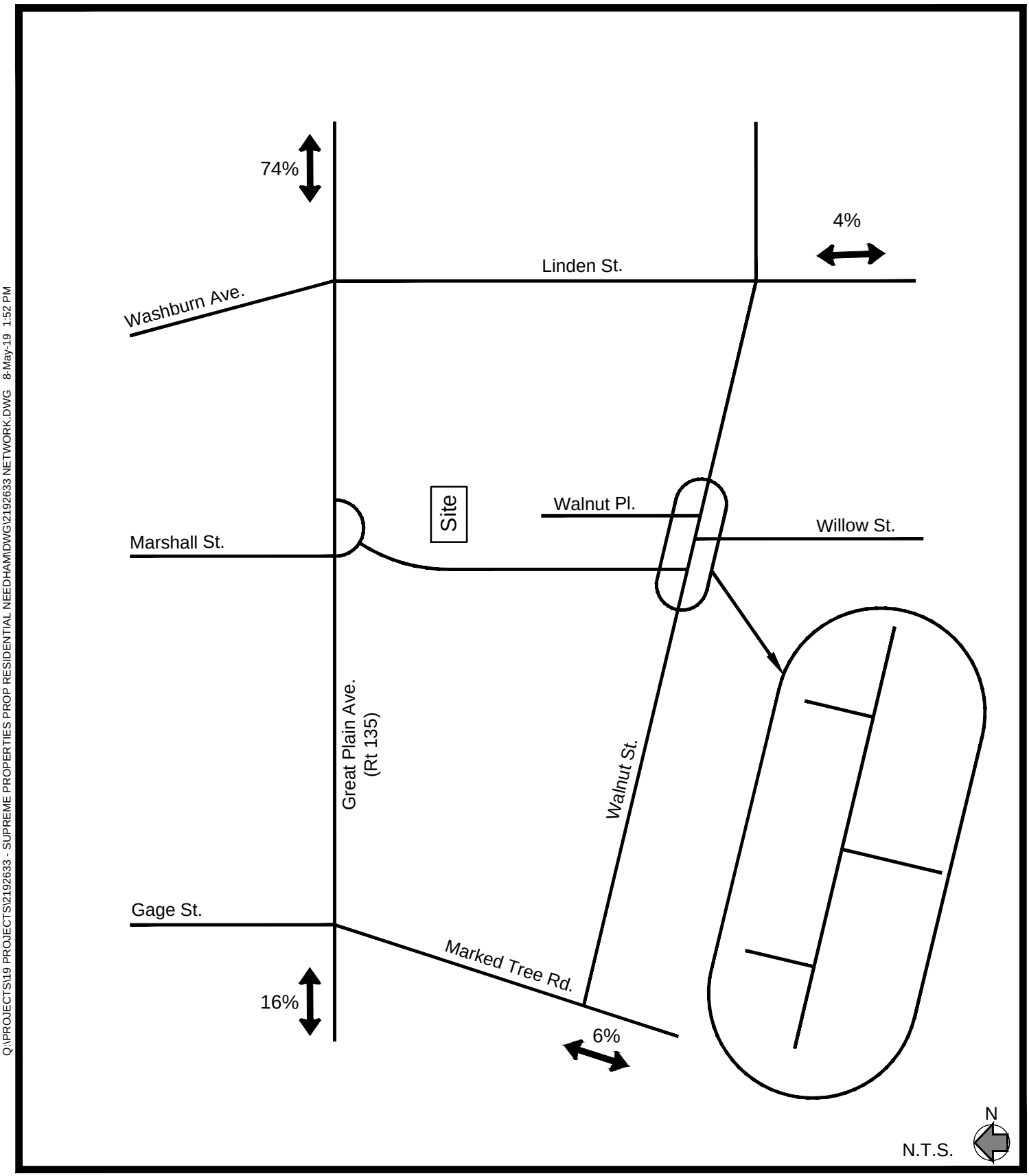

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Figure 6

Trip Distribution

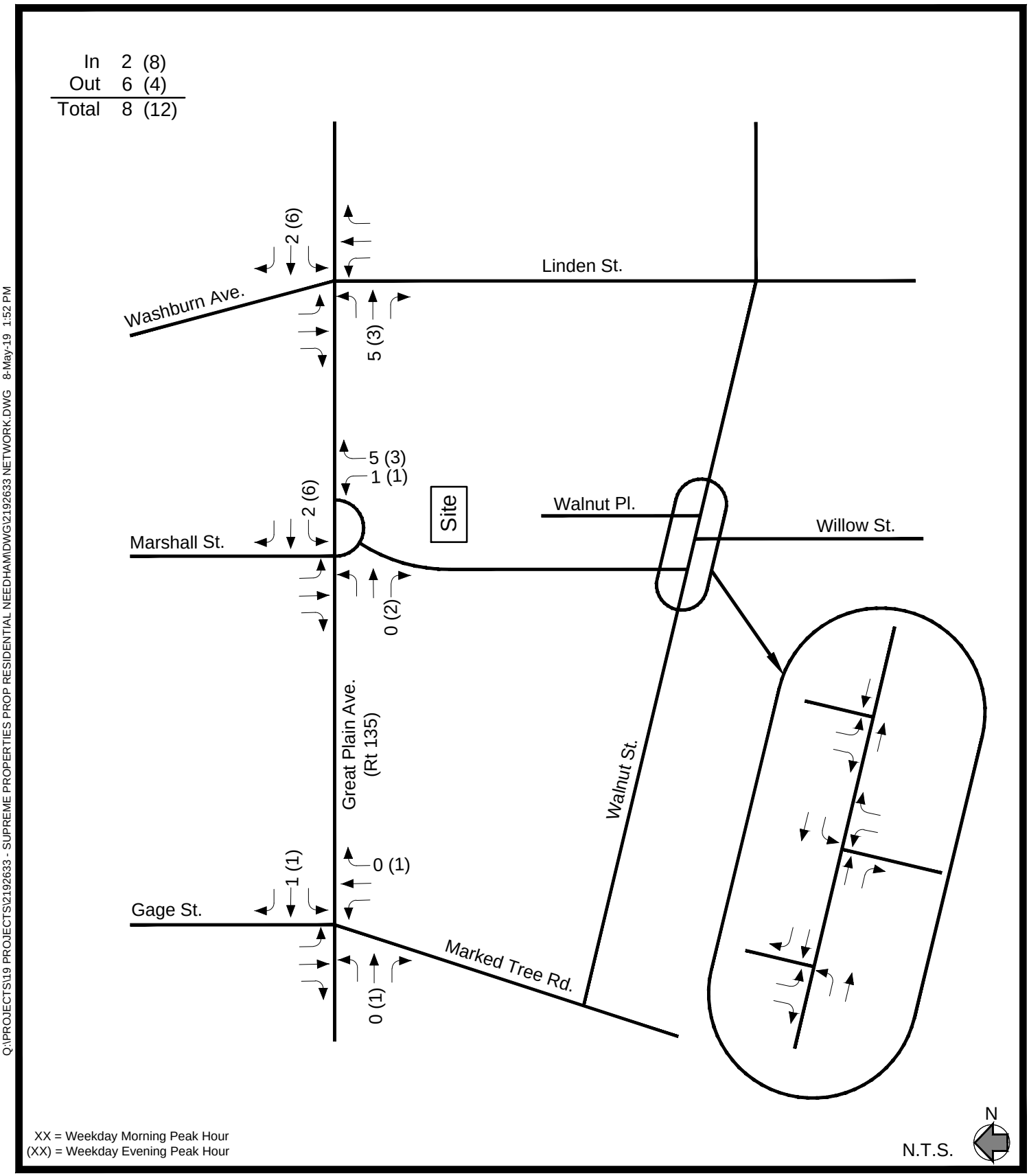

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Figure 7

Site Generated
Peak Hour Traffic Volumes

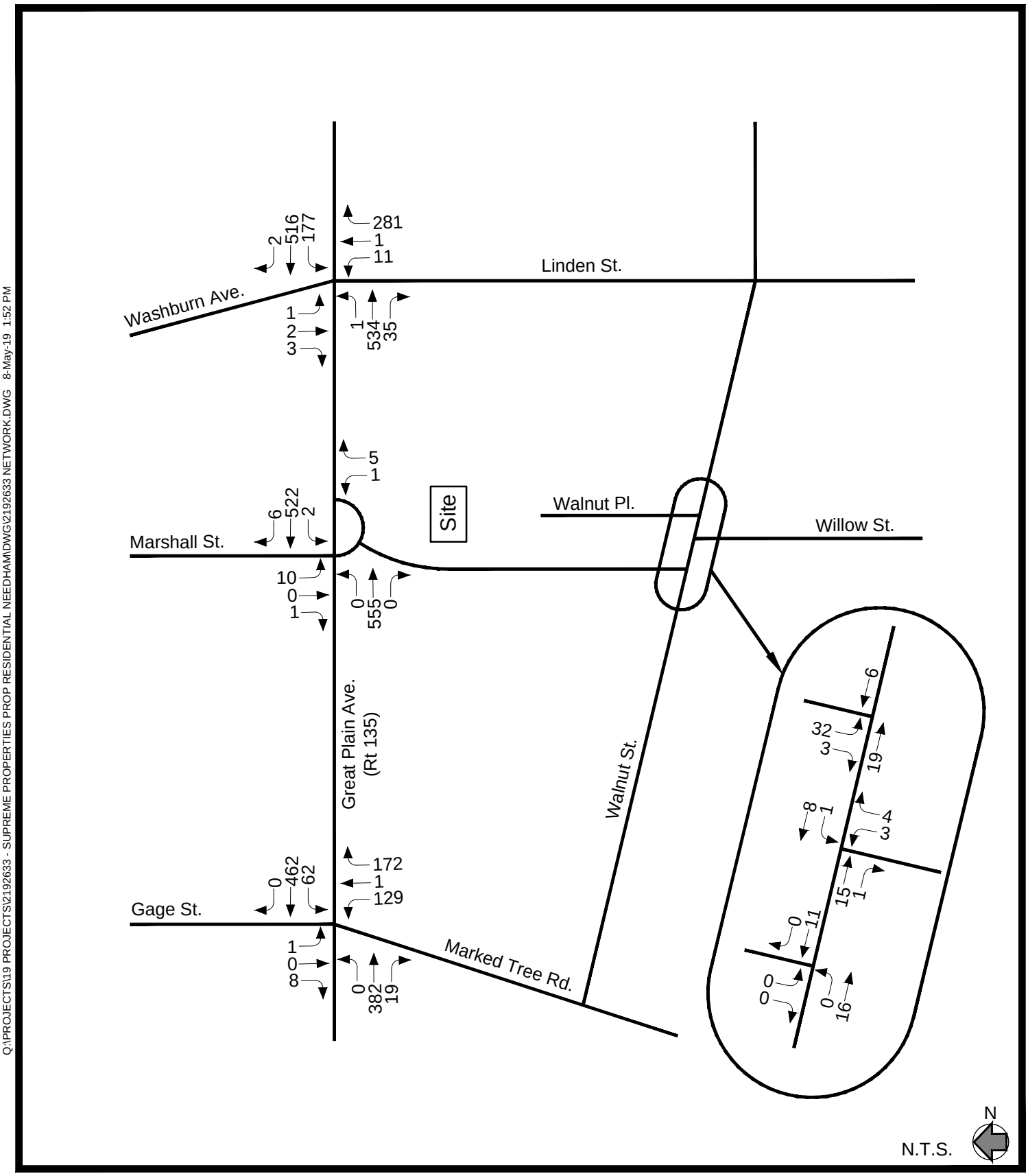

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Figure 8

2026 Build
Weekday Morning
Peak Hour Traffic Volumes

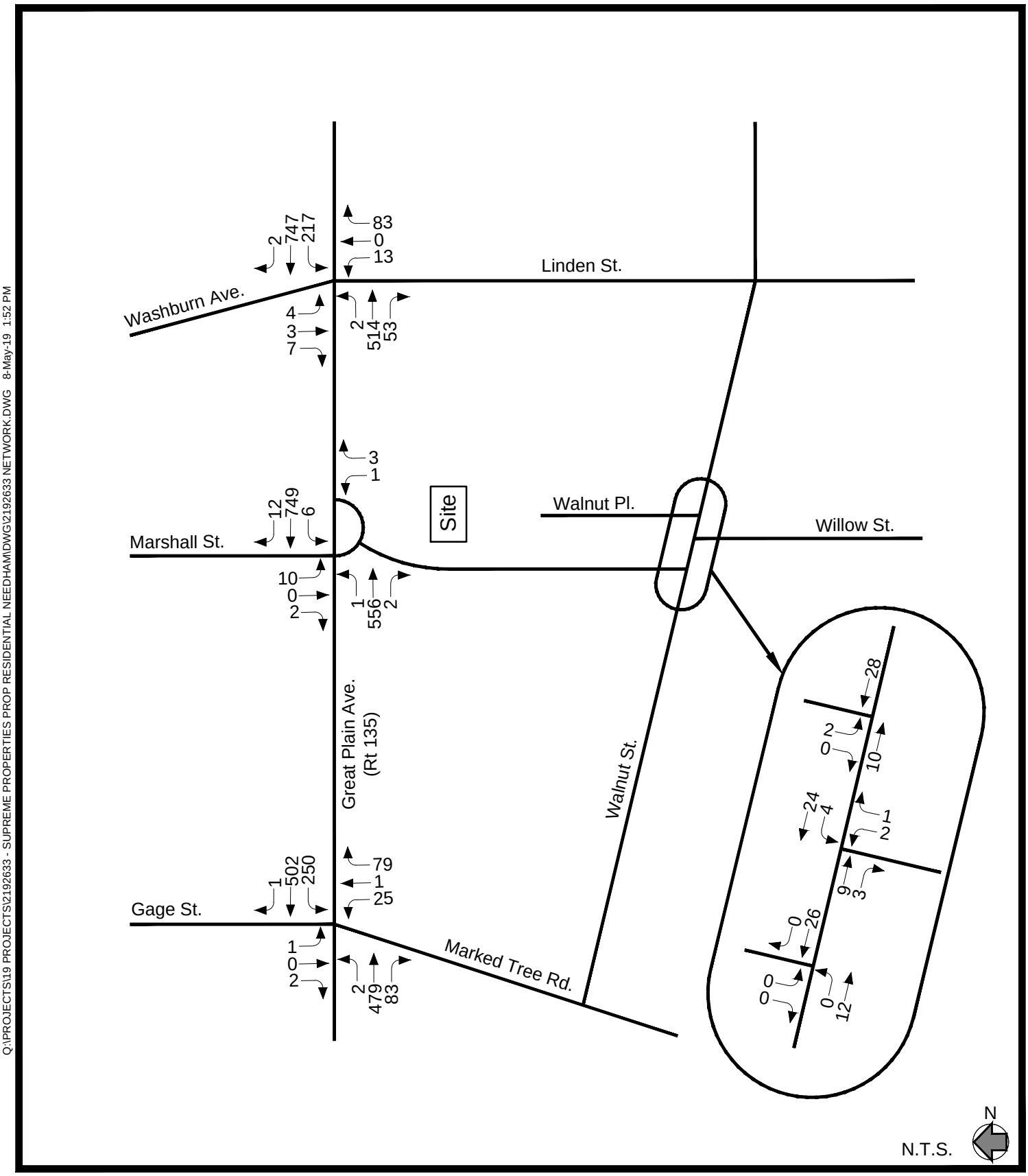

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Figure 9

2026 Build
Weekday Evening
Peak Hour Traffic Volumes

TABLE 7
TRAFFIC-VOLUME INCREASES[a]

Location/Peak Hour	2026 No-Build	2026 Build	Volume Increase over No-Build
Great Plain Avenue, west of Marked Tree Road			
Weekday Morning	999	1000	1
Weekday Evening	1091	1093	2
Great Plain Avenue, east of Linden Street			
Weekday Morning	1504	1511	7
Weekday Evening	1558	1567	9
Marked Tree Road, south of Great Plain Avenue			
Weekday Morning	383	383	0
Weekday Evening	437	438	1
Linden Street, south of Great Plain Avenue			
Weekday Morning	507	507	0
Weekday Evening	369	369	0

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

As shown in Table 7, project-related increases are in the range of 0 to 9 bi-directional vehicles during the peak hours entering or exiting the study area. This is approximately equivalent to one additional vehicle every twelve (12) minutes or less per direction on average during the peak hours.

Future Traffic Volumes - Build Condition with Modified Access

A second access scenario was also reviewed for the proposed residential apartment units. Under this scenario, all access would be from Walnut Street and all egress would be to Great Plain Avenue.

The site-generated traffic was re-distributed within the study area according to the percentages summarized in Table 6 with the modified access scheme and are shown on Figure 10. The site generated volumes shown on Figure 10 were then superimposed onto the 2026 No-Build traffic volumes to represent the 2026 Build traffic-volume conditions. The anticipated 2026 Build weekday morning and weekday evening peak-hour traffic volumes are graphically presented in Figures 11 and 12. These volumes were used as the basis for all analysis as well as to identify potential mitigation measures to ameliorate the project's impacts.

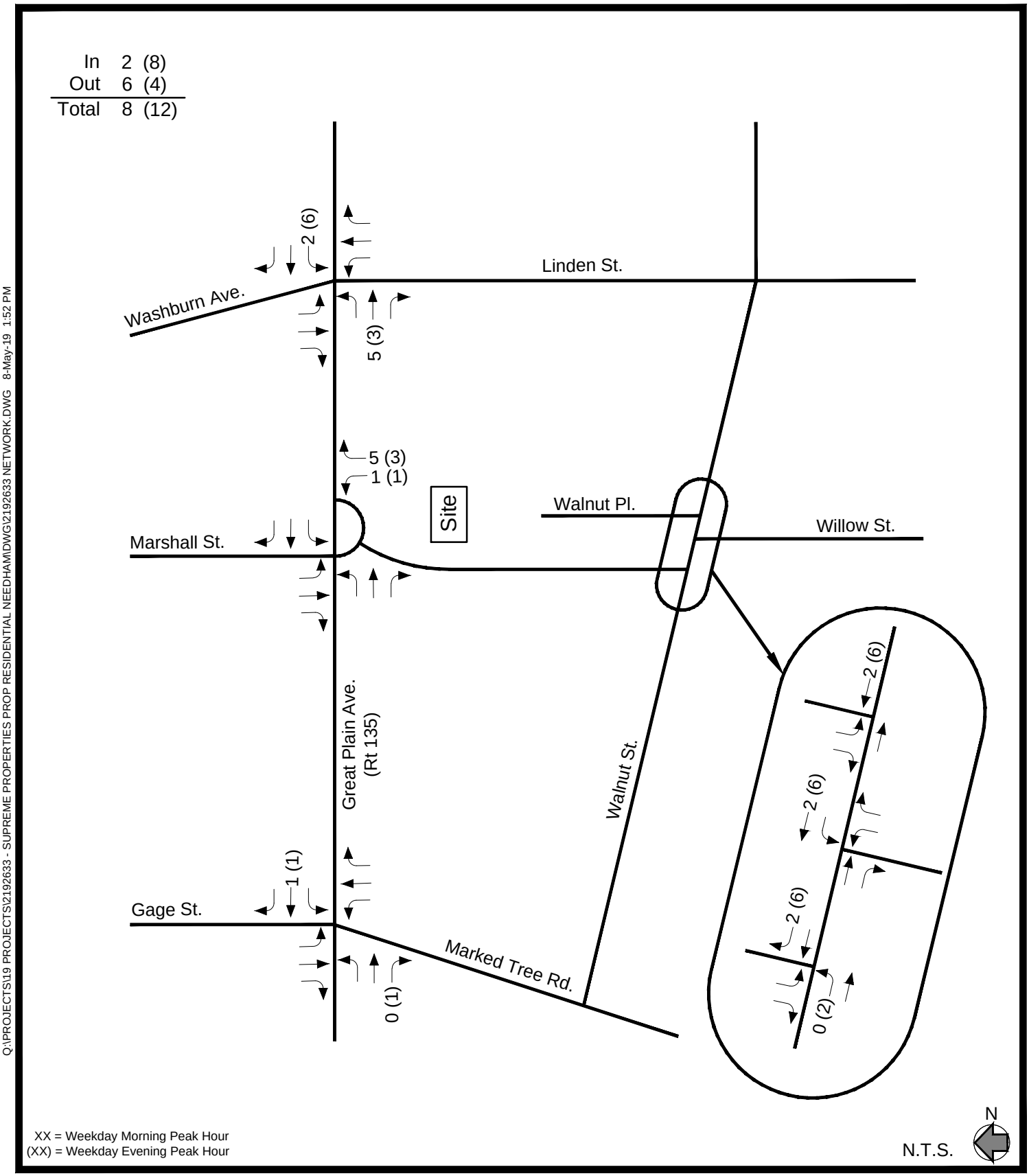

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Figure 10

Site Generated
with Modified Access
Peak Hour Traffic Volumes

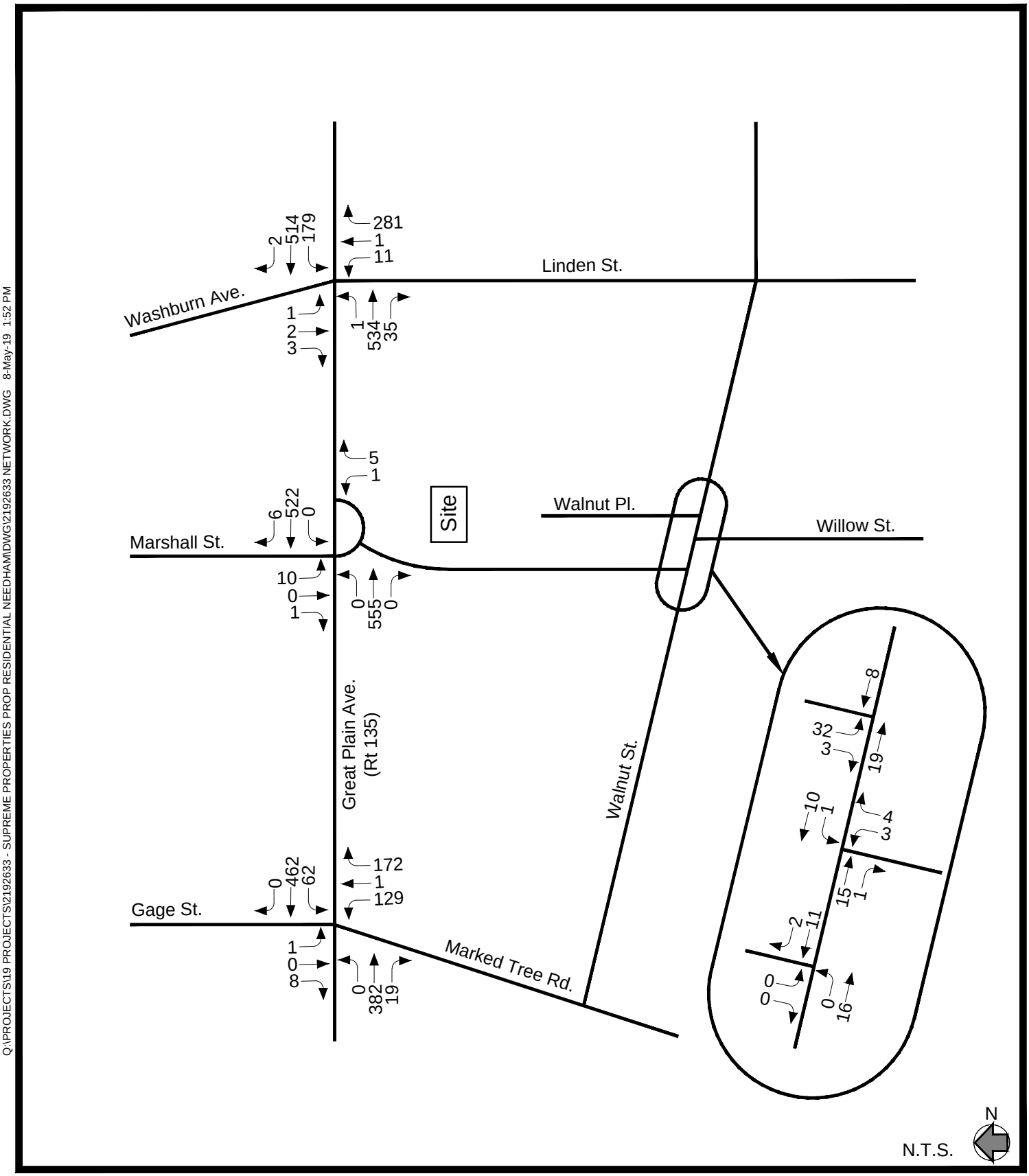

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Figure 11

2026 Build
with Modified Access
Weekday Morning
Peak Hour Traffic Volumes

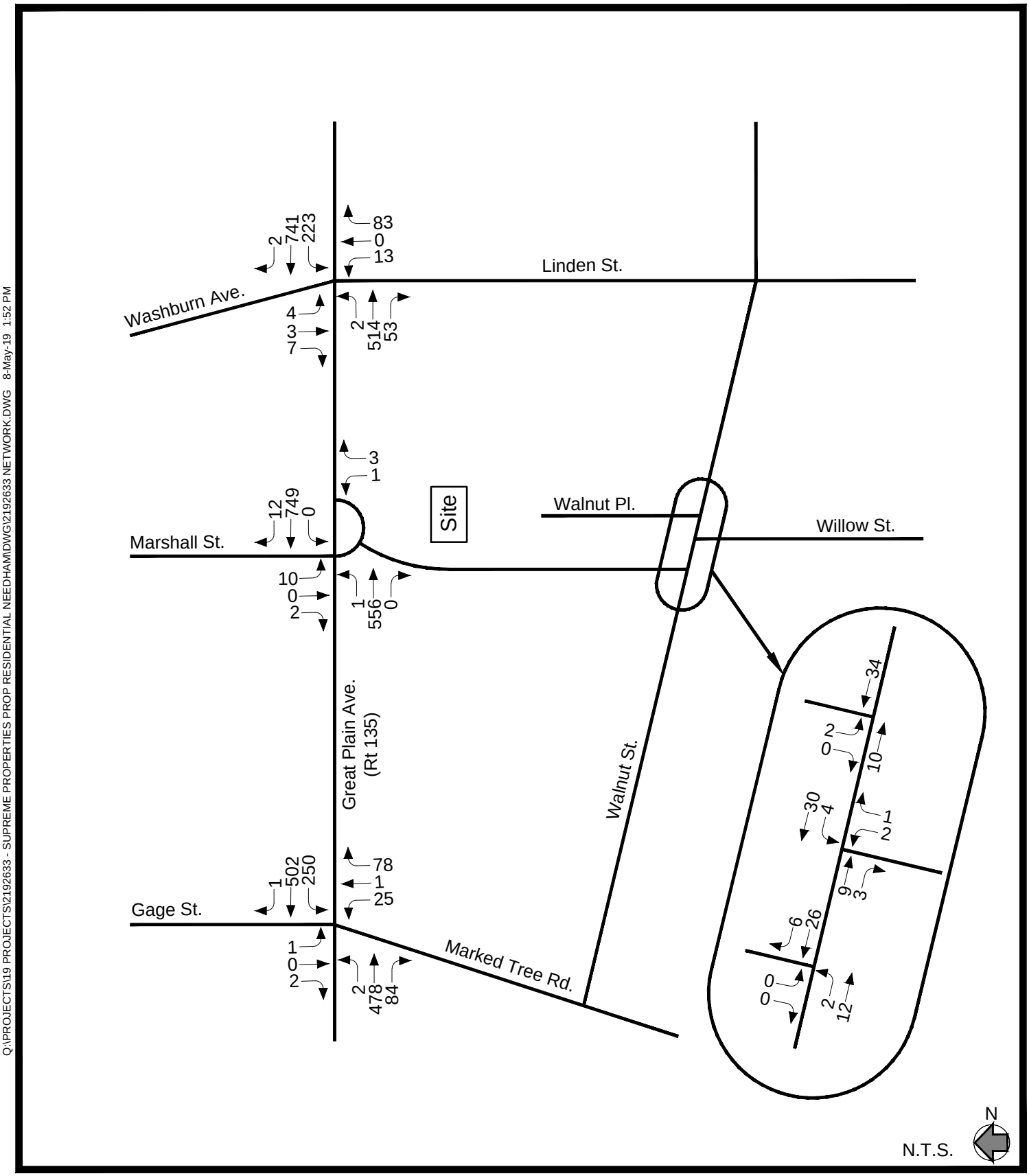

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Figure 12

2026 Build
with Modified Access
Weekday Evening
Peak Hour Traffic Volumes

A summary of 2026 peak-hour projected traffic-volume changes in the site vicinity are shown in Table 8 with the modified access. These volumes are based on the expected increases from the site traffic generation.

TABLE 8
TRAFFIC-VOLUME INCREASES WITH MODIFIED ACCESS[a]

Location/Peak Hour	2026 No-Build	2026 Build	Volume Increase over No-Build
Great Plain Avenue, west of Marked Tree Road			
Weekday Morning	999	1000	1
Weekday Evening	1091	1093	2
Great Plain Avenue, east of Linden Street			
Weekday Morning	1504	1511	7
Weekday Evening	1558	1567	9
Marked Tree Road, south of Great Plain Avenue			
Weekday Morning	383	383	0
Weekday Evening	437	438	1
Linden Street, south of Great Plain Avenue			
Weekday Morning	507	509	2
Weekday Evening	369	375	6

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

Future Traffic Volumes - Build Condition with Day Care Center

A second development scenario was also reviewed. The site was most recently used as a day care center. Therefore, for comparison purposes, the potential impact of a 10,000 square foot (sf) day care center was evaluated, with all access from Great Plain Avenue and all egress to Walnut Street.

The site-generated traffic was distributed within the study area according to the percentages summarized in Table 6 with the proposed access scheme and are shown on Figure 13. The site generated volumes shown on Figure 13 were then superimposed onto the 2026 No-Build traffic volumes to represent the 2026 Build traffic-volume conditions. The anticipated 2026 Build weekday morning and weekday evening peak-hour traffic volumes are graphically presented in Figures 14 and 15. These volumes were used as the

basis for all analysis as well as to identify potential mitigation measures to ameliorate the project's impacts.

A summary of 2026 peak-hour projected traffic-volume changes in the site vicinity are shown in Table 9 with the modified access. These volumes are based on the expected increases from the site traffic generation.

TABLE 9
TRAFFIC-VOLUME INCREASES WITH DAY CARE CENTER[a]

Location/Peak Hour	2026 No-Build	2026 Build	Volume Increase over No-Build
Great Plain Avenue, west of Marked Tree Road			
Weekday Morning	999	1043	44
Weekday Evening	1091	1135	44
Great Plain Avenue, east of Linden Street			
Weekday Morning	1504	1548	44
Weekday Evening	1558	1603	45
Marked Tree Road, south of Great Plain Avenue			
Weekday Morning	383	410	27
Weekday Evening	437	465	28
Linden Street, south of Great Plain Avenue			
Weekday Morning	507	534	27
Weekday Evening	369	398	29

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

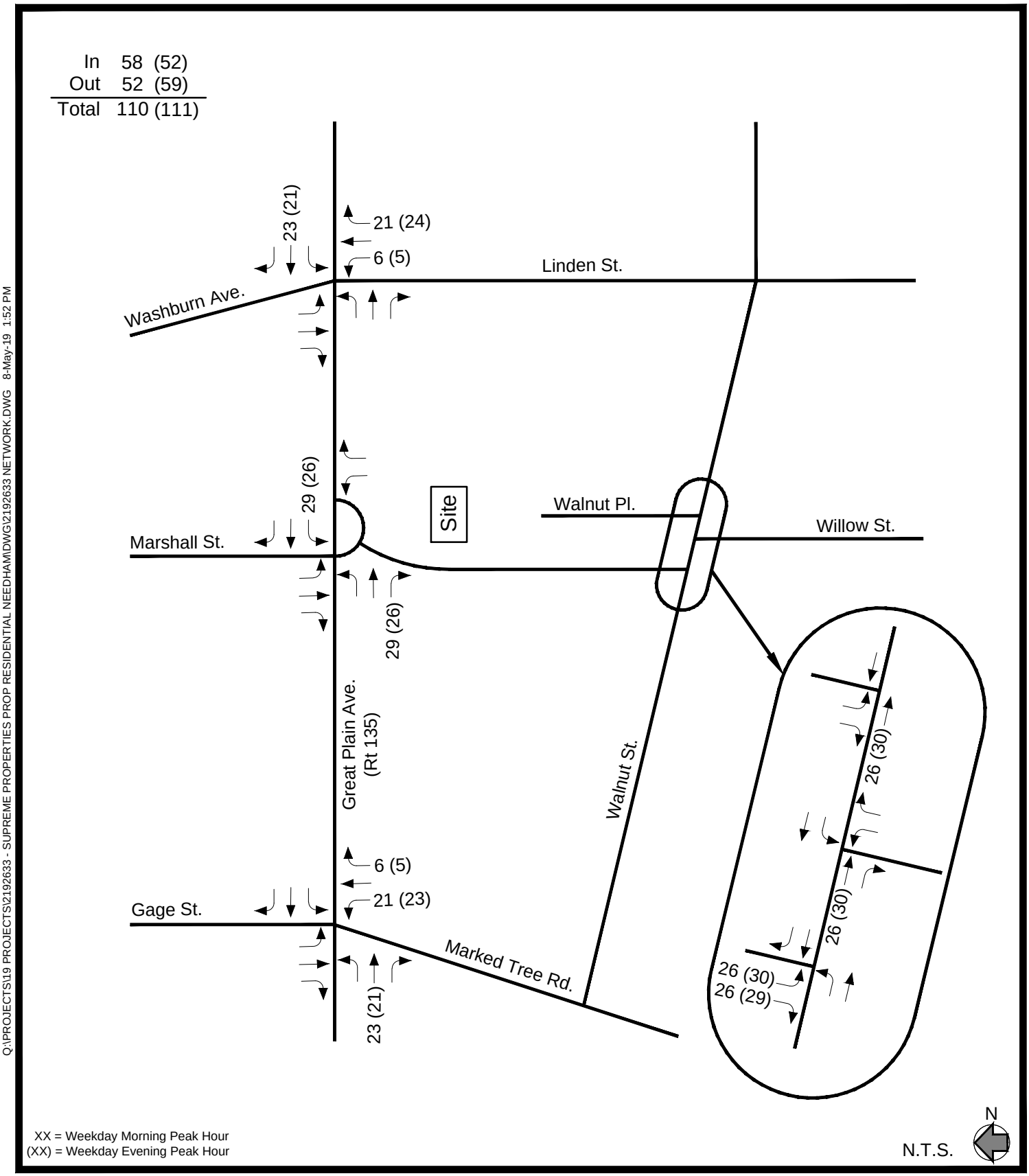

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Figure 13

Site Generated
with Day Care
Peak Hour Traffic Volumes

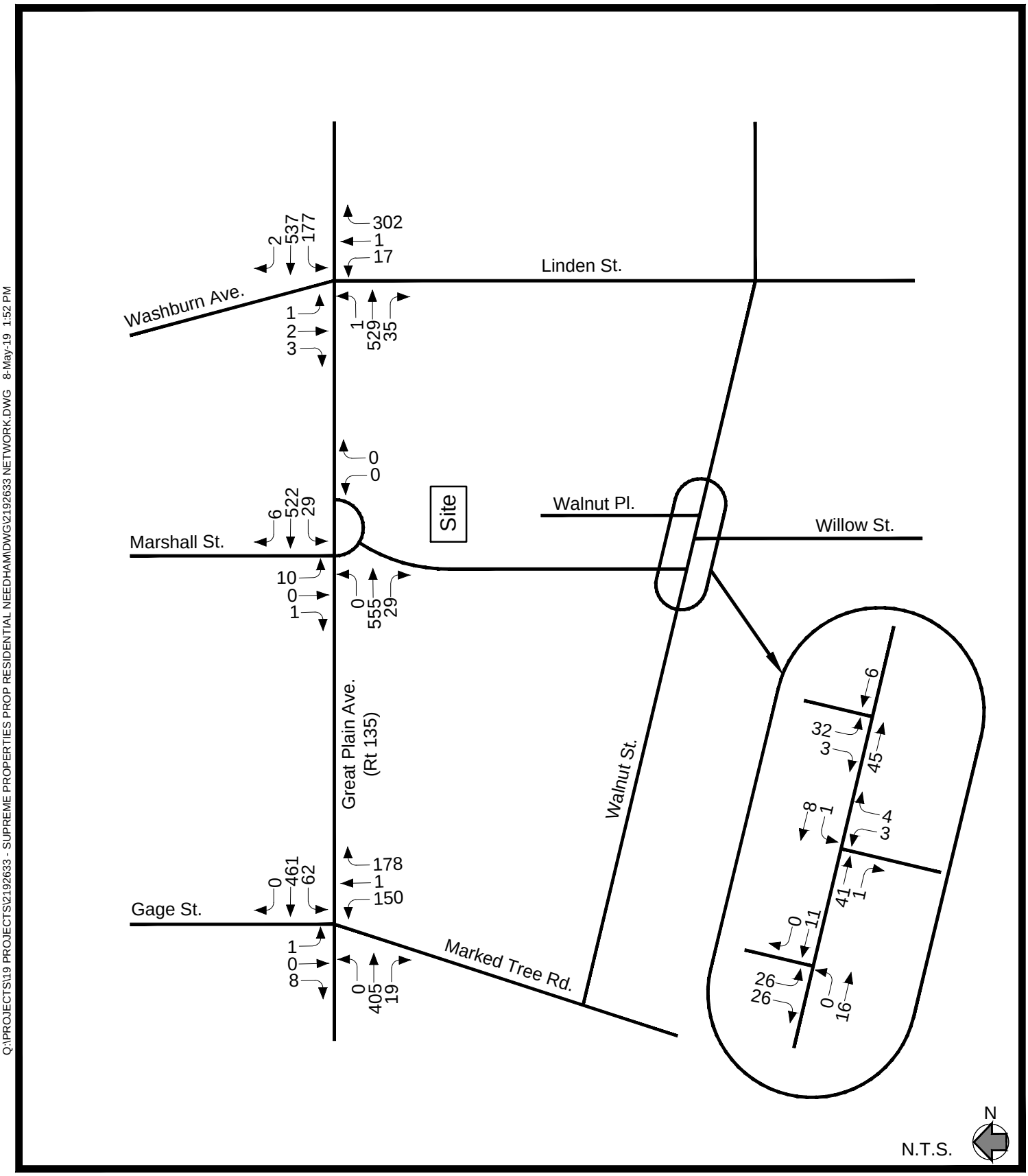

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Figure 14

2026 Build
with Day Care
Weekday Morning
Peak Hour Traffic Volumes

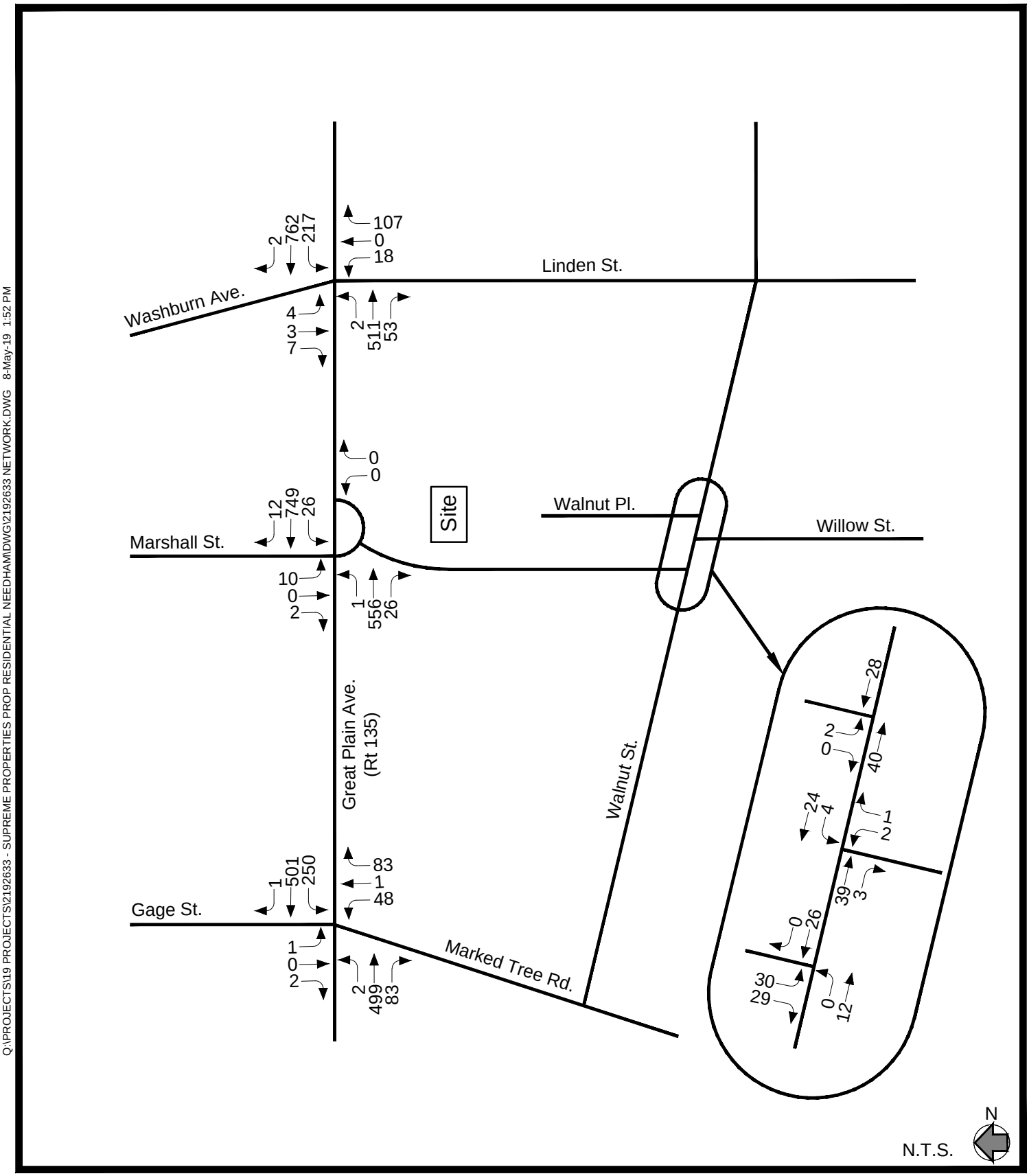

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Figure 15

2026 Build
with Day Care
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[3] 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*. 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 based on the delay per vehicle. Table 10 summarizes the relationship between level of service and delay. The calculated delay values result in level-of-service designations which are applied to individual lane groups, to individual intersection approaches, and to the entire

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

intersection. In the 2010 HCM methodology, the critical lane group volume to capacity ratio is reported.

TABLE 10
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 *Highway Capacity Manual.*[4] 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 11 summarizes the relationship between level of service and average control delay for the critical movements at unsignalized intersections.

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

TABLE 11
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 on minor streets 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 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 2019 Existing, 2026 No-Build, and 2026 Build conditions for the intersections within the study area. The results of the 2026 analyses are summarized in Table 12. Detailed analysis sheets are presented in the Appendix.

The proposed residential development traffic will have very little, if any impact at the study area intersections. This would be true for either access scenario. A review of the impacts associated with a day care center indicate that delays would be increased for the side-streets, and vehicle queues increase by four (4) to five (5) vehicles during peak periods.

Great Plain Avenue, Marked Tree Road and Gage Street

Under 2019 Existing weekday morning conditions, the critical movements at this unsignalized intersection (all movements from Marked Tree Road) are modeled to

currently operate at LOS F and at LOS E during the weekday evening peak hour. Under future 2026 No-Build conditions, the critical movements are projected to operate at LOS F during both the weekday morning and weekday evening peak hours. Under 2026 Build conditions, with the project, the critical movements are projected to operate at LOS F during the weekday morning and weekday evening peak hours.

Great Plain Avenue, Marshal Street and Existing Site Driveway

Under 2019 Existing weekday morning conditions, the critical movements at this unsignalized intersection (all movements from Marshall Street) are modeled to operate at LOS C and at LOS D during the weekday evening peak hour. Under future 2026 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 2026 Build conditions, with the project, 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.

Great Plain Avenue, Linden Street and Washburn Avenue

Under 2019 Existing weekday morning conditions, the critical movements at this unsignalized intersection (all movements from Linden Street) are modeled to operate at LOS F and at LOS D during the weekday evening peak hour. Under future 2026 No-Build conditions, the critical movements are projected to operate at LOS F during the weekday morning peak hour and at LOS E during the weekday evening peak hour. Under 2026 Build conditions, with the project, the critical movements are projected to operate at LOS F during the weekday morning and weekday evening peak hours.

Walnut Street, Willow Street and Walnut Place

Under 2019 Existing weekday morning conditions, the critical movements at this unsignalized intersection (all movements from Willow Street) are modeled to operate at LOS A and at LOS A during the weekday evening peak hour. Under future 2026 No-Build conditions, the critical movements are projected to operate at LOS A during the weekday morning and weekday evening peak hours. Under 2026 Build conditions, with the project, the critical movements are projected to continue to operate at LOS A during the weekday morning and weekday evening peak hours.

TABLE 12
UNSIGNALIZED LEVEL-OF-SERVICE ANALYSIS SUMMARY

	2019 Existing					2026 No-Build					2026 Build					2026 Build with Modified Access					2026 Build with Day Care Center				
Critical Movement/ Peak Hour	Demand[a]	V/C[b]	Delay[c]	LOS[d]	Queue[e]	Demand	V/C	Delay	LOS	Queue	Demand	V/C	Delay	LOS	Queue	Demand	V/C	Delay	LOS	Queue	Demand	V/C	Delay	LOS	Queue
Great Plain Avenue, Marked Tree Road and Gage Street																									
All movements from Marked Tree Road:																									
Weekday Morning	282	1.01	88.7	F	277.5	302	1.20	156.5	F	387.5	302	1.20	158.2	F	387.5	302	1.20	158.2	F	387.5	329	1.41	239.7	F	510.0
Weekday Evening	97	0.51	37.6	E	65.0	104	0.65	56.1	F	95.0	105	0.67	58.1	F	97.5	104	0.66	58.1	F	97.5	132	1.15	192.1	F	222.5
All movements from Gage Street:																									
Weekday Morning	8	0.05	16.7	C	5.0	9	0.06	17.7	C	5.0	9	0.06	17.7	C	5.0	9	0.06	17.7	C	5.0	9	0.06	18.4	C	5.0
Weekday Evening	3	0.08	45.8	E	7.5	3	0.11	60.2	F	7.5	3	0.11	60.2	F	7.5	3	0.11	60.2	F	7.5	3	0.11	63.8	F	10.0
Great Plain Avenue, Marshall Street and Site Driveway																									
All movements from Marshall Street																									
Weekday Morning	10	0.09	24.6	C	7.5	11	0.11	27.9	D	10.0	11	0.11	28.5	D	10.0	11	0.11	28.3	D	10.0	11	0.13	32.2	D	10.0
Weekday Evening	11	0.12	30.7	D	10.0	12	0.15	35.9	E	12.5	12	0.16	37.6	E	12.5	12	0.15	36.2	E	12.5	12	0.17	41.1	E	15.0
All movements from Site Driveway:																									
Weekday Morning	0	-	0.0	A	0.0	0	-	0.0	A	0.0	6	0.02	15.1	C	2.5	6	0.02	15.1	C	2.5	0	-	0.0	A	0.0
Weekday Evening	0	-	0.0	A	0.0	0	-	0.0	A	0.0	4	0.02	18.3	C	0.0	4	0.02	18.0	C	0.0	0	-	0.0	A	0.0
Great Plain Avenue, Linden Street and Washburn Avenue																									
All movements from Linden Street:																									
Weekday Morning	273	1.02	83.4	F	312.5	293	1.23	160.2	F	460.0	293	1.25	166.2	F	467.5	293	1.25	166.2	F	467.5	320	1.51	279.1	F	26.0
Weekday Evening	89	0.45	32.7	D	55.0	96	0.60	48.9	E	82.5	96	0.61	51.0	F	85.0	96	0.62	53.2	F	87.5	125	0.85	86.2	F	147.5
All movements from Washburn Avenue:																									
Weekday Morning	6	0.22	102.5	F	17.5	6	0.44	242.1	F	32.5	6	0.44	242.1	F	32.5	6	0.44	242.1	F	32.5	6	0.66	422.4	F	42.5
Weekday Evening	14	0.19	56.7	F	17.5	14	0.26	78.5	F	22.5	14	0.27	81.6	F	22.5	14	0.27	83.2	F	22.5	14	0.28	88.5	F	25.0
Walnut Street, Willow Street and Walnut Place																									
All movements from Willow Street:																									
Weekday Morning	7	0.02	8.6	A	2.5	7	0.02	8.6	A	2.5	7	0.02	8.6	A	2.5	7	0.02	8.6	A	2.5	7	0.02	8.7	A	2.5
Weekday Evening	3	0.01	8.7	A	0.0	3	0.01	8.7	A	0.0	3	0.01	8.7	A	0.0	3	0.01	8.7	A	0.0	3	0.01	9.0	A	0.0
All movements from Walnut Place:																									
Weekday Morning	35	0.07	9.0	A	5.0	35	0.07	9.0	A	5.0	35	0.07	9.0	A	5.0	35	0.08	9.1	A	2.5	35	0.08	9.2	A	7.5
Weekday Evening	2	0.00	8.8	A	0.0	2	0.00	8.8	A	0.0	2	0.00	8.8	A	0.0	2	0.00	8.9	A	0.0	2	0.01	9.2	A	0.0

[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]Queue in feet.
NC = Not calculated in Synchro model as volume exceeds capacity.

SIGHT DISTANCE

Sight distance measurements were performed at the existing intersection of Great Plain Avenue and the existing site driveway in accordance with Massachusetts Department of Transportation (MassDOT) and American Association of State Highway and Transportation Officials (AASHTO) standards. Stopping sight distance (SSD) measurements were performed. In brief, SSD is the distance required by a vehicle traveling at the design speed of a roadway, on wet pavement, to stop prior to striking an object in its travel path. Intersection sight distance (ISD) or corner sight distance (CSD) is the sight distance required by a driver entering or crossing an intersecting roadway, to perceive an on-coming vehicle and safely complete a turning or crossing maneuver with on-coming traffic. Table 13 presents the measured SSD at the driveway intersection. The sight distance calculations are included in the Appendix.

TABLE 13
SIGHT DISTANCE SUMMARY

	Required Minimum (Feet)[a]	Measured (Feet)
Great Plain Avenue and Site Driveway		
Stopping Sight Distance:		
Great Plain Avenue approaching from the east	257	500+
Great Plain Avenue approaching from the west	246	500+
Intersection Sight Distance:		
Great Plain Avenue Connector looking to the east	344[b]/397[c]	400+
Great Plain Avenue Connector looking to the west	344[b]/397[c]	400+

[a]Recommended minimum values obtained from *A Policy on Geometric Design of Highways and Streets*; American Association of State Highway and Transportation Officials (AASHTO); 2010, and based on observed 85th percentile speed.
[b]Recommended minimum value for vehicles turning right exiting a roadway under STOP-sign control.
[c]Recommended minimum value for vehicles turning left exiting a roadway under STOP-sign control.

As can be seen in Table 13, the SSD measurements performed at Great Plain Avenue and the site driveway intersection indicate that the SSD exceeds the recommended minimum requirements based on the 85th percentile speeds. In accordance with the AASHTO manual, *"If the available sight distance for an entering or crossing vehicle is at least equal to the appropriate stopping sight distance for the major road, then drivers have sufficient sight distance to anticipate and avoid collisions. However, in some cases, this may require a major-road vehicle to stop or slow to accommodate the maneuver by a minor-road vehicle. To enhance traffic operations, intersection sight distances that exceed stopping sight distances are desirable along the major road."* Accordingly, the ISD should be at least equal to the SSD, which would allow a driver approaching the minor road to safely stop. It is recommended that any signage or landscaping that would occur along the Great Plain Avenue frontage be set back and designed to not impact sight lines.

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 2019 Existing and 2026 future No-Build and Build conditions indicate some traffic deficiencies currently exist within the study area. The addition of the site generated traffic will marginally increase projected delays.

Mitigation Related to Project

The following measures have been identified to mitigate the project's impacts and improve intersection operations. The project proponent is committed to working with the Town of Needham to implement the mitigation measures listed below.

It is recommended that the exit to Great Plain Avenue be under STOP sign control. It is recommended that any signage or landscaping that would occur along the Great Plain Avenue frontage be set back and designed to not impact sight lines.

Transportation Demand Management

The goal of a Transportation Demand Management (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 showers, 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. On an area-wide basis, the provision of park-and-ride facilities and transit services can also provide a competitive alternative to drive-alone commuting. TDM strategies are the supporting measures that encourage the use of alternatives to driving alone. TDM strategies 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 a number of measures that contribute toward the reduction of vehicular traffic to and from the site. The following describes the TDM program:

- The management company responsible for the renting of the apartments will responsible for coordinating the TDM program.

- The management company will promote alternative transportation modes by posting local bus schedules and encouraging tenants to provide incentives to employees using public transportation. The MBTA currently has a bus route that runs along Great Plain Avenue, as well as the nearby commuter rail stations.

- Bicycle racks will be located within 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 0 to 9 bi-directional vehicles during the peak hours at the study area boundaries. This is approximately equivalent to one additional vehicle every twelve (12) minutes or less per direction on average during the peak hours.

With the proposed access, in conjunction with the mitigation measures described above and maintaining sight distances from the driveway (clear sight lines along frontage), safe and efficient access can be provided to the residents of the proposed project and to the motoring public in the area.