TRAFFIC IMPACT STUDY

PROPOSED RESIDENTIAL DEVELOPMENT
AMHERST, NEW HAMPSHIRE

Prepared for:
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DESCRIPTION OF PROJECT

Vanasse & Associates, Inc. (VAI) has conducted a Traffic Impact Study (TIS) in order to determine the traffic impacts associated with a proposed residential development to be located at 153-169 Hollis Road (Route 122) in Amherst, New Hampshire. The purpose of this TIS is to review existing and future traffic conditions in the vicinity of the site, determine the traffic impact from the proposed project at key intersections expected to experience increased traffic levels from the Project, and review the need for improvements to mitigate the Project's traffic impact.

FACILITY AND PROJECT BACKGROUND

The site currently consists of two (2) existing single-family homes located in the south portion of the site. The proposed project will consist of the construction of 52 single family residential units. Access to the Project site will be provided by way of three driveways; a north driveway that will intersect south of Hollis Road aligned with Peacock Brook Lane, a center driveway that will intersection Hollis Road approximately 400 south of Peacock Brook Lane, and a south driveway approximately 300 feet northwest of Rocky Hill Road.

EXISTING CONDITIONS

A comprehensive field inventory of existing traffic conditions on the study area roadways was conducted in September 2020. The field investigation consisted of an inventory of existing roadway geometrics, traffic volumes, and operating characteristics, as well as posted speed limits, sight distances, and land use information within the study area. Traffic volumes were collected at the intersections of Hollis Road at Rocky Hill Road, Hollis Road at Ponemah Hill Road, and Hollis Road at Old Nashua Road during the weekday morning and evening time periods. Traffic volumes were adjusted both for peak-month conditions per New Hampshire Department of Transportation (NHDOT) guidelines for TISs and for COVID-19 traffic-volume reductions.

FUTURE CONDITIONS

The 2021 and 2031 No-Build peak-month peak-hour traffic volumes were developed by applying the 0.5 percent per year compounded annual background traffic growth rate to the 2020 Existing peak-month peak-hour traffic volumes then adding the peak-hour traffic volumes associated with the identified specific development projects by others, and the 2021 Opening Year and 2031 Build condition traffic volumes were developed by adding Project-generated traffic to the corresponding 2021 and 2031 No-Build peak-month peak-hour traffic-volumes.

PROJECT-GENERATED TRAFFIC

The proposed project will entail the construction of 54-unit residential development. The project is expected to generate 452 vehicle trips (226 entering and 226 exiting) on an average weekday, with 38 new vehicle trips (10 entering and 28 exiting) during the weekday morning peak hour. During the weekday evening peak hour, the Project is expected to generate 47 vehicle trips (30 entering and 17 exiting).

RECOMMENDATIONS

A detailed transportation improvement program has been developed and it is designed to provide safe and efficient access to the Project site. The following improvements have been recommended as a part of this evaluation and, where applicable, will be completed in conjunction with the Project subject to receipt of all necessary rights, permits, and approvals.

Site Roadway

Access to the Project site will be provided by way of three driveways; a north driveway that will intersect south of Hollis Road aligned with Peacock Brook Lane, a center driveway that will intersection Hollis Road approximately 400 south of Peacock Brook Lane, and a south driveway approximately 300 feet northwest of Rocky Hill Road. The following recommendations are offered with respect to the design and operation of the Project site access and internal circulation, many of which are reflected on the Site Plans:

- In order to provide safe operation for vehicles exiting and approaching the site roadway intersections with Hollis Road, the following recommendations are suggested:

  - The site roadway intersections with Hollis Road should be a minimum of 24 feet in width and support the turning and maneuvering requirements of delivery trucks and the largest anticipated responding emergency vehicle as defined by the Amherst Fire Department;

  - Existing trees and vegetation located along the eastbound/south side of Hollis Road within the intersection triangle area of the Project North and South site driveways should be selectively trimmed or removed and maintained; and

  - STOP signs should be installed and STOP bars be marked at the site roadway intersections with Hollis Road.

- All signs and pavement markings to be installed within the Project site should conform to the applicable standards of the *Manual on Uniform Traffic Control Devices* (MUTCD).[1]

- Americans with Disabilities Act (ADA)-compliant wheelchair ramps should be provided at all pedestrian crossings that are to be constructed or modified as a part of the Project where a connecting sidewalk is also provided.

- A sidewalk or other suitable pedestrian accommodation should be provided along at least one side of the internal roadway network and extend to Hollis Road. Crosswalks with ADA-compliant wheelchair ramps should be provided at all pedestrian crossings internal to the Project site.

- Snow windrows within sight triangle areas of the Project site driveways should be promptly removed where such accumulations would impede sight lines.

CONCLUSIONS

The traffic assessment contained herein indicates that the Project will not have substantial impacts at the study area intersections and Project-related traffic increases are expected to be between 0.0 and 5.0 percent during the peak hours depending on location. Adequate site distances exist at the new site roadway intersections with Hollis Road to see vehicles exiting the site roadway and to be seen by the operators of these vehicles. Recommendations have been identified to ensure visibility at the roadway. With these recommended measures in place, safe and efficient access and egress will be provided to the proposed development with minimal impact to the surrounding transportation system.

[1] *Manual on Uniform Traffic Control Devices (MUTCD)*; Federal Highway Administration; Washington, D.C.; 2009.

INTRODUCTION

VAI has conducted a TIS in order to determine the traffic impacts associated with a proposed residential development to be located at 153-169 Hollis Road (Route 122) in Amherst, New Hampshire. This study evaluates the following specific areas as they relate to the Project: i) access requirements; ii) potential off-site improvements; and iii) safety considerations; and identifies and analyzes existing traffic conditions and future traffic conditions, both with and without the Project, along Hollis Street and at major intersections located along this roadway through which Project-related traffic will travel as defined in consultation with the Town of Amherst.

PROJECT DESCRIPTION

The Project will entail the construction of a 54-unit residential community that will be comprised of 30 single family homes, 5 two-unit multifamily buildings (10 dwelling units), and 14-unit age restricted (to 65+ seniors) buildings to be located 153-169 Hollis Road (Route 122) in Amherst, New Hampshire. The Project site is bounded by Hollis Road to the north; areas of open and wooded space to the south and west; and Rocky Hill Road to the east. The Project site is currently occupied by two (2) single family homes and associated appurtenances, and areas of open and wooded space. Figure 1 depicts the Project site location in relation to the existing roadway network.

Access to the Project site will be provided by way of three driveways; a north driveway that will intersect south of Hollis Road aligned with Peacock Brook Lane, a center driveway that will intersection Hollis Road approximately 400 south of Peacock Brook Lane, and a south driveway approximately 300 feet northwest of Rocky Hill Road.

Off-street parking will be provided for a minimum of two (2) vehicles per unit in individual driveways. In addition, total of 20 parking spaces are proposed for the Club House and visitors adjacent to the Club House, and 10 parking spaces for visitors, trail head access and the community garden adjacent to the community garden.

STUDY METHODOLOGY

This study was performed in consultation with the Town of Amherst Town Planner and Director of the Department of Public Work (DPW); and the NHDOT; was performed in general accordance with: i) the NHDOT guidelines for the preparation of TISs; and ii) the standards of the and Traffic

Engineering and Transportation Planning Professions for the preparation of such report; and was conducted in three distinct stages.

The first stage involved an assessment of existing conditions in the study area and included an inventory of roadway geometrics, observations of traffic flow, and collection of daily and peak-period traffic counts.

In the second stage of the study, future traffic conditions on the transportation system were projected and analyzed. Specific travel demand forecasts for the Project were assessed along with future demands on the transportation system that are expected due to growth independent of the Project. In accordance with NHDOT guidelines for the preparation of TISs, four (4) future conditions were evaluated: 1) 2021 No-Build conditions <u>without</u> the Project; 2) 2021 Opening Year Build conditions <u>with</u> the Project; 3) 2031 No-Build conditions <u>without</u> the Project; and 4) 2031 Build conditions (ten-year projection from opening-year) <u>with</u> the Project. The analyses conducted in stage two of the study identify existing or projected future roadway capacity and traffic safety issues.

The third stage of the study presents and evaluates measures to address traffic and safety issues, if any, identified in stage two of the study.

EXISTING CONDITIONS

A comprehensive field inventory of existing conditions within the study area was conducted in September 2020. The field investigation consisted of an inventory of existing roadway geometrics; traffic volumes; and operating characteristics; as well as posted speed limits, and land use information within the study area. The study area for the project contains the major roadway which provide access to the project, as well as the intersections which are expected to accommodate the majority of project-related traffic. The study area was discussed with the Town Planning Board and DPW staff and is listed below with a graphic depiction provided in Figure 1.

- Hollis Road at Rocky Hill Road
- Hollis Road at Ponemah Hill Road and Barlett Drive
- Hollis Road at Old Nashua Road

The following describes the study area roadway and intersections which are also shown in Figure 2 which summarizes existing lane use, and travel lane widths at the study area intersections.

ROADWAY

Hollis Road (Route 122)

Hollis Road is classified as a major collector under the jurisdiction of the NHDOT. Hollis Road traverses the study area in a general north-south alignment and connects to Ponemah Road to the north and Silver Lake Road to the south. Holli Road provides two 11- to 12-foot travel lanes separated by a double-yellow centerline. Illumination is provided at major intersections on Hollis Road. The land uses along Hollis Road generally consists of undeveloped land and some residential properties.

INTERSECTIONS

Old Nashua Road at Hollis Road and Ponemah Road

Old Nashua Road is intersected by Hollis Road/Ponemah Road to form a three-way intersection with a triangular island at the center which is under STOP-sign control. Note that vehicles approaching from east-west portion of Old Nashua Road to the north-south portion of this road are not under STOP-sign control. Direction of travel at this intersection is separated by a double-yellow centerline with 1- to 2-foot wide shoulders provided on Ponemah Road/Hollis Road. Illuminations is provided via street light mounted on wood poles. Land use in the vicinity of this intersection consists of residential houses and areas of open and wooded space. This intersection is under the jurisdiction of the NHDOT and the Town of Amherst.

Hollis Road at Ponemah Hill Road and Barlett Drive

Hollis Road is intersected by Ponemah Hill Road from the west and Barlett Drive from the east to form this four-way intersection under STOP-sign control. Direction of travel on Hollis Road and Ponemah Road is separated by a double-yellow centerline with 1- to 2-foot wide marked shoulders. Illumination is provided via street light mounted on wood poles. Land use in the vicinity of this intersection consists of residential properties and areas of open and wooded space. This intersection is under the jurisdiction of the NHDOT and Town of Amherst.

Hollis Road at Rocky Hill Road

Hollis Road is intersected by Rocky Hill Road from the west to form this three-way intersection under STOP-sign control. Direction of travel on Hollis Road is separated by a double-yellow centerline with 1- to 3-foot wide marked shoulders. Illumination is provided via street lights mounted on wood poles. Land use in the vicinity of this intersection consists of residential properties and areas of open and wooded space. This intersection is under the jurisdiction of the NHDOT and Town of Amherst.

EXISTING TRAFFIC VOLUMES

In order to determine existing traffic-volume demands and flow patterns within the study area, manual turning movement counts (TMCs), and vehicle classification counts were completed in September 2020. Weekday morning (7:00 to 9:00 AM) and evening (4:00 to 6:00 PM) peak-period manual TMCs were performed at the study area intersections on September 16th, 2020 (Wednesday).

In order to account for the reduction in traffic volumes caused by the COVID-19 travel restrictions, a review of NHDOT traffic count data at NH permanent count station No. 62315281 on the Frederick E. Everett Turnpike in Nashua was conducted. Based on this comparison, the Average Daily Traffic (ADT) in September 2020 was found to be approximately 20 percent lower than the ADT in September 2019. Based on this traffic count data comparison, the traffic-volume data that was collected as a part of this assessment were adjusted upward by 20.0 percent in order to account for the reduced traffic volumes resulting from COVID-19 pandemic.

Traffic volumes associated with the existing 19-unit single family homes exiting Peacock Brook Lane, opposite side of north site driveway, were developed using trip-generation statistics published by the Institute of Transportation Engineers (ITE)[2] for similar land use.

Seasonal Adjustments

In order to evaluate the potential for seasonal fluctuation of traffic volumes within the study area, peak hour traffic count data by the NHDOT permanent count station No. 02037090 on the Frederick

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

E. Everett Turnpike at the Bedford Tolls in Bedford was conducted. Based on a review of this data, it was determined that the traffic volumes collected in September were found to be approximately 8.0 percent lower than peak-month traffic volumes. Therefore, the peak-hour volumes were adjusted upwards accordingly to represent peak-month conditions in accordance with NHDOT standards. The 2020 Existing weekday morning and evening peak-month peak-hour traffic volumes are depicted on Figures 3 and 4.

A review of the traffic counts indicates that the weekday morning peak hour occurred between 7:15 and 8:15 AM, the weekday evening peak hour occurred between 4:00 and 5:00 PM.

PEDESTRIAN AND BICYCLE FACILITIES

A comprehensive field inventory of pedestrian and bicycle facilities within the study area was undertaken in September 2020. The field inventory consisted of a review of the location of sidewalks and pedestrian crossing locations along the study roadways and at the study intersections, as well as the location of bicycle facilities. There are no sidewalks, crosswalks or bicycle accommodations provided within the study area.

PUBLIC TRANSPORTATION

No public transportation services are provided within the study area.

SPOT SPEED MEASUREMENTS

Vehicle travel speed measurements were performed on Hollis Road in the vicinity of the Project site. Table 1 summarizes the vehicle travel speed measurements.

Table 1
VEHICLE TRAVEL SPEED MEASUREMENTS

	Hollis Road	
	Northbound	Southbound
Mean Travel Speed (mph)	42	42
85th Percentile Speed (mph)	45	45
Regulated Speed Limit (mph)	40	40

mph = miles per hour.

As can be seen in Table 1, the mean vehicle travel speed along Hollis Road in the vicinity of the Project site was found to be 42 miles per hour (mph) in the northbound and southbound directions. The measured 85th percentile vehicle travel speed, or the speed at which 85 percent of the observed vehicles traveled at or below, was found to be 45 mph in both directions, which is 5 mph above the posted speed limit on Hollis Road (40 mph). The 85th percentile speed is used as the basis of engineering design and in the evaluation of sight distances, and is often used in establishing posted speed limits.

MOTOR VEHICLE CRASH DATA

Motor vehicle crash information for the study area intersections was provided by the Amherst Police Department for the most recent five-year period available (2015 through 2019, inclusive) in order to examine motor vehicle crash trends occurring within the study area. The data is presented in Table 2.

Table 2
MOTOR VEHICLE CRASH DATA SUMMARY[a]

	Old Nashua Rd./ Hollis Rd.	Hollis Rd/ Ponemah Hill Rd.	Hollis Rd./ Rocky Hill Rd.
Traffic Control Type:[b]	U	U	U
Year:			
2013	0	0	0
2014	0	1	0
2015	0	1	0
2016	0	0	1
2017	0	1	0
Total	0	3	1
Total Collisions	0	3	1
Average	0.0	0.6	0.2
Rate[c]	0.00	0.31	0.12

[a]Source: Amherst Police Department, 2015 through 2019.
[b]Traffic Control Type: U = unsignalized.
[c]Crash rate per million vehicles entering the intersection.

As can be seen in Table 2, the study area intersections were found to have experienced an average 0.6 or fewer motor vehicle crashes per year over the five-year review period. Based on the volume of traffic traversing the intersections, the calculated motor vehicle crash rate is up to 0.31 crashes per million entering vehicles. No fatal motor vehicle crashes were reported to have occurred at the study area intersection over the five-year review period. No motor vehicle crashes were reported at the Old Nashua Road and Hollis Road intersection. The detailed crash log is provided in the Appendix.

FUTURE CONDITIONS

Traffic volumes in the study area were projected to the year 2021 and 2031, which reflect the anticipated opening year of the development and a ten-year planning horizon from opening year, respectively, consistent with State traffic study guidelines. The future condition traffic-volume projections incorporate identified specific development projects by others, as well as general background traffic growth as a result of development external to the study area and presently unforeseen projects. Anticipated Project-generated traffic volumes superimposed upon the 2021 and 2031 No-Build traffic volumes reflect the Build conditions with the Project.

BACKGROUND TRAFFIC GROWTH

Traffic growth is a function of the expected land development in the immediate area and 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. However, the drawback to such a procedure is that some turning volumes may actually grow at either a higher or 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 procedure produces a more realistic estimate of growth for local traffic. However, the drawback of this procedure is that 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.

Specific Development by Others

The Towns of Amherst and Hollis were contacted in order to determine if there are any planned or approved specific development projects within the area that would have an impact on future traffic volumes at the study intersections. Based on that discussion, the following project was identified:

- ***Residential Development, Hollis, New Hampshire.*** This proposed project entails the construction of a 50-unit residential development to be located off Silver Lake Road in Amherst, New Hampshire.

Traffic volumes associated with the aforementioned specific development project by others were developed using trip-generation information available from the ITE[3] for the appropriate land use, and were assigned onto the study area roadway network based on existing traffic patterns where no other information was available.

No other developments were identified at this time that are expected to result in an increase in traffic within the study area beyond the general background traffic growth rate.

General Background Traffic Growth

A review of historic traffic growth information compiled by NHDOT for the Town of Amherst was undertaken in order to determine general traffic growth trends. Based on a review of this data, it was determined that traffic volumes have generally increased by approximately 0.4 percent per year over the past several years. To be conservative a 0.5 percent compounded annual background traffic growth rate was used in order to account for future traffic growth and presently unforeseen development within the study area.

Roadway Improvement Projects

The Towns of Amherst, and Hollis and NHDOT were contacted in order to determine if there are any planned roadway improvement projects expected to be completed within the study area over the ten-year study duration. Based on these discussions, the following improvement project was identified:

- ***State Highway Improvements on Ponemah Road*** – the curve warning sign will be installed along the segment of Ponemah Road near Old Nashua Road (project #42953) which is expected to be completed in 2021.

No other roadway improvement projects aside from routine maintenance activities were identified to be planned within the study area at this time.

NO-BUILD TRAFFIC VOLUMES

The 2021 and 2031 No-Build peak-month peak-hour traffic volumes were developed by applying the 0.5 percent per year compounded annual background traffic growth rate to the 2020 Existing peak-month peak-hour traffic volumes then adding the peak-hour traffic volumes associated with the identified specific development projects by others. The resulting 2021 No-Build weekday morning, and weekday evening peak-month peak-hour traffic volumes are shown on Figures 5 and 6, respectively, with the corresponding 2031 No-Build peak-month peak-hour traffic volumes shown on Figures 7 and 8.

PROJECT-GENERATED TRAFFIC

Design year (2021 Opening Year and 2031 Build) traffic volumes for the study area roadways were determined by estimating project-generated traffic volumes and assigning these volumes on the study roadways. The following sections describe the procedures used to develop the Build condition traffic-volume networks.

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[3]Ibid 2.

The proposed project consists of the construction of a 54-unit residential development. In order to develop the traffic characteristics of the proposed project, trip-generation statistics published by the ITE for a land use consistent with the proposed was used. ITE Land Use Codes (LUC) 210, *Single-Family Detached Housing*; LUC 220, *Multifamily Housing (Low-Rise)*; and LUC 251, *Senior Adult Housing-Detached* were used to estimate project traffic generation. The total trip generation is summarized in Table 3. Note that, two (2) existing single-family homes were excluded from trip-generation calculations as traffic from these developments is present in the observed traffic counts.

Table 3
TRIP-GENERATION SUMMARY

Time Period/Direction	Single-Family Detached Housing (26 units)[a]	Multifamily Building (12 units)[b]	Senior Housing (14 units)[c]	Total
Weekday Daily	302	50	100	452
Weekday Morning Peak Hour:				
Entering	6	1	3	10
Exiting	17	5	6	28
Total	23	6	9	38
Weekday Evening Peak Hour:				
Entering	18	6	6	30
Exiting	10	3	4	17
Total	28	9	10	47

[a]Based on ITE LUC 210, Single-Family Detached Housing
[b]Based on ITE LUC 220, Multifamily Housing (Low-Rise)
[c]Based on ITE LUC 251, Senior Adult Housing- Detached

As can be seen in Table 3, the proposed Project is expected to generate 452 vehicle trips (226 entering and 226 exiting) on an average weekday, with 38 new vehicle trips (10 entering and 28 exiting) during the weekday morning peak hour and 47 vehicle trips (30 entering and 17 exiting) during the weekday evening peak hour.

Trip Distribution and Assignment

The directional distribution of generated trips to and from the Project site was determined based on a review of Journey-to-Work data obtained from the U.S. Census for persons residing in the Town of Amherst and then refined based on existing traffic patterns within the study area during the commuter peak periods. This methodology is consistent with the residential nature of the Project and commuter traffic patterns during the peak hours. The anticipated distribution is shown in Table 4 and Figure 9. Traffic volumes expected to be generated by the Project were assigned onto the study area roadway network as shown on Figures 10, and 11 for the respective peak hours.

Table 4
TRIP-DISTRIBUTION SUMMARY

Roadway	To/From Site (Direction)	To/From Site (Percent)
Hollis Road	North	60
Hollis Road	South	30
Old Nashua Road	East	10
TOTAL		100

FUTURE TRAFFIC VOLUMES - BUILD CONDITION

The 2021 Opening-Year and 2031 Build condition traffic volumes were developed by adding Project-generated traffic to the corresponding 2021 and 2031 No-Build peak-month peak-hour traffic-volumes. The resulting 2021 Opening Year Build condition weekday morning and weekday evening peak-month peak-hour traffic volumes are graphically depicted on Figures 12 and 13, respectively, with the corresponding 2031 Build condition peak-month peak-hour traffic volumes depicted on Figures 14 and 15 for the respective peak hours.

A summary of peak-hour projected traffic-volume increases by phases in the site proximity are shown in Table 5. These volumes are based on the expected increases from the proposed development.

Table 5
PEAK-HOUR TRAFFIC-VOLUME INCREASES[a]

Location/Peak Hour	2020 Existing	2021/2031 No-Build	2021/2031 Build	Traffic-Volume Increase Over No-Build (2021/2031)	Percent Increase Over No-Build (2021/2031)
Ponemah Road, north of Old Nashua Road:					
Weekday Morning	533	459/480	482/503	23	5.0/4.8
Weekday Evening	565	597/623	625/651	28	4.7/4.5
Old Nashua Road, east of Hollis Road:					
Weekday Morning	132	130/137	134/141	4	3.0/2.9
Weekday Evening	150	150/157	155/162	5	3.3/3.2
Hollis Road, south of Rocky Hill Road:					
Weekday Morning	407	417/436	428/447	11	2.6/2.5
Weekday Evening	352	567/592	581/606	14	2.5/2.4
Rocky Hill Road, west of Hollis Road:					
Weekday Morning	10	10/10	10/10	0	0.0/0.0
Weekday Evening	19	19/19	19/19	0	0.0/0.0
Ponemah Hill Road, west of Hollis Road:					
Weekday Morning	112	113/119	113/119	0	0.0/0.0
Weekday Evening	134	134/141	134/141	0	0.0/0.0

As shown in Table 5, Project-related traffic-volume increases outside of the study area relative to 2021 and 2031 No-Build conditions are anticipated to range from 0.0 to 5.0 percent during the peak periods, with vehicle increases shown to range from 0 to 28 vehicles. ***When distributed over the peak-hour, the predicted traffic volume increases would not result in a significant impact (increase) on motorist delays or vehicle queuing within the immediate study area that is the subject of this assessment.***

TRAFFIC OPERATIONS ANALYSIS

Measuring existing and future traffic volumes quantifies traffic flow within the study area. To assess quality of flow, roadway capacity and vehicle queue analyses were conducted under Existing, No-Build, and Build traffic-volume conditions. Capacity analyses provide an indication of how well the roadway facilities serve the traffic demands placed upon them, with vehicle queue analyses providing a secondary measure of the operational characteristics of an intersection or section of roadway under study.

METHODOLOGY

Levels of Service

A primary result of capacity analyses is the assignment of level of service to traffic facilities under various traffic-flow conditions.[4] The concept of level of service is defined as a qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers. A level-of-service definition provides an index to quality of traffic flow in terms of such factors as speed, travel time, freedom to maneuver, traffic interruptions, comfort, convenience, and safety.

Six levels of service are defined for each type of facility. They are given letter designations from A to F, with level-of-service (LOS) A representing the best operating conditions and LOS F representing congested or constrained operating conditions.

Since the level of service of a traffic facility is a function of the traffic flows placed upon it, such a facility may operate at a wide range of levels of service, depending on the time of day, day of week, or period of year.

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

Unsignalized Intersections

The six levels of service for unsignalized intersections may be described as follows:

- *LOS A* represents a condition with little or no control delay to minor street traffic.
- *LOS B* represents a condition with short control delays to minor street traffic.
- *LOS C* represents a condition with average control delays to minor street traffic.
- *LOS D* represents a condition with long control delays to minor street traffic.
- *LOS E* represents operating conditions at or near capacity level, with very long control delays to minor street traffic.
- *LOS F* represents a condition where minor street demand volume exceeds capacity of an approach lane, with extreme control delays resulting.

The levels of service of unsignalized intersections are determined by application of a procedure described in the 2010 *Highway Capacity Manual.*[5] Level of service is measured in terms of average control delay. Mathematically, control delay is a function of the capacity and degree of saturation of the lane group and/or approach under study and is a quantification of motorist delay associated with traffic control devices such as traffic signals and STOP signs. Control delay 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. Definitions for level of service at unsignalized intersections are also given in the 2010 *Highway Capacity Manual*. Table 6 summarizes the relationship between level of service and average control delay for two way stop controlled and all-way stop controlled intersections.

Table 6
LEVEL-OF-SERVICE CRITERIA FOR UNSIGNALIZED INTERSECTIONS[a]

Level-Of-Service by Volume-to-Capacity Ratio		Average Control Delay (Seconds Per Vehicle)
v/c ≤ 1.0	v/c > 1.0	
A	F	≤10.0
B	F	10.1 to 15.0
C	F	15.1 to 25.0
D	F	25.1 to 35.0
E	F	35.1 to 50.0
F	F	>50.0

[a]Source: *Highway Capacity Manual*; Transportation Research Board; Washington, DC; 2010; page 19-2.

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

ANALYSIS RESULTS

Level-of-service and vehicle queue analyses were conducted for 2020 Existing, 2021 and 2031 No-Build, and 2021 Opening Year and 2031 Build peak-month conditions for the study area intersections. The results of the intersection capacity and vehicle queue analyses are summarized in Table 7. The analysis worksheets are presented in the Appendix.

Unsignalized Intersection Analysis Results

Hollis Road/Ponemah Road/Old Nahua Road – All the critical movements were shown to operate at LOS B or better with negligible vehicle queuing expected during the peak hours.

Hollis Road/Old Nashua Road (East-West) – Under all conditions during both the weekday morning and weekday evening peak hours the critical movement at this intersection operates at LOS C or better.

Old Nashua Road/ Old Nashua Road (East-West) – Under all conditions during both the weekday morning and weekday evening peak hours the critical movements at this intersection operate at LOS A.

Hollis Road/Rocky Hill Road – Under all conditions during both the weekday morning and weekday evening peak hours the critical movements at this intersection operate at LOS B or better with negligible vehicle queuing expected.

Hollis Road/Ponemah Hill Road/Barlett Drive – Under 2020 Existing conditions, the critical movements operate at LOS B or better during the weekday morning and evening peak hours. Under 2020 Opening Year, 2030 No-Build, and 2030 Build conditions, the critical movements are expected to operate at LOS B or better during the weekday morning peak hour and at LOS C or better during the weekday evening peak hour. Vehicle queues at this intersection were shown to range from 0 to 1 vehicle during the peak periods.

Hollis Road at Project Site Roadway Intersections– All movements at the Project site roadway intersections with Hollis Road were shown to operate at LOS B or better during the peak hours under all analysis conditions, with negligible vehicle queuing expected.

Table 7
UNSIGNALIZED INTERSECTION LEVEL-OF-SERVICE AND VEHICLE QUEUE SUMMARY

	2020 Existing				2021 No-Build				2021 Opening Year Build				2031 No-Build				2031 Build			
Unsignalized Intersection/ Peak Hour/Movement	Demand[a]	Delay[b]	LOS[c]	Queue[d] 95th	Demand[a]	Delay	LOS	Queue 95th	Demand[a]	Delay	LOS	Queue 95th	Demand[a]	Delay	LOS	Queue 95th	Demand[a]	Delay	LOS	Queue 95th
Hollis Road/Ponemah Road/Old Nahua Road:																				
Weekday Morning:																				
Old Nashua Road NWB RT	35	9.6	A	0	35	9.6	A	0	35	9.8	A	0	37	9.7	A	0	37	9.8	A	0
Weekday Evening:																				
Old Nashua Road NWB RT	47	11.0	B	0	47	11.1	B	0	47	11.2	B	0	49	11.3	B	0	49	11.4	B	0
Hollis Road/Old Nashua Road (East-West):																				
Weekday Morning:																				
Old Nashua Road WB LT	13	12.1	B	0	13	12.3	B	0	14	12.6	B	0	14	12.5	B	0	15	12.8	B	0
Weekday Evening:																				
Old Nashua Road WB LT	42	14.2	B	0	42	14.4	B	0	45	15.0	C	1	44	14.9	B	1	47	15.6	C	1
Old Nashua Road/ Old Nashua Road (East-West):																				
Weekday Morning:																				
Old Nashua Road NWB LT	13	7.5	A	0	13	7.5	A	0	14	7.5	A	0	14	7.5	A	0	15	7.5	A	0
Old Nashua Road EB RT	36	8.7	A	0	36	8.7	A	0	39	8.8	A	0	38	8.8	A	0	41	8.8	A	0
Weekday Evening:																				
Old Nashua Road NWB LT	42	7.3	A	0	42	7.3	A	0	45	7.3	A	0	44	7.3	A	0	47	7.3	A	0
Old Nashua Road EB RT	41	8.6	A	0	41	8.6	A	0	43	8.6	A	0	43	8.6	A	0	45	8.6	A	0
Hollis Road/Rocky Hill Road:																				
Weekday Morning:																				
Hollis Road NB LT	1	9.0	A	0	1	9.0	A	0	1	9.1	A	0	1	9.1	A	0	1	9.1	A	0
Old Nashua Road EB LT	3	10.5	B	0	3	10.6	B	0	3	10.6	B	0	3	10.7	B	0	3	10.8	B	0
Weekday Evening:																				
Hollis Road NB LT	3	7.7	A	0	3	7.7	A	0	3	7.7	A	0	3	7.7	A	0	3	7.7	A	0
Old Nashua Road EB LT	5	12.1	B	0	5	12.3	B	0	5	12.4	B	0	5	12.5	B	0	5	12.7	B	0
Hollis Road/Ponemah Hill Road/Barlett Drive:																				
Weekday Morning:																				
Ponemah Hill Road EB LT	28	11.2	B	1	28	11.3	B	1	28	11.5	B	1	29	11.5	B	1	29	11.7	B	1
Barlett Drive WB LT/RT	2	12.8	B	0	2	12.9	B	0	2	13.3	B	0	2	13.2	B	0	2	13.6	B	0
Hollis Road NB LT	20	7.7	A	0	20	7.8	A	0	20	7.8	A	0	21	7.8	A	0	21	7.8	A	0
Weekday Evening:																				
Ponemah Hill Road EB LT	29	14.5	B	1	29	14.9	B	1	29	15.5	C	1	30	15.5	C	1	30	16.1	C	1
Barlett Drive WB RT	1	10.3	B	0	1	10.4	B	0	1	10.5	B	0	1	10.5	B	0	1	10.6	B	0
Hollis Road NB LT	52	7.8	A	0	52	7.9	A	0	52	7.9	A	0	55	7.9	A	0	55	8.0	A	0
Hollis Road/Peacock Brook Lane/North Site Driveway:																				
Weekday Morning:																				
North Site Driveway EB LT/RT	--	--	--	--	--	--	--	--	5	12.0	B	0	--	--	--	--	5	12.2	B	0
Hollis Road NB LT	--	--	--	--	--	--	--	--	1	7.7	A	0	--	--	--	--	1	7.8	A	0
Weekday Evening:																				
North Site Driveway EB LT/RT	--	--	--	--	--	--	--	--	3	13.3	B	0	--	--	--	--	3	13.6	B	0
Hollis Road NB LT	--	--	--	--	--	--	--	--	1	7.8	A	0	--	--	--	--	1	7.8	A	0
Hollis Road/Middle Site Driveway:																				
Weekday Morning:																				
Middle Site Driveway EB LT/RT	--	--	--	--	--	--	--	--	17	11.4	B	0	--	--	--	--	17	11.5	B	0
Hollis Road NB LT	--	--	--	--	--	--	--	--	1	7.8	A	0	--	--	--	--	1	7.8	A	0
Weekday Evening:																				
Middle Site Driveway EB LT/RT	--	--	--	--	--	--	--	--	11	12.8	B	0	--	--	--	--	11	13.1	B	0
Hollis Road NB LT	--	--	--	--	--	--	--	--	3	7.7	A	0	--	--	--	--	3	7.8	A	0

See notes at end of table.

Table 7
UNSIGNALIZED INTERSECTION LEVEL-OF-SERVICE AND VEHICLE QUEUE SUMMARY

Unsignalized Intersection/ Peak Hour/Movement	2020 Existing				2021 No-Build				2021 Opening Year Build				2031 No-Build				2031 Build			
	Demand[a]	Delay[b]	LOS[c]	Queue[d] 95th	Demand[a]	Delay	LOS	Queue 95th	Demand[a]	Delay	LOS	Queue 95th	Demand[a]	Delay	LOS	Queue 95th	Demand[a]	Delay	LOS	Queue 95th
Hollis Road/South Site Driveway:																				
Weekday Morning:																				
South Site Driveway EB LT/RT	--	--	--	--	--	--	--	--	6	10.3	B	0	--	--	--	--	6	10.4	B	0
Hollis Road NB LT	--	--	--	--	--	--	--	--	2	7.8	A	0	--	--	--	--	2	7.4	A	0
Weekday Evening:																				
South Site Driveway EB LT/RT	--	--	--	--	--	--	--	--	3	10.8	B	0	--	--	--	--	3	11.0	B	0
Hollis Road NB LT	--	--	--	--	--	--	--	--	5	7.7	A	0	--	--	--	--	5	7.8	A	0

[a]Demand in vehicles per hour.
[b]Average control delay per vehicle (in seconds).
[c]Level-of-Service.
[d]Queue length in vehicles.
NB = northbound; SB = southbound; EB = eastbound; WB = westbound; SB = southbound; NB = northbound; NWB=northwest bound; LT = left-turning movements; TH = through movements; RT = right-turning movements.

SIGHT DISTANCE EVALUATION

Sight distance measurements were performed at the Project site driveway intersections with Hollis Road in accordance with American Association of State Highway and Transportation Officials (AASHTO)[6] standards, NHDOT requirements for All-Season Safe Sight Distance, and Town of Amherst Development Regulations[7].

AASHTO requirements indicate both stopping sight distance (SSD) and intersection sight distance (ISD) measurements should be reviewed. 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. 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. In accordance with AASHTO standards, if the measured ISD is at least equal to the required SSD value for the appropriate design speed, the intersection can operate in a safe manner.

Also reviewed were the NHDOT requirements for All-Season Safe Sight Distance and the Town of Amherst Roadway and Utility Standards. The Town standards indicate that with the posted speed limit between 36 to 55 mph, the intersection can operate in a safe manner if the measured sight distance is at least equal to 400 feet, similar to the NHDOT requirement for 400 feet of All-Season Safe Sight Distance.

Table 8 presents the measured SSD and ISD at the subject intersections.

---

[6] *A Policy on Geometric Design of Highway and Streets,* 7th Edition; American Association of State Highway and Transportation Officials (AASHTO); 2018.

[7] Town of Amherst Development Regulations- Part 3: Roads and Utilities Standards, page 26.

Table 8
SIGHT DISTANCE MEASUREMENTS[a]

Intersection/Sight Distance Measurement	Feet: Required Minimum (SSD)[a]	Feet: Desirable (ISD)[b]	Feet: Measured
Hollis Road at the North Site Driveway			
Stopping Sight Distance:			
Hollis Road approaching from the north	360/400		500+[c]
Hollis Road approaching from the south	360/400		500+
Intersection Sight Distance:			
Looking to the north from the Site Driveway	360/400	430	500+
Looking to the south from the Site Driveway	360/400	500	500+
Hollis Road at the Middle Site Driveway			
Stopping Sight Distance:			
Hollis Road approaching from the north	360/400		500+
Hollis Road approaching from the south	360/400		500+
Intersection Sight Distance:			
Looking to the north from the Site Driveway	360/400	430	500+
Looking to the south from the Site Driveway	360/400	500	500+
Hollis Road at the South Site Driveway			
Stopping Sight Distance:			
Hollis Road approaching from the north	360/400		500+
Hollis Road approaching from the south	360/400		500+
Intersection Sight Distance:			
Looking to the north from the Site Driveway	360/400	430	500+[c]
Looking to the south from the Site Driveway	360/400	500	450[c]

[a]Recommended minimum values obtained from *A Policy on Geometric Design of Highways and Streets,* 7th Edition; American Association of State Highway and Transportation Officials (AASHTO); 2018; NHDOT requirements for All-Season Safe Sight Distance and Town of Amherst Roadway and Utility Standards; and based on a 45 mph approach speed on Hollis Road.

[b]Values shown are the intersection sight distance for a vehicle turning right or left exiting a roadway under STOP control such that motorists approaching the intersection on the major street should not need to adjust their travel speed to less than 70 percent of their initial approach speed.

[c]Available sight distance with the selective trimming/removal of vegetation situated within the sight triangle of the driveway

As can be seen in Table 8, with the selective trimming or removal of vegetation located within the sight triangle areas of the Project North and South site driveway intersections with Hollis Road, lines of site to and from the Project site roadway were found to exceed the recommended minimum sight distances to function in a safe manner based on the observed vehicle travel speed along Hollis Road.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

VAI has completed a detailed assessment of the potential impacts on the transportation infrastructure associated with the proposed construction of a commercial building that is to be located at 153-169 Hollis Road (Route 122) in Amherst, New Hampshire. The following specific areas have been evaluated as they relate to the Project: i) access requirements; ii) potential off-site improvements; and iii) safety considerations; under existing and future conditions, both with and without the Project. Based on this assessment, we have concluded the following with respect to the Project:

1. Using trip-generation statistics published by the ITE,[8] the Project is expected to generate approximately 452 vehicle trips on an average weekday (two-way, 24-hour volume), with 38 vehicle trips expected during the weekday morning peak hour and 47 vehicle trips expected during the weekday evening peak hour;

2. The Project will not have a significant impact (increase) on motorist delays or vehicle queuing over Existing or anticipated future conditions without the Project (No-Build conditions), with the majority of the movements at the study intersections shown to continue to operate at a LOS C or better;

3. No apparent safety deficiencies were noted with respect to the motor vehicle crash history at the study area intersections; and

4. Lines of sight at the Project site roadway intersections with Hollis Road were found to exceed or could be made to meet or exceed the recommended minimum distance for safe operation based on the appropriate approach speed.

In consideration of the above, we have concluded that the Project can be accommodated within the confines of the existing transportation infrastructure in a safe and efficient manner with implementation of the recommendations that follow.

[8] Ibid 2.

RECOMMENDATIONS

A detailed transportation improvement program has been developed that is designed to provide safe and efficient access to the Project site and address any deficiencies identified at off-site locations evaluated in conjunction with this study. The following improvements have been recommended as a part of this evaluation and, where applicable, will be completed in conjunction with the Project subject to receipt of all necessary rights, permits, and approvals.

Site Roadway

Access to the Project site will be provided by way of a new roadway that will intersect south of Hollis Road aligned with Peacock Brook Lane; and approximately 300 and 1,090-feet northwest of Rocky Hill Road. The following recommendations are offered with respect to the design and operation of the Project site access and internal circulation, many of which are reflected on the Site Plans:

- In order to provide safe operation for vehicles exiting and approaching the site roadway intersections with Hollis Road, the following recommendations are suggested:
    - The site roadway intersections with Hollis Road should be a minimum of 24 feet in width and support the turning and maneuvering requirements of delivery trucks and the largest anticipated responding emergency vehicle as defined by the Amherst Fire Department;
    - Existing trees and vegetation located along the eastbound/south side of Hollis Road within the intersection triangle area of the Project North and South site driveways should be selectively trimmed or removed and maintained; and
    - STOP signs should be installed and STOP bars be marked at the site roadway intersections with Hollis Road.
- All signs and pavement markings to be installed within the Project site should conform to the applicable standards of the MUTCD.[9]
- ADA-compliant wheelchair ramps should be provided at all pedestrian crossings that are to be constructed or modified as a part of the Project where a connecting sidewalk is also provided.
- A sidewalk or other suitable pedestrian accommodation should be provided along at least one side of the internal roadway network and extend to Hollis Road. Crosswalks with ADA compliant wheelchair ramps should be provided at all pedestrian crossings internal to the Project site.
- Snow windrows within sight triangle areas of the Project site driveways should be promptly removed where such accumulations would impede sight lines.

With implementation of the aforementioned recommendations, safe and efficient access will be provided to the Project site and the Project can be accommodated within the confines of the existing and improved transportation system.

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[9] Ibid 2.

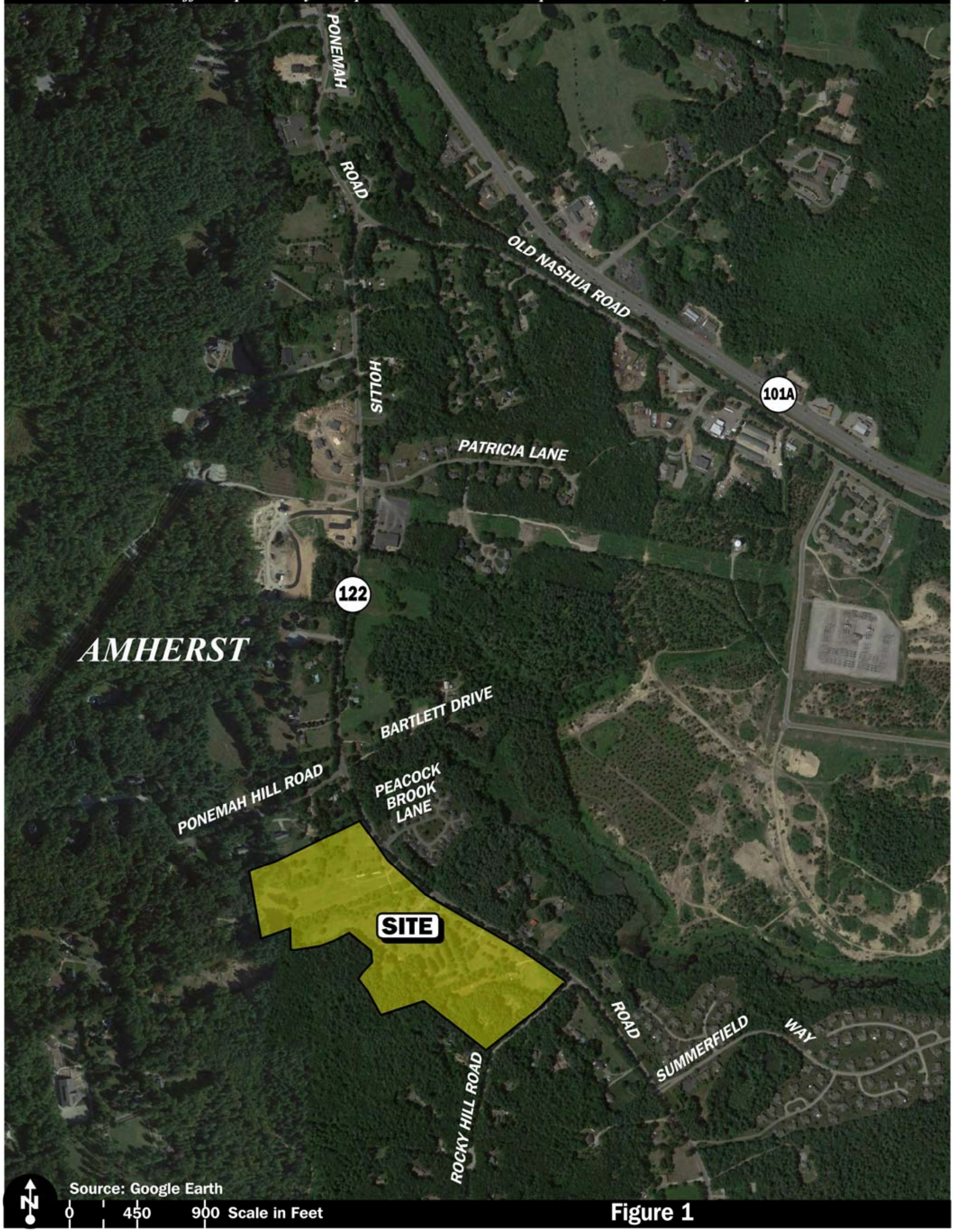

Figure 1

Site Location Map

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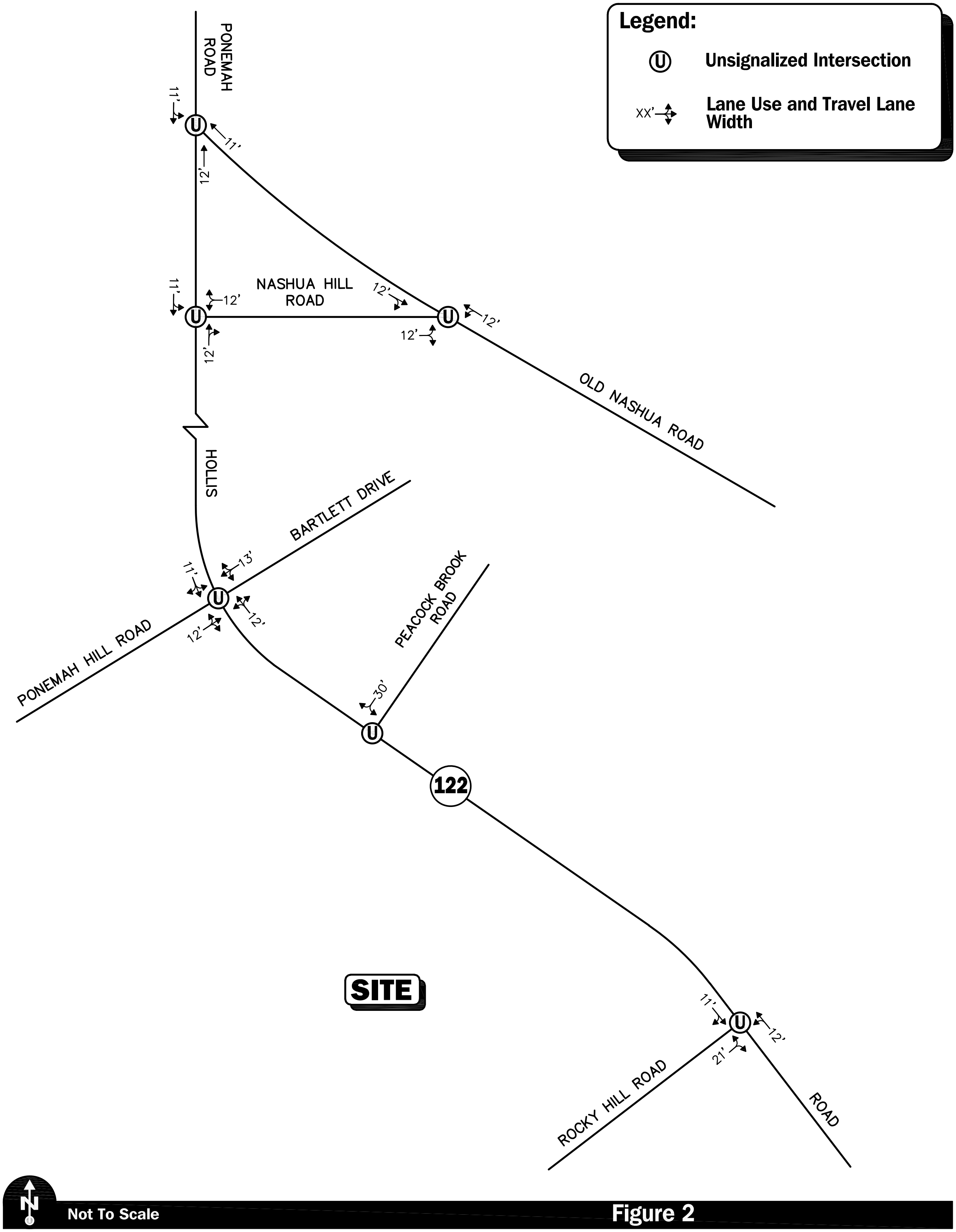

Figure 2

Existing Intersection Lane Use, Travel Lane Width and Pedestrian Facilities

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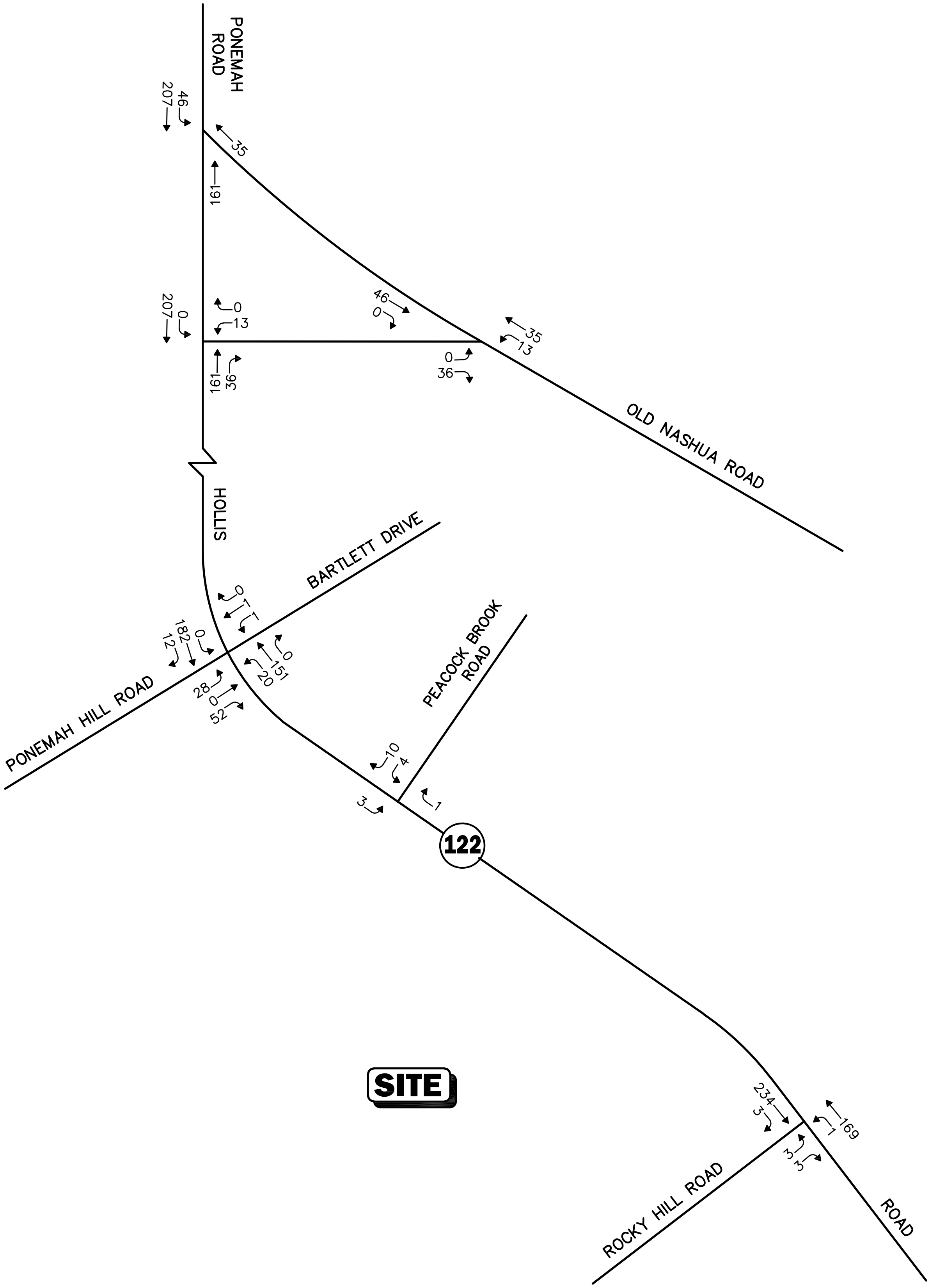

Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure 3

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2020 Existing Weekday Morning Peak Month Peak Hour Traffic Volumes (7:15 to 8:15 AM)

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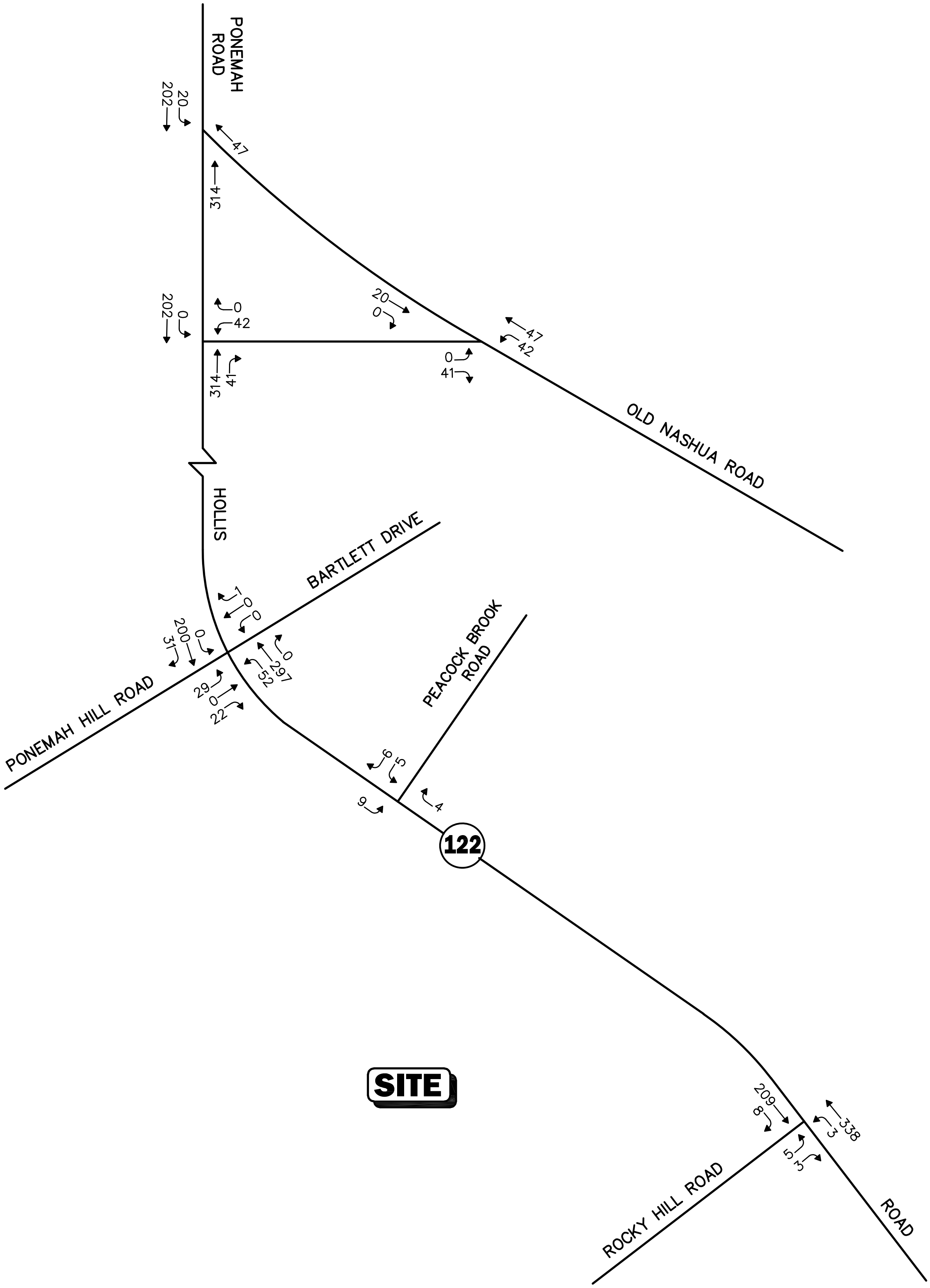

Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure 4

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2020 Existing Weekday Evening Peak Month Peak Hour Traffic Volumes (4:00 to 5:00 PM)

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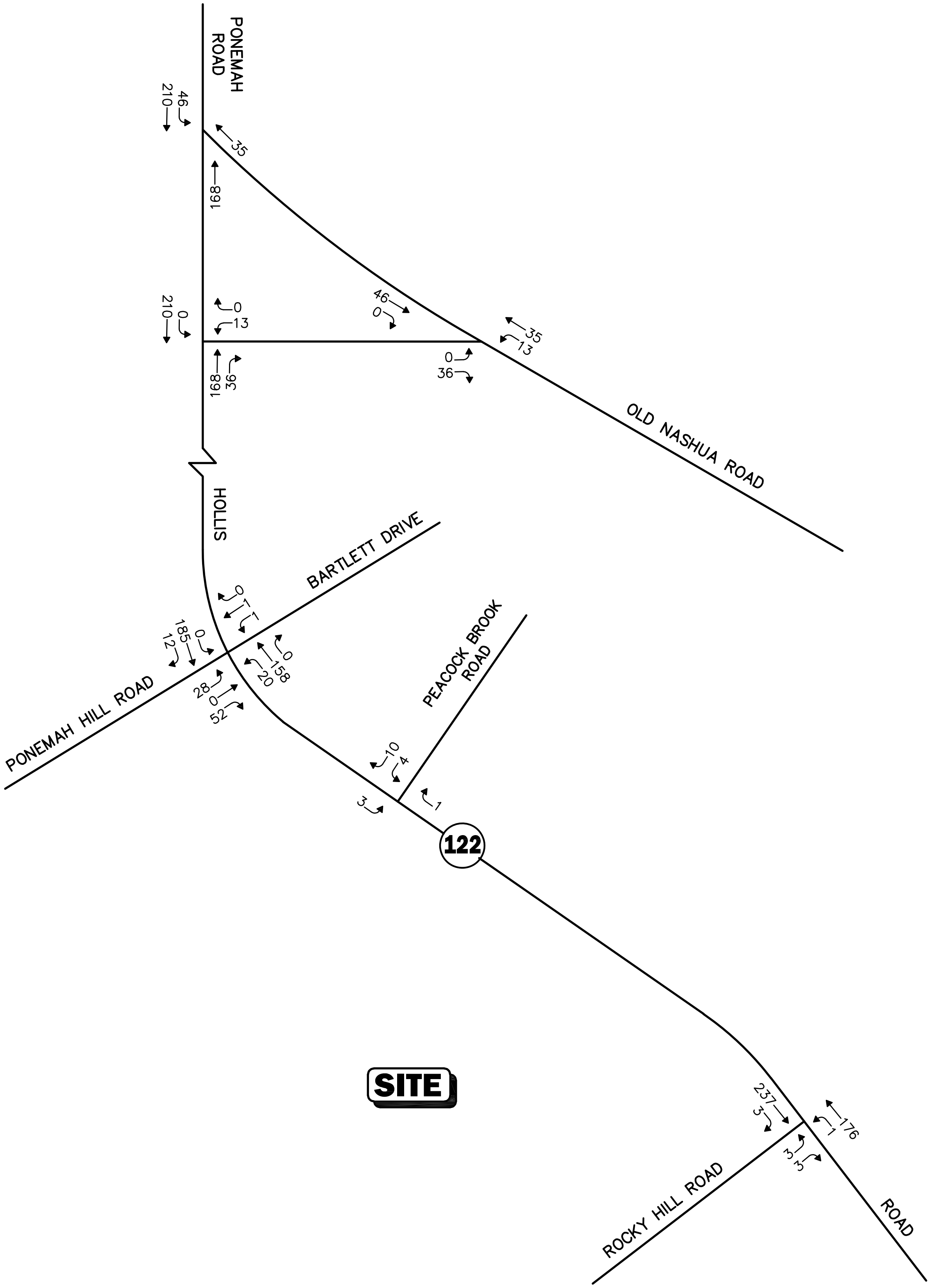

Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure 5

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2021 No-Build Weekday Morning Peak Month Peak Hour Traffic Volumes (7:15 to 8:15 AM)

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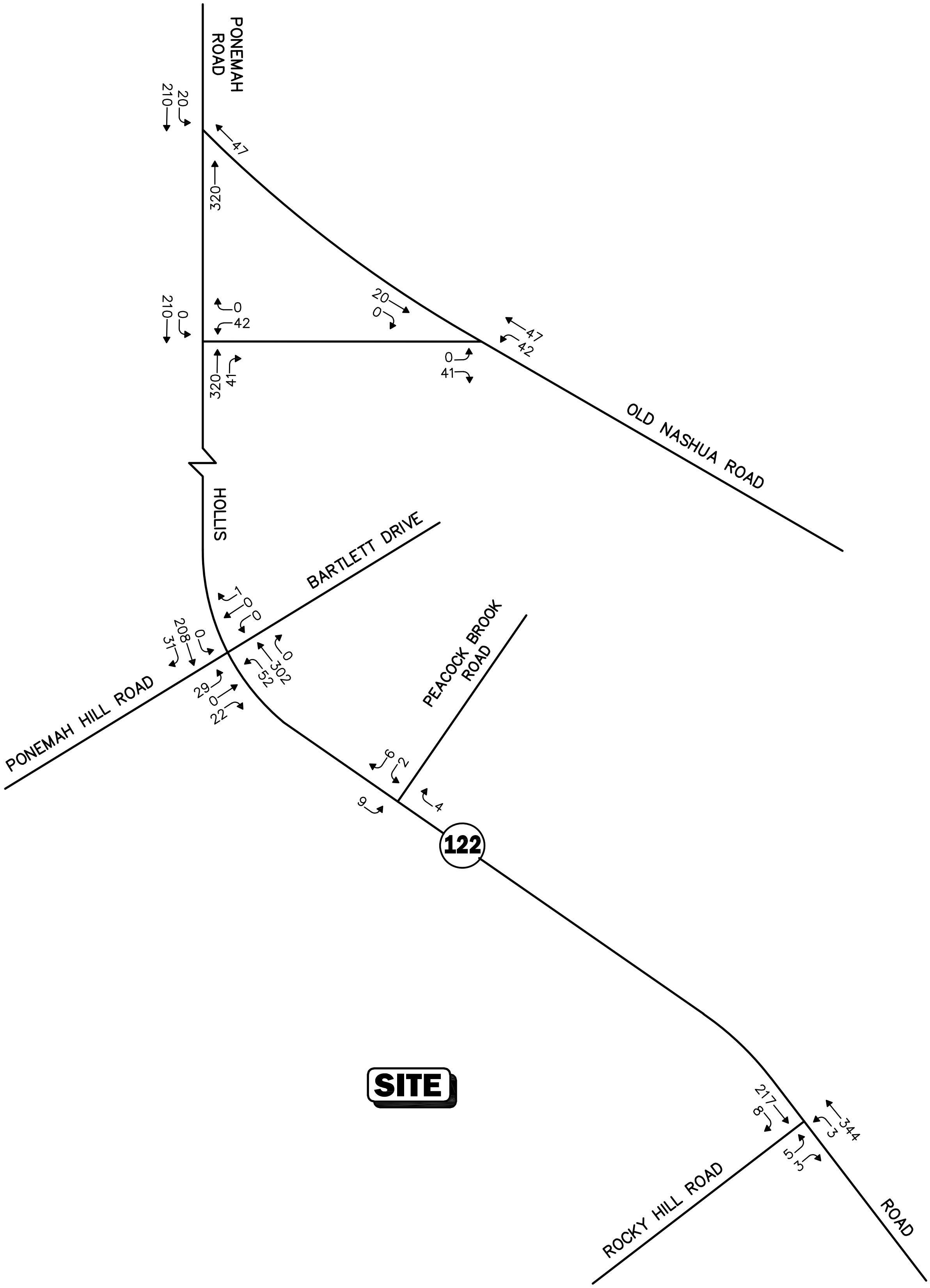

Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure 6

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2021 No-Build Weekday Evening Peak Month Peak Hour Traffic Volumes (4:00 to 5:00 PM)

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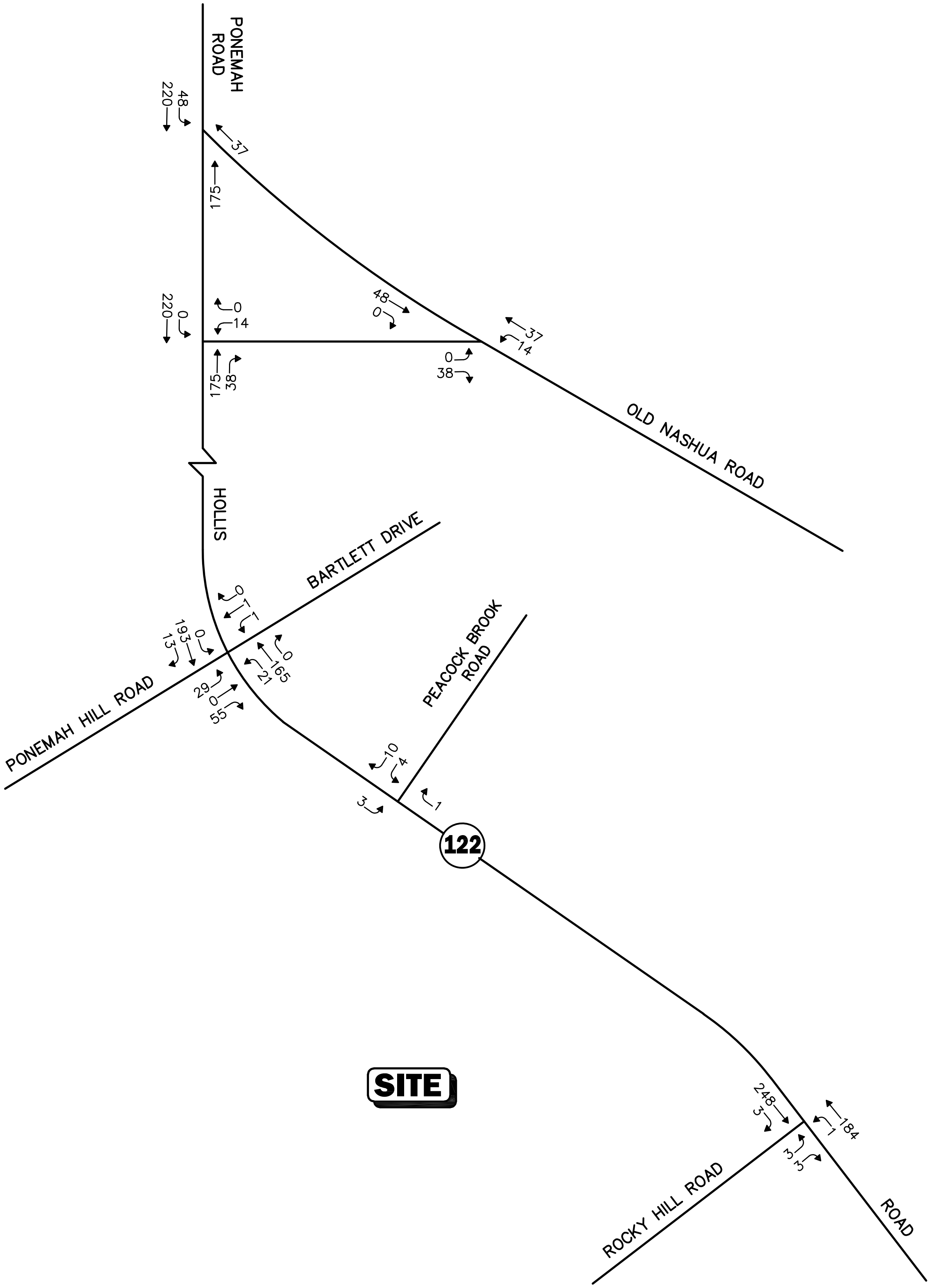

Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure 7

2031 No-Build Weekday Morning Peak Month Peak Hour Traffic Volumes (7:15 to 8:15 AM)

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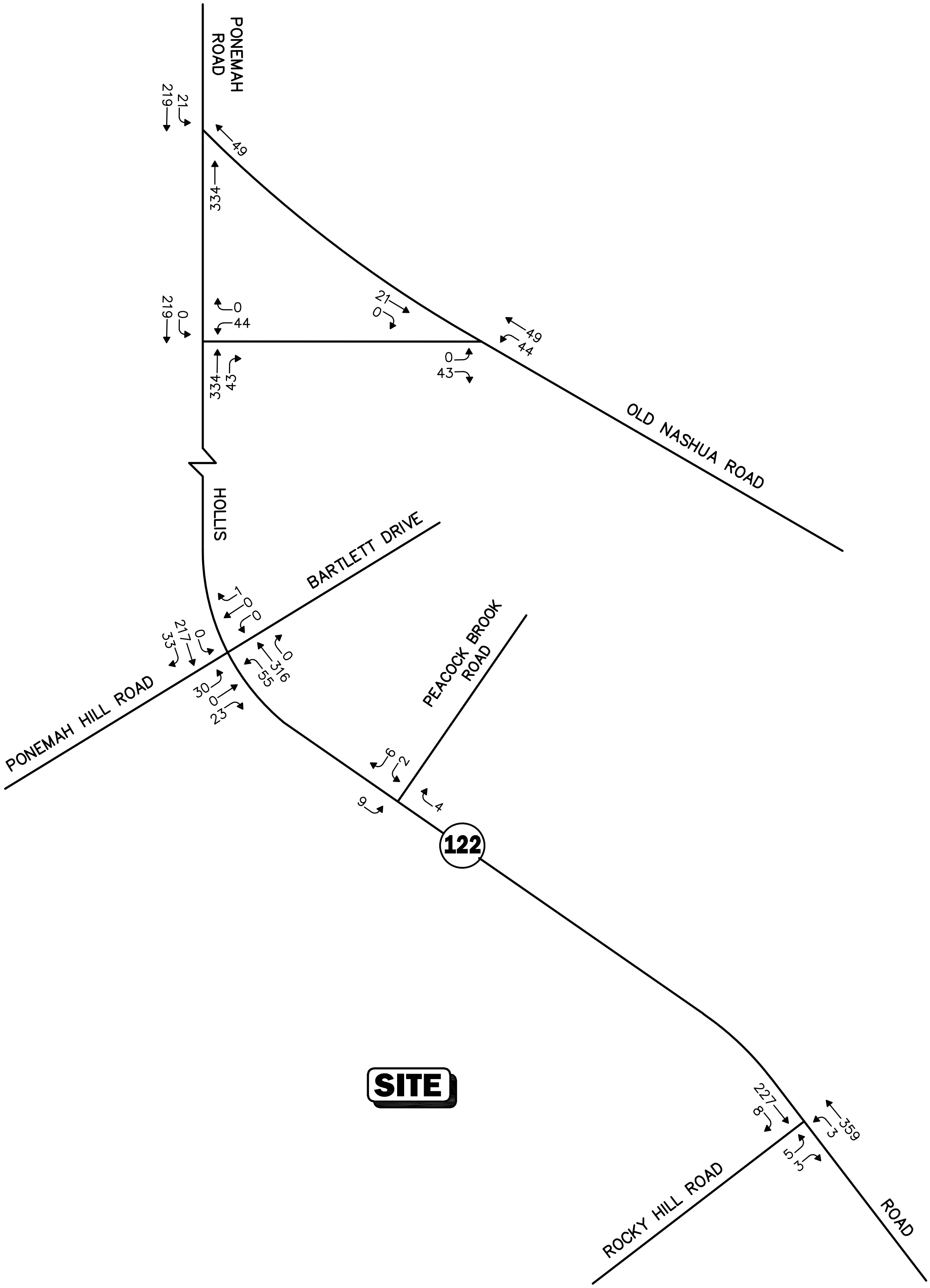

Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure 8

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2031 No-Build
Weekday Evening
Peak Month
Peak Hour Traffic Volumes
(4:00 to 5:00 PM)

9/24/2020 12:39:12 PM, R:\8582

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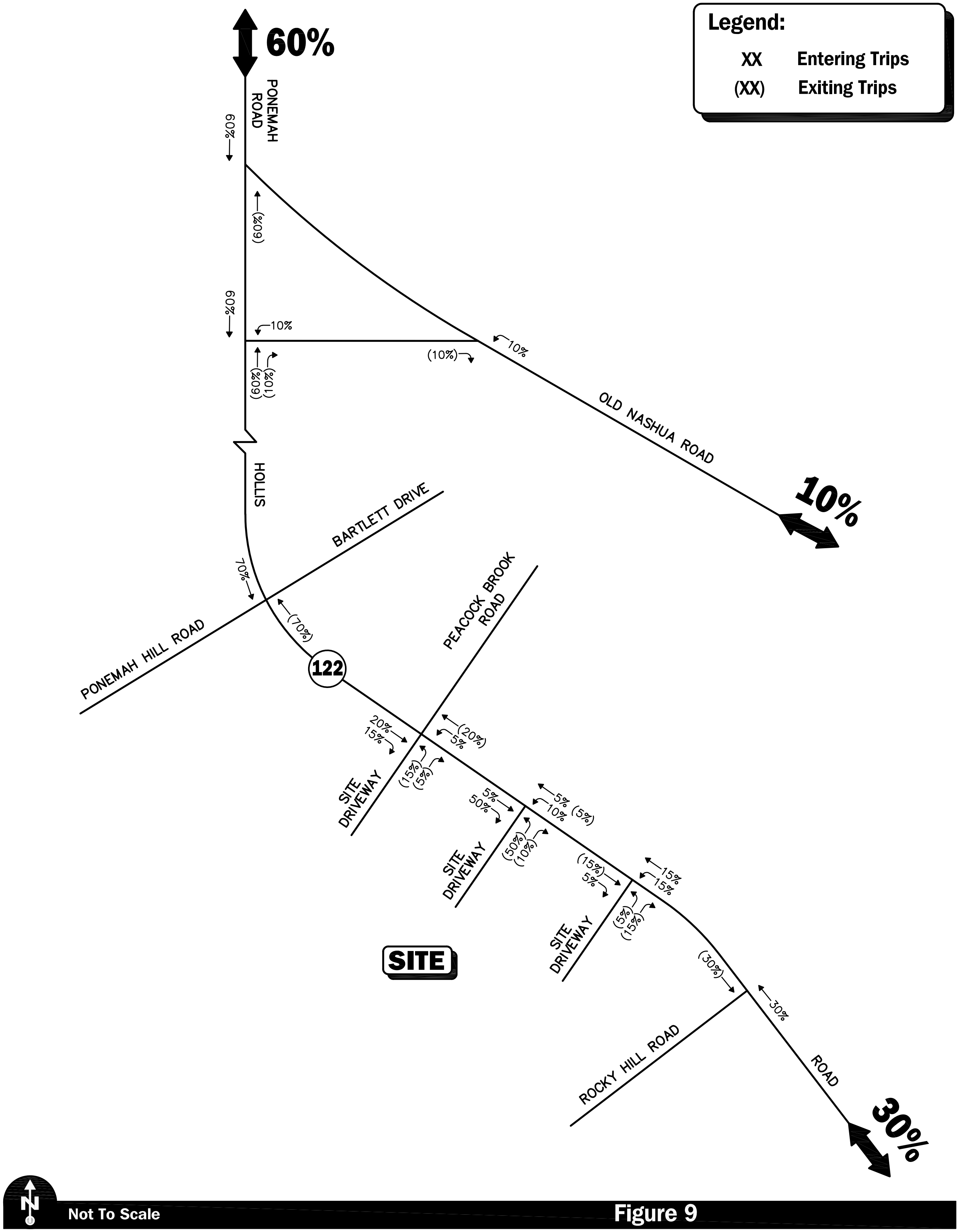

Figure 9

Trip Distribution Map

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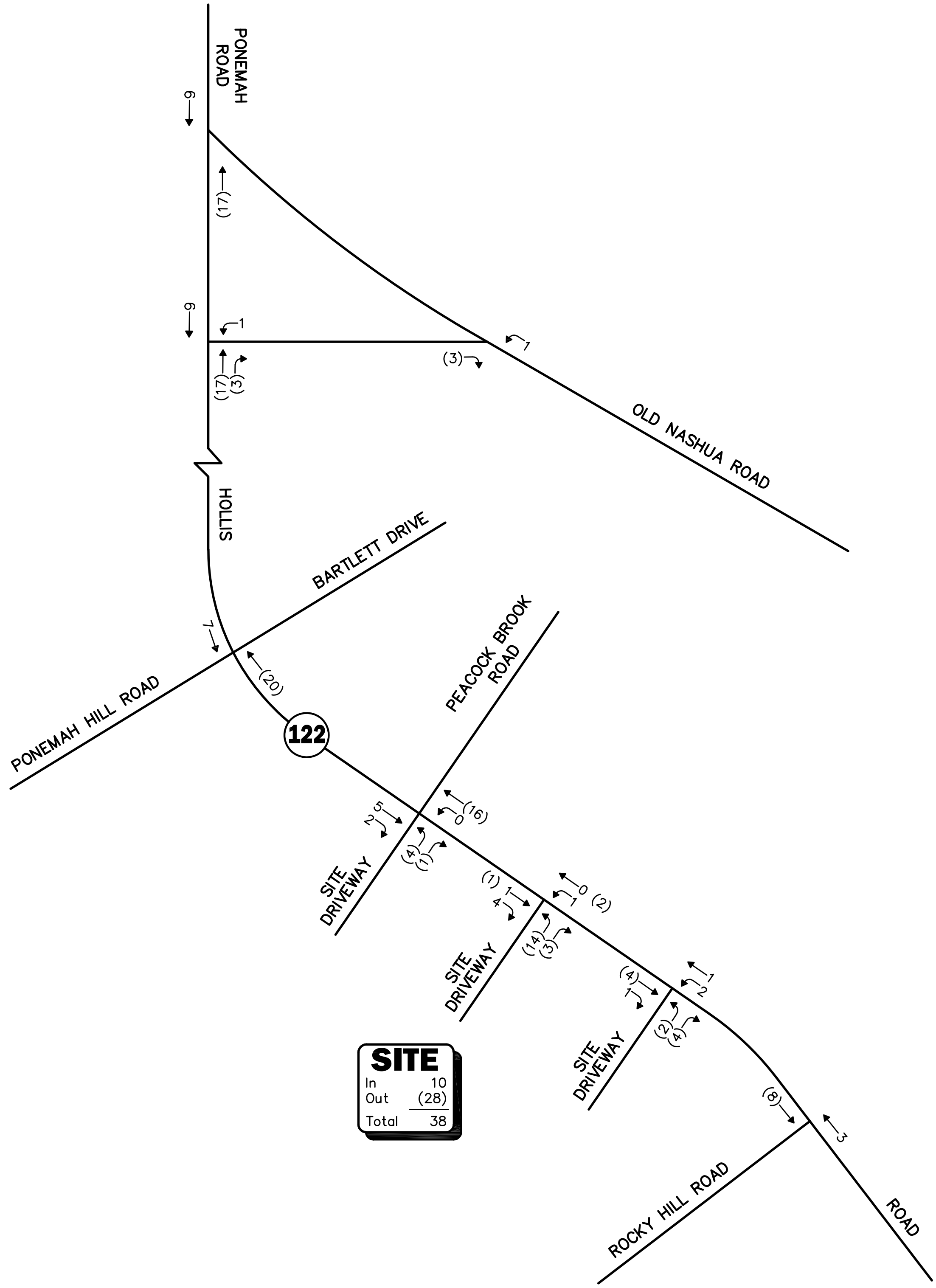

Not To Scale

Figure 10

Project-Generated Weekday Morning Peak Month Peak Hour Traffic Volumes

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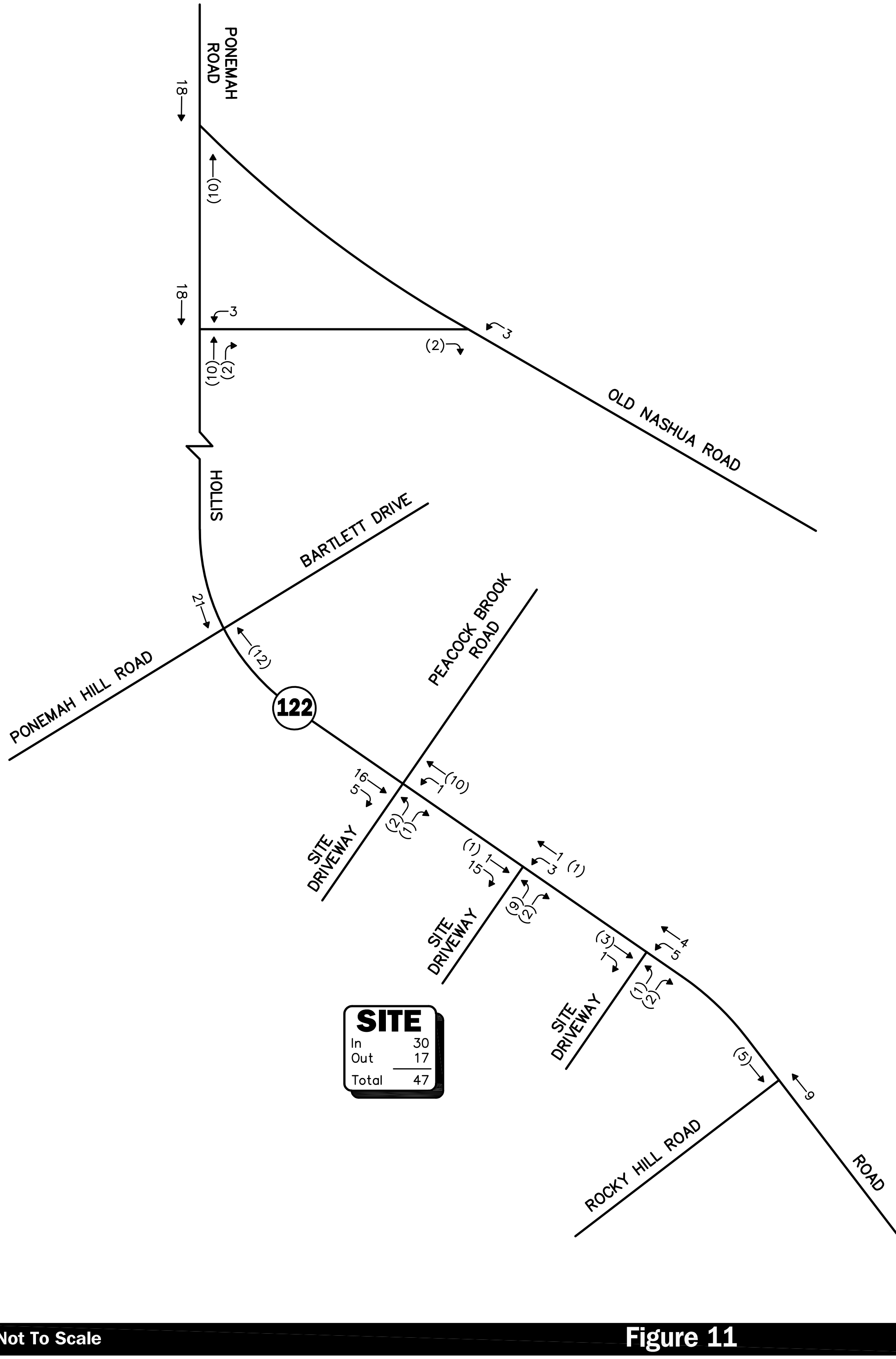

Figure 11

Project-Generated Weekday Evening Peak Month Peak Hour Traffic Volumes

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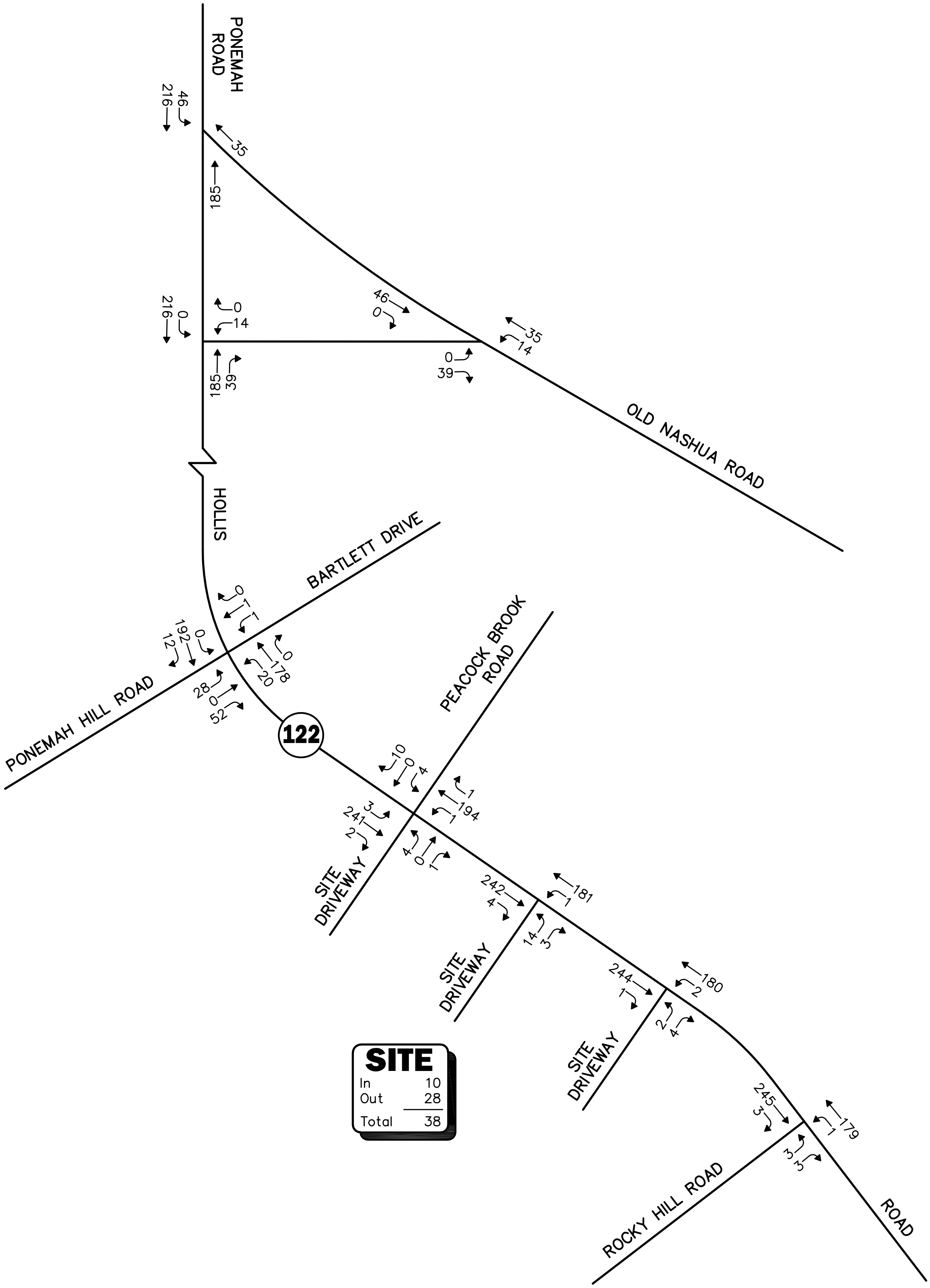

Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure 12

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2021 Opening-Year Build
Weekday Morning
Peak Month
Peak Hour Traffic Volumes
(7:15 to 8:15 AM)

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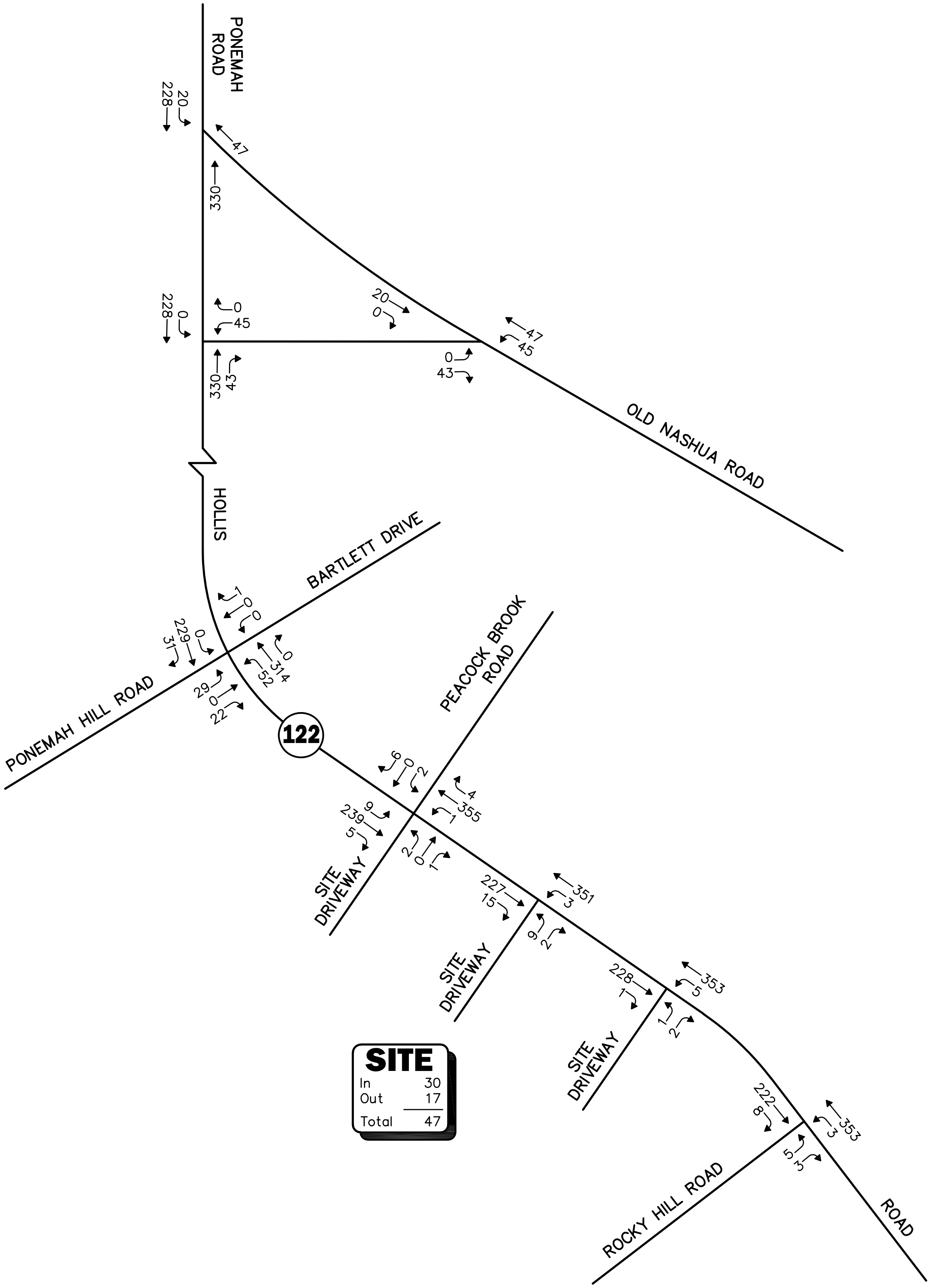

Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure 13

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2021 Opening-Year Build
Weekday Evening
Peak Month
Peak Hour Traffic Volumes
(4:00 to 5:00 PM)

9/25/2020 2:11:22 PM, R:\8582

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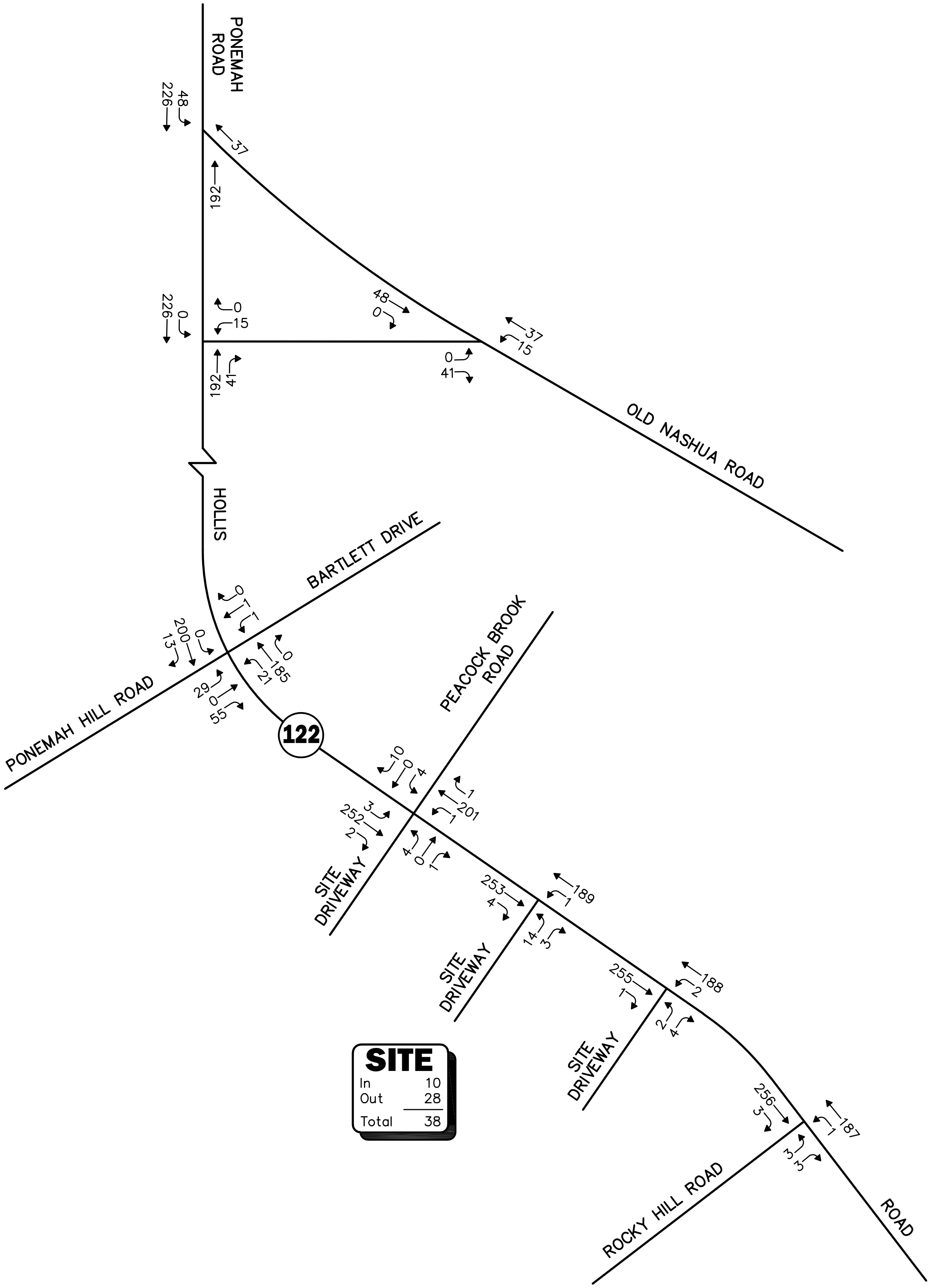

Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure 14

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2031 Build
Weekday Morning
Peak Month
Peak Hour Traffic Volumes
(7:15 to 8:15 AM)

9/25/2020 2:11:36 PM, R:\8582

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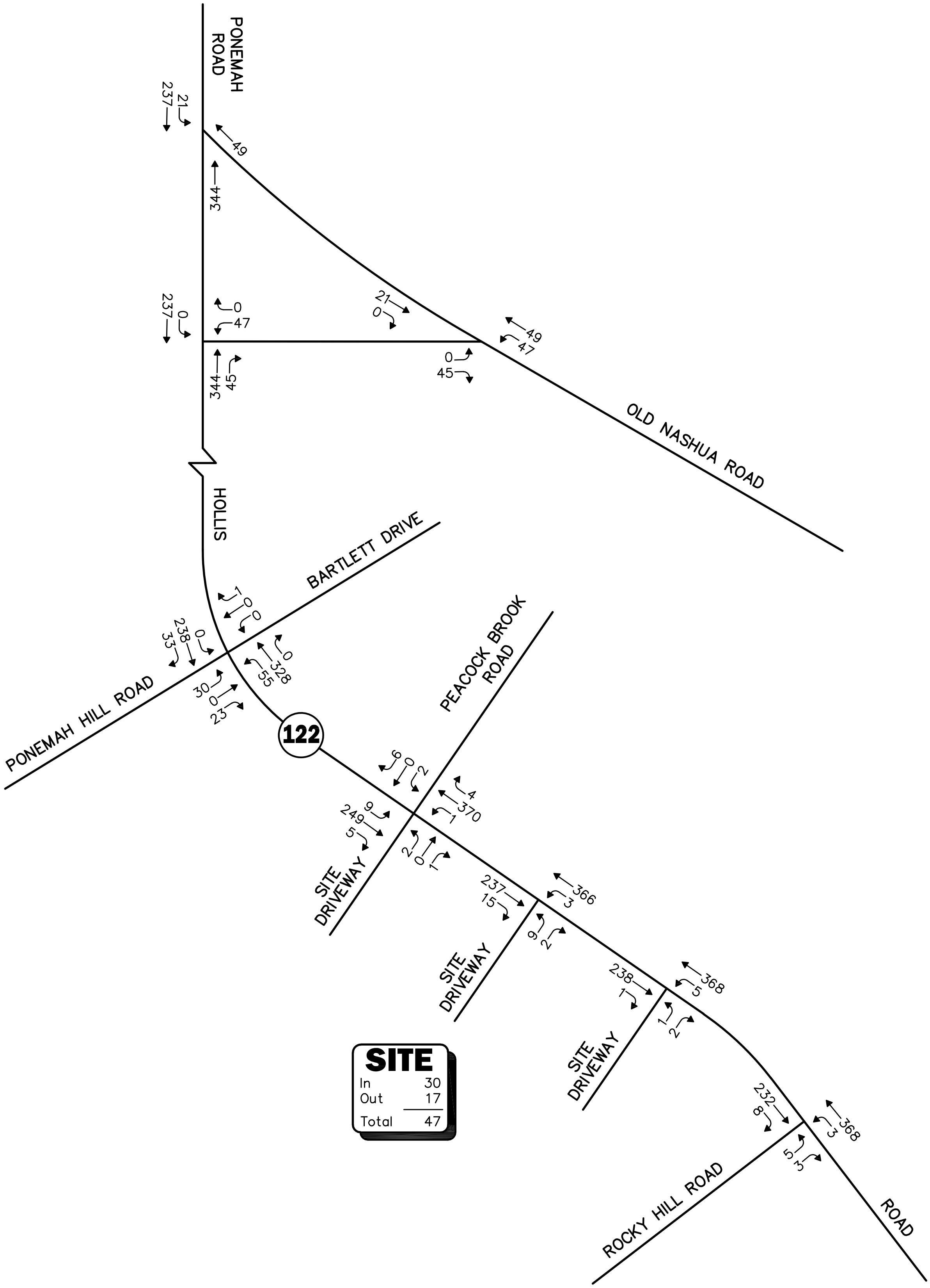

Note: Imbalances exist due to numerous curb cuts and side streets that are not shown.

Not To Scale

Figure 15

Vanasse & Associates inc

2031 Build
Weekday Evening
Peak Month
Peak Hour Traffic Volumes
(4:00 to 5:00 PM)

9/25/2020 2:11:50 PM, R:\8582

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