

TRAFFIC IMPACT AND ACCESS STUDY

COLD BROOK CROSSING

*North Road
Sudbury, Massachusetts*

Prepared for:
Quarry North Road, LLC

February 2020

MDM TRANSPORTATION CONSULTANTS, INC.
Planners & Engineers

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EXECUTIVE SUMMARY

MDM Transportation Consultants, Inc. (MDM) has prepared this Traffic Impact and Access Study (TIAS) for a proposed residential development referred to as Cold Brook Crossing on North Road in Sudbury, Massachusetts. This report documents existing operational and safety-related characteristics of roadways serving the development Site, estimates future year operating characteristics of these roadways independent of the development, estimates development-related trip generation, and identifies incremental impacts of Site-related traffic. Access improvements are identified for the development to meet operational needs of the Site and the adjacent roadways.

This TIAS has been prepared in accordance with requirements and standards for the preparation of traffic studies as jointly issued by the Commonwealth of Massachusetts Executive Office of Energy & Environmental Affairs/Massachusetts Department of Transportation (EEA/MassDOT).

E.1 PROJECT DESCRIPTION

The Site comprises approximately 38± acres in Sudbury, Massachusetts that is bounded by North Road to the south, Northwood Road/ Residential properties to the west, and the Concord Town Line to the northeast. The Site is comprised of wooded undeveloped property and a former gravel pit. The adjacent gravel pit parcel within the Town of Concord is not part of the development program.

The proposed Site programming consists of developing the Site to include 274 residential units comprised of 151 mid-rise multifamily units and 123 townhome style units. On-site parking is planned to include 392 surface parking spaces and 374 garage spaces for a total of 766 total spaces. A full access driveway will be provided along North Road with secondary emergency-only (gated) driveway located west of the primary site driveway.

E.2 STUDY AREA

This TIAS evaluates transportation characteristics of roadways and intersections that provide a primary means of access to the Site within the Town of Sudbury and that are likely to sustain a measurable level of traffic impact from the development. The study area includes the following primary intersections:

- North Road at Dakin Road/Pantry Road (Signalized)
- North Road at Powder Mill Road/Mossman Road
- North Road at Primary Site Driveway

E.3 SUMMARY OF ANALYSIS AND FINDINGS

Capacity analyses were conducted for each study area intersection to quantify existing and future year traffic operations with and without the development for the weekday morning and weekday evening peak hours. These time periods represent the highest activity periods of the proposed project and the adjacent roadway system.

The analyses presented in this TIAS are based on industry-standard trip rates and methodology published by the Institute of Transportation Engineers (ITE). Based on industry-standard trip rates, the proposed development is estimated to generate approximately 111 vehicle trips during the weekday morning peak hour (27 entering and 84 exiting) and 135 vehicle trips during the weekday evening peak hour (83 entering and 52 exiting). On a daily basis, the development is estimated to generate approximately 1,722 vehicle trips on a weekday. Journey to work data for the Town of Sudbury served as the primary basis for distribution for the trips to/from the Site.

Capacity analyses indicate that the project will not result in any consequential changes in intersection operations compared to No-Build conditions. The site driveway will operate at LOS D or better during peak hours. The signalized intersection of North Road at Dakin Road and Pantry Road will continue to operate at overall LOS C or better during the weekday morning and weekday evening peak hours. During peak hours, the Powder Mill Road and Mossman Road approaches to North Road operate with longer delays; however, the project is not anticipated to add any additional turning vehicles from these roadway approaches and will result in a nominal traffic increases along North Road that will not materially impact traffic operations. Relative traffic increases for the proposed project fall well within normal day-to-day fluctuations in traffic.

In summary, the proposed development is a modest traffic generator that will not result in any material change in traffic operations at intersections within the study area compared to No-Build conditions. Access improvements as outlined in the *Conclusions and Recommendations* section of this report will meet applicable safety requirements including sight lines based on measured ambient travel speeds.

E.4 RECOMMENDATIONS

MDM finds North Road and the roadways within the site vicinity can accommodate modest traffic increases of the project. Relative traffic increases for the proposed project represents an inconsequential change in area roadway volumes - a level of change that falls well within normal day-to-day fluctuations in traffic entering and exiting the study intersections and is immaterial to traffic operations along North Road. The Proponent has entered into a Land Disposition and Development Agreement (“LDDA”) with the Town to provide \$1,000,000 to the Town of Sudbury for transportation improvements. In addition to these funds, specific mitigation actions are identified within this TIAS to further support the project in compliance with the LDDA, to enhance site access, to provide pedestrian and bicycle accommodations on-site, and to reduce dependency on single-occupant auto use. These include (a) access-related improvements, (b) pedestrian and bicycle accommodations, and (d) transportation demand management (TDM) actions as summarized below.

Access/Egress Improvements

- *Driveway Design.* Recommended access improvements at the primary North Road driveway location are shown conceptually in **Figure 9** that address the LDDA section IV.7 mitigation requirements. The driveway design features a widening of North Road to accommodate an exclusive eastbound left-turn lane to minimize through traffic disruption on North Road and 30-foot curb radii to facilitate decelerating turns to/from North Road and emergency response vehicle maneuverability to/from the Site. Driveway grading and orientation will provide unimpeded sight lines that meet or exceed minimum recommended stopping sight distances. The driveway design will also include provisions for a future sidewalk to be constructed if the Town opts to build a sidewalk along North Road at a future date. Appropriate signs and pavement markings that are compliant with the Manual on Uniform Traffic Control Devices (MUTCD) will be installed including a STOP sign (R1-1) and STOP line pavement markings. Edge line and centerline pavement markings along the boulevard section of the driveway will be provided for positive driver guidance entering and exiting the property.

Additional widening of North Road for an exclusive right-turn lane into the Site is not warranted or recommended based on limited traffic volumes, noting further that this lane would result in a substantial grading impact and associated tree removal the along a lengthy portion of the north side of North Road including those on property owned by the Sudbury Water District. The Applicant has consulted with the Town Engineering department on this issue with general concurrence on design elements as presented in **Figure 9**.

- *Sight Line Triangles.* Plantings (shrubs, bushes) and structures (walls, fences, etc.) will be maintained at a height of 2 feet or less within the sight lines in vicinity of the Site driveway intersection with North Road to provide unobstructed sight lines. Existing vegetation and structures within these driveway sight lines will be cleared, removed or trimmed/maintained with grading modifications as necessary to ensure minimum recommended sight line requirements are met or exceeded.

Pedestrian and Bicycle Accommodations

- *Pedestrian Connections.* The Site Plan incorporates sidewalks that connect the proposed building to the on-site surface parking areas and amenities. Reserved area for a future sidewalk will also be provided along the primary site driveway to North Road to accommodate any future sidewalk along North Road that may be built by the Town at a future date.
- *Bicycle Amenities.* The Proponent will provide bicycle accommodations within the property including bike racks near the buildings entranceways to encourage and facilitate this mode of transportation within and to/from the Site. A bike share program is also proposed as outlined under TDM below.

Transportation Demand Management (TDM)

The Proponent is committed to reduce auto dependency by residents by implementing a TDM program. A preliminary list of potential TDM program elements may include the following, subject to refinement of the development program and further evaluation by the Proponent:

- *CrossTown Connect (TMA).* The Proponent will become a member of the CrossTown Connect TMA upon issuance of an initial certificate of occupancy. Membership will include access to services such as online commuter resources, carpool/vanpool matching, active commuting tools, public transportation resources, emergency ride home (ERH) services and other TDM strategies.
- *On-Site Transportation Coordinator.* The Proponent will designate a member of the leasing staff as transportation coordinator responsible disseminating relevant TDM information to residents including provision of a tenant manual that provides information on area bicycle routes, shuttle service, bicycle sharing and parking, parking policies and Site amenities including the proposed bike share program.
- *Car Share Accommodation.* Up to three (3) on-site parking spaces will be designated for use by car share vehicles (Zip Car or equivalent), subject to agreement by a car sharing service provider to assign such vehicles to the property. The location of these spaces will be proximate to the Clubhouse facility.

- *Bicycle Facilities.* Bicycle parking, including weather protected racks for residents and conveniently located racks for visitors proximate to the building entrances will be provided.
- *Bike Share Program.* The Proponent will offer a Bike Share program for residents that will be administered by the Property Manager under which bicycles may be checked out and returned for local use. Multiple sized helmets will be made available. The program will be offered Monday through Sunday between the hours of 7:00 am and 4:00 pm though the property managers office.
- *Preferential Parking and Incentives for Low-Emission Vehicles.* Preferential parking locations for residents who use low-emission vehicles will be provided. Up to three (3) Electric vehicle charging stations will also be provided on the Site.
- *Unbundled Parking.* The Proponent proposes unbundling residential parking to provide an option for residents to rent fewer or no parking spaces with their unit, thereby encouraging lower vehicle ownership at time of lease.
- *Walking Paths.* The Site will include a system of walking paths that will be available to public use.
- *Van Shuttle Service.* The Proponent will purchase a 12-passenger van which will be managed by the property manager. The property manager will engage residents to serve as van drivers to provide scheduled service Monday through Friday to Concord Station and Lincoln Station, Friday service to B'nai Torah Synagogue, Saturday service to Market Basket, and Sunday service to Our Lady of Fatima. Service will be periodically adjusted to meet the needs of the residents for travel to local transit stations, recreational, and shopping destinations.
- *Ride-share/Transportation Hub/Bus Stop.* The Site will include a multipurpose shelter for passenger pick-up/drop-off for ride-share, shuttle service, and school bus use.
- *Pedestrian Infrastructure.* Sidewalk connections within the property will be provided along primary pedestrian desire lines that connect building entrances parking areas and on-site amenities. Area for a future sidewalk will be provided along the primary site driveway which will be constructed if the Town opts to construct a future public sidewalk along North Road. The Proponent will also post area maps that highlight area walking/bicycle routes to promote walking and bicycle travel to/from the Site and area businesses, and recreational facilities.

E.5 CONCLUSIONS

In summary, trip generation for the development is projected to be moderate. MDM finds that incremental traffic associated with the proposed development is not expected to materially impact operating conditions at the study intersections. The study intersections exhibit below-average crash rates based on historic crash data; safety countermeasures are therefore not warranted. Likewise, with clearing and re-grading associated with the construction of the driveways, the available sight lines at the site driveway intersection with North Road will exceed the recommended sight line requirements from AASHTO. Funding provisions of the Land Disposition and Development Agreement along with proposed access access/egress improvements, pedestrian and bicycle accommodations a TDM program and as outlined in the *Conclusions and Recommendations* section of this report will adequately mitigate the project impacts.

1.0 INTRODUCTION

MDM Transportation Consultants, Inc. (MDM) has prepared this Traffic Impact and Access Study (TIAS) for a proposed residential development referred to as Cold Brook Crossing on North Road in Sudbury, Massachusetts. The proximity of the Site in relation to the regional transportation system is shown in **Figure 1**. This report documents existing operational and safety-related characteristics of roadways serving the development Site, estimates future year operating characteristics of these roadways independent of the development, estimates development-related trip generation, and identifies incremental impacts of Site-related traffic. Access improvements are identified for the development to meet operational needs of the Site and the adjacent roadways.

This TIAS has been prepared in accordance with requirements and standards for the preparation of traffic studies as jointly issued by the Commonwealth of Massachusetts Executive Office of Energy & Environmental Affairs/ Massachusetts Department of Transportation (EEA/MassDOT).

1.1 PROPOSED DEVELOPMENT

The Site comprises approximately 38± acres in Sudbury, Massachusetts that is bounded by North Road to the south, Northwood Road/ Residential properties to the west, and the Concord Town Line to the northeast. The Site is comprised of wooded undeveloped property and a former gravel pit. The adjacent gravel pit parcel within the Town of Concord is not part of the development program.

The proposed Site programming consists of developing the Site to include 274 residential units comprised of 151 mid-rise multifamily units and 123 townhome style units. On-site parking is planned to include 392 surface parking spaces and 374 garage spaces for a total of 766 total spaces. A full access driveway will be provided along North Road with secondary emergency-only (gated) driveway located west of the primary site driveway. The preliminary Site layout plan prepared by The Civil Design Group; LLC is presented in **Figure 2**.



Figure 1

Site Location



Source: Civil Design Group, LLC

Figure 2

Preliminary Site Layout

1.2 STUDY METHODOLOGY

This transportation impact and access evaluation is conducted in accordance with EEA/MassDOT guidelines and consists of several steps. The first step documents existing conditions in the transportation study area including an inventory of roadway geometry, observed traffic volumes, public transportation, and safety characteristics. Next, future year traffic conditions are forecast that account for other planned area developments, normal area growth, and development-related traffic increases. The third step quantifies operating characteristics of the study intersection. Specific attention is given to the incremental impacts of the proposed development. Finally, improvements are identified to address specific development-related requirements as needed.

1.3 STUDY AREA

This TIAS evaluates transportation characteristics of roadways and intersections that provide a primary means of access to the Site within the Town of Sudbury and that are likely to sustain a measurable level of traffic impact from the development. The study area includes the following primary intersections:

- North Road at Dakin Road/Pantry Road (Signalized)
- North Road at Powder Mill Road/Mossman Road
- North Road at Primary Site Driveway

2.0 BASELINE CONDITIONS

In order to provide a basis for quantifying the transportation impacts of the development, the Baseline roadway system and the baseline traffic operations of study area roadways were reviewed. This section describes the existing traffic characteristics and operations of roadways and intersection within the study area. Specifically, this section presents an overview of the traffic data collection program, baseline traffic volumes, safety issues and public transportation systems serving the area.

2.1 STUDY AREA ROADWAY NETWORK

The study area roadways and intersection are described briefly in this section. A general description of the physical roadway and intersection features is provided. The study area includes roadways under local jurisdiction. The study area and intersection are depicted in **Figure 1**.

2.1.1 Roadways

North Road (Route 117)

North Road (Route 117) is generally an east-west roadway under local jurisdiction within the study area. North Road is classified by the Massachusetts Department of Transportation (MassDOT) as an urban minor arterial roadway and provides a connection between Waltham Street to the west and Fitchburg Turnpike to the east. North Road provides a single travel lane in each direction separated by a double yellow centerline with white edge lines. There are no sidewalks provided in the immediate project area; however, a sidewalk is provided along the southern side of North Road between Great Road and Davis Field. The posted speed limit is 40 mph in both travel directions. There is a mix of land uses along North Road in the study area that includes residential homes, Davis Field, undeveloped farmland/recreational space, a restaurant, Sudbury Fire Department and office/commercial space.

2.1.2 Intersections

North Road at Dakin Road/Pantry Road

North Road meets Dakin Road and Pantry Road to form a four-legged, signalized intersection under local jurisdiction. All approaches to the intersection provide a single shared left/through/right travel lane. Crosswalks are provided on the eastern and southern legs of the intersection. Land uses at the intersection the Sudbury Fire Department and residential homes.

North Road at Mossman Road/Power Mill Road

North Road meets Mossman Road and Mill Road to form a four-legged, unsignalized intersection under local jurisdiction. The Eastbound and westbound North Road approaches provide a single shared lane. The Mossman Road and Power Mill Road northbound and southbound approaches provides a single lane approach under "STOP" sign control. A crosswalk is provided across the North Road westbound approach to the intersection. Land uses at the intersection include residential homes.

2.2 BASELINE TRAFFIC VOLUMES

Traffic-volume data used in this study were obtained by mechanical and manual methods in September 2018. An automatic traffic recorder count (ATR) was conducted along North Road while manual turning movement counts (TMCs) were conducted at the existing study intersections. Traffic data were collected during the weekday morning (7:00 to 9:00 AM) and weekday evening (4:00 to 6:00 PM) peak periods. These hours represent the combination of busiest activity periods of the Site and adjacent roadway network.

2.2.1 Daily Traffic

Daily traffic volumes along North Road in the Site vicinity were collected in September 2018 are summarized in **Table 1** and included in the **Appendix**.

TABLE 1
BASELINE TRAFFIC VOLUME SUMMARY
NORTH ROAD WEST OF MELONE PARCEL

Time Period	Daily Volume (vpd) ¹	Percent Daily Traffic ²	Peak Hour Volume (vph) ³	Peak Flow Direction ⁴	Peak Hour Directional Volume (vph)
Weekday Morning Peak Hour	12,390	9%	1,100	92% EB	1,014
Weekday Evening Peak Hour	12,390	9%	1,145	78% WB	893

¹Two-way daily traffic expressed in vehicles per day without seasonal adjustment.

²The percent of daily traffic that occurs during the peak hour.

³Two-way peak-hour volume expressed in vehicles per hour.

⁴EB = Eastbound, WB = Westbound

As summarized in **Table 1**, the weekday daily traffic volume North Road adjacent to the Site is approximately 12,390 vehicles per day (vpd) on a weekday. Weekday peak hour traffic flow on North Road ranges from approximately 1,100 to 1,145 vehicles per hour (vph) representing approximately 9 percent of daily traffic flow. Vehicle flow is skewed heavily towards the eastbound direction during weekday morning peak hours and heavily towards the westbound direction during the weekday evening peak hour. The travel patterns are consistent with commuter traffic relative to major travel routes in the area.

2.2.2 Peak-Hour Traffic

Manual turning movement counts (TMCs) were conducted along study area roadways and intersections in September 2018. This traffic data was collected during the weekday morning (7:00 AM to 9:00 AM) and weekday evening (4:00 PM to 6:00 PM) peak periods to coincide with peak traffic activity of the proposed residential development and the adjacent streets.

Review of MassDOT permanent count station data indicates that September is an average traffic month; therefore, no seasonal adjustment was required. However, the counts were adjusted by 0.5% to represent 2020 Baseline conditions. Permanent count station data is provided in the **Appendix**. The resulting existing weekday morning and weekday evening peak-hour traffic volumes for study intersections are depicted in **Figure 3**.

2.3 MEASURED TRAVEL SPEEDS

Vehicle speeds were obtained for the North Road eastbound and westbound travel directions in the site vicinity using an ATR machine over a 24-hour period by timing vehicles over a known distance and then converting the travel times to speeds. **Table 2** summarizes the average and 85th percentile speeds for the location and time period studied. Field data are provided in the **Appendix**.

TABLE 2
SPEED STUDY RESULTS – NORTH ROAD

Travel Direction	Speed Limit	Travel Speed	
		Mean ¹	85 th Percentile ²
Eastbound	40	36	41
Westbound	40	41	45

¹ Arithmetic mean

² The speed at or below which 85 percent of the vehicles are traveling.

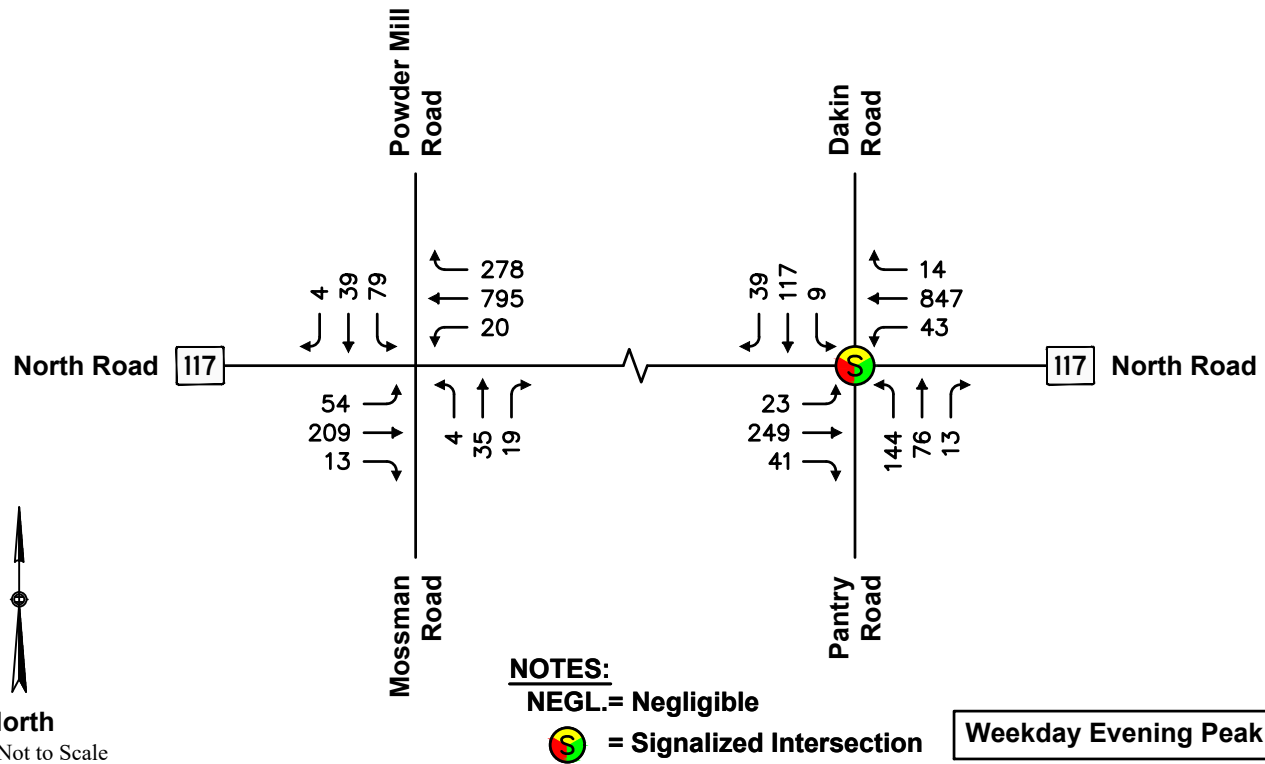
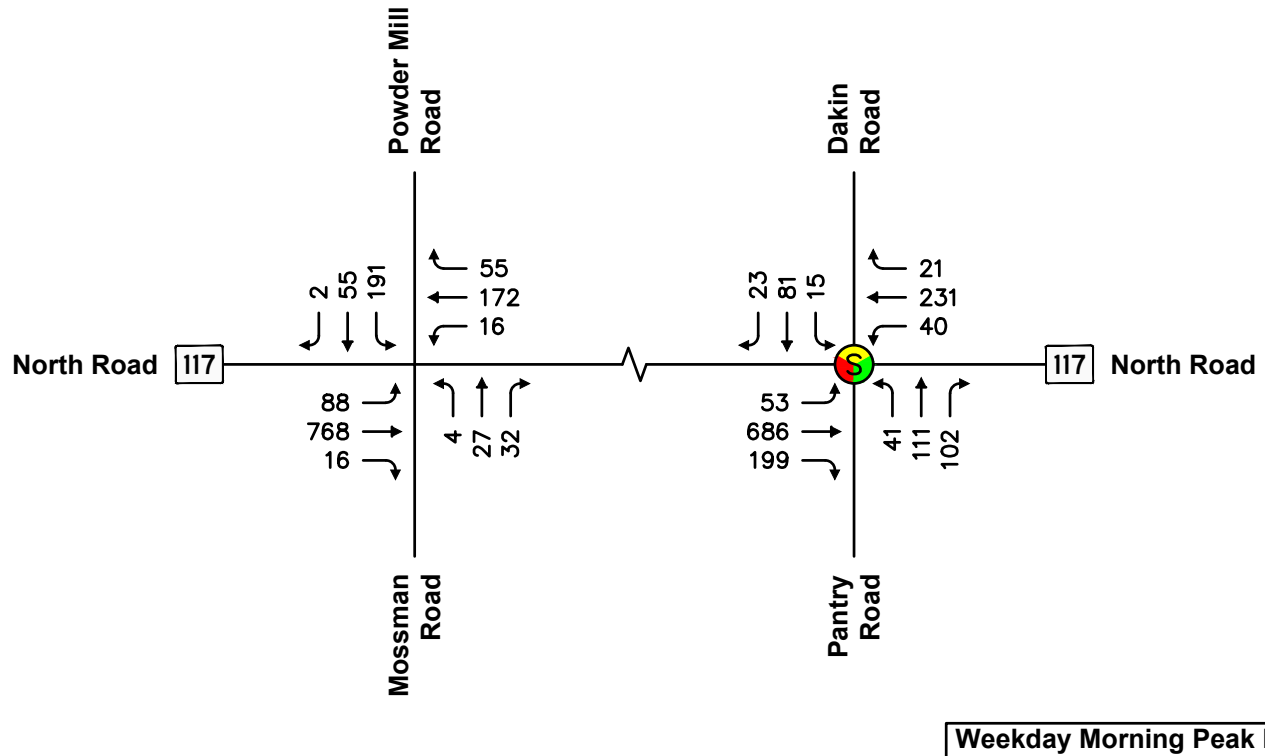


Figure 3

As summarized in **Table 2**, the mean (average) travel speed on North Road in the site vicinity is 36 mph traveling eastbound and 39 mph traveling westbound. The 85th percentile travel speed was observed to be 41 mph eastbound and 45 mph westbound. The observed travel speeds are consistent with the regulatory speed limit of 40 mph on North Road in the study area.

2.4 SAFETY

In order to identify crash trends and safety characteristics for study area intersections, crash data was obtained from MassDOT for the Town of Sudbury for the three-year period 2017 through 2019 (the most recent data currently available from MassDOT). Crash data for the study intersections is summarized in **Table 3** with detailed data provided in the **Appendix**.

Crash rates were calculated for the study area intersections as reported in **Table 3**. This rate quantifies the number of crashes per million entering vehicles. MassDOT has determined the official District 3 (which includes the Town of Sudbury) crash rate to be 0.61 for unsignalized intersections and 0.89 for signalized intersections. This rate represents MassDOT's "average" crash experience for District 3 communities and serves as a basis for comparing reported crash rates for the study intersections. Where calculated crash rates notably exceed the district average, some form of safety countermeasures may be warranted. In addition, review of the MassDOT high crash cluster mapping was conducted to determine locations listed as eligible for Highway Safety Improvement Program (HSIP) evaluation and funding.

TABLE 3
INTERSECTION CRASH SUMMARY
2017 THROUGH 2019¹

Data Category	STUDY LOCATIONS	
	North Rd at Dakin Rd/Pantry Rd	North Rd at Powder Mill Rd/Mossman Rd
Traffic Control	Signalized	Unsignalized
Crash Rate ²	0.26	0.27
MassDOT Avg. Rate ³	0.89	0.66
<i>Year:</i>		
2017	5	2
2018	0	2
<u>2019</u>	<u>1</u>	<u>2</u>
Total	6	6
<i>Type:</i>		
Angle	4	2
Rear-End	0	2
Head-On	0	0
Sideswipe	1	1
Single Vehicle	1	1
Other/Unknown	0	0
<i>Severity:</i>		
P. Damage Only	5	4
Personal Injury	1	2
Fatality	0	0
<i>Conditions:</i>		
Dry	4	5
Wet	0	1
Snow	2	0
<i>Time:</i>		
7:00 to 9:00 AM	1	1
4:00 to 6:00 PM	1	1
Rest of Day	4	4

¹Source: MassDOT Crash Database

²Crashes per million entering vehicles

³District 3 Average Crash Rate

As summarized in **Table 3**:

- *North Road at Dakin Road/Pantry Road.* Six (6) crashes were reported at or near the North Road signalized intersection with Dakin Road and Pantry Road. The resulting crash rate of 0.26 is lower than the District 3 average. The reported crashes included five (5) angle/sideswipe type collisions and one (1) single vehicle type collision. Eighty-three percent (83%) of the crashes resulted in property-damage only, generally indicative of low-speed crashes. No fatalities or pedestrian-related incidents were reported during the study period.
- *North Road at Powder Mill Road/Mossman Road:* Six (6) crashes were reported at or near the North Road unsignalized intersection with Powder Mill Road and Mossman Road. The resulting crash rate of 0.27 is lower than the District 3 average. The reported crashes included three (3) angle/sideswipe type collisions, two (2) rear-end type collision and one (1) single vehicle type collision. Sixty-seven percent (67%) of the crashes resulted in property-damage only, generally indicative of low-speed crashes. No fatalities or pedestrian-related incidents were reported during the study period.

In summary, based on extensive review of MassDOT crash data, the study intersections both experienced crash rates that are below the MassDOT District 3 averages and none of the intersection are listed as HSIP locations; therefore, no immediate safety countermeasures are warranted based on the crash history at the remaining study intersections.

2.5 SIGHT LINE ANALYSIS

An evaluation of sight lines was conducted at the proposed primary site driveway location to ensure that minimum recommended sight lines are available at the intersection with North Road. The evaluation documents existing sight lines for vehicles as they relate to North Road with comparison to recommended guidelines.

The American Association of State Highway and Transportation Officials' (AASHTO) standards¹ reference two types of sight distance which are relevant at the site driveway intersections at North Road: stopping sight distance (SSD) and intersection sight distance (ISD). Sight lines for critical vehicle movements at the site driveway intersection were compared to minimum SSD and ISD recommendations for the travel speeds in the site vicinity.

¹A policy on Geometric Design of Highways and Streets, American Association of State Highway and Transportation Officials (AASHTO), 2018.

Stopping Sight Distance

Sight distance is the length of roadway visible to the motorist to a fixed object. The minimum sight distance available on a roadway should be sufficiently long enough to enable a below-average operator, traveling at or near a regulatory speed limit, to stop safely before reaching a stationary object in its path, in this case, a vehicle exiting onto North Road. The SSD criteria are defined by AASHTO based on design and operating speeds, anticipated driver behavior and vehicle performance, as well as physical roadway conditions. SSD includes the length of roadway traveled during the perception and reaction time of a driver to an object, and the distance traveled during brake application on wet level pavement. Adjustment factors are applied to account for roadway grades when applicable.

SSD was estimated in the field using AASHTO standards for driver's eye (3.5 feet) and object height equivalent to the taillight height of a passenger car (2.0 feet) for the eastbound and westbound North Road approaches to the site driveway. **Table 4** presents a summary of the available SSD as they relate to Waltham Street and AASHTO's recommended SSD. SSD calculations are provided in the **Appendix**.

TABLE 4
STOPPING SIGHT DISTANCE SUMMARY
NORTH ROAD APPROACHES TO SITE DRIVEWAY

Approach/ Travel Direction	Available SSD	AASHTO Recommended SSD ¹	
		Regulatory Speed ²	85 th Percentile Travel Speed ³
<i>Eastbound</i>	>450 Feet	250 Feet	315 Feet
<i>Westbound</i>	>400 Feet	305 Feet	360 Feet

¹Recommended sight distance based on AASHTO, A Policy on Geometric Design of Highways and Streets. Based on driver height of eye of 3.5 feet to object height of 2.0 feet.

²Regulatory speed = 40 mph EB and WB

³85th Percentile travel speed: 41 mph EB, 45 mph WB

As summarized in **Table 4** analysis results indicate that the available sight lines exceed AASHTO's recommended SSD criteria for both travel directions along North Road based on the regulatory and 85th percentile travel speeds.

Intersection Sight Distance

Clear sight lines provide sufficient sight distance for a stopped driver on a minor-road approach to depart from the intersection and enter or cross the major road. As stated under AASHTO's Intersection Sight Distance (ISD) considerations, "...If the available sight distance for an entering ...vehicle is at least equal to the appropriate stopping sight distance for the major road, then drivers have sufficient sight distance to avoid collisions...To enhance traffic operations, intersection sight distances that exceed stopping sight distances are desirable along the major road." AASHTO's ISD criteria are defined into several "cases". In this case, the proposed site driveway approach to the intersection is proposed to be under STOP signal control and the ISD in question relates to the ability to turn left or turn right onto North Road.

Available ISD was estimated in the field using AASHTO standards for driver's eye (3.5 feet), object height (3.5 feet) and decision point (8 to 14.5 feet from the edge of the travel way) for the eastbound and westbound directions along North Road. **Table 5** presents a summary of the available ISD for the departure from the site driveway and AASHTO's minimum ISD criteria.

TABLE 5
INTERSECTION SIGHT DISTANCE SUMMARY
SITE DRIVEWAY DEPARTURE TO NORTH ROAD

View Direction	Available ISD	AASHTO Minimum ¹	AASHTO Ideal ¹
		85 th Percentile Travel Speed ³	Regulatory Speed ²
Looking East	445± Feet	360 Feet	445 Feet
Looking West	385± Feet	315 Feet	385 Feet

¹ Recommended sight distance based on AASHTO, A Policy on Geometric Design of Highways and Streets. Based on driver height of eye of 3.5 feet and an object height of 3.5 feet and adjustments for roadway grade if required. Minimum value as noted represents SSD per AASHTO guidance.

²Regulatory speed = 40 mph EB and WB

³85th Percentile travel speed: 41 mph EB, 45 mph WB

The results of the ISD analysis presented in **Table 5** indicates that with clearing and regrading associated with the construction of the primary site driveway, the available sight lines at the North Road intersection with the proposed site driveway will exceed the sight line requirements from AASHTO for the regulatory and 85th percentile travel speeds. The ISD sight lines are graphically shown in **Figure 4**. MDM recommends any new plantings (shrubs, bushes) or physical landscape features to be located within the sight lines should also be maintained at a height of 2 feet or less above the adjacent roadway grade to ensure unobstructed lines of sight.

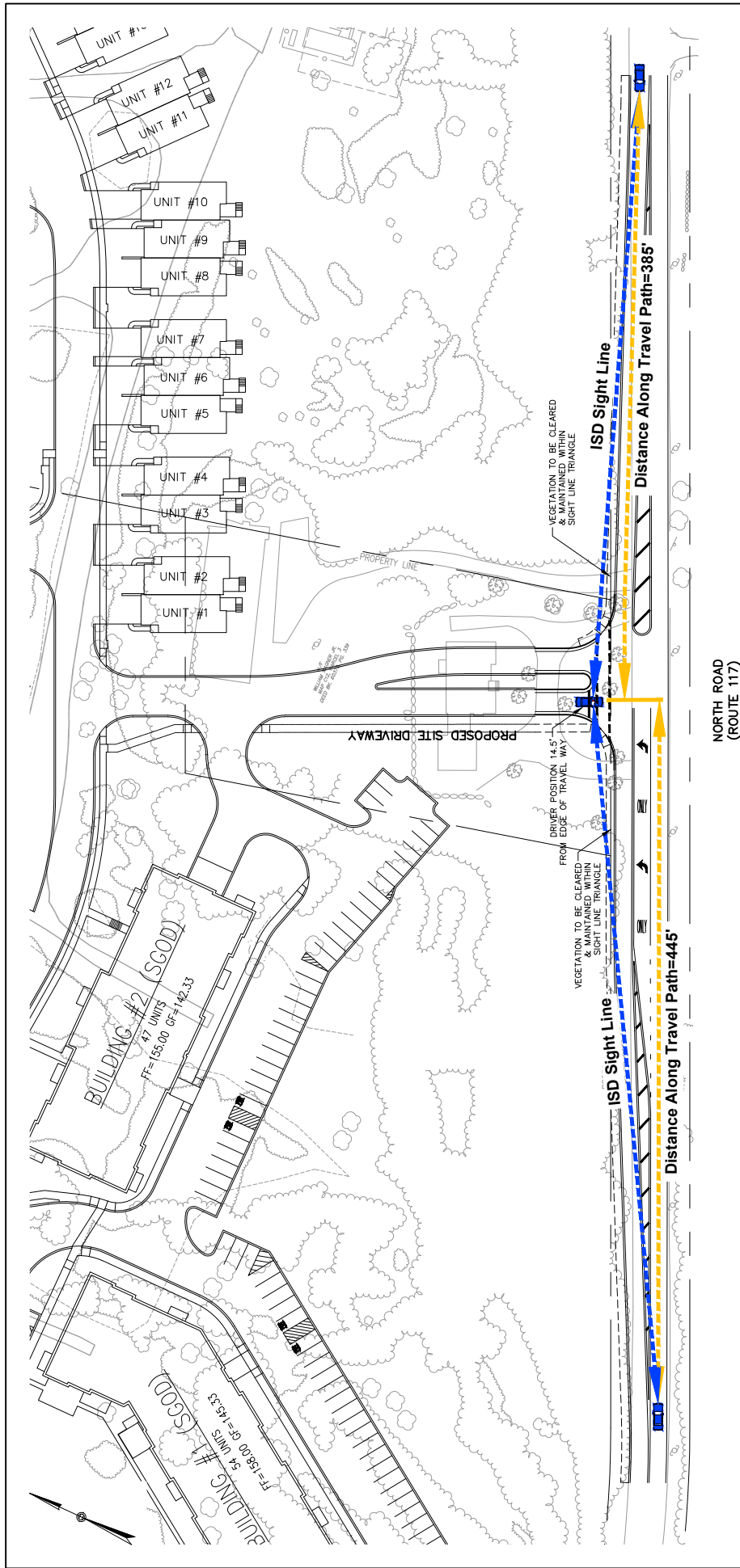


Figure 4

Intersection Sight Distance Analysis
MELONE QUARRY NORTH ROAD (ROUTE 117) SUDBURY, MASSACHUSETTS PREPARED FOR: QUARRY NORTH ROAD LLC 379 CONCORD ROAD SUDBURY, MASSACHUSETTS 01776
MDM TRANSPORTATION CONSULTANTS, INC. PLANNERS & ENGINEERS 28 Lord Road, Suite 200 Methuen, MA 01752 Tel: (978) 350-0371 Fax: (978) 350-0371
DATE: February 28, 2020 PROJECT No. 1073
SCALE: As Noted FILE: 1073 Concept Plan (2020-2-28).dwg
Sheet 1 of 1

NOTES

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2. FINAL DESIGN IS SUBJECT TO FIELD SURVEY BY OTHERS.
3. PROPERTY LINES AND ACCESS LINE LOCATIONS ARE APPROXIMATE ONLY AND ARE SUBJECT TO DEED AND TITLE RECORDS.
4. BASE PLAN SOURCE: SULLIVAN CONNORS & ASSOCIATES AND CIVIL DESIGN GROUP, LLC.



3.0 FUTURE CONDITIONS

Evaluation of the proposed development impacts requires the establishment of a future baseline analysis condition. This section estimates future roadway and traffic conditions with and without the proposed development. To be consistent with EEA/MassDOT guidelines, a five-year planning horizon was selected.

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 a future year condition. Traffic volumes on the roadway network at that time, in the absence of the development (that is, the No-Build condition), would include existing traffic, new traffic due to general background traffic growth, and traffic related to specific development by others that is currently under review at the local and/or state level. Consideration of these factors resulted in the development of No-Build traffic volumes. Anticipated Site-generated traffic volumes were then superimposed upon these No-Build traffic-flow networks to develop future Build conditions.

The following sections provide an overview of future No-Build traffic volumes and projected Build traffic volumes.

3.1 BACKGROUND TRAFFIC GROWTH

Background traffic includes demand generated by other planned developments in the area as well as demand increases caused by external factors. External factors are general increases in traffic not attributable to a specific development and are determined using historical data.

3.1.1 Historical Area Growth

Nearby permanent count station data published by MassDOT indicates a 0.4-percent per year growth rate. For purposes of this evaluation, a 1-percent compounded annual growth rate was used (7.2 percent increase over a 7-year horizon) which is consistent with the recent master plan traffic study² for the property. This growth rate is higher than historic rates and is also expected to account for any small fluctuation in hourly traffic as may occur from time to time in the study area and traffic associated with other potential small developments or vacancies in the area. MassDOT permanent count station data and background growth calculations are provided in the **Attachments**.

3.1.2 Background Development-Related Growth

Development of future No-Build traffic volumes also considers traffic generated through the study area from other specific area developments. Review of Massachusetts Environmental Policy Act (MEPA) files and consultation with the Town of Sudbury Planning Staff indicates that there is one Site-specific development project in the area that may increase baseline traffic at the study intersections as follows:

- **Maynard Crossing:** This mixed-use project includes 240,490± sf of retail space including a 68,000± sf supermarket, 30,300± sf of commercial, office, or retail space, 20,000± sf fitness center, 180 apartments, and 143 units of senior independent living. The project includes access/egress points along Parker Street. Traffic associated with this development was estimated based on the Traffic Impact and Access Study prepared for the project by Green International Affiliates, Inc. in January 2017. The Site-specific trip tracings were extrapolated through the project area based on existing travel patterns and are provided in the **Appendix**.

3.2 NO-BUILD TRAFFIC VOLUMES

To account for future traffic growth along the corridor, the 1-percent annual growth rate was applied to existing traffic volumes over a seven-year period, as well as traffic associated with the build-out of Maynard Crossing. The resulting effective growth rate used in this traffic study was 1.3 to 1.7-percent per year which is highly conservative based MassDOT permanent count station data which indicates a 0.4% per year growth rate. Future 2027 No-Build traffic volumes are displayed in **Figure 5**.

²Traffic Impact Study, Melone Residential Development prepared by McMahon Associates, Inc. dated October 2018

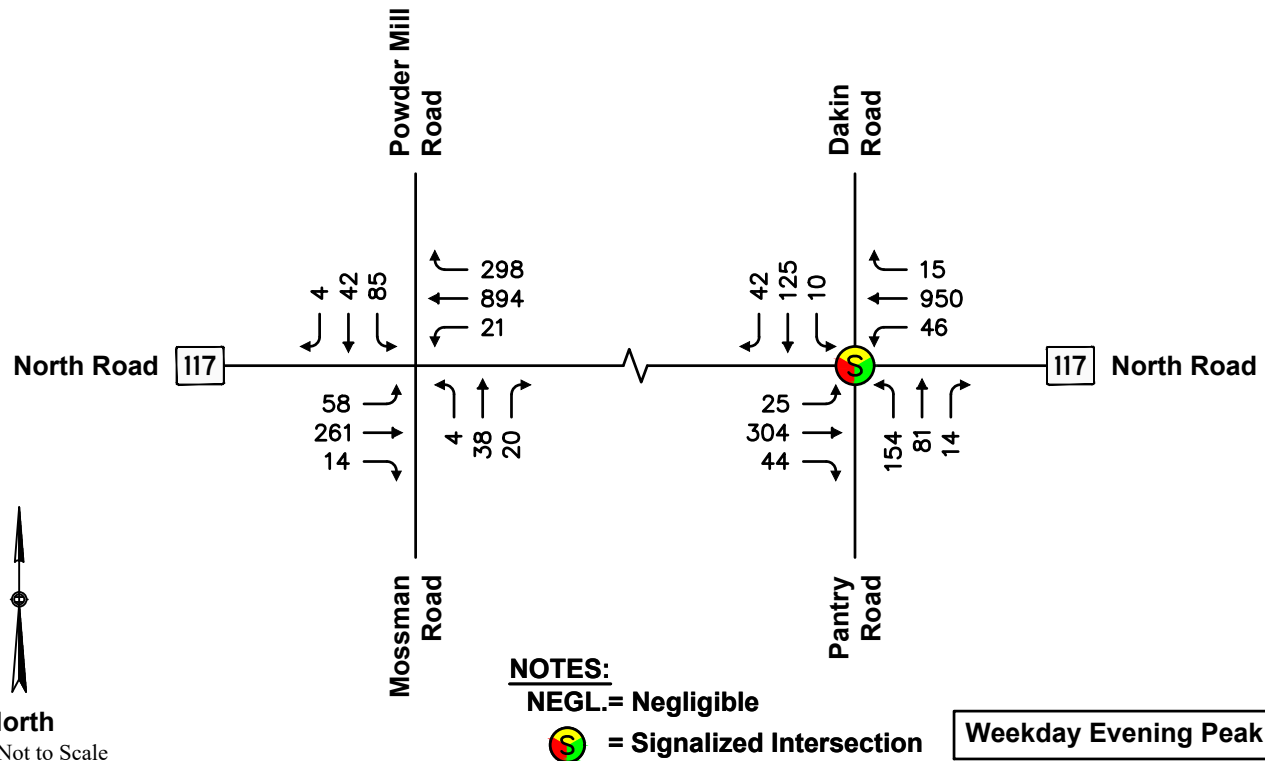
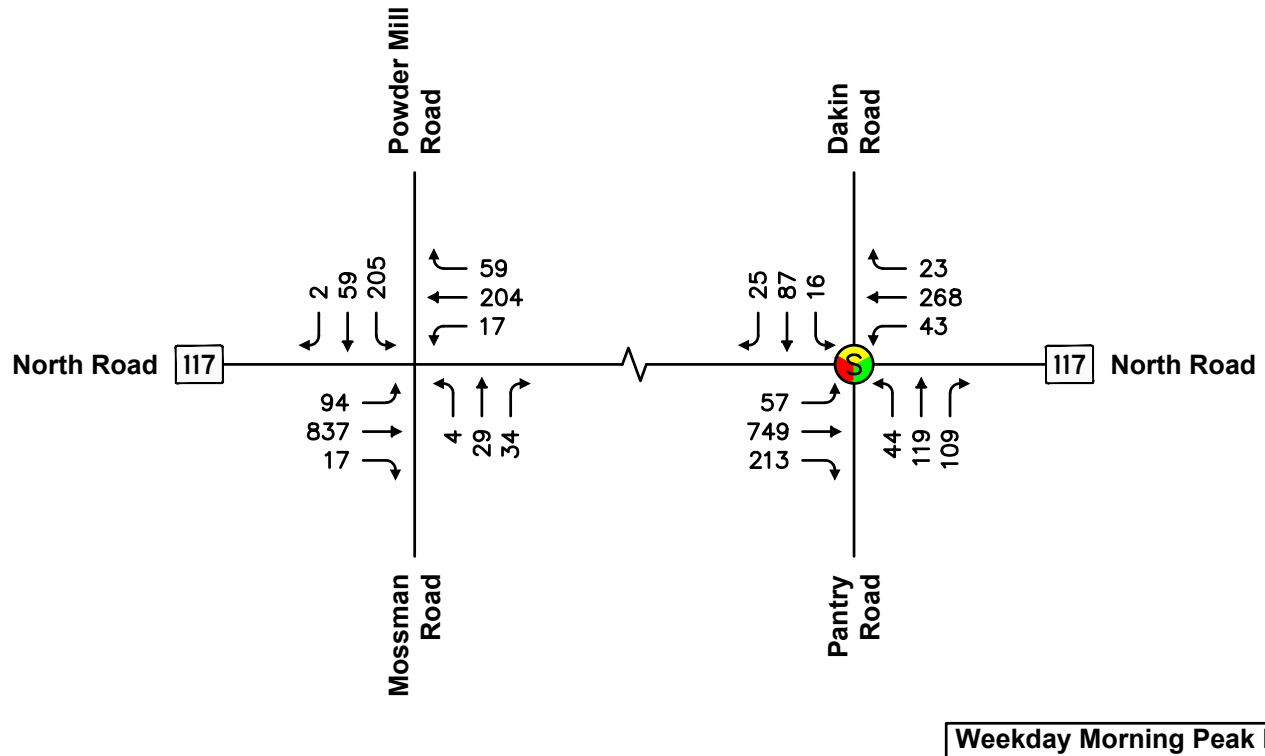


Figure 5

3.3 SITE-GENERATED TRAFFIC – ITE BASIS

Future Build condition traffic volumes were developed by estimating the number of peak-hour trips expected to be generated by the proposed development and distributing this additional traffic onto the local roadway network. These future development-related trips were added to future No-Build traffic volumes to evaluate future traffic operations with the proposed residential development in place. The methodology utilized to estimate the future trip-generation characteristics of the proposed development are summarized below. In accordance with EEA/MassDOT guidelines, the traffic generated by the proposed development was estimated using trip rates published in ITE's *Trip Generation* for the Land Use Codes (LUCs) based on trip rates for Multifamily Housing – Low Rise (LUC 220) and Multifamily Housing – Mid Rise (LUC 221).

Table 6 presents the trip-generation estimates for the proposed development based on ITE methodology and EEA/MassDOT guidelines.

TABLE 6
TRIP-GENERATION SUMMARY

Peak Hour/Direction	Townhomes (123 Units) ¹	Apartments (151 Units) ²	Total
<i>Weekday Morning Peak Hour:</i>			
Entering	13	14	27
<u>Exiting</u>	<u>44</u>	<u>40</u>	<u>84</u>
Total	57	54	111
<i>Weekday Evening Peak Hour:</i>			
Entering	43	40	83
<u>Exiting</u>	<u>26</u>	<u>26</u>	<u>52</u>
Total	69	66	135
<i>Weekday Daily (24 hours)</i>	900	822	1,722

Source: ITE *Trip Generation*, 10th Edition; 2017.

¹ITE LUC 220 – Multifamily – Low Rise applied to 123 units.

³ITE LUC 221 – Multifamily – Mid Rise applied to 151 units.

Based on industry-standard trip rates, the proposed development is estimated to generate approximately 111 vehicle trips during the weekday morning peak hour (27 entering and 84 exiting) and 135 vehicle trips during the weekday evening peak hour (83 entering and 52 exiting). On a daily basis, the development is estimated to generate approximately 1,722 vehicle trips on a weekday.

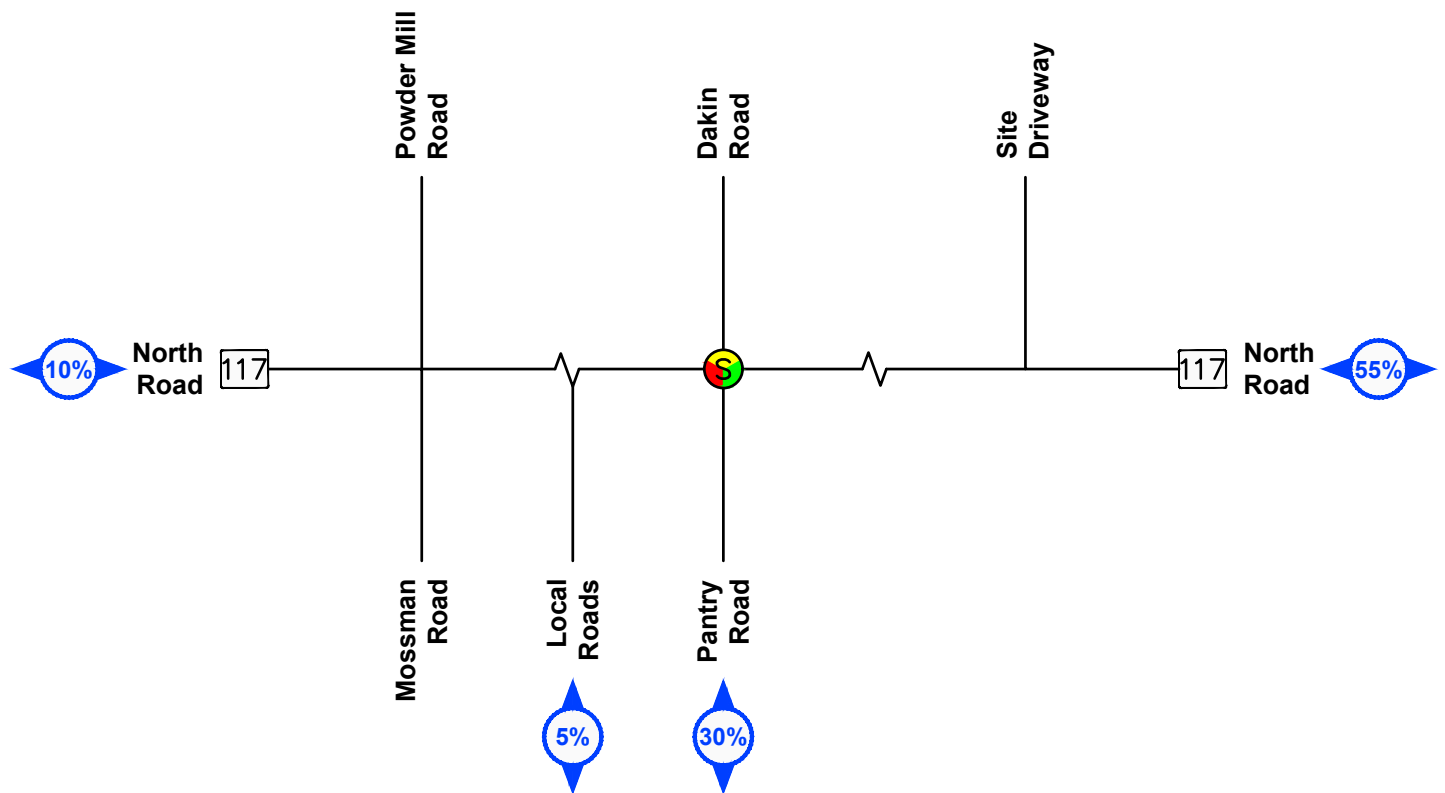
3.4 TRIP DISTRIBUTION AND ASSIGNMENT

The directional distribution of development-generated trips on the roadway network is a function of a number of variables including area population centers and the efficiency of these roadways leading to the Site. US Census Journey-to-work data and existing area travel patterns serve as the primary bases for determining the trip distribution pattern for the proposed development. Trip distribution calculations for the Site are presented in **Figure 6** with supporting calculations provided in the **Appendix**.

Development-related trips for the Site were assigned to the roadway network using the ITE trip-generation estimates shown in **Table 6** and the distribution patterns presented in the **Figure 6**. New development-related trips at each intersection for the weekday morning and weekday evening peak hours are quantified in **Figure 7**.

3.5 BUILD TRAFFIC VOLUMES

Future Build condition traffic volumes were arrived at by adding development-specific traffic volumes to the 2027 No-Build conditions. The 2027 Build condition traffic-volume networks for the weekday morning and weekday evening peak hours are displayed in **Figure 8**.



North

Scale: Not to Scale

NOTES:



= Signalized Intersection

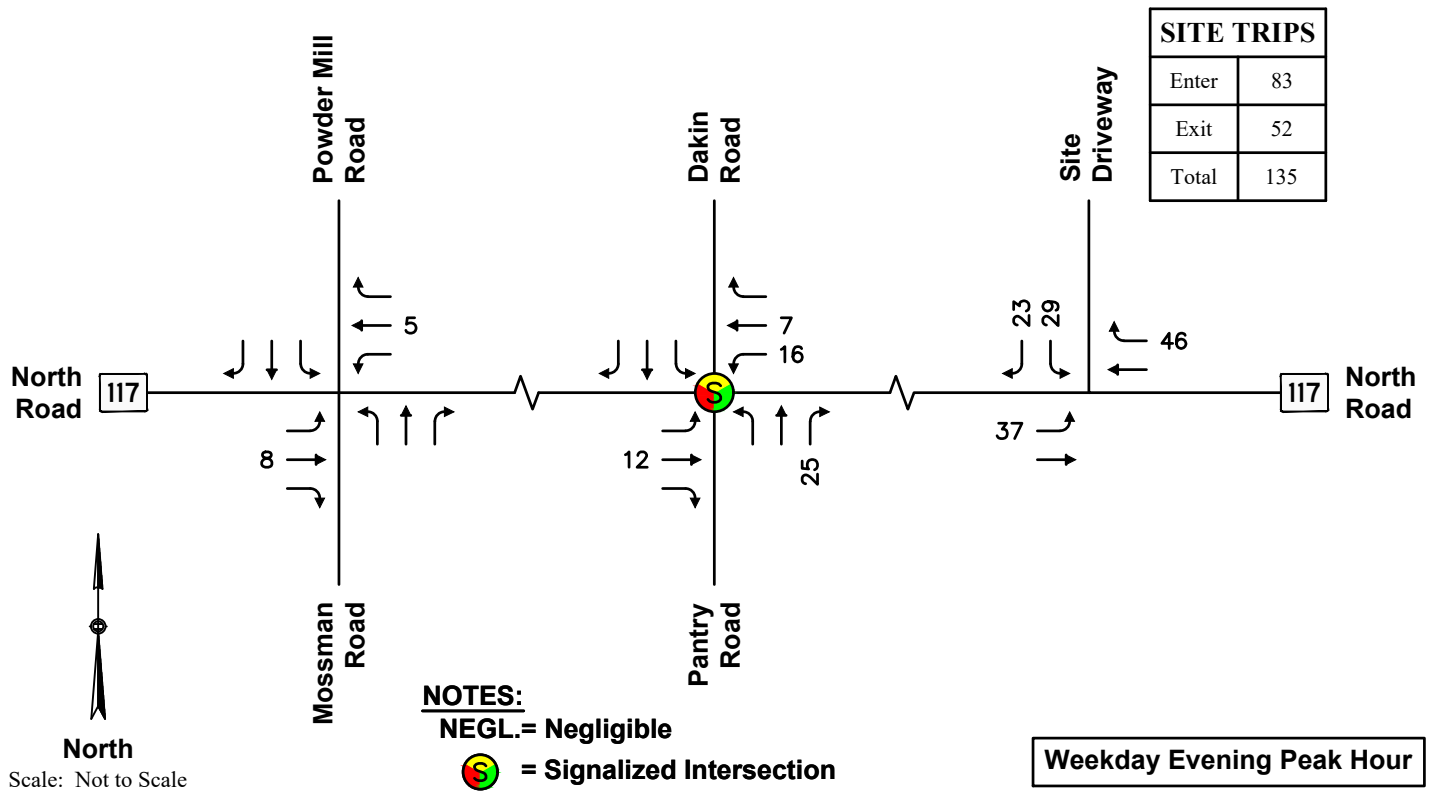
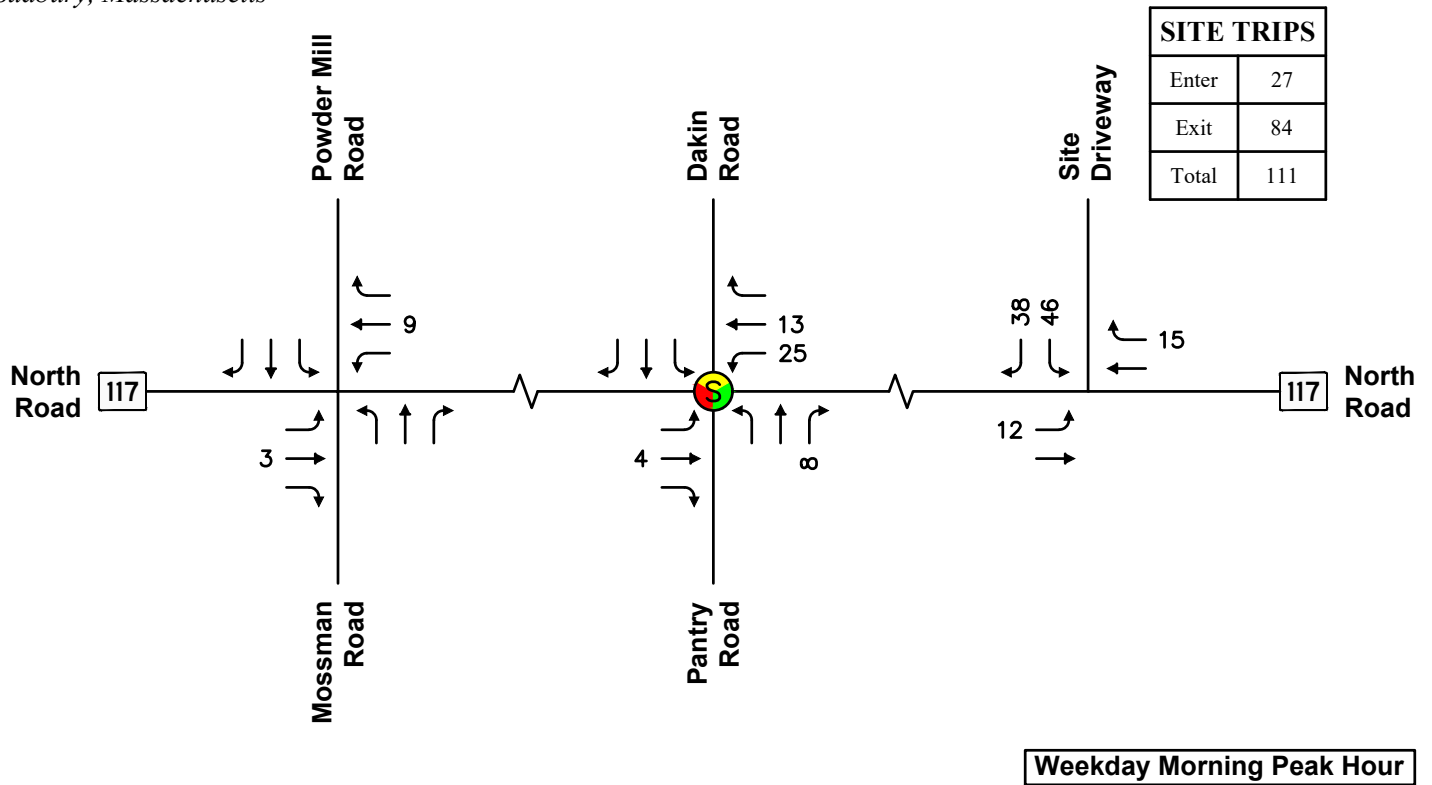


Figure 7

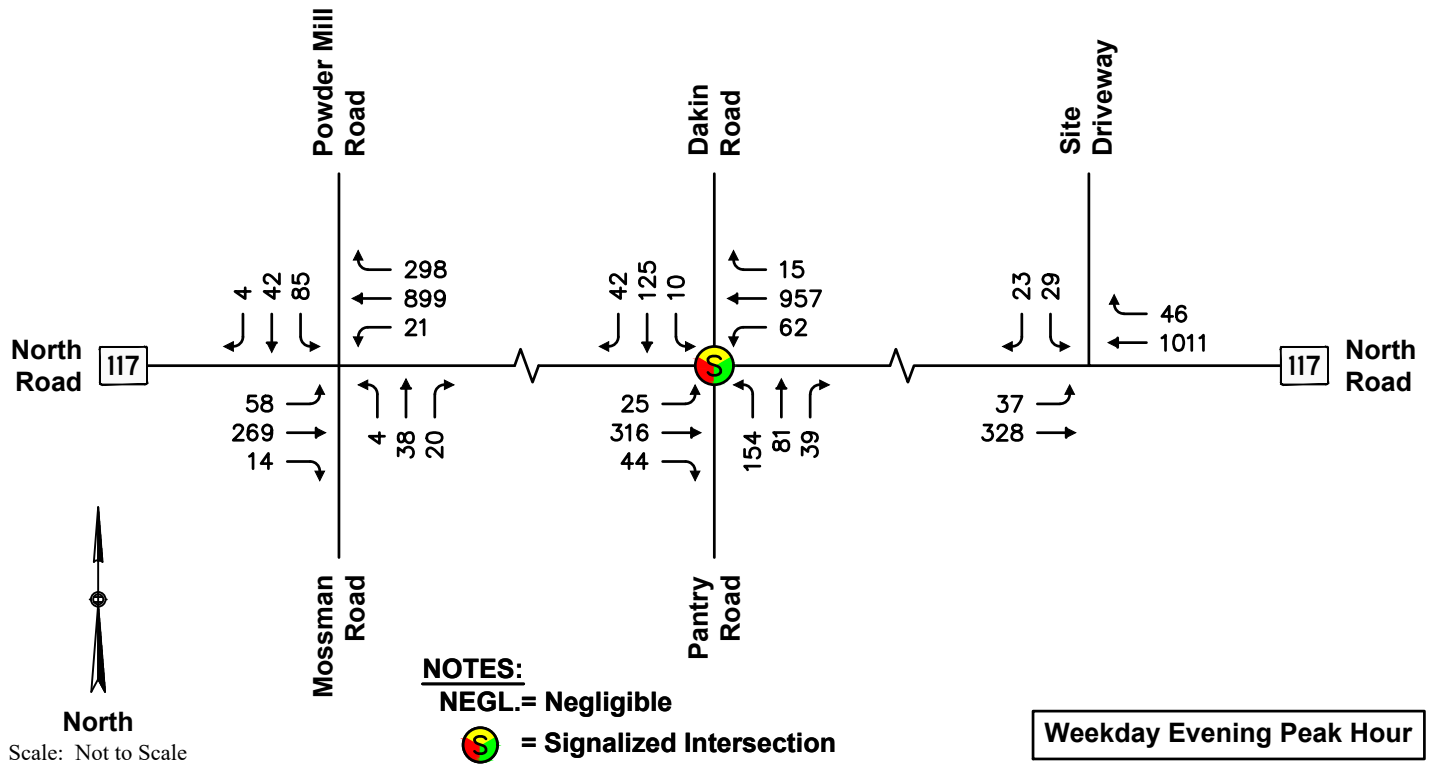
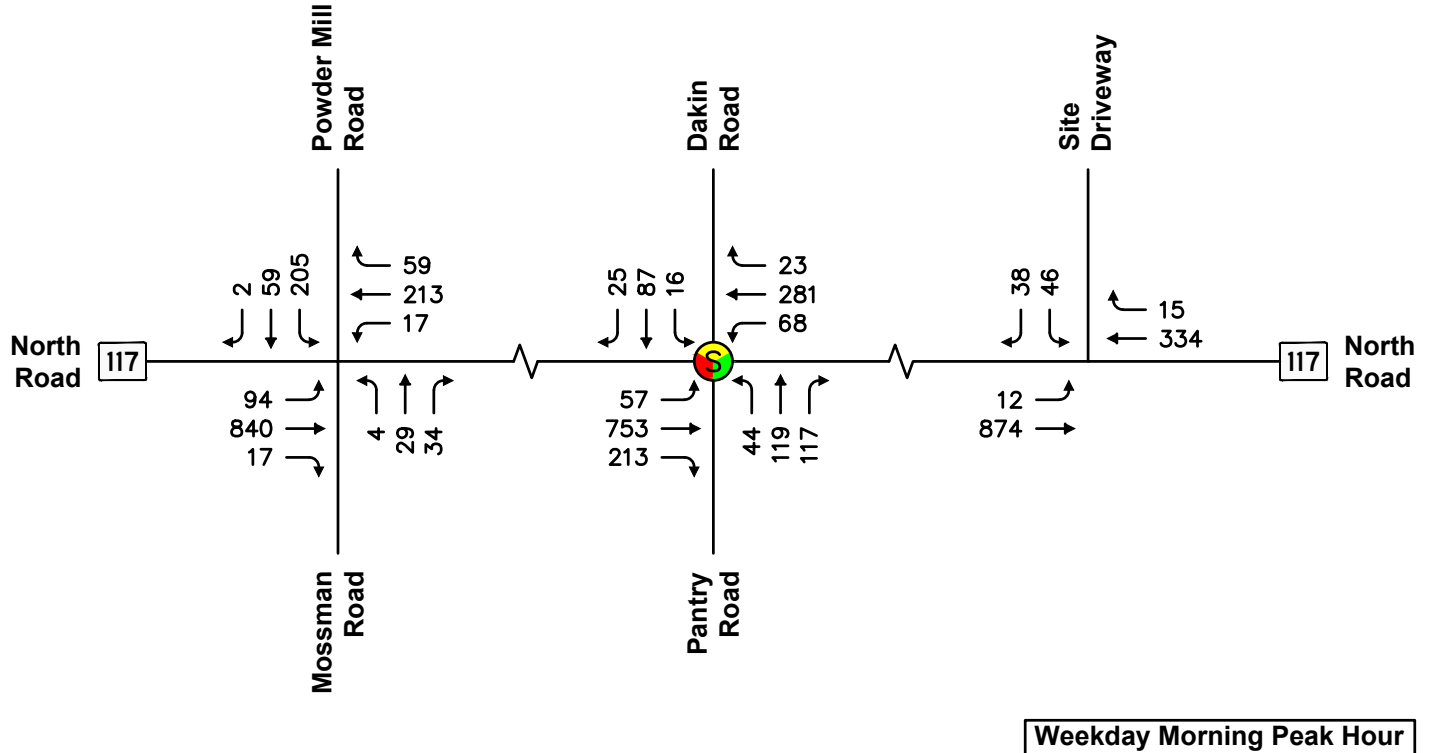


Figure 8

4.0 TRAFFIC OPERATIONS ANALYSIS

Intersection capacity analyses for the primary study intersections are presented in this section for the Baseline, No-Build, and Build traffic-volume conditions. Capacity analyses, conducted in accordance with EEA/MassDOT guidelines, provide an index of how well the roadway facilities serve the traffic demands placed upon them. The operational results provide the basis for recommended access and roadway improvements in the following section.

4.1 CAPACITY ANALYSIS PROCEDURES

Capacity analysis of intersections is developed using the Synchro® computer software, which implements the methods of the Highway Capacity Manual 6th Edition (HCM). The resulting analysis presents a level-of-service (LOS) designation for individual intersection movements. The LOS is a letter designation that provides a qualitative measure of operating conditions based on several factors including roadway geometry, speeds, ambient traffic volumes, traffic controls, and driver characteristics. Since the LOS of a traffic facility is a function of the traffic flows placed upon it, such a facility may operate at a wide range of LOS, depending on the time of day, day of week, or period of year. A range of six levels of service are defined on the basis of average delay, ranging from LOS A (the least delay) to LOS F (delays greater than 50 seconds for unsignalized movements and 80 seconds for signalized movements). The specific control delays and associated LOS designations are presented in the **Appendix**.

4.2 INTERSECTION CAPACITY ANALYSIS RESULTS

Capacity analysis results for the weekday morning and weekday evening peak hour capacity analysis results for the study intersections are described below, with detailed analysis results presented in the **Appendix**.

4.2.1 Level of Service Analysis

The capacity analysis results for the intersections in the study area are summarized in **Table 7** and **Table 8** for the weekday morning and weekday evening peak hours, respectively. Detailed analysis results are presented in the **Appendix**.

TABLE 7
INTERSECTION CAPACITY ANALYSIS RESULTS
WEEKDAY MORNING PEAK HOUR

Intersection	Approach	2020 Baseline			2027 No-Build			2027 Build		
		v/c ¹	Delay ²	LOS ³	v/c	Delay	LOS	v/c	Delay	LOS
North Rd at Dakin Rd/ Pantry Rd	Eastbound	0.81	14	B	0.87	19	B	0.88	19	B
	Westbound	0.32	6	A	0.34	6	A	0.42	7	A
	Northbound	0.67	31	C	0.76	39	D	0.77	40	D
	<u>Southbound</u>	<u>0.31</u>	<u>24</u>	<u>C</u>	<u>0.37</u>	<u>28</u>	<u>C</u>	<u>0.37</u>	<u>28</u>	<u>C</u>
	OVERALL	0.81	16	B	0.87	20	C	0.88	20	C
North Rd at Powder Mill Rd/ Mossman Rd	Eastbound	0.07	<5	A	0.08	<5	A	0.08	<5	A
	Westbound	0.02	<5	A	0.02	<5	A	0.02	<5	A
	NB Exit	0.35	34	D	0.46	47	E	0.47	48	E
	SB Exit	>1.0	>50	F	>1.0	>50	F	>1.0	>50	F
North Road at Site Driveway	Eastbound	n/a ⁴	n/a	n/a	n/a ⁴	n/a	n/a	0.01	<5	A
	Westbound	n/a	n/a	n/a	n/a	n/a	n/a	0.00	<5	A
	SB Exit	n/a	n/a	n/a	n/a	n/a	n/a	0.37	28	D

¹ Volume-to-capacity ratio

² Average control delay per vehicle (in seconds)

³ Level of service

⁴ n/a = not applicable

TABLE 8
INTERSECTION CAPACITY ANALYSIS RESULTS
WEEKDAY EVENING PEAK HOUR

Intersection	Approach	2020 Baseline			2027 No-Build			2027 Build		
		v/c ¹	Delay ²	LOS ³	v/c	Delay	LOS	v/c	Delay	LOS
North Rd at Dakin Rd/ Pantry Rd	Eastbound	0.29	6	A	0.32	6	A	0.33	6	A
	Westbound	0.80	16	B	0.83	17	B	0.84	17	B
	Northbound	0.58	29	C	0.74	42	D	0.88	52	D
	<u>Southbound</u>	<u>0.31</u>	<u>20</u>	<u>C</u>	<u>0.37</u>	<u>25</u>	<u>C</u>	<u>0.38</u>	<u>27</u>	<u>C</u>
	OVERALL	0.80	16	B	0.83	19	B	0.84	21	C
North Rd at Powder Mill Rd/ Mossman Rd	Eastbound	0.09	<5	A	0.11	<5	A	0.11	<5	A
	Westbound	0.02	<5	A	0.02	<5	A	0.02	<5	A
	NB Exit	0.43	48	E	0.63	>50	F	0.65	>50	F
	SB Exit	>1.0	>50	F	>1.0	>50	F	>1.0	>50	F
North Road at Site Driveway	Eastbound	n/a ⁴	n/a	n/a	n/a ⁴	n/a	n/a	0.07	<5	A
	Westbound	n/a	n/a	n/a	n/a	n/a	n/a	0.00	<5	A
	SB Exit	n/a	n/a	n/a	n/a	n/a	n/a	0.18	19	C

¹ Volume-to-capacity ratio

² Average control delay per vehicle (in seconds)

³ Level of service

⁴ n/a = not applicable

As summarized in **Table 7** and **Table 8**:

- *North Road at Dakin Road/Pantry Road:* Under future Build conditions, capacity analyses indicate that the signalized intersection will continue to operate at overall LOS C or better during the weekday morning and weekday evening peak hours. All of the intersection approaches will continue to operate at LOS D or better. To the west of the Site, the project will result in the largest increase in trips along Pantry Road with one directional trip or less along Pantry Road every 2 minutes during the critical weekday evening peak hour. Specifically, relative traffic increases for the proposed project represents less than one additional right turning vehicle in the northbound direction during the weekday evening peak hour per traffic cycle at the signal.
- *North Road at Powder Mill Road/Mossman Road:* Under future No-Build conditions, capacity analyses indicate that the Powder Mill Road and Mossman Road approaches to North Road will operate with long delays during the weekday morning and weekday evening peak hours. The project is not anticipated to add any additional turning vehicles from the minor roadway approaches and will result in a traffic increases along North Road representing one new trip every 7 minutes during the peak hours. Relative traffic increases for the proposed project represents an inconsequential change in area roadway volumes - a level of change that falls well within normal day-to-day fluctuations in traffic entering and exiting the study intersection and is immaterial to traffic operations along North Road.
- *North Road at Proposed Site Driveway:* Under future Build conditions, Proposed Site Driveway approach to North Road will operate under capacity at LOS D or better during the peak hours. Mainline travel along North Road will continue to operate unimpeded with minimal delay.

In summary, the proposed development does not result in any significant change in operations along North Road compared to No-Build conditions. Furthermore, transportation funding, access/egress improvements, and a robust TDM plan as outlined in the *Conclusions and Recommendations* section of this report will enhance site access/egress, enhance pedestrian and bicycle accommodations on-site, and to reduce dependency on single-occupant auto use.

4.2.2 Vehicle Queue Analysis

Vehicle queue results are presented for the signalized North Road intersection with Dakin Road/Pantry Road. These vehicle queues are compared to available storage lengths, which are defined as lengths of exclusive turn lanes or the distance to the nearest major intersection for through lanes. Vehicle queue results from the capacity analysis are summarized in **Table 9**. Detailed worksheets of the queuing analysis are provided in the **Appendix**.

TABLE 9
VEHICLE QUEUE ANALYSIS SUMMARY
NORTH ROAD AT DAKIN ROAD/PANTRY ROAD

Approach	Storage Length (feet)	2027 No-Build		2027 Build	
		Average Queue Length ¹	95 th Percentile Queue Length ¹	Average Queue Length	95 th Percentile Queue Length
Weekday Morning Peak Hour					
Eastbound L/T/R	>1500	328	535	333	544
Westbound L/T/R	>1500	60	98	72	119
Northbound L/T/R	>1500	111	256	116	265
Southbound L/T/R	>1500	49	109	50	109
Weekday Evening Peak Hour					
Eastbound L/T/R	>1500	58	91	61	94
Westbound L/T/R	>1500	268	405	286	431
Northbound L/T/R	>1500	88	286	104	345
Southbound L/T/R	>1500	52	141	55	151

¹Average and 95th percentile queue lengths are reported in feet per lane.

Negl.=Negligible

As presented in **Table 9**, average and 95th percentile vehicle queues at the signalized study intersection of North Road at Dakin Road/Pantry Road will continue to be contained within available storage lanes during peak hours. The project will not significantly change queue lengths compared to No-Build conditions and will generally result in an increase of 1 vehicle or less on all intersection approaches.

5.0 RECOMMENDATIONS AND CONCLUSIONS

5.1 RECOMMENDATIONS

MDM finds North Road and the roadways within the site vicinity can accommodate modest traffic increases of the project. Relative traffic increases for the proposed project represents an inconsequential change in area roadway volumes - a level of change that falls well within normal day-to-day fluctuations in traffic entering and exiting the study intersections and is immaterial to traffic operations along North Road. The Proponent has entered into a Land Disposition and Development Agreement (“LDDA”) with the Town to provide \$1,000,000 to the Town of Sudbury for transportation improvements. In addition to these funds, specific mitigation actions are identified within this TIAS to further support the project in compliance with the LDDA, to enhance site access, to provide pedestrian and bicycle accommodations on-site, and to reduce dependency on single-occupant auto use. These include (a) access-related improvements, (b) pedestrian and bicycle accommodations, and (d) transportation demand management (TDM) actions as summarized below.

Access/Egress Improvements

- *Driveway Design.* Recommended access improvements at the primary North Road driveway location are shown conceptually in **Figure 9** that address the LDDA section IV.7 mitigation requirements. The driveway design features a widening of North Road to accommodate an exclusive eastbound left-turn lane to minimize through traffic disruption on North Road and 30-foot curb radii to facilitate decelerating turns to/from North Road and emergency response vehicle maneuverability to/from the Site. Driveway grading and orientation will provide unimpeded sight lines that meet or exceed minimum recommended stopping sight distances. The driveway design will also include provisions for a future sidewalk to be constructed if the Town opts to build a sidewalk along North Road at a future date. Appropriate signs and pavement markings that are compliant with the Manual on Uniform Traffic Control Devices (MUTCD) will be installed including a STOP sign (R1-1) and STOP line pavement markings. Edge line and centerline pavement markings along the boulevard section of the driveway will be provided for positive driver guidance entering and exiting the property.

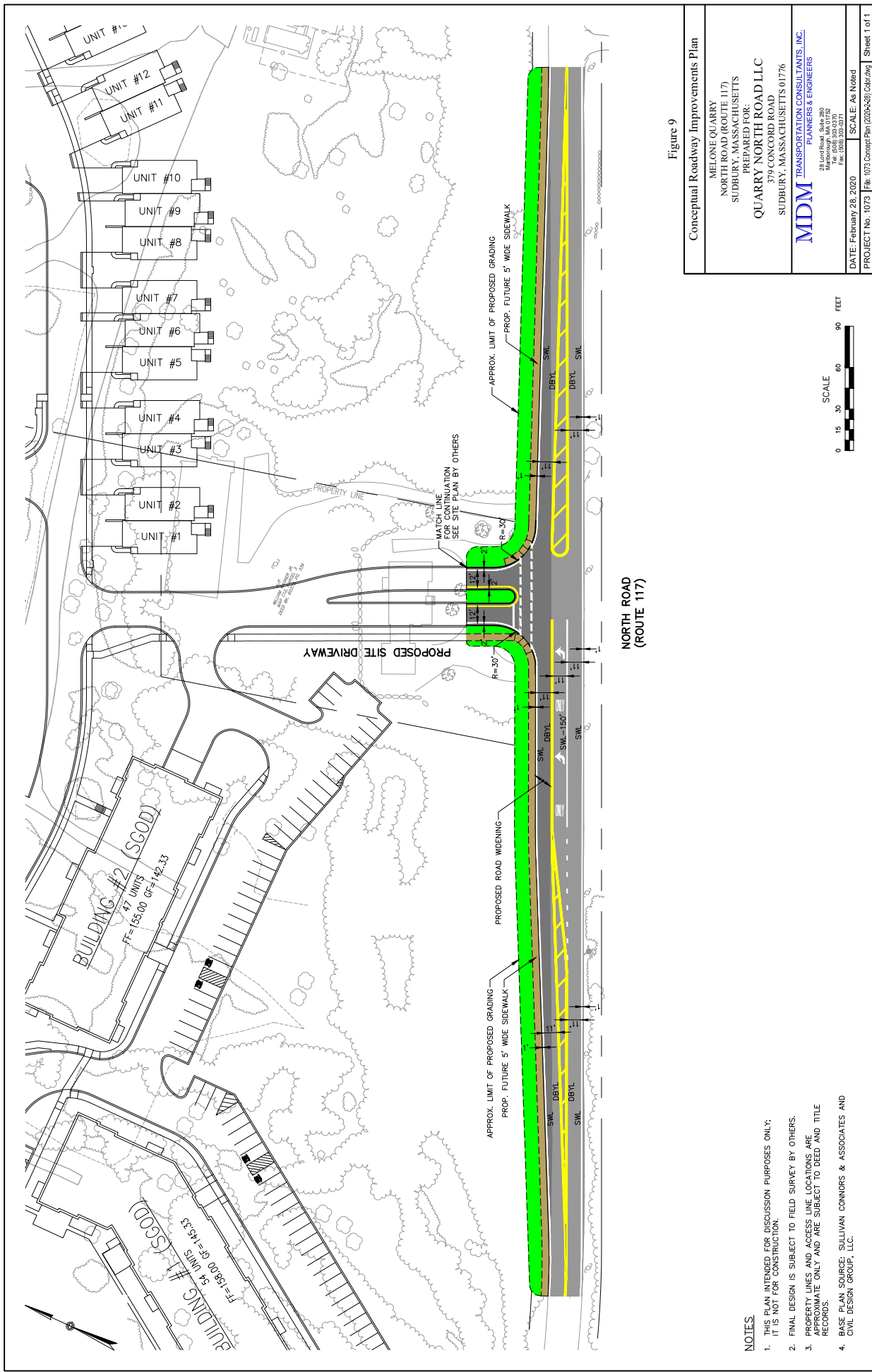


Figure 9

Conceptual Roadway Improvements Plan	
MELONE QUARRY NORTH ROAD (ROUTE 117) SUDBURY, MASSACHUSETTS	
PREPARED FOR: QUARRY NORTH ROAD LLC 379 CONCORD ROAD SUDBURY, MASSACHUSETTS 01776	
 MDM TRANSPORTATION CONSULTANTS, INC. PLANNERS & ENGINEERS 28 Lord Road, Suite 200 Methuen, MA 01752 Tel: (978) 352-0371 Fax: (978) 352-0371	
DATE: February 28, 2020	SCALE: As Noted
PROJECT No. 1073	File: 1073 Concept Plan (2020-2-28) Color.dwg
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Additional widening of North Road for an exclusive right-turn lane into the Site is not warranted or recommended based on limited traffic volumes, noting further that this lane would result in a substantial grading impact and associated tree removal the along a lengthy portion of the north side of North Road including those on property owned by the Sudbury Water District. The Applicant has consulted with the Town Engineering department on this issue with general concurrence on design elements as presented in **Figure 9**.

- *Sight Line Triangles*. Plantings (shrubs, bushes) and structures (walls, fences, etc.) will be maintained at a height of 2 feet or less within the sight lines in vicinity of the Site driveway intersection with North Road to provide unobstructed sight lines. Existing vegetation and structures within these driveway sight lines will be cleared, removed or trimmed/maintained with grading modifications as necessary to ensure minimum recommended sight line requirements are met or exceeded.

Pedestrian and Bicycle Accommodations

- *Pedestrian Connections*. The Site Plan incorporates sidewalks that connect the proposed building to the on-site surface parking areas and amenities. Reserved area for a future sidewalk will also be provided along the primary site driveway to North Road to accommodate any future sidewalk along North Road that may be built by the Town at a future date.
- *Bicycle Amenities*. The Proponent will provide bicycle accommodations within the property including bike racks near the buildings entranceways to encourage and facilitate this mode of transportation within and to/from the Site. A bike share program is also proposed as outlined under TDM below.

Transportation Demand Management (TDM)

The Proponent is committed to reduce auto dependency by residents by implementing a TDM program. A preliminary list of potential TDM program elements may include the following, subject to refinement of the development program and further evaluation by the Proponent:

- *CrossTown Connect (TMA)*. The Proponent will become a member of the CrossTown Connect TMA upon issuance of an initial certificate of occupancy. Membership will include access to services such as online commuter resources, carpool/vanpool matching, active commuting tools, public transportation resources, emergency ride home (ERH) services and other TDM strategies.
- *On-Site Transportation Coordinator*. The Proponent will designate a member of the leasing staff as transportation coordinator responsible disseminating relevant TDM information to residents including provision of a tenant manual that provides information on area bicycle routes, shuttle service, bicycle sharing and parking, parking policies and Site amenities including the proposed bike share program.

- *Car Share Accommodation.* Up to three (3) on-site parking spaces will be designated for use by car share vehicles (Zip Car or equivalent), subject to agreement by a car sharing service provider to assign such vehicles to the property. The location of these spaces will be proximate to the Clubhouse facility.
- *Bicycle Facilities.* Bicycle parking, including weather protected racks for residents and conveniently located racks for visitors proximate to the building entrances will be provided.
- *Bike Share Program.* The Proponent will offer a Bike Share program for residents that will be administered by the Property Manager under which bicycles may be checked out and returned for local use. Multiple sized helmets will be made available. The program will be offered Monday through Sunday between the hours of 7:00 am and 4:00 pm through the property managers office.
- *Preferential Parking and Incentives for Low-Emission Vehicles.* Preferential parking locations for residents who use low-emission vehicles will be provided. Up to three (3) Electric vehicle charging stations will also be provided on the Site.
- *Unbundled Parking.* The Proponent proposes unbundling residential parking to provide an option for residents to rent fewer or no parking spaces with their unit, thereby encouraging lower vehicle ownership at time of lease.
- *Walking Paths.* The Site will include a system of walking paths that will be available to public use.
- *Van Shuttle Service.* The Proponent will purchase a 12-passenger van which will be managed by the property manager. The property manager will engage residents to serve as van drivers to provide scheduled service Monday through Friday to Concord Station and Lincoln Station, Friday service to B'nai Torah Synagogue, Saturday service to Market Basket, and Sunday service to Our Lady of Fatima. Service will be periodically adjusted to meet the needs of the residents for travel to local transit stations, recreational, and shopping destinations.
- *Ride-share/Transportation Hub/Bus Stop.* The Site will include a multipurpose shelter for passenger pick-up/drop-off for ride-share, shuttle service, and school bus use.
- *Pedestrian Infrastructure.* Sidewalk connections within the property will be provided along primary pedestrian desire lines that connect building entrances parking areas and on-site amenities. Area for a future sidewalk will be provided along the primary site driveway which will be constructed if the Town opts to construct a future public sidewalk along North Road. The Proponent will also post area maps that highlight area walking/bicycle routes to promote walking and bicycle travel to/from the Site and area businesses, and recreational facilities.

5.2 CONCLUSIONS

In summary, trip generation for the development is projected to be moderate. MDM finds that incremental traffic associated with the proposed development is not expected to materially impact operating conditions at the study intersections. The study intersections exhibit below-average crash rates based on historic crash data; safety countermeasures are therefore not warranted. Likewise, with clearing and re-grading associated with the construction of the driveways, the available sight lines at the site driveway intersection with North Road will exceed the recommended sight line requirements from AASHTO. Funding provisions of the Land Disposition and Development Agreement along with proposed access access/egress improvements, pedestrian and bicycle accommodations a TDM program and as outlined in the *Conclusions and Recommendations* section of this report will adequately mitigate the project impacts.

APPENDIX

- Traffic Volume Data
- Seasonal/ Yearly Growth Data
- Speed Data
- Crash Data
- Sight Distance Calculations
- Background Projects
- Trip Generation
- Trip Distribution Calculations
- Capacity Analysis

□ Traffic Volume Data



PRECISION
D A T A
INDUSTRIES, LLC

46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdilic.com

North Road (Route 117)
west of Melone Gravel Pit Access
City, State: Sudbury, MA
Client: McMahon Associates/ C. Medeiros

186494 A Volume
Site Code: Y18699.11

Start	EB		WB		Combin		09/27/18	
Time	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	Thu	
12:00	0	69	3	61	3	130		
12:15	0	62	4	72	4	134		
12:30	0	48	6	71	6	119		
12:45	0	76	6	68	6	144	527	
01:00	1	50	3	66	4	116		
01:15	0	65	4	69	4	134		
01:30	1	58	2	75	3	133		
01:45	0	57	2	71	2	128	511	
02:00	2	42	1	67	3	109		
02:15	0	50	2	82	2	132		
02:30	2	79	1	100	3	179		
02:45	2	38	0	135	2	173	593	
03:00	1	96	0	144	1	240		
03:15	1	73	0	174	1	247		
03:30	2	57	3	181	5	238		
03:45	0	79	0	240	0	319	1044	
04:00	4	61	1	235	5	296		
04:15	12	73	0	209	12	282		
04:30	12	58	0	236	12	294		
04:45	18	60	3	213	21	273	1145	
05:00	17	66	3	205	20	271		
05:15	54	69	1	230	55	299		
05:30	79	75	7	212	86	287		
05:45	102	70	7	213	109	283	1140	
06:00	154	58	21	225	175	283		
06:15	295	63	19	226	314	289		
06:30	316	43	16	185	332	228		
06:45	249	35	29	173	278	208	1008	
07:00	255	37	29	128	284	165		
07:15	227	38	35	88	262	126		
07:30	200	20	48	76	248	96		
07:45	160	21	51	55	211	76	463	
08:00	165	40	56	55	221	95		
08:15	159	28	57	59	216	87		
08:30	188	22	53	54	241	76		
08:45	181	22	62	48	243	70	328	
09:00	208	22	42	43	250	65		
09:15	167	26	57	50	224	76		
09:30	141	28	42	34	183	62		
09:45	114	11	54	38	168	49	252	
10:00	101	12	59	16	160	28		
10:15	86	9	46	28	132	37		
10:30	64	4	40	21	104	25		
10:45	65	6	56	18	121	24	114	
11:00	56	4	44	15	100	19		
11:15	59	2	55	16	114	18		
11:30	56	2	56	19	112	21		
11:45	78	3	55	11	133	14	72	
Total	4054	2087	1141	5110	5195	7197		
Percent	78.0%	29.0%	22.0%	71.0%				
Day Total		6141		6251		12392		
Peak	06:15	-	03:00	-	08:00	-	03:45	-
Vol.	1115	-	305	-	228	-	1208	-
P.H.F.	0.882		0.794		0.919		0.933	



PRECISION
D A T A
INDUSTRIES, LLC

46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdilic.com

North Road (Route 117)
west of Melone Gravel Pit Access
City, State: Sudbury, MA
Client: McMahon Associates/ C. Medeiros

186494 A Class
Site Code: Y18699.11

EB															
Start Time	Cycles	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total	
09/27/11															
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01:00	0	1	1	0	0	0	0	0	0	0	0	0	0	0	2
02:00	0	5	1	0	0	0	0	0	0	0	0	0	0	0	6
03:00	1	2	1	0	0	0	0	0	0	0	0	0	0	0	4
04:00	0	36	8	0	0	1	0	1	0	0	0	0	0	0	46
05:00	2	191	53	1	4	1	0	0	0	0	0	0	0	0	252
06:00	4	831	138	3	27	3	5	2	1	0	0	0	0	0	1014
07:00	7	701	104	5	14	2	3	6	0	0	0	0	0	0	842
08:00	2	587	91	1	8	0	2	2	0	0	0	0	0	0	693
09:00	4	532	67	1	20	2	4	0	0	0	0	0	0	0	630
10:00	1	246	54	1	9	0	4	1	0	0	0	0	0	0	316
11:00	3	200	34	1	8	2	1	0	0	0	0	0	0	0	249
12 PM	2	194	39	0	11	5	2	1	0	1	0	0	0	0	255
13:00	2	189	24	1	8	1	5	0	0	0	0	0	0	0	230
14:00	4	165	32	1	6	1	0	0	0	0	0	0	0	0	209
15:00	8	236	44	1	14	1	1	0	0	0	0	0	0	0	305
16:00	6	213	23	4	4	1	0	0	1	0	0	0	0	0	252
17:00	1	259	14	0	6	0	0	0	0	0	0	0	0	0	280
18:00	1	178	17	0	3	0	0	0	0	0	0	0	0	0	199
19:00	0	99	16	0	0	1	0	0	0	0	0	0	0	0	116
20:00	1	92	16	0	2	1	0	0	0	0	0	0	0	0	112
21:00	1	76	6	0	4	0	0	0	0	0	0	0	0	0	87
22:00	1	25	5	0	0	0	0	0	0	0	0	0	0	0	31
23:00	0	10	1	0	0	0	0	0	0	0	0	0	0	0	11
Total	51	5068	789	20	148	22	27	13	2	1	0	0	0	0	6141
Percent	0.8%	82.5%	12.8%	0.3%	2.4%	0.4%	0.4%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
AM Peak	07:00	06:00	06:00	07:00	06:00	06:00	06:00	07:00	06:00						06:00
Vol.	7	831	138	5	27	3	5	6	1						1014
PM Peak	15:00	17:00	15:00	16:00	15:00	12:00	13:00	12:00	16:00	12:00					15:00
Vol.	8	259	44	4	14	5	5	1	1	1					305

North Road (Route 117)
west of Melone Gravel Pit Access
City, State: Sudbury, MA
Client: McMahon Associates/ C. Medeiros



46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdilic.com

186494 A Class
Site Code: Y18699.11

WB															
Start Time	Cycles	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Total	
09/27/1															
8	0	16	3	0	0	0	0	0	0	0	0	0	0	19	
01:00	0	11	0	0	0	0	0	0	0	0	0	0	0	11	
02:00	0	4	0	0	0	0	0	0	0	0	0	0	0	4	
03:00	0	3	0	0	0	0	0	0	0	0	0	0	0	3	
04:00	0	3	1	0	0	0	0	0	0	0	0	0	0	4	
05:00	0	11	2	0	5	0	0	0	0	0	0	0	0	18	
06:00	0	68	11	1	5	0	0	0	0	0	0	0	0	85	
07:00	2	129	22	1	8	0	0	1	0	0	0	0	0	163	
08:00	0	177	32	2	13	3	0	1	0	0	0	0	0	228	
09:00	0	147	32	2	11	2	0	1	0	0	0	0	0	195	
10:00	0	136	43	0	19	2	1	0	0	0	0	0	0	201	
11:00	1	147	35	0	23	3	0	1	0	0	0	0	0	210	
12 PM	2	195	46	0	21	6	1	1	0	0	0	0	0	272	
13:00	2	193	54	0	28	2	0	2	0	0	0	0	0	281	
14:00	3	255	89	0	24	5	0	5	2	1	0	0	0	384	
15:00	8	493	164	3	67	3	0	1	0	0	0	0	0	739	
16:00	4	634	177	1	67	3	2	5	0	0	0	0	0	893	
17:00	3	680	128	0	42	2	0	5	0	0	0	0	0	860	
18:00	3	627	147	1	29	1	0	0	1	0	0	0	0	809	
19:00	1	263	66	0	17	0	0	0	0	0	0	0	0	347	
20:00	0	157	49	0	9	1	0	0	0	0	0	0	0	216	
21:00	1	124	35	0	4	0	0	1	0	0	0	0	0	165	
22:00	1	67	12	0	3	0	0	0	0	0	0	0	0	83	
23:00	0	53	6	0	2	0	0	0	0	0	0	0	0	61	
Total	31	4593	1154	11	397	33	4	24	3	1	0	0	0	6251	
Percent	0.5%	73.5%	18.5%	0.2%	6.4%	0.5%	0.1%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%		
AM Peak	07:00	08:00	10:00	08:00	11:00	08:00	10:00	07:00						08:00	
Vol.	2	177	43	2	23	3	1	1						228	
PM Peak	15:00	17:00	16:00	15:00	15:00	12:00	16:00	14:00	14:00	14:00				16:00	
Vol.	8	680	177	3	67	6	2	5	2	1				893	



120 Water Street, 4th Floor
Boston, MA 02109
617-556-0020

N/S: Pantry Road/Dakin Road
E/W: North Road (Route 117)
Sudbury, MA
Weekday AM

File Name : AM_North Rd at Dakin Rd
Site Code : 00000000
Start Date : 9/20/2018
Page No : 1

Groups Printed- Cars & Peds - Heavy Vehicles

	Dakin Road From North					North Road (Route 117) From East					Pantry Road From South					North Road (Route 117) From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
07:00 AM	1	22	12	1	36	2	23	4	0	29	8	17	6	0	31	11	226	3	0	240	336
07:15 AM	4	25	5	0	34	2	34	4	0	40	9	24	14	0	47	14	206	10	0	230	351
07:30 AM	3	13	7	1	24	8	34	7	0	49	22	16	6	0	44	26	200	11	0	237	354
07:45 AM	4	15	4	0	23	9	72	2	0	83	48	17	9	0	74	40	205	15	0	260	440
Total	12	75	28	2	117	21	163	17	0	201	87	74	35	0	196	91	837	39	0	967	1481
08:00 AM	4	19	3	0	26	6	57	10	0	73	22	20	9	1	52	60	178	20	0	258	409
08:15 AM	4	16	4	0	24	4	50	14	0	68	24	46	15	0	85	57	150	6	0	213	390
08:30 AM	11	30	4	0	45	2	50	14	0	66	7	27	8	0	42	40	146	11	0	197	350
08:45 AM	4	26	7	0	37	0	58	4	0	62	10	27	10	0	47	47	187	18	0	252	398
Total	23	91	18	0	132	12	215	42	0	269	63	120	42	1	226	204	661	55	0	920	1547
Grand Total	35	166	46	2	249	33	378	59	0	470	150	194	77	1	422	295	1498	94	0	1887	3028
Apprch %	14.1	66.7	18.5	0.8		7	80.4	12.6	0		35.5	46	18.2	0.2		15.6	79.4	5	0		
Total %	1.2	5.5	1.5	0.1	8.2	1.1	12.5	1.9	0	15.5	5	6.4	2.5	0	13.9	9.7	49.5	3.1	0	62.3	
Cars & Peds	32	165	45	2	244	31	361	57	0	449	144	187	70	1	402	288	1468	89	0	1845	2940
% Cars & Peds	91.4	99.4	97.8	100	98	93.9	95.5	96.6	0	95.5	96	96.4	90.9	100	95.3	97.6	98	94.7	0	97.8	97.1
Heavy Vehicles	3	1	1	0	5	2	17	2	0	21	6	7	7	0	20	7	30	5	0	42	88
% Heavy Vehicles	8.6	0.6	2.2	0	2	6.1	4.5	3.4	0	4.5	4	3.6	9.1	0	4.7	2.4	2	5.3	0	2.2	2.9

	Dakin Road From North					North Road (Route 117) From East					Pantry Road From South					North Road (Route 117) From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:30 AM																					
07:30 AM	3	13	7	1	24	8	34	7	0	49	22	16	6	0	44	26	200	11	0	237	354
07:45 AM	4	15	4	0	23	9	72	2	0	83	48	17	9	0	74	40	205	15	0	260	440
08:00 AM	4	19	3	0	26	6	57	10	0	73	22	20	9	1	52	60	178	20	0	258	409
08:15 AM	4	16	4	0	24	4	50	14	0	68	24	46	15	0	85	57	150	6	0	213	390
Total Volume	15	63	18	1	97	27	213	33	0	273	116	99	39	1	255	183	733	52	0	968	1593
% App. Total	15.5	64.9	18.6	1		9.9	78	12.1	0		45.5	38.8	15.3	0.4		18.9	75.7	5.4	0		
PHF	.938	.829	.643	.250	.933	.750	.740	.589	.000	.822	.604	.538	.650	.250	.750	.763	.894	.650	.000	.931	.905



120 Water Street, 4th Floor
Boston, MA 02109
617-556-0020

N/S: Pantry Road/Dakin Road
E/W: North Road (Route 117)
Sudbury, MA
Weekday AM

File Name : AM_North Rd at Dakin Rd
Site Code : 00000000
Start Date : 9/20/2018
Page No : 1

Groups Printed- Heavy Vehicles

Start Time	Dakin Road From North					North Road (Route 117) From East					Pantry Road From South					North Road (Route 117) From West					Int. Total
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
07:00 AM	1	0	0	0	1	0	0	0	0	0	0	1	0	0	1	0	6	0	0	6	8
07:15 AM	0	0	0	0	0	0	1	1	0	2	1	1	1	0	3	2	3	1	0	6	11
07:30 AM	0	0	0	0	0	1	2	1	0	4	0	1	1	0	2	0	1	1	0	2	8
07:45 AM	0	0	0	0	0	1	3	0	0	4	3	0	1	0	4	2	4	0	0	6	14
Total	1	0	0	0	1	2	6	2	0	10	4	3	3	0	10	4	14	2	0	20	41
08:00 AM	0	0	0	0	0	0	0	0	0	0	1	1	1	0	3	0	5	2	0	7	10
08:15 AM	0	0	0	0	0	0	5	0	0	5	0	3	2	0	5	1	1	1	0	3	13
08:30 AM	2	0	1	0	3	0	3	0	0	3	0	0	0	0	0	1	2	0	0	3	9
08:45 AM	0	1	0	0	1	0	3	0	0	3	1	0	1	0	2	1	8	0	0	9	15
Total	2	1	1	0	4	0	11	0	0	11	2	4	4	0	10	3	16	3	0	22	47
Grand Total	3	1	1	0	5	2	17	2	0	21	6	7	7	0	20	7	30	5	0	42	88
Apprch %	60	20	20	0		9.5	81	9.5	0		30	35	35	0		16.7	71.4	11.9	0		
Total %	3.4	1.1	1.1	0	5.7	2.3	19.3	2.3	0	23.9	6.8	8	8	0	22.7	8	34.1	5.7	0	47.7	

	Dakin Road From North					North Road (Route 117) From East					Pantry Road From South					North Road (Route 117) From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 08:00 AM																					
08:00 AM	0	0	0	0	0	0	0	0	0	0	1	1	1	0	3	0	5	2	0	7	10
08:15 AM	0	0	0	0	0	0	5	0	0	5	0	3	2	0	5	1	1	1	0	3	13
08:30 AM	2	0	1	0	3	0	3	0	0	3	0	0	0	0	0	1	2	0	0	3	9
08:45 AM	0	1	0	0	1	0	3	0	0	3	1	0	1	0	2	1	8	0	0	9	15
Total Volume	2	1	1	0	4	0	11	0	0	11	2	4	4	0	10	3	16	3	0	22	47
% App. Total	50	25	25	0		0	100	0	0		20	40	40	0		13.6	72.7	13.6	0		
PHF	.250	.250	.250	.000	.333	.000	.550	.000	.000	.550	.500	.333	.500	.000	.500	.750	.500	.375	.000	.611	.783



120 Water Street, 4th Floor
Boston, MA 02109
617-556-0020

N/S: Pantry Road/Dakin Road
E/W: North Road (Route 117)
Sudbury, MA
Weekday AM

File Name : AM_North Rd at Dakin Rd
Site Code : 00000000
Start Date : 9/20/2018
Page No : 1

Groups Printed- Bikes by Direction

	Dakin Road From North					North Road (Route 117) From East					Pantry Road From South					North Road (Route 117) From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	2	2
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	1	2
08:30 AM	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	1	0	0	1	0	1	0	0	1	0	0	0	0	0	0	1	0	0	1	3
Grand Total	0	1	0	0	1	0	1	0	0	1	0	0	0	0	0	1	2	0	0	3	5
Apprch %	0	100	0	0		0	100	0	0		0	0	0	0		33.3	66.7	0	0		
Total %	0	20	0	0	20	0	20	0	0	20	0	0	0	0	0	20	40	0	0	60	

	Dakin Road From North					North Road (Route 117) From East					Pantry Road From South					North Road (Route 117) From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:45 AM																					
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	1	2
08:30 AM	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Total Volume	0	1	0	0	1	0	1	0	0	1	0	0	0	0	0	0	2	0	0	2	4
% App. Total	0	100	0	0		0	100	0	0		0	0	0	0		0	100	0	0		
PHF	.000	.250	.000	.000	.250	.000	.250	.000	.000	.250	.000	.000	.000	.000	.000	.000	.500	.000	.000	.500	.500



120 Water Street, 4th Floor
Boston, MA 02109
617-556-0020

N/S: Pantry Road/Dakin Road
E/W: North Road (Route 117)
Sudbury, MA
Weekday PM

File Name : PM_North Rd at Dakin Rd
Site Code : 09272018
Start Date : 9/27/2018
Page No : 1

Groups Printed- Cars & Peds - Heavy Vehicles

	Dakin Road From North					North Road (Route 117) From East					Pantry Road From South					North Road (Route 117) From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
04:00 PM	7	24	3	1	35	4	224	7	0	235	10	15	21	0	46	13	58	6	0	77	393
04:15 PM	12	22	3	0	37	3	199	20	0	222	7	23	28	0	58	8	59	3	0	70	387
04:30 PM	12	24	1	0	37	5	220	14	0	239	3	16	21	1	41	9	55	3	0	67	384
04:45 PM	13	22	1	0	36	4	220	4	0	228	2	14	22	0	38	8	59	2	0	69	371
Total	44	92	8	1	145	16	863	45	0	924	22	68	92	1	183	38	231	14	0	283	1535
05:00 PM	13	29	3	0	45	3	203	17	0	223	2	19	33	0	54	17	62	5	0	84	406
05:15 PM	11	36	2	0	49	5	223	7	0	235	2	14	33	0	49	9	54	5	0	68	401
05:30 PM	5	23	2	0	30	5	202	8	0	215	4	20	47	1	72	11	71	6	1	89	406
05:45 PM	10	28	2	0	40	1	211	11	0	223	5	22	30	0	57	4	60	7	0	71	391
Total	39	116	9	0	164	14	839	43	0	896	13	75	143	1	232	41	247	23	1	312	1604
Grand Total	83	208	17	1	309	30	1702	88	0	1820	35	143	235	2	415	79	478	37	1	595	3139
Apprch %	26.9	67.3	5.5	0.3		1.6	93.5	4.8	0		8.4	34.5	56.6	0.5		13.3	80.3	6.2	0.2		
Total %	2.6	6.6	0.5	0	9.8	1	54.2	2.8	0	58	1.1	4.6	7.5	0.1	13.2	2.5	15.2	1.2	0	19	
Cars & Peds	80	206	14	0	300	29	1671	85	0	1785	34	142	223	2	401	78	466	36	1	581	3067
% Cars & Peds	96.4	99	82.4	0	97.1	96.7	98.2	96.6	0	98.1	97.1	99.3	94.9	100	96.6	98.7	97.5	97.3	100	97.6	97.7
Heavy Vehicles	3	2	3	1	9	1	31	3	0	35	1	1	12	0	14	1	12	1	0	14	72
% Heavy Vehicles	3.6	1	17.6	100	2.9	3.3	1.8	3.4	0	1.9	2.9	0.7	5.1	0	3.4	1.3	2.5	2.7	0	2.4	2.3

	Dakin Road From North					North Road (Route 117) From East					Pantry Road From South					North Road (Route 117) From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
05:00 PM	13	29	3	0	45	3	203	17	0	223	2	19	33	0	54	17	62	5	0	84	406
05:15 PM	11	36	2	0	49	5	223	7	0	235	2	14	33	0	49	9	54	5	0	68	401
05:30 PM	5	23	2	0	30	5	202	8	0	215	4	20	47	1	72	11	71	6	1	89	406
05:45 PM	10	28	2	0	40	1	211	11	0	223	5	22	30	0	57	4	60	7	0	71	391
Total Volume	39	116	9	0	164	14	839	43	0	896	13	75	143	1	232	41	247	23	1	312	1604
% App. Total	23.8	70.7	5.5	0		1.6	93.6	4.8	0		5.6	32.3	61.6	0.4		13.1	79.2	7.4	0.3		
PHF	.750	.806	.750	.000	.837	.700	.941	.632	.000	.953	.650	.852	.761	.250	.806	.603	.870	.821	.250	.876	.988
Cars & Peds	97.4	98.3	66.7	0	96.3	100	98.0	97.7	0	98.0	100	100	92.3	100	95.3	100	99.2	95.7	100	99.0	97.6
% Cars & Peds																					
Heavy Vehicles	1	2	3	0	6	0	17	1	0	18	0	0	11	0	11	0	2	1	0	3	38
% Heavy Vehicles	2.6	1.7	33.3	0	3.7	0	2.0	2.3	0	2.0	0	0	7.7	0	4.7	0	0.8	4.3	0	1.0	2.4

Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1

Peak Hour for Entire Intersection Begins at 05:00 PM



120 Water Street, 4th Floor
Boston, MA 02109
617-556-0020

N/S: Pantry Road/Dakin Road
E/W: North Road (Route 117)
Sudbury, MA
Weekday PM

File Name : PM_North Rd at Dakin Rd
Site Code : 09272018
Start Date : 9/27/2018
Page No : 1

Groups Printed- Heavy Vehicles

	Dakin Road From North					North Road (Route 117) From East					Pantry Road From South					North Road (Route 117) From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
04:00 PM	0	0	0	1	1	0	5	0	0	5	0	0	0	0	0	0	4	0	0	4	10
04:15 PM	0	0	0	0	0	0	6	1	0	7	0	1	1	0	2	1	3	0	0	4	13
04:30 PM	1	0	0	0	1	0	1	1	0	2	1	0	0	0	1	0	2	0	0	2	6
04:45 PM	1	0	0	0	1	1	2	0	0	3	0	0	0	0	0	0	1	0	0	1	5
Total	2	0	0	1	3	1	14	2	0	17	1	1	1	0	3	1	10	0	0	11	34
05:00 PM	0	1	1	0	2	0	4	1	0	5	0	0	4	0	4	0	2	1	0	3	14
05:15 PM	0	0	1	0	1	0	4	0	0	4	0	0	3	0	3	0	0	0	0	0	8
05:30 PM	1	1	0	0	2	0	3	0	0	3	0	0	4	0	4	0	0	0	0	0	9
05:45 PM	0	0	1	0	1	0	6	0	0	6	0	0	0	0	0	0	0	0	0	0	7
Total	1	2	3	0	6	0	17	1	0	18	0	0	11	0	11	0	2	1	0	3	38
Grand Total	3	2	3	1	9	1	31	3	0	35	1	1	12	0	14	1	12	1	0	14	72
Apprch %	33.3	22.2	33.3	11.1		2.9	88.6	8.6	0		7.1	7.1	85.7	0		7.1	85.7	7.1	0		
Total %	4.2	2.8	4.2	1.4	12.5	1.4	43.1	4.2	0	48.6	1.4	1.4	16.7	0	19.4	1.4	16.7	1.4	0	19.4	

	Dakin Road From North					North Road (Route 117) From East					Pantry Road From South					North Road (Route 117) From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:15 PM																					
04:15 PM	0	0	0	0	0	0	6	1	0	7	0	1	1	0	2	1	3	0	0	4	13
04:30 PM	1	0	0	0	1	0	1	1	0	2	1	0	0	0	1	0	2	0	0	2	6
04:45 PM	1	0	0	0	1	1	2	0	0	3	0	0	0	0	0	0	1	0	0	1	5
05:00 PM	0	1	1	0	2	0	4	1	0	5	0	0	4	0	4	0	2	1	0	3	14
Total Volume	2	1	1	0	4	1	13	3	0	17	1	1	5	0	7	1	8	1	0	10	38
% App. Total	50	25	25	0		5.9	76.5	17.6	0		14.3	14.3	71.4	0		10	80	10	0		
PHF	.500	.250	.250	.000	.500	.250	.542	.750	.000	.607	.250	.250	.313	.000	.438	.250	.667	.250	.000	.625	.679



120 Water Street, 4th Floor
Boston, MA 02109
617-556-0020

N/S: Pantry Road/Dakin Road
E/W: North Road (Route 117)
Sudbury, MA
Weekday PM

File Name : PM_North Rd at Dakin Rd
Site Code : 09272018
Start Date : 9/27/2018
Page No : 1

Groups Printed- Bikes by Direction

	Dakin Road From North					North Road (Route 117) From East					Pantry Road From South					North Road (Route 117) From West						
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total	
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
04:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:45 PM	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Total	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	1	2
05:00 PM	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
05:15 PM	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
05:30 PM	0	1	0	0	1	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	3
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1
Total	0	2	0	0	2	0	1	0	0	1	0	3	0	0	3	0	0	0	0	0	0	6
Grand Total	0	2	0	0	2	0	2	0	0	2	0	3	0	0	3	0	1	0	0	1	8	
Apprch %	0	100	0	0		0	100	0	0		0	100	0	0		0	100	0	0			
Total %	0	25	0	0	25	0	25	0	0	25	0	37.5	0	0	37.5	0	12.5	0	0	12.5		

	Dakin Road From North					North Road (Route 117) From East					Pantry Road From South					North Road (Route 117) From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:45 PM																					
04:45 PM	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1
05:00 PM	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1
05:15 PM	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
05:30 PM	0	1	0	0	1	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	3
Total Volume	0	2	0	0	2	0	2	0	0	2	0	2	0	0	2	0	0	0	0	0	6
% App. Total	0	100	0	0		0	100	0	0		0	100	0	0		0	0	0	0		
PHF	.000	.500	.000	.000	.500	.000	.500	.000	.000	.500	.000	.250	.000	.000	.250	.000	.000	.000	.000	.000	.500

120 Water Street, 4th Floor
Boston, MA 02109
617-556-0020

N/S: Mossman Road/Powder Hill Road
E/W: North Road (Route 117)
Sudbury, MA
Weekday AM

File Name : AM_North Road at Powder Mill Rd
Site Code : 20180920
Start Date : 9/20/2018
Page No : 1

Groups Printed- Cars & Peds - Heavy Vehicles

	Powder Hill Road From North					North Road (Route 117) From East					Mossman Road From South					North Road (Route 117) From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
07:00 AM	0	7	51	0	58	13	19	0	0	32	5	4	0	1	10	4	215	25	0	244	344
07:15 AM	0	8	46	0	54	6	26	0	0	32	4	1	0	0	5	4	198	39	0	241	332
07:30 AM	1	15	41	0	57	8	27	4	0	39	7	7	0	0	14	7	187	34	0	228	338
07:45 AM	1	21	48	0	70	10	38	4	0	52	8	10	1	4	23	6	194	35	0	235	380
Total	2	51	186	0	239	37	110	8	0	155	24	22	1	5	52	21	794	133	0	948	1394
08:00 AM	0	14	44	0	58	13	48	4	0	65	8	3	2	0	13	2	194	28	0	224	360
08:15 AM	0	11	53	0	64	17	36	4	0	57	7	6	0	4	17	5	186	15	0	206	344
08:30 AM	1	8	44	0	53	14	48	4	0	66	9	8	1	0	18	3	186	9	0	198	335
08:45 AM	2	2	46	0	50	15	48	5	0	68	16	10	2	0	28	1	178	9	0	188	334
Total	3	35	187	0	225	59	180	17	0	256	40	27	5	4	76	11	744	61	0	816	1373
Grand Total	5	86	373	0	464	96	290	25	0	411	64	49	6	9	128	32	1538	194	0	1764	2767
Apprch %	1.1	18.5	80.4	0		23.4	70.6	6.1	0		50	38.3	4.7	7		1.8	87.2	11	0		
Total %	0.2	3.1	13.5	0	16.8	3.5	10.5	0.9	0	14.9	2.3	1.8	0.2	0.3	4.6	1.2	55.6	7	0	63.8	
Cars & Peds	5	81	354	0	440	88	279	24	0	391	60	48	6	9	123	32	1508	187	0	1727	2681
% Cars & Peds	100	94.2	94.9	0	94.8	91.7	96.2	96	0	95.1	93.8	98	100	100	96.1	100	98	96.4	0	97.9	96.9
Heavy Vehicles	0	5	19	0	24	8	11	1	0	20	4	1	0	0	5	0	30	7	0	37	86
% Heavy Vehicles	0	5.8	5.1	0	5.2	8.3	3.8	4	0	4.9	6.2	2	0	0	3.9	0	2	3.6	0	2.1	3.1

[illegible]



120 Water Street, 4th Floor
Boston, MA 02109
617-556-0020

N/S: Mossman Road/Powder Hill Road
E/W: North Road (Route 117)
Sudbury, MA
Weekday AM

File Name : AM_North Road at Powder Mill Rd
Site Code : 20180920
Start Date : 9/20/2018
Page No : 1

Groups Printed- Heavy Vehicles

	Powder Hill Road From North					North Road (Route 117) From East					Mossman Road From South					North Road (Route 117) From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
07:00 AM	0	1	5	0	6	3	1	0	0	4	0	0	0	0	0	0	7	0	0	7	17
07:15 AM	0	1	4	0	5	0	0	0	0	0	0	0	0	0	0	0	2	1	0	3	8
07:30 AM	0	2	3	0	5	0	3	0	0	3	0	0	0	0	0	0	1	1	0	2	10
07:45 AM	0	1	2	0	3	0	1	0	0	1	0	1	0	0	1	0	4	2	0	6	11
Total	0	5	14	0	19	3	5	0	0	8	0	1	0	0	1	0	14	4	0	18	46
08:00 AM	0	0	1	0	1	1	0	0	0	1	0	0	0	0	0	0	4	1	0	5	7
08:15 AM	0	0	1	0	1	1	2	1	0	4	0	0	0	0	0	0	3	0	0	3	8
08:30 AM	0	0	2	0	2	2	3	0	0	5	1	0	0	0	1	0	5	1	0	6	14
08:45 AM	0	0	1	0	1	1	1	0	0	2	3	0	0	0	3	0	4	1	0	5	11
Total	0	0	5	0	5	5	6	1	0	12	4	0	0	0	4	0	16	3	0	19	40
Grand Total	0	5	19	0	24	8	11	1	0	20	4	1	0	0	5	0	30	7	0	37	86
Apprch %	0	20.8	79.2	0		40	55	5	0		80	20	0	0		0	81.1	18.9	0		
Total %	0	5.8	22.1	0	27.9	9.3	12.8	1.2	0	23.3	4.7	1.2	0	0	5.8	0	34.9	8.1	0	43	

	Powder Hill Road From North					North Road (Route 117) From East					Mossman Road From South					North Road (Route 117) From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
07:00 AM	0	1	5	0	6	3	1	0	0	4	0	0	0	0	0	0	7	0	0	7	17
07:15 AM	0	1	4	0	5	0	0	0	0	0	0	0	0	0	0	0	2	1	0	3	8
07:30 AM	0	2	3	0	5	0	3	0	0	3	0	0	0	0	0	0	1	1	0	2	10
07:45 AM	0	1	2	0	3	0	1	0	0	1	0	1	0	0	1	0	4	2	0	6	11
Total Volume	0	5	14	0	19	3	5	0	0	8	0	1	0	0	1	0	14	4	0	18	46
% App. Total	0	26.3	73.7	0		37.5	62.5	0	0		0	100	0	0		0	77.8	22.2	0		
PHF	.000	.625	.700	.000	.792	.250	.417	.000	.000	.500	.000	.250	.000	.000	.250	.000	.500	.500	.000	.643	.676

Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1
Peak Hour for Entire Intersection Begins at 07:00 AM



120 Water Street, 4th Floor
Boston, MA 02109
617-556-0020

N/S: Mossman Road/Powder Hill Road
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Sudbury, MA
Weekday AM

File Name : AM_North Road at Powder Mill Rd
Site Code : 20180920
Start Date : 9/20/2018
Page No : 1

Groups Printed- Bikes by Direction

	Powder Hill Road From North					North Road (Route 117) From East					Mossman Road From South					North Road (Route 117) From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	1	1	0	1	0	0	1	0	0	0	0	0	2
07:30 AM	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	2
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
Total	0	1	0	0	1	0	0	0	1	1	0	1	0	0	1	0	2	0	0	2	5
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	2
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
08:30 AM	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	1	0	0	1	0	2	0	0	2	0	1	0	0	1	4
Grand Total	0	1	0	0	1	0	1	0	1	2	0	3	0	0	3	0	3	0	0	3	9
Apprch %	0	100	0	0		0	50	0	50		0	100	0	0		0	100	0	0		
Total %	0	11.1	0	0	11.1	0	11.1	0	11.1	22.2	0	33.3	0	0	33.3	0	33.3	0	0	33.3	

	Powder Hill Road From North					North Road (Route 117) From East					Mossman Road From South					North Road (Route 117) From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:15 AM																					
07:15 AM	0	0	0	0	0	0	0	0	1	1	0	1	0	0	1	0	0	0	0	0	2
07:30 AM	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	2
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	2
Total Volume	0	1	0	0	1	0	0	0	1	1	0	3	0	0	3	0	2	0	0	2	7
% App. Total	0	100	0	0		0	0	0	100		0	100	0	0		0	100	0	0		
PHF	.000	.250	.000	.000	.250	.000	.000	.000	.250	.250	.000	.375	.000	.000	.375	.000	.500	.000	.000	.500	.875



120 Water Street, 4th Floor
Boston, MA 02109
617-556-0020

N/S: Mossman Road/Powder Hill Road
E/W: North Road (Route 117)
Sudbury, MA
Weekday PM

File Name : PM_North Road at Powder Mill Rd
Site Code : 20180927
Start Date : 9/27/2018
Page No : 1

Groups Printed- Cars & Peds - Heavy Vehicles

	Powder Hill Road From North					North Road (Route 117) From East					Mossman Road From South					North Road (Route 117) From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
04:00 PM	2	6	16	0	24	57	179	6	0	242	3	5	3	2	13	1	52	9	0	62	341
04:15 PM	1	6	15	0	22	40	174	9	0	223	2	5	1	1	9	4	47	10	0	61	315
04:30 PM	3	5	9	0	17	53	182	6	1	242	5	5	2	1	13	0	52	7	0	59	331
04:45 PM	4	4	9	0	17	63	192	5	0	260	3	4	2	0	9	2	55	9	0	66	352
Total	10	21	49	0	80	213	727	26	1	967	13	19	8	4	44	7	206	35	0	248	1339
05:00 PM	1	9	20	0	30	60	190	2	0	252	9	10	0	0	19	2	50	14	0	66	367
05:15 PM	1	11	17	0	29	72	220	5	0	297	3	6	0	1	10	4	48	10	0	62	398
05:30 PM	2	10	15	0	27	67	188	5	0	260	1	11	3	0	15	2	60	10	0	72	374
05:45 PM	0	9	26	0	35	76	189	8	0	273	6	8	1	0	15	5	49	19	0	73	396
Total	4	39	78	0	121	275	787	20	0	1082	19	35	4	1	59	13	207	53	0	273	1535
Grand Total	14	60	127	0	201	488	1514	46	1	2049	32	54	12	5	103	20	413	88	0	521	2874
Apprch %	7	29.9	63.2	0		23.8	73.9	2.2	0		31.1	52.4	11.7	4.9		3.8	79.3	16.9	0		
Total %	0.5	2.1	4.4	0	7	17	52.7	1.6	0	71.3	1.1	1.9	0.4	0.2	3.6	0.7	14.4	3.1	0	18.1	
Cars & Peds	14	59	126	0	199	477	1488	46	1	2012	31	52	11	5	99	19	402	83	0	504	2814
% Cars & Peds	100	98.3	99.2	0	99	97.7	98.3	100	100	98.2	96.9	96.3	91.7	100	96.1	95	97.3	94.3	0	96.7	97.9
Heavy Vehicles	0	1	1	0	2	11	26	0	0	37	1	2	1	0	4	1	11	5	0	17	60
% Heavy Vehicles	0	1.7	0.8	0	1	2.3	1.7	0	0	1.8	3.1	3.7	8.3	0	3.9	5	2.7	5.7	0	3.3	2.1

	Powder Hill Road From North					North Road (Route 117) From East					Mossman Road From South					North Road (Route 117) From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 05:00 PM																					
05:00 PM	1	9	20	0	30	60	190	2	0	252	9	10	0	0	19	2	50	14	0	66	367
05:15 PM	1	11	17	0	29	72	220	5	0	297	3	6	0	1	10	4	48	10	0	62	398
05:30 PM	2	10	15	0	27	67	188	5	0	260	1	11	3	0	15	2	60	10	0	72	374
05:45 PM	0	9	26	0	35	76	189	8	0	273	6	8	1	0	15	5	49	19	0	73	396
Total Volume	4	39	78	0	121	275	787	20	0	1082	19	35	4	1	59	13	207	53	0	273	1535
% App. Total	3.3	32.2	64.5	0		25.4	72.7	1.8	0		32.2	59.3	6.8	1.7		4.8	75.8	19.4	0		
PHF	.500	.886	.750	.000	.864	.905	.894	.625	.000	.911	.528	.795	.333	.250	.776	.650	.863	.697	.000	.935	.964
Cars & Peds																					
% Cars & Peds	100	97.4	100	0	99.2	97.5	98.3	100	0	98.2	94.7	100	75.0	100	96.6	100	99.0	94.3	0	98.2	98.2
Heavy Vehicles	0	1	0	0	1	7	13	0	0	20	1	0	1	0	2	0	2	3	0	5	28
% Heavy Vehicles	0	2.6	0	0	0.8	2.5	1.7	0	0	1.8	5.3	0	25.0	0	3.4	0	1.0	5.7	0	1.8	1.8



120 Water Street, 4th Floor
Boston, MA 02109
617-556-0020

N/S: Mossman Road/Powder Hill Road
E/W: North Road (Route 117)
Sudbury, MA
Weekday PM

File Name : PM_North Road at Powder Mill Rd
Site Code : 20180927
Start Date : 9/27/2018
Page No : 1

Groups Printed- Heavy Vehicles

	Powder Hill Road From North					North Road (Route 117) From East					Mossman Road From South					North Road (Route 117) From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
04:00 PM	0	0	1	0	1	1	3	0	0	4	0	1	0	0	1	1	3	1	0	5	11
04:15 PM	0	0	0	0	0	2	4	0	0	6	0	1	0	0	1	0	4	1	0	5	12
04:30 PM	0	0	0	0	0	1	4	0	0	5	0	0	0	0	0	0	0	0	0	0	5
04:45 PM	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	2	0	0	2	4
Total	0	0	1	0	1	4	13	0	0	17	0	2	0	0	2	1	9	2	0	12	32
05:00 PM	0	1	0	0	1	3	4	0	0	7	0	0	0	0	0	0	2	0	0	2	10
05:15 PM	0	0	0	0	0	2	2	0	0	4	0	0	0	0	0	0	0	0	0	0	4
05:30 PM	0	0	0	0	0	2	4	0	0	6	1	0	1	0	2	0	0	2	0	2	10
05:45 PM	0	0	0	0	0	0	3	0	0	3	0	0	0	0	0	0	0	1	0	1	4
Total	0	1	0	0	1	7	13	0	0	20	1	0	1	0	2	0	2	3	0	5	28
Grand Total	0	1	1	0	2	11	26	0	0	37	1	2	1	0	4	1	11	5	0	17	60
Apprch %	0	50	50	0		29.7	70.3	0	0		25	50	25	0		5.9	64.7	29.4	0		
Total %	0	1.7	1.7	0	3.3	18.3	43.3	0	0	61.7	1.7	3.3	1.7	0	6.7	1.7	18.3	8.3	0	28.3	

	Powder Hill Road From North					North Road (Route 117) From East					Mossman Road From South					North Road (Route 117) From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:00 PM																					
04:00 PM	0	0	1	0	1	1	3	0	0	4	0	1	0	0	1	1	3	1	0	5	11
04:15 PM	0	0	0	0	0	2	4	0	0	6	0	1	0	0	1	0	4	1	0	5	12
04:30 PM	0	0	0	0	0	1	4	0	0	5	0	0	0	0	0	0	0	0	0	0	5
04:45 PM	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	2	0	0	2	4
Total Volume	0	0	1	0	1	4	13	0	0	17	0	2	0	0	2	1	9	2	0	12	32
% App. Total	0	0	100	0		23.5	76.5	0	0		0	100	0	0		8.3	75	16.7	0		
PHF	.000	.000	.250	.000	.250	.500	.813	.000	.000	.708	.000	.500	.000	.000	.500	.250	.563	.500	.000	.600	.667



120 Water Street, 4th Floor
Boston, MA 02109
617-556-0020

N/S: Mossman Road/Powder Hill Road
E/W: North Road (Route 117)
Sudbury, MA
Weekday PM

File Name : PM_North Road at Powder Mill Rd
Site Code : 20180927
Start Date : 9/27/2018
Page No : 1

Groups Printed- Bikes by Direction

	Powder Hill Road From North					North Road (Route 117) From East					Mossman Road From South					North Road (Route 117) From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
04:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1
04:15 PM	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
04:30 PM	0	1	0	0	1	0	0	0	0	0	3	0	0	0	3	0	0	0	0	0	4
04:45 PM	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Total	0	1	0	0	1	1	1	0	0	2	3	0	0	0	3	0	1	0	0	1	7
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	1	0	0	1	3
05:30 PM	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1
05:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	3	0	0	3	0	0	0	0	0	0	1	0	0	1	4
Grand Total	0	1	0	0	1	1	4	0	0	5	3	0	0	0	3	0	2	0	0	2	11
Apprch %	0	100	0	0		20	80	0	0		100	0	0	0		0	100	0	0		
Total %	0	9.1	0	0	9.1	9.1	36.4	0	0	45.5	27.3	0	0	0	27.3	0	18.2	0	0	18.2	

	Powder Hill Road From North					North Road (Route 117) From East					Mossman Road From South					North Road (Route 117) From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:30 PM																					
04:30 PM	0	1	0	0	1	0	0	0	0	0	3	0	0	0	3	0	0	0	0	0	4
04:45 PM	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1
05:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	1	0	0	1	3
Total Volume	0	1	0	0	1	0	3	0	0	3	3	0	0	0	3	0	1	0	0	1	8
% App. Total	0	100	0	0		0	100	0	0		100	0	0	0		0	100	0	0		
PHF	.000	.250	.000	.000	.250	.000	.375	.000	.000	.375	.250	.000	.000	.000	.250	.000	.250	.000	.000	.250	.500

□ Seasonal Data/ Yearly Growth

STATION 403 - CONCORD - RTE.2 - 0.2 km EAST OF CONCORD ROTARY

YR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
10	41,546	41,883	46,472	50,492	45,910	46,524	43,534	39,595	40,709	46,285	43,576	44,350	44,240
	-6%	-4%	-6%	-12%	0%	-1%	0%	9%	10%	-2%	-1%	-5%	-2%
11	39,037	40,138	43,732	44,191	45,777	46,145	43,496	43,117	44,740	45,508	43,282	42,043	43,434
	6%	5%	-2%	0%	0%	-1%	-7%	4%	0%	-1%	-1%	-1%	0%
12	41,311	42,111	43,069	44,294	45,759	45,640	40,408	44,775	44,720	44,904	42,980	41,701	43,473
	1%	-7%	-2%	-3%	-3%	-1%	4%	-3%	-1%	0%	-1%	3%	-1%
13	41,792	39,095	42,007	42,993	44,222	44,984	41,995	43,310	44,422	45,062	42,684	42,773	42,945
	-3%	-3%	1%	1%	1%	1%	2%	0%	0%	1%	1%	5%	1%
15	39,457	36,908	42,703	44,051	45,401	45,790	43,572	43,700	43,992	46,043	43,701	47,474	43,566
	6%	15%	4%	1%	3%	4%	3%	6%	3%	2%	4%	-9%	3%
16	41,896	42,396	44,580	44,670	46,737	47,669	45,004	46,441	45,499	47,080	45,357	43,312	45,053
	3%	1%	1%	1%	2%	2%	1%	1%	4%	4%	3%	-2%	2%
17	43,250	43,008	45,196	45,139	47,491	48,619	45,489	46,860	47,255	48,955	46,715	42,282	45,855
	0%	3%	0%	4%	1%	1%	-2%	-2%	-5%	-1%	-9%	7%	0%
18	43,289	44,164	45,201	46,965	48,147	49,054	44,492	45,928	44,882	48,454	42,446	45,171	45,683
	1.07	1.08	1.00	0.98	0.96	0.95	1.02	1.00	1.00	0.95	1.01	1.02	
Seasonal Adjustment Factor (to average month)	Growth 0.4%												

□ Speed Data



PRECISION
D A T A
INDUSTRIES, LLC

46 Morton Street, Framingham, MA 01702
Office: 508-875-0100 Fax: 508-875-0118
Email: datarequests@pdilic.com

North Road (Route 117)
west of Melone Gravel Pit Access
City, State: Sudbury, MA
Client: McMahon Associates/ C. Medeiros

186494 A Speed
Site Code: Y18699.11

Start Time	1	15	20	25	30	35	40	45	50	55	60	65	70	Total	85th % ile	Ave Speed
	14	19	24	29	34	39	44	49	54	59	64	69	9999			
09/27/																
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	*
01:00	0	0	0	0	0	0	1	0	1	0	0	0	0	2	52	47
02:00	0	0	0	0	0	4	2	0	0	0	0	0	0	6	41	39
03:00	0	0	0	0	0	1	2	1	0	0	0	0	0	4	46	42
04:00	0	0	0	0	2	11	23	8	2	0	0	0	0	46	45	42
05:00	0	0	0	6	24	108	97	15	2	0	0	0	0	252	42	39
06:00	43	48	66	51	269	434	101	2	0	0	0	0	0	1014	38	33
07:00	87	18	77	64	182	312	96	6	0	0	0	0	0	842	38	31
08:00	11	23	34	26	82	339	164	12	1	0	0	1	0	693	41	36
09:00	1	0	0	9	106	339	161	14	0	0	0	0	0	630	41	37
10:00	0	0	0	0	31	161	102	21	1	0	0	0	0	316	42	39
11:00	0	0	1	1	24	109	97	16	1	0	0	0	0	249	42	39
12 PM	0	0	0	2	38	119	86	9	1	0	0	0	0	255	42	38
13:00	0	1	2	15	23	108	76	4	1	0	0	0	0	230	42	38
14:00	0	0	1	1	31	115	54	5	1	0	1	0	0	209	41	38
15:00	0	1	9	4	47	152	84	6	2	0	0	0	0	305	41	37
16:00	0	1	1	3	37	98	96	14	2	0	0	0	0	252	42	39
17:00	0	0	0	0	24	131	100	24	1	0	0	0	0	280	43	39
18:00	0	0	0	2	24	105	55	12	1	0	0	0	0	199	42	38
19:00	0	1	2	4	13	56	35	4	1	0	0	0	0	116	42	38
20:00	0	0	1	7	27	48	26	3	0	0	0	0	0	112	41	36
21:00	0	0	0	0	11	41	27	8	0	0	0	0	0	87	43	39
22:00	0	0	0	0	3	14	10	3	1	0	0	0	0	31	43	40
23:00	0	0	0	0	3	4	4	0	0	0	0	0	0	11	41	37
Total	142	93	194	195	1001	2809	1499	187	19	0	1	1	0	6141		
%	2.3%	1.5%	3.2%	3.2%	16.3%	45.7%	24.4%	3.0%	0.3%	0.0%	0.0%	0.0%	0.0%			
AM Peak	07:00	06:00	07:00	07:00	06:00	06:00	08:00	10:00	04:00			08:00		06:00		
Vol.	87	48	77	64	269	434	164	21	2			1		1014		
PM Peak		13:00	15:00	13:00	15:00	15:00	17:00	17:00	15:00		14:00			15:00		
Vol.		1	9	15	47	152	100	24	2		1			305		

Stats

15th Percentile :	30 MPH
50th Percentile :	36 MPH
85th Percentile :	41 MPH
95th Percentile :	43 MPH
Mean Speed(Average) :	36 MPH
10 MPH Pace Speed :	35-44 MPH
Number in Pace :	4308
Percent in Pace :	70.2%
Number of Vehicles > 35 MPH :	3954
Percent of Vehicles > 35 MPH :	64.4%



PRECISION
D A T A
INDUSTRIES, LLC

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Email: datarequests@pdillc.com

North Road (Route 117)
west of Melone Gravel Pit Access
City, State: Sudbury, MA
Client: McMahon Associates/ C. Medeiros

186494 A Speed
Site Code: Y18699.11

WB	Start Time	14	15	19	20	24	25	29	30	34	35	39	40	44	45	49	50	54	55	59	60	64	65	69	70	9999	Total	85th % ile	Ave Speed
09/27/	18	0	0	0	0	0	0	5	7	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	47	43	
01:00	0	0	0	0	0	1	4	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	45	41	
02:00	0	0	0	0	1	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	42	36	
03:00	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	46	40	
04:00	0	0	0	0	1	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	42	37	
05:00	0	0	0	0	0	1	4	10	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	44	41	
06:00	0	0	0	8	2	4	25	28	16	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	85	45	39	
07:00	0	0		15	3	10	39	66	25	4	0	0	0	0	0	0	0	0	0	0	0	0	0	1	163	44	39		
08:00	0	0		5	3	3	58	100	50	6	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	228	46	42	
09:00	0	0		0	0	12	49	85	45	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	195	46	41	
10:00	0	0		0	0	8	48	100	38	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	201	45	42	
11:00	0	0		0	0	6	55	99	44	3	1	1	0	0	1	0	1	0	1	210	46	42							
12 PM	0	0		7	1	11	67	135	47	4	0	0	0	0	0	0	0	0	0	272	45	41							
13:00	0		1	6	10	25	93	100	39	7	0	0	0	0	0	0	0	0	0	281	44	39							
14:00	1	1		0	1	5	95	195	67	19	0	0	0	0	0	0	0	0	0	384	46	42							
15:00	0	0		0	0	21	244	355	111	6	0	1	1	0	739	44	41												
16:00	0	0		0	2	44	204	493	141	9	0	0	0	0	893	44	41												
17:00	0	0		0	0	11	187	497	154	11	0	0	0	0	860	45	42												
18:00	0	0		0	4	34	315	361	90	5	0	0	0	0	809	43	40												
19:00	0	0		0	0	7	103	169	56	8	4	0	0	0	347	45	42												
20:00	0	0		0	0	7	50	110	41	6	2	0	0	0	216	46	42												
21:00	0	0		0	0	2	47	67	44	3	1	0	0	1	165	46	42												
22:00	0	0		0	0	0	11	34	26	10	2	0	0	0	83	48	44												
23:00	0	0		0	0	0	11	16	25	8	1	0	0	0	61	48	45												
Total	1	2	41	28	214	1715	3036	1069	125	13	3	1	3	6251															
%	0.0%	0.0%	0.7%	0.4%	3.4%	27.4%	48.6%	17.1%	2.0%	0.2%	0.0%	0.0%	0.0%																
AM Peak			07:00	07:00	09:00	08:00	08:00	08:00	10:00	08:00	08:00		07:00	08:00															
Vol.			15	3	12	58	100	50	7	2	1		1	228															
PM Peak	14:00	13:00	12:00	13:00	16:00	18:00	17:00	17:00	14:00	19:00	15:00	15:00	21:00	16:00															
Vol.	1	1	7	10	44	315	497	154	19	4	1	1	1	893															

Stats
15th Percentile : 35 MPH
50th Percentile : 40 MPH
85th Percentile : 45 MPH
95th Percentile : 48 MPH

Mean Speed(Average) : 41 MPH
10 MPH Pace Speed : 35-44 MPH
Number in Pace : 4751
Percent in Pace : 76.0%
Number of Vehicles > 35 MPH : 5622
Percent of Vehicles > 35 MPH : 89.9%

□ Crash Data

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Sudbury, MA COUNT DATE : Jan-20

DISTRICT : 3 UNSIGNALIZED : ☒ X SIGNALIZED : ☐

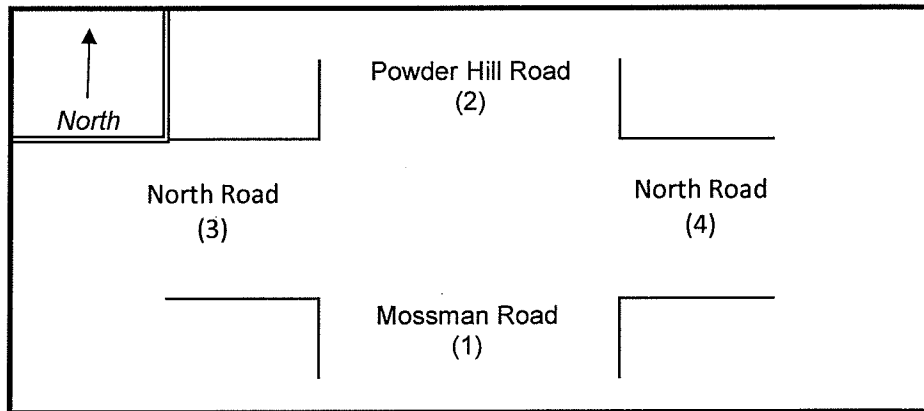
~ INTERSECTION DATA ~

MAJOR STREET : North Road

MINOR STREET(S) : Powder Hill Road

Mossman Road

INTERSECTION
DIAGRAM
(Label Approaches)



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	NB	SB	EB	WB		
PEAK HOURLY VOLUMES (PM) :	58	122	276	1,093		1,549

" K " FACTOR :

0.092

INTERSECTION ADT (V) = TOTAL DAILY
APPROACH VOLUME :

16,837

TOTAL # OF CRASHES :

5

OF
YEARS :

3

AVERAGE # OF
CRASHES PER YEAR (A) :

1.67

CRASH RATE CALCULATION :

0.27

RATE = $\frac{(A * 1,000,000)}{(V * 365)}$

Comments : MassDOT District 4 Avg: Signalized = 0.73; Unsignalized = 0.57

Project Title & Date : 1071 - Salem

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Sudbury, MA COUNT DATE : Jan-20

DISTRICT : 3 UNSIGNALIZED : ☐ SIGNALIZED : ☒

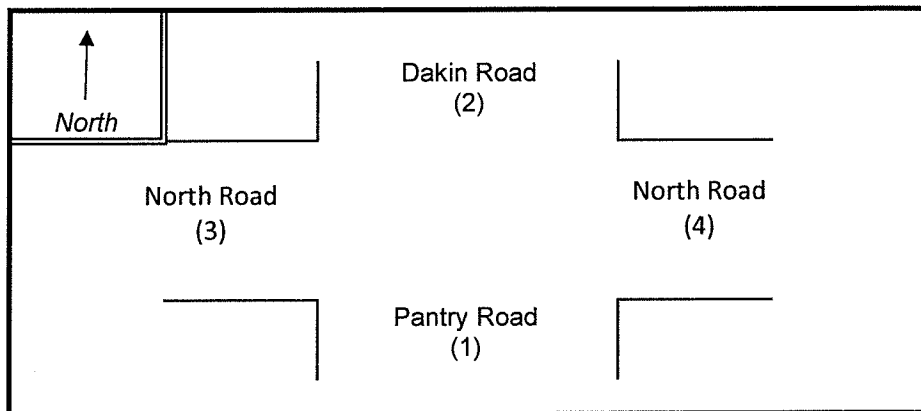
~ INTERSECTION DATA ~

MAJOR STREET : North Road

MINOR STREET(S) : Dakin Road

Pantry Road

INTERSECTION
DIAGRAM
(Label Approaches)



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	NB	SB	EB	WB		
PEAK HOURLY VOLUMES (PM) :	233	165	313	904		1,615

" K " FACTOR :

0.092

INTERSECTION ADT (V) = TOTAL DAILY
APPROACH VOLUME :

17,554

TOTAL # OF CRASHES :

5

OF
YEARS :

3

AVERAGE # OF
CRASHES PER YEAR (A) :

1.67

CRASH RATE CALCULATION :

0.26

RATE = $\frac{(A * 1,000,000)}{(V * 365)}$

Comments : MassDOT District 4 Avg: Signalized = 0.73; Unsignalized = 0.57

Project Title & Date: 1071 - Salem

MassDOT																
MassDOT Crash Report for Sudbury for the years 2017-2019																
Crash Number	City/Town Name	Crash Date	Crash Time	Crash Severity	Number of Vehicle	Total Fatal Injuries	Total Nonfatal Injuries	Manner of Collision	Vehicle Action Prior to Crash	Vehicle Travel Directions	Most Harmful Events	Vehicle Configuration	Road Surface Condition	Ambient Light	Weather Condition	At Roadway Intersection
2017																
North Road at Dakin Road and Panty Road																
4353876	SUDBURY	02/07/2017	10:12 AM	Property damage only (none injured)	1	0	0	Single vehicle crash	V1: Travelling straight ahead	V1: W	V1: (Collision with highway traffic sign post)	V1: (Light truck/van, mini-van, pickup, sport utility)	Snow	Daylight	Snow	NORTH ROAD Rte 117 W
4353912	SUDBURY	02/09/2017	9:12 AM	Property damage only (none injured)	2	0	0	Angle	V1: Turning left / V2: Travelling straight ahead	V1: E / V2: W	V1: (Collision with motor vehicle in traffic)	V1: (Passenger car) / V2: (Passenger car)	Snow	Daylight	Snow	NORTH ROAD Rte 117 / DAKIN ROAD
4412453	SUDBURY	07/27/2017	12:39 PM	Property damage only (none injured)	2	0	0	Angle	V1: Travelling straight ahead / V2: Turning left	V1: S / V2: W	V1: (Collision with motor vehicle in traffic)	V1: (Passenger car) / V2: (Passenger car)	Dry	Daylight	Cloudy/Rain	NORTH ROAD Rte 117 / PANTRY ROAD
4413599	SUDBURY	08/11/2017	2:50 PM	Property damage only (none injured)	2	0	0	Sideswipe, same direction	V1: Travelling straight ahead / V2: Travelling straight ahead	V1: N / V2: W	V1: (Collision with motor vehicle in traffic)	V1: (Passenger car) / V2: (Passenger car)	Dry	Daylight	Clear	NORTH ROAD / PANTRY ROAD / DAKIN ROAD
4439406	SUDBURY	09/14/2017	8:59 AM	Property damage only (none injured)	2	0	0	Angle	V1: Travelling straight ahead / V2: Turning left	V1: W / V2: N	V1: (Collision with motor vehicle in traffic)	V1: (Passenger car) / V2: (Passenger car)	Dry	Daylight	Cloudy	NORTH ROAD / DAKIN ROAD
North Road at Powder Mill Road and Mossman Road																
4347055	SUDBURY	01/16/2017	11:14 AM	Property damage only (none injured)	2	0	0	Angle	V1: Travelling straight ahead / V2: Turning left	V1: E / V2: W	V1: (Collision with motor vehicle in traffic)	V1: (Light truck/van, mini-van, pickup, sport utility) / V2: (Passenger car)	Dry	Daylight	Clear	NORTH ROAD Rte 117 E / MOSSMAN ROAD / POWDER MILL ROAD
4366960	SUDBURY	04/13/2017	7:28 AM	Non-fatal injury	3	1	0	Angle	V1: Travelling straight ahead / V2: Travelling straight ahead / V3: Slowing or stopped in traffic	V1: W / V2: S / V3: E	V1: (Collision with motor vehicle in traffic)	V1: (Passenger car) / V2: (Passenger car) / V3: (Light truck/van, mini-van, pickup, sport utility)	Dry	Daylight	Clear	NORTH ROAD / MOSSMAN ROAD
2018																
North Road at Powder Mill Road and Mossman Road																
4637410	SUDBURY	04/19/2018	12:41 PM	Property damage only (none injured)	1	0	0	Rear-end	V1: Slowing or stopped in traffic	V1: E	V1: (Collision with motor vehicle in traffic)	V1: (Passenger car)	Dry	Daylight	Clear	MOSSMAN RD
4633107	SUDBURY	10/18/2018	4:43 PM	Property damage only (none injured)	2	0	0	Sideswipe, same direction	V1: Turning left / V2: Turning left	V1: S / V2: S	V1: (Collision with motor vehicle in traffic)	V1: (Passenger car) / V2: (Passenger car)	Dry	Daylight	Clear/Cloudy	NORTH ROAD Rte 117 / POWDER MILL ROAD / MOSSMAN ROAD
2019																
North Road at Dakin Road and Panty Road																
4721622	SUDBURY	05/06/2019	5:08 PM	Non-fatal injury	2	0	0	Angle	V2: Travelling straight ahead / V1: Travelling straight ahead	V2: S / V1: W	V2: (Collision with motor vehicle in traffic) / V1: (Collision with motor vehicle in traffic)	V2: (Passenger car) / V1: (Light truck/van, mini-van, pickup, sport utility)	Dry	Daylight	Clear	NORTH RD / DAKIN RD
4676836	SUDBURY	03/11/2019	1:23 PM	Property damage only (none injured)	2	0	0	Rear-end	V1: Slowing or stopped in traffic / V2: Travelling straight ahead	V1: E / V2: E	V1: (Collision with motor vehicle in traffic)	V1: (Passenger car) / V2: (Passenger car)	Wet	Daylight	Clear	NORTH RD / POWDERMILL RD / MOSSMAN RD
4707767	SUDBURY	05/11/2019	8:25 PM	Non-fatal injury	1	0	0	Single vehicle crash	V1: Travelling straight ahead	V1: W	V1: (Overturn/rollover)	V1: (Motorcycle)	Dry	Daylight	Clear	NORTH RD / POWDERMILL RD / BOWBERMILL RD

□ Sight Distance Calculations

Stopping Sight Distance - Regulatory

North Road approaches to Site Driveway

		SPEED (MPH)	BRAKE REACTION DISTANCE (FT)	BRAKING DISTANCE (FT)	CALCULATED STOPPING SIGHT DISTANCE (FT)
Direction 1	EB	40	147	153.3	300.3
Direction 2	WB	40	147	153.3	300.3

INPUTS

Direction 1

Direction 2

Travel Direction

EB

WB

Speed

40

40

Grade

0

0

t

2.5

2.5

a

11.2

11.2

Stopping Sight Distance (SSD) - Source: AASHTO

SSD = Reaction Distance + Brake Distance

Reaction Distance = $1.47 \times t \times V$

Brake Distance = $V^2 / (30 \times ((a/32.2) + G))$

Where:

t = reaction time (sec)

V = travel speed (mph)

G = roadway grade

a = deceleration rate (ft/sec²)

Stopping Sight Distance - 85th Percentile

North Road approaches to Site Driveway

		SPEED (MPH)	BRAKE REACTION DISTANCE (FT)	BRAKING DISTANCE (FT)	CALCULATED STOPPING SIGHT DISTANCE (FT)
Direction 1	EB	41	150.675	161.1	311.8
Direction 2	WB	45	165.375	194.1	359.4

INPUTS

Direction 1

Direction 2

Travel Direction

EB

WB

Speed

41

45

Grade

0

0

t

2.5

2.5

a

11.2

11.2

Stopping Sight Distance (SSD) - Source: AASHTO

SSD = Reaction Distance + Brake Distance

Reaction Distance = $1.47 \times t \times V$

Brake Distance = $V^2 / (30 \times ((a/32.2) + G))$

Where:

t = reaction time (sec)

V = travel speed (mph)

G = roadway grade

a = deceleration rate (ft/sec²)

Intersection Sight Distance Calculations

Source: *A Policy on Geometric Design of Highways and Street, 6th Edition*; AASHTO; 2011.

$$ISD = 1.47 * V * t$$

V = speed

t = time gap

t = 7.5 s for a passenger car for Left Turn from a Stop

t = 6.5 s for a passenger car for Right Turn from a Stop

North Road

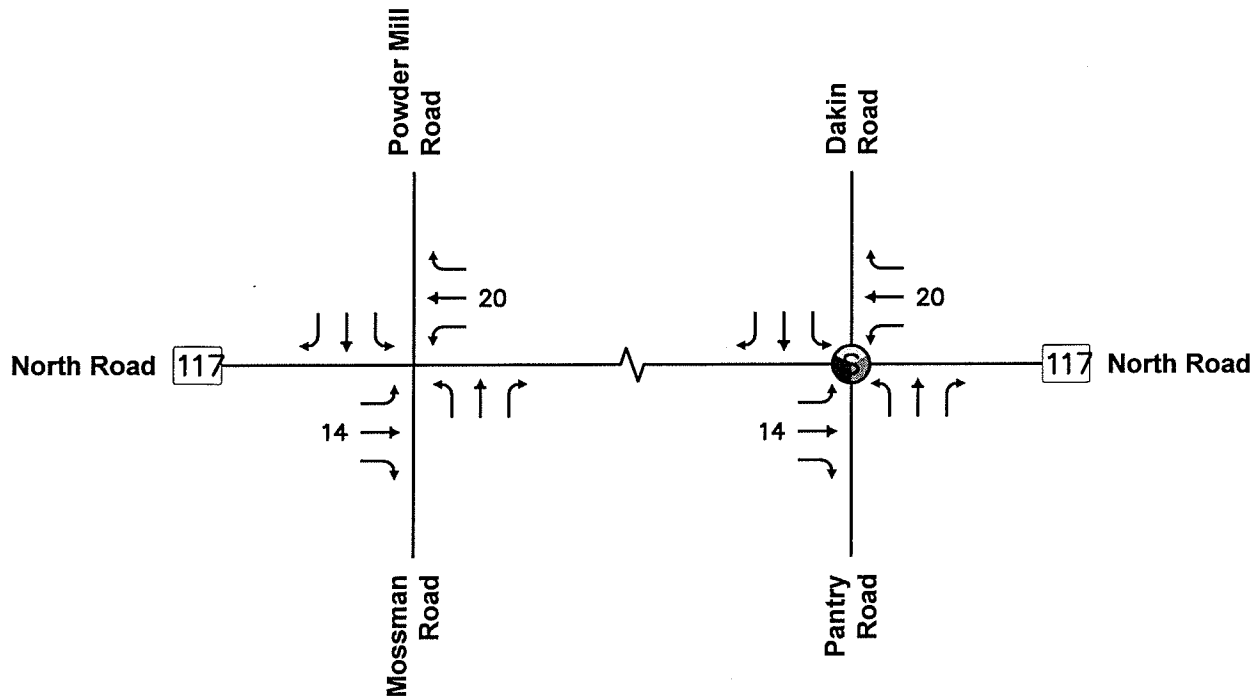
$$ISD = 1.47 * 40 * 7.5 = 441 \text{ ft } \mathbf{SAY 445 \text{ ft}}$$

(left-turn from a stop)

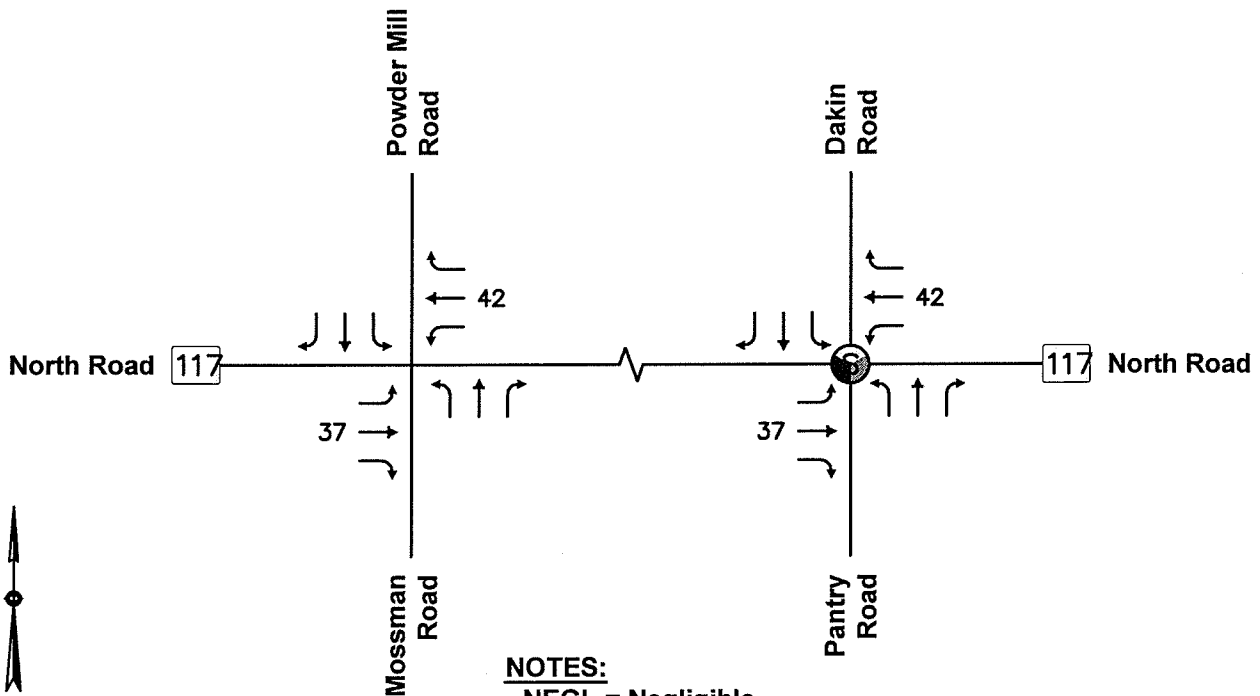
$$ISD = 1.47 * 40 * 6.5 = 382 \text{ ft } \mathbf{SAY 385 \text{ ft}}$$

(right-turn from a stop)

□ Background Projects



Weekday Morning Peak Hour



NOTES:

NEGL.= Negligible



= Signalized Intersection

Weekday Evening Peak Hour

North

Scale: Not to Scale

MDM TRANSPORTATION CONSULTANTS, INC.
Planners & Engineers

Attachments

129 Parker Street
Mixed Use Development
Site Generated Trips

□ Trip Generation Calculations

**Institute of Transportation Engineers (ITE) 10th Edition
Land Use Code (LUC) 220 - Multifamily Housing (Low-Rise)**

Average Vehicle Trips Ends vs: Dwelling Units
Independent Variable (X): 123

AVERAGE WEEKDAY DAILY

$T = 7.32 * X$
 $T = 7.32 * 123$
 $T = 900.36$
 $T = 900$ vehicle trips
with 50% (450 vpd) entering and 50% (450 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

$T = 0.46 * X$
 $T = 0.46 * 123$
 $T = 56.58$
 $T = 57$ vehicle trips
with 23% (13 vph) entering and 77% (44 vph) exiting.

WEEKDAY MORNING PEAK HOUR OF GENERATOR

$T = 0.56 * X$
 $T = 0.56 * 0$
 $T = 68.88$
 $T = 69$ vehicle trips
with 28% (19 vph) entering and 72% (50 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

$T = 0.56 * X$
 $T = 0.56 * 123$
 $T = 68.88$
 $T = 69$ vehicle trips
with 63% (43 vph) entering and 37% (26 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF GENERATOR

$T = 0.67 * X$
 $T = 0.67 * 0$
 $T = 82.41$
 $T = 82$ vehicle trips
with 59% (48 vph) entering and 41% (34 vph) exiting.

SATURDAY DAILY

$T = 8.14 * X$
 $T = 8.14 * 123$
 $T = 1001.22$
 $T = 1,002$ vehicle trips
with 50% (501 vpd) entering and 50% (501 vpd) exiting.

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

$T = 0.70 * X$
 $T = 0.70 * 123$
 $T = 86.10$
 $T = 86$ vehicle trips
with 49% (42 vph) entering and 51% (44 vph) exiting.

Institute of Transportation Engineers (ITE) 10th Edition
Land Use Code (LUC) 221 - Multifamily Housing (Mid-Rise)

Average Vehicle Trips Ends vs: Dwelling Units

Independent Variable (X): 151

AVERAGE WEEKDAY DAILY

$$T = 5.44 * X$$

$$T = 5.44 * 151$$

$$T = 821.44$$

$$T = 822 \text{ vehicle trips}$$

with 50% (411 vpd) entering and 50% (411 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$T = 0.36 * X$$

$$T = 0.36 * 151$$

$$T = 54.36$$

$$T = 54 \text{ vehicle trips}$$

with 26% (14 vph) entering and 74% (40 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

$$T = 0.44 * X$$

$$T = 0.44 * 151$$

$$T = 66.44$$

$$T = 66 \text{ vehicle trips}$$

with 61% (40 vph) entering and 39% (26 vph) exiting.

SATURDAY DAILY

$$T = 4.91 * X$$

$$T = 4.91 * 151$$

$$T = 741.41$$

$$T = 742 \text{ vehicle trips}$$

with 50% (371 vpd) entering and 50% (371 vpd) exiting.

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

$$T = 0.44 * X$$

$$T = 0.44 * 151$$

$$T = 66.44$$

$$T = 66 \text{ vehicle trips}$$

with 49% (32 vph) entering and 51% (34 vph) exiting.

□ Trip Distribution Calculations

To/From Routes							
		Pantry Road		North Road		North Road	
		(South)		(East)		(West)	
%	Number	Residence	Workplace	Regional			
		MCD	MCD	Total			
20.9%	1,620	Sudbury town	Sudbury town	75.0%	15.7%	0.0%	20.9%
12.4%	959	Sudbury town	Boston city		0.0%	12.4%	12.4%
5.9%	459	Sudbury town	Framingham town	100%	5.9%	0.0%	5.9%
4.7%	365	Sudbury town	Waltham city		0.0%	4.7%	4.7%
4.7%	361	Sudbury town	Cambridge city		0.0%	4.7%	4.7%
4.1%	315	Sudbury town	Marlborough city	50%	2.0%	0.0%	4.1%
3.7%	290	Sudbury town	Lexington town		0.0%	3.7%	3.7%
2.7%	206	Sudbury town	Natick town	25%	0.7%	2.0%	2.7%
2.5%	194	Sudbury town	Newton city		0.0%	2.5%	2.5%
2.4%	184	Sudbury town	Burlington town		0.0%	2.4%	2.4%
2.2%	168	Sudbury town	Concord town		0.0%	2.2%	2.2%
1.9%	146	Sudbury town	Maynard town		0.0%	1.9%	1.9%
1.8%	138	Sudbury town	Woburn city		0.0%	1.8%	1.8%
1.7%	129	Sudbury town	Weston town		0.0%	1.7%	1.7%
1.6%	120	Sudbury town	Wayland town	50%	0.8%	0.0%	1.6%
1.5%	119	Sudbury town	Hudson town		0.0%	1.5%	1.5%
1.4%	107	Sudbury town	Wellesley town		0.0%	1.4%	1.4%
1.3%	104	Sudbury town	Brookline town		0.0%	1.3%	1.3%
1.3%	99	Sudbury town	Westborough town	25%	0.3%	1.0%	1.3%
1.2%	93	Sudbury town	Bedford town		0.0%	1.2%	1.2%
1.2%	93	Sudbury town	Worcester city		0.0%	1.2%	1.2%
1.1%	83	Sudbury town	Action town		0.0%	1.1%	1.1%
0.8%	63	Sudbury town	Lowell city		0.0%	0.8%	0.8%
0.8%	61	Sudbury town	Needham town		0.0%	0.8%	0.8%
0.8%	60	Sudbury town	Canton town		0.0%	0.8%	0.8%
0.7%	54	Sudbury town	Wakefield town		0.0%	0.7%	0.7%
0.7%	54	Sudbury town	Southborough town	50%	0.3%	0.3%	0.7%
0.6%	48	Sudbury town	Belmont town		0.0%	0.6%	0.6%
0.6%	47	Sudbury town	Billerica town		0.0%	0.6%	0.6%
0.6%	45	Sudbury town	Somerville city		0.0%	0.6%	0.6%
0.6%	43	Sudbury town	Chelmsford town		0.0%	0.6%	0.6%
88%				25.8%	48.7%	13.7%	88.3%
				29.2%	55.2%	15.6%	
				30%	55%	15%	
				SAY			

□ Capacity Analysis

LEVEL OF SERVICE METHODOLOGY

Capacity analysis of intersections is developed using the Synchro® computer software, which implements the methods of the 2010 Highway Capacity Manual (HCM). The resulting analysis presents a level-of-service (LOS) designation for individual intersection movements and (for signalized intersections) for the entire intersection. The LOS is a letter designation that provides a qualitative measure of operating conditions based on several factors including roadway geometry, speeds, ambient traffic volumes, traffic controls, and driver characteristics. Since the LOS of a traffic facility is a function of the traffic flows placed upon it, such a facility may operate at a wide range of LOS, depending on the time of day, day of week, or period of year. A range of six levels of service are defined on the basis of average delay, ranging from LOS A (the least delay) to LOS F (delays greater than 50 seconds for unsignalized movements, and greater than 80 seconds for signalized movements).

Signalized Intersection Performance Measures

The six LOS designations for signalized intersections may be described as follows:

- *LOS A* describes operations with low control delay; most vehicles do not stop at all.
- *LOS B* describes operations with relatively low control delay. However, more vehicles stop than LOS A.
- *LOS C* describes operations with higher control delays. Individual cycle failures may begin to appear. The number of vehicles stopping is significant at this level, although many still pass through the intersection without stopping.
- *LOS D* describes operations with control delay in the range where the influence of congestion becomes more noticeable. Many vehicles stop and individual cycle failures are noticeable.
- *LOS E* describes operations with high control delay values. Individual cycle failures are frequent occurrences.
- *LOS F* describes operations with high control delay values that often occur with over-saturation. Poor progression and long cycle lengths may also be major contributing causes to such delay levels.

The LOS for signalized intersections are calculated using the operational analysis methodology of the 2010 *Highway Capacity Manual*.¹ This method assesses the effects of signal type, timing, phasing, and progression; vehicle mix; and geometrics on delay. LOS designations are based on the criterion of control or signal delay per vehicle. Control or signal delay is a measure of driver discomfort, frustration, and fuel consumption, and includes initial deceleration delay approaching the traffic signal, queue move-up time, stopped delay and final acceleration delay. **Table A1** summarizes the relationship between LOS and control delay. The tabulated control delay criterion may be applied in assigning LOS designations to individual lane groups, to individual intersection approaches, or to entire intersections.

Table A1
LEVEL-OF-SERVICE CRITERIA
FOR SIGNALIZED INTERSECTIONS¹

Control (Signal) Delay per Vehicle (seconds per vehicle)	Level of Service	
	v/c ≤ 1	v/c > 1
≤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

¹Source: *Highway Capacity Manual 2010*, Transportation Research Board; Washington, DC; 2010.

¹*Highway Capacity Manual 2010*; Transportation Research Board; Washington, DC; 2010.

Unsignalized Intersection Performance Measures

The six LOS designations 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 LOS designations of unsignalized intersections are determined by application of a procedure described in the 2010 *Highway Capacity Manual*.² LOS 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 LOS at unsignalized intersections are also given in the *Highway Capacity Manual 2010*. **Table A2** summarizes the relationship between LOS and average control delay.

Table A2
LEVEL-OF-SERVICE CRITERIA FOR
UNSIGNALIZED INTERSECTIONS¹

Average Control Delay (seconds per vehicle)	Level of Service	
	$v/c \leq 1$	$v/c > 1$
≤ 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

¹Source: *Highway Capacity Manual 2010*, Transportation Research Board; Washington, DC; 2010.

² *ibid*

HCM 6th TWSC
1: Mossman Road/Powder Mill Road & North Road

2020 Baseline Condition
Weekday Morning Peak Hour

Intersection

Int Delay, s/veh 144.7

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Vol, veh/h	88	768	16	16	172	55	4	27	32	191	55	2
Future Vol, veh/h	88	768	16	16	172	55	4	27	32	191	55	2
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	94	94	94	94	94	94	94	94	94	94	94	94
Heavy Vehicles, %	4	2	0	4	4	8	0	2	6	5	6	0
Mvmt Flow	94	817	17	17	183	59	4	29	34	203	59	2

Major/Minor	Major1		Major2		Minor1		Minor2					
Conflicting Flow All	242	0	0	834	0	0	1291	1290	826	1292	1269	213
Stage 1	-	-	-	-	-	-	1014	1014	-	247	247	-
Stage 2	-	-	-	-	-	-	277	276	-	1045	1022	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.1	6.52	6.26	7.15	6.56	6.2
Critical Hdwy Stg 1	-	-	-	-	-	-	6.1	5.52	-	6.15	5.56	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.1	5.52	-	6.15	5.56	-
Follow-up Hdwy	2.236	-	-	2.236	-	-	3.5	4.018	3.354	3.545	4.054	3.3
Pot Cap-1 Maneuver	1313	-	-	791	-	-	142	163	366	~ 138	165	832
Stage 1	-	-	-	-	-	-	290	316	-	750	695	-
Stage 2	-	-	-	-	-	-	734	682	-	273	308	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1313	-	-	791	-	-	85	138	366	~ 93	139	832
Mov Cap-2 Maneuver	-	-	-	-	-	-	85	138	-	~ 93	139	-
Stage 1	-	-	-	-	-	-	251	274	-	650	678	-
Stage 2	-	-	-	-	-	-	652	665	-	~ 192	267	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.8	0.6	33.7	\$ 819.9
HCM LOS			D	F

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	191	1313	-	-	791	-	-	101
HCM Lane V/C Ratio	0.351	0.071	-	-	0.022	-	-	2.612
HCM Control Delay (s)	33.7	8	0	-	9.7	0	-	\$ 819.9
HCM Lane LOS	D	A	A	-	A	A	-	F
HCM 95th %tile Q(veh)	1.5	0.2	-	-	0.1	-	-	24.4

Notes

~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Lanes, Volumes, Timings
2: Pantry Road/Dakin Road & North Road

2020 Baseline Condition
Weekday Morning Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	23	686	199	40	231	21	41	111	102	15	81	23
Future Volume (vph)	23	686	199	40	231	21	41	111	102	15	81	23
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	16	16	16	16	16	16	16	16	16	16	16	16
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.970			0.990			0.946			0.974	
Flt Protected		0.999			0.993			0.992			0.994	
Satd. Flow (prot)	0	2044	0	0	2020	0	0	1928	0	0	2031	0
Flt Permitted		0.988			0.826			0.931			0.942	
Satd. Flow (perm)	0	2022	0	0	1680	0	0	1810	0	0	1924	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		40			11			37			13	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		5000			5000			500			500	
Travel Time (s)		113.6			113.6			11.4			11.4	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Heavy Vehicles (%)	5%	2%	2%	3%	5%	6%	9%	4%	4%	2%	1%	9%
Adj. Flow (vph)	25	754	219	44	254	23	45	122	112	16	89	25
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	998	0	0	321	0	0	279	0	0	130	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100		20	100		20	100		20	100	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	0		0	0	
Detector 1 Size(ft)	20	6		20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Detector Phase	2	2		6	6		8	8		4	4	

Lanes, Volumes, Timings
2: Pantry Road/Dakin Road & North Road

2020 Baseline Condition
Weekday Morning Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0		6.0	6.0		6.0	6.0	
Minimum Split (s)	15.0	15.0		15.0	15.0		11.0	11.0		11.0	11.0	
Total Split (s)	60.0	60.0		60.0	60.0		20.0	20.0		20.0	20.0	
Total Split (%)	75.0%	75.0%		75.0%	75.0%		25.0%	25.0%		25.0%	25.0%	
Maximum Green (s)	55.0	55.0		55.0	55.0		15.0	15.0		15.0	15.0	
Yellow Time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		5.0			5.0			5.0			5.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	Min	Min		Min	Min		None	None		None	None	
Act Effct Green (s)		35.7			35.7			12.7			12.7	
Actuated g/C Ratio		0.60			0.60			0.21			0.21	
v/c Ratio		0.81			0.32			0.67			0.31	
Control Delay		14.4			6.1			30.8			23.6	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		14.4			6.1			30.8			23.6	
LOS		B			A			C			C	
Approach Delay		14.4			6.1			30.8			23.6	
Approach LOS		B			A			C			C	
90th %ile Green (s)	55.0	55.0		55.0	55.0		15.0	15.0		15.0	15.0	
90th %ile Term Code	Max	Max		Hold	Hold		Max	Max		Hold	Hold	
70th %ile Green (s)	43.6	43.6		43.6	43.6		15.0	15.0		15.0	15.0	
70th %ile Term Code	Gap	Gap		Hold	Hold		Max	Max		Hold	Hold	
50th %ile Green (s)	36.2	36.2		36.2	36.2		13.9	13.9		13.9	13.9	
50th %ile Term Code	Gap	Gap		Hold	Hold		Gap	Gap		Hold	Hold	
30th %ile Green (s)	28.2	28.2		28.2	28.2		10.9	10.9		10.9	10.9	
30th %ile Term Code	Gap	Gap		Hold	Hold		Gap	Gap		Hold	Hold	
10th %ile Green (s)	19.4	19.4		19.4	19.4		8.1	8.1		8.1	8.1	
10th %ile Term Code	Gap	Gap		Hold	Hold		Gap	Gap		Hold	Hold	
Queue Length 50th (ft)		232			47			78			35	
Queue Length 95th (ft)		383			83			#230			100	
Internal Link Dist (ft)		4920			4920			420			420	
Turn Bay Length (ft)												
Base Capacity (vph)		1786			1481			519			533	
Starvation Cap Reductn		0			0			0			0	
Spillback Cap Reductn		0			0			0			0	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		0.56			0.22			0.54			0.24	

Intersection Summary

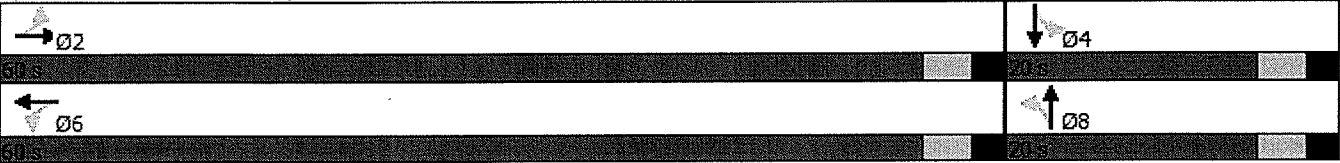
Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 59.1
Natural Cycle: 60
Control Type: Semi Act-Uncoord

Lanes, Volumes, Timings
2: Pantry Road/Dakin Road & North Road

2020 Baseline Condition
Weekday Morning Peak Hour

Maximum v/c Ratio: 0.81
Intersection Signal Delay: 16.2
Intersection Capacity Utilization 81.1%
Analysis Period (min) 15
90th %ile Actuated Cycle: 80
70th %ile Actuated Cycle: 68.6
50th %ile Actuated Cycle: 60.1
30th %ile Actuated Cycle: 49.1
10th %ile Actuated Cycle: 37.5
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 2: Pantry Road/Dakin Road & North Road



HCM 6th TWSC
1: Mossman Road/Powder Mill Road & North Road

2020 Baseline Condition
Weekday Evening Peak Hour

Intersection

Int Delay, s/veh 26.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Vol, veh/h	54	209	13	20	795	279	4	35	19	79	39	4
Future Vol, veh/h	54	209	13	20	795	279	4	35	19	79	39	4
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	96	96	96	96	96	96	96	96	96	96	96	96
Heavy Vehicles, %	6	1	0	0	2	3	25	0	5	0	3	0
Mvmt Flow	56	218	14	21	828	291	4	36	20	82	41	4

Major/Minor	Major1		Major2		Minor1		Minor2					
Conflicting Flow All	1119	0	0	232	0	0	1375	1498	225	1381	1360	974
Stage 1	-	-	-	-	-	-	337	337	-	1016	1016	-
Stage 2	-	-	-	-	-	-	1038	1161	-	365	344	-
Critical Hdwy	4.16	-	-	4.1	-	-	7.35	6.5	6.25	7.1	6.53	6.2
Critical Hdwy Stg 1	-	-	-	-	-	-	6.35	5.5	-	6.1	5.53	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.35	5.5	-	6.1	5.53	-
Follow-up Hdwy	2.254	-	-	2.2	-	-	3.725	4	3.345	3.5	4.027	3.3
Pot Cap-1 Maneuver	610	-	-	1348	-	-	109	124	807	123	148	308
Stage 1	-	-	-	-	-	-	632	645	-	289	314	-
Stage 2	-	-	-	-	-	-	253	272	-	658	635	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	610	-	-	1348	-	-	72	106	807	~ 79	126	308
Mov Cap-2 Maneuver	-	-	-	-	-	-	72	106	-	~ 79	126	-
Stage 1	-	-	-	-	-	-	565	577	-	258	300	-
Stage 2	-	-	-	-	-	-	206	260	-	538	568	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	2.2	0.1	47.9	\$ 307.9
HCM LOS			E	F

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	142	610	-	-	1348	-	-	92
HCM Lane V/C Ratio	0.425	0.092	-	-	0.015	-	-	1.381
HCM Control Delay (s)	47.9	11.5	0	-	7.7	0	-	\$ 307.9
HCM Lane LOS	E	B	A	-	A	A	-	F
HCM 95th %tile Q(veh)	1.9	0.3	-	-	0	-	-	9.4

Notes

~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Lanes, Volumes, Timings
2: Pantry Road/Dakin Road & North Road

2020 Baseline Condition
Weekday Evening Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	23	249	41	43	847	14	144	76	13	9	117	39
Future Volume (vph)	23	249	41	43	847	14	144	76	13	9	117	39
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	16	16	16	16	16	16	16	16	16	16	16	16
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.982			0.998			0.993			0.968	
Flt Protected		0.996			0.998			0.970			0.997	
Satd. Flow (prot)	0	2083	0	0	2103	0	0	1977	0	0	2000	0
Flt Permitted		0.921			0.973			0.743			0.978	
Satd. Flow (perm)	0	1927	0	0	2051	0	0	1514	0	0	1962	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		21			2			3			15	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		5000			5000			500			500	
Travel Time (s)		113.6			113.6			11.4			11.4	
Peak Hour Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Heavy Vehicles (%)	4%	1%	0%	2%	2%	0%	8%	0%	0%	33%	2%	3%
Adj. Flow (vph)	23	252	41	43	856	14	145	77	13	9	118	39
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	316	0	0	913	0	0	235	0	0	166	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100		20	100		20	100		20	100	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	0		0	0	
Detector 1 Size(ft)	20	6		20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Detector Phase	2	2		6	6		8	8		4	4	

Lanes, Volumes, Timings

2: Pantry Road/Dakin Road & North Road

2020 Baseline Condition

Weekday Evening Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0		6.0	6.0		6.0	6.0	
Minimum Split (s)	15.0	15.0		15.0	15.0		11.0	11.0		11.0	11.0	
Total Split (s)	70.0	70.0		70.0	70.0		20.0	20.0		20.0	20.0	
Total Split (%)	77.8%	77.8%		77.8%	77.8%		22.2%	22.2%		22.2%	22.2%	
Maximum Green (s)	65.0	65.0		65.0	65.0		15.0	15.0		15.0	15.0	
Yellow Time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		5.0			5.0			5.0			5.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	Min	Min		Min	Min		None	None		None	None	
Act Effct Green (s)		32.0			32.0			15.4			15.4	
Actuated g/C Ratio		0.56			0.56			0.27			0.27	
v/c Ratio		0.29			0.80			0.58			0.31	
Control Delay		6.5			15.9			28.9			20.2	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		6.5			15.9			28.9			20.2	
LOS		A			B			C			C	
Approach Delay		6.5			15.9			28.9			20.2	
Approach LOS		A			B			C			C	
90th %ile Green (s)	47.1	47.1		47.1	47.1		15.0	15.0		15.0	15.0	
90th %ile Term Code	Hold	Hold		Gap	Gap		Max	Max		Hold	Hold	
70th %ile Green (s)	37.3	37.3		37.3	37.3		15.0	15.0		15.0	15.0	
70th %ile Term Code	Hold	Hold		Gap	Gap		Max	Max		Hold	Hold	
50th %ile Green (s)	31.5	31.5		31.5	31.5		15.0	15.0		15.0	15.0	
50th %ile Term Code	Hold	Hold		Gap	Gap		Max	Max		Hold	Hold	
30th %ile Green (s)	26.5	26.5		26.5	26.5		15.0	15.0		15.0	15.0	
30th %ile Term Code	Hold	Hold		Gap	Gap		Max	Max		Hold	Hold	
10th %ile Green (s)	20.7	20.7		20.7	20.7		15.0	15.0		15.0	15.0	
10th %ile Term Code	Hold	Hold		Gap	Gap		Max	Max		Hold	Hold	
Queue Length 50th (ft)		46			217			68			40	
Queue Length 95th (ft)		78			338			#202			111	
Internal Link Dist (ft)		4920			4920			420			420	
Turn Bay Length (ft)												
Base Capacity (vph)		1889			2011			406			534	
Starvation Cap Reductn		0			0			0			0	
Spillback Cap Reductn		0			0			0			0	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		0.17			0.45			0.58			0.31	

Intersection Summary

Area Type: Other

Cycle Length: 90

Actuated Cycle Length: 57.6

Natural Cycle: 50

Control Type: Semi Act-Uncoord

Lanes, Volumes, Timings
2: Pantry Road/Dakin Road & North Road

2020 Baseline Condition
Weekday Evening Peak Hour

Maximum v/c Ratio: 0.80

Intersection Signal Delay: 16.4

Intersection Capacity Utilization 91.1%

Analysis Period (min) 15

90th %ile Actuated Cycle: 72.1

70th %ile Actuated Cycle: 62.3

50th %ile Actuated Cycle: 56.5

30th %ile Actuated Cycle: 51.5

10th %ile Actuated Cycle: 45.7

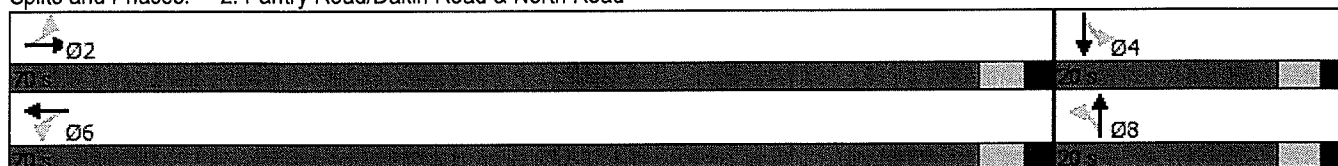
95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Intersection LOS: B

ICU Level of Service F

Splits and Phases: 2: Pantry Road/Dakin Road & North Road



HCM 6th TWSC
1: Mossman Road/Powder Mill Road & North Road

2027 No-Build Condition
Weekday Morning Peak Hour

Intersection

Int Delay, s/veh 230.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Vol, veh/h	94	837	17	17	204	59	4	29	34	205	59	2
Future Vol, veh/h	94	837	17	17	204	59	4	29	34	205	59	2
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	94	94	94	94	94	94	94	94	94	94	94	94
Heavy Vehicles, %	4	2	0	4	4	8	0	2	6	5	6	0
Mvmt Flow	100	890	18	18	217	63	4	31	36	218	63	2

Major/Minor	Major1		Major2		Minor1		Minor2					
Conflicting Flow All	280	0	0	908	0	0	1416	1415	899	1418	1393	249
Stage 1	-	-	-	-	-	-	1099	1099	-	285	285	-
Stage 2	-	-	-	-	-	-	317	316	-	1133	1108	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.1	6.52	6.26	7.15	6.56	6.2
Critical Hdwy Stg 1	-	-	-	-	-	-	6.1	5.52	-	6.15	5.56	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.1	5.52	-	6.15	5.56	-
Follow-up Hdwy	2.236	-	-	2.236	-	-	3.5	4.018	3.354	3.545	4.054	3.3
Pot Cap-1 Maneuver	1271	-	-	741	-	-	116	137	332	~ 113	139	795
Stage 1	-	-	-	-	-	-	260	288	-	716	668	-
Stage 2	-	-	-	-	-	-	698	655	-	243	281	-
Platoon blocked, %		-	-	-	-	-						
Mov Cap-1 Maneuver	1271	-	-	741	-	-	57	112	332	~ 69	113	795
Mov Cap-2 Maneuver	-	-	-	-	-	-	57	112	-	~ 69	113	-
Stage 1	-	-	-	-	-	-	218	242	-	601	649	-
Stage 2	-	-	-	-	-	-	611	636	-	~ 159	236	-

Approach	EB		WB		NB		SB
HCM Control Delay, s	0.8		0.6		46.6		\$ 1339.6
HCM LOS					E		F

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	155	1271	-	-	741	-	-	76
HCM Lane V/C Ratio	0.46	0.079	-	-	0.024	-	-	3.723
HCM Control Delay (s)	46.6	8.1	0	-	10	0		\$ 1339.6
HCM Lane LOS	E	A	A	-	A	A	-	F
HCM 95th %tile Q(veh)	2.1	0.3	-	-	0.1	-	-	29.5

Notes

~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Lanes, Volumes, Timings
2: Pantry Road/Dakin Road & North Road

2027 No-Build Condition
Weekday Morning Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	57	749	213	43	268	23	44	119	109	16	87	25
Future Volume (vph)	57	749	213	43	268	23	44	119	109	16	87	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	16	16	16	16	16	16	16	16	16	16	16	16
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.972			0.991			0.946			0.974	
Flt Protected		0.997			0.994			0.992			0.994	
Satd. Flow (prot)	0	2042	0	0	2024	0	0	1928	0	0	2031	0
Flt Permitted		0.961			0.808			0.932			0.906	
Satd. Flow (perm)	0	1969	0	0	1645	0	0	1812	0	0	1851	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		38			11			37			13	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		5000			5000			500			500	
Travel Time (s)		113.6			113.6			11.4			11.4	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Heavy Vehicles (%)	5%	2%	2%	3%	5%	6%	9%	4%	4%	2%	1%	9%
Adj. Flow (vph)	63	823	234	47	295	25	48	131	120	18	96	27
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1120	0	0	367	0	0	299	0	0	141	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100		20	100		20	100		20	100	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	0		0	0	
Detector 1 Size(ft)	20	6		20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Detector Phase	2	2		6	6		8	8		4	4	

Lanes, Volumes, Timings
2: Pantry Road/Dakin Road & North Road

2027 No-Build Condition
Weekday Morning Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0		6.0	6.0		6.0	6.0	
Minimum Split (s)	15.0	15.0		15.0	15.0		11.0	11.0		11.0	11.0	
Total Split (s)	60.0	60.0		60.0	60.0		20.0	20.0		20.0	20.0	
Total Split (%)	75.0%	75.0%		75.0%	75.0%		25.0%	25.0%		25.0%	25.0%	
Maximum Green (s)	55.0	55.0		55.0	55.0		15.0	15.0		15.0	15.0	
Yellow Time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		5.0			5.0			5.0			5.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	Min	Min		Min	Min		None	None		None	None	
Act Effct Green (s)		43.9			43.9			13.7			13.7	
Actuated g/C Ratio		0.64			0.64			0.20			0.20	
v/c Ratio		0.87			0.34			0.76			0.37	
Control Delay		18.5			6.1			39.2			27.6	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		18.5			6.1			39.2			27.6	
LOS		B			A			D			C	
Approach Delay		18.5			6.1			39.2			27.6	
Approach LOS		B			A			D			C	
90th %ile Green (s)	55.0	55.0		55.0	55.0		15.0	15.0		15.0	15.0	
90th %ile Term Code	Max	Max		Hold	Hold		Max	Max		Max	Max	
70th %ile Green (s)	55.0	55.0		55.0	55.0		15.0	15.0		15.0	15.0	
70th %ile Term Code	Max	Max		Hold	Hold		Max	Max		Hold	Hold	
50th %ile Green (s)	47.6	47.6		47.6	47.6		15.0	15.0		15.0	15.0	
50th %ile Term Code	Gap	Gap		Hold	Hold		Max	Max		Hold	Hold	
30th %ile Green (s)	38.8	38.8		38.8	38.8		13.5	13.5		13.5	13.5	
30th %ile Term Code	Gap	Gap		Hold	Hold		Gap	Gap		Hold	Hold	
10th %ile Green (s)	25.9	25.9		25.9	25.9		9.6	9.6		9.6	9.6	
10th %ile Term Code	Gap	Gap		Hold	Hold		Gap	Gap		Hold	Hold	
Queue Length 50th (ft)		328			60			111			49	
Queue Length 95th (ft)		535			98			#256			109	
Internal Link Dist (ft)		4920			4920			420			420	
Turn Bay Length (ft)												
Base Capacity (vph)		1588			1323			445			436	
Starvation Cap Reductn		0			0			0			0	
Spillback Cap Reductn		0			0			0			0	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		0.71			0.28			0.67			0.32	

Intersection Summary

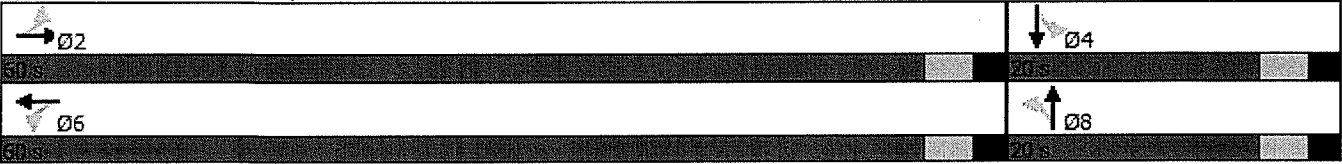
Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 68.1
Natural Cycle: 60
Control Type: Semi Act-Uncoord

Lanes, Volumes, Timings
2: Pantry Road/Dakin Road & North Road

2027 No-Build Condition
Weekday Morning Peak Hour

Maximum v/c Ratio: 0.87
Intersection Signal Delay: 20.0
Intersection Capacity Utilization 93.1%
Analysis Period (min) 15
90th %ile Actuated Cycle: 80
70th %ile Actuated Cycle: 80
50th %ile Actuated Cycle: 72.6
30th %ile Actuated Cycle: 62.3
10th %ile Actuated Cycle: 45.5
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 2: Pantry Road/Dakin Road & North Road



HCM 6th TWSC
1: Mossman Road/Powder Mill Road & North Road

2027 No-Build Condition
Weekday Evening Peak Hour

Intersection

Int Delay, s/veh 61.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	58	261	14	21	894	298	4	38	20	85	42	4
Future Vol, veh/h	58	261	14	21	894	298	4	38	20	85	42	4
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	96	96	96	96	96	96	96	96	96	96	96	96
Heavy Vehicles, %	6	1	0	0	2	3	25	0	5	0	3	0
Mvmt Flow	60	272	15	22	931	310	4	40	21	89	44	4

Major/Minor	Major1		Major2		Minor1		Minor2					
Conflicting Flow All	1241	0	0	287	0	0	1554	1685	280	1560	1537	1086
Stage 1	-	-	-	-	-	-	400	400	-	1130	1130	-
Stage 2	-	-	-	-	-	-	1154	1285	-	430	407	-
Critical Hdwy	4.16	-	-	4.1	-	-	7.35	6.5	6.25	7.1	6.53	6.2
Critical Hdwy Stg 1	-	-	-	-	-	-	6.35	5.5	-	6.1	5.53	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.35	5.5	-	6.1	5.53	-
Follow-up Hdwy	2.254	-	-	2.2	-	-	3.725	4	3.345	3.5	4.027	3.3
Pot Cap-1 Maneuver	548	-	-	1287	-	-	81	95	752	92	115	265
Stage 1	-	-	-	-	-	-	583	605	-	250	278	-
Stage 2	-	-	-	-	-	-	216	237	-	607	596	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	548	-	-	1287	-	-	44	78	752	~ 47	94	265
Mov Cap-2 Maneuver	-	-	-	-	-	-	44	78	-	~ 47	94	-
Stage 1	-	-	-	-	-	-	507	526	-	218	261	-
Stage 2	-	-	-	-	-	-	166	222	-	475	519	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	2.2	0.1	86	\$ 769.4
HCM LOS			F	F

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	103	548	-	-	1287	-	-	58
HCM Lane V/C Ratio	0.627	0.11	-	-	0.017	-	-	2.353
HCM Control Delay (s)	86	12.4	0	-	7.8	0	-	\$ 769.4
HCM Lane LOS	F	B	A	-	A	A	-	F
HCM 95th %tile Q(veh)	3.1	0.4	-	-	0.1	-	-	13.6

Notes

~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Lanes, Volumes, Timings
2: Pantry Road/Dakin Road & North Road

2027 No-Build Condition
Weekday Evening Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	25	304	44	46	950	15	154	81	14	10	125	42
Future Volume (vph)	25	304	44	46	950	15	154	81	14	10	125	42
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	16	16	16	16	16	16	16	16	16	16	16	16
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.984			0.998			0.992			0.968	
Flt Protected		0.997			0.998			0.970			0.997	
Satd. Flow (prot)	0	2090	0	0	2103	0	0	1974	0	0	1999	0
Flt Permitted		0.916			0.971			0.693			0.976	
Satd. Flow (perm)	0	1920	0	0	2046	0	0	1410	0	0	1957	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		19			2			3			15	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		5000			5000			500			500	
Travel Time (s)		113.6			113.6			11.4			11.4	
Peak Hour Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Heavy Vehicles (%)	4%	1%	0%	2%	2%	0%	8%	0%	0%	33%	2%	3%
Adj. Flow (vph)	25	307	44	46	960	15	156	82	14	10	126	42
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	376	0	0	1021	0	0	252	0	0	178	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100		20	100		20	100		20	100	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	0		0	0	
Detector 1 Size(ft)	20	6		20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Detector Phase	2	2		6	6		8	8		4	4	

Lanes, Volumes, Timings

2: Pantry Road/Dakin Road & North Road

2027 No-Build Condition

Weekday Evening Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0		6.0	6.0		6.0	6.0	
Minimum Split (s)	15.0	15.0		15.0	15.0		11.0	11.0		11.0	11.0	
Total Split (s)	70.0	70.0		70.0	70.0		20.0	20.0		20.0	20.0	
Total Split (%)	77.8%	77.8%		77.8%	77.8%		22.2%	22.2%		22.2%	22.2%	
Maximum Green (s)	65.0	65.0		65.0	65.0		15.0	15.0		15.0	15.0	
Yellow Time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		5.0			5.0			5.0			5.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	Min	Min		Min	Min		None	None		None	None	
Act Effct Green (s)		38.7			38.7			15.5			15.5	
Actuated g/C Ratio		0.60			0.60			0.24			0.24	
v/c Ratio		0.32			0.83			0.74			0.37	
Control Delay		6.3			16.5			42.4			25.1	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		6.3			16.5			42.4			25.1	
LOS		A			B			D			C	
Approach Delay		6.3			16.5			42.4			25.1	
Approach LOS		A			B			D			C	
90th %ile Green (s)	59.5	59.5		59.5	59.5		15.0	15.0		15.0	15.0	
90th %ile Term Code	Hold	Hold		Gap	Gap		Max	Max		Max	Max	
70th %ile Green (s)	45.2	45.2		45.2	45.2		15.0	15.0		15.0	15.0	
70th %ile Term Code	Hold	Hold		Gap	Gap		Max	Max		Hold	Hold	
50th %ile Green (s)	37.8	37.8		37.8	37.8		15.0	15.0		15.0	15.0	
50th %ile Term Code	Hold	Hold		Gap	Gap		Max	Max		Hold	Hold	
30th %ile Green (s)	31.7	31.7		31.7	31.7		15.0	15.0		15.0	15.0	
30th %ile Term Code	Hold	Hold		Gap	Gap		Max	Max		Hold	Hold	
10th %ile Green (s)	23.8	23.8		23.8	23.8		15.0	15.0		15.0	15.0	
10th %ile Term Code	Hold	Hold		Gap	Gap		Max	Max		Hold	Hold	
Queue Length 50th (ft)		58			268			88			52	
Queue Length 95th (ft)		91			405			#286			141	
Internal Link Dist (ft)		4920			4920			420			420	
Turn Bay Length (ft)												
Base Capacity (vph)		1804			1921			341			481	
Starvation Cap Reductn		0			0			0			0	
Spillback Cap Reductn		0			0			0			0	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		0.21			0.53			0.74			0.37	

Intersection Summary

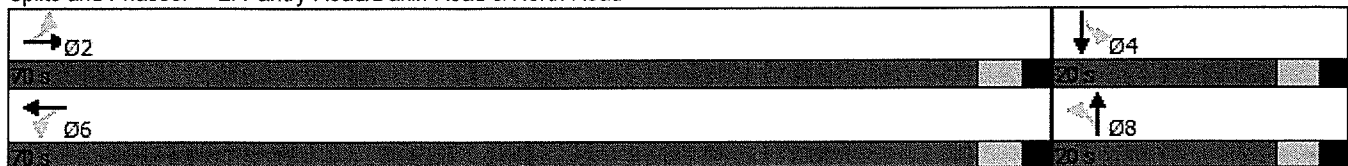
Area Type: Other
 Cycle Length: 90
 Actuated Cycle Length: 64.6
 Natural Cycle: 60
 Control Type: Semi Act-Uncoord

Lanes, Volumes, Timings
2: Pantry Road/Dakin Road & North Road

2027 No-Build Condition
Weekday Evening Peak Hour

Maximum v/c Ratio: 0.83
Intersection Signal Delay: 18.8
Intersection Capacity Utilization 99.6%
Analysis Period (min) 15
90th %ile Actuated Cycle: 84.5
70th %ile Actuated Cycle: 70.2
50th %ile Actuated Cycle: 62.8
30th %ile Actuated Cycle: 56.7
10th %ile Actuated Cycle: 48.8
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 2: Pantry Road/Dakin Road & North Road



HCM 6th TWSC
1: Mossman Road/Powder Mill Road & North Road

2027 Build Condition
Weekday Morning Peak Hour

Intersection

Int Delay, s/veh 241.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Vol, veh/h	94	840	17	17	213	59	4	29	34	205	59	2
Future Vol, veh/h	94	840	17	17	213	59	4	29	34	205	59	2
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	94	94	94	94	94	94	94	94	94	94	94	94
Heavy Vehicles, %	4	2	0	4	4	8	0	2	6	5	6	0
Mvmt Flow	100	894	18	18	227	63	4	31	36	218	63	2

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	290	0	0	912	0	0	1430	1429	903	1432	1407	259
Stage 1	-	-	-	-	-	-	1103	1103	-	295	295	-
Stage 2	-	-	-	-	-	-	327	326	-	1137	1112	-
Critical Hdwy	4.14	-	-	4.14	-	-	7.1	6.52	6.26	7.15	6.56	6.2
Critical Hdwy Stg 1	-	-	-	-	-	-	6.1	5.52	-	6.15	5.56	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.1	5.52	-	6.15	5.56	-
Follow-up Hdwy	2.236	-	-	2.236	-	-	3.5	4.018	3.354	3.545	4.054	3.3
Pot Cap-1 Maneuver	1260	-	-	739	-	-	113	135	330	~110	136	785
Stage 1	-	-	-	-	-	-	259	287	-	707	662	-
Stage 2	-	-	-	-	-	-	690	648	-	242	280	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1260	-	-	739	-	-	54	110	330	~66	111	785
Mov Cap-2 Maneuver	-	-	-	-	-	-	54	110	-	~66	111	-
Stage 1	-	-	-	-	-	-	217	241	-	593	643	-
Stage 2	-	-	-	-	-	-	603	629	-	~158	235	-

Approach	EB		WB		NB		SB
HCM Control Delay, s	0.8		0.6		48		\$ 1412.1
HCM LOS					E		F

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	152	1260	-	-	739	-	-	73
HCM Lane V/C Ratio	0.469	0.079	-	-	0.024	-	-	3.876
HCM Control Delay (s)	48	8.1	0	-	10	0		\$ 1412.1
HCM Lane LOS	E	A	A	-	A	A	-	F
HCM 95th %tile Q(veh)	2.2	0.3	-	-	0.1	-	-	29.8

Notes

~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Lanes, Volumes, Timings
2: Pantry Road/Dakin Road & North Road

2027 Build Condition
Weekday Morning Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	57	753	213	68	281	23	44	119	117	16	87	25
Future Volume (vph)	57	753	213	68	281	23	44	119	117	16	87	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	16	16	16	16	16	16	16	16	16	16	16	16
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.972			0.992			0.943			0.974	
Flt Protected		0.997			0.991			0.992			0.994	
Satd. Flow (prot)	0	2042	0	0	2022	0	0	1922	0	0	2031	0
Flt Permitted		0.958			0.729			0.934			0.901	
Satd. Flow (perm)	0	1963	0	0	1487	0	0	1810	0	0	1841	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		38			9			40			13	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		5000			5000			500			500	
Travel Time (s)		113.6			113.6			11.4			11.4	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Heavy Vehicles (%)	5%	2%	2%	3%	5%	6%	9%	4%	4%	2%	1%	9%
Adj. Flow (vph)	63	827	234	75	309	25	48	131	129	18	96	27
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1124	0	0	409	0	0	308	0	0	141	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100		20	100		20	100		20	100	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	0		0	0	
Detector 1 Size(ft)	20	6		20	6		20	6		20	6	
Detector 1 Type	Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex		Cl+Ex	Cl+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		Cl+Ex			Cl+Ex			Cl+Ex			Cl+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Detector Phase	2	2		6	6		8	8		4	4	

Lanes, Volumes, Timings
2: Pantry Road/Dakin Road & North Road

2027 Build Condition
Weekday Morning Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0		6.0	6.0		6.0	6.0	
Minimum Split (s)	15.0	15.0		15.0	15.0		11.0	11.0		11.0	11.0	
Total Split (s)	60.0	60.0		60.0	60.0		20.0	20.0		20.0	20.0	
Total Split (%)	75.0%	75.0%		75.0%	75.0%		25.0%	25.0%		25.0%	25.0%	
Maximum Green (s)	55.0	55.0		55.0	55.0		15.0	15.0		15.0	15.0	
Yellow Time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		5.0			5.0			5.0			5.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	Min	Min		Min	Min		None	None		None	None	
Act Effct Green (s)		44.3			44.3			13.9			13.9	
Actuated g/C Ratio		0.64			0.64			0.20			0.20	
v/c Ratio		0.88			0.42			0.77			0.37	
Control Delay		18.9			7.1			40.1			27.7	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		18.9			7.1			40.1			27.7	
LOS		B			A			D			C	
Approach Delay		18.9			7.1			40.1			27.7	
Approach LOS		B			A			D			C	
90th %ile Green (s)	55.0	55.0		55.0	55.0		15.0	15.0		15.0	15.0	
90th %ile Term Code	Max	Max		Hold	Hold		Max	Max		Max	Max	
70th %ile Green (s)	55.0	55.0		55.0	55.0		15.0	15.0		15.0	15.0	
70th %ile Term Code	Max	Max		Hold	Hold		Max	Max		Hold	Hold	
50th %ile Green (s)	48.4	48.4		48.4	48.4		15.0	15.0		15.0	15.0	
50th %ile Term Code	Gap	Gap		Hold	Hold		Max	Max		Hold	Hold	
30th %ile Green (s)	39.4	39.4		39.4	39.4		14.0	14.0		14.0	14.0	
30th %ile Term Code	Gap	Gap		Hold	Hold		Gap	Gap		Hold	Hold	
10th %ile Green (s)	26.7	26.7		26.7	26.7		10.0	10.0		10.0	10.0	
10th %ile Term Code	Gap	Gap		Hold	Hold		Gap	Gap		Hold	Hold	
Queue Length 50th (ft)		333			72			116			50	
Queue Length 95th (ft)		544			119			#265			109	
Internal Link Dist (ft)		4920			4920			420			420	
Turn Bay Length (ft)												
Base Capacity (vph)		1574			1189			442			428	
Starvation Cap Reductn		0			0			0			0	
Spillback Cap Reductn		0			0			0			0	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		0.71			0.34			0.70			0.33	

Intersection Summary

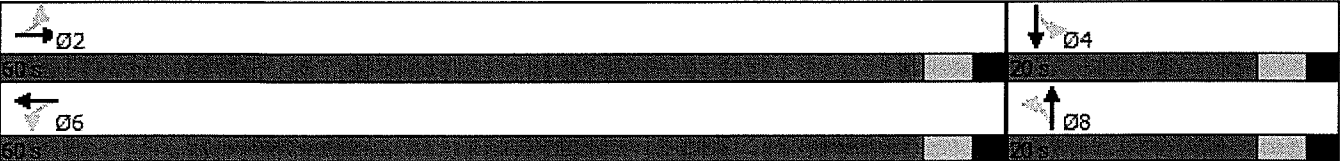
Area Type: Other
Cycle Length: 80
Actuated Cycle Length: 68.7
Natural Cycle: 60
Control Type: Semi Act-Uncoord

Lanes, Volumes, Timings
2: Pantry Road/Dakin Road & North Road

2027 Build Condition
Weekday Morning Peak Hour

Maximum v/c Ratio: 0.88
Intersection Signal Delay: 20.4
Intersection Capacity Utilization 91.2%
Analysis Period (min) 15
90th %ile Actuated Cycle: 80
70th %ile Actuated Cycle: 80
50th %ile Actuated Cycle: 73.4
30th %ile Actuated Cycle: 63.4
10th %ile Actuated Cycle: 46.7
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 2: Pantry Road/Dakin Road & North Road



HCM 6th TWSC
3: North Road & Site Driveway

2027 Build Condition
Weekday Morning Peak Hour

Intersection

Int Delay, s/veh 1.8

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	12	874	334	15	46	38
Future Vol, veh/h	12	874	334	15	46	38
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	2	5	0	0	0
Mvmt Flow	13	950	363	16	50	41

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	379	0	0 1347 371
Stage 1	-	-	- 371 -
Stage 2	-	-	- 976 -
Critical Hdwy	4.1	-	- 6.4 6.2
Critical Hdwy Stg 1	-	-	- 5.4 -
Critical Hdwy Stg 2	-	-	- 5.4 -
Follow-up Hdwy	2.2	-	- 3.5 3.3
Pot Cap-1 Maneuver	1191	-	- 168 679
Stage 1	-	-	- 702 -
Stage 2	-	-	- 368 -
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	1191	-	- 164 679
Mov Cap-2 Maneuver	-	-	- 164 -
Stage 1	-	-	- 686 -
Stage 2	-	-	- 368 -

Approach	EB	WB	SB
HCM Control Delay, s	0.1	0	27.5
HCM LOS			D

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1191	-	-	-	250
HCM Lane V/C Ratio	0.011	-	-	-	0.365
HCM Control Delay (s)	8.1	0	-	-	27.5
HCM Lane LOS	A	A	-	-	D
HCM 95th %tile Q(veh)	0	-	-	-	1.6

HCM 6th TWSC
1: Mossman Road/Powder Mill Road & North Road

2027 Build Condition
Weekday Evening Peak Hour

Intersection

Int Delay, s/veh 66

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Vol, veh/h	58	269	14	21	899	298	4	38	20	85	42	4
Future Vol, veh/h	58	269	14	21	899	298	4	38	20	85	42	4
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	96	96	96	96	96	96	96	96	96	96	96	96
Heavy Vehicles, %	6	1	0	0	2	3	25	0	5	0	3	0
Mvmt Flow	60	280	15	22	936	310	4	40	21	89	44	4

Major/Minor	Major1		Major2		Minor1		Minor2					
Conflicting Flow All	1246	0	0	295	0	0	1567	1698	288	1573	1550	1091
Stage 1	-	-	-	-	-	-	408	408	-	1135	1135	-
Stage 2	-	-	-	-	-	-	1159	1290	-	438	415	-
Critical Hdwy	4.16	-	-	4.1	-	-	7.35	6.5	6.25	7.1	6.53	6.2
Critical Hdwy Stg 1	-	-	-	-	-	-	6.35	5.5	-	6.1	5.53	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.35	5.5	-	6.1	5.53	-
Follow-up Hdwy	2.254	-	-	2.2	-	-	3.725	4	3.345	3.5	4.027	3.3
Pot Cap-1 Maneuver	545	-	-	1278	-	-	80	93	744	90	113	264
Stage 1	-	-	-	-	-	-	577	600	-	248	276	-
Stage 2	-	-	-	-	-	-	215	236	-	601	591	-
Platoon blocked, %		-	-	-	-	-						
Mov Cap-1 Maneuver	545	-	-	1278	-	-	43	76	744	~45	92	264
Mov Cap-2 Maneuver	-	-	-	-	-	-	43	76	-	~45	92	-
Stage 1	-	-	-	-	-	-	501	521	-	215	259	-
Stage 2	-	-	-	-	-	-	165	221	-	469	513	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	2.1	0.1	91	\$ 832.8
HCM LOS			F	F

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	100	545	-	-	1278	-	-	55
HCM Lane V/C Ratio	0.646	0.111	-	-	0.017	-	-	2.481
HCM Control Delay (s)	91	12.4	0	-	7.9	0	-	\$ 832.8
HCM Lane LOS	F	B	A	-	A	A	-	F
HCM 95th %tile Q(veh)	3.2	0.4	-	-	0.1	-	-	13.9

Notes

~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon

Lanes, Volumes, Timings
2: Pantry Road/Dakin Road & North Road

2027 Build Condition
Weekday Evening Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	25	316	44	62	957	15	154	81	39	10	125	42
Future Volume (vph)	25	316	44	62	957	15	154	81	39	10	125	42
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	16	16	16	16	16	16	16	16	16	16	16	16
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.985			0.998			0.981			0.968	
Flt Protected		0.997			0.997			0.973			0.997	
Satd. Flow (prot)	0	2092	0	0	2101	0	0	1967	0	0	1999	0
Flt Permitted		0.916			0.956			0.700			0.979	
Satd. Flow (perm)	0	1922	0	0	2015	0	0	1415	0	0	1963	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		18			2			8			15	
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		5000			5000			500			500	
Travel Time (s)		113.6			113.6			11.4			11.4	
Peak Hour Factor	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Heavy Vehicles (%)	4%	1%	0%	2%	2%	0%	8%	0%	0%	33%	2%	3%
Adj. Flow (vph)	25	319	44	63	967	15	156	82	39	10	126	42
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	388	0	0	1045	0	0	277	0	0	178	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	2		1	2		1	2		1	2	
Detector Template	Left	Thru		Left	Thru		Left	Thru		Left	Thru	
Leading Detector (ft)	20	100		20	100		20	100		20	100	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	0		0	0	
Detector 1 Size(ft)	20	6		20	6		20	6		20	6	
Detector 1 Type	CI+Ex	CI+Ex		CI+Ex	CI+Ex		CI+Ex	CI+Ex		CI+Ex	CI+Ex	
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 2 Position(ft)		94			94			94			94	
Detector 2 Size(ft)		6			6			6			6	
Detector 2 Type		CI+Ex			CI+Ex			CI+Ex			CI+Ex	
Detector 2 Channel												
Detector 2 Extend (s)		0.0			0.0			0.0			0.0	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases	2			6			8			4		
Detector Phase	2	2		6	6		8	8		4	4	

Lanes, Volumes, Timings
2: Pantry Road/Dakin Road & North Road

2027 Build Condition
Weekday Evening Peak Hour

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Switch Phase												
Minimum Initial (s)	10.0	10.0		10.0	10.0		6.0	6.0		6.0	6.0	
Minimum Split (s)	15.0	15.0		15.0	15.0		11.0	11.0		11.0	11.0	
Total Split (s)	70.0	70.0		70.0	70.0		20.0	20.0		20.0	20.0	
Total Split (%)	77.8%	77.8%		77.8%	77.8%		22.2%	22.2%		22.2%	22.2%	
Maximum Green (s)	65.0	65.0		65.0	65.0		15.0	15.0		15.0	15.0	
Yellow Time (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
All-Red Time (s)	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Lost Time Adjust (s)		0.0			0.0			0.0			0.0	
Total Lost Time (s)		5.0			5.0			5.0			5.0	
Lead/Lag												
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	Min	Min		Min	Min		None	None		None	None	
Act Effct Green (s)		41.5			41.5			15.6			15.6	
Actuated g/C Ratio		0.62			0.62			0.23			0.23	
v/c Ratio		0.33			0.84			0.83			0.38	
Control Delay		6.1			16.9			51.9			26.9	
Queue Delay		0.0			0.0			0.0			0.0	
Total Delay		6.1			16.9			51.9			26.9	
LOS		A			B			D			C	
Approach Delay		6.1			16.9			51.9			26.9	
Approach LOS		A			B			D			C	
90th %ile Green (s)	64.3	64.3		64.3	64.3		15.0	15.0		15.0	15.0	
90th %ile Term Code	Hold	Hold		Gap	Gap		Max	Max		Max	Max	
70th %ile Green (s)	48.2	48.2		48.2	48.2		15.0	15.0		15.0	15.0	
70th %ile Term Code	Hold	Hold		Gap	Gap		Max	Max		Hold	Hold	
50th %ile Green (s)	40.1	40.1		40.1	40.1		15.0	15.0		15.0	15.0	
50th %ile Term Code	Hold	Hold		Gap	Gap		Max	Max		Hold	Hold	
30th %ile Green (s)	33.4	33.4		33.4	33.4		15.0	15.0		15.0	15.0	
30th %ile Term Code	Hold	Hold		Gap	Gap		Max	Max		Hold	Hold	
10th %ile Green (s)	25.9	25.9		25.9	25.9		15.0	15.0		15.0	15.0	
10th %ile Term Code	Hold	Hold		Gap	Gap		Max	Max		Hold	Hold	
Queue Length 50th (ft)		61			286			102			54	
Queue Length 95th (ft)		94			431			#337			149	
Internal Link Dist (ft)		4920			4920			420			420	
Turn Bay Length (ft)												
Base Capacity (vph)		1775			1859			333			465	
Starvation Cap Reductn		0			0			0			0	
Spillback Cap Reductn		0			0			0			0	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		0.22			0.56			0.83			0.38	

Intersection Summary

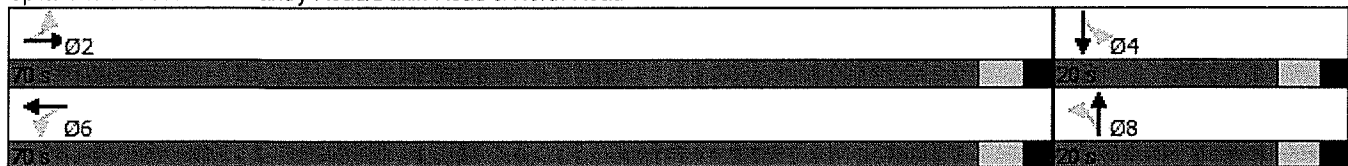
Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 67.4
Natural Cycle: 55
Control Type: Semi Act-Uncoord

Lanes, Volumes, Timings
2: Pantry Road/Dakin Road & North Road

2027 Build Condition
Weekday Evening Peak Hour

Maximum v/c Ratio: 0.84
Intersection Signal Delay: 20.8
Intersection Capacity Utilization 106.7%
Analysis Period (min) 15
90th %ile Actuated Cycle: 89.3
70th %ile Actuated Cycle: 73.2
50th %ile Actuated Cycle: 65.1
30th %ile Actuated Cycle: 58.4
10th %ile Actuated Cycle: 50.9
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 2: Pantry Road/Dakin Road & North Road



HCM 6th TWSC
3: North Road & Site Driveway

2027 Build Condition
Weekday Evening Peak Hour

Intersection

Int Delay, s/veh	0.9					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	37	328	46	1011	29	23
Future Vol, veh/h	37	328	46	1011	29	23
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	0	1	2	0	0	0
Mvmt Flow	40	357	50	1099	32	25

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	1149	0	0 1037 600
Stage 1	-	-	- 600 -
Stage 2	-	-	- 437 -
Critical Hdwy	4.1	-	- 6.4 6.2
Critical Hdwy Stg 1	-	-	- 5.4 -
Critical Hdwy Stg 2	-	-	- 5.4 -
Follow-up Hdwy	2.2	-	- 3.5 3.3
Pot Cap-1 Maneuver	615	-	- 258 505
Stage 1	-	-	- 552 -
Stage 2	-	-	- 655 -
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	615	-	- 237 505
Mov Cap-2 Maneuver	-	-	- 237 -
Stage 1	-	-	- 507 -
Stage 2	-	-	- 655 -

Approach	EB	WB	SB
HCM Control Delay, s	1.1	0	19.2
HCM LOS			C

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	615	-	-	-	310
HCM Lane V/C Ratio	0.065	-	-	-	0.182
HCM Control Delay (s)	11.3	0	-	-	19.2
HCM Lane LOS	B	A	-	-	C
HCM 95th %tile Q(veh)	0.2	-	-	-	0.7