

Department of Planning and Zoning

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TO: Development Review Board
FROM: Scott Gustin & Mary O'Neil, Principal Planners
DATE: January 17, 2017
RE: 17-0623CA/MA; 329-375 North Avenue

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Note: These are staff comments only; decisions on projects are made by the Development Review Board, which may approve, deny, table or modify any project. THE APPLICANT OR REPRESENTATIVE MUST ATTEND THE MEETING.

Zone: NAC-CR Ward: 4N

Owner/Applicant: BCCH, LLC & 375 North Ave, LLC / Eric Farrell

Request: Proposed development consisting of 11 buildings containing 735 residential units, approximately 45,000 sq. ft. of non-residential support/amenity space, approximately 40,000 sq. ft. of neighborhood commercial spaces and 1,093 parking spaces.

Applicable Regulations:

Article 3 (Applications and Reviews), Article 4 (Maps & Districts), Article 5 (Citywide General Regulations), Article 6 (Development Criteria & Guidelines), Article 8 (Parking), Article 9 (Inclusionary and Replacement Housing), Article 10 (Subdivision), and Article 11 (Planned Unit Development)

Background Information:

Known as Cambrian Rise, the application proposes development with mixed commercial and residential uses, related buildings and infrastructure across approximately 21.65 acres (per plan BA1) at 329-375 North Avenue. The total unit count has fluctuated somewhat and is presently at 735 residential units, inclusive of the 65 units already permitted in the former orphanage building.

During the summer and fall of 2016, this project underwent several sketch plan reviews with the Conservation Board, Design Advisory Board, and Development Review Board. Conservation Board comments centered on stormwater management and commended the proposed management of stormwater management onsite, rather than utilization of the city system. The Design Advisory Board reviewed the sketch plans twice. Doing so allowed the DAB an opportunity to get an overview of the proposal; comments were limited to questions about the overall development, and a desire to cut back the hard edges of the buildings along North Avenue as they abutted smaller structures (to the south). The Board acknowledged the large scope of the project, and their limited time or opportunity to discuss any particular building or part of the plan in any depth. They requested additional work sessions during the formal review process. The Development Review Board also reviewed the sketch plans twice. DRB comments discouraged shared pedestrian/bike use of sidewalks, noted concerns about the consistently large massing of the proposed structures, particularly near the orphanage, suggested reduction in surface parking, and encouraged strengthening of the streetscape.

Following the final sketch plan reviews, the project was revised to address comments from the boards and the public. Formal application for this project was made December 1, 2016.

The Conservation Board reviewed this application December 19, 2016. The Board unanimously recommended approval of the project as presented. In their recommendation, the Board noted their appreciation of the stormwater management design and that the applicants joined CATMA as part of their transportation management initiatives.

The Design Advisory Board reviewed this project several times and ultimately recommended approval with a 5-0-0 vote. The DAB recommended the following conditions:

1. Any ground-mounted or roof-mounted mechanical equipment shall be screened from view from the public way,
2. The handicapped accessible path leading to the waterfront bike path shall be constructed earlier than phase 10,
3. At Building C, the visible amount of retaining wall along the south side of the building shall be decreased through the use of earth berming and/or landscaping,
4. At Building C, the screening detail that is utilized at parking structures shall not be also utilized at commercial spaces,
5. At Building H, the entrance to the commercial space at the southwest corner of the building shall be made more prominent and welcoming by the addition of more glazing,
6. At building I, the main residential entrance facing west shall be made more prominent, and the exterior stair at the northwest corner of the building that leads to a secondary entrance shall be made less prominent,
7. At building I, no rooftop mechanical equipment shall be located on the roof of the gymnasium due to the visibility of this roof from neighboring buildings,
8. At building M, the trash enclosure at the southeast corner of the building shall be made less dominant, such as by changing the material or color, and
9. At building Q, the stair tower at the northwest corner of the building shall be treated with similar cladding and screening materials as the main building, to improve the terminus view from North Road.

Revised project plans have been submitted to address, in part, the recommendations of the DAB. Some items remain outstanding as noted in these findings.

The City Council approved the new zoning district (NAC-CR) affecting this project area. Those standards and dimensional requirements apply to this review.

The project plans depict property lines presently under separate subdivision review. Preliminary plat approval was granted October 19, 2016. Final plat approval is required in order to finalize the proposed boundary lines.

Previous zoning actions for this property are noted below.

- Zoning Permit 16-022CA; Remove slate roof and install copper. Approved January 2016.
- Zoning Permit 16-1077MP; Tree maintenance plan. Approved November 2015.

- Zoning Permit 16-007CA/MA; Convert orphanage to 63 residential units. Approved September 2015. Amended February 2016 to increase to 65 residential units and minor exterior alterations.
- Zoning Permit 15-0702LL; Lot line adjustment with 329 North Avenue. Approved December 2014. [Plat recorded 1/16/2015; Plat file 509C.]
- Zoning Permit 14-1286CA; Installation of CCTA bus shelter on Burlington College property. Approved June 2014.
- Zoning Permit 12-0706SN; replace existing non-conforming freestanding sign with new freestanding sign for Burlington College – Main Campus. Approved March, 2012.
- Zoning Permit 12-0121CA; Install rooftop air handler, five ac units, bike racks, and remove walls from garage. Approved August 11, 2011.
- Zoning Permit 11-0282CU; convert existing institutional office use and group home use to post-secondary school. No site or exterior building changes proposed. Approved November 2010.
- Zoning Permit 09-526CA; Demolish single car garage. Approved February 2009.
- Non-applicability of zoning permit requirements; continued use of existing group home. June 1998.
- Zoning Permit 92-096 / COA 092-016; Removal of existing wooden cross with installation of fiberglass statuary of St. Mary on top of Diocese building. Overall height to be 104' with exterior illumination to surround statue. Approved September 1991.
- Notice of selective landscape removal on west. No change in grade of site or drainage of runoff water. December 1991.
- Zoning Permit 79-352; install septic tank and seepage bed. July 1979.
- Zoning Permit 77-03; renovation of existing structure “St. Josephs Child Center” into office space and three apartments for Bishop and two priests. Approved January 1977.
- Zoning Permit 77-628; Convert St. Joseph’s Child Center into office building, three apartments and three guests’ rooms. Remove some windows and brick up openings. Install new windows. Erect 28’6” x 30’ addition and 32’ x 66’ addition. December 1976.

Recommendation: Initial review and continuation of public hearing to address the outstanding items noted in the findings below:

I. Findings

Article 3: Applications and Reviews

Part 5, Conditional Use & Major Impact Review:

Section 3.5.6 (a) Conditional Use Review Standards

Approval shall be granted only if the DRB, after public notice and public hearing, determines that the proposed conditional use and associated development shall not result in an undue adverse effect on each of the following general standards:

1. *Existing or planned public utilities, facilities or services are capable of supporting the proposed use in addition to the existing uses in the area;*

New public streets and related infrastructure are included in this development. Even so, it is expected to have impacts on existing public utilities, facilities, and services. Burlington Electric Department and the Department of Public Works have both been extensively involved in the municipal review of this proposal since Technical Review Committee on June 9, 2016. BED has commented specifically for this zoning permit application that the Department is confident about the overall energy performance of the development. DPW has been even more extensively involved due to the array of new public infrastructure. Final comments as to this application have not yet been received. Municipal services are further addressed under item (b) 7 below. **(No finding possible)**

2. *The character of the area affected as defined by the purpose or purposes of the zoning district(s) within which the project is located, and specifically stated policies and standards of the municipal development plan;*

The subject properties, formerly comprising Burlington College, are located within the newly established Neighborhood Activity Center – Cambrian Rise (NAC-CR) zone. They are bordered on three sides by RCO and/or conserved lands. Across North Avenue, there is a strip of Residential Low Density zone comprised mostly of detached dwellings and a handful of nonresidential uses.

This project is transformative and will establish an entirely new character within the subject properties. As proposed, the intensity and diversity of uses is consistent with the intent of the NAC-CR zone. The zone is intended to create a new center for mixed use development that allows for a range of housing types and tenures and to accommodate a diverse range of complimentary commercial, institutional, and neighborhood-oriented retail and service uses. **(Affirmative finding)**

3. *The proposed use will not have nuisance impacts from noise, odor, dust, heat, and vibrations greater than typically generated by other permitted uses in the same zoning district;*

A variety of uses is included in the proposed development. They include:

- Residential (attached multi-family dwellings)
- Commercial bakery
- Restaurant
- General office
- College (post-secondary school)
- General retail (small < 4,000 sf)
- Health club
- Large daycare
- Hotel

The proposed residential uses will not have nuisance impacts from noise, odor, dust, heat, and vibrations greater than that generated by other residential neighborhoods in the area. None of the non-residential uses are expected to generate exceptional nuisance impacts either. The impacts considered under this criterion are most typically associated with industrial uses – none are included in this project. **(Affirmative finding)**

4. *The transportation system is capable of supporting the proposed use in addition to the existing uses in the area. Evaluation factors include street designations and capacity; level of service and other performance measures; access to arterial roadways; connectivity; transit availability; parking and access; impacts on pedestrian, bicycle and transit circulation; safety for all modes; and adequate transportation demand management strategies;*

A comprehensive traffic analysis has been provided and addresses all of the typical key considerations such as traffic generation, intersection LOS, queues, sight lines, and safety. The Department of Public Works is reviewing the traffic analysis and has not yet provided comment. That department's comments are needed before anticipated traffic impacts on the city's transportation network can be fully understood.

The traffic study is predicated on 667 new residential units (this unit count reflects the net increase from the previously evaluated and permitted 65-unit conversion of the orphanage building, but is still 3 units shy of the actual net increase of 670 units [670+65 = 735]). Similarly, the sizes of the non-residential uses included in the traffic study do not mirror the sizes noted in the parking calculation table. The applicants should be prepared to address this discrepancy and to what degree it is significant (or not).

Not surprisingly, this project is expected to generate significant traffic. A daily total of 4,500 vehicle trip ends is projected. AM peak hour is expected to generate 369 vehicle trip ends, and PM peak hour is expected to generate 414 vehicle trip ends. These traffic generation estimates assume 10% vehicular trip reduction due to transportation demand management measures. While a reduction may reasonably be expected, there is no apparent explanation of exactly why the reduction is expected to be 10%. Specific basis for this assumption is needed.

Extensive intersection analysis is included in the traffic study. Most intersection LOS remains unchanged by the project, although some worsen or even improve. The LOS figures assume recommended transportation improvements are in place (noted in Sec. 5.2, Congestion Analysis Assumptions). This assumption is significant and is contingent on Department of Public Works approval of public street alterations. Queue length analysis is also included and presumably carries the same assumptions. In most cases, queue lengths increased modestly by 2-3 vehicles.

The safety analysis within the study identified no high crash locations within immediate vicinity of the development.

Sight distance analysis found that sight distances along North Avenue relative to the project's new roads are more than double the standard (600 feet available vs. 280 feet standard).

Traffic impact fees will be due to help fund capital improvements to the city's transportation infrastructure. **(No finding yet possible)**

and,

5. *The utilization of renewable energy resources;*

Utilization of renewable energy resources is included in this project. As proposed, the development will incorporate solar panels and geothermal heating. Building design and orientation is intended to maximize solar access. **(Affirmative finding)**

and,

6. *Any standards or factors set forth in existing City bylaws and city and state ordinances;*

This project was reviewed by the Technical Review Committee on June 9, 2016. Insofar as comments from that review pertained to zoning standards, they are noted in these findings. Discussions with affected city departments are ongoing. Separate Act 250 review will likely be required.

(b) Major Impact Review Standards

1. *Not result in undue water, air, or noise pollution;*

A comprehensive stormwater management plan has been developed for this project. Minimal water quality impacts on Lake Champlain are anticipated as a result. Details are addressed under Sec. 5.5.3.

Air and noise pollution are expected to be minimal. As noted above, no industrial uses typically associated with air or noise pollution are included in the project plans. **(Affirmative finding)**

2. *Have sufficient water available for its needs;*

See Sec. 3.5.6 (a) 1.

3. *Not unreasonably burden the city's present or future water supply or distribution system;*

See Sec. 3.5.6 (a) 1.

4. *Not cause unreasonable soil erosion or reduction in the capacity of the land to hold water so that a dangerous or unhealthy condition may result;*

See Sec. 5.5.3.

5. *Not cause unreasonable congestion or unsafe conditions on highways, streets, waterways, railways, bikeways, pedestrian pathways or other means of transportation, existing or proposed;*

See Sec. 3.5.6 (a) 4.

6. *Not cause an unreasonable burden on the city's ability to provide educational services;*

Single detached residential units are commonly the most significant per-unit dwelling type for families with school age children in Vermont. This project contains no such units; it contains exclusively attached multi-family dwellings of various sizes. With 735 residential units; however, this project can be reasonably expected to contain at least some families with school-age children. The application postulates an estimate of 54 school-age children. This figure is based on estimates for the studio, 1-, 2-, and 3-bedroom units. There is no indication of what the anticipated per-unit ratios are based on. That information needs to be specifically noted. No final comments from the School Department have yet been received. Discussions with that department have been ongoing. If this project receives final approval, impact fees would be paid to help offset impacts on the school system. **(No finding yet possible)**

7. *Not place an unreasonable burden on the city's ability to provide municipal services;*

The Fire Department provided technical comments relative to fire safety at Technical Review. These technical requirements will be administered through the offices of the Fire Marshal and the Building Inspector. The Fire Marshal has issued an ability to serve letter regarding the project.

No Police Department comment has yet been received but is anticipated.

See Sec. 3.5.6 (a) 1 for Electric and Public Works Departments.

See Sec. 3.5.6 (b) 12 for Parks and Recreation Department.

See Sec. 3.5.6 (b) 6 for School Department.

Impact fees will be paid to help fund necessary capital improvements necessitated by this development. **(No finding yet possible)**

8. Not have an undue adverse effect on rare, irreplaceable or significant natural areas, historic or archaeological sites, nor on the scenic or natural beauty of the area or any part of the city;
See Article 6 for effects on significant natural areas, historic buildings, and archaeological significance.

9. Not have an undue adverse effect on the city's present or future growth patterns nor on the city's fiscal ability to accommodate such growth, nor on the city's investment in public services and facilities;

The project is proposed in an area long targeted in the city's Municipal Development Plan for intensified development. The newly established NAC-CR articulates purpose and standards for this growth center. Insofar as the proposed development is consistent with the intent of the NAC-CR zone, it is consistent with the city's anticipated growth patterns. As noted in these findings, improvements to public infrastructure, at the cost of the applicants, are required to adequately support the development. **(Affirmative finding)**

10. Be in substantial conformance with the city's municipal development plan;

The application demonstrates substantial conformance with the Municipal Development Plan.

The property is located within an area identified as a center for growth and development (Future Land Use Map – Centers for Growth and Development & Land Use Policies, pg. I-2).

The introduction of a variety of attached multi-family housing unit types and bedroom counts is consistent with the city policy to support the development of additional housing opportunities within identified activity centers (Land Use Plan, pg. I-2 & Housing Plan, pg. IX-1).

The project will handle essentially all of its stormwater onsite utilizing the available green spaces and sandy soils for infiltration (Natural Environment Action Plan, pg. II-12).

The development will provide inclusionary housing units (City Policies, pg. IX-1) as required by the Comprehensive Development Ordinance.

The project incorporates alternative energies (solar and geothermal), thereby reducing utilization of fossil fuels (City Policies, pg. VIII-1).

The project will provide ready access to GMT bus service. Carshare Vermont service is anticipated. The project includes far more than the minimum requirement for bike storage and maintenance facilities and provides easy access to the waterfront bike path (Stressing Other Modes of Travel, pg. V-12). **(Affirmative finding)**

11. Not have an undue adverse impact on the present or projected housing needs of the city in terms of amount, type, affordability and location;

As noted above, the proposed development is located in an area targeted for higher intensity development. The proposed housing units are all multi-family in nature. There is; however, a variety of bedroom counts and price points (including inclusionary, “work force,” and market rate units). There is also a mix of owner-occupied and rental units. Senior housing units will also be provided. The development addresses city policy to provide a variety of housing types.

(Affirmative finding)

12. Not have an undue adverse impact on the present or projected park and recreation needs of the city.

Residents of the new dwelling units will likely utilize the city’s park and recreation facilities. As part of the overall development scheme for these properties, the 12-acre parcel that hugs the development site to the south and west was conveyed to the city for conservation and designation as an “urban wild.” Within the development, a variety of recreational features are included, such as a community pool, fitness center, garden spaces, and paths. Parks impact fees will be paid to help offset any related impact on public park needs. Per the development agreement, a \$300K credit will apply to parks impact fees due. **(Affirmative finding if conditioned)**

(c) Conditions of Approval:

In addition to imposing conditions of approval necessary to satisfy the General Standards specified in (a) or (b) above, the DRB may also impose additional conditions of approval relative to any of the following:

1. Mitigation measures, including but not limited to screening, landscaping, where necessary to reduce noise and glare and to maintain the property in a character in keeping with the surrounding area.

The proposed development is not expected to generate offsite noise or glare substantial enough to require mitigation. **(Affirmative finding)**

2. Time limits for construction.

A “sequencing plan” is included in the application. An initial 10-year timeframe that is automatically renewable thereafter is requested. For a project of this size, a 10-year timeframe is reasonable. Any extension thereto; however, will require approval by the Development Review Board per Sec. 3.2.9, *Zoning Permits*, (d) *Time Limits on Zoning Permits*. There is no provision within the zoning code for automatic extensions.

Phasing plans are also provided that indicate distinct phases within the development. The phasing plan depicted on the civil drawings indicates the anticipated year of construction of each phase, but the application requests flexibility as to when each phase is ultimately constructed. Flexibility within the phasing schedule is largely acceptable so long as each phase can stand on its own and the inclusionary units are provided early or on a schedule concurrent with the market rate units.

Deletion of the anticipated years of construction is strongly recommended so as to avoid confusion if the schedule changes. The phasing plan depicted in the landscaping plans, L-EX4, accomplishes as much; however, significantly, the phases depicted in this plan do not mirror those in the civil plans. Consistency is needed. Better yet, there should be only 1 phasing plan. Whichever plan is used should utilize the labeling of the landscaping plan. Note also the DAB's recommendation that the handicap accessible path leading to the waterfront bike path be constructed before phase 10.

The phasing plans indicate that all of the rental inclusionary housing units will be constructed within the first two years of construction (phases 2 & 3 sheet L-EX4). Doing so is acceptable and consistent with the intent of Sec. 9.1.17, *Review of Proposal for Phasing*. When and where the for-sale inclusionary units will be constructed is unclear and must be articulated.

Curiously, the sequencing plan requests that the development be allowed to be constructed in a single phase but also notes the critical importance of each building receiving an individual certificate of occupancy upon completion. These two items are mutually exclusive. A single phase would require total project completion prior to issuance of a single unified certificate of occupancy. Project phasing allows each phase to receive a unified certificate of occupancy upon completion. The applicant is strongly advised to pursue the latter: A phasing schedule as depicted in the project plans that allows for issuance of unified certificates of occupancy upon completion of each phase.

The sequencing plan also makes note of temporary project features, such as interim parking areas needed to support completed buildings while others are under construction. Given the scope and duration of this project, such temporary facilities are reasonably anticipated. **(No finding yet possible)**

3. Hours of operation and/or construction to reduce the impacts on surrounding properties.

With the exception of post-secondary school, all of the specific uses articulated in the application are permitted within the NAC-CR zone and are not subject to limitations on days or hours of operation. A typical post-secondary school is operative 24/7 year round with intermittent breaks. At least general parameters around the operation of the anticipated post-secondary school are needed.

No days or hours of construction are evident in the sequencing plan or elsewhere in the application. This information is needed. **(No finding yet possible)**

4. That any future enlargement or alteration of the use return for review to the DRB to permit the specifying of new conditions; and,

Any future enlargement or alteration will be reviewed under the zoning regulations in effect at that time.

5. Such additional reasonable performance standards, conditions and safeguards, as it may deem necessary to implement the purposes of this chapter and the zoning regulations.

To be addressed in conditions of approval.

Article 4: Maps & Districts

Sec. 4.4.2, Neighborhood Mixed Use Districts:

(a) Purpose

(4) Neighborhood Activity Center – Cambrian Rise (NAC-CR)

The Neighborhood Activity Center – Cambrian Rise District is intended to create a new center for mixed use development that allows for a range of housing types and tenures, and to accommodate a diverse range of complimentary general office, institutional and neighborhood oriented small-scale retail and service uses. Development should be compact, pedestrian-oriented and enhance the community with creative design, durable materials, and quality construction. Buildings should be oriented towards the streets. Human scale elements should help to define new streets as civic spaces. Parking should be located as to be screened from view from public streets and community spaces.

The diversity of uses included in this proposal reflects the intent of this new zoning district. The compact site design and street layout provide the framework for a new mixed use neighborhood. Sidewalks, shared use paths, hardscaping, and street-level treatments of the proposed buildings establish a pedestrian-friendly environment. With revisions as recommended by the Design Advisory Board, the project design can be found consistent with this criterion. **(Affirmative finding)**

(b) Dimensional Standards & Density

FAR in the NAC-CR zone is limited to 2.0. The subject properties amount to 21.65 acres (943,074 sf). Total above-ground building area could be up to 1,886,148 sf (FAR 2.0 in this case). As proposed, FAR will be 0.98 (921,000 sf above-ground building area).

Maximum permissible lot coverage is 60% in the NAC-CR zone. As proposed, lot coverage will total 64%. This additional coverage is allowable under the provisions of Article 9 for provision of inclusionary housing. Note that this percentage is based on November 28, 2016 calculations. There have been plan revisions since then. Confirmation of current lot coverage is needed.

Within the NAC-CR zone, front yard setbacks of 0' – 20' are permissible, except that along North Avenue front yard setbacks of 20' – 30' are permissible. Within the development, all of the buildings comply with the 0' – 20' front yard setback. Along North Avenue, the southern portion of Building G appears to encroach into the 20' minimum setback – it appears to come as close as 17' to the front property line. Minimum side and rear yard setbacks of 10' and 20', respectively, only apply to the periphery of the NAC-CR zone. The project plans comply with these peripheral side and rear yard setbacks.

Within the NAC-CR zone, buildings must be at least 2 stories and 22' tall up to a maximum of 65'. An additional 10' in height may be afforded for provision of inclusionary housing as noted in Article 9 of these findings. As all of the buildings are set back further than 10' from the public sidewalks, height is measured from the average finished grade around each building. Building heights are noted in elevation drawings and also summarized in sheet L-EX3, Building Heights. All of the buildings are under the 75' (with inclusionary) maximum height. All but two of them are below the standard 65' height limit. Building C reaches 70' and Building I reaches 73.'

(Affirmative finding if conditioned)

(c) Permitted & Conditional Uses

Multifamily residential development is a permitted use in the NAC-CR zone. As noted previously, all of the non-residential uses, except for post-secondary school, included in this application are

permitted in the NAC-CR zone. The post-secondary school is a conditional use. As a note of clarification, the proposed uses are most evident through the parking calculations. A specific bullet list of proposed uses within the application narrative would clarify expressly those uses included in this application. **(Affirmative finding if conditioned)**

(d) District Specific Regulations

(1) Ground Floor Residential Uses Restricted

Not applicable in the NAC-CR zone.

(2) Exception to Maximum Lot Coverage in NAC District

Not applicable.

(3) Development Bonuses/Additional Allowances

See Article 9 for height increase relative to inclusionary zoning requirements.

Article 5: Citywide General Regulations

Sec. 5.2.3, Lot Coverage Requirements

See Article 4 above.

Sec. 5.2.4, Buildable Area Calculation

Not applicable in the NAC-CR zone.

Sec. 5.2.5, Setbacks

See Article 4 above.

Sec. 5.2.6, Building Height Limits

See Article 4 above.

Sec. 5.2.7, Density and Intensity of Development Calculations

See Article 4 above.

Sec. 5.5.1, Nuisance Regulations

Nothing in the proposal appears to constitute a nuisance under this criterion. **(Affirmative finding)**

Sec. 5.5.2, Outdoor Lighting

See Sec. 6.2.2 (o).

Sec. 5.5.3, Stormwater and Erosion Control

A comprehensive stormwater management plan is proposed. While details are many, the system is basically geared towards using the sandy soils onsite to infiltrate stormwater into the ground. Infiltration facilities will be located in a number of places within the development. Green streets, underground infiltration chambers, and swales are some of the design components. 100% of the 1-year storm event will be infiltrated onsite. Post-development runoff rates will match pre-development rates for the 10-year storm event. What overflow there is will discharge into Lake Champlain. No additional runoff will enter the city system. In addition, the stormwater management plan includes provision for capturing and storing stormwater for gardening and possibly some toilet flushing. Given the size of this project and the anticipated duration of its

construction, the stormwater management plan also incorporates interim measures for utilization while construction is ongoing.

An erosion prevention and sediment control plan has been provided. It addresses site management per phase for the duration of construction.

The Conservation Board reviewed these proposed measures at their December 19, 2016 meeting and recommended approval. Final review and approval by the city's stormwater program is required. **(Affirmative finding if conditioned)**

Article 6: Development Review Standards:

Part 1: Land Division Design Standards

Subdivision approval is being sought separately.

Part 2: Site Plan Design Standards

Sec. 6.2.2 Review Standards

(a) Protection of Important Natural Features:

At present, the majority of the project area west of the former orphanage is lawn. Extensive examination has been made of the existing site conditions during preparation of a tree management plan for this and the parkland area (2016) and stormwater planning for this development. The precipitous grade change from North Avenue west to the parkland is the most significant natural feature; one which is incorporated within the development plans submitted. A tree survey is included. A fully developed landscaping plan has been provided as part of the submission packet. **(Affirmative finding)**

(b) Topographical Alterations:

One of the most distinctive features of this site is the grade change; nearly a 70' difference between North Avenue and the westerly edge of the project area. The buildings and parking decks are arranged to take advantage of the steep grade change specific to the site. Documents provided outline, where necessary, topographic adjustment to facilitate the development, including construction of sub-grade parking garages, building foundations, pathways, green areas, and roads. Plans C2.1-C2.5 specifically address grading. Reference is made to specific landscaping plans within the submission documents to identify grade elevations at identified areas of the site. Modeled renderings reveal a complicated fabric where openings provide access to differing floor and parking plates; stairs emerge and a variety of retaining walls resolve grade changes. The DAB has recommended modification of site and landscaping to ameliorate the visual impact of some retaining walls. These changes are reflected in revised plans. **(Affirmative finding)**

(c) Protection of Important Public Views:

Views from and through private property are typically not protected. The new public park, west of this development, will provide an opportunity for the public to enjoy westerly views of the lake and mountains. Residents within these new housing units will be afforded a similar vista.

An east-west greenway will extend behind the orphanage, with buildings C and E, P, Q and R as a structural frame. The visual greenway continues west, across west road (trees allowing) to the walkway and orchard. Buildings with favorable orientation have included rooftop terraces and decks, patios, balconies and *galerias* to exploit opportunities for extraordinary views.

Public views can be created by orchestrated terminus vistas via public roadway; east/west on both South and North roads. South Road offers a greater potential as the westerly end is not interrupted by structure. The Design Advisory Board expressed concern that the westward vista on North Road would be of an external stair tower. They have recommended that the stair tower be revised to be expressed in the same material and similar design as on the building to provide an enhanced terminus view.

Revised design has created a more focused terminus view southward on West Road, where the building has been treated with additional attention to attract and define a focal point of interest. Plans include a notation for an additional “focal element” (Plan L204), which has not been defined. Revised plans for a cemetery access point (L-EXa, L208 and *Cemetery Access Plan*) at the northerly terminus of West Road have been submitted; something that was only suggested at Design Advisory Board. Intended to provide that street-end focal point, it intends to allow access across a boundary line onto an adjoining property. Some assurance of acceptability is needed from that abutting owner before circulation through that property is encouraged by design.

(Affirmative finding if conditioned)

(d) Protection of Important Cultural Resources:

Burlington’s architectural and cultural heritage shall be protected through sensitive and respectful redevelopment, rehabilitation, and infill. Archeological sites likely to yield information important to the city’s or the region’s pre-history or history shall be evaluated, documented, and avoided whenever feasible. Where the proposed development involves sites listed or eligible for listing on a state or national register of historic places, the applicant shall meet the applicable development and design standards pursuant to Sec. 5.4.8(b).

Alterations to the former orphanage have been permitted under earlier review. The former elementary school / priests’ quarters attached to the south of the orphanage has been incorporated into this development, now as building “B”. Building G has been pulled to the southerly corner providing greater space between the new construction and the former orphanage. Building F has been modified from original plans at the request of the DAB to reduce the height along North Avenue to three stories (articulated in brick) immediately adjacent to the orphanage to increase the opportunity to view the historic orphanage earlier while traveling on North Avenue.

The newly created zoning district (NAC-CR) offers a range of setbacks from North Avenue from 20’ (minimum) to 30’ (maximum.) From scaled plans, Building G appears to be set back approximately 17’ from the front property line. This does not meet the required setback. To better afford view of the orphanage, the maximum setback is recommended.

The UVM Consulting Archaeology Program (CAP) conducted an extensive Phase I site identification survey within previously determined sensitive portions of the development parcel. No pre-contact era Native American archaeological sites were identified. Test pits confirm some re-grading (suggested related to farming activities) and plow zone strata disturbance. The historic period artifacts that were recovered reflected the mixed uses of the parcel over time, such as children’s toys likely associated with the orphanage (jacks, marbles), and building materials from structures no longer extant (bricks, cinders, mortar). That study recommended no further archaeological analysis.

The Historic Preservation consultant’s report is dated June, 2016, and addresses only the addition of buildings K and L. It does not incorporate the entire neighborhood buildout.

(Affirmative finding if conditioned for building setback; **No Finding Possible** based on limited assessment by preservation consultant)

(e) Supporting the Use of Renewable Energy Resources:

The project proposes limited solar installation; identified in images on Building I and H. No part of the application will preclude the use of other renewable energy resources. **(Affirmative finding)**



(f) Brownfield Sites:

The Vermont DEC website does not include these addresses. **(Affirmative finding)**

(g) Provide for nature's events:

Special attention shall be accorded to stormwater runoff so that neighboring properties and/or the public stormwater drainage system are not adversely affected. All development and site disturbance shall follow applicable city and state erosion and stormwater management guidelines in accordance with the requirements of Art 5, Sec 5.5.3.

A fully developed Stormwater Management Plan has been prepared and included within the application materials. The material has been forwarded for review to the Stormwater Engineering program.

Design features which address the effects of rain, snow, and ice at building entrances, and to provisions for snow and ice removal or storage from circulation areas shall also be incorporated. Snow storage locations are provided on the same plan as “Bike Amenities” and “Commercial Spaces”. The snow storage area between Building K and L is on the smoking patio; the applicant must assure that the loss of that feature for snow storage will still meet the programmatic requirements of Champlain Housing Trust. That location also presents the likelihood of heavy snow melt to impact the abutting Redstone Cottage, which sits below grade.

Building features that address the effects of inclement weather and the adequacy of resident shelter at entrances can be reviewed on a building-by-building nature. **(Affirmative finding if conditioned)**

(h) Building Location and Orientation:

The overall plan continues to be one of very large buildings encircled with new streets or parking areas. The importance of building orientation toward the street (which will be eventually turned over to the city) becomes essential in reinforcing the streetline. Building G has been relocated south; fronting on both North Avenue and South Road; creating a distinct street anchor on both South Road and the Avenue, replacing a void that had previously been proposed.

Buildings remain substantially set back from the public sidewalk and inner streets. Streets are spatially designed by a wall of buildings that front the sidewalk in an ordered manner. The plan leans toward the maximum front yard setback (0-20' for inner streets, as prescribed by the standards for the new zoning district). (Building P 15' front yard setback; Building I 20'.)

Building Q appears detached from a new building R. Q is setback approximately 66' from West Road, in conflict with the required setbacks on interior streets. If substantially attached to Building B, that concern is moot. R scales at 7' setback. Arrangement that holds the street wall is essential in strengthening the arrangement.

Setbacks from North Avenue are 20' minimum, 30' maximum. Plan L 001 and C2.3 suggest Building G at the southeasterly edge does not meet the minimum setback from North Avenue of 20'. This will need confirmation or correction.

The proposed buildings on either side of the orphanage are in the neighborhood of 25'; Building K south of South Road ranges from 20'-45' as angled.

Front yard setbacks *within* the development may be between 0-20', with structures setback a minimum of 12' from the curb on a public street. Although the streets have not yet been turned over to the city, the arrangement is required be designed to meet that standard.

Side and rear yard setbacks only apply to the periphery of the district and not individual parcels. Building N has been modified to pull a corner out of a required 20' rear yard setback along the westerly boundary of the district, although that new building footprint is different across revised plans. (Identifiable on plan C2.0. Older plans do not show revision.) Required 15' setbacks from the residential zoning district to the south are required; revised plans now show a patio and walkway from the parking lot across property lines. The patio may encroach up to 5' from the property line.

Parking has also been pulled out of the setback on the westerly boundary line. See T.J. Boyle plan dated 1/2/2017.

Principal buildings shall have their main entrance facing and clearly identifiable from the public street. The development of corner lots shall be subject to review by the city engineer regarding the adequacy of sight distances along the approaches to the intersection. To the extent practicable, development of corner lots in non-residential areas should try to place the building mass near the intersection and parallel to the street to help anchor the corner and take advantage of the high visibility location.

Revisions and relocation of Building G have in turn strengthened the corner and eliminated the "void" in the streetscape. There remains the large gap between Building G and C populated largely by surface parking, directly fronting South Road. The illustrated lawn area in the Lincoln Brownell illustrations ameliorates the breadth of pavement.

Analysis of building entrances is complex, given the number of buildings and their orientation toward streets, sidewalks, parking areas, inner walkways, and recreation paths.

Building “C” has a principle (southerly) entrance fronting South Road. The concrete retaining wall and the isolation of the entrance make this a particularly unfriendly portal. As a residential entrance, greater emphasis toward creating an inviting entry should be exercised here (and with other residential buildings). The Design Advisory Board has recommended that the visible amount of the exposed concrete retaining wall be reduced with berming or landscaping. Plan L502 defines increased landscaping and illustrates the inclusion of 2 park benches in this location.

The DAB also recommended that the screening illustrated at the commercial entry to Building C be eliminated, as the entry should be warmer and welcoming.

Building “G” has easily identifiable entrances along North Avenue; one is labeled “Residential” the other “Commercial” on elevations BG-2. The east elevation provides a partial canopy/porch roof over window glazing, adjacent to the southerly entrance. The southeast corner has a wraparound overhang inviting visitor entrance. Confirmation is needed that Building G meets the required 20’ minimum setback from the Avenue.

There is a clearly articulated entry portal between Buildings E and F. Building E along North Road is primarily dedicated to vehicular entry/parking deck openings. Some correction has been made to imagery where vehicular entry points had seemed unusually steep in grade.

Building F has an entry focus within the brick three story portion on North Avenue, under a porch roof with heavy piers. Other entries are more difficult to identify as they are recessed within the arcade area. There are a series of identifiable entrances along North Road, their location identified by stairs of increasing height.

Building I has a vehicular entry portal on the north and pedestrian doors on the raised porch area. Pedestrian entries exist on the west and south as well. Adjustments have been made to the elevated entries over the sidewalk, making them more identifiable and accessible (via at grade or stair access.) The west entry is more successful for identification under an abbreviated canopy and welcome presentation to West Road. The gym/event space has no identified specific entrance; it is assumed via the general West Road portal which leads also to the apartment building and garage. The DAB recommended the main entrance to residential units on Building I facing west be made more prominent; and the stairs at the northwest corner made less prominent. Those changes are reflected in revised plans.

Building Q has now evolved into 2 buildings; Q and R. (Plans are inconsistent; some show the buildings as connected; The TJ Boyle plan dated 1/2/2017 has them detached.) The applicant has suggested that R is intended to be a 48 room boutique hotel. R has a visible pedestrian entry on the east (fronting West Road), within a narrow 2 bay pavilion with recessed porch entry, resembling a walk-up. Building Q has no easily identifiable entrance from West Road, although a patio and covered porch is present. The plan relies on principal entry from the inner courtyard/parking drop-off. There needs to remain a strong visible entrance from West Road.

If Building R and Building Q are not substantially connected, Q does not meet the required setback from an interior road of 1-20'. The building is located approximately 66' from West Road, in conflict with setback standards.

Buildings O and P have a centrally identifiable pedestrian entrance (Plan OP-2 & OP-3), two wing entrances and apparent first floor entries from West Road.

Building H has clearly identifiable entrances from raised stoops along West Road, and one along South Road under an extended canopy.

The north elevation of Building M fronts South Road, which has several double entries. Building N does not front any street, but has been described as connected to Building M. If not a detached structure, entrance may be considered with its host, M.

Building K fronts North Avenue and South Road; entrances are visible under extended canopies and highlighted by a change in building material. The applicant has assured the DAB that the central, identified entry along the Avenue connects to a public entry space, not a meeting room. Building L (L-2) has visible entries along South Road under a canopy; and on secondary east and west elevations.

Opportunities to create terminus views have evolved through Design Review. The plan has lacked an identified structural focus at the west end of North Road. The DAB pointed out that the exterior stairs had become the terminus, and recommended they be treated in the same manner as the rest of Building Q. A condition of their approval was to use similar design and materials as the host building.

The north end of West Road now articulates an entrance to the abutting lot (Lakeview Cemetery). Access to that separate parcel will require agreement between City representatives and the Parks and Recreation Department, which is responsible for the grounds. A plan that encourages access and circulation across boundary lines to another parcel will require agreement from that property owner.

The DAB previously acknowledged revisions that created a positive viewscape at the south end of West Road.

The garage entrances and service access on North Road have been set back from the principal structure, becoming secondary and subordinate in scale and design. See Plan I-3 and EF-3. **(Adverse finding** for setbacks if Building Q is detached from R; **No finding possible** for cemetery access plan)

(i) Vehicular Access:

Curb cuts shall be arranged and limited in number to reduce congestion and improve traffic safety. A secondary access point from side roads is encouraged where possible to improve traffic flow and safety along major streets. The width and radius of curb cuts should be kept to the minimum width necessary, and sight triangles and sufficient turnarounds for vehicles shall be provided to reduce the potential for accidents at point of egress.

The number of curb cuts has been diminished along interior roads, although entrances to parking lots punctuate South Road. West and North Road have minimized curb cuts dramatically from

earlier plans. The width of these openings will need to meet the approval of the city engineer as these streets are expected to be adopted as public thoroughfares.

Driveways that have a slope of 5% or greater (towards the right of way) shall be made of a solid surface including conventional pavement, pavers or pervious pavement.

Pavement is proposed for vehicular circulation areas. Modeling images of the driveway access at Building E were markedly steep. The applicant shall confirm or correct the accuracy of that image.

DPW typically expects continuous sidewalks at vehicular entrances. The applicant shall consult with the Traffic Engineering staff to assure the plan meets their criteria, as the dedication of streets and street adoption by the city is anticipated.

Driveways for commercial properties may require a traffic study to identify the impacts of the movement of traffic to and from the property, and design for safe access. Access for service and loading areas should be located behind buildings or otherwise screened from streets or public ways with landscaping or other barriers. Whether commercial or residential shared driveways are encouraged where possible and appropriate.

A traffic study has been submitted to DPW; its effectiveness and acceptability to be determined by their transportation engineers.

The service/loading access is from North Road, between buildings E and I. The garage openings now have doors screening the large openings from the public street.

(Affirmative finding if conditioned)

(j) Pedestrian Access:

Pedestrians shall be provided one or more direct and unobstructed paths between a public sidewalk and the primary building entrance. Well defined pedestrian routes shall be provided through parking areas to primary building access points and be designed to provide a physical separation between vehicles and pedestrians in a manner that minimizes conflicts and improves safety. Where sidewalks and driveways meet, the sidewalk shall be clearly marked by differentiated ground materials and/or pavement markings.

Sidewalks line each street, connecting to walkways to each building. The network continues on the interior of the site, with connected access between buildings, parking areas, and green spaces. Sidewalks line parking areas as well, providing a separation between vehicles and pedestrians. See previous note about continuous sidewalks at vehicular entries. **(Affirmative finding if conditioned)**

(k) Accessibility for the Handicapped:

Special attention shall be given to the location and integration of accessible routes, parking spaces, and ramps for the disabled. Special attention shall also be given to identifying accessible access points between buildings and parking areas, public streets and sidewalks. The federal Americans with Disabilities Act Accessibility Guidelines (ADAAG) shall be used as a guide in determining the adequacy of the proposed development in addressing the needs of the disabled. From pre-development meetings to the present, the applicant has remained committed to providing an all-accessible community. Buildings have been projected to be served by (sometimes multiple) elevators; grades are intended to meet accessibility requirements, and h/c parking spaces are

illustrated on plans. Full compliance with ADA requirements will be under the jurisdiction of the building inspector.

Some of the handicapped parking spaces identified on surface lots (L503) do not include a loading area but are adjacent to walkways. Conformance with standards for ADAAG parking/loading will be confirmed and implemented by the building inspector. **(Affirmative finding if conditioned)**

(l) Parking and Circulation:

*To the extent possible, parking should be placed at the side or rear of the lot and screened from view from surrounding properties and adjacent public rights of ways. **Any off-street parking occupying street level frontage in a Downtown Mixed Use District shall be setback from the edge of the front property line in order to provide space for active pedestrian-oriented uses.** Where street-level parking is provided within an existing structure, the cars shall be screened from the sidewalk and the area shall be activated with landscaping, public art, or other design amenities. Parking areas of more than 20 spaces should be broken into smaller areas separated by landscaping.*

South Road continues to have great visibility of pavement and parking. Generally, parking areas are located interior to the site and between buildings, less visible from streets. The parking areas east of Building C and on D are greater than 20 spaces (which require breaking into smaller areas with landscaping), although protection of the viewshed to the west is a goal of the plan and multi-level parking precludes the planting of trees. Landscaping plans confirm the intent to plant around the lot as feasible. (See Plans L-501 and 502.)

Attempts to link adjacent parking lots or provide shared parking areas which can serve neighboring properties simultaneously shall be strongly encouraged.

Access to parking and lots is shared across the plan. Ordinance amendment ZA17-01 will facilitate parking across parcel boundaries within the same zoning district.

Parking shall be laid out to provide ease in maneuvering of vehicles and so that vehicles do not have to back out onto city streets. Dimensions of spaces shall at a minimum meet the requirements as provided in Article 8. The perimeter of all parking areas shall be designed with anchored curb stops, landscaping, or other such physical barriers to prevent vehicles from encroaching into adjacent green spaces.

Parking spaces in Building D are 20' x 9', as are parking spaces east of Building H and east and west of Building L. Parking dimensions are not expressly given, meet the requirements of Table 8.1.11-1 as scaled on the project plans. If applicable, the applicant should identify any areas where leniency in parking standards is requested. Backup space is deficient in many of the parking garage plans.

*Surface parking and maneuvering areas should be shaded in an effort to reduce their effect on the local microclimate, air quality, and stormwater runoff with an objective of shading at least 30% of the parking lot. Shading should be distributed throughout the parking area to the greatest extent practical, including within the interior depending on the configuration. New or substantially improved parking areas with 15 or more parking spaces shall include a minimum of **1 shade tree per 5 parking spaces** with a minimum caliper size of 2.5"-3" at planting. Up to a 30% waiver of the tree planting requirement may be granted by the development review board if it is found that the standard requirement would prove impractical given physical site constraints and required compliance with minimum parking requirements. All new shade trees shall be: of a species*

appropriate for such planting environments, expected to provide a mature canopy of no less than 25-feet in diameter, and selected from an approved list maintained by the city arborist. Existing trees retained within 25-feet of the perimeter of the parking area (including public street trees), and with a minimum caliper size greater than 3-inches, may be counted towards the new tree planting requirement.

The requirement for 1 shade tree for every 5 parking spaces is met across the development. The parking lot west of P has 18 spaces, requiring 4 new trees (L505.) One proposed tree (an Ivory Silk Tree Lilac) meets the required minimum caliper but as located is not likely to provide any shade for that parking area. Another tree west of the lot would do so.

The submission materials include a shading calculation (L-EX1) which now provides a shading calculation on a parking lot by parking lot analysis. The most challenging is “D”, which is a multi story parking facility where planting trees is not possible. When calculating the entire parking deck that is shaded by the northerly section of Building C, the total parking lot shading is greater than the 30% prescriptive standard. The standard specifically states: *Surface parking and maneuvering areas should be shaded in an effort to reduce their effect on the local microclimate, air quality, and stormwater runoff with an objective of shading at least 30% of the parking lot.* With this consideration, and anticipating some natural shading from adjacent buildings the required objective will be met.

All parking areas shall provide a physical separation between moving and parked vehicles and pedestrians in a manner that minimizes conflicts and gives pedestrians a safe and unobstructed route to building entrance(s) or a public sidewalk.

See Section 6.2.2. (j), above.

Where bicycle parking is provided, access shall be provided along vehicular driveways or separate paths, with clearly marked signs indicating the location of parking areas. Where bicycle parking is located proximate to a building entrance, all shared walkways shall be of sufficient width to separate bicycles and pedestrians, and be clearly marked to avoid conflicts. All bicycle parking areas shall link directly to a pedestrian route to a building entrance. All bicycle parking shall be in conformance with applicable design & construction details as provided by the dept. of public works.

Bicycle parking is a strong feature of this application. Reference is made to all Hardscape plans (L201-206) for specific locations and L605 for bike racks specs. The applicant must demonstrate by calculation compliance with Table 8.2.5-1 for each building. All bicycle parking shall meet the requirements and guidance of Section 8.2.7. *Location and Design Standards.*

(Affirmative finding as conditioned for backup space in parking garages. See Article 8.)

(m) Landscaping and Fences:

A fully articulated landscaping plan has been submitted. See plans LL501-508 for planting schedule, and associated plans for hardscape, play equipment, street furniture and site amenities. The city arborist has confirmed a meeting date with the applicant team to select species and caliper of street trees. **(Affirmative finding if conditioned)**

(n) Public Plazas and Open Space:

Where public open space is provided as an amenity to the site plan, it should be sited on the parcel to maximize solar exposure, with landscaping and hardscape (including fountains, sitting walls, public art, and street furniture) to encourage its use by the public in all seasons. Public plazas

should be visually and physically accessible from public rights-of-ways and building entrances where appropriate and shall be designed to maximize accessibility for all individuals, including the disabled and encourage social interaction.

A plaza type area has been more finely defined between Buildings K and L, intended for use by Cathedral Square and Champlain Housing Trust residents. Planters, seating, garden areas and a play area are illustrated; all welcome amenities for resident use and enjoyment.

A large uninterrupted viewscape to the west is provided behind the former orphanage. Accessible at differing levels as the grade falls to the west, several public gathering or green areas are included. Plans include a swimming pool, bath house facilities, public gardens, an orchard, and pathways between Liberty House (the orphanage) and the bike path.

Public space should be coordinated with the surrounding buildings without compromising safety and visibility. Public spaces should be surrounded by active uses that generate pedestrian traffic, and connect the space to major activity centers, streets, or corridors.

Public spaces are directly linked via the sidewalk network to other areas within the site and beyond. Appropriate lighting will assure safe circulation throughout and between buildings. Commercial uses are broadly scattered, providing a mix that will promise active uses generating pedestrian traffic.

New structures and additions to existing structures shall be shaped to reduce shadows on public plazas and other publicly accessible spaces. In determining the impact of shadows, the following factors shall be taken into account: the mass of area shaded, the duration of shading, and the importance of sunlight to the utility of the type of open space being shadowed. Proposed development shall be considered for solar impact based the sun angle during the Vernal and Autumnal equinox.

Although the development is the creation of an entire new neighborhood, a shading study will be valuable to the DRB to understand impacts of large buildings across the project area. The shading plan submitted is relative to a calculation of shading provided to meet requirements for parking lot shading. An overall study of site shading (Vernal and Autumnal equinox) is recommended. It is anticipated that the distances between buildings will preclude significant shading impact on adjacent structures. **(Affirmative finding)**

(o) Outdoor Lighting:

Where exterior lighting is proposed the applicant shall meet the lighting performance standards as per Sec 5.5.2.

A lighting plan, with fixtures, illumination levels and a photometric has been submitted. In general, street lighting (which is typically not reviewed by this office, however the project will be “private” until the streets are accepted by the city) is a hybrid of what has been installed at Waterfront North. BED engineers have indicated that districts need to be adopted for decorative fixtures (as are proposed here) before they will agree to adopt the streets and lights. That designation has not as yet occurred.

Streetlight poles are proposed to be 28.5’ mounting height’ (they are 30’ on the waterfront); poles and fixtures will be black rather than Burlington’s preferred grey. Parking lot poles are proposed to be 20’, and “pedestrian lights” at 12.5 mounting height. See details, L-607.

Lighting itself is LED. Assurance has been provided that BED will have the capability to repair and replace these fixtures within the right-of-way when and if they are damaged. As LED, they are anticipated to have a life expectancy of 20 years. If they fail (or are knocked over), BED officials say they will be replaced with grey as that is the city standard.

Lighting levels will be driven by street classification (collector roads versus residential roads.) That discussion must find an agreement with the public utility prior to DRB approval. The photometric shows some ‘hot spots’ in illumination. Areas under building canopies tend to be a little higher, but footcandle measurement up to 5 is acceptable at a building entrance. If not an entrance, light levels should diminish in those areas. Walkways have a specific maximum illumination of 2 fc. Average illumination on walkways must not exceed 0.5 footcandles. Many of the sidewalk readings exceed .5, so an average reading is essential to assurance compliance.

A few patio areas have had elevated lighting on earlier plan; the one west of Building A is now compliant, but one south of Building F no longer includes footcandle measurement. A patio south of E has readings > 2fc; this is acceptable only if this is at a building entrance. See Plan L401. A walkway west of Building L has light readings >2 fc; a fixture must be modified. The walkway east of Building C has several light readings > 2 fc as does the west walkway behind Building K. The area between buildings M and N have higher light levels as well. Per the ordinance, walkways shall not exceed 2 fc; parking lots 4 fc, and building entrances 5 fc. Photometrics do not include average illumination levels (other than for the intended roadway), or min/max uniformity ratios, which are required by Section 5.5.2. Reference to Plan L600 for further information is misdirected, as that provides information on pavers. Staff may exercise the option for secondary review by a lighting consultant to assure overall conformance. **(Affirmative finding if conditioned)**

(p) Integrate infrastructure into the design:

Exterior storage areas, machinery and equipment installations, service and loading areas, utility meters and structures, mailboxes, and similar accessory structures shall utilize setbacks, plantings, enclosures and other mitigation or screening methods to minimize their auditory and visual impact on the public street and neighboring properties to the extent practicable.

Utility and service enclosures and screening shall be coordinated with the design of the principal building, and should be grouped in a service court away from public view. On-site utilities shall be placed underground whenever practicable. Trash and recycling bins and dumpsters shall be located, within preferably, or behind buildings, enclosed on all four (4) sides to prevent blowing trash, and screened from public view.

Any development involving the installation of machinery or equipment which emits heat, vapor, fumes, vibration, or noise shall minimize, insofar as practicable, any adverse impact on neighboring properties and the environment pursuant to the requirements of Article 5, Part 4 Performance Standards.

It is challenging to find appropriate locations for service areas, dumpsters, recycling and similar facilities within a project area that has so many public and visible frontages. Collective trash and recycling areas for connected buildings are recommended for efficiency and to minimize visibility. A trash access is identified for building K (Plan AO-0.0) A trash enclosure for Building M was recommended for revision by the DAB to become less prominent with a change in color or materials. Revised plans M3 reflect those suggested changes.

Transformers are recommended to be buried.

The North Road loading area has been somewhat diminished with suggested internalization of activities. Service loading bays are now illustrated with doors.

Mailbox locations will need to be identified for each building. Any HVAC or external machinery must be identified on site plans and/or elevations as appropriate. If roof mounted, roof plans will be required with an assessment of total area utilized to assure compliance with height limitations. The DAB recommended that no rooftop equipment be installed on the gymnasium building “I”, rear, due to its visibility from many of the structures. **(Affirmative finding if conditioned)**

Part 3: Architectural Design Standards

Sec. 6.3.2 Review Standards

(a) Relate development to its environment:

1. Massing, Height and Scale:

This is a neighborhood without an easy comparison. From revised summary, there are seven five-story buildings (including the orphanage, and the new Building R), 7 four-story, 2 three story, a three story parking garage, and two one story/ ground level structures for a fitness center and greenhouse. Rather than a typical neighborhood that may have evolved over a period of time, this proposal will create an entire new one out of whole cloth. There is no analogous prototype, short of college dormitories or congregated mill buildings. The structures themselves are all large scale; most with flat roofs. The size of the orphanage, itself one of the largest buildings in Burlington, will be insignificant among this collection of sizable buildings. This is a newly created neighborhood based on a building model of supersized structures; which in itself invents its own context.

Common design elements include breaking up building mass by color block and window arrangement; top floors are on occasion “pedestaled” and set back from the lower block. Some buildings enjoy balconies or *galleries*, particularly those facing the west. There is homogeneity in the treatment of building mass by articulation, despite the rearrangement of windows and manipulation of building plane. This is not a typical neighborhood that conveys evolutionary development over an extended period of time; it is a new model composed entirely of large buildings based on the context of the existing orphanage. In that manner, the milieu is that of large scale. **(Affirmative finding)**

2. Roofs and Rooflines.

Building I, the pavilion tops and the south portion of H have pitched roofs. All others are flat. A few roofs appear to be parapetted, but there is rarely any rooftop elaboration or detailing, further emphasizing the cubist vocabulary (Building F, B, G.) Building M has the suggestion of a corbelled cornice which artfully softens the building’s upper edge. Building H has a sawtooth reference in the jagged rooftop pavilions, but abruptly transitions to flat roofs at the south end. Porch roofs are typically flat projections with hefty piers.

The orphanage building retains its gabled roof, although now oversheathed in copper. Within the context of the neighborhood there is consistency. **(Affirmative finding)**

3. Building Openings

Openings vary by building, elevation, frontage to a public way or by topography. Overall, buildings have similar treatments of organizing windows in columns or reflective of floor plate.

Rhythms are established within wall plane; the geometries of the building mass are echoed in the manipulation of window shapes and sizes. Greater complexity is evident in the buildings fronting the lake (M, N, O, P and Q.) At the DAB's urging (in part because of visibility from the Avenue), more detail and articulation has been afforded buildings K and L. See plans K3 and revised drawings for Building L (L2, L2-1.)

Some window arrangements appear to be without schedule (like south elevation or green pavilions of L); other times a pattern emerges bringing familiarity to the overall design. See building M. As the window refrain is repeated across the façade and around the corner, a rhythmic pattern emerges. Other times the buildings themselves change so dramatically within their own footprint that irregularity emerges, which may be an intentional design distinction between building components. See building H, as it presents on South Road.

The Design Advisory Board recommended that there be no screening at the commercial corner of Building C. (See CD-2 and CD -3, view from southwest.) Similarly, they advised that the commercial space at Building H be improved with more glazing, which would make the space prominent and welcoming. Those revisions are evident on plan H-3. **(Affirmative finding)**

(b) Protection of Important Architectural Resources:

Burlington's architectural and cultural heritage shall be protected through sensitive and respectful redevelopment, rehabilitation, and infill. Where the proposed development involves buildings listed or eligible for listing on a state or national register of historic places, the applicant shall meet the applicable development and design standards pursuant to Sec. 5.4.8. The introduction of new buildings to a historic district listed on a state or national register of historic places shall make every effort to be compatible with nearby historic buildings.

Building G has been distanced from Building B and the former orphanage (A). Pulling that building to the south has created greater visibility of the historic structure when traveling along North Avenue.

Overall, the scale of proposed buildings and their collection reduces the stateliness of the iconic orphanage, which loses its spatial context and becomes less grand among the assemblage.

Similarly, the large buildings placed close to North Avenue minimize the view of both the



orphanage and the former home of Dr. Waldo Upton / Lakeview Sanitarium / John Bosco school, at 311 North Avenue just south of the development area which is also listed on the Vermont State Register of Historic Resources. That building is of a substantially smaller scale than the abutting development. Efforts to transition from the 4 story building K to this more modest structure have been suggested by the DAB to help ease the difference. Revised plans illustrate a line of mature plantings between parcels.

The submitted consultant's report considers the construction of only Buildings K and L. From that document:

These will be prominent buildings at a new corner location set between two distinctive masonry buildings. The site plan, landscaping and design elements all help tie the new buildings to the historic streetscape. The buildings will stand very close to the historic Redstone Cottage but effort will be made to visually tie the cottage into the overall design plan so that it becomes a focal point that contributes to the appreciation of its historic character and architectural elements.

It is not defined what design elements visually tie the cottage into the overall design plan. But the report finds the potential for no adverse effect when conditioned. Staff recommends a revised consultant's report that considers the impact of the entire build-out. **(No finding possible)**

(c) Protection of Important Public Views:

See Section 6.2.2. (c).

(d) Provide an active and inviting street edge:

As noted in Section 6.2.2, there remains a void in the streetscape (South Road, behind Building G), elongated buildings that can strain comfortable pedestrian distances (Buildings F, E, I and G, B, A), and an abundance of visible surface parking that collectively diminish the comfort and attractiveness of the development. Building facades demonstrate variation by building materials, window openings and plane changes. The 340' continuous building wall of Buildings E and F is broken by plane and material changes, the interruption of exterior staircases and building entries. The Design Advisory Board has recommended that the main residential entrance to Building I (facing west) shall be made more prominent. Stairs at the northwest corner should be made less prominent. Plan I-2 reflects those recommendations.

Building design with two, three or four story block finishes over a five story building front are a strategy to differentiate blocks and to create human scale surroundings. Roof overhangs, identifiable and inviting building portals and colonnaded entrance porches help in that manner along ground levels. The newly designed public area between buildings K and L have humanized and warmed that area for collective use. **(Affirmative finding)**

(e) Quality of materials:

All development shall maximize the use of highly durable building materials that extend the life cycle of the building, and reduce maintenance, waste, and environmental impacts. Such materials are particularly important in certain highly trafficked locations such as along major streets, sidewalks, loading areas, and driveways. Efforts to incorporate the use of recycled content materials and building materials and products that are extracted and/or manufactured within the region are highly encouraged.

Owners of historic structures are encouraged to consult with an architectural historian in order to determine the most appropriate repair, restoration or replacement of historic building materials as outlined by the requirements of Art 5, Sec. 5.4.8.

The permit set includes identified sheathing and roofing materials for each building. In general, exterior sheathing draws from a palette of fiber cement panel or lap siding, corrugated metal, board and batten and wood siding. Walls are concrete, brick, stone veneer or gabion. Roofs are typically metal. Trim is composite or aluminum; windows fiberglass or storefront framing. The ribbon-style screening along first floors has not been identified. With that exception, all are considered of reasonable durability. It is not believed that any are extracted or manufactured locally. The screening material at some building openings has not been defined and needs to be.

(Affirmative finding if conditioned)

(f) Reduce energy utilization:

All new structures must meet the Guidelines for Energy Efficient Construction pursuant to the requirements of Article VI. Energy Conservation, Section 8 of the City of Burlington Code of Ordinances. **(Affirmative finding if conditioned)**

(g) Make advertising features complementary to the site:

No advertising features are included within this review. A sign plan for informational, traffic and directional purposes is included, and is subject to DPW review and approval as appropriate within anticipated public rights-of-way.

Any commercial or advertising signage will require separate permitting. **(Affirmative finding if conditioned)**

(h) Integrate infrastructure into the building design:

See Section 6.2.2 (p) above.

(i) Make spaces secure and safe:

All appropriate means of ingress and egress, and code requirements for building and life safety as defined by the building inspector and fire marshal must be observed.

Building entrances must be visible and adequately lit. Intercom systems for multi-family housing is recommended to maximize personal safety. **(Affirmative finding if conditioned)**

Article 8: Parking

Sec. 8.1.8, Minimum Off-Street Parking Requirements

The proposed development is located in the Shared Use Parking District. Within this district, the following minimum parking standards apply:

- Multi-family attached dwellings – 1 space per unit
- Commercial bakery – 2.5 spaces per 1,000 sf
- Restaurant – 3 spaces per 1,000 sf

- General office – 2 spaces per 1,000 sf
- College (post-secondary school) – 2 spaces per 1,000 sf
- General retail (small < 4,000 sf) – 2 spaces per 1,000 sf
- Health club – 2 spaces per 1,000 sf
- Large daycare - 1 space per every 2 employees + 1 per every 5 children
- Hotel – 0.75 space per room

Proposed parking is likely adequate; however, additional details are needed to clearly demonstrate compliance. A total of 1,093 off-street parking spaces is proposed (888 garage + 205 surface parking spaces). The proposed parking exceeds the minimum requirements for the 735 residential units (735 spaces) and non-residential uses:

- Multi-family attached dwellings – 735 provided (735 required)
- Commercial bakery is 600 sf – 2 spaces provided (1.5 required)
- Restaurant is 2,050 sf – 6 spaces provided (6.15 required)
- General office is 23,264 sf – 69 provided (46.5 required)
- College (post-secondary school) – 50 provided (33.1 required)
- General retail (small < 4,000 sf units) – 5 provided (5.35 required)
- Health club – 0 provided (38 required)
- Large daycare – 16 provided (unknown required – need staffing info)
- Hotel – 32 provided (31.5 required)

The parking tables provided do not make clear how the surplus 178 parking spaces are to be used. The proposed parking provides 3 spaces per 1,000 sf general office and almost 3 spaces per 1,000 sf post-secondary school space. No parking is provided for the “fitness center.” If this center is for use by onsite residents only, then no additional parking is needed. If it is a health club open to the general public, then a parking allocation of 2 spaces per 1,000 sf is needed. The large daycare is allocated 16 parking spaces. This allotment is not sufficient. A parking space for every 5 children is needed (75 children are anticipated), plus 1 parking space for every 2 staff. The 16 spaces would be sufficient for the 75 children plus only 1 staff person. No staff information is evident for the daycare and must be provided. **(No finding yet possible)**

Sec. 8.1.9, Maximum Parking Spaces

This section limits surface parking to 125% of the Neighborhood Parking District minimum parking requirement. Under the residential parking requirements alone (2 spaces per dwelling = 1,470 X 125% = 1,838 spaces), the proposed 1,093 parking spaces proposed comply with this limitation. Of the 1,093 off street parking spaces, 205 are within surface parking lots.

(Affirmative finding)

Sec. 8.1.10, Off-Street Loading Requirements

While the project plans depict some service areas, such as that at between Building I and Building E, no loading areas are expressly noted for the commercial spaces. Per this criterion, loading areas for all of the commercial uses are needed. The project plans must specifically note as much. **(No finding yet possible)**

Sec. 8.1.11, Parking Dimensional Requirements

Parking spaces depicted in the project plans, both within garages and in surface parking lots, comply with the dimensional standards of Table 8.1.11-1, *Minimum Parking Dimensions*. In parking lots that contain 90-degree spaces on both sides, back-up length is frequently only 18.’ The standard is 24.’ There is precedent, particularly within garages, for back-up length of only 20’; however, 18’ is even less. Back-up length must be lengthened to 20’ to 24.’ **(Affirmative finding if conditioned)**

Sec. 8.1.12, Limitations, Location, Use of Facilities

(a) Offsite parking facilities

(Not applicable)

(b) Downtown street level setback

(Not applicable)

(c) Front yard parking restricted

(Not applicable)

(d) Shared parking in the Neighborhood Parking Districts

(Not applicable)

(e) Single story structures in Shared Use Districts

(Not applicable)

(f) Joint use of facilities

There is nothing in the application expressly stating that parking facilities will be shared among the various uses. Given the layout of the site and variety of uses, it seems that shared use is likely, albeit not required. **(Affirmative finding)**

(g) Availability of facilities

Nothing in the application indicates that the proposed parking will be used for the storage or display of vehicles or materials by offsite users. Parking will be for residents, customers, employees, students, and visitors only. **(Affirmative finding)**

(h) Compact car parking

There is no indication of “compact” parking spaces within the development. Spot measurements of surface and garage parking spaces yielded acceptable dimensions for standard parking spaces (9’ X 20’). **(Affirmative finding)**

Sec. 8.1.13, Parking for Disabled Persons

The site plans depict a number of handicap parking spaces in close proximity to pathways and building entries. ADA compliance is administered via the city’s building permit process. **(Affirmative finding)**

Sec. 8.1.14, Stacked and Tandem Parking Restrictions

(Not applicable)

Sec. 8.1.15, Waivers from Parking Requirements / Parking Management Plans

(Not applicable)

Sec. 8.2.5, Bicycle Parking Requirements

As with vehicular parking, bicycle parking requirements are tied to use and, in some cases, the size thereof. A total of 898 bike parking spaces are proposed (594 indoor/covered & 304 outdoor/rack spaces). The applicants' bike parking table shows building, use, requirements (long and short term), and total spaces provided. A total of 92 long term bike parking spaces is required. A total of 45 short term bike parking spaces is required. As proposed, 594 long term and 304 short term bike parking spaces will be provided. Long term spaces will be enclosed within the buildings onsite. Short term spaces will be provided at racks throughout the development. **(Affirmative finding)**

Article 9: Inclusionary and Replacement Housing

Sec. 9.1.5, Applicability

As the proposed development includes more than 5 new dwelling units, it is subject to the inclusionary housing provisions of Article 9. Per Table 9.1.8-1, *Inclusionary Zoning Percentages*, 25% of the total unit count must be inclusionary (25% of 735 is 184 dwelling units) in the NAC-CR zone. In partnership with local housing nonprofit organizations, all of the inclusionary housing units are incorporated into this development proposal and will be provided onsite.

The applicants' inclusionary housing proposal amounts to 166 inclusionary housing units. It is 25% of 665 housing units (735 total – 70 senior housing units). The application cites the exemption under Sec. 9.1.6 (c). This exemption; however, is not available to projects in the NAC-CR or NMU zones. The 166 proposed inclusionary units are only 22.6% of 735. The inclusionary housing requirement for this project is 25% of the 735 total, inclusive of the senior housing. The applicants have been made aware of this shortcoming and will make adjustments. **(No finding yet possible)**

Sec. 9.1.12, Additional Density and Other Development Allowances

Provision of the required inclusionary housing affords the development an additional 0.5 FAR and 10' building height (set back 10' from the street façade). Additional lot coverage of up to 72% is also enabled. In this case, no additional FAR is sought. Lot coverage of 64% is sought and is compliant with this section. Similarly, two of the buildings (C and I) exceed the 65' standard height limit and reach 70' and 73,' respectively. These two heights are below the 75' maximum afforded by this section. In both cases, upper stories are set back. Compliance with the 25% inclusionary requirement as noted above is, of course, required. **(Affirmative finding if conditioned)**

Sec. 9.1.17, Review of Proposal for Phasing

See Sec. 3.5.6 (c) 2.

Article 10: Subdivision

Subdivision of the properties is under separate application (17-0267SD). Preliminary plat approval was granted October 19, 2016. Final plat application has not yet been filed. The proposed lot and street layout is contingent on the would-be subdivision. At the very latest, final plat approval must be sought and granted prior to commencement of construction. **(Affirmative finding if conditioned)**

Article 11: Planned Unit Development

The NAC-CR zoning district essentially functions as a PUD zone. Dimensional requirements are handled across the entire zone, rather than on a lot-by-lot basis. Therefore, pursuit of PUD approval is not required for this project. In instances where multiple lot, tracts, or parcels of land are to be developed as a single entity, PUD approval may be sought. Such is the case with this application.

Sec. 11.1.6, Approval Requirements

(a) The minimum project size requirements of Sec. 11.1.3 shall be met

There is no minimum lot size for PUD in the NAC-CR zone. **(Not applicable)**

(b) The minimum setbacks required for the district have been met at the periphery of the project

Peripheral setbacks have largely been met. A small portion of Building G needs to be pulled out of the North Avenue front yard setback. **(Affirmative finding if conditioned)**

(c) The project shall be subject to design review and site plan review of Article 3, Part 4

See Articles 3 and 6 above.

(d) The project shall meet the requirements of Article 10 for subdivision review where applicable

See Article 10 above.

(e) Density, frontage, and lot coverage requirements of the underlying zoning district have been met as calculated across the entire project

See Article 4 above.

(f) All other requirements of the underlying zoning district have been met as calculated across the entire project

Compliance with this criterion is addressed article-by-article in the findings above.

(g) Open space or common land shall be assured and maintained in accordance with the conditions as prescribed by the DRB

Within the development, there are a number of green space areas and other recreational amenities accessible to residents. Presumably, some sort of HOA will be formed and will be charged with maintenance of these green spaces and recreational amenities; however, no details are included in the application. Perhaps more significantly, 12 acres of the original ~33 acres of former Burlington College lands have been sold to the city for open space preservation. Management of those lands will be handled by the city's Parks & Recreation Department. **(No finding possible)**

(h) The development plan shall specify reasonable periods within which development of each phase of the planned unit development may be started and shall be completed. Deviation from the required amount of usable open space per dwelling unit may be allowed provided such deviation shall be provided for in other sections of the planned unit development.

See Sec. 3.5.6 (a) 11.

(i) The intent as defined in Sec. 11.1.1 is met in a way not detrimental to the city's interests

Sec. 11.1.1, Intent

(a) Promote the most appropriate use of land through flexibility of design and development of land;

This proposal includes a variety of uses, amenities, and new public infrastructure that is based on the public outreach process centered development and conservation of the original ~33 acre property. The PUD process enables plasticity in design to create something other than a traditional residential subdivision with detached dwelling units on individual lots. Peripheral setbacks and project-wide lot coverage calculations enable significant flexibility within the project. **(Affirmative finding)**

(b) Facilitate the adequate and economical provision of streets and utilities;

Multiple residences and businesses will be served by shared streets and utilities within the development. **(Affirmative finding)**

(c) Preserve the natural and scenic qualities of open space;

The most significant open space of the original acreage is the 12-acres of conservation land recently sold to the city. Much of this land remains wooded and preserves views to and from the lake. Within the development, a large center green space will also afford easy access to open space and outdoor activities. **(Affirmative finding)**

(d) Provide for a variety of housing types;

All of the housing will be in the form of multi-family attached units. Within that format, a variety of bedroom counts and price points (including inclusionary, “work force,” and market rate units) are included. There is also a mix of owner-occupied and rental units. Senior housing units will also be provided. **(Affirmative finding)**

(e) Provide a method of development for existing parcels which because of physical, topographical, or geological conditions could not otherwise be developed; and,

The subject property does not need to be developed as a PUD; however, it may be. The scale, intensity, and type of development proposed is most appropriately reviewed as a collective PUD. **(Affirmative finding)**

(f) Achieve a high level of design qualities and amenities.

With revisions as recommended by the Design Advisory Board, the project will comply with this criterion. **(Affirmative finding if conditioned)**

(j) The proposed development shall be consistent with the Municipal Development Plan

See Sec. 3.5.6 (b) 10.

(k) Any proposed accessory uses and facilities shall meet the requirements of Sec. 11.1.6 below.

Not applicable to the development as proposed.

II. Conditions of Approval

In light of the outstanding items in the foregoing findings, approval at this time would be premature. No conditions are yet recommended.



TRANSPORTATION IMPACT ASSESSMENT

CAMBRIAN RISE 351 NORTH AVE, BURLINGTON, VT

12.21.2016



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Appendix A. Peak Hour Network Traffic Volume Turning Movement Maps

Appendix B. Crash Data

Appendix C. Traffic Volume Adjustments

Appendix D. Signal Warrant Analysis

Appendix E. Traffic Analysis Worksheets

On behalf of Farrell Real Estate, RSG has conducted an analysis of traffic operations and overall safety proximate to the Cambrian Rise development proposed in Burlington, Vermont.

1.0 SUMMARY OF KEY FINDINGS

We offer the following summary of key findings based on the analysis presented in this memorandum:

- The project, located on the former Catholic Diocese property, between North Avenue and the bike path in Burlington Vermont, south of Lakeview Cemetery, involves the construction of 667 residential apartments, a 40 room hotel, and approximately 45,000 square feet of mixed commercial use.
- Vehicular access to the site will be provided by a main access road with a new traffic signal, and a secondary stop controlled access road off North Avenue.
- The most recent use of the existing site was by Burlington College. A portion of the existing college buildings (referred to as the former catholic diocese orphanage building) is permitted for re-purposing as residential apartments (65 units).
- The project is anticipated to generate 4,500 vehicle trips per day (369 in the AM peak hour and 414 in the PM peak hour).
- During the 5 year period from January 2010 – December 2014 there were 15 vehicle crashes on North Avenue adjacent to the project.
- RSG observed the intersection sight distance at both site access locations and found them to significantly exceed recommended guidelines for both intersection sight distance and stopping sight distance.
- Numerous transportation impact mitigation strategies are proposed as part of the project, including;
 - Comprehensive Transportation Demand Management measures, including membership in a Transportation Management Association (CATMA).
 - Comprehensive bicycle and pedestrian facilities within and connecting to the adjacent existing facilities.
 - A new traffic signal at the southern entrance, with signalized pedestrian crossings.
 - Payment of significant transportation specific impact fees, both locally to the City of Burlington and to the State of Vermont through the administration of Act 145.
- 16 roadway intersections were analyzed for the expected impact from the project, finding that all but one intersection meets the VTrans Level of Service policy in the AM and PM peak hours, in the full build scenario (2022), as well as 5 years hence (2027). The one intersection in question will be improved as part of the Champlain Parkway project.
- Maximum peak hour vehicle queues (in the design hour) generally increase modestly, with the largest increases at intersections with North Street, Sherman Street, and Pearl Street.

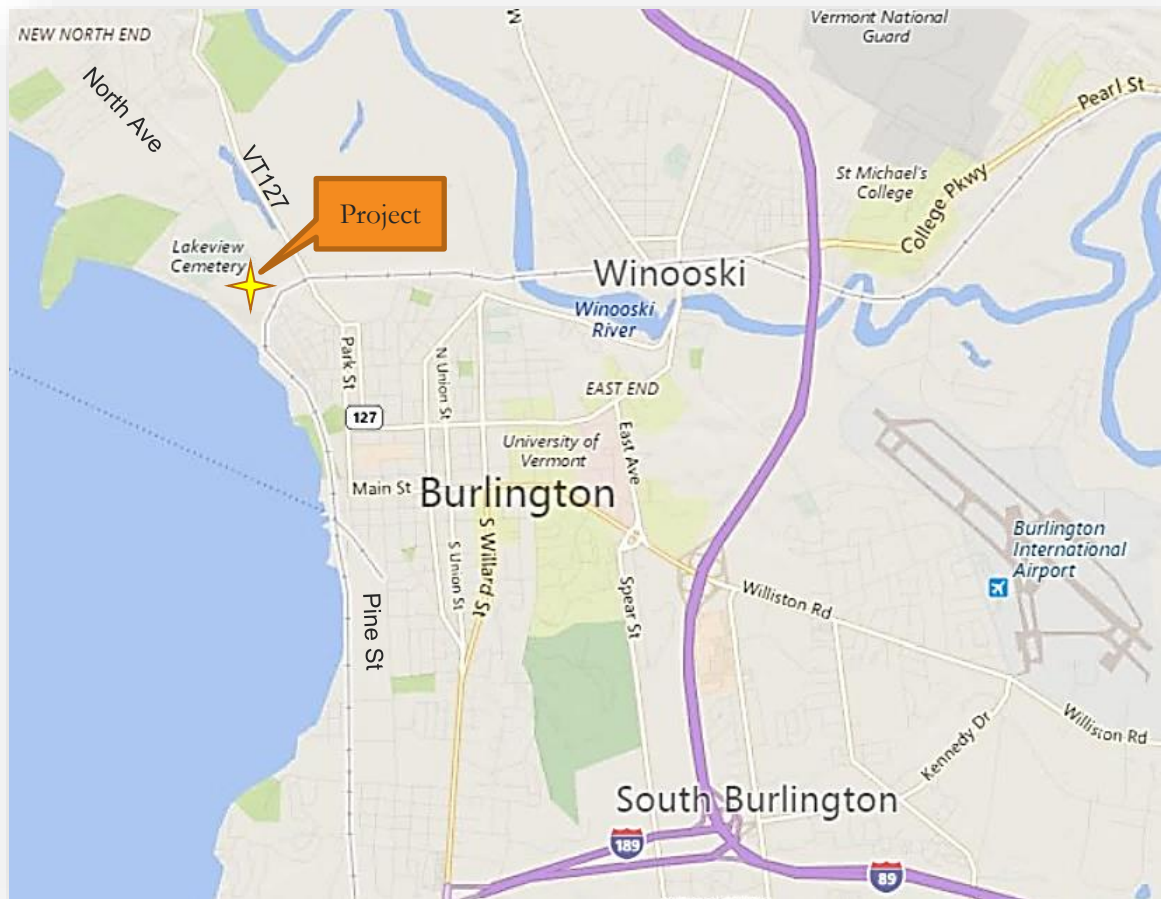
The latter being the worst case, with expected maximum increases of 7-8 vehicles. Signal timing optimization is likely to reduce these increases significantly.

- With the proposed improvements, we conclude this project will not cause undue adverse traffic congestion or safety conditions and will not unnecessarily or unreasonably endanger the public investment in roads, highways, and related infrastructure.

2.0 PROJECT DESCRIPTION

This study evaluates the transportation related infrastructure impacts associated with the Cambrian Rise development proposed on a portion of the former catholic diocese property and the former campus of Burlington College on North Avenue in Burlington, Vermont (Figure 1).

FIGURE 1. PROJECT LOCATION



The proposed development land uses are listed in Table 1 below.

TABLE 1. PROPOSED LAND USES

ITE LUC	Land Use		
223	Residential Apts	667	dwelling units
311	All-suites Hotel	40	room
540	Trade/Professional school	13,600	square feet
565	Daycare	4,025	square feet
710	Service/office	22,541	square feet
826	Specialty Retail	2,675	square feet
932	Restaurant	1,800	square feet
932	Bakery	600	square feet

As shown in the proposed site plan in Figure 2, the development involves a number of new multi-story buildings, and will have two access points on North Avenue, connected by a “U” shaped series of connected public streets.

FIGURE 2: PROJECT SITE PLAN



This study relies upon design standards and analysis procedures documented in the 2010 Highway Capacity Manual,¹ Trip Generation,² A Policy on Geometric Design of Highways and Streets,³ Manual on Uniform Traffic Control Devices (MUTCD),⁴ Traffic Impact Evaluation: Study and Review Guide,⁵ and the Vermont State Design Standards,⁶ which are the generally accepted traffic analysis references relied upon by traffic engineering professionals and VTrans for projects of this type in Vermont.

VTrans guidelines specify that a traffic study should be considered if the proposed development will generate 75 or more peak hour trips. The geographic scope of the study should also include the immediate access points and those intersections or highway segments receiving 75 or more project-generated peak hour trips.⁷ We project nine existing intersections will meet the 75 trip threshold, plus the two site access points. Several more intersections are included in this analysis at the request of the City Department of Public Works. The study area is depicted in Figure 3 with the expected peak hour trips through each study intersection.

¹ Transportation Research Board, National Research Council, *Highway Capacity Manual* (Washington, DC: National Academy of Sciences, 2010).

² Institute of Transportation Engineers, *Trip Generation* 9th Edition (Washington, D.C.: Institute of Transportation Engineers, 2012).

³ American Association of State Highway and Transportation Officials (AASHTO), *A Policy on Geometric Design of Highways and Streets*, 6th Edition (Washington DC: AASHTO, 2011).

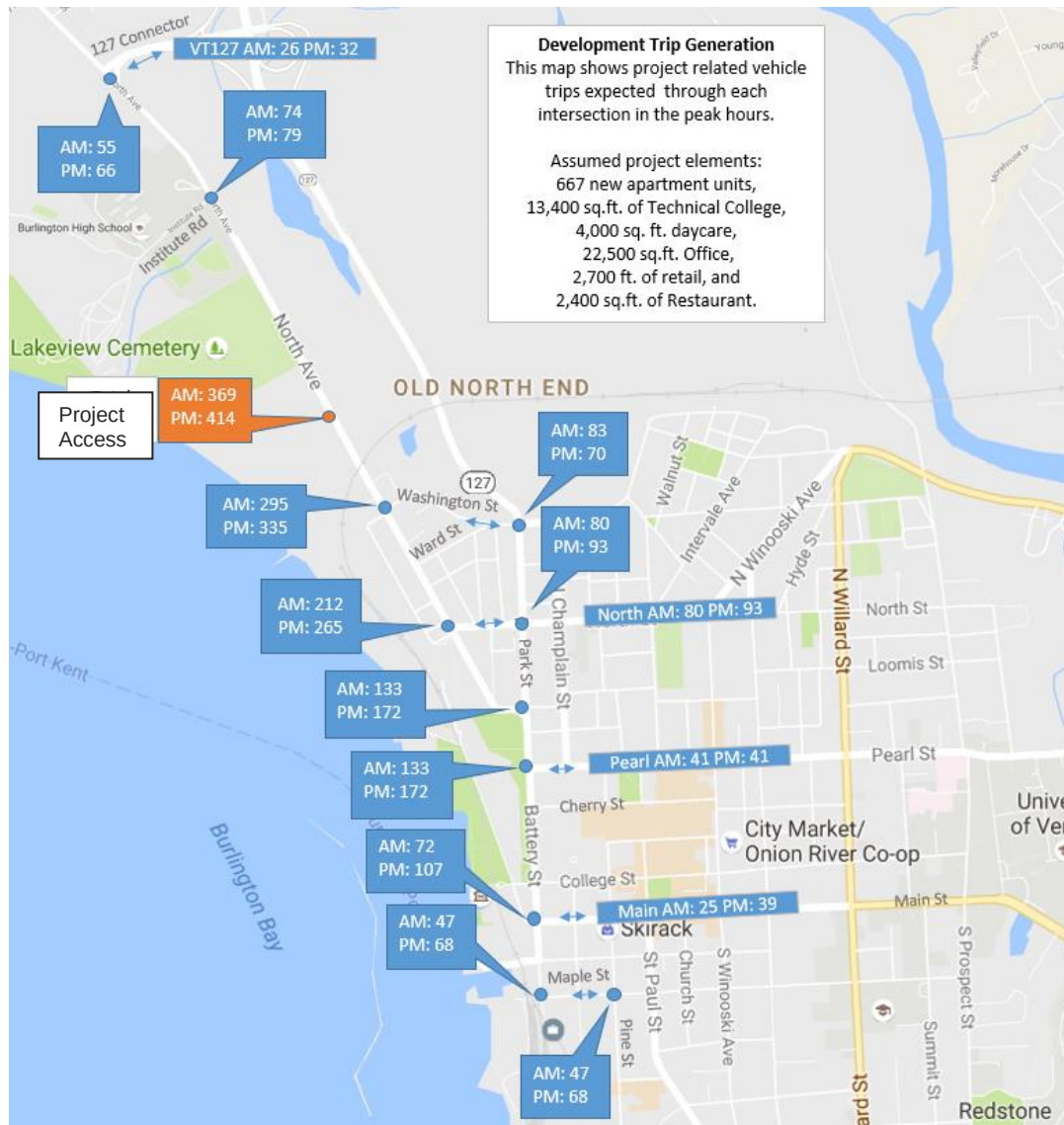
⁴ American Traffic Safety Services Association (ATSSA), ITE, and AASHTO, *Manual on Uniform Traffic Control Devices*, 2009 Edition (Washington DC: FHWA, 2009).

⁵ Vermont Agency of Transportation, Development Review Section, *Traffic Impact Evaluation Study and Review Guide* (October 2008).

⁶ State of Vermont Agency of Transportation, *Vermont State Standards* (Montpelier: VTrans, 1 July 1997).

⁷ Vermont Agency of Transportation, Development Review Section, *Traffic Impact Evaluation Study and Review Guide* (January 2003).

FIGURE 3. STUDY INTERSECTIONS AND PROJECT PEAK HOUR VEHICLE TRIPS



3.0 LOCAL TRAFFIC

The section of North Avenue proximate to the proposed site access is a two-lane roadway (one lanes in each direction) with a posted speed limit of 25 miles per hour. North Avenue’s designated functional class is a Minor Arterial roadway (Federal Aid Urban designation 5026). In 2016, VTrans recorded an annual average daily traffic volume (AADT) of 11,316 vehicles per day along North Avenue at station S6D045, approximately 0.2 miles north of the project site. Count data indicate the highest traffic volumes along North Avenue occur during the weekday AM (7:30-8:30) and PM (3:45-4:45) peak hours. The peaks in the Battery Street corridor varies in the AM period from 7:35 to 9:30 AM and from 4:30 to 5:45 PM. Traffic impacts are analyzed in the highest AM and PM hour at each intersection. Counts were performed in late May, June, or early July, and all include pedestrian counts, which were included in the traffic analysis.

As noted above, the wide breadth of the study area captures intersections or groups of intersections with significantly different peak hours (e.g. the high school peak vs the Battery St. peak). This study assumes the project traffic and all study intersections peak at the same time, which is a conservative assumption.

4.0 ANALYSIS TRAFFIC VOLUMES

Vehicle delays and queues are examined first with baseline, **No Build** scenario, traffic volumes, which represent the anticipated design hour conditions in the target study years without the proposed development in place.

Once baseline conditions are established, anticipated traffic associated with the proposed development is added to the No Build scenario volumes to create **Build** scenario traffic volumes, which are in turn used to project intersection delays, levels of service and vehicle queues with the proposed development in place.

A detailed description of the elements that contribute to the No Build and Build scenario traffic volumes is presented below.

4.1 | BACKGROUND TRAFFIC VOLUMES AND ADJUSTMENTS

RSG obtained the most recent VTrans⁸ turning movement count data at most study intersections. Additional count data was collected by RSG for the North Street/Park Street intersection on 4/13/2016. Baseline northbound and southbound through traffic volumes along North Avenue at the future site access points were obtained from the northbound entering and southbound exiting traffic at the Berry Street/Washington Street/North Avenue. intersection counts.

Following VTrans traffic study guidelines, raw peak hour traffic volumes were adjusted to represent the design hour volume (DHV)⁹ in 2022 and 2027¹⁰ using two adjustment factors: design hour adjustment (typically referred to as the 30th highest hour of the year) and growth factor based on localized growth trends.

Two Adjustments

1. Design hour adjustment factors are based on VTrans permanent count station P6D001, which is located 0.4 miles north of Manhattan Drive on VT 127 in Burlington, VT. The 2016 DHV at this station was compared to the peak hour volumes on the date of the turning movement count to formulate DHV adjustments. DHV adjustments increase raw count volumes by 1% to 10% at the various study intersections.
2. An annual adjustment factor, representing general background traffic growth, which is based on historic count data at VTrans count station P6D045, located just north of the project on North Avenue. Traffic volumes on North Avenue are projected to increase by 0.47% per

⁸ Some counts were performed by the CCRPC, but are provided on the VTrans web portal

⁹ The DHV is the 30th highest hour of traffic for the year and is used as the design standard in Vermont.

¹⁰ VTrans requires analysis during the year project construction is expected to be complete and in a future year scenario 5 years after project completion.

year. For comparison, the annual growth factor assumed in the North Avenue Corridor Study was 0.6%, but this *included* development of the Burlington College North Avenue parcel.

4.2 | OTHER DEVELOPMENT VOLUMES

Other development volumes (ODVs) represent trips generated by anticipated developments in the study area. Trips generated by ODVs are included in every scenario (both No Build and Build) because we assume they are already present on the road network in the analysis years.

Through discussion with Planning and Zoning staff, the following two ODVs were identified for inclusion in this study:

- COTS expansion at North Ave. /North St.
- Burlington Diocese Orphanage (a previously approved and permitted part of Cambrian Rise, currently under construction).

Traffic projections from these ODVs were obtained from traffic analyses previously conducted for these locations.

4.3 | TRANSPORTATION DEMAND MANAGEMENT (TDM)

Transportation Demand Management (TDM) is the application of strategies that either reduce travel demand, or redistribute demand in space or time. TDM has the benefit of reducing a development's impact on public infrastructure, particularly streets and highways, as well as benefiting the local economy by reducing environmental impacts and saving energy. TDM measures also provide more options for transportation, thus improving mobility, most notably for the underserved population.

Cambrian Rise development proposes a number of TDM measures, including:

- Direct and easily accessible connections to multimodal facilities such as:
 - The buffered bike lanes on North Avenue
 - Sidewalks on North Avenue
 - The Burlington Bike Path ("Greenway")
 - A new multi-use path along the South Road
 - A new enhanced and heated bus stop shelter at the corner of South Road and North Avenue
 - New signalized pedestrian crossing at South Road on North Avenue
 - Bike storage rooms and bike repair facilities for residents
 - Paid parking

VTrans has recently published guidelines¹¹ for determining the expected reduction in trip generation from various TDM measures. Their guidance considers specific physical, organizational, operational and financial measures. Cambrian Rise includes these relevant measures:

- Physical:
 - Bus stop with shelter

¹¹ TDM Guidance, VTrans Policy, Planning and Intermodal Development, March 2016

- Design site to support transit and walk access
- Secure bike parking
- Sidewalk or shared path improvements
- Operational:
 - On-site car sharing “pod” (dedicated parking and car for sharing) in collaboration with CarShare Vermont
- Financial:
 - Parking pricing
- Organizational:
 - Join a Transportation Management Association (i.e. CATMA¹²)

These measures are expected to substantially reduce traffic impacts, and the TDM Guidance indicates Cambrian Rise development is eligible to realize maximum trip reduction of 20%. For the purposes of this study, we have accounted for a 10% reduction in external trips due to TDM measures.

4.4 | TRIP GENERATION

Trip generation refers to the number of new trips originating at or destined for a land use development.

To estimate the number of new trips for the project the Institute of Transportation Engineer’s *Trip Generation Manual*¹³ was used, applying trip generation rates for the various ITE Land Use Codes (ITE LUC) expected. The base level of trip generation is before any multi-modal estimates of residents walking, biking, taking transit, or other methods of reducing single occupant vehicles.

Site generated traffic can be differentiated between primary, multi-modal (i.e. due to TDM), internal and pass-by trips. New primary peak hour trips expected to each proposed land use are summarized below:

TABLE 2. PRIMARY PEAK HOUR TRIPS BY LAND USE

ITE LUC	Description	Units/size		AM Peak		PM Peak	
				enter	exit	enter	exit
223	Mid-Rise Apartment	667	d.u.	89	198	192	139
311	All-Suites Hotel	40	room	8	7	7	9
540	Junior/Community College	13,600	s.f.	30	11	20	15
565	Daycare Center	4,025	s.f.	26	23	23	26
710	General Office Building	22,541	s.f.	31	4	6	28
826	Specialty Retail Center	2,675	s.f.	0	0	3	4
932	High-Turnover (Sit-Down) Restaurant	2,400	s.f.	14	12	8	5
		sub-total		198	254	260	226
		total		453		486	

Multi-modal trips represent people who use biking, walking or transit to complete their trip, avoiding a trip by personal vehicle. Multimodal use is enhanced by the project’s proposed Transportation

¹² Chittenden Area Transportation Management Association

¹³ Institute of Transportation Engineers, Trip Generation 9th Edition (Washington, D.C.: Institute of Transportation Engineers, 2012).

Demand Management (TDM) strategies, which are addressed in a separate section of this report. In summary, it is assumed that 10% of the primary trips generated by this project will be by other modes.

Internal trips are unique to multi-use developments such as this, as they represent trips from one use to another. For example, a restaurant patron may come from a residential or office use on site. Table 3 summarizes the expected¹⁴ internal capture by land use.

TABLE 3. INTERNAL CAPTURE PEAK HOUR TRIPS BY LAND USE

ITE LUC	Description	Units/size		AM Peak		PM Peak	
				enter	exit	enter	exit
223	Mid-Rise Apartment	667	d.u.	0	4	3	5
311	All-Suites Hotel	40	room	0	2	1	0
540	Junior/Community College	13,600	s.f.	0	0	0	0
565	Daycare Center	4,025	s.f.	8	8	8	8
710	General Office Building	22,541	s.f.	6	3	3	1
826	Specialty Retail Center	2,675	s.f.	0	0	2	2
932	High-Turnover (Sit-Down) Restaurant	2,400	s.f.	7	4	2	3
	sub-total			21	21	19	19
	total			42		38	

While primary trips represent people who leave their home, place of work, or other origin expressly to visit the site and who would not otherwise have gotten into their vehicle to make a trip, pass-by trips represent vehicles that currently pass by the site on the local road network and who, when the proposed development is present, turn into the site on their way to another destination. Pass-by trips are converted from through movements to turning movements to and from the site at the development access points but do not add new trips to intersections beyond the site access. Due to the nature of the land uses, only the restaurant is expected to have any pass-by trips. No estimates for morning pass-by trips are available for this use.

TABLE 4. PASS-BY PEAK HOUR TRIPS BY LAND USE

ITE LUC	Description	Units/size		AM Peak		PM Peak	
				enter	exit	enter	exit
223	Mid-Rise Apartment	667	d.u.				
311	All-Suites Hotel	40	room				
540	Junior/Community College	13,600	s.f.				
565	Daycare Center	4,025	s.f.				
710	General Office Building	22,541	s.f.				
826	Specialty Retail Center	2,675	s.f.				
932	High-Turnover (Sit-Down) Restaurant	2,400	s.f.			6	4
	sub-total			0	0	6	4
	total			0		10	

Table 5 presents a map of the estimated distribution of project-generated trips. Primary trips entering and exiting the site access are distributed onto the roadway network based on background traffic volumes.

¹⁴ As detailed in NCHRP Report 684, dated March 2016

TABLE 5. TOTAL OFF-SITE GENERATED TRIPS

ITE LUC	Description	Units/size		AM Peak		PM Peak	
				enter	exit	enter	exit
223	Mid-Rise Apartment	667	d.u.	80	174	170	121
311	All-Suites Hotel	40	room	8	4	6	8
540	Junior/Community College	13,600	s.f.	27	10	18	13
565	Daycare Center	4,025	s.f.	16	13	14	16
710	General Office Building	22,541	s.f.	22	1	2	24
826	Specialty Retail Center	2,675	s.f.	0	0	1	2
932	High-Turnover (Sit-Down) Restaurant	2,400	s.f.	7	7	12	7
		sub-total		160	210	223	191
		total		369		414	

d.u. = dwelling unit

s.f. = square feet

4.5 | SCENARIO VOLUME GRAPHICS

The distribution of traffic generated by the project onto the existing road network was determined using the CCRPC Transportation Model. The amount of proposed commercial and residential development from the project was added to the calibrated network model, then resulting traffic volumes were subtracted from results without the development. The fraction of development traffic using various routes in the study area was then used to determine the distribution of trips for this assessment.

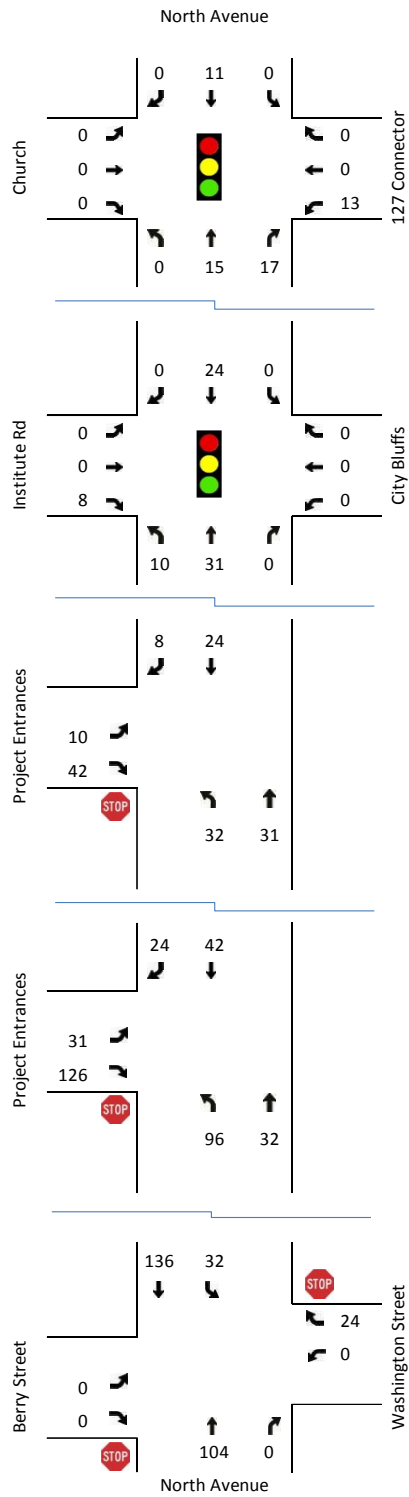
Figure 4 - 6 present the full buildout development traffic volumes, in the AM and PM peak hours, distributed to the 15 study intersections. The appendix provides similar diagrams representing:

1. No Build traffic volumes, including the raw count volumes, adjusted to design hour conditions, and projected traffic from recently permitted developments in the area (ODVs
2. Build scenario volumes, with the addition of project-generated traffic (both primary and pass-by trips) to the No Build traffic volumes.

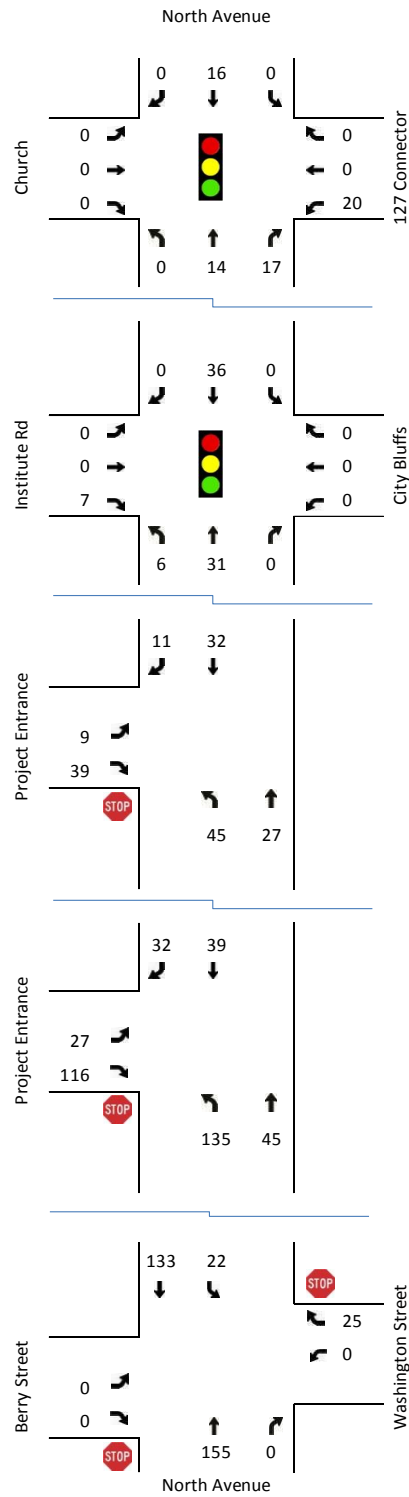
“Pass-by trips” are those that previously passed-by the site in the No Build scenario but turn into and out of the site once the project is in place.

FIGURE 4: FULL-BUILD DEVELOPMENT TRAFFIC (1 OF 3)

AM Peak Hour



PM Peak Hour



Map not to scale.

FIGURE 5: FULL-BUILD DEVELOPMENT TRAFFIC (2 OF 3)

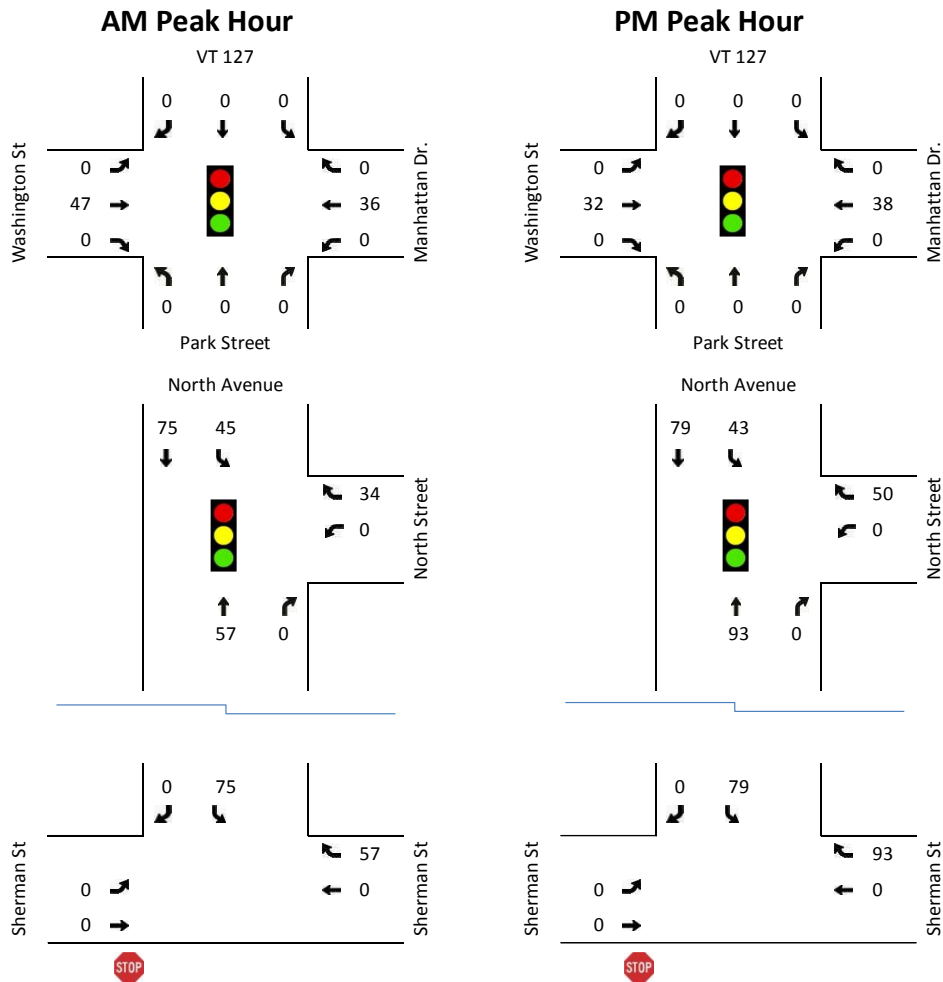
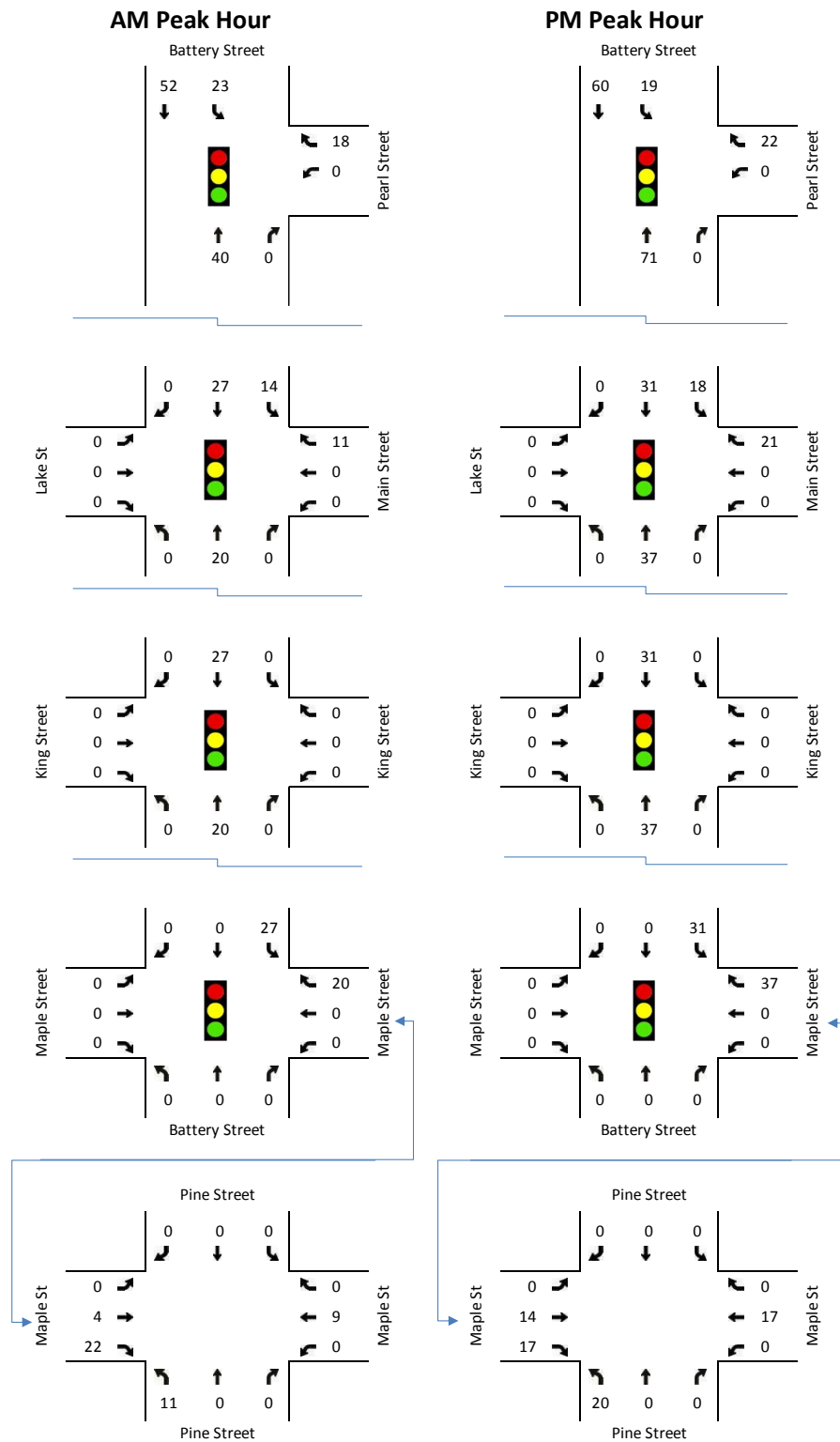


FIGURE 6: FULL-BUILD DEVELOPMENT TRAFFIC (3 OF 3)



Map not to scale.



5.0 CONGESTION ANALYSIS

5.1 | LEVEL-OF-SERVICE DEFINITION

Level-of-service (LOS) is a qualitative measure describing the operating conditions as perceived by motorists driving in a traffic stream. LOS is calculated using the procedures outlined in the 2000 and 2010 Highway Capacity Manuals.¹⁵ In addition to traffic volumes, key inputs include the number of lanes at each intersection, traffic control type (signalized or unsignalized), and the traffic signal timing plans.

The 2010 Highway Capacity Manual defines six qualitative grades to describe the level of service at an intersection. Level-of-Service is based on the average control delay per vehicle. Figure 7 shows the various LOS grades and descriptions for signalized and unsignalized intersections.

FIGURE 7: LEVEL-OF-SERVICE CRITERIA FOR SIGNALIZED AND UNSIGNALIZED INTERSECTIONS

LOS	CHARACTERISTICS	UNSIGNALIZED	SIGNALIZED
		TOTAL DELAY (SEC)	TOTAL DELAY (SEC)
A	Little or no delay	≤ 10.0	≤ 10.0
B	Short delays	10.1-15.0	10.1-20.0
C	Average delays	15.1-25.0	20.1-35.0
D	Long delays	25.1-35.0	35.1-55.0
E	Very long delays	35.1-50.0	55.1-80.0
F	Extreme delays	> 50.0	> 80.0

The delay thresholds for LOS at signalized and unsignalized intersections differ because of the driver's expectations of the operating efficiency for the respective traffic control conditions. According to HCM procedures, an overall LOS cannot be calculated for two-way stop-controlled intersections because not all movements experience delay. In signalized and all-way stop-controlled intersections, all movements experience delay and an overall LOS can be calculated.

The VTrans policy on level of service is:

- Overall LOS C should be maintained for state-maintained highways and other streets accessing the state's facilities
- Reduced LOS may be acceptable on a case-by-case basis when considering, at minimum, current and future traffic volumes, delays, volume to capacity ratios, crash rates, and negative impacts as a result of improvement necessary to achieve LOS C.
- LOS D should be maintained for side roads with volumes exceeding 100 vehicles/hour for a single lane approach (150 vehicles/hour for a two-lane approach) at two-way stop-controlled intersections.

¹⁵ The HCM 2010 does not provide methodologies for calculating intersection delays at certain intersection types including signalized intersections with exclusive pedestrian phases and signalized intersections with non NEMA-standard phasing. Because of these limitations, HCM 2000 methodologies are employed where necessary.

No policy applies to unsignalized intersections with a volume less than 100 vehicles for a single lane approach, and the volume/capacity ratio (v/c) is used to determine the degree of congestion.

Detailed Synchro LOS worksheets are available in the Appendix.

5.2 | CONGESTION ANALYSIS ASSUMPTIONS

The congestion analysis makes several important assumptions regarding the geometric configuration and other control measures at several intersections, including:

1. No-build scenarios assume the orphanage apartments are occupied and the southern site entrance has a one lane approach. The orphanage was pre-permitted and considered an ODV in this study (see Section 4.2).
2. Build scenarios assume a traffic signal at the southern site road intersection on North Avenue, a northbound left turn lane with protected permitted phasing, and a one lane approach on the sideline (serving traffic exiting the development at South Road). This intersection was tested without a northbound left turn lane and resulting in poor performance and long northbound queues.
3. At the northern access road a one lane approach with stop control is assumed.
4. The analysis assumes existing signal timings for all scenarios, as provided by the City DPW, unless specifically noted.
5. Geometry and signalization at North Avenue and North Street.
6. All scenarios with the Champlain Parkway assume a traffic signal at Pine Street/ Maple Street.
7. Geometry at the VT127 Connector road assumes the recommended mid-term condition which eliminates the northbound right turn slip lane (as currently being realized in the North Avenue Pilot Study). Signal timings were derived from models developed by the CCRPC for the Pilot Study.
8. At Battery St. and King St. the eastbound lane designation is for a shared left+thru and a right turn lane. In reality, this approach functions more like a left turn lane and a shared thru+right. The intersection was modeled accordingly.

5.3 | LEVEL-OF-SERVICE RESULTS

The Highway Capacity Manual congestion reports within Synchro (v8), a traffic analysis software package from Trafficware, routinely relied upon by transportation engineering professionals, were used to assess traffic congestion at the study intersections.

Level of Service at all 16 study intersections exceeds (is better than) the standards set by the State of Vermont Agency of Transportation (VTrans) Level of Service Policy for all scenarios (AM/PM peak, build/no-build, build year/build year+5), with the following exceptions;

- The 4-way stop intersection of Pine St. and Maple St. experiences LOS is F on several approaches in both the no-build and build scenarios. This intersection is scheduled to be improved with a traffic signal as part of the Champlain Parkway project.

Tables 6 - 9 present detailed LOS results for each study intersection during the weekday AM and PM peak hours.

TABLE 6. AM PEAK HOUR LOS RESULTS – NORTHERN INTERSECTIONS

		AM Peak Hour											
		2022 No Build			2022 Build			2027 No Build			2027 Build		
		LOS	Delay	v/c	LOS	Delay	v/c	LOS	Delay	v/c	LOS	Delay	v/c
	North Ave / 127 Connector												
	Overall	A	8	0.65	A	9	0.66	A	8	0.66	A	9	0.68
	EB, exiting Church	B	18	-	B	18	-	B	18	-	B	18	-
	WB, exiting 127	A	9	-	A	10	-	A	9	-	A	10	-
	NB, along North Ave	B	15	-	B	16	-	B	15	-	B	17	-
	SB, along North Ave	A	6	-	A	7	-	A	7	-	A	7	-
	North Ave / Institute												
	Overall	B	13	0.61	B	13	0.61	B	13	0.60	B	13	0.62
	EB, exiting High School	C	23	-	C	23	-	C	23	-	C	23	-
	WB, exiting development	C	25	-	C	25	-	C	25	-	C	25	-
	NB, along North Ave	A	7	-	A	7	-	A	7	-	A	8	-
	SB, along North Ave	B	13	-	B	13	-	B	13	-	B	14	-
	North Driveway / North Ave												
	EB, exiting site				C	19	0.17				C	20	0.17
	NBL, along North Ave				A	1	0.04				A	1	0.04
	SB, along North Ave				A	<1	0.46				A	<1	0.47
	South Driveway / North Ave												
	EB approach	C	17	0.05				C	17	0.05			
	EBR, exiting site	A	<1	0.00				A	<1	0.00			
	NBL, along North Ave	A	<1	0.44				A	<1	0.45			
	South Driveway / North Ave (w/ NBL lane)												
	Overall				B	13	0.71				C	24	0.79
	EB, exiting site				C	22	-				B	18	-
	NB, along Battery Street				A	4	-				A	5	-
	SB, along Battery Street				B	16	-				D	37	-
	North Ave / Washington St.												
	EB, exiting Berry St.	C	15	0.04	C	22	0.06	C	16	0.04	C	22	0.06
	WB, Washington St.	B	14	0.10	C	20	0.22	B	14	0.11	C	20	0.23
	NB, along North Ave	A	<1	0.00	A	<1	0.01	A	<1	0.00	A	<1	0.01
	SB, along North Ave	A	<1	0.03	A	2	0.06	A	<1	0.03	A	2	0.06
	VT 127 / Manhattan Drive												
	Overall	A	7	0.49	A	8	0.51	A	7	0.50	A	8	0.53
	EB, exiting Manhattan Drive	B	19	-	B	20	-	B	19	-	B	19	-
	WB, exiting Manhattan Drive	A	5	-	A	6	-	A	5	-	A	6	-
	SB, exiting VT 127	A	7	-	A	7	-	A	7	-	A	7	-
	North Ave / North Street												
	Overall	A	7	0.40	A	9	0.46	A	8	0.41	A	9	0.47
	WB, exiting North Street	D	36	-	C	34	-	D	35	-	C	34	-
	NB, along North Ave	A	6	-	A	8	-	A	7	-	A	8	-
	SB, along North Ave	A	5	-	A	6	-	A	5	-	A	6	-
	North Street / Park Street												
	Overall	B	15	0.51	B	19	0.54	B	15	0.52	B	19	0.55
	EB, exiting North Street	B	18	-	C	21	-	B	18	-	C	20	-
	WB, exiting North Street	C	24	-	C	33	-	C	25	-	C	33	-
	SB, along Park Street	B	12	-	B	14	-	B	12	-	B	15	-

TABLE 7. AM PEAK HOUR LOS RESULTS – SOUTHERN INTERSECTIONS

		AM Peak Hour											
		2022 No Build			2022 Build			2027 No Build			2027 Build		
		LOS	Delay	v/c	LOS	Delay	v/c	LOS	Delay	v/c	LOS	Delay	v/c
	Sherman Street / Battery Street												
	Overall	B	18	0.66	B	19	0.73	B	17	0.68	B	19	0.74
	EB, right from Sherman Street	C	20	-	B	19	-	C	20	-	B	19	-
	NB, left from Battery Street	A	10	-	B	13	-	A	7	-	A	9	-
	SB, exiting Park Street	C	21	-	C	24	-	C	22	-	C	25	-
	Battery Street / Pearl Street												
	Overall	B	15	0.73	B	17	0.79	B	16	0.75	B	18	0.81
	WB, exiting Pearl St.	D	37	-	D	37	-	D	38	-	D	37	-
	NB, along Battery Street	B	11	-	B	11	-	A	8	-	A	8	-
	SB, along Battery Street	B	13	-	B	16	-	B	15	-	B	19	-
	Battery Street / Main Street												
	Overall	B	15	0.56	B	16	0.59	B	14	0.58	B	14	0.61
	EB, exiting Main Street	D	39	-	D	39	-	D	40	-	D	40	-
	WB, exiting Main Street	D	36	-	D	36	-	D	37	-	D	37	-
	NB, along Battery Street	B	14	-	B	14	-	B	14	-	B	14	-
	SB, along Battery Street	A	8	-	A	8	-	A	6	-	A	6	-
	Battery Street / King Street												
	Overall	A	9	0.51	A	9	0.53	A	10	0.53	B	10	0.55
	EB, exiting Main Street	D	38	-	D	38	-	D	38	-	D	38	-
	WB, exiting Main Street	D	39	-	D	39	-	D	39	-	D	39	-
	NB, along Battery Street	A	2	-	A	2	-	A	2	-	A	2	-
	SB, along Battery Street	A	6	-	A	7	-	A	8	-	A	9	-
	Battery Street / Maple Street (w/Champlain Prkwy)												
	Overall	B	17	0.45	B	17	0.00	B	17	0.46	B	17	0.48
	EB, exiting Maple Street	D	36	-	D	36	-	D	36	-	D	36	-
	WB, exiting Maple Street	D	38	-	D	37	-	D	37	-	D	37	-
	NB, along Battery Street	A	2	-	A	2	-	A	2	-	A	2	-
	SB, along Battery Street	A	1	-	A	2	-	A	2	-	A	2	-
	Battery Street / Maple Street (wo/Champlain Prkwy)												
	Overall	B	18	0.39	B	19	0.41	B	19	0.40	B	19	0.42
	EB, exiting Maple Street	D	36	-	D	36	-	D	36	-	D	36	-
	WB, exiting Maple Street	D	38	-	D	38	-	D	37	-	D	38	-
	NB, along Battery Street	A	2	-	A	2	-	A	2	-	A	2	-
	SB, along Battery Street	A	4	-	A	4	-	A	5	-	A	5	-
	Maple Street / Pine Street (w/Champlain Prkwy)												
	Overall	C	23	0.78	C	25	0.82	C	25	0.81	C	28	0.84
	EB, exiting Maple Street	B	17	-	B	18	-	B	18	-	B	18	-
	WB, exiting Maple Street	C	29	-	C	34	-	C	33	-	D	38	-
	NB, along Battery Street	C	33	-	D	38	-	D	36	-	D	45	-
	SB, along Battery Street	B	13	-	B	13	-	B	13	-	B	14	-
	Maple Street / Pine Street (wo/Champlain Prkwy)												
	EB, exiting Maple Street	C	23	0.68	D	29	0.75	D	26	0.71	E	35	0.79
	WB, exiting Maple Street	C	17	0.47	C	19	0.50	C	18	0.49	C	20	0.53
	NB, along Pine Street	D	31	0.76	E	39	0.81	E	36	0.79	E	49	0.86
	SB, along Pine Street	C	19	0.55	C	21	0.57	C	20	0.57	C	23	0.61

TABLE 8. PM PEAK HOUR LOS RESULTS – NORTHERN INTERSECTIONS

	PM Peak Hour											
	2022 No Build			2022 Build			2027 No Build			2027 Build		
	LOS	Delay	v/c	LOS	Delay	v/c	LOS	Delay	v/c	LOS	Delay	v/c
 North Ave / 127 Connector												
Overall	C	25	0.86	C	27	0.89	C	27	0.89	C	30	0.93
EB, exiting Church	C	26	-	C	26	-	C	26	-	C	26	-
WB, exiting 127	D	36	-	C	35	-	D	38	-	D	41	-
NB, along North Ave	C	27	-	C	30	-	C	28	-	C	29	-
SB, along North Ave	B	14	-	B	16	-	B	16	-	C	21	-
 North Ave / Institute												
Overall	B	12	0.61	B	12	0.58	B	12	0.56	B	12	0.59
EB, exiting High School	C	26	-	C	26	-	C	26	-	C	26	-
WB, exiting development	C	24	-	C	24	-	C	24	-	C	24	-
NB, along North Ave	A	9	-	A	10	-	A	9	-	A	10	-
SB, along North Ave	A	7	-	A	7	-	A	7	-	A	7	-
 North Driveway / North Ave												
EB, exiting site				C	22	0.18				C	23	0.19
NBL, along North Ave				A	1	0.05				A	1	0.05
SB, along North Ave				A	<1	0.40				A	<1	0.41
 South Driveway / North Ave												
EB approach	C	22	0.08				C	22	0.08			
EBR, exiting site	A	<1	0.02				A	<1	0.02			
NBL, along North Ave	A	<1	0.38				A	<1	0.39			
SB, along North Ave	A	<1	0.00				A	<1	0.00			
 South Driveway / North Ave (w/ NBL lane)												
Overall				B	11	0.70				B	15	0.78
EB, exiting site				C	22	-				B	17	-
NB, along Battery Street				A	5	-				A	7	-
SB, along Battery Street				B	14	-				C	24	-
 North Ave / Washington St.												
EB, exiting Berry St.	C	22	0.13	E	44	0.26	C	23	0.14	E	46	0.27
WB, Washington St.	C	16	0.15	C	22	0.28	C	17	0.16	C	23	0.29
NB, along North Ave	A	<1	0.01	A	<1	0.01	A	<1	0.01	A	<1	0.01
SB, along North Ave	A	<1	0.03	A	2	0.06	A	<1	0.03	A	2	0.06
 VT 127 / Manhattan Drive												
Overall	A	6	0.88	A	7	0.86	A	6	0.90	A	6	0.90
EB, exiting Manhattan Drive	A	7	-	A	7	-	A	7	-	A	8	-
WB, exiting Manhattan Drive	A	2	-	A	2	-	A	2	-	A	3	-
SB, exiting VT 127	B	16	-	C	20	-	B	15	-	B	15	-
 North Ave / North Street												
Overall	B	11	0.47	B	13	0.56	B	11	0.48	B	14	0.57
WB, exiting North Street	D	36	-	C	34	-	D	36	-	C	34	-
NB, along North Ave	A	10	-	B	14	-	B	11	-	B	14	-
SB, along North Ave	A	4	-	A	6	-	A	5	-	A	6	-
 North Street / Park Street												
Overall	C	22	0.33	C	24	0.36	C	22	0.34	C	25	0.37
EB, exiting North Street	C	21	-	C	21	-	C	21	-	C	21	-
WB, exiting North Street	C	31	-	C	35	-	C	32	-	D	36	-
SB, along Park Street	B	11	-	B	12	-	B	11	-	B	12	-

TABLE 9. PM PEAK HOUR LOS RESULTS – SOUTHERN INTERSECTIONS

	Sherman Street / Battery Street												
	Overall	B	16	0.65	B	17	0.73	B	16	0.67	B	17	0.74
	EB, right from Sherman Street	B	12	-	B	11	-	B	12	-	B	11	-
	NB, left from Battery Street	B	15	-	B	17	-	B	15	-	B	18	-
	SB, exiting Park Street	C	22	-	C	25	-	C	23	-	C	25	-
	Battery Street / Pearl Street												
	Overall	B	16	0.58	B	19	0.64	B	17	0.59	B	19	0.65
	WB, exiting Pearl St.	C	35	-	C	34	-	C	35	-	C	35	-
	NB, along Battery Street	B	16	-	B	19	-	B	16	-	B	20	-
	SB, along Battery Street	A	10	-	B	12	-	A	10	-	B	12	-
	Battery Street / Main Street												
	Overall	B	17	0.51	B	17	0.56	B	18	0.53	B	17	0.57
	EB, exiting Main Street	D	39	-	D	39	-	D	39	-	D	39	-
	WB, exiting Main Street	C	32	-	C	32	-	C	33	-	C	33	-
	NB, along Battery Street	B	14	-	B	15	-	B	15	-	B	16	-
	SB, along Battery Street	A	8	-	A	6	-	A	8	-	A	6	-
	Battery Street / King Street												
	Overall	B	13	0.51	B	14	0.53	B	14	0.52	B	14	0.55
	EB, exiting King Street	D	44	-	D	44	-	D	45	-	D	45	-
	WB, exiting King Street	D	37	-	D	37	-	D	37	-	D	37	-
	NB, along Battery Street	A	3	-	A	3	-	A	3	-	A	3	-
	SB, along Battery Street	A	9	-	B	10	-	A	10	-	B	11	-
	Battery Street / Maple Street (w/Champlain Prkwy)												
	Overall	B	16	0.37	B	17	0.40	B	17	0.38	B	17	0.40
	EB, exiting Maple Street	D	39	-	D	39	-	D	39	-	D	39	-
	WB, exiting Maple Street	D	37	-	D	38	-	D	37	-	D	38	-
	NB, along Battery Street	A	2	-	A	2	-	A	2	-	A	2	-
	SB, along Battery Street	A	6	-	A	6	-	A	6	-	A	6	-
	Battery Street / Maple Street (wo/Champlain Prkwy)												
	Overall	C	23	0.33	C	24	0.36	C	23	0.34	C	24	0.37
	EB, exiting Maple Street	D	37	-	D	37	-	D	37	-	D	37	-
	WB, exiting Maple Street	D	37	-	D	37	-	D	37	-	D	37	-
	NB, along Battery Street	A	2	-	A	2	-	A	2	-	A	2	-
	SB, along Battery Street	A	7	-	A	8	-	A	7	-	A	8	-
	Maple Street / Pine Street (w/Champlain Prkwy)												
	Overall	B	12	0.76	B	13	0.79	B	12	0.77	B	14	0.81
	EB, exiting Maple Street	B	12	-	B	14	-	B	13	-	B	15	-
	WB, exiting Maple Street	B	14	-	B	16	-	B	15	-	B	17	-
	NB, along Battery Street	B	13	-	B	15	-	B	14	-	B	16	-
	SB, along Battery Street	A	8	-	A	8	-	A	8	-	A	8	-
	Maple Street / Pine Street (wo/Champlain Prkwy)												
	EB, exiting Maple Street	F	67	0.90	F	>100	0.99	F	91	0.95	F	>100	1.00
	WB, exiting Maple Street	E	36	0.74	E	45	0.80	E	41	0.78	F	51	0.83
	NB, along Pine Street	F	98	0.96	F	>100	1.00	F	>100	1.00	F	>100	1.00
	SB, along Pine Street	E	36	0.74	E	42	0.78	E	43	0.79	E	47	0.80

6.0 QUEUING ANALYSIS

In addition to the congestion analysis, estimated maximum queues in each peak hour were evaluated using Synchro.¹⁶ With the addition of project generated traffic, maximum peak hour queues generally increase as follows (refer to Tables 10 and 11). It is assumed on average 25 feet per vehicle:

¹⁶ 95th percentile queues as reported by HCM 2000 for signalized intersections, and HCM 2010 for unsignalized intersections. The 95th-percentile queue is defined to be the queue length that has only a 5-percent probability of being exceeded during the analysis time period. It is a useful parameter for determining the appropriate length of turn pockets, but it is not typical of what an average driver would experience. Driver experiences would be better characterized by the mean queue length.

- Build scenarios queues increase by 2 car lengths or less (~50 ft.) at most study intersections. Exceptions include:
 - North/North - southbound queues increase by 3-4 vehicles in AM, northbound by 7-8 in PM
 - Sherman/Battery - northbound queues increase by 3-4 vehicles in AM and PM
 - Battery /Pearl - northbound queues increase by 4 vehicles in AM and PM
 - Pine/Maple - without the Champlain Parkway improvements, maximum eastbound queues increase as much as 8 vehicles

A summary of queues for each intersection and scenario is presented in Table 10 and 11.

TABLE 10. 95TH PERCENTILE QUEUE LENGTHS (FEET) - NORTHERN INTERSECTIONS

Intersections	AM Peak Hour				PM Peak Hour			
	2022 No Build	2022 Build	2027 No Build	2027 Build	2022 No Build	2022 Build	2027 No Build	2027 Build
 North Ave / 127 Connector								
EB, exiting Church	4	4	4	4	7	7	7	7
WB, exiting 127	22	30	22	31	14	36	14	36
NB, along North Ave	170	218	177	224	645	690	668	701
SB, thru on North Ave	243	251	252	261	114	121	117	123
SB, left from North Ave	283	297	306	324	205	231	230	254
 North Ave / Institute								
EB, Institute Rd.	84	84	86	86	111	111	114	114
WB, City Bluffs	0	0	0	0	12	12	12	12
NB, thru on North Ave	158	180	163	184	511	547	527	562
NB, left turn	155	186	175	198	30	31	30	32
SB, along North Ave	432	459	448	474	150	168	154	172
 North Driveway / North Ave								
EB, exiting site		15		15		15		15
NBL, along North Ave		3		3		5		5
 South Driveway / North Ave								
EB, exiting site	5		5		5		5	
NBL, along North Ave	0		0		3		3	
 South Driveway / North Ave (w/ NBL lane)								
EB, exiting site		64		54		63		53
NB, along Battery Street		109		113		281		353
NB, left turns		28		29		54		62
SB, along Battery Street		561		549		480		471
 North Ave / Washington St.								
SB, left from North Ave.	3	5	3	5	3	5	3	5
EB, exiting Berry St.	3	5	3	5	13	25	13	28
WB, Washington St.	10	18	10	18	15	30	15	30
 VT 127 / Manhattan Drive								
EB, exiting Manhattan Drive	46	72	46	72	24	34	26	36
WB, exiting Manhattan Drive	69	89	70	91	37	49	39	51
SB, left from VT 127	191	209	198	216	186	186	184	184
SB, thru from VT 127	246	270	258	281	145	145	145	145
 North Ave / North Street								
WB, exiting North Street	57	69	58	71	95	114	97	117
NB, along North Ave	212	267	219	271	521	724	580	747
SB, along North Ave	339	429	352	446	174	239	180	245
SB, left turns	29	51	30	51	34	57	35	58
 North Street / Park Street								
EB, exiting North Street	115	152	118	155	117	152	120	155
WB, exiting North Street	179	244	184	251	244	323	252	334
SB, along Park Street	270	271	277	277	88	88	90	90

TABLE 11. 95TH PERCENTILE QUEUE LENGTHS (FEET) - SOUTHERN INTERSECTIONS

Intersections	AM Peak Hour				PM Peak Hour			
	2022 No Build	2022 Build	2027 No Build	2027 Build	2022 No Build	2022 Build	2027 No Build	2027 Build
 Sherman Street / Battery Street								
EB, right from Sherman Street	341	341	346	350	157	201	163	200
NB, left from Battery Street	143	229	84	127	604	675	618	700
SB, along Park Street	286	358	300	375	119	121	122	125
 Battery Street / Pearl Street								
WB, left from Pearl St.	141	141	144	144	130	130	132	132
NB, along Battery Street	199	235	224	258	645	751	669	775
SB, along Battery Street	684	753	711	778	226	250	231	258
 Battery Street / Main Street								
EB, exiting lower Main Street	49	49	52	52	94	94	96	96
WB, exiting Main Street	147	147	156	156	118	118	120	120
NB, along Battery Street	94	111	98	122	226	244	231	257
SB, left from Battery Street	m116	m112	m69	m66	42	40	42	40
SB, thru on Battery Street	m181	m175	m95	m91	281	210	274	205
 Battery Street / King Street								
EB, exiting King Street	13	13	13	13	40	40	41	41
WB, exiting King Street	64	64	66	66	91	91	94	94
NB, along Battery Street	59	64	60	65	105	116	109	121
SB, along Battery Street	361	379	446	466	379	414	394	428
 Battery Street / Maple Street (w/Champlain Prkwy)								
EB, exiting Maple Street	25	25	26	25	54	54	54	54
WB, thru from Maple Street	73	72	74	72	19	19	19	19
WB, right from Maple	104	108	105	108	72	82	75	85
NB, along Battery Street	10	10	10	11	14	14	14	14
SB, along Battery Street	4	4	4	4	156	238	198	246
 Battery Street / Maple Street (wo/Champlain Prkwy)								
EB, exiting Maple Street	24	24	25	25	49	48	48	48
WB, thru from Maple Street	73	73	74	74	18	18	18	18
WB, right from Maple	96	101	98	103	130	139	133	142
NB, along Battery Street	10	10	10	10	17	17	17	18
SB, along Battery Street	243	261	250	269	259	310	265	331
 Maple Street / Pine Street (w/Champlain Prkwy)								
EB, exiting Maple Street	106	114	109	116	178	225	206	235
WB, exiting Maple Street	228	243	238	252	207	225	215	232
NB, along Battery Street	342	356	354	369	244	270	255	280
SB, along Battery Street	215	215	220	220	121	121	123	123
 Maple Street / Pine Street (wo/Champlain Prkwy)								
EB, exiting Maple Street	145	195	165	228	380	583	523	638
WB, exiting Maple Street	63	73	70	83	180	243	230	268
NB, along Pine Street	205	255	238	305	488	618	618	618
SB, along Pine Street	85	93	95	108	183	215	235	240

m Volume for 95th percentile queue is metered by upstream signal.

In summary, increased traffic from the project generally causes negligible to modest increases in queues in the study area. Average queues, typical of what an average driver would experience, are significantly less (refer to worksheets in the appendix).

A review of signal timings and coordination between adjacent signals may reduce these queues significantly, particularly at North Street and North Avenue.

7.0 SAFETY ANALYSIS

As defined in the *2011 Policy on Geometric Design of Highways and Streets*, sight distance is the “the length of roadway ahead that is visible to the driver.”¹⁷ Sight distances of sufficient length are necessary at all points along a roadway to ensure vehicles can safely stop or avoid colliding with potential obstructions on the roadway.

Two types of sight distance are routinely examined to ensure safe operations. The first is referred to as Stopping sight distance, and is the distance along a given roadway between a driver’s eye and any potential obstruction on the roadway. The second is referred to as intersection corner sight distance and is the distance available between the driver’s eye of an intersecting vehicle waiting to join mainline traffic and the driver’s eye of an approaching mainline vehicle.

The provision of adequate stopping sight distance is critical for safe operations and design standards are defined based on roadway speed and gradient. For the section of North Avenue proximate to the site access, the minimum design stopping sight distance is 150 feet.

To ensure safe operation, intersection sight distances must also equal the design minimum stopping sight distance (150 feet) but longer intersection sight distances are desirable to improve overall intersection operations and minimize major route deceleration events. The *2011 Policy on Geometric Design of Highways and Streets* states that, “If the available sight distance for an entering or crossing vehicle is at least equal to the appropriate stopping sight distance for the major road, then drivers have sufficient sight distance to anticipate and avoid collisions. However, in some cases, a major-road vehicle may need to stop or slow to accommodate the maneuver by a minor-road vehicle. To enhance traffic operations, intersection sight distances that exceed stopping sight distances are desirable along the major road.”¹⁸ The target desirable intersection corner sight distance for a 25 mph roadway is presented to be 275 feet.

The available stopping sight distance approaching the project entrance was measured to be more than 400 feet from either approach. Similarly, corner sight distance from the project access exceeds 400 feet.

7.1 | CRASH HISTORIES

VTrans maintains a statewide database of all reported crashes along all state highways and federal aid road segments. Crash histories were reviewed for the most recent 5 years of available data (January 2010 - December 2014). Within this 5 year period, 15 crashes were reported on North Avenue adjacent to the project and/or within the design stopping sight distance (150 feet at 25 mph) of the two project entrances (North Avenue mile marker 0.64 to 0.83).

¹⁷ American Association of State Highway and Transportation Officials, *A Policy on Geometric Design of Highways and Streets*, Fifth Edition (Washington D.C.: American Association of State Highway and Transportation Officials, 2011). Page 3-2.

¹⁸ American Association of State Highway and Transportation Officials, *A Policy on Geometric Design of Highways and Streets*, Fifth Edition (Washington D.C.: American Association of State Highway and Transportation Officials, 2011). Page 9-29.

A summary of the 15 crashes includes:

- 80% of the crashes (12) were during daylight hours
- 73% were with dry road conditions (11)
- The crash type mix was:
 - 47% (7) rear end
 - 33% (5) single vehicle
 - 13% (2) broadside
 - 7% (1) head on
- 27% (4) crashes resulted in injuries, with no fatalities

Bicycle and Pedestrian Crashes

While no specific location for bike and pedestrian crashes is provided in the VTrans report system¹⁹, there were 16 bicycle and 6 pedestrian crashes reported in the 2010-2014 period on the 3.1 mile length of North Avenue. Of the 345 vehicle crashes reported on North Avenue during that period, 15 involved a cyclist, and 6 involved a pedestrian.

High Crash Locations

The Vermont Agency of Transportation maintains a list of high crash locations (HCL), which are intersections and roadway segments that have high crash rates over five years compared to other intersections or segments with similar functional classification and traffic levels. In order to be classified as a High Crash Location, an intersection or road segment (0.3 mile segments) must have more than 5 crashes in 5 years and must have an actual crash rate higher than the critical crash rate calculated by VTrans for similar roadways.

There are no high crash locations in the immediate vicinity of this project. The closest HCL is the segment of North Avenue from Sherman Street to North Avenue (mm 0.0-0.3), where 36 crashes were recorded in the same period (2010-2014).

7.2 | INTERSECTION SIGHT DISTANCE

Intersection sight distance is the distance available along the major road travelled way corresponding with the maximum visibility between an advancing motorist on the major road and an entering motorist on an intersecting minor road. It is measured between a point representing the advancing driver's eye above the major road and the entering driver's eye above the intersecting road.²⁰

The 2011 *Policy on Geometric Design of Highways and Streets* states that the available intersection sight distance should be at least equal to the required stopping sight distance along the major road, which in this case equals 155 feet (at 25 mph).

"Sight distance is also provided at intersections to allow the drivers of stopped vehicles a sufficient view of the intersecting highway to decide when to enter the intersecting highway or to cross it. If the available sight

¹⁹ Using the online Public Crash Data Query Tool

²⁰ As noted in the 2011 *Policy on Geometric Design of Highways and Streets* (page 3-14 to 3-15), the height of the driver's eye of the approaching vehicle is assumed to be 3.5' above the road surface of the major road and the height of the driver's eye of the entering vehicle is assumed to be 3.5' above the minor road surface and 14.5' back from the edge of the major road travelled way.

distance for an entering or crossing vehicle is at least equal to the appropriate stopping sight distance for the major road, then drivers have sufficient sight distance to anticipate and avoid collisions.”

However, when possible it is desirable to have intersection sight distances that exceed the design minimum stopping sight distances in order to offer improved operations, such that major road traffic need not decelerate to accommodate entering traffic.

“However, in some cases a major-road vehicle may need to stop or slow to accommodate the maneuver by a minor road vehicle. To enhance traffic operations, intersection sight distances that exceed stopping sight distances are desirable along the major road.”

Desirable target intersection sight distances are based on design speeds.²¹ For traffic at either development entrance the target intersection sight distance is 280 feet. The available sight distance exceeds 600 feet at either location, in either direction (see Figures 8-11).

FIGURE 8: VIEW LOOKING NORTH FROM SOUTH ROAD EXIT



²¹ As noted in the 2011 Policy on Geometric Design of Highways and Streets (page 9-38) grade is not factored into target intersection sight distances because “both the major- and minor-road vehicle will be on the same grade when departing from the intersection.”

FIGURE 9: VIEW LOOKING SOUTH FROM SOUTH ROAD EXIT



FIGURE 10. LOOKING NORTH FROM NORTH ROAD EXIT



FIGURE 11. LOOKING SOUTH FROM NORTH ROAD EXIT



8.0 SIGNAL WARRANT

A signal warrant analysis is a set of tests that are run to determine whether a traffic signal would significantly improve operations, mobility, and safety at an intersection. There are a total of 8 warrants:

- 1) Eight-Hour Vehicular Traffic Warrant: when a large amount of intersecting traffic occurring over an 8-hour period is the principal reason for installing a traffic signal, or where excessive delays occur on minor approaches to an intersection.
- 2) Four-Hour Vehicular Traffic Warrant: when a large amount of intersecting traffic occurring over a 4-hour period is the principal reason for installing a traffic signal.
- 3) Peak Hour Warrant: when the minor-street traffic suffers unduly delay when entering or crossing the major-street during the average peak hour is the principal reason for installing a traffic signal.
- 4) Pedestrian Volume Warrant: when the traffic volumes on a major street are so heavy that pedestrians experience excessive delays.
- 5) School Crossing Warrant: when school children crossing a major street are the principal reason for installing a traffic signal.

- 6) Coordinated Signal System Warrant: when maintaining proper platooning of vehicles is the principal reason for installing a traffic signal.
- 7) Crash Experience Warrant: when the severity and frequency of accidents is the principal reason for installing a traffic signal.
- 8) Roadway Network Warrant: when the concentration and organization of traffic flow is the principal reason for installing a traffic signal.

A signal warrant analysis is considered advisory only. This means that simply meeting any warrant may not be sufficient cause for installing a traffic signal. For example, meeting the peak hour warrant is usually not sufficient in and of itself to warrant installing a traffic signal. The rationale for this is that one hour (or less) of congestion in a day is probably not severe enough to justify the investment in the traffic signal controller and related equipment and software. Experience in Vermont suggests that meeting at least two other warrants is needed to justify investment in a traffic signal. This condition is met at the South Road intersection.

A 12-hour turning movement count at the Berry/Washington/North Ave intersection was conducted in June of 2016. The 2-way raw volumes leading in and out of the north approach to the intersection were adjusted to average daily traffic conditions as recommended in the MUTCD. Then volumes from other permitted but not yet built developments and site-generated primary and pass-by trips were proportionally added to the traffic counts for each hour.

Based on the existing information gathered for this traffic study, the following traffic signal warrants are met:

- Eight-Hour Vehicular Traffic Warrant
- Four-Hour Vehicular Traffic Warrant

The detailed signal warrant analysis is available in the Appendix.

9.0 BICYCLE AND PEDESTRIAN FACILITIES

9.1 | EXISTING CONDITIONS

There are currently several significant bicycle and pedestrian features in the study area, including;

- Sidewalks exist on both sides of North Avenue throughout the project vicinity, connecting the site to the High School at Institute Road to the north and leading south to North Street, Battery and Waterfront parks, and beyond into the urban core,
- The Burlington Greenway (shared use path) runs adjacent to the west edge of the property, and
- Bike lanes are present on North Avenue starting at North Street and ending at Institute Road (northbound), starting at Institute Rd and ending at Berry St (southbound).

9.2 | FUTURE CONDITIONS

The recently completed North Ave Corridor Study recommends the following bicycle and pedestrian improvements in the project area on North Avenue:

- A midblock crosswalk at the bus stop pair south of VT 127 Connector (long term)
- A midblock crosswalk at Burlington College. Note that as part of this development this crosswalk will be supplanted by the proposed signalized crosswalks at the southern access road.
- A midblock crosswalk at Convent Square (long term), and
- A raised intersection at Washington Street and Berry Street (long term) with other crosswalk enhancements including RRFB's

In addition, features proposed as part of this project include:

- A shared path adjacent to South Road, connecting North Avenue to the Burlington Greenway (bikepath), and
- An informal bike trail making the same connection to the south of the development.

Crosswalk Warrants and Guidance

VTrans Guidelines for Pedestrian Crossing Treatments²² indicates that a 2-lane roadway such as North Avenue (with a speed limit ≤ 30 mph and an AADT of between 9,000 and 12,000 vehicles per day) is a good candidate for a marked crosswalk, provided that²³;

- There are sidewalks or suitable pedestrian ways on either side,
- There is a certain amount of existing or desired crossing activity²⁴, and
- Some form of additional enhancement should be considered, such as Rectangular Rapid Flashing Beacons (RRFB).²⁵

Findings include:

- The existing crosswalk (and bus stop) near Champlain Farms should be removed, as the ultimate spacing of crosswalks and stops (see Figure 12) will be more uniform with the planned crossings and stops at South Road.
- An additional crossing at the North Road should be considered when (if) future crossing activity warrants it.

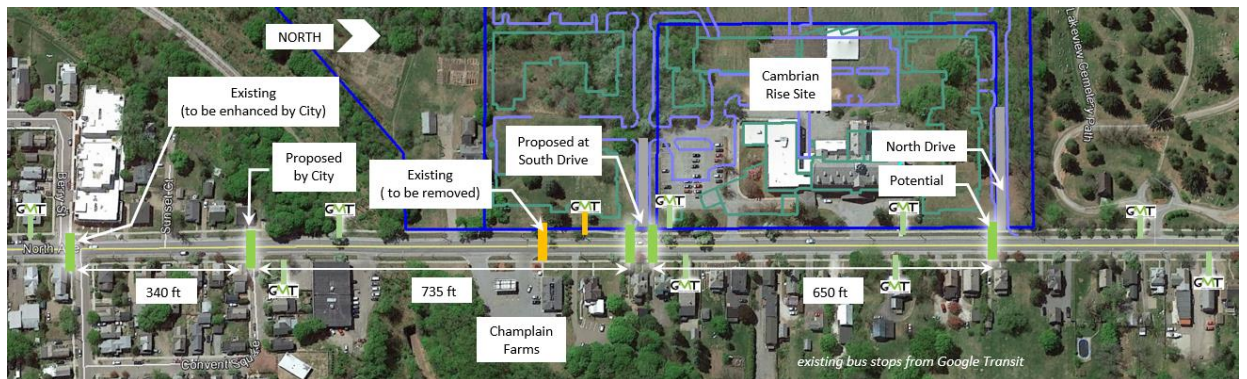
²² Updated January 2015

²³ And there's not another crosswalk within 200 ft., and it is a suitable location for pedestrians to have the right of way – e.g. sightlines are adequate

²⁴ Guidance recommends that “a minimum of 20 pedestrian crossing per peak hour (or 15 or more elderly and/or child pedestrians) exist at a location before placing a high priority on the installation of a marked crosswalk alone.” Since crossing activity in future is hard to predict, we recommend installing a crosswalk once pedestrian volumes meet the recommended threshold.

²⁵ Vermont Agency of Transportation, *Vermont Pedestrian and Bicycle Facility Planning and Design Manual* (Montpelier: VTrans, 2002) 3-41.

FIGURE 12. EXISTING AND PROPOSED CROSSWALKS AND BUS STOPS IN PROJECT AREA



10.0 SUMMARY AND CONCLUSIONS

The proposed project would add 667 Apartments, a 40 room hotel and 45,000 s.f. of commercial use to a parcel located west of North Avenue in Burlington, Vermont. We project this project will generate approximately 369/414 external vehicle trips during the weekday AM/PM peak hour.

Vehicular access to the site will be facilitated by a main access road with a new traffic signal, and a secondary stop controlled access road off North Avenue.

The wide breadth of the study area captures intersections or groups of intersections with significantly different peak hours (e.g. the high school peak vs the Battery St. peak). This study assumes the project traffic and all study intersections peak at the same time, which is a conservative assumption.

Furthermore:

- The project is anticipated to generate 4500 vehicle trips per day (including 369 in the AM peak hour and 414 in the PM peak hour).
- Numerous transportation impact mitigation strategies are proposed as part of the project, including;
 - Comprehensive Transportation Demand Management measures, including participation in, and support of a Transportation Management Association (CATMA).
 - Comprehensive bicycle and pedestrian facilities within and connecting to the adjacent existing facilities, including;
 - A new share use path between North Avenue and the Burlington bike path (“Greenway”)
 - A handicap accessible route from North Avenue to the Greenway
 - A new traffic signal at the southern entrance, with signalized pedestrian crossings.
 - Payment of significant transportation specific impact fees, both locally to the City of Burlington and to the State of Vermont through the administration of Act 145.
- 16 roadway intersections were analyzed for the expected impact from the project, finding that all but one intersection meets the VTrans Level of Service policy in the AM and PM

peak hours, in the full build scenario (2022), as well as 5 years hence (2027). The one intersection in question will be improved as part of the Champlain Parkway project.

- Maximum peak hour vehicle queues (in the design hour) generally increase modestly, with the largest increases at North Street, Sherman Street and Pearl Street. The latter being the worst case with expected increases of 7-8 vehicles. Signal timing optimization is likely to reduce these increases significantly.
- The existing crosswalk (and bus stop) near Champlain Farms on North Avenue, south of the site, should be removed once the crosswalk and traffic signal is installed at South Road and is operating in a least “flashing” mode.
- An additional crossing at the North Road on North Avenue should be considered when (if) future crossing activity warrants it.
- We have reviewed recent VTrans crash data and found no existing safety concerns proximate to the site access roads on North Avenue.
- Sight distances were observed to exceed the design standards in both directions from both site access roads on North Avenue.
- With the proposed improvements, we conclude this project will not cause undue adverse traffic congestion or safety conditions and will not unnecessarily or unreasonably endanger the public investment in roads, highways, and related infrastructure.

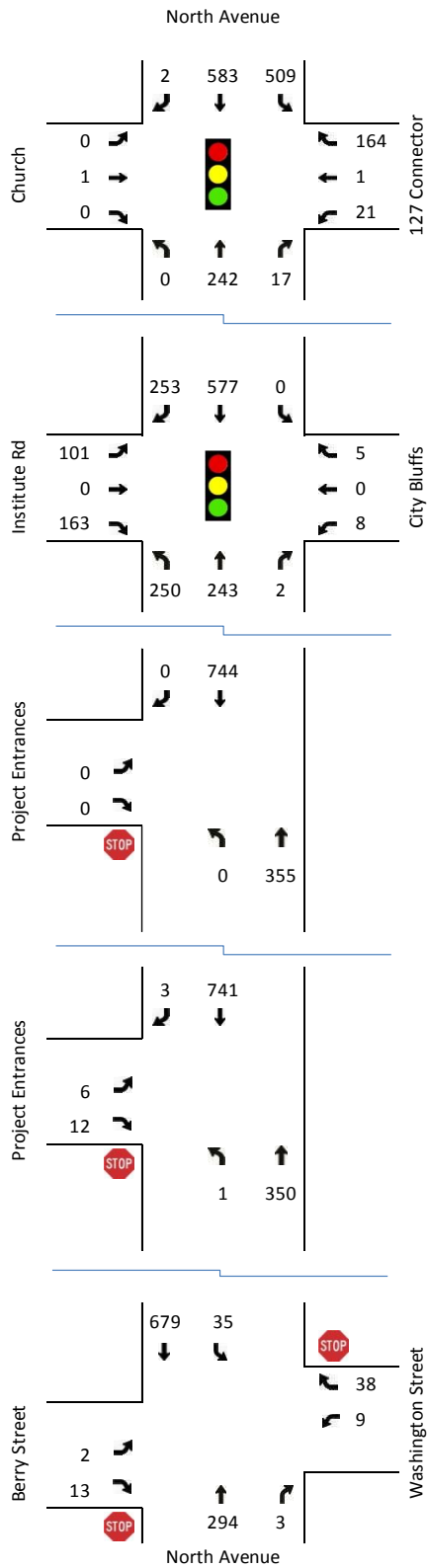
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APPENDIX A. PEAK HOUR NETWORK TRAFFIC VOLUME TURNING MOVEMENT MAPS

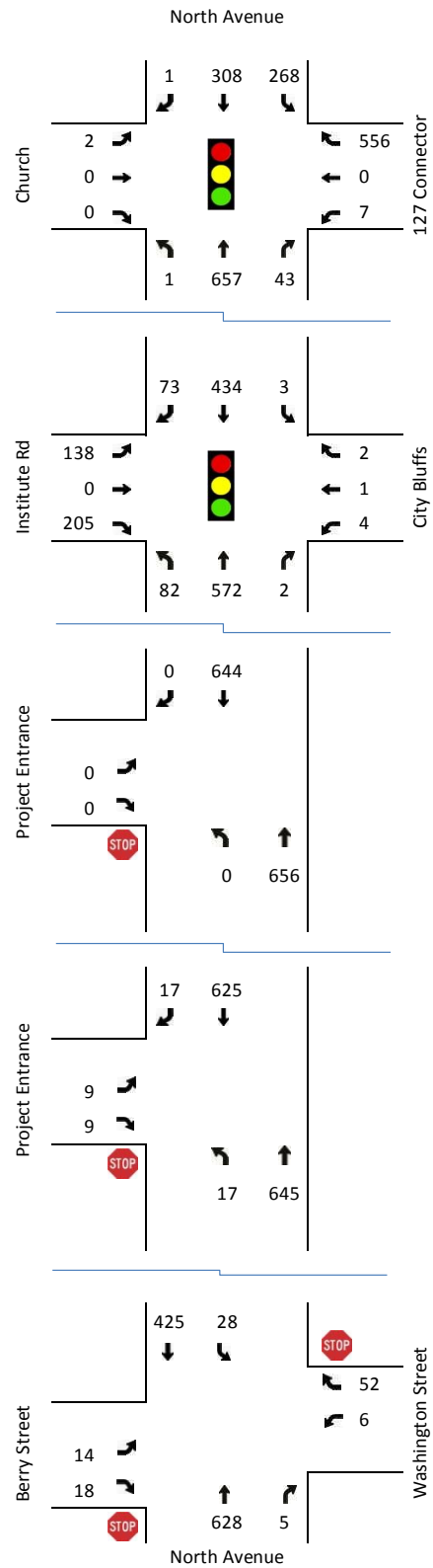
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 - 2022 AM & PM Peak Hour Build
- 2027 AM & PM Peak Hour No-Build
 - 2027 AM & PM Peak Hour Build



AM 2022 No Build

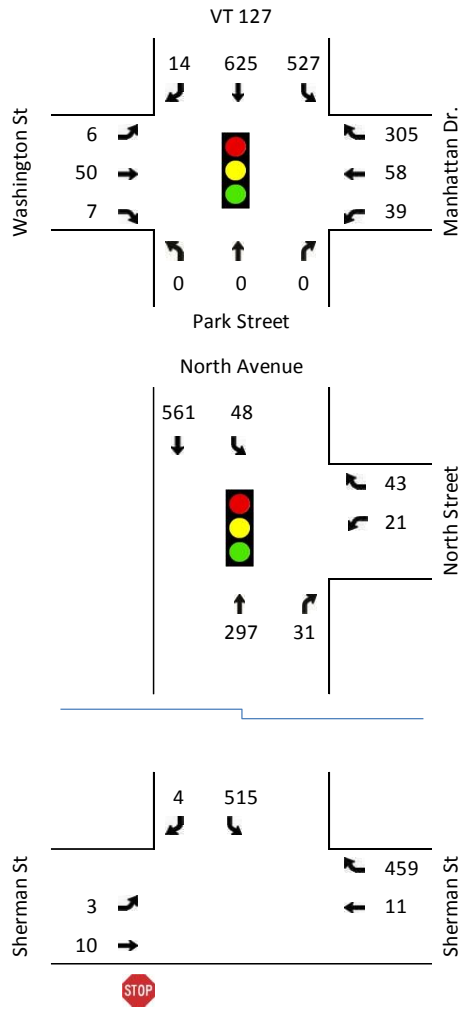


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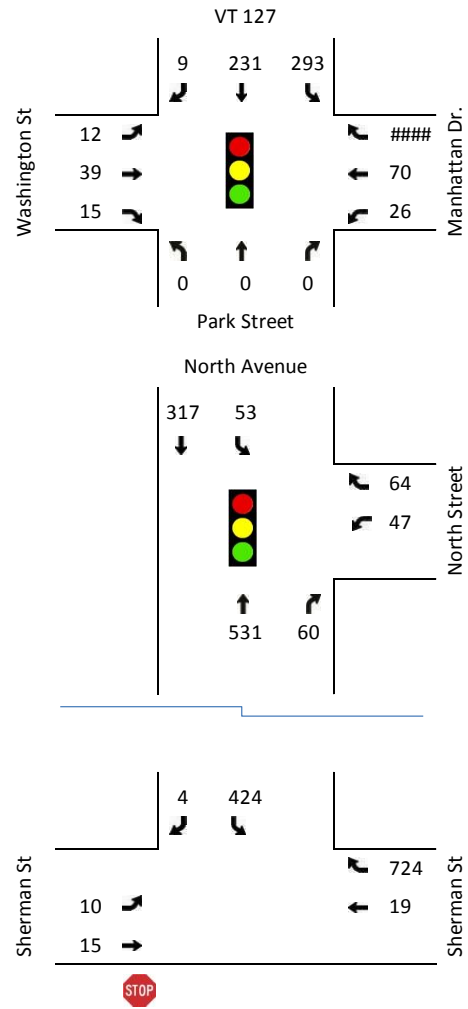


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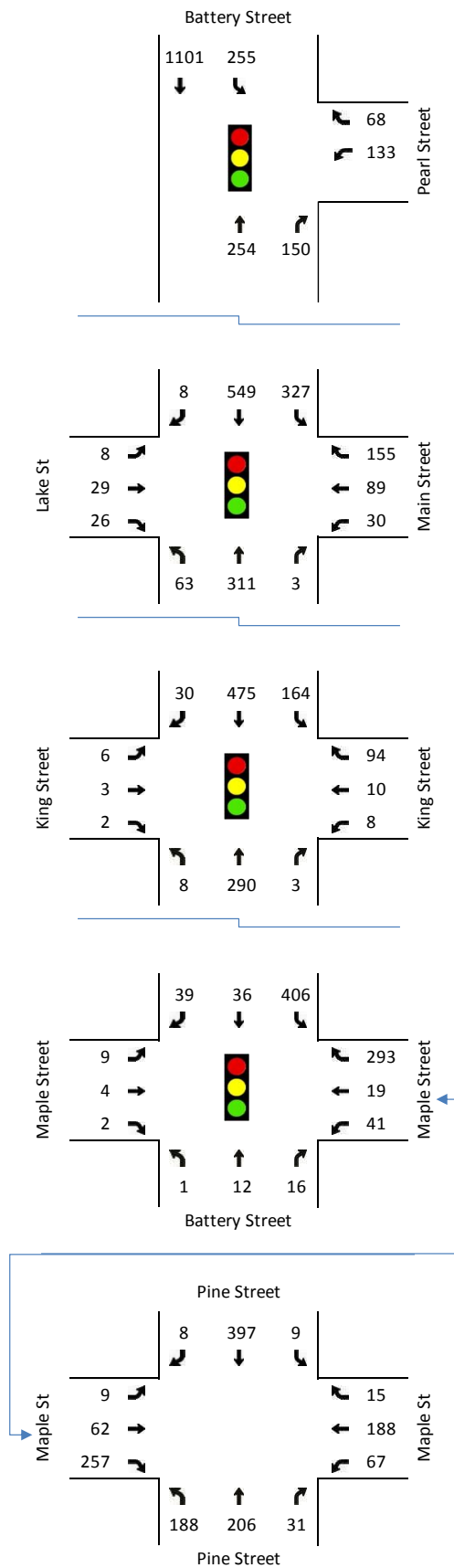
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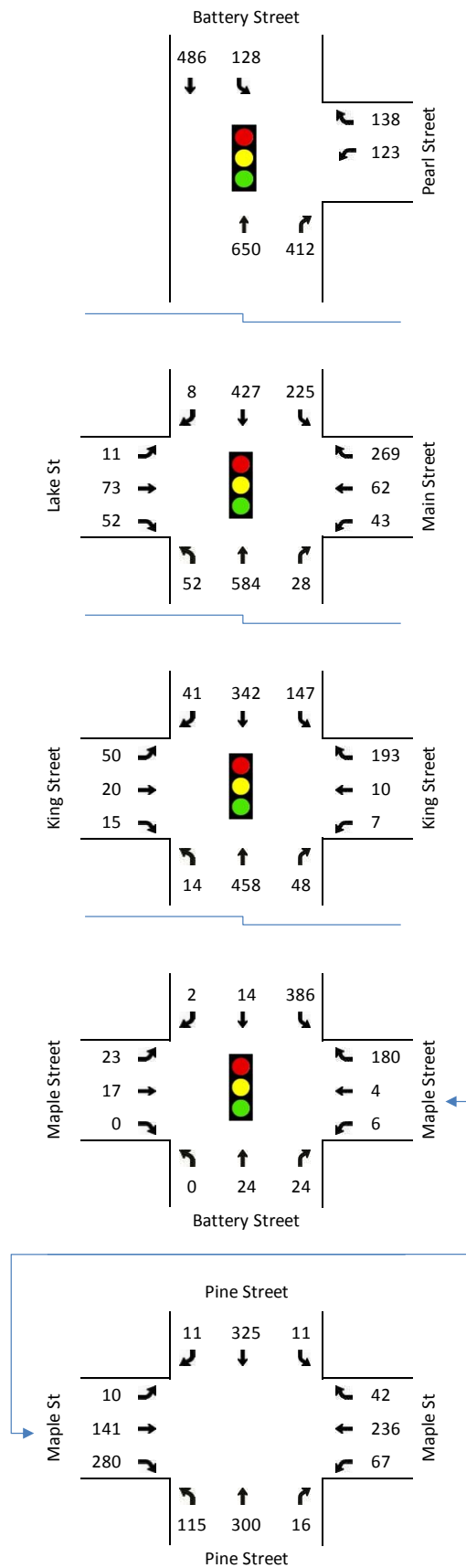
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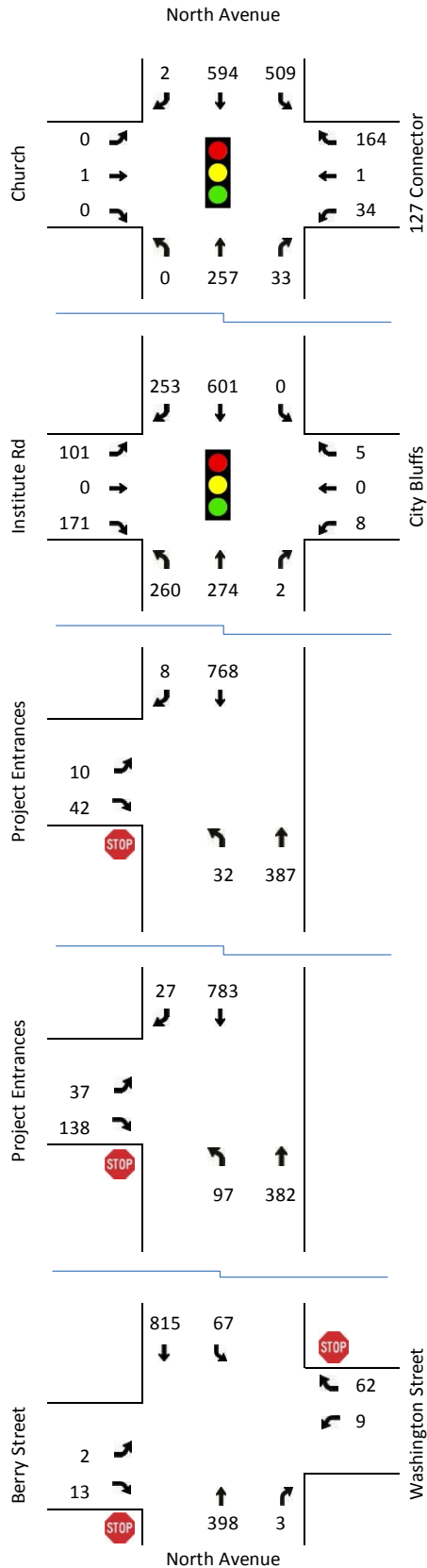


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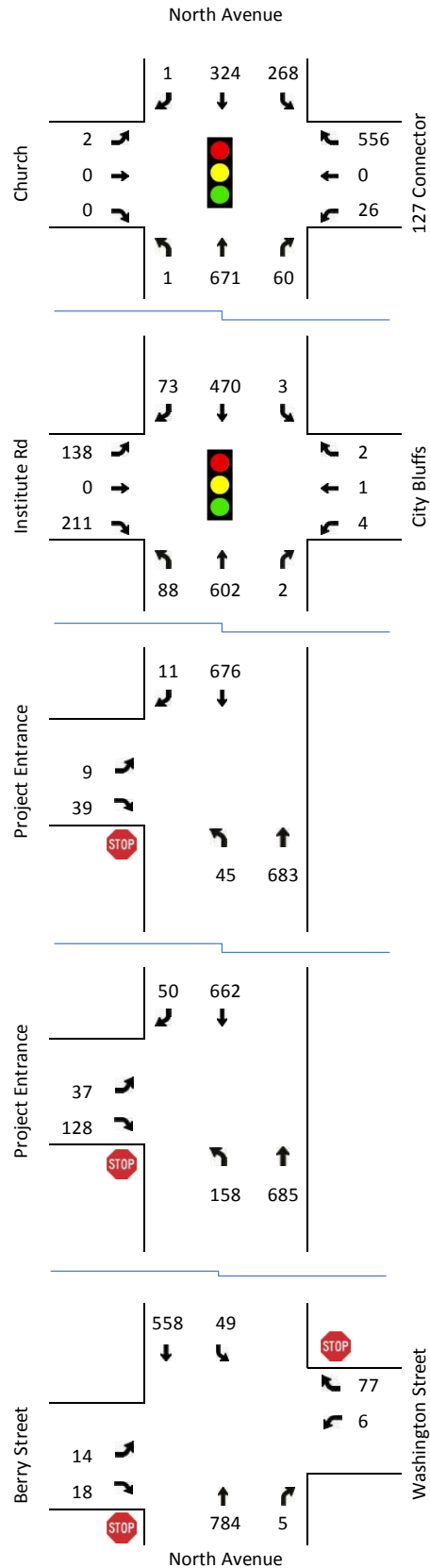


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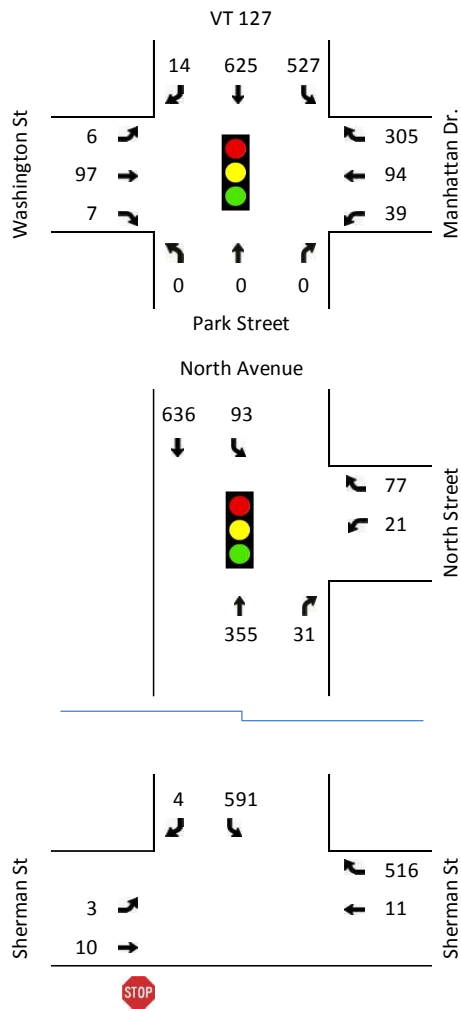
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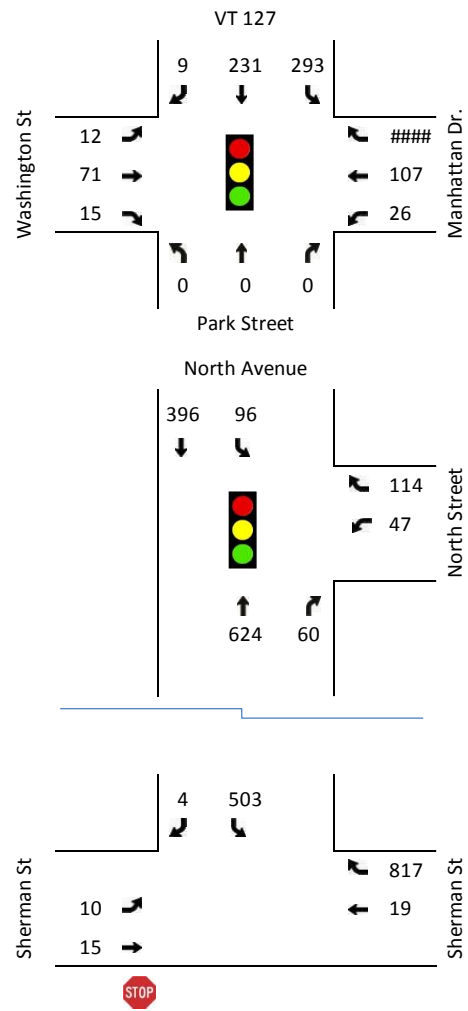
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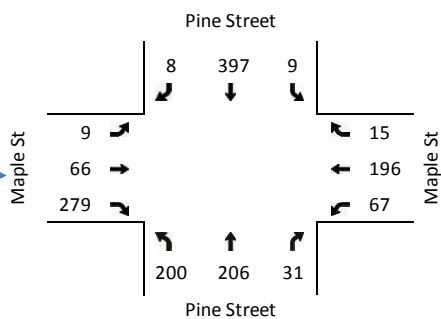
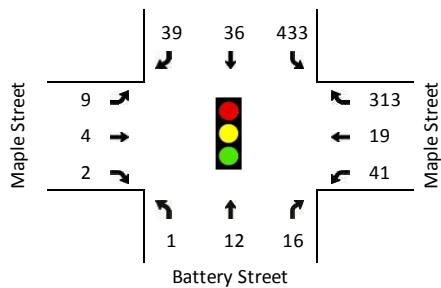
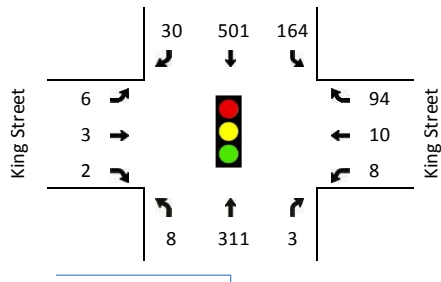
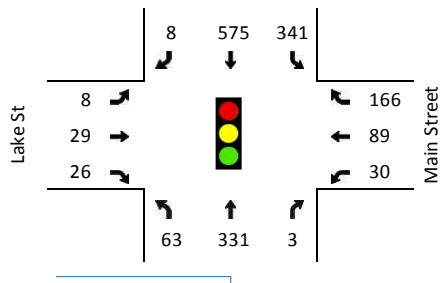
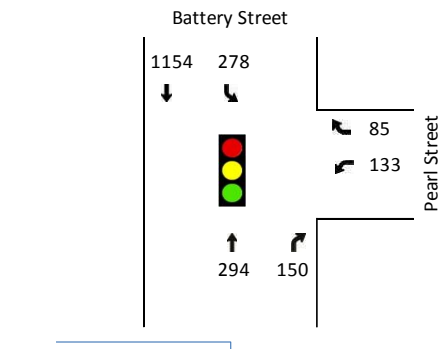


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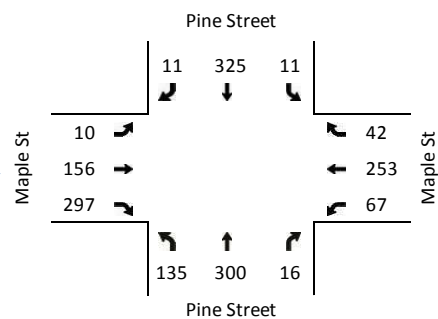
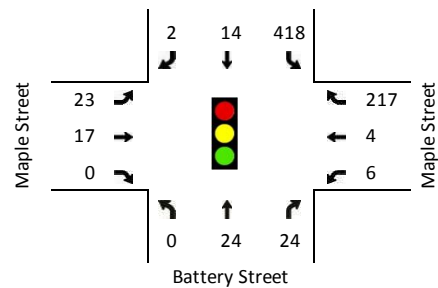
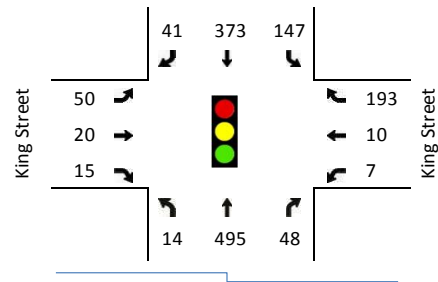
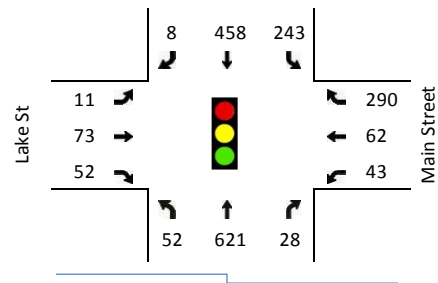
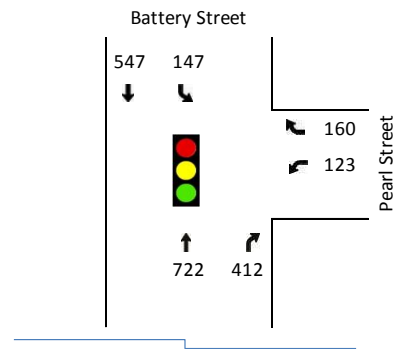


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AM 2022 Build



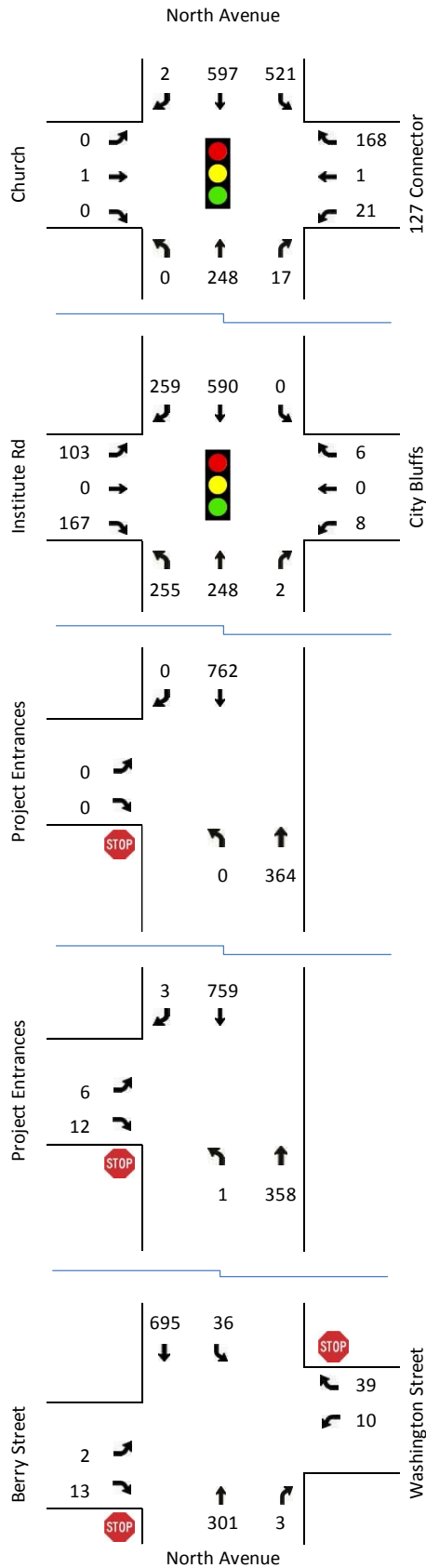
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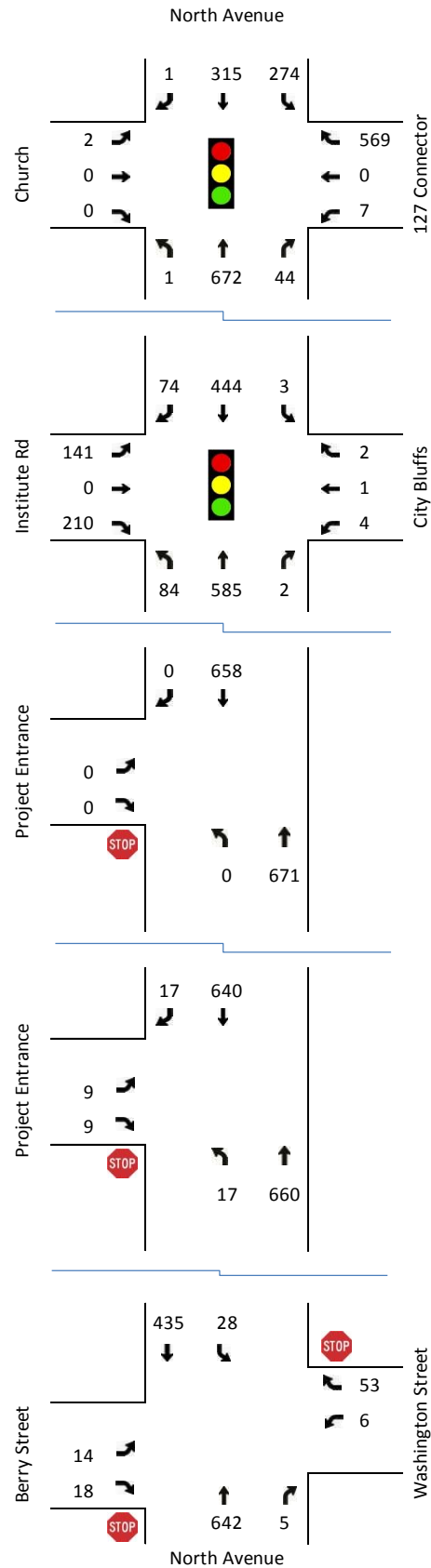
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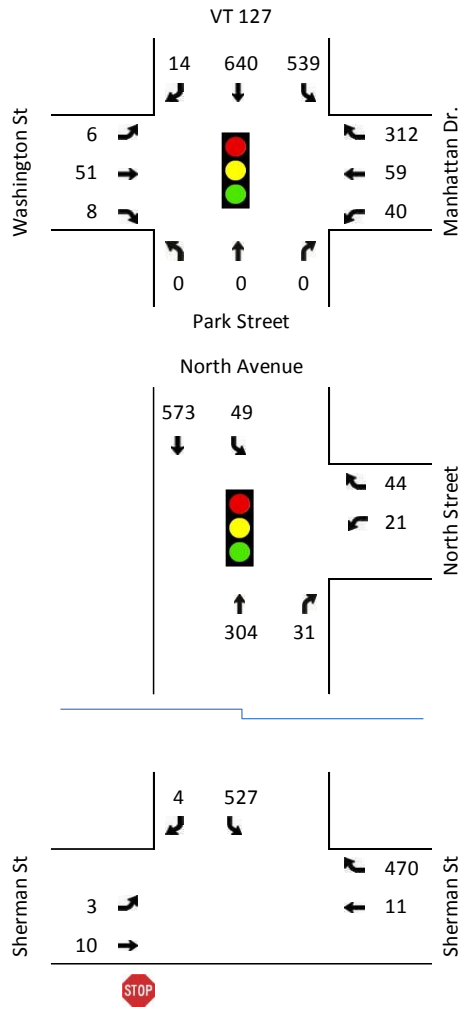


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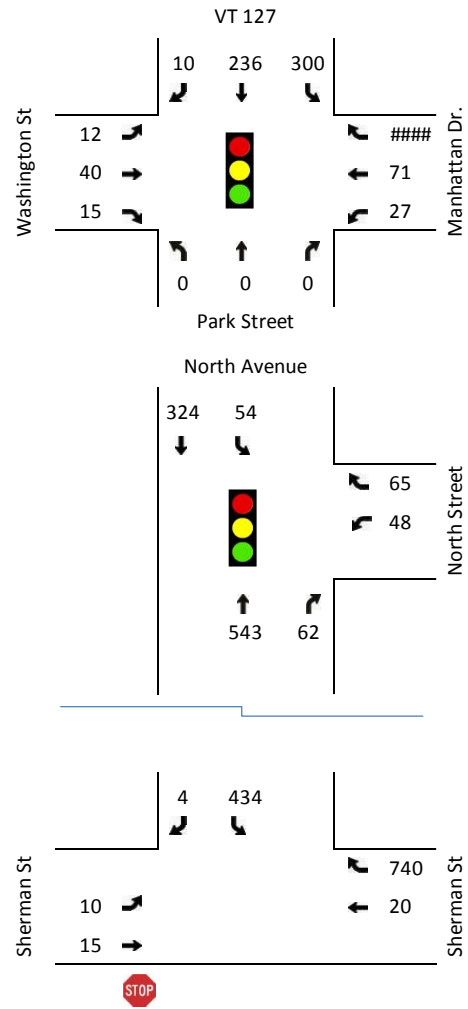


Map not to scale.

AM 2027 No Build



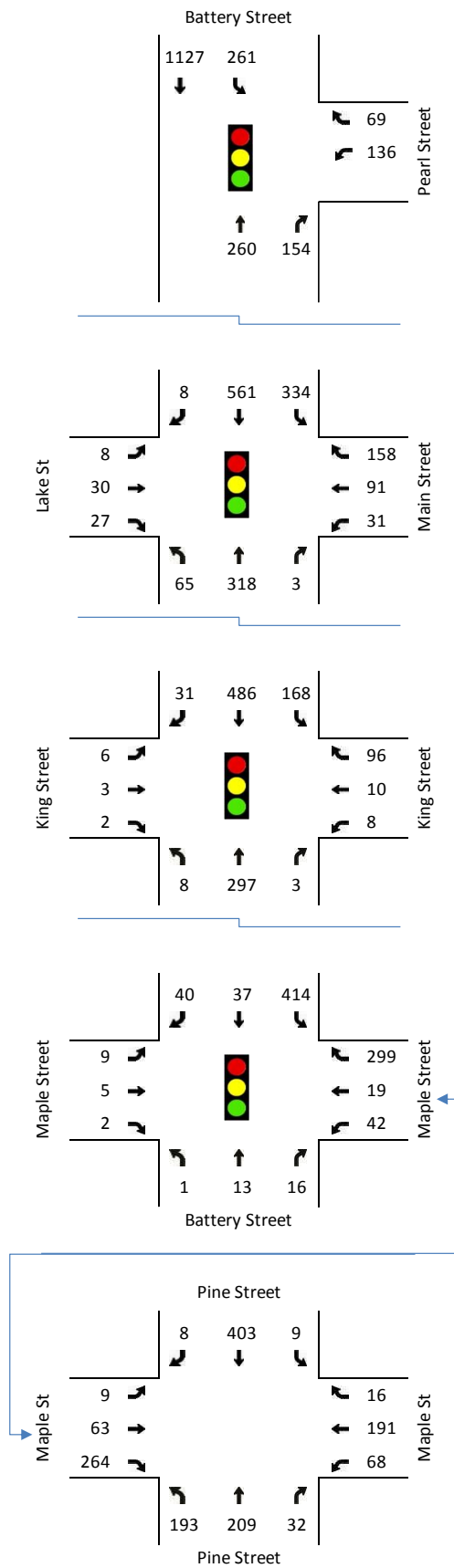
PM 2027 No Build



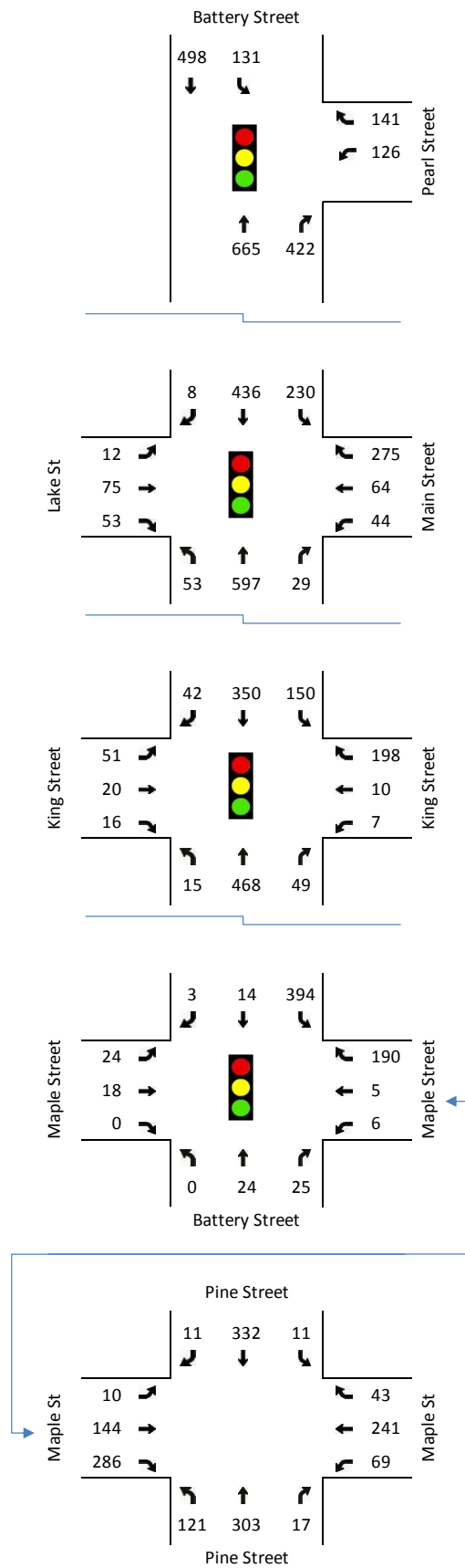
Map not to scale.



AM 2027 No Build

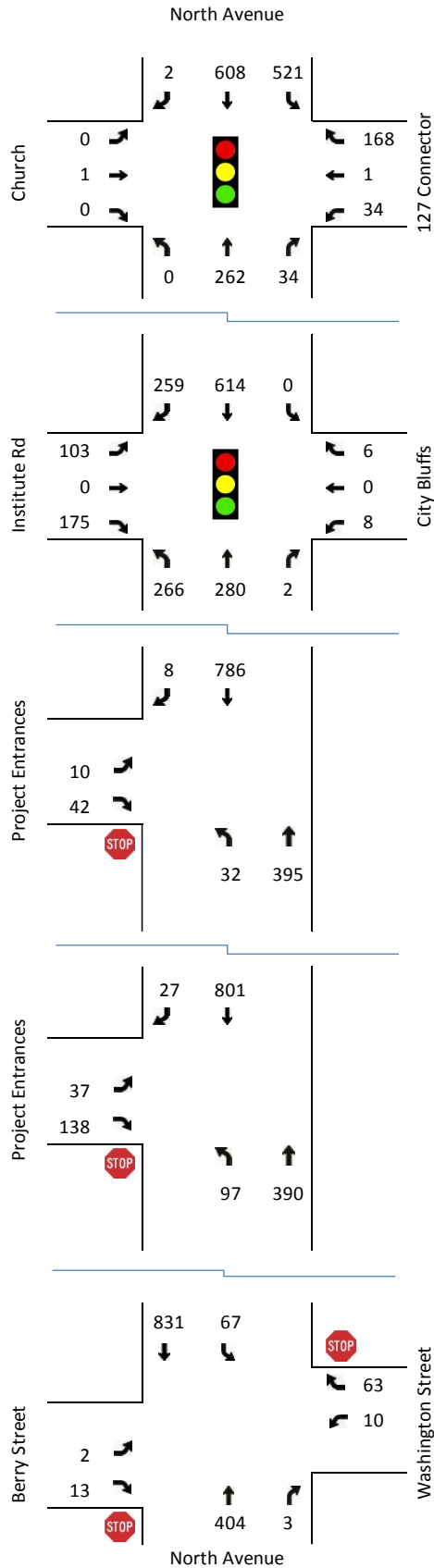


PM 2027 No Build

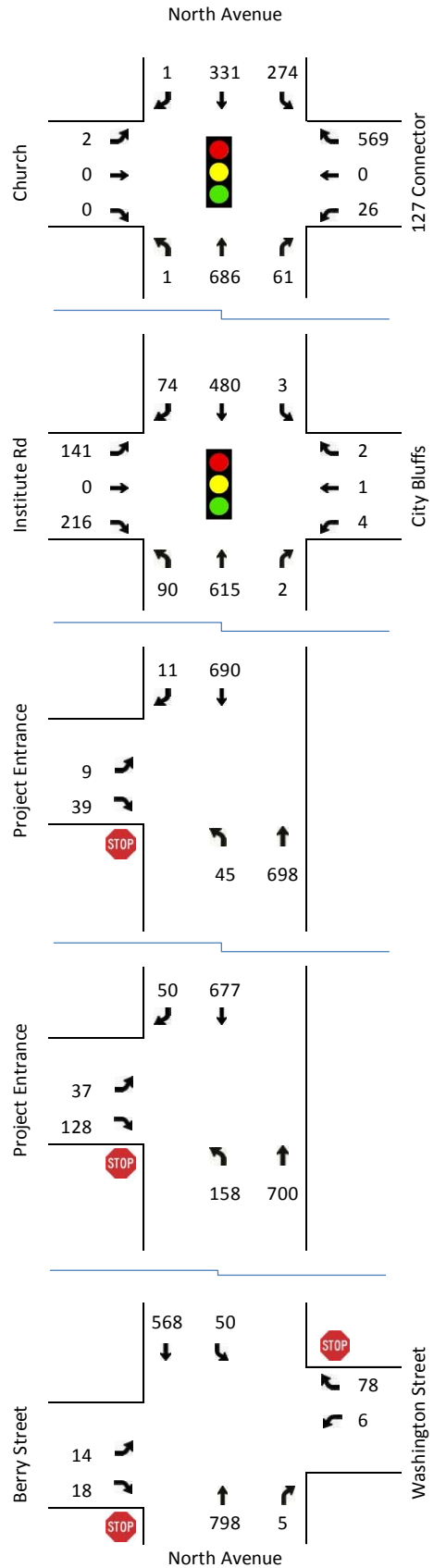


Map not to scale.

AM 2027 Build



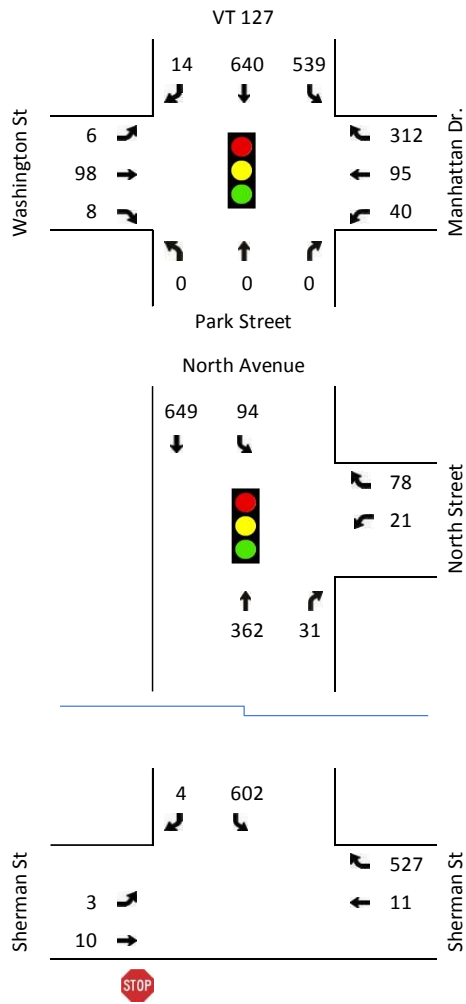
PM 2027 Build



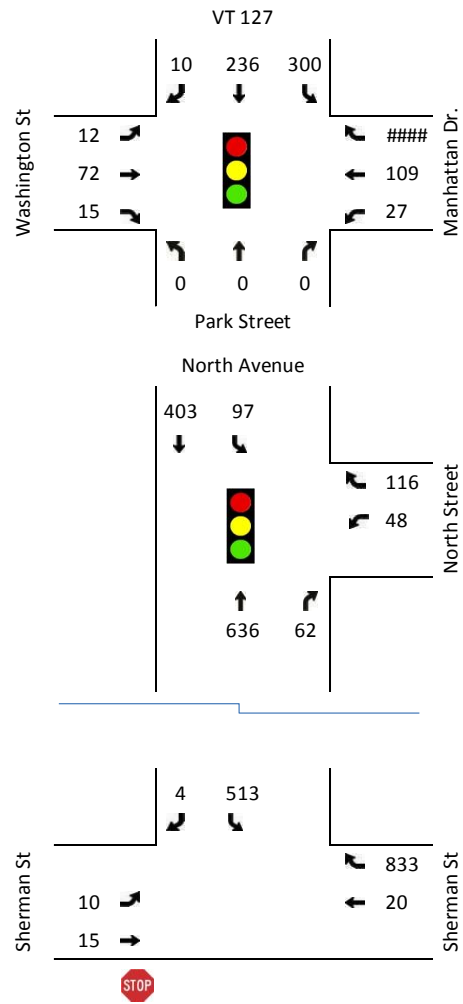
Map not to scale.



AM 2027 Build

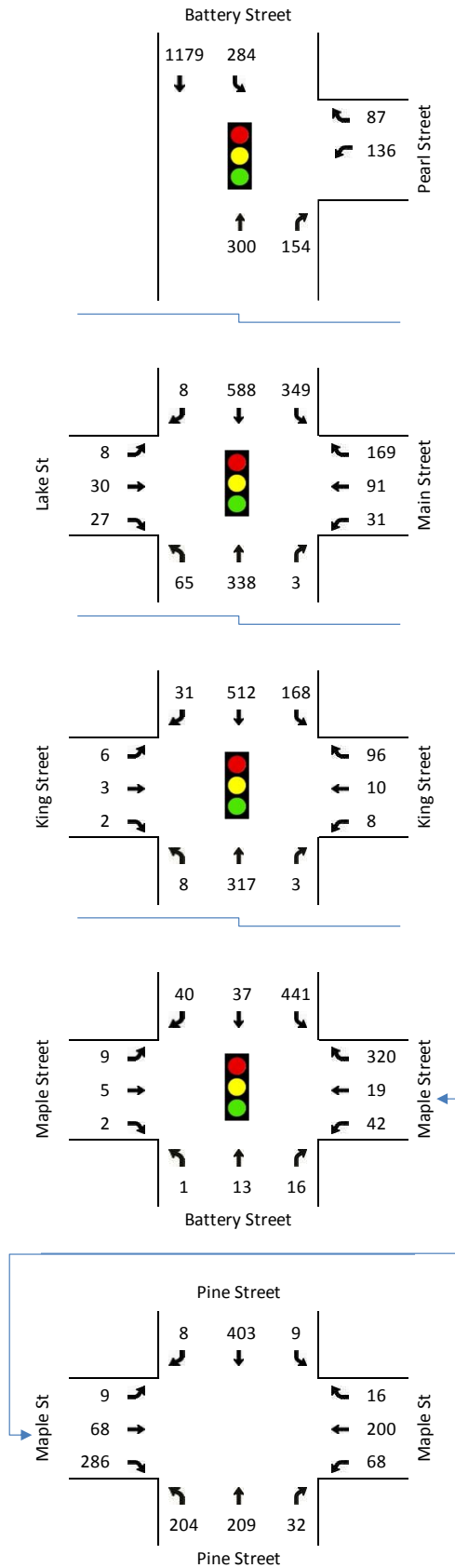


PM 2027 Build

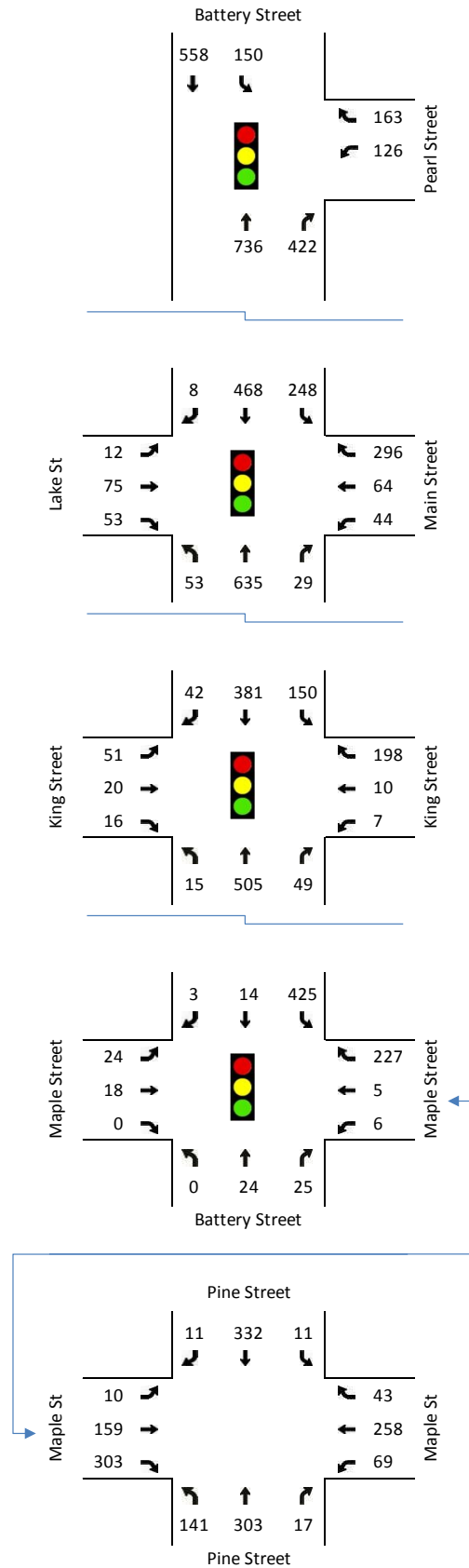


Map not to scale.

AM 2027 Build



PM 2027 Build



Map not to scale.



APPENDIX B. CRASH DATA

APPENDIX C. TRAFFIC VOLUME ADJUSTMENTS

- AM Peak Hour
- PM Peak Hour

Study Area ATRs and Corresponding AADTs

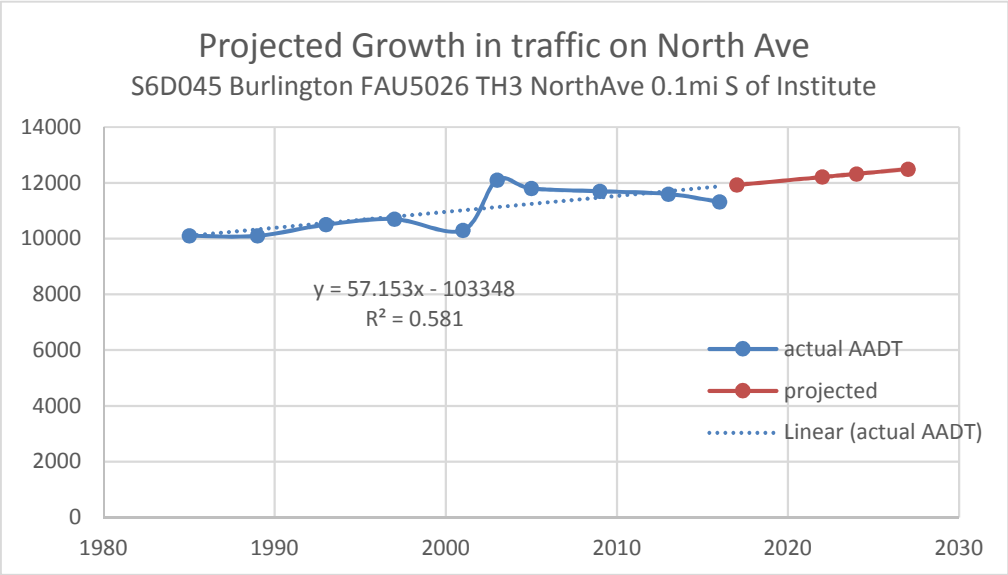
ATR	Year	AADT	
D045	2016	11316	FAU5011 0.1 m S of Institute Rd
	2013	11600	

Cambrian Rise Development,
North Ave, Burlington, VT

Annual Growth Adjustment Factor Calculation

S6D045 Burlington FAU5026 TH3 NorthAve 0.1mi Sof Institute

	AADT	change	5 yr change	avg	
2027	12495	101.4%	102.3%	0.47%	projected
2024	12324	100.9%			
2022	12209	102.4%			
2017	11924	105.4%			
2016	11316				
2013	11600				
2009	11700				
2005	11800				
2003	12100				
2001	10300				
1997	10700				
1993	10500				
1989	10100				
1985	10100				



APPENDIX D. SIGNAL WARRANT ANALYSIS

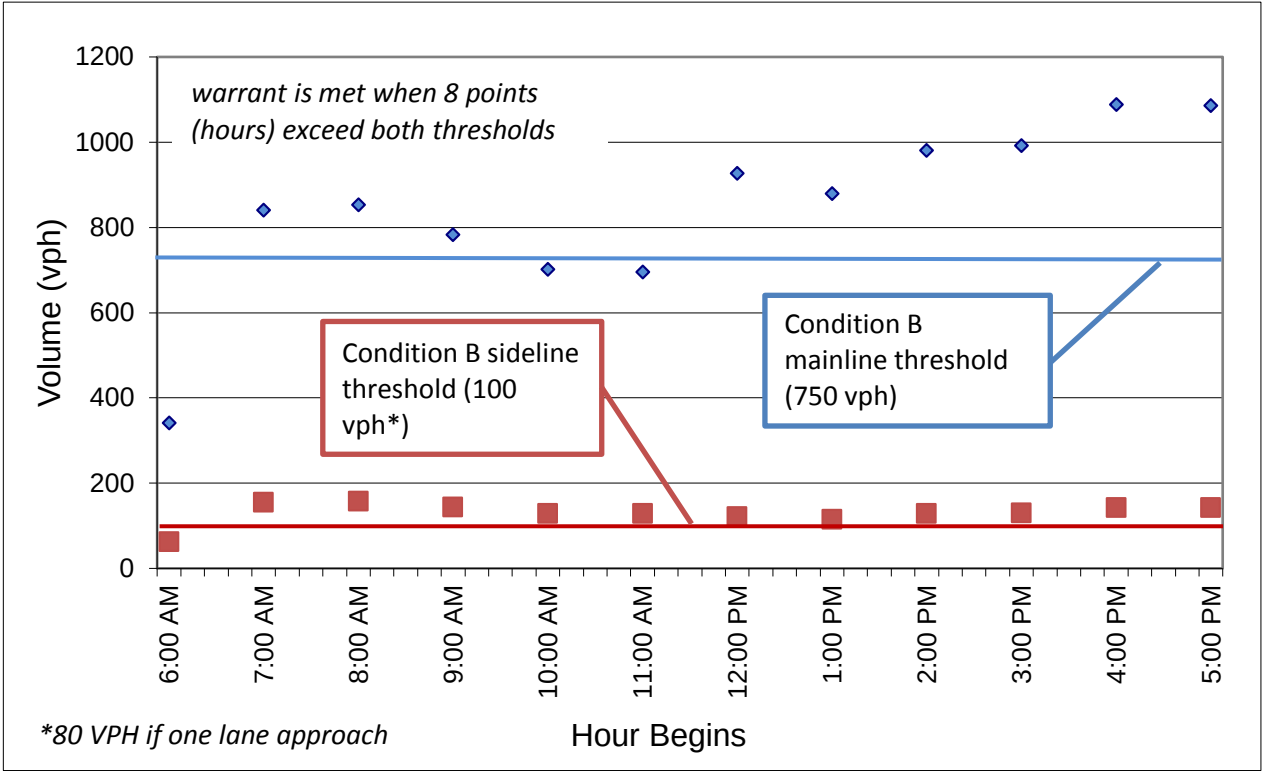
Signal Warrant Analysis - South Drive, Cambrian Rise

Existing traffic north of Washington/Berry/North Ave:

start time	Sideline traffic synthisized:		existing adjusted North Ave 2 way	N Avenue with DEV	AWDT vol. adjust 0.9
	EB Exit	SBR + NBL			
6:00 AM	62		293	341	
7:00 AM	155		723	841	
8:00 AM	157	120	734	853	
9:00 AM	144		673	783	
10:00 AM	129		603	701	
11:00 AM	128		599	696	
12:00 PM	122		785	927	
1:00 PM	115		744	879	
2:00 PM	129		831	981	
3:00 PM	130		840	992	
4:00 PM	143	167	922	1089	
5:00 PM	143		919	1086	

8 Hour Warrant Analysis:
Note condition A is not met, min sideline is 200 vph

Condition B - interruption of traffic:



4 Hour Warrant Analysis:

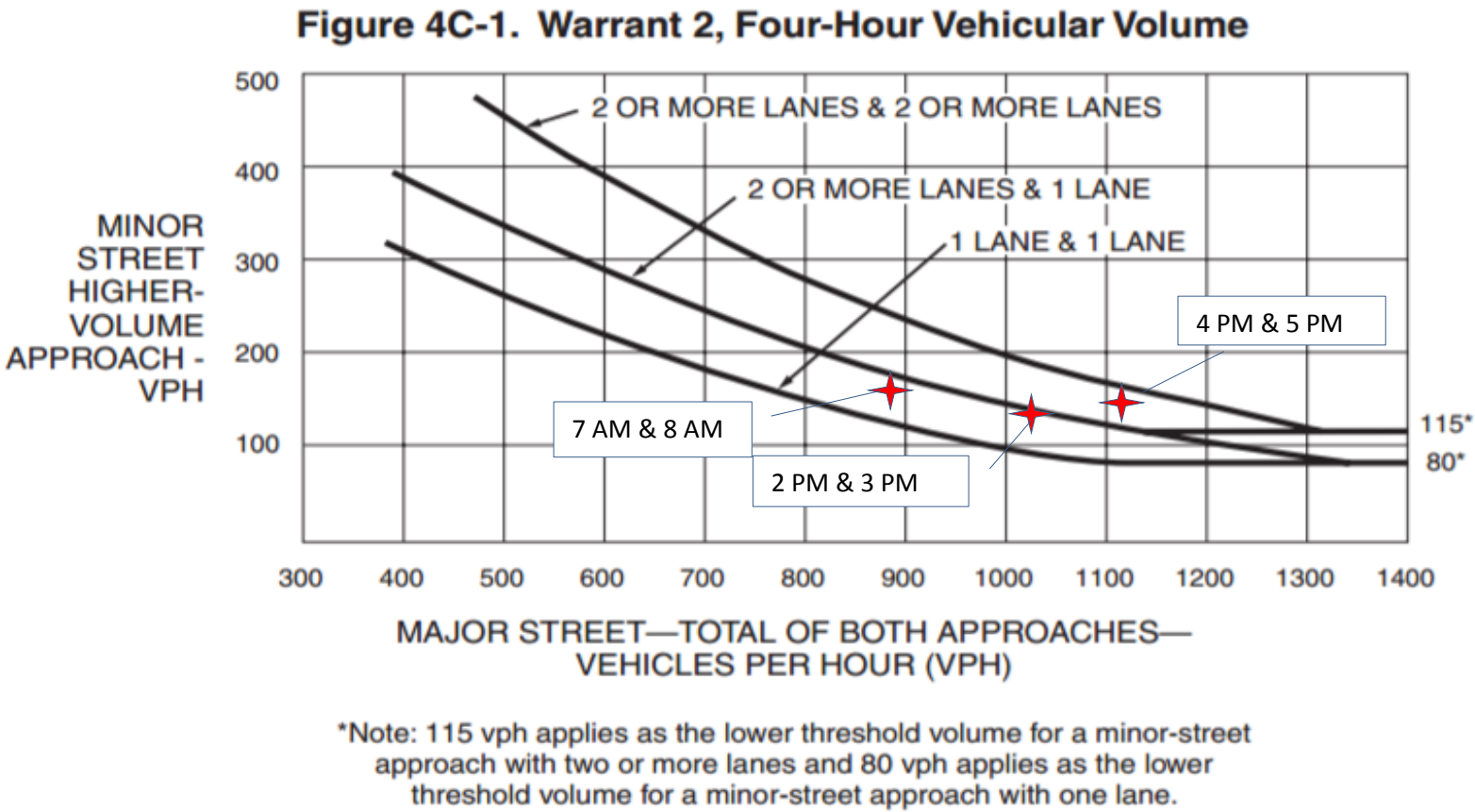


Table 4C-1. Warrant 1, Eight-Hour Vehicular Volume

Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
		100% ^a	80% ^a	70% ^c	56% ^d	100% ^a	80% ^a	70% ^c	56% ^d
1	1	500	400	350	280	150	120	105	84
2 or more	1	600	480	420	336	150	120	105	84
2 or more	2 or more	600	480	420	336	200	160	140	112
1	2 or more	500	400	350	280	200	160	140	112

Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
		100% ^a	80% ^a	70% ^c	56% ^d	100% ^a	80% ^a	70% ^c	56% ^d
1	1	750	600	525	420	75	60	53	42
2 or more	1	900	720	630	504	75	60	53	42
2 or more	2 or more	900	720	630	504	100	80	70	56
1	2 or more	750	600	525	420	100	80	70	56

^a Basic minimum hourly volume
^b Used for combination of Conditions A and B after adequate trial of other remedial measures
^c May be used when the major-street speed exceeds 40 mph or in an isolated community with a population of less than 10,000
^d May be used for combination of Conditions A and B after adequate trial of other remedial measures when the major-street speed exceeds 40 mph or in an isolated community with a population of less than 10,000

AWDT volume adjustment from Maureen Carr 9-1-16

Monthly DOW Factors							
Group 3 Urban							
From Year:		2015	To Year:		2015		
	Sun	Mon	Tue	Wed	Thu	Fri	Sat
Jan	1.639	1.064	1.063	1.001	1.138	0.949	1.252
Feb	1.708	1.202	1.007	0.983	0.992	0.919	1.251
Mar	1.526	1.013	0.988	0.974	0.959	0.908	1.195
Apr	1.514	0.978	0.947	0.933	0.916	0.879	1.176
May	1.309	1.016	0.893	0.886	0.864	0.829	1.081
Jun	1.289	0.911	0.895	0.870	0.856	0.825	1.083
Jul	1.308	0.902	0.883	0.870	0.848	0.863	1.242
Aug	1.286	0.899	0.875	0.867	0.847	0.830	1.111
Sep	1.324	1.002	0.886	0.890	0.867	0.823	1.089
Oct	1.314	0.922	0.900	0.894	0.866	0.826	1.075
Nov	1.452	0.954	0.917	0.949	1		8
Dec	1.458	0.937	0.986	0.912	0		5

AWD factor for signal warrant

Signal Warrant Analysis - South Drive, Cambrian Rise

Peak Hour Warrant

using the largest consecutive 15 minute volumes:

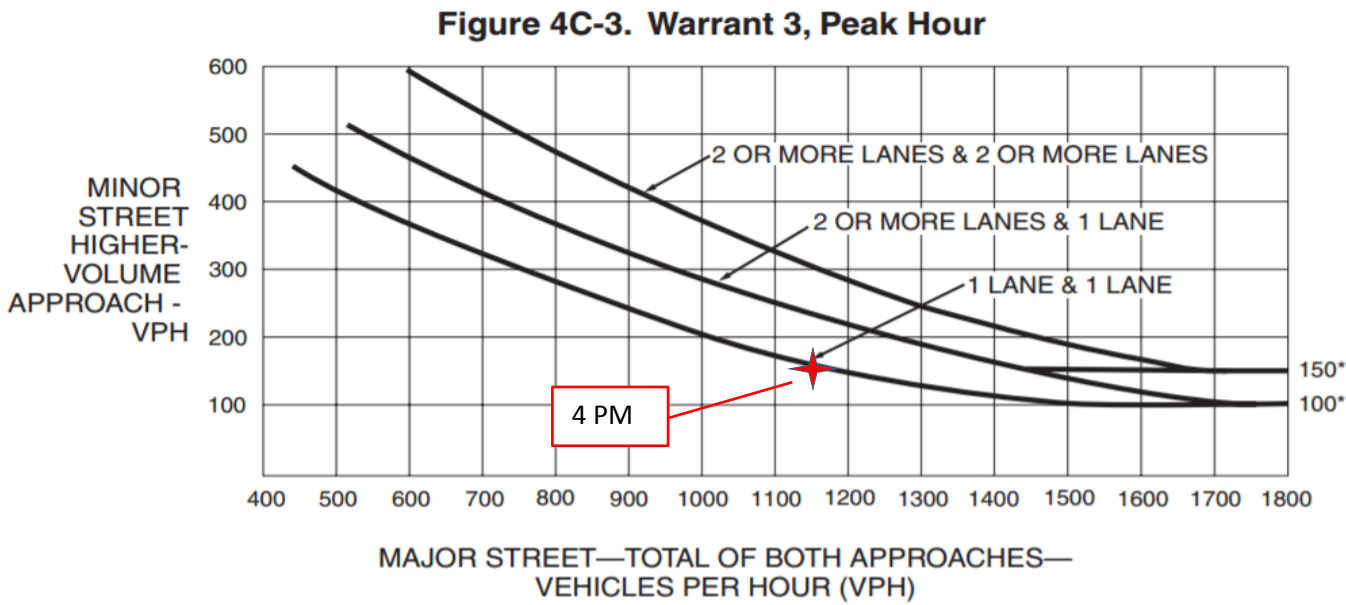
	main	side
peak vol	1155	143

alternately, meet these 3 conditions:

stop delay must exceed 5 hours (2 la)

volume on minor exceeds 150 (2 lanes on side approach)

total volume excee 650 (3 approaches)



*Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

This signal warrant shall be applied only in unusual cases, such as office complexes, manufacturing plants, industrial complexes, or high-occupancy vehicle facilities that attract or discharge large numbers of vehicles over a short time.

APPENDIX E. TRAFFIC ANALYSIS WORKSHEETS

- HCM Output (15 intersections)
- Queuing Output (15 intersections)
- HCM Output with the Champlain Parkway (2 intersections)
- Queuing Output with the Champlain Parkway (2 intersections)



- HCM Output (15 intersections)

HCM Signalized Intersection Capacity Analysis

2: North Ave & Church/127 Connector

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1	0	20	1	164	0	242	16	508	583	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	10	10	10	10	10	10
Total Lost time (s)		4.0			4.0	4.0		4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00	1.00		1.00		1.00	1.00	
Frpb, ped/bikes		1.00			1.00	1.00		1.00		1.00	1.00	
Flpb, ped/bikes		1.00			0.99	1.00		1.00		1.00	1.00	
Frt		1.00			1.00	0.85		0.99		1.00	1.00	
Flt Protected		1.00			0.95	1.00		1.00		0.95	1.00	
Satd. Flow (prot)		1900			1725	1553		1612		1652	1738	
Flt Permitted		1.00			0.77	1.00		1.00		0.46	1.00	
Satd. Flow (perm)		1900			1395	1553		1612		795	1738	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	1	0	20	1	164	0	242	16	508	583	2
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	1	0	0	21	164	0	258	0	508	585	0
Confl. Peds. (#/hr)	9		7	7		9	1					1
Heavy Vehicles (%)	0%	0%	0%	4%	4%	4%	9%	9%	9%	2%	2%	2%
Turn Type		NA		Perm	NA	pt+ov	Perm	NA		pm+pt	NA	
Protected Phases		4			8	8 1		2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		7.7			7.7	24.1		18.3		34.7	34.7	
Effective Green, g (s)		8.7			8.7	25.1		19.3		35.7	35.7	
Actuated g/C Ratio		0.17			0.17	0.48		0.37		0.68	0.68	
Clearance Time (s)		5.0			5.0			5.0		5.0	5.0	
Vehicle Extension (s)		3.0			3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)		315			231	743		593		744	1184	
v/s Ratio Prot		0.00				c0.11		0.16		c0.16	0.34	
v/s Ratio Perm					0.02					c0.30		
v/c Ratio		0.00			0.09	0.22		0.44		0.68	0.49	
Uniform Delay, d1		18.2			18.5	8.0		12.4		4.4	4.0	
Progression Factor		1.00			1.00	1.00		1.00		1.00	1.00	
Incremental Delay, d2		0.0			0.2	0.2		2.3		2.6	1.5	
Delay (s)		18.2			18.7	8.1		14.8		7.0	5.5	
Level of Service		B			B	A		B		A	A	
Approach Delay (s)		18.2			9.3			14.8			6.2	
Approach LOS		B			A			B			A	
Intersection Summary												
HCM 2000 Control Delay			8.0				HCM 2000 Level of Service			A		
HCM 2000 Volume to Capacity ratio			0.65									
Actuated Cycle Length (s)			52.4				Sum of lost time (s)			12.0		
Intersection Capacity Utilization			61.1%				ICU Level of Service			B		
Analysis Period (min)			60									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

3: North Ave & Institute Rd/City Bluffs

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	100	0	163	7	0	5	249	242	2	0	577	253
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	10	10	10	10	10	10
Total Lost time (s)		4.0	5.0		4.0		5.0	4.0			4.0	4.0
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00			1.00	1.00
Frpb, ped/bikes		1.00	0.97		1.00		1.00	1.00			1.00	0.97
Flpb, ped/bikes		1.00	1.00		0.98		1.00	1.00			1.00	1.00
Frt		1.00	0.85		0.94		1.00	1.00			1.00	0.85
Flt Protected		0.95	1.00		0.97		0.95	1.00			1.00	1.00
Satd. Flow (prot)		1787	1559		1716		1636	1719			1756	1450
Flt Permitted		0.75	1.00		0.84		0.27	1.00			1.00	1.00
Satd. Flow (perm)		1410	1559		1480		460	1719			1756	1450
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	100	0	163	7	0	5	249	242	2	0	577	253
RTOR Reduction (vph)	0	0	120	0	10	0	0	0	0	0	0	119
Lane Group Flow (vph)	0	100	43	0	2	0	249	244	0	0	577	134
Confl. Peds. (#/hr)			14	14			9		1	1		9
Heavy Vehicles (%)	1%	1%	1%	0%	0%	0%	3%	3%	3%	1%	1%	1%
Turn Type	Perm	NA	pm+ov	Perm	NA		pm+pt	NA			NA	Perm
Protected Phases		4	5		8		5	2		1	6	
Permitted Phases	4		4	8			2			6		6
Actuated Green, G (s)		9.1	17.8		9.1		48.5	40.7			34.8	34.8
Effective Green, g (s)		10.1	17.8		10.1		48.5	41.7			35.8	35.8
Actuated g/C Ratio		0.15	0.26		0.15		0.72	0.62			0.53	0.53
Clearance Time (s)		5.0	5.0		5.0		5.0	5.0			5.0	5.0
Vehicle Extension (s)		4.0	3.0		4.0		3.0	3.0			3.0	3.0
Lane Grp Cap (vph)		210	525		221		481	1060			929	767
v/s Ratio Prot			0.01				c0.07	0.14			c0.33	
v/s Ratio Perm		c0.07	0.02		0.00		0.30					0.09
v/c Ratio		0.48	0.08		0.01		0.52	0.23			0.62	0.17
Uniform Delay, d1		26.3	18.7		24.5		6.0	5.8			11.1	8.2
Progression Factor		1.00	1.00		1.00		1.00	1.00			1.00	1.00
Incremental Delay, d2		2.3	0.1		0.0		0.9	0.5			3.2	0.5
Delay (s)		28.7	18.8		24.5		6.9	6.3			14.3	8.7
Level of Service		C	B		C		A	A			B	A
Approach Delay (s)		22.6			24.5			6.6			12.6	
Approach LOS		C			C			A			B	
Intersection Summary												
HCM 2000 Control Delay			12.5				HCM 2000 Level of Service				B	
HCM 2000 Volume to Capacity ratio			0.58									
Actuated Cycle Length (s)			67.6				Sum of lost time (s)			13.0		
Intersection Capacity Utilization			67.4%				ICU Level of Service			C		
Analysis Period (min)			60									

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

4: North Ave & North Drive

12/21/2016

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	0	0	0	355	744	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	0	0	0	355	744	0
Pedestrians	25			10	10	
Lane Width (ft)	12.0			10.0	10.0	
Walking Speed (ft/s)	4.0			4.0	4.0	
Percent Blockage	2			1	1	
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1134	779	769			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1134	779	769			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	100	100			
cM capacity (veh/h)	220	388	823			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	0	355	744			
Volume Left	0	0	0			
Volume Right	0	0	0			
cSH	1700	823	1700			
Volume to Capacity	0.00	0.00	0.44			
Queue Length 95th (ft)	0	0	0			
Control Delay (s)	0.0	0.0	0.0			
Lane LOS	A					
Approach Delay (s)	0.0	0.0	0.0			
Approach LOS	A					
Intersection Summary						
Average Delay		0.0				
Intersection Capacity Utilization		52.0%		ICU Level of Service		A
Analysis Period (min)		60				

HCM Unsignalized Intersection Capacity Analysis

5: North Ave & South Access Drive

12/21/2016

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	5	11	1	349	741	2
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	5	11	1	349	741	2
Pedestrians	25			10	10	
Lane Width (ft)	12.0			10.0	12.0	
Walking Speed (ft/s)	4.0			4.0	4.0	
Percent Blockage	2			1	1	
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1128	777	768			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1128	777	768			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	97	100			
cM capacity (veh/h)	221	389	824			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	16	350	743			
Volume Left	5	1	0			
Volume Right	11	0	2			
cSH	314	824	1700			
Volume to Capacity	0.05	0.00	0.44			
Queue Length 95th (ft)	4	0	0			
Control Delay (s)	17.1	0.0	0.0			
Lane LOS	C	A				
Approach Delay (s)	17.1	0.0	0.0			
Approach LOS	C					
Intersection Summary						
Average Delay			0.3			
Intersection Capacity Utilization		52.0%		ICU Level of Service		A
Analysis Period (min)		60				

HCM Unsignalized Intersection Capacity Analysis

6: North Ave & Berry St/Washington

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	0	12	9	1	37	4	293	3	34	679	2
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour 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
Hourly flow rate (vph)	2	0	12	9	1	37	4	293	3	34	679	2
Pedestrians		2			12			8				
Lane Width (ft)		12.0			12.0			12.0				
Walking Speed (ft/s)		4.0			4.0			4.0				
Percent Blockage		0			1			1				
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1090	1066	690	1082	1066	306	683			308		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1090	1066	690	1082	1066	306	683			308		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	99	100	97	95	100	95	100			97		
cM capacity (veh/h)	178	214	445	182	215	731	904			1246		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	14	47	300	715								
Volume Left	2	9	4	34								
Volume Right	12	37	3	2								
cSH	366	449	904	1246								
Volume to Capacity	0.04	0.10	0.00	0.03								
Queue Length 95th (ft)	3	9	0	2								
Control Delay (s)	15.2	14.0	0.2	0.7								
Lane LOS	C	B	A	A								
Approach Delay (s)	15.2	14.0	0.2	0.7								
Approach LOS	C	B										
Intersection Summary												
Average Delay			1.3									
Intersection Capacity Utilization			74.8%		ICU Level of Service					D		
Analysis Period (min)			60									

HCM Signalized Intersection Capacity Analysis

7: VT 127 - Park & Manhattan Dr.

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	6	49	7	38	57	304	0	0	0	527	625	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0	5.0				5.0	5.0	
Lane Util. Factor		1.00			1.00	1.00				1.00	1.00	
Frpb, ped/bikes		1.00			1.00	1.00				1.00	1.00	
Flpb, ped/bikes		1.00			1.00	1.00				1.00	1.00	
Frt		0.98			1.00	0.85				1.00	1.00	
Flt Protected		1.00			0.98	1.00				0.95	1.00	
Satd. Flow (prot)		1822			1739	1509				1805	1894	
Flt Permitted		0.97			0.84	1.00				0.95	1.00	
Satd. Flow (perm)		1768			1495	1509				1805	1894	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	6	49	7	38	57	304	0	0	0	527	625	13
RTOR Reduction (vph)	0	6	0	0	0	0	0	0	0	0	1	0
Lane Group Flow (vph)	0	56	0	0	95	304	0	0	0	527	637	0
Confl. Peds. (#/hr)			2	2					9	9		
Heavy Vehicles (%)	2%	2%	2%	7%	7%	7%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA	pt+ov				Prot	NA	
Protected Phases		8			4	4 1				1	6	
Permitted Phases	8			4								
Actuated Green, G (s)		9.2			9.2	53.3				34.1	34.1	
Effective Green, g (s)		9.2			9.2	53.3				34.1	34.1	
Actuated g/C Ratio		0.17			0.17	1.00				0.64	0.64	
Clearance Time (s)		5.0			5.0					5.0	5.0	
Vehicle Extension (s)		3.0			3.0					3.0	3.0	
Lane Grp Cap (vph)		305			258	1509				1154	1211	
v/s Ratio Prot						0.20				0.29	c0.34	
v/s Ratio Perm		0.03			c0.06							
v/c Ratio		0.18			0.37	0.20				0.46	0.53	
Uniform Delay, d1		18.8			19.5	0.0				4.9	5.2	
Progression Factor		1.00			1.00	1.00				1.00	1.00	
Incremental Delay, d2		0.3			0.9	0.1				1.3	1.6	
Delay (s)		19.1			20.4	0.1				6.2	6.9	
Level of Service		B			C	A				A	A	
Approach Delay (s)		19.1			4.9			0.0			6.6	
Approach LOS		B			A			A			A	
Intersection Summary												
HCM 2000 Control Delay			6.6				HCM 2000 Level of Service			A		
HCM 2000 Volume to Capacity ratio			0.49									
Actuated Cycle Length (s)			53.3				Sum of lost time (s)			10.0		
Intersection Capacity Utilization			53.8%				ICU Level of Service			A		
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

8: North Ave & North Street

12/21/2016

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	20	42	297	30	47	560
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	12	10	10	10	10
Total Lost time (s)	3.0		3.0		3.0	3.0
Lane Util. Factor	1.00		1.00		1.00	1.00
Frpb, ped/bikes	1.00		1.00		1.00	1.00
Flpb, ped/bikes	1.00		1.00		1.00	1.00
Frt	0.91		0.99		1.00	1.00
Flt Protected	0.98		1.00		0.95	1.00
Satd. Flow (prot)	1699		1697		1651	1739
Flt Permitted	0.98		1.00		0.50	1.00
Satd. Flow (perm)	1699		1697		876	1739
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	20	42	297	30	47	560
RTOR Reduction (vph)	39	0	0	0	0	0
Lane Group Flow (vph)	23	0	327	0	47	560
Confl. Peds. (#/hr)	7			3	3	
Heavy Vehicles (%)	0%	0%	3%	3%	2%	2%
Turn Type	Prot		NA		pm+pt	NA
Protected Phases	8		2		1	6
Permitted Phases					6	
Actuated Green, G (s)	4.5		53.1		60.4	60.4
Effective Green, g (s)	6.5		55.1		62.4	62.4
Actuated g/C Ratio	0.08		0.67		0.76	0.76
Clearance Time (s)	5.0		5.0		5.0	5.0
Vehicle Extension (s)	3.0		4.0		3.0	4.0
Lane Grp Cap (vph)	134		1134		703	1316
v/s Ratio Prot	c0.01		0.19		0.00	c0.32
v/s Ratio Perm					0.05	
v/c Ratio	0.17		0.29		0.07	0.43
Uniform Delay, d1	35.4		5.6		2.7	3.6
Progression Factor	1.00		1.00		1.00	1.00
Incremental Delay, d2	0.6		0.6		0.0	1.0
Delay (s)	36.1		6.2		2.8	4.6
Level of Service	D		A		A	A
Approach Delay (s)	36.1		6.2			4.5
Approach LOS	D		A			A
Intersection Summary						
HCM 2000 Control Delay			7.0		HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio			0.40			
Actuated Cycle Length (s)			82.4		Sum of lost time (s)	14.0
Intersection Capacity Utilization			39.8%		ICU Level of Service	A
Analysis Period (min)			60			

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

9: Sherman St & North Ave

12/21/2016



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	3	9	10	458	515	4
Sign Control		Stop	Yield		Free	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	3	9	10	458	515	4
Pedestrians		4	10		8	
Lane Width (ft)		12.0	12.0		10.0	
Walking Speed (ft/s)		4.0	4.0		4.0	
Percent Blockage		0	1		1	
Right turn flare (veh)						
Median type					None	
Median storage (veh)						
Upstream signal (ft)					986	
pX, platoon unblocked						
vC, conflicting volume	1049	1046	1048	18	10	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1049	1046	1048	18	10	
tC, single (s)	7.1	6.5	6.6	6.3	4.1	
tC, 2 stage (s)						
tF (s)	3.5	4.0	4.1	3.4	2.2	
p0 queue free %	96	94	93	56	67	
cM capacity (veh/h)	81	153	149	1032	1577	
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	12	468	519			
Volume Left	3	0	515			
Volume Right	0	458	4			
cSH	125	915	1577			
Volume to Capacity	0.10	0.51	0.33			
Queue Length 95th (ft)	8	77	36			
Control Delay (s)	36.8	13.0	8.3			
Lane LOS	E	B	A			
Approach Delay (s)	36.8	13.0	8.3			
Approach LOS	E	B				
Intersection Summary						
Average Delay		10.9				
Intersection Capacity Utilization		65.1%		ICU Level of Service		C
Analysis Period (min)		60				

HCM Signalized Intersection Capacity Analysis

10: Battery Street & Pearl Street

12/21/2016

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	132	67	253	150	254	1101
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0		5.0
Lane Util. Factor	1.00	1.00	1.00	1.00		0.95
Frpb, ped/bikes	1.00	1.00	1.00	0.97		1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00		1.00
Frt	1.00	0.85	1.00	0.85		1.00
Flt Protected	0.95	1.00	1.00	1.00		0.99
Satd. Flow (prot)	1612	1442	1727	1418		3502
Flt Permitted	0.95	1.00	1.00	1.00		0.76
Satd. Flow (perm)	1612	1442	1727	1418		2692
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	132	67	253	150	254	1101
RTOR Reduction (vph)	0	55	0	71	0	0
Lane Group Flow (vph)	132	12	253	79	0	1355
Confl. Peds. (#/hr)	7			15	15	
Heavy Vehicles (%)	12%	12%	10%	10%	2%	2%
Turn Type	Prot	pt+ov	NA	Perm	pm+pt	NA
Protected Phases	3	3 1	2		1	6
Permitted Phases				2	6	
Actuated Green, G (s)	12.3	16.4	47.2	47.2		56.3
Effective Green, g (s)	12.3	16.4	47.2	47.2		56.3
Actuated g/C Ratio	0.14	0.18	0.52	0.52		0.63
Clearance Time (s)	5.0		5.0	5.0		5.0
Vehicle Extension (s)	3.0		3.0	3.0		3.0
Lane Grp Cap (vph)	220	262	905	743		1720
v/s Ratio Prot	c0.08	0.01	0.15			c0.04
v/s Ratio Perm				0.06		c0.46
v/c Ratio	0.60	0.05	0.28	0.11		0.79
Uniform Delay, d1	36.5	30.4	11.9	10.8		12.4
Progression Factor	1.00	1.00	0.75	1.26		0.87
Incremental Delay, d2	4.4	0.1	0.8	0.3		2.2
Delay (s)	41.0	30.4	9.7	13.9		13.0
Level of Service	D	C	A	B		B
Approach Delay (s)	37.4		11.3			13.0
Approach LOS	D		B			B
Intersection Summary						
HCM 2000 Control Delay			15.1		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.73			
Actuated Cycle Length (s)			90.0		Sum of lost time (s)	20.0
Intersection Capacity Utilization			70.9%		ICU Level of Service	C
Analysis Period (min)			60			
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis

11: Battery Street & Main Street/Main Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	7	29	25	30	89	154	63	310	3	326	548	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0		5.0	5.0		5.0		5.0	5.0	
Lane Util. Factor		1.00	1.00		1.00	1.00		0.95		1.00	1.00	
Frpb, ped/bikes		1.00	0.97		1.00	0.99		1.00		1.00	1.00	
Flpb, ped/bikes		1.00	1.00		1.00	1.00		1.00		1.00	1.00	
Frt		1.00	0.85		1.00	0.85		1.00		1.00	1.00	
Flt Protected		0.99	1.00		0.99	1.00		0.99		0.95	1.00	
Satd. Flow (prot)		1725	1432		1717	1469		3497		1779	1877	
Flt Permitted		0.91	1.00		0.59	1.00		0.80		0.43	1.00	
Satd. Flow (perm)		1580	1432		1029	1469		2811		803	1877	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	7	29	25	30	89	154	63	310	3	326	548	7
RTOR Reduction (vph)	0	0	23	0	0	110	0	1	0	0	0	0
Lane Group Flow (vph)	0	36	2	0	119	44	0	375	0	326	555	0
Confl. Peds. (#/hr)	2		5	5		2	10		10	10		10
Heavy Vehicles (%)	9%	9%	9%	9%	9%	9%	2%	2%	2%	1%	1%	1%
Turn Type	Perm	NA	Perm	Perm	NA	pm+ov	Perm	NA		pm+pt	NA	
Protected Phases		4			8	1		2		1	6	
Permitted Phases	4		4	8		8	2			6		
Actuated Green, G (s)		7.2	7.2		14.4	25.5		44.8		65.6	61.0	
Effective Green, g (s)		7.2	7.2		14.4	25.5		44.8		65.6	61.0	
Actuated g/C Ratio		0.08	0.08		0.16	0.28		0.50		0.73	0.68	
Clearance Time (s)		5.0	5.0		5.0	5.0		5.0		5.0	5.0	
Vehicle Extension (s)		3.0	3.0		3.0	3.0		3.0		3.0	3.0	
Lane Grp Cap (vph)		126	114		164	497		1399		705	1272	
v/s Ratio Prot						0.01				c0.06	0.30	
v/s Ratio Perm		0.02	0.00		c0.12	0.02		0.13		c0.28		
v/c Ratio		0.29	0.02		0.73	0.09		0.27		0.46	0.44	
Uniform Delay, d1		39.0	38.1		35.9	23.7		13.1		4.9	6.6	
Progression Factor		1.00	1.00		1.00	1.00		1.01		1.57	1.10	
Incremental Delay, d2		1.3	0.1		16.0	0.1		0.5		0.3	0.7	
Delay (s)		40.2	38.2		51.9	23.8		13.6		8.1	8.0	
Level of Service		D	D		D	C		B		A	A	
Approach Delay (s)		39.4			36.0			13.6			8.1	
Approach LOS		D			D			B			A	
Intersection Summary												
HCM 2000 Control Delay			15.4				HCM 2000 Level of Service			B		
HCM 2000 Volume to Capacity ratio			0.56									
Actuated Cycle Length (s)			90.0				Sum of lost time (s)			19.0		
Intersection Capacity Utilization			68.1%				ICU Level of Service			C		
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

12: Battery Street & King St

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	5	3	2	7	9	94	7	290	3	163	474	29
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0			5.0			5.0	
Lane Util. Factor	1.00	1.00			1.00			1.00			1.00	
Frpb, ped/bikes	1.00	0.99			0.98			1.00			1.00	
Flpb, ped/bikes	0.99	1.00			1.00			1.00			1.00	
Frt	1.00	0.94			0.88			1.00			0.99	
Flt Protected	0.95	1.00			1.00			1.00			0.99	
Satd. Flow (prot)	1631	1603			1586			1771			1787	
Flt Permitted	0.55	1.00			0.98			0.99			0.83	
Satd. Flow (perm)	941	1603			1556			1751			1506	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	5	3	2	7	9	94	7	290	3	163	474	29
RTOR Reduction (vph)	0	2	0	0	86	0	0	0	0	0	1	0
Lane Group Flow (vph)	5	3	0	0	24	0	0	300	0	0	665	0
Confl. Peds. (#/hr)	3		4	4		3	2		6	6		2
Heavy Vehicles (%)	10%	10%	10%	3%	3%	3%	7%	7%	7%	4%	4%	4%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	7.3	7.3			7.3			72.7			72.7	
Effective Green, g (s)	7.3	7.3			7.3			72.7			72.7	
Actuated g/C Ratio	0.08	0.08			0.08			0.81			0.81	
Clearance Time (s)	5.0	5.0			5.0			5.0			5.0	
Vehicle Extension (s)	3.0	3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)	76	130			126			1414			1216	
v/s Ratio Prot		0.00										
v/s Ratio Perm	0.01				c0.02			0.17			c0.44	
v/c Ratio	0.07	0.02			0.19			0.21			0.55	
Uniform Delay, d1	38.2	38.1			38.6			2.0			3.0	
Progression Factor	1.00	1.00			1.00			0.77			1.56	
Incremental Delay, d2	0.4	0.1			0.7			0.3			1.7	
Delay (s)	38.6	38.1			39.3			1.9			6.3	
Level of Service	D	D			D			A			A	
Approach Delay (s)		38.4			39.3			1.9			6.3	
Approach LOS		D			D			A			A	
Intersection Summary												
HCM 2000 Control Delay			8.7									
HCM 2000 Volume to Capacity ratio			0.51									
Actuated Cycle Length (s)			90.0								10.0	
Intersection Capacity Utilization			77.2%								D	
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

13: Battery Street & Maple Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	8	3	2	41	18	263	1	12	15	349	39	24
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0	5.0		5.0			5.0	
Lane Util. Factor		1.00			1.00	1.00		1.00			1.00	
Frpb, ped/bikes		0.99			1.00	0.97		0.98			1.00	
Flpb, ped/bikes		1.00			0.99	1.00		1.00			0.99	
Frt		0.98			1.00	0.85		0.93			0.99	
Flt Protected		0.97			0.97	1.00		1.00			0.96	
Satd. Flow (prot)		1626			1759	1528		1442			1754	
Flt Permitted		0.82			0.78	1.00		0.99			0.74	
Satd. Flow (perm)		1382			1428	1528		1436			1351	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	8	3	2	41	18	263	1	12	15	349	39	24
RTOR Reduction (vph)	0	2	0	0	0	235	0	3	0	0	1	0
Lane Group Flow (vph)	0	11	0	0	59	28	0	25	0	0	411	0
Confl. Peds. (#/hr)	2		7	7		2	3		4	4		3
Heavy Vehicles (%)	10%	10%	10%	3%	3%	3%	20%	20%	20%	2%	2%	2%
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)		9.6			9.6	9.6		70.4			70.4	
Effective Green, g (s)		9.6			9.6	9.6		70.4			70.4	
Actuated g/C Ratio		0.11			0.11	0.11		0.78			0.78	
Clearance Time (s)		5.0			5.0	5.0		5.0			5.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0			3.0	
Lane Grp Cap (vph)		147			152	162		1123			1056	
v/s Ratio Prot												
v/s Ratio Perm		0.01			c0.04	0.02		0.02			c0.30	
v/c Ratio		0.08			0.39	0.17		0.02			0.39	
Uniform Delay, d1		36.2			37.5	36.6		2.2			3.1	
Progression Factor		1.00			1.00	1.00		1.00			0.97	
Incremental Delay, d2		0.2			1.7	0.5		0.0			0.9	
Delay (s)		36.4			39.1	37.1		2.2			3.9	
Level of Service		D			D	D		A			A	
Approach Delay (s)		36.4			37.5			2.2			3.9	
Approach LOS		D			D			A			A	
Intersection Summary												
HCM 2000 Control Delay		18.3										
HCM 2000 Volume to Capacity ratio		0.39										
Actuated Cycle Length (s)		90.0										
Intersection Capacity Utilization		47.8%										
Analysis Period (min)		60										
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis

14: Pine Street & Maple Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	7	52	317	56	158	13	210	161	26	7	256	6
Peak Hour 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
Hourly flow rate (vph)	7	52	317	56	158	13	210	161	26	7	256	6
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	376	227	397	269								
Volume Left (vph)	7	56	210	7								
Volume Right (vph)	317	13	26	6								
Hadj (s)	-0.47	0.05	0.12	0.16								
Departure Headway (s)	6.5	7.4	6.9	7.3								
Degree Utilization, x	0.68	0.47	0.76	0.55								
Capacity (veh/h)	514	419	490	439								
Control Delay (s)	22.9	16.9	30.9	19.0								
Approach Delay (s)	22.9	16.9	30.9	19.0								
Approach LOS	C	C	D	C								
Intersection Summary												
Delay				23.5								
Level of Service				C								
Intersection Capacity Utilization				85.0%	ICU Level of Service	E						
Analysis Period (min)				60								

HCM Signalized Intersection Capacity Analysis

15: Park St/VT 127 - Park & North Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											  	
Volume (vph)	0	123	28	96	111	0	0	0	0	104	648	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0						5.0	
Lane Util. Factor		1.00			1.00						0.95	
Frpb, ped/bikes		0.99			1.00						1.00	
Flpb, ped/bikes		1.00			0.99						1.00	
Frt		0.97			1.00						1.00	
Flt Protected		1.00			0.98						0.99	
Satd. Flow (prot)		1549			1579						3572	
Flt Permitted		1.00			0.78						0.99	
Satd. Flow (perm)		1549			1257						3572	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	123	28	96	111	0	0	0	0	104	648	5
RTOR Reduction (vph)	0	11	0	0	0	0	0	0	0	0	1	0
Lane Group Flow (vph)	0	140	0	0	207	0	0	0	0	0	756	0
Confl. Peds. (#/hr)	17		18	18		17	20		16	16		20
Heavy Vehicles (%)	7%	7%	7%	5%	5%	5%	0%	0%	0%	0%	0%	0%
Parking (#/hr)	0	0			0	0				0		
Turn Type		NA		Perm	NA					Perm	NA	
Protected Phases		4			8						6	
Permitted Phases				8						6		
Actuated Green, G (s)		14.7			14.7						26.3	
Effective Green, g (s)		14.7			14.7						26.3	
Actuated g/C Ratio		0.25			0.25						0.45	
Clearance Time (s)		5.0			5.0						5.0	
Vehicle Extension (s)		3.0			3.0						3.0	
Lane Grp Cap (vph)		391			317						1614	
v/s Ratio Prot		0.09										
v/s Ratio Perm					c0.16						0.21	
v/c Ratio		0.36			0.65						0.47	
Uniform Delay, d1		17.9			19.5						11.1	
Progression Factor		1.00			1.00						1.00	
Incremental Delay, d2		0.6			4.9						1.0	
Delay (s)		18.4			24.3						12.1	
Level of Service		B			C						B	
Approach Delay (s)		18.4			24.3			0.0			12.1	
Approach LOS		B			C			A			B	
Intersection Summary												
HCM 2000 Control Delay			15.2			HCM 2000 Level of Service				B		
HCM 2000 Volume to Capacity ratio			0.51									
Actuated Cycle Length (s)			58.2			Sum of lost time (s)			15.0			
Intersection Capacity Utilization			56.6%			ICU Level of Service			B			
Analysis Period (min)			60									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

16: Battery Street/Park St & Sherman St

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	524	0	0	0	469	0	0	0	773	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)			5.0				5.0				5.0	
Lane Util. Factor			1.00				1.00				0.95	
Frt			0.86				1.00				1.00	
Flt Protected			1.00				0.95				1.00	
Satd. Flow (prot)			1644				1805				3610	
Flt Permitted			1.00				0.26				1.00	
Satd. Flow (perm)			1644				492				3610	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	0	524	0	0	0	469	0	0	0	773	0
RTOR Reduction (vph)	0	0	13	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	511	0	0	0	469	0	0	0	773	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type			pt+ov				D.P+P				NA	
Protected Phases			8 5		8		5				6	
Permitted Phases							5 6					
Actuated Green, G (s)			42.7				67.0				37.3	
Effective Green, g (s)			42.7				67.0				37.3	
Actuated g/C Ratio			0.47				0.74				0.41	
Clearance Time (s)							5.0				5.0	
Vehicle Extension (s)							3.0				3.0	
Lane Grp Cap (vph)			779				799				1496	
v/s Ratio Prot			c0.31				0.19				0.21	
v/s Ratio Perm							c0.24					
v/c Ratio			0.66				0.59				0.52	
Uniform Delay, d1			18.1				12.2				19.6	
Progression Factor			1.00				0.68				1.00	
Incremental Delay, d2			2.0				1.1				1.3	
Delay (s)			20.1				9.5				20.9	
Level of Service			C				A				C	
Approach Delay (s)		20.1			0.0			9.5			20.9	
Approach LOS		C			A			A			C	
Intersection Summary												
HCM 2000 Control Delay			17.6				HCM 2000 Level of Service				B	
HCM 2000 Volume to Capacity ratio			0.66									
Actuated Cycle Length (s)			90.0				Sum of lost time (s)			15.0		
Intersection Capacity Utilization			62.1%				ICU Level of Service			B		
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: North Ave & Church/127 Connector

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1	0	33	1	164	0	256	33	508	594	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	10	10	10	10	10	10
Total Lost time (s)		4.0			4.0	4.0		4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00	1.00		1.00		1.00	1.00	
Frpb, ped/bikes		1.00			1.00	1.00		1.00		1.00	1.00	
Flpb, ped/bikes		1.00			0.99	1.00		1.00		1.00	1.00	
Frt		1.00			1.00	0.85		0.98		1.00	1.00	
Flt Protected		1.00			0.95	1.00		1.00		0.95	1.00	
Satd. Flow (prot)		1900			1723	1553		1599		1652	1738	
Flt Permitted		1.00			0.75	1.00		1.00		0.42	1.00	
Satd. Flow (perm)		1900			1350	1553		1599		730	1738	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	1	0	33	1	164	0	256	33	508	594	2
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	1	0	0	34	164	0	289	0	508	596	0
Confl. Peds. (#/hr)	9		7	7		9	1					1
Heavy Vehicles (%)	0%	0%	0%	4%	4%	4%	9%	9%	9%	2%	2%	2%
Turn Type		NA		Perm	NA	pt+ov	Perm	NA		pm+pt	NA	
Protected Phases		4			8	8 1		2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		7.7			7.7	24.5		17.9		34.7	34.7	
Effective Green, g (s)		8.7			8.7	25.5		18.9		35.7	35.7	
Actuated g/C Ratio		0.17			0.17	0.49		0.36		0.68	0.68	
Clearance Time (s)		5.0			5.0			5.0		5.0	5.0	
Vehicle Extension (s)		3.0			3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)		315			224	755		576		722	1184	
v/s Ratio Prot		0.00				c0.11		0.18		c0.17	0.34	
v/s Ratio Perm					0.03					c0.31		
v/c Ratio		0.00			0.15	0.22		0.50		0.70	0.50	
Uniform Delay, d1		18.2			18.7	7.7		13.1		4.6	4.1	
Progression Factor		1.00			1.00	1.00		1.00		1.00	1.00	
Incremental Delay, d2		0.0			0.3	0.1		3.1		3.2	1.5	
Delay (s)		18.2			19.0	7.9		16.2		7.8	5.6	
Level of Service		B			B	A		B		A	A	
Approach Delay (s)		18.2			9.8			16.2			6.6	
Approach LOS		B			A			B			A	
Intersection Summary												
HCM 2000 Control Delay		8.8			HCM 2000 Level of Service					A		
HCM 2000 Volume to Capacity ratio		0.66										
Actuated Cycle Length (s)		52.4			Sum of lost time (s)					12.0		
Intersection Capacity Utilization		63.4%			ICU Level of Service					B		
Analysis Period (min)		60										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

3: North Ave & Institute Rd/City Bluffs

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	100	0	170	7	0	5	260	274	2	0	600	253
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	10	10	10	10	10	10
Total Lost time (s)		4.0	5.0		4.0		5.0	4.0			4.0	4.0
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00			1.00	1.00
Frpb, ped/bikes		1.00	0.98		1.00		1.00	1.00			1.00	0.97
Flpb, ped/bikes		1.00	1.00		0.98		1.00	1.00			1.00	1.00
Frt		1.00	0.85		0.94		1.00	1.00			1.00	0.85
Flt Protected		0.95	1.00		0.97		0.95	1.00			1.00	1.00
Satd. Flow (prot)		1787	1559		1716		1636	1720			1756	1450
Flt Permitted		0.75	1.00		0.84		0.25	1.00			1.00	1.00
Satd. Flow (perm)		1410	1559		1480		433	1720			1756	1450
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	100	0	170	7	0	5	260	274	2	0	600	253
RTOR Reduction (vph)	0	0	125	0	10	0	0	0	0	0	0	119
Lane Group Flow (vph)	0	100	45	0	2	0	260	276	0	0	600	134
Confl. Peds. (#/hr)			14	14			9		1	1		9
Heavy Vehicles (%)	1%	1%	1%	0%	0%	0%	3%	3%	3%	1%	1%	1%
Turn Type	Perm	NA	pm+ov	Perm	NA		pm+pt	NA			NA	Perm
Protected Phases		4	5		8		5	2		1	6	
Permitted Phases	4		4	8			2			6		6
Actuated Green, G (s)		9.1	17.9		9.1		48.6	40.7			34.8	34.8
Effective Green, g (s)		10.1	17.9		10.1		48.6	41.7			35.8	35.8
Actuated g/C Ratio		0.15	0.26		0.15		0.72	0.62			0.53	0.53
Clearance Time (s)		5.0	5.0		5.0		5.0	5.0			5.0	5.0
Vehicle Extension (s)		4.0	3.0		4.0		3.0	3.0			3.0	3.0
Lane Grp Cap (vph)		210	527		220		467	1059			928	766
v/s Ratio Prot			0.01				c0.07	0.16			c0.34	
v/s Ratio Perm		c0.07	0.02		0.00		0.33					0.09
v/c Ratio		0.48	0.09		0.01		0.56	0.26			0.65	0.17
Uniform Delay, d1		26.4	18.7		24.5		6.4	5.9			11.4	8.3
Progression Factor		1.00	1.00		1.00		1.00	1.00			1.00	1.00
Incremental Delay, d2		2.3	0.1		0.0		1.4	0.6			3.5	0.5
Delay (s)		28.7	18.8		24.6		7.9	6.5			14.9	8.8
Level of Service		C	B		C		A	A			B	A
Approach Delay (s)		22.5			24.6			7.2			13.1	
Approach LOS		C			C			A			B	
Intersection Summary												
HCM 2000 Control Delay			12.8				HCM 2000 Level of Service			B		
HCM 2000 Volume to Capacity ratio			0.61									
Actuated Cycle Length (s)			67.7				Sum of lost time (s)			13.0		
Intersection Capacity Utilization			68.6%				ICU Level of Service			C		
Analysis Period (min)			60									

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

4: North Ave & North Drive

12/21/2016

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	10	41	31	386	768	7
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	10	41	31	386	768	7
Pedestrians	25			10	10	
Lane Width (ft)	12.0			10.0	10.0	
Walking Speed (ft/s)	4.0			4.0	4.0	
Percent Blockage	2			1	1	
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (ft)				380		
pX, platoon unblocked	0.95					
vC, conflicting volume	1254	806	800			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1241	806	800			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	94	89	96			
cM capacity (veh/h)	173	374	801			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	51	417	775			
Volume Left	10	31	0			
Volume Right	41	0	7			
cSH	304	801	1700			
Volume to Capacity	0.17	0.04	0.46			
Queue Length 95th (ft)	15	3	0			
Control Delay (s)	19.2	1.2	0.0			
Lane LOS	C	A				
Approach Delay (s)	19.2	1.2	0.0			
Approach LOS	C					
Intersection Summary						
Average Delay		1.2				
Intersection Capacity Utilization		59.2%		ICU Level of Service		B
Analysis Period (min)		60				

HCM Signalized Intersection Capacity Analysis

5: North Ave & South Access

12/21/2016

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	37	137	97	381	783	26
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	12	10	10	12	12
Total Lost time (s)	5.0		5.0	5.0	5.0	
Lane Util. Factor	1.00		1.00	1.00	1.00	
Frpb, ped/bikes	0.97		1.00	1.00	1.00	
Flpb, ped/bikes	1.00		1.00	1.00	1.00	
Frt	0.89		1.00	1.00	1.00	
Flt Protected	0.99		0.95	1.00	1.00	
Satd. Flow (prot)	1632		1636	1722	1833	
Flt Permitted	0.99		0.15	1.00	1.00	
Satd. Flow (perm)	1632		253	1722	1833	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	37	137	97	381	783	26
RTOR Reduction (vph)	121	0	0	0	1	0
Lane Group Flow (vph)	53	0	97	381	808	0
Confl. Peds. (#/hr)	10	10	25			25
Heavy Vehicles (%)	0%	0%	3%	3%	3%	3%
Turn Type	Prot		pm+pt	NA	NA	
Protected Phases	4		5	2	6	
Permitted Phases			2			
Actuated Green, G (s)	6.2		36.6	36.6	28.5	
Effective Green, g (s)	6.2		36.6	36.6	28.5	
Actuated g/C Ratio	0.12		0.69	0.69	0.54	
Clearance Time (s)	5.0		5.0	5.0	5.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	191		256	1193	989	
v/s Ratio Prot	c0.03		0.02	c0.22	c0.44	
v/s Ratio Perm			0.24			
v/c Ratio	0.28		0.38	0.32	0.82	
Uniform Delay, d1	21.3		7.1	3.2	10.0	
Progression Factor	1.00		1.00	1.00	1.00	
Incremental Delay, d2	0.8		0.9	0.2	5.5	
Delay (s)	22.1		8.0	3.3	15.5	
Level of Service	C		A	A	B	
Approach Delay (s)	22.1			4.3	15.5	
Approach LOS	C			A	B	
Intersection Summary						
HCM 2000 Control Delay			12.6	HCM 2000 Level of Service		B
HCM 2000 Volume to Capacity ratio			0.71			
Actuated Cycle Length (s)			52.8	Sum of lost time (s)		15.0
Intersection Capacity Utilization			72.6%	ICU Level of Service		C
Analysis Period (min)			60			

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

6: North Ave & Berry St/Washington

12/21/2016

																				
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR								
Lane Configurations																				
Volume (veh/h)	2	0	12	9	1	61	4	397	3	66	815	2								
Sign Control		Stop			Stop			Free			Free									
Grade		0%			0%			0%			0%									
Peak Hour 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								
Hourly flow rate (vph)	2	0	12	9	1	61	4	397	3	66	815	2								
Pedestrians		2			12			8												
Lane Width (ft)		12.0			12.0			12.0												
Walking Speed (ft/s)		4.0			4.0			4.0												
Percent Blockage		0			1			1												
Right turn flare (veh)																				
Median type								None			None									
Median storage (veh)																				
Upstream signal (ft)											1205									
pX, platoon unblocked	0.62	0.62	0.62	0.62	0.62		0.62													
vC, conflicting volume	1418	1370	826	1386	1370	410	819			412										
vC1, stage 1 conf vol																				
vC2, stage 2 conf vol																				
vCu, unblocked vol	1368	1291	415	1317	1290	410	403			412										
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1										
tC, 2 stage (s)																				
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2										
p0 queue free %	97	100	97	88	99	90	99			94										
cM capacity (veh/h)	66	95	395	76	95	639	713			1141										
Direction, Lane #	EB 1	WB 1	NB 1	SB 1																
Volume Total	14	71	404	883																
Volume Left	2	9	4	66																
Volume Right	12	61	3	2																
cSH	230	316	713	1141																
Volume to Capacity	0.06	0.22	0.01	0.06																
Queue Length 95th (ft)	5	22	0	5																
Control Delay (s)	21.6	19.7	0.2	1.5																
Lane LOS	C	C	A	A																
Approach Delay (s)	21.6	19.7	0.2	1.5																
Approach LOS	C	C																		
Intersection Summary																				
Average Delay			2.2																	
Intersection Capacity Utilization			91.6%	ICU Level of Service						F										
Analysis Period (min)			60																	

HCM Signalized Intersection Capacity Analysis

7: VT 127 - Park & Manhattan Dr.

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	6	96	7	38	93	304	0	0	0	527	625	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0	5.0				5.0	5.0	
Lane Util. Factor		1.00			1.00	1.00				1.00	1.00	
Frpb, ped/bikes		1.00			1.00	1.00				1.00	1.00	
Flpb, ped/bikes		1.00			1.00	1.00				1.00	1.00	
Frt		0.99			1.00	0.85				1.00	1.00	
Flt Protected		1.00			0.99	1.00				0.95	1.00	
Satd. Flow (prot)		1840			1749	1509				1805	1894	
Flt Permitted		0.98			0.88	1.00				0.95	1.00	
Satd. Flow (perm)		1807			1565	1509				1805	1894	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	6	96	7	38	93	304	0	0	0	527	625	13
RTOR Reduction (vph)	0	5	0	0	0	0	0	0	0	0	1	0
Lane Group Flow (vph)	0	104	0	0	131	304	0	0	0	527	637	0
Confl. Peds. (#/hr)			2	2					9	9		
Heavy Vehicles (%)	2%	2%	2%	7%	7%	7%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA	pt+ov				Prot	NA	
Protected Phases		8			4	4 1				1	6	
Permitted Phases	8			4								
Actuated Green, G (s)		10.2			10.2	54.3				34.1	34.1	
Effective Green, g (s)		10.2			10.2	54.3				34.1	34.1	
Actuated g/C Ratio		0.19			0.19	1.00				0.63	0.63	
Clearance Time (s)		5.0			5.0					5.0	5.0	
Vehicle Extension (s)		3.0			3.0					3.0	3.0	
Lane Grp Cap (vph)		339			293	1509				1133	1189	
v/s Ratio Prot						0.20				0.29	c0.34	
v/s Ratio Perm		0.06			c0.08							
v/c Ratio		0.31			0.45	0.20				0.47	0.54	
Uniform Delay, d1		19.0			19.5	0.0				5.3	5.7	
Progression Factor		1.00			1.00	1.00				1.00	1.00	
Incremental Delay, d2		0.5			1.1	0.1				1.4	1.7	
Delay (s)		19.5			20.6	0.1				6.7	7.4	
Level of Service		B			C	A				A	A	
Approach Delay (s)		19.5			6.3			0.0			7.1	
Approach LOS		B			A			A			A	
Intersection Summary												
HCM 2000 Control Delay		7.7			HCM 2000 Level of Service					A		
HCM 2000 Volume to Capacity ratio		0.51										
Actuated Cycle Length (s)		54.3			Sum of lost time (s)					10.0		
Intersection Capacity Utilization		55.7%			ICU Level of Service					B		
Analysis Period (min)		60										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

8: North Ave & North Street

12/21/2016

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	20	77	354	30	93	635
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	12	10	10	10	10
Grade (%)	0%		6%			0%
Total Lost time (s)	3.0		3.0		3.0	3.0
Lane Util. Factor	1.00		1.00		1.00	1.00
Frpb, ped/bikes	1.00		1.00		1.00	1.00
Flpb, ped/bikes	1.00		1.00		1.00	1.00
Frt	0.89		0.99		1.00	1.00
Flt Protected	0.99		1.00		0.95	1.00
Satd. Flow (prot)	1679		1650		1651	1739
Flt Permitted	0.99		1.00		0.46	1.00
Satd. Flow (perm)	1679		1650		793	1739
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	20	77	354	30	93	635
RTOR Reduction (vph)	70	0	0	0	0	0
Lane Group Flow (vph)	27	0	384	0	93	635
Confl. Peds. (#/hr)	7			3	3	
Heavy Vehicles (%)	0%	0%	3%	3%	2%	2%
Turn Type	Prot		NA		pm+pt	NA
Protected Phases	8		2		1	6
Permitted Phases					6	
Actuated Green, G (s)	5.9		49.9		58.0	58.0
Effective Green, g (s)	7.9		51.9		60.0	60.0
Actuated g/C Ratio	0.10		0.64		0.74	0.74
Clearance Time (s)	5.0		5.0		5.0	5.0
Vehicle Extension (s)	3.0		4.0		3.0	4.0
Lane Grp Cap (vph)	162		1052		638	1281
v/s Ratio Prot	c0.02		0.23		0.01	c0.37
v/s Ratio Perm					0.10	
v/c Ratio	0.17		0.37		0.15	0.50
Uniform Delay, d1	33.7		7.0		3.4	4.4
Progression Factor	1.00		1.00		1.00	1.00
Incremental Delay, d2	0.5		1.0		0.1	1.4
Delay (s)	34.2		7.9		3.5	5.8
Level of Service	C		A		A	A
Approach Delay (s)	34.2		7.9			5.5
Approach LOS	C		A			A
Intersection Summary						
HCM 2000 Control Delay			8.6		HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio			0.46			
Actuated Cycle Length (s)			81.4		Sum of lost time (s)	14.0
Intersection Capacity Utilization			45.9%		ICU Level of Service	A
Analysis Period (min)			60			
c Critical Lane Group						

HCM Unsignalized Intersection Capacity Analysis

9: Sherman St & North Ave

12/21/2016



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	3	9	10	516	590	4
Sign Control		Stop	Yield		Free	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	3	9	10	516	590	4
Pedestrians		4	10		8	
Lane Width (ft)		12.0	12.0		10.0	
Walking Speed (ft/s)		4.0	4.0		4.0	
Percent Blockage		0	1		1	
Right turn flare (veh)						
Median type					None	
Median storage veh						
Upstream signal (ft)					986	
pX, platoon unblocked						
vC, conflicting volume	1199	1196	1198	18	10	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1199	1196	1198	18	10	
tC, single (s)	7.1	6.5	6.6	6.3	4.1	
tC, 2 stage (s)						
tF (s)	3.5	4.0	4.1	3.4	2.2	
p0 queue free %	94	92	91	50	63	
cM capacity (veh/h)	53	116	112	1032	1577	
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	12	526	594			
Volume Left	3	0	590			
Volume Right	0	516	4			
cSH	90	893	1577			
Volume to Capacity	0.13	0.59	0.37			
Queue Length 95th (ft)	11	105	45			
Control Delay (s)	51.3	14.8	8.6			
Lane LOS	F	B	A			
Approach Delay (s)	51.3	14.8	8.6			
Approach LOS	F	B				
Intersection Summary						
Average Delay			11.9			
Intersection Capacity Utilization			72.9%	ICU Level of Service	C	
Analysis Period (min)			60			

HCM Signalized Intersection Capacity Analysis

10: Battery Street & Pearl Street

12/21/2016

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	132	85	293	150	277	1153
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0		5.0
Lane Util. Factor	1.00	1.00	1.00	1.00		0.95
Frpb, ped/bikes	1.00	1.00	1.00	0.97		1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00		1.00
Frt	1.00	0.85	1.00	0.85		1.00
Flt Protected	0.95	1.00	1.00	1.00		0.99
Satd. Flow (prot)	1612	1442	1727	1418		3502
Flt Permitted	0.95	1.00	1.00	1.00		0.74
Satd. Flow (perm)	1612	1442	1727	1418		2609
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	132	85	293	150	277	1153
RTOR Reduction (vph)	0	70	0	71	0	0
Lane Group Flow (vph)	132	15	293	79	0	1430
Confl. Peds. (#/hr)	7			15	15	
Heavy Vehicles (%)	12%	12%	10%	10%	2%	2%
Turn Type	Prot	pt+ov	NA	Perm	pm+pt	NA
Protected Phases	8	8 1	2		1	6
Permitted Phases				2	6	
Actuated Green, G (s)	12.3	16.4	47.2	47.2		56.3
Effective Green, g (s)	12.3	16.4	47.2	47.2		56.3
Actuated g/C Ratio	0.14	0.18	0.52	0.52		0.63
Clearance Time (s)	5.0		5.0	5.0		5.0
Vehicle Extension (s)	3.0		3.0	3.0		3.0
Lane Grp Cap (vph)	220	262	905	743		1672
v/s Ratio Prot	c0.08	0.01	0.17			c0.04
v/s Ratio Perm				0.06		c0.50
v/c Ratio	0.60	0.06	0.32	0.11		0.86
Uniform Delay, d1	36.5	30.4	12.3	10.8		13.6
Progression Factor	1.00	1.00	0.76	1.21		0.87
Incremental Delay, d2	4.4	0.1	0.9	0.3		4.0
Delay (s)	41.0	30.5	10.2	13.3		15.7
Level of Service	D	C	B	B		B
Approach Delay (s)	36.9		11.3			15.7
Approach LOS	D		B			B
Intersection Summary						
HCM 2000 Control Delay			17.0		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.79			
Actuated Cycle Length (s)			90.0		Sum of lost time (s)	20.0
Intersection Capacity Utilization			75.1%		ICU Level of Service	D
Analysis Period (min)			60			
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis

11: Battery Street & Main Street/Main Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	7	29	25	30	89	165	63	331	3	340	575	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0		5.0	5.0		5.0		5.0	5.0	
Lane Util. Factor		1.00	1.00		1.00	1.00		0.95		1.00	1.00	
Frpb, ped/bikes		1.00	0.97		1.00	0.99		1.00		1.00	1.00	
Flpb, ped/bikes		1.00	1.00		1.00	1.00		1.00		1.00	1.00	
Frt		1.00	0.85		1.00	0.85		1.00		1.00	1.00	
Flt Protected		0.99	1.00		0.99	1.00		0.99		0.95	1.00	
Satd. Flow (prot)		1725	1432		1717	1469		3499		1780	1877	
Flt Permitted		0.91	1.00		0.59	1.00		0.80		0.42	1.00	
Satd. Flow (perm)		1580	1432		1029	1469		2812		779	1877	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	7	29	25	30	89	165	63	331	3	340	575	7
RTOR Reduction (vph)	0	0	23	0	0	118	0	1	0	0	0	0
Lane Group Flow (vph)	0	36	2	0	119	47	0	396	0	340	582	0
Confl. Peds. (#/hr)	2		5	5		2	10		10	10		10
Heavy Vehicles (%)	9%	9%	9%	9%	9%	9%	2%	2%	2%	1%	1%	1%
Turn Type	Perm	NA	Perm	Perm	NA	pm+ov	Perm	NA		pm+pt	NA	
Protected Phases		4			8	1		2		1	6	
Permitted Phases	4		4	8		8	2			6		
Actuated Green, G (s)		7.2	7.2		14.4	25.8		44.5		65.6	61.0	
Effective Green, g (s)		7.2	7.2		14.4	25.8		44.5		65.6	61.0	
Actuated g/C Ratio		0.08	0.08		0.16	0.29		0.49		0.73	0.68	
Clearance Time (s)		5.0	5.0		5.0	5.0		5.0		5.0	5.0	
Vehicle Extension (s)		3.0	3.0		3.0	3.0		3.0		3.0	3.0	
Lane Grp Cap (vph)		126	114		164	502		1390		694	1272	
v/s Ratio Prot						0.01				c0.06	0.31	
v/s Ratio Perm		0.02	0.00		c0.12	0.02		0.14		c0.29		
v/c Ratio		0.29	0.02		0.73	0.09		0.29		0.49	0.46	
Uniform Delay, d1		39.0	38.1		35.9	23.5		13.4		5.1	6.8	
Progression Factor		1.00	1.00		1.00	1.00		1.02		1.71	1.07	
Incremental Delay, d2		1.3	0.1		16.0	0.1		0.5		0.3	0.7	
Delay (s)		40.2	38.2		51.9	23.6		14.1		9.0	8.0	
Level of Service		D	D		D	C		B		A	A	
Approach Delay (s)		39.4			35.5			14.1			8.3	
Approach LOS		D			D			B			A	
Intersection Summary												
HCM 2000 Control Delay			15.5				HCM 2000 Level of Service			B		
HCM 2000 Volume to Capacity ratio			0.59									
Actuated Cycle Length (s)			90.0				Sum of lost time (s)			19.0		
Intersection Capacity Utilization			69.6%				ICU Level of Service			C		
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

12: Battery Street & King St

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	5	3	2	7	9	94	7	310	3	163	501	29
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0			5.0			5.0	
Lane Util. Factor	1.00	1.00			1.00			1.00			1.00	
Frpb, ped/bikes	1.00	0.99			0.98			1.00			1.00	
Flpb, ped/bikes	0.99	1.00			1.00			1.00			1.00	
Frt	1.00	0.94			0.88			1.00			0.99	
Flt Protected	0.95	1.00			1.00			1.00			0.99	
Satd. Flow (prot)	1631	1603			1586			1771			1789	
Flt Permitted	0.55	1.00			0.98			0.99			0.83	
Satd. Flow (perm)	941	1603			1556			1752			1506	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	5	3	2	7	9	94	7	310	3	163	501	29
RTOR Reduction (vph)	0	2	0	0	86	0	0	0	0	0	1	0
Lane Group Flow (vph)	5	3	0	0	24	0	0	320	0	0	692	0
Confl. Peds. (#/hr)	3		4	4		3	2		6	6		2
Heavy Vehicles (%)	10%	10%	10%	3%	3%	3%	7%	7%	7%	4%	4%	4%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	7.3	7.3			7.3			72.7			72.7	
Effective Green, g (s)	7.3	7.3			7.3			72.7			72.7	
Actuated g/C Ratio	0.08	0.08			0.08			0.81			0.81	
Clearance Time (s)	5.0	5.0			5.0			5.0			5.0	
Vehicle Extension (s)	3.0	3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)	76	130			126			1415			1216	
v/s Ratio Prot		0.00										
v/s Ratio Perm	0.01				c0.02			0.18			c0.46	
v/c Ratio	0.07	0.02			0.19			0.23			0.57	
Uniform Delay, d1	38.2	38.1			38.6			2.0			3.1	
Progression Factor	1.00	1.00			1.00			0.77			1.60	
Incremental Delay, d2	0.4	0.1			0.7			0.4			1.8	
Delay (s)	38.6	38.1			39.3			1.9			6.7	
Level of Service	D	D			D			A			A	
Approach Delay (s)		38.4			39.3			1.9			6.7	
Approach LOS		D			D			A			A	
Intersection Summary												
HCM 2000 Control Delay			8.8									
HCM 2000 Volume to Capacity ratio			0.53									
Actuated Cycle Length (s)			90.0									
Intersection Capacity Utilization			79.7%									
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

13: Battery Street & Maple Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	8	3	2	41	18	283	1	12	15	375	39	24
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0	5.0		5.0			5.0	
Lane Util. Factor		1.00			1.00	1.00		1.00			1.00	
Frpb, ped/bikes		0.99			1.00	0.97		0.98			1.00	
Flpb, ped/bikes		1.00			0.99	1.00		1.00			0.99	
Frt		0.98			1.00	0.85		0.93			0.99	
Flt Protected		0.97			0.97	1.00		1.00			0.96	
Satd. Flow (prot)		1626			1759	1528		1442			1754	
Flt Permitted		0.82			0.78	1.00		0.99			0.74	
Satd. Flow (perm)		1382			1428	1528		1435			1348	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	8	3	2	41	18	283	1	12	15	375	39	24
RTOR Reduction (vph)	0	2	0	0	0	253	0	3	0	0	1	0
Lane Group Flow (vph)	0	11	0	0	59	30	0	25	0	0	437	0
Confl. Peds. (#/hr)	2		7	7		2	3		4	4		3
Heavy Vehicles (%)	10%	10%	10%	3%	3%	3%	20%	20%	20%	2%	2%	2%
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)		9.6			9.6	9.6		70.4			70.4	
Effective Green, g (s)		9.6			9.6	9.6		70.4			70.4	
Actuated g/C Ratio		0.11			0.11	0.11		0.78			0.78	
Clearance Time (s)		5.0			5.0	5.0		5.0			5.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0			3.0	
Lane Grp Cap (vph)		147			152	162		1122			1054	
v/s Ratio Prot												
v/s Ratio Perm		0.01			c0.04	0.02		0.02			c0.32	
v/c Ratio		0.08			0.39	0.19		0.02			0.41	
Uniform Delay, d1		36.2			37.5	36.6		2.2			3.2	
Progression Factor		1.00			1.00	1.00		1.00			1.04	
Incremental Delay, d2		0.2			1.7	0.6		0.0			1.0	
Delay (s)		36.4			39.1	37.2		2.2			4.3	
Level of Service		D			D	D		A			A	
Approach Delay (s)		36.4			37.5			2.2			4.3	
Approach LOS		D			D			A			A	
Intersection Summary												
HCM 2000 Control Delay		18.6										
HCM 2000 Volume to Capacity ratio		0.41										
Actuated Cycle Length (s)		90.0										
Intersection Capacity Utilization		49.0%										
Analysis Period (min)		60										
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis

14: Pine Street & Maple Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	7	56	339	56	167	13	221	161	26	7	256	6
Peak Hour 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
Hourly flow rate (vph)	7	56	339	56	167	13	221	161	26	7	256	6
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	402	236	408	269								
Volume Left (vph)	7	56	221	7								
Volume Right (vph)	339	13	26	6								
Hadj (s)	-0.47	0.05	0.12	0.16								
Departure Headway (s)	6.7	7.7	7.2	7.6								
Degree Utilization, x	0.75	0.50	0.81	0.57								
Capacity (veh/h)	502	400	479	416								
Control Delay (s)	28.9	18.5	38.7	20.6								
Approach Delay (s)	28.9	18.5	38.7	20.6								
Approach LOS	D	C	E	C								
Intersection Summary												
Delay				28.4								
Level of Service				D								
Intersection Capacity Utilization				87.7%	ICU Level of Service					E		
Analysis Period (min)				60								

HCM Signalized Intersection Capacity Analysis

15: Park St/VT 127 - Park & North Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											  	
Volume (vph)	0	169	28	96	146	0	0	0	0	104	648	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0						5.0	
Lane Util. Factor		1.00			1.00						0.95	
Frpb, ped/bikes		1.00			1.00						1.00	
Flpb, ped/bikes		1.00			0.99						1.00	
Frt		0.98			1.00						1.00	
Flt Protected		1.00			0.98						0.99	
Satd. Flow (prot)		1560			1587						3572	
Flt Permitted		1.00			0.75						0.99	
Satd. Flow (perm)		1560			1214						3572	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	169	28	96	146	0	0	0	0	104	648	5
RTOR Reduction (vph)	0	8	0	0	0	0	0	0	0	0	1	0
Lane Group Flow (vph)	0	189	0	0	242	0	0	0	0	0	756	0
Confl. Peds. (#/hr)	17		18	18		17	20		16	16		20
Heavy Vehicles (%)	7%	7%	7%	5%	5%	5%	0%	0%	0%	0%	0%	0%
Parking (#/hr)	0	0			0	0				0		
Turn Type		NA		Perm	NA					Perm	NA	
Protected Phases		4			8						6	
Permitted Phases				8						6		
Actuated Green, G (s)		16.3			16.3						26.7	
Effective Green, g (s)		16.3			16.3						26.7	
Actuated g/C Ratio		0.26			0.26						0.43	
Clearance Time (s)		5.0			5.0						5.0	
Vehicle Extension (s)		3.0			3.0						3.0	
Lane Grp Cap (vph)		404			315						1518	
v/s Ratio Prot		0.12										
v/s Ratio Perm					c0.20						0.21	
v/c Ratio		0.47			0.77						0.50	
Uniform Delay, d1		19.6			21.5						13.2	
Progression Factor		1.00			1.00						1.00	
Incremental Delay, d2		0.9			11.5						1.2	
Delay (s)		20.5			33.0						14.3	
Level of Service		C			C						B	
Approach Delay (s)		20.5			33.0			0.0			14.3	
Approach LOS		C			C			A			B	
Intersection Summary												
HCM 2000 Control Delay			19.1			HCM 2000 Level of Service				B		
HCM 2000 Volume to Capacity ratio			0.54									
Actuated Cycle Length (s)			62.8			Sum of lost time (s)			15.0			
Intersection Capacity Utilization			60.8%			ICU Level of Service			B			
Analysis Period (min)			60									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

16: Battery Street/Park St & Sherman St

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											  	
Volume (vph)	0	0	600	0	0	0	526	0	0	0	773	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)			5.0				5.0				5.0	
Lane Util. Factor			1.00				1.00				0.95	
Frt			0.86				1.00				1.00	
Flt Protected			1.00				0.95				1.00	
Satd. Flow (prot)			1644				1805				3610	
Flt Permitted			1.00				0.24				1.00	
Satd. Flow (perm)			1644				452				3610	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	0	600	0	0	0	526	0	0	0	773	0
RTOR Reduction (vph)	0	0	12	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	588	0	0	0	526	0	0	0	773	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type			pt+ov				D.P+P				NA	
Protected Phases			8 5		8		5				6	
Permitted Phases							5 6					
Actuated Green, G (s)			46.2				65.1				33.8	
Effective Green, g (s)			46.2				65.1				33.8	
Actuated g/C Ratio			0.51				0.72				0.38	
Clearance Time (s)							5.0				5.0	
Vehicle Extension (s)							3.0				3.0	
Lane Grp Cap (vph)			843				797				1355	
v/s Ratio Prot			c0.36				0.23				0.21	
v/s Ratio Perm							c0.25					
v/c Ratio			0.70				0.66				0.57	
Uniform Delay, d1			16.6				14.0				22.3	
Progression Factor			1.00				0.76				1.00	
Incremental Delay, d2			2.6				2.0				1.8	
Delay (s)			19.2				12.6				24.1	
Level of Service			B				B				C	
Approach Delay (s)		19.2			0.0			12.6			24.1	
Approach LOS		B			A			B			C	
Intersection Summary												
HCM 2000 Control Delay			19.4				HCM 2000 Level of Service			B		
HCM 2000 Volume to Capacity ratio			0.73									
Actuated Cycle Length (s)			90.0				Sum of lost time (s)			15.0		
Intersection Capacity Utilization			66.9%				ICU Level of Service			C		
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: North Ave & Church/127 Connector

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	2	0	0	6	0	555	1	657	43	267	307	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	10	10	10	10	10	10
Total Lost time (s)		4.0			4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Flpb, ped/bikes		0.99			0.99	1.00	1.00	1.00		1.00	1.00	
Frt		1.00			1.00	0.85	1.00	0.99		1.00	1.00	
Flt Protected		0.95			0.95	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1785			1777	1599	1665	1740		1668	1755	
Flt Permitted		0.75			0.76	1.00	0.57	1.00		0.17	1.00	
Satd. Flow (perm)		1416			1415	1599	1004	1740		296	1755	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	2	0	0	6	0	555	1	657	43	267	307	1
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	2	0	0	6	555	1	700	0	267	308	0
Confl. Peds. (#/hr)	4		2	2		4	1					1
Heavy Vehicles (%)	0%	0%	0%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Turn Type	Perm	NA		Perm	NA	pt+ov	Perm	NA		pm+pt	NA	
Protected Phases		4			8	8 1		2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		21.0			21.0	35.7	44.3	44.3		59.0	59.0	
Effective Green, g (s)		22.0			22.0	36.7	45.3	45.3		60.0	60.0	
Actuated g/C Ratio		0.24			0.24	0.41	0.50	0.50		0.67	0.67	
Clearance Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		346			345	652	505	875		360	1170	
v/s Ratio Prot						c0.35		c0.40		0.09	0.18	
v/s Ratio Perm		0.00			0.00		0.00			0.41		
v/c Ratio		0.01			0.02	0.85	0.00	0.80		0.74	0.26	
Uniform Delay, d1		25.7			25.8	24.2	11.1	18.6		13.2	6.1	
Progression Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.0			0.0	11.5	0.0	8.0		8.4	0.5	
Delay (s)		25.7			25.8	35.7	11.1	26.6		21.6	6.6	
Level of Service		C			C	D	B	C		C	A	
Approach Delay (s)		25.7			35.6			26.6			13.6	
Approach LOS		C			D			C			B	
Intersection Summary												
HCM 2000 Control Delay		25.3					HCM 2000 Level of Service			C		
HCM 2000 Volume to Capacity ratio		0.86										
Actuated Cycle Length (s)		90.0					Sum of lost time (s)			12.0		
Intersection Capacity Utilization		86.0%					ICU Level of Service			E		
Analysis Period (min)		60										

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

3: North Ave & Institute Rd/City Bluffs

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	137	0	204	4	1	2	82	571	2	3	434	72
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	10	10	10	10	10	10
Total Lost time (s)		4.0	5.0		4.0		5.0	4.0			4.0	4.0
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00			1.00	1.00
Frpb, ped/bikes		1.00	0.98		1.00		1.00	1.00			1.00	0.96
Flpb, ped/bikes		1.00	1.00		0.99		0.99	1.00			1.00	1.00
Frt		1.00	0.85		0.96		1.00	1.00			1.00	0.85
Flt Protected		0.95	1.00		0.97		0.95	1.00			1.00	1.00
Satd. Flow (prot)		1805	1575		1545		1630	1737			1721	1406
Flt Permitted		0.75	1.00		0.85		0.51	1.00			1.00	1.00
Satd. Flow (perm)		1431	1575		1352		873	1737			1718	1406
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	137	0	204	4	1	2	82	571	2	3	434	72
RTOR Reduction (vph)	0	0	159	0	2	0	0	0	0	0	0	31
Lane Group Flow (vph)	0	137	45	0	5	0	82	573	0	0	437	41
Confl. Peds. (#/hr)			8	8			23		3	3		23
Heavy Vehicles (%)	0%	0%	0%	14%	14%	14%	2%	2%	2%	3%	3%	3%
Turn Type	Perm	NA	pm+ov	Perm	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases		4	5		8		5	2		1	6	
Permitted Phases	4		4	8			2			6		6
Actuated Green, G (s)		10.1	15.2		10.1		46.0	40.9			41.6	38.7
Effective Green, g (s)		11.1	15.2		11.1		46.0	41.9			43.6	39.7
Actuated g/C Ratio		0.16	0.22		0.16		0.67	0.61			0.63	0.58
Clearance Time (s)		5.0	5.0		5.0		5.0	5.0			5.0	5.0
Vehicle Extension (s)		4.0	3.0		4.0		3.0	3.0			3.0	3.0
Lane Grp Cap (vph)		230	461		217		638	1056			1087	810
v/s Ratio Prot			0.01				0.01	c0.33			c0.02	
v/s Ratio Perm		c0.10	0.02		0.00		0.08				0.23	0.03
v/c Ratio		0.60	0.10		0.02		0.13	0.54			0.40	0.05
Uniform Delay, d1		26.8	21.4		24.3		4.0	7.9			6.2	6.4
Progression Factor		1.00	1.00		1.00		1.00	1.00			1.00	1.00
Incremental Delay, d2		4.9	0.1		0.1		0.1	2.0			0.3	0.1
Delay (s)		31.7	21.5		24.4		4.1	9.9			6.6	6.5
Level of Service		C	C		C		A	A			A	A
Approach Delay (s)		25.6			24.4			9.2			6.6	
Approach LOS		C			C			A			A	
Intersection Summary												
HCM 2000 Control Delay			12.1				HCM 2000 Level of Service			B		
HCM 2000 Volume to Capacity ratio			0.55									
Actuated Cycle Length (s)			68.9				Sum of lost time (s)			13.0		
Intersection Capacity Utilization			75.4%				ICU Level of Service			D		
Analysis Period (min)			60									
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis

4: North Ave & North Drive

12/21/2016

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	0	0	0	656	643	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	0	0	0	656	643	0
Pedestrians	25			10	10	
Lane Width (ft)	12.0			10.0	10.0	
Walking Speed (ft/s)	4.0			4.0	4.0	
Percent Blockage	2			1	1	
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1334	678	668			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1334	678	668			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	100	100			
cM capacity (veh/h)	167	443	898			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	0	656	643			
Volume Left	0	0	0			
Volume Right	0	0	0			
cSH	1700	898	1700			
Volume to Capacity	0.00	0.00	0.38			
Queue Length 95th (ft)	0	0	0			
Control Delay (s)	0.0	0.0	0.0			
Lane LOS	A					
Approach Delay (s)	0.0	0.0	0.0			
Approach LOS	A					
Intersection Summary						
Average Delay			0.0			
Intersection Capacity Utilization			47.4%	ICU Level of Service		A
Analysis Period (min)			60			

HCM Unsignalized Intersection Capacity Analysis

5: North Ave & South Drive

12/21/2016

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	9	9	17	644	625	16
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	9	9	17	644	625	16
Pedestrians	25			10	10	
Lane Width (ft)	12.0			10.0	12.0	
Walking Speed (ft/s)	4.0			4.0	4.0	
Percent Blockage	2			1	1	
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1346	668	666			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1346	668	666			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	94	98	98			
cM capacity (veh/h)	161	449	900			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	18	661	641			
Volume Left	9	17	0			
Volume Right	9	0	16			
cSH	236	900	1700			
Volume to Capacity	0.08	0.02	0.38			
Queue Length 95th (ft)	6	1	0			
Control Delay (s)	21.5	0.5	0.0			
Lane LOS	C	A				
Approach Delay (s)	21.5	0.5	0.0			
Approach LOS	C					
Intersection Summary						
Average Delay		0.5				
Intersection Capacity Utilization		60.4%		ICU Level of Service		B
Analysis Period (min)		60				

HCM Unsignalized Intersection Capacity Analysis

6: North Ave & Berry/Washington

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	13	2	17	6	0	51	10	628	5	27	425	10
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour 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
Hourly flow rate (vph)	13	2	17	6	0	51	10	628	5	27	425	10
Pedestrians					18			29			13	
Lane Width (ft)					12.0			12.0			10.0	
Walking Speed (ft/s)					4.0			4.0			4.0	
Percent Blockage					1			2			1	
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1198	1155	459	1200	1158	662	435			651		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1198	1155	459	1200	1158	662	435			651		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	91	99	97	96	100	89	99			97		
cM capacity (veh/h)	138	188	592	145	187	455	1119			917		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	32	57	643	462								
Volume Left	13	6	10	27								
Volume Right	17	51	5	10								
cSH	240	371	1119	917								
Volume to Capacity	0.13	0.15	0.01	0.03								
Queue Length 95th (ft)	11	14	1	2								
Control Delay (s)	22.3	16.4	0.2	0.9								
Lane LOS	C	C	A	A								
Approach Delay (s)	22.3	16.4	0.2	0.9								
Approach LOS	C	C										
Intersection Summary												
Average Delay			1.8									
Intersection Capacity Utilization			60.3%		ICU Level of Service					B		
Analysis Period (min)			60									

HCM Signalized Intersection Capacity Analysis

7: VT 127 - Park & Manhattan Dr.

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	11	38	14	26	69	1132	0	0	0	293	230	9
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0	5.0				5.0	5.0	
Lane Util. Factor		1.00			1.00	1.00				1.00	1.00	
Frpb, ped/bikes		1.00			1.00	1.00				1.00	1.00	
Flpb, ped/bikes		1.00			1.00	1.00				1.00	1.00	
Frt		0.97			1.00	0.85				1.00	0.99	
Flt Protected		0.99			0.99	1.00				0.95	1.00	
Satd. Flow (prot)		1822			1837	1583				1787	1871	
Flt Permitted		0.96			0.93	1.00				0.95	1.00	
Satd. Flow (perm)		1770			1740	1583				1787	1871	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	11	38	14	26	69	1132	0	0	0	293	230	9
RTOR Reduction (vph)	0	7	0	0	0	0	0	0	0	0	2	0
Lane Group Flow (vph)	0	56	0	0	95	1132	0	0	0	293	237	0
Confl. Peds. (#/hr)			2	2					35	35		
Heavy Vehicles (%)	0%	0%	0%	2%	2%	2%	0%	0%	0%	1%	1%	1%
Turn Type	Perm	NA		Perm	NA	pt+ov				Prot	NA	
Protected Phases		8			4	4 1				1	6	
Permitted Phases	8			4								
Actuated Green, G (s)		25.0			25.0	52.4				17.4	17.4	
Effective Green, g (s)		25.0			25.0	52.4				17.4	17.4	
Actuated g/C Ratio		0.48			0.48	1.00				0.33	0.33	
Clearance Time (s)		5.0			5.0					5.0	5.0	
Vehicle Extension (s)		3.0			3.0					3.0	3.0	
Lane Grp Cap (vph)		844			830	1583				593	621	
v/s Ratio Prot						c0.71				0.16	0.13	
v/s Ratio Perm		0.03			0.05							
v/c Ratio		0.07			0.11	0.72				0.49	0.38	
Uniform Delay, d1		7.4			7.6	0.0				14.0	13.4	
Progression Factor		1.00			1.00	1.00				1.00	1.00	
Incremental Delay, d2		0.0			0.1	1.6				3.0	1.8	
Delay (s)		7.4			7.6	1.6				16.9	15.2	
Level of Service		A			A	A				B	B	
Approach Delay (s)		7.4			2.0			0.0			16.1	
Approach LOS		A			A			A			B	
Intersection Summary												
HCM 2000 Control Delay		6.3			HCM 2000 Level of Service					A		
HCM 2000 Volume to Capacity ratio		0.88										
Actuated Cycle Length (s)		52.4			Sum of lost time (s)					10.0		
Intersection Capacity Utilization		81.9%			ICU Level of Service					D		
Analysis Period (min)		60										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

8: North Ave & North Street

12/21/2016

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	47	64	531	60	52	316
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	12	10	10	10	10
Total Lost time (s)	3.0		3.0		3.0	3.0
Lane Util. Factor	1.00		1.00		1.00	1.00
Frpb, ped/bikes	1.00		1.00		1.00	1.00
Flpb, ped/bikes	1.00		1.00		1.00	1.00
Frt	0.92		0.99		1.00	1.00
Flt Protected	0.98		1.00		0.95	1.00
Satd. Flow (prot)	1634		1710		1651	1739
Flt Permitted	0.98		1.00		0.33	1.00
Satd. Flow (perm)	1634		1710		573	1739
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	47	64	531	60	52	316
RTOR Reduction (vph)	52	0	0	0	0	0
Lane Group Flow (vph)	59	0	591	0	52	316
Confl. Peds. (#/hr)	13			6	6	
Heavy Vehicles (%)	5%	5%	2%	2%	2%	2%
Turn Type	Prot		NA		pm+pt	NA
Protected Phases	8		2		1	6
Permitted Phases					6	
Actuated Green, G (s)	7.4		53.4		60.7	60.7
Effective Green, g (s)	9.4		55.4		62.7	62.7
Actuated g/C Ratio	0.11		0.65		0.73	0.73
Clearance Time (s)	5.0		5.0		5.0	5.0
Vehicle Extension (s)	3.0		4.0		3.0	4.0
Lane Grp Cap (vph)	179		1106		473	1273
v/s Ratio Prot	c0.04		c0.35		0.01	c0.18
v/s Ratio Perm					0.07	
v/c Ratio	0.33		0.53		0.11	0.25
Uniform Delay, d1	35.2		8.1		4.5	3.7
Progression Factor	1.00		1.00		1.00	1.00
Incremental Delay, d2	1.1		1.9		0.1	0.5
Delay (s)	36.3		10.0		4.6	4.2
Level of Service	D		B		A	A
Approach Delay (s)	36.3		10.0			4.3
Approach LOS	D		B			A
Intersection Summary						
HCM 2000 Control Delay			10.8		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.47			
Actuated Cycle Length (s)			85.6		Sum of lost time (s)	14.0
Intersection Capacity Utilization			51.5%		ICU Level of Service	A
Analysis Period (min)			60			

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

9: Sherman St & North Ave

12/21/2016



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	9	15	19	723	424	4
Sign Control		Stop	Yield		Free	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	9	15	19	723	424	4
Pedestrians		9	20		20	
Lane Width (ft)		12.0	12.0		10.0	
Walking Speed (ft/s)		4.0	4.0		4.0	
Percent Blockage		1	2		1	
Right turn flare (veh)						
Median type					None	
Median storage (veh)						
Upstream signal (ft)					986	
pX, platoon unblocked						
vC, conflicting volume	888	879	881	40	20	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	888	879	881	40	20	
tC, single (s)	7.1	6.5	6.5	6.2	4.1	
tC, 2 stage (s)						
tF (s)	3.5	4.0	4.0	3.3	2.2	
p0 queue free %	83	93	91	28	73	
cM capacity (veh/h)	52	203	205	1006	1582	
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	24	742	428			
Volume Left	9	0	424			
Volume Right	0	723	4			
cSH	98	914	1582			
Volume to Capacity	0.25	0.81	0.27			
Queue Length 95th (ft)	24	285	27			
Control Delay (s)	53.8	25.1	8.1			
Lane LOS	F	D	A			
Approach Delay (s)	53.8	25.1	8.1			
Approach LOS	F	D				
Intersection Summary						
Average Delay		19.6				
Intersection Capacity Utilization		78.0%		ICU Level of Service		D
Analysis Period (min)		60				

HCM Signalized Intersection Capacity Analysis

10: Battery Street & Pearl Street

12/21/2016

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	122	138	650	412	128	486
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0		5.0
Lane Util. Factor	1.00	1.00	1.00	1.00		0.95
Frpb, ped/bikes	1.00	1.00	1.00	0.98		1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00		1.00
Frt	1.00	0.85	1.00	0.85		1.00
Flt Protected	0.95	1.00	1.00	1.00		0.99
Satd. Flow (prot)	1719	1538	1863	1546		3537
Flt Permitted	0.95	1.00	1.00	1.00		0.61
Satd. Flow (perm)	1719	1538	1863	1546		2171
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	122	138	650	412	128	486
RTOR Reduction (vph)	0	112	0	183	0	0
Lane Group Flow (vph)	122	26	650	229	0	614
Confl. Peds. (#/hr)		3		4	4	
Heavy Vehicles (%)	5%	5%	2%	2%	1%	1%
Turn Type	Prot	pt+ov	NA	Perm	pm+pt	NA
Protected Phases	3	3 1	2		1	6
Permitted Phases				2	6	
Actuated Green, G (s)	11.6	16.8	50.0	50.0		60.2
Effective Green, g (s)	11.6	16.8	50.0	50.0		60.2
Actuated g/C Ratio	0.13	0.19	0.56	0.56		0.67
Clearance Time (s)	5.0		5.0	5.0		5.0
Vehicle Extension (s)	3.0		3.0	3.0		3.0
Lane Grp Cap (vph)	221	287	1035	858		1531
v/s Ratio Prot	c0.07	0.02	c0.35			c0.02
v/s Ratio Perm				0.15		0.25
v/c Ratio	0.55	0.09	0.63	0.27		0.40
Uniform Delay, d1	36.8	30.3	13.7	10.4		6.7
Progression Factor	1.00	1.00	0.94	1.42		1.43
Incremental Delay, d2	3.0	0.1	2.8	0.7		0.2
Delay (s)	39.8	30.4	15.6	15.5		9.8
Level of Service	D	C	B	B		A
Approach Delay (s)	34.8		15.6			9.8
Approach LOS	C		B			A
Intersection Summary						
HCM 2000 Control Delay			16.3		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.58			
Actuated Cycle Length (s)			90.0		Sum of lost time (s)	20.0
Intersection Capacity Utilization			70.6%		ICU Level of Service	C
Analysis Period (min)			60			
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis

11: Battery Street & Main Street/Main Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	11	73	51	42	62	269	51	583	28	225	426	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0		5.0	5.0		5.0		5.0	5.0	
Lane Util. Factor		1.00	1.00		1.00	1.00		0.95		1.00	1.00	
Frpb, ped/bikes		1.00	0.92		1.00	0.98		1.00		1.00	1.00	
Flpb, ped/bikes		1.00	1.00		0.98	1.00		1.00		1.00	1.00	
Frt		1.00	0.85		1.00	0.85		0.99		1.00	1.00	
Flt Protected		0.99	1.00		0.98	1.00		1.00		0.95	1.00	
Satd. Flow (prot)		1845	1464		1794	1549		3560		1784	1875	
Flt Permitted		0.94	1.00		0.59	1.00		0.89		0.30	1.00	
Satd. Flow (perm)		1750	1464		1076	1549		3171		556	1875	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	11	73	51	42	62	269	51	583	28	225	426	7
RTOR Reduction (vph)	0	0	46	0	0	119	0	3	0	0	1	0
Lane Group Flow (vph)	0	84	5	0	104	150	0	659	0	225	432	0
Confl. Peds. (#/hr)	15		20	20		15	15		10	10		15
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	0%	0%	1%	1%	1%
Turn Type	Perm	NA	Perm	Perm	NA	pm+ov	Perm	NA		pm+pt	NA	
Protected Phases		4			8	1		2		1	6	
Permitted Phases	4		4	8		8	2			6		
Actuated Green, G (s)		8.9	8.9		13.6	22.8		47.5		66.4	61.7	
Effective Green, g (s)		8.9	8.9		13.6	22.8		47.5		66.4	61.7	
Actuated g/C Ratio		0.10	0.10		0.15	0.25		0.53		0.74	0.69	
Clearance Time (s)		5.0	5.0		5.0	5.0		5.0		5.0	5.0	
Vehicle Extension (s)		3.0	3.0		3.0	3.0		3.0		3.0	3.0	
Lane Grp Cap (vph)		173	144		162	478		1673		535	1285	
v/s Ratio Prot						c0.03				c0.04	0.23	
v/s Ratio Perm		0.05	0.00		c0.10	0.06		0.21		c0.27		
v/c Ratio		0.49	0.04		0.64	0.31		0.39		0.42	0.34	
Uniform Delay, d1		38.4	36.7		35.9	27.2		12.7		5.3	5.8	
Progression Factor		1.00	1.00		1.00	1.00		1.07		1.35	1.19	
Incremental Delay, d2		2.2	0.1		8.7	0.4		0.7		0.5	0.7	
Delay (s)		40.5	36.8		44.6	27.6		14.2		7.7	7.6	
Level of Service		D	D		D	C		B		A	A	
Approach Delay (s)		39.1			32.4			14.2			7.6	
Approach LOS		D			C			B			A	
Intersection Summary												
HCM 2000 Control Delay			17.4				HCM 2000 Level of Service			B		
HCM 2000 Volume to Capacity ratio			0.51									
Actuated Cycle Length (s)			90.0				Sum of lost time (s)			19.0		
Intersection Capacity Utilization			66.6%				ICU Level of Service			C		
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

12: Battery Street & King St

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	49	19	15	6	9	193	14	457	47	147	341	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0			5.0			5.0	
Lane Util. Factor	1.00	1.00			1.00			1.00			1.00	
Frpb, ped/bikes	1.00	0.96			0.94			0.99			0.99	
Flpb, ped/bikes	0.97	1.00			1.00			1.00			1.00	
Frt	1.00	0.93			0.87			0.99			0.99	
Flt Protected	0.95	1.00			1.00			1.00			0.99	
Satd. Flow (prot)	1758	1709			1534			1864			1818	
Flt Permitted	0.38	1.00			0.99			0.98			0.75	
Satd. Flow (perm)	712	1709			1523			1838			1378	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	49	19	15	6	9	193	14	457	47	147	341	40
RTOR Reduction (vph)	0	13	0	0	171	0	0	2	0	0	2	0
Lane Group Flow (vph)	49	21	0	0	37	0	0	516	0	0	526	0
Confl. Peds. (#/hr)	18		23	23		18	18		13	13		18
Heavy Vehicles (%)	0%	0%	0%	1%	1%	1%	0%	0%	0%	1%	1%	1%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	10.4	10.4			10.4			69.6			69.6	
Effective Green, g (s)	10.4	10.4			10.4			69.6			69.6	
Actuated g/C Ratio	0.12	0.12			0.12			0.77			0.77	
Clearance Time (s)	5.0	5.0			5.0			5.0			5.0	
Vehicle Extension (s)	3.0	3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)	82	197			175			1421			1065	
v/s Ratio Prot		0.01										
v/s Ratio Perm	c0.07				0.02			0.28			c0.38	
v/c Ratio	0.60	0.11			0.21			0.36			0.49	
Uniform Delay, d1	37.8	35.6			36.1			3.2			3.7	
Progression Factor	1.00	1.00			1.00			0.78			2.00	
Incremental Delay, d2	11.7	0.2			0.6			0.7			1.6	
Delay (s)	49.5	35.9			36.7			3.2			9.1	
Level of Service	D	D			D			A			A	
Approach Delay (s)		43.9			36.7			3.2			9.1	
Approach LOS		D			D			A			A	
Intersection Summary												
HCM 2000 Control Delay			13.2									
HCM 2000 Volume to Capacity ratio			0.51									
Actuated Cycle Length (s)			90.0									
Intersection Capacity Utilization			96.2%									
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

13: Battery Street & Maple Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	23	15	0	5	4	432	0	23	24	336	11	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0	5.0		5.0			5.0	
Lane Util. Factor		1.00			1.00	1.00		1.00			1.00	
Frpb, ped/bikes		1.00			1.00	1.00		0.99			1.00	
Flpb, ped/bikes		1.00			1.00	1.00		1.00			1.00	
Frt		1.00			1.00	0.85		0.93			1.00	
Flt Protected		0.97			0.97	1.00		1.00			0.95	
Satd. Flow (prot)		1844			1849	1615		1748			1807	
Flt Permitted		0.82			0.86	1.00		1.00			0.70	
Satd. Flow (perm)		1558			1643	1615		1748			1324	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	23	15	0	5	4	432	0	23	24	336	11	1
RTOR Reduction (vph)	0	0	0	0	0	383	0	5	0	0	0	0
Lane Group Flow (vph)	0	38	0	0	9	49	0	42	0	0	348	0
Confl. Peds. (#/hr)									1	1		
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA	Perm		NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)		10.2			10.2	10.2		69.8			69.8	
Effective Green, g (s)		10.2			10.2	10.2		69.8			69.8	
Actuated g/C Ratio		0.11			0.11	0.11		0.78			0.78	
Clearance Time (s)		5.0			5.0	5.0		5.0			5.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0			3.0	
Lane Grp Cap (vph)		176			186	183		1355			1026	
v/s Ratio Prot								0.02				
v/s Ratio Perm		0.02			0.01	c0.03					c0.26	
v/c Ratio		0.22			0.05	0.27		0.03			0.34	
Uniform Delay, d1		36.3			35.6	36.5		2.3			3.1	
Progression Factor		1.00			1.00	1.00		1.00			2.05	
Incremental Delay, d2		0.6			0.1	0.8		0.0			0.8	
Delay (s)		36.9			35.7	37.3		2.4			7.1	
Level of Service		D			D	D		A			A	
Approach Delay (s)		36.9			37.2			2.4			7.1	
Approach LOS		D			D			A			A	
Intersection Summary												
HCM 2000 Control Delay		23.4					HCM 2000 Level of Service			C		
HCM 2000 Volume to Capacity ratio		0.33										
Actuated Cycle Length (s)		90.0					Sum of lost time (s)		10.0			
Intersection Capacity Utilization		55.9%					ICU Level of Service		B			
Analysis Period (min)		60										
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis

14: Pine Street & Maple Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	8	126	274	59	210	37	250	145	14	9	289	9
Peak Hour 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
Hourly flow rate (vph)	8	126	274	59	210	37	250	145	14	9	289	9
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	408	306	409	307								
Volume Left (vph)	8	59	250	9								
Volume Right (vph)	274	37	14	9								
Hadj (s)	-0.38	0.00	0.17	0.04								
Departure Headway (s)	8.0	8.7	8.4	8.7								
Degree Utilization, x	0.90	0.74	0.96	0.74								
Capacity (veh/h)	408	393	423	393								
Control Delay (s)	66.7	35.5	98.2	36.0								
Approach Delay (s)	66.7	35.5	98.2	36.0								
Approach LOS	F	E	F	E								
Intersection Summary												
Delay				62.4								
Level of Service				F								
Intersection Capacity Utilization				92.9%	ICU Level of Service	F						
Analysis Period (min)				60								

HCM Signalized Intersection Capacity Analysis

15: Park St/VT 127 - Park & North Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											  	
Volume (vph)	0	126	18	68	210	0	0	0	0	36	197	6
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0						5.0	
Lane Util. Factor		1.00			1.00						0.95	
Frpb, ped/bikes		0.99			1.00						1.00	
Flpb, ped/bikes		1.00			0.99						1.00	
Frt		0.98			1.00						1.00	
Flt Protected		1.00			0.99						0.99	
Satd. Flow (prot)		1620			1656						3563	
Flt Permitted		1.00			0.88						0.99	
Satd. Flow (perm)		1620			1477						3563	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	126	18	68	210	0	0	0	0	36	197	6
RTOR Reduction (vph)	0	7	0	0	0	0	0	0	0	0	2	0
Lane Group Flow (vph)	0	137	0	0	278	0	0	0	0	0	237	0
Confl. Peds. (#/hr)	56		43	43		56	9		7	7		9
Heavy Vehicles (%)	3%	3%	3%	1%	1%	1%	0%	0%	0%	0%	0%	0%
Parking (#/hr)	0	0			0	0				0		
Turn Type		NA		Perm	NA					Perm	NA	
Protected Phases		4			8						6	
Permitted Phases				8						6		
Actuated Green, G (s)		17.4			17.4						30.9	
Effective Green, g (s)		17.4			17.4						30.9	
Actuated g/C Ratio		0.26			0.26						0.45	
Clearance Time (s)		5.0			5.0						5.0	
Vehicle Extension (s)		3.0			3.0						3.0	
Lane Grp Cap (vph)		413			376						1614	
v/s Ratio Prot		0.08										
v/s Ratio Perm					c0.19						0.07	
v/c Ratio		0.33			0.74						0.15	
Uniform Delay, d1		20.7			23.3						10.9	
Progression Factor		1.00			1.00						1.00	
Incremental Delay, d2		0.5			7.8						0.2	
Delay (s)		21.2			31.1						11.1	
Level of Service		C			C						B	
Approach Delay (s)		21.2			31.1			0.0			11.1	
Approach LOS		C			C			A			B	
Intersection Summary												
HCM 2000 Control Delay			21.7			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.33									
Actuated Cycle Length (s)			68.2			Sum of lost time (s)			15.0			
Intersection Capacity Utilization			45.5%			ICU Level of Service			A			
Analysis Period (min)			60									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

16: Battery Street/Park St & Sherman St

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											 	
Volume (vph)	0	0	439	0	0	0	742	0	0	0	285	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)			5.0				5.0				5.0	
Lane Util. Factor			1.00				1.00				0.95	
Frt			0.86				1.00				1.00	
Flt Protected			1.00				0.95				1.00	
Satd. Flow (prot)			1644				1805				3610	
Flt Permitted			1.00				0.57				1.00	
Satd. Flow (perm)			1644				1080				3610	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	0	439	0	0	0	742	0	0	0	285	0
RTOR Reduction (vph)	0	0	50	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	389	0	0	0	742	0	0	0	285	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type			pt+ov				D.P+P				NA	
Protected Phases			8 5		8		5				6	
Permitted Phases							5 6					
Actuated Green, G (s)			49.9				68.1				30.1	
Effective Green, g (s)			49.9				68.1				30.1	
Actuated g/C Ratio			0.55				0.76				0.33	
Clearance Time (s)							5.0				5.0	
Vehicle Extension (s)							3.0				3.0	
Lane Grp Cap (vph)			911				1123				1207	
v/s Ratio Prot			c0.24				c0.28				0.08	
v/s Ratio Perm							c0.22					
v/c Ratio			0.43				0.66				0.24	
Uniform Delay, d1			11.7				6.9				21.6	
Progression Factor			1.00				2.02				1.00	
Incremental Delay, d2			0.3				1.3				0.5	
Delay (s)			12.0				15.2				22.1	
Level of Service			B				B				C	
Approach Delay (s)		12.0			0.0			15.2			22.1	
Approach LOS		B			A			B			C	
Intersection Summary												
HCM 2000 Control Delay			15.6				HCM 2000 Level of Service			B		
HCM 2000 Volume to Capacity ratio			0.65									
Actuated Cycle Length (s)			90.0				Sum of lost time (s)			15.0		
Intersection Capacity Utilization			56.5%				ICU Level of Service			B		
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: North Ave & Church/127 Connector

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	2	0	0	26	0	555	1	671	59	267	323	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	10	10	10	10	10	10
Total Lost time (s)		4.0			4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Flpb, ped/bikes		0.99			0.99	1.00	1.00	1.00		1.00	1.00	
Frt		1.00			1.00	0.85	1.00	0.99		1.00	1.00	
Flt Protected		0.95			0.95	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1785			1777	1599	1665	1734		1668	1755	
Flt Permitted		0.74			0.76	1.00	0.56	1.00		0.15	1.00	
Satd. Flow (perm)		1391			1415	1599	989	1734		258	1755	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	2	0	0	26	0	555	1	671	59	267	323	1
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	2	0	0	26	555	1	730	0	267	324	0
Confl. Peds. (#/hr)	4		2	2		4	1					1
Heavy Vehicles (%)	0%	0%	0%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Turn Type	Perm	NA		Perm	NA	pt+ov	Perm	NA		pm+pt	NA	
Protected Phases		4			8	8 1		2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		21.0			21.0	35.8	44.2	44.2		59.0	59.0	
Effective Green, g (s)		22.0			22.0	36.8	45.2	45.2		60.0	60.0	
Actuated g/C Ratio		0.24			0.24	0.41	0.50	0.50		0.67	0.67	
Clearance Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		340			345	653	496	870		341	1170	
v/s Ratio Prot						c0.35		c0.42		0.09	0.18	
v/s Ratio Perm		0.00			0.02		0.00			0.43		
v/c Ratio		0.01			0.08	0.85	0.00	0.84		0.78	0.28	
Uniform Delay, d1		25.7			26.2	24.1	11.2	19.3		15.1	6.1	
Progression Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.0			0.1	11.2	0.0	10.4		12.0	0.6	
Delay (s)		25.7			26.3	35.3	11.2	29.7		27.2	6.7	
Level of Service		C			C	D	B	C		C	A	
Approach Delay (s)		25.7			34.9			29.7			16.0	
Approach LOS		C			C			C			B	
Intersection Summary												
HCM 2000 Control Delay		27.0					HCM 2000 Level of Service			C		
HCM 2000 Volume to Capacity ratio		0.89										
Actuated Cycle Length (s)		90.0					Sum of lost time (s)			12.0		
Intersection Capacity Utilization		87.7%					ICU Level of Service			E		
Analysis Period (min)		60										

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

3: North Ave & Institute Rd/City Bluffs

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	137	0	211	4	1	2	87	602	2	3	470	72
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	10	10	10	10	10	10
Total Lost time (s)		4.0	5.0		4.0		5.0	4.0			4.0	4.0
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00			1.00	1.00
Frpb, ped/bikes		1.00	0.98		1.00		1.00	1.00			1.00	0.96
Flpb, ped/bikes		1.00	1.00		0.99		0.99	1.00			1.00	1.00
Frt		1.00	0.85		0.96		1.00	1.00			1.00	0.85
Flt Protected		0.95	1.00		0.97		0.95	1.00			1.00	1.00
Satd. Flow (prot)		1805	1575		1545		1632	1738			1721	1406
Flt Permitted		0.75	1.00		0.85		0.49	1.00			1.00	1.00
Satd. Flow (perm)		1431	1575		1352		846	1738			1718	1406
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	137	0	211	4	1	2	87	602	2	3	470	72
RTOR Reduction (vph)	0	0	164	0	2	0	0	0	0	0	0	31
Lane Group Flow (vph)	0	137	47	0	5	0	87	604	0	0	473	41
Confl. Peds. (#/hr)			8	8			23		3	3		23
Heavy Vehicles (%)	0%	0%	0%	14%	14%	14%	2%	2%	2%	3%	3%	3%
Turn Type	Perm	NA	pm+ov	Perm	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases		4	5		8		5	2		1	6	
Permitted Phases	4		4	8			2			6		6
Actuated Green, G (s)		10.1	15.2		10.1		46.0	40.9			41.6	38.7
Effective Green, g (s)		11.1	15.2		11.1		46.0	41.9			43.6	39.7
Actuated g/C Ratio		0.16	0.22		0.16		0.67	0.61			0.63	0.58
Clearance Time (s)		5.0	5.0		5.0		5.0	5.0			5.0	5.0
Vehicle Extension (s)		4.0	3.0		4.0		3.0	3.0			3.0	3.0
Lane Grp Cap (vph)		230	461		217		622	1056			1087	810
v/s Ratio Prot			0.01				0.01	c0.35			c0.02	
v/s Ratio Perm		c0.10	0.02		0.00		0.08				0.25	0.03
v/c Ratio		0.60	0.10		0.02		0.14	0.57			0.44	0.05
Uniform Delay, d1		26.8	21.4		24.3		4.0	8.1			6.4	6.4
Progression Factor		1.00	1.00		1.00		1.00	1.00			1.00	1.00
Incremental Delay, d2		4.9	0.1		0.1		0.1	2.3			0.4	0.1
Delay (s)		31.7	21.5		24.4		4.1	10.4			6.8	6.5
Level of Service		C	C		C		A	B			A	A
Approach Delay (s)		25.5			24.4			9.6			6.8	
Approach LOS		C			C			A			A	
Intersection Summary												
HCM 2000 Control Delay			12.2				HCM 2000 Level of Service			B		
HCM 2000 Volume to Capacity ratio			0.58									
Actuated Cycle Length (s)			68.9				Sum of lost time (s)			13.0		
Intersection Capacity Utilization			78.9%				ICU Level of Service			D		
Analysis Period (min)			60									

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

4: North Ave & North Drive

12/21/2016

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	9	38	45	683	675	10
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	9	38	45	683	675	10
Pedestrians	25			10	10	
Lane Width (ft)	12.0			10.0	10.0	
Walking Speed (ft/s)	4.0			4.0	4.0	
Percent Blockage	2			1	1	
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (ft)				380		
pX, platoon unblocked	0.78					
vC, conflicting volume	1488	715	710			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1485	715	710			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	91	91	95			
cM capacity (veh/h)	99	422	866			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	47	728	685			
Volume Left	9	45	0			
Volume Right	38	0	10			
cSH	260	866	1700			
Volume to Capacity	0.18	0.05	0.40			
Queue Length 95th (ft)	16	4	0			
Control Delay (s)	21.9	1.3	0.0			
Lane LOS	C	A				
Approach Delay (s)	21.9	1.3	0.0			
Approach LOS	C					
Intersection Summary						
Average Delay			1.4			
Intersection Capacity Utilization		85.9%		ICU Level of Service		E
Analysis Period (min)		60				

HCM Signalized Intersection Capacity Analysis

5: North Ave & South Drive

12/21/2016

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	37	128	157	685	662	49
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	10	10	10	10	12	12
Total Lost time (s)	5.0		5.0	5.0	5.0	
Lane Util. Factor	1.00		1.00	1.00	1.00	
Frpb, ped/bikes	0.97		1.00	1.00	1.00	
Flpb, ped/bikes	1.00		1.00	1.00	1.00	
Frt	0.90		1.00	1.00	0.99	
Flt Protected	0.99		0.95	1.00	1.00	
Satd. Flow (prot)	1526		1636	1722	1791	
Flt Permitted	0.99		0.19	1.00	1.00	
Satd. Flow (perm)	1526		327	1722	1791	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	37	128	157	685	662	49
RTOR Reduction (vph)	113	0	0	0	4	0
Lane Group Flow (vph)	52	0	157	685	707	0
Confl. Peds. (#/hr)	10	10	25			25
Heavy Vehicles (%)	0%	0%	3%	3%	3%	3%
Bus Blockages (#/hr)	0	0	0	0	4	0
Turn Type	Prot		pm+pt	NA	NA	
Protected Phases	4		5	2	6	
Permitted Phases			2			
Actuated Green, G (s)	6.3		35.8	35.8	26.8	
Effective Green, g (s)	6.3		35.8	35.8	26.8	
Actuated g/C Ratio	0.12		0.69	0.69	0.51	
Clearance Time (s)	5.0		5.0	5.0	5.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	184		325	1183	921	
v/s Ratio Prot	c0.03		0.04	c0.40	c0.39	
v/s Ratio Perm			0.29			
v/c Ratio	0.29		0.48	0.58	0.77	
Uniform Delay, d1	20.8		6.2	4.2	10.2	
Progression Factor	1.00		1.00	1.00	1.00	
Incremental Delay, d2	0.9		1.1	0.7	4.0	
Delay (s)	21.7		7.4	4.9	14.1	
Level of Service	C		A	A	B	
Approach Delay (s)	21.7			5.4	14.1	
Approach LOS	C			A	B	
Intersection Summary						
HCM 2000 Control Delay			10.6	HCM 2000 Level of Service		B
HCM 2000 Volume to Capacity ratio			0.70			
Actuated Cycle Length (s)			52.1	Sum of lost time (s)		15.0
Intersection Capacity Utilization			70.6%	ICU Level of Service		C
Analysis Period (min)			60			
c Critical Lane Group						

HCM Unsignalized Intersection Capacity Analysis

6: North Ave & Berry/Washington

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	13	2	17	6	0	76	10	783	5	49	557	10
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour 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
Hourly flow rate (vph)	13	2	17	6	0	76	10	783	5	49	557	10
Pedestrians					18			29			13	
Lane Width (ft)					12.0			12.0			10.0	
Walking Speed (ft/s)					4.0			4.0			4.0	
Percent Blockage					1			2			1	
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)											1205	
pX, platoon unblocked	0.94	0.94	0.94	0.94	0.94		0.94					
vC, conflicting volume	1554	1486	591	1530	1488	816	567			806		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1558	1485	530	1533	1488	816	504			806		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	80	98	97	92	100	79	99			94		
cM capacity (veh/h)	64	108	506	77	108	371	989			802		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	32	82	798	616								
Volume Left	13	6	10	49								
Volume Right	17	76	5	10								
cSH	125	290	989	802								
Volume to Capacity	0.26	0.28	0.01	0.06								
Queue Length 95th (ft)	25	29	1	5								
Control Delay (s)	43.6	22.3	0.3	1.6								
Lane LOS	E	C	A	A								
Approach Delay (s)	43.6	22.3	0.3	1.6								
Approach LOS	E	C										
Intersection Summary												
Average Delay			2.9									
Intersection Capacity Utilization			84.9%		ICU Level of Service					E		
Analysis Period (min)			60									

HCM Signalized Intersection Capacity Analysis

7: VT 127 - Park & Manhattan Dr

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	11	71	14	26	107	1132	0	0	0	293	230	9
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0	5.0				5.0	5.0	
Lane Util. Factor		1.00			1.00	1.00				1.00	1.00	
Frpb, ped/bikes		1.00			1.00	1.00				1.00	1.00	
Flpb, ped/bikes		1.00			1.00	1.00				1.00	1.00	
Frt		0.98			1.00	0.85				1.00	0.99	
Flt Protected		0.99			0.99	1.00				0.95	1.00	
Satd. Flow (prot)		1848			1844	1583				1787	1871	
Flt Permitted		0.97			0.95	1.00				0.95	1.00	
Satd. Flow (perm)		1812			1767	1583				1787	1871	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	11	71	14	26	107	1132	0	0	0	293	230	9
RTOR Reduction (vph)	0	6	0	0	0	0	0	0	0	0	2	0
Lane Group Flow (vph)	0	90	0	0	133	1132	0	0	0	293	237	0
Confl. Peds. (#/hr)			2	2					35	35		
Heavy Vehicles (%)	0%	0%	0%	2%	2%	2%	0%	0%	0%	1%	1%	1%
Turn Type	Perm	NA		Perm	NA	pt+ov				Prot	NA	
Protected Phases		8			4	4 1				1	6	
Permitted Phases	8			4								
Actuated Green, G (s)		33.0			33.0	60.0				17.0	17.0	
Effective Green, g (s)		33.0			33.0	60.0				17.0	17.0	
Actuated g/C Ratio		0.55			0.55	1.00				0.28	0.28	
Clearance Time (s)		5.0			5.0					5.0	5.0	
Vehicle Extension (s)		3.0			3.0					3.0	3.0	
Lane Grp Cap (vph)		996			971	1583				506	530	
v/s Ratio Prot						c0.71				0.16	0.13	
v/s Ratio Perm		0.05			0.08							
v/c Ratio		0.09			0.14	0.72				0.58	0.45	
Uniform Delay, d1		6.4			6.6	0.0				18.4	17.6	
Progression Factor		1.00			1.00	1.00				1.00	1.00	
Incremental Delay, d2		0.2			0.3	1.6				1.6	2.7	
Delay (s)		6.6			6.9	1.6				20.1	20.4	
Level of Service		A			A	A				C	C	
Approach Delay (s)		6.6			2.1			0.0			20.2	
Approach LOS		A			A			A			C	
Intersection Summary												
HCM 2000 Control Delay		7.4			HCM 2000 Level of Service					A		
HCM 2000 Volume to Capacity ratio		0.86										
Actuated Cycle Length (s)		60.0			Sum of lost time (s)					10.0		
Intersection Capacity Utilization		83.7%			ICU Level of Service					E		
Analysis Period (min)		60										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

8: North Ave & North Street

12/21/2016

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	47	114	624	60	95	395
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	12	10	10	10	10
Total Lost time (s)	3.0		3.0		3.0	3.0
Lane Util. Factor	1.00		1.00		1.00	1.00
Frpb, ped/bikes	1.00		1.00		1.00	1.00
Flpb, ped/bikes	1.00		1.00		1.00	1.00
Frt	0.90		0.99		1.00	1.00
Flt Protected	0.99		1.00		0.95	1.00
Satd. Flow (prot)	1613		1714		1651	1739
Flt Permitted	0.99		1.00		0.25	1.00
Satd. Flow (perm)	1613		1714		440	1739
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	47	114	624	60	95	395
RTOR Reduction (vph)	90	0	0	0	0	0
Lane Group Flow (vph)	71	0	684	0	95	395
Confl. Peds. (#/hr)	13			6	6	
Heavy Vehicles (%)	5%	5%	2%	2%	2%	2%
Turn Type	Prot		NA		pm+pt	NA
Protected Phases	8		2		1	6
Permitted Phases					6	
Actuated Green, G (s)	9.1		48.7		56.9	56.9
Effective Green, g (s)	11.1		50.7		58.9	58.9
Actuated g/C Ratio	0.13		0.61		0.71	0.71
Clearance Time (s)	5.0		5.0		5.0	5.0
Vehicle Extension (s)	3.0		4.0		3.0	4.0
Lane Grp Cap (vph)	214		1040		385	1226
v/s Ratio Prot	c0.04		c0.40		0.02	c0.23
v/s Ratio Perm					0.16	
v/c Ratio	0.33		0.66		0.25	0.32
Uniform Delay, d1	32.8		10.7		6.6	4.7
Progression Factor	1.00		1.00		1.00	1.00
Incremental Delay, d2	0.9		3.3		0.3	0.7
Delay (s)	33.7		14.0		7.0	5.4
Level of Service	C		B		A	A
Approach Delay (s)	33.7		14.0			5.7
Approach LOS	C		B			A
Intersection Summary						
HCM 2000 Control Delay			13.4		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.56			
Actuated Cycle Length (s)			83.5		Sum of lost time (s)	14.0
Intersection Capacity Utilization			61.4%		ICU Level of Service	B
Analysis Period (min)			60			

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

9: Sherman St & North Ave

12/21/2016



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	9	15	19	816	503	4
Sign Control		Stop	Yield		Free	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	9	15	19	816	503	4
Pedestrians		9	20		20	
Lane Width (ft)		12.0	12.0		10.0	
Walking Speed (ft/s)		4.0	4.0		4.0	
Percent Blockage		1	2		1	
Right turn flare (veh)						
Median type					None	
Median storage veh						
Upstream signal (ft)					986	
pX, platoon unblocked						
vC, conflicting volume	1046	1037	1039	40	20	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1046	1037	1039	40	20	
tC, single (s)	7.1	6.5	6.5	6.2	4.1	
tC, 2 stage (s)						
tF (s)	3.5	4.0	4.0	3.3	2.2	
p0 queue free %	65	90	88	19	68	
cM capacity (veh/h)	25	153	155	1006	1582	
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	24	835	507			
Volume Left	9	0	503			
Volume Right	0	816	4			
cSH	53	894	1582			
Volume to Capacity	0.45	0.93	0.32			
Queue Length 95th (ft)	54	591	35			
Control Delay (s)	125.6	51.2	8.3			
Lane LOS	F	F	A			
Approach Delay (s)	125.6	51.2	8.3			
Approach LOS	F	F				
Intersection Summary						
Average Delay			36.6			
Intersection Capacity Utilization			88.2%	ICU Level of Service	E	
Analysis Period (min)			60			

HCM Signalized Intersection Capacity Analysis

10: Battery Street & Pearl Street

12/21/2016

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						 
Volume (vph)	122	159	721	412	147	546
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0		5.0
Lane Util. Factor	1.00	1.00	1.00	1.00		0.95
Frpb, ped/bikes	1.00	1.00	1.00	0.98		1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00		1.00
Frt	1.00	0.85	1.00	0.85		1.00
Flt Protected	0.95	1.00	1.00	1.00		0.99
Satd. Flow (prot)	1719	1538	1863	1546		3536
Flt Permitted	0.95	1.00	1.00	1.00		0.54
Satd. Flow (perm)	1719	1538	1863	1546		1930
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	122	159	721	412	147	546
RTOR Reduction (vph)	0	129	0	195	0	0
Lane Group Flow (vph)	122	30	721	217	0	693
Confl. Peds. (#/hr)		3		4	4	
Heavy Vehicles (%)	5%	5%	2%	2%	1%	1%
Turn Type	Prot	pt+ov	NA	Perm	pm+pt	NA
Protected Phases	3	3 1	2		1	6
Permitted Phases				2	6	
Actuated Green, G (s)	11.6	17.0	46.6	46.6		57.0
Effective Green, g (s)	11.6	17.0	46.6	46.6		57.0
Actuated g/C Ratio	0.13	0.19	0.52	0.52		0.63
Clearance Time (s)	5.0		5.0	5.0		5.0
Vehicle Extension (s)	3.0		3.0	3.0		3.0
Lane Grp Cap (vph)	221	290	964	800		1318
v/s Ratio Prot	c0.07	0.02	c0.39			c0.03
v/s Ratio Perm				0.14		0.30
v/c Ratio	0.55	0.10	0.75	0.27		0.53
Uniform Delay, d1	36.8	30.2	17.1	12.2		9.1
Progression Factor	1.00	1.00	0.91	1.32		1.29
Incremental Delay, d2	3.0	0.2	5.2	0.8		0.4
Delay (s)	39.8	30.4	20.8	16.8		12.1
Level of Service	D	C	C	B		B
Approach Delay (s)	34.4		19.4			12.1
Approach LOS	C		B			B
Intersection Summary						
HCM 2000 Control Delay			19.0		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.64			
Actuated Cycle Length (s)			90.0		Sum of lost time (s)	20.0
Intersection Capacity Utilization			76.6%		ICU Level of Service	D
Analysis Period (min)			60			
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis

11: Battery Street & Main Street/Main Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	11	73	51	42	62	289	51	621	28	243	457	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0		5.0	5.0		5.0		5.0	5.0	
Lane Util. Factor		1.00	1.00		1.00	1.00		0.95		1.00	1.00	
Frpb, ped/bikes		1.00	0.92		1.00	0.98		1.00		1.00	1.00	
Flpb, ped/bikes		1.00	1.00		0.98	1.00		1.00		1.00	1.00	
Frt		1.00	0.85		1.00	0.85		0.99		1.00	1.00	
Flt Protected		0.99	1.00		0.98	1.00		1.00		0.95	1.00	
Satd. Flow (prot)		1845	1464		1794	1549		3563		1785	1875	
Flt Permitted		0.94	1.00		0.59	1.00		0.89		0.28	1.00	
Satd. Flow (perm)		1750	1464		1076	1549		3171		524	1875	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	11	73	51	42	62	289	51	621	28	243	457	7
RTOR Reduction (vph)	0	0	46	0	0	107	0	2	0	0	1	0
Lane Group Flow (vph)	0	84	5	0	104	182	0	698	0	243	463	0
Confl. Peds. (#/hr)	15		20	20		15	15		10	10		15
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	0%	0%	1%	1%	1%
Turn Type	Perm	NA	Perm	Perm	NA	pm+ov	Perm	NA		pm+pt	NA	
Protected Phases		4			8	1		2		1	6	
Permitted Phases	4		4	8		8	2			6		
Actuated Green, G (s)		8.9	8.9		13.6	23.2		47.1		66.4	61.7	
Effective Green, g (s)		8.9	8.9		13.6	23.2		47.1		66.4	61.7	
Actuated g/C Ratio		0.10	0.10		0.15	0.26		0.52		0.74	0.69	
Clearance Time (s)		5.0	5.0		5.0	5.0		5.0		5.0	5.0	
Vehicle Extension (s)		3.0	3.0		3.0	3.0		3.0		3.0	3.0	
Lane Grp Cap (vph)		173	144		162	485		1659		521	1285	
v/s Ratio Prot						c0.04				c0.05	0.25	
v/s Ratio Perm		0.05	0.00		c0.10	0.08		0.22		c0.29		
v/c Ratio		0.49	0.04		0.64	0.38		0.42		0.47	0.36	
Uniform Delay, d1		38.4	36.7		35.9	27.4		13.1		5.7	5.9	
Progression Factor		1.00	1.00		1.00	1.00		1.09		0.86	0.83	
Incremental Delay, d2		2.2	0.1		8.7	0.5		0.7		0.6	0.7	
Delay (s)		40.5	36.8		44.6	27.9		15.1		5.4	5.6	
Level of Service		D	D		D	C		B		A	A	
Approach Delay (s)		39.1			32.4			15.1			5.6	
Approach LOS		D			C			B			A	
Intersection Summary												
HCM 2000 Control Delay			16.8				HCM 2000 Level of Service			B		
HCM 2000 Volume to Capacity ratio			0.56									
Actuated Cycle Length (s)			90.0				Sum of lost time (s)			19.0		
Intersection Capacity Utilization			69.3%				ICU Level of Service			C		
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

12: Battery Street & King St

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	49	19	15	6	9	193	14	494	47	147	372	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0			5.0			5.0	
Lane Util. Factor	1.00	1.00			1.00			1.00			1.00	
Frpb, ped/bikes	1.00	0.96			0.94			1.00			1.00	
Flpb, ped/bikes	0.97	1.00			1.00			1.00			1.00	
Frt	1.00	0.93			0.87			0.99			0.99	
Flt Protected	0.95	1.00			1.00			1.00			0.99	
Satd. Flow (prot)	1758	1709			1534			1866			1822	
Flt Permitted	0.38	1.00			0.99			0.98			0.75	
Satd. Flow (perm)	712	1709			1523			1840			1378	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	49	19	15	6	9	193	14	494	47	147	372	40
RTOR Reduction (vph)	0	13	0	0	171	0	0	2	0	0	2	0
Lane Group Flow (vph)	49	21	0	0	37	0	0	553	0	0	557	0
Confl. Peds. (#/hr)	18		23	23		18	18		13	13		18
Heavy Vehicles (%)	0%	0%	0%	1%	1%	1%	0%	0%	0%	1%	1%	1%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	10.4	10.4			10.4			69.6			69.6	
Effective Green, g (s)	10.4	10.4			10.4			69.6			69.6	
Actuated g/C Ratio	0.12	0.12			0.12			0.77			0.77	
Clearance Time (s)	5.0	5.0			5.0			5.0			5.0	
Vehicle Extension (s)	3.0	3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)	82	197			175			1422			1065	
v/s Ratio Prot		0.01										
v/s Ratio Perm	c0.07				0.02			0.30			c0.40	
v/c Ratio	0.60	0.11			0.21			0.39			0.52	
Uniform Delay, d1	37.8	35.6			36.1			3.3			3.9	
Progression Factor	1.00	1.00			1.00			0.78			2.23	
Incremental Delay, d2	11.7	0.2			0.6			0.7			1.8	
Delay (s)	49.5	35.9			36.7			3.3			10.4	
Level of Service	D	D			D			A			B	
Approach Delay (s)		43.9			36.7			3.3			10.4	
Approach LOS		D			D			A			B	
Intersection Summary												
HCM 2000 Control Delay			13.5									
HCM 2000 Volume to Capacity ratio			0.53									
Actuated Cycle Length (s)			90.0									
Intersection Capacity Utilization			99.7%									
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

13: Battery Street & Maple Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	23	15	0	5	4	469	0	23	24	367	11	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0	5.0		5.0			5.0	
Lane Util. Factor		1.00			1.00	1.00		1.00			1.00	
Frpb, ped/bikes		1.00			1.00	1.00		0.99			1.00	
Flpb, ped/bikes		1.00			1.00	1.00		1.00			1.00	
Frt		1.00			1.00	0.85		0.93			1.00	
Flt Protected		0.97			0.97	1.00		1.00			0.95	
Satd. Flow (prot)		1844			1849	1615		1748			1807	
Flt Permitted		0.82			0.87	1.00		1.00			0.70	
Satd. Flow (perm)		1562			1647	1615		1748			1323	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	23	15	0	5	4	469	0	23	24	367	11	1
RTOR Reduction (vph)	0	0	0	0	0	415	0	5	0	0	0	0
Lane Group Flow (vph)	0	38	0	0	9	54	0	42	0	0	379	0
Confl. Peds. (#/hr)									1	1		
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA	Perm		NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)		10.4			10.4	10.4		69.6			69.6	
Effective Green, g (s)		10.4			10.4	10.4		69.6			69.6	
Actuated g/C Ratio		0.12			0.12	0.12		0.77			0.77	
Clearance Time (s)		5.0			5.0	5.0		5.0			5.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0			3.0	
Lane Grp Cap (vph)		180			190	186		1351			1023	
v/s Ratio Prot								0.02				
v/s Ratio Perm		0.02			0.01	c0.03					c0.29	
v/c Ratio		0.21			0.05	0.29		0.03			0.37	
Uniform Delay, d1		36.1			35.4	36.4		2.4			3.2	
Progression Factor		1.00			1.00	1.00		1.00			2.04	
Incremental Delay, d2		0.6			0.1	0.9		0.0			0.9	
Delay (s)		36.7			35.5	37.3		2.4			7.5	
Level of Service		D			D	D		A			A	
Approach Delay (s)		36.7			37.3			2.4			7.5	
Approach LOS		D			D			A			A	
Intersection Summary												
HCM 2000 Control Delay		23.5										
HCM 2000 Volume to Capacity ratio		0.36										
Actuated Cycle Length (s)		90.0										
Intersection Capacity Utilization		58.2%										
Analysis Period (min)		60										
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis

14: Pine Street & Maple Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	8	140	291	59	226	37	270	145	14	9	289	9
Peak Hour 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
Hourly flow rate (vph)	8	140	291	59	226	37	270	145	14	9	289	9
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	439	322	429	307								
Volume Left (vph)	8	59	270	9								
Volume Right (vph)	291	37	14	9								
Hadj (s)	-0.38	0.00	0.17	0.04								
Departure Headway (s)	8.2	9.0	8.9	9.1								
Degree Utilization, x	0.99	0.80	1.0	0.78								
Capacity (veh/h)	436	393	411	387								
Control Delay (s)	127.5	45.4	205.1	41.6								
Approach Delay (s)	127.5	45.4	205.1	41.6								
Approach LOS	F	E	F	E								
Intersection Summary												
Delay				114.5								
Level of Service				F								
Intersection Capacity Utilization				96.6%	ICU Level of Service	F						
Analysis Period (min)				60								

HCM Signalized Intersection Capacity Analysis

15: Park St/VT 127 - Park & North Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	169	18	68	260	0	0	0	0	36	197	6
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0						5.0	
Lane Util. Factor		1.00			1.00						0.95	
Frpb, ped/bikes		0.99			1.00						1.00	
Flpb, ped/bikes		1.00			0.99						1.00	
Frt		0.99			1.00						1.00	
Flt Protected		1.00			0.99						0.99	
Satd. Flow (prot)		1629			1663						3563	
Flt Permitted		1.00			0.89						0.99	
Satd. Flow (perm)		1629			1495						3563	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	169	18	68	260	0	0	0	0	36	197	6
RTOR Reduction (vph)	0	4	0	0	0	0	0	0	0	0	2	0
Lane Group Flow (vph)	0	183	0	0	328	0	0	0	0	0	237	0
Confl. Peds. (#/hr)	56		43	43		56	9		7	7		9
Heavy Vehicles (%)	3%	3%	3%	1%	1%	1%	0%	0%	0%	0%	0%	0%
Parking (#/hr)	0	0			0	0				0		
Turn Type		NA		Perm	NA					Perm	NA	
Protected Phases		4			8						6	
Permitted Phases				8						6		
Actuated Green, G (s)		19.3			19.3						30.9	
Effective Green, g (s)		19.3			19.3						30.9	
Actuated g/C Ratio		0.28			0.28						0.44	
Clearance Time (s)		5.0			5.0						5.0	
Vehicle Extension (s)		3.0			3.0						3.0	
Lane Grp Cap (vph)		448			411						1570	
v/s Ratio Prot		0.11										
v/s Ratio Perm					0.22						0.07	
v/c Ratio		0.41			0.80						0.15	
Uniform Delay, d1		20.7			23.6						11.7	
Progression Factor		1.00			1.00						1.00	
Incremental Delay, d2		0.6			11.2						0.2	
Delay (s)		21.3			34.8						11.9	
Level of Service		C			C						B	
Approach Delay (s)		21.3			34.8			0.0			11.9	
Approach LOS		C			C			A			B	
Intersection Summary												
HCM 2000 Control Delay			24.2			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.36									
Actuated Cycle Length (s)			70.1			Sum of lost time (s)			15.0			
Intersection Capacity Utilization			50.3%			ICU Level of Service			A			
Analysis Period (min)			60									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

16: Battery Street/Park St & Sherman St

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											  	
Volume (vph)	0	0	518	0	0	0	835	0	0	0	285	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)			5.0				5.0				5.0	
Lane Util. Factor			1.00				1.00				0.95	
Frt			0.86				1.00				1.00	
Flt Protected			1.00				0.95				1.00	
Satd. Flow (prot)			1644				1805				3610	
Flt Permitted			1.00				0.56				1.00	
Satd. Flow (perm)			1644				1066				3610	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	0	518	0	0	0	835	0	0	0	285	0
RTOR Reduction (vph)	0	0	46	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	472	0	0	0	835	0	0	0	285	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type			pt+ov				D.P+P				NA	
Protected Phases			8 5		8		5				6	
Permitted Phases							5 6					
Actuated Green, G (s)			53.2				67.7				26.8	
Effective Green, g (s)			53.2				67.7				26.8	
Actuated g/C Ratio			0.59				0.75				0.30	
Clearance Time (s)							5.0				5.0	
Vehicle Extension (s)							3.0				3.0	
Lane Grp Cap (vph)			971				1137				1074	
v/s Ratio Prot			c0.29				c0.33				0.08	
v/s Ratio Perm							c0.22					
v/c Ratio			0.49				0.73				0.27	
Uniform Delay, d1			10.6				7.5				24.1	
Progression Factor			1.00				2.04				1.00	
Incremental Delay, d2			0.4				2.0				0.6	
Delay (s)			10.9				17.2				24.7	
Level of Service			B				B				C	
Approach Delay (s)		10.9			0.0			17.2			24.7	
Approach LOS		B			A			B			C	
Intersection Summary												
HCM 2000 Control Delay			16.5				HCM 2000 Level of Service			B		
HCM 2000 Volume to Capacity ratio			0.73									
Actuated Cycle Length (s)			90.0				Sum of lost time (s)			15.0		
Intersection Capacity Utilization			61.6%				ICU Level of Service			B		
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: North Ave & Church/127 Connector

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1	0	21	1	167	0	247	16	520	596	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	10	10	10	10	10	10
Total Lost time (s)		4.0			4.0	4.0		4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00	1.00		1.00		1.00	1.00	
Frpb, ped/bikes		1.00			1.00	1.00		1.00		1.00	1.00	
Flpb, ped/bikes		1.00			0.99	1.00		1.00		1.00	1.00	
Frt		1.00			1.00	0.85		0.99		1.00	1.00	
Flt Protected		1.00			0.95	1.00		1.00		0.95	1.00	
Satd. Flow (prot)		1900			1725	1553		1612		1652	1738	
Flt Permitted		1.00			0.77	1.00		1.00		0.45	1.00	
Satd. Flow (perm)		1900			1391	1553		1612		780	1738	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	1	0	21	1	167	0	247	16	520	596	2
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	1	0	0	22	167	0	263	0	520	598	0
Confl. Peds. (#/hr)	9		7	7		9	1					1
Heavy Vehicles (%)	0%	0%	0%	4%	4%	4%	9%	9%	9%	2%	2%	2%
Turn Type		NA		Perm	NA	pt+ov	Perm	NA		pm+pt	NA	
Protected Phases		4			8	8 1		2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		7.7			7.7	24.4		18.0		34.7	34.7	
Effective Green, g (s)		8.7			8.7	25.4		19.0		35.7	35.7	
Actuated g/C Ratio		0.17			0.17	0.48		0.36		0.68	0.68	
Clearance Time (s)		5.0			5.0			5.0		5.0	5.0	
Vehicle Extension (s)		3.0			3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)		315			230	752		584		742	1184	
v/s Ratio Prot		0.00				c0.11		0.16		c0.17	0.34	
v/s Ratio Perm					0.02					c0.31		
v/c Ratio		0.00			0.10	0.22		0.45		0.70	0.51	
Uniform Delay, d1		18.2			18.5	7.8		12.7		4.5	4.1	
Progression Factor		1.00			1.00	1.00		1.00		1.00	1.00	
Incremental Delay, d2		0.0			0.2	0.2		2.5		3.1	1.5	
Delay (s)		18.2			18.7	7.9		15.2		7.6	5.6	
Level of Service		B			B	A		B		A	A	
Approach Delay (s)		18.2			9.2			15.2			6.5	
Approach LOS		B			A			B			A	
Intersection Summary												
HCM 2000 Control Delay			8.3				HCM 2000 Level of Service			A		
HCM 2000 Volume to Capacity ratio			0.66									
Actuated Cycle Length (s)			52.4				Sum of lost time (s)			12.0		
Intersection Capacity Utilization			62.1%				ICU Level of Service			B		
Analysis Period (min)			60									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

3: North Ave & Institute Rd/City Bluffs

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	103	0	166	7	0	5	255	248	2	0	590	259
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	10	10	10	10	10	10
Total Lost time (s)		4.0	5.0		4.0		5.0	4.0			4.0	4.0
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00			1.00	1.00
Frpb, ped/bikes		1.00	0.97		1.00		1.00	1.00			1.00	0.97
Flpb, ped/bikes		1.00	1.00		0.99		1.00	1.00			1.00	1.00
Frt		1.00	0.85		0.94		1.00	1.00			1.00	0.85
Flt Protected		0.95	1.00		0.97		0.95	1.00			1.00	1.00
Satd. Flow (prot)		1787	1559		1716		1636	1719			1756	1450
Flt Permitted		0.75	1.00		0.84		0.26	1.00			1.00	1.00
Satd. Flow (perm)		1410	1559		1479		443	1719			1756	1450
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	103	0	166	7	0	5	255	248	2	0	590	259
RTOR Reduction (vph)	0	0	122	0	10	0	0	0	0	0	0	122
Lane Group Flow (vph)	0	103	44	0	2	0	255	250	0	0	590	137
Confl. Peds. (#/hr)			14	14			9		1	1		9
Heavy Vehicles (%)	1%	1%	1%	0%	0%	0%	3%	3%	3%	1%	1%	1%
Turn Type	Perm	NA	pm+ov	Perm	NA		pm+pt	NA			NA	Perm
Protected Phases		4	5		8		5	2		1	6	
Permitted Phases	4		4	8			2			6		6
Actuated Green, G (s)		9.2	18.0		9.2		48.6	40.7			34.8	34.8
Effective Green, g (s)		10.2	18.0		10.2		48.6	41.7			35.8	35.8
Actuated g/C Ratio		0.15	0.27		0.15		0.72	0.62			0.53	0.53
Clearance Time (s)		5.0	5.0		5.0		5.0	5.0			5.0	5.0
Vehicle Extension (s)		4.0	3.0		4.0		3.0	3.0			3.0	3.0
Lane Grp Cap (vph)		212	528		222		472	1057			927	765
v/s Ratio Prot			0.01				c0.07	0.15			c0.34	
v/s Ratio Perm		c0.07	0.02		0.00		0.32					0.09
v/c Ratio		0.49	0.08		0.01		0.54	0.24			0.64	0.18
Uniform Delay, d1		26.4	18.7		24.5		6.3	5.9			11.4	8.3
Progression Factor		1.00	1.00		1.00		1.00	1.00			1.00	1.00
Incremental Delay, d2		2.4	0.1		0.0		1.3	0.5			3.4	0.5
Delay (s)		28.8	18.8		24.5		7.5	6.4			14.8	8.9
Level of Service		C	B		C		A	A			B	A
Approach Delay (s)		22.6			24.5			7.0			13.0	
Approach LOS		C			C			A			B	
Intersection Summary												
HCM 2000 Control Delay			12.8				HCM 2000 Level of Service				B	
HCM 2000 Volume to Capacity ratio			0.60									
Actuated Cycle Length (s)			67.8				Sum of lost time (s)			13.0		
Intersection Capacity Utilization			68.2%				ICU Level of Service			C		
Analysis Period (min)			60									

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

4: North Ave & North Drive

12/21/2016

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	0	0	0	363	761	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	0	0	0	363	761	0
Pedestrians	25			10	10	
Lane Width (ft)	12.0			10.0	10.0	
Walking Speed (ft/s)	4.0			4.0	4.0	
Percent Blockage	2			1	1	
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1159	796	786			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1159	796	786			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	100	100			
cM capacity (veh/h)	212	379	811			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	0	363	761			
Volume Left	0	0	0			
Volume Right	0	0	0			
cSH	1700	811	1700			
Volume to Capacity	0.00	0.00	0.45			
Queue Length 95th (ft)	0	0	0			
Control Delay (s)	0.0	0.0	0.0			
Lane LOS	A					
Approach Delay (s)	0.0	0.0	0.0			
Approach LOS	A					
Intersection Summary						
Average Delay			0.0			
Intersection Capacity Utilization			52.9%	ICU Level of Service		A
Analysis Period (min)			60			

HCM Unsignalized Intersection Capacity Analysis

5: North Ave & South Drive

12/21/2016

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	5	11	1	357	758	2
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	5	11	1	357	758	2
Pedestrians	25			10	10	
Lane Width (ft)	12.0			10.0	12.0	
Walking Speed (ft/s)	4.0			4.0	4.0	
Percent Blockage	2			1	1	
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1153	794	785			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1153	794	785			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	98	97	100			
cM capacity (veh/h)	214	380	812			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	16	358	760			
Volume Left	5	1	0			
Volume Right	11	0	2			
cSH	306	812	1700			
Volume to Capacity	0.05	0.00	0.45			
Queue Length 95th (ft)	4	0	0			
Control Delay (s)	17.4	0.0	0.0			
Lane LOS	C	A				
Approach Delay (s)	17.4	0.0	0.0			
Approach LOS	C					
Intersection Summary						
Average Delay			0.3			
Intersection Capacity Utilization		52.9%		ICU Level of Service		A
Analysis Period (min)		60				

HCM Unsignalized Intersection Capacity Analysis

6: North Ave & Berry St/Washington

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	0	12	9	1	38	4	300	3	35	694	2
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour 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
Hourly flow rate (vph)	2	0	12	9	1	38	4	300	3	35	694	2
Pedestrians		2			12			8				
Lane Width (ft)		12.0			12.0			12.0				
Walking Speed (ft/s)		4.0			4.0			4.0				
Percent Blockage		0			1			1				
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1115	1090	705	1106	1090	314	698			315		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1115	1090	705	1106	1090	314	698			315		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	99	100	97	95	100	95	100			97		
cM capacity (veh/h)	170	207	436	175	208	724	892			1238		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	14	48	307	731								
Volume Left	2	9	4	35								
Volume Right	12	38	3	2								
cSH	357	442	892	1238								
Volume to Capacity	0.04	0.11	0.00	0.03								
Queue Length 95th (ft)	3	9	0	2								
Control Delay (s)	15.5	14.1	0.2	0.7								
Lane LOS	C	B	A	A								
Approach Delay (s)	15.5	14.1	0.2	0.7								
Approach LOS	C	B										
Intersection Summary												
Average Delay			1.4									
Intersection Capacity Utilization			76.5%		ICU Level of Service					D		
Analysis Period (min)			60									

HCM Signalized Intersection Capacity Analysis

7: VT 127 - Park & Manhattan Dr.

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	6	50	7	39	59	311	0	0	0	539	639	14
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0	5.0				5.0	5.0	
Lane Util. Factor		1.00			1.00	1.00				1.00	1.00	
Frpb, ped/bikes		1.00			1.00	1.00				1.00	1.00	
Flpb, ped/bikes		1.00			1.00	1.00				1.00	1.00	
Frt		0.98			1.00	0.85				1.00	1.00	
Flt Protected		1.00			0.98	1.00				0.95	1.00	
Satd. Flow (prot)		1823			1739	1509				1805	1894	
Flt Permitted		0.97			0.84	1.00				0.95	1.00	
Satd. Flow (perm)		1770			1495	1509				1805	1894	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	6	50	7	39	59	311	0	0	0	539	639	14
RTOR Reduction (vph)	0	6	0	0	0	0	0	0	0	0	1	0
Lane Group Flow (vph)	0	57	0	0	98	311	0	0	0	539	652	0
Confl. Peds. (#/hr)			2	2					9	9		
Heavy Vehicles (%)	2%	2%	2%	7%	7%	7%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA	pt+ov				Prot	NA	
Protected Phases		8			4	4 1				1	6	
Permitted Phases	8			4								
Actuated Green, G (s)		9.3			9.3	53.4				34.1	34.1	
Effective Green, g (s)		9.3			9.3	53.4				34.1	34.1	
Actuated g/C Ratio		0.17			0.17	1.00				0.64	0.64	
Clearance Time (s)		5.0			5.0					5.0	5.0	
Vehicle Extension (s)		3.0			3.0					3.0	3.0	
Lane Grp Cap (vph)		308			260	1509				1152	1209	
v/s Ratio Prot						0.21				0.30	c0.34	
v/s Ratio Perm		0.03			c0.07							
v/c Ratio		0.19			0.38	0.21				0.47	0.54	
Uniform Delay, d1		18.8			19.5	0.0				5.0	5.3	
Progression Factor		1.00			1.00	1.00				1.00	1.00	
Incremental Delay, d2		0.3			0.9	0.1				1.4	1.7	
Delay (s)		19.1			20.4	0.1				6.3	7.1	
Level of Service		B			C	A				A	A	
Approach Delay (s)		19.1			4.9			0.0			6.7	
Approach LOS		B			A			A			A	
Intersection Summary												
HCM 2000 Control Delay			6.8				HCM 2000 Level of Service			A		
HCM 2000 Volume to Capacity ratio			0.50									
Actuated Cycle Length (s)			53.4				Sum of lost time (s)			10.0		
Intersection Capacity Utilization			54.7%				ICU Level of Service			A		
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

8: North Ave & North Street

12/21/2016

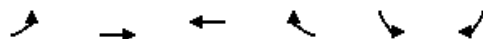
						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	21	43	304	31	49	573
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	12	10	10	10	10
Total Lost time (s)	3.0		3.0		3.0	3.0
Lane Util. Factor	1.00		1.00		1.00	1.00
Frpb, ped/bikes	1.00		1.00		1.00	1.00
Flpb, ped/bikes	1.00		1.00		1.00	1.00
Frt	0.91		0.99		1.00	1.00
Flt Protected	0.98		1.00		0.95	1.00
Satd. Flow (prot)	1700		1697		1651	1739
Flt Permitted	0.98		1.00		0.49	1.00
Satd. Flow (perm)	1700		1697		859	1739
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	21	43	304	31	49	573
RTOR Reduction (vph)	39	0	0	0	0	0
Lane Group Flow (vph)	25	0	335	0	49	573
Confl. Peds. (#/hr)	7			3	3	
Heavy Vehicles (%)	0%	0%	3%	3%	2%	2%
Turn Type	Prot		NA		pm+pt	NA
Protected Phases	8		2		1	6
Permitted Phases					6	
Actuated Green, G (s)	5.9		52.5		59.9	59.9
Effective Green, g (s)	7.9		54.5		61.9	61.9
Actuated g/C Ratio	0.09		0.65		0.74	0.74
Clearance Time (s)	5.0		5.0		5.0	5.0
Vehicle Extension (s)	3.0		4.0		3.0	4.0
Lane Grp Cap (vph)	161		1108		679	1290
v/s Ratio Prot	c0.01		0.20		0.00	c0.33
v/s Ratio Perm					0.05	
v/c Ratio	0.16		0.30		0.07	0.44
Uniform Delay, d1	34.7		6.2		3.1	4.1
Progression Factor	1.00		1.00		1.00	1.00
Incremental Delay, d2	0.5		0.7		0.0	1.1
Delay (s)	35.1		6.9		3.2	5.2
Level of Service	D		A		A	A
Approach Delay (s)	35.1		6.9			5.1
Approach LOS	D		A			A
Intersection Summary						
HCM 2000 Control Delay			7.6		HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio			0.41			
Actuated Cycle Length (s)			83.4		Sum of lost time (s)	14.0
Intersection Capacity Utilization			40.6%		ICU Level of Service	A
Analysis Period (min)			60			

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

9: Sherman St & North Ave

12/21/2016



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	3	9	10	469	527	4
Sign Control		Stop	Yield		Free	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	3	9	10	469	527	4
Pedestrians		4	10		8	
Lane Width (ft)		12.0	12.0		10.0	
Walking Speed (ft/s)		4.0	4.0		4.0	
Percent Blockage		0	1		1	
Right turn flare (veh)						
Median type					None	
Median storage (veh)						
Upstream signal (ft)					986	
pX, platoon unblocked						
vC, conflicting volume	1073	1070	1072	18	10	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1073	1070	1072	18	10	
tC, single (s)	7.1	6.5	6.6	6.3	4.1	
tC, 2 stage (s)						
tF (s)	3.5	4.0	4.1	3.4	2.2	
p0 queue free %	96	94	93	55	67	
cM capacity (veh/h)	75	147	142	1032	1577	
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	12	479	531			
Volume Left	3	0	527			
Volume Right	0	469	4			
cSH	119	912	1577			
Volume to Capacity	0.10	0.52	0.33			
Queue Length 95th (ft)	8	82	38			
Control Delay (s)	38.8	13.3	8.4			
Lane LOS	E	B	A			
Approach Delay (s)	38.8	13.3	8.4			
Approach LOS	E	B				
Intersection Summary						
Average Delay		11.0				
Intersection Capacity Utilization		66.5%		ICU Level of Service		C
Analysis Period (min)		60				

HCM Signalized Intersection Capacity Analysis

10: Battery Street & Pearl Street

12/21/2016

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						 
Volume (vph)	135	69	259	153	260	1126
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0		5.0
Lane Util. Factor	1.00	1.00	1.00	1.00		0.95
Frpb, ped/bikes	1.00	1.00	1.00	0.97		1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00		1.00
Frt	1.00	0.85	1.00	0.85		1.00
Flt Protected	0.95	1.00	1.00	1.00		0.99
Satd. Flow (prot)	1612	1442	1727	1418		3502
Flt Permitted	0.95	1.00	1.00	1.00		0.76
Satd. Flow (perm)	1612	1442	1727	1418		2681
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	135	69	259	153	260	1126
RTOR Reduction (vph)	0	56	0	73	0	0
Lane Group Flow (vph)	135	13	259	80	0	1386
Confl. Peds. (#/hr)	7			15	15	
Heavy Vehicles (%)	12%	12%	10%	10%	2%	2%
Turn Type	Prot	pt+ov	NA	Perm	pm+pt	NA
Protected Phases	3	3 1	2		1	6
Permitted Phases				2	6	
Actuated Green, G (s)	12.4	16.4	47.2	47.2		56.2
Effective Green, g (s)	12.4	16.4	47.2	47.2		56.2
Actuated g/C Ratio	0.14	0.18	0.52	0.52		0.62
Clearance Time (s)	5.0		5.0	5.0		5.0
Vehicle Extension (s)	3.0		3.0	3.0		3.0
Lane Grp Cap (vph)	222	262	905	743		1710
v/s Ratio Prot	c0.08	0.01	0.15			c0.04
v/s Ratio Perm				0.06		c0.47
v/c Ratio	0.61	0.05	0.29	0.11		0.81
Uniform Delay, d1	36.5	30.4	12.0	10.8		12.9
Progression Factor	1.00	1.00	0.69	0.54		0.96
Incremental Delay, d2	4.7	0.1	0.8	0.3		2.7
Delay (s)	41.3	30.4	9.0	6.2		15.0
Level of Service	D	C	A	A		B
Approach Delay (s)	37.6		8.0			15.0
Approach LOS	D		A			B
Intersection Summary						
HCM 2000 Control Delay			15.9		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.75			
Actuated Cycle Length (s)			90.0		Sum of lost time (s)	20.0
Intersection Capacity Utilization			72.3%		ICU Level of Service	C
Analysis Period (min)			60			
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis

11: Battery Street & Main Street/Main Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	8	30	26	31	91	158	64	318	3	334	561	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0		5.0	5.0		5.0		5.0	5.0	
Lane Util. Factor		1.00	1.00		1.00	1.00		0.95		1.00	1.00	
Frpb, ped/bikes		1.00	0.97		1.00	0.99		1.00		1.00	1.00	
Flpb, ped/bikes		1.00	1.00		1.00	1.00		1.00		1.00	1.00	
Frt		1.00	0.85		1.00	0.85		1.00		1.00	1.00	
Flt Protected		0.99	1.00		0.99	1.00		0.99		0.95	1.00	
Satd. Flow (prot)		1724	1432		1717	1469		3497		1779	1876	
Flt Permitted		0.90	1.00		0.58	1.00		0.79		0.42	1.00	
Satd. Flow (perm)		1564	1432		1014	1469		2801		792	1876	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	8	30	26	31	91	158	64	318	3	334	561	8
RTOR Reduction (vph)	0	0	24	0	0	113	0	1	0	0	1	0
Lane Group Flow (vph)	0	38	2	0	122	45	0	384	0	334	568	0
Confl. Peds. (#/hr)	2		5	5		2	10		10	10		10
Heavy Vehicles (%)	9%	9%	9%	9%	9%	9%	2%	2%	2%	1%	1%	1%
Turn Type	Perm	NA	Perm	Perm	NA	pm+ov	Perm	NA		pm+pt	NA	
Protected Phases		4			8	1		2		1	6	
Permitted Phases	4		4	8		8	2			6		
Actuated Green, G (s)		7.2	7.2		14.5	25.8		44.5		65.5	60.9	
Effective Green, g (s)		7.2	7.2		14.5	25.8		44.5		65.5	60.9	
Actuated g/C Ratio		0.08	0.08		0.16	0.29		0.49		0.73	0.68	
Clearance Time (s)		5.0	5.0		5.0	5.0		5.0		5.0	5.0	
Vehicle Extension (s)		3.0	3.0		3.0	3.0		3.0		3.0	3.0	
Lane Grp Cap (vph)		125	114		163	502		1384		700	1269	
v/s Ratio Prot						0.01				c0.06	0.30	
v/s Ratio Perm		0.02	0.00		c0.12	0.02		0.14		c0.29		
v/c Ratio		0.30	0.02		0.75	0.09		0.28		0.48	0.45	
Uniform Delay, d1		39.0	38.1		36.0	23.5		13.3		5.0	6.8	
Progression Factor		1.00	1.00		1.00	1.00		1.00		1.20	0.65	
Incremental Delay, d2		1.4	0.1		18.8	0.1		0.5		0.3	0.8	
Delay (s)		40.4	38.2		54.8	23.6		13.9		6.4	5.1	
Level of Service		D	D		D	C		B		A	A	
Approach Delay (s)		39.5			37.2			13.9			5.6	
Approach LOS		D			D			B			A	
Intersection Summary												
HCM 2000 Control Delay			14.3				HCM 2000 Level of Service			B		
HCM 2000 Volume to Capacity ratio			0.58									
Actuated Cycle Length (s)			90.0				Sum of lost time (s)			19.0		
Intersection Capacity Utilization			69.0%				ICU Level of Service			C		
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

12: Battery Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	5	3	2	7	10	96	7	297	3	167	485	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0			5.0			5.0	
Lane Util. Factor	1.00	1.00			1.00			1.00			1.00	
Frpb, ped/bikes	1.00	0.99			0.98			1.00			1.00	
Flpb, ped/bikes	0.99	1.00			1.00			1.00			1.00	
Frt	1.00	0.94			0.89			1.00			0.99	
Flt Protected	0.95	1.00			1.00			1.00			0.99	
Satd. Flow (prot)	1631	1603			1588			1771			1787	
Flt Permitted	0.55	1.00			0.98			0.99			0.83	
Satd. Flow (perm)	941	1603			1558			1751			1501	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	5	3	2	7	10	96	7	297	3	167	485	30
RTOR Reduction (vph)	0	2	0	0	88	0	0	0	0	0	1	0
Lane Group Flow (vph)	5	3	0	0	25	0	0	307	0	0	681	0
Confl. Peds. (#/hr)	3		4	4		3	2		6	6		2
Heavy Vehicles (%)	10%	10%	10%	3%	3%	3%	7%	7%	7%	4%	4%	4%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	7.3	7.3			7.3			72.7			72.7	
Effective Green, g (s)	7.3	7.3			7.3			72.7			72.7	
Actuated g/C Ratio	0.08	0.08			0.08			0.81			0.81	
Clearance Time (s)	5.0	5.0			5.0			5.0			5.0	
Vehicle Extension (s)	3.0	3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)	76	130			126			1414			1212	
v/s Ratio Prot		0.00										
v/s Ratio Perm	0.01				c0.02			0.18			c0.45	
v/c Ratio	0.07	0.02			0.20			0.22			0.56	
Uniform Delay, d1	38.2	38.1			38.6			2.0			3.0	
Progression Factor	1.00	1.00			1.00			0.77			2.11	
Incremental Delay, d2	0.4	0.1			0.8			0.3			1.8	
Delay (s)	38.6	38.1			39.4			1.9			8.2	
Level of Service	D	D			D			A			A	
Approach Delay (s)		38.4			39.4			1.9			8.2	
Approach LOS		D			D			A			A	
Intersection Summary												
HCM 2000 Control Delay			9.9									
HCM 2000 Volume to Capacity ratio			0.53									
Actuated Cycle Length (s)			90.0								10.0	
Intersection Capacity Utilization			78.6%								D	
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

13: Battery Street & Maple Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	9	3	2	42	19	269	1	12	15	357	40	24
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0	5.0		5.0			5.0	
Lane Util. Factor		1.00			1.00	1.00		1.00			1.00	
Frpb, ped/bikes		0.99			1.00	0.97		0.98			1.00	
Flpb, ped/bikes		1.00			0.99	1.00		1.00			0.99	
Frt		0.98			1.00	0.85		0.93			0.99	
Flt Protected		0.97			0.97	1.00		1.00			0.96	
Satd. Flow (prot)		1627			1760	1528		1442			1754	
Flt Permitted		0.81			0.79	1.00		0.99			0.74	
Satd. Flow (perm)		1368			1430	1528		1436			1351	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	9	3	2	42	19	269	1	12	15	357	40	24
RTOR Reduction (vph)	0	2	0	0	0	240	0	3	0	0	1	0
Lane Group Flow (vph)	0	12	0	0	61	29	0	25	0	0	420	0
Confl. Peds. (#/hr)	2		7	7		2	3		4	4		3
Heavy Vehicles (%)	10%	10%	10%	3%	3%	3%	20%	20%	20%	2%	2%	2%
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)		9.7			9.7	9.7		70.3			70.3	
Effective Green, g (s)		9.7			9.7	9.7		70.3			70.3	
Actuated g/C Ratio		0.11			0.11	0.11		0.78			0.78	
Clearance Time (s)		5.0			5.0	5.0		5.0			5.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0			3.0	
Lane Grp Cap (vph)		147			154	164		1121			1055	
v/s Ratio Prot												
v/s Ratio Perm		0.01			c0.04	0.02		0.02			c0.31	
v/c Ratio		0.08			0.40	0.18		0.02			0.40	
Uniform Delay, d1		36.1			37.4	36.5		2.2			3.1	
Progression Factor		1.00			1.00	1.00		1.00			1.24	
Incremental Delay, d2		0.2			1.7	0.5		0.0			1.0	
Delay (s)		36.4			39.1	37.0		2.2			4.8	
Level of Service		D			D	D		A			A	
Approach Delay (s)		36.4			37.4			2.2			4.8	
Approach LOS		D			D			A			A	
Intersection Summary												
HCM 2000 Control Delay		18.9					HCM 2000 Level of Service		B			
HCM 2000 Volume to Capacity ratio		0.40										
Actuated Cycle Length (s)		90.0					Sum of lost time (s)		10.0			
Intersection Capacity Utilization		48.1%					ICU Level of Service		A			
Analysis Period (min)		60										
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis

14: Pine Street & Maple Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	7	53	325	57	162	13	214	164	27	8	262	6
Peak Hour 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
Hourly flow rate (vph)	7	53	325	57	162	13	214	164	27	8	262	6
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	385	232	405	276								
Volume Left (vph)	7	57	214	8								
Volume Right (vph)	325	13	27	6								
Hadj (s)	-0.47	0.05	0.12	0.16								
Departure Headway (s)	6.7	7.6	7.1	7.5								
Degree Utilization, x	0.71	0.49	0.79	0.57								
Capacity (veh/h)	502	406	484	429								
Control Delay (s)	25.6	17.8	35.6	20.4								
Approach Delay (s)	25.6	17.8	35.6	20.4								
Approach LOS	D	C	E	C								
Intersection Summary												
Delay				26.2								
Level of Service				D								
Intersection Capacity Utilization				86.7%	ICU Level of Service				E			
Analysis Period (min)				60								

HCM Signalized Intersection Capacity Analysis

15: Park St/VT 127 - Park & North Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											  	
Volume (vph)	0	126	29	98	114	0	0	0	0	106	663	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0						5.0	
Lane Util. Factor		1.00			1.00						0.95	
Frpb, ped/bikes		0.99			1.00						1.00	
Flpb, ped/bikes		1.00			0.99						1.00	
Frt		0.97			1.00						1.00	
Flt Protected		1.00			0.98						0.99	
Satd. Flow (prot)		1548			1579						3572	
Flt Permitted		1.00			0.78						0.99	
Satd. Flow (perm)		1548			1256						3572	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	126	29	98	114	0	0	0	0	106	663	5
RTOR Reduction (vph)	0	11	0	0	0	0	0	0	0	0	1	0
Lane Group Flow (vph)	0	144	0	0	212	0	0	0	0	0	773	0
Confl. Peds. (#/hr)	17		18	18		17	20		16	16		20
Heavy Vehicles (%)	7%	7%	7%	5%	5%	5%	0%	0%	0%	0%	0%	0%
Parking (#/hr)	0	0			0	0				0		
Turn Type		NA		Perm	NA					Perm	NA	
Protected Phases		4			8						6	
Permitted Phases				8						6		
Actuated Green, G (s)		14.9			14.9						26.2	
Effective Green, g (s)		14.9			14.9						26.2	
Actuated g/C Ratio		0.26			0.26						0.45	
Clearance Time (s)		5.0			5.0						5.0	
Vehicle Extension (s)		3.0			3.0						3.0	
Lane Grp Cap (vph)		395			321						1605	
v/s Ratio Prot		0.09										
v/s Ratio Perm					c0.17						0.22	
v/c Ratio		0.36			0.66						0.48	
Uniform Delay, d1		17.8			19.4						11.3	
Progression Factor		1.00			1.00						1.00	
Incremental Delay, d2		0.6			5.1						1.0	
Delay (s)		18.4			24.6						12.3	
Level of Service		B			C						B	
Approach Delay (s)		18.4			24.6			0.0			12.3	
Approach LOS		B			C			A			B	
Intersection Summary												
HCM 2000 Control Delay			15.4			HCM 2000 Level of Service				B		
HCM 2000 Volume to Capacity ratio			0.52									
Actuated Cycle Length (s)			58.3			Sum of lost time (s)			15.0			
Intersection Capacity Utilization			57.5%			ICU Level of Service			B			
Analysis Period (min)			60									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

16: Battery Street/Park St & Sherman St

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											  	
Volume (vph)	0	0	536	0	0	0	480	0	0	0	791	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)			5.0				5.0				5.0	
Lane Util. Factor			1.00				1.00				0.95	
Frt			0.86				1.00				1.00	
Flt Protected			1.00				0.95				1.00	
Satd. Flow (prot)			1644				1805				3610	
Flt Permitted			1.00				0.25				1.00	
Satd. Flow (perm)			1644				470				3610	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	0	536	0	0	0	480	0	0	0	791	0
RTOR Reduction (vph)	0	0	13	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	523	0	0	0	480	0	0	0	791	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type			pt+ov				D.P+P				NA	
Protected Phases			8 5		8		5				6	
Permitted Phases							5 6					
Actuated Green, G (s)			43.1				66.8				36.9	
Effective Green, g (s)			43.1				66.8				36.9	
Actuated g/C Ratio			0.48				0.74				0.41	
Clearance Time (s)							5.0				5.0	
Vehicle Extension (s)							3.0				3.0	
Lane Grp Cap (vph)			787				792				1480	
v/s Ratio Prot			c0.32				0.20				0.22	
v/s Ratio Perm							c0.25					
v/c Ratio			0.67				0.61				0.53	
Uniform Delay, d1			17.9				12.7				20.1	
Progression Factor			1.00				0.48				1.00	
Incremental Delay, d2			2.2				1.3				1.4	
Delay (s)			20.1				7.4				21.5	
Level of Service			C				A				C	
Approach Delay (s)		20.1			0.0			7.4			21.5	
Approach LOS		C			A			A			C	
Intersection Summary												
HCM 2000 Control Delay			17.3				HCM 2000 Level of Service				B	
HCM 2000 Volume to Capacity ratio			0.68									
Actuated Cycle Length (s)			90.0				Sum of lost time (s)			15.0		
Intersection Capacity Utilization			63.4%				ICU Level of Service			B		
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: North Ave & Church/127 Connector

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1	0	34	1	167	0	262	33	520	607	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	10	10	10	10	10	10
Total Lost time (s)		4.0			4.0	4.0		4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00	1.00		1.00		1.00	1.00	
Frpb, ped/bikes		1.00			1.00	1.00		1.00		1.00	1.00	
Flpb, ped/bikes		1.00			0.99	1.00		1.00		1.00	1.00	
Frt		1.00			1.00	0.85		0.98		1.00	1.00	
Flt Protected		1.00			0.95	1.00		1.00		0.95	1.00	
Satd. Flow (prot)		1900			1723	1553		1600		1652	1738	
Flt Permitted		1.00			0.75	1.00		1.00		0.41	1.00	
Satd. Flow (perm)		1900			1347	1553		1600		717	1738	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	1	0	34	1	167	0	262	33	520	607	2
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	1	0	0	35	167	0	295	0	520	609	0
Confl. Peds. (#/hr)	9		7	7		9	1					1
Heavy Vehicles (%)	0%	0%	0%	4%	4%	4%	9%	9%	9%	2%	2%	2%
Turn Type		NA		Perm	NA	pt+ov	Perm	NA		pm+pt	NA	
Protected Phases		4			8	8 1		2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		7.7			7.7	24.6		17.8		34.7	34.7	
Effective Green, g (s)		8.7			8.7	25.6		18.8		35.7	35.7	
Actuated g/C Ratio		0.17			0.17	0.49		0.36		0.68	0.68	
Clearance Time (s)		5.0			5.0			5.0		5.0	5.0	
Vehicle Extension (s)		3.0			3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)		315			223	758		574		718	1184	
v/s Ratio Prot		0.00				c0.11		0.18		c0.18	0.35	
v/s Ratio Perm					0.03					c0.31		
v/c Ratio		0.00			0.16	0.22		0.51		0.72	0.51	
Uniform Delay, d1		18.2			18.7	7.7		13.2		4.7	4.1	
Progression Factor		1.00			1.00	1.00		1.00		1.00	1.00	
Incremental Delay, d2		0.0			0.3	0.1		3.3		3.7	1.6	
Delay (s)		18.2			19.0	7.8		16.5		8.5	5.7	
Level of Service		B			B	A		B		A	A	
Approach Delay (s)		18.2			9.8			16.5			7.0	
Approach LOS		B			A			B			A	
Intersection Summary												
HCM 2000 Control Delay			9.1		HCM 2000 Level of Service					A		
HCM 2000 Volume to Capacity ratio			0.68									
Actuated Cycle Length (s)			52.4		Sum of lost time (s)					12.0		
Intersection Capacity Utilization			64.4%		ICU Level of Service					C		
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

3: North Ave & Institute Rd/City Bluffs

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	103	0	174	7	0	5	265	279	2	0	614	259
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	10	10	10	10	10	10
Total Lost time (s)		4.0	5.0		4.0		5.0	4.0			4.0	4.0
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00			1.00	1.00
Frpb, ped/bikes		1.00	0.98		1.00		1.00	1.00			1.00	0.97
Flpb, ped/bikes		1.00	1.00		0.98		1.00	1.00			1.00	1.00
Frt		1.00	0.85		0.94		1.00	1.00			1.00	0.85
Flt Protected		0.95	1.00		0.97		0.95	1.00			1.00	1.00
Satd. Flow (prot)		1787	1559		1716		1636	1720			1756	1450
Flt Permitted		0.75	1.00		0.84		0.24	1.00			1.00	1.00
Satd. Flow (perm)		1410	1559		1479		415	1720			1756	1450
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	103	0	174	7	0	5	265	279	2	0	614	259
RTOR Reduction (vph)	0	0	122	0	10	0	0	0	0	0	0	122
Lane Group Flow (vph)	0	103	52	0	2	0	265	281	0	0	614	137
Confl. Peds. (#/hr)			14	14			9		1	1		9
Heavy Vehicles (%)	1%	1%	1%	0%	0%	0%	3%	3%	3%	1%	1%	1%
Turn Type	Perm	NA	pm+ov	Perm	NA		pm+pt	NA			NA	Perm
Protected Phases		4	5		8		5	2		1	6	
Permitted Phases	4		4	8			2			6		6
Actuated Green, G (s)		9.2	18.1		9.2		48.7	40.8			34.8	34.8
Effective Green, g (s)		10.2	18.1		10.2		48.7	41.8			35.8	35.8
Actuated g/C Ratio		0.15	0.27		0.15		0.72	0.62			0.53	0.53
Clearance Time (s)		5.0	5.0		5.0		5.0	5.0			5.0	5.0
Vehicle Extension (s)		4.0	3.0		4.0		3.0	3.0			3.0	3.0
Lane Grp Cap (vph)		211	530		222		457	1058			925	764
v/s Ratio Prot			0.01				c0.08	0.16			c0.35	
v/s Ratio Perm		c0.07	0.02		0.00		0.34					0.09
v/c Ratio		0.49	0.10		0.01		0.58	0.27			0.66	0.18
Uniform Delay, d1		26.5	18.7		24.5		6.8	6.0			11.7	8.4
Progression Factor		1.00	1.00		1.00		1.00	1.00			1.00	1.00
Incremental Delay, d2		2.4	0.1		0.0		1.8	0.6			3.8	0.5
Delay (s)		28.9	18.8		24.6		8.6	6.6			15.5	8.9
Level of Service		C	B		C		A	A			B	A
Approach Delay (s)		22.6			24.6			7.6			13.5	
Approach LOS		C			C			A			B	
Intersection Summary												
HCM 2000 Control Delay			13.2				HCM 2000 Level of Service			B		
HCM 2000 Volume to Capacity ratio			0.62									
Actuated Cycle Length (s)			67.9				Sum of lost time (s)			13.0		
Intersection Capacity Utilization			69.5%				ICU Level of Service			C		
Analysis Period (min)			60									

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

4: North Ave & North Drive

12/21/2016

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	10	41	31	394	785	7
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	10	41	31	394	785	7
Pedestrians	25			10	10	
Lane Width (ft)	12.0			10.0	10.0	
Walking Speed (ft/s)	4.0			4.0	4.0	
Percent Blockage	2			1	1	
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (ft)				380		
pX, platoon unblocked	0.94					
vC, conflicting volume	1280	824	817			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1264	824	817			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	94	89	96			
cM capacity (veh/h)	165	366	790			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	51	425	792			
Volume Left	10	31	0			
Volume Right	41	0	7			
cSH	295	790	1700			
Volume to Capacity	0.17	0.04	0.47			
Queue Length 95th (ft)	16	3	0			
Control Delay (s)	19.7	1.2	0.0			
Lane LOS	C	A				
Approach Delay (s)	19.7	1.2	0.0			
Approach LOS	C					
Intersection Summary						
Average Delay		1.2				
Intersection Capacity Utilization		59.6%		ICU Level of Service		B
Analysis Period (min)		60				

HCM Signalized Intersection Capacity Analysis

5: North Ave & South Drive

12/21/2016

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	37	137	97	389	800	26
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	12	10	10	12	12
Total Lost time (s)	5.0		5.0	5.0	5.0	
Lane Util. Factor	1.00		1.00	1.00	1.00	
Frpb, ped/bikes	0.97		1.00	1.00	1.00	
Flpb, ped/bikes	1.00		1.00	1.00	1.00	
Frt	0.89		1.00	1.00	1.00	
Flt Protected	0.99		0.95	1.00	1.00	
Satd. Flow (prot)	1636		1636	1722	1834	
Flt Permitted	0.99		0.15	1.00	1.00	
Satd. Flow (perm)	1636		266	1722	1834	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	37	137	97	389	800	26
RTOR Reduction (vph)	119	0	0	0	2	0
Lane Group Flow (vph)	55	0	97	389	824	0
Confl. Peds. (#/hr)	10	10	25			25
Heavy Vehicles (%)	0%	0%	3%	3%	3%	3%
Turn Type	Prot		pm+pt	NA	NA	
Protected Phases	4		5	2	6	
Permitted Phases			2			
Actuated Green, G (s)	5.8		28.2	28.2	20.9	
Effective Green, g (s)	5.8		28.2	28.2	20.9	
Actuated g/C Ratio	0.13		0.64	0.64	0.47	
Clearance Time (s)	5.0		5.0	5.0	5.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	215		242	1103	871	
v/s Ratio Prot	c0.03		0.02	c0.23	c0.45	
v/s Ratio Perm			0.24			
v/c Ratio	0.26		0.40	0.35	0.95	
Uniform Delay, d1	17.2		7.8	3.7	11.0	
Progression Factor	1.00		1.00	1.00	1.00	
Incremental Delay, d2	0.6		1.1	0.2	26.0	
Delay (s)	17.8		8.9	3.9	37.0	
Level of Service	B		A	A	D	
Approach Delay (s)	17.8			4.9	37.0	
Approach LOS	B			A	D	
Intersection Summary						
HCM 2000 Control Delay			24.3	HCM 2000 Level of Service		C
HCM 2000 Volume to Capacity ratio			0.79			
Actuated Cycle Length (s)			44.0	Sum of lost time (s)		15.0
Intersection Capacity Utilization			73.5%	ICU Level of Service		D
Analysis Period (min)			60			
c Critical Lane Group						

HCM Unsignalized Intersection Capacity Analysis

6: North Ave & Berry St/Washington

12/21/2016

																				
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR								
Lane Configurations																				
Volume (veh/h)	2	0	12	9	1	62	4	404	3	67	830	2								
Sign Control		Stop			Stop			Free			Free									
Grade		0%			0%			0%			0%									
Peak Hour 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								
Hourly flow rate (vph)	2	0	12	9	1	62	4	404	3	67	830	2								
Pedestrians		2			12			8												
Lane Width (ft)		12.0			12.0			12.0												
Walking Speed (ft/s)		4.0			4.0			4.0												
Percent Blockage		0			1			1												
Right turn flare (veh)																				
Median type								None			None									
Median storage (veh)																				
Upstream signal (ft)											1205									
pX, platoon unblocked	0.66	0.66	0.66	0.66	0.66		0.66													
vC, conflicting volume	1443	1394	841	1410	1394	418	834			419										
vC1, stage 1 conf vol																				
vC2, stage 2 conf vol																				
vCu, unblocked vol	1414	1339	501	1364	1339	418	490			419										
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1										
tC, 2 stage (s)																				
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2										
p0 queue free %	97	100	97	88	99	90	99			94										
cM capacity (veh/h)	65	94	376	75	94	633	703			1134										
Direction, Lane #	EB 1	WB 1	NB 1	SB 1																
Volume Total	14	72	411	899																
Volume Left	2	9	4	67																
Volume Right	12	62	3	2																
cSH	223	314	703	1134																
Volume to Capacity	0.06	0.23	0.01	0.06																
Queue Length 95th (ft)	5	22	0	5																
Control Delay (s)	22.3	19.9	0.2	1.5																
Lane LOS	C	C	A	A																
Approach Delay (s)	22.3	19.9	0.2	1.5																
Approach LOS	C	C																		
Intersection Summary																				
Average Delay			2.3																	
Intersection Capacity Utilization			93.0%	ICU Level of Service						F										
Analysis Period (min)			60																	

HCM Signalized Intersection Capacity Analysis

7: VT 127 - Park & Manhattan Dr.

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	6	97	7	39	95	311	0	0	0	539	639	14
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0	5.0				5.0	5.0	
Lane Util. Factor		1.00			1.00	1.00				1.00	1.00	
Frpb, ped/bikes		1.00			1.00	1.00				1.00	1.00	
Flpb, ped/bikes		1.00			1.00	1.00				1.00	1.00	
Frt		0.99			1.00	0.85				1.00	1.00	
Flt Protected		1.00			0.99	1.00				0.95	1.00	
Satd. Flow (prot)		1840			1749	1509				1805	1894	
Flt Permitted		0.98			0.88	1.00				0.95	1.00	
Satd. Flow (perm)		1808			1560	1509				1805	1894	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	6	97	7	39	95	311	0	0	0	539	639	14
RTOR Reduction (vph)	0	5	0	0	0	0	0	0	0	0	1	0
Lane Group Flow (vph)	0	105	0	0	134	311	0	0	0	539	652	0
Confl. Peds. (#/hr)			2	2					9	9		
Heavy Vehicles (%)	2%	2%	2%	7%	7%	7%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA	pt+ov				Prot	NA	
Protected Phases		8			4	4 1				1	6	
Permitted Phases	8			4								
Actuated Green, G (s)		10.5			10.5	54.6				34.1	34.1	
Effective Green, g (s)		10.5			10.5	54.6				34.1	34.1	
Actuated g/C Ratio		0.19			0.19	1.00				0.62	0.62	
Clearance Time (s)		5.0			5.0					5.0	5.0	
Vehicle Extension (s)		3.0			3.0					3.0	3.0	
Lane Grp Cap (vph)		347			300	1509				1127	1182	
v/s Ratio Prot						0.21				0.30	c0.34	
v/s Ratio Perm		0.06			c0.09							
v/c Ratio		0.30			0.45	0.21				0.48	0.55	
Uniform Delay, d1		18.9			19.5	0.0				5.5	5.9	
Progression Factor		1.00			1.00	1.00				1.00	1.00	
Incremental Delay, d2		0.5			1.1	0.1				1.5	1.9	
Delay (s)		19.4			20.5	0.1				6.9	7.7	
Level of Service		B			C	A				A	A	
Approach Delay (s)		19.4			6.2			0.0			7.4	
Approach LOS		B			A			A			A	
Intersection Summary												
HCM 2000 Control Delay			7.8				HCM 2000 Level of Service			A		
HCM 2000 Volume to Capacity ratio			0.53									
Actuated Cycle Length (s)			54.6				Sum of lost time (s)			10.0		
Intersection Capacity Utilization			56.6%				ICU Level of Service			B		
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

8: North Ave & North Street

12/21/2016

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	21	78	361	31	94	648
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	12	10	10	10	10
Total Lost time (s)	3.0		3.0		3.0	3.0
Lane Util. Factor	1.00		1.00		1.00	1.00
Frpb, ped/bikes	1.00		1.00		1.00	1.00
Flpb, ped/bikes	1.00		1.00		1.00	1.00
Frt	0.89		0.99		1.00	1.00
Flt Protected	0.99		1.00		0.95	1.00
Satd. Flow (prot)	1680		1700		1651	1739
Flt Permitted	0.99		1.00		0.45	1.00
Satd. Flow (perm)	1680		1700		783	1739
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	21	78	361	31	94	648
RTOR Reduction (vph)	70	0	0	0	0	0
Lane Group Flow (vph)	29	0	392	0	94	648
Confl. Peds. (#/hr)	7			3	3	
Heavy Vehicles (%)	0%	0%	3%	3%	2%	2%
Turn Type	Prot		NA		pm+pt	NA
Protected Phases	8		2		1	6
Permitted Phases					6	
Actuated Green, G (s)	5.9		49.7		57.8	57.8
Effective Green, g (s)	7.9		51.7		59.8	59.8
Actuated g/C Ratio	0.10		0.64		0.74	0.74
Clearance Time (s)	5.0		5.0		5.0	5.0
Vehicle Extension (s)	3.0		4.0		3.0	4.0
Lane Grp Cap (vph)	163		1082		631	1280
v/s Ratio Prot	c0.02		0.23		0.01	c0.37
v/s Ratio Perm					0.10	
v/c Ratio	0.18		0.36		0.15	0.51
Uniform Delay, d1	33.7		7.0		3.5	4.5
Progression Factor	1.00		1.00		1.00	1.00
Incremental Delay, d2	0.5		0.9		0.1	1.4
Delay (s)	34.2		7.9		3.6	5.9
Level of Service	C		A		A	A
Approach Delay (s)	34.2		7.9			5.6
Approach LOS	C		A			A
Intersection Summary						
HCM 2000 Control Delay			8.6		HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio			0.47			
Actuated Cycle Length (s)			81.2		Sum of lost time (s)	14.0
Intersection Capacity Utilization			46.7%		ICU Level of Service	A
Analysis Period (min)			60			

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

9: Sherman St & North Ave

12/21/2016



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↰		↰	
Volume (veh/h)	3	9	10	526	602	4
Sign Control		Stop	Yield		Free	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	3	9	10	526	602	4
Pedestrians		4	10		8	
Lane Width (ft)		12.0	12.0		10.0	
Walking Speed (ft/s)		4.0	4.0		4.0	
Percent Blockage		0	1		1	
Right turn flare (veh)						
Median type					None	
Median storage (veh)						
Upstream signal (ft)					986	
pX, platoon unblocked						
vC, conflicting volume	1223	1220	1222	18	10	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1223	1220	1222	18	10	
tC, single (s)	7.1	6.5	6.6	6.3	4.1	
tC, 2 stage (s)						
tF (s)	3.5	4.0	4.1	3.4	2.2	
p0 queue free %	94	92	91	49	62	
cM capacity (veh/h)	50	111	107	1032	1577	
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	12	536	606			
Volume Left	3	0	602			
Volume Right	0	526	4			
cSH	85	889	1577			
Volume to Capacity	0.14	0.60	0.38			
Queue Length 95th (ft)	12	111	46			
Control Delay (s)	54.3	15.2	8.7			
Lane LOS	F	C	A			
Approach Delay (s)	54.3	15.2	8.7			
Approach LOS	F	C				
Intersection Summary						
Average Delay		12.1				
Intersection Capacity Utilization		74.2%		ICU Level of Service		D
Analysis Period (min)		60				

HCM Signalized Intersection Capacity Analysis

10: Battery Street & Pearl Street

12/21/2016

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	135	86	299	153	283	1179
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0		5.0
Lane Util. Factor	1.00	1.00	1.00	1.00		0.95
Frpb, ped/bikes	1.00	1.00	1.00	0.97		1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00		1.00
Frt	1.00	0.85	1.00	0.85		1.00
Flt Protected	0.95	1.00	1.00	1.00		0.99
Satd. Flow (prot)	1612	1442	1727	1418		3502
Flt Permitted	0.95	1.00	1.00	1.00		0.74
Satd. Flow (perm)	1612	1442	1727	1418		2599
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	135	86	299	153	283	1179
RTOR Reduction (vph)	0	70	0	73	0	0
Lane Group Flow (vph)	135	16	299	80	0	1462
Confl. Peds. (#/hr)	7			15	15	
Heavy Vehicles (%)	12%	12%	10%	10%	2%	2%
Turn Type	Prot	pt+ov	NA	Perm	pm+pt	NA
Protected Phases	3	3 1	2		1	6
Permitted Phases				2	6	
Actuated Green, G (s)	12.4	16.4	47.2	47.2		56.2
Effective Green, g (s)	12.4	16.4	47.2	47.2		56.2
Actuated g/C Ratio	0.14	0.18	0.52	0.52		0.62
Clearance Time (s)	5.0		5.0	5.0		5.0
Vehicle Extension (s)	3.0		3.0	3.0		3.0
Lane Grp Cap (vph)	222	262	905	743		1663
v/s Ratio Prot	c0.08	0.01	0.17			c0.04
v/s Ratio Perm				0.06		c0.51
v/c Ratio	0.61	0.06	0.33	0.11		0.88
Uniform Delay, d1	36.5	30.4	12.3	10.8		14.1
Progression Factor	1.00	1.00	0.69	0.50		0.96
Incremental Delay, d2	4.7	0.1	1.0	0.3		5.0
Delay (s)	41.3	30.5	9.4	5.7		18.5
Level of Service	D	C	A	A		B
Approach Delay (s)	37.1		8.2			18.5
Approach LOS	D		A			B
Intersection Summary						
HCM 2000 Control Delay			18.2		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.81			
Actuated Cycle Length (s)			90.0		Sum of lost time (s)	20.0
Intersection Capacity Utilization			76.5%		ICU Level of Service	D
Analysis Period (min)			60			
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis

11: Battery Street & Main Street/Main Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	8	30	26	31	91	169	64	338	3	348	587	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0		5.0	5.0		5.0		5.0	5.0	
Lane Util. Factor		1.00	1.00		1.00	1.00		0.95		1.00	1.00	
Frpb, ped/bikes		1.00	0.97		1.00	0.99		1.00		1.00	1.00	
Flpb, ped/bikes		1.00	1.00		1.00	1.00		1.00		1.00	1.00	
Frt		1.00	0.85		1.00	0.85		1.00		1.00	1.00	
Flt Protected		0.99	1.00		0.99	1.00		0.99		0.95	1.00	
Satd. Flow (prot)		1724	1432		1717	1469		3500		1780	1876	
Flt Permitted		0.90	1.00		0.58	1.00		0.79		0.41	1.00	
Satd. Flow (perm)		1564	1432		1014	1469		2801		769	1876	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	8	30	26	31	91	169	64	338	3	348	587	8
RTOR Reduction (vph)	0	0	24	0	0	120	0	1	0	0	0	0
Lane Group Flow (vph)	0	38	2	0	122	49	0	404	0	348	595	0
Confl. Peds. (#/hr)	2		5	5		2	10		10	10		10
Heavy Vehicles (%)	9%	9%	9%	9%	9%	9%	2%	2%	2%	1%	1%	1%
Turn Type	Perm	NA	Perm	Perm	NA	pm+ov	Perm	NA		pm+pt	NA	
Protected Phases		4			8	1		2		1	6	
Permitted Phases	4		4	8		8	2			6		
Actuated Green, G (s)		7.2	7.2		14.5	26.1		44.2		65.5	60.9	
Effective Green, g (s)		7.2	7.2		14.5	26.1		44.2		65.5	60.9	
Actuated g/C Ratio		0.08	0.08		0.16	0.29		0.49		0.73	0.68	
Clearance Time (s)		5.0	5.0		5.0	5.0		5.0		5.0	5.0	
Vehicle Extension (s)		3.0	3.0		3.0	3.0		3.0		3.0	3.0	
Lane Grp Cap (vph)		125	114		163	507		1375		689	1269	
v/s Ratio Prot						0.01				c0.07	0.32	
v/s Ratio Perm		0.02	0.00		c0.12	0.02		0.14		c0.30		
v/c Ratio		0.30	0.02		0.75	0.10		0.29		0.51	0.47	
Uniform Delay, d1		39.0	38.1		36.0	23.3		13.6		5.2	6.9	
Progression Factor		1.00	1.00		1.00	1.00		1.02		1.38	0.62	
Incremental Delay, d2		1.4	0.1		18.8	0.1		0.5		0.3	0.7	
Delay (s)		40.4	38.2		54.8	23.4		14.4		7.5	5.0	
Level of Service		D	D		D	C		B		A	A	
Approach Delay (s)		39.5			36.6			14.4			5.9	
Approach LOS		D			D			B			A	
Intersection Summary												
HCM 2000 Control Delay			14.4				HCM 2000 Level of Service			B		
HCM 2000 Volume to Capacity ratio			0.61									
Actuated Cycle Length (s)			90.0				Sum of lost time (s)			19.0		
Intersection Capacity Utilization			70.4%				ICU Level of Service			C		
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

12: Battery Street & King St

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	5	3	2	7	10	96	7	317	3	167	512	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0			5.0			5.0	
Lane Util. Factor	1.00	1.00			1.00			1.00			1.00	
Frpb, ped/bikes	1.00	0.99			0.98			1.00			1.00	
Flpb, ped/bikes	0.99	1.00			1.00			1.00			1.00	
Frt	1.00	0.94			0.89			1.00			0.99	
Flt Protected	0.95	1.00			1.00			1.00			0.99	
Satd. Flow (prot)	1631	1603			1588			1771			1789	
Flt Permitted	0.55	1.00			0.98			0.99			0.83	
Satd. Flow (perm)	941	1603			1558			1752			1501	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	5	3	2	7	10	96	7	317	3	167	512	30
RTOR Reduction (vph)	0	2	0	0	88	0	0	0	0	0	1	0
Lane Group Flow (vph)	5	3	0	0	25	0	0	327	0	0	708	0
Confl. Peds. (#/hr)	3		4	4		3	2		6	6		2
Heavy Vehicles (%)	10%	10%	10%	3%	3%	3%	7%	7%	7%	4%	4%	4%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	7.3	7.3			7.3			72.7			72.7	
Effective Green, g (s)	7.3	7.3			7.3			72.7			72.7	
Actuated g/C Ratio	0.08	0.08			0.08			0.81			0.81	
Clearance Time (s)	5.0	5.0			5.0			5.0			5.0	
Vehicle Extension (s)	3.0	3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)	76	130			126			1415			1212	
v/s Ratio Prot		0.00										
v/s Ratio Perm	0.01				c0.02			0.19			c0.47	
v/c Ratio	0.07	0.02			0.20			0.23			0.58	
Uniform Delay, d1	38.2	38.1			38.6			2.0			3.1	
Progression Factor	1.00	1.00			1.00			0.77			2.16	
Incremental Delay, d2	0.4	0.1			0.8			0.4			1.9	
Delay (s)	38.6	38.1			39.4			1.9			8.7	
Level of Service	D	D			D			A			A	
Approach Delay (s)		38.4			39.4			1.9			8.7	
Approach LOS		D			D			A			A	
Intersection Summary												
HCM 2000 Control Delay			10.1			HCM 2000 Level of Service			B			
HCM 2000 Volume to Capacity ratio			0.55									
Actuated Cycle Length (s)			90.0			Sum of lost time (s)			10.0			
Intersection Capacity Utilization			81.0%			ICU Level of Service			D			
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

13: Battery Street & Maple Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	9	3	2	42	19	289	1	12	15	383	40	24
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0	5.0		5.0			5.0	
Lane Util. Factor		1.00			1.00	1.00		1.00			1.00	
Frpb, ped/bikes		0.99			1.00	0.97		0.98			1.00	
Flpb, ped/bikes		1.00			0.99	1.00		1.00			0.99	
Frt		0.98			1.00	0.85		0.93			0.99	
Flt Protected		0.97			0.97	1.00		1.00			0.96	
Satd. Flow (prot)		1627			1760	1528		1442			1754	
Flt Permitted		0.81			0.79	1.00		0.99			0.74	
Satd. Flow (perm)		1368			1430	1528		1435			1348	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	9	3	2	42	19	289	1	12	15	383	40	24
RTOR Reduction (vph)	0	2	0	0	0	258	0	3	0	0	1	0
Lane Group Flow (vph)	0	12	0	0	61	31	0	25	0	0	446	0
Confl. Peds. (#/hr)	2		7	7		2	3		4	4		3
Heavy Vehicles (%)	10%	10%	10%	3%	3%	3%	20%	20%	20%	2%	2%	2%
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)		9.7			9.7	9.7		70.3			70.3	
Effective Green, g (s)		9.7			9.7	9.7		70.3			70.3	
Actuated g/C Ratio		0.11			0.11	0.11		0.78			0.78	
Clearance Time (s)		5.0			5.0	5.0		5.0			5.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0			3.0	
Lane Grp Cap (vph)		147			154	164		1120			1052	
v/s Ratio Prot												
v/s Ratio Perm		0.01			c0.04	0.02		0.02			c0.33	
v/c Ratio		0.08			0.40	0.19		0.02			0.42	
Uniform Delay, d1		36.1			37.4	36.6		2.2			3.2	
Progression Factor		1.00			1.00	1.00		1.00			1.28	
Incremental Delay, d2		0.2			1.7	0.6		0.0			1.0	
Delay (s)		36.4			39.1	37.1		2.2			5.2	
Level of Service		D			D	D		A			A	
Approach Delay (s)		36.4			37.5			2.2			5.2	
Approach LOS		D			D			A			A	
Intersection Summary												
HCM 2000 Control Delay			19.1				HCM 2000 Level of Service			B		
HCM 2000 Volume to Capacity ratio			0.42									
Actuated Cycle Length (s)			90.0				Sum of lost time (s)			10.0		
Intersection Capacity Utilization			49.4%				ICU Level of Service			A		
Analysis Period (min)			60									
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis

14: Pine Street & Maple Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	7	58	347	57	171	13	226	164	27	8	262	6
Peak Hour 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
Hourly flow rate (vph)	7	58	347	57	171	13	226	164	27	8	262	6
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	412	241	417	276								
Volume Left (vph)	7	57	226	8								
Volume Right (vph)	347	13	27	6								
Hadj (s)	-0.47	0.05	0.12	0.16								
Departure Headway (s)	6.9	8.0	7.4	7.9								
Degree Utilization, x	0.79	0.53	0.86	0.61								
Capacity (veh/h)	493	400	469	405								
Control Delay (s)	35.1	20.1	49.2	22.9								
Approach Delay (s)	35.1	20.1	49.2	22.9								
Approach LOS	E	C	E	C								
Intersection Summary												
Delay				34.3								
Level of Service				D								
Intersection Capacity Utilization				89.4%	ICU Level of Service	E						
Analysis Period (min)				60								

HCM Signalized Intersection Capacity Analysis

15: Park St/VT 127 - Park & North Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	172	29	98	148	0	0	0	0	106	663	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0						5.0	
Lane Util. Factor		1.00			1.00						0.95	
Frpb, ped/bikes		1.00			1.00						1.00	
Flpb, ped/bikes		1.00			0.99						1.00	
Frt		0.98			1.00						1.00	
Flt Protected		1.00			0.98						0.99	
Satd. Flow (prot)		1560			1587						3572	
Flt Permitted		1.00			0.74						0.99	
Satd. Flow (perm)		1560			1203						3572	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	172	29	98	148	0	0	0	0	106	663	5
RTOR Reduction (vph)	0	8	0	0	0	0	0	0	0	0	1	0
Lane Group Flow (vph)	0	193	0	0	246	0	0	0	0	0	773	0
Confl. Peds. (#/hr)	17		18	18		17	20		16	16		20
Heavy Vehicles (%)	7%	7%	7%	5%	5%	5%	0%	0%	0%	0%	0%	0%
Parking (#/hr)	0	0			0	0				0		
Turn Type		NA		Perm	NA					Perm	NA	
Protected Phases		4			8						6	
Permitted Phases				8						6		
Actuated Green, G (s)		16.7			16.7						26.6	
Effective Green, g (s)		16.7			16.7						26.6	
Actuated g/C Ratio		0.26			0.26						0.42	
Clearance Time (s)		5.0			5.0						5.0	
Vehicle Extension (s)		3.0			3.0						3.0	
Lane Grp Cap (vph)		412			318						1505	
v/s Ratio Prot		0.12										
v/s Ratio Perm					c0.20						0.22	
v/c Ratio		0.47			0.77						0.51	
Uniform Delay, d1		19.5			21.5						13.5	
Progression Factor		1.00			1.00						1.00	
Incremental Delay, d2		0.8			12.0						1.3	
Delay (s)		20.3			33.4						14.7	
Level of Service		C			C						B	
Approach Delay (s)		20.3			33.4			0.0			14.7	
Approach LOS		C			C			A			B	
Intersection Summary												
HCM 2000 Control Delay			19.4			HCM 2000 Level of Service				B		
HCM 2000 Volume to Capacity ratio			0.55									
Actuated Cycle Length (s)			63.1			Sum of lost time (s)			15.0			
Intersection Capacity Utilization			61.7%			ICU Level of Service			B			
Analysis Period (min)			60									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

16: Battery Street/Park St & Sherman St

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											  	
Volume (vph)	0	0	612	0	0	0	537	0	0	0	791	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)			5.0				5.0				5.0	
Lane Util. Factor			1.00				1.00				0.95	
Frt			0.86				1.00				1.00	
Flt Protected			1.00				0.95				1.00	
Satd. Flow (prot)			1644				1805				3610	
Flt Permitted			1.00				0.23				1.00	
Satd. Flow (perm)			1644				430				3610	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	0	612	0	0	0	537	0	0	0	791	0
RTOR Reduction (vph)	0	0	12	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	600	0	0	0	537	0	0	0	791	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type			pt+ov				D.P+P				NA	
Protected Phases			8 5		8		5				6	
Permitted Phases							5 6					
Actuated Green, G (s)			46.5				65.1				33.5	
Effective Green, g (s)			46.5				65.1				33.5	
Actuated g/C Ratio			0.52				0.72				0.37	
Clearance Time (s)							5.0				5.0	
Vehicle Extension (s)							3.0				3.0	
Lane Grp Cap (vph)			849				793				1343	
v/s Ratio Prot			c0.37				0.24				0.22	
v/s Ratio Perm							c0.25					
v/c Ratio			0.71				0.68				0.59	
Uniform Delay, d1			16.6				14.4				22.7	
Progression Factor			1.00				0.48				1.00	
Incremental Delay, d2			2.8				2.3				1.9	
Delay (s)			19.3				9.2				24.6	
Level of Service			B				A				C	
Approach Delay (s)		19.3			0.0			9.2			24.6	
Approach LOS		B			A			A			C	
Intersection Summary												
HCM 2000 Control Delay			18.7				HCM 2000 Level of Service			B		
HCM 2000 Volume to Capacity ratio			0.74									
Actuated Cycle Length (s)			90.0				Sum of lost time (s)			15.0		
Intersection Capacity Utilization			68.1%				ICU Level of Service			C		
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: North Ave & Church/127 Connector

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	2	0	0	6	0	568	1	672	44	274	314	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	10	10	10	10	10	10
Total Lost time (s)		4.0			4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Flpb, ped/bikes		0.99			0.99	1.00	1.00	1.00		1.00	1.00	
Frt		1.00			1.00	0.85	1.00	0.99		1.00	1.00	
Flt Protected		0.95			0.95	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1785			1777	1599	1665	1740		1668	1755	
Flt Permitted		0.75			0.76	1.00	0.57	1.00		0.16	1.00	
Satd. Flow (perm)		1416			1415	1599	998	1740		275	1755	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	2	0	0	6	0	568	1	672	44	274	314	1
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	2	0	0	6	568	1	716	0	274	315	0
Confl. Peds. (#/hr)	4		2	2		4	1					1
Heavy Vehicles (%)	0%	0%	0%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Turn Type	Perm	NA		Perm	NA	pt+ov	Perm	NA		pm+pt	NA	
Protected Phases		4			8	8 1		2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		21.0			21.0	35.8	44.2	44.2		59.0	59.0	
Effective Green, g (s)		22.0			22.0	36.8	45.2	45.2		60.0	60.0	
Actuated g/C Ratio		0.24			0.24	0.41	0.50	0.50		0.67	0.67	
Clearance Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		346			345	653	501	873		350	1170	
v/s Ratio Prot						c0.36		0.41		0.09	0.18	
v/s Ratio Perm		0.00			0.00		0.00			c0.43		
v/c Ratio		0.01			0.02	0.87	0.00	0.82		0.78	0.27	
Uniform Delay, d1		25.7			25.8	24.4	11.2	19.0		14.1	6.1	
Progression Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.0			0.0	13.5	0.0	9.1		11.7	0.6	
Delay (s)		25.7			25.8	37.9	11.2	28.1		25.8	6.7	
Level of Service		C			C	D	B	C		C	A	
Approach Delay (s)		25.7			37.8			28.1			15.6	
Approach LOS		C			D			C			B	
Intersection Summary												
HCM 2000 Control Delay		27.1										
HCM 2000 Volume to Capacity ratio		0.89										
Actuated Cycle Length (s)		90.0								12.0		
Intersection Capacity Utilization		87.6%								E		
Analysis Period (min)		60										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

3: North Ave & Institute Rd/City Bluffs

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	140	0	209	4	1	2	84	584	2	3	444	74
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	10	10	10	10	10	10
Total Lost time (s)		4.0	5.0		4.0		5.0	4.0			4.0	4.0
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00			1.00	1.00
Frpb, ped/bikes		1.00	0.98		1.00		1.00	1.00			1.00	0.96
Flpb, ped/bikes		1.00	1.00		0.99		0.99	1.00			1.00	1.00
Frt		1.00	0.85		0.96		1.00	1.00			1.00	0.85
Flt Protected		0.95	1.00		0.97		0.95	1.00			1.00	1.00
Satd. Flow (prot)		1805	1575		1546		1631	1738			1721	1406
Flt Permitted		0.75	1.00		0.85		0.50	1.00			1.00	1.00
Satd. Flow (perm)		1431	1575		1350		865	1738			1718	1406
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	140	0	209	4	1	2	84	584	2	3	444	74
RTOR Reduction (vph)	0	0	163	0	2	0	0	0	0	0	0	31
Lane Group Flow (vph)	0	140	46	0	5	0	84	586	0	0	447	43
Confl. Peds. (#/hr)			8	8			23		3	3		23
Heavy Vehicles (%)	0%	0%	0%	14%	14%	14%	2%	2%	2%	3%	3%	3%
Turn Type	Perm	NA	pm+ov	Perm	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases		4	5		8		5	2		1	6	
Permitted Phases	4		4	8			2			6		6
Actuated Green, G (s)		10.1	15.2		10.1		46.0	40.9			41.6	38.7
Effective Green, g (s)		11.1	15.2		11.1		46.0	41.9			43.6	39.7
Actuated g/C Ratio		0.16	0.22		0.16		0.67	0.61			0.63	0.58
Clearance Time (s)		5.0	5.0		5.0		5.0	5.0			5.0	5.0
Vehicle Extension (s)		4.0	3.0		4.0		3.0	3.0			3.0	3.0
Lane Grp Cap (vph)		230	461		217		634	1056			1087	810
v/s Ratio Prot			0.01				0.01	c0.34			c0.02	
v/s Ratio Perm		c0.10	0.02		0.00		0.08				0.24	0.03
v/c Ratio		0.61	0.10		0.02		0.13	0.55			0.41	0.05
Uniform Delay, d1		26.9	21.4		24.3		4.0	8.0			6.3	6.4
Progression Factor		1.00	1.00		1.00		1.00	1.00			1.00	1.00
Incremental Delay, d2		5.3	0.1		0.1		0.1	2.1			0.3	0.1
Delay (s)		32.2	21.5		24.4		4.1	10.1			6.6	6.5
Level of Service		C	C		C		A	B			A	A
Approach Delay (s)		25.8			24.4			9.4			6.6	
Approach LOS		C			C			A			A	
Intersection Summary												
HCM 2000 Control Delay			12.2				HCM 2000 Level of Service				B	
HCM 2000 Volume to Capacity ratio			0.56									
Actuated Cycle Length (s)			68.9				Sum of lost time (s)			13.0		
Intersection Capacity Utilization			76.8%				ICU Level of Service			D		
Analysis Period (min)			60									
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis

4: North Ave & North Drive

12/21/2016

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	0	0	0	671	658	0
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	0	0	0	671	658	0
Pedestrians	25			10	10	
Lane Width (ft)	12.0			10.0	10.0	
Walking Speed (ft/s)	4.0			4.0	4.0	
Percent Blockage	2			1	1	
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1364	693	683			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1364	693	683			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	100	100	100			
cM capacity (veh/h)	160	434	886			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	0	671	658			
Volume Left	0	0	0			
Volume Right	0	0	0			
cSH	1700	886	1700			
Volume to Capacity	0.00	0.00	0.39			
Queue Length 95th (ft)	0	0	0			
Control Delay (s)	0.0	0.0	0.0			
Lane LOS	A					
Approach Delay (s)	0.0	0.0	0.0			
Approach LOS	A					
Intersection Summary						
Average Delay			0.0			
Intersection Capacity Utilization			48.2%	ICU Level of Service		A
Analysis Period (min)			60			

HCM Unsignalized Intersection Capacity Analysis

5: North Ave & South Drive

12/21/2016

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	9	9	17	659	639	16
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	9	9	17	659	639	16
Pedestrians	25			10	10	
Lane Width (ft)	12.0			10.0	12.0	
Walking Speed (ft/s)	4.0			4.0	4.0	
Percent Blockage	2			1	1	
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1375	682	680			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1375	682	680			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	94	98	98			
cM capacity (veh/h)	154	441	889			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	18	676	655			
Volume Left	9	17	0			
Volume Right	9	0	16			
cSH	228	889	1700			
Volume to Capacity	0.08	0.02	0.39			
Queue Length 95th (ft)	6	1	0			
Control Delay (s)	22.1	0.5	0.0			
Lane LOS	C	A				
Approach Delay (s)	22.1	0.5	0.0			
Approach LOS	C					
Intersection Summary						
Average Delay		0.5				
Intersection Capacity Utilization		61.2%		ICU Level of Service		B
Analysis Period (min)		60				

HCM Unsignalized Intersection Capacity Analysis

6: North Ave & Berry/Washington

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	13	2	18	6	0	52	10	642	5	28	434	10
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour 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
Hourly flow rate (vph)	13	2	18	6	0	52	10	642	5	28	434	10
Pedestrians					18			29			13	
Lane Width (ft)					12.0			12.0			10.0	
Walking Speed (ft/s)					4.0			4.0			4.0	
Percent Blockage					1			2			1	
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1224	1180	468	1226	1182	676	444			665		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1224	1180	468	1226	1182	676	444			665		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	90	99	97	96	100	88	99			97		
cM capacity (veh/h)	132	181	585	139	181	446	1111			906		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	33	58	657	472								
Volume Left	13	6	10	28								
Volume Right	18	52	5	10								
cSH	235	363	1111	906								
Volume to Capacity	0.14	0.16	0.01	0.03								
Queue Length 95th (ft)	12	14	1	2								
Control Delay (s)	22.8	16.8	0.2	0.9								
Lane LOS	C	C	A	A								
Approach Delay (s)	22.8	16.8	0.2	0.9								
Approach LOS	C	C										
Intersection Summary												
Average Delay			1.9									
Intersection Capacity Utilization			61.6%		ICU Level of Service					B		
Analysis Period (min)			60									

HCM Signalized Intersection Capacity Analysis

7: VT 127 - Park & Manhattan Dr.

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	11	39	15	26	71	1158	0	0	0	300	236	9
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0	5.0				5.0	5.0	
Lane Util. Factor		1.00			1.00	1.00				1.00	1.00	
Frpb, ped/bikes		1.00			1.00	1.00				1.00	1.00	
Flpb, ped/bikes		1.00			1.00	1.00				1.00	1.00	
Frt		0.97			1.00	0.85				1.00	0.99	
Flt Protected		0.99			0.99	1.00				0.95	1.00	
Satd. Flow (prot)		1820			1838	1583				1787	1871	
Flt Permitted		0.96			0.94	1.00				0.95	1.00	
Satd. Flow (perm)		1769			1741	1583				1787	1871	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	11	39	15	26	71	1158	0	0	0	300	236	9
RTOR Reduction (vph)	0	8	0	0	0	0	0	0	0	0	2	0
Lane Group Flow (vph)	0	57	0	0	97	1158	0	0	0	300	243	0
Confl. Peds. (#/hr)			2	2					35	35		
Heavy Vehicles (%)	0%	0%	0%	2%	2%	2%	0%	0%	0%	1%	1%	1%
Turn Type	Perm	NA		Perm	NA	custom				pm+pt	NA	
Protected Phases		8			4	4 1				1	6	
Permitted Phases	8			4		4				6		
Actuated Green, G (s)		25.2			25.2	53.6				18.4	18.4	
Effective Green, g (s)		25.2			25.2	53.6				18.4	18.4	
Actuated g/C Ratio		0.47			0.47	1.00				0.34	0.34	
Clearance Time (s)		5.0			5.0					5.0	5.0	
Vehicle Extension (s)		3.0			3.0					3.0	3.0	
Lane Grp Cap (vph)		831			818	1583				613	642	
v/s Ratio Prot						c0.73				0.17	0.13	
v/s Ratio Perm		0.03			0.06							
v/c Ratio		0.07			0.12	0.73				0.49	0.38	
Uniform Delay, d1		7.8			8.0	0.0				13.9	13.3	
Progression Factor		1.00			1.00	1.00				1.00	1.00	
Incremental Delay, d2		0.0			0.1	1.8				2.8	1.7	
Delay (s)		7.8			8.0	1.8				16.7	15.0	
Level of Service		A			A	A				B	B	
Approach Delay (s)		7.8			2.3			0.0			15.9	
Approach LOS		A			A			A			B	
Intersection Summary												
HCM 2000 Control Delay		6.5			HCM 2000 Level of Service					A		
HCM 2000 Volume to Capacity ratio		0.90										
Actuated Cycle Length (s)		53.6			Sum of lost time (s)					10.0		
Intersection Capacity Utilization		83.7%			ICU Level of Service					E		
Analysis Period (min)		60										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

8: North Ave & North Street

12/21/2016

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	48	65	543	61	53	323
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	12	10	10	10	10
Total Lost time (s)	3.0		3.0		3.0	3.0
Lane Util. Factor	1.00		1.00		1.00	1.00
Frpb, ped/bikes	1.00		1.00		1.00	1.00
Flpb, ped/bikes	1.00		1.00		1.00	1.00
Frt	0.92		0.99		1.00	1.00
Flt Protected	0.98		1.00		0.95	1.00
Satd. Flow (prot)	1634		1711		1651	1739
Flt Permitted	0.98		1.00		0.32	1.00
Satd. Flow (perm)	1634		1711		548	1739
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	48	65	543	61	53	323
RTOR Reduction (vph)	51	0	0	0	0	0
Lane Group Flow (vph)	62	0	604	0	53	323
Confl. Peds. (#/hr)	13			6	6	
Heavy Vehicles (%)	5%	5%	2%	2%	2%	2%
Turn Type	Prot		NA		pm+pt	NA
Protected Phases	8		2		1	6
Permitted Phases					6	
Actuated Green, G (s)	8.8		53.0		60.4	60.4
Effective Green, g (s)	10.8		55.0		62.4	62.4
Actuated g/C Ratio	0.12		0.63		0.72	0.72
Clearance Time (s)	5.0		5.0		5.0	5.0
Vehicle Extension (s)	3.0		4.0		3.0	4.0
Lane Grp Cap (vph)	203		1084		449	1250
v/s Ratio Prot	c0.04		c0.35		0.01	c0.19
v/s Ratio Perm					0.08	
v/c Ratio	0.31		0.56		0.12	0.26
Uniform Delay, d1	34.6		9.0		5.1	4.2
Progression Factor	1.00		1.00		1.00	1.00
Incremental Delay, d2	0.9		2.1		0.1	0.5
Delay (s)	35.5		11.1		5.3	4.7
Level of Service	D		B		A	A
Approach Delay (s)	35.5		11.1			4.8
Approach LOS	D		B			A
Intersection Summary						
HCM 2000 Control Delay			11.4		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.48			
Actuated Cycle Length (s)			86.8		Sum of lost time (s)	14.0
Intersection Capacity Utilization			52.3%		ICU Level of Service	A
Analysis Period (min)			60			

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

9: Sherman St & North Ave

12/21/2016



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	9	15	19	740	433	4
Sign Control		Stop	Yield		Free	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	9	15	19	740	433	4
Pedestrians		9	20		20	
Lane Width (ft)		12.0	12.0		10.0	
Walking Speed (ft/s)		4.0	4.0		4.0	
Percent Blockage		1	2		1	
Right turn flare (veh)						
Median type					None	
Median storage veh						
Upstream signal (ft)					986	
pX, platoon unblocked						
vC, conflicting volume	906	897	899	40	20	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	906	897	899	40	20	
tC, single (s)	7.1	6.5	6.5	6.2	4.1	
tC, 2 stage (s)						
tF (s)	3.5	4.0	4.0	3.3	2.2	
p0 queue free %	81	92	90	26	73	
cM capacity (veh/h)	47	197	199	1006	1582	
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	24	759	437			
Volume Left	9	0	433			
Volume Right	0	740	4			
cSH	90	913	1582			
Volume to Capacity	0.27	0.83	0.27			
Queue Length 95th (ft)	26	317	28			
Control Delay (s)	59.2	27.3	8.1			
Lane LOS	F	D	A			
Approach Delay (s)	59.2	27.3	8.1			
Approach LOS	F	D				
Intersection Summary						
Average Delay			21.0			
Intersection Capacity Utilization			79.6%	ICU Level of Service	D	
Analysis Period (min)			60			

HCM Signalized Intersection Capacity Analysis

10: Battery Street & Pearl Street

12/21/2016

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	125	141	665	421	131	497
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0		5.0
Lane Util. Factor	1.00	1.00	1.00	1.00		0.95
Frpb, ped/bikes	1.00	1.00	1.00	0.98		1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00		1.00
Frt	1.00	0.85	1.00	0.85		1.00
Flt Protected	0.95	1.00	1.00	1.00		0.99
Satd. Flow (prot)	1719	1538	1863	1546		3537
Flt Permitted	0.95	1.00	1.00	1.00		0.60
Satd. Flow (perm)	1719	1538	1863	1546		2135
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	125	141	665	421	131	497
RTOR Reduction (vph)	0	115	0	188	0	0
Lane Group Flow (vph)	125	26	665	233	0	628
Confl. Peds. (#/hr)		3		4	4	
Heavy Vehicles (%)	5%	5%	2%	2%	1%	1%
Turn Type	Prot	pt+ov	NA	Perm	pm+pt	NA
Protected Phases	3	3 1	2		1	6
Permitted Phases				2	6	
Actuated Green, G (s)	11.7	16.9	49.9	49.9		60.1
Effective Green, g (s)	11.7	16.9	49.9	49.9		60.1
Actuated g/C Ratio	0.13	0.19	0.55	0.55		0.67
Clearance Time (s)	5.0		5.0	5.0		5.0
Vehicle Extension (s)	3.0		3.0	3.0		3.0
Lane Grp Cap (vph)	223	288	1032	857		1506
v/s Ratio Prot	c0.07	0.02	c0.36			c0.02
v/s Ratio Perm				0.15		0.25
v/c Ratio	0.56	0.09	0.64	0.27		0.42
Uniform Delay, d1	36.7	30.2	13.9	10.5		6.9
Progression Factor	1.00	1.00	0.94	1.49		1.41
Incremental Delay, d2	3.2	0.1	3.0	0.8		0.2
Delay (s)	40.0	30.3	16.1	16.5		9.9
Level of Service	D	C	B	B		A
Approach Delay (s)	34.9		16.3			9.9
Approach LOS	C		B			A
Intersection Summary						
HCM 2000 Control Delay			16.7		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.59			
Actuated Cycle Length (s)			90.0		Sum of lost time (s)	20.0
Intersection Capacity Utilization			72.0%		ICU Level of Service	C
Analysis Period (min)			60			
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis

11: Battery Street & Main Street/Main Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	11	75	53	43	63	275	53	597	28	230	436	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0		5.0	5.0		5.0		5.0	5.0	
Lane Util. Factor		1.00	1.00		1.00	1.00		0.95		1.00	1.00	
Frpb, ped/bikes		1.00	0.92		1.00	0.98		1.00		1.00	1.00	
Flpb, ped/bikes		1.00	1.00		0.98	1.00		1.00		1.00	1.00	
Frt		1.00	0.85		1.00	0.85		0.99		1.00	1.00	
Flt Protected		0.99	1.00		0.98	1.00		1.00		0.95	1.00	
Satd. Flow (prot)		1846	1464		1794	1549		3560		1785	1874	
Flt Permitted		0.94	1.00		0.59	1.00		0.88		0.29	1.00	
Satd. Flow (perm)		1753	1464		1073	1549		3160		542	1874	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	11	75	53	43	63	275	53	597	28	230	436	8
RTOR Reduction (vph)	0	0	48	0	0	115	0	2	0	0	1	0
Lane Group Flow (vph)	0	86	5	0	106	160	0	676	0	230	443	0
Confl. Peds. (#/hr)	15		20	20		15	15		10	10		15
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	0%	0%	1%	1%	1%
Turn Type	Perm	NA	Perm	Perm	NA	pm+ov	Perm	NA		pm+pt	NA	
Protected Phases		4			8	1		2		1	6	
Permitted Phases	4		4	8		8	2			6		
Actuated Green, G (s)		9.0	9.0		13.7	23.0		47.3		66.3	61.6	
Effective Green, g (s)		9.0	9.0		13.7	23.0		47.3		66.3	61.6	
Actuated g/C Ratio		0.10	0.10		0.15	0.26		0.53		0.74	0.68	
Clearance Time (s)		5.0	5.0		5.0	5.0		5.0		5.0	5.0	
Vehicle Extension (s)		3.0	3.0		3.0	3.0		3.0		3.0	3.0	
Lane Grp Cap (vph)		175	146		163	481		1660		527	1282	
v/s Ratio Prot						c0.03				c0.05	0.24	
v/s Ratio Perm		0.05	0.00		c0.10	0.07		0.21		c0.28		
v/c Ratio		0.49	0.04		0.65	0.33		0.41		0.44	0.35	
Uniform Delay, d1		38.3	36.6		35.9	27.3		12.9		5.5	5.9	
Progression Factor		1.00	1.00		1.00	1.00		1.08		1.38	1.21	
Incremental Delay, d2		2.2	0.1		9.3	0.4		0.7		0.6	0.7	
Delay (s)		40.5	36.7		45.2	27.7		14.6		8.1	7.8	
Level of Service		D	D		D	C		B		A	A	
Approach Delay (s)		39.1			32.6			14.6			7.9	
Approach LOS		D			C			B			A	
Intersection Summary												
HCM 2000 Control Delay			17.6				HCM 2000 Level of Service			B		
HCM 2000 Volume to Capacity ratio			0.53									
Actuated Cycle Length (s)			90.0				Sum of lost time (s)			19.0		
Intersection Capacity Utilization			67.7%				ICU Level of Service			C		
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

12: Battery Street & King St

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	50	20	15	6	10	197	14	468	48	150	349	41
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0			5.0			5.0	
Lane Util. Factor	1.00	1.00			1.00			1.00			1.00	
Frpb, ped/bikes	1.00	0.96			0.94			0.99			0.99	
Flpb, ped/bikes	0.97	1.00			1.00			1.00			1.00	
Frt	1.00	0.94			0.88			0.99			0.99	
Flt Protected	0.95	1.00			1.00			1.00			0.99	
Satd. Flow (prot)	1759	1714			1535			1864			1818	
Flt Permitted	0.38	1.00			0.99			0.98			0.74	
Satd. Flow (perm)	705	1714			1525			1838			1370	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	50	20	15	6	10	197	14	468	48	150	349	41
RTOR Reduction (vph)	0	13	0	0	174	0	0	3	0	0	2	0
Lane Group Flow (vph)	50	22	0	0	39	0	0	527	0	0	538	0
Confl. Peds. (#/hr)	18		23	23		18	18		13	13		18
Heavy Vehicles (%)	0%	0%	0%	1%	1%	1%	0%	0%	0%	1%	1%	1%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	10.5	10.5			10.5			69.5			69.5	
Effective Green, g (s)	10.5	10.5			10.5			69.5			69.5	
Actuated g/C Ratio	0.12	0.12			0.12			0.77			0.77	
Clearance Time (s)	5.0	5.0			5.0			5.0			5.0	
Vehicle Extension (s)	3.0	3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)	82	199			177			1419			1057	
v/s Ratio Prot		0.01										
v/s Ratio Perm	c0.07				0.03			0.29			c0.39	
v/c Ratio	0.61	0.11			0.22			0.37			0.51	
Uniform Delay, d1	37.8	35.6			36.0			3.3			3.8	
Progression Factor	1.00	1.00			1.00			0.78			2.04	
Incremental Delay, d2	12.8	0.2			0.6			0.7			1.7	
Delay (s)	50.6	35.8			36.7			3.3			9.5	
Level of Service	D	D			D			A			A	
Approach Delay (s)		44.5			36.7			3.3			9.5	
Approach LOS		D			D			A			A	
Intersection Summary												
HCM 2000 Control Delay			13.5			HCM 2000 Level of Service			B			
HCM 2000 Volume to Capacity ratio			0.52									
Actuated Cycle Length (s)			90.0			Sum of lost time (s)			10.0			
Intersection Capacity Utilization			97.7%			ICU Level of Service			F			
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

13: Battery Street & Maple Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	23	15	0	5	4	442	0	24	24	343	11	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0	5.0		5.0			5.0	
Lane Util. Factor		1.00			1.00	1.00		1.00			1.00	
Frpb, ped/bikes		1.00			1.00	1.00		0.99			1.00	
Flpb, ped/bikes		1.00			1.00	1.00		1.00			1.00	
Frt		1.00			1.00	0.85		0.93			1.00	
Flt Protected		0.97			0.97	1.00		1.00			0.95	
Satd. Flow (prot)		1844			1849	1615		1752			1807	
Flt Permitted		0.82			0.86	1.00		1.00			0.70	
Satd. Flow (perm)		1558			1643	1615		1752			1322	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	23	15	0	5	4	442	0	24	24	343	11	1
RTOR Reduction (vph)	0	0	0	0	0	392	0	5	0	0	0	0
Lane Group Flow (vph)	0	38	0	0	9	50	0	43	0	0	355	0
Confl. Peds. (#/hr)									1	1		
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA	Perm		NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)		10.2			10.2	10.2		69.8			69.8	
Effective Green, g (s)		10.2			10.2	10.2		69.8			69.8	
Actuated g/C Ratio		0.11			0.11	0.11		0.78			0.78	
Clearance Time (s)		5.0			5.0	5.0		5.0			5.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0			3.0	
Lane Grp Cap (vph)		176			186	183		1358			1025	
v/s Ratio Prot								0.02				
v/s Ratio Perm		0.02			0.01	c0.03					c0.27	
v/c Ratio		0.22			0.05	0.27		0.03			0.35	
Uniform Delay, d1		36.3			35.6	36.5		2.3			3.1	
Progression Factor		1.00			1.00	1.00		1.00			2.06	
Incremental Delay, d2		0.6			0.1	0.8		0.0			0.8	
Delay (s)		36.9			35.7	37.3		2.4			7.2	
Level of Service		D			D	D		A			A	
Approach Delay (s)		36.9			37.3			2.4			7.2	
Approach LOS		D			D			A			A	
Intersection Summary												
HCM 2000 Control Delay		23.4										
HCM 2000 Volume to Capacity ratio		0.34										
Actuated Cycle Length (s)		90.0								10.0		
Intersection Capacity Utilization		56.5%										
Analysis Period (min)		60										
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis

14: Pine Street & Maple Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	9	129	280	61	215	38	256	149	14	10	296	10
Peak Hour 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
Hourly flow rate (vph)	9	129	280	61	215	38	256	149	14	10	296	10
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	418	314	419	316								
Volume Left (vph)	9	61	256	10								
Volume Right (vph)	280	38	14	10								
Hadj (s)	-0.38	0.00	0.17	0.04								
Departure Headway (s)	8.2	8.9	8.8	9.0								
Degree Utilization, x	0.95	0.78	1.0	0.79								
Capacity (veh/h)	418	388	419	380								
Control Delay (s)	90.6	41.2	161.0	42.5								
Approach Delay (s)	90.6	41.2	161.0	42.5								
Approach LOS	F	E	F	E								
Intersection Summary												
Delay				89.8								
Level of Service				F								
Intersection Capacity Utilization				94.9%	ICU Level of Service							F
Analysis Period (min)				60								

HCM Signalized Intersection Capacity Analysis

15: Park St/VT 127 - Park & North Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											  	
Volume (vph)	0	129	19	70	215	0	0	0	0	37	202	6
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0						5.0	
Lane Util. Factor		1.00			1.00						0.95	
Frpb, ped/bikes		0.99			1.00						1.00	
Flpb, ped/bikes		1.00			0.99						1.00	
Frt		0.98			1.00						1.00	
Flt Protected		1.00			0.99						0.99	
Satd. Flow (prot)		1619			1656						3563	
Flt Permitted		1.00			0.88						0.99	
Satd. Flow (perm)		1619			1474						3563	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	129	19	70	215	0	0	0	0	37	202	6
RTOR Reduction (vph)	0	7	0	0	0	0	0	0	0	0	2	0
Lane Group Flow (vph)	0	141	0	0	285	0	0	0	0	0	243	0
Confl. Peds. (#/hr)	56		43	43		56	9		7	7		9
Heavy Vehicles (%)	3%	3%	3%	1%	1%	1%	0%	0%	0%	0%	0%	0%
Parking (#/hr)	0	0			0	0				0		
Turn Type		NA		Perm	NA						Perm	NA
Protected Phases		4			8						6	
Permitted Phases				8						6		
Actuated Green, G (s)		17.7			17.7						30.9	
Effective Green, g (s)		17.7			17.7						30.9	
Actuated g/C Ratio		0.26			0.26						0.45	
Clearance Time (s)		5.0			5.0						5.0	
Vehicle Extension (s)		3.0			3.0						3.0	
Lane Grp Cap (vph)		418			380						1607	
v/s Ratio Prot		0.09										
v/s Ratio Perm					c0.19						0.07	
v/c Ratio		0.34			0.75						0.15	
Uniform Delay, d1		20.6			23.4						11.1	
Progression Factor		1.00			1.00						1.00	
Incremental Delay, d2		0.5			8.5						0.2	
Delay (s)		21.1			31.9						11.3	
Level of Service		C			C						B	
Approach Delay (s)		21.1			31.9			0.0			11.3	
Approach LOS		C			C			A			B	
Intersection Summary												
HCM 2000 Control Delay			22.1			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.34									
Actuated Cycle Length (s)			68.5			Sum of lost time (s)			15.0			
Intersection Capacity Utilization			46.3%			ICU Level of Service			A			
Analysis Period (min)			60									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

16: Battery Street/Park St & Sherman St

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											 	
Volume (vph)	0	0	449	0	0	0	759	0	0	0	291	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)			5.0				5.0				5.0	
Lane Util. Factor			1.00				1.00				0.95	
Frt			0.86				1.00				1.00	
Flt Protected			1.00				0.95				1.00	
Satd. Flow (prot)			1644				1805				3610	
Flt Permitted			1.00				0.56				1.00	
Satd. Flow (perm)			1644				1066				3610	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	0	449	0	0	0	759	0	0	0	291	0
RTOR Reduction (vph)	0	0	47	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	402	0	0	0	759	0	0	0	291	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type			pt+ov				D.P+P				NA	
Protected Phases			8 5		8		5				6	
Permitted Phases							5 6					
Actuated Green, G (s)			50.6				68.0				29.4	
Effective Green, g (s)			50.6				68.0				29.4	
Actuated g/C Ratio			0.56				0.76				0.33	
Clearance Time (s)							5.0				5.0	
Vehicle Extension (s)							3.0				3.0	
Lane Grp Cap (vph)			924				1122				1179	
v/s Ratio Prot			c0.24				c0.29				0.08	
v/s Ratio Perm							c0.22					
v/c Ratio			0.43				0.68				0.25	
Uniform Delay, d1			11.4				7.0				22.2	
Progression Factor			1.00				1.95				1.00	
Incremental Delay, d2			0.3				1.4				0.5	
Delay (s)			11.7				15.1				22.7	
Level of Service			B				B				C	
Approach Delay (s)		11.7			0.0			15.1			22.7	
Approach LOS		B			A			B			C	
Intersection Summary												
HCM 2000 Control Delay			15.6				HCM 2000 Level of Service			B		
HCM 2000 Volume to Capacity ratio			0.67									
Actuated Cycle Length (s)			90.0				Sum of lost time (s)			15.0		
Intersection Capacity Utilization			57.6%				ICU Level of Service			B		
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: North Ave & Church/127 Connector

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	2	0	0	26	0	568	1	686	60	274	330	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	10	10	10	10	10	10
Total Lost time (s)		4.0			4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Flpb, ped/bikes		0.99			0.99	1.00	1.00	1.00		1.00	1.00	
Frt		1.00			1.00	0.85	1.00	0.99		1.00	1.00	
Flt Protected		0.95			0.95	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1785			1777	1599	1665	1735		1668	1755	
Flt Permitted		0.74			0.76	1.00	0.56	1.00		0.14	1.00	
Satd. Flow (perm)		1391			1415	1599	983	1735		253	1755	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	2	0	0	26	0	568	1	686	60	274	330	1
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	2	0	0	26	568	1	746	0	274	331	0
Confl. Peds. (#/hr)	4		2	2		4	1					1
Heavy Vehicles (%)	0%	0%	0%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Turn Type	Perm	NA		Perm	NA	pt+ov	Perm	NA		pm+pt	NA	
Protected Phases		4			8	8 1		2		1	6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		21.0			21.0	35.0	45.0	45.0		59.0	59.0	
Effective Green, g (s)		22.0			22.0	36.0	46.0	46.0		60.0	60.0	
Actuated g/C Ratio		0.24			0.24	0.40	0.51	0.51		0.67	0.67	
Clearance Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		340			345	639	502	886		325	1170	
v/s Ratio Prot						c0.36		0.43		0.09	0.19	
v/s Ratio Perm		0.00			0.02		0.00			c0.47		
v/c Ratio		0.01			0.08	0.89	0.00	0.84		0.84	0.28	
Uniform Delay, d1		25.7			26.2	25.1	10.8	18.9		16.6	6.2	
Progression Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.0			0.1	16.8	0.0	10.4		20.6	0.6	
Delay (s)		25.7			26.3	41.9	10.8	29.3		37.2	6.8	
Level of Service		C			C	D	B	C		D	A	
Approach Delay (s)		25.7			41.2			29.3			20.6	
Approach LOS		C			D			C			C	
Intersection Summary												
HCM 2000 Control Delay			30.2				HCM 2000 Level of Service			C		
HCM 2000 Volume to Capacity ratio			0.93									
Actuated Cycle Length (s)			90.0				Sum of lost time (s)			12.0		
Intersection Capacity Utilization			89.3%				ICU Level of Service			E		
Analysis Period (min)			60									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

3: North Ave & Institute Rd/City Bluffs

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	140	0	216	4	1	2	89	615	2	3	480	74
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	10	10	10	10	10	10
Total Lost time (s)		4.0	5.0		4.0		5.0	4.0			4.0	4.0
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00			1.00	1.00
Frpb, ped/bikes		1.00	0.98		1.00		1.00	1.00			1.00	0.96
Flpb, ped/bikes		1.00	1.00		0.99		0.99	1.00			1.00	1.00
Frt		1.00	0.85		0.96		1.00	1.00			1.00	0.85
Flt Protected		0.95	1.00		0.97		0.95	1.00			1.00	1.00
Satd. Flow (prot)		1805	1575		1546		1632	1738			1721	1406
Flt Permitted		0.75	1.00		0.85		0.49	1.00			1.00	1.00
Satd. Flow (perm)		1431	1575		1350		838	1738			1718	1406
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	140	0	216	4	1	2	89	615	2	3	480	74
RTOR Reduction (vph)	0	0	168	0	2	0	0	0	0	0	0	31
Lane Group Flow (vph)	0	140	48	0	5	0	89	617	0	0	483	43
Confl. Peds. (#/hr)			8	8			23		3	3		23
Heavy Vehicles (%)	0%	0%	0%	14%	14%	14%	2%	2%	2%	3%	3%	3%
Turn Type	Perm	NA	pm+ov	Perm	NA		pm+pt	NA		pm+pt	NA	Perm
Protected Phases		4	5		8		5	2		1	6	
Permitted Phases	4		4	8			2			6		6
Actuated Green, G (s)		10.1	15.2		10.1		46.0	40.9			41.6	38.7
Effective Green, g (s)		11.1	15.2		11.1		46.0	41.9			43.6	39.7
Actuated g/C Ratio		0.16	0.22		0.16		0.67	0.61			0.63	0.58
Clearance Time (s)		5.0	5.0		5.0		5.0	5.0			5.0	5.0
Vehicle Extension (s)		4.0	3.0		4.0		3.0	3.0			3.0	3.0
Lane Grp Cap (vph)		230	461		217		618	1056			1087	810
v/s Ratio Prot			0.01				0.01	c0.36			c0.03	
v/s Ratio Perm		c0.10	0.02		0.00		0.09				0.26	0.03
v/c Ratio		0.61	0.10		0.02		0.14	0.58			0.44	0.05
Uniform Delay, d1		26.9	21.4		24.3		4.0	8.2			6.5	6.4
Progression Factor		1.00	1.00		1.00		1.00	1.00			1.00	1.00
Incremental Delay, d2		5.3	0.1		0.1		0.1	2.4			0.4	0.1
Delay (s)		32.2	21.5		24.4		4.1	10.6			6.9	6.5
Level of Service		C	C		C		A	B			A	A
Approach Delay (s)		25.7			24.4			9.8			6.8	
Approach LOS		C			C			A			A	
Intersection Summary												
HCM 2000 Control Delay			12.3				HCM 2000 Level of Service				B	
HCM 2000 Volume to Capacity ratio			0.59									
Actuated Cycle Length (s)			68.9				Sum of lost time (s)			13.0		
Intersection Capacity Utilization			80.4%				ICU Level of Service			D		
Analysis Period (min)			60									

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

4: North Ave & North Drive

12/21/2016

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	9	38	45	698	690	10
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	9	38	45	698	690	10
Pedestrians	25			10	10	
Lane Width (ft)	12.0			10.0	10.0	
Walking Speed (ft/s)	4.0			4.0	4.0	
Percent Blockage	2			1	1	
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (ft)				380		
pX, platoon unblocked	0.73					
vC, conflicting volume	1518	730	725			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1525	730	725			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	90	91	95			
cM capacity (veh/h)	88	414	855			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	47	743	700			
Volume Left	9	45	0			
Volume Right	38	0	10			
cSH	242	855	1700			
Volume to Capacity	0.19	0.05	0.41			
Queue Length 95th (ft)	18	4	0			
Control Delay (s)	23.4	1.4	0.0			
Lane LOS	C	A				
Approach Delay (s)	23.4	1.4	0.0			
Approach LOS	C					
Intersection Summary						
Average Delay			1.4			
Intersection Capacity Utilization			86.7%	ICU Level of Service		E
Analysis Period (min)			60			

HCM Signalized Intersection Capacity Analysis

5: North Ave & South Drive

12/21/2016

						
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	37	128	157	700	677	49
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	12	10	10	12	12
Total Lost time (s)	5.0		5.0	5.0	5.0	
Lane Util. Factor	1.00		1.00	1.00	1.00	
Frpb, ped/bikes	0.97		1.00	1.00	1.00	
Flpb, ped/bikes	1.00		1.00	1.00	1.00	
Frt	0.90		1.00	1.00	0.99	
Flt Protected	0.99		0.95	1.00	1.00	
Satd. Flow (prot)	1639		1636	1722	1821	
Flt Permitted	0.99		0.16	1.00	1.00	
Satd. Flow (perm)	1639		281	1722	1821	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	37	128	157	700	677	49
RTOR Reduction (vph)	111	0	0	0	4	0
Lane Group Flow (vph)	54	0	157	700	722	0
Confl. Peds. (#/hr)	10	10	25			25
Heavy Vehicles (%)	0%	0%	3%	3%	3%	3%
Turn Type	Prot		pm+pt	NA	NA	
Protected Phases	4		5	2	6	
Permitted Phases			2			
Actuated Green, G (s)	5.8		27.6	27.6	19.5	
Effective Green, g (s)	5.8		27.6	27.6	19.5	
Actuated g/C Ratio	0.13		0.64	0.64	0.45	
Clearance Time (s)	5.0		5.0	5.0	5.0	
Vehicle Extension (s)	3.0		3.0	3.0	3.0	
Lane Grp Cap (vph)	219		275	1095	818	
v/s Ratio Prot	c0.03		0.04	c0.41	c0.40	
v/s Ratio Perm			0.32			
v/c Ratio	0.25		0.57	0.64	0.88	
Uniform Delay, d1	16.8		6.9	4.8	10.9	
Progression Factor	1.00		1.00	1.00	1.00	
Incremental Delay, d2	0.6		2.9	1.2	12.6	
Delay (s)	17.4		9.8	6.1	23.5	
Level of Service	B		A	A	C	
Approach Delay (s)	17.4			6.8	23.5	
Approach LOS	B			A	C	
Intersection Summary						
HCM 2000 Control Delay			14.7	HCM 2000 Level of Service		B
HCM 2000 Volume to Capacity ratio			0.78			
Actuated Cycle Length (s)			43.4	Sum of lost time (s)		15.0
Intersection Capacity Utilization			71.4%	ICU Level of Service		C
Analysis Period (min)			60			
c Critical Lane Group						

HCM Unsignalized Intersection Capacity Analysis

6: North Ave & Berry/Washington

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	13	2	18	6	0	77	10	797	5	49	567	10
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour 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
Hourly flow rate (vph)	13	2	18	6	0	77	10	797	5	49	567	10
Pedestrians					18			29			13	
Lane Width (ft)					12.0			12.0			10.0	
Walking Speed (ft/s)					4.0			4.0			4.0	
Percent Blockage					1			2			1	
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)											1205	
pX, platoon unblocked	0.93	0.93	0.93	0.93	0.93		0.93					
vC, conflicting volume	1580	1510	601	1556	1512	830	577			820		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1585	1511	536	1559	1513	830	510			820		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	78	98	96	92	100	79	99			94		
cM capacity (veh/h)	60	104	499	73	103	364	979			792		
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	33	83	812	626								
Volume Left	13	6	10	49								
Volume Right	18	77	5	10								
cSH	122	283	979	792								
Volume to Capacity	0.27	0.29	0.01	0.06								
Queue Length 95th (ft)	27	31	1	5								
Control Delay (s)	45.5	23.0	0.3	1.6								
Lane LOS	E	C	A	A								
Approach Delay (s)	45.5	23.0	0.3	1.6								
Approach LOS	E	C										
Intersection Summary												
Average Delay			3.0									
Intersection Capacity Utilization			85.7%		ICU Level of Service					E		
Analysis Period (min)			60									

HCM Signalized Intersection Capacity Analysis

7: VT 127 - Park St/VT 127 & Manhattan Dr.

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	11	72	15	26	108	1158	0	0	0	300	236	9
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0	5.0				5.0	5.0	
Lane Util. Factor		1.00			1.00	1.00				1.00	1.00	
Frpb, ped/bikes		1.00			1.00	1.00				1.00	1.00	
Flpb, ped/bikes		1.00			1.00	1.00				1.00	1.00	
Frt		0.98			1.00	0.85				1.00	0.99	
Flt Protected		0.99			0.99	1.00				0.95	1.00	
Satd. Flow (prot)		1846			1844	1583				1787	1871	
Flt Permitted		0.97			0.95	1.00				0.95	1.00	
Satd. Flow (perm)		1807			1763	1583				1787	1871	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	11	72	15	26	108	1158	0	0	0	300	236	9
RTOR Reduction (vph)	0	8	0	0	0	0	0	0	0	0	2	0
Lane Group Flow (vph)	0	90	0	0	134	1158	0	0	0	300	243	0
Confl. Peds. (#/hr)			2	2					35	35		
Heavy Vehicles (%)	0%	0%	0%	2%	2%	2%	0%	0%	0%	1%	1%	1%
Turn Type	Perm	NA		Perm	NA	pt+ov				Prot	NA	
Protected Phases		8			4	4 1				1	6	
Permitted Phases	8			4								
Actuated Green, G (s)		25.8			25.8	54.1				18.3	18.3	
Effective Green, g (s)		25.8			25.8	54.1				18.3	18.3	
Actuated g/C Ratio		0.48			0.48	1.00				0.34	0.34	
Clearance Time (s)		5.0			5.0					5.0	5.0	
Vehicle Extension (s)		3.0			3.0					3.0	3.0	
Lane Grp Cap (vph)		861			840	1583				604	632	
v/s Ratio Prot						c0.73				0.17	0.13	
v/s Ratio Perm		0.05			0.08							
v/c Ratio		0.10			0.16	0.73				0.50	0.38	
Uniform Delay, d1		7.8			8.0	0.0				14.2	13.6	
Progression Factor		1.00			1.00	1.00				1.00	1.00	
Incremental Delay, d2		0.1			0.1	1.8				0.6	1.8	
Delay (s)		7.8			8.1	1.8				14.9	15.4	
Level of Service		A			A	A				B	B	
Approach Delay (s)		7.8			2.5			0.0			15.1	
Approach LOS		A			A			A			B	
Intersection Summary												
HCM 2000 Control Delay		6.3			HCM 2000 Level of Service					A		
HCM 2000 Volume to Capacity ratio		0.90										
Actuated Cycle Length (s)		54.1			Sum of lost time (s)				10.0			
Intersection Capacity Utilization		85.9%			ICU Level of Service				E			
Analysis Period (min)		60										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

8: North Ave & North Street

12/21/2016

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	48	115	636	61	96	402
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	12	12	10	10	10	10
Total Lost time (s)	3.0		3.0		3.0	3.0
Lane Util. Factor	1.00		1.00		1.00	1.00
Frpb, ped/bikes	1.00		1.00		1.00	1.00
Flpb, ped/bikes	1.00		1.00		1.00	1.00
Frt	0.90		0.99		1.00	1.00
Flt Protected	0.99		1.00		0.95	1.00
Satd. Flow (prot)	1613		1714		1651	1739
Flt Permitted	0.99		1.00		0.25	1.00
Satd. Flow (perm)	1613		1714		426	1739
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	48	115	636	61	96	402
RTOR Reduction (vph)	89	0	0	0	0	0
Lane Group Flow (vph)	74	0	697	0	96	402
Confl. Peds. (#/hr)	13			6	6	
Heavy Vehicles (%)	5%	5%	2%	2%	2%	2%
Turn Type	Prot		NA		pm+pt	NA
Protected Phases	8		2		1	6
Permitted Phases					6	
Actuated Green, G (s)	9.2		48.7		56.9	56.9
Effective Green, g (s)	11.2		50.7		58.9	58.9
Actuated g/C Ratio	0.13		0.61		0.70	0.70
Clearance Time (s)	5.0		5.0		5.0	5.0
Vehicle Extension (s)	3.0		4.0		3.0	4.0
Lane Grp Cap (vph)	216		1039		376	1225
v/s Ratio Prot	c0.05		c0.41		0.02	c0.23
v/s Ratio Perm					0.16	
v/c Ratio	0.34		0.67		0.26	0.33
Uniform Delay, d1	32.9		10.9		6.9	4.7
Progression Factor	1.00		1.00		1.00	1.00
Incremental Delay, d2	1.0		3.5		0.4	0.7
Delay (s)	33.8		14.4		7.2	5.5
Level of Service	C		B		A	A
Approach Delay (s)	33.8		14.4			5.8
Approach LOS	C		B			A
Intersection Summary						
HCM 2000 Control Delay			13.6		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.57			
Actuated Cycle Length (s)			83.6		Sum of lost time (s)	14.0
Intersection Capacity Utilization			62.3%		ICU Level of Service	B
Analysis Period (min)			60			

c Critical Lane Group

HCM Unsignalized Intersection Capacity Analysis

9: Sherman St & North Ave

12/21/2016



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	9	15	19	833	513	4
Sign Control		Stop	Yield		Free	
Grade		0%	0%		0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	9	15	19	833	513	4
Pedestrians		9	20		20	
Lane Width (ft)		12.0	12.0		10.0	
Walking Speed (ft/s)		4.0	4.0		4.0	
Percent Blockage		1	2		1	
Right turn flare (veh)						
Median type					None	
Median storage veh						
Upstream signal (ft)					986	
pX, platoon unblocked						
vC, conflicting volume	1066	1057	1059	40	20	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1066	1057	1059	40	20	
tC, single (s)	7.1	6.5	6.5	6.2	4.1	
tC, 2 stage (s)						
tF (s)	3.5	4.0	4.0	3.3	2.2	
p0 queue free %	60	90	87	17	68	
cM capacity (veh/h)	22	147	149	1006	1582	
Direction, Lane #	EB 1	WB 1	SB 1			
Volume Total	24	852	517			
Volume Left	9	0	513			
Volume Right	0	833	4			
cSH	47	892	1582			
Volume to Capacity	0.51	0.96	0.32			
Queue Length 95th (ft)	63	680	36			
Control Delay (s)	153.1	61.5	8.3			
Lane LOS	F	F	A			
Approach Delay (s)	153.1	61.5	8.3			
Approach LOS	F	F				
Intersection Summary						
Average Delay			43.4			
Intersection Capacity Utilization			89.8%	ICU Level of Service	E	
Analysis Period (min)			60			

HCM Signalized Intersection Capacity Analysis

10: Battery Street & Pearl Street

12/21/2016

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	125	163	736	421	150	558
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0		5.0
Lane Util. Factor	1.00	1.00	1.00	1.00		0.95
Frpb, ped/bikes	1.00	1.00	1.00	0.98		1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00		1.00
Frt	1.00	0.85	1.00	0.85		1.00
Flt Protected	0.95	1.00	1.00	1.00		0.99
Satd. Flow (prot)	1719	1538	1863	1546		3536
Flt Permitted	0.95	1.00	1.00	1.00		0.53
Satd. Flow (perm)	1719	1538	1863	1546		1898
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	125	163	736	421	150	558
RTOR Reduction (vph)	0	132	0	195	0	0
Lane Group Flow (vph)	125	31	736	226	0	708
Confl. Peds. (#/hr)		3		4	4	
Heavy Vehicles (%)	5%	5%	2%	2%	1%	1%
Turn Type	Prot	pt+ov	NA	Perm	pm+pt	NA
Protected Phases	3	3 1	2		1	6
Permitted Phases				2	6	
Actuated Green, G (s)	11.7	17.1	46.5	46.5		56.9
Effective Green, g (s)	11.7	17.1	46.5	46.5		56.9
Actuated g/C Ratio	0.13	0.19	0.52	0.52		0.63
Clearance Time (s)	5.0		5.0	5.0		5.0
Vehicle Extension (s)	3.0		3.0	3.0		3.0
Lane Grp Cap (vph)	223	292	962	798		1298
v/s Ratio Prot	c0.07	0.02	c0.40			c0.03
v/s Ratio Perm				0.15		0.31
v/c Ratio	0.56	0.11	0.77	0.28		0.55
Uniform Delay, d1	36.7	30.1	17.4	12.3		9.3
Progression Factor	1.00	1.00	0.91	1.30		1.29
Incremental Delay, d2	3.2	0.2	5.7	0.8		0.4
Delay (s)	40.0	30.3	21.5	16.9		12.4
Level of Service	D	C	C	B		B
Approach Delay (s)	34.5		19.8			12.4
Approach LOS	C		B			B
Intersection Summary						
HCM 2000 Control Delay			19.3		HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio			0.65			
Actuated Cycle Length (s)			90.0		Sum of lost time (s)	20.0
Intersection Capacity Utilization			77.9%		ICU Level of Service	D
Analysis Period (min)			60			
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis

11: Battery Street & Main Street/Main Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	11	75	53	43	63	296	53	634	28	248	467	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0		5.0	5.0		5.0		5.0	5.0	
Lane Util. Factor		1.00	1.00		1.00	1.00		0.95		1.00	1.00	
Frpb, ped/bikes		1.00	0.92		1.00	0.98		1.00		1.00	1.00	
Flpb, ped/bikes		1.00	1.00		0.98	1.00		1.00		1.00	1.00	
Frt		1.00	0.85		1.00	0.85		0.99		1.00	1.00	
Flt Protected		0.99	1.00		0.98	1.00		1.00		0.95	1.00	
Satd. Flow (prot)		1846	1464		1794	1549		3563		1787	1874	
Flt Permitted		0.94	1.00		0.59	1.00		0.88		0.27	1.00	
Satd. Flow (perm)		1753	1464		1073	1549		3158		511	1874	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	11	75	53	43	63	296	53	634	28	248	467	8
RTOR Reduction (vph)	0	0	48	0	0	102	0	2	0	0	1	0
Lane Group Flow (vph)	0	86	5	0	106	194	0	713	0	248	474	0
Confl. Peds. (#/hr)	15		20	20		15	15		10	10		15
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	0%	0%	1%	1%	1%
Turn Type	Perm	NA	Perm	Perm	NA	pm+ov	Perm	NA		pm+pt	NA	
Protected Phases		4			8	1		2		1	6	
Permitted Phases	4		4	8		8	2			6		
Actuated Green, G (s)		9.0	9.0		13.7	23.4		46.9		66.3	61.6	
Effective Green, g (s)		9.0	9.0		13.7	23.4		46.9		66.3	61.6	
Actuated g/C Ratio		0.10	0.10		0.15	0.26		0.52		0.74	0.68	
Clearance Time (s)		5.0	5.0		5.0	5.0		5.0		5.0	5.0	
Vehicle Extension (s)		3.0	3.0		3.0	3.0		3.0		3.0	3.0	
Lane Grp Cap (vph)		175	146		163	488		1645		513	1282	
v/s Ratio Prot						c0.04				c0.05	0.25	
v/s Ratio Perm		0.05	0.00		c0.10	0.08		0.23		c0.30		
v/c Ratio		0.49	0.04		0.65	0.40		0.43		0.48	0.37	
Uniform Delay, d1		38.3	36.6		35.9	27.5		13.3		5.8	6.0	
Progression Factor		1.00	1.00		1.00	1.00		1.11		0.88	0.83	
Incremental Delay, d2		2.2	0.1		9.3	0.5		0.8		0.6	0.7	
Delay (s)		40.5	36.7		45.2	28.0		15.5		5.8	5.7	
Level of Service		D	D		D	C		B		A	A	
Approach Delay (s)		39.1			32.5			15.5			5.7	
Approach LOS		D			C			B			A	
Intersection Summary												
HCM 2000 Control Delay			17.1				HCM 2000 Level of Service			B		
HCM 2000 Volume to Capacity ratio			0.57									
Actuated Cycle Length (s)			90.0				Sum of lost time (s)			19.0		
Intersection Capacity Utilization			70.3%				ICU Level of Service			C		
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

12: Battery Street & King St

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	50	20	15	6	10	197	14	505	48	150	380	41
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0			5.0			5.0			5.0	
Lane Util. Factor	1.00	1.00			1.00			1.00			1.00	
Frpb, ped/bikes	1.00	0.96			0.94			1.00			1.00	
Flpb, ped/bikes	0.97	1.00			1.00			1.00			1.00	
Frt	1.00	0.94			0.88			0.99			0.99	
Flt Protected	0.95	1.00			1.00			1.00			0.99	
Satd. Flow (prot)	1759	1714			1535			1866			1822	
Flt Permitted	0.38	1.00			0.99			0.98			0.74	
Satd. Flow (perm)	705	1714			1525			1840			1369	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	50	20	15	6	10	197	14	505	48	150	380	41
RTOR Reduction (vph)	0	13	0	0	174	0	0	2	0	0	2	0
Lane Group Flow (vph)	50	22	0	0	39	0	0	565	0	0	569	0
Confl. Peds. (#/hr)	18		23	23		18	18		13	13		18
Heavy Vehicles (%)	0%	0%	0%	1%	1%	1%	0%	0%	0%	1%	1%	1%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	10.5	10.5			10.5			69.5			69.5	
Effective Green, g (s)	10.5	10.5			10.5			69.5			69.5	
Actuated g/C Ratio	0.12	0.12			0.12			0.77			0.77	
Clearance Time (s)	5.0	5.0			5.0			5.0			5.0	
Vehicle Extension (s)	3.0	3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)	82	199			177			1420			1057	
v/s Ratio Prot		0.01										
v/s Ratio Perm	c0.07				0.03			0.31			c0.42	
v/c Ratio	0.61	0.11			0.22			0.40			0.54	
Uniform Delay, d1	37.8	35.6			36.0			3.4			4.0	
Progression Factor	1.00	1.00			1.00			0.78			2.24	
Incremental Delay, d2	12.8	0.2			0.6			0.8			1.9	
Delay (s)	50.6	35.8			36.7			3.4			10.8	
Level of Service	D	D			D			A			B	
Approach Delay (s)		44.5			36.7			3.4			10.8	
Approach LOS		D			D			A			B	
Intersection Summary												
HCM 2000 Control Delay			13.7			HCM 2000 Level of Service			B			
HCM 2000 Volume to Capacity ratio			0.55									
Actuated Cycle Length (s)			90.0			Sum of lost time (s)			10.0			
Intersection Capacity Utilization			101.3%			ICU Level of Service			G			
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

13: Battery Street & Maple Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	23	15	0	5	4	479	0	24	24	375	11	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0	5.0		5.0			5.0	
Lane Util. Factor		1.00			1.00	1.00		1.00			1.00	
Frpb, ped/bikes		1.00			1.00	1.00		0.99			1.00	
Flpb, ped/bikes		1.00			1.00	1.00		1.00			1.00	
Frt		1.00			1.00	0.85		0.93			1.00	
Flt Protected		0.97			0.97	1.00		1.00			0.95	
Satd. Flow (prot)		1844			1849	1615		1752			1807	
Flt Permitted		0.82			0.87	1.00		1.00			0.70	
Satd. Flow (perm)		1563			1648	1615		1752			1321	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	23	15	0	5	4	479	0	24	24	375	11	1
RTOR Reduction (vph)	0	0	0	0	0	423	0	5	0	0	0	0
Lane Group Flow (vph)	0	38	0	0	9	56	0	43	0	0	387	0
Confl. Peds. (#/hr)									1	1		
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA	Perm		NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)		10.5			10.5	10.5		69.5			69.5	
Effective Green, g (s)		10.5			10.5	10.5		69.5			69.5	
Actuated g/C Ratio		0.12			0.12	0.12		0.77			0.77	
Clearance Time (s)		5.0			5.0	5.0		5.0			5.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0			3.0	
Lane Grp Cap (vph)		182			192	188		1352			1020	
v/s Ratio Prot								0.02				
v/s Ratio Perm		0.02			0.01	c0.03					c0.29	
v/c Ratio		0.21			0.05	0.30		0.03			0.38	
Uniform Delay, d1		36.0			35.3	36.4		2.4			3.3	
Progression Factor		1.00			1.00	1.00		1.00			2.07	
Incremental Delay, d2		0.6			0.1	0.9		0.0			0.9	
Delay (s)		36.6			35.4	37.3		2.4			7.8	
Level of Service		D			D	D		A			A	
Approach Delay (s)		36.6			37.2			2.4			7.8	
Approach LOS		D			D			A			A	
Intersection Summary												
HCM 2000 Control Delay		23.6					HCM 2000 Level of Service			C		
HCM 2000 Volume to Capacity ratio		0.37										
Actuated Cycle Length (s)		90.0					Sum of lost time (s)		10.0			
Intersection Capacity Utilization		58.8%					ICU Level of Service		B			
Analysis Period (min)		60										
c Critical Lane Group												

HCM Unsignalized Intersection Capacity Analysis

14: Pine Street & Maple Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	9	143	297	61	231	38	276	149	14	10	296	10
Peak Hour 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
Hourly flow rate (vph)	9	143	297	61	231	38	276	149	14	10	296	10
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total (vph)	449	330	439	316								
Volume Left (vph)	9	61	276	10								
Volume Right (vph)	297	38	14	10								
Hadj (s)	-0.38	0.00	0.17	0.04								
Departure Headway (s)	8.3	9.1	8.9	9.2								
Degree Utilization, x	1.0	0.83	1.0	0.80								
Capacity (veh/h)	431	382	415	385								
Control Delay (s)	171.4	51.4	232.5	46.5								
Approach Delay (s)	171.4	51.4	232.5	46.5								
Approach LOS	F	F	F	E								
Intersection Summary												
Delay				137.4								
Level of Service				F								
Intersection Capacity Utilization				98.6%	ICU Level of Service		F					
Analysis Period (min)				60								

HCM Signalized Intersection Capacity Analysis

15: Park St/VT 127 - Park St & North Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											  	
Volume (vph)	0	172	19	70	265	0	0	0	0	37	202	6
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0						5.0	
Lane Util. Factor		1.00			1.00						0.95	
Frpb, ped/bikes		0.99			1.00						1.00	
Flpb, ped/bikes		1.00			0.99						1.00	
Frt		0.99			1.00						1.00	
Flt Protected		1.00			0.99						0.99	
Satd. Flow (prot)		1629			1663						3563	
Flt Permitted		1.00			0.89						0.99	
Satd. Flow (perm)		1629			1491						3563	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	172	19	70	265	0	0	0	0	37	202	6
RTOR Reduction (vph)	0	5	0	0	0	0	0	0	0	0	2	0
Lane Group Flow (vph)	0	186	0	0	335	0	0	0	0	0	243	0
Confl. Peds. (#/hr)	56		43	43		56	9		7	7		9
Heavy Vehicles (%)	3%	3%	3%	1%	1%	1%	0%	0%	0%	0%	0%	0%
Parking (#/hr)	0	0			0	0				0		
Turn Type		NA		Perm	NA					Perm	NA	
Protected Phases		4			8						6	
Permitted Phases				8						6		
Actuated Green, G (s)		19.6			19.6						30.8	
Effective Green, g (s)		19.6			19.6						30.8	
Actuated g/C Ratio		0.28			0.28						0.44	
Clearance Time (s)		5.0			5.0						5.0	
Vehicle Extension (s)		3.0			3.0						3.0	
Lane Grp Cap (vph)		454			415						1561	
v/s Ratio Prot		0.11										
v/s Ratio Perm					c0.22						0.07	
v/c Ratio		0.41			0.81						0.16	
Uniform Delay, d1		20.6			23.6						11.9	
Progression Factor		1.00			1.00						1.00	
Incremental Delay, d2		0.6			11.9						0.2	
Delay (s)		21.2			35.5						12.1	
Level of Service		C			D						B	
Approach Delay (s)		21.2			35.5			0.0			12.1	
Approach LOS		C			D			A			B	
Intersection Summary												
HCM 2000 Control Delay			24.6			HCM 2000 Level of Service				C		
HCM 2000 Volume to Capacity ratio			0.37									
Actuated Cycle Length (s)			70.3			Sum of lost time (s)			15.0			
Intersection Capacity Utilization			51.1%			ICU Level of Service			A			
Analysis Period (min)			60									

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

16: Battery Street/Park St & Sherman St

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations											 	
Volume (vph)	0	0	528	0	0	0	852	0	0	0	291	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)			5.0				5.0				5.0	
Lane Util. Factor			1.00				1.00				0.95	
Frt			0.86				1.00				1.00	
Flt Protected			1.00				0.95				1.00	
Satd. Flow (prot)			1644				1805				3610	
Flt Permitted			1.00				0.55				1.00	
Satd. Flow (perm)			1644				1050				3610	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	0	0	528	0	0	0	852	0	0	0	291	0
RTOR Reduction (vph)	0	0	43	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	485	0	0	0	852	0	0	0	291	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type			pt+ov				D.P+P				NA	
Protected Phases			8 5		8		5				6	
Permitted Phases							5 6					
Actuated Green, G (s)			54.0				67.4				26.0	
Effective Green, g (s)			54.0				67.4				26.0	
Actuated g/C Ratio			0.60				0.75				0.29	
Clearance Time (s)							5.0				5.0	
Vehicle Extension (s)							3.0				3.0	
Lane Grp Cap (vph)			986				1133				1042	
v/s Ratio Prot			c0.29				c0.35				0.08	
v/s Ratio Perm							c0.22					
v/c Ratio			0.49				0.75				0.28	
Uniform Delay, d1			10.2				7.9				24.8	
Progression Factor			1.00				1.96				1.00	
Incremental Delay, d2			0.4				2.2				0.7	
Delay (s)			10.6				17.6				25.4	
Level of Service			B				B				C	
Approach Delay (s)		10.6			0.0			17.6			25.4	
Approach LOS		B			A			B			C	
Intersection Summary												
HCM 2000 Control Delay			16.7				HCM 2000 Level of Service			B		
HCM 2000 Volume to Capacity ratio			0.74									
Actuated Cycle Length (s)			90.0				Sum of lost time (s)			15.0		
Intersection Capacity Utilization			62.7%				ICU Level of Service			B		
Analysis Period (min)			60									
c Critical Lane Group												

- Queuing Output (15 intersections)



Queues

2: North Ave & Church/127 Connector

12/21/2016

	→	←	↖	↑	↘	↓
Lane Group	EBT	WBT	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	1	21	164	258	508	585
v/c Ratio	0.00	0.07	0.23	0.43	0.67	0.47
Control Delay	16.0	17.5	7.4	18.2	11.5	6.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	16.0	17.5	7.4	18.2	11.5	6.9
Queue Length 50th (ft)	0	6	24	63	58	70
Queue Length 95th (ft)	4	22	55	#170	#283	243
Internal Link Dist (ft)	325	1535		1769		1314
Turn Bay Length (ft)					150	
Base Capacity (vph)	643	471	803	602	792	1246
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.00	0.04	0.20	0.43	0.64	0.47

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

3: North Ave & Institute Rd/City Bluffs

12/21/2016

							
Lane Group	EBT	EBR	WBT	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	100	163	12	249	244	577	253
v/c Ratio	0.36	0.29	0.03	0.53	0.21	0.65	0.29
Control Delay	27.0	4.0	0.1	12.2	9.0	18.1	2.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	27.0	4.0	0.1	12.2	9.0	18.1	2.8
Queue Length 50th (ft)	35	0	0	30	27	166	0
Queue Length 95th (ft)	84	40	0	#155	158	#432	50
Internal Link Dist (ft)	563		438		2146	1769	
Turn Bay Length (ft)		200		250			150
Base Capacity (vph)	392	571	546	483	1179	890	858
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.26	0.29	0.02	0.52	0.21	0.65	0.29

Intersection Summary

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

Queue shown is maximum after two cycles.

Queues

7: VT 127 - Park & Manhattan Dr.

12/21/2016

	→	←	↖	↗	↓
Lane Group	EBT	WBT	WBR	SBL	SBT
Lane Group Flow (vph)	62	95	304	527	638
v/c Ratio	0.20	0.37	0.20	0.46	0.53
Control Delay	18.3	23.5	0.3	7.1	7.8
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	18.3	23.5	0.3	7.1	7.8
Queue Length 50th (ft)	15	27	0	65	83
Queue Length 95th (ft)	46	69	0	191	246
Internal Link Dist (ft)	492	1130			624
Turn Bay Length (ft)			200	225	
Base Capacity (vph)	537	450	1493	1154	1212
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.12	0.21	0.20	0.46	0.53
Intersection Summary					

Queues

8: North Ave & North Street

12/21/2016

				
Lane Group	WBL	NBT	SBL	SBT
Lane Group Flow (vph)	62	327	47	560
v/c Ratio	0.26	0.25	0.06	0.39
Control Delay	18.9	7.7	4.6	5.6
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	18.9	7.7	4.6	5.6
Queue Length 50th (ft)	8	49	3	48
Queue Length 95th (ft)	57	212	29	339
Internal Link Dist (ft)	673	906		1344
Turn Bay Length (ft)			150	
Base Capacity (vph)	477	1295	777	1449
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	0.13	0.25	0.06	0.39
Intersection Summary				

Queues

10: Battery Street & Pearl Street

12/21/2016

					
Lane Group	WBL	WBR	NBT	NBR	SBT
Lane Group Flow (vph)	132	67	253	150	1355
v/c Ratio	0.60	0.18	0.26	0.17	0.75
Control Delay	48.2	5.2	11.5	4.8	16.0
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	48.2	5.2	11.5	4.8	16.0
Queue Length 50th (ft)	71	0	43	0	51
Queue Length 95th (ft)	141	24	199	85	#684
Internal Link Dist (ft)	810		1567		581
Turn Bay Length (ft)					
Base Capacity (vph)	286	378	983	867	1811
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.46	0.18	0.26	0.17	0.75

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

11: Battery Street & Main Street/Main Street

12/21/2016

	→	↘	←	↙	↑	↗	↓
Lane Group	EBT	EBR	WBT	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	36	25	119	154	376	326	555
v/c Ratio	0.22	0.09	0.84	0.31	0.26	0.45	0.42
Control Delay	37.8	0.6	94.0	4.6	14.3	7.8	7.9
Queue Delay	0.0	0.0	1.7	0.0	0.0	0.0	0.0
Total Delay	37.8	0.6	95.7	4.6	14.3	7.8	7.9
Queue Length 50th (ft)	19	0	67	0	66	35	96
Queue Length 95th (ft)	49	0	#147	42	94	m116	m181
Internal Link Dist (ft)	431		399		342		1567
Turn Bay Length (ft)		25		50			
Base Capacity (vph)	298	398	228	658	1462	841	1314
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	45	32	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.12	0.07	0.61	0.23	0.26	0.39	0.42

Intersection Summary

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

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Queues

12: Battery Street & King St

12/21/2016

					
Lane Group	EBL	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	5	5	110	300	666
v/c Ratio	0.06	0.03	0.48	0.21	0.53
Control Delay	35.2	28.8	17.8	2.3	7.9
Queue Delay	0.0	0.0	0.0	0.2	0.4
Total Delay	35.2	28.8	17.8	2.6	8.3
Queue Length 50th (ft)	3	2	9	25	135
Queue Length 95th (ft)	14	13	64	59	361
Internal Link Dist (ft)		171	601	315	342
Turn Bay Length (ft)	50				
Base Capacity (vph)	167	286	354	1454	1250
Starvation Cap Reductn	0	0	0	571	192
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.03	0.02	0.31	0.34	0.63
Intersection Summary					

Queues

13: Battery Street & Maple Street

12/21/2016

	→	←	↖	↑	↓
Lane Group	EBT	WBT	WBR	NBT	SBT
Lane Group Flow (vph)	13	59	263	28	412
v/c Ratio	0.09	0.39	0.66	0.02	0.39
Control Delay	31.8	43.6	13.7	2.1	4.6
Queue Delay	0.0	0.0	0.0	0.0	0.5
Total Delay	31.8	43.6	13.7	2.1	5.0
Queue Length 50th (ft)	6	32	0	1	12
Queue Length 95th (ft)	24	73	96	10	243
Internal Link Dist (ft)	108	704		121	315
Turn Bay Length (ft)			150		
Base Capacity (vph)	553	571	769	1126	1058
Starvation Cap Reductn	0	0	0	0	281
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.02	0.10	0.34	0.02	0.53
Intersection Summary					

Queues

15: Park St/VT 127 - Park & North Street

12/21/2016

	→	←	↓
Lane Group	EBT	WBT	SBT
Lane Group Flow (vph)	151	207	757
v/c Ratio	0.35	0.61	0.44
Control Delay	17.7	26.8	13.3
Queue Delay	0.0	0.0	0.0
Total Delay	17.7	26.8	13.3
Queue Length 50th (ft)	30	50	58
Queue Length 95th (ft)	115	179	270
Internal Link Dist (ft)	673	1314	1001
Turn Bay Length (ft)			
Base Capacity (vph)	727	583	1723
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.21	0.36	0.44
Intersection Summary			

Queues

16: Battery Street/Park St & Sherman St

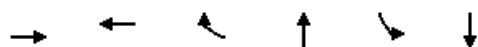
12/21/2016

			
Lane Group	EBR	NBL	SBT
Lane Group Flow (vph)	524	469	773
v/c Ratio	0.66	0.59	0.52
Control Delay	21.2	10.7	22.3
Queue Delay	0.0	0.0	0.0
Total Delay	21.2	10.7	22.3
Queue Length 50th (ft)	194	33	178
Queue Length 95th (ft)	341	143	286
Internal Link Dist (ft)			828
Turn Bay Length (ft)			
Base Capacity (vph)	954	865	1498
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.55	0.54	0.52
Intersection Summary			

Queues

2: North Ave & Church/127 Connector

12/21/2016



Lane Group	EBT	WBT	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	1	34	164	289	508	596
v/c Ratio	0.00	0.13	0.22	0.49	0.69	0.48
Control Delay	16.0	18.3	7.3	19.5	12.5	7.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	16.0	18.3	7.3	19.5	12.5	7.0
Queue Length 50th (ft)	0	9	24	72	58	72
Queue Length 95th (ft)	4	30	55	#218	#297	251
Internal Link Dist (ft)	325	1535		1769		1314
Turn Bay Length (ft)					150	
Base Capacity (vph)	643	456	803	587	765	1246
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.00	0.07	0.20	0.49	0.66	0.48

Intersection Summary

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

Queue shown is maximum after two cycles.

Queues

3: North Ave & Institute Rd/City Bluffs

12/21/2016

							
Lane Group	EBT	EBR	WBT	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	100	170	12	260	276	600	253
v/c Ratio	0.36	0.30	0.03	0.56	0.23	0.68	0.30
Control Delay	27.0	4.0	0.1	14.0	9.1	19.1	2.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	27.0	4.0	0.1	14.0	9.1	19.1	2.8
Queue Length 50th (ft)	35	0	0	32	31	176	0
Queue Length 95th (ft)	84	40	0	#186	180	#459	50
Internal Link Dist (ft)	563		438		2146	1769	
Turn Bay Length (ft)		200		250			150
Base Capacity (vph)	391	576	545	468	1179	887	857
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.26	0.30	0.02	0.56	0.23	0.68	0.30

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

5: North Ave & South Access

12/21/2016

				
Lane Group	EBL	NBL	NBT	SBT
Lane Group Flow (vph)	174	97	381	809
v/c Ratio	0.49	0.34	0.31	0.75
Control Delay	11.9	7.0	4.8	20.1
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	11.9	7.0	4.8	20.1
Queue Length 50th (ft)	10	8	36	196
Queue Length 95th (ft)	64	28	109	#561
Internal Link Dist (ft)	700		1125	300
Turn Bay Length (ft)		75		
Base Capacity (vph)	610	287	1246	1074
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	0.29	0.34	0.31	0.75

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

7: VT 127 - Park & Manhattan Dr.

12/21/2016

	→	←	↖	↗	↓
Lane Group	EBT	WBT	WBR	SBL	SBT
Lane Group Flow (vph)	109	131	304	527	638
v/c Ratio	0.32	0.45	0.20	0.47	0.54
Control Delay	20.2	24.3	0.3	7.8	8.6
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	20.2	24.3	0.3	7.8	8.6
Queue Length 50th (ft)	29	38	0	70	91
Queue Length 95th (ft)	72	89	0	209	270
Internal Link Dist (ft)	492	1130			622
Turn Bay Length (ft)			200	225	
Base Capacity (vph)	537	462	1502	1132	1189
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.20	0.28	0.20	0.47	0.54
Intersection Summary					

Queues

8: North Ave & North Street

12/21/2016

				
Lane Group	WBL	NBT	SBL	SBT
Lane Group Flow (vph)	97	384	93	635
v/c Ratio	0.35	0.33	0.13	0.46
Control Delay	16.2	9.2	4.9	6.8
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	16.2	9.2	4.9	6.8
Queue Length 50th (ft)	8	60	6	58
Queue Length 95th (ft)	69	267	51	429
Internal Link Dist (ft)	673	906		632
Turn Bay Length (ft)			150	
Base Capacity (vph)	468	1155	691	1381
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	0.33	0.13	0.46
Intersection Summary				

Queues

10: Battery Street & Pearl Street

12/21/2016

					
Lane Group	WBL	WBR	NBT	NBR	SBT
Lane Group Flow (vph)	132	85	293	150	1430
v/c Ratio	0.60	0.22	0.30	0.17	0.81
Control Delay	48.2	5.1	11.9	4.6	18.4
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	48.2	5.1	11.9	4.6	18.4
Queue Length 50th (ft)	71	0	60	0	77
Queue Length 95th (ft)	141	27	235	86	#753
Internal Link Dist (ft)	810		1567		581
Turn Bay Length (ft)					
Base Capacity (vph)	286	392	983	867	1759
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.46	0.22	0.30	0.17	0.81

Intersection Summary

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

Queue shown is maximum after two cycles.

Queues

11: Battery Street & Main Street/Main Street

12/21/2016

							
Lane Group	EBT	EBR	WBT	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	36	25	119	165	397	340	582
v/c Ratio	0.22	0.09	0.84	0.32	0.27	0.48	0.44
Control Delay	37.8	0.6	94.0	4.5	14.8	8.4	7.8
Queue Delay	0.0	0.0	4.4	0.0	0.0	0.0	0.0
Total Delay	37.8	0.6	98.4	4.5	14.8	8.4	7.8
Queue Length 50th (ft)	19	0	67	0	72	35	96
Queue Length 95th (ft)	49	0	#147	44	111	m112	m175
Internal Link Dist (ft)	431		399		342		1567
Turn Bay Length (ft)		25		50			
Base Capacity (vph)	298	398	228	665	1452	829	1314
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	72	56	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.12	0.08	0.69	0.25	0.27	0.41	0.44

Intersection Summary

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

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Queues

12: Battery Street & King St

12/21/2016

					
Lane Group	EBL	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	5	5	110	320	693
v/c Ratio	0.06	0.03	0.48	0.22	0.55
Control Delay	35.2	28.8	17.8	2.4	8.5
Queue Delay	0.0	0.0	0.0	0.2	0.4
Total Delay	35.2	28.8	17.8	2.6	8.9
Queue Length 50th (ft)	3	2	9	28	142
Queue Length 95th (ft)	14	13	64	64	379
Internal Link Dist (ft)		171	601	315	342
Turn Bay Length (ft)	50				
Base Capacity (vph)	167	286	354	1454	1251
Starvation Cap Reductn	0	0	0	563	192
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.03	0.02	0.31	0.36	0.65
Intersection Summary					

Queues

13: Battery Street & Maple Street

12/21/2016

	→	←	↖	↑	↓
Lane Group	EBT	WBT	WBR	NBT	SBT
Lane Group Flow (vph)	13	59	283	28	438
v/c Ratio	0.09	0.39	0.68	0.02	0.41
Control Delay	31.8	43.6	13.9	2.1	5.0
Queue Delay	0.0	0.0	0.0	0.0	0.5
Total Delay	31.8	43.6	13.9	2.1	5.5
Queue Length 50th (ft)	6	32	0	1	12
Queue Length 95th (ft)	24	73	101	10	261
Internal Link Dist (ft)	108	704		121	315
Turn Bay Length (ft)			150		
Base Capacity (vph)	553	571	781	1126	1056
Starvation Cap Reductn	0	0	0	0	274
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.02	0.10	0.36	0.02	0.56
Intersection Summary					

Queues

15: Park St/VT 127 - Park & North Street

12/21/2016

	→	←	↓
Lane Group	EBT	WBT	SBT
Lane Group Flow (vph)	197	242	757
v/c Ratio	0.46	0.73	0.48
Control Delay	22.4	36.9	17.1
Queue Delay	0.0	0.0	0.0
Total Delay	22.4	36.9	17.1
Queue Length 50th (ft)	42	61	65
Queue Length 95th (ft)	152	#244	271
Internal Link Dist (ft)	673	1314	1001
Turn Bay Length (ft)			
Base Capacity (vph)	677	522	1585
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.29	0.46	0.48

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

16: Battery Street/Park St & Sherman St

12/21/2016

			
Lane Group	EBR	NBL	SBT
Lane Group Flow (vph)	600	526	773
v/c Ratio	0.70	0.66	0.57
Control Delay	20.4	15.2	25.8
Queue Delay	0.0	0.0	0.0
Total Delay	20.4	15.2	25.8
Queue Length 50th (ft)	237	39	180
Queue Length 95th (ft)	341	229	#358
Internal Link Dist (ft)			828
Turn Bay Length (ft)			
Base Capacity (vph)	987	831	1357
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.61	0.63	0.57

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

2: North Ave & Church/127 Connector

12/21/2016

							
Lane Group	EBT	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	2	6	555	1	700	267	308
v/c Ratio	0.01	0.02	0.85	0.00	0.80	0.74	0.26
Control Delay	26.0	26.2	40.4	11.0	27.8	23.6	6.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	26.0	26.2	40.4	11.0	27.8	23.6	6.8
Queue Length 50th (ft)	1	3	277	0	317	53	62
Queue Length 95th (ft)	7	14	#563	3	#645	#205	114
Internal Link Dist (ft)	325	1535			1769		1314
Turn Bay Length (ft)				50		150	
Base Capacity (vph)	346	346	657	505	875	365	1170
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.01	0.02	0.84	0.00	0.80	0.73	0.26

Intersection Summary

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

Queue shown is maximum after two cycles.

Queues

3: North Ave & Institute Rd/City Bluffs

12/21/2016

	→	↘	←	↙	↑	↓	↗
Lane Group	EBT	EBR	WBT	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	137	204	7	82	573	437	72
v/c Ratio	0.46	0.39	0.03	0.13	0.49	0.43	0.09
Control Delay	28.9	5.0	18.6	6.0	13.8	9.9	1.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	28.9	5.0	18.6	6.0	13.8	9.9	1.2
Queue Length 50th (ft)	50	0	2	10	92	104	0
Queue Length 95th (ft)	111	50	12	30	#511	150	13
Internal Link Dist (ft)	563		438		2146	1769	
Turn Bay Length (ft)		200		250			150
Base Capacity (vph)	388	529	368	628	1172	1009	831
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.35	0.39	0.02	0.13	0.49	0.43	0.09

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

7: VT 127 - Park & Manhattan Dr.

12/21/2016



Lane Group	EBT	WBT	WBR	SBL	SBT
Lane Group Flow (vph)	63	95	1132	293	239
v/c Ratio	0.07	0.12	0.72	0.50	0.39
Control Delay	5.6	7.2	2.8	20.1	18.1
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	5.6	7.2	2.8	20.1	18.1
Queue Length 50th (ft)	7	15	0	80	62
Queue Length 95th (ft)	24	37	0	#186	145
Internal Link Dist (ft)	492	1130			626
Turn Bay Length (ft)			200	225	
Base Capacity (vph)	1141	1117	1578	591	620
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.06	0.09	0.72	0.50	0.39

Intersection Summary

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

Queue shown is maximum after two cycles.

Queues

8: North Ave & North Street

12/21/2016

				
Lane Group	WBL	NBT	SBL	SBT
Lane Group Flow (vph)	111	591	52	316
v/c Ratio	0.41	0.48	0.10	0.23
Control Delay	22.3	11.5	5.6	5.4
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	22.3	11.5	5.6	5.4
Queue Length 50th (ft)	22	118	4	26
Queue Length 95th (ft)	95	#521	34	174
Internal Link Dist (ft)	673	906		618
Turn Bay Length (ft)			150	
Base Capacity (vph)	425	1222	526	1363
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	0.26	0.48	0.10	0.23

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

10: Battery Street & Pearl Street

12/21/2016

					
Lane Group	WBL	WBR	NBT	NBR	SBT
Lane Group Flow (vph)	122	138	650	412	614
v/c Ratio	0.55	0.30	0.58	0.38	0.38
Control Delay	45.8	5.2	16.5	3.6	10.6
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	45.8	5.2	16.5	3.6	10.6
Queue Length 50th (ft)	66	0	178	3	76
Queue Length 95th (ft)	130	35	#645	84	226
Internal Link Dist (ft)	810		1567		581
Turn Bay Length (ft)					
Base Capacity (vph)	305	452	1116	1090	1626
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.40	0.31	0.58	0.38	0.38

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

11: Battery Street & Main Street/Main Street

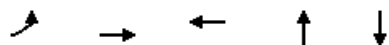
12/21/2016

							
Lane Group	EBT	EBR	WBT	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	84	51	104	269	662	225	433
v/c Ratio	0.43	0.17	0.69	0.54	0.39	0.42	0.33
Control Delay	42.9	1.2	61.4	13.5	15.0	7.5	8.0
Queue Delay	0.0	0.0	0.3	0.0	0.0	0.0	0.0
Total Delay	42.9	1.2	61.7	13.5	15.0	7.5	8.1
Queue Length 50th (ft)	46	0	57	47	98	55	116
Queue Length 95th (ft)	94	0	118	116	226	42	281
Internal Link Dist (ft)	431		399		342		1567
Turn Bay Length (ft)		25		50			
Base Capacity (vph)	350	419	250	620	1708	648	1306
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	16	17	0	0	0	53
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.24	0.13	0.45	0.43	0.39	0.35	0.35
Intersection Summary							

Queues

12: Battery Street & King St

12/21/2016



Lane Group	EBL	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	49	34	208	518	528
v/c Ratio	0.60	0.16	0.60	0.36	0.49
Control Delay	68.9	23.9	14.7	3.6	10.7
Queue Delay	0.0	0.0	0.0	0.5	0.8
Total Delay	68.9	23.9	14.7	4.1	11.4
Queue Length 50th (ft)	27	10	8	64	54
Queue Length 95th (ft)	70	40	91	105	379
Internal Link Dist (ft)		171	601	315	342
Turn Bay Length (ft)	50				
Base Capacity (vph)	173	429	518	1425	1068
Starvation Cap Reductn	0	0	0	491	259
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.28	0.08	0.40	0.55	0.65

Intersection Summary

Queues

13: Battery Street & Maple Street

12/21/2016

	→	←	↖	↑	↓
Lane Group	EBT	WBT	WBR	NBT	SBT
Lane Group Flow (vph)	38	9	432	47	348
v/c Ratio	0.22	0.05	0.76	0.03	0.34
Control Delay	36.3	31.9	13.7	2.4	9.3
Queue Delay	0.0	0.0	0.0	0.0	0.6
Total Delay	36.3	31.9	13.7	2.4	9.9
Queue Length 50th (ft)	21	5	0	2	39
Queue Length 95th (ft)	49	18	130	17	259
Internal Link Dist (ft)	108	704		121	315
Turn Bay Length (ft)			150		
Base Capacity (vph)	588	621	878	1361	1027
Starvation Cap Reductn	0	0	0	0	359
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.06	0.01	0.49	0.03	0.52
Intersection Summary					

Queues

15: Park St/VT 127 - Park & North Street

12/21/2016

	→	←	↓
Lane Group	EBT	WBT	SBT
Lane Group Flow (vph)	144	278	239
v/c Ratio	0.33	0.71	0.14
Control Delay	21.5	34.0	14.6
Queue Delay	0.0	0.0	0.0
Total Delay	21.5	34.0	14.6
Queue Length 50th (ft)	34	78	17
Queue Length 95th (ft)	117	244	88
Internal Link Dist (ft)	673	1314	1001
Turn Bay Length (ft)			
Base Capacity (vph)	772	700	1686
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.19	0.40	0.14
Intersection Summary			

Queues

16: Battery Street/Park St & Sherman St

12/21/2016

			
Lane Group	EBR	NBL	SBT
Lane Group Flow (vph)	439	742	285
v/c Ratio	0.46	0.66	0.24
Control Delay	9.3	15.3	24.3
Queue Delay	0.0	0.0	0.0
Total Delay	9.3	15.3	24.3
Queue Length 50th (ft)	94	89	62
Queue Length 95th (ft)	157	604	119
Internal Link Dist (ft)			828
Turn Bay Length (ft)			
Base Capacity (vph)	1086	1259	1210
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.40	0.59	0.24
Intersection Summary			

Queues

2: North Ave & Church/127 Connector

12/21/2016

	→	←	↖	↗	↑	↘	↓
Lane Group	EBT	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	2	26	555	1	730	267	324
v/c Ratio	0.01	0.08	0.85	0.00	0.84	0.78	0.28
Control Delay	26.0	27.0	40.2	11.0	30.9	30.6	6.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	26.0	27.0	40.2	11.0	30.9	30.6	6.9
Queue Length 50th (ft)	1	11	277	0	341	57	66
Queue Length 95th (ft)	7	36	#563	3	#690	#231	121
Internal Link Dist (ft)	325	1535			1769		1314
Turn Bay Length (ft)				50		150	
Base Capacity (vph)	340	346	657	496	871	344	1170
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.01	0.08	0.84	0.00	0.84	0.78	0.28

Intersection Summary

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

Queue shown is maximum after two cycles.

Queues

3: North Ave & Institute Rd/City Bluffs

12/21/2016

							
Lane Group	EBT	EBR	WBT	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	137	211	7	87	604	473	72
v/c Ratio	0.46	0.39	0.03	0.14	0.51	0.47	0.09
Control Delay	28.9	5.0	18.6	6.1	14.3	10.4	1.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	28.9	5.0	18.6	6.1	14.3	10.4	1.2
Queue Length 50th (ft)	50	0	2	10	99	115	0
Queue Length 95th (ft)	111	51	12	31	#547	168	13
Internal Link Dist (ft)	563		438		2146	1769	
Turn Bay Length (ft)		200		250			150
Base Capacity (vph)	388	535	368	612	1173	1009	831
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.35	0.39	0.02	0.14	0.51	0.47	0.09

Intersection Summary

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

Queue shown is maximum after two cycles.

Queues

5: North Ave & South Drive

12/21/2016

				
Lane Group	EBL	NBL	NBT	SBT
Lane Group Flow (vph)	165	157	685	711
v/c Ratio	0.50	0.47	0.55	0.75
Control Delay	12.6	8.9	7.4	19.4
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	12.6	8.9	7.4	19.4
Queue Length 50th (ft)	10	13	85	159
Queue Length 95th (ft)	63	#54	281	#480
Internal Link Dist (ft)	700		1125	300
Turn Bay Length (ft)		75		
Base Capacity (vph)	567	332	1244	942
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	0.29	0.47	0.55	0.75

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

7: VT 127 - Park & Manhattan Dr

12/21/2016



Lane Group	EBT	WBT	WBR	SBL	SBT
Lane Group Flow (vph)	96	133	1132	293	239
v/c Ratio	0.10	0.14	0.72	0.58	0.45
Control Delay	6.0	7.1	2.8	24.0	20.7
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	6.0	7.1	2.8	24.0	20.7
Queue Length 50th (ft)	13	21	0	90	69
Queue Length 95th (ft)	34	49	0	#186	145
Internal Link Dist (ft)	492	1130			623
Turn Bay Length (ft)			200	225	
Base Capacity (vph)	1001	971	1583	506	531
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.10	0.14	0.72	0.58	0.45

Intersection Summary

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

Queue shown is maximum after two cycles.

Queues

8: North Ave & North Street

12/21/2016

				
Lane Group	WBL	NBT	SBL	SBT
Lane Group Flow (vph)	161	684	95	395
v/c Ratio	0.51	0.62	0.23	0.31
Control Delay	19.4	15.2	6.6	6.4
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	19.4	15.2	6.6	6.4
Queue Length 50th (ft)	23	151	7	36
Queue Length 95th (ft)	114	#724	57	239
Internal Link Dist (ft)	673	906		833
Turn Bay Length (ft)			150	
Base Capacity (vph)	457	1109	418	1289
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	0.35	0.62	0.23	0.31

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

10: Battery Street & Pearl Street

12/21/2016

					
Lane Group	WBL	WBR	NBT	NBR	SBT
Lane Group Flow (vph)	122	159	721	412	693
v/c Ratio	0.55	0.34	0.70	0.40	0.50
Control Delay	45.8	4.8	23.2	4.3	14.2
Queue Delay	0.0	0.5	0.0	0.0	0.0
Total Delay	45.8	5.3	23.2	4.3	14.2
Queue Length 50th (ft)	66	0	200	4	85
Queue Length 95th (ft)	130	38	#751	97	250
Internal Link Dist (ft)	810		1567		581
Turn Bay Length (ft)					
Base Capacity (vph)	305	470	1026	1031	1381
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	95	3	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.40	0.42	0.70	0.40	0.50

Intersection Summary

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

Queue shown is maximum after two cycles.

Queues

11: Battery Street & Main Street/Main Street

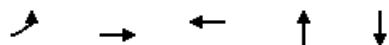
12/21/2016

							
Lane Group	EBT	EBR	WBT	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	84	51	104	289	700	243	464
v/c Ratio	0.43	0.17	0.69	0.59	0.41	0.46	0.36
Control Delay	42.9	1.2	61.4	16.6	16.0	6.0	6.0
Queue Delay	0.0	0.0	0.3	0.0	0.0	0.0	0.0
Total Delay	42.9	1.2	61.7	16.6	16.0	6.0	6.0
Queue Length 50th (ft)	46	0	57	64	110	60	133
Queue Length 95th (ft)	94	0	118	137	244	40	210
Internal Link Dist (ft)	431		399		342		1567
Turn Bay Length (ft)		25		50			
Base Capacity (vph)	350	419	250	610	1696	631	1306
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	20	17	0	0	0	89
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.24	0.13	0.45	0.47	0.41	0.39	0.38
Intersection Summary							

Queues

12: Battery Street & King St

12/21/2016



Lane Group	EBL	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	49	34	208	555	559
v/c Ratio	0.60	0.16	0.60	0.39	0.52
Control Delay	68.9	23.9	14.7	3.7	12.4
Queue Delay	0.0	0.0	0.0	0.6	0.9
Total Delay	68.9	23.9	14.7	4.3	13.3
Queue Length 50th (ft)	27	10	8	72	81
Queue Length 95th (ft)	70	40	91	116	414
Internal Link Dist (ft)		171	601	315	342
Turn Bay Length (ft)	50				
Base Capacity (vph)	173	429	518	1426	1068
Starvation Cap Reductn	0	0	0	474	251
Spillback Cap Reductn	0	0	1	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.28	0.08	0.40	0.58	0.68

Intersection Summary

Queues

13: Battery Street & Maple Street

12/21/2016

	→	←	↖	↑	↓
Lane Group	EBT	WBT	WBR	NBT	SBT
Lane Group Flow (vph)	38	9	469	47	379
v/c Ratio	0.21	0.05	0.78	0.03	0.37
Control Delay	35.8	31.3	13.8	2.5	10.0
Queue Delay	0.0	0.0	0.0	0.0	0.7
Total Delay	35.8	31.3	13.8	2.5	10.7
Queue Length 50th (ft)	21	5	0	2	40
Queue Length 95th (ft)	48	18	139	17	310
Internal Link Dist (ft)	108	704		121	315
Turn Bay Length (ft)			150		
Base Capacity (vph)	590	622	901	1356	1022
Starvation Cap Reductn	0	0	0	0	348
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.06	0.01	0.52	0.03	0.56
Intersection Summary					

Queues

15: Park St/VT 127 - Park & North Street

12/21/2016

	→	←	↓
Lane Group	EBT	WBT	SBT
Lane Group Flow (vph)	187	328	239
v/c Ratio	0.40	0.76	0.15
Control Delay	22.6	36.8	15.3
Queue Delay	0.0	0.0	0.0
Total Delay	22.6	36.8	15.3
Queue Length 50th (ft)	47	96	19
Queue Length 95th (ft)	152	#323	88
Internal Link Dist (ft)	673	1314	1001
Turn Bay Length (ft)			
Base Capacity (vph)	752	687	1638
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.25	0.48	0.15

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

16: Battery Street/Park St & Sherman St

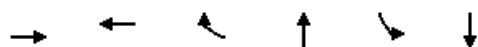
12/21/2016

			
Lane Group	EBR	NBL	SBT
Lane Group Flow (vph)	518	835	285
v/c Ratio	0.51	0.73	0.27
Control Delay	9.4	19.7	26.5
Queue Delay	0.0	0.0	0.0
Total Delay	9.4	19.7	26.5
Queue Length 50th (ft)	110	125	67
Queue Length 95th (ft)	201	675	121
Internal Link Dist (ft)			828
Turn Bay Length (ft)			
Base Capacity (vph)	1136	1219	1074
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.46	0.68	0.27
Intersection Summary			

Queues

2: North Ave & Church/127 Connector

12/21/2016



Lane Group	EBT	WBT	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	1	22	167	263	520	598
v/c Ratio	0.00	0.08	0.23	0.44	0.68	0.48
Control Delay	16.0	17.5	7.4	18.5	12.3	7.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	16.0	17.5	7.4	18.5	12.3	7.0
Queue Length 50th (ft)	0	6	25	64	61	73
Queue Length 95th (ft)	4	22	56	#177	#306	252
Internal Link Dist (ft)	325	1535		1769		1314
Turn Bay Length (ft)					150	
Base Capacity (vph)	642	469	804	593	786	1245
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.00	0.05	0.21	0.44	0.66	0.48

Intersection Summary

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

Queue shown is maximum after two cycles.

Queues

3: North Ave & Institute Rd/City Bluffs

12/21/2016

							
Lane Group	EBT	EBR	WBT	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	103	166	12	255	250	590	259
v/c Ratio	0.37	0.29	0.03	0.55	0.21	0.66	0.30
Control Delay	27.2	4.0	0.1	13.3	9.0	18.7	2.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	27.2	4.0	0.1	13.3	9.0	18.7	2.9
Queue Length 50th (ft)	36	0	0	31	28	172	0
Queue Length 95th (ft)	86	40	0	#175	163	#448	50
Internal Link Dist (ft)	563		438		2146	1769	
Turn Bay Length (ft)		200		250			150
Base Capacity (vph)	391	574	545	474	1177	888	860
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.26	0.29	0.02	0.54	0.21	0.66	0.30

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

7: VT 127 - Park & Manhattan Dr.

12/21/2016

	→	←	↖	↗	↓
Lane Group	EBT	WBT	WBR	SBL	SBT
Lane Group Flow (vph)	63	98	311	539	653
v/c Ratio	0.20	0.38	0.21	0.47	0.54
Control Delay	18.3	23.6	0.3	7.3	8.1
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	18.3	23.6	0.3	7.3	8.1
Queue Length 50th (ft)	15	28	0	68	87
Queue Length 95th (ft)	46	70	0	198	258
Internal Link Dist (ft)	492	1130			623
Turn Bay Length (ft)			200	225	
Base Capacity (vph)	536	449	1492	1152	1210
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.12	0.22	0.21	0.47	0.54
Intersection Summary					

Queues

8: North Ave & North Street

12/21/2016

				
Lane Group	WBL	NBT	SBL	SBT
Lane Group Flow (vph)	64	335	49	573
v/c Ratio	0.27	0.27	0.07	0.42
Control Delay	19.0	8.0	4.7	6.2
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	19.0	8.0	4.7	6.2
Queue Length 50th (ft)	8	50	3	50
Queue Length 95th (ft)	58	219	30	352
Internal Link Dist (ft)	673	906		645
Turn Bay Length (ft)			150	
Base Capacity (vph)	461	1229	738	1380
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	0.14	0.27	0.07	0.42
Intersection Summary				

Queues

10: Battery Street & Pearl Street

12/21/2016

					
Lane Group	WBL	WBR	NBT	NBR	SBT
Lane Group Flow (vph)	135	69	259	153	1386
v/c Ratio	0.61	0.18	0.26	0.18	0.77
Control Delay	48.3	5.2	10.6	2.3	17.9
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	48.3	5.2	10.6	2.3	17.9
Queue Length 50th (ft)	73	0	20	0	100
Queue Length 95th (ft)	144	24	224	4	#711
Internal Link Dist (ft)	810		1567		581
Turn Bay Length (ft)					
Base Capacity (vph)	286	380	981	867	1798
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.47	0.18	0.26	0.18	0.77

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

11: Battery Street & Main Street/Main Street

12/21/2016

							
Lane Group	EBT	EBR	WBT	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	38	26	122	158	385	334	569
v/c Ratio	0.23	0.09	0.87	0.31	0.27	0.47	0.43
Control Delay	38.0	0.6	104.2	4.6	14.6	6.4	5.0
Queue Delay	0.0	0.0	6.8	0.0	0.0	0.0	0.0
Total Delay	38.0	0.6	111.1	4.6	14.6	6.4	5.1
Queue Length 50th (ft)	20	0	69	0	68	34	59
Queue Length 95th (ft)	52	0	#156	43	98	m69	m95
Internal Link Dist (ft)	431		399		342		1567
Turn Bay Length (ft)		25		50			
Base Capacity (vph)	295	398	225	662	1447	834	1312
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	79	62	0	0	0	30
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.13	0.08	0.75	0.24	0.27	0.40	0.44

Intersection Summary

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

Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Queues
12: Battery Street

12/21/2016

					
Lane Group	EBL	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	5	5	113	307	682
v/c Ratio	0.06	0.03	0.49	0.21	0.55
Control Delay	35.2	28.8	18.0	2.4	10.5
Queue Delay	0.0	0.0	0.0	0.2	0.4
Total Delay	35.2	28.8	18.0	2.6	10.9
Queue Length 50th (ft)	3	2	9	26	143
Queue Length 95th (ft)	14	13	66	60	446
Internal Link Dist (ft)		171	601	315	342
Turn Bay Length (ft)	50				
Base Capacity (vph)	167	286	355	1454	1247
Starvation Cap Reductn	0	0	0	564	191
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.03	0.02	0.32	0.34	0.65
Intersection Summary					

Queues

13: Battery Street & Maple Street

12/21/2016

	→	←	↖	↑	↓
Lane Group	EBT	WBT	WBR	NBT	SBT
Lane Group Flow (vph)	14	61	269	28	421
v/c Ratio	0.09	0.40	0.67	0.02	0.40
Control Delay	31.6	43.7	13.6	2.1	5.7
Queue Delay	0.0	0.0	0.0	0.0	0.5
Total Delay	31.6	43.7	13.6	2.1	6.2
Queue Length 50th (ft)	6	33	0	1	12
Queue Length 95th (ft)	25	74	98	10	250
Internal Link Dist (ft)	108	704		121	315
Turn Bay Length (ft)			150		
Base Capacity (vph)	548	572	772	1125	1056
Starvation Cap Reductn	0	0	0	0	280
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.03	0.11	0.35	0.02	0.54
Intersection Summary					

Queues

15: Park St/VT 127 - Park & North Street

12/21/2016

	→	←	↓
Lane Group	EBT	WBT	SBT
Lane Group Flow (vph)	155	212	774
v/c Ratio	0.36	0.62	0.45
Control Delay	17.8	27.1	13.5
Queue Delay	0.0	0.0	0.0
Total Delay	17.8	27.1	13.5
Queue Length 50th (ft)	31	51	61
Queue Length 95th (ft)	118	184	277
Internal Link Dist (ft)	673	1314	1001
Turn Bay Length (ft)			
Base Capacity (vph)	723	580	1716
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.21	0.37	0.45
Intersection Summary			

Queues

16: Battery Street/Park St & Sherman St

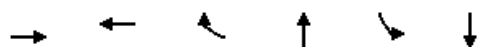
12/21/2016

			
Lane Group	EBR	NBL	SBT
Lane Group Flow (vph)	536	480	791
v/c Ratio	0.67	0.61	0.53
Control Delay	21.2	9.1	22.9
Queue Delay	0.0	0.0	0.0
Total Delay	21.2	9.1	22.9
Queue Length 50th (ft)	200	97	184
Queue Length 95th (ft)	346	84	300
Internal Link Dist (ft)			828
Turn Bay Length (ft)			
Base Capacity (vph)	974	854	1480
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.55	0.56	0.53
Intersection Summary			

Queues

2: North Ave & Church/127 Connector

12/21/2016



Lane Group	EBT	WBT	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	1	35	167	295	520	609
v/c Ratio	0.00	0.13	0.23	0.51	0.71	0.49
Control Delay	16.0	18.3	7.4	19.9	13.4	7.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	16.0	18.3	7.4	19.9	13.4	7.1
Queue Length 50th (ft)	0	9	25	74	61	75
Queue Length 95th (ft)	4	31	56	#224	#324	261
Internal Link Dist (ft)	325	1535		1769		1314
Turn Bay Length (ft)					150	
Base Capacity (vph)	642	454	804	582	759	1245
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.00	0.08	0.21	0.51	0.69	0.49

Intersection Summary

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

Queue shown is maximum after two cycles.

Queues

3: North Ave & Institute Rd/City Bluffs

12/21/2016

							
Lane Group	EBT	EBR	WBT	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	103	174	12	265	281	614	259
v/c Ratio	0.37	0.31	0.03	0.58	0.24	0.69	0.30
Control Delay	27.2	4.3	0.1	15.1	9.2	19.8	2.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	27.2	4.3	0.1	15.1	9.2	19.8	2.9
Queue Length 50th (ft)	36	2	0	33	32	183	0
Queue Length 95th (ft)	86	43	0	#198	184	#474	50
Internal Link Dist (ft)	563		438		2146	1769	
Turn Bay Length (ft)		200		250			150
Base Capacity (vph)	390	574	544	458	1177	885	858
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.26	0.30	0.02	0.58	0.24	0.69	0.30

Intersection Summary

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

Queue shown is maximum after two cycles.

Queues

5: North Ave & South Drive

12/21/2016

				
Lane Group	EBL	NBL	NBT	SBT
Lane Group Flow (vph)	174	97	389	826
v/c Ratio	0.44	0.32	0.34	0.83
Control Delay	9.3	7.2	5.8	29.5
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	9.3	7.2	5.8	29.5
Queue Length 50th (ft)	8	7	36	~247
Queue Length 95th (ft)	54	29	113	#549
Internal Link Dist (ft)	700		1125	300
Turn Bay Length (ft)		75		
Base Capacity (vph)	727	304	1167	993
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	0.24	0.32	0.33	0.83

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

7: VT 127 - Park & Manhattan Dr.

12/21/2016

	→	←	↖	↗	↓
Lane Group	EBT	WBT	WBR	SBL	SBT
Lane Group Flow (vph)	110	134	311	539	653
v/c Ratio	0.31	0.45	0.21	0.48	0.55
Control Delay	20.0	24.1	0.3	8.1	8.9
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	20.0	24.1	0.3	8.1	8.9
Queue Length 50th (ft)	29	39	0	79	102
Queue Length 95th (ft)	72	91	0	216	281
Internal Link Dist (ft)	492	1130			622
Turn Bay Length (ft)			200	225	
Base Capacity (vph)	535	458	1501	1126	1182
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.21	0.29	0.21	0.48	0.55
Intersection Summary					

Queues

8: North Ave & North Street

12/21/2016

				
Lane Group	WBL	NBT	SBL	SBT
Lane Group Flow (vph)	99	392	94	648
v/c Ratio	0.36	0.33	0.14	0.47
Control Delay	16.3	9.1	4.9	7.0
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	16.3	9.1	4.9	7.0
Queue Length 50th (ft)	8	61	6	60
Queue Length 95th (ft)	71	271	51	446
Internal Link Dist (ft)	673	906		667
Turn Bay Length (ft)			150	
Base Capacity (vph)	471	1190	685	1381
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	0.33	0.14	0.47
Intersection Summary				

Queues

10: Battery Street & Pearl Street

12/21/2016

					
Lane Group	WBL	WBR	NBT	NBR	SBT
Lane Group Flow (vph)	135	86	299	153	1462
v/c Ratio	0.61	0.22	0.30	0.18	0.84
Control Delay	48.3	5.0	11.0	2.2	20.5
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	48.3	5.0	11.0	2.2	20.5
Queue Length 50th (ft)	73	0	23	0	125
Queue Length 95th (ft)	144	27	258	4	#778
Internal Link Dist (ft)	810		1567		581
Turn Bay Length (ft)					
Base Capacity (vph)	286	393	981	867	1748
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.47	0.22	0.30	0.18	0.84

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

11: Battery Street & Main Street/Main Street

12/21/2016

							
Lane Group	EBT	EBR	WBT	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	38	26	122	169	405	348	595
v/c Ratio	0.23	0.09	0.87	0.33	0.28	0.49	0.45
Control Delay	38.0	0.6	104.2	4.5	15.1	7.2	4.9
Queue Delay	0.0	0.0	6.8	0.0	0.0	0.0	0.0
Total Delay	38.0	0.6	111.1	4.5	15.1	7.2	4.9
Queue Length 50th (ft)	20	0	69	0	74	34	59
Queue Length 95th (ft)	52	0	#156	44	122	m66	m91
Internal Link Dist (ft)	431		399		342		1567
Turn Bay Length (ft)		25		50			
Base Capacity (vph)	295	398	225	669	1438	822	1312
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	80	62	0	0	0	40
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.13	0.08	0.75	0.25	0.28	0.42	0.47

Intersection Summary

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

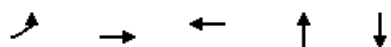
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Queues

12: Battery Street & King St

12/21/2016



Lane Group	EBL	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	5	5	113	327	709
v/c Ratio	0.06	0.03	0.49	0.22	0.57
Control Delay	35.2	28.8	18.0	2.4	11.3
Queue Delay	0.0	0.0	0.0	0.2	0.5
Total Delay	35.2	28.8	18.0	2.6	11.7
Queue Length 50th (ft)	3	2	9	29	150
Queue Length 95th (ft)	14	13	66	65	466
Internal Link Dist (ft)		171	601	315	342
Turn Bay Length (ft)	50				
Base Capacity (vph)	167	286	355	1454	1246
Starvation Cap Reductn	0	0	0	556	191
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.03	0.02	0.32	0.36	0.67

Intersection Summary

Queues

13: Battery Street & Maple Street

12/21/2016

	→	←	↖	↑	↓
Lane Group	EBT	WBT	WBR	NBT	SBT
Lane Group Flow (vph)	14	61	289	28	447
v/c Ratio	0.09	0.40	0.68	0.02	0.42
Control Delay	31.6	43.7	13.8	2.1	6.1
Queue Delay	0.0	0.0	0.0	0.0	0.6
Total Delay	31.6	43.7	13.8	2.1	6.7
Queue Length 50th (ft)	6	33	0	1	13
Queue Length 95th (ft)	25	74	103	10	269
Internal Link Dist (ft)	108	704		121	315
Turn Bay Length (ft)			150		
Base Capacity (vph)	548	572	784	1125	1054
Starvation Cap Reductn	0	0	0	0	274
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.03	0.11	0.37	0.02	0.57
Intersection Summary					

Queues

15: Park St/VT 127 - Park & North Street

12/21/2016

	→	←	↓
Lane Group	EBT	WBT	SBT
Lane Group Flow (vph)	201	246	774
v/c Ratio	0.46	0.74	0.49
Control Delay	22.3	37.6	17.4
Queue Delay	0.0	0.0	0.0
Total Delay	22.3	37.6	17.4
Queue Length 50th (ft)	43	62	68
Queue Length 95th (ft)	155	#251	277
Internal Link Dist (ft)	673	1314	1001
Turn Bay Length (ft)			
Base Capacity (vph)	673	514	1574
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.30	0.48	0.49

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

16: Battery Street/Park St & Sherman St

12/21/2016

			
Lane Group	EBR	NBL	SBT
Lane Group Flow (vph)	612	537	791
v/c Ratio	0.71	0.68	0.59
Control Delay	20.5	12.0	26.5
Queue Delay	0.0	0.0	0.0
Total Delay	20.5	12.0	26.5
Queue Length 50th (ft)	244	131	185
Queue Length 95th (ft)	350	#127	#375
Internal Link Dist (ft)			828
Turn Bay Length (ft)			
Base Capacity (vph)	1007	821	1341
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.61	0.65	0.59

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

2: North Ave & Church/127 Connector

12/21/2016

							
Lane Group	EBT	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	2	6	568	1	716	274	315
v/c Ratio	0.01	0.02	0.87	0.00	0.82	0.78	0.27
Control Delay	26.0	26.2	42.9	11.0	29.3	29.0	6.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	26.0	26.2	42.9	11.0	29.3	29.0	6.8
Queue Length 50th (ft)	1	3	288	0	330	55	64
Queue Length 95th (ft)	7	14	#582	3	#668	#230	117
Internal Link Dist (ft)	325	1535			1769		1314
Turn Bay Length (ft)				50		150	
Base Capacity (vph)	346	346	657	500	874	354	1170
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.01	0.02	0.86	0.00	0.82	0.77	0.27

Intersection Summary

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

Queue shown is maximum after two cycles.

Queues

3: North Ave & Institute Rd/City Bluffs

12/21/2016

	→	↘	←	↙	↑	↓	↗
Lane Group	EBT	EBR	WBT	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	140	209	7	84	586	447	74
v/c Ratio	0.47	0.39	0.02	0.13	0.50	0.44	0.09
Control Delay	29.0	5.0	18.6	6.1	14.1	10.1	1.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.0	5.0	18.6	6.1	14.1	10.1	1.3
Queue Length 50th (ft)	51	0	2	10	96	108	0
Queue Length 95th (ft)	114	51	12	30	#527	154	14
Internal Link Dist (ft)	563		438		2146	1769	
Turn Bay Length (ft)		200		250			150
Base Capacity (vph)	388	535	367	623	1170	1008	830
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.36	0.39	0.02	0.13	0.50	0.44	0.09

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

7: VT 127 - Park & Manhattan Dr.

12/21/2016



Lane Group	EBT	WBT	WBR	SBL	SBT
Lane Group Flow (vph)	65	97	1158	300	245
v/c Ratio	0.08	0.12	0.73	0.49	0.38
Control Delay	5.9	7.6	3.1	19.6	17.6
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	5.9	7.6	3.1	19.6	17.6
Queue Length 50th (ft)	8	16	0	86	67
Queue Length 95th (ft)	26	39	#7	184	145
Internal Link Dist (ft)	492	1130			624
Turn Bay Length (ft)			200	225	
Base Capacity (vph)	1081	1058	1564	611	641
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.06	0.09	0.74	0.49	0.38

Intersection Summary

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

Queue shown is maximum after two cycles.

Queues

8: North Ave & North Street

12/21/2016

				
Lane Group	WBL	NBT	SBL	SBT
Lane Group Flow (vph)	113	604	53	323
v/c Ratio	0.42	0.52	0.11	0.25
Control Delay	22.6	12.1	5.7	5.6
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	22.6	12.1	5.7	5.6
Queue Length 50th (ft)	23	123	4	27
Queue Length 95th (ft)	97	#580	35	180
Internal Link Dist (ft)	673	906		630
Turn Bay Length (ft)			150	
Base Capacity (vph)	415	1165	492	1306
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	0.27	0.52	0.11	0.25

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

10: Battery Street & Pearl Street

12/21/2016

					
Lane Group	WBL	WBR	NBT	NBR	SBT
Lane Group Flow (vph)	125	141	665	421	628
v/c Ratio	0.56	0.30	0.60	0.39	0.39
Control Delay	46.1	5.2	16.9	3.7	10.6
Queue Delay	0.0	0.1	0.0	0.0	0.0
Total Delay	46.1	5.3	16.9	3.7	10.6
Queue Length 50th (ft)	68	0	183	3	79
Queue Length 95th (ft)	132	36	#669	91	231
Internal Link Dist (ft)	810		1567		581
Turn Bay Length (ft)					
Base Capacity (vph)	305	455	1114	1092	1603
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	29	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.41	0.33	0.60	0.39	0.39

Intersection Summary

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

Queue shown is maximum after two cycles.

Queues

11: Battery Street & Main Street/Main Street

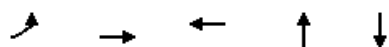
12/21/2016

							
Lane Group	EBT	EBR	WBT	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	86	53	106	275	678	230	444
v/c Ratio	0.43	0.17	0.70	0.55	0.40	0.43	0.34
Control Delay	43.0	1.2	62.4	14.5	15.4	7.9	8.3
Queue Delay	0.0	0.0	0.4	0.0	0.0	0.0	0.0
Total Delay	43.0	1.2	62.7	14.5	15.4	7.9	8.3
Queue Length 50th (ft)	47	0	58	52	103	57	122
Queue Length 95th (ft)	96	0	120	123	231	42	274
Internal Link Dist (ft)	431		399		342		1567
Turn Bay Length (ft)		25		50			
Base Capacity (vph)	350	419	250	618	1695	640	1302
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	19	18	0	0	0	70
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.25	0.13	0.46	0.44	0.40	0.36	0.36
Intersection Summary							

Queues

12: Battery Street & King St

12/21/2016



Lane Group	EBL	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	50	35	213	530	540
v/c Ratio	0.61	0.16	0.61	0.37	0.51
Control Delay	70.0	24.1	14.7	3.7	11.3
Queue Delay	0.0	0.0	0.0	0.5	0.8
Total Delay	70.0	24.1	14.7	4.2	12.1
Queue Length 50th (ft)	28	10	8	68	65
Queue Length 95th (ft)	71	41	94	109	394
Internal Link Dist (ft)		171	601	315	342
Turn Bay Length (ft)	50				
Base Capacity (vph)	172	430	521	1422	1060
Starvation Cap Reductn	0	0	0	483	248
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.29	0.08	0.41	0.56	0.67

Intersection Summary

Queues

13: Battery Street & Maple Street

12/21/2016

	→	←	↖	↑	↓
Lane Group	EBT	WBT	WBR	NBT	SBT
Lane Group Flow (vph)	38	9	442	48	355
v/c Ratio	0.21	0.05	0.77	0.04	0.35
Control Delay	36.2	31.8	13.7	2.4	9.5
Queue Delay	0.0	0.0	0.0	0.0	0.6
Total Delay	36.2	31.8	13.7	2.4	10.1
Queue Length 50th (ft)	21	5	0	2	39
Queue Length 95th (ft)	48	18	133	17	265
Internal Link Dist (ft)	108	704		121	315
Turn Bay Length (ft)			150		
Base Capacity (vph)	588	621	885	1362	1025
Starvation Cap Reductn	0	0	0	0	357
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.06	0.01	0.50	0.04	0.53
Intersection Summary					

Queues

15: Park St/VT 127 - Park & North Street

12/21/2016

	→	←	↓
Lane Group	EBT	WBT	SBT
Lane Group Flow (vph)	148	285	245
v/c Ratio	0.33	0.72	0.15
Control Delay	21.5	34.5	14.7
Queue Delay	0.0	0.0	0.0
Total Delay	21.5	34.5	14.7
Queue Length 50th (ft)	35	81	18
Queue Length 95th (ft)	120	252	90
Internal Link Dist (ft)	673	1314	1001
Turn Bay Length (ft)			
Base Capacity (vph)	768	696	1678
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.19	0.41	0.15
Intersection Summary			

Queues

16: Battery Street/Park St & Sherman St

12/21/2016

			
Lane Group	EBR	NBL	SBT
Lane Group Flow (vph)	449	759	291
v/c Ratio	0.46	0.68	0.25
Control Delay	9.4	15.7	24.8
Queue Delay	0.0	0.0	0.0
Total Delay	9.4	15.7	24.8
Queue Length 50th (ft)	97	93	65
Queue Length 95th (ft)	163	618	122
Internal Link Dist (ft)			828
Turn Bay Length (ft)			
Base Capacity (vph)	1094	1248	1179
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.41	0.61	0.25
Intersection Summary			

Queues

2: North Ave & Church/127 Connector

12/21/2016

	→	←	↖	↗	↑	↘	↓
Lane Group	EBT	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	2	26	568	1	746	274	331
v/c Ratio	0.01	0.08	0.89	0.00	0.84	0.84	0.28
Control Delay	26.0	27.0	47.2	11.0	30.6	40.8	6.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	26.0	27.0	47.2	11.0	30.6	40.8	6.9
Queue Length 50th (ft)	1	11	294	0	345	63	68
Queue Length 95th (ft)	7	36	#593	3	#701	#254	123
Internal Link Dist (ft)	325	1535			1769		1314
Turn Bay Length (ft)				50		150	
Base Capacity (vph)	340	346	639	502	886	325	1170
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.01	0.08	0.89	0.00	0.84	0.84	0.28

Intersection Summary

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

Queue shown is maximum after two cycles.

Queues

3: North Ave & Institute Rd/City Bluffs

12/21/2016

	→	↘	←	↙	↑	↓	↗
Lane Group	EBT	EBR	WBT	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	140	216	7	89	617	483	74
v/c Ratio	0.47	0.40	0.02	0.15	0.53	0.48	0.09
Control Delay	29.0	5.0	18.6	6.2	14.6	10.6	1.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.0	5.0	18.6	6.2	14.6	10.6	1.3
Queue Length 50th (ft)	51	0	2	11	104	120	0
Queue Length 95th (ft)	114	51	12	32	#562	172	14
Internal Link Dist (ft)	563		438		2146	1769	
Turn Bay Length (ft)		200		250			150
Base Capacity (vph)	388	540	367	608	1171	1008	830
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.36	0.40	0.02	0.15	0.53	0.48	0.09

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

5: North Ave & South Drive

12/21/2016

				
Lane Group	EBL	NBL	NBT	SBT
Lane Group Flow (vph)	165	157	700	726
v/c Ratio	0.43	0.50	0.61	0.79
Control Delay	9.5	12.1	9.6	26.3
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	9.5	12.1	9.6	26.3
Queue Length 50th (ft)	8	13	85	~170
Queue Length 95th (ft)	53	#62	#353	#471
Internal Link Dist (ft)	700		1125	300
Turn Bay Length (ft)		75		
Base Capacity (vph)	716	313	1155	916
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	0.23	0.50	0.61	0.79

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

7: VT 127 - Park St/VT 127 & Manhattan Dr.

12/21/2016



Lane Group	EBT	WBT	WBR	SBL	SBT
Lane Group Flow (vph)	98	134	1158	300	245
v/c Ratio	0.11	0.16	0.73	0.50	0.39
Control Delay	6.6	7.9	3.1	19.9	17.9
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	6.6	7.9	3.1	19.9	17.9
Queue Length 50th (ft)	13	22	0	89	69
Queue Length 95th (ft)	36	51	#7	184	145
Internal Link Dist (ft)	492	1130			617
Turn Bay Length (ft)			200	225	
Base Capacity (vph)	1089	1057	1559	602	632
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.09	0.13	0.74	0.50	0.39

Intersection Summary

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

Queue shown is maximum after two cycles.

Queues

8: North Ave & North Street

12/21/2016

				
Lane Group	WBL	NBT	SBL	SBT
Lane Group Flow (vph)	163	697	96	402
v/c Ratio	0.51	0.63	0.24	0.31
Control Delay	19.8	15.7	6.8	6.5
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	19.8	15.7	6.8	6.5
Queue Length 50th (ft)	25	157	7	37
Queue Length 95th (ft)	117	#747	58	245
Internal Link Dist (ft)	673	906		679
Turn Bay Length (ft)			150	
Base Capacity (vph)	456	1107	408	1287
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	0.36	0.63	0.24	0.31

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

10: Battery Street & Pearl Street

12/21/2016

					
Lane Group	WBL	WBR	NBT	NBR	SBT
Lane Group Flow (vph)	125	163	736	421	708
v/c Ratio	0.56	0.35	0.72	0.41	0.52
Control Delay	46.1	4.8	23.8	4.5	14.6
Queue Delay	0.0	0.5	0.0	0.0	0.0
Total Delay	46.1	5.3	23.9	4.5	14.6
Queue Length 50th (ft)	68	0	204	3	87
Queue Length 95th (ft)	132	38	#775	106	#258
Internal Link Dist (ft)	810		1567		581
Turn Bay Length (ft)					
Base Capacity (vph)	305	474	1024	1030	1360
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	96	7	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.41	0.43	0.72	0.41	0.52

Intersection Summary

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

Queue shown is maximum after two cycles.

Queues

11: Battery Street & Main Street/Main Street

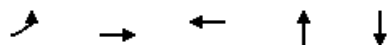
12/21/2016

							
Lane Group	EBT	EBR	WBT	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	86	53	106	296	715	248	475
v/c Ratio	0.43	0.17	0.70	0.61	0.43	0.48	0.36
Control Delay	43.0	1.2	62.4	17.8	16.5	6.4	6.0
Queue Delay	0.0	0.0	0.4	0.0	0.0	0.0	0.1
Total Delay	43.0	1.2	62.7	17.8	16.5	6.4	6.1
Queue Length 50th (ft)	47	0	58	70	116	63	139
Queue Length 95th (ft)	96	0	120	145	257	40	205
Internal Link Dist (ft)	431		399		342		1567
Turn Bay Length (ft)		25		50			
Base Capacity (vph)	350	419	250	607	1682	623	1303
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	21	18	0	0	0	95
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.25	0.13	0.46	0.49	0.43	0.40	0.39
Intersection Summary							

Queues

12: Battery Street & King St

12/21/2016



Lane Group	EBL	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	50	35	213	567	571
v/c Ratio	0.61	0.16	0.61	0.40	0.54
Control Delay	70.0	24.1	14.7	3.8	12.9
Queue Delay	0.0	0.0	0.0	0.6	0.9
Total Delay	70.0	24.1	14.7	4.4	13.8
Queue Length 50th (ft)	28	10	8	75	92
Queue Length 95th (ft)	71	41	94	121	428
Internal Link Dist (ft)		171	601	315	342
Turn Bay Length (ft)	50				
Base Capacity (vph)	172	430	521	1424	1060
Starvation Cap Reductn	0	0	0	467	242
Spillback Cap Reductn	0	0	2	0	5
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.29	0.08	0.41	0.59	0.70

Intersection Summary

Queues

13: Battery Street & Maple Street

12/21/2016

	→	←	↖	↑	↓
Lane Group	EBT	WBT	WBR	NBT	SBT
Lane Group Flow (vph)	38	9	479	48	387
v/c Ratio	0.21	0.05	0.78	0.04	0.38
Control Delay	35.6	31.2	13.8	2.6	10.4
Queue Delay	0.0	0.0	0.0	0.0	0.8
Total Delay	35.6	31.2	13.8	2.6	11.1
Queue Length 50th (ft)	21	5	0	2	48
Queue Length 95th (ft)	48	18	142	18	331
Internal Link Dist (ft)	108	704		121	315
Turn Bay Length (ft)			150		
Base Capacity (vph)	590	622	908	1357	1019
Starvation Cap Reductn	0	0	0	0	347
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.06	0.01	0.53	0.04	0.58
Intersection Summary					

Queues

15: Park St/VT 127 - Park St & North Street

12/21/2016

	→	←	↓
Lane Group	EBT	WBT	SBT
Lane Group Flow (vph)	191	335	245
v/c Ratio	0.40	0.78	0.15
Control Delay	22.5	37.5	15.4
Queue Delay	0.0	0.0	0.0
Total Delay	22.5	37.5	15.4
Queue Length 50th (ft)	48	99	20
Queue Length 95th (ft)	155	#334	90
Internal Link Dist (ft)	673	1314	1001
Turn Bay Length (ft)			
Base Capacity (vph)	749	682	1630
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.26	0.49	0.15

Intersection Summary

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

Queue shown is maximum after two cycles.

Queues

16: Battery Street/Park St & Sherman St

12/21/2016

			
Lane Group	EBR	NBL	SBT
Lane Group Flow (vph)	528	852	291
v/c Ratio	0.51	0.75	0.28
Control Delay	9.3	20.6	27.3
Queue Delay	0.0	0.0	0.0
Total Delay	9.3	20.6	27.3
Queue Length 50th (ft)	112	252	70
Queue Length 95th (ft)	200	#700	125
Internal Link Dist (ft)			828
Turn Bay Length (ft)			
Base Capacity (vph)	1141	1205	1041
Starvation Cap Reductn	0	0	0
Spillback Cap Reductn	0	0	0
Storage Cap Reductn	0	0	0
Reduced v/c Ratio	0.46	0.71	0.28

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

- HCM Output with the Champlain Parkway (2 intersections)

HCM Signalized Intersection Capacity Analysis

13: Battery Street & Maple Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	8	4	2	41	18	293	1	12	15	405	35	39
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0	5.0		5.0			5.0	
Lane Util. Factor		1.00			1.00	1.00		1.00			1.00	
Frpb, ped/bikes		0.99			1.00	0.97		0.98			1.00	
Flpb, ped/bikes		1.00			0.99	1.00		1.00			0.99	
Frt		0.98			1.00	0.85		0.93			0.99	
Flt Protected		0.97			0.97	1.00		1.00			0.96	
Satd. Flow (prot)		1633			1759	1528		1442			1747	
Flt Permitted		0.84			0.78	1.00		0.99			0.74	
Satd. Flow (perm)		1403			1427	1528		1435			1346	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	8	4	2	41	18	293	1	12	15	405	35	39
RTOR Reduction (vph)	0	2	0	0	0	261	0	3	0	0	2	0
Lane Group Flow (vph)	0	12	0	0	59	32	0	25	0	0	477	0
Confl. Peds. (#/hr)	2		7	7		2	3		4	4		3
Heavy Vehicles (%)	10%	10%	10%	3%	3%	3%	20%	20%	20%	2%	2%	2%
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)		9.7			9.7	9.7		70.3			70.3	
Effective Green, g (s)		9.7			9.7	9.7		70.3			70.3	
Actuated g/C Ratio		0.11			0.11	0.11		0.78			0.78	
Clearance Time (s)		5.0			5.0	5.0		5.0			5.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0			3.0	
Lane Grp Cap (vph)		151			153	164		1120			1051	
v/s Ratio Prot												
v/s Ratio Perm		0.01			c0.04	0.02		0.02			c0.35	
v/c Ratio		0.08			0.39	0.19		0.02			0.45	
Uniform Delay, d1		36.1			37.4	36.6		2.2			3.3	
Progression Factor		1.00			1.00	1.00		1.00			0.06	
Incremental Delay, d2		0.2			1.6	0.6		0.0			1.2	
Delay (s)		36.4			39.0	37.2		2.2			1.4	
Level of Service		D			D	D		A			A	
Approach Delay (s)		36.4			37.5			2.2			1.4	
Approach LOS		D			D			A			A	
Intersection Summary												
HCM 2000 Control Delay		16.5										
HCM 2000 Volume to Capacity ratio		0.45										
Actuated Cycle Length (s)		90.0										
Intersection Capacity Utilization		50.4%										
Analysis Period (min)		60										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

13: Battery Street & Maple Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	8	4	2	41	18	313	1	12	15	432	35	39
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0	5.0		5.0			5.0	
Lane Util. Factor		1.00			1.00	1.00		1.00			1.00	
Frpb, ped/bikes		0.99			1.00	0.97		0.98			1.00	
Flpb, ped/bikes		1.00			0.99	1.00		1.00			0.99	
Frt		0.98			1.00	0.85		0.93			0.99	
Flt Protected		0.97			0.97	1.00		1.00			0.96	
Satd. Flow (prot)		1633			1759	1528		1442			1748	
Flt Permitted		0.84			0.78	1.00		0.99			0.74	
Satd. Flow (perm)		1409			1427	1528		1434			1344	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	8	4	2	41	18	313	1	12	15	432	35	39
RTOR Reduction (vph)	0	2	0	0	0	278	0	3	0	0	2	0
Lane Group Flow (vph)	0	12	0	0	59	35	0	25	0	0	504	0
Confl. Peds. (#/hr)	2		7	7		2	3		4	4		3
Heavy Vehicles (%)	10%	10%	10%	3%	3%	3%	20%	20%	20%	2%	2%	2%
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)		10.0			10.0	10.0		70.0			70.0	
Effective Green, g (s)		10.0			10.0	10.0		70.0			70.0	
Actuated g/C Ratio		0.11			0.11	0.11		0.78			0.78	
Clearance Time (s)		5.0			5.0	5.0		5.0			5.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0			3.0	
Lane Grp Cap (vph)		156			158	169		1115			1045	
v/s Ratio Prot												
v/s Ratio Perm		0.01			c0.04	0.02		0.02			c0.38	
v/c Ratio		0.08			0.37	0.21		0.02			0.48	
Uniform Delay, d1		35.9			37.1	36.4		2.3			3.6	
Progression Factor		1.00			1.00	1.00		1.00			0.07	
Incremental Delay, d2		0.2			1.5	0.6		0.0			1.4	
Delay (s)		36.1			38.6	37.0		2.3			1.6	
Level of Service		D			D	D		A			A	
Approach Delay (s)		36.1			37.2			2.3			1.6	
Approach LOS		D			D			A			A	
Intersection Summary												
HCM 2000 Control Delay			16.6				HCM 2000 Level of Service			B		
HCM 2000 Volume to Capacity ratio			0.47									
Actuated Cycle Length (s)			90.0				Sum of lost time (s)			10.0		
Intersection Capacity Utilization			51.9%				ICU Level of Service			A		
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

14: Pine Street & Maple Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	9	66	279	66	196	15	199	205	31	9	396	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0			5.0			5.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		0.97			1.00			1.00			1.00	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		0.89			0.99			0.99			1.00	
Flt Protected		1.00			0.99			0.98			1.00	
Satd. Flow (prot)		1614			1822			1780			1721	
Flt Permitted		0.99			0.72			0.62			0.99	
Satd. Flow (perm)		1596			1335			1135			1704	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	9	66	279	66	196	15	199	205	31	9	396	7
RTOR Reduction (vph)	0	208	0	0	4	0	0	5	0	0	1	0
Lane Group Flow (vph)	0	146	0	0	273	0	0	430	0	0	411	0
Confl. Peds. (#/hr)	1		10	10		1	4		2	2		4
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	3%	3%	3%	10%	10%	10%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		7			8			3			4	
Permitted Phases	7			8			3			4		
Actuated Green, G (s)		14.3			14.3			24.0			24.0	
Effective Green, g (s)		14.3			14.3			24.0			24.0	
Actuated g/C Ratio		0.25			0.25			0.43			0.43	
Clearance Time (s)		5.0			5.0			5.0			5.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		405			339			483			726	
v/s Ratio Prot												
v/s Ratio Perm		0.09			0.20			0.38			0.24	
v/c Ratio		0.36			0.81			0.89			0.57	
Uniform Delay, d1		17.2			19.7			14.9			12.2	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.6			14.4			22.5			1.0	
Delay (s)		17.8			34.1			37.5			13.2	
Level of Service		B			C			D			B	
Approach Delay (s)		17.8			34.1			37.5			13.2	
Approach LOS		B			C			D			B	
Intersection Summary												
HCM 2000 Control Delay			25.4				HCM 2000 Level of Service			C		
HCM 2000 Volume to Capacity ratio			0.82									
Actuated Cycle Length (s)			56.3				Sum of lost time (s)		16.0			
Intersection Capacity Utilization			99.0%				ICU Level of Service		F			
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

13: Battery Street & Maple Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	23	17	0	5	4	179	0	23	24	386	13	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0	5.0		5.0			5.0	
Lane Util. Factor		1.00			1.00	1.00		1.00			1.00	
Frpb, ped/bikes		1.00			1.00	1.00		0.99			1.00	
Flpb, ped/bikes		1.00			1.00	1.00		1.00			1.00	
Frt		1.00			1.00	0.85		0.93			1.00	
Flt Protected		0.97			0.97	1.00		1.00			0.95	
Satd. Flow (prot)		1847			1849	1615		1748			1807	
Flt Permitted		0.82			0.85	1.00		1.00			0.70	
Satd. Flow (perm)		1553			1613	1615		1748			1325	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	23	17	0	5	4	179	0	23	24	386	13	2
RTOR Reduction (vph)	0	0	0	0	0	161	0	5	0	0	0	0
Lane Group Flow (vph)	0	40	0	0	9	18	0	42	0	0	401	0
Confl. Peds. (#/hr)									1	1		
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA	Perm		NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)		8.8			8.8	8.8		71.2			71.2	
Effective Green, g (s)		8.8			8.8	8.8		71.2			71.2	
Actuated g/C Ratio		0.10			0.10	0.10		0.79			0.79	
Clearance Time (s)		5.0			5.0	5.0		5.0			5.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0			3.0	
Lane Grp Cap (vph)		151			157	157		1382			1048	
v/s Ratio Prot								0.02				
v/s Ratio Perm		c0.03			0.01	0.01					c0.30	
v/c Ratio		0.26			0.06	0.11		0.03			0.38	
Uniform Delay, d1		37.6			36.8	37.0		2.0			2.8	
Progression Factor		1.00			1.00	1.00		1.00			1.70	
Incremental Delay, d2		0.9			0.2	0.3		0.0			1.0	
Delay (s)		38.5			37.0	37.4		2.1			5.8	
Level of Service		D			D	D		A			A	
Approach Delay (s)		38.5			37.3			2.1			5.8	
Approach LOS		D			D			A			A	
Intersection Summary												
HCM 2000 Control Delay		16.2			HCM 2000 Level of Service			B				
HCM 2000 Volume to Capacity ratio		0.37										
Actuated Cycle Length (s)		90.0			Sum of lost time (s)			10.0				
Intersection Capacity Utilization		46.0%			ICU Level of Service			A				
Analysis Period (min)		60										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

14: Pine Street & Maple Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	9	141	279	67	235	42	115	300	16	11	325	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0			5.0			3.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		0.98			1.00			1.00			1.00	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		0.91			0.98			0.99			1.00	
Flt Protected		1.00			0.99			0.99			1.00	
Satd. Flow (prot)		1685			1807			1788			1832	
Flt Permitted		0.99			0.85			0.82			0.99	
Satd. Flow (perm)		1668			1551			1490			1811	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	9	141	279	67	235	42	115	300	16	11	325	11
RTOR Reduction (vph)	0	116	0	0	9	0	0	2	0	0	2	0
Lane Group Flow (vph)	0	313	0	0	335	0	0	429	0	0	345	0
Confl. Peds. (#/hr)	8		5	5		8	11		5	5		11
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	4%	4%	4%	3%	3%	3%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		7			8			3			4	
Permitted Phases	7			8			3			4		
Actuated Green, G (s)		14.4			14.4			17.5			19.5	
Effective Green, g (s)		14.4			14.4			17.5			19.5	
Actuated g/C Ratio		0.34			0.34			0.42			0.47	
Clearance Time (s)		5.0			5.0			5.0			3.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		573			533			622			842	
v/s Ratio Prot												
v/s Ratio Perm		0.19			0.22			0.29			0.19	
v/c Ratio		0.55			0.63			0.69			0.41	
Uniform Delay, d1		11.1			11.5			10.0			7.4	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		1.1			2.4			3.2			0.3	
Delay (s)		12.2			13.9			13.2			7.7	
Level of Service		B			B			B			A	
Approach Delay (s)		12.2			13.9			13.2			7.7	
Approach LOS		B			B			B			A	
Intersection Summary												
HCM 2000 Control Delay			11.8									
HCM 2000 Volume to Capacity ratio			0.76									
Actuated Cycle Length (s)			41.9									
Intersection Capacity Utilization			101.5%									
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

13: Battery Street & Maple Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	23	17	0	5	4	217	0	23	24	417	13	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0	5.0		5.0			5.0	
Lane Util. Factor		1.00			1.00	1.00		1.00			1.00	
Frpb, ped/bikes		1.00			1.00	1.00		0.99			1.00	
Flpb, ped/bikes		1.00			1.00	1.00		1.00			1.00	
Frt		1.00			1.00	0.85		0.93			1.00	
Flt Protected		0.97			0.97	1.00		1.00			0.95	
Satd. Flow (prot)		1847			1849	1615		1748			1807	
Flt Permitted		0.82			0.85	1.00		1.00			0.70	
Satd. Flow (perm)		1553			1613	1615		1748			1324	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	23	17	0	5	4	217	0	23	24	417	13	2
RTOR Reduction (vph)	0	0	0	0	0	196	0	5	0	0	0	0
Lane Group Flow (vph)	0	40	0	0	9	21	0	42	0	0	432	0
Confl. Peds. (#/hr)									1	1		
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA	Perm		NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)		8.8			8.8	8.8		71.2			71.2	
Effective Green, g (s)		8.8			8.8	8.8		71.2			71.2	
Actuated g/C Ratio		0.10			0.10	0.10		0.79			0.79	
Clearance Time (s)		5.0			5.0	5.0		5.0			5.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0			3.0	
Lane Grp Cap (vph)		151			157	157		1382			1047	
v/s Ratio Prot								0.02				
v/s Ratio Perm		c0.03			0.01	0.01					c0.33	
v/c Ratio		0.26			0.06	0.14		0.03			0.41	
Uniform Delay, d1		37.6			36.8	37.1		2.0			2.9	
Progression Factor		1.00			1.00	1.00		1.00			1.67	
Incremental Delay, d2		0.9			0.2	0.4		0.0			1.1	
Delay (s)		38.5			37.0	37.5		2.1			6.0	
Level of Service		D			D	D		A			A	
Approach Delay (s)		38.5			37.5			2.1			6.0	
Approach LOS		D			D			A			A	
Intersection Summary												
HCM 2000 Control Delay		17.0										
HCM 2000 Volume to Capacity ratio		0.40										
Actuated Cycle Length (s)		90.0								10.0		
Intersection Capacity Utilization		47.7%								A		
Analysis Period (min)		60										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

14: Pine Street & Maple Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	9	155	296	67	252	42	135	300	16	11	325	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0			5.0			3.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		0.98			1.00			1.00			1.00	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		0.91			0.98			1.00			1.00	
Flt Protected		1.00			0.99			0.99			1.00	
Satd. Flow (prot)		1686			1809			1785			1832	
Flt Permitted		0.99			0.84			0.79			0.99	
Satd. Flow (perm)		1671			1527			1433			1811	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	9	155	296	67	252	42	135	300	16	11	325	11
RTOR Reduction (vph)	0	112	0	0	8	0	0	2	0	0	2	0
Lane Group Flow (vph)	0	348	0	0	353	0	0	449	0	0	345	0
Confl. Peds. (#/hr)	8		5	5		8	11		5	5		11
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	4%	4%	4%	3%	3%	3%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		7			8			3			4	
Permitted Phases	7			8			3			4		
Actuated Green, G (s)		15.3			15.3			19.3			21.3	
Effective Green, g (s)		15.3			15.3			19.3			21.3	
Actuated g/C Ratio		0.34			0.34			0.43			0.48	
Clearance Time (s)		5.0			5.0			5.0			3.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		573			523			620			864	
v/s Ratio Prot												
v/s Ratio Perm		0.21			c0.23			c0.31			0.19	
v/c Ratio		0.61			0.68			0.72			0.40	
Uniform Delay, d1		12.2			12.5			10.4			7.5	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		1.8			3.5			4.3			0.3	
Delay (s)		14.0			16.0			14.7			7.8	
Level of Service		B			B			B			A	
Approach Delay (s)		14.0			16.0			14.7			7.8	
Approach LOS		B			B			B			A	
Intersection Summary												
HCM 2000 Control Delay			13.3									
HCM 2000 Volume to Capacity ratio			0.79									
Actuated Cycle Length (s)			44.6									
Intersection Capacity Utilization			105.3%									
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

13: Battery Street & Maple Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	9	4	2	42	19	299	1	12	15	414	36	39
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0	5.0		5.0			5.0	
Lane Util. Factor		1.00			1.00	1.00		1.00			1.00	
Frpb, ped/bikes		0.99			1.00	0.97		0.98			1.00	
Flpb, ped/bikes		1.00			0.99	1.00		1.00			0.99	
Frt		0.98			1.00	0.85		0.93			0.99	
Flt Protected		0.97			0.97	1.00		1.00			0.96	
Satd. Flow (prot)		1633			1760	1528		1442			1748	
Flt Permitted		0.83			0.79	1.00		0.99			0.74	
Satd. Flow (perm)		1390			1429	1528		1435			1346	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	9	4	2	42	19	299	1	12	15	414	36	39
RTOR Reduction (vph)	0	2	0	0	0	266	0	3	0	0	2	0
Lane Group Flow (vph)	0	13	0	0	61	33	0	25	0	0	487	0
Confl. Peds. (#/hr)	2		7	7		2	3		4	4		3
Heavy Vehicles (%)	10%	10%	10%	3%	3%	3%	20%	20%	20%	2%	2%	2%
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)		9.9			9.9	9.9		70.1			70.1	
Effective Green, g (s)		9.9			9.9	9.9		70.1			70.1	
Actuated g/C Ratio		0.11			0.11	0.11		0.78			0.78	
Clearance Time (s)		5.0			5.0	5.0		5.0			5.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0			3.0	
Lane Grp Cap (vph)		152			157	168		1117			1048	
v/s Ratio Prot												
v/s Ratio Perm		0.01			c0.04	0.02		0.02			c0.36	
v/c Ratio		0.09			0.39	0.20		0.02			0.46	
Uniform Delay, d1		36.0			37.2	36.4		2.2			3.4	
Progression Factor		1.00			1.00	1.00		1.00			0.07	
Incremental Delay, d2		0.2			1.6	0.6		0.0			1.3	
Delay (s)		36.2			38.8	37.0		2.3			1.5	
Level of Service		D			D	D		A			A	
Approach Delay (s)		36.2			37.3			2.3			1.5	
Approach LOS		D			D			A			A	
Intersection Summary												
HCM 2000 Control Delay		16.6					HCM 2000 Level of Service		B			
HCM 2000 Volume to Capacity ratio		0.46										
Actuated Cycle Length (s)		90.0					Sum of lost time (s)		10.0			
Intersection Capacity Utilization		51.0%					ICU Level of Service		A			
Analysis Period (min)		60										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

14: Pine Street & Maple Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	9	63	264	68	191	15	193	209	32	9	403	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0			5.0			5.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		0.97			1.00			1.00			1.00	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		0.89			0.99			0.99			1.00	
Flt Protected		1.00			0.99			0.98			1.00	
Satd. Flow (prot)		1614			1820			1781			1720	
Flt Permitted		0.99			0.73			0.62			0.99	
Satd. Flow (perm)		1596			1348			1137			1704	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	9	63	264	68	191	15	193	209	32	9	403	8
RTOR Reduction (vph)	0	197	0	0	4	0	0	5	0	0	1	0
Lane Group Flow (vph)	0	139	0	0	270	0	0	429	0	0	419	0
Confl. Peds. (#/hr)	1		10	10		1	4		2	2		4
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	3%	3%	3%	10%	10%	10%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		7			8			3			4	
Permitted Phases	7			8			3			4		
Actuated Green, G (s)		14.2			14.2			23.9			23.9	
Effective Green, g (s)		14.2			14.2			23.9			23.9	
Actuated g/C Ratio		0.25			0.25			0.43			0.43	
Clearance Time (s)		5.0			5.0			5.0			5.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		403			341			484			725	
v/s Ratio Prot												
v/s Ratio Perm		0.09			c0.20			c0.38			0.25	
v/c Ratio		0.34			0.79			0.89			0.58	
Uniform Delay, d1		17.1			19.6			14.9			12.3	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.5			13.0			21.4			1.1	
Delay (s)		17.7			32.6			36.2			13.4	
Level of Service		B			C			D			B	
Approach Delay (s)		17.7			32.6			36.2			13.4	
Approach LOS		B			C			D			B	
Intersection Summary												
HCM 2000 Control Delay			24.7									
HCM 2000 Volume to Capacity ratio			0.81									
Actuated Cycle Length (s)			56.1									
Intersection Capacity Utilization			98.1%									
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

13: Battery Street & Maple Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	9	4	2	42	19	319	1	12	15	440	36	39
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0	5.0		5.0			5.0	
Lane Util. Factor		1.00			1.00	1.00		1.00			1.00	
Frpb, ped/bikes		0.99			1.00	0.97		0.98			1.00	
Flpb, ped/bikes		1.00			0.99	1.00		1.00			0.99	
Frt		0.98			1.00	0.85		0.93			0.99	
Flt Protected		0.97			0.97	1.00		1.00			0.96	
Satd. Flow (prot)		1633			1760	1528		1442			1748	
Flt Permitted		0.83			0.79	1.00		0.99			0.74	
Satd. Flow (perm)		1396			1429	1528		1434			1344	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	9	4	2	42	19	319	1	12	15	440	36	39
RTOR Reduction (vph)	0	2	0	0	0	283	0	3	0	0	2	0
Lane Group Flow (vph)	0	13	0	0	61	36	0	25	0	0	513	0
Confl. Peds. (#/hr)	2		7	7		2	3		4	4		3
Heavy Vehicles (%)	10%	10%	10%	3%	3%	3%	20%	20%	20%	2%	2%	2%
Turn Type	Perm	NA		Perm	NA	Perm	Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)		10.2			10.2	10.2		69.8			69.8	
Effective Green, g (s)		10.2			10.2	10.2		69.8			69.8	
Actuated g/C Ratio		0.11			0.11	0.11		0.78			0.78	
Clearance Time (s)		5.0			5.0	5.0		5.0			5.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0			3.0	
Lane Grp Cap (vph)		158			161	173		1112			1042	
v/s Ratio Prot												
v/s Ratio Perm		0.01			c0.04	0.02		0.02			c0.38	
v/c Ratio		0.08			0.38	0.21		0.02			0.49	
Uniform Delay, d1		35.7			37.0	36.2		2.3			3.7	
Progression Factor		1.00			1.00	1.00		1.00			0.07	
Incremental Delay, d2		0.2			1.5	0.6		0.0			1.4	
Delay (s)		35.9			38.5	36.8		2.3			1.7	
Level of Service		D			D	D		A			A	
Approach Delay (s)		35.9			37.1			2.3			1.7	
Approach LOS		D			D			A			A	
Intersection Summary												
HCM 2000 Control Delay		16.6					HCM 2000 Level of Service		B			
HCM 2000 Volume to Capacity ratio		0.48										
Actuated Cycle Length (s)		90.0					Sum of lost time (s)		10.0			
Intersection Capacity Utilization		52.5%					ICU Level of Service		A			
Analysis Period (min)		60										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

14: Pine Street & Maple Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	9	67	286	68	200	15	204	209	32	9	403	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0			5.0			5.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		0.97			1.00			1.00			1.00	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		0.89			0.99			0.99			1.00	
Flt Protected		1.00			0.99			0.98			1.00	
Satd. Flow (prot)		1613			1822			1780			1720	
Flt Permitted		0.99			0.71			0.62			0.99	
Satd. Flow (perm)		1596			1312			1122			1704	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	9	67	286	68	200	15	204	209	32	9	403	8
RTOR Reduction (vph)	0	213	0	0	4	0	0	5	0	0	1	0
Lane Group Flow (vph)	0	149	0	0	279	0	0	440	0	0	419	0
Confl. Peds. (#/hr)	1		10	10		1	4		2	2		4
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	3%	3%	3%	10%	10%	10%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		7			8			3			4	
Permitted Phases	7			8			3			4		
Actuated Green, G (s)		14.7			14.7			24.6			24.6	
Effective Green, g (s)		14.7			14.7			24.6			24.6	
Actuated g/C Ratio		0.26			0.26			0.43			0.43	
Clearance Time (s)		5.0			5.0			5.0			5.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		409			336			481			731	
v/s Ratio Prot												
v/s Ratio Perm		0.09			0.21			0.39			0.25	
v/c Ratio		0.37			0.83			0.92			0.57	
Uniform Delay, d1		17.5			20.1			15.4			12.4	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		0.6			18.1			29.2			1.1	
Delay (s)		18.0			38.3			44.5			13.5	
Level of Service		B			D			D			B	
Approach Delay (s)		18.0			38.3			44.5			13.5	
Approach LOS		B			D			D			B	
Intersection Summary												
HCM 2000 Control Delay			28.4				HCM 2000 Level of Service			C		
HCM 2000 Volume to Capacity ratio			0.84									
Actuated Cycle Length (s)			57.3				Sum of lost time (s)		16.0			
Intersection Capacity Utilization			100.8%				ICU Level of Service		G			
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

13: Battery Street & Maple Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	23	17	0	5	4	189	0	24	24	394	14	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0	5.0		5.0			5.0	
Lane Util. Factor		1.00			1.00	1.00		1.00			1.00	
Frpb, ped/bikes		1.00			1.00	1.00		0.99			1.00	
Flpb, ped/bikes		1.00			1.00	1.00		1.00			1.00	
Frt		1.00			1.00	0.85		0.93			1.00	
Flt Protected		0.97			0.97	1.00		1.00			0.95	
Satd. Flow (prot)		1847			1849	1615		1752			1807	
Flt Permitted		0.82			0.85	1.00		1.00			0.70	
Satd. Flow (perm)		1553			1613	1615		1752			1324	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	23	17	0	5	4	189	0	24	24	394	14	2
RTOR Reduction (vph)	0	0	0	0	0	171	0	5	0	0	0	0
Lane Group Flow (vph)	0	40	0	0	9	18	0	43	0	0	410	0
Confl. Peds. (#/hr)									1	1		
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA	Perm		NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)		8.8			8.8	8.8		71.2			71.2	
Effective Green, g (s)		8.8			8.8	8.8		71.2			71.2	
Actuated g/C Ratio		0.10			0.10	0.10		0.79			0.79	
Clearance Time (s)		5.0			5.0	5.0		5.0			5.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0			3.0	
Lane Grp Cap (vph)		151			157	157		1386			1047	
v/s Ratio Prot								0.02				
v/s Ratio Perm		c0.03			0.01	0.01					c0.31	
v/c Ratio		0.26			0.06	0.12		0.03			0.39	
Uniform Delay, d1		37.6			36.8	37.1		2.0			2.8	
Progression Factor		1.00			1.00	1.00		1.00			1.72	
Incremental Delay, d2		0.9			0.2	0.3		0.0			1.0	
Delay (s)		38.5			37.0	37.4		2.1			5.9	
Level of Service		D			D	D		A			A	
Approach Delay (s)		38.5			37.4			2.1			5.9	
Approach LOS		D			D			A			A	
Intersection Summary												
HCM 2000 Control Delay		16.5			HCM 2000 Level of Service			B				
HCM 2000 Volume to Capacity ratio		0.38										
Actuated Cycle Length (s)		90.0			Sum of lost time (s)			10.0				
Intersection Capacity Utilization		46.5%			ICU Level of Service			A				
Analysis Period (min)		60										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

14: Pine Street & Maple Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	10	144	286	68	240	43	121	303	16	11	332	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0			5.0			3.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		0.98			1.00			1.00			1.00	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		0.91			0.98			1.00			1.00	
Flt Protected		1.00			0.99			0.99			1.00	
Satd. Flow (prot)		1684			1807			1788			1832	
Flt Permitted		0.99			0.84			0.81			0.99	
Satd. Flow (perm)		1666			1536			1470			1812	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	10	144	286	68	240	43	121	303	16	11	332	11
RTOR Reduction (vph)	0	116	0	0	9	0	0	2	0	0	2	0
Lane Group Flow (vph)	0	324	0	0	342	0	0	438	0	0	352	0
Confl. Peds. (#/hr)	8		5	5		8	11		5	5		11
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	4%	4%	4%	3%	3%	3%
Turn Type	Perm	NA		Perm		NA		Perm		NA		Perm
Protected Phases		7			8			3			4	
Permitted Phases	7			8			3			4		
Actuated Green, G (s)		14.8			14.8			18.3			20.3	
Effective Green, g (s)		14.8			14.8			18.3			20.3	
Actuated g/C Ratio		0.34			0.34			0.42			0.47	
Clearance Time (s)		5.0			5.0			5.0			3.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		572			527			624			853	
v/s Ratio Prot												
v/s Ratio Perm		0.19			0.22			0.30			0.19	
v/c Ratio		0.57			0.65			0.70			0.41	
Uniform Delay, d1		11.5			12.0			10.2			7.5	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		1.3			2.8			3.6			0.3	
Delay (s)		12.8			14.8			13.8			7.8	
Level of Service		B			B			B			A	
Approach Delay (s)		12.8			14.8			13.8			7.8	
Approach LOS		B			B			B			A	
Intersection Summary												
HCM 2000 Control Delay			12.4		HCM 2000 Level of Service					B		
HCM 2000 Volume to Capacity ratio			0.77									
Actuated Cycle Length (s)			43.1		Sum of lost time (s)					14.0		
Intersection Capacity Utilization			103.4%		ICU Level of Service					G		
Analysis Period (min)			60									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

13: Battery Street & Maple Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	23	17	0	5	4	227	0	24	24	425	14	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0	5.0		5.0			5.0	
Lane Util. Factor		1.00			1.00	1.00		1.00			1.00	
Frpb, ped/bikes		1.00			1.00	1.00		0.99			1.00	
Flpb, ped/bikes		1.00			1.00	1.00		1.00			1.00	
Frt		1.00			1.00	0.85		0.93			1.00	
Flt Protected		0.97			0.97	1.00		1.00			0.95	
Satd. Flow (prot)		1847			1849	1615		1752			1807	
Flt Permitted		0.82			0.85	1.00		1.00			0.70	
Satd. Flow (perm)		1553			1613	1615		1752			1323	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	23	17	0	5	4	227	0	24	24	425	14	2
RTOR Reduction (vph)	0	0	0	0	0	205	0	5	0	0	0	0
Lane Group Flow (vph)	0	40	0	0	9	22	0	43	0	0	441	0
Confl. Peds. (#/hr)									1	1		
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Perm	NA		Perm	NA	Perm		NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)		8.8			8.8	8.8		71.2			71.2	
Effective Green, g (s)		8.8			8.8	8.8		71.2			71.2	
Actuated g/C Ratio		0.10			0.10	0.10		0.79			0.79	
Clearance Time (s)		5.0			5.0	5.0		5.0			5.0	
Vehicle Extension (s)		3.0			3.0	3.0		3.0			3.0	
Lane Grp Cap (vph)		151			157	157		1386			1046	
v/s Ratio Prot								0.02				
v/s Ratio Perm		c0.03			0.01	0.01					c0.33	
v/c Ratio		0.26			0.06	0.14		0.03			0.42	
Uniform Delay, d1		37.6			36.8	37.1		2.0			2.9	
Progression Factor		1.00			1.00	1.00		1.00			1.67	
Incremental Delay, d2		0.9			0.2	0.4		0.0			1.1	
Delay (s)		38.5			37.0	37.6		2.1			6.0	
Level of Service		D			D	D		A			A	
Approach Delay (s)		38.5			37.5			2.1			6.0	
Approach LOS		D			D			A			A	
Intersection Summary												
HCM 2000 Control Delay		17.2										
HCM 2000 Volume to Capacity ratio		0.40										
Actuated Cycle Length (s)		90.0								10.0		
Intersection Capacity Utilization		48.2%								A		
Analysis Period (min)		60										
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

14: Pine Street & Maple Street

12/21/2016

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	10	158	303	68	257	43	140	303	16	11	332	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0			5.0			3.0	
Lane Util. Factor		1.00			1.00			1.00			1.00	
Frpb, ped/bikes		0.98			1.00			1.00			1.00	
Flpb, ped/bikes		1.00			1.00			1.00			1.00	
Frt		0.91			0.98			1.00			1.00	
Flt Protected		1.00			0.99			0.98			1.00	
Satd. Flow (prot)		1686			1809			1785			1832	
Flt Permitted		0.99			0.83			0.78			0.99	
Satd. Flow (perm)		1669			1515			1411			1811	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	10	158	303	68	257	43	140	303	16	11	332	11
RTOR Reduction (vph)	0	112	0	0	9	0	0	2	0	0	2	0
Lane Group Flow (vph)	0	359	0	0	359	0	0	457	0	0	352	0
Confl. Peds. (#/hr)	8		5	5		8	11		5	5		11
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	4%	4%	4%	3%	3%	3%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		7			8			3			4	
Permitted Phases	7			8			3			4		
Actuated Green, G (s)		15.7			15.7			19.8			21.8	
Effective Green, g (s)		15.7			15.7			19.8			21.8	
Actuated g/C Ratio		0.35			0.35			0.44			0.48	
Clearance Time (s)		5.0			5.0			5.0			3.0	
Vehicle Extension (s)		3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)		575			522			614			867	
v/s Ratio Prot												
v/s Ratio Perm		0.22			c0.24			c0.32			0.19	
v/c Ratio		0.62			0.69			0.74			0.41	
Uniform Delay, d1		12.4			12.8			10.7			7.7	
Progression Factor		1.00			1.00			1.00			1.00	
Incremental Delay, d2		2.1			3.8			5.0			0.3	
Delay (s)		14.6			16.6			15.8			8.0	
Level of Service		B			B			B			A	
Approach Delay (s)		14.6			16.6			15.8			8.0	
Approach LOS		B			B			B			A	
Intersection Summary												
HCM 2000 Control Delay			13.9									
HCM 2000 Volume to Capacity ratio			0.81									
Actuated Cycle Length (s)			45.5									
Intersection Capacity Utilization			107.1%									
Analysis Period (min)			60									
c Critical Lane Group												

- Queuing Output with the Champlain Parkway (2 intersections)



Queues

13: Battery Street & Maple Street

12/21/2016

	→	←	↖	↑	↓
Lane Group	EBT	WBT	WBR	NBT	SBT
Lane Group Flow (vph)	14	59	293	28	479
v/c Ratio	0.09	0.39	0.69	0.02	0.45
Control Delay	31.6	43.3	13.9	2.1	1.5
Queue Delay	0.0	0.0	0.0	0.0	0.2
Total Delay	31.6	43.3	13.9	2.1	1.6
Queue Length 50th (ft)	6	32	0	1	1
Queue Length 95th (ft)	25	73	104	10	4
Internal Link Dist (ft)	108	704		121	315
Turn Bay Length (ft)			150		
Base Capacity (vph)	407	412	649	1124	1053
Starvation Cap Reductn	0	0	0	0	109
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.03	0.14	0.45	0.02	0.51
Intersection Summary					

Queues

14: Pine Street & Maple Street

12/21/2016

	→	←	↑	↓
Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	327	268	424	412
v/c Ratio	0.55	0.77	0.88	0.58
Control Delay	9.3	37.9	41.5	16.5
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	9.3	37.9	41.5	16.5
Queue Length 50th (ft)	20	86	128	105
Queue Length 95th (ft)	106	#228	#342	215
Internal Link Dist (ft)	704	804	1131	829
Turn Bay Length (ft)				
Base Capacity (vph)	649	409	553	816
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	0.50	0.66	0.77	0.50

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

13: Battery Street & Maple Street

12/21/2016

	→	←	↖	↑	↓
Lane Group	EBT	WBT	WBR	NBT	SBT
Lane Group Flow (vph)	14	59	313	28	506
v/c Ratio	0.09	0.37	0.70	0.03	0.48
Control Delay	31.0	42.3	13.7	2.2	1.6
Queue Delay	0.0	0.0	0.0	0.0	0.2
Total Delay	31.0	42.3	13.7	2.2	1.8
Queue Length 50th (ft)	6	32	0	1	1
Queue Length 95th (ft)	25	72	108	10	4
Internal Link Dist (ft)	108	704		121	315
Turn Bay Length (ft)			150		
Base Capacity (vph)	408	412	664	1119	1047
Starvation Cap Reductn	0	0	0	0	101
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.03	0.14	0.47	0.03	0.53
Intersection Summary					

Queues

14: Pine Street & Maple Street

12/21/2016

	→	←	↑	↓
Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	354	277	435	412
v/c Ratio	0.58	0.81	0.90	0.57
Control Delay	9.4	44.0	46.7	16.3
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	9.4	44.0	46.7	16.3
Queue Length 50th (ft)	21	91	134	105
Queue Length 95th (ft)	114	#243	#356	215
Internal Link Dist (ft)	704	804	1131	829
Turn Bay Length (ft)				
Base Capacity (vph)	656	385	531	794
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	0.54	0.72	0.82	0.52

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

13: Battery Street & Maple Street

12/21/2016

	→	←	↖	↑	↓
Lane Group	EBT	WBT	WBR	NBT	SBT
Lane Group Flow (vph)	40	9	179	47	401
v/c Ratio	0.26	0.06	0.56	0.03	0.38
Control Delay	40.2	34.7	13.0	1.9	7.0
Queue Delay	0.0	0.0	0.0	0.0	0.4
Total Delay	40.2	34.7	13.0	1.9	7.4
Queue Length 50th (ft)	22	5	0	2	132
Queue Length 95th (ft)	54	19	72	14	156
Internal Link Dist (ft)	108	704		121	315
Turn Bay Length (ft)			150		
Base Capacity (vph)	713	741	839	1387	1048
Starvation Cap Reductn	0	0	0	0	275
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.06	0.01	0.21	0.03	0.52
Intersection Summary					

Queues

14: Pine Street & Maple Street

12/21/2016

	→	←	↑	↓
Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	429	344	431	347
v/c Ratio	0.63	0.64	0.70	0.41
Control Delay	12.1	18.6	17.8	9.6
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	12.1	18.6	17.8	9.6
Queue Length 50th (ft)	48	67	87	55
Queue Length 95th (ft)	#178	#207	#244	121
Internal Link Dist (ft)	704	804	1131	829
Turn Bay Length (ft)				
Base Capacity (vph)	798	656	807	1071
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	0.54	0.52	0.53	0.32

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

13: Battery Street & Maple Street

12/21/2016

	→	←	↖	↑	↓
Lane Group	EBT	WBT	WBR	NBT	SBT
Lane Group Flow (vph)	40	9	217	47	432
v/c Ratio	0.26	0.06	0.61	0.03	0.41
Control Delay	40.2	34.7	13.4	1.9	7.3
Queue Delay	0.0	0.0	0.0	0.0	0.5
Total Delay	40.2	34.7	13.4	1.9	7.7
Queue Length 50th (ft)	22	5	0	2	142
Queue Length 95th (ft)	54	19	82	14	238
Internal Link Dist (ft)	108	704		121	315
Turn Bay Length (ft)			150		
Base Capacity (vph)	713	741	860	1387	1046
Starvation Cap Reductn	0	0	0	0	264
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.06	0.01	0.25	0.03	0.55
Intersection Summary					

Queues

14: Pine Street & Maple Street

12/21/2016

	→	←	↑	↓
Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	460	361	451	347
v/c Ratio	0.67	0.68	0.73	0.40
Control Delay	14.2	21.5	19.9	9.4
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	14.2	21.5	19.9	9.4
Queue Length 50th (ft)	63	82	95	56
Queue Length 95th (ft)	#225	#225	#270	121
Internal Link Dist (ft)	704	804	1131	829
Turn Bay Length (ft)				
Base Capacity (vph)	753	600	723	997
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	0.61	0.60	0.62	0.35

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

13: Battery Street & Maple Street

12/21/2016

	→	←	↖	↑	↓
Lane Group	EBT	WBT	WBR	NBT	SBT
Lane Group Flow (vph)	15	61	299	28	489
v/c Ratio	0.10	0.39	0.69	0.03	0.47
Control Delay	31.5	42.9	13.6	2.2	1.6
Queue Delay	0.0	0.0	0.0	0.0	0.2
Total Delay	31.5	42.9	13.6	2.2	1.7
Queue Length 50th (ft)	7	33	0	1	1
Queue Length 95th (ft)	26	74	105	10	4
Internal Link Dist (ft)	108	704		121	315
Turn Bay Length (ft)			150		
Base Capacity (vph)	403	412	654	1120	1049
Starvation Cap Reductn	0	0	0	0	111
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.04	0.15	0.46	0.03	0.52
Intersection Summary					

Queues

14: Pine Street & Maple Street

12/21/2016

	→	←	↑	↓
Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	336	274	434	420
v/c Ratio	0.56	0.80	0.89	0.58
Control Delay	9.2	41.8	46.0	16.5
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	9.2	41.8	46.0	16.5
Queue Length 50th (ft)	20	89	134	108
Queue Length 95th (ft)	109	#238	#354	220
Internal Link Dist (ft)	704	804	1131	829
Turn Bay Length (ft)				
Base Capacity (vph)	646	391	535	797
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	0.52	0.70	0.81	0.53

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

13: Battery Street & Maple Street

12/21/2016

	→	←	↖	↑	↓
Lane Group	EBT	WBT	WBR	NBT	SBT
Lane Group Flow (vph)	15	61	319	28	515
v/c Ratio	0.09	0.38	0.70	0.03	0.49
Control Delay	30.9	41.8	13.4	2.3	1.7
Queue Delay	0.0	0.0	0.0	0.0	0.2
Total Delay	30.9	41.8	13.4	2.3	1.9
Queue Length 50th (ft)	7	33	0	1	1
Queue Length 95th (ft)	25	72	108	11	4
Internal Link Dist (ft)	108	704		121	315
Turn Bay Length (ft)			150		
Base Capacity (vph)	404	412	668	1115	1043
Starvation Cap Reductn	0	0	0	0	103
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.04	0.15	0.48	0.03	0.55
Intersection Summary					

Queues

14: Pine Street & Maple Street

12/21/2016

	→	←	↑	↓
Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	362	283	445	420
v/c Ratio	0.58	0.83	0.92	0.58
Control Delay	9.3	47.8	53.5	16.5
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	9.3	47.8	53.5	16.5
Queue Length 50th (ft)	21	93	140	108
Queue Length 95th (ft)	116	#252	#369	220
Internal Link Dist (ft)	704	804	1131	829
Turn Bay Length (ft)				
Base Capacity (vph)	652	371	515	776
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	0.76	0.86	0.54

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

13: Battery Street & Maple Street

12/21/2016

	→	←	↖	↑	↓
Lane Group	EBT	WBT	WBR	NBT	SBT
Lane Group Flow (vph)	40	9	189	48	410
v/c Ratio	0.26	0.06	0.58	0.03	0.39
Control Delay	40.2	34.7	13.1	1.9	7.2
Queue Delay	0.0	0.0	0.0	0.0	0.5
Total Delay	40.2	34.7	13.1	1.9	7.6
Queue Length 50th (ft)	22	5	0	2	136
Queue Length 95th (ft)	54	19	75	14	198
Internal Link Dist (ft)	108	704		121	315
Turn Bay Length (ft)			150		
Base Capacity (vph)	713	741	844	1390	1046
Starvation Cap Reductn	0	0	0	0	273
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.06	0.01	0.22	0.03	0.53
Intersection Summary					

Queues

14: Pine Street & Maple Street

12/21/2016

	→	←	↑	↓
Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	440	351	440	354
v/c Ratio	0.64	0.66	0.71	0.42
Control Delay	12.8	20.0	18.4	9.6
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	12.8	20.0	18.4	9.6
Queue Length 50th (ft)	55	76	91	58
Queue Length 95th (ft)	#206	#215	#255	123
Internal Link Dist (ft)	704	804	1131	829
Turn Bay Length (ft)				
Base Capacity (vph)	778	629	772	1038
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	0.57	0.56	0.57	0.34

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

13: Battery Street & Maple Street

12/21/2016

	→	←	↖	↑	↓
Lane Group	EBT	WBT	WBR	NBT	SBT
Lane Group Flow (vph)	40	9	227	48	441
v/c Ratio	0.26	0.06	0.63	0.03	0.42
Control Delay	40.2	34.7	13.5	1.9	7.3
Queue Delay	0.0	0.0	0.0	0.0	0.5
Total Delay	40.2	34.7	13.5	1.9	7.9
Queue Length 50th (ft)	22	5	0	2	145
Queue Length 95th (ft)	54	19	85	14	246
Internal Link Dist (ft)	108	704		121	315
Turn Bay Length (ft)			150		
Base Capacity (vph)	713	741	865	1390	1046
Starvation Cap Reductn	0	0	0	0	267
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.06	0.01	0.26	0.03	0.57
Intersection Summary					

Queues

14: Pine Street & Maple Street

12/21/2016

	→	←	↑	↓
Lane Group	EBT	WBT	NBT	SBT
Lane Group Flow (vph)	471	368	459	354
v/c Ratio	0.69	0.70	0.75	0.41
Control Delay	15.0	22.4	21.2	9.6
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	15.0	22.4	21.2	9.6
Queue Length 50th (ft)	66	84	98	58
Queue Length 95th (ft)	#235	#232	#280	123
Internal Link Dist (ft)	704	804	1131	829
Turn Bay Length (ft)				
Base Capacity (vph)	738	582	693	971
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	0.64	0.63	0.66	0.36

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

RECEIVED
JAN 05 2017

Cambrian Rise Narrative

**DEPARTMENT OF
PLANNING & ZONING**

We are pleased to submit our proposal for approx. 735 mixed income residential units in approximately 10 mixed use structures surrounded by a public park on 3 (mostly) undeveloped parcels totaling 33.65 acres. This submission punctuates a 2+ year process that included: negotiations with the City of Burlington and the Vermont Land Trust to purchase approximately 12 acres to be used as a public park, collaboration with Champlain Housing Trust and Cathedral Square Corporation, 125 of which are proposed to be affordable and senior rental housing, multiple meetings held for the input and edification of all city residents, Wards 2/3 and Wards 4/7 NPAs, neighbor meetings to inform of progress and encourage input/discussion, 2 sketch plans apiece with both the Design Advisory Board and the Development Review Board and thousands of hours of design, revisions and consulting with experts and City departments to refine the building designs, site plan and engineering.

The intent of this development is to create a dynamic new mixed income, mixed use, inclusive, pet-friendly neighborhood in the City of Burlington. The site is less than .5mile from businesses and services on North Street and will be directly connected to the bikepath and one of the most highly traveled bus corridors (#7 bus). It is intended to support a healthy lifestyle that embraces various transportation alternatives to the single family car – biking, walking and taking the bus, as well as fitness and community gardening in a neighborhood that is not quite downtown, but far from the suburbs.

The Cambrian Rise site is extremely complex, with a 70' grade change between North Avenue and the lowest part of the site, necessitating teamwork and collaboration between our architects, landscape architects and engineers. Each building has been carefully considered and designed to be attractive and usable to the residents, as well as to integrate seamlessly into the site, maximizing accessibility to and connections with the public realm. To a great degree, extensive swaths of retaining walls and structured parking have been bermed and covered by greenhouses and other design features. The site was designed to welcome and balance movement through it by the larger Burlington population (ADA accessible path, 8' rec path and both walking and biking connections to the Burlington Bike Path), while offering various scales of private space (stoops, balconies, roof decks, community gardens, etc) for the residents of each building. The engineering team tackled the design challenge of our commitment to infiltrating all stormwater runoff onsite during the 1- year storm event, and matching existing peak discharge rates during the 10-year storm event, far in excess of State permitting standards, which require that the project manage only the first inch of runoff. We will be storing stormwater where possible, for use in the greenhouses, community gardens and potentially some toilet flushing and on-site water features. Finally, special attention has been given to the "activation" of North Avenue, with a restaurant and public seating, patios and main entrances and commercial spaces proposed along part of the streetscape, complementing the beautifully landscaped parklet/green that highlights and celebrates the historic former Orphanage.

All of the buildings will meet or exceed the highest State of VT codes for energy efficiency, with some solar panels, geothermal heating, maximized solar orientation, and balconies (where possible). All of the buildings will contain bike storage and repair rooms, laundry, common rooms (most with phenomenal views), professional pet wash room, grilling areas and (mostly) a range of unit sizes from micro units to studios to 1,2 and 3 bedrooms. Most will also contain storage cages. The site will contain a centralized fitness center with half court gymnasium to double as a community gathering space, off-leash dog park, community greenhouses and community gardens, some centralized storage cages, a

larger “community” bike repair proposed daycare, scattered tot lots, all required recycling and (soon to be required) composting facilities, structured parking, an ADA accessible path from North Avenue through the site to the waterfront and surface parking areas stamped with a pattern to host outdoor events like farmer’s markets and food truck events/rallies/gatherings. Approximately 40,000 square feet of commercial space will support neighborhood needs including small office spaces, restaurant/café, bakery, daycare and services. The centralized compactor facility for garbage, recycling and composting which will be collected by our property management from smaller facilities in each building (we are still working out the details).

The types of units in each building are broken out as follows (approximately):

Building A (Liberty House) – 17 studios, 48 one bedrooms – TOTAL: 65

Buildings B+G – 59 studios, 10 one bedrooms, 2 two bedrooms – TOTAL: 71

Building C – 6 studios, 61 one bedrooms, 6 two bedrooms, 8 three bedrooms – TOTAL: 81

Building D – PARKING GARAGE

Buildings E+F– 21 micros, 60 studios, 15 one bedrms, 25 two bedrms, 1 three bedrm– TOTAL: 122

Building H – 1 studio, 18 one bedrooms, 38 two bedrooms – TOTAL: 57

Building I – 20 two bedrooms, 8 three bedrooms – TOTAL: 28

Building J – GREENHOUSE

Building K – 63 one bedrooms, 7 two bedrooms, three bedrooms – TOTAL: 70

Building L – 36 one bedrooms, 33 two bedrooms, 7 three bedrooms – TOTAL: 76

Building M (formerly M+N) – 4 studios, 7 one bedrooms, 42 two bedrooms, 26 three bedrooms – TOTAL: 79

Building P (formerly O+P) – 24 one bedrooms, 28 two bedrooms – TOTAL: 52

Building Q – 24 two bedrooms, 10 three bedrooms – TOTAL: 34

Inclusionary Zoning, Parking Summary + Transportation Alternatives

Proposed Rental Units:

500 Total Rental Units

Rental IZ Requirement: 119 units (excludes senior housing in the calculation due to exemption)

Rental IZ units to be developed: 125

Required Parking: 500 spaces

Parking supplied for rental units: 494 spaces in parking garages, 115 spaces in surface parking lots

Proposed Non-Profit and Condo Units:

165 Total Condominium (124) + Non-Profit (41) Units

Condo IZ Requirement: 41 units

Condo IZ units to be developed: 41

Parking supplied for condo units: 498 spaces in parking garages, 123 spaces in surface parking lots

Transportation Initiatives

Our transportation initiatives include:

- Superior site design (including sufficient connections to City sidewalks) and lighting to encourage walking
 - Early stages of discussion with City Arts to discuss possibilities for public art to be incorporated into buildings and the project site
- Accessible walking/wheelchair path through the site at a grade of no more than 5%
- Indoor bike storage, on-site bike repair rooms and bike washes in each building
- Ample outdoor bike racks and potential host of future bike share pod
- Enhanced Green Mountain Bus shelter, proposed to be in a stand-alone conditioned structure in an accessible location
- Connection to Burlington Bike Path with 8' shared rec path connecting North Avenue and the city's trail
- CarShare pod(s)
- Member of CATMA, allowing us access to their profound body of knowledge on transportation issues
- CATMA membership allows residents to receive a 28% discount on bus passes (10-ride, monthly and commuter) + CATMA's guaranteed ride home and prize opportunities
- Upgrade of City sidewalks along the entire North Avenue portion of the project site
- Enhancement of primary intersection of North Avenue, as directed by DPW as buildings are developed and occupied

We have been working extensively to create a less car-dependent atmosphere at this site, by providing options to driving on the part of our future residents. From the beginning of the process, the design team incorporated such elements as bike storage at a rate of one bike per unit, common bike repair and bike wash rooms in each building, in addition to the provision of standard outdoor bike racks.

In June of this year Farrell Real Estate (on behalf of Thayer Commons and Cambrian Rise) joined CATMA as its first non-employer member. Since then we have been working with CATMA to strategize how to lessen car-dependence at our properties, including surveying residents at Thayer Commons (further down North Avenue) to understand more about their travel/commuting needs, and extending CATMA's

28% passes to residents. We have given away discount on 10 ride passes to introduce residents to taking the bus and held a tabling event to get feedback from residents on car/vanpooling. We'll hopefully be rolling the carpool option out to residents at Thayer to use as a prototype and work out the kinks for applying the same principles at the Cambrian Rise site.

Additionally, we have had multiple conversations with Annie Bourdin of CarShare VT and will be incorporating a CarShare car into Phase I of our development at the Orphanage, with the understanding that early exposure and marketing will be a key to educating and informing future residents on the various transportation options available as alternatives to owning multiple vehicles. We have had various conversations about bike storage and locations in buildings with Jason Dreische at Local Motion and have met and notified the coordinator of UVM's impending bikeshare program that we are very interested in hosting a bikeshare pod on our site.

Our efforts are ongoing to generate and incorporate ideas that will make this development one of the most special places in Burlington – whether through programming, design features or public art.

Inclusionary Housing Statement

(revised 1.10.17)

25% requirement for Inclusionary Housing in NAC-CR districts

Out of 735 units (for the entire PUD, including Liberty House/former Orphanage), 166 (25% of all units, not including the 70 Senior units, which are not subject to IZ calculations) are required to be Inclusionary, as per the City of Burlington's Inclusionary Zoning (IZ) requirement and as described in the Development Agreement between BC Community Housing, LLC (the Developer), Champlain Housing Trust (CHT) and the City of Burlington on January 7, 2016.

Out of 495 rental units (not including the 70 Senior rental units, which are not subject to IZ calculations), 125 units (broken out as 66 units of family housing by CHT and 59 units of affordable senior housing by Cathedral Square Corporation) amounting to 25% of all units are proposed to be rented or sold at a price which is affordable for a household with an annual income that is sixty-five percent (65%) of median income adjusted for household size, as per Article 9 of the City of Burlington's Zoning Ordinance.

Out of 165 total condominium (for-sale) units, 41 (25% of all units) will be developed to meet the IZ for-sale requirement will be sold at a price which is affordable for a household with an annual income that is seventy-five percent (75%) of median income adjusted for household size, as per Article 9 of the City of Burlington's Zoning Ordinance.

We will determine and verify the units with the Manager of the City's Housing Trust Fund.

Note: As per the Development Agreement, II.2., in addition to the affordable rental housing to be developed by CHT and others, BC Community Housing, LLC will endeavor, but not be obligated, to create some "work force housing," both for sale and for rent; work force housing being that which targets households with incomes between 80% and 120% of the median income for the Burlington/South Burlington MSA, adjusted for family size.

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PLANNING & ZONING

Sequencing Plan

Cambrian Rise (CR) requests that it be permitted under a single PUD application (i.e. a single zoning permit), entitled to be constructed in a single phase. As a practical matter, CR will likely be built out over 5 – 8 years, subject to market conditions, and therefore, we request the zoning permit have an initial duration of 10 years and be automatically renewable thereafter.

The attached Phasing Plan is CR's good faith estimate of the sequence in which the various buildings and site infrastructure improvements will be constructed, some of which may be concurrent. CR needs to reserve the right to change the sequence, in response to market conditions and to facilitate infrastructure installation changes to accommodate changes in the sequencing.

It is critically important that upon completion, each building is entitled to secure a Unified Certificate of Occupancy from the City.

Upon the completion of Liberty House (Phase I, former Orphanage), a temporary (gravel only) parking lot on the north side of the building will be constructed and used by the residents, until the completion of Phase 2, at which time the temporary parking lot will be removed or retained for use as a staging area for Phase 5. This arrangement allows Phase I to be fenced off from ongoing construction activities on the site for the protection and benefit of the residents of Liberty House.

Similar temporary parking arrangements may be necessary as each phase of the project is constructed. Specific requests in this regard will be submitted to the Planning Office when and as the need arises. This process reflects the complex nature of constructing a multi-building project over several years.

The new proposed public street, currently scheduled for completion at the end of Phase 6, will be offered for dedication to the City at that time.

In light of the multi-year sequencing of the buildout of CR, we respectfully request that the Planning Department support our request to the City Council to time the payment of zoning permit release fees to coincide with the construction of each phase.

**Cambrian Rise
North Avenue
Burlington, Vermont**

11/28/2016

COVERAGE CALCS					
Building					288,641.00
Walks					148,883.00
Roads					167,284.00
Total Coverage					604,808.00
Paving Outside Development Zone (21.65 ac)					29,378.00
Total Coverage (Total Site 33.65 ac - with 12 ac Community Park)					634,186.00
Development Zone Area			21.65 ac		943,074.00
Total Site Area			33.65 ac		1,465,794.00
Development Zone Coverage (21.65ac)					64%
Total Site Coverage (33.65ac with 12 ac Community Park)					43%

Cambrian Rise FAR Calculations

Lot size=
21.65 acres
@1 acre=43,560sf
943,074 sf

Building	# stories	Sq Feet	FAR
Building A (existing)	5	60,000	0.063621731
Building B+G	4	71,500	0.075815896
Building C	5	95,000	0.100734407
Building D - garage	3	-	0
Building E+F	5	118,500	0.125652918
Building H	4-5*	73,000	0.077406439
Building I	5	62,000	0.065742455
Building J- Greenhouse	1	3,000	0.003181087
Building K	4	69,500	0.073695171
Building L	4	88,800	0.094160161
Building M	5	111,000	0.117700202
Building P	4	66,500	0.070514085
Building Q	4	75,800	0.080375453
Building R	5	27,100	0.028735815
TOTALS:		921,700	0.977335819

*only a small portion is 5 stories (along South Rd), to transition from the height of Bldg C

RECEIVED
JAN 10 2017
DEPARTMENT OF
PLANNING & ZONING

Scott Gustin

From: Owiso Makuku <omakuku@farrellrealestatevt.com>
Sent: Tuesday, January 10, 2017 9:59 AM
To: Scott Gustin
Subject: Updates on Ability to Serve Letters
Attachments: Fire Dept CR Ability to Serve letter 1-9-17.pdf; Capacity to Serve. Parks for Cambrian Rise.pdf

Hi Scott,
We have reached out to the following departments/contacts for the Ability to Serve/Capacity Letters:
Jesse Bridges: Parks (attached)
Barry Simays: Fire (attached)
Laura Wheelock: DPW/Streets – I believe that she has sent this to you. Would it be possible for you to share her concerns/a copy with us?
Brandon Del Pozo: Police – have communicated a couple of times, but still haven't gotten letter (it just occurred to me to send Barry's letter to him as a prototype, since he is new to this concept)
Marty Spaulding: Schools – I can share with you the thread of communications, dating back to early to mid-October. We're guesstimating 53-54 children when the project is fully built out based on our unit mix of:

Schools Ratio			
Studios	168	0	0
1 bdrm	219	0	0
2 bdrm	225	0.185	42
3 bdrm	60	0.2	12
TOTAL			
SCHOOLCHILDREN:	53,625		

Even using estimates of children in our buildings + CHT's buildings we come to a similar guesstimate of 52-53 children

Please let me know what further actions you would like me to take.



Burlington Fire Department
Office of the City Fire Marshal



Fax (802) 658-7665

132 NORTH AVENUE • BURLINGTON, VERMONT 05401

(TTY) (802) 865-7142

Plan Review and Inspection Services: (802) 864-5577

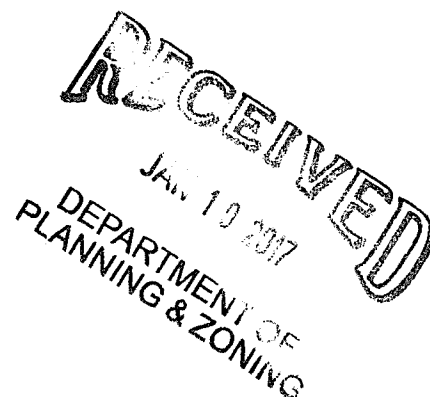
Public Information and Education: (802) 864-6923

www.burlingtonvt.gov/fire

9 January 2017

Farrell Real Estate
Attn: Owiso Makuku
875 Roosevelt Highway
Colchester, VT 05446

Re: Fire Department Letter of Approval (Ability-to-serve)
Cambrian Rise Development
Farrell Real Estate
North Avenue (Development address not assigned)
Burlington, Vermont



Dear Ms. Makuku,

This letter is to inform you that I have reviewed the plans you provided for the proposed site improvements to be located at the Cambrian Rise development on North Avenue in Burlington, VT and feel this project will not negatively impact our fire department or our ability to serve this site. Furthermore, this project will not have an adverse effect on the surrounding properties as it relates to safety and fire suppression.

This review is based on development site plans to include fire hydrant layout, fire department access road specifications, and project phasing plan reviewed with both you and Charles Pughe at the Burlington Fire Marshal's Office on 5 December 2016. In addition to this plan review meeting, The Technical Review Committee (TRC) staff comments filed by the Burlington Fire Marshal's Office on 27 September 2016 remain in effect for this project.

For the record, while no single development project in the City of Burlington can be identified as the sole trigger for significant impact on the service that the Burlington Fire Department provides to our citizens on a daily basis, it must be noted that the cumulative volume of current and future development within the City will certainly impact the service provision of our department over time. We anticipate seeing an increase in both fire and emergency medical services (EMS) annual requests for service as a result of your 700-unit, mixed-use residential and commercial multi-structure development following project completion.

We appreciate your notification of this project to us, and for giving us the opportunity to comment. If you should have any questions in the future, please do not hesitate to contact me.

Yours in Public Safety,

BC Barry J. Simays CFI, IAAI-FIT
Fire Marshal

Cc: Chief Engineer Steven A. Locke
File, Firehouse database # CAMBRIDE

Scott Gustin

From: Burns, Chris <cburns@burlingtonelectric.com>
Sent: Monday, January 09, 2017 9:43 AM
To: Scott Gustin
Subject: RE: Cambrian Rise

Hi Scott, Energy Services is engaged with the project design team and feeling fairly confident about the overall projected energy performance.

We have also started conversations with CHT and Cathedral Square on their proposed buildings.

Thanks, Chris

From: Scott Gustin [mailto:SGustin@burlingtonvt.gov]
Sent: Friday, January 06, 2017 1:12 PM
To: Burns, Chris <cburns@burlingtonelectric.com>
Subject: Cambrian Rise

Hi Chris,
Do you/BED have any comments relative to Cambrian Rise for DRB consideration? They are scheduled for DRB on January 17. If you have comments, please send them to me by next Tuesday 1/10. In doing so, they will be included in the DRB's packet. Alternatively, submission by 1/17 would be the latest to provide the DRB your comments at their meeting.
Thank you.
Scott

Scott Gustin, AICP, CFM
Principal Planner & Asst. Administrative Officer
Dept. of Planning & Zoning
149 Church Street
Burlington, VT 05401
(802) 865-7189

Please note that this communication and any response to it will be maintained as a public record and may be subject to disclosure under the Vermont Public Records Act.



BURLINGTON
**PARKS
RECREATION
WATERFRONT**

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JAN 09 2017
DEPARTMENT OF
PLANNING & ZONING

MEMO

Date: January 6, 2017
To: Owiso Makuku
From: Jesse Bridges, Director *Jesse Bridges*
RE: Capacity to Serve – Cambrian Rise
Cc: Scott Gustin

This memo serves as the Parks Departments acknowledgement of our capacity to serve the new development contemplated for the former Burlington College property known now as Cambrian Rise. Per the Development Agreement signed in January of 2016 improvements to the property as well as continued collaboration will be important for the success of the project and surrounding parkland.

With the purchase of 12 acres of parkland for conservation our City boasts over 550 acres of parkland, this translates to 12.2 acres per thousand residents, just about the national average for a population our size. However, we also have a regional park district home to 465 acres. When combined the acreage per resident increases to 23.5 acres per thousand residents, almost double the national average.

Having enough park acreage is not the only factor that matters. The connectivity of the parkland is equally important and the trail that will be improved in coordination with the development will continue to serve generations to come in accessing our miles of trails and acres of parks. We look forward to continuing to advance the goals of conservation, connectivity and recreation throughout the development of much needed housing for our community.

150 Elm Street
Montpelier VT 05602
November 23 2016

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NOV 29 2016
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PLANNING & ZONING

Burlington Development Review Board
Burlington City Hall
149 Church Street
Burlington VT 05401

Attn: Austin Hart; Brad Rabinowitz; Israel Smith; AJ Larose; Geoff Hand; Alexandria Zipparo; Wayne Senville; Jim Drummond; Robert Purvee

Dear Board Members,

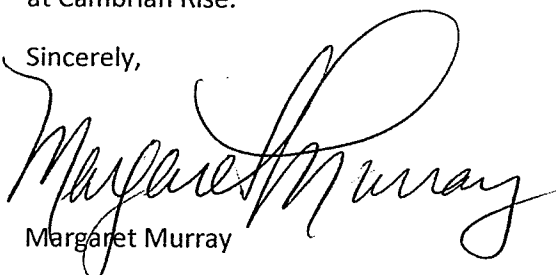
I appeared at the November 1, 2016 board meeting, because I wanted to speak concerning 17-0267SD; 311-375 North Ave (ARM-W.Ward 4N) BCCH. I was advised that this applicant had requested deferral of the final plat application for this 11-lot subdivision. I am concerned that the board was only notified of this on the date of the meeting, which gave no time for public notification.

As a citizen I have expressed numerous concerns about this development. At this time there are additional areas of concern, most recently conveyed in letters and emails to; Miro Weinburger; Mayor, Lucy Leriche; VT Agency of Commerce and Community Development as well as Robert D Shumeyko; Housing and Urban Development(HUD), Boston.

In reviewing just two items under Cambrian rise, I noted the Texaco beach design plan and the Section A-1 proposed conditions showing the height and slope to Lake Champlain. Although this property has generated a lot of newsprint in the last 2-4 years, I am not sure the public is fully aware of the environmental impact this development could have on one of the last open spaces near Burlington's downtown.

Finally, I am concerned that this important issue will be decided at a time when most people are not available for evening meetings in the crush of the holiday season. The suggestion from the developer was this be postponed till December 20 2016. I ask that the board wait for the new year for a new look at Cambrian Rise.

Sincerely,


Margaret Murray

cc: Scott Gustin

**END OF FIELD LETTER REPORT FOR ARCHAEOLOGICAL PHASE I SITE
IDENTIFICATION SURVEY FOR THE PROPOSED BURLINGTON COLLEGE 329-
351-375 NORTH AVENUE DEVELOPMENT PROJECT, BURLINGTON,
CHITTENDEN COUNTY, VERMONT**



**University of Vermont
Consulting Archaeology Program
180 Colchester Avenue
111 Delehanty Hall
Burlington, VT 05405**

Report No. 990

June, 2016

**END OF FIELD LETTER REPORT FOR ARCHAEOLOGICAL PHASE I SITE
IDENTIFICATION SURVEY FOR THE PROPOSED BURLINGTON COLLEGE 329-
351-375 NORTH AVENUE DEVELOPMENT PROJECT, BURLINGTON,
CHITTENDEN COUNTY, VERMONT**

Prepared by:

**Geoffrey A. Mandel
Kate M. Kenny
&
Charles Knight, Ph.D.**

Prepared for:

**Owiso Makuku
Farrell Real Estate
875 Roosevelt Highway
Colchester, VT 05446**

**University of Vermont
Consulting Archaeology Program
180 Colchester Avenue
111 Delehanty Hall
Burlington, VT 05405**

Report No. 990

June, 2016

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INTRODUCTION

Farrell Real Estate proposes the Burlington College Development at 329-351-375 North Avenue, Burlington, Chittenden County, Vermont (Figure 1). The proposed project will develop sections of the parcel that once contained the Lakeview Sanitarium and all its associated buildings, such as the Redstone cottage, a farm and associated stables, and various cottage annexes. The sanitarium complex was located in the south third of the proposed project parcel. To the north, but within the same project parcel, was housed the Catholic Diocese and orphanage and more recently, Burlington College.

Scott Dillon, field archaeologist for the Vermont Division for Historic Preservation (VDHP) visited the project area and identified many areas of archaeological sensitivity for pre-Contact Native American sites, as well as historic period Euroamerican sites. He recommended a Phase I site identification survey as part of the ACT 250 permitting process. Specifically, he recommended 180 standard archaeological test pits be excavated within the sensitive portions of the property (Figure 2). These include a large block to the south which encompasses the sanitarium and its associated farm, and undeveloped area to the north and northwest of the existing Diocese/orphanage buildings. A rectilinear feature identified in an early 1937 orthographic photo represents the smallest red block and this will be investigated, as well as light testing east of this block in areas of known historic disturbances in order to evaluate the degree of this disturbance.

ENVIRONMENTAL CONTEXT

The proposed project parcel is located on a prominent ridge located between the Winooski River and its intervalle to the east and Lake Champlain to the west. The surficial geology is derived from glaciofluvial deposits of sand that formed as part of the Winooski River delta complex in the early Holocene period. The soils found across the project area are classified by the USDA SCS (2016) as Adams and Windsor Loamy sands, 0-30% slope. These soils are excessively drained and subject to moderate erosion if left unvegetated. Once used as farmland, the project area is currently partially wooded, covered in lawn or is fallow field covered with grasses. The project parcel ranges in elevation from 63-70 m (207-230 ft), with the highest point being in the northeast corner along North Avenue.

PROJECT AREA PRE-CONTACT ERA NATIVE AMERICAN CONTEXT

Numerous archaeological sites are known within the Winooski River Intervale. These sites range in size and function from small short-term encampments to large semi-permanent sites where a variety of activities occurred over millennia. Several sites are known along the ridge separating the Intervale from Lake Champlain, although none have received extensive archaeological study. One site, VT-CH-264, is poorly documented in the Vermont Archaeological Inventory (VAI) but it is reported in close proximity to North Beach, located just to the northwest of the project parcel. For obvious environmental and topographic reasons, the proposed project parcel is ideally located and sensitive for containing pre-Contact era Native American archaeological sites.

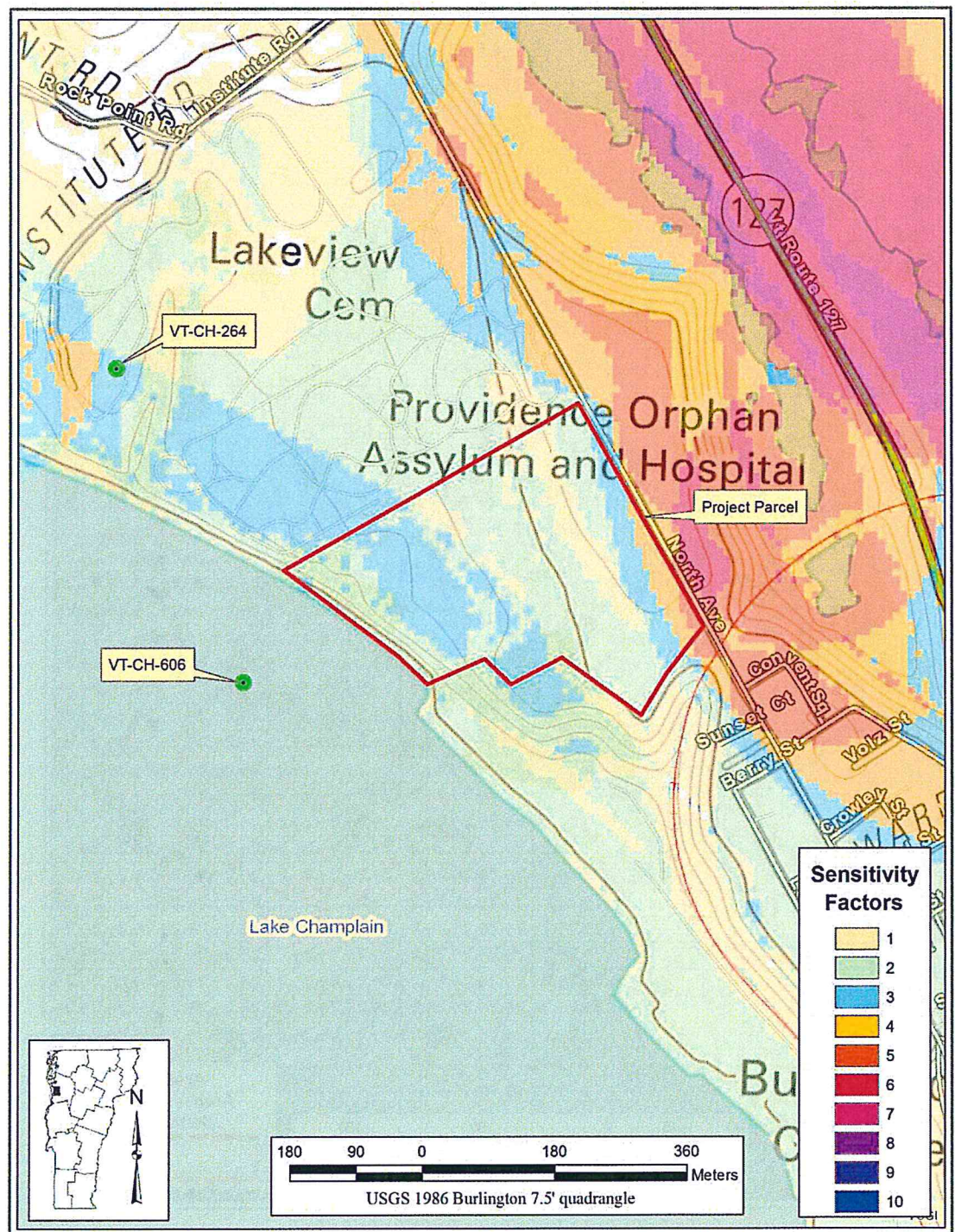


Figure 1. Map showing the location of the proposed Burlington College Development 329-351-375 North Avenue project, in relation to archaeological sensitivity factors, Burlington, Chittenden County, Vermont.



Figure 2. Map showing the archaeologically sensitive areas within the proposed Burlington College Development 329-351-375 North Avenue project, Burlington, Chittenden County, Vermont.

PROJECT AREA HISTORIC CONTEXT

Although the proposed project area appears to have been part of, what was termed "Lot 14", there is yet no evidence of development/occupation of the property prior to ca. 1846.

Henry B. Stacy's Farm

In the mid-1800s this property belonged to Henry Baldwin Stacy (1804-1869), one of twelve children of John (1760-1846) and Mary (Baldwin) Stacy of Orange, Vermont (*Bennington Banner* July 29, 1869; State of Vermont, Vermont Vital Records 1720-1908). "At the age of 16" Henry Stacy "went to Bennington to learn the printer's trade in the office of the *Vermont Gazette*. He subsequently worked at his trade in Middlebury and Montreal" (*Bennington Banner* July 29, 1869). He moved to Burlington in 1827 and took a job with Luman Foote, who had just established the *Burlington Free Press* (*Bennington Banner* July 29, 1869). "In January 1833, Mr. Stacy bought out Mr. Foote and became sole editor and proprietor of the paper" (*Bennington Banner* July 29, 1869). "He conducted the paper till 1846," when he sold the *Free Press* to Gen. DeWitt Clinton Clarke of Brandon, Vermont (*Bennington Banner* July 29, 1869; *St. Albans Messenger* July 15, 1846). "Having purchased some land, north of Burlington, on the Lake Shore, he afterwards turned his attention to agricultural pursuits" (Figure 3) (*Bennington Banner* July 29, 1869). H.B. Stacy also once owned the old fairgrounds (Presdee and Edwards 1853). He was also a representative and selectman for Burlington.

Henry Stacy ran into financial difficulties in the 1850s. "Long litigation and some unfortunate investments involved the loss of property, and in 1861 he accepted an appointment as U.S. Consul at Revel," Russia (*Bennington Banner* July 29, 1869). "He remained abroad till November 1868, when he returned on leave of absence to visit his family and his home" (*Bennington Banner* July 29, 1869). In May 1869, he again left for Russia to close out his duties there "intending to return home again in August and to spend his days here in his old homestead north of the city, which he repurchased just before his last departure" (Figure 4) (*Bennington Banner* July 29, 1869). Henry Stacy died suddenly of 'inflammation of lungs' in Revel on June 18, 1869, aged 65, leaving a wife and four grown children (*Bennington Banner* July 29, 1869; Vermont Secretary of State, Vermont Vital Records 1720-1908). In his estate inventory, this property was listed as a "lot on North Avenue" valued at \$2000—he also owned a house on the corner of Champlain Street and North Bend valued at \$450 and a few other small lots on Battery and Lake Streets (Chittenden County Probate Court Records 1869). His property passed jointly to his widow, Maria (Corning) Stacy, and his children: Helen Stacy (d. 1894); Jennie Stacy (d. 1911); Amanda Stacy (d. 1910); and William C. Stacy (1836-1919) (Figure 5) (Chittenden County Probate Court Records 1869).

St. Joseph's Providence Orphan Asylum and Hospital

In October of 1872, Henry Stacy's heirs sold/donated an initial 14 acres to the Roman Catholic Church (Figure 6) (Allen 1905:12; Hopkins 1890). This appears to have been augmented with a later purchase that extended all the way down to the lake. The Church operated an orphanage / old age home here from 1883 to 1982(?) (Blow 1991:13). The St. Joseph's Providence Orphan Asylum and Hospital was operated by the Sisters of Providence

from Montreal (Blow 1991:13). This site was actually the second home of this institution. The 'Asylum' had been founded by Bishop DeGoesbriand on May 3, 1854, at which time the institution occupied a former tavern located at the southwest corner of Pearl and South Prospect Streets formerly known as the 'Pearl Street House' (Allen 1905:12).

The large brick building located in the northern part of the project area was designed by the Rev. Cyril Beaudry of Joliette, Quebec, and built under the direction of the Rev. Michaud of Winooski, Vermont (*Argus and Patriot* March 5, 1884; Blow 1991:13). The foundation were laid in the spring and summer of 1879, but there was a "delay of two years" before the construction resumed (*Argus and Patriot* March 5, 1884). The cornerstone was placed in May of 1882. The contract for the stone work was given to G.N. Willard, that of the brickwork to Cummings & Son of Rutland, and that for the framing and interior work to James Ross (*Argus and Patriot* March 5, 1884). The building was completed in 1883 and officially opened on December 10, 1883 (Allen 1905:12).

Several outbuildings including a barn (possibly left over from Stacy's days), carriage house, ice house, hen house, work shop & etc. were located west of the main structure (Sanborn Mapping and Publishing Company 1889, 1894, 1900, 1906, 1912, 1919, 1926, 1938, 1926/1942, 1942/1950, 1942/1960). The large southern addition, containing a school and auditorium & etc., was built in 1940 (Blow 1991:14). As the number of children in residence declined, the building was converted into administrative offices for the diocese beginning ca. 1978(?) (Blow 1991:13-14).

Lake View Retreat

The southern section of the current project area encompasses a property formerly known as the Lake View Retreat. This area may have been part of the Henry Stacy Farm in the 1840s and 1850s, but was sold off to Sion E. Howard before Stacy managed to repurchase his farm. Sion E. Howard (1800-1866), a prominent local hotel keeper/businessman, began construction of a "substantial brick" mansion on the property ca. 1865, but died before the structure was completed (*Burlington Free Press* September 24, 1858; Rann 1886:255).

This property appears to have been owned/occupied by G. C. Appleton ca. 1869 (see Figure 6) (Beers 1869). This was probably George Cleaves Appleton (1836-1895), a railroad agent/conductor, who also may helped with the construction of the nearby railroad tunnel. (Gravestone, Lake View Cemetery, Burlington, Vermont; U.S. Census 1870).

In about 1882, the property was acquired by Dr. John M. Clarke (1846-1931), who converted the house into a 'private institution for the treatment and care of mental and nervous diseases' being mostly 'mild cases' (e.g. exhaustion, over-work, insomnia & etc.) (*Argus and Patriot* October 7, 1885; Gravestone, Lakeview Cemetery, Burlington, Vermont; Rann 1886:255; Vermont Secretary of State, Vermont Death Records 1909-2008). This private hospital was opened "for the reception of patients October 1, 1882" (Rann 1886:256). In the summer of 1898, "Dr. Clark built an addition 40 x 40 feet, three stories high of solid brick walls. The inside is finished in hard wood and will be fitted with new dining-rooms, bath rooms, steam heat and electric lights" (Figure 7) (Supervisors of the Insane of the State of Vermont 1898:7). A

description of the institution from 1886 noted that the 10-15 acre property was “made up of lawns, groves, gardens and orchards, and are traversed by pleasant driveways and walks” (Rann 1886:255). The same source noted that “the main building” was “situated upon the highest portion of the grounds, . . . set back from the street, and has in the foreground a large, handsome lawn, dotted with ornamental shade trees and clumps of flowing shrubs” (Rann 1886:255) (Figure 8). The building remained a private sanitarium for many years. However, it appears that the property was sold in the early 1940s to the Catholic Church. In 1945, Bishop Ryan founded the Don Bosco (boarding) High School for (delinquent?) Boys at this location (Sanborn Mapping and Publishing Company 1942/1950). It is likely that this old house was torn down/lost before the 1990s.

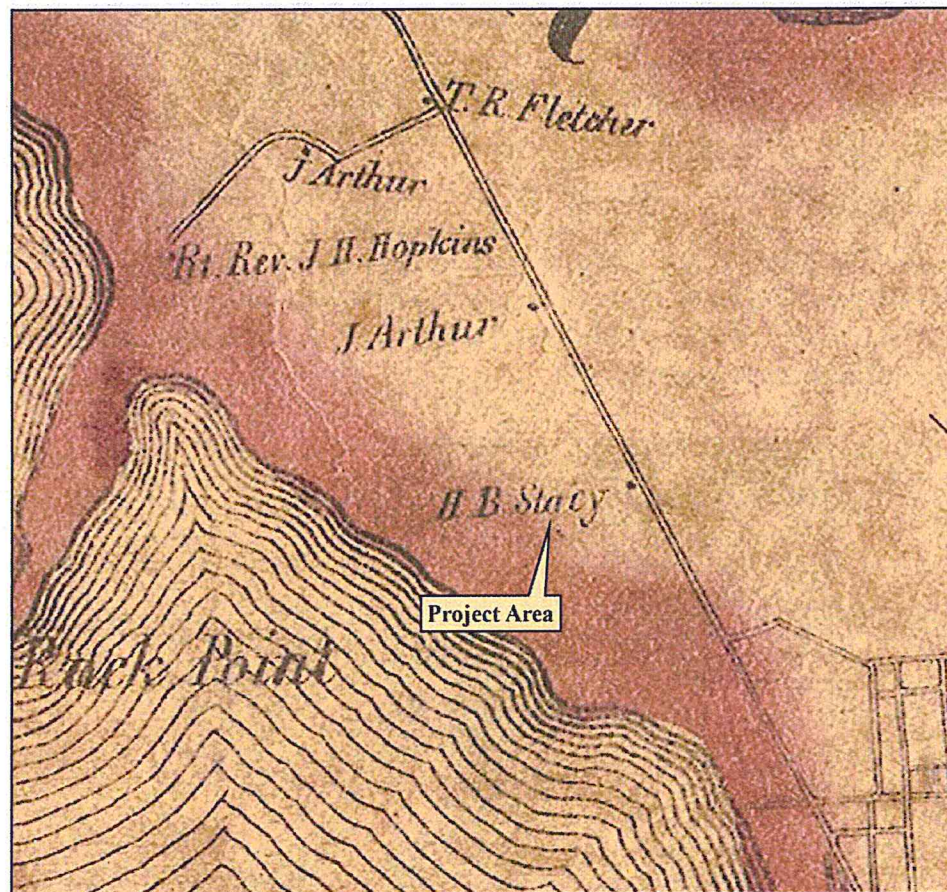


Figure 3. Location of the proposed project area within a detail of H.F. Walling’s *Map of Chittenden County, Vermont* (1857).

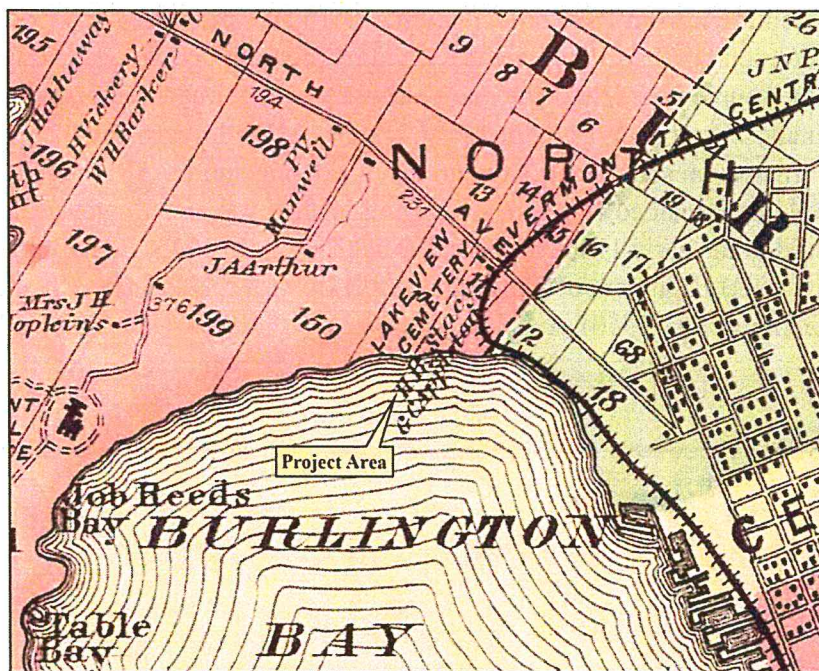


Figure 4. Detail of the “Plan of City of Burlington and Town of South Burlington” in F.W. Beers’ *Atlas of Chittenden County, Vermont* (1869). Lake View Cemetery land bought by city in 1867 probably from John A. Arthur (Blow 1991:14-15). Note: the Central Vermont Railroad built the tunnel under North Avenue in 1862.

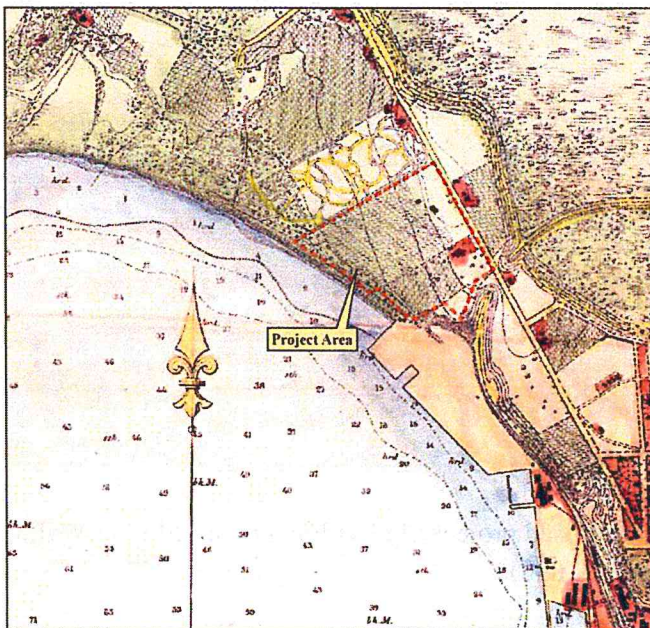


Figure 5. Detail of H.G. Ogden and F.D. Granger’s *U.S. Coast Guard Survey, Burlington, Vermont* (1872).

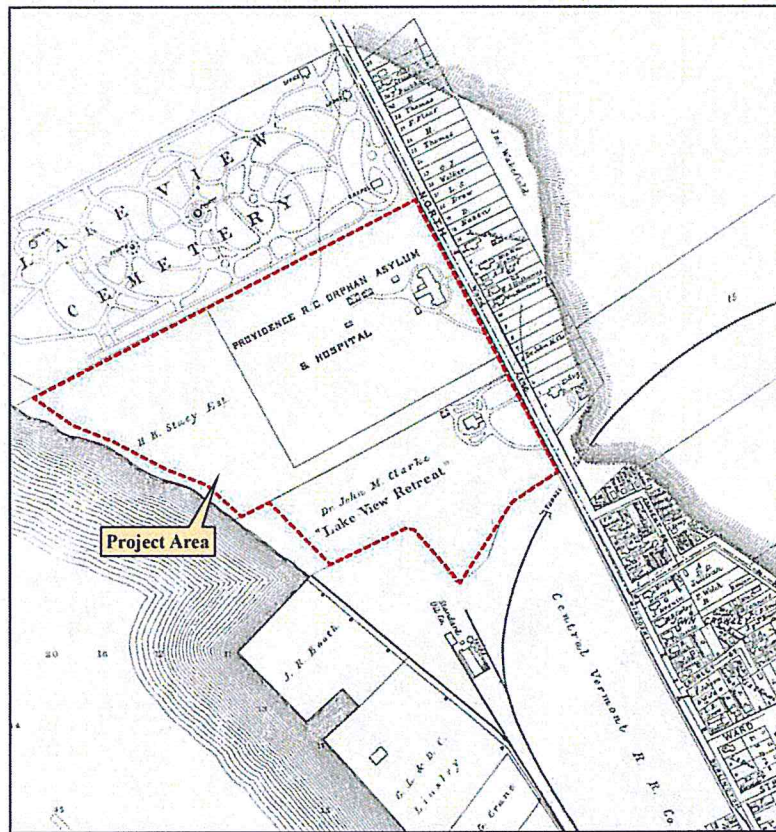


Figure 6. Detail of G.M. Hopkins' *Map of the City of Burlington, Vermont* (1890).

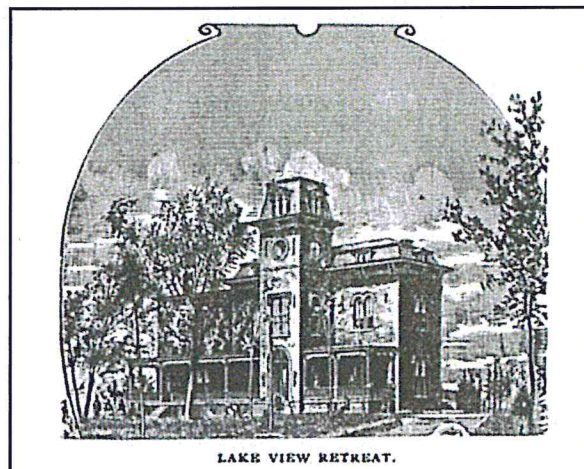


Figure 7. View of the Sion E. Howard House/Lake View Retreat (Burlington Board of Trade 1889).



Figure 8. Detail of a 1937 aerial photograph showing the project area (Aerial Explorations Inc., 1937).



Figure 9. Areas of possible historic disturbance (Base map: Google Maps 2004; image data: Aerial Explorations Inc. 1937; Geotechnics & Resources Inc., 1962; Hopkins 1890; Ogden and Granger 1872; and Stanley 1933; with additional information on building use/purpose from Sanborn Mapping and Publishing Company 1889, 1894, 1900, 1906, 1912, 1919, 1926, 1938, 1926/1942, 1942/1950, and 1942/1960).

FIELD METHODS

Given the large scale of the proposed project's Area of Potential Effects, the Phase I site identification survey excavated standard-sized 50 x 50 cm (20 x 20 in) test pits along linear transects within each of the defined archaeologically sensitive areas. The number of test pits and transects and their alignment was determined by the VHDP, but their placement was determined by the size of each archaeologically sensitive area, local topography, visible ground disturbance

and local soil conditions. The transects were emplaced using a metric tape and Brunton compass. In addition, a handheld Global Positioning System (GPS) would also be used to record the locations of the transects to allow for accurate plotting on appropriate maps. Each test pit was excavated in arbitrary 10 cm (4 in) vertical levels with respect to the local soil stratigraphy. A schematic stratigraphic soil profile was recorded for each test pit and representative samples appear in Appendix 1 of this report. All soils were screened through 0.64 cm (1/4 in) mesh screens. The Phase I survey was recorded in digital camera format.

PHASE I RESULTS

The Phase I study included the excavation of a total of 181 test pits aligned along 33 linear transects (Figure 10). Transects 1-6, 17-29 were located in the large wooded area in the southern portion of the APE. Transects 7-13 were located in the northwestern sensitive area and Transect 14-16 in the central sensitive area. Transects 30-33 were emplaced in the northeastern sensitive area.

Transects 1 and 2 were located in the eastern strip of lawn along the eastern side of the southern parking lot (see Figure 10). The ground surface in this area was visibly higher in elevation than the parking lot to the west and sidewalk located to the east, suggesting that some degree of filling has occurred in this area. Only four test pits, Transect 1, Test Pits 5-8, were excavated in this area as indeed, thick, compact fill was encountered in this area to an average depth of 50 cm (20 in) below the ground surface. Intact "B" subsoil was identified in three of the test pits beneath the fill. In two of the excavated test pits, evidence for the original ground surface, and/or plowzone stratum had been entirely removed, but it was present in the other two test pits along this transect. Because of this variability in soil stratigraphy, this area was considered to not be archaeologically sensitive and no further testing was undertaken in this area.

Transects 3-5 were located across a section of broad lawn south of the southern parking lot and north of the former Burlington College Residence Hall (see Figure 10). These transects were oriented parallel to a prominent terrace edge that formed the lawn's western side. The transects were spaced 10 m (33 ft) apart with the test pits spaced at 10 m (33 ft) intervals. Test pits in adjacent transects were offset by 5 m (16 ft). Transect 3 was located closest to the terrace edge and contained three test pits. The soils encountered in these test pits included an uppermost plowzone(s) stratum which was underlain by intact subsoil. Except for historic era plowing, this portion of the APE does not appear to have been otherwise disturbed. The test pits along Transect 3 were excavated to depths from 40-50 cm (14-20 in).

Transect 4 contained a total of eight test pits and the soil stratigraphy encountered along this transect was highly variable with multiple fill layers encountered in Test Pits 1-5, and no fill in Test Pits 6-8. Transect 4, Test Pit 1 was located along the southern limits of the APE and along the margins of a terrace edge that now appears to have been artificially formed by depositing fill to expand the terrace in this direction. In Test Pits 1 and 2, a buried plowzone

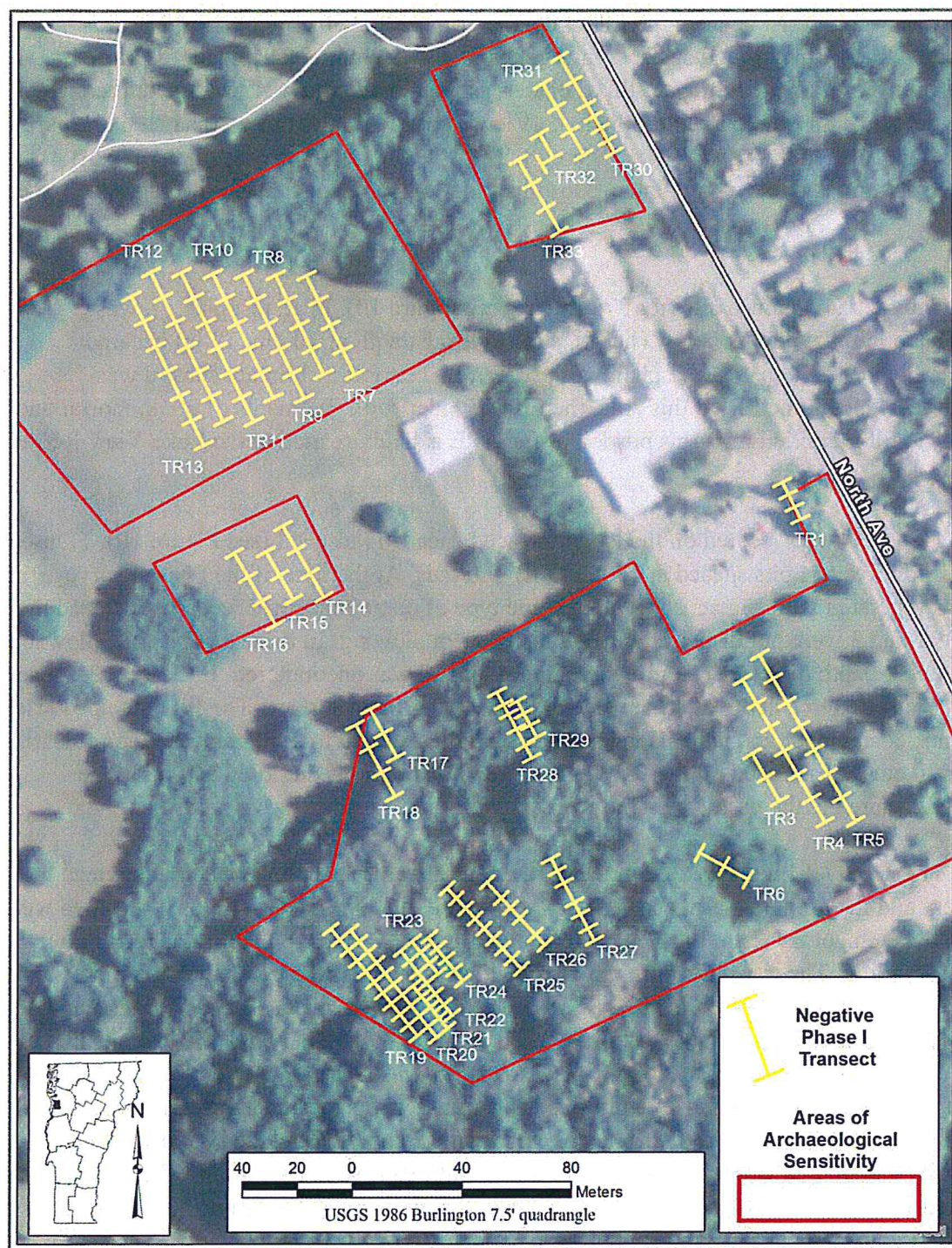


Figure 10. Location of all Phase I transects and test pits for the proposed Burlington College 329-351-375 North Avenue Development Project, Burlington, Chittenden County, Vermont.

stratum was encountered beneath the fill, at depths from 62 and 30 cm (24 and 12 in), respectively, below the ground surface. Intact subsoil was encountered beneath the buried plowzone. In Test Pits 3-5, compact fill of cinder, asphalt, brick and rock was encountered to varying depths. It appears that either the Lake View Retreat or one of its associated paths/parking lots was once located in this area (see Figure 9). Test Pits 6-8 included only an uppermost plowzone stratum and underlying intact subsoil similar to that identified along Transect 3 to the west.

Transect 5 contained a total of 7 test pits (see Figure 10). In all test pits, fill was incorporated into the plowzone(s). The fill, at an average depth of 30 cm (12 in) became impenetrable in Test Pits 4-7 as asphalt was present. In Test Pits 1-3, intact subsoil was encountered beneath the fill. In this area, the fill was laden with fragments of brick, mortar and cinder. The fill identified in this portion of the APE is likely related to the Lake View Retreat (see Figure 9).

Transect 6 was located on the lower terrace beneath Transect 3 (see Figure 10). Transect 6 contained three test pits spaced at 10 m (33 ft) intervals. At the time of the Phase I survey, the area was vegetated with sumac, suggesting some type of disturbance had recently occurred there. Test Pits 1 and 2 were not disturbed beyond historic era plowing. In these test pits, the plowzone extended to a depth of 25 cm (10 in) where intact subsoil was encountered. In Test Pit 3, loose fill was excavated to a depth of 45 cm (18 in) below the ground surface. The fill contained brick fragments, coal, cinder and nails. Hand soil coring indicated that this fill continued for at least another 20 cm (8 in). Based on the fill, we concluded that various dumping activities had disturbed the area in the past.

Transects 7-13 were located in the northwestern sensitive area, between Lakeview Cemetery and the previous farm access road (see Figure 10). The eastern limits of the area were defined by a temporary chain link fence erected during renovations to the former Burlington College Building. The transects were oriented south-north across the gentle west sloping field, with Test Pit 1 of each transect located adjacent to the former farm access road. Transects 7-13 were spaced 10 m (33 ft) with the test pits spaced at 10 m (33 ft) intervals. The test pits in adjacent transects were offset by 5 m (16 ft). Transect 7 was located along the eastern limits of the area and contained a total of five test pits. This transect was located across the western half of a slightly elevated terrace. The soils encountered along Transect 7 included an historic era plowzone containing a variety of historic era structural debris such as mortar, bricks, rock and nails, and in several test pits, intact subsoil beneath the plowzone/fill stratum. The debris may be related to the former carriage and ice houses (see Figure 9).

Transect 8 was located to the west of Transect 7 and it traversed the gradual face of the terrace. Like Transect 7, the test pits along Transect 8 included a plowzone containing structural debris. In many test pits, impenetrable rock was found at the base of the plowzone/fill stratum. The debris is likely associated with the former barn (see Figure 9). The debris decreased to the

north and in Test Pits 4 and 5, was no longer present. In these test pits, a plowzone underlain by intact subsoil was identified.

Transects 9 and 10 were located to the west of Transect 8 (see Figure 10). Based on the soils encountered in this portion of the sensitive area, it appears that localized grading had occurred as the remnant plowzone varied from 9-22 cm (3.5-8.6 in) in thickness, with the shallower depths found closer to the former farm access road. Transects 11-13 were located to the west of Transect 10. In this area, the grading appears to have abated as the plowzone averaged from 17-26 cm (6.6-10.2 in) in thickness. In all test pits excavated along Transects 9-13, intact subsoil was encountered beneath the plowzone stratum.

Transects 14-16 were located in the west-central archaeologically sensitive area (see Figure 10). Transects 14 and 16 contained four test pits each, and Transect 15, three test pits. The transects were spaced 10 m (33 ft) apart and test pits excavated at 10 m (33 ft) intervals. The test pits in adjacent transects were offset by 5 m (16 ft). In all but one test pit Transect 16, Test Pit 4, the soil stratigraphy was comprised of an uppermost historic era plowzone underlain by intact subsoil. In Transect 16, Test Pit 4, two distinct plowzone strata were identified, the lowest of which contained nails and fragments of brick. The second plowzone extended to a depth of 57 cm (22 in). The location of this test pit suggests that it intersected either the work shop or hen house (see Figure 9).

Transects 17 and 18 were located along the northern side of the southern archaeologically sensitive area (see Figure 10). Both transects began in the wooded area and extended north into the grassy area and were oriented parallel to a prominent terrace edge, which may have been modified by past quarrying activities. Transect 17 contained three test pits and Transect 18, four test pits. The transects were spaced 10 m (33 ft) apart and test pits within adjacent transects were offset by 5 m (16 ft). The soils encountered along these two transects included an uppermost historic plowzone that was underlain by intact subsoil.

Transects 19-29 were located within the wooded southern archaeologically sensitive area (see Figure 10). In this area, given its sensitivity for pre-Contact era Native American sites, the test pits along each transect were spaced at 5 m (16 ft) intervals, and adjusted to accommodate trees and areas inaccessible due to tree blowdowns. For transects 19-24, the transects were spaced 5 m (16 ft) apart with test pits in adjacent transects offset by 2.5 m (8 ft). For Transects 25-27, the distance separating them was predicated upon trees and disturbed areas. Transects 28 and 29 were located in the northern portion of the area where the understory was less dense. The soil stratigraphy in all test pits included one or two successive historic plowzones that were underlain by intact subsoil. In particular, the test pits excavated along Transect 24 included two successive plowzones, which cumulatively were much thicker than those identified elsewhere within the wooded area. The reason for this unknown, but it appears that some infilling may occurred in the historic past to accommodate agriculture.

Transects 30-33 were located in the northeast archaeologically sensitive area (see Figure 10). The area is bounded by Lakeview Cemetery to the north and the former Burlington College building to the south. The eastern limits of the area are defined by a sidewalk along North Avenue, and the western side by a terrace edge and slope that is vegetated with thick lilac bushes and locust trees. At the time of the Phase I study, portions of this area were being used for parking, trailers and limited storage related to the renovation of the building. The transects were spaced 10 m (33 ft) with test pits emplaced at 10 m (33 ft) intervals. The test pits in adjacent transects were offset by 5 m (16 ft) intervals.

Transect 30 was located closest to and parallel to the North Avenue sidewalk. Transect 30 originally contained five test pits. Two additional test pits were excavated 5 m to the north of Test Pits 1 and 2, for a total of seven along this transect. All test pits included varying levels of historic fill, beginning at the ground surface and extending to depths ranging from 35-75 cm (14-30 in). In some test pits, at the base of the fill, a buried plowzone was encountered, which was underlain by intact subsoil. In other test pits, the buried plowzone was absent and only subsoil was present. The fill included fragments of brick and cinder, as well as small quantities of nails, marbles, ceramic fragments and modern era plastic.

The soils encountered in the test pits excavated along Transect 31 were similar to those identified along Transect 30. The artifact type and quantity was also similar. In Transect 32, which originally contained two test pits with a third added later 5 m (16 ft) to the west of Test Pit 2, the fill layers were greatly compressed in Test Pit 1, had been incorporated into the upper and only plowzone of Test Pit 2, and not present in the test pit excavated 5 m (16 ft) to the west of Test Pit 1. Intact subsoil was identified beneath the fill/plowzone of each test pit. Transect 33 was located along the western terrace edge and originally contained five test pits. Two additional test pits were excavated along this transect, one each 5 m (16 ft) to the north and south of Test Pit 3 (see Figure 10). Two layers of plow incorporated fill were identified in Test Pit 1, to a depth of 49 cm (19 in) below the ground surface. Intact subsoil was found below. In Test Pits 2-4, the fill was absent. These test pits were situated on a slightly elevated portion of the terrace and their soil profiles included a single plowzone stratum underlain by intact subsoil. Artifacts recovered included nails, marbles, and glass and brick fragments. None of which are significant cultural artifacts.

CONCLUSIONS AND RECOMMENDATIONS

The UVM CAP conducted an extensive Phase I site identification survey within four previously determined archaeologically sensitive portions of the proposed Burlington College Development project parcel located in Burlington, Chittenden County, Vermont. As a result of the study, no pre-Contact era Native American archaeological sites were identified. Although the primary goal of the Phase I study was to locate pre-Contact era Native American sites, evidence of the parcel's past historic use was encountered in many areas. The historic period artifacts that were recovered reflected the mixed-use of the parcel over time, such as children's toys (jacks and marbles) from when it housed an orphanage. However, none of these archaeological deposits were determined to be significant. Therefore, the UVM CAP recommends that no further

archaeological study is warranted for this project as its construction will have no effect on potentially significant cultural resources. Please let us know if you would like us to send a copy of this report to Scott Dillon of the Vermont Division for Historic Preservation (VDHP) for his review and concurrence.

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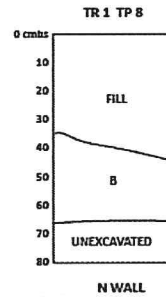
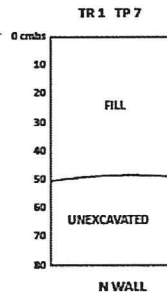
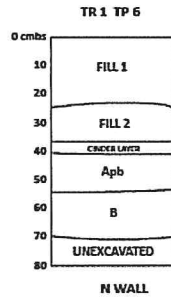
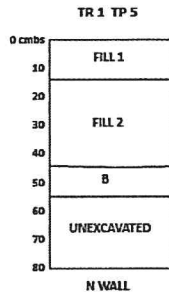
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Appendix 1: Soil Profiles
Key to Soil Profiles

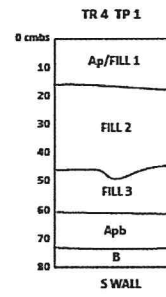
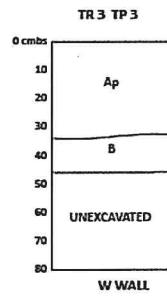
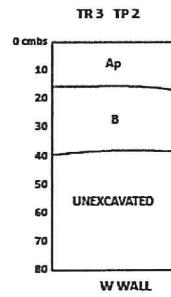
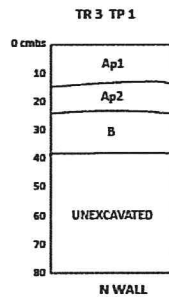
OA	Undisturbed organic horizon
A	Organic horizon
Al	Alluvial horizon
Ap	Plow zone or disturbed layer
B	Horizon which has been physically And chemically weathered
b	Buried horizon
C	Subsoil horizon; parent material From which soil forms
E	Pale gray to gray mineral horizon Containing predominantly quartz And lacking clay, iron, and aluminum
cl	Clay
g	Gravel
l	Loam
s	Sand
si	Silt
c	Coarse
dk	Dark
f	Fine
lt	Light
m	Medium
v	Very
blk	Black
brn	Brown
brwnsh	Brownish
gry	Gray
olv	Olive
pl	Pale
yllw	Yellow
yllwsh	Yellowish

**BURLINGTON COLLEGE DEVELOPMENT
PHASE I, JUNE 2016
SCHEMATIC STRATIGRAPHIC SOIL PROFILES
TRANSECTS 1, 3 AND 4**



KEY:

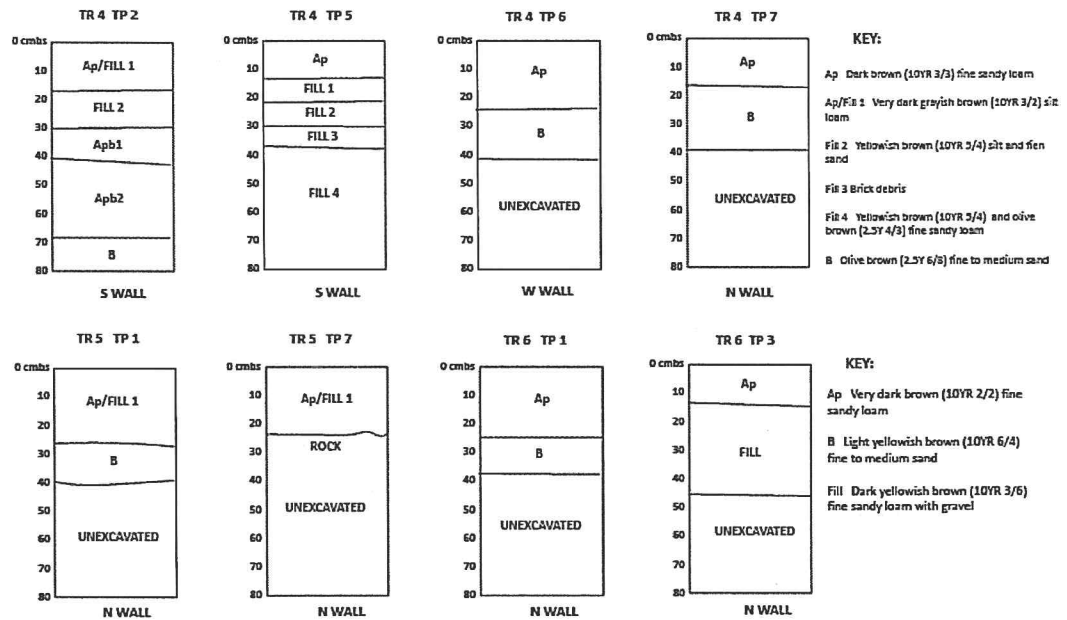
FILL and FILL 1 Dark brownish gray (10YR 4/2) fine sandy loam with gravel and rocks
FILL 2 Very dark grayish brown (10YR 3/2) fine sandy loam with gravel
Apb Dark brown (10YR 3/8) fine sandy loam
B Light Olive brown (2.5Y 3/6) fine to coarse sand



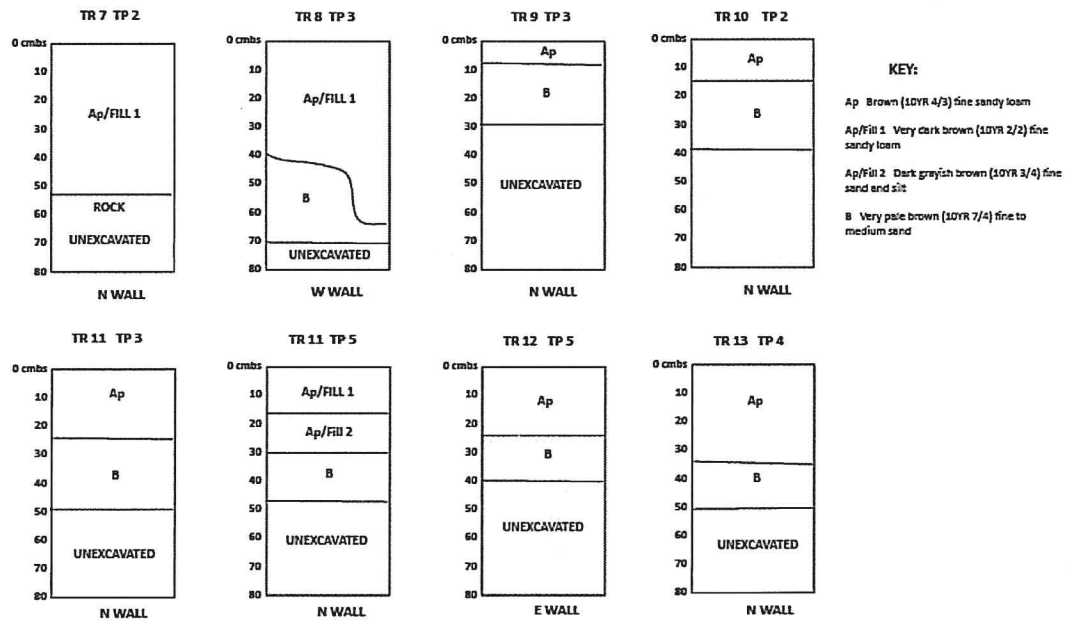
KEY:

Ap1 Dark brown (10YR 3/3) fine sandy loam
Ap2 Light olive brown (2.5Y 3/3) fine sand with light gravel
Ap/FILL 1 Very dark grayish brown (10 YR 3/2) fine sandy loam
FILL 2 dark brown and yellowish brown (10YR 3/3 and 10YR 3/6) fine sandy loam
FILL 3 Pale brown (10YR 6/3) fine sand

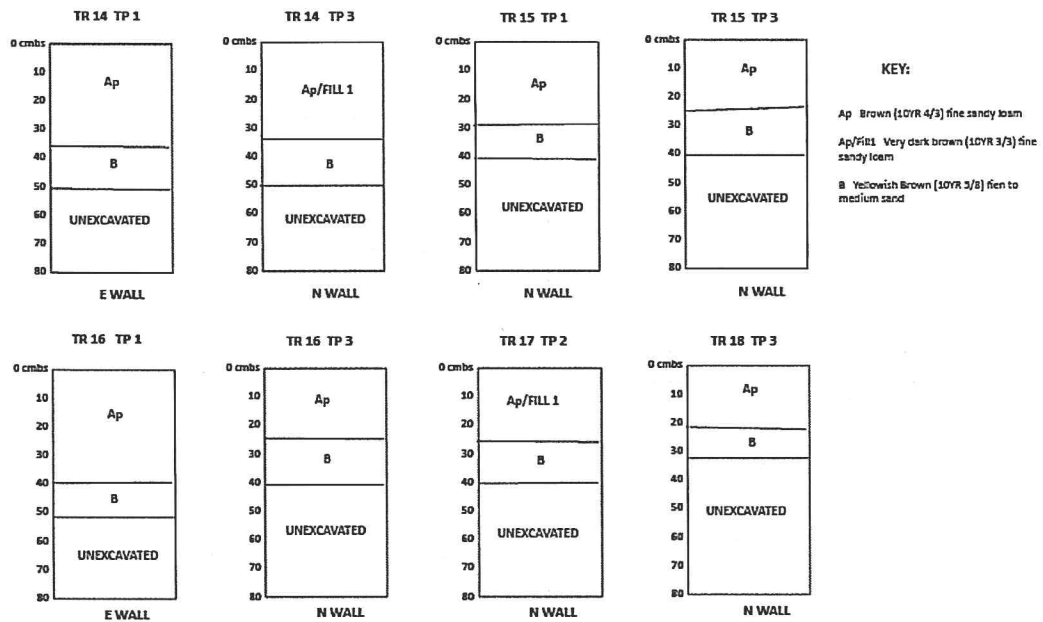
BURLINGTON COLLEGE DEVELOPMENT
PHASE I, JUNE 2016
SCHEMATIC STRATIGRAPHIC SOIL PROFILES
TRANSECTS 4, 5 AND 6



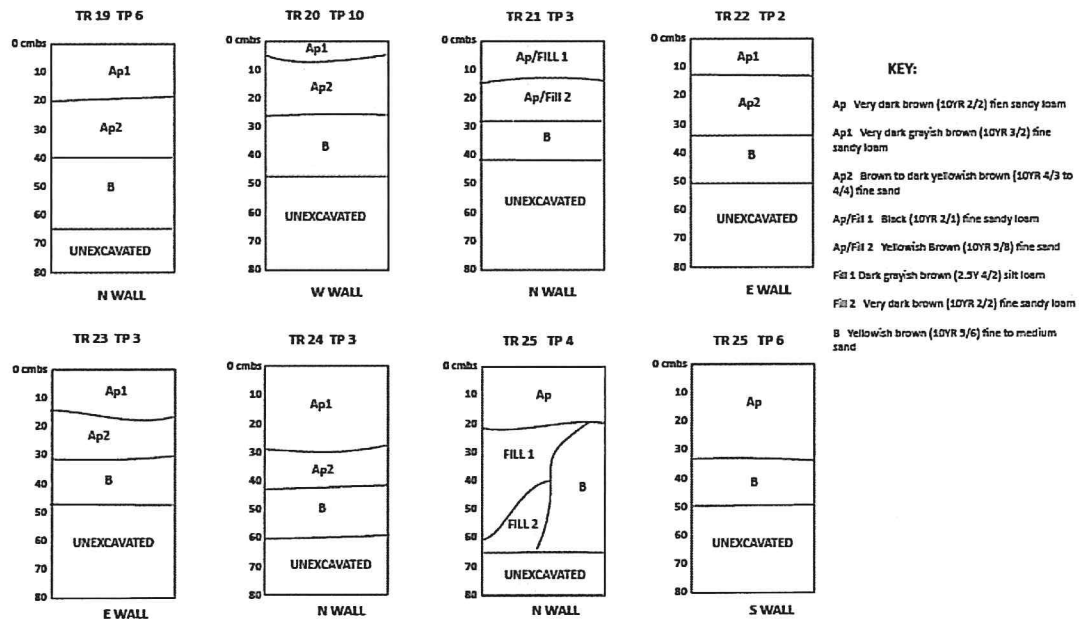
BURLINGTON COLLEGE DEVELOPMENT
PHASE I, JUNE 2016
SCHEMATIC STRATIGRAPHIC SOIL PROFILES
TRANSECTS 7-13



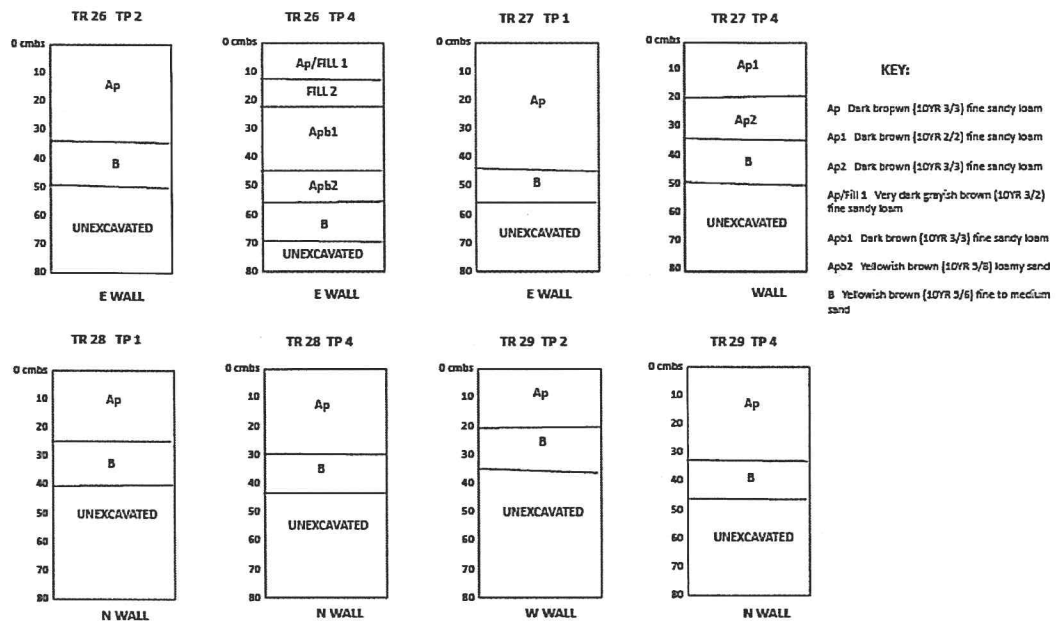
BURLINGTON COLLEGE DEVELOPMENT
 PHASE I, JUNE 2016
 SCHEMATIC STRATIGRAPHIC PROFILES
 TRNSECTA 14-18



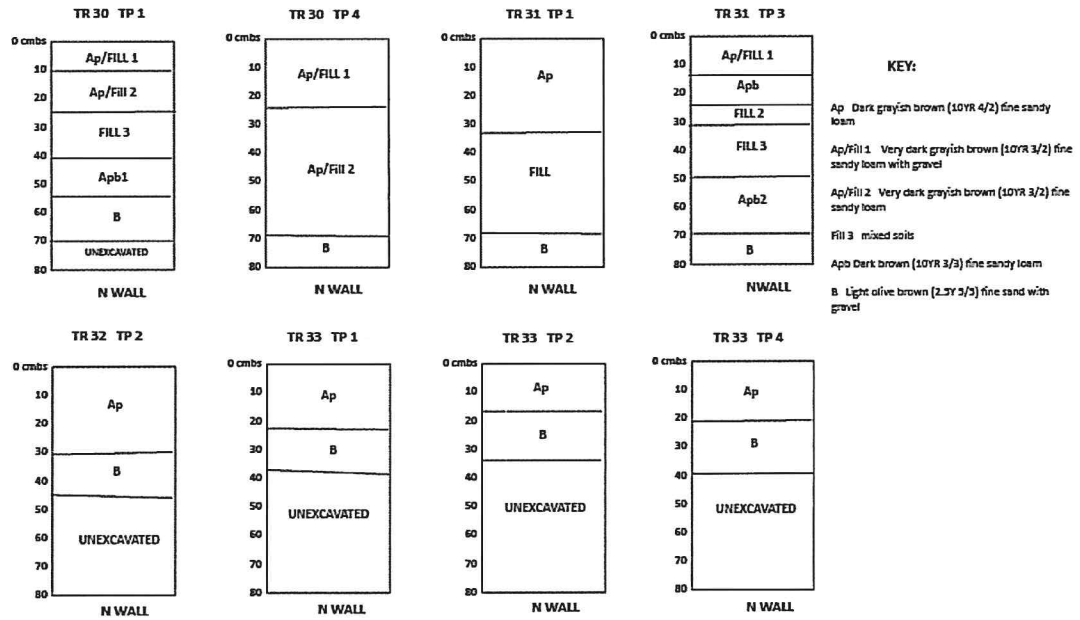
BURLINGTON COLLEGE DEVELOPMENT
PHASE I, JUNE 2016
SCHEMATIC STRATIGRAPHIC SOIL PROFILES
TRANSECTS 19-25



BURLINGTON COLLEGE DEVELOPMENT
PHASE I, JUNE 2016
SCHEMATIC STRATIGRAPHIC SOIL PROFILES
TRANSECTS 26-29



**BURLINGTON COLLEGE DEVELOPMENT
PHASE I, JUNE 2016
SCHEMATIC STRATIGRAPHIC SOIL PROFILES
TRANSECTS 30-33**



			Residential						Parking Spaces
Building	Use	Type	Unit Count	Non-residential	Non-residential	Non-residential	Non-res.	No. Levels	Provided
				Square Footage	Primary	Secondary	Tertiary		Structured + Surface
Burlington College Parcel									
A	Residential	For Rent	65					5 Story	
B & G	Former College	For Rent/Sale	71	23,000	Prof./Trade School	Restaurant	Bakery	3 Story	
C	Multi-Use	For Rent	81	10,476	Office	Retail		5 Story	
D	Parking Garage	For Rent	-	23,000	Garage			3 Story	
E & F	Residential	For Rent	122	2,000	Office			5 Story	
Sub-total - College Parcel			339	58,476					
Relative Percentage (based upon building SF)						College Parcel Parking Total:			477 spaces
BC Community Housing, LLC parcel									
H	Residential	For Rent	57	5,639	Office			4 Story	91
I	Residential	For Rent	28	4,025	Daycare	Office		5 Story	41
I	Fitness	N/A		19,000	Fitness			Ground Fl	
J	Greenhouse	N/A		3,000	Greenhouse			1 Story	
K & L	CSC/CSC Residential	Sell Off	146					4 Story	179
M	Residential	For Sale	79	3,024	Retail	Office		4 Story	106
P	Residential	For Sale	52	1,000	Retail			4 Story	82
Q	Residential	For Sale	34					5 Story	75
R	Commercial		42	33,000	42 room Hotel				42
Sub-total - BCCH Parcel			396	68,688		BCCH + Non-Profit Parcel Parking Total:			616
Grand Totals			735	127,164					1093

RECEIVED
JAN 06 2017
DEPARTMENT OF
PLANNING & ZONING

RECEIVED

JAN 06 2017

PARKING REQUIREMENTS FOR ALL CAMBRIAN RISE SITES										
915 Required Spaces		Allocated as Shown		DEPARTMENT OF PLANNING & ZONING						
Residential Uses		Non-Residential	Commercial Uses			Professional/Trade College				
	Apartment	Residential	Bakery	Restaurant	Hotel	Office	Daycare	Retail	Trade College	
	1	Commercial	2.5	3.0	0.75	3.0	1.0	2.0	3.0	
	space/unit	in Square Ft	spaces/per 1000sf	spaces/per 1000sf	spaces/ hotel room	spaces/per 1000sf	per 5 children+1	spaces/per 1000sf	spaces/per 1000sf	TOTALS
Building A	65									65
Residential	71									71
Bldgs B+G (Comm)BAKERY		600	2							2
Restaurant		2,050		6						6
General Office		3,800				11				11
College Use		16,550							50	50
Building C	81									81
Comm./Bldg C										
General Office		8,801				26				26
Retail		1,675						3		3
Bldg D Garage		23,000								
Building E	122									122
Building F										
Comm/Bldg E+F										
General Office		2,000				6				6
Building H	57									57
Commercial		5,639				17				17
Building I	28									28
Building I/Fitness**		19,000								
Daycare (75 total kids)		4,025					16			16
Building J/Grnhse(accessory)**		3,000								
Building K/CSC	70									70
Building L/CHT	76									76
Building M	79									79
Office/Service		3,024				9				9
Building P	52									52
Retail		1,000						2		2
Building Q	34									34
Bldg R - 42 Room Hotel		33,000			32					32
TOTAL REQ'D PARKING:			2	6	32	69	16	5	50	915
Total Residential (in Units): 735										
Total Non-Residential (in SF): 127,164										
NON-RESIDENTIAL SUMMARY										
82,164	sf/commercial space									
45,000	sf/non-residential + support space									
127,164	sf TOTAL NON-RESIDENTIAL									
SUMMARY OF PARKING SUPPLIED										
TOTAL PARKING IN GARAGES:										888
TOTAL SURFACE LOT PARKING:										205
TOTAL SURFACE + GARAGE PARKING:										1093
On-Street Spaces (not counted in total)										92

Breakdown of Parking Supplied for Cambrian Rise Residents				
	Spaces for Rental Units	Spaces for Condos + Non-Profits	Street Spaces	TOTALS
Total Garage:	494	394		888
Total Surface Lots:	<u>115</u>	<u>90</u>		<u>205</u>
SUBTOTALS:	609	484		1093
Total On-Street:				
North Rd			20	20
South Rd			27	27
West Rd			45	45
	TOTAL with On-StreetSpaces:			1185

November 30, 2015

Development Agreement

This Development Agreement ("Agreement") is entered into as of the ___ day of _____ 2015 (the "Effective Date") by and between the **CITY OF BURLINGTON**, a Vermont municipal corporation (the "City"), **VERMONT LAND TRUST, INC.**, a Vermont non-profit corporation ("VLT"), **CHAMPLAIN HOUSING TRUST, INC.**, a Vermont non-profit corporation ("CHT"), and **BC COMMUNITY HOUSING, LLC**, a Vermont limited liability company ("BCCH"). Hereafter, the City, VLT, CHT, and BCCH may each be referred to individually as a "Party" and collectively as the "Parties."

WHEREAS, BCCH is the owner of ± 27.65 acres of land situated between North Avenue and Lake Champlain, with an address of 311 and 329 North Avenue, Burlington, as more particularly described on *Exhibit A* attached hereto ("the Property"), and as depicted on the plan entitled "BC Community Housing & Burlington College, Site Concepts" prepared by TJ Boyle Associates, a copy of which is attached hereto as *Exhibit B* (the "Plan"); and

WHEREAS, BCCH, the City, CHT, and VLT undertook a non-binding collaborative planning process for the purpose of exploring possible site designs for the Property that resulted in the Plan outlined in the Site Design Process Memorandum of Understanding (*Exhibit C*); and

WHEREAS, the City and VLT wish to preserve ± 12 acres of the Property for use as open space/park space (the "Public Open Space"); and

WHEREAS, CHT is working in collaboration with non-profit partners and other affordable housing entities and wishes to develop 160 units of affordable rental housing for seniors and families which satisfy the inclusionary zoning requirements for rental housing established by the Burlington zoning ordinance (the "CHT Project") on a portion of the remaining ± 15.65 acres of the Property; and

WHEREAS, BCCH wishes to develop a portion of the remaining ± 15.65 acres of the Property for a variety of housing types and non-residential uses (the "BCCH Project"), in conjunction with the development of a 6 acre parcel owned by Burlington College as depicted on the plan (the "College Parcel") for a variety of housing types and non-residential uses; and

WHEREAS, the Parties have reached conceptual agreement on a development and public open space plan for the Property; and

WHEREAS, the process to develop the Plan identified a number of principles restricted by current zoning including, but not limited to, clustering density towards North Avenue and away from the Lake, increasing allowable building heights and reducing surface parking, with an understanding that the above changes are not for the purposes of increasing unit counts or decreasing affordable housing units but rather for the purposes of reconfiguring allowable development and conserving open space, as generally depicted on the Plan; and

WHEREAS, the Parties are in mutual support of good faith efforts to achieve zoning ordinance changes which will allow for reasonable phasing of a project of this magnitude and that will implement the design principles described in the previous paragraph.

WHEREAS, the Public Open Space, the CHT Project the BCCH Project and any development on the College Parcel by BCCH (all as defined below) may be referred to collectively herein as the “Projects.”

WHEREAS, for the purposes of permitting, it is the intent of the Parties that all the Projects will be considered and reviewed as a single PUD; and

NOW THEREFORE, in consideration of the covenants, considerations and mutual benefits set forth herein, and other good and valuable consideration, the receipt and adequacy of which is hereby acknowledged, the Parties agree as follows:

I. Property Use and Development.

1. BCCH, including CHT’s project, plans to establish a multi-lot mixed-use subdivision on the Property. Division and development of the Property shall occur substantially as depicted on the Plan. Any material modifications made to the Plan by BCCH shall be submitted to the City, CHT and VLT with a 10-day opportunity to provide reasonable objections in writing. An objection shall not be reasonable if the material modification(s) proposed by BCCH are consistent with the goals set forth in this Agreement and do not adversely affect a Party’s realization of its expectations under this Agreement. In the event BCCH receives reasonable objections in writing, BCCH shall revise and modify said material modifications to the extent necessary to satisfy any reasonable objections thereto and resubmit the same, as revised, to the City, CHT and VLT. If no objections are made, any such material modification(s) shall be deemed approved by the Parties. In addition, BCCH may make non-material modifications to the Plan from time to time as final design, engineering and permitting of the Development Parcel proceeds provided such modifications are consistent with the goals set forth in this Agreement and do not adversely affect a Party’s realization of its expectations under this Agreement. In addition, provided BCCH adheres to the requirements set forth in Section II below, BCCH shall have the right, in its sole discretion, to make adjustments and modifications to the individual building designs, unit mix and other aspects of the buildings on the Development Parcel without the prior agreement of the Parties, provided such adjustments and modifications are consistent with the goals set forth in this Agreement and do not adversely affect a Party’s realization of its expectations under this Agreement.
2. The Plan contemplates significant development by BCCH and others, including CHT, on a ±15.65 acre portion of the Property (hereafter referred to as the “Development Parcel”), consisting of housing of a variety of types, including affordable and market price residences, both for sale and for rent. A portion of the Development Parcel will be purchased by CHT (the “CHT Parcel”) and improved by CHT and others with 160 units of affordable rental housing for seniors and family housing (the “CHT Project”). The balance of the Development Parcel will be developed by BCCH in the manner described in Section II (1), below, and as shown on the Plan.

3. The Plan contemplates that the City will purchase the Public Open Space, which includes the so-called "Stone House" and its associated garage and which includes that portion of so-called "Texaco Beach" owned by BCCH. The Plan contemplates that the City will improve, own and manage the Public Open Space as open space/park for public purposes; without limitation, except for the provisions of section III below, the City will maintain that portion of so-called "Texaco Beach" owned by BCCH as a public beach under such rules and regulations as apply to City beaches.

II. Development Parcel.

1. Construction on the Development Parcel may include, but not be limited to:
 - a. Approximately 2,200 square feet of new public street with two access points on North Avenue, to be constructed at BCCH's expense.
 - b. 410 units, more or less, of market-rate housing units, both for sale and for rent, including work force housing, so-called and as described in Section II(2) below, developed by BCCH or others together with such non-residential neighborhood-oriented uses as deemed appropriate.
2. In addition to the affordable rental housing to be developed by CHT and others, as set forth in section V below, BCCH will endeavor, but not be obligated, to develop some "work force housing," both for sale and for rent; work force housing being that which targets households with incomes between 80% and 120% of the median income for the Burlington/South Burlington MSA, adjusted for family size. If CHT so elects, BCCH will make a good faith effort to develop all or a portion of the work force housing in partnership with CHT. BCCH will develop a sufficient number of units, which may include the work force housing that targets the 80% level, in satisfaction of the "for sale" inclusionary zoning ("IZ") requirements of the BCCH Project. These "for sale" IZ units will be located on the lot identified as #3 on Exhibit B and such units shall be occupied as per the requirements of Article 9 of the City of Burlington Comprehensive Development Ordinance.
3. The infrastructure developed on the College Parcel may include certain infrastructure shared with the Property, including shared access, utility connections and similar improvements for the mutual benefit of the College Parcel and the Property.
4. BCCH shall use good faith efforts to design and develop the Development Parcel as a "sustainable neighborhood," considering and applying a standard agreed upon by the Parties and established with the advice and guidance of Burlington Electric Department and such other professionals as BCCH may retain, provided, however, that the application of said standards shall be determined by BCCH, in its sole discretion, and

shall be economically feasible and appropriate to the Development Parcel. The Parties will agree on the standard by February 1, 2016. BCCH recognizes that economic feasibility will be analyzed considering both construction costs as well operating costs over the life of the BCCH Project and will explore design options that demonstrate sustainability innovation.

5. The Projects shall have no more than 770 total residential units.

III. Public Open Space.

1. The City shall designate the Public Open Space as part of its Urban Wilds (Exhibit D) category taking into account proposed limited recreational use (trail, community gardens, recreational path connecting to the new public street and open field space) and the existing stone house and garage.
2. BCCH and the City will work collaboratively and in good faith to select a location and configuration for a paved recreation path on the Public Open Space, connecting the new public street to the City's existing recreation path; such new section of the recreation path to be constructed by BCCH at its expense, however, upon its completion, it shall be owned and maintained by the City and made perpetually available to the public. If the City and BCCH cannot agree on a location and/or configuration for the new portion of the recreation path, then BCCH shall have the right to construct, concurrent with the completion of the public street, a privately-owned and maintained recreation path on the Building #8 parcel as depicted on the Plan (the "Building #8 Parcel") with an easement on, over and through the Public Open Space to construct and maintain a recreation path to connect to the City's existing recreation path.
3. The Parties' goals are to manage all storm water on site and to not increase storm water discharge into the City's combined sewer system. BCCH and the City shall collaboratively work on effective, primarily subterranean storm water management on the Public Open Space and serving the Development Parcel and the College Parcel, that maintains the drainage regime to Lake Champlain in the northwest corner of the Property, including BCCH's access to and use of the existing "box culvert" in that location as a component of the overall storm water management strategy for the Property and the College Parcel. This storm water management system may include an easement over, on and through the Public Open Space for BCCH to establish and maintain a storm water detention pond and to install, use and maintain a pump station in the northwest corner of the Property. Such management system shall not impede public use of the Public Open Space, nor shall it adversely impact use and maintenance of the Public Open Space or cause erosion of the recreation path.

IV. Acquisition of the Public Open Space by the City and VLT.

1. On or before February 1, 2016, the City and VLT shall close on the purchase of the Public Open Space from BCCH, for a purchase price of Two Million and 00/100 Dollars (\$2,000,00.00) (the "Conservation Payment") due in cash at closing, on the following terms and conditions:
 - a) BCCH shall survey, and secure a boundary line adjustment to create the 12 acre Public Open Space parcel as depicted on the Plan.
 - b) The sale will be subject to an existing lease of the stone house to Burlington College, provided that the College is current on all payments and is otherwise in compliance with all terms and conditions of the lease at the time of closing.
 - c) The City and VLT agree to be co-applicants and agree that the Public Open Space will be included in BCCH's application for a Planned Unit Development encompassing the Development Parcel, the College Parcel and the Public Open Space. The City and VLT's obligation to participate as co-applicants shall expire if and when the City approves an amendment to zoning that supports the development depicted on the Plan.
 - d) The sale shall be subject to an Option reserved and held by BCCH to repurchase the Public Open Space if either of the following conditions are not met: the City does not approve the requisite zoning changes for the Projects, as provided in paragraph VI(2), below; or if the DRB, for any reason, fails to accept the Certificate of Inclusionary Housing Compliance and/or otherwise fails to accept CHT's right to develop affordable housing (qualifying IZ) units on the CHT parcel, now or in the future, as representing the full satisfaction of BCCH's inclusionary zoning requirements for the BCCH Parcel and the College Parcel for the portion of the Projects developed as multi-family rental units. The Option shall expire upon the City's approval of the zoning change and the DRB's acceptance of the Certificate(s) of Inclusionary Housing Compliance based upon CHT's right to develop the CHT Project on the CHT Parcel, now or in the future, in full satisfaction of BCCH's inclusionary zoning requirements for the portion of the Projects developed as multi-family rental units. If either of the two conditions cited above are not met, then BCCH shall have the right within ninety (90) days of the failure of either condition to provide its notice of intent to repurchase. Within six (6) months of the notice BCCH shall close on the repurchase of the Public Open Space, including any and all improvements thereon, made by the City or VLT after the closing referred to in paragraph 1 above, for a price of Two Million Dollars, plus interest at the rate of 5% per annum running from original date of City/VLT acquisition, free and clear of all liens, mortgages, conservation easements and

encumbrances. Additionally, if BCCH exercises this option, all applicable Parks Impact Fees will be assessed against the BCCH Project notwithstanding the provisions of Section VI, Paragraph 1 of this Agreement.

2. On or before January 15, 2016, the City, VLT and BCCH shall enter into a Purchase and Sale Agreement that incorporates the relevant terms and conditions outlined in this Agreement and additional terms and conditions customarily contained in Purchase and Sale Agreements for commercial property in Chittenden County, Vermont. Although this Section IV accurately describes the Parties' intent, the terms outlined in this Section IV shall only become enforceable obligations under and in accordance with such Purchase and Sale Agreement. The City's obligation to purchase the Public Open Space is further contingent on performance by VLT under the terms of a separate agreement to be entered into by and between the City and VLT.
3. The City and VLT shall pay for their closing costs, including legal fees, related to the acquisition of the Public Open Space.
4. The City shall obtain the necessary local and State permits for any and all improvements it makes to the Public Open Space and pay for all costs and expenses associated therewith, except as otherwise set forth herein.

V. Acquisition of a portion of the Property by CHT.

1. CHT shall enter into an option agreement ("Option") with BCCH on or before December 15, 2015, to acquire a portion of the Property, identified on the Plan as #1 and #2, from BCCH sufficient to develop the CHT Project and related site improvements (exact acreage and location to be determined) (the "CHT Parcel") for a purchase price of One Million Six Hundred Thousand and 00/100 Dollars (\$1,600,000.00). The Option shall incorporate the relevant terms and conditions outlined in this Agreement, including a closing condition such that the parcel to be purchased by CHT will have been assigned or allocated up to 160 units of residential density.
2. Conditional upon the CHT Project approval by the DRB and provided that a) the total number of rental units in the Projects does not exceed 640, b) all 160 units in the CHT Project qualify as IZ units, and c) the CHT Project complies with all IZ requirements including, but not limited to, 9.1.15 of the Burlington Comprehensive Development Ordinance, then the CHT Project shall be deemed to fully satisfy the City's IZ requirement for the portion of the Projects developed as multi-family rental units. In any event, CHT shall only be required to develop the lesser of (i) the actual number of inclusionary zoning units necessary to satisfy the requirement for the portion of the Projects developed as multi-family rental units; or (ii) 160 inclusionary units.
3. Nothing in the Agreement or this Section is intended to waive or reduce the obligations of BCCH under Article 9 of the City of Burlington Comprehensive Development

Ordinance, which is entitled “Inclusionary and Replacement Housing”; however, it is the intent of the Parties to the Agreement that CHT, on its own or with partners, will be fulfilling BCCH’s obligation under Article 9. By virtue of its execution of the Agreement and the Option referenced in Paragraph (V) 1 above, the IZ obligations for that portion of the Projects developed on the College Parcel that consists of multi-family rental units shall be considered fulfilled. Upon the issuance of all necessary municipal and state permits for the CHT Project, the remaining IZ requirements for that portion of the BCCH Project that consists of multi-family rental units shall be considered fulfilled.

4. CHT will seek permits for the CHT Parcel and will create several building pads that will allow for the construction of the units that satisfy IZ requirements in phases. If CHT is unable to perform and complete all phases within six years of receipt of its permits, with an option to extend for an additional three years, then the City will have the option to take possession of the pads as permitted, for consideration of \$10,000 per unit, to ensure that the balance of the units intended to satisfy IZ requirements for the portion of the Projects developed as multi-family rental units are actually constructed. The Parties shall work together in good faith to develop the mechanism by which this paragraph shall be implemented.
5. The City shall not have the right to exercise the option referenced in Paragraph (V)4, above, if the reason CHT has not performed is due to a failure of the DRB to approve CHT’s application for the required number of IZ units.
6. In the event the City takes possession of the pad as permitted, pursuant to the option referenced in 4 above, it shall not be allowed to construct, nor allow others to construct, units on the building pads that do not fulfill CHT’s obligation to develop IZ units, as set forth in this Agreement.

VI. Responsibilities Specific to the City and VLT.

In addition to the City’s responsibilities contained throughout this Agreement, the City shall also be responsible for the following:

1. The City shall, in consideration of improvements to be made to the new Public Open Space and the establishment of the Conservation Payment at a price below fair market value, reduce the Parks & Recreation Department permit and/or impact fees for the Development Parcel by \$300,000.00, with such reduction applicable to the BCCH Project only.
2. The City and BCCH acknowledge and agree that the proposed development of the Development Parcel in the manner described herein and indicated on the Plan will require changes to existing zoning, and they agree to work in good faith to reach agreement on zoning changes required to implement the Plan as it may be amended from time to time.

The City and BCCH's commitments under this Agreement are contingent upon reaching agreement with regard to an array of zoning issues that may be required to implement the development of the BCCH Project and the CHT Projects as generally depicted on the Plan. The City, acting through the Office of the Mayor, shall use good faith efforts to support amendments to the existing zoning ordinance in order to facilitate BCCH's ability to secure approval for the development of the Property in the manner described herein and depicted on the Plan, with the understanding that only the Burlington City Council and Planning Commission have the authority to adopt amendments to the zoning ordinance. The Parties acknowledge that prior to developing the Property in the manner described herein and depicted on the Plan, it will be necessary for BCCH and CHT to obtain approval for the Projects from the Burlington Development Review Board, that the Development Review Board is an independent body not under the City's control, and that the City does not and cannot guaranty that the Development Review Board will approve the Projects.

3. Through the City Council's authorization and upon the execution of this Agreement, the Manager of the City's Housing Trust Fund shall issue Certificates of Inclusionary Housing Compliance, when and as such certificates are required, such that the CHT Project shall be deemed to fully satisfy the City's inclusionary zoning requirement for the portions of the Projects that are developed as multi-family rental units subject to the terms of this agreement. Certificates of Housing compliance with respect to the development of multi-family rental units on the College Parcel will be issued by virtue of the execution of this Agreement and the Option referenced in Paragraph (V) 1 above. Upon the issuance of all necessary municipal and state permits for the CHT Project, Certificates of Housing Compliance will be issued as needed for that portion of the BCCH Project that consists of multi-family rental units.
4. The City and VLT hereby acknowledge that an appraisal commissioned by BCCH may reveal that the Public Open Space has a value in excess of the purchase price. The City and VLT recognize that it is the intent of BCCH to make a charitable contribution to them of the difference between the fair market value and the purchase price. The City and VLT shall cooperate with BCCH in the preparation of Tax Form 8283, as required by the Internal Revenue Service, to substantiate the occurrence of the closing on the sale of the Public Open Space and that a charitable contribution occurred to a qualified organization, but BCCH shall be solely responsible for the calculation and substantiation of the amount and other details of the charitable contribution; provided, however, that neither the City nor VLT will be obligated to so cooperate if it has significant concerns about the tax deduction. BCCH acknowledges that in order to claim a charitable contribution, BCCH will have to comply with the IRS substantiation requirements. This provision shall survive closing of the sale of the "Public Open Space."

VII. Responsibilities Specific to BCCH.

In addition to BCCH's responsibilities contained throughout this Agreement, BCCH shall

also be responsible for the following:

1. BCCH will make contributions to public improvements planned for the existing nature trail (i.e. reconstruction of trail base, widening of trail, tree trimming/removal, and signage) on the Public Open Space as depicted on the Plan after the City Closing as and when such improvements are completed in an amount not to exceed \$100,000.00 in consultation with the Department of Parks, Recreation and Waterfront.
2. BCCH shall use its best efforts to preserve significant trees located within thirty (30) feet of its common northerly boundary line with the City cemetery in collaboration with the City Arborist, meaning that at the very least; BCCH shall not remove any trees with a diameter greater than 36 inch in caliper without the prior consent of the City Arborist.
3. BCCH shall not install any solid privacy/screening fencing along its common boundary line between the Public Open Space and the Building #8 Parcel; however, it reserves the right to install ornamental fencing and/or dense landscaping in that location, as well as security lighting.
4. BCCH shall be responsible for paying all costs of developing the new public street as depicted on the Plan and associated infrastructure improvements, including, but not limited to sidewalks, utility connections, storm water management system, street trees, public recreation paths, etc., as may be required by the City or State.

VIII. Responsibilities Specific to CHT.

In addition to CHT's responsibilities contained throughout this Agreement, CHT shall also be responsible for the following:

1. CHT shall be responsible for obtaining its own financing for the development and construction of the CHT Project.
2. CHT shall fully cooperate with BCCH, so that BCCH can qualify for a charitable deduction, in connection with the sale of the CHT Parcel to CHT, or non-profit designee, as a "bargain sale", as defined by the IRC. CHT shall cooperate with BCCH in the preparation of Tax Form 8283, as required by the Internal Revenue Service, to substantiate the occurrence of the closing on the sale of the CHT Project and that a charitable contribution occurred to a qualified organization, but BCCH shall be solely responsible for the calculation and substantiation of the amount and other details of the charitable contribution; provided, however, that CHT will not be obligated to so cooperate if it has significant concerns about the tax deduction. BCCH acknowledges that in order to claim a charitable contribution, BCCH will have to comply with the IRS substantiation requirements. This provision shall survive closing of the sale of the CHT Project.
3. CHT shall be responsible for developing affordable multi-family rental housing units for the Projects, such that BCCH's inclusionary zoning requirements are met for the portions of the Projects that are developed as multi-family rental units.

IX. Responsibilities of the Parties and General Representations and Agreements.

1. As additional consideration for entering into this Agreement, the Parties agree to cooperate with each other, in a timely and expeditious manner, to obtain permits and approvals for the Projects including, without limitation, execution of permit applications. Further, the Parties agree to attend hearings as requested from time to time in support of the Projects (provided the Projects meet the goals set forth in this Agreement) and agree not to appeal, oppose, or otherwise obstruct, either directly or indirectly, the Projects herein in any permit or approval proceeding, including applications for all local, state and federal permits, permit amendments, licenses and approvals required for the development, construction, use and occupancy of the Projects. As used herein, the term “oppose” shall include a request for a hearing or party status in any proceeding or the filing of any action, petition or complaint in or with any court, tribunal or administrative agency opposing or raising claims or objections against the construction or development of the Projects.
2. The Parties agree that the final plan for the Property will accommodate and support alternative forms of transportation, including the use of bicycles, car-sharing and other progressive concepts.

X. Notices.

Any Notices, requests, demands and other communications to be given hereunder shall be in writing and shall be deemed given if delivered or mailed by certified mail, postage pre-paid, return receipt requested, addressed as follows:

If to the City of Burlington:

City of Burlington
149 Church St.
Burlington, VT 05401

If to the Vermont Land Trust:

Vermont Land Trust, Inc.
8 Bailey Avenue
Montpelier, VT 05602

If to Champlain Housing Trust:

Champlain Housing Trust, Inc.
88 King Street
Burlington, VT 05401

If to BC Community Housing, LLC:

BC Community Housing, LLC
P.O. Box 1335
Burlington, VT 05402-1335

XI. Force Majeure.

1. A party shall not be deemed in violation of this Agreement if it is prevented from performing any obligations hereunder by reasons of strikes, boycotts, labor disputes, acts

of God, acts of the public enemy, acts of superior governmental authority, severe weather conditions, riots, rebellion, sabotage, or any other circumstances for which it is not responsible or which is not under its control, and the party experiencing force majeure gives written notice to the other Parties identifying the nature of such force majeure, and when it began. The party experiencing force majeure shall take immediate action to attempt to remove such causes of the force majeure as may occur from time to time, and its operations under this Agreement shall be resumed immediately after such cause has been removed, provided that no party shall be required to settle any labor dispute except upon terms that party deems acceptable. The suspension of any obligations shall not affect any rights accrued under this Agreement prior to the occurrence of the force majeure.

XII. Dispute Resolution; Waiver

1. Dispute Resolution.

a. If any dispute shall arise with regard to the performance or interpretation of any terms of this Agreement, the Parties agree to use the following procedures prior to any party pursuing other available avenues of legal redress: (i) **Negotiation**. A meeting shall be held between representatives of the Parties with decision-making authority regarding the dispute to attempt in good faith to negotiate a resolution of the dispute; such Negotiation Meeting shall be held within three (3) business days of any Party's written request for such a meeting; or (ii) **Mediation** in accordance with this provision in the event the Parties are unable to resolve their dispute through Negotiation.

b. Any Party (the "**Notifying Party**") may initiate Dispute Resolution of any dispute by giving written Notice of Dispute to the other Party (the "**Receiving Party**"). The Notice of Dispute shall include, in detail, the issues in dispute that the Notifying party deems relevant to the mediation. Within five (5) business days following the date of the Notice of Dispute, the Receiving Party shall submit to the party who initiated the Mediation a list of three (3) persons in Vermont who (i) do not have any professional, business, family or personal affiliation with any of the parties that would compromise their independence, (ii) have training, experience and expertise in real estate law, development, permitting, financing and/or construction (as may be relevant to the dispute), and (iii) are reasonably available to mediate the dispute (the "**Mediator List**"). The party initiating the Notice of Mediation shall, within three (3) business days following receipt of the Mediator List select a mediator (the "**Designated Mediator**") from the Mediator List, and give written notice of the identification of the Designated Mediator to the Receiving Party and to the Designated Mediator. If the Receiving Party fails to approve a Mediator List within the time provided above, the Notifying Party shall have the right, upon notice to the Receiving Party, to designate a Designated Mediator who the Notifying Party reasonably believes will satisfy the Mediator criteria set forth above. The Designated Mediator shall, as expeditiously as is reasonably possible, schedule and conduct a mediation of the dispute. The parties shall use their best efforts to make themselves available and to cooperate in the mediation. If a party fails to attend or otherwise participate in the Mediation as scheduled by the Designated Mediator, the

Designated Mediator shall conduct the Mediation and, within ten (10) business days following the Mediation, issue a Mediator's Report with recommendations as to the resolution of the dispute. The cost of Mediation, including any fees charged by the Mediator, shall be paid in equal shares by the Notifying Party and the Receiving Party.

c. All Negotiation shall occur at a mutually agreeable location; all Mediation shall occur or at the office of the Designated Mediator unless the parties to the dispute otherwise agree.

d. The substantially prevailing party in any claim or counterclaim in any legal proceeding relating to or arising from this Agreement shall be entitled to an award of its reasonable attorneys' fees and costs.

2. A waiver by any party of any default in the performance of any of the covenants, terms or conditions of this Agreement shall not be deemed or considered to be a waiver of any other matter, and the various rights, powers, privileges, options and remedies of the Parties herein contained shall be cumulative, and no one of them shall be deemed to be exclusive of any other, or exclusive of any rights, powers, privileges, options or remedies provided by law.

XIII. Miscellaneous

1. This Agreement shall not be assigned by any party without the advance written approval of the other Parties, which shall not be unreasonably withheld or delayed.
2. This Agreement shall be binding on and benefit the parties and the approved successors and assigns. The representations, commitments and obligations of the Parties set forth herein shall survive the execution of this agreement, the Purchase and Sale Agreement, and any and all of the closings referenced herein.
3. This Agreement shall be governed and construed in accordance with the laws of the State of Vermont. In the event any term, covenant or condition herein contained is held to be invalid by any court of competent jurisdiction, such invalidity shall not affect any other term, covenant or condition herein contained, provided that such invalidity does not materially prejudice any party in their respective rights and obligations contained in the valid terms, covenants or conditions hereof. The language in all parts of this Agreement shall in all cases be construed simply according to its fair meaning and not strictly construed against any party, as it is agreed that the Parties participated in the drafting hereof.
4. This Agreement may not be amended except by mutually agreed upon written amendment, signed and dated by the Parties.
5. This Agreement, together with the exhibits referenced herein and/or attached hereto, constitutes the entire agreement between the Parties with respect to the subject matter hereof and supersedes any prior agreements or representations, oral or written, on the

same subject.

6. The headings in this Agreement are for the purposes of reference only and shall not limit or otherwise affect the meaning hereof.

Two Signature Pages To Follow

IN WITNESS WHEREOF, this Agreement is executed by the duly authorized officers or representatives of the parties hereto.

DATED this _____ day of _____, 2015.

CITY OF BURLINGTON

By: _____
Title: _____

STATE OF VERMONT
CHITTENDEN COUNTY, SS

At _____, in said County and State, this ____ day of _____, 2015, personally appeared _____, Member and Duly Authorized Agent of the City of Burlington and he/she acknowledged the within instrument by him/her subscribed, to be his/her free act and deed and the free act and deed of the City of Burlington.

Before me, _____
Notary Public
My Commission expires: 2/10/19

VERMONT LAND TRUST, INC.

By: _____
Title: _____

STATE OF VERMONT
CHITTENDEN COUNTY, SS

At _____, in said County and State, this ____ day of _____, 2015, personally appeared _____, Member and Duly Authorized Agent of Vermont Land Trust, Inc. and he/she acknowledged the within instrument by him/her subscribed, to be his/her free act and deed and the free act and deed of Vermont Land Trust, Inc.

Before me, _____
Notary Public
My Commission expires: 2/10/19

CHAMPLAIN HOUSING TRUST, INC.

By: _____
Title: _____

STATE OF VERMONT
CHITTENDEN COUNTY, SS

At _____, in said County and State, this ____ day of _____, 2015, personally appeared _____, Member and Duly Authorized Agent of Champlain Housing Trust, Inc. and he/she acknowledged the within instrument by him/her subscribed, to be his/her free act and deed and the free act and deed of Champlain Housing Trust, Inc.

Before me, _____
Notary Public
My Commission expires: 2/10/19

BC COMMUNITY HOUSING, LLC

By: _____
Eric F. Farrell, Sole Member of EF Farrell, LLC,
General Member

STATE OF VERMONT
CHITTENDEN COUNTY, SS

At _____, in said County and State, this ____ day of _____, 2015, personally appeared _____, Member and Duly Authorized Agent of BC Community Housing, LLC and he/she acknowledged the within instrument by him/her subscribed, to be his/her free act and deed and the free act and deed of BC Community Housing, LLC.

Before me, _____
Notary Public
My Commission expires: 2/10/19

List of Exhibits

Exhibit A	Property Description
Exhibit B	Plan entitled “BC Community Housing & Burlington College, Site Concepts” prepared by TJ Boyle Associates.
Exhibit C	Site Design Process - Memorandum of Understanding
Exhibit D	Definition of an Urban Wild park

Exhibit A

Being all and the same lands and premises conveyed to BC Community Housing, LLC by Warranty Deed of Burlington College by Warranty Deed dated February 2, 2015 and recorded in Volume 1268, Page 198 of the City of Burlington Land Records, and described therein as follows:

Parcel One:

Being a 9.16 acre, more or less, parcel of land with improvements thereon and depicted as "Burlington College Vol. 1126 Pg. 34 Lot B Exist. 9.16 Ac. (Not Modified)" on a survey entitled "Lot Line Adjustment between 329 & 351 North Avenue Burlington College Burlington, Vermont" dated December 18, 2014, prepared by Civil Engineering Associates, Inc. and recorded in Map Slide 509c of the City of Burlington Land Records (the "Plat").

Being all and the same land and premises conveyed to Burlington College by Warranty Deed of The Roman Catholic Diocese of Burlington, Vermont, Inc. dated December 31, 2010 and recorded in Volume 1126, Page 34 of the City of Burlington Land Records, and being described therein as follows:

"The lands and premises situated on the westerly side of North Avenue in the City of Burlington, commonly known and designated as No. 311 thereon, formerly known as the "Lakeview Sanitarium" property and the "St. Joseph Group Home" property, containing three separate and distinct parcels of land. Said parcels are described as follows:

Parcel 1: Being all and the same lands and premises conveyed to The Roman Catholic Diocese of Burlington, Vermont by Warranty Deed of Alfred Perrota, dated May 19, 1945 and recorded in Volume 122, at Pages 622-623 of the City of Burlington Land Records.

Parcel 2: Being a portion of the lands and premises conveyed to the Roman Catholic Diocese of Burlington, Vermont, Inc. by Warranty Deed of Vermont Catholic Charities, Inc., (resulting successor corporation by way of a merger with St. Joseph Child Center, Inc., formerly known as The Providence Orphan Asylum and Hospital of Burlington) dated December 28, 2010 and recorded in Volume 1126 at Page 32 of the City of Burlington Land Records, which corrects and confirms the Warranty Deed dated April 18, 1975, and recorded in Volume 231, at Pages 561-562 of the Land Records of the City of Burlington. Further being all of "Lot A" as described by Warranty Deed to Vermont Catholic Charities, Inc. from Central Vermont Railway, Inc. dated June 24, 1955 and of record at Volume 146, Page 619 of said Land Records.

Parcel 3: Being a portion of the lands and premises conveyed to the Roman Catholic Diocese of Burlington, Vermont, Inc. by Warranty Deed of Vermont

Catholic Charities, Inc., (resulting successor corporation by way of a merger with St. Joseph Child Center, Inc., formerly known as The Providence Orphan Asylum and Hospital of Burlington) dated December 28, 2010 and recorded in Volume 1126 at Page 32 of the City of Burlington Land Records, which corrects and confirms the Warranty Deed dated April 18, 1975, and recorded in Volume 231, at Pages 561-562 of the Land Records of the City of Burlington. Further being all of "Lot B" as described by Warranty Deed to Vermont Catholic Charities, Inc. from Central Vermont Railway, Inc. dated June 24, 1955 and of record at Volume 146, Page 619 of said Land Records."

Reference is made to the above mentioned deeds and documents, the records thereof and the references therein contained in further aid of this description.

Parcel Two:

Being an 18.49 acre, more or less, unimproved parcel of land depicted as "Burlington College Vol. 1126 Pg. 36 Lot C" on the Plat.

Being all and the same land and premises conveyed to Burlington College by the following two deeds: 1) Warranty Deed of The Roman Catholic Diocese of Burlington, Vermont, Inc. dated December 31, 2010 and recorded in Volume 1126, Page 36 of the Burlington Land Records; and 2) Warranty Deed of The Roman Catholic Diocese of Burlington, Vermont, Inc. dated December 31, 2010 and recorded in Volume 1126, Page 38 of the Burlington Land Records LESS AND EXCEPT a six (6) acre, more or less, improved parcel of land retained by Burlington College and depicted as Lot A on the Plat (the "Retained Parcel"). Being a portion of the lands and premises conveyed to the Roman Catholic Diocese of Burlington, Vermont, Inc. by Warranty Deed of Vermont Catholic Charities, Inc., (resulting successor corporation by way of a merger with St. Joseph Child Center, Inc., formerly known as The Providence Orphan Asylum and Hospital of Burlington) dated December 28, 2010 and recorded in Volume 1126 at Page 32 of the City of Burlington Land Records. Also being a portion of the lands and premises conveyed to the Roman Catholic Diocese of Burlington, by Warranty Deed of Vermont Catholic Charities, Inc., (resulting successor corporation by way of a merger with St. Joseph Child Center, Inc., formerly known as The Providence Orphan Asylum and Hospital of Burlington) dated April 18, 1975, and recorded in Volume 231, at Pages 561-562 of the Land Records of the City of Burlington.

Grantor hereby reserves the following non-exclusive easements over the parcels herein conveyed, which shall be for the benefit of and appurtenant to the Retained Parcel:

1. An easement for the discharge of stormwater from the Retained Parcel via sheet flow or into existing drainage areas and stormwater

- facilities, as such drainage areas and stormwater facilities may be modified and developed by Grantee on the herein conveyed parcels;
2. An easement for utilities providing service to the Retained Parcel; and
 3. An easement, to: i) construct and maintain driveways and sidewalks connecting the Retained Parcel to any future private drives or sidewalks constructed by Grantee or its successors within sixty (60) feet of the Retained Parcel, the locations of which shall be subject to the written approval of Grantee or its successors, which approval shall not be unreasonably withheld, delayed or conditioned; and ii) use said constructed private drives and sidewalks to provide vehicular and pedestrian ingress and egress to and from the Retained Parcel (until such time as any such private drives and sidewalks are accepted by the City of Burlington as a public road(s) or public sidewalks). Grantee shall be under no obligation to construct any private drives or sidewalks in connection with the foregoing easement.

Grantor shall exercise such easement rights in a manner that does not unreasonably interfere with Grantee's development of the parcels herein conveyed. Grantee may, at its expense, re-locate any of the foregoing easements from time-to-time provided that the new location serves the Retained Parcel in a no less convenient manner.

Grantor hereby conveys the following non-exclusive easements over the Retained Parcel, which shall be for the benefit of and appurtenant to the parcels herein conveyed:

1. An easement for the discharge of stormwater from the parcels herein conveyed via sheet flow or into existing drainage areas and stormwater facilities, as such drainage areas and stormwater facilities may be modified and developed by Grantor on the Retained Parcel; and
2. An easement for utilities providing service to the parcels herein conveyed.

Grantee shall exercise such easement rights in a manner that does not unreasonably interfere with Grantor's existing or future use of the Retained Parcel. Grantor may, at its expense, re-locate any of the foregoing easements from time-to-time provided that the new location serves the parcels herein conveyed in a no less convenient manner.

Reference is hereby made to a Declaration of Restrictive Covenant by BC Community Housing, LLC dated February 2, 2015 and to be recorded subsequent hereto in the City of Burlington Land Records, which shall subject a portion of the lands and premises herein conveyed to a restrictive covenant for the benefit of the Retained Parcel.

The lands and premises are conveyed subject to Commissioner's Award in favor of Rutland Canadian Railroad Company dated August 14, 1899 of record in Volume 46, Page 201 of said Land Records.

This parcel is conveyed subject to the terms and conditions of a certain Lease Agreement between the State of Vermont and the City of Burlington, dated June 18, 1985 and recorded in Volume 319 at Page 575 of the Land Records of the City of Burlington.

This parcel is conveyed subject to all matters depicted or noted on the Plat, including but not limited to the railroad right of way. Any and all parts of this parcel below the mean low water mark are conveyed by quitclaim only.

To the extent that it has not been extinguished by merger of title of the dominant and servient estates, Grantor hereby conveys and transfers to Grantee, by quitclaim only, all of its right, title and interest in that certain right-of-way described as an "open and unobstructed right of way for all purposes" in the Warranty Deed from William C. Stacy, et al to the Providence Orphan Asylum and Hospital of Burlington dated September 30, 1872 and recorded in Volume 10 at Page 374 of the City of Burlington Land Records.

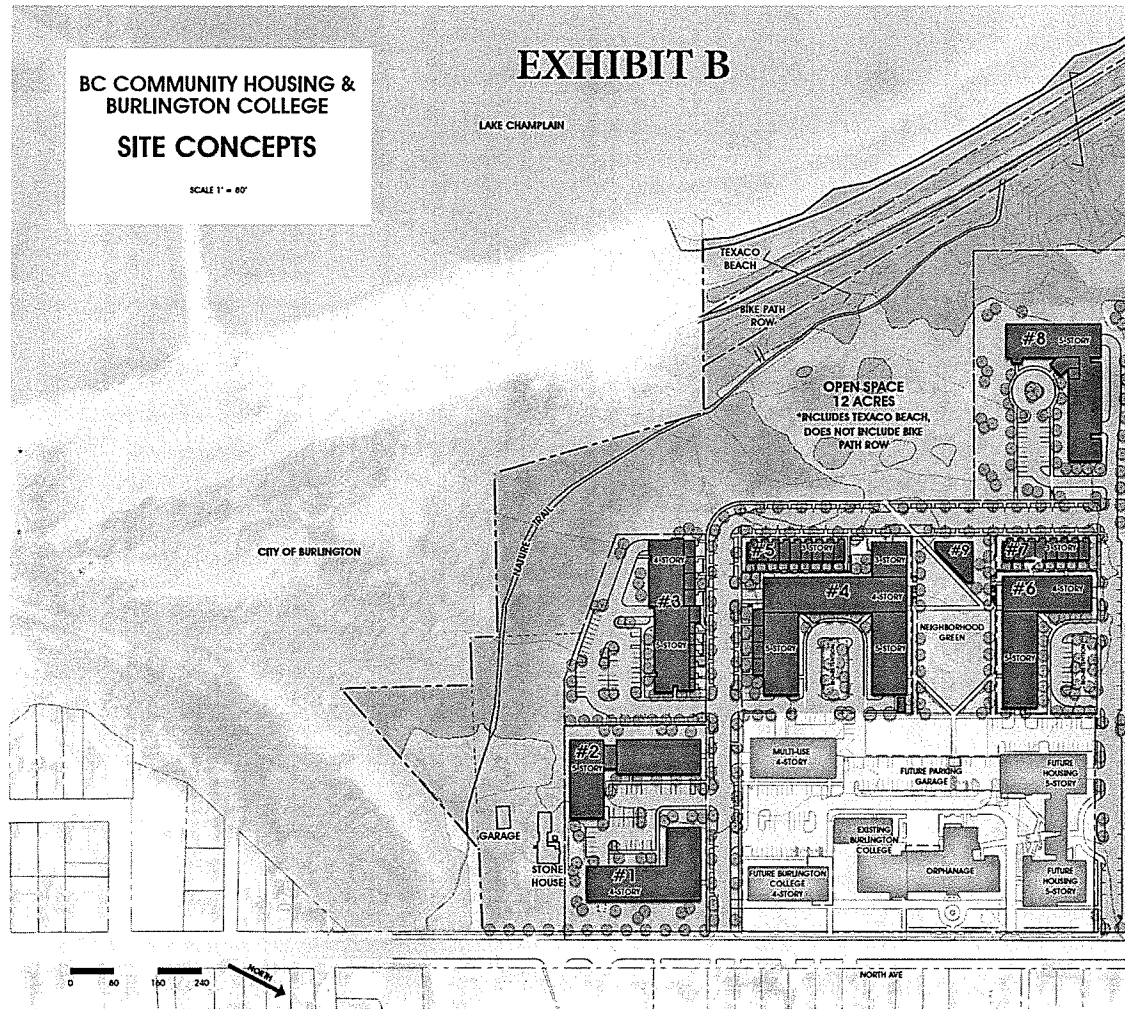
Reference is made to the above mentioned deeds and documents, the records thereof and the references therein contained in further aid of this description.

BC COMMUNITY HOUSING &
BURLINGTON COLLEGE
SITE CONCEPTS

SCALE 1" = 80'

EXHIBIT B

LAKE CHAMPLAIN



BC COMMUNITY HOUSING SITE
DEVELOPMENT PROGRAM

Bldg.

FOR RENT - AFFORDABLE HOUSING

#1 Senior
#2 Family

FOR RENT - MARKET RATE HOUSING

#4 Multi-Family
#6 Multi-Family

FOR SALE - MARKET RATE HOUSING

#3 Multi-Family (Workforce)
#5 Townhouses
#7 Townhouses
#8 Multi-Family

#9 Neighborhood Community Building

TOTAL HOUSING UNITS

BURLINGTON COLLEGE SITE
DEVELOPMENT PROGRAM

COLLEGE BUILDINGS	SF
Exsting	32,000
Future	40,000

RENTAL HOUSING	UNITS
Orphanage	63
Future Housing	177
TOTAL HOUSING UNITS	240

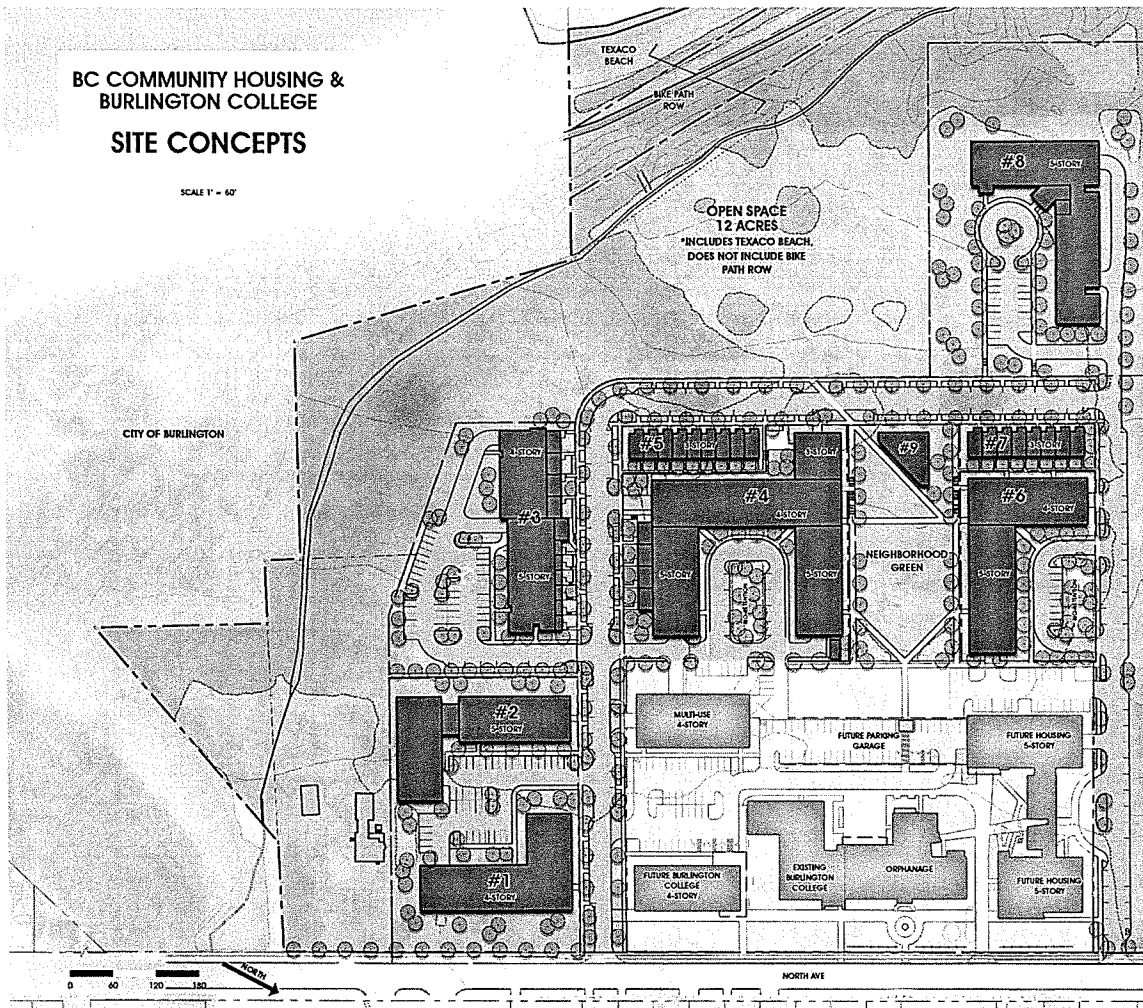
NON-RESIDENTIAL	SF
Future	20,000

LAKE VIEW CEMETERY

T. J. Boyle Assoc.
landscape architects + planners

BC COMMUNITY HOUSING & BURLINGTON COLLEGE SITE CONCEPTS

SCALE 1" = 60'



BC COMMUNITY HOUSING & BURLINGTON COLLEGE DEVELOPMENT PROGRAM

Bldg.

FOR RENT - AFFORDABLE HOUSING

- #1 Senior
- #2 Family

FOR RENT - MARKET RATE HOUSING

- #4 Multi-Family
- #6 Multi-Family

FOR SALE - MARKET RATE HOUSING

- #3 Multi-Family (Workforce)
- #5 Townhouses
- #7 Townhouses
- #8 Multi-Family

- #9 Neighborhood Community Building

TOTAL HOUSING UNITS

BURLINGTON COLLEGE SITE DEVELOPMENT PROGRAM

COLLEGE BUILDINGS	
Existing	3
Future	4

RENTAL HOUSING	
Orphanage	4
Future Housing	1
TOTAL HOUSING UNITS	2

NON-RESIDENTIAL	
Future	2

LAKE VIEW CEMETERY

T. J. Boyle
landscape architects

EXHIBIT C

Site Design Process - Memorandum of Understanding

Former Burlington College Land

BC Community Housing, LLC ("BCCH") is the owner of 27.65 acres of land recently purchased from Burlington College, located at 311 and 329 North Avenue, Burlington and situated between North Avenue and Lake Champlain ("the Property").

BCCH desires to engage with the following entities: the City of Burlington ("City"), the Vermont Land Trust ("VLT"), and the Champlain Housing Trust ("CHT"), (collectively, the "Interested Parties"), in a non-binding collaborative planning process for the purpose of exploring possible site designs for the Property.

The Interested Parties and BCCH recognize that the Property is iconic and offers the community a unique opportunity to address the significant demand for additional housing within the City, while also responding to other important community needs in creative ways.

The Interested Parties also recognize that any outcome of this process must take into consideration BCCH's substantial investment in the Property and financial risk and allow BCCH to achieve its financial objectives, as determined by BCCH, in its sole discretion.

The Interested Parties also recognize that while the City of Burlington may participate in the process outlined in this MOU, this process shall occur prior to the commencement of the formal regulatory approval process, and no participation by the City or term of this MOU shall bind the City in its role as regulatory authority (e.g., its Development Review Board) or require or authorize the City to act contrary to any constitutional or statutory obligation it may have.

The Interested Parties will explore alternative designs to BCCH's current Master Plan consistent with the City's comprehensive plan that incorporate the following goals:

1. A range of housing types should be incorporated into the development, including housing that will serve a range of income levels and that will provide opportunity for homeownership as well as rental opportunities;
2. The final Plan should include open space, some of which may be required as part of the zoning process, but some of which may require consideration of reasonable compensation to the owner; the open space, including the waterfront beach area west of the bike path, should be open to the public; community gardens and the existing East – West connection to the Bike Path should be enhanced so as to increase the public access to the Waterfront from the Old North End;
3. The bluffs directly east of the bike path should be protected from any construction and development;
4. The development should be sensitive to and protect significant natural features, especially a path, and the tree scape on the bluffs, as well as cultural resources, such as the old orphanage;
5. Neighborhood commercial uses that serve the local neighborhood should be allowed but not required and as a result, consideration should be given to allowing currently prohibited uses;

6. Development of this property should enhance revitalization of Old North End, and commerce along North Avenue should be considered;
7. The development should support alternative modes of transportation in order to minimize traffic impacts;
8. The site plan should incorporate "sustainability" components, such as composting, stormwater management, food production, and energy savings where possible and appropriate.

The Interested Parties will retain a qualified consultant ("Consultant") to facilitate a process that will take broad public input, the product of which may be one or more alternative site plans for the Property. VLT, the City and BCCH will establish a reasonable budget for and share in underwriting the cost of the Consultant's work, and BCCH together with the Interested Parties will direct this work. This process will include:

- The Consultant's familiarizing itself with the Property's physical characteristics, its history, the surrounding landscape context, applicable regulatory and permit constraints, and other relevant information.
- The Consultant's preparing for and conducting an intensive workshop in which the BCCH, the Interested Parties and other community members and experts, including real estate experts, are brought together to help envision one or more alternative site plans for the Property.
- Opportunities for community input before the Interested Parties and BCCH reach agreement on a preferred site plan.

The formal participants in the workshop will be:

BCCH through Eric Farrell and Will Raap, together with its design team of TJ Boyle and Associates, Duncan-Wisniewski Architecture, Civil Engineering Associates

Champlain Housing Trust through Michael Monte

City of Burlington through Jesse Bridges, Peter Owens and a Representative to be selected by the Council

Vermont Land Trust through Gil Livingston

BCCH and the Interested Parties may invite other participants whose knowledge or perspective could improve the process and design outcomes.

During the design process, or as a product of that process, if BCCH and the Interested Parties reach consensus on a preferred site plan that meets the above goals ("Plan"), the Interested Parties will:

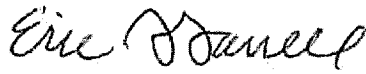
- 1) Work collaboratively to address any conflict or issues related to City regulations, zoning ordinances, or permitting processes (to the extent this would not conflict with the City's regulatory role or statutory obligations);
- 2) Work in good faith to determine a fair and equitable way to achieve all the components of a successful Plan, including utilizing sources such as the Open Space Conservation Fund and other creative methods for offsetting the cost/financial impact to BCCH of the public access and open space components of the Plan to the extent they are not required by existing regulations;

- 3) Consider how other reasonable public incentives, financing mechanisms or other tools could help advance the success of the Plan; and
- 4) If appropriate, coordinate with the City Council to facilitate the approval of an agreement by the Council to any public funding or actions.

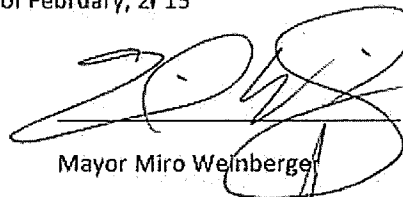
If despite the good faith efforts of BCCH and the Interested Parties, it appears to either BCCH or the City that they have reached or will likely reach an impasse and/or are unlikely to reach agreement on a revised Plan to be submitted for regulatory approval, then this agreement may be unilaterally terminated by either BCCH or the City. Upon termination, the Interested Parties shall have no obligation under this agreement.

BCCH and the Interested Parties will meet with the Consultant to develop a scope of services, timeline and design process details.

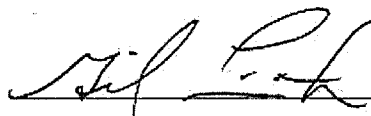
Dated at Burlington, Vermont this 21st day of February, 2015



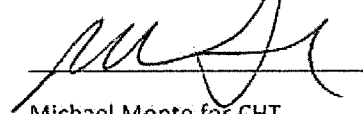
Eric Farrell for BCCH



Mayor Miro Weinberger



Gil Livingston for VLT



Michael Monte for CHT

Exhibit D

Urban Wild

Urban Wilds will be defined as those lands that provide habitat for rare and endangered plant and animal communities, wetlands and other riparian systems, flood plain, unique geological and hydrological features, important wildlife habitat and travel corridors, areas important for scientific research and education, scenic vistas, trails, passive and active recreation, sustainable forest communities, and cultural features.

Portions of other parks within the city possessing sensitive natural features may also be considered "Urban Wilds" for management purposes. All future acquisitions of significant natural areas and important open space for conservation and passive and active recreational purposes will be placed into this category.

Burlington Development Review Board

149 Church Street, City Hall
Burlington, VT 05401

www.burlingtonvt.gov/pz/DRB

Telephone: (802) 865-7188

Fax (802) 865-7195

*Austin Hart
Brad Rabinowitz
Israel Smith
AJ LaRosa
Geoff Hand
Alexandra Zipparo
Wayne Senville
Jim Drummond, (Alternate)
Robert Purvee, (Alternate)*



BURLINGTON DEVELOPMENT REVIEW BOARD Tuesday January 17, 2017, 5:00 PM PUBLIC HEARING NOTICE

The Burlington Development Review Board will hold a meeting on
Tuesday January 17, 2017 at 5:00pm in Contois Auditorium, City Hall.

- 1. 17-0623CA/MA; 311 North Ave (RM-W, Ward 4N) and 329-275 North Ave (NAC-CR, Ward 4N) VLTBTV Parkland LLC, BC Community Housing LLC & Eric Farrell**
Proposed development consisting of 11 buildings containing 733 residential units, Approximately 45000 sq. ft. of non-residential support/amenity space, approximately 45,000 sq. ft. of neighborhood commercial spaces and 1093 parking spaces.
(Project Managers, Scott Gustin, Mary O'Neil)

Plans may be viewed in the Planning and Zoning Office, (City Hall, 149 Church Street, Burlington), between the hours of 8:00 a.m. and 4:30 p.m.

Participation in the DRB proceeding is a prerequisite to the right to take any subsequent appeal. Please note that ANYTHING submitted to the Planning and Zoning office is considered public and cannot be kept confidential.

This may not be the final order in which items will be heard. Please view final Agenda, at www.burlingtonvt.gov/pz/drb/agendas or the office notice board, one week before the hearing for the order in which items will be heard.

Burlington Development Review Board

149 Church Street, City Hall

Burlington, VT 05401

www.burlingtonvt.gov/pz/DRB

Telephone: (802) 865-7188

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Jim Drummond, (Alternate)
Robert Purvee, (Alternate)



BURLINGTON DEVELOPMENT REVIEW BOARD Tuesday January 17, 2017, 5:00 PM Contois Auditorium, City Hall, 149 Church Street, Burlington, VT AGENDA

- I. Agenda**
- II. Communications**
- III. Minutes**
- IV. Public Hearing**

- 1. 17-0623CA/MA; 311 North Ave(RM, Ward 4N) and 329-375 North Ave (NAC-CR, Ward 4N) VLTBTV Parkland LLC, BC Community Housing LLC & Eric Farrell**
Proposed development consisting of 11 buildings containing 733 residential units, approximately 45,000 sq. ft. of non-residential support/amenity space, approximately 45,000 sq. ft. of neighborhood commercial spaces and 1093 parking spaces.
(Project Managers, Scott Gustin and Mary O'Neil)

- V. Other Business**
- VI. Adjournment**

Plans may be viewed in the Planning and Zoning Office, (City Hall, 149 Church Street, Burlington), between the hours of 8:00 a.m. and 4:30 p.m.

Participation in the DRB proceeding is a prerequisite to the right to take any subsequent appeal. Please note that ANYTHING submitted to the Planning and Zoning office is considered public and cannot be kept confidential.

This may not be the final order in which items will be heard. Please view final Agenda, at www.burlingtonvt.gov/pz/drdb/agendas or the office notice board, one week before the hearing for the order in which items will be heard.

The programs and services of the City of Burlington are accessible to people with disabilities. Individuals who require special arrangements to participate are encouraged to contact the Department of Planning & Zoning at least 72 hours in advance so that proper accommodations can be arranged. For information call 865-7188 (TTY users: 865-7142).
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MEMO

TO: Eric Farrell, Owiso Makuku, Charlie Pughe
Copy: Laura Wheelock, BTV DPW
FROM: Mark Smith, PE.
DATE: December 28, 2016
SUBJECT: Cambrian Rise – Development Changes

Several changes to the mix of land use are proposed since the Transportation Impact Assessment (TIA), dated 12/21/16 for the Cambrian Rise development project on North Avenue in Burlington, Vermont.

This memorandum is provided as a supplement to the TIA, documenting these changes and their effects on the traffic analysis presented in the original Assessment cited above.

1.0 PROPOSED CHANGES

The development has been revised to include the following additional components:

- 2 hotel rooms
- 6 apartment units
- 2,950 s.f. of technical college space
- 250 s.f. of restaurant space

Vehicle trip generation, as determined by the methods used in the TIA, now includes the following:

Primary trips, as determined by the Institute of Transportation Engineers *Trip Generation Manual*, are summarized by land use code (ITE LUC) in Table 1.

TABLE 1. PRIMARY TRIPS

ITE LUC	Description	Units/size		AM Peak		PM Peak	
				enter	exit	enter	exit
223	Mid-Rise Apartment	673	d.u.	90	199	194	140
311	All-Suites Hotel	42	room	9	7	8	9
540	Junior/Community College	16,550	s.f.	37	13	24	18
565	Daycare Center	4,025	s.f.	26	23	23	26
710	General Office Building	22,541	s.f.	31	4	6	28
826	Specialty Retail Center	2,675	s.f.	0	0	3	4
932	High-Turnover (Sit-Down) Restaurant	2,650	s.f.	16	13	9	6
sub-total				208	260	267	231
total				467		498	

Pass-by trips are not expected to change from the original assessment.

Trips that are associated with each land use, but are expected to take advantage of other uses within the development, are shown in Table 2.

TABLE 2. INTERNAL CAPTURE TRIPS

ITE LUC	Description	Units/size		AM Peak		PM Peak	
				enter	exit	enter	exit
223	Mid-Rise Apartment	673	d.u.	1	4	3	5
311	All-Suites Hotel	42	room	0	2	1	0
540	Junior/Community College	16,550	s.f.	0	0	0	0
565	Daycare Center	4,025	s.f.	8	8	8	8
710	General Office Building	22,541	s.f.	6	3	3	1
826	Specialty Retail Center	2,675	s.f.	0	0	2	2
932	High-Turnover (Sit-Down) Restaurant	2,650	s.f.	7	5	2	3
	sub-total			22	22	19	19
	total			44		38	

In summary, including a 10% reduction in trips due to the effects of Transportation Demand Management, the total external vehicle trips due to the project are shown in Table 3.

TABLE 3. TOTAL EXTERNAL VEHICLE TRIPS

ITE LUC	Description	Units/size		AM Peak		PM Peak	
				enter	exit	enter	exit
223	Mid-Rise Apartment	673	d.u.	80	176	172	122
311	All-Suites Hotel	42	room	8	5	6	8
540	Junior/Community College	16,550	s.f.	33	12	22	16
565	Daycare Center	4,025	s.f.	16	13	14	16
710	General Office Building	22,541	s.f.	22	1	2	24
826	Specialty Retail Center	2,675	s.f.	0	0	1	2
932	High-Turnover (Sit-Down) Restaurant	2,650	s.f.	8	7	13	8
	sub-total			167	214	230	196
	total			381		425	

The net effect of the additional land use is an additional 12 trips in the AM peak hour and 11 trips in the PM peak hour. The total daily trip generation is expected to be 4,620 vehicles per day.

2.0 NET EFFECT OF CHANGES ON TRAFFIC

The net effect of these additional land uses is generally negligible throughout the study area (adding 0.1 seconds of average delay or 1% of capacity utilization (v/c)). Minor exceptions include:

- 1 sec. / 2 sec. average delay added to the Berry St. approach to North Avenue (2022 PM / 2027 PM)
- 4 sec. average delay added to the eastbound approach at Maple and Pine St. (without the planned Champlain Parkway improvements)

Maximum vehicle queue increases were generally negligible as well. Small increases (3-7 ft.) are noted from North St/North Ave. to Battery/Pearl St.

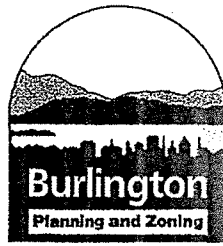
END OF MEMO



Burlington Development Review Board

149 Church Street, City Hall
Burlington, VT 05401
www.burlingtonvt.gov/pz/DRB
Telephone: (802) 865-7188
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Austin Hart
Brad Rabinowitz
Israel Smith
AJ LaRosa
Geoff Hand
Alexandra Zipparo
Wayne Senville
Jim Drummond, (Alternate)
Robert Purvee, (Alternate)



BURLINGTON DEVELOPMENT REVIEW BOARD

Tuesday January 17, 2017, 5:00 PM

Contois Auditorium, City Hall, 149 Church Street, Burlington, VT
Minutes

Board Members Present: Austin Hart, Brad Rabinowitz, Israel Smith, Alexander LaRosa, Alexandra Zipparo, Wayne Senville, Jim Drummond (Ait), Robert Purvee (Ait)

Board Members Absent: Geoff Hand

Staff Members Present: Scott Gustin, Mary O'Neil, Anita Wade

- I. Agenda
- II. Communications
- III. Minutes
- IV. Public Hearing

1. **17-0623CAIMA; 311 North Ave(RM, Ward 4N) and 329-375 North Ave (NAC-CR, Ward 4N)**
VLTBTV Parkland LLC, BC Community Housing LLC & Eric Farrell

Proposed development consisting of 11 buildings containing 733 residential units, approximately 45,000 sq. ft. of non-residential support/amenity space, approximately 45,000 sq. ft. of neighborhood commercial spaces and 1093 parking spaces.
(Project Managers, Scott Gustin and Mary O'Neil)

AHart: asks staff for full address.

S.Gustin: 329-375 North Ave.

AHart: asks the applicant if he will speak about the project overview and general issue of massing of the building and development as a whole.

EFarrell: applicant confirms. Delivers the presentation and provides handouts on the site concept to Board members. Presents a series of slides and animation. Says the technical aspects will be for next week. Discusses rendered site plan handout and proceeds with slide presentation. Mentions minor adjustments to boundary lines on north end.

W.Senville: asks about parking areas, underground parking, and parking for orphanages building.

E.Farrell: intends to bury parking as much as possible for every building except for the orphanage and adjacent building. Shows how buildings create an integrated neighborhood. Many connections for pedestrian access throughout with bike path connections and trails to the bike path. Working with Park and Rec to make sure there is a connection to the bike path. During the opening of the Liberty (orphanage) building temporary parking will be located at building F. Plans to change this concept when phasing in other buildings. Asks other supporters of the project to speak.

G.Livingston: President of VT Land Trust, feels the project integrates a diverse new neighborhood. In agreement with City, Eric and CHT for affordable housing. The execution of the project and the goals meet our expectations.

B.Rabinowitz: asks if Land Trust is involved with the project.

G.Livingston: assisted with loans, but most involvement rests with Jesse.

J.O'Sullivan: state representative and ranking member of the house development and economic committee, is supportive about entire project.

C.Spencer: director of DPW is working with applicant. Reviewed project and stormwater design on West St along with transportation site facilities.

G.Nanton: staff person from the CEDO Office was pleased to support the development, which speaks the largest mixed development and affordable housing project in the City. Mentioned how the developer partnered with CHT and Cathedral Square. Project fosters interaction and community sense of place. Sees an economic benefit with the new retail as an opportunity for new small businesses providing jobs and training.

J.Bridges: City lead with the development agreement and acquisition over a year ago. Spoke of enhanced community gardens and shared boundaries bringing ecological benefits.

A.Hart: questioned Park and Rec's stone house and proximity to large building.

J.Bridges: doesn't see a problem with this. Mentioned link to community gardens having senior access.

B.Rabinowitz: said the park to the west has 10' elevation change. Questioned grading and undefined edge. Asks for the demarcation of the landscaped edge in relation to the park.

J.Bridges: planted 500 trees in area. Viewed as a connection to all park lands in the area. The work on the western edge does not have enough public input to finish the design.

A.Zipparo: asks for types of plantings and those attracting pollinators.

J.Bridges: focus on permaculture edge for fruit trees and pollinators.

A.Zipparo: asks what type of education will happen.

J.Bridges: discussed a natural field program.

A.Zippora: asked if the bike path will be widened.

J.Bridges: said the current path will get widened and formalized but not the non-paved areas.

A.Zipparo: concerned about parts of the path and the tunnel being safe.

M.Montif: CHT financial officer, discussed the partnership over time with Cathedral Square and applicant and that all properties are successful. Will meet inclusionary housing for 25% and a Sash program for seniors, separate from other buildings. Said the need for affordable housing is great. This is the best mixed income development we've seen.

A.Zipparo: asked about housing for homeless persons.

M.Montif: set aside 25%

A.Zipparo: asked if this is long term housing.

M.Monty: yes.

C.Reid: reiterates along with CHT and Eric about the opportunity to build mixed use and offer housing for approximately 750 people who have been waiting up to 3 years for housing. Need more well- designed housing. This project has good access, transportation, social inclusion, and a SASH program as well as a garden of wellness.

A.Zipparo: asks about bus stop on North Ave.

C.Reid: proximity and location are good.

A.Zipparo: asks if there are problems with accessibility.

C.Reid: there are ongoing concerns with safety since this is more densely developed, but seems safer and better.

S.Thibault: Executive Director of CATMA, has had discussions with Eric about TBM for residents for diverse transportation options. Developers are able to be members. Eric has joined to learn how to best serve residents. CATMA will implement programs for a commuter event, customize transportation site, fun themed car-pooling, and regional bike share program starting at the colleges hubs and with hubs at Cambrian rise.

A.Hart: traffic issue will be for a future hearing and it would be helpful for you to be there.

A.Demetrowitz: from Carshare VT said she met with Eric offering incentive program for residents to car share.

E.Boedecker: from Local Motion supported one bike parking space per unit and indoor bike facility.

AHart: introduced Design Advisory Board Member.

M.Bushey: DAB member spoke of design review process and opinions of the Board. Had four meetings and work sessions to review buildings along North Ave due to higher visibility. Applicant revisions satisfied Board. Changes included building F, G, and K.

W.Senville: asked for number of units of housing.

E.Farrell: said there were 735 units.

M.Smith: traffic study includes orphanage building units which is 65 units for a total of 735 units.

A.Hart: opens for public comments on massing and scale of project.

J.Burden: direct neighbor, across the street wanted to know if there would be access to waterfront, and if affordable housing and commercial space would be set aside for women and minorities. Feels the delineation between Cambrian Rise and City Park is a vague community space.

M.Murray: lives in Montpelier. Believes this property is being treated by DNR since it is near brownfield sites. She has written to the mayor and state to determine the environmental health of properties.

A.Hart: do you have more information.

M.Murray: yes.

A.Hart: this is out of our scope tonight and will address this another time.

M.Murray: no one has addressed or considered the condition of the Lake. Asks to leave letters.

A.Hart: leave information with staff.

M.Murray: staff not giving out information.

S.Gustin: have the information in the packet and also have previous correspondence.

A.Hart: will make determination based on your letter.

M.Higgin: lives across the street. Feels there are environmental concerns but feels it is a great opportunity. Thinks it's a densely populated environment. He sees a need for compromise and general consideration toward everyone and in finding the greater good. Suggests all roofs have solar panels and keep sustainable opportunities for housing, and health and environment.

A.Hart: asks Eric to address these concerns.

B.Rabinowitz: addressing scale, less height in some areas, concerns about west property line, grading of walkways, and some accommodation for more landscaping at edge of park showing some differentiation from Park and Rec.

W.Senville: asks the reasoning for a hotel.

E.Farrell: to make area more diverse and hospitable.

A.Zipparo: questions inclusionary housing details in each of building.

E.Farrell: development has an agreement with City, CHT, and with Cathedral Square, signing an agreement for a 25% requirement.

A.Zipparo: asks if they are all inclusionary units.

E.Farrell: building M, K and L units. The landscaping scheme is ongoing and access to the bike path will happen in 2018. Commercial spaces are small individual affordable shops within the community even at large.

W.Senville: asks for staff comment on orphanage building and that overall scale reduces scale of orphanage.

M.O'Neil: article 6.3.2 in the CDO speaks to a site dominated by very large building but that the context is changing.

A.Hart: what happens next and what will be the order of presentation.

E.Farrell: order will be shading, building heights, bike amenities, traffic, stormwater, and lighting, for next week.

A.Hart: asks for phasing and what it looks like over time, traffic, asking for DPW's comments on traffic, stormwater, and also Conservation Board comments.

E.Farrell: will meet with staff and find a better way to organize material.

B.Rabinowitz: asked about lighting fixtures

E.Farrell: there are some inconsistencies and different standards and need to meet with staff

I.Smith: questions the inclusionary housing renderings and that units are all to the south of the street showing a difference in detailing compared with market rate housing. Other questions pertaining to shading requirement for roof of parking areas, and phasing of buildings and connection to the waterfront with any break in the timing of phasing.

E.Farrell: as a partner with nonprofits for years, said that buildings are of equal quality and are indistinguishable.

A.Zipparo: they are segregated. They are farthest away from gardens and open space, and other amenities. This is a problem if inclusionary housing is far off in the corner.

J.Drummond: how much street activity will take place with CATMA and public transportation.

A.Hart: asks for meeting schedule.

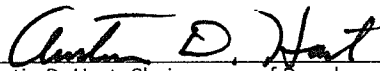
S.Gustin: meeting is reserved for January 24th at the BCA City Arts, Fire House Gallery at 5:00pm located at 139 Church Street.

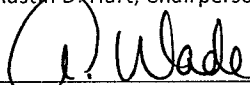
A.Hart: closed public hearing.

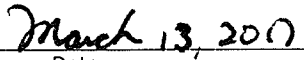
V. Other Business

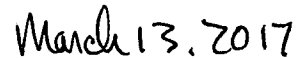
VI. Adjournment

Meeting adjourned at 7:35pm.


Austin D. Hart, Chairperson of Development Review Board


A. Wade, Planning & Zoning Clerk


Date


Date

Plans may be viewed in the Planning and Zoning Office, (City Hall, 149 Church Street, Burlington), between the hours of 8:00 a.m. and 4:30 p.m.

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