Kimley»Horn

***MEMORANDUM***

TO: Cindy Petkac, AICP
Director
Department of Planning and Zoning
Town of Vienna, Virginia

FROM: David Samba, P.E., PTOE

DATE: February 22, 2018

SUBJECT: Mill Street Public Parking Condominium
Traffic and Intersection Analysis

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**Introduction**

The Town of Vienna is reviewing the potential to purchase one floor within a proposed building for use as public parking. The proposed building is a commercial/self-storage development with integrated parking levels. Overall, the building is anticipated to accommodate approximately 300 parking spaces. The parking floor under review by the Town includes approximately 127 spaces. As the Town reviews the project, they have asked Kimley-Horn for ongoing engineering and planning support related to this project.

Based on the proposed locations of the site entrances and the likely routes that would be used to access the site, Town staff directed Kimley-Horn to conduct a traffic and intersection analysis at the intersection of Mill Street and Church Street, including a signal warrant evaluation. The purpose of the evaluation is to determine if the additional traffic generated by the proposed building results in total traffic volumes that exceed the typical amounts that trigger the consideration of a traffic signal.

Town staff also directed Kimley-Horn to provide some guidance on the potential queue spillback to the intersection of Mill Street and Park Street that may result from implementation of a traffic signal at this location.

The analyses described herein were conducted in accordance with Chapter 4C of the Manual on Uniform Traffic Control Devices (MUTCD), 2009 Edition published by the Federal Highway Administration (FHWA).

**Existing Conditions**

The proposed site will be located at 223 to 241 Mill Street in the Town of Vienna, Virginia. The site is located in the northern quadrant of the intersection of Mill Street and Church Street. Mill Street is classified as a local street with one lane in each direction and with no posted speed limits. In the vicinity of the proposed site, Church Street is classified as a collector street with one travel lane and one on-street parking lane in each direction and a posted 25 miles per hour speed limit.

The intersection of Mill Street and Church Street currently operates as an all-way stop controlled intersection and has crosswalks on all approaches. Immediately adjacent intersections are all unsignalized and are located 600 feet to the west (Ayr Hill Avenue NE), 450 feet to the east (Maple Avenue), 215 feet to the south (Dominion Road), and 260 feet to the north (Park Street).

The subject study area shown in **Figure 1.**


*Figure 1: Study Area*

Traffic counts were conducted on Tuesday, February 13, 2018 at the intersection of Mill Street and Church Street between the hours 6:00 AM and 7:00 PM. The peak hours of traffic were identified as 7:45 AM to 8:45 AM in the morning and 4:45 to 5:45 PM in the evening. Hourly traffic counts at the intersection of Mill Street and Church Street are presented in **Table 1**.

Traffic counts were also conducted on February 13, 2018 at the intersection of Park Street and Church Street between the hours 6:00 AM and 9:00 AM and between the hours of 3:30 PM and 6:30 PM. The peak hours of traffic were identified as 7:45 AM to 8:45 AM in the morning and 5:00 PM to 6:00 PM in the evening. The full 6-hour peak period traffic counts are presented in **Table 2**.

*Table 1: Hourly Traffic Counts at Intersection of Church Street and Mill Street*

| Hour Start Time | Church Street | | | | | | | | Mill Street | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NORTHBOUND | | | | SOUTHBOUND | | | | EASTBOUND | | | | WESTBOUND | | | |
| | L | T | R | U | L | T | R | U | L | T | R | U | L | T | R | U |
| **6:45 AM** | 6 | 246 | 5 | 0 | 21 | 106 | 36 | 0 | 218 | 6 | 4 | 0 | 12 | 50 | 10 | 0 |
| **7:45 AM** | 7 | 343 | 16 | 0 | 43 | 218 | 70 | 0 | 343 | 16 | 5 | 0 | 12 | 31 | 10 | 0 |
| **8:45 AM** | 14 | 317 | 26 | 0 | 26 | 148 | 70 | 0 | 266 | 34 | 12 | 0 | 16 | 33 | 23 | 0 |
| **9:45 AM** | 17 | 210 | 15 | 1 | 9 | 127 | 54 | 0 | 127 | 18 | 13 | 0 | 6 | 47 | 6 | 0 |
| **10:45 AM** | 15 | 205 | 8 | 0 | 12 | 184 | 58 | 0 | 119 | 28 | 17 | 0 | 18 | 63 | 11 | 0 |
| **11:45 AM** | 15 | 204 | 22 | 0 | 17 | 210 | 74 | 0 | 128 | 24 | 20 | 0 | 21 | 45 | 21 | 0 |
| **12:45 PM** | 16 | 225 | 10 | 0 | 11 | 227 | 79 | 0 | 107 | 25 | 16 | 0 | 31 | 42 | 13 | 0 |
| **1:45 PM** | 18 | 216 | 18 | 0 | 16 | 220 | 91 | 0 | 94 | 29 | 13 | 0 | 30 | 66 | 15 | 0 |
| **2:45 PM** | 15 | 261 | 7 | 0 | 15 | 265 | 130 | 0 | 141 | 29 | 20 | 0 | 24 | 88 | 6 | 0 |
| **3:45 PM** | 15 | 232 | 12 | 0 | 13 | 330 | 215 | 0 | 147 | 19 | 18 | 0 | 35 | 65 | 16 | 0 |
| **4:45 PM** | 19 | 234 | 19 | 0 | 27 | 421 | 357 | 0 | 182 | 31 | 30 | 0 | 44 | 88 | 9 | 0 |
| **5:45 PM** | 21 | 230 | 14 | 0 | 18 | 394 | 343 | 0 | 155 | 26 | 25 | 0 | 43 | 76 | 8 | 0 |

Peak Hour; L- Left, T- Through, R- Right, U- U-turn

*Table 2: Hourly Peak Period Traffic Count at Church Street and Park Street*

| Hour Start Time | Church Street | | | | | | | | Mill Street | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NORTHBOUND | | | | SOUTHBOUND | | | | EASTBOUND | | | | WESTBOUND | | | |
| | L | T | R | U | L | T | R | U | L | T | R | U | L | T | R | U |
| **6:45 AM** | 37 | 261 | 165 | 0 | 12 | 54 | 1 | 0 | 3 | 35 | 66 | 0 | 46 | 10 | 9 | 0 |
| **7:45 AM** | 69 | 482 | 142 | 0 | 26 | 121 | 1 | 0 | 1 | 70 | 165 | 0 | 50 | 17 | 25 | 0 |
| **8:45 AM** | 28 | 350 | 48 | 0 | 23 | 144 | 53 | 1 | 190 | 53 | 28 | 0 | 27 | 32 | 31 | 0 |
| **4:00 PM** | 74 | 204 | 119 | 0 | 38 | 355 | 2 | 0 | 0 | 61 | 134 | 0 | 139 | 42 | 32 | 1 |
| **5:00 PM** | 60 | 215 | 114 | 0 | 25 | 396 | 1 | 0 | 2 | 119 | 265 | 0 | 167 | 50 | 29 | 0 |
| **6:00 PM*** | 20 | 107 | 74 | 0 | 14 | 168 | 2 | 0 | 3 | 38 | 140 | 0 | 93 | 21 | 14 | 0 |

Peak Hour; L- Left, T- Through, R- Right, U- U-turn; *indicates counts are from 6:00 - 6:30 PM

**Warrant Analysis Methodology**
The MUTCD provides the following standard, among others, regarding justification for traffic control signals:

> **"The satisfaction of a traffic signal warrant or warrants shall not in itself require the installation of a traffic control signal." (Source: MUTCD 2009, Section 4C.01, Paragraph 03)**

According to the MUTCD, the investigation of the need for a traffic control signal shall include an analysis of the applicable factors contained in the following traffic signal warrants and other factors related to existing operation and safety at the study location:

- Warrant 1, Eight-Hour Vehicular Volume
- Warrant 2, Four-Hour Vehicular Volume
- Warrant 3, Peak Hour
- Warrant 4, Pedestrian Volume
- Warrant 5, School Crossing
- Warrant 6, Coordinated Signal System
- Warrant 7, Crash Experience
- Warrant 8, Roadway Network
- Warrant 9, Intersection Near a Grade Crossing

For the purposed this analysis, Warrants 1, 2, and 3 were evaluated.

**Warrant 1 (Eight Hour Vehicular Volume)** Condition 1A is intended for application at locations where a large volume of intersecting traffic is the principal reason to consider installing a traffic signal. Warrant 1 Condition 1B is intended for application where Condition 1A is not satisfied and where the traffic volume on a major street is so heavy that traffic on a minor intersecting street suffers excessive delay or conflict in entering or crossing the major street. If both Condition 1A and Condition 1B are 80% satisfied, Warrant 1C would be satisfied. The criteria thresholds for Warrant 1 are shown in **Table 3**.

*Table 3: Warrant 1, 8 Hour Vehicular Volume Traffic Signal Warrant Thresholds*

| Intersection | Condition A | | Condition B | | Combination Condition | | | |
|---|---|---|---|---|---|---|---|---|
| | Major Street (vph) | Minor Street (vph) | Major Street (vph) | Minor Street (vph) | Condition A | | Condition B | |
| | | | | | Major Street (vph) | Minor Street (vph) | Major Street (vph) | Minor Street (vph) |
| **Mill Street and Church Street** | **500** | **150** | **750** | **75** | **400** | **120** | **600** | **60** |

vph – vehicles per hour

**Warrant 2 (Four Hour Vehicular Volume)** is intended to be applied at locations where the volume of intersecting traffic is the principal reason to consider installing a traffic signal. **Figure 2** shows the threshold chart for the four-hour vehicle volume warrant, based on traffic volume and street configuration.

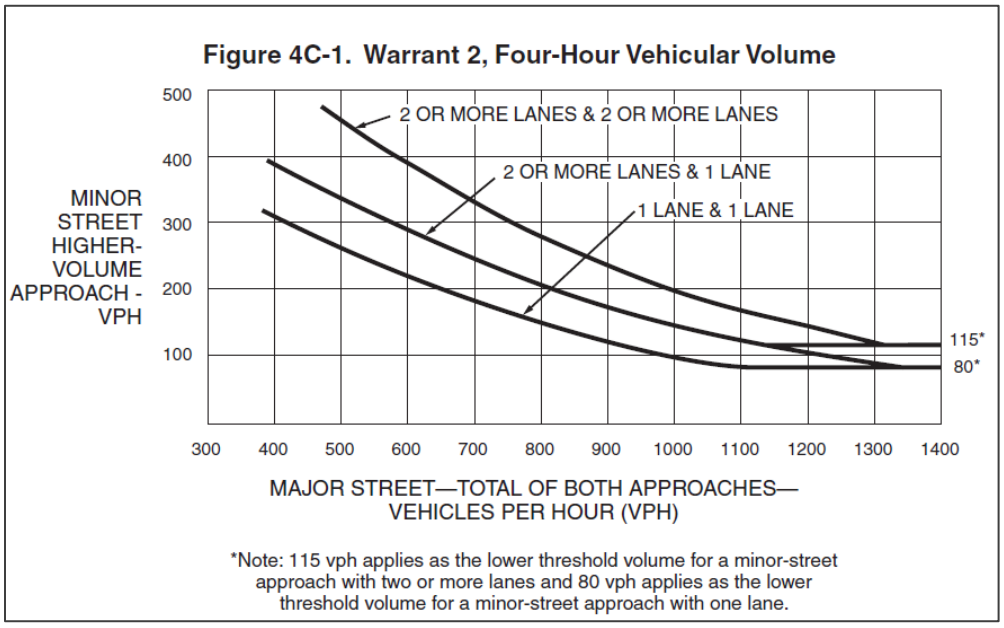


*Figure 2: Warrant 2, 4 Hour Vehicular Volume Traffic Signal Warrant Thresholds*

**Warrant 3 (Peak Hour)** is intended for use at locations where traffic conditions are such that for a minimum of 1 hour of an average day, the minor-street traffic suffers undue delay when entering or crossing the major street. **Figure 3** shows the thresholds for the peak hour vehicle volume warrant, based on traffic volume and street configuration.

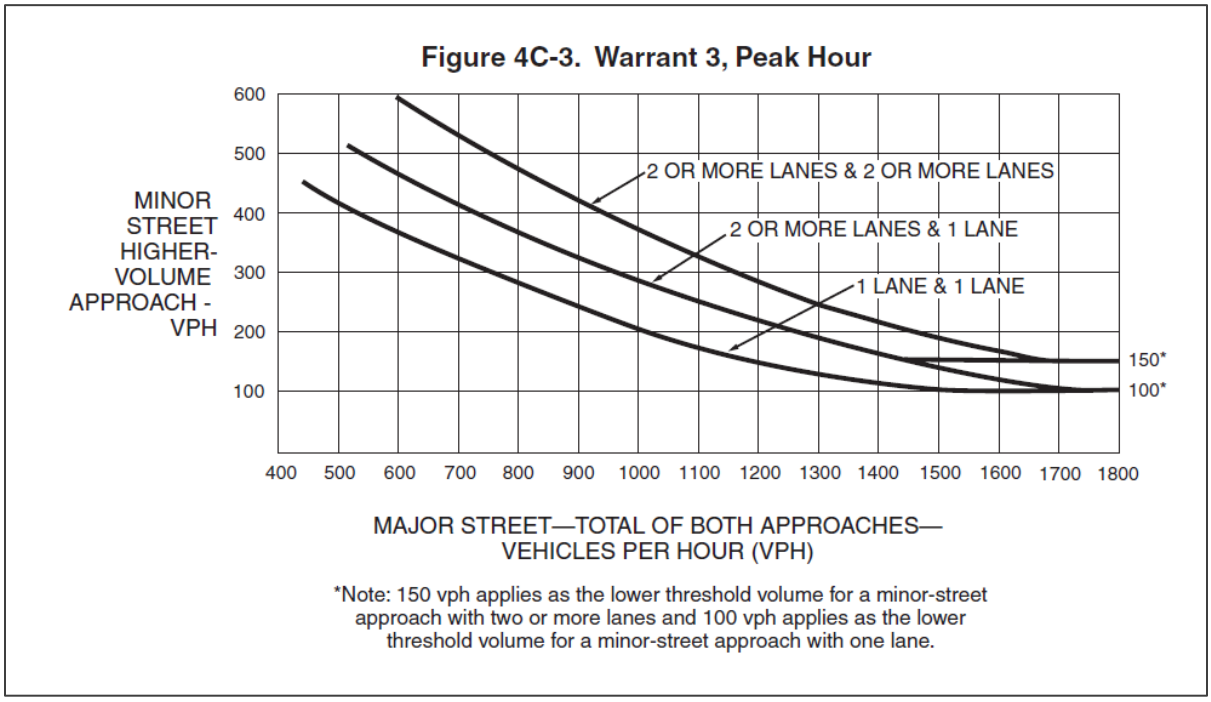


*Figure 3: Warrant 3, Peak Hour Traffic Signal Warrant Thresholds*

**Warrant Analysis Results**

The existing turning movement counts were summarized as major and minor street approach volumes. Based on the observed traffic volumes, Church Street is the major street and Mill Street is the minor street.

The major street traffic volumes, given as the sum of both approaches, and the minor street traffic volumes, given for the highest approach, at the intersection of Mill street and Church Street are shown in **Table 4**.

*Table 4: Existing Hourly Major and Minor Street Approach Volumes at Intersection of Church Street and Mill Street*

| Time | Major Street (Church Street) | Minor Street (Mill Street) |
|---|---|---|
| **6:45 AM** | 420 | 228 |
| **7:45 AM** | 697 | 364 |
| **8:45 AM** | 601 | 312 |
| **9:45 AM** | 433 | 158 |
| **10:45 AM** | 482 | 164 |
| **11:45 AM** | 542 | 172 |
| **12:45 PM** | 568 | 148 |
| **1:45 PM** | 579 | 136 |
| **2:45 PM** | 693 | 190 |
| **3:45 PM** | 817 | 184 |
| **4:45 PM** | 1077 | 243 |
| **5:45 PM** | 1020 | 206 |

The existing conditions warrant results for the traffic analysis and approach lane combinations at the study intersection is shown in **Table 5**.

*Table 5: Existing Hourly Major and Minor Street Approach Volumes at Intersection of Church Street and Mill Street*

| Time | Major Street (Church Street) | Minor Street (Mill Street) | Warrant 1 Condition A Met | Warrant 1 Condition B Met | Warrant 1 Combination Condition Met | Warrant 2 Met | Warrant 3 Met |
|---|---|---|---|---|---|---|---|
| **6:45 AM** | 420 | 228 | No | No | No | **Yes** | No |
| **7:45 AM** | 697 | 364 | **Yes** | No | **Yes** | **Yes** | No |
| **8:45 AM** | 601 | 312 | **Yes** | No | **Yes** | **Yes** | No |
| **9:45 AM** | 433 | 158 | No | No | No | No | No |
| **10:45 AM** | 482 | 164 | No | No | No | No | No |
| **11:45 AM** | 542 | 172 | **Yes** | No | No | No | No |
| **12:45 PM** | 568 | 148 | No | No | No | No | No |
| **1:45 PM** | 579 | 136 | No | No | No | No | No |
| **2:45 PM** | 693 | 190 | **Yes** | No | **Yes** | **Yes** | **Yes** |
| **3:45 PM** | 817 | 184 | **Yes** | **Yes** | **Yes** | **Yes** | No |
| **4:45 PM** | 1077 | 243 | **Yes** | **Yes** | **Yes** | No | No |
| **5:45 PM** | 1020 | 206 | **Yes** | **Yes** | **Yes** | No | No |
| **Hours Met** | | | **7** | **3** | **6** | **5** | **1** |
| **Hours Needed to Meet Warrant** | | | 8 | 8 | 8 | 5 | 1 |
| **Warrant Met?** | | | No | No | No | **Yes** | **Yes** |

A trip generation analysis for the proposed commercial development and parking activity was prepared by Gorove/Slade. The estimate of trips generated by the proposed site is shown as **Figure 4.**

| Land Use | ITE Code | Size | Units | Weekday | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | AM Peak Hour | | | PM Peak Hour | | | Weekday |
| | | | | In | Out | Total | In | Out | Total | Total |
| **Current Use** | | | | | | | | | | |
| Specialty Retail | 826 | 28.0 | kSF | 10 | 12 | 22 | 40 | 49 | 89 | 1,236 |
| **Total Current Use Trips** | | | | **10** | **12** | **22** | **40** | **49** | **89** | **1,236** |
| **Proposed Uses** | | | | | | | | | | |
| Specialty Retail* | 826 | 25.7 | kSF | 9 | 12 | 21 | 37 | 47 | 84 | 1,137 |
| Self-Storage | 151 | 116.5 | kSF | 9 | 7 | 16 | 16 | 15 | 31 | 292 |
| Garage** | N/A | 130 | Spaces | 9 | 12 | 21 | 37 | 47 | 84 | 1,150 |
| **Total Proposed Uses Trips** | | | | **27** | **31** | **58** | **90** | **109** | **199** | **2,579** |
| **Difference (Proposed Uses - Current Use)** | | | | **17** | **19** | **36** | **50** | **60** | **110** | **1,343** |

* The AM peak hour trip generation rates for the Specialty Retail use (ITE Code: 826) are not provided in the ITE Trip Generation Manual. Hence, a trip generation rate equal to 25% of the PM peak hour rate was used.

** The trip generation for the garage use was calculated using the rates for Specialty Retail use. Since approximately 130 spaces will be provided in the parking garage for visitors to the Town of Vienna for shopping, the trip generation was calculated based on a 26,000 square foot specialty retail center (1 parking space per 200 square foot retail).

*Figure 4: Proposed Trip Generation (Source: Trip Generation Comparison Memorandum, Gorove/Slade)*

The peak hour trips associated with the specialty retail and self-storage portions of the development and with 50 percent of the town's proposed parking spaces were used to estimate hourly commercial trips per recommended *ITE Trip Generation* methodology. The 50 percent figure represents parking activity of visitors to the Town and additional retail patrons.

The trips associated with the remaining 50 percent of the town's proposed parking spaces represents parking activity in parking spaces designated for commuters per the proposed NVTA funding request. These trips were assigned to the hour directly before or after the AM and PM peak hour, respectively, to represent commuter parking.

The resulting hourly trips associated with the proposed development and town parking spaces, assigned to the major and minor street, are shown in **Table 6**. The resulting future major and minor street approach volumes are shown in **Table 7**.

*Table 6: Hourly Traffic Associated with the Retail and Commuter Activity of the Proposed Development Along Major and Minor Street Approaches at Intersection of Church Street and Mill Street*

| Time | Major Street (Church Street) | Minor Street (Mill Street) |
|---|---|---|
| **6:45 AM** | 31 | 6 |
| **7:45 AM** | 9 | 13 |
| **8:45 AM** | 16 | 22 |
| **9:45 AM** | 21 | 37 |
| **10:45 AM** | 29 | 55 |
| **11:45 AM** | 47 | 71 |
| **12:45 PM** | 23 | 38 |
| **1:45 PM** | 20 | 36 |
| **2:45 PM** | 19 | 34 |
| **3:45 PM** | 24 | 35 |
| **4:45 PM** | 27 | 37 |
| **5:45 PM** | 24 | 97 |

*Table 7: Future Hourly Major and Minor Street Approach Volumes at Intersection of Church Street and Mill Street*

| Time | Major Street (Church Street) | Minor Street (Mill Street) |
|---|---|---|
| **6:45 AM** | 451 | 234 |
| **7:45 AM** | 706 | 377 |
| **8:45 AM** | 617 | 334 |
| **9:45 AM** | 454 | 195 |
| **10:45 AM** | 511 | 219 |
| **11:45 AM** | 589 | 243 |
| **12:45 PM** | 591 | 186 |
| **1:45 PM** | 599 | 172 |
| **2:45 PM** | 712 | 224 |
| **3:45 PM** | 841 | 219 |
| **4:45 PM** | 1104 | 280 |
| **5:45 PM** | 1044 | 303 |

The future conditions traffic signal warrant results for the traffic volumes and approach lane combinations at the study intersection is shown in **Table 8**.

*Table 8: Future Hourly Major and Minor Street Approach Volumes at Intersection of Church Street and Mill Street*

| Time | Major Street (Church Street) | Minor Street (Mill Street) | Warrant 1 Condition A Met | Warrant 1 Condition B Met | Warrant 1 Combination Condition Met | Warrant 2 Met | Warrant 3 Met |
|---|---|---|---|---|---|---|---|
| **6:45 AM** | 451 | 234 | No | No | No | **Yes** | No |
| **7:45 AM** | 706 | 377 | **Yes** | No | **Yes** | **Yes** | **Yes** |
| **8:45 AM** | 617 | 334 | **Yes** | No | **Yes** | **Yes** | No |
| **9:45 AM** | 454 | 195 | No | No | No | No | No |
| **10:45 AM** | 511 | 219 | **Yes** | No | No | No | No |
| **11:45 AM** | 589 | 243 | **Yes** | No | No | **Yes** | No |
| **12:45 PM** | 591 | 186 | **Yes** | No | No | **Yes** | No |
| **1:45 PM** | 599 | 172 | **Yes** | No | No | **Yes** | No |
| **2:45 PM** | 712 | 224 | **Yes** | No | **Yes** | **Yes** | **Yes** |
| **3:45 PM** | 841 | 219 | **Yes** | **Yes** | **Yes** | **Yes** | **Yes** |
| **4:45 PM** | 1104 | 280 | **Yes** | **Yes** | **Yes** | No | No |
| **5:45 PM** | 1044 | 303 | **Yes** | **Yes** | **Yes** | No | No |
| **Hours Met** | | | **10** | **3** | **6** | **8** | **3** |
| **Hours Needed to meet Warrant** | | | 8 | 8 | 8 | 5 | 1 |
| **Warrant Met?** | | | **Yes** | No | No | **Yes** | **Yes** |

**Table 9** summarizes the traffic signal warrant analysis for the existing and future conditions. The Appendix of this memorandum contains summary worksheets of the traffic volume thresholds and warrant analysis results.

*Table 9: Signal Warrant Analysis Summary*

| Warrants | | Existing Conditions | Future Conditions |
|---|---|---|---|
| **Warrant 1** | **Condition A** | No | Yes |
| | **Condition B** | No | No |
| | **Combination** | No | No |
| **Warrant 2** | | Yes | Yes |
| **Warrant 3** | | Yes | Yes |

Warrant 1 (Condition A) is met under future conditions based on the 8-hour volumes at the study intersection. Warrant 2 is met under both existing and future conditions based on the 4-hour volumes at the study intersection. Warrant 3 is met under both existing and future conditions based on the peak hour volumes at the study intersection.

Traffic signal warrants are not additive, triggering the criteria for multiple warrants does not suggest that there is a higher need for a traffic signal. What the analysis suggest is that, under existing conditions and with the current level of traffic that passes through the intersection on a typical day, a traffic signal is warranted. The addition of traffic related to the development and to the parking activity will result in some amount of additional delay and queuing at the intersection, but does not justify the need for a traffic signal any more than the current traffic does.

It is critical to consider additional factors beyond the results of a warrant analysis when considering the implementation of a traffic signal; a warrant analysis can be part of the *justification* for a signal, but should not be sole reason for one.

Church Street is envisioned as a pedestrian corridor and thus, the pedestrian experience is essential. A traffic signal could potentially increase the delays for pedestrians waiting crossing at the intersection of Church Street and Mill Street, which is antithetical to the pedestrian experience.

Similarly, the compatibility of a traffic signal at this location with a surrounding transportation network of closely spaced all- or two-way stop controlled intersections along Church Street must be closely evaluated. The true effectiveness of the traffic signal may be directly related to the overall compatibility of the entire street.

### Alternative Intersection Analysis

In addition to the signal warrant analysis, an alternative intersection analysis was considered at the intersection of Mill Street and Church Street, using the Virginia Department of Transportation's (VDOT's) Junction Screen Tool (VJust). The tool analyzes, at planning-level, the potential suitability of alternative intersection treatments based on approach lane configuration and peak hour traffic volumes. Based on the geometric constraints of the intersection the following intersection types were considered: conventional (i.e. traffic signal), 50' mini roundabout, 75' mini roundabout, roundabout, and two-way stop control.

The results of the tool are presented in **Figure 5**. Based on the planning level alternatives analysis, it is anticipated that a conventional intersection or a roundabout treatment would operate with acceptable levels of congestion. A two-way stop control intersection would be over-capacity and likely offer no better service than the current all-way stop control. The roundabouts have a potential safety advantage over the conventional intersection due to a reduced number of vehicular conflict points.

**VDOT Junction Screening Tool**

**Results Worksheet**

| General Information | |
|---|---|
| Project Title: | Town Of Vienna Parking Garage |
| EW Facility: | Mill Street |
| NS Facility: | Church Street |
| Date: | |

| Volumes (veh/hr) | U-Turn / Left | Through | Right |
|---|---|---|---|
| Eastbound | 343 | 16 | 5 |
| Westbound | 12 | 31 | 10 |
| Northbound | 7 | 343 | 16 |
| Southbound | 43 | 218 | 70 |

**General Instructions:** All intersection and interchange configurations have a default assumption of one exclusive lane per movement. No results shall be interpreted until the user has verified the lane configurations on each worksheet.

**Intersection Results**

| Type | Dir | Maximum V/C | Accommodation Compared to Conventional | Weighted Total Conflict Points | Notes |
|---|---|---|---|---|---|
| | | Congestion | Pedestrian | Safety | |
| Conventional | - | 0.47 | | 48 | |
| 50 Mini Roundabout | - | 0.62 | | 8 | |
| 75 Mini Roundabout | - | 0.58 | | 8 | |
| Roundabout | - | 0.49 | | 8 | |
| Two-Way Stop Control | - | 1.46 | | 48 | |

*Figure 5: Alternative Junction Screening at Mill Street and Church Street*

## Traffic Analysis

A traffic analysis of the intersection of Mill Street and Church Street and the intersection of Church Street and Park Street was conducted to determine the impacts (vehicle delay/Level of Service and queuing) of a proposed signal. The analysis was conducted using Synchro 9.2 traffic software. The peak hour traffic impact results for the two study intersections are provided in Table 10 (existing conditions), 11 (future conditions), and 12 (future conditions with a traffic signal).

*Table 10: Existing Traffic Operations at Study Intersections*

| Intersection | Approach | Mvmnt | Vehicle Delay (seconds) AM / PM | Level of Service AM / PM | 95 Percentile Queuing (feet) AM / PM |
|---|---|---|---|---|---|
| Mill Street and Church Street | Northbound | TL | 26.1 / 27.2 | D / D | 145 / 127.5 |
| | | R | 9.3 / 10.5 | A / B | 2.5 / 2.5 |
| | Southbound | TLR | 32.0 / 300.3 | D / F | 200 / 1242.5 |
| | Eastbound | TLR | 27.1 / 22.4 | D / C | 155 / 85 |
| | Westbound | TLR | 12.2 / 17.1 | B / C | 12.5 / 37.5 |
| | | **Overall** | **27.6 / 170.4** | **D / F** | - |
| Park Street and Church Street | Northbound | TLR | 98.1 / 99.0 | F / F | 560 / 367.5 |
| | Southbound | TLR | 13.3 / 107.5 | B / F | 37.5 / 385 |
| | Eastbound | TLR | 15.9 / 69.7 | C / F | 70 / 282.5 |
| | Westbound | TLR | 12.6 / 38.7 | B / E | 22.5 / 147.5 |
| | | **Overall** | **60.2 / 83.0** | **F / F** | - |

*Table 11: Future Traffic Operations at Study Intersections (Intersection of Church Street and Mill Street unsignalized)*

| Intersection | Approach | Mvmnt | Vehicle Delay (seconds) AM / PM | Level of Service AM / PM | 95 Percentile Queuing (feet) AM / PM |
|---|---|---|---|---|---|
| Mill Street and Church Street | Northbound | TL | 28.4 / 31.8 | D / D | 155 / 142.5 |
| | | R | 9.6 / 11.1 | A / B | 2.5 / 5.0 |
| | Southbound | TLR | 40.8 / 357.1 | E / F | 247.5 / 1385.0 |
| | Eastbound | TLR | 31.3 / 28.5 | D / D | 177.5 / 115 |
| | Westbound | TLR | 12.8 / 18.8 | B / C | 12.5 / 42.5 |
| | | **Overall** | **32.8 / 200.2** | **D / F** | - |
| Park Street and Church Street | Northbound | TLR | 109.9 / 124.1 | F / F | 605 / 427.5 |
| | Southbound | TLR | 13.5 / 128.5 | B / F | 40 / 432.5 |
| | Eastbound | TLR | 16.5 / 71.8 | C / F | 75 / 280 |
| | Westbound | TLR | 12.8 / 40.1 | B / E | 22.5 / 147.5 |
| | | **Overall** | **67.0 / 97.7** | **F / F** | - |

*Table 12: Future Traffic Operations at Study Intersections (Intersection of Church Street and Mill Street signalized)*

| Intersection | Approach | Mvmnt | Vehicle Delay (seconds) AM / PM | Level of Service AM / PM | 95 Percentile Queuing (feet) AM / PM |
|---|---|---|---|---|---|
| Mill Street and Church Street | Northbound | TL | 9.6 / 6.7 | A / A | 157 / 88.0 |
| | | R | 0 / 0 | A / B | 6.0 / 5.0 |
| | Southbound | TLR | 11.1 / 22.6 | B / C | 160 / #523 |
| | Eastbound | TLR | 12.6 / 21.3 | B / C | #249 / #217 |
| | Westbound | TLR | 8.9 / 17.4 | A / B | 30 / 87 |
| | | **Overall** | **11.0 / 18.8** | **B / B** | - |
| Park Street and Church Street | Northbound | TLR | 109.9 / 124.1 | F / F | 605 / 427.5 |
| | Southbound | TLR | 13.5 / 128.5 | B / F | 40 / 432.5 |
| | Eastbound | TLR | 16.5 / 71.8 | C / F | 75 / 280 |
| | Westbound | TLR | 12.8 / 40.1 | B / E | 22.5 / 147.5 |
| | | **Overall** | **67.0 / 97.7** | **F / F** | - |

# – 95$^{TH}$ percentile queue volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.

Based on the analysis, the intersections currently operate with significant delays. In the future, with the addition of traffic generated by the proposed retail development and parking activity, both intersections will operate with the same level of service as existing conditions but with additional vehicle delays and queuing.

The analysis also demonstrates that the intersection of Mill Street and Church Street can operate with significantly improved level of service with the implementation of a traffic signal. This also significantly reduces the queuing along Church Street, reducing the likelihood of queue spillback to Park Street.

It is noted that while a traffic signal may improve some of the traffic operations at the intersection, the implementation of a traffic signal or of an alternate intersection treatment should consider additional factors such as cost-effectiveness, pedestrian and vehicular safety, geometric impacts, and compatibility with the existing transportation network.

## Close

Thank you for the opportunity to be of service on this important project for the Town of Vienna.

Please do not hesitate to contact us with any further questions.

# Intersection

## TRAFFIC SIGNAL VOLUME WARRANT ANALYSIS

Based on 2003 MUTCD

INTERSECTION NAME: Church Street and Mill Street

COUNT DATE:

INTERSECTION CONDITION: Existing

MAJOR STREET: Church Street

# OF APPROACH LANES: 1

MINOR STREET: Mill Street

# OF APPROACH LANES: 1

ISOLATED COMMUNITY WITH POPULATION LESS THAN 10,000 (Y OR N): N

85TH PERCENTILE SPEED GREATER THAN 40 MPH ON MAJOR STREET (Y OR N): N

| | | | MAJOR ST BOTH APPROACHES | MINOR ST HIGHEST APPROACH | WARRANT 1, Condition A | | | WARRANT 1, Condition B | | | WARRANT 1, Combination Warrant | | | | | | WARRANT 2 | WARRANT 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | CONDITION A | | | CONDITION B | | | | |
| | | | | | MAJOR STREET | MINOR STREET | BOTH MET | MAJOR STREET | MINOR STREET | BOTH MET | MAJOR STREET | MINOR STREET | BOTH MET | MAJOR STREET | MINOR STREET | BOTH MET | | |
| THRESHOLD VALUES | | | | → | 500 | 150 | | 750 | 75 | | 400 | 120 | | 600 | 60 | | | |
| 6:45 AM | TO | 7:45 AM | 420 | 228 | | Y | | | Y | | Y | Y | **Y** | | Y | | **Y** | |
| 7:45 AM | TO | 8:45 AM | 697 | 364 | Y | Y | **Y** | | Y | | Y | Y | **Y** | Y | Y | **Y** | **Y** | |
| 8:45 AM | TO | 9:45 AM | 601 | 312 | Y | Y | **Y** | | Y | | Y | Y | **Y** | Y | Y | **Y** | **Y** | |
| 9:45 AM | TO | 10:45 AM | 433 | 158 | | Y | | | Y | | Y | Y | **Y** | | Y | | | |
| 10:45 AM | TO | 11:45 AM | 482 | 164 | | Y | | | Y | | Y | Y | **Y** | | Y | | | |
| 11:45 AM | TO | 12:45 PM | 542 | 172 | Y | Y | **Y** | | Y | | Y | Y | **Y** | | Y | | | |
| 12:45 PM | TO | 1:45 PM | 568 | 148 | Y | | | | Y | | Y | Y | **Y** | | Y | | | |
| 1:45 PM | TO | 2:45 PM | 579 | 136 | Y | | | | Y | | Y | Y | **Y** | | Y | | | |
| 2:45 PM | TO | 3:45 PM | 693 | 190 | Y | Y | **Y** | | Y | | Y | Y | **Y** | Y | Y | **Y** | **Y** | **Y** |
| 3:45 PM | TO | 4:45 PM | 817 | 184 | Y | Y | **Y** | Y | Y | **Y** | Y | Y | **Y** | Y | Y | **Y** | **Y** | |
| 4:45 PM | TO | 5:45 PM | 1077 | 243 | Y | Y | **Y** | Y | Y | **Y** | Y | Y | **Y** | Y | Y | **Y** | | |
| 5:45 PM | TO | 06:45 PM | 1020 | 206 | Y | Y | **Y** | Y | Y | **Y** | Y | Y | **Y** | Y | Y | **Y** | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | 7,929 | 2,505 | | | **7** | | | **3** | | | **12** | | | **6** | **5** | **1** |
| | | | | | 8 HOURS NEEDED | | | 8 HOURS NEEDED | | | 8 HOURS OF BOTH COND. A AND COND. B NEEDED | | | | | | 4 HRS NEEDED | 1 HR NEEDED |
| | | | | | **NOT SATISFIED** | | | **NOT SATISFIED** | | | **NOT SATISFIED** | | | | | | **SATISFIED** | **SATISFIED** |

WARRANT 1 -- Eight-Hour Vehicular Volume Warrant

Condition A : Minimum Vehicular Volume

Condition B : Interruption of Continuous Traffic

Combination : Combination of Condition A and Condition B

WARRANT 2 -- Four-Hour Vehicular Volume Warrant

WARRANT 3 -- Peak Hour Warrant

# Intersection

## TRAFFIC SIGNAL VOLUME WARRANT ANALYSIS

Based on 2003 MUTCD

INTERSECTION NAME: Church Street and Mill Street

COUNT DATE:

INTERSECTION CONDITION: Future

MAJOR STREET: Church Street

# OF APPROACH LANES: 1

MINOR STREET: Mill Street

# OF APPROACH LANES: 1

ISOLATED COMMUNITY WITH POPULATION LESS THAN 10,000 (Y OR N): N

85TH PERCENTILE SPEED GREATER THAN 40 MPH ON MAJOR STREET (Y OR N): N

| | | | MAJOR ST BOTH APPROACHES | MINOR ST HIGHEST APPROACH | WARRANT 1, Condition A | | | WARRANT 1, Condition B | | | WARRANT 1, Combination Warrant | | | | | | WARRANT 2 | WARRANT 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | CONDITION A | | | CONDITION B | | | | |
| | | | | | MAJOR STREET | MINOR STREET | BOTH MET | MAJOR STREET | MINOR STREET | BOTH MET | MAJOR STREET | MINOR STREET | BOTH MET | MAJOR STREET | MINOR STREET | BOTH MET | | |
| THRESHOLD VALUES → | | | | | 500 | 150 | | 750 | 75 | | 400 | 120 | | 600 | 60 | | | |
| 6:45 AM | TO | 7:45 AM | 451 | 234 | | Y | | | Y | | Y | Y | **Y** | | Y | | **Y** | |
| 7:45 AM | TO | 8:45 AM | 706 | 377 | Y | Y | **Y** | | Y | | Y | Y | **Y** | Y | Y | **Y** | **Y** | **Y** |
| 8:45 AM | TO | 9:45 AM | 617 | 334 | Y | Y | **Y** | | Y | | Y | Y | **Y** | Y | Y | **Y** | **Y** | |
| 9:45 AM | TO | 10:45 AM | 454 | 195 | | Y | | | Y | | Y | Y | **Y** | | Y | | | |
| 10:45 AM | TO | 11:45 AM | 511 | 219 | Y | Y | **Y** | | Y | | Y | Y | **Y** | | Y | | | |
| 11:45 AM | TO | 12:45 PM | 589 | 243 | Y | Y | **Y** | | Y | | Y | Y | **Y** | | Y | | **Y** | |
| 12:45 PM | TO | 1:45 PM | 591 | 186 | Y | Y | **Y** | | Y | | Y | Y | **Y** | | Y | | **Y** | |
| 1:45 PM | TO | 2:45 PM | 599 | 172 | Y | Y | **Y** | | Y | | Y | Y | **Y** | | Y | | **Y** | |
| 2:45 PM | TO | 3:45 PM | 712 | 224 | Y | Y | **Y** | | Y | | Y | Y | **Y** | Y | Y | **Y** | **Y** | **Y** |
| 3:45 PM | TO | 4:45 PM | 841 | 219 | Y | Y | **Y** | Y | Y | **Y** | Y | Y | **Y** | Y | Y | **Y** | **Y** | **Y** |
| 4:45 PM | TO | 5:45 PM | 1104 | 280 | Y | Y | **Y** | Y | Y | **Y** | Y | Y | **Y** | Y | Y | **Y** | | |
| 5:45 PM | TO | 6:45 PM | 1044 | 303 | Y | Y | **Y** | Y | Y | **Y** | Y | Y | **Y** | Y | Y | **Y** | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | 8,219 | 2,986 | | | **10** | | | **3** | | | **12** | | | **6** | **8** | **3** |
| | | | | | 8 HOURS NEEDED | | | 8 HOURS NEEDED | | | 8 HOURS OF BOTH COND. A AND COND. B NEEDED | | | | | | 4 HRS NEEDED | 1 HR NEEDED |
| | | | | | **SATISFIED** | | | **NOT SATISFIED** | | | **NOT SATISFIED** | | | | | | **SATISFIED** | **SATISFIED** |

WARRANT 1 -- Eight-Hour Vehicular Volume Warrant

Condition A : Minimum Vehicular Volume

Condition B : Interruption of Continuous Traffic

Combination : Combination of Condition A and Condition B

WARRANT 2 -- Four-Hour Vehicular Volume Warrant

WARRANT 3 -- Peak Hour Warrant

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 27.6 |
| Intersection LOS | D |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Vol, veh/h | 343 | 16 | 5 | 12 | 31 | 10 | 7 | 343 | 16 | 43 | 218 | 70 |
| Future Vol, veh/h | 343 | 16 | 5 | 12 | 31 | 10 | 7 | 343 | 16 | 43 | 218 | 70 |
| Peak Hour Factor | 0.95 | 0.95 | 0.95 | 0.88 | 0.88 | 0.88 | 0.96 | 0.96 | 0.96 | 0.73 | 0.73 | 0.73 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 361 | 17 | 5 | 14 | 35 | 11 | 7 | 357 | 17 | 59 | 299 | 96 |
| Number of Lanes | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| Opposing Approach | WB | EB | SB | NB |
| Opposing Lanes | 1 | 1 | 1 | 2 |
| Conflicting Approach Left | SB | NB | EB | WB |
| Conflicting Lanes Left | 1 | 2 | 1 | 1 |
| Conflicting Approach Right | NB | SB | WB | EB |
| Conflicting Lanes Right | 2 | 1 | 1 | 1 |
| HCM Control Delay | 27.1 | 12.2 | 25.4 | 32 |
| HCM LOS | D | B | D | D |

| Lane | NBLn1 | NBLn2 | EBLn1 | WBLn1 | SBLn1 |
|---|---|---|---|---|---|
| Vol Left, % | 2% | 0% | 94% | 23% | 13% |
| Vol Thru, % | 98% | 0% | 4% | 58% | 66% |
| Vol Right, % | 0% | 100% | 1% | 19% | 21% |
| Sign Control | Stop | Stop | Stop | Stop | Stop |
| Traffic Vol by Lane | 350 | 16 | 364 | 53 | 331 |
| LT Vol | 7 | 0 | 343 | 12 | 43 |
| Through Vol | 343 | 0 | 16 | 31 | 218 |
| RT Vol | 0 | 16 | 5 | 10 | 70 |
| Lane Flow Rate | 365 | 17 | 383 | 60 | 453 |
| Geometry Grp | 7 | 7 | 2 | 2 | 5 |
| Degree of Util (X) | 0.718 | 0.029 | 0.737 | 0.134 | 0.813 |
| Departure Headway (Hd) | 7.086 | 6.358 | 6.924 | 8.001 | 6.456 |
| Convergence, Y/N | Yes | Yes | Yes | Yes | Yes |
| Cap | 507 | 560 | 521 | 451 | 558 |
| Service Time | 4.867 | 4.138 | 4.998 | 6.001 | 4.534 |
| HCM Lane V/C Ratio | 0.72 | 0.03 | 0.735 | 0.133 | 0.812 |
| HCM Control Delay | 26.1 | 9.3 | 27.1 | 12.2 | 32 |
| HCM Lane LOS | D | A | D | B | D |
| HCM 95th-tile Q | 5.8 | 0.1 | 6.2 | 0.5 | 8 |

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 60.2 |
| Intersection LOS | F |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Vol, veh/h | 1 | 70 | 165 | 50 | 17 | 25 | 69 | 482 | 142 | 26 | 121 | 1 |
| Future Vol, veh/h | 1 | 70 | 165 | 50 | 17 | 25 | 69 | 482 | 142 | 26 | 121 | 1 |
| Peak Hour Factor | 0.81 | 0.81 | 0.81 | 0.79 | 0.79 | 0.79 | 0.95 | 0.95 | 0.95 | 0.76 | 0.76 | 0.76 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 1 | 86 | 204 | 63 | 22 | 32 | 73 | 507 | 149 | 34 | 159 | 1 |
| Number of Lanes | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| Opposing Approach | WB | EB | SB | NB |
| Opposing Lanes | 1 | 1 | 1 | 1 |
| Conflicting Approach Left | SB | NB | EB | WB |
| Conflicting Lanes Left | 1 | 1 | 1 | 1 |
| Conflicting Approach Right | NB | SB | WB | EB |
| Conflicting Lanes Right | 1 | 1 | 1 | 1 |
| HCM Control Delay | 15.9 | 12.6 | 98.1 | 13.3 |
| HCM LOS | C | B | F | B |

| Lane | NBLn1 | EBLn1 | WBLn1 | SBLn1 |
|---|---|---|---|---|
| Vol Left, % | 10% | 0% | 54% | 18% |
| Vol Thru, % | 70% | 30% | 18% | 82% |
| Vol Right, % | 20% | 70% | 27% | 1% |
| Sign Control | Stop | Stop | Stop | Stop |
| Traffic Vol by Lane | 693 | 236 | 92 | 148 |
| LT Vol | 69 | 1 | 50 | 26 |
| Through Vol | 482 | 70 | 17 | 121 |
| RT Vol | 142 | 165 | 25 | 1 |
| Lane Flow Rate | 729 | 291 | 116 | 195 |
| Geometry Grp | 1 | 1 | 1 | 1 |
| Degree of Util (X) | 1.128 | 0.5 | 0.226 | 0.348 |
| Departure Headway (Hd) | 5.566 | 6.545 | 7.427 | 6.731 |
| Convergence, Y/N | Yes | Yes | Yes | Yes |
| Cap | 649 | 554 | 487 | 537 |
| Service Time | 3.613 | 4.545 | 5.427 | 4.731 |
| HCM Lane V/C Ratio | 1.123 | 0.525 | 0.238 | 0.363 |
| HCM Control Delay | 98.1 | 15.9 | 12.6 | 13.3 |
| HCM Lane LOS | F | C | B | B |
| HCM 95th-tile Q | 22.4 | 2.8 | 0.9 | 1.5 |

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 170.4 |
| Intersection LOS | F |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Vol, veh/h | 182 | 31 | 30 | 44 | 88 | 9 | 19 | 234 | 19 | 27 | 421 | 357 |
| Future Vol, veh/h | 182 | 31 | 30 | 44 | 88 | 9 | 19 | 234 | 19 | 27 | 421 | 357 |
| Peak Hour Factor | 0.89 | 0.89 | 0.89 | 0.90 | 0.90 | 0.90 | 0.74 | 0.74 | 0.74 | 0.89 | 0.89 | 0.89 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 204 | 35 | 34 | 49 | 98 | 10 | 26 | 316 | 26 | 30 | 473 | 401 |
| Number of Lanes | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| Opposing Approach | WB | EB | SB | NB |
| Opposing Lanes | 1 | 1 | 1 | 2 |
| Conflicting Approach Left | SB | NB | EB | WB |
| Conflicting Lanes Left | 1 | 2 | 1 | 1 |
| Conflicting Approach Right | NB | SB | WB | EB |
| Conflicting Lanes Right | 2 | 1 | 1 | 1 |
| HCM Control Delay | 22.4 | 17.1 | 26 | 300.3 |
| HCM LOS | C | C | D | F |

| Lane | NBLn1 | NBLn2 | EBLn1 | WBLn1 | SBLn1 |
|---|---|---|---|---|---|
| Vol Left, % | 8% | 0% | 75% | 31% | 3% |
| Vol Thru, % | 92% | 0% | 13% | 62% | 52% |
| Vol Right, % | 0% | 100% | 12% | 6% | 44% |
| Sign Control | Stop | Stop | Stop | Stop | Stop |
| Traffic Vol by Lane | 253 | 19 | 243 | 141 | 805 |
| LT Vol | 19 | 0 | 182 | 44 | 27 |
| Through Vol | 234 | 0 | 31 | 88 | 421 |
| RT Vol | 0 | 19 | 30 | 9 | 357 |
| Lane Flow Rate | 342 | 26 | 273 | 157 | 904 |
| Geometry Grp | 7 | 7 | 2 | 2 | 5 |
| Degree of Util (X) | 0.689 | 0.046 | 0.562 | 0.341 | 1.611 |
| Departure Headway (Hd) | 8.212 | 7.447 | 8.768 | 9.366 | 6.412 |
| Convergence, Y/N | Yes | Yes | Yes | Yes | Yes |
| Cap | 444 | 484 | 415 | 387 | 579 |
| Service Time | 5.912 | 5.147 | 6.768 | 7.366 | 4.412 |
| HCM Lane V/C Ratio | 0.77 | 0.054 | 0.658 | 0.406 | 1.561 |
| HCM Control Delay | 27.2 | 10.5 | 22.4 | 17.1 | 300.3 |
| HCM Lane LOS | D | B | C | C | F |
| HCM 95th-tile Q | 5.1 | 0.1 | 3.4 | 1.5 | 49.7 |

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 83 |
| Intersection LOS | F |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Vol, veh/h | 2 | 119 | 265 | 167 | 50 | 29 | 60 | 215 | 114 | 25 | 396 | 1 |
| Future Vol, veh/h | 2 | 119 | 265 | 167 | 50 | 29 | 60 | 215 | 114 | 25 | 396 | 1 |
| Peak Hour Factor | 0.94 | 0.94 | 0.94 | 0.87 | 0.87 | 0.87 | 0.88 | 0.88 | 0.88 | 0.95 | 0.95 | 0.95 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 2 | 127 | 282 | 192 | 57 | 33 | 68 | 244 | 130 | 26 | 417 | 1 |
| Number of Lanes | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| Opposing Approach | WB | EB | SB | NB |
| Opposing Lanes | 1 | 1 | 1 | 1 |
| Conflicting Approach Left | SB | NB | EB | WB |
| Conflicting Lanes Left | 1 | 1 | 1 | 1 |
| Conflicting Approach Right | NB | SB | WB | EB |
| Conflicting Lanes Right | 1 | 1 | 1 | 1 |
| HCM Control Delay | 69.7 | 38.7 | 99 | 107.5 |
| HCM LOS | F | E | F | F |

| Lane | NBLn1 | EBLn1 | WBLn1 | SBLn1 |
|---|---|---|---|---|
| Vol Left, % | 15% | 1% | 68% | 6% |
| Vol Thru, % | 55% | 31% | 20% | 94% |
| Vol Right, % | 29% | 69% | 12% | 0% |
| Sign Control | Stop | Stop | Stop | Stop |
| Traffic Vol by Lane | 389 | 386 | 246 | 422 |
| LT Vol | 60 | 2 | 167 | 25 |
| Through Vol | 215 | 119 | 50 | 396 |
| RT Vol | 114 | 265 | 29 | 1 |
| Lane Flow Rate | 442 | 411 | 283 | 444 |
| Geometry Grp | 1 | 1 | 1 | 1 |
| Degree of Util (X) | 1.079 | 0.973 | 0.751 | 1.104 |
| Departure Headway (Hd) | 9.18 | 9.158 | 10.305 | 9.285 |
| Convergence, Y/N | Yes | Yes | Yes | Yes |
| Cap | 398 | 398 | 353 | 395 |
| Service Time | 7.18 | 7.158 | 8.305 | 7.285 |
| HCM Lane V/C Ratio | 1.111 | 1.033 | 0.802 | 1.124 |
| HCM Control Delay | 99 | 69.7 | 38.7 | 107.5 |
| HCM Lane LOS | F | F | E | F |
| HCM 95th-tile Q | 14.7 | 11.3 | 5.9 | 15.4 |

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 32.8 |
| Intersection LOS | D |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Vol, veh/h | 356 | 16 | 5 | 12 | 35 | 10 | 8 | 343 | 16 | 54 | 218 | 78 |
| Future Vol, veh/h | 356 | 16 | 5 | 12 | 35 | 10 | 8 | 343 | 16 | 54 | 218 | 78 |
| Peak Hour Factor | 0.95 | 0.95 | 0.95 | 0.88 | 0.88 | 0.88 | 0.96 | 0.96 | 0.96 | 0.73 | 0.73 | 0.73 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 375 | 17 | 5 | 14 | 40 | 11 | 8 | 357 | 17 | 74 | 299 | 107 |
| Number of Lanes | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| Opposing Approach | WB | EB | SB | NB |
| Opposing Lanes | 1 | 1 | 1 | 2 |
| Conflicting Approach Left | SB | NB | EB | WB |
| Conflicting Lanes Left | 1 | 2 | 1 | 1 |
| Conflicting Approach Right | NB | SB | WB | EB |
| Conflicting Lanes Right | 2 | 1 | 1 | 1 |
| HCM Control Delay | 31.3 | 12.8 | 27.6 | 40.8 |
| HCM LOS | D | B | D | E |

| Lane | NBLn1 | NBLn2 | EBLn1 | WBLn1 | SBLn1 |
|---|---|---|---|---|---|
| Vol Left, % | 2% | 0% | 94% | 21% | 15% |
| Vol Thru, % | 98% | 0% | 4% | 61% | 62% |
| Vol Right, % | 0% | 100% | 1% | 18% | 22% |
| Sign Control | Stop | Stop | Stop | Stop | Stop |
| Traffic Vol by Lane | 351 | 16 | 377 | 57 | 350 |
| LT Vol | 8 | 0 | 356 | 12 | 54 |
| Through Vol | 343 | 0 | 16 | 35 | 218 |
| RT Vol | 0 | 16 | 5 | 10 | 78 |
| Lane Flow Rate | 366 | 17 | 397 | 65 | 479 |
| Geometry Grp | 7 | 7 | 2 | 2 | 5 |
| Degree of Util (X) | 0.741 | 0.03 | 0.781 | 0.149 | 0.88 |
| Departure Headway (Hd) | 7.295 | 6.564 | 7.085 | 8.309 | 6.605 |
| Convergence, Y/N | Yes | Yes | Yes | Yes | Yes |
| Cap | 494 | 541 | 508 | 434 | 547 |
| Service Time | 5.094 | 4.362 | 5.175 | 6.309 | 4.698 |
| HCM Lane V/C Ratio | 0.741 | 0.031 | 0.781 | 0.15 | 0.876 |
| HCM Control Delay | 28.4 | 9.6 | 31.3 | 12.8 | 40.8 |
| HCM Lane LOS | D | A | D | B | E |
| HCM 95th-tile Q | 6.2 | 0.1 | 7.1 | 0.5 | 9.9 |

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 67 |
| Intersection LOS | F |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Vol, veh/h | 1 | 70 | 173 | 50 | 17 | 25 | 69 | 495 | 142 | 26 | 121 | 1 |
| Future Vol, veh/h | 1 | 70 | 173 | 50 | 17 | 25 | 69 | 495 | 142 | 26 | 121 | 1 |
| Peak Hour Factor | 0.81 | 0.81 | 0.81 | 0.79 | 0.79 | 0.79 | 0.95 | 0.95 | 0.95 | 0.76 | 0.76 | 0.76 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 1 | 86 | 214 | 63 | 22 | 32 | 73 | 521 | 149 | 34 | 159 | 1 |
| Number of Lanes | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| Opposing Approach | WB | EB | SB | NB |
| Opposing Lanes | 1 | 1 | 1 | 1 |
| Conflicting Approach Left | SB | NB | EB | WB |
| Conflicting Lanes Left | 1 | 1 | 1 | 1 |
| Conflicting Approach Right | NB | SB | WB | EB |
| Conflicting Lanes Right | 1 | 1 | 1 | 1 |
| HCM Control Delay | 16.5 | 12.8 | 109.9 | 13.5 |
| HCM LOS | C | B | F | B |

| Lane | NBLn1 | EBLn1 | WBLn1 | SBLn1 |
|---|---|---|---|---|
| Vol Left, % | 10% | 0% | 54% | 18% |
| Vol Thru, % | 70% | 29% | 18% | 82% |
| Vol Right, % | 20% | 71% | 27% | 1% |
| Sign Control | Stop | Stop | Stop | Stop |
| Traffic Vol by Lane | 706 | 244 | 92 | 148 |
| LT Vol | 69 | 1 | 50 | 26 |
| Through Vol | 495 | 70 | 17 | 121 |
| RT Vol | 142 | 173 | 25 | 1 |
| Lane Flow Rate | 743 | 301 | 116 | 195 |
| Geometry Grp | 1 | 1 | 1 | 1 |
| Degree of Util (X) | 1.16 | 0.52 | 0.228 | 0.351 |
| Departure Headway (Hd) | 5.619 | 6.608 | 7.538 | 6.828 |
| Convergence, Y/N | Yes | Yes | Yes | Yes |
| Cap | 647 | 548 | 480 | 530 |
| Service Time | 3.663 | 4.608 | 5.538 | 4.828 |
| HCM Lane V/C Ratio | 1.148 | 0.549 | 0.242 | 0.368 |
| HCM Control Delay | 109.9 | 16.5 | 12.8 | 13.5 |
| HCM Lane LOS | F | C | B | B |
| HCM 95th-tile Q | 24.2 | 3 | 0.9 | 1.6 |

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 200.2 |
| Intersection LOS | F |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Vol, veh/h | 210 | 36 | 34 | 44 | 93 | 9 | 21 | 234 | 19 | 27 | 421 | 382 |
| Future Vol, veh/h | 210 | 36 | 34 | 44 | 93 | 9 | 21 | 234 | 19 | 27 | 421 | 382 |
| Peak Hour Factor | 0.89 | 0.89 | 0.89 | 0.90 | 0.90 | 0.90 | 0.74 | 0.74 | 0.74 | 0.89 | 0.89 | 0.89 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 236 | 40 | 38 | 49 | 103 | 10 | 28 | 316 | 26 | 30 | 473 | 429 |
| Number of Lanes | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| Opposing Approach | WB | EB | SB | NB |
| Opposing Lanes | 1 | 1 | 1 | 2 |
| Conflicting Approach Left | SB | NB | EB | WB |
| Conflicting Lanes Left | 1 | 2 | 1 | 1 |
| Conflicting Approach Right | NB | SB | WB | EB |
| Conflicting Lanes Right | 2 | 1 | 1 | 1 |
| HCM Control Delay | 28.5 | 18.8 | 30.4 | 357.1 |
| HCM LOS | D | C | D | F |

| Lane | NBLn1 | NBLn2 | EBLn1 | WBLn1 | SBLn1 |
|---|---|---|---|---|---|
| Vol Left, % | 8% | 0% | 75% | 30% | 3% |
| Vol Thru, % | 92% | 0% | 13% | 64% | 51% |
| Vol Right, % | 0% | 100% | 12% | 6% | 46% |
| Sign Control | Stop | Stop | Stop | Stop | Stop |
| Traffic Vol by Lane | 255 | 19 | 280 | 146 | 830 |
| LT Vol | 21 | 0 | 210 | 44 | 27 |
| Through Vol | 234 | 0 | 36 | 93 | 421 |
| RT Vol | 0 | 19 | 34 | 9 | 382 |
| Lane Flow Rate | 345 | 26 | 315 | 162 | 933 |
| Geometry Grp | 7 | 7 | 2 | 2 | 5 |
| Degree of Util (X) | 0.73 | 0.049 | 0.665 | 0.369 | 1.738 |
| Departure Headway (Hd) | 8.776 | 8.004 | 9.156 | 10.038 | 6.711 |
| Convergence, Y/N | Yes | Yes | Yes | Yes | Yes |
| Cap | 417 | 450 | 396 | 362 | 550 |
| Service Time | 6.476 | 5.704 | 7.156 | 8.038 | 4.76 |
| HCM Lane V/C Ratio | 0.827 | 0.058 | 0.795 | 0.448 | 1.696 |
| HCM Control Delay | 31.8 | 11.1 | 28.5 | 18.8 | 357.1 |
| HCM Lane LOS | D | B | D | C | F |
| HCM 95th-tile Q | 5.7 | 0.2 | 4.6 | 1.7 | 55.4 |

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 97.7 |
| Intersection LOS | F |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Vol, veh/h | 2 | 119 | 265 | 167 | 50 | 29 | 60 | 243 | 114 | 25 | 421 | 1 |
| Future Vol, veh/h | 2 | 119 | 265 | 167 | 50 | 29 | 60 | 243 | 114 | 25 | 421 | 1 |
| Peak Hour Factor | 0.94 | 0.94 | 0.94 | 0.87 | 0.87 | 0.87 | 0.88 | 0.88 | 0.88 | 0.95 | 0.95 | 0.95 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 2 | 127 | 282 | 192 | 57 | 33 | 68 | 276 | 130 | 26 | 443 | 1 |
| Number of Lanes | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| Opposing Approach | WB | EB | SB | NB |
| Opposing Lanes | 1 | 1 | 1 | 1 |
| Conflicting Approach Left | SB | NB | EB | WB |
| Conflicting Lanes Left | 1 | 1 | 1 | 1 |
| Conflicting Approach Right | NB | SB | WB | EB |
| Conflicting Lanes Right | 1 | 1 | 1 | 1 |
| HCM Control Delay | 71.8 | 40.1 | 124.1 | 128.5 |
| HCM LOS | F | E | F | F |

| Lane | NBLn1 | EBLn1 | WBLn1 | SBLn1 |
|---|---|---|---|---|
| Vol Left, % | 14% | 1% | 68% | 6% |
| Vol Thru, % | 58% | 31% | 20% | 94% |
| Vol Right, % | 27% | 69% | 12% | 0% |
| Sign Control | Stop | Stop | Stop | Stop |
| Traffic Vol by Lane | 417 | 386 | 246 | 447 |
| LT Vol | 60 | 2 | 167 | 25 |
| Through Vol | 243 | 119 | 50 | 421 |
| RT Vol | 114 | 265 | 29 | 1 |
| Lane Flow Rate | 474 | 411 | 283 | 471 |
| Geometry Grp | 1 | 1 | 1 | 1 |
| Degree of Util (X) | 1.152 | 0.976 | 0.754 | 1.163 |
| Departure Headway (Hd) | 9.342 | 9.473 | 10.665 | 9.468 |
| Convergence, Y/N | Yes | Yes | Yes | Yes |
| Cap | 393 | 386 | 342 | 386 |
| Service Time | 7.342 | 7.473 | 8.665 | 7.468 |
| HCM Lane V/C Ratio | 1.206 | 1.065 | 0.827 | 1.22 |
| HCM Control Delay | 124.1 | 71.8 | 40.1 | 128.5 |
| HCM Lane LOS | F | F | E | F |
| HCM 95th-tile Q | 17.1 | 11.2 | 5.9 | 17.3 |

| Lane Group | EBT | WBT | NBT | NBR | SBT |
|---|---|---|---|---|---|
| Lane Group Flow (vph) | 397 | 65 | 365 | 17 | 480 |
| v/c Ratio | 0.78 | 0.10 | 0.52 | 0.03 | 0.76 |
| Control Delay | 26.6 | 9.4 | 15.2 | 2.2 | 21.8 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 26.6 | 9.4 | 15.2 | 2.2 | 21.8 |
| Queue Length 50th (ft) | 99 | 10 | 81 | 0 | 113 |
| Queue Length 95th (ft) | #249 | 30 | 157 | 6 | 160 |
| Internal Link Dist (ft) | 308 | 303 | 224 | | 251 |
| Turn Bay Length (ft) | | | | | |
| Base Capacity (vph) | 703 | 903 | 1006 | 882 | 890 |
| 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 | 0.56 | 0.07 | 0.36 | 0.02 | 0.54 |

Intersection Summary

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

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 356 | 16 | 5 | 12 | 35 | 10 | 8 | 343 | 16 | 54 | 218 | 78 |
| Future Volume (veh/h) | 356 | 16 | 5 | 12 | 35 | 10 | 8 | 343 | 16 | 54 | 218 | 78 |
| Number | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus, Adj | 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 Sat Flow, veh/h/ln | 1900 | 1863 | 1900 | 1900 | 1863 | 1900 | 1900 | 1863 | 1863 | 1900 | 1863 | 1900 |
| Adj Flow Rate, veh/h | 375 | 17 | 5 | 14 | 40 | 11 | 8 | 357 | 0 | 74 | 299 | 107 |
| Adj No. of Lanes | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 |
| Peak Hour Factor | 0.95 | 0.95 | 0.95 | 0.88 | 0.88 | 0.88 | 0.96 | 0.96 | 0.96 | 0.73 | 0.73 | 0.73 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 642 | 21 | 6 | 186 | 451 | 108 | 93 | 736 | 632 | 166 | 453 | 149 |
| Arrive On Green | 0.36 | 0.36 | 0.36 | 0.36 | 0.36 | 0.36 | 0.40 | 0.40 | 0.00 | 0.40 | 0.40 | 0.40 |
| Sat Flow, veh/h | 1317 | 60 | 18 | 224 | 1257 | 302 | 11 | 1842 | 1583 | 164 | 1134 | 372 |
| Grp Volume(v), veh/h | 397 | 0 | 0 | 65 | 0 | 0 | 365 | 0 | 0 | 480 | 0 | 0 |
| Grp Sat Flow(s),veh/h/ln | 1394 | 0 | 0 | 1783 | 0 | 0 | 1853 | 0 | 1583 | 1670 | 0 | 0 |
| Q Serve(g_s), s | 9.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.5 | 0.0 | 0.0 |
| Cycle Q Clear(g_c), s | 10.4 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 6.0 | 0.0 | 0.0 | 9.6 | 0.0 | 0.0 |
| Prop In Lane | 0.94 | | 0.01 | 0.22 | | 0.17 | 0.02 | | 1.00 | 0.15 | | 0.22 |
| Lane Grp Cap(c), veh/h | 669 | 0 | 0 | 745 | 0 | 0 | 829 | 0 | 632 | 768 | 0 | 0 |
| V/C Ratio(X) | 0.59 | 0.00 | 0.00 | 0.09 | 0.00 | 0.00 | 0.44 | 0.00 | 0.00 | 0.63 | 0.00 | 0.00 |
| Avail Cap(c_a), veh/h | 1006 | 0 | 0 | 1161 | 0 | 0 | 1204 | 0 | 958 | 1096 | 0 | 0 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 |
| Uniform Delay (d), s/veh | 11.7 | 0.0 | 0.0 | 8.8 | 0.0 | 0.0 | 9.3 | 0.0 | 0.0 | 10.2 | 0.0 | 0.0 |
| Incr Delay (d2), s/veh | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 4.1 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 3.1 | 0.0 | 0.0 | 4.7 | 0.0 | 0.0 |
| LnGrp Delay(d),s/veh | 12.6 | 0.0 | 0.0 | 8.9 | 0.0 | 0.0 | 9.6 | 0.0 | 0.0 | 11.1 | 0.0 | 0.0 |
| LnGrp LOS | B | | | A | | | A | | | B | | |
| Approach Vol, veh/h | | 397 | | | 65 | | | 365 | | | 480 | |
| Approach Delay, s/veh | | 12.6 | | | 8.9 | | | 9.6 | | | 11.1 | |
| Approach LOS | | B | | | A | | | A | | | B | |

| Timer | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Assigned Phs | | 2 | | 4 | | 6 | | 8 |
| Phs Duration (G+Y+Rc), s | | 21.5 | | 19.8 | | 21.5 | | 19.8 |
| Change Period (Y+Rc), s | | 5.0 | | 5.0 | | 5.0 | | 5.0 |
| Max Green Setting (Gmax), s | | 25.0 | | 25.0 | | 25.0 | | 25.0 |
| Max Q Clear Time (g_c+I1), s | | 8.0 | | 12.4 | | 11.6 | | 3.0 |
| Green Ext Time (p_c), s | | 5.6 | | 2.5 | | 4.9 | | 3.1 |

| Intersection Summary | |
|---|---|
| HCM 2010 Ctrl Delay | 11.0 |
| HCM 2010 LOS | B |

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 67 |
| Intersection LOS | F |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Vol, veh/h | 1 | 70 | 173 | 50 | 17 | 25 | 69 | 495 | 142 | 26 | 121 | 1 |
| Future Vol, veh/h | 1 | 70 | 173 | 50 | 17 | 25 | 69 | 495 | 142 | 26 | 121 | 1 |
| Peak Hour Factor | 0.81 | 0.81 | 0.81 | 0.79 | 0.79 | 0.79 | 0.95 | 0.95 | 0.95 | 0.76 | 0.76 | 0.76 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 1 | 86 | 214 | 63 | 22 | 32 | 73 | 521 | 149 | 34 | 159 | 1 |
| Number of Lanes | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| Opposing Approach | WB | EB | SB | NB |
| Opposing Lanes | 1 | 1 | 1 | 1 |
| Conflicting Approach Left | SB | NB | EB | WB |
| Conflicting Lanes Left | 1 | 1 | 1 | 1 |
| Conflicting Approach Right | NB | SB | WB | EB |
| Conflicting Lanes Right | 1 | 1 | 1 | 1 |
| HCM Control Delay | 16.5 | 12.8 | 109.9 | 13.5 |
| HCM LOS | C | B | F | B |

| Lane | NBLn1 | EBLn1 | WBLn1 | SBLn1 |
|---|---|---|---|---|
| Vol Left, % | 10% | 0% | 54% | 18% |
| Vol Thru, % | 70% | 29% | 18% | 82% |
| Vol Right, % | 20% | 71% | 27% | 1% |
| Sign Control | Stop | Stop | Stop | Stop |
| Traffic Vol by Lane | 706 | 244 | 92 | 148 |
| LT Vol | 69 | 1 | 50 | 26 |
| Through Vol | 495 | 70 | 17 | 121 |
| RT Vol | 142 | 173 | 25 | 1 |
| Lane Flow Rate | 743 | 301 | 116 | 195 |
| Geometry Grp | 1 | 1 | 1 | 1 |
| Degree of Util (X) | 1.16 | 0.52 | 0.228 | 0.351 |
| Departure Headway (Hd) | 5.619 | 6.608 | 7.538 | 6.828 |
| Convergence, Y/N | Yes | Yes | Yes | Yes |
| Cap | 647 | 548 | 480 | 530 |
| Service Time | 3.663 | 4.608 | 5.538 | 4.828 |
| HCM Lane V/C Ratio | 1.148 | 0.549 | 0.242 | 0.368 |
| HCM Control Delay | 109.9 | 16.5 | 12.8 | 13.5 |
| HCM Lane LOS | F | C | B | B |
| HCM 95th-tile Q | 24.2 | 3 | 0.9 | 1.6 |

| Lane Group | EBT | WBT | NBT | NBR | SBT |
|---|---|---|---|---|---|
| Lane Group Flow (vph) | 314 | 162 | 344 | 26 | 932 |
| v/c Ratio | 0.83 | 0.36 | 0.38 | 0.03 | 0.95 |
| Control Delay | 39.9 | 18.5 | 9.5 | 2.3 | 33.0 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 39.9 | 18.5 | 9.5 | 2.3 | 33.0 |
| Queue Length 50th (ft) | 99 | 43 | 66 | 0 | 265 |
| Queue Length 95th (ft) | #217 | 87 | 88 | 5 | #523 |
| Internal Link Dist (ft) | 308 | 303 | 224 | | 251 |
| Turn Bay Length (ft) | | | | | |
| Base Capacity (vph) | 414 | 496 | 931 | 890 | 998 |
| 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 | 0.76 | 0.33 | 0.37 | 0.03 | 0.93 |

Intersection Summary

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

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Volume (veh/h) | 210 | 36 | 34 | 44 | 93 | 9 | 21 | 234 | 19 | 27 | 421 | 382 |
| Future Volume (veh/h) | 210 | 36 | 34 | 44 | 93 | 9 | 21 | 234 | 19 | 27 | 421 | 382 |
| Number | 7 | 4 | 14 | 3 | 8 | 18 | 5 | 2 | 12 | 1 | 6 | 16 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus, Adj | 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 Sat Flow, veh/h/ln | 1900 | 1863 | 1900 | 1900 | 1863 | 1900 | 1900 | 1863 | 1863 | 1900 | 1863 | 1900 |
| Adj Flow Rate, veh/h | 236 | 40 | 38 | 49 | 103 | 10 | 28 | 316 | 0 | 30 | 473 | 429 |
| Adj No. of Lanes | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 |
| Peak Hour Factor | 0.89 | 0.89 | 0.89 | 0.90 | 0.90 | 0.90 | 0.74 | 0.74 | 0.74 | 0.89 | 0.89 | 0.89 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 394 | 49 | 46 | 176 | 327 | 28 | 103 | 941 | 897 | 81 | 506 | 444 |
| Arrive On Green | 0.26 | 0.26 | 0.26 | 0.26 | 0.26 | 0.26 | 0.57 | 0.57 | 0.00 | 0.57 | 0.57 | 0.57 |
| Sat Flow, veh/h | 1100 | 191 | 178 | 363 | 1275 | 108 | 61 | 1662 | 1583 | 26 | 894 | 785 |
| Grp Volume(v), veh/h | 314 | 0 | 0 | 162 | 0 | 0 | 344 | 0 | 0 | 932 | 0 | 0 |
| Grp Sat Flow(s),veh/h/ln | 1469 | 0 | 0 | 1747 | 0 | 0 | 1722 | 0 | 1583 | 1705 | 0 | 0 |
| Q Serve(g_s), s | 7.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 12.7 | 0.0 | 0.0 |
| Cycle Q Clear(g_c), s | 11.1 | 0.0 | 0.0 | 4.0 | 0.0 | 0.0 | 5.5 | 0.0 | 0.0 | 29.4 | 0.0 | 0.0 |
| Prop In Lane | 0.75 | | 0.12 | 0.30 | | 0.06 | 0.08 | | 1.00 | 0.03 | | 0.46 |
| Lane Grp Cap(c), veh/h | 488 | 0 | 0 | 531 | 0 | 0 | 1045 | 0 | 897 | 1031 | 0 | 0 |
| V/C Ratio(X) | 0.64 | 0.00 | 0.00 | 0.31 | 0.00 | 0.00 | 0.33 | 0.00 | 0.00 | 0.90 | 0.00 | 0.00 |
| Avail Cap(c_a), veh/h | 575 | 0 | 0 | 635 | 0 | 0 | 1048 | 0 | 900 | 1035 | 0 | 0 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 |
| Uniform Delay (d), s/veh | 19.4 | 0.0 | 0.0 | 17.1 | 0.0 | 0.0 | 6.5 | 0.0 | 0.0 | 11.6 | 0.0 | 0.0 |
| Incr Delay (d2), s/veh | 1.9 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 11.0 | 0.0 | 0.0 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 4.8 | 0.0 | 0.0 | 2.1 | 0.0 | 0.0 | 2.8 | 0.0 | 0.0 | 16.6 | 0.0 | 0.0 |
| LnGrp Delay(d),s/veh | 21.3 | 0.0 | 0.0 | 17.4 | 0.0 | 0.0 | 6.7 | 0.0 | 0.0 | 22.6 | 0.0 | 0.0 |
| LnGrp LOS | C | | | B | | | A | | | C | | |
| Approach Vol, veh/h | | 314 | | | 162 | | | 344 | | | 932 | |
| Approach Delay, s/veh | | 21.3 | | | 17.4 | | | 6.7 | | | 22.6 | |
| Approach LOS | | C | | | B | | | A | | | C | |

| Timer | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Assigned Phs | | 2 | | 4 | | 6 | | 8 |
| Phs Duration (G+Y+Rc), s | | 36.9 | | 19.4 | | 36.9 | | 19.4 |
| Change Period (Y+Rc), s | | 5.0 | | 5.0 | | 5.0 | | 5.0 |
| Max Green Setting (Gmax), s | | 32.0 | | 18.0 | | 32.0 | | 18.0 |
| Max Q Clear Time (g_c+I1), s | | 7.5 | | 13.1 | | 31.4 | | 6.0 |
| Green Ext Time (p_c), s | | 12.1 | | 1.4 | | 0.5 | | 2.5 |

| Intersection Summary | |
|---|---|
| HCM 2010 Ctrl Delay | 18.8 |
| HCM 2010 LOS | B |

| Intersection | |
|---|---|
| Intersection Delay, s/veh | 97.7 |
| Intersection LOS | F |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Traffic Vol, veh/h | 2 | 119 | 265 | 167 | 50 | 29 | 60 | 243 | 114 | 25 | 421 | 1 |
| Future Vol, veh/h | 2 | 119 | 265 | 167 | 50 | 29 | 60 | 243 | 114 | 25 | 421 | 1 |
| Peak Hour Factor | 0.94 | 0.94 | 0.94 | 0.87 | 0.87 | 0.87 | 0.88 | 0.88 | 0.88 | 0.95 | 0.95 | 0.95 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 2 | 127 | 282 | 192 | 57 | 33 | 68 | 276 | 130 | 26 | 443 | 1 |
| Number of Lanes | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| Opposing Approach | WB | EB | SB | NB |
| Opposing Lanes | 1 | 1 | 1 | 1 |
| Conflicting Approach Left | SB | NB | EB | WB |
| Conflicting Lanes Left | 1 | 1 | 1 | 1 |
| Conflicting Approach Right | NB | SB | WB | EB |
| Conflicting Lanes Right | 1 | 1 | 1 | 1 |
| HCM Control Delay | 71.8 | 40.1 | 124.1 | 128.5 |
| HCM LOS | F | E | F | F |

| Lane | NBLn1 | EBLn1 | WBLn1 | SBLn1 |
|---|---|---|---|---|
| Vol Left, % | 14% | 1% | 68% | 6% |
| Vol Thru, % | 58% | 31% | 20% | 94% |
| Vol Right, % | 27% | 69% | 12% | 0% |
| Sign Control | Stop | Stop | Stop | Stop |
| Traffic Vol by Lane | 417 | 386 | 246 | 447 |
| LT Vol | 60 | 2 | 167 | 25 |
| Through Vol | 243 | 119 | 50 | 421 |
| RT Vol | 114 | 265 | 29 | 1 |
| Lane Flow Rate | 474 | 411 | 283 | 471 |
| Geometry Grp | 1 | 1 | 1 | 1 |
| Degree of Util (X) | 1.152 | 0.976 | 0.754 | 1.163 |
| Departure Headway (Hd) | 9.342 | 9.473 | 10.665 | 9.468 |
| Convergence, Y/N | Yes | Yes | Yes | Yes |
| Cap | 393 | 386 | 342 | 386 |
| Service Time | 7.342 | 7.473 | 8.665 | 7.468 |
| HCM Lane V/C Ratio | 1.206 | 1.065 | 0.827 | 1.22 |
| HCM Control Delay | 124.1 | 71.8 | 40.1 | 128.5 |
| HCM Lane LOS | F | F | E | F |
| HCM 95th-tile Q | 17.1 | 11.2 | 5.9 | 17.3 |