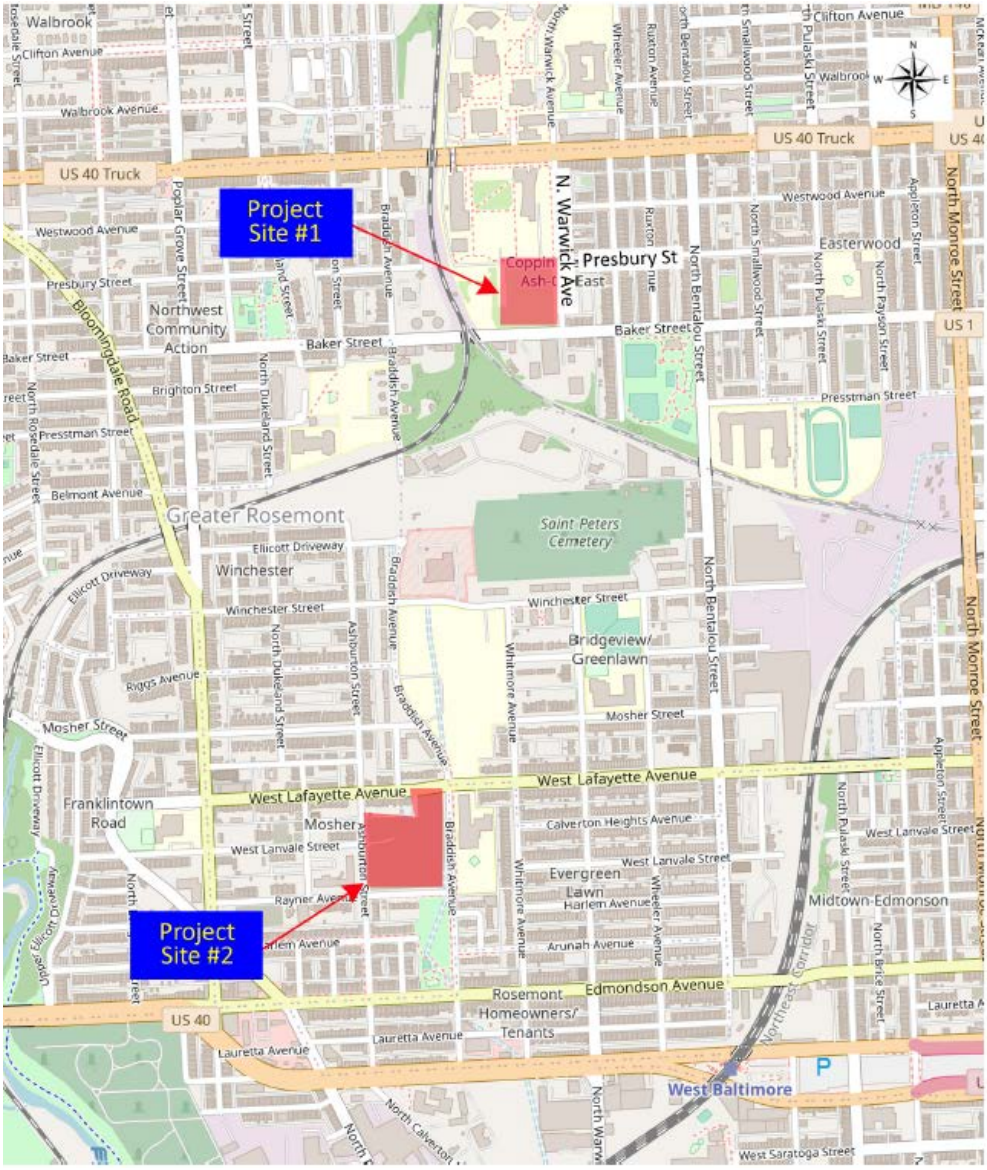
# APPENDIX D.3

# CONSULTANT REPORTS – TRAFFIC

Coppin State University is in the process of reviewing two separate sites for the proposed development of a Public Safety Facility. The site is intended to serve training needs for Baltimore City Police Department, Baltimore City Fire Department, and provide classroom space for public safety related curriculum at Coppin State University. This Traffic Analysis has been prepared to evaluate the impact each site will have on the immediate surrounding road network.

Project Site No. 1 is situated in the southwest quadrant of the intersection of N. Warwick Avenue at Presbury Street, immediately south of Coppin State University. Project Site No. 2 is located approximately 3,500 ft to the southwest of Coppin State University and is bounded by W. Lafayette Avenue to the north, Braddish Avenue to the east, Rayner Avenue to the south, and Ashburton Street to the west. A map showing the general location of the two project sites can be found in Figure 1.

**Figure 1. Location Map for Site**



## Project Site No. 1

Project Site No. 1 is immediately adjacent to Coppin State University. Currently, it is undeveloped and features frontage along Presbury Street within Coppin State University, N. Warwick Avenue, and Baker Street. Figure 2 provides an aerial photo detailing the subject site and surrounding intersections.

**Figure 2. Aerial Photo**

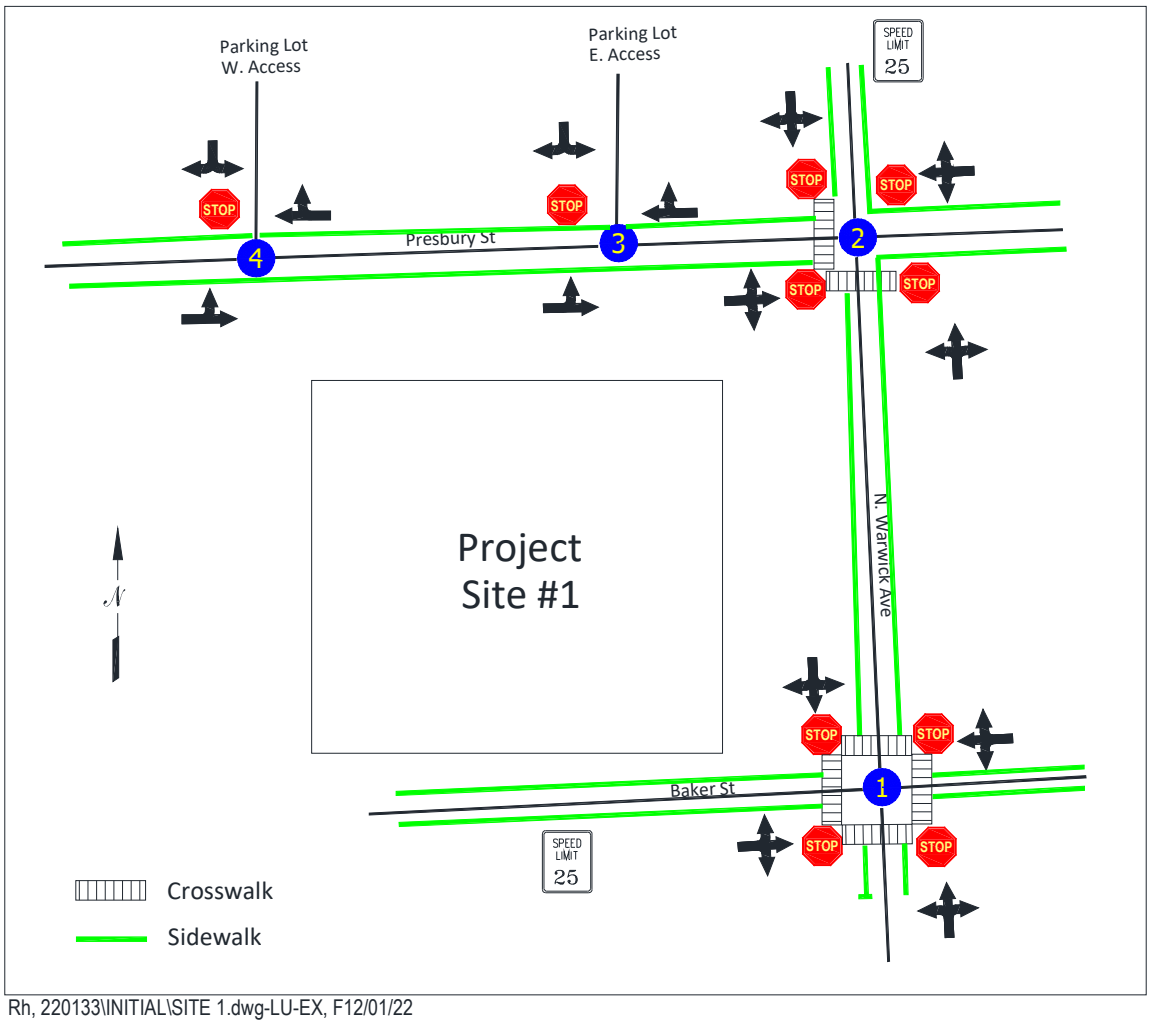

N. Warwick Avenue is a two-lane undivided roadway running in the north-south direction from Baker Street northerly for a distance of approximately 3,700 ft to W. Northern Parkway. In the vicinity of this site, parking is generally permitted on both sides of the street.

At the N. Warwick Avenue intersections with Baker Street and Presbury Street, all-way stop conditions exist at both locations. There are no auxiliary lanes to provide additional capacity at either location. Parking is generally permitted along both sides of Baker Street, and parking is restricted along the north frontage of Presbury Street.

Campus parking is provided on the north side of Presbury Street in a mixture of general parking for faculty, staff, students, and visitors. A total of 230 spaces are available on the north side of the roadway and approximately 50 to the south. A visitor parking pay station is also available in the area.

Sidewalk is generally available throughout the entire study area on both sides of each study roadway. Crosswalks span all four legs of the intersection of N. Warwick Avenue at Baker Street. There are crosswalks on the west and south legs only at the intersection of N. Warwick Avenue at Presbury Street. Figure 3 provides a detail of the existing lane use, traffic control devices, and speed limits at the study intersections.

**Figure 3. Existing Lane Use – Project Site No. 1**

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## Project Site No. 2

Project Site No. 2 is bounded by W. Lafayette Avenue to the north, Braddish Avenue to the east, Rayner Avenue to the south, and Ashburton Street to the west. It is currently vacant and is separated from Coppin State University by approximately 3,500 ft. Empowerment Academy is located immediately to the east of the site, and Katherine Johnson Global Academy is situated to the north and east. An aerial photo detailing the site can be found in Figure 4.

**Figure 4. Aerial Photo**

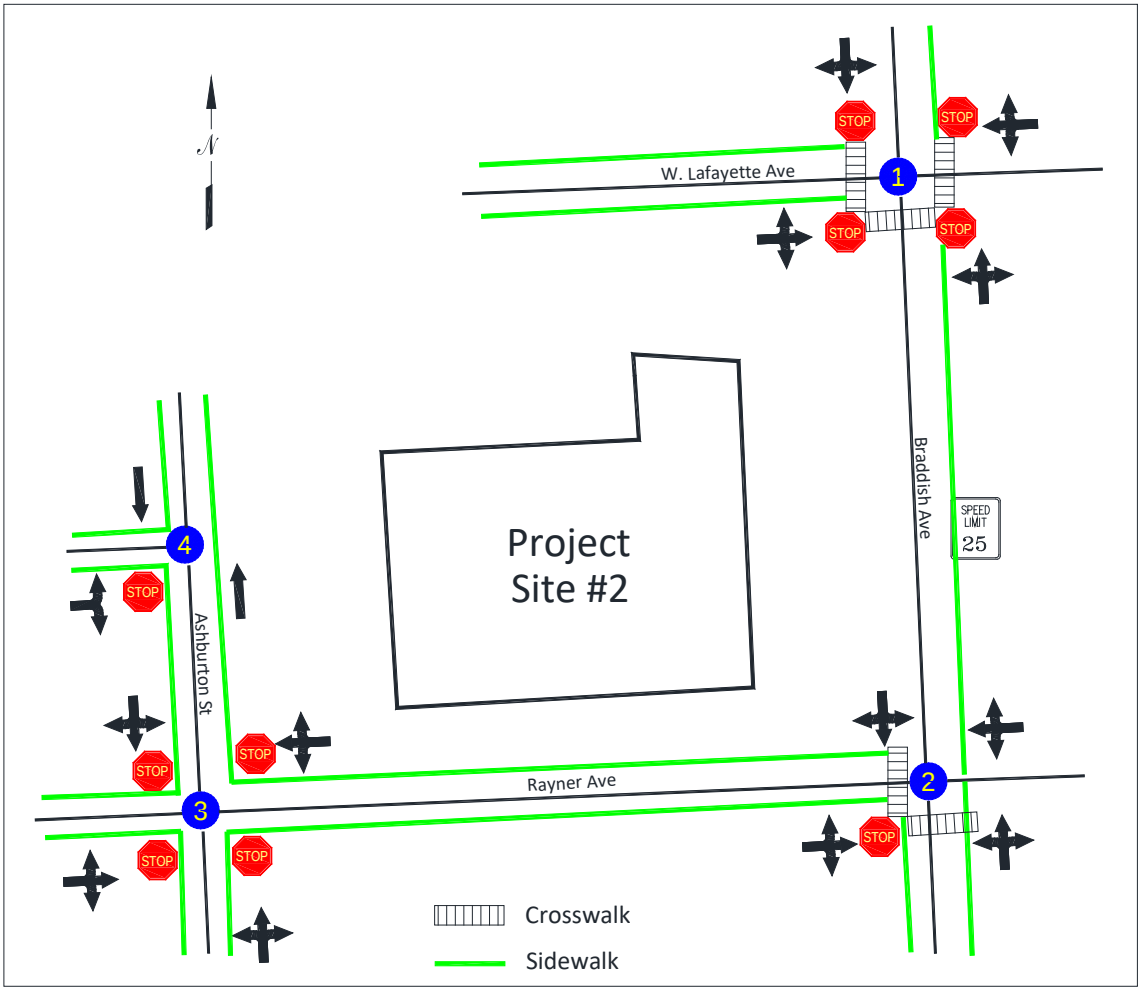

Empowerment Academy is a public charter school for Grades K–8 operated by Baltimore City Public Schools (BCPS) with a current student population of 255. School hours are posted as 7:45 AM to 2:25 PM. Katherine Johnson Global Academy is also a BCPS school serving Grades 3–8. Its hours extend from 8:00 AM to 2:40 PM. A total of 439 students attend this school.

Braddish Avenue extends for a distance of approximately 3,100 ft in the north/south direction from US 40 northerly to Winchester Street. Along site frontage, one travel lane is available in each direction. The roadway is not divided, and parking is generally permitted on both sides.

W. Lafayette Avenue similarly features single thru lanes and parking near the site. It runs for a distance of 2.75 miles from N. Franklintown Road easterly to Mount Royal Avenue.

The intersection of W. Lafayette Avenue at Braddish Avenue features all-way stop control as does the intersection of Rayner Avenue at Ashburton Street. Only the Rayner Avenue approach to Braddish Avenue operates under stop control. Sidewalks are generally available within the study area with the exception of the site frontage along Braddish Avenue. Sidewalk is, however, available on the east side of the roadway. Figure 5 provides a summary of the lane use, traffic control devices, and speed limits for the intersections adjacent to Project Site No. 2.

**Figure 5. Existing Lane Use – Project Site No. 2**




## Traffic Data

Intersection turning movement counts were collected at all study intersections through the use of Miovision cameras on Thursday, October 20, 2022. The cameras videoed traffic operations between the hours of 7–9 AM and 4–6 PM. The peak hour was selected by reviewing the highest consecutive 15-minute intervals at each intersection. The peak hour traffic volumes are summarized in Figures 6 and 7 for Project Site Nos. 1 and 2, respectively. Full details on the turning movement counts can be found in Appendix A.

**Figure 6. 2022 Existing Peak Hour Traffic Volumes – Project Site No. 1**

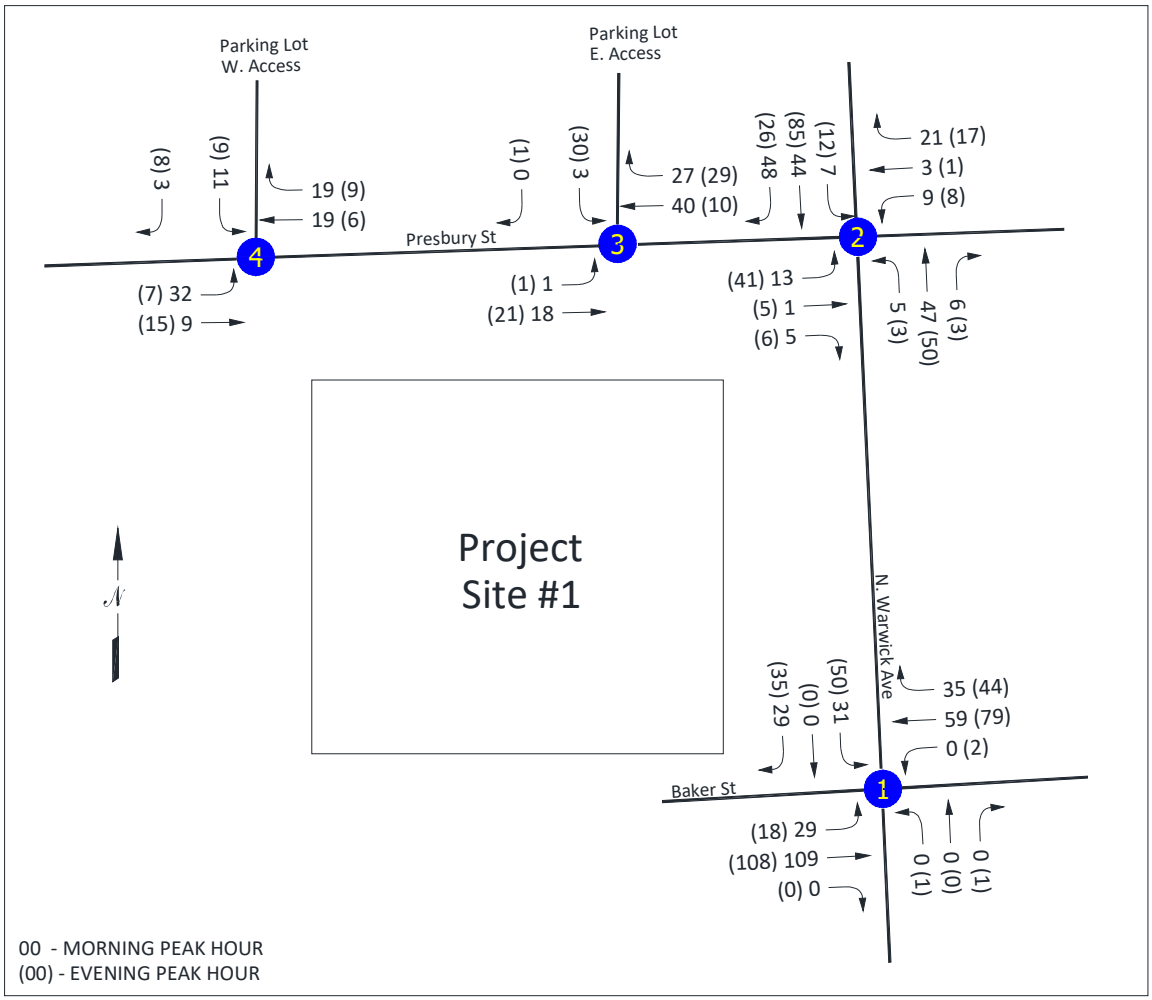
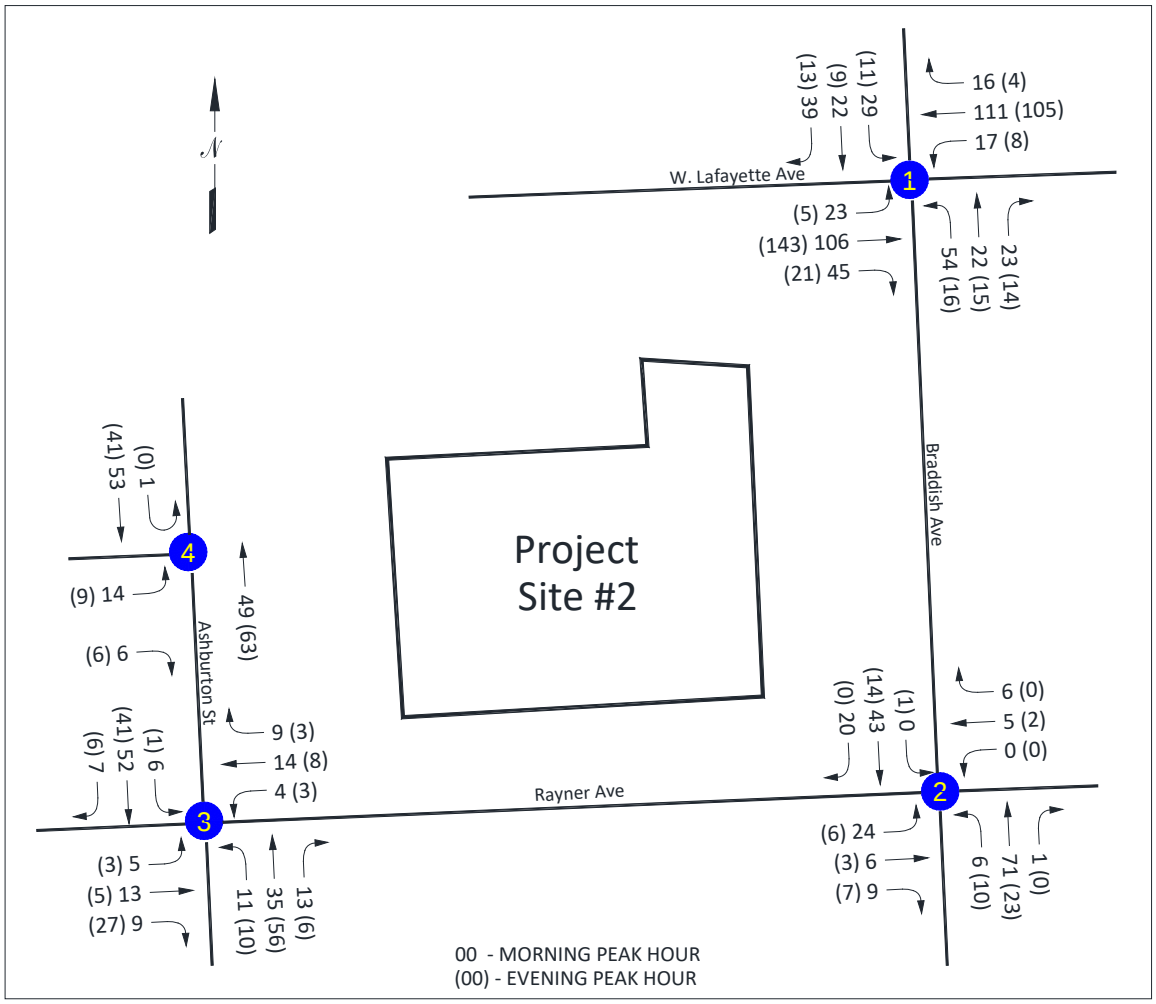


**Figure 7. 2022 Existing Peak Hour Traffic Volumes – Project Site No. 2**




A review of the turning movement counts shows relatively low traffic volumes at each of the study intersections. At Project Site No. 1, traffic volumes entering and exiting the parking area were low during both peak periods. Similarly, traffic along Warwick Avenue and Baker Street was also relatively low.

Project Site No. 2 featured slightly higher traffic volumes along W. Lafayette Avenue in both the eastbound and westbound directions, which is likely due to its length and connectivity to other roadways. Other study intersections, however, had significantly lower volumes. Empowerment Academy was open for a full day of school when counts were collected. During the AM peak, volumes along Braddish Avenue are consistent with a school arrival time that coincides with the peak hour. The PM school peak would occur earlier than 4 PM, which is not part of the typical roadway peak, thus the volumes are significantly lower.

While turning movement counts were collected, pedestrians and bicycle movements were also noted. While significant pedestrian infrastructure is available, relatively minimal pedestrian activity was noted with the exception of the intersection of Braddish Avenue at Lafayette Avenue. During the AM count, a total of 77 pedestrians crossed the north leg of the intersection and 33 crossed at the west leg. All other locations within the study area featured minimal pedestrian activity.

## Proposed Development

The proposed Public Safety Facility at Coppin State University is a unique project that will serve the Baltimore City Police Department, Baltimore City Fire Department, and provide academic space for public safety related curriculum at Coppin State University. Regardless of the site selection, the proposed use would remain the same at either location from a traffic perspective. To project future traffic, typically the Institute of Transportation Engineers (ITE) Trip Generation (11th Edition) is consulted. This document contains rates and equations for different land uses based on surveys undertaken throughout the United States. While this reference is useful for typical proposed developments, the use at this facility is unique and is not covered within the document. As a result, information was obtained through interviews with the end users of the parking garage as shown below:

| Department | Employees | Students |
|---|---|---|
| Baltimore City Fire Department | 30 | 110 |
| Baltimore City Police Department | 100 | 200 |
| Coppin State University | 4 | 0 |

Based on anticipated class schedules and work time, AM and PM peak hour trips were projected. It is important to recognize not all site trips will arrive during one hour in the morning and one hour in the afternoon. Instead, there is a high percentage of vehicles that will arrive and depart during these time periods, however, some employees or students will arrive and depart before or after those time periods. Therefore, the peak hour trips do not directly align with the total proposed parking spaces. In addition, it is possible for employees and/or students to utilize public transit, which would further reduce peak hour trips.

Furthermore, it is expected that use of this facility will vary throughout the year. There will be periods of heavier use, which is accounted for within this document. Other times of the year when classes may not be in session, volumes may be significantly lower. The goal of this Traffic Analysis is to review projected peak hour operations on a typical weekday while the facility is being used for training.

It is anticipated that Coppin State University faculty assigned to the new facility will have access to the parking garage. All students, however, will park at other locations on campus.

Table 1 details the projected trip generation inbound and outbound during the AM and PM peak hours. As shown within the table, a total of 411 AM peak hour trips and 419 PM peak hour trips are projected. As previously stated, this trip generation would be relevant for either Site No. 1 or Site No. 2.

**Table 1. Trip Generation for Garage**

| | | AM | | | PM | | |
|---|---|---|---|---|---|---|---|
| Fire Department | | In | Out | Total | In | Out | Total |
| 30 | Employees | 27 | 3 | 30 | 3 | 27 | 30 |
| 110 | Students | 99 | 11 | 110 | 11 | 99 | 110 |
| Police Department | | | | | | | |
| 100 | Employees | 90 | 10 | 100 | 10 | 90 | 100 |
| 200 | Students | 140 | 20 | 160 | 20 | 140 | 160 |
| MSU | | | | | | | |
| 4 | Employees | 4 | 0 | 4 | 0 | 4 | 4 |
| Miscellaneous | | | | | | | |
| | Visitors/Delivery | 4 | 3 | 7 | 5 | 10 | 15 |
| ***Total Trips*** | | ***364*** | ***47*** | ***411*** | ***49*** | ***370*** | ***419*** |

Access to Project Site No. 1 is proposed via one point along Presbury Street opposite the west parking lot access and one new point along Baker Street. Each access point would provide inbound and outbound movements to the parking garage.

At Project Site No. 2, two entrances are proposed to the garage and a separate surface visitor parking lot is also proposed. The garage access points are proposed along W. Lafayette Avenue and Ashburton Street. Rayner Avenue will provide access to the visitor parking lot.

Based on existing traffic counts and projected future demand, site trips were distributed and assigned to the road network. Figures 8 and 9 show the trip distribution and assignment for the individual garages. Adding the site trips to the existing peak hour traffic volumes results in the total peak hour traffic volumes as shown in Figures 10 and 11.

**Figure 8. Trip Assignment for Garage – Project Site No. 1**

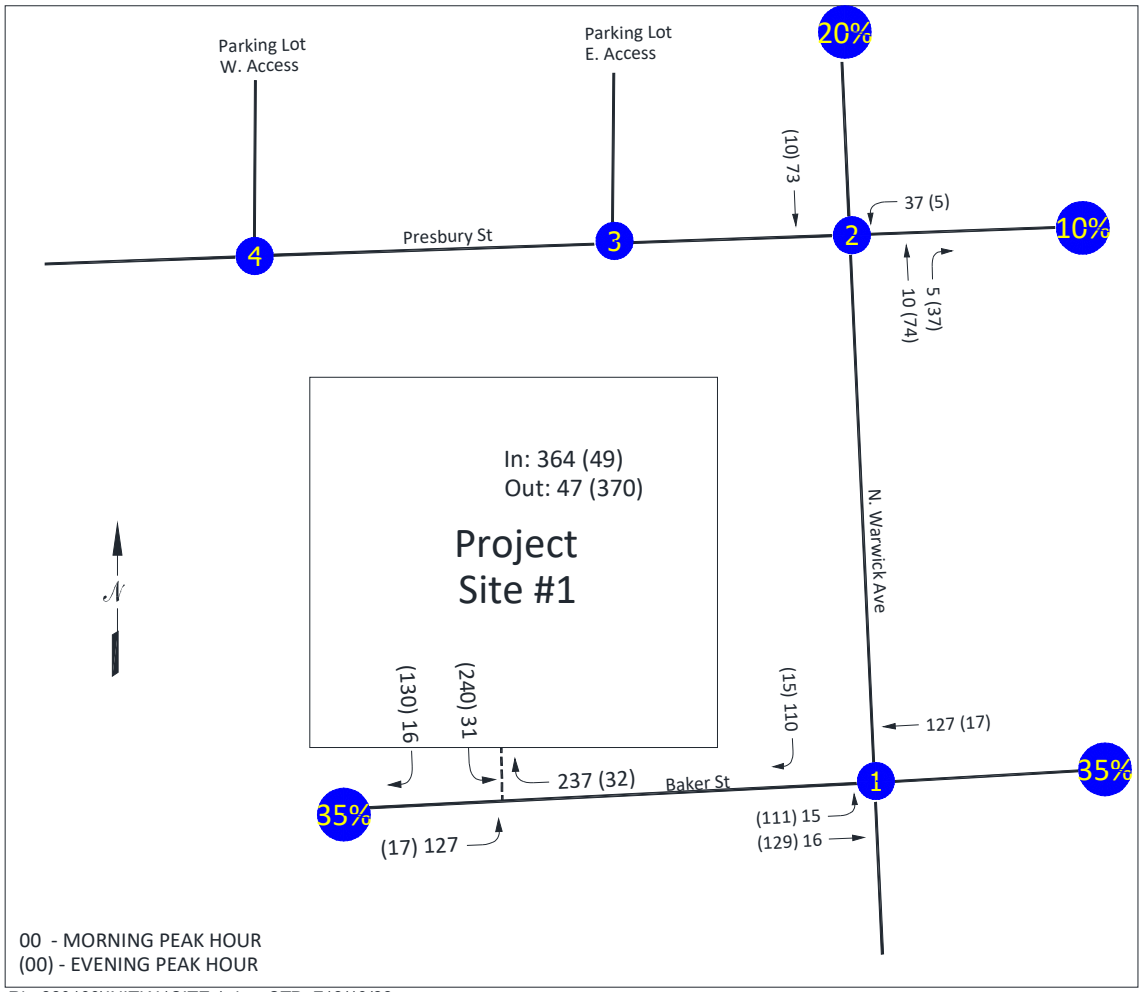



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**Figure 9. Trip Assignment for Garage – Project Site No. 2**

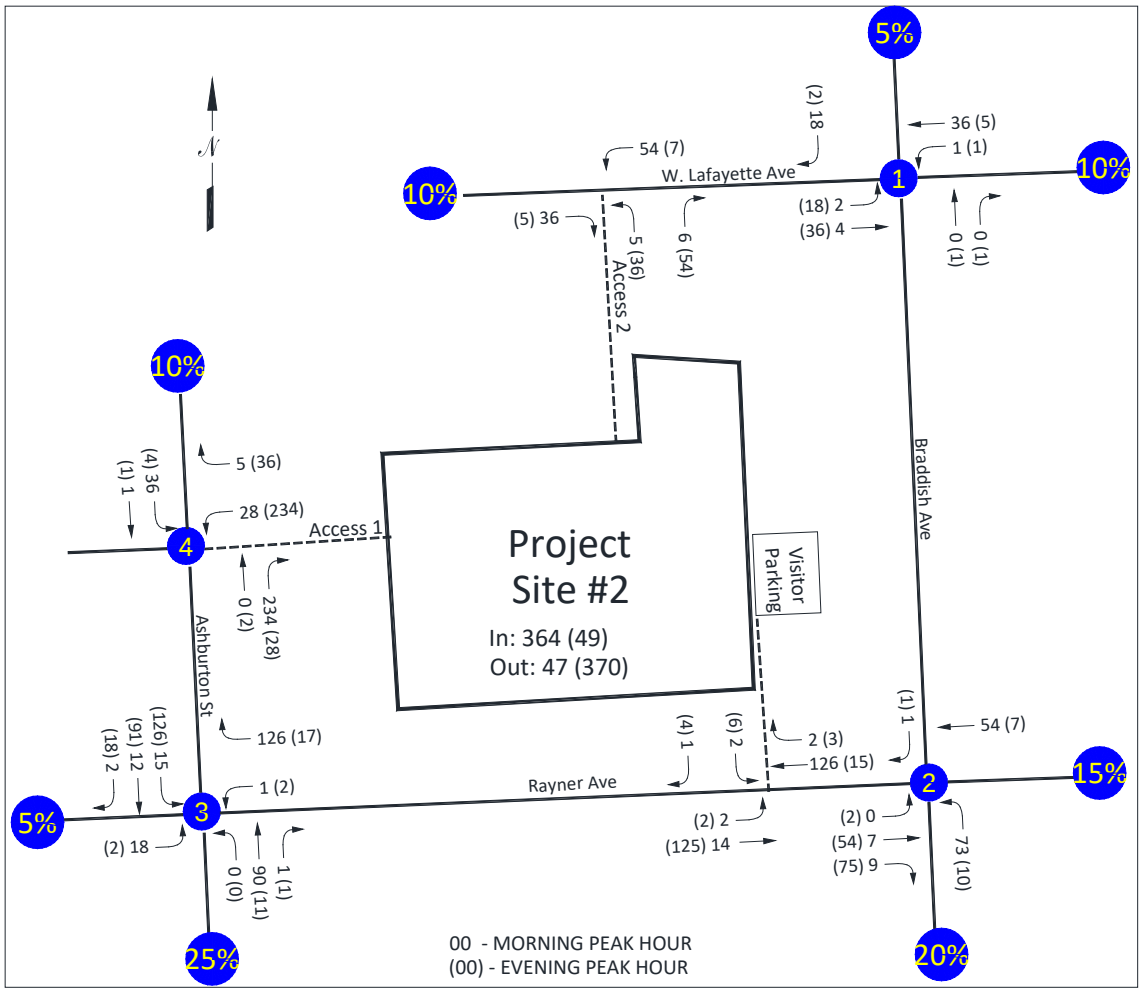

**Figure 10. Total Peak Hour Traffic Volumes – Project Site No. 1**

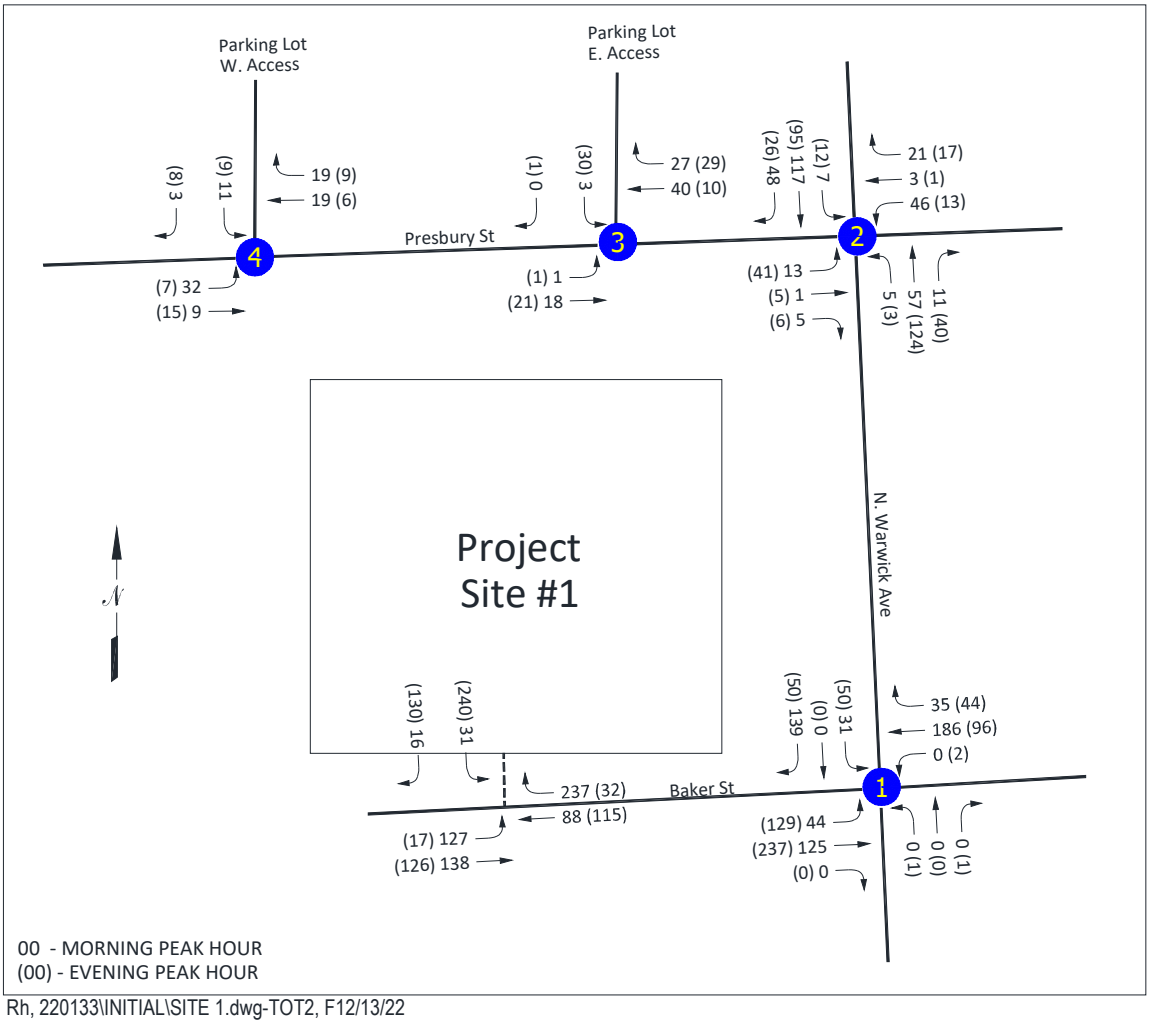


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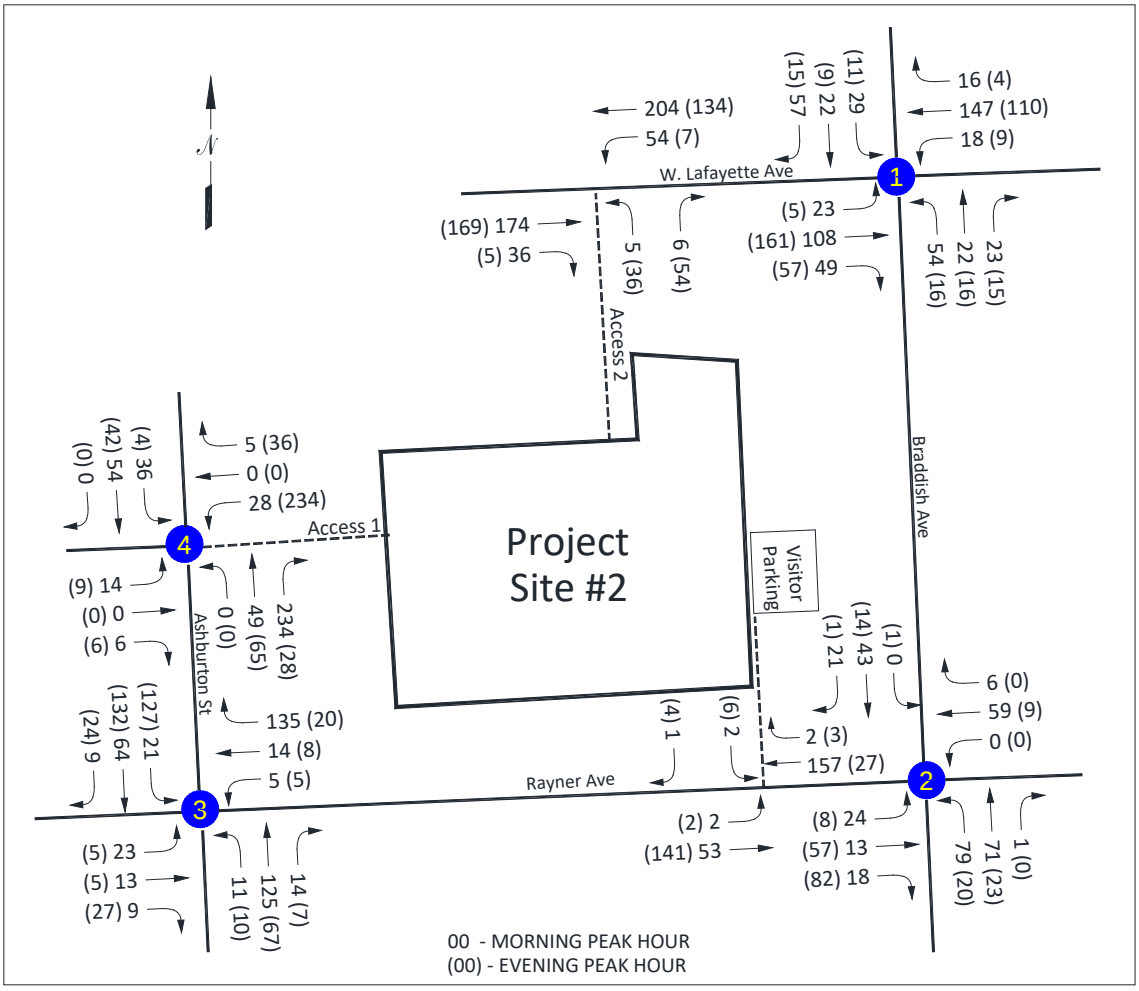
**Figure 11. Total Peak Hour Traffic Volumes – Project Site No. 2**




## Intersection Capacity Analysis

Highway Capacity Manual (HCM) analysis was reviewed at all of the study intersections to quantify peak hour levels of service for the existing and total future conditions. The HCM calculates the average delay experienced by vehicles on each approach at traditional stop-controlled intersections and for the overall intersection at all-way stop locations. Table 2 details the level of service based on the calculated average control delay for each vehicle. As shown, for vehicles waiting between 0 and 10 seconds, Level of Service "A" is achieved. If a vehicle must wait for more than 50 seconds, Level of Service "F" is assigned.

**Table 2. HCM Level of Service Criteria for Unsignalized Intersections**

| Level of Service | Average Control Delay (Second/Vehicle) |
|---|---|
| A | 0 - 10 |
| B | > 10 - 15 |
| C | > 15 - 25 |
| D | > 25 - 35 |
| E | > 35 - 50 |
| F | > 50 |

It is important to recognize at two-way stop-controlled intersections, there is no delay calculated for the mainline (unstopped) approach. This movement occurs under free flow conditions and therefore has no delay associated with it.

Tables 3 and 4 summarize the average delay for intersections associated with Project Site No. 1 and Project Site No. 2, respectively. As shown, all intersections operate at Level of Service "A" under existing conditions with the exception of the eastbound movement of Braddish Avenue at Rayner Avenue, which operates at Level of Service "B" during the AM peak. In the future, all intersections will maintain Level of Service "A" or "B" operations with the increased traffic associated with the proposed Public Safety Facility, which is a result of the minimal traffic counted under existing conditions combined with the relatively limited site peak hour trips.

HCM 95$^{th}$ percentile queue lengths were also reviewed from the software output. The queue length represents the distance that will accommodate 95% of all vehicles throughout the peak hour. Tables 5 and 6 show the existing and projected 95$^{th}$ percentile queues for Project Sites No. 1 and No. 2, respectively.

The values shown within the tables are quantified in feet. For reference, one vehicle length is 25 ft. A review of the data shows queuing is minimal at all locations.

## Table 3. Summary of Intersection Capacity Analysis

| Project Site #1 | Control Type | HCM - LOS/Delay (sec/Veh) | | | |
|---|---|---|---|---|---|
| | | Existing Traffic | | Total Traffic | |
| Intersection | | AM | PM | AM | PM |
| 1. N Warwick Ave at Baker St | All Way | A/7.9 | A/8.0 | A/9.4 | B/10.6 |
| EB/LTR | Stop Sign | A/8.2 | A/8.2 | A/9.4 | B/11.9 |
| WB/LTR | | A/7.6 | A/7.9 | A/9.7 | A/8.6 |
| NB/LTR | | --- | A/7.5 | --- | A/8.2 |
| SB/LTR | | A/7.7 | A/8.0 | A/9.0 | A/8.9 |
| 2. N. Warwick Ave at Presbury St | All Way | A/7.4 | A/7.7 | A/8.0 | A/8.1 |
| EB/LTR | Stop Sign | A/7.4 | A/7.8 | A/7.0 | A/8.2 |
| WB/LTR | | A/7.2 | A/7.2 | A/8.0 | A/7.7 |
| NB/LTR | | A/7.4 | A/7.6 | A/7.7 | A/8.3 |
| SB/LTR | | A/7.4 | A/7.8 | A/8.2 | A/8.1 |
| 3. Presbury St at Parking Access (East) | Two Way | | | | |
| EB/LT | Stop Sign | A/<1.0 | A/<1.0 | A/<1.0 | A/<1.0 |
| SB/ LR | | A/9.1 | A/8.9 | A/9.1 | A/8.9 |
| 4. Presbury St at Parking Access (West) | Two Way | | | | |
| EB/LT or LTR (total traffic) | Stop Sign | A/5.8 | A/2.3 | A/5.8 | A/2.3 |
| WB/LTR (Total Traffic) | | --- | --- | --- | --- |
| SB/LTR | | A/9.3 | A/8.7 | A/9.3 | A/8.7 |
| 5. Baker St at Garage Access | Two Way | | | | |
| EB/LT | Stop Sign | --- | --- | A/5.0 | A/1.0 |
| SB/LR | | --- | --- | C/18.7 | C/23.4 |

## Table 4. Summary of Intersection Capacity Analysis

| Project Site #2 | Control Type | HCM - LOS/Delay (sec/Veh) | | | |
|---|---|---|---|---|---|
| | | Existing Traffic | | Total Traffic | |
| Intersection | | AM | PM | AM | PM |
| 1. W. Lafayette Ave at Braddish Ave | All Way | A/9.4 | A/8.1 | A/9.9 | A/8.3 |
| EB/LTR | Stop Sign | A/9.6 | A/8.2 | A/10.0 | A/8.6 |
| WB/LTR | | A/9.4 | A/8.0 | B/10.2 | A/8.2 |
| NB/LTR | | A/9.2 | A/7.8 | A/9.5 | A/7.9 |
| SB/LTR | | A/8.9 | A/7.7 | A/9.3 | A/7.8 |
| 2. Braddish Ave at Rayner Ave | Two Way | | | | |
| EB/LTR | Stop Sign | B/10.4 | A/8.9 | B/15.0 | A/9.9 |
| WB/LTR | | A/9.7 | A/9.5 | C/15.4 | A/9.7 |
| NB/LTR | | A/<1.0 | A/2.2 | A/4.4 | A/3.5 |
| SB/LTR | | --- | A/<1.0 | --- | A/<1.0 |
| 3. Rayner Ave at Ashburton St | All Way | A/7.5 | A/7.3 | A/9.1 | A/9.4 |
| EB/LTR | Stop Sign | A/7.4 | A/7.0 | A/8.5 | A/7.8 |
| WB/LTR | | A/7.4 | A/7.3 | A/8.9 | A/7.9 |
| NB/LTR | | A/7.5 | A/7.5 | A/9.5 | A/8.1 |
| SB/ LTR | | A/7.6 | A/7.3 | A/8.9 | B/10.1 |
| 4. Ashburton St at Lanvale St/Garage Access 1 | Two Way | | | | |
| EB/LR | Stop Sign | A/9.1 | A/9.0 | B/10.9 | A/9.4 |
| WB/LR | | --- | --- | B/11.6 | B/12.2 |
| SB/LT | | --- | --- | A/3.4 | A/<1.0 |
| 5. W. Lafayette Ave at Garage Access 2 | Two Way | | | | |
| WB/LT | Stop Sign | --- | --- | A/2.1 | A/<1.0 |
| NB/LR | | --- | --- | B/11.9 | B/11.2 |
| 6. Rayner Ave at Visitor Parking Access | Two Way | | | | |
| EB/LT | Stop Sign | --- | --- | A/<1.0 | A/<1.0 |
| SB/LR | | --- | --- | A/9.9 | A/9.3 |

## Table 5. Summary of 95th Queue Analysis (HCM)

| Project Site #1 | Control Type | 95th Queue (ft) | | | |
|---|---|---|---|---|---|
| | | Existing Traffic | | Total Traffic | |
| Intersection | | AM | PM | AM | PM |
| 1. N Warwick Ave at Baker St | All Way | | | | |
| EB/LTR | Stop Sign | <25 | <25 | 25 | 70 |
| WB/LTR | | <25 | <25 | 35 | <25 |
| NB/LTR | | <25 | <25 | <25 | <25 |
| SB/LTR | | <25 | <25 | 25 | <25 |
| 2. N. Warwick Ave at Presbury St | All Way | | | | |
| EB/LTR | Stop Sign | <25 | <25 | <25 | <25 |
| WB/LTR | | <25 | <25 | <25 | <25 |
| NB/LTR | | <25 | <25 | <25 | <25 |
| SB/LTR | | <25 | <25 | <25 | <25 |
| 3. Presbury St at Parking Access (East) | Two Way | | | | |
| EB/LT | Stop Sign | <25 | <25 | <25 | <25 |
| SB/ LR | | <25 | <25 | <25 | <25 |
| 4. Presbury St at Parking Access (West)/Garage Access 1 | Two Way | | | | |
| EB/LT or LTR (total traffic) | Stop Sign | <25 | <25 | <25 | <25 |
| SB/LTR | | <25 | <25 | <25 | <25 |
| 5. Baker St at Garage Access | Two Way | | | | |
| EB/LT | Stop Sign | --- | --- | <25 | <25 |
| SB/LR | | --- | --- | <25 | 160 |

**Table 6. Summary of 95th Queue Analysis (HCM)**

| Project Site #2 | Control Type | 95th Queue (ft) | | | |
|---|---|---|---|---|---|
| | | Existing Traffic | | Total Traffic | |
| Intersection | | AM | PM | AM | PM |
| 1. W. Lafayette Ave at Braddish Ave | All Way | | | | |
| EB/LTR | Stop Sign | 30 | <25 | 33 | 28 |
| WB/LTR | | 25 | <25 | 35 | <25 |
| NB/LTR | | <25 | <25 | <25 | <25 |
| SB/LTR | | <25 | <25 | <25 | <25 |
| 2. Braddish Ave at Rayner Ave | Two Way | | | | |
| EB/LTR | Stop Sign | <25 | <25 | <25 | <25 |
| WB/LTR | | <25 | <25 | <25 | <25 |
| NB/LTR | | <25 | <25 | <25 | <25 |
| SB/LTR | | --- | <25 | --- | <25 |
| 3. Rayner Ave at Ashburton St | All Way | | | | |
| EB/LTR | Stop Sign | <25 | <25 | <25 | <25 |
| WB/LTR | | <25 | <25 | 28 | <25 |
| NB/LTR | | <25 | <25 | 28 | <25 |
| SB/ LTR | | <25 | <25 | <25 | 48 |
| 4. Ashburton St at Lanvale St/Garage Access 1 | Two Way | | | | |
| EB/LR | Stop Sign | <25 | <25 | <25 | <25 |
| WB/LR | | --- | --- | <25 | 45 |
| SB/LT | | --- | --- | <25 | <25 |
| 5. W. Lafayette Ave at Garage Access 2 | Two Way | | | | |
| WB/LT | Stop Sign | --- | --- | <25 | <25 |
| NB/LR | | --- | --- | <25 | <25 |
| 6. Rayner Ave at Visitor Parking Access | Two Way | | | | |
| EB/LT | Stop Sign | --- | --- | <25 | <25 |
| SB/LR | | --- | --- | <25 | <25 |

## Site Access Analysis

Further analysis was undertaken for the access points based on different scenarios of arrival times and gate operations. Specifically, it is expected that the garage will be secured through gated access, however, it is unclear how the gates will operate and how efficient they will be. As a result, a conservative analysis was undertaken projecting either a 4-second inbound arrival time or 5-second inbound arrival time. For a typical garage facility, it would be expected that peak hour traffic would arrive relatively evenly distributed over the entire course of an hour. Given the educational nature of this site, however, it is possible that a higher percentage could arrive at times closer to the beginning of a class period. Therefore, different percentages of arrivals were considered, ranging from 10% to 100% arriving during a 15-minute period.

To project queuing demand for the proposed site access points an M/M/1 queue model was utilized. The M/M/1 model is a stochastic process whose state space is the set to a value that corresponds to the number of vehicles in the system, including any currently in service. The following characteristics define the model:

- Arrivals occur at rate λ according to a Poisson process.
- Service times have an exponential distribution.
- All arrival times and services times are assumed to be independent of one another.
- A single server (gate) serves vehicles one at a time from the front of the queue, according to a first-come, first-served basis. When the service is complete the customer leaves the queue and the number of customers in the system reduces by one.

The model is considered stable only service rate greater than arrival rate. If the arrival rate greater than service rate, then the queue will grow indefinitely long.

Under the stable condition, various performance measures such as average number of customers in the system and average waiting time can be computed explicitly for the M/M/1 queue

Tables 7 and 8 summarize the queue lengths associated with the inbound movement for the different combinations. Since inbound and outbound volumes are similar, the same model would be applicable to exiting traffic.

As shown within the table, most scenarios could be adequately accommodated with a single lane entering and minimal queuing on the road network. It is important to recognize these "worst-case" conditions would occur over the course of 15 minutes only, assuming that number of vehicles arriving.

**Table 7. Summary of Average Queue Length in Front of Gate**

| | Vehicle In Front of Gate | | | |
|---|---|---|---|---|
| | Access 1 at Presbury | | Access 2 at Baker St | |
| Gate Processing Time | 4 Seconds | 5 Seconds | 4 Seconds | 5 Seconds |
| 10% in 15 Minutes | <1 | <1 | <1 | <1 |
| 20% in 15 Minutes | <1 | <1 | <1 | <1 |
| 30% in 15 Minutes | <1 | <1 | <1 | 1 |
| 40% in 15 Minutes | <1 | 1 | 1 | 1 |
| 50% in 15 Minutes | 1 | 1 | 1 | 1 |
| 60% in 15 Minutes | 1 | 1 | 1 | 2 |
| 70% in 15 Minutes | 1 | 2 | 2 | 4 |
| 80% in 15 Minutes | 1 | 3 | 2 | 8 |
| 90% in 15 Minutes | 2 | 5 | 4 | Need 2 Gates |
| 100% in 15 Minutes | 3 | 10 | 8 | Need 2 Gates |

Note:

1. "#" represents average number of Vehicle in front of Gate processing or waiting for processing.

**Table 8. Summary of Average Queue Length in Front of Gate**

| | Vehicle In Front of Gate | | | |
|---|---|---|---|---|
| | Access at Baker St - 1 Gate | | Access at Baker St - 2 Gate | |
| Gate Processing Time | 4 Seconds | 5 Seconds | 4 Seconds | 5 Seconds |
| 10% in 15 Minutes | <1 | <1 | <1 | <1 |
| 20% in 15 Minutes | <1 | 1 | <1 | <1 |
| 30% in 15 Minutes | 1 | 2 | 1 | 1 |
| 40% in 15 Minutes | 2 | 4 | 1 | 1 |
| 50% in 15 Minutes | 4 | Need 2 Gates | 1 | 1 |
| 60% in 15 Minutes | Need 2 Gates | Need 2 Gates | 1 | 2 |
| 70% in 15 Minutes | Need 2 Gates | Need 2 Gates | 2 | 3 |
| 80% in 15 Minutes | Need 2 Gates | Need 2 Gates | 2 | 5 |
| 90% in 15 Minutes | Need 2 Gates | Need 2 Gates | 3 | 11 |
| 100% in 15 Minutes | Need 2 Gates | Need 3 Gates | 5 | Need 3 Gates |

Note:

1. "#" represents average number of Vehicle in front of Gate processing or waiting for processing.

# HCS Two-Way Stop-Control Report

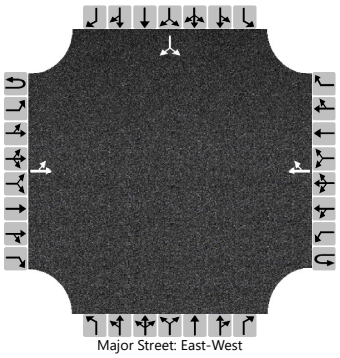
## General Information

| | |
|---|---|
| Analyst | RH |
| Agency/Co. | The Traffic Group, Inc. |
| Date Performed | 11/18/2022 |
| Analysis Year | 2022 |
| Time Analyzed | |
| Intersection Orientation | East-West |
| Project Description | Coppin State Univ |

## Site Information

| | |
|---|---|
| Intersection | Baker St at Garage Access |
| Jurisdiction | City of Baltimore |
| East/West Street | Baker St |
| North/South Street | Garage Access 2 |
| Peak Hour Factor | 0.75 |
| Analysis Time Period (hrs) | 0.25 |

## Lanes




## Vehicle Volumes and Adjustments

| Approach | Eastbound | | | | Westbound | | | | Northbound | | | | Southbound | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | U | L | T | R | U | L | T | R | U | L | T | R | U | L | T | R |
| Priority | 1U | 1 | 2 | 3 | 4U | 4 | 5 | 6 | | 7 | 8 | 9 | | 10 | 11 | 12 |
| Number of Lanes | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | | 0 | 0 | 0 | | 0 | 1 | 0 |
| Configuration | | LT | | | | | | TR | | | | | | | LR | |
| Volume (veh/h) | | 127 | 138 | | | | 237 | 88 | | | | | | 31 | | 16 |
| Percent Heavy Vehicles (%) | | 3 | | | | | | | | | | | | 3 | | 3 |
| Proportion Time Blocked | | | | | | | | | | | | | | | | |
| Percent Grade (%) | | | | | | | | | | | | | | 0 | | |
| Right Turn Channelized | | | | | | | | | | | | | | | | |
| Median Type \| Storage | | Undivided | | | | | | | | | | | | | | |

## Critical and Follow-up Headways

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Base Critical Headway (sec) | | 4.1 | | | | | | | | | | | | 7.1 | | 6.2 |
| Critical Headway (sec) | | 4.13 | | | | | | | | | | | | 6.43 | | 6.23 |
| Base Follow-Up Headway (sec) | | 2.2 | | | | | | | | | | | | 3.5 | | 3.3 |
| Follow-Up Headway (sec) | | 2.23 | | | | | | | | | | | | 3.53 | | 3.33 |

## Delay, Queue Length, and Level of Service

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Flow Rate, v (veh/h) | | 169 | | | | | | | | | | | | | 63 | |
| Capacity, c (veh/h) | | 1121 | | | | | | | | | | | | | 325 | |
| v/c Ratio | | 0.15 | | | | | | | | | | | | | 0.19 | |
| 95% Queue Length, $Q_{95}$ (veh) | | 0.5 | | | | | | | | | | | | | 0.7 | |
| Control Delay (s/veh) | | 8.8 | 1.5 | | | | | | | | | | | | 18.7 | |
| Level of Service (LOS) | | A | A | | | | | | | | | | | | C | |
| Approach Delay (s/veh) | | 5.0 | | | | | | | | | | | | 18.7 | | |
| Approach LOS | | A | | | | | | | | | | | | C | | |

# HCS Two-Way Stop-Control Report

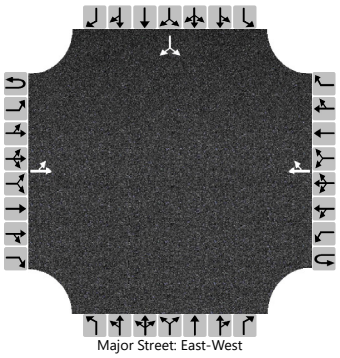
## General Information

| | |
|---|---|
| Analyst | RH |
| Agency/Co. | The Traffic Group, Inc. |
| Date Performed | 11/18/2022 |
| Analysis Year | 2022 |
| Time Analyzed | Total PM |
| Intersection Orientation | East-West |
| Project Description | Coppin State Univ |

## Site Information

| | |
|---|---|
| Intersection | Baker St at Garage Access |
| Jurisdiction | City of Baltimore |
| East/West Street | Baker St |
| North/South Street | Garage Access 2 |
| Peak Hour Factor | 0.75 |
| Analysis Time Period (hrs) | 0.25 |

## Lanes




## Vehicle Volumes and Adjustments

| Approach | Eastbound | | | | Westbound | | | | Northbound | | | | Southbound | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | U | L | T | R | U | L | T | R | U | L | T | R | U | L | T | R |
| Priority | 1U | 1 | 2 | 3 | 4U | 4 | 5 | 6 | | 7 | 8 | 9 | | 10 | 11 | 12 |
| Number of Lanes | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | | 0 | 0 | 0 | | 0 | 1 | 0 |
| Configuration | | LT | | | | | | TR | | | | | | | LR | |
| Volume (veh/h) | | 17 | 126 | | | | 115 | 32 | | | | | | 240 | | 130 |
| Percent Heavy Vehicles (%) | | 3 | | | | | | | | | | | | 3 | | 3 |
| Proportion Time Blocked | | | | | | | | | | | | | | | | |
| Percent Grade (%) | | | | | | | | | | | | | | 0 | | |
| Right Turn Channelized | | | | | | | | | | | | | | | | |
| Median Type \| Storage | Undivided | | | | | | | | | | | | | | | |

## Critical and Follow-up Headways

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Base Critical Headway (sec) | | 4.1 | | | | | | | | | | | | 7.1 | | 6.2 |
| Critical Headway (sec) | | 4.13 | | | | | | | | | | | | 6.43 | | 6.23 |
| Base Follow-Up Headway (sec) | | 2.2 | | | | | | | | | | | | 3.5 | | 3.3 |
| Follow-Up Headway (sec) | | 2.23 | | | | | | | | | | | | 3.53 | | 3.33 |

## Delay, Queue Length, and Level of Service

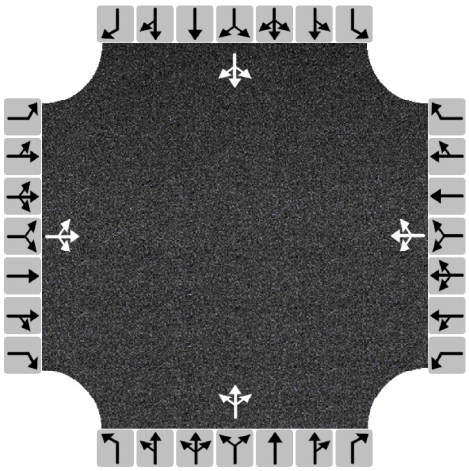
| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Flow Rate, v (veh/h) | | 23 | | | | | | | | | | | | | 493 | |
| Capacity, c (veh/h) | | 1371 | | | | | | | | | | | | | 675 | |
| v/c Ratio | | 0.02 | | | | | | | | | | | | | 0.73 | |
| 95% Queue Length, $Q_{95}$ (veh) | | 0.1 | | | | | | | | | | | | | 6.4 | |
| Control Delay (s/veh) | | 7.7 | 0.1 | | | | | | | | | | | | 23.4 | |
| Level of Service (LOS) | | A | A | | | | | | | | | | | | C | |
| Approach Delay (s/veh) | 1.0 | | | | | | | | | | | | 23.4 | | | |
| Approach LOS | A | | | | | | | | | | | | C | | | |

# HCS All-Way Stop Control Report

## General and Site Information

| | |
|---|---|
| Analyst | RH |
| Agency/Co. | The Traffic Group, Inc. |
| Date Performed | 11/18/2022 |
| Analysis Year | 2022 |
| Analysis Time Period (hrs) | 0.25 |
| Time Analyzed | Total AM_Alt 2 |
| Project Description | Coppin State Univ. |
| Intersection | N. Warwick Ave & Baker |
| Jurisdiction | City of Baltimore, MD |
| East/West Street | Baker St |
| North/South Street | N. Warwick Ave |
| Peak Hour Factor | 0.87 |

## Lanes



## Turning Movement Demand Volumes

| Approach | Eastbound | | | Westbound | | | Northbound | | | Southbound | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Volume (veh/h) | 44 | 125 | 0 | 0 | 186 | 35 | 0 | 0 | 0 | 31 | 0 | 139 |
| % Thrus in Shared Lane | | | | | | | | | | | | |

## Lane Flow Rate and Adjustments

| Approach | Eastbound | | | Westbound | | | Northbound | | | Southbound | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane | L1 | L2 | L3 | L1 | L2 | L3 | L1 | L2 | L3 | L1 | L2 | L3 |
| Configuration | LTR | | | LTR | | | LTR | | | LTR | | |
| Flow Rate, v (veh/h) | 194 | | | 254 | | | 0 | | | 195 | | |
| Percent Heavy Vehicles | 2 | | | 2 | | | 2 | | | 2 | | |
| Initial Departure Headway, $h_d$ (s) | 3.20 | | | 3.20 | | | 3.20 | | | 3.20 | | |
| Initial Degree of Utilization, x | 0.173 | | | 0.226 | | | 0.000 | | | 0.174 | | |
| Final Departure Headway, $h_d$ (s) | 4.76 | | | 4.56 | | | 5.28 | | | 4.53 | | |
| Final Degree of Utilization, x | 0.257 | | | 0.321 | | | 0.000 | | | 0.246 | | |
| Move-Up Time, m (s) | 2.0 | | | 2.0 | | | 2.0 | | | 2.0 | | |
| Service Time, $t_s$ (s) | 2.76 | | | 2.56 | | | 3.28 | | | 2.53 | | |

## Capacity, Delay and Level of Service

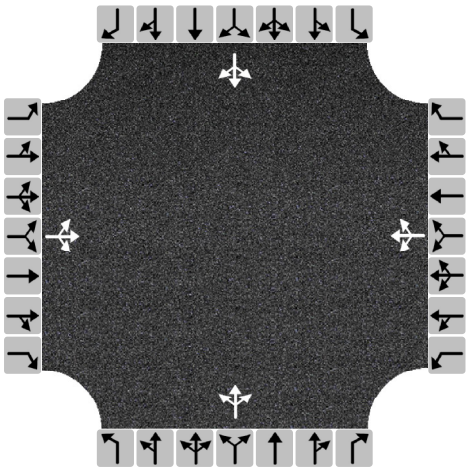
| Approach | Eastbound | | | Westbound | | | Northbound | | | Southbound | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane | L1 | L2 | L3 | L1 | L2 | L3 | L1 | L2 | L3 | L1 | L2 | L3 |
| Configuration | LTR | | | LTR | | | LTR | | | LTR | | |
| Flow Rate, v (veh/h) | 194 | | | 254 | | | 0 | | | 195 | | |
| Capacity (veh/h) | 756 | | | 790 | | | 0 | | | 795 | | |
| 95% Queue Length, $Q_{95}$ (veh) | 1.0 | | | 1.4 | | | 0.0 | | | 1.0 | | |
| Control Delay (s/veh) | 9.4 | | | 9.7 | | | 8.3 | | | 9.0 | | |
| Level of Service, LOS | A | | | A | | | | | | A | | |
| Approach Delay (s/veh) \| LOS | 9.4 | A | | 9.7 | A | | 0.0 | A | | 9.0 | A | |
| Intersection Delay (s/veh) \| LOS | 9.4 | | | | | | A | | | | | |

# HCS All-Way Stop Control Report

## General and Site Information

| | |
|---|---|
| Analyst | RH |
| Agency/Co. | The Traffic Group, Inc. |
| Date Performed | 11/18/2022 |
| Analysis Year | 2022 |
| Analysis Time Period (hrs) | 0.25 |
| Time Analyzed | Total PM_Alt 2 |
| Project Description | Coppin State Univ. |
| Intersection | N. Warwick Ave & Baker |
| Jurisdiction | City of Baltimore, MD |
| East/West Street | Baker St |
| North/South Street | N. Warwick Ave |
| Peak Hour Factor | 0.91 |

## Lanes



## Turning Movement Demand Volumes

| Approach | Eastbound | | | Westbound | | | Northbound | | | Southbound | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Volume (veh/h) | 129 | 237 | 0 | 2 | 96 | 44 | 1 | 0 | 1 | 50 | 0 | 50 |
| % Thrus in Shared Lane | | | | | | | | | | | | |

## Lane Flow Rate and Adjustments

| Approach | Eastbound | | | Westbound | | | Northbound | | | Southbound | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane | L1 | L2 | L3 | L1 | L2 | L3 | L1 | L2 | L3 | L1 | L2 | L3 |
| Configuration | LTR | | | LTR | | | LTR | | | LTR | | |
| Flow Rate, v (veh/h) | 402 | | | 156 | | | 2 | | | 110 | | |
| Percent Heavy Vehicles | 2 | | | 2 | | | 2 | | | 2 | | |
| Initial Departure Headway, $h_d$ (s) | 3.20 | | | 3.20 | | | 3.20 | | | 3.20 | | |
| Initial Degree of Utilization, x | 0.358 | | | 0.139 | | | 0.002 | | | 0.098 | | |
| Final Departure Headway, $h_d$ (s) | 4.48 | | | 4.49 | | | 5.19 | | | 5.01 | | |
| Final Degree of Utilization, x | 0.500 | | | 0.195 | | | 0.003 | | | 0.153 | | |
| Move-Up Time, m (s) | 2.0 | | | 2.0 | | | 2.0 | | | 2.0 | | |
| Service Time, $t_s$ (s) | 2.48 | | | 2.49 | | | 3.19 | | | 3.01 | | |

## Capacity, Delay and Level of Service

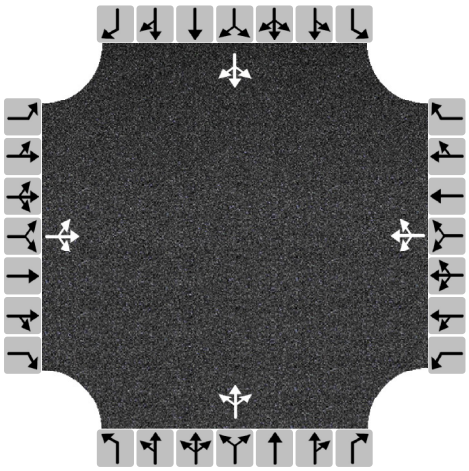
| Approach | Eastbound | | | Westbound | | | Northbound | | | Southbound | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane | L1 | L2 | L3 | L1 | L2 | L3 | L1 | L2 | L3 | L1 | L2 | L3 |
| Configuration | LTR | | | LTR | | | LTR | | | LTR | | |
| Flow Rate, v (veh/h) | 402 | | | 156 | | | 2 | | | 110 | | |
| Capacity (veh/h) | 804 | | | 801 | | | 693 | | | 719 | | |
| 95% Queue Length, $Q_{95}$ (veh) | 2.8 | | | 0.7 | | | 0.0 | | | 0.5 | | |
| Control Delay (s/veh) | 11.9 | | | 8.6 | | | 8.2 | | | 8.9 | | |
| Level of Service, LOS | B | | | A | | | A | | | A | | |
| Approach Delay (s/veh) \| LOS | 11.9 | B | | 8.6 | A | | 8.2 | A | | 8.9 | A | |
| Intersection Delay (s/veh) \| LOS | 10.6 | | | | | | B | | | | | |

# HCS All-Way Stop Control Report

## General and Site Information

| | |
|---|---|
| Analyst | RH |
| Agency/Co. | The Traffic Group, Inc. |
| Date Performed | 12/1/2022 |
| Analysis Year | 2022 |
| Analysis Time Period (hrs) | 0.25 |
| Time Analyzed | TOT PM_Alt 2 |
| Project Description | Coppin State Univ |
| Intersection | N Warwick Ave & Presbury St |
| Jurisdiction | City of Baltimore |
| East/West Street | Presbury St |
| North/South Street | N Warwick Ave |
| Peak Hour Factor | 0.92 |

## Lanes



## Turning Movement Demand Volumes

| Approach | Eastbound | | | Westbound | | | Northbound | | | Southbound | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Volume (veh/h) | 41 | 5 | 6 | 13 | 1 | 17 | 3 | 124 | 40 | 12 | 95 | 26 |
| % Thrus in Shared Lane | | | | | | | | | | | | |

## Lane Flow Rate and Adjustments

| Approach | Eastbound | | | Westbound | | | Northbound | | | Southbound | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane | L1 | L2 | L3 | L1 | L2 | L3 | L1 | L2 | L3 | L1 | L2 | L3 |
| Configuration | LTR | | | LTR | | | LTR | | | LTR | | |
| Flow Rate, v (veh/h) | 57 | | | 34 | | | 182 | | | 145 | | |
| Percent Heavy Vehicles | 2 | | | 2 | | | 2 | | | 2 | | |
| Initial Departure Headway, $h_d$ (s) | 3.20 | | | 3.20 | | | 3.20 | | | 3.20 | | |
| Initial Degree of Utilization, x | 0.050 | | | 0.030 | | | 0.161 | | | 0.129 | | |
| Final Departure Headway, $h_d$ (s) | 4.77 | | | 4.47 | | | 4.17 | | | 4.24 | | |
| Final Degree of Utilization, x | 0.075 | | | 0.042 | | | 0.210 | | | 0.170 | | |
| Move-Up Time, m (s) | 2.0 | | | 2.0 | | | 2.0 | | | 2.0 | | |
| Service Time, $t_s$ (s) | 2.77 | | | 2.47 | | | 2.17 | | | 2.24 | | |

## Capacity, Delay and Level of Service

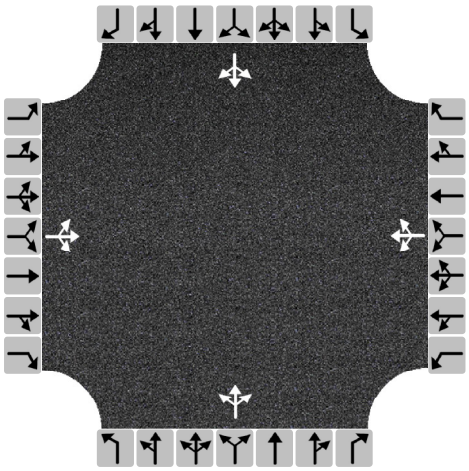
| Approach | Eastbound | | | Westbound | | | Northbound | | | Southbound | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane | L1 | L2 | L3 | L1 | L2 | L3 | L1 | L2 | L3 | L1 | L2 | L3 |
| Configuration | LTR | | | LTR | | | LTR | | | LTR | | |
| Flow Rate, v (veh/h) | 57 | | | 34 | | | 182 | | | 145 | | |
| Capacity (veh/h) | 755 | | | 806 | | | 864 | | | 849 | | |
| 95% Queue Length, $Q_{95}$ (veh) | 0.2 | | | 0.1 | | | 0.8 | | | 0.6 | | |
| Control Delay (s/veh) | 8.2 | | | 7.7 | | | 8.3 | | | 8.1 | | |
| Level of Service, LOS | A | | | A | | | A | | | A | | |
| Approach Delay (s/veh) \| LOS | 8.2 | A | | 7.7 | A | | 8.3 | A | | 8.1 | A | |
| Intersection Delay (s/veh) \| LOS | 8.1 | | | | | | A | | | | | |

# HCS All-Way Stop Control Report

## General and Site Information

| | |
|---|---|
| Analyst | RH |
| Agency/Co. | The Traffic Group, Inc. |
| Date Performed | 12/1/2022 |
| Analysis Year | 2022 |
| Analysis Time Period (hrs) | 0.25 |
| Time Analyzed | TOT AM_Alt 2 |
| Project Description | Coppin State Univ |
| Intersection | N Warwick Ave & Presbury St |
| Jurisdiction | City of Baltimore |
| East/West Street | Presbury St |
| North/South Street | N Warwick Ave |
| Peak Hour Factor | 0.90 |

## Lanes



## Turning Movement Demand Volumes

| Approach | Eastbound | | | Westbound | | | Northbound | | | Southbound | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | L | T | R | L | T | R | L | T | R | L | T | R |
| Volume (veh/h) | 13 | 1 | 5 | 46 | 3 | 21 | 5 | 57 | 11 | 7 | 117 | 48 |
| % Thrus in Shared Lane | | | | | | | | | | | | |

## Lane Flow Rate and Adjustments

| Approach | Eastbound | | | Westbound | | | Northbound | | | Southbound | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane | L1 | L2 | L3 | L1 | L2 | L3 | L1 | L2 | L3 | L1 | L2 | L3 |
| Configuration | LTR | | | LTR | | | LTR | | | LTR | | |
| Flow Rate, v (veh/h) | 21 | | | 78 | | | 81 | | | 191 | | |
| Percent Heavy Vehicles | 2 | | | 2 | | | 2 | | | 2 | | |
| Initial Departure Headway, $h_d$ (s) | 3.20 | | | 3.20 | | | 3.20 | | | 3.20 | | |
| Initial Degree of Utilization, x | 0.019 | | | 0.069 | | | 0.072 | | | 0.170 | | |
| Final Departure Headway, $h_d$ (s) | 4.59 | | | 4.49 | | | 4.28 | | | 4.10 | | |
| Final Degree of Utilization, x | 0.027 | | | 0.097 | | | 0.097 | | | 0.217 | | |
| Move-Up Time, m (s) | 2.0 | | | 2.0 | | | 2.0 | | | 2.0 | | |
| Service Time, $t_s$ (s) | 2.59 | | | 2.49 | | | 2.28 | | | 2.10 | | |

## Capacity, Delay and Level of Service

| Approach | Eastbound | | | Westbound | | | Northbound | | | Southbound | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane | L1 | L2 | L3 | L1 | L2 | L3 | L1 | L2 | L3 | L1 | L2 | L3 |
| Configuration | LTR | | | LTR | | | LTR | | | LTR | | |
| Flow Rate, v (veh/h) | 21 | | | 78 | | | 81 | | | 191 | | |
| Capacity (veh/h) | 784 | | | 801 | | | 841 | | | 879 | | |
| 95% Queue Length, $Q_{95}$ (veh) | 0.1 | | | 0.3 | | | 0.3 | | | 0.8 | | |
| Control Delay (s/veh) | 7.7 | | | 8.0 | | | 7.7 | | | 8.2 | | |
| Level of Service, LOS | A | | | A | | | A | | | A | | |
| Approach Delay (s/veh) \| LOS | 7.7 | A | | 8.0 | A | | 7.7 | A | | 8.2 | A | |
| Intersection Delay (s/veh) \| LOS | 8.0 | | | | | | A | | | | | |

## Summary and Conclusions

This Traffic Analysis has shown that the development of the Coppin State Public Safety Facility will have a minimal impact on surrounding intersection operations if it is developed at Project Site No. 1 or Project Site No. 2. Further analysis indicates that single lanes entering and exiting the garage will accommodate projected traffic under most conditions. If gates operate with less efficiency or a very high percentage of inbound traffic arrives during a very short amount of time, queuing could occur, however, this is not the expected regular operation for the garage.

From a traffic perspective, there is not a benefit to developing one site over the other. Adequate operations are achieved at all locations with the proposed development.