TRAFFIC SIGNAL WARRANT ANALYSIS

MONTGOMERY COUNTY 3RD DISTRICT POLICE STATION

June, 2009

Submitted to:

MARYLAND STATE HIGHWAY ADMINISTRATION (SHA)
ENGINEERING ACCESS PERMITS DIVISION
707 NORTH CALVERT STREET
BALTIMORE, MARYLAND 21202

Dewberry

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Introduction

The Montgomery County Police Department is proposing to relocate their 3rd District Police Station to White Oak, Maryland on the north quadrant of the US 29 (Columbia Pike)/MD 650 (New Hampshire Ave.) interchange (see Figure 1 for general location). The County has purchased the parcel of land that is adjacent to Milestone Drive. The County plans to subdivide the parcel into an east and west section by removing the sharp curve of Sherbrooke Woods Lane and instead extend the street south to Milestone Drive to divide the parcel in two (see Figure 2). The west section would be the location of the police station and the east section would be a development for up to 180 housing units. The development is being designed to accommodate for the future US 29 / Stewart Lane interchange that SHA is currently proposing.

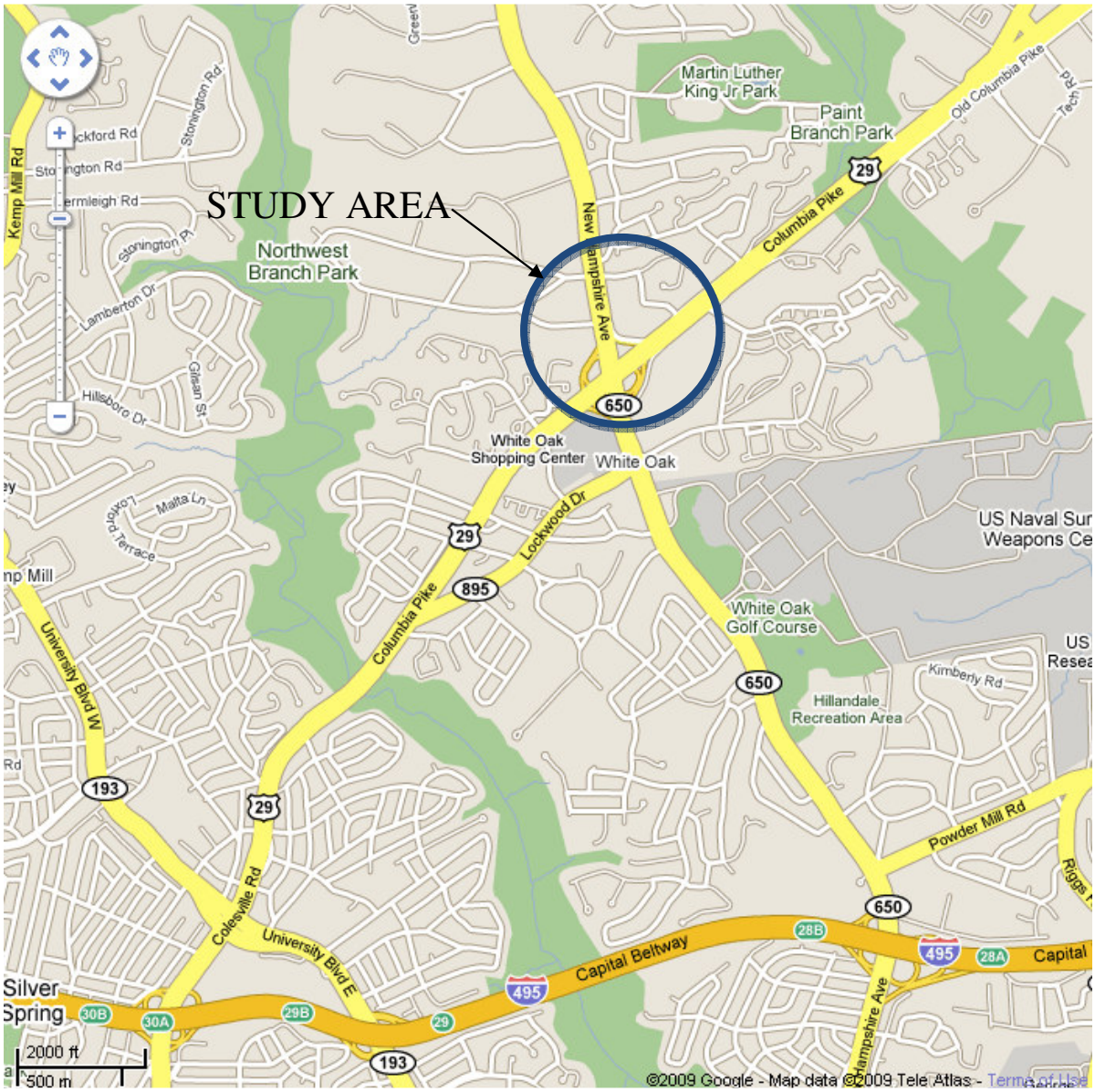

Figure 1: General Location Map

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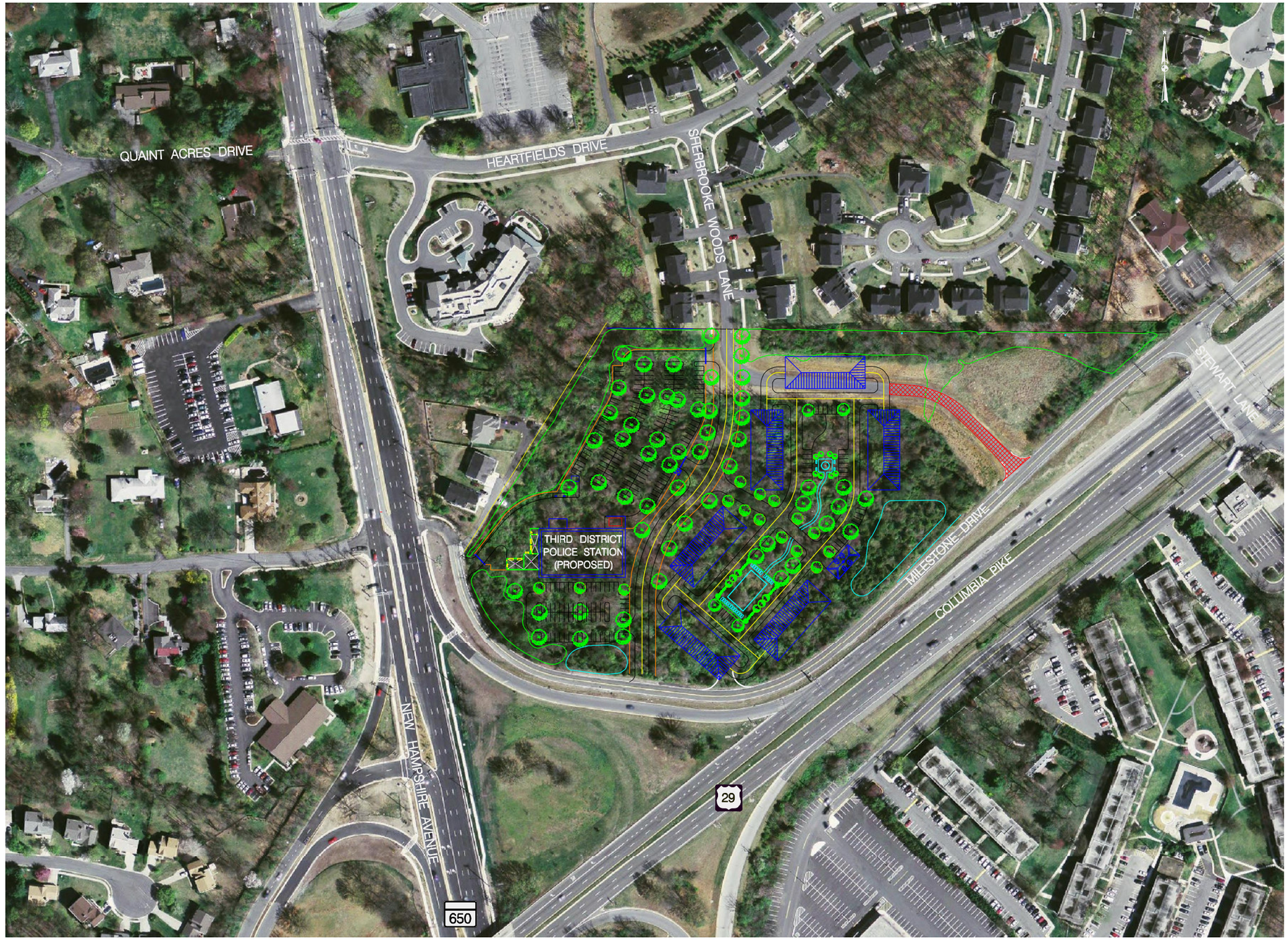
SCALE: 1" = 200'



LEGEND

REMOVE PAVEMENT

FIGURE 2
PROPOSED DEVELOPMENT WITH EXISTING CONDITIONS.

A Traffic Impact Study was conducted in January, 2009 and submitted to SHA that requested full access at the MD 650/Milestone Drive intersection. SHA responded on March 26, 2009 indicating that there were safety and operational issues if full access was allowed at this intersection and therefore rejected the request. In the same letter, SHA suggested "exploring the feasibility and traffic warrants of a potential full signal at the MD 650/Heartfields Drive intersection," if desired.

The County has decided that exploring the feasibility of a full traffic signal at this intersection is within their interest and is submitting this report for the sole purpose of this request. The decision to submit this request to SHA was determined after consultations with both Maryland-National Capital Park and Planning Commission (M-NCPPC) and SHA. As will be explained in the study, the distribution of the proposed traffic volumes would change depending on whether a full traffic signal was granted at the MD 650/Heartfields Drive intersection. Rather than doing two analyses on the study area with and without a full traffic signal and submitting that to M-NCPPC, the determination was made to first submit the request for the full signal from SHA and then submit one analysis to M-NCPPC based on SHA's decision of a full traffic signal.

Therefore, this study will only focus on whether a full signal is warranted at MD 650/Heartfields Drive/Quaint Acres Drive intersection and will not investigate any other intersections in the vicinity. This full signal study will investigate the validity of installing a full signal based on the current conditions as well as the largest possible proposed scenario. The proposed scenario would be contingent on the future approval from M-NCPPC and SHA for the complete traffic impact study.

Site Conditions

The study intersection is the second intersection north of the US 29/MD 650 interchange. Heartfields Drive is the eastern leg of the intersection. On the southeast corner is a senior center and on the northeast corner is the White Oak Public Library. Both have their access points on Heartfields Drive. Beyond these parcels, there are approximately 50 single family houses. This intersection is the only direct access to MD 650 from the neighborhood. The only other access to the neighborhood is via Milestone Drive which connects to MD 650 and US 29.

Quaint Acres Drive is the western leg of the study intersection. The neighborhood consists of low density single family houses. The neighborhood has three access points to MD 650 at Milestone Drive, Quaint Acres Drive, and Tanley Road. Left turns are restricted from Milestone Drive with a median barrier. There are no other ways to access the neighborhood other than from MD 650. Quaint Acres Drive is the main access point from the neighborhood to head north on MD 650.

MD 650 is a north-south arterial that extends into Washington D.C. to the south. To the north of the intersection, MD 650 remains suburban for approximately six miles to the Spencerville area with medium density housing development surrounding MD 650, along with some commercial strips and religious buildings for worship. MD 650 continues north and then west into the rural parts of Montgomery County as it heads towards Damascus, MD.

To the south of the intersection, MD 650 becomes more urbanized. There are two major interchanges with US 29 and I-495. Then it passes through the highly developed area of Langley Park before entering the District of Columbia. This is a popular commuter route into and out of Washington D.C.

The MD 650 corridor between US 29 and Randolph Road is confined by Northwest Branch Park to the west and Paint Branch Park to the east. For approximately 1.5 miles north of US 29, there are no other outlets for the neighborhoods west of MD 650 except for MD 650 itself. North of Heartfields Drive, there is only one other outlet other than MD 650 for about 1 mile to the east. Those outlets would require intimate knowledge of the neighborhood since it requires several turns on different roads to leave the neighborhood at a location other than MD 650. Therefore MD 650 acts both as an arterial and a neighborhood road.

The area surrounding the study intersection is completely built-out except for the parcel on the north quadrant of the US 29/MD 650 interchange. This parcel is owned by Montgomery County and is being used to relocate the 3rd District Police Station and up to 180 housing units. The other properties along the MD 650 corridor are mainly medium density residential units, with some sporadic commercial properties, churches, parks and schools in the area.

Figure 3 shows the general geometrics of the study intersection. MD 650 has a very gentle horizontal curve to the north and is straight to the south. The vertical grades on MD 650 are below 3% in each direction. There is a vertical crest curve to the south of the intersection. Although from field observations there appears to be enough vertical sight distance, it is not a desirable sight distance especially if drivers are speeding though this section. Only right turns are permitted from Heartfields Drive to northbound (NB) MD 650. There is a small concrete island on Heartfields Drive at the intersection to guide drivers to make a right turn.

The intersection currently has a flashing beacon that flashes yellow in both directions for MD 650 and flashes red for the cross road. There is a pedestrian signal for crossing MD 650 on the north side of the intersection that is only activated when the pedestrian crossing button is pushed. When activated, there is an all-red phase for vehicular traffic. No turns on red are permitted from southbound (SB) MD 650 when the pedestrian signal is on.

Pedestrian traffic is generated from the surrounding neighborhoods and bus stops on MD 650. There are sidewalks on both sides of Heartfields Drive. On MD 650, there are sidewalks on both sides to the south of the intersection. North of the intersection, there is only a sidewalk along the NB side of MD 650. There are no sidewalks on either side of Quaint Acres Drive.

Traffic Volumes

A 13-hour traffic count was conducted at the intersection of MD 650/Heartfields Drive/Quaint Acres Drive in April 2009 after the completion of the Easter and Passover holidays, when all public and private schools were back in session. The traffic count went from 6 AM to 7 PM and can be found in Appendix A. Truck volumes were not counted but they appeared very light on MD 650 from field observations.

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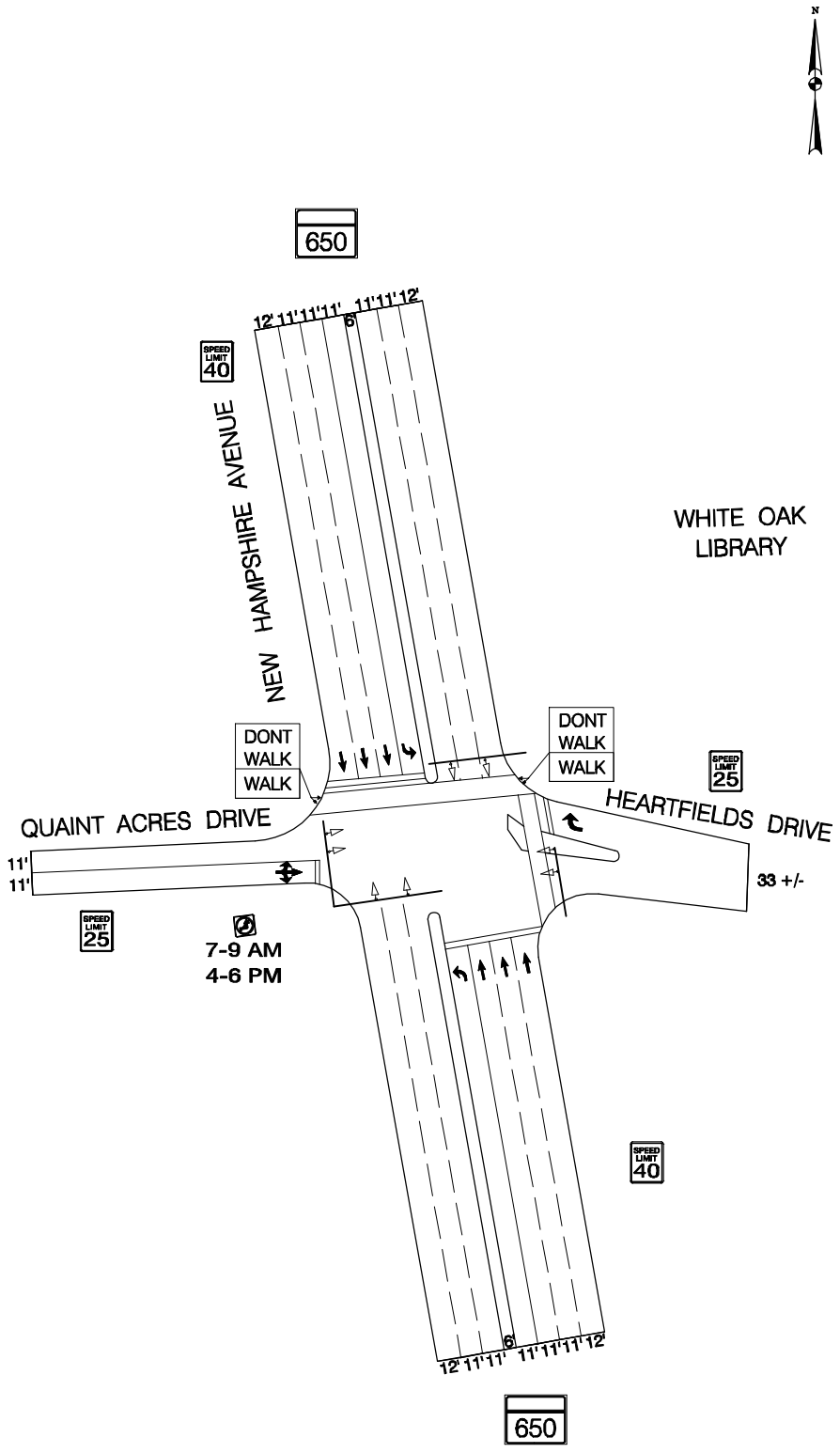
NOT TO SCALE



LEGEND

- SIGNAL HEAD (YELLOW AND RED FOR MD 650 RED ONLY FOR SIDE ROADS)
- PEDESTRIAN SIGNAL

FIGURE 3
EXISTING CONDITION DIAGRAM

Due to the left turn restriction from Heartfields Drive, a second traffic count was conducted at the White Oak Public Library. This count was taken since the traffic pattern out of the library would change if a full traffic signal were installed as explained later in this report. The library opens at 10 AM on weekdays and 9 AM on Saturdays. It closes at 9 PM, Monday through Wednesday and closes at 5 PM, Thursday through Saturday. The library is closed on Sundays. The count was conducted in early May on a Tuesday from 10 AM to 6:30 PM and the count consisted of only vehicles exiting the library parking lot. There were no scheduled events at the library on the day of this count. This count can also be seen in Appendix A.

The U.S. Federal and Drug Administration (FDA) has a campus approximately one mile south of the study intersection off of MD 650. There are approved plans for expanding the facility. The plans have been divided into several phases. By the end of 2009, the total number of employees will expand from 3,174 to approximately 5,734. This is expected to generate a significant amount of traffic on MD 650 through the study intersection as shown in Table 1.

Traffic Generated through study intersection	AM	PM
NB MD 650	36	264
SB MD 650	291	41

Table 1 – Traffic Generated from FDA development (Traffic numbers supplied by M-NCPPC)

South of the US 29/MD 650 interchange there are plans to build 1,000 more apartment units on the southern quadrant of the interchange. The proposed development was introduced after this study was underway, so there is no traffic data to this point from the developer and no approval for this development. If approved, we anticipate 10-15% of the traffic generated will travel through the MD 650/Heartfields Drive/Quaint Acres Drive intersection.

Over the past year in Maryland, traffic volumes have decreased on average between 2% to 5% (FHWA - http://www.fhwa.dot.gov/ohim/tvtw/tvtpage.cfm) from traffic volumes over the previous year. These trends are very different from the historical trends that see traffic increase on average 2% to 3% annually. It is believed that the traffic volume reductions are based on the current recession and may therefore be a low representation of normal traffic volume conditions during "normal" economic times.

Operations

Several field observations were taken at the study intersection. From Heartfields Drive a total of 14 vehicles made a left turn or went straight at the intersection. Both movements are illegal. Of those fourteen, half of those violations occurred during the morning rush hour (6-9 AM). Those illegal movements would sometimes be made by first entering the median of MD 650 and then waiting for a gap in the SB direction before completing the movement.

From Quaint Acres Drive, it was also common for vehicles that made a left or went straight to stop in the middle of MD 650 and wait for a gap from the NB MD 650 traffic, before completing the movement. The left turn movements are restricted at the intersection during the morning and afternoon rush hour, making these movements illegal during this time.

Counts were also taken at the first median break north of the study intersection to observe the number of vehicles that made a u-turn at this median break after making a right from Heartfields Drive. Out of the 356 total right turns during the count, 160 of them made a u-turn with the vast majority of them continuing south on MD 650 through the intersection. When including the illegal turns from Heartfields Drive, 47% of vehicles at the intersection desired to go in one of the two restricted movements, southbound on MD 650 or straight to Quaint Acres Drive.

The library traffic was distributed based on observations during the traffic count. It appeared that over 90% of the vehicles that entered the library parking lot did so from the southern entrance (Heartfields Drive). When leaving, about 78% of the vehicles in the library parking lot chose to leave the parking lot via the north exit (Tracy Drive) based on the traffic count. The exit choice seemed to be based on the fact that it was a shorter distance to access both northbound and southbound MD 650. The vehicles that chose to use the Heartfields Drive exit seemed to have chosen this exit based mainly on the close proximity of where they parked. There were some vehicles that chose to use the Heartfields Drive exit and then make a left away from MD 650, towards US 29.

If a full traffic signal were installed at the study intersection which allowed lefts out of Heartfields Drive, the assumption is that the majority of the library traffic exiting the parking lot would want to go to the full signal. Therefore, the distribution for the library used for this study assumed that 50% of the library users would make a left on MD 650 from Heartfields Drive, 25% would make a right on MD 650 from Heartfields Drive, and 25% would either exit from the north access point (Tracy Drive) or exit from the south access point and turn away from MD 650. Figure 4 indicates the estimated changes in traffic volumes from the library during the PM peak hour, with a full traffic signal that allowed all traffic movements from Heartfields Drive.

In the middle of the afternoon (approximately 2:30 PM), there was one period when a surge of vehicles left the library at the same time. This caused a small queue of up to six vehicles waiting to access MD 650 from Tracy Drive. There were no scheduled events at the library during the count, but this appeared to be a group leaving at the same time. The library has scheduled events multiple times a week where it is expected that heavier queues than those observed would take place. Most of these scheduled events are shortly after the library opens (10:15 AM) or after the afternoon rush hour (7:00 PM).

Figure 5 shows the peak hour turning movements for the existing conditions. There are two scenarios for this. The turning movements shown on the top of the figure are based on existing conditions plus the volumes generated from the FDA development. The turning movements at the bottom of the figure show the traffic distribution based on existing conditions and the approved FDA development if a full signal were installed. This distributes the library traffic into this intersection.

The proposed traffic volumes of the housing units and its distribution were based on the *2008 Local Area Transportation Review (LATR) and Policy Area Mobility Review (PAMR) Guidelines* (http://www.mc-mncppc.org/transportation/latr_guidelines/latr_guidelines_2008.shtm) from M-NCPPC. It was assumed that all traffic exiting the housing units would access MD 650 at Heartfields Drive, except for traffic that would go northbound on US 29. The distribution can be

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FIGURE 4
CHANGES IN LIBRARY
TRAFFIC WITH SIGNAL

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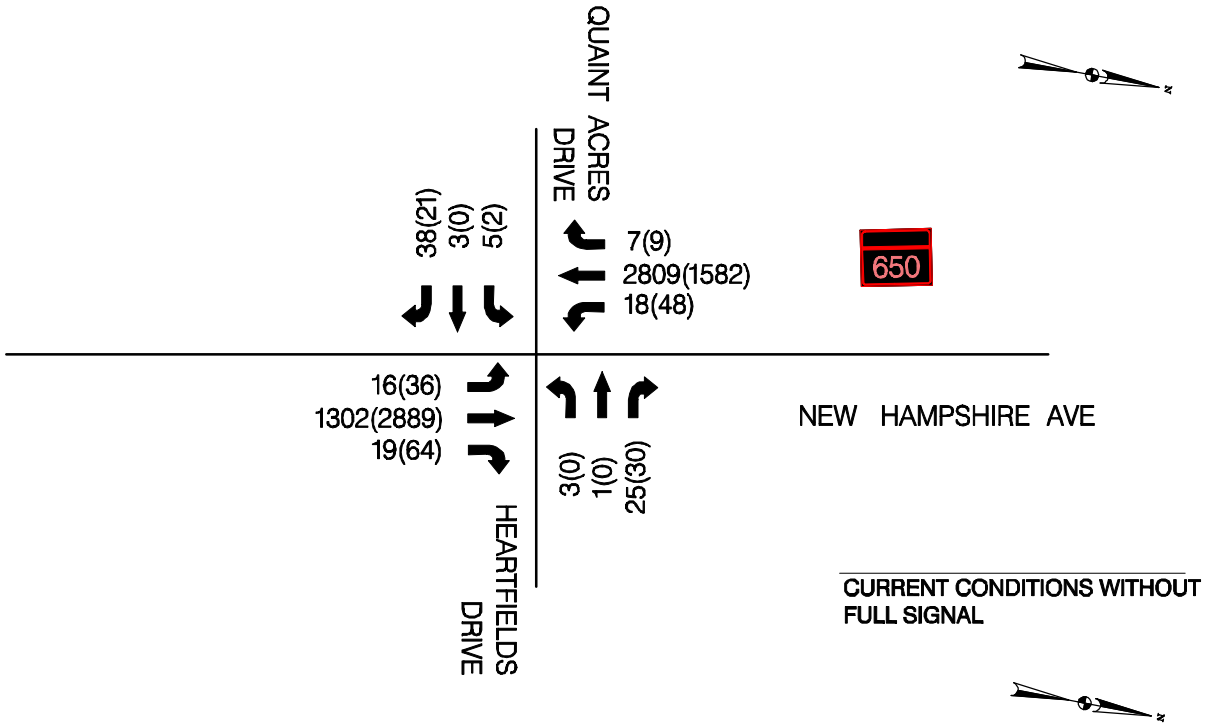
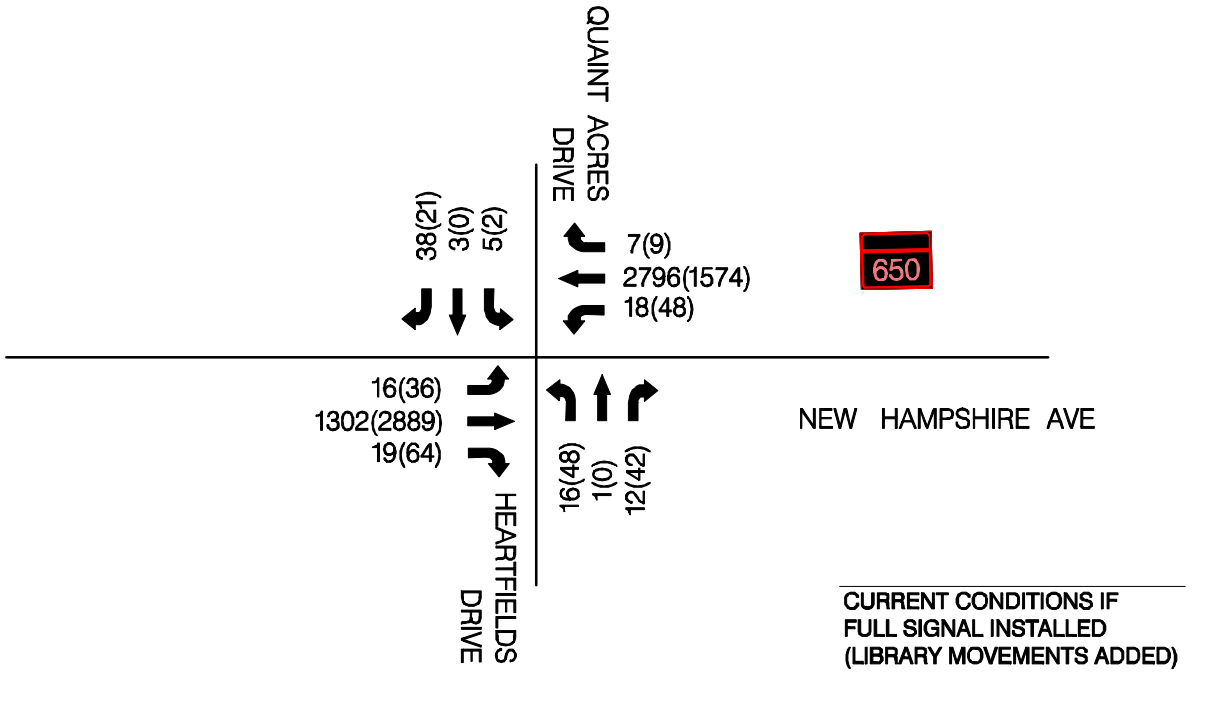


CURRENT CONDITIONS WITHOUT FULL SIGNAL



CURRENT CONDITIONS IF FULL SIGNAL INSTALLED (LIBRARY MOVEMENTS ADDED)

NOT TO SCALE

FIGURE 5
EXISTING VOLUMES

seen in Appendix B. It should be noted that the planning for the housing development is at the preliminary stages and there are several proposals being considered. The 180 units were chosen for this study as a conservative assumption for the most possible units at this location.

Traffic volumes for the police station were generated by taking counts of vehicles entering and exiting the 4th District Police Station on Randolph Road in the Wheaton area (see Appendix B). This location was chosen due to the nearly identical size and function the 4th District Police Station has to the proposed 3rd District Police Station. Those volumes were then used as the estimate for the proposed volumes for the 3rd District Police Station. Since the Montgomery County 3rd District is mainly the US 29 corridor from the Howard County Line to the D.C. Line (see http://gis2.montgomerycountymd.gov/ims/publicsafety/viewer.htm for an interactive map of the police districts), the assumption was made that 80% of vehicles accessing the new police station would come from US 29. The other 20% would come from MD 650. Both distributions were split evenly between north and south. To be conservative, it was assumed that all police traffic would use the MD 650/Milestone Drive intersection.

Figure 6 shows the trip distributions for both the police station and housing units including how the distributions were derived. Figure 7 displays the proposed volume distributions with and without a traffic signal.

A Synchro analysis was conducted at the study intersection for four scenarios. The first two scenarios were based on existing traffic volumes with or without a full traffic signal. The second two scenarios were based on a built condition of the police station and housing units with or without a traffic signal. Table 2 shows the summary of the delay for this analysis.

		NB MD 650		SB MD 650		EB Quaint Acres Dr		WB Heartfields Dr		Overall Intersection	
		Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
Existing Condition	AM	0.5	A	0.1	A	Err*	F	Err*	F	Err*	F
	PM	0.2	A	2.5	A	326.5	F	24.9	C	2.8	A
Existing with Library Counts and Signal	AM	2.3	A	4.3	A	73.1	E	68.2	E	4.8	A
	PM	5.5	A	7.0	A	65.8	E	73.5	E	7.6	A
Build with Housing, Police Station, Library, and Signal	AM	3.4	A	5.3	A	68.5	E	79.7	E	6.8	A
	PM	7.2	A	10.2	B	62.9	E	72.7	E	10.0	B
Build with Housing, Police Station, no Signal	AM	1.0	A	0.1	A	Err*	F	Err*	F	Err*	F
	PM	0.3	A	2.7	A	579.2	F	29.6	D	4.2	A

Table 2: Synchro Analysis Summary

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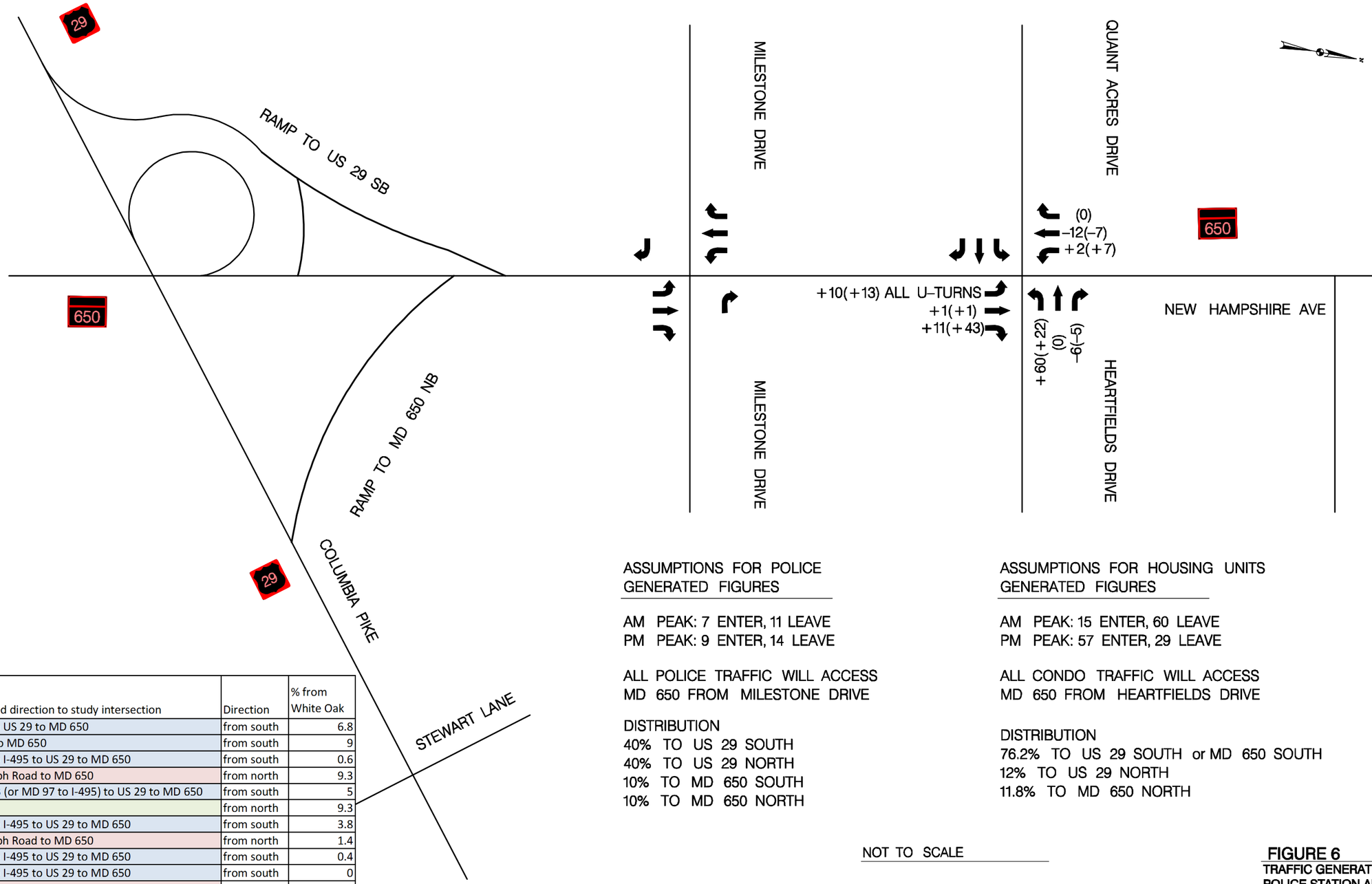

Super District	Assumed direction to study intersection	Direction	% from White Oak
Bethesda/Chevy Chase	I-495 to US 29 to MD 650	from south	6.8
Silver Spring/Takoma Park	US 29 to MD 650	from south	9
Potomac/Darnestown	I-270 to I-495 to US 29 to MD 650	from south	0.6
Rockville/North Bethesda	Randolph Road to MD 650	from north	9.3
Kensington/Wheaton	MD 193 (or MD 97 to I-495) to US 29 to MD 650	from south	5
White Oak/Fairland	US 29	from north	9.3
Gaithersburg/Shady Grove	I-270 to I-495 to US 29 to MD 650	from south	3.8
Aspen Hill/Olney	Randolph Road to MD 650	from north	1.4
Germantown/Clarksburg	I-270 to I-495 to US 29 to MD 650	from south	0.4
Rural: West of I-270	I-270 to I-495 to US 29 to MD 650	from south	0
Rural: East of I-270	MD 650	from north	1.1
Washington, DC	US 29 to MD 650	from south	23.4
P.G. County	I-495 to MD 650	from south	20.1
VA	I-495 to US 29 to MD 650	from south	7.1
Frederick County	I-270 to I-495 to US 29 to MD 650	from south	0
Howard County	US 29	from north	2.7

ASSUMPTIONS FOR POLICE GENERATED FIGURES

AM PEAK: 7 ENTER, 11 LEAVE
PM PEAK: 9 ENTER, 14 LEAVE

ALL POLICE TRAFFIC WILL ACCESS MD 650 FROM MILESTONE DRIVE

DISTRIBUTION
40% TO US 29 SOUTH
40% TO US 29 NORTH
10% TO MD 650 SOUTH
10% TO MD 650 NORTH

ASSUMPTIONS FOR HOUSING UNITS GENERATED FIGURES

AM PEAK: 15 ENTER, 60 LEAVE
PM PEAK: 57 ENTER, 29 LEAVE

ALL CONDO TRAFFIC WILL ACCESS MD 650 FROM HEARTFIELDS DRIVE

DISTRIBUTION
76.2% TO US 29 SOUTH or MD 650 SOUTH
12% TO US 29 NORTH
11.8% TO MD 650 NORTH

NOT TO SCALE

FIGURE 6
TRAFFIC GENERATED FROM POLICE STATION AND HOUSING UNITS (WITH SIGNAL AT STUDY INTERSECTION)

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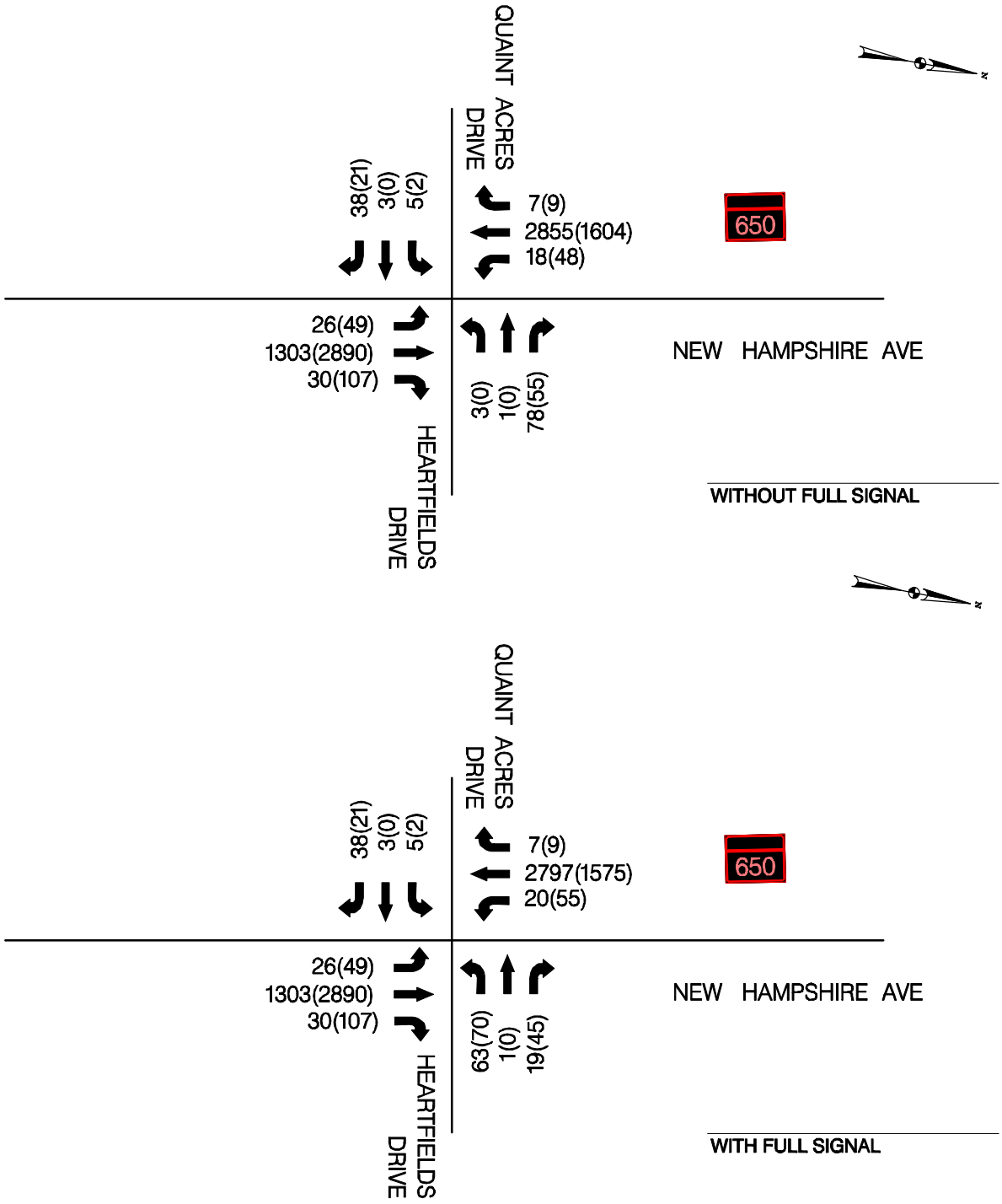

NOT TO SCALE

FIGURE 7
PROPOSED VOLUMES
WITH HOUSING UNITS AND
POLICE STATION

The analysis was setup based on the existing field conditions, except Heartfields Drive was given two lanes at the intersection and assigned as a right turn only lane and a shared thru-left. This was done so that in the scenarios without a signal, the illegal movements would not interfere with the legal movements. For the scenarios with a signal, there is enough width to accommodate two lanes for about 125' or approximately five vehicles. A cycle length of 2:30 was used to match the cycle length at the next signal south for synchronization concerns.

The Synchro analysis showed that MD 650 traffic will have a delay level of service (LOS) A with or without a signal at all times except during the afternoon PM peak in the built condition where the LOS turns into a B with a full signal. This analysis was done without consideration for synchronizing the signal with other signals on MD 650. Thus, this analysis is likely showing the worst case scenario for MD 650 delay and the average delay would be slightly better in reality with synchronization. The full Synchro report can be found in Appendix C.

The major differences between having a full signal and not having a full signal are the benefits for Quaint Acres Drive and Heartfields Drive. Without a full signal, the illegal movements that are being made from Quaint Acres Drive and Heartfields Drive causes major delays from queuing. In the AM peak period, it becomes impossible to get all the traffic from the side roads on to MD 650 and therefore the Synchro results in an error since the delay is infinite.

The turns out of Quaint Acres Drive and Heartfields Drive that are represented in Synchro do not totally represent the reality at the intersection. This is due to drivers making the unsafe decision for left turns or thru movements to find a gap in one direction of MD 650 traffic and then wait in the median for a gap in the opposite direction. The Synchro analysis does not allow this unsafe decision.

The delays from the right turns out of Heartfields Drive are also misleading. In the PM peak, where there are no illegal turns in the count, the delay appears to be 40 to 50 seconds longer with a signal than without for the existing and proposed volumes. However, what is missing from this analysis is that approximately ½ of those vehicles want to go SB on MD 650 (this includes library traffic). So for these vehicles, it will take approximately 20 seconds to go 0.1 mile north to go to the median break for the u-turn. Finding a gap for a u-turn movement would average about 15 seconds, and then it would take another 15 seconds to get back through the study intersection. All of these movements would add about 50 seconds to the movement.

So when comparing the conditions with or without a signal, it would benefit Heartfields Drive to have a signal for all movements. This is because the delay for right turns would not change when the light is red (assuming a right turn lane with right turns on red), but they would get their own green phase, which would decrease the average delay. Left turn and thru movements would take more time to make a right and then a u-turn as compared to waiting for a green phase at a signal.

A critical lane volume (CLV) analysis was also conducted for evaluation (see Appendix D for worksheets). The analysis indicates that there is no difference in LOS between having a full signal and not having a full signal. This CLV analysis does not take into account any of the lost time for pedestrian crossings. It also does not take into account the gaps needed in both

directions for the thru and left turn movements out of Quaint Acres Drive. A summarization of the analysis can be seen in Table 3.

		Overall Intersection	
		Volume / Capacity	LOS
Existing Condition	AM	0.69	B
	PM	0.73	C
Existing with Library Counts and Signal	AM	0.70	B
	PM	0.76	C
Build with Housing, Police Station, Library, and Signal	AM	0.73	C
	PM	0.79	C
Build with Housing, Police Station, no Signal	AM	0.73	C
	PM	0.77	C

Table 3: CLV Analysis Summary

Safety

As indicated in the report, several unsafe movements are occurring at the study intersection. The left and thru movements from Quaint Acres Drive often wait in the middle of the intersection before finding a gap in the NB direction. About 8% of these movements are illegal in the morning and 6% are illegal movements in the afternoon. And although thru and left turn movements are fully restricted from Heartfields Drive, about 4% of vehicles are illegally performing these movements in a similar unsafe manner. These movements were likely restricted because of safety issues. These illegal movements are unsafe for several reasons:

- the median island on Heartfields Drive makes these movements more difficult
- the need to usually wait in the median of MD 650 for a gap causes a dangerous situation for thru MD 650 traffic in the left lane
- an illegal movement is not expected from other drivers

Other safety concerns that were observed included the vertical sight distance on MD 650 to the south of the intersection, consistent red-light running during the pedestrian phase, and speeding.

The vertical sight distance was discussed earlier in the report. It appears from observation that the vertical sight distance is about 400' from the SB MD 650 left turn lane. This meets the minimum requirements for a 40 mph design speed but it does not for a 50 mph design speed.

The right turns out of Heartfields Drive have a similar sight distance issue and may be another reason for the left turn restrictions. Some neighborhood residents stated that they avoid this intersection due to the poor sight distance by either cutting through the library parking lot or accessing MD 650 from US 29 by using Milestone Drive to Stewart Lane. It is possible that installing a full traffic signal would add more vehicles from the neighborhood to the study intersection, but since this was difficult to calculate, it was not included in the analysis.

When the signal turned all-red for the pedestrian phase, there were often drivers who would run the red light at beginning of the phase. This might be due to the infrequency of this signal turning red, so a red phase is not anticipated. It may also be due to the unconventional signal heads and phasing when the signal changes to red. Drivers were also observed running the red light in the middle of the phase when no pedestrians were present to restrict their movement.

During the traffic count, there were not enough pedestrians crossing MD 650 to warrant the pedestrian signal. The community informed the County that residents in the surrounding neighborhoods tend to avoid this crossing due to safety concerns of inattentive drivers. They believed that if the safety issues were addressed, there would be more pedestrian crossings.

Speed measurements were not taken for this study. However this section of MD 650 is susceptible to speeding due to the open road environment with three lanes in each direction, no full signal for over a mile, and an interchange with US 29, which is a high speed road. Based on observations, it would not be surprising if the average speed on MD 650 was at least 10 mph over the posted speed limit.

SHA recently changed its policy to not give out accident data to developers. Because of this, we were unable to do a safety analysis for this intersection. We are requesting that SHA perform a safety analysis for this intersection and consider the safety traffic signal warrant in the Manual on Uniform Traffic Control Devices (MUTCD).

Impacts of Full Traffic Signalization

A full traffic signal at the study intersection would likely improve both safety and operations. For safety, a signal would allow the lefts and thru movements from both Quaint Acres Drive and Heartfields Drive to become safe and legal. Note that all movements from Heartfields Drive would be legal with a signal and the median island at the intersection on Heartfields Drive would be eliminated.

From an operational perspective, currently MD 650 traffic has the right of way at all times in both directions unless the pedestrian signal is activated. A full traffic signal would cause some temporary stoppages on MD 650. Both NB and SB MD 650 traffic could see some minimal delay compared to no current delay without a pedestrian crossing. However, the reduction of delay on both Quaint Acres Drive and Heartfields Drive will be reduced significantly. When comparing the synchro delays with a signal to without a signal, the improvements are evident.

The Synchro analysis was done with this signal in isolation and therefore vehicles on MD 650 arrived completely randomly. In realty, a full signal could be synchronized with the existing

system. The study intersection is approximately 2,800' south of the next signal on MD 650 which is Jackson Road. To the south, there is a half signal for the SB traffic approximately 1,100' away. This is the signal for the SB US 29 ramp. The next full signal is approximately 1,800' south of this intersection at MD 895 (Lockwood Drive). Synchronization from the south for NB MD 650 traffic would be more difficult due to the significant amount of traffic that comes from the US 29 interchange. However, with optimal synchronization, SB MD 650 traffic could experience very little delay.

A fully signalized intersection would also allow movements for Heartfields Drive and Quaint Acres Drive during a pedestrian crossing phase across MD 650. This is currently not allowed. The green phase for Quaint Acres Drive and Heartfields Drive could be delayed so that pedestrians have an exclusive phase at the beginning.

No additional storage area would be needed for queuing. However, it would be suggested to paint the Heartfields Drive approach with two lanes towards and one lane away from the intersection between the library entrance and MD 650 (approximately 125' in length and 33' minimum in width). The lane assignments would be a right turn only and a shared thru/left.

A full traffic signal would also see great benefits for events that are held at the library when many vehicles will leave the library at the same time. These events include library sponsored events, community meetings, or other meetings in one or both of their two meeting rooms.

Alternate Solutions

The full traffic signal proposed in this report is the alternative to the existing conditions. Other alternate solutions do not seem to make sense. These alternates could include:

Roundabout – A roundabout in this location would require the first three-lane roundabout in Maryland. It is not practical due to the high differences in volumes from the major street to the minor street and the high speed of MD 650.

Four way stop sign – This would cause excessive undue delay on MD 650.

Allowing lefts from Milestone Drive to SB MD 650 – This would spread out the distribution when the housing units and police station are built. However a request for this was denied from SHA, even with adjusting the SB US 29 to NB MD 650 ramp for safety.

Opening the MD 650 median to allow lefts from Tracy Drive – This would not be advisable since it would encourage u-turns at this opening for NB MD 650 traffic from the left thru lane.

Removing the median on MD 650 and replacing it with a center lane – This would allow left turning traffic from the side roads to enter the center lane if no opposing lefts turns are in that center lane. This may be considered less safe than the existing conditions.

MUTCD Warrants

There are eight traffic signal warrants listed in the MUTCD. Below is a list of these warrants with an evaluation of whether the warrant was met.

Due to the changes in traffic volumes if a signal were installed, the first three signal warrants show an analysis for a scenario with and without the library traffic. Additionally, an analysis is shown for both one and two lanes from the minor street, since (a) it is not known if it is more preferable to have two lanes in or out on Heartfields Drive at the intersection and (b) two lanes out would only be for a physical queue of just five vehicles and therefore would not act as two lanes if queues exceeded that (which could easily happen after a library event, for example).

For Warrants 1, 2, and 3, an evaluation was made on three scenarios for both the existing volumes and proposed volumes (see Appendix E for calculations). Those scenarios were:

(1) Warrant for traffic volumes with no signal
(2) Warrant if traffic signal were built and evaluated for one (1) lane out of Heartfields Drive
(3) Warrant if traffic signal were built and evaluated for two (2) lane out of Heartfields Drive

A warrant was labeled ALMOST, if the traffic volume was within 10% of meeting the warrant. It is likely that this warrant will be met if a signal is installed due to an increase in volume from residents who would avoid the intersection as well as more volume from when the economy recovers from the current recession.

Warrant 1: Eight-Hour Vehicular Volume

Table 4 shows the warrants for the Eight-Hour Vehicular Volume under each scenario for the existing volumes. Condition B was evaluated for this warrant, since the issue is for needing an interruption of continuous traffic. MD 650 always has an hourly volume of over 1,000 vehicles, so only the side roads needed to meet the minimum volume to meet the warrant.

Time (without library traffic)	Hourly Volume from side roads	Meet Warrant? (75 min)	Time (with library traffic)	Hourly Volume from side roads	Meet Warrant? (one lane - 75 min)	Meet Warrant? (two lanes - 100 min)
7:15-8:15	34	NO	**10:15-11:15**	54	NO	NO
8:15-9:15	51	NO	**11:15-12:15**	64	NO	NO
9:30-10:30	34	NO	**12:15-1:15**	70	ALMOST	NO
10:30-11:30	38	NO	**1:15-2:15**	74	ALMOST	NO
1:30-2:30	41	NO	**2:15-3:15**	96	**YES**	ALMOST
2:30-3:30	32	NO	**3:15-4:15**	88	**YES**	NO
3:30-4:30	44	NO	**4:15-5:15**	102	**YES**	**YES**
4:30-5:30	42	NO	**5:15-6:15**	71	ALMOST	NO

Table 4: Eight-hour warrant analysis for existing volumes

Under all the existing scenarios, Warrant 1 is not met. If a full signal was installed and library traffic shifted to the signal, the warrant would be met or close to being met for six of the eight

required hours under the one-lane requirement. It is possible that if the library had an event in the morning (typical event start at 10:15 AM) and evening (typical event start at 7:00 PM), two more hourly volumes would approach or exceed the minimum volume for the warrant.

Table 5 shows the warrants for the Eight-Hour Vehicular Volume under each scenario for the proposed added volumes from the housing units. The police station traffic was ignored, since the assumption during the traffic distribution was that all police station traffic would enter and exit from Milestone Drive and therefore that generated traffic would only affect MD 650. If any police traffic does use Heartfields Drive, it could be enough vehicles to bring an hourly volume that is close to meeting the warrant threshold to exceeding that threshold.

Time (without library traffic)	Hourly Volume from side roads	Meet Warrant? (75 min)	Time (with library traffic)	Hourly Volume from side roads	Meet Warrant? (one lane - 75 min)	Meet Warrant? (two lanes - 100 min)
6:30-7:30	61	NO	**10:15-11:15**	100	**YES**	**YES**
7:30-8:30	84	**YES**	**11:15-12:15**	96	**YES**	ALMOST
8:30-9:30	75	**YES**	**12:15-1:15**	105	**YES**	**YES**
10:15-11:15	71	ALMOST	**1:15-2:15**	105	**YES**	**YES**
1:30-2:30	77	**YES**	**2:15-3:15**	135	**YES**	**YES**
2:30-3:30	68	ALMOST	**3:15-4:15**	120	**YES**	**YES**
3:45-4:45	79	**YES**	**4:15-5:15**	135	**YES**	**YES**
5:00-6:00	66	NO	**5:15-6:15**	99	**YES**	ALMOST

Table 5: Eight-hour warrant analysis for proposed volumes

If a full traffic signal was installed with the housing units and police station built, the traffic volume generated would justify a full traffic signal under this warrant.

Warrant 2: Four-Hour Vehicular Volume

Table 6 shows the warrants for the Four-Hour Vehicular Volume under each scenario for the existing volumes. MD 650 always has an hourly volume of over 1,000 vehicles, so only the side roads needed to meet the minimum volume to meet the warrant.

Time (without library traffic)	Hourly Volume from side roads	Meet Warrant? (80 min)	Time (with library traffic)	Hourly Volume from side roads	Meet Warrant? (one lane - 80 min)	Meet Warrant? (two lanes - 115 min)
8:00-9:00	51	NO	**2:00-3:00**	93	**YES**	NO
1:30-2:30	41	NO	**3:00-4:00**	95	**YES**	NO
3:30-4:30	44	NO	**4:00-5:00**	95	**YES**	NO
4:30-5:30	42	NO	**5:00-6:00**	83	**YES**	NO

Table 6: Four-hour warrant analysis for existing volumes

The existing volumes do not warrant a full signal based on the current configuration. However, if a full signal were placed, this warrant would be met for a one lane approach.

Table 7 shows the warrants for the Four-Hour Vehicular Volume under each scenario for the proposed added volumes from the housing units.

Time (without library traffic)	Hourly Volume from side roads	Meet Warrant? (80 min)	Time (with library traffic)	Hourly Volume from side roads	Meet Warrant? (one lane - 80 min)	Meet Warrant? (two lanes - 115 min)
7:30-8:30	84	**YES**	**2:00-3:00**	132	**YES**	**YES**
8:30-9:30	75	ALMOST	**3:00-4:00**	130	**YES**	**YES**
1:30-2:30	77	ALMOST	**4:00-5:00**	123	**YES**	**YES**
3:45-4:45	79	ALMOST	**5:00-6:00**	115	**YES**	**YES**

Table 7: Four-hour warrant analysis for proposed volumes

With the added traffic from the housing units, a full traffic signal could be justified under this warrant in any scenario.

Warrant 3: Peak Hour Vehicular Volume

Table 8 shows the warrants for the Peak Hour Vehicular Volume under each scenario for the existing volumes.

Time (without library traffic)	Hourly Volume from side roads	Meet Warrant? (100 min)	Time (with library traffic)	Hourly Volume from side roads	Meet Warrant? (one lane - 100 min)	Meet Warrant? (two lanes - 150 min)
8:00-9:00	51	NO	**4:30-5:30**	103	**YES**	NO

Table 8: Peak hour warrant analysis for existing volumes

Similar to Warrant 2, this warrant is met when considering a full signal with a one lane approach from Heartfields Drive.

Table 9 shows the warrants for the Peak Hour Vehicular Volume under each scenario for the proposed added volumes from the housing units.

Time (without library traffic)	Hourly Volume from side roads	Meet Warrant? (100 min)	Time (with library traffic)	Hourly Volume from side roads	Meet Warrant? (one lane - 100 min)	Meet Warrant? (two lanes - 150 min)
8:00-9:00	92	ALMOST	**2:30-3:30**	136	**YES**	ALMOST

Table 9: Peak hour warrant analysis for proposed volumes

With the added traffic from the housing units, a full traffic signal could be justified under this warrant for a one lane approach with library traffic. The other scenarios have traffic volumes on the side roads that are within 10% of meeting the warrant.

Warrant 4: Pedestrian Volume – YES
Although the pedestrians counted during the day the traffic count was conducted did not have the minimum required amount of pedestrians, the fact that a pedestrian crossing already exists indicates that there is likely another time of the day or possibly a weekend time, when this warrant is met. It could also be met if the safety issues of the intersection were addressed.

Warrant 5: School Crossing – NO
There are two schools approximately ½ mile to the north, White Oak Middle School and Jackson Road Elementary. The sidewalk on the west side of MD 650 ends at Quaint Acres Drive, so students who walk to school would need to cross at this location. However, the pedestrian crossing never met the minimum amount of students needed to meet this warrant.

Warrant 6: Coordinated Signal System – POSSIBLY
For NB MD 650 traffic, the majority of traffic that comes from the next signal to the south (Lockwood Drive, approximately 0.55 mile south) disperses at the US 29 interchange, so synchronizing the two signals would have little benefit. The next signal north is approximately ½ mile away which is Jackson Road. A signal at Heartfields Drive could start the progression NB to the next signal, if controlling speeds are an issue here.

For SB MD 650 traffic, a signal here would provide more progression for traffic coming from the Jackson Road intersection. It could also continue the progression to the half signal with the US 29 ramp, which is approximately 0.2 mile to the south. A signal here could also allow left turns from NB MD 650 to the SB US 29 ramp more opportunities for gaps.

Warrant 7: Crash Experience – UNKNOWN
The observations seen at the study intersection shows several safety concerns, so it would not be a surprise if there were frequent crashes at this intersection or if they were some severe outcomes to any of the crashes. However, since SHA does not release the crash data anymore, it will be up to SHA to determine if this warrant is met. It should be noted that research has shown that a flashing beacon at an intersection does not produce a major safety benefit and in this scenario it may be causing more driver confusion than anything else.

Warrant 8: Roadway Network – POSSIBLY
There are no other significant north-south routes that accommodate thru traffic in this vicinity. Therefore all north-south traffic uses MD 650 and there is no need to encourage traffic differently. However, a signal here would encourage traffic from the neighborhoods to the east and west of MD 650 to use this intersection and would generate the volumes needed to meet Warrants 1, 2, and 3 as shown under the different scenarios. Although no counts were conducted on a non-normal business day, the high volumes on MD 650 along with several weekend destinations along the highway (stores, religious centers, etc.) make it extremely likely that there are over 1,000 vehicles per hour entering this intersection for each of any 5 hours of a non-normal business day.

Recommendations

This signal warrant study showed that there are several reasons that would justify a signal at this location. They include:

- A full traffic signal would reduce delay on the side streets without a significant impact on MD 650.
- A full traffic signal would likely make this intersection safer by allowing illegal movements that are being conducted from Heartfields Drive and Quaint Acres Drive to become legal and to stop the unsafe practice of these turns entering the median area of MD 650 to wait for a gap. It would also provide protection for any vertical sight distance concerns.
- A full traffic signal would allow the intersection to be more efficient during a pedestrian crossing phase by allowing traffic to go from the side roads.
- The MUTCD traffic signal warrants show that several warrants can be met if a signal is installed, especially when considering the temporary economic conditions for lower traffic volumes and the vehicles unaccounted for due to residents avoiding this intersection.
- A full signal would likely increase safety to pedestrians.
- A full traffic signal would eliminate the driver confusion from the existing signal heads.

A full traffic signal would not have a significant cost, since a signal already exists at the intersection. The only items needed to install a full signal would be to replace the signal heads, add detection devices, and install a new traffic box.

A full traffic signal is also desired by the local community who uses this intersection on a daily basis and understands the deficiencies of the intersection. The community has written letters in support of installing a full traffic signal, which is separate from this report.

Therefore it is recommended that a full traffic signal should be installed at the intersection of MD 650/Heartfields Drive/Quaint Acres Drive based on the existing conditions due to volume, operations, safety, and improving the neighborhood roadway network. Furthermore, with the addition (and approval) of a built police station and the housing units, the volume and operations make the justification of a full traffic signal even more apparent.

APPENDIX A

TRAFFIC COUNTS

MCV Associates, Inc.

4605-C Pinecrest Office Park Dr
Alexandria, VA 22312
703-914-4850

File Name : md650 at heartfields dr
Site Code : 00000033
Start Date : 4/21/2009
Page No : 1

Groups Printed- Unshifted

	New Hampshire Ave MD650 From North				Heartfields Dr From East					New Hampshire Ave MD650 From South				Quaint Acres Dr From West						
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	U Turns*	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Exclu. Total	Inclu. Total	Int. Total
06:00 AM	1	213	0	0	1	0	2	1	1	0	163	0	0	0	0	2	0	2	382	384
06:15 AM	5	337	1	2	0	0	0	0	0	0	179	1	0	0	0	4	0	2	527	529
06:30 AM	1	389	0	2	1	0	3	1	2	1	303	3	0	2	0	5	0	5	708	713
06:45 AM	3	486	2	2	0	0	9	0	2	0	328	2	1	4	0	7	1	6	841	847
Total	10	1425	3	6	2	0	14	2	5	1	973	6	1	6	0	18	1	15	2458	2473
07:00 AM	3	503	2	6	0	0	7	0	4	1	336	2	0	1	0	4	0	10	859	869
07:15 AM	7	679	1	1	0	0	6	0	3	1	285	0	0	0	0	6	0	4	985	989
07:30 AM	1	670	2	0	1	0	9	1	4	4	345	4	0	3	0	7	0	5	1046	1051
07:45 AM	4	638	3	1	0	0	8	0	5	3	284	6	0	0	0	7	0	6	953	959
Total	15	2490	8	8	1	0	30	1	16	9	1250	12	0	4	0	24	0	25	3843	3868
08:00 AM	4	592	1	0	1	0	3	1	1	6	311	4	0	1	0	10	0	2	933	935
08:15 AM	9	618	1	0	1	1	5	1	3	3	326	5	0	1	3	14	0	4	987	991
08:30 AM	4	646	1	0	0	0	15	0	5	2	308	7	0	0	5	5	0	5	993	998
08:45 AM	5	634	6	1	0	1	5	0	2	16	236	4	0	0	0	12	0	3	919	922
Total	22	2490	9	1	2	2	28	2	11	27	1181	20	0	2	8	41	0	14	3832	3846
09:00 AM	6	538	0	0	0	0	3	0	1	12	253	16	0	0	0	11	0	1	839	840
09:15 AM	6	514	0	4	0	0	6	0	4	9	239	5	0	1	0	4	0	8	784	792
09:30 AM	7	371	1	4	0	0	8	0	3	4	238	7	0	2	0	5	0	7	643	650
09:45 AM	4	382	3	6	0	0	2	0	1	5	209	8	0	3	0	6	0	7	622	629
Total	23	1805	4	14	0	0	19	0	9	30	939	36	0	6	0	26	0	23	2888	2911
10:00 AM	5	358	2	1	0	0	7	0	2	7	241	12	0	2	0	8	0	3	642	645
10:15 AM	4	320	1	0	1	0	7	1	5	9	214	10	0	0	0	8	0	6	574	580
10:30 AM	3	296	1	0	0	0	5	0	2	9	221	11	0	2	0	9	0	2	557	559
10:45 AM	4	304	2	0	0	0	3	0	1	6	211	13	0	0	2	7	0	1	552	553
Total	16	1278	6	1	1	0	22	1	10	31	887	46	0	4	2	32	0	12	2325	2337
11:00 AM	7	252	1	2	0	0	9	0	5	8	212	12	0	2	6	3	0	7	512	519
11:15 AM	4	271	1	2	0	0	2	0	0	7	210	17	0	1	0	6	0	2	519	521
11:30 AM	5	277	1	0	0	0	5	0	3	7	223	11	0	1	0	5	0	3	535	538
11:45 AM	4	220	2	5	0	0	7	0	6	5	215	15	0	2	0	7	0	11	477	488
Total	20	1020	5	9	0	0	23	0	14	27	860	55	0	6	6	21	0	23	2043	2066
12:00 PM	9	266	0	0	3	0	4	3	3	4	271	13	0	0	0	5	0	6	575	581
12:15 PM	6	245	6	3	1	0	10	1	6	10	273	8	0	0	0	5	0	10	564	574
12:30 PM	9	268	0	1	0	0	3	0	1	9	262	15	0	0	0	5	0	2	571	573
12:45 PM	6	261	2	0	0	0	3	0	2	9	271	16	0	3	0	11	0	2	582	584
Total	30	1040	8	4	4	0	20	4	12	32	1077	52	0	3	0	26	0	20	2292	2312
01:00 PM	4	257	0	1	0	0	5	0	3	5	275	13	0	0	0	5	0	4	564	568
01:15 PM	8	234	1	0	0	0	3	0	1	7	266	11	0	1	0	4	0	1	535	536
01:30 PM	12	226	0	2	0	0	8	0	1	10	268	13	0	1	0	7	1	4	545	549
01:45 PM	9	243	1	0	0	0	9	0	5	7	341	15	0	1	0	3	0	5	629	634
Total	33	960	2	3	0	0	25	0	10	29	1150	52	0	3	0	19	1	14	2273	2287

MCV Associates, Inc.

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Site Code : 00000033
Start Date : 4/21/2009

Groups Printed- Unshifted

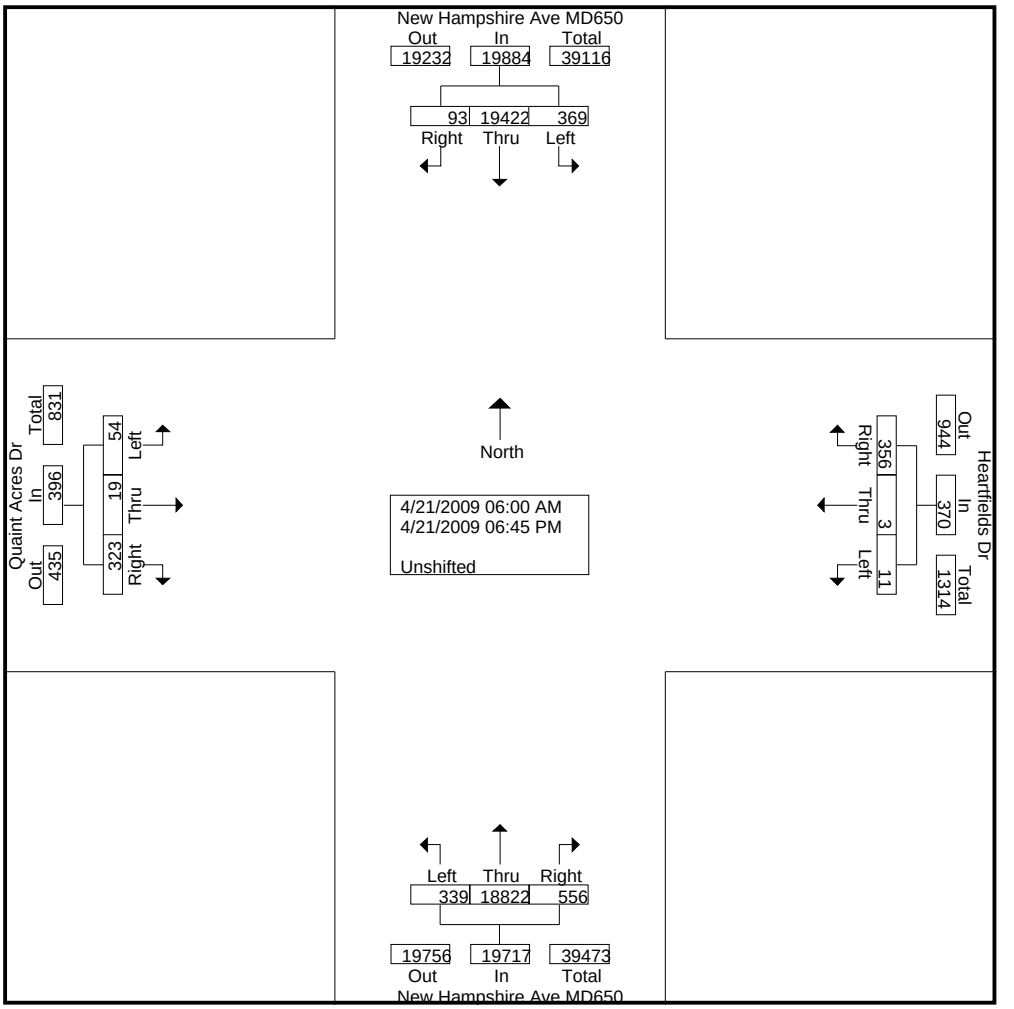
	New Hampshire Ave MD650 From North				Heartfields Dr From East					New Hampshire Ave MD650 From South				Quaint Acres Dr From West						
Start Time	Left	Thru	Right	Peds	Left	Thru	Right	Peds	U Turns*	Left	Thru	Right	Peds	Left	Thru	Right	Peds	Exclu. Total	Inclu. Total	Int. Total
02:00 PM	9	253	2	0	0	0	14	0	9	6	350	8	0	1	0	8	1	10	651	661
02:15 PM	11	291	0	3	0	1	9	0	3	4	374	15	0	2	0	7	0	6	714	720
02:30 PM	6	299	2	2	0	0	6	0	1	1	375	13	0	2	0	2	0	3	706	709
02:45 PM	13	299	5	2	0	0	7	0	2	10	498	13	0	1	0	7	0	4	853	857
Total	39	1142	9	7	0	1	36	0	15	21	1597	49	0	6	0	24	1	23	2924	2947
03:00 PM	6	303	2	2	0	0	12	0	8	9	451	14	0	3	0	6	3	13	806	819
03:15 PM	11	339	3	0	0	0	5	0	5	6	464	19	0	0	0	8	0	5	855	860
03:30 PM	7	365	4	3	0	0	12	0	7	13	471	14	0	0	0	2	1	11	888	899
03:45 PM	9	336	5	0	0	0	12	0	6	7	480	18	0	3	0	7	0	6	877	883
Total	33	1343	14	5	0	0	41	0	26	35	1866	65	0	6	0	23	4	35	3426	3461
04:00 PM	6	312	3	1	1	0	10	1	2	8	535	12	0	1	1	5	0	4	894	898
04:15 PM	15	358	1	1	0	0	9	0	2	14	574	13	0	0	0	10	0	3	994	997
04:30 PM	16	368	1	4	0	0	12	0	6	10	557	14	0	0	1	1	0	10	980	990
04:45 PM	7	349	4	1	0	0	10	0	2	7	613	18	0	1	0	3	0	3	1012	1015
Total	44	1387	9	7	1	0	41	1	12	39	2279	57	0	2	2	19	0	20	3880	3900
05:00 PM	5	351	0	0	0	0	10	0	3	4	576	6	0	1	1	10	0	3	964	967
05:15 PM	11	355	4	2	0	0	10	0	3	11	656	17	0	0	0	2	0	5	1066	1071
05:30 PM	12	362	0	2	0	0	4	0	1	4	631	15	0	0	0	8	0	3	1036	1039
05:45 PM	12	388	3	0	0	0	10	0	0	12	697	20	0	0	0	5	0	0	1147	1147
Total	40	1456	7	4	0	0	34	0	7	31	2560	58	0	1	1	25	0	11	4213	4224
06:00 PM	13	436	2	1	0	0	6	0	4	9	641	12	0	2	0	6	1	6	1127	1133
06:15 PM	10	373	1	0	0	0	9	0	4	5	566	17	0	0	0	5	0	4	986	990
06:30 PM	13	401	2	0	0	0	5	0	4	5	508	8	0	0	0	6	0	4	948	952
06:45 PM	8	376	4	0	0	0	3	0	1	8	488	11	0	3	0	8	0	1	909	910
Total	44	1586	9	1	0	0	23	0	13	27	2203	48	0	5	0	25	1	15	3970	3985
Grand Total	369	19422	93	70	11	3	356	11	160	339	18822	556	1	54	19	323	8	250	40367	40617
Apprch %	1.9	97.7	0.5		3	0.8	96.2			1.7	95.5	2.8		13.6	4.8	81.6				
Total %	0.9	48.1	0.2		0	0	0.9			0.8	46.6	1.4		0.1	0	0.8		0.6	99.4	

U-Turns* = Only U-Turns after taking Right Turn from East. and these volumes are included in Right turn.
From East Left turns are illegal.

MCV Associates, Inc.

4605-C Pinecrest Office Park Dr
Alexandria, VA 22312
703-914-4850

File Name : md650 at heartfields dr
Site Code : 00000033
Start Date : 4/21/2009
Page No : 3

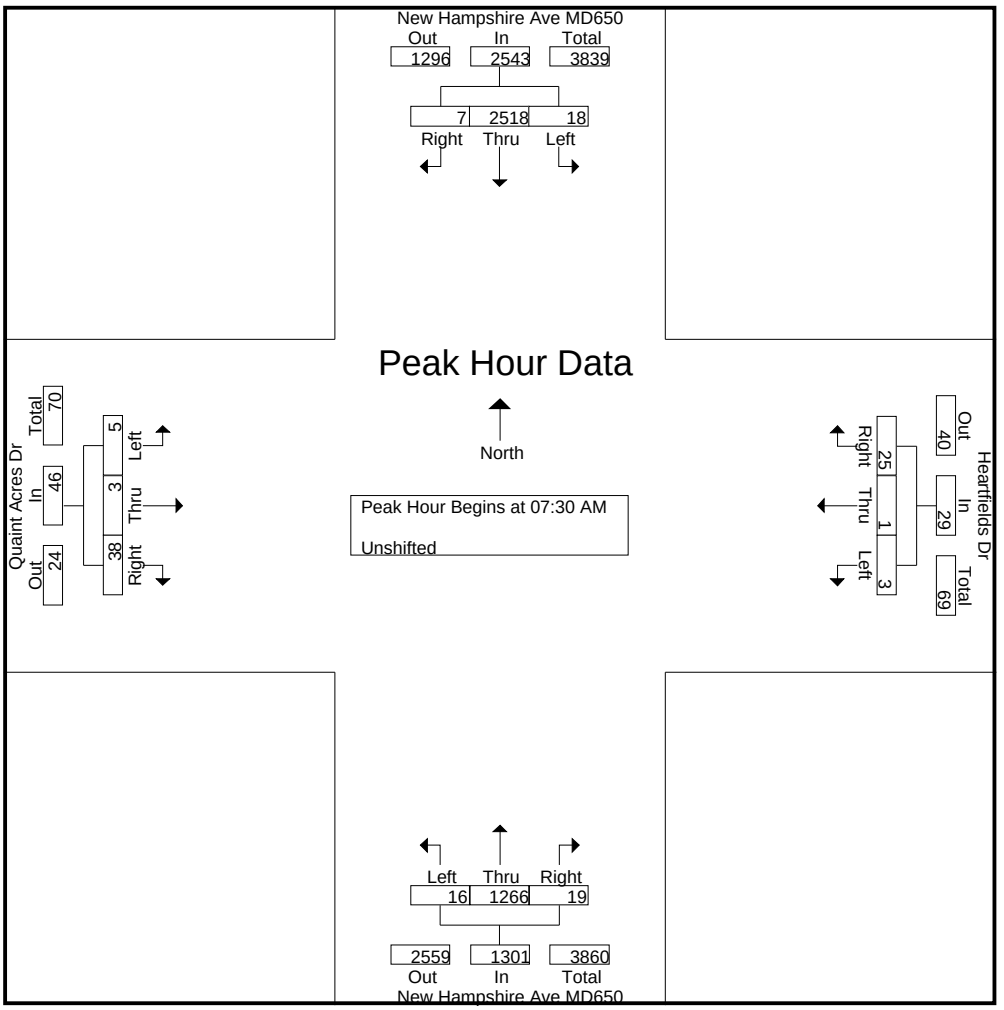


MCV Associates, Inc.

4605-C Pinecrest Office Park Dr
Alexandria, VA 22312
703-914-4850

File Name : md650 at heartfields dr
Site Code : 00000033
Start Date : 4/21/2009
Page No : 4

	New Hampshire Ave MD650 From North				Heartfields Dr From East				New Hampshire Ave MD650 From South				Quaint Acres Dr From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 08:45 AM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 07:30 AM																	
07:30 AM	1	670	2	673	1	0	9	10	4	345	4	353	3	0	7	10	1046
07:45 AM	4	638	3	645	0	0	8	8	3	284	6	293	0	0	7	7	953
08:00 AM	4	592	1	597	1	0	3	4	6	311	4	321	1	0	10	11	933
08:15 AM	9	618	1	628	1	1	5	7	3	326	5	334	1	3	14	18	987
Total Volume	18	2518	7	2543	3	1	25	29	16	1266	19	1301	5	3	38	46	3919
% App. Total	0.7	99	0.3		10.3	3.4	86.2		1.2	97.3	1.5		10.9	6.5	82.6		
PHF	.500	.940	.583	.945	.750	.250	.694	.725	.667	.917	.792	.921	.417	.250	.679	.639	.937

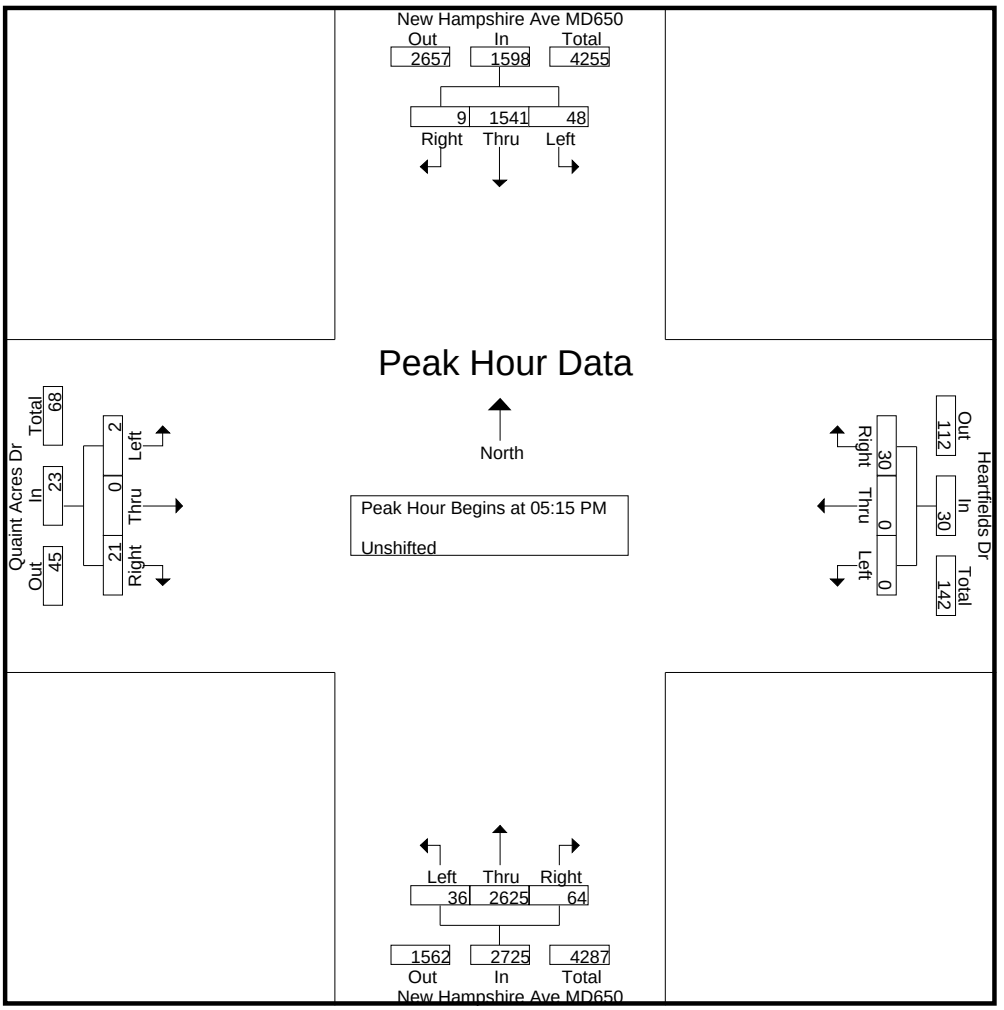


MCV Associates, Inc.

4605-C Pinecrest Office Park Dr
Alexandria, VA 22312
703-914-4850

File Name : md650 at heartfields dr
Site Code : 00000033
Start Date : 4/21/2009

	New Hampshire Ave MD650 From North				Heartfields Dr From East				New Hampshire Ave MD650 From South				Quaint Acres Dr From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 06:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 05:15 PM																	
05:15 PM	11	355	4	370	0	0	10	10	11	656	17	684	0	0	2	2	1066
05:30 PM	12	362	0	374	0	0	4	4	4	631	15	650	0	0	8	8	1036
05:45 PM	12	388	3	403	0	0	10	10	12	697	20	729	0	0	5	5	1147
06:00 PM	13	436	2	451	0	0	6	6	9	641	12	662	2	0	6	8	1127
Total Volume	48	1541	9	1598	0	0	30	30	36	2625	64	2725	2	0	21	23	4376
% App. Total	3	96.4	0.6		0	0	100		1.3	96.3	2.3		8.7	0	91.3		
PHF	.923	.884	.563	.886	.000	.000	.750	.750	.750	.942	.800	.934	.250	.000	.656	.719	.954



Location: White Oak Public Library
Date of Count: May 5, 2009
Weather: Cloudy, rain started at 4:15, steady rain until 6:15
Library opened at 10 AM

Time	South Side	North Side	Total	1-hr total
10:00 AM	3	3	6	
10:15 AM	1	8	9	
10:30 AM	4	5	9	
10:45 AM	2	7	9	33
11:00 AM	1	9	10	37
11:15 AM	5	7	12	40
11:30 AM	1	11	12	43
11:45 AM	1	10	11	45
12:00 PM	3	18	21	56
12:15 PM	0	12	12	56
12:30 PM	2	11	13	57
12:45 PM	6	13	19	65
1:00 PM	8	10	18	62
1:15 PM	0	13	13	63
1:30 PM	3	11	14	64
1:45 PM	5	6	11	56
2:00 PM	4	9	13	51
2:15 PM	3	8	11	49
2:30 PM	3	30	33	68
2:45 PM	3	12	15	72
3:00 PM	4	15	19	78
3:15 PM	5	16	21	88
3:30 PM	3	9	12	67
3:45 PM	5	13	18	70
4:00 PM	2	9	11	62
4:15 PM	2	18	20	61
4:30 PM	5	18	23	72
4:45 PM	3	11	14	68
5:00 PM	4	18	22	79
5:15 PM	4	14	18	77
5:30 PM	3	13	16	70
5:45 PM	2	6	8	64
6:00 PM	1	10	11	53
6:15 PM	4	9	13	48
	105	392		

78.87 % used the south exit

APPENDIX B

PROJECTED TRAFFIC DISTRIBUTION

				AM PEAK Housing Units		PM PEAK Housing Units	
Super District	Assumed direction to study intersection	Direction	% from White Oak	Entering	Leaving	Entering	Leaving
Bethesda/Chevy Chase	I-495 to US 29 to MD 650	from south	6.8	1	4	4	2
Silver Spring/Takoma Park	US 29 to MD 650	from south	9	1	5	5	3
Potomac/Darnestown	I-270 to I-495 to US 29 to MD 650	from south	0.6	0	0	0	0
Rockville/North Bethesda	Randolph Road to MD 650	from north	9.3	1	6	5	3
Kensington/Wheaton	MD 193 (or MD 97 to I-495) to US 29 to MD 650	from south	5	1	3	3	1
White Oak/Fairland	US 29	from north	9.3	1	6	5	3
Gaithersburg/Shady Grove	I-270 to I-495 to US 29 to MD 650	from south	3.8	1	2	2	1
Aspen Hill/Olney	Randolph Road to MD 650	from north	1.4	0	1	1	0
Germantown/Clarksburg	I-270 to I-495 to US 29 to MD 650	from south	0.4	0	0	0	0
Rural: West of I-270	I-270 to I-495 to US 29 to MD 650	from south	0	0	0	0	0
Rural: East of I-270	MD 650	from north	1.1	0	1	1	0
Washington, DC	US 29 to MD 650	from south	23.4	4	14	13	7
P.G. County	I-495 to MD 650	from south	20.1	3	12	11	6
VA	I-495 to US 29 to MD 650	from south	7.1	1	4	4	2
Frederick County	I-270 to I-495 to US 29 to MD 650	from south	0	0	0	0	0
Howard County	US 29	from north	2.7	0	2	2	1
Assume all police traffic uses Milestone Drive		Total		15	60	57.0	29
Assume all other generated traffic uses Heartsfield Drive		From MD 650 South		11.4	45.7	43.4	22.1

Housing units (180 units assumed) generated 86 trips in the PM, 66% entering and 34% leaving, so 57 entering and 29 leaving-

The lightly shaded cells represent those vehciles going to or coming from MD 650 South. So in the PM 43 vehicles, and 11 in AM will head up MD 650 toward the Heartsfield intersection in order to turn towards the housing units, and 11 in the AM. Those unshaded cells depict the vehicles going to or coming from MD 650 North. So as can be seen in the PM 7 vehicles will drive down MD 650 and turn left at Heartsfield to the housing units, and 2 in AM . Finally the dark shaded cells represent the vehcies coming from US 29 North, so as can be seen during the PM peak, 7 vehicles make a right to enter the site at the intersection of US 29 and Stewart Lane, while only 2 vehciles turn into that intersection in the AM.

For traffic from housing units, the site heading to MD 650 southbound 22 vehicles turn left out of Heartsfield to MD 650 southbound in the PM, and 46 in the AM. Those heading NB on MD 650 turn right coming out of Heartsfield to MD 650, and that totals to 3 in the PM and 7 in the AM. Finally the dark shaded cells represent the vehicles heading ot US 29 north. In this case vehicles would use the Stewart Lane intersection and turn left out of the site to US 29 northbound, this totals to 7 vehicles in the AM and 4 in the PM.

File Name: 2300 Randolph Road
Start Date: 12/11/2008
Start Time: 06:00 AM

Start Time	IN	OUT
06:00 AM	1	2
06:15 AM	0	5
06:30 AM	6	3
06:45 AM	3	4
07:00 AM	3	2
07:15 AM	5	4
07:30 AM	1	1
07:45 AM	0	5
08:00 AM	1	1
08:15 AM	2	3
08:30 AM	1	4
08:45 AM	5	2
04:00 PM	2	3
04:15 PM	3	4
04:30 PM	6	5
04:45 PM	2	4
05:00 PM	3	3
05:15 PM	2	3
05:30 PM	1	4
05:45 PM	3	4
06:00 PM	3	3
06:15 PM	1	3
06:30 PM	3	2
06:45 PM	3	5

4th District Police Station Count
6-9 AM, 4-7 PM

Note: Counts used to estimate traffic that will be generated by the new 3rd District Police Station

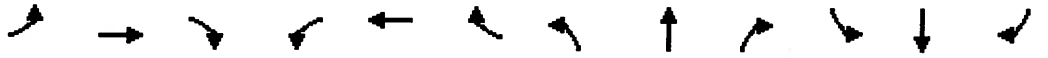
The police station was determined the have the following trip generation.
AM Peak : 7 entering, 11 leaving
PM Peak : 9 entering, 14 leaving.

All these vehicles will be entering or leaving from the Milestone Intersection. 40% will go south on US 29, 40% will go north on US 29, 10% will go north on MD 650 and 10% will go south on MD 650.
For the percentage heading to US 29 and to southbound MD 650, which makes up 90%, those vehicles will turn right from Milestone Dr and make a U-turn at Heartsfield in order to head down MD 650. The other 10% will also turn right from Milestone but will continue thru the Hearstfield intersection to continue north. So for the PM peak of the 14 vehicles leaving police station all 14 will turn right out of Milestone , however 90% which eqautes to 13 vehicles will make a U-turn at Heartsfield and only 1 vehicle (10%) will continue on thru. In the AM 11 will turn right out of Milestone, 1 will continue thru NB MD 650 and 10 will make the U-turn at Heartsfield to head to US 29 or to continue SB on MD 650.

APPENDIX C

SYNCHRO OUTPUT

EXISTING AM



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	5	3	38	3	1	25	16	1302	19	18	2809	7
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	3	41	3	1	27	17	1415	21	20	3053	8
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	3630	4567	1022	2560	4560	482	3061			1436		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	3630	4567	1022	2560	4560	482	3061			1436		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	0	82	0	0	95	84			96		
cM capacity (veh/h)	0	1	234	0	1	530	107			469		

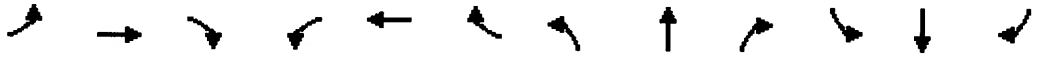
Direction, Lane #	EB 1	WB 1	WB 2	NB 1	NB 2	NB 3	NB 4	SB 1	SB 2	SB 3	SB 4
Volume Total	50	4	27	17	566	566	304	20	1221	1221	618
Volume Left	5	3	0	17	0	0	0	20	0	0	0
Volume Right	41	0	27	0	0	0	21	0	0	0	8
cSH	0	0	530	107	1700	1700	1700	469	1700	1700	1700
Volume to Capacity	Err	Err	0.05	0.16	0.33	0.33	0.18	0.04	0.72	0.72	0.36
Queue Length 95th (ft)	Err	Err	4	14	0	0	0	3	0	0	0
Control Delay (s)	Err	Err	12.2	45.2	0.0	0.0	0.0	13.0	0.0	0.0	0.0
Lane LOS	F	F	B	E				B			
Approach Delay (s)	Err	Err		0.5				0.1			
Approach LOS	F	F									

Intersection Summary				
Average Delay	Err			
Intersection Capacity Utilization	68.3%	ICU Level of Service	C	
Analysis Period (min)	15			

HCM Unsignalized Intersection Capacity Analysis
8: Quaint Acres Dr & MD 650

EXISTING PM

5/12/2009



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	0	21	0	0	30	36	2889	64	48	1582	9
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	0	23	0	0	33	39	3140	70	52	1720	10
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	2986	5117	578	3954	5087	1082	1729			3210		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	2986	5117	578	3954	5087	1082	1729			3210		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	18	100	95	100	100	85	89			44		
cM capacity (veh/h)	3	0	459	0	0	213	361			93		

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	NB 2	NB 3	NB 4	SB 1	SB 2	SB 3	SB 4
Volume Total	25	0	33	39	1256	1256	698	52	688	688	354
Volume Left	2	0	0	39	0	0	0	52	0	0	0
Volume Right	23	0	33	0	0	0	70	0	0	0	10
cSH	29	1700	213	361	1700	1700	1700	93	1700	1700	1700
Volume to Capacity	0.87	0.00	0.15	0.11	0.74	0.74	0.41	0.56	0.40	0.40	0.21
Queue Length 95th (ft)	71	0	13	9	0	0	0	64	0	0	0
Control Delay (s)	326.5	0.0	24.9	16.2	0.0	0.0	0.0	84.9	0.0	0.0	0.0
Lane LOS	F	A	C	C				F			
Approach Delay (s)	326.5	24.9		0.2				2.5			
Approach LOS	F	C									

Intersection Summary				
Average Delay	2.8			
Intersection Capacity Utilization	73.9%	ICU Level of Service		D
Analysis Period (min)	15			

HCM Signalized Intersection Capacity Analysis

EXISTING COUNT WITH LIBRARY

AM

3: Quaint Acres Dr & MD 650

5/12/2009

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	5	3	38	16	1	12	16	1302	19	18	2769	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00			1.00	1.00	1.00	0.91		1.00	0.91	
Frt		0.89			1.00	0.85	1.00	1.00		1.00	1.00	
Flt Protected		0.99			0.95	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1644			1779	1583	1770	5074		1770	5083	
Flt Permitted		0.96			0.77	1.00	0.03	1.00		0.17	1.00	
Satd. Flow (perm)		1588			1439	1583	57	5074		317	5083	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	5	3	41	17	1	13	17	1415	21	20	3010	8
RTOR Reduction (vph)	0	5	0	0	0	12	0	1	0	0	0	0
Lane Group Flow (vph)	0	44	0	0	18	1	17	1435	0	20	3018	0
Turn Type	Perm			Perm		Perm	Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)		8.4			8.4	8.4	129.6	129.6		129.6	129.6	
Effective Green, g (s)		8.4			8.4	8.4	129.6	129.6		129.6	129.6	
Actuated g/C Ratio		0.06			0.06	0.06	0.86	0.86		0.86	0.86	
Clearance Time (s)		6.0			6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		89			81	89	49	4384		274	4392	
v/s Ratio Prot								0.28			c0.59	
v/s Ratio Perm		c0.03			0.01	0.00	0.30			0.06		
v/c Ratio		0.50			0.22	0.01	0.35	0.33		0.07	0.69	
Uniform Delay, d1		68.8			67.7	66.9	2.0	1.9		1.5	3.4	
Progression Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2		4.3			1.4	0.0	18.4	0.2		0.5	0.9	
Delay (s)		73.1			69.1	66.9	20.3	2.1		2.0	4.3	
Level of Service		E			E	E	C	A		A	A	
Approach Delay (s)		73.1			68.2			2.3			4.3	
Approach LOS		E			E			A			A	

Intersection Summary			
HCM Average Control Delay	4.8	HCM Level of Service	A
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	70.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

EXISTING COUNTS WITH LIBRARY
PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	2	0	21	48	0	42	36	2889	64	48	1574	9
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00			1.00	1.00	1.00	0.91		1.00	0.91	
Frt		0.88			1.00	0.85	1.00	1.00		1.00	1.00	
Flt Protected		1.00			0.95	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1625			1770	1583	1770	5069		1770	5081	
Flt Permitted		0.97			0.74	1.00	0.12	1.00		0.03	1.00	
Satd. Flow (perm)		1587			1380	1583	228	5069		58	5081	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2	0	23	52	0	46	39	3140	70	52	1711	10
RTOR Reduction (vph)	0	21	0	0	0	5	0	1	0	0	0	0
Lane Group Flow (vph)	0	4	0	0	52	41	39	3209	0	52	1721	0
Turn Type	Perm			Perm		Perm	Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)		9.8			9.8	9.8	128.2	128.2		128.2	128.2	
Effective Green, g (s)		9.8			9.8	9.8	128.2	128.2		128.2	128.2	
Actuated g/C Ratio		0.07			0.07	0.07	0.85	0.85		0.85	0.85	
Clearance Time (s)		6.0			6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		104			90	103	195	4332		50	4343	
v/s Ratio Prot								0.63			0.34	
v/s Ratio Perm		0.00			c0.04	0.03	0.17			c0.89		
v/c Ratio		0.03			0.58	0.40	0.20	0.74		1.04	0.40	
Uniform Delay, d1		65.7			68.1	67.3	1.9	4.3		10.9	2.4	
Progression Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.1			8.7	2.6	2.3	1.2		139.1	0.3	
Delay (s)		65.8			76.8	69.8	4.2	5.5		150.0	2.7	
Level of Service		E			E	E	A	A		F	A	
Approach Delay (s)		65.8			73.5			5.5			7.0	
Approach LOS		E			E			A			A	

Intersection Summary			
HCM Average Control Delay	7.6	HCM Level of Service	A
HCM Volume to Capacity ratio	1.02		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	78.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

BUILD CONDITIONS WITH CONDOS, POLICE STATION, AND LIBRARY
AM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	5	3	38	63	1	19	26	1303	30	20	2797	7
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00			1.00	1.00	1.00	0.91		1.00	0.91	
Frt		0.89			1.00	0.85	1.00	1.00		1.00	1.00	
Flt Protected		0.99			0.95	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1644			1775	1583	1770	5068		1770	5083	
Flt Permitted		0.96			0.76	1.00	0.03	1.00		0.17	1.00	
Satd. Flow (perm)		1588			1411	1583	59	5068		310	5083	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	5	3	41	68	1	21	28	1416	33	22	3040	8
RTOR Reduction (vph)	0	6	0	0	0	19	0	1	0	0	0	0
Lane Group Flow (vph)	0	43	0	0	69	2	28	1448	0	22	3048	0
Turn Type	Perm			Perm		Perm	Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)		10.8			10.8	10.8	127.2	127.2		127.2	127.2	
Effective Green, g (s)		10.8			10.8	10.8	127.2	127.2		127.2	127.2	
Actuated g/C Ratio		0.07			0.07	0.07	0.85	0.85		0.85	0.85	
Clearance Time (s)		6.0			6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		114			102	114	50	4298		263	4310	
v/s Ratio Prot								0.29			c0.60	
v/s Ratio Perm		0.03			c0.05	0.00	0.48			0.07		
v/c Ratio		0.38			0.68	0.01	0.56	0.34		0.08	0.71	
Uniform Delay, d1		66.4			67.9	64.7	3.3	2.4		1.9	4.3	
Progression Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2		2.1			16.3	0.0	38.4	0.2		0.6	1.0	
Delay (s)		68.5			84.2	64.7	41.7	2.6		2.5	5.3	
Level of Service		E			F	E	D	A		A	A	
Approach Delay (s)		68.5			79.7			3.4			5.3	
Approach LOS		E			E			A			A	

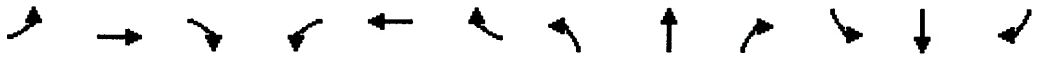
Intersection Summary			
HCM Average Control Delay	6.8	HCM Level of Service	A
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	74.4%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

BUILD CONDITION WITH CONDOS, POLICE STATION AND LIBRARY
PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	2	0	21	70	0	45	49	2890	107	55	1575	9
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0			6.0	6.0	6.0	6.0		6.0	6.0	
Lane Util. Factor		1.00			1.00	1.00	1.00	0.91		1.00	0.91	
Frt		0.88			1.00	0.85	1.00	0.99		1.00	1.00	
Flt Protected		1.00			0.95	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1625			1770	1583	1770	5058		1770	5081	
Flt Permitted		0.98			0.74	1.00	0.12	1.00		0.03	1.00	
Satd. Flow (perm)		1593			1380	1583	224	5058		60	5081	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2	0	23	76	0	49	53	3141	116	60	1712	10
RTOR Reduction (vph)	0	21	0	0	0	5	0	2	0	0	0	0
Lane Group Flow (vph)	0	4	0	0	76	44	53	3255	0	60	1722	0
Turn Type	Perm			Perm		Perm	Perm			Perm		
Protected Phases		4			8			2			6	
Permitted Phases	4			8		8	2			6		
Actuated Green, G (s)		12.9			12.9	12.9	125.1	125.1		125.1	125.1	
Effective Green, g (s)		12.9			12.9	12.9	125.1	125.1		125.1	125.1	
Actuated g/C Ratio		0.09			0.09	0.09	0.83	0.83		0.83	0.83	
Clearance Time (s)		6.0			6.0	6.0	6.0	6.0		6.0	6.0	
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		137			119	136	187	4218		50	4238	
v/s Ratio Prot								0.64			0.34	
v/s Ratio Perm		0.00			c0.06	0.03	0.24			c1.01		
v/c Ratio		0.03			0.64	0.33	0.28	0.77		1.20	0.41	
Uniform Delay, d1		62.8			66.3	64.5	2.7	5.8		12.5	3.1	
Progression Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.1			10.7	1.4	3.8	1.4		191.5	0.3	
Delay (s)		62.9			77.0	65.9	6.5	7.2		204.0	3.4	
Level of Service		E			E	E	A	A		F	A	
Approach Delay (s)		62.9			72.7			7.2			10.2	
Approach LOS		E			E			A			B	

Intersection Summary			
HCM Average Control Delay	10.0	HCM Level of Service	B
HCM Volume to Capacity ratio	1.15		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	79.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

NO SIGNAL WITH CONDO AND POLICE STATION VOLUME AM



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	5	3	38	3	1	78	26	1303	30	18	2855	7
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	5	3	41	3	1	85	28	1416	33	20	3103	8
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	3760	4652	1038	2606	4639	488	3111			1449		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	3760	4652	1038	2606	4639	488	3111			1449		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	0	82	0	0	84	72			96		
cM capacity (veh/h)	0	1	228	0	1	525	102			463		

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	NB 2	NB 3	NB 4	SB 1	SB 2	SB 3	SB 4
Volume Total	50	4	85	28	567	567	316	20	1241	1241	628
Volume Left	5	3	0	28	0	0	0	20	0	0	0
Volume Right	41	0	85	0	0	0	33	0	0	0	8
cSH	0	0	525	102	1700	1700	1700	463	1700	1700	1700
Volume to Capacity	Err	Err	0.16	0.28	0.33	0.33	0.19	0.04	0.73	0.73	0.37
Queue Length 95th (ft)	Err	Err	14	26	0	0	0	3	0	0	0
Control Delay (s)	Err	Err	13.2	53.4	0.0	0.0	0.0	13.1	0.0	0.0	0.0
Lane LOS	F	F	B	F				B			
Approach Delay (s)	Err	Err		1.0				0.1			
Approach LOS	F	F									

Intersection Summary				
Average Delay	Err			
Intersection Capacity Utilization	69.2%	ICU Level of Service	C	
Analysis Period (min)	15			

HCM Unsignalized Intersection Capacity Analysis
8: Quaint Acres Dr & MD 650

NO SIGNAL WITH CONDO AND POLICE STATION VOLUME PM

5/12/2009

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	0	21	0	0	55	49	2890	107	48	1604	9
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	2	0	23	0	0	60	53	3141	116	52	1743	10
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	3066	5217	586	4014	5164	1105	1753			3258		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	3066	5217	586	4014	5164	1105	1753			3258		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	100	95	100	100	71	85			41		
cM capacity (veh/h)	2	0	454	0	0	205	353			89		

Direction, Lane #	EB 1	WB 1	WB 2	NB 1	NB 2	NB 3	NB 4	SB 1	SB 2	SB 3	SB 4
Volume Total	25	0	60	53	1257	1257	745	52	697	697	358
Volume Left	2	0	0	53	0	0	0	52	0	0	0
Volume Right	23	0	60	0	0	0	116	0	0	0	10
cSH	20	1700	205	353	1700	1700	1700	89	1700	1700	1700
Volume to Capacity	1.27	219.02	0.29	0.15	0.74	0.74	0.44	0.59	0.41	0.41	0.21
Queue Length 95th (ft)	85	Err	29	13	0	0	0	67	0	0	0
Control Delay (s)	579.2	0.0	29.6	17.0	0.0	0.0	0.0	91.8	0.0	0.0	0.0
Lane LOS	F	A	D	C				F			
Approach Delay (s)	579.2	29.6		0.3				2.7			
Approach LOS	F	D									

Intersection Summary				
Average Delay	4.2			
Intersection Capacity Utilization	75.0%	ICU Level of Service	D	
Analysis Period (min)	15			

APPENDIX D

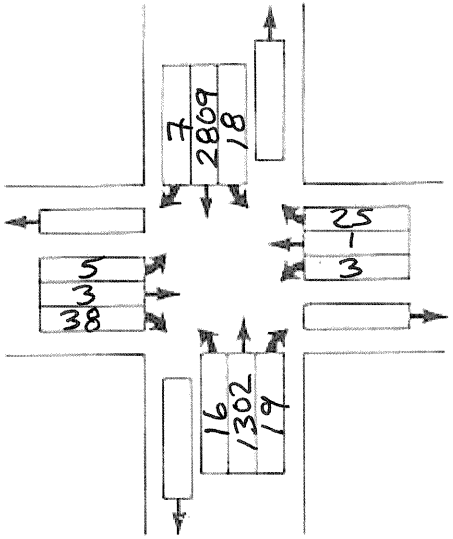
CRITICAL LANE VOLUME WORKSHEETS

TURNING MOVEMENT SUMMARY AND LEVEL-OF-SERVICE

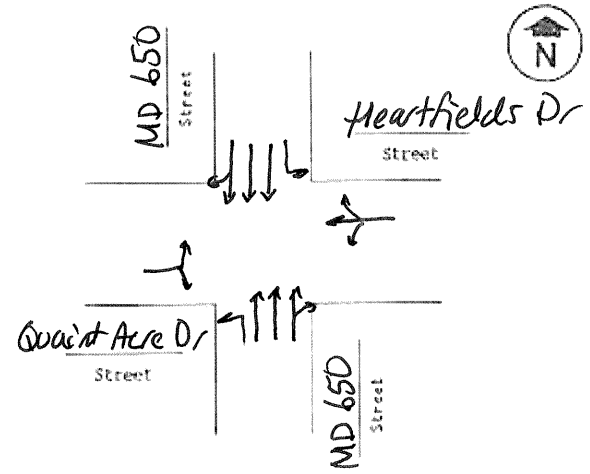
Count Date: _____
Conditions/
Design Year: _____
Computed by: _____ Date: _____

Location: MD 650 @ Heartfields Dr
EXISTING

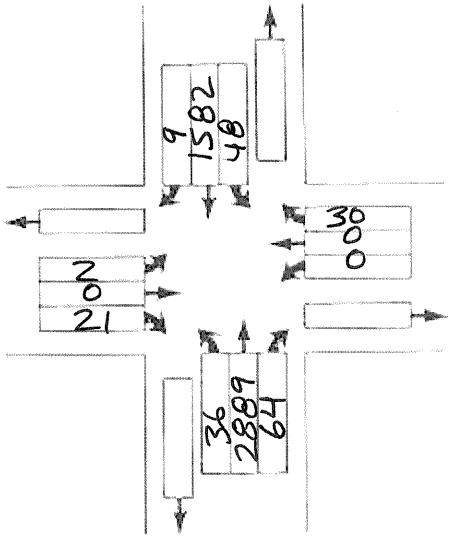
Morning Peak Hour _____



LANE CONFIGURATION



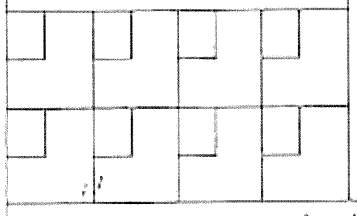
Evening Peak Hour _____



Intersection Control: Signal ___ Stop ✓ Ways 2

RTOR: NB ___ SB ___ EB ___ WB ___

Phasing (0)



No. of Lanes	Lane Use Factor	Service Level	Critical Lane Vol. Total
1	= 1.00	A ≤	1000
2	= .55	B ≤	1150
3	= .40	C ≤	1300
4	= .30	D ≤	1450
Dble. L.T.	= .60	E ≤	1600
		F >	1600

Opposing Volume (vph)	PCE
≤ 199	1.1
≤ 599	2.0
≤ 799	3.0
≤ 999	4.0
> 1000	5.0

0	Movement	Volume (1)	Lane Use Factor (2)	Lane Volume (1)x(2)	Opposing Lefts	Critical Lane Volume	*
	NB	1321	.37	489	18	507	
	SB	2816	.37	1042	16	1058	*
	EB	46	1	46	3	49	*
	WB	25	1	25	5	30	

Remarks:

* Critical Volume TOTAL 1107 V/C .69

LEVEL OF SERVICE B

0	Movement	Volume (1)	Lane Use Factor (2)	Lane Volume (1)x(2)	Opposing Lefts	Critical Lane Volume	*
	NB	2953	.37	1093	48	1141	*
	SB	1591	.37	589	36	625	
	EB	23	1	23		23	
	WB	30	1	30	2	32	*

* Critical Volume TOTAL 1173 V/C .73

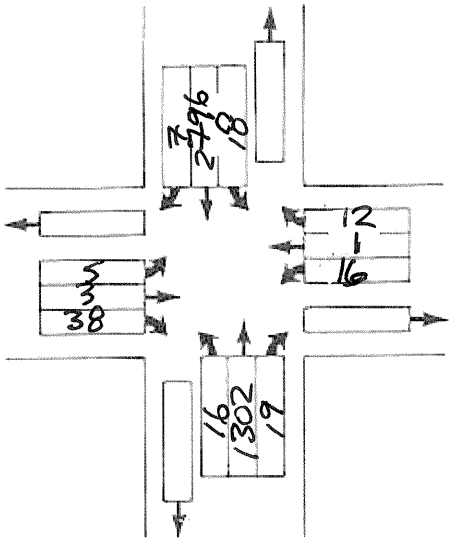
LEVEL OF SERVICE C

TURNING MOVEMENT SUMMARY AND LEVEL-OF-SERVICE

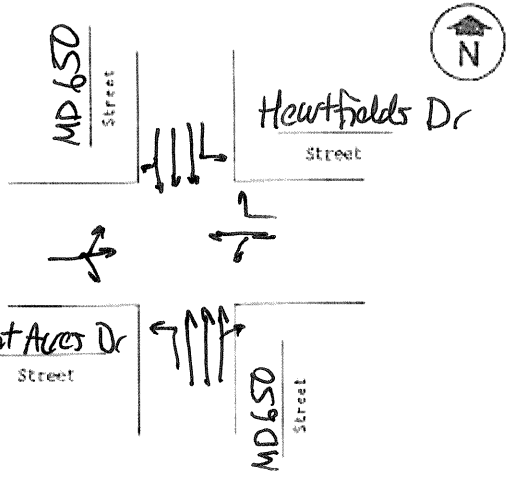
Count Date: _____
Conditions/
Design Year: _____
Computed by: _____ Date: _____

Location: MD 650 @ Heartfields Dr
with library counts

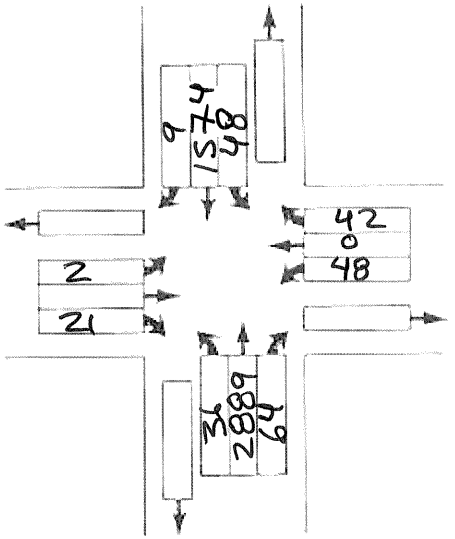
Morning Peak Hour _____



LANE CONFIGURATION



Evening Peak Hour _____



Intersection Control: Signal ✓ Stop ___ Ways ___

RTOR: NB ___ SB ___ EB ___ WB ___

Phasing [0]

1 NBL	2 SB		4 EB
5 SBL	6 NB		8 WB

No. of Lanes	Lane Use Factor	Service Level	Critical Lane Vol. Total
1	= 1.00	A ≤	1000
2	= .55	B ≤	1150
3	= .40	C ≤	1300
4	= .30	D ≤	1450
Uble. L.T.	= .60	E ≤	1600
		F >	1600

Opposing Volume (vph)	PCE
≤ 199	1.1
≤ 599	2.0
≤ 799	3.0
≤ 999	4.0
> 1000	5.0

0	Movement	Volume (1)	Lane Use Factor (2)	Lane Volume (1)x(2)	Opposing Lefts	Critical Lane Volume	*
6	NB	1321	.37	489	18	507	
2	SB	2803	.37	1037	16	1053	*
4	EB	46	1	46	16	62	
8	WB	17	1	17	5	23	

Remarks:

* Critical Volume TOTAL 1115 V/C .70

LEVEL OF SERVICE B

0	Movement	Volume (1)	Lane Use Factor (2)	Lane Volume (1)x(2)	Opposing Lefts	Critical Lane Volume	*
6	NB	2953	.37	1093	48	1141	*
2	SB	1583	.37	586	36	622	
4	EB	23	1	23	48	71	*
8	WB	48	1	48	2	50	

* Critical Volume TOTAL 1212 V/C .76

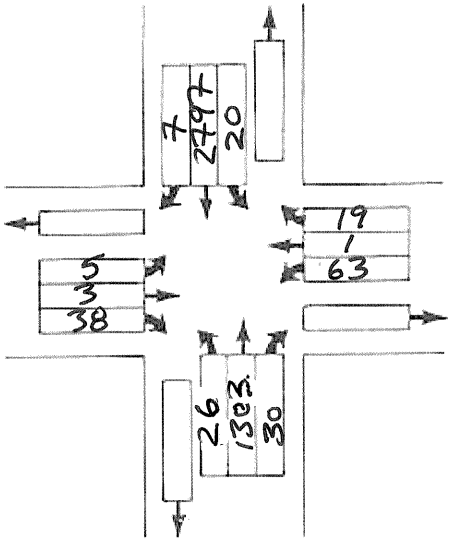
LEVEL OF SERVICE C

TURNING MOVEMENT SUMMARY AND LEVEL-OF-SERVICE

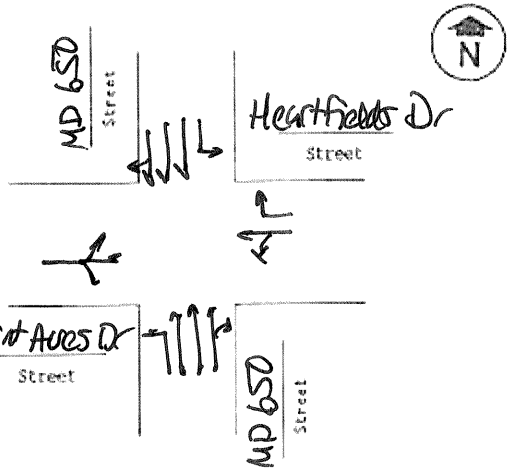
Count Date: _____
Conditions/
Design Year: _____
Computed by: _____ Date: _____

Location: MD 650 @ Heartfields Dr
with condos, police station and library

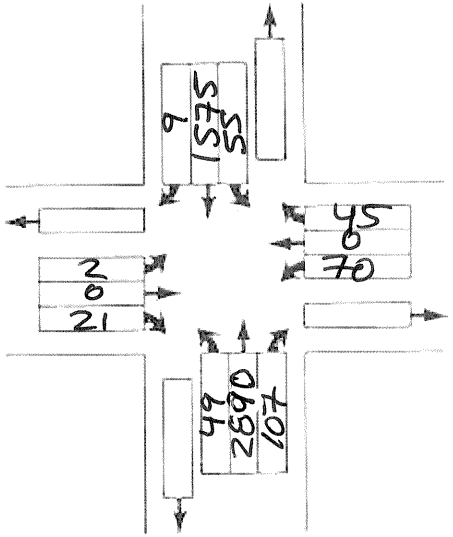
Morning Peak Hour _____



LANE CONFIGURATION



Evening Peak Hour _____



Intersection Control: Signal ✓ Stop ____ Ways ____

RTOR: NB ✓ SB ✓ EB ✓ WB ✓

Phasing [0]

1	2		4
NBL	SB		EB
5	6		8
SBL	NB		WB

No. of Lanes	Lane Use Factor
1	= 1.00
2	= .55
3	= .40
4	= .30
Dble. L.T.	= .60

Service Level	Critical Lane Vol. Total
A (	1000
B (	1150
C (	1300
D (	1450
E (	1600
F)	1600

Opposing Volume (vph)	PCE
(199	1.1
(599	2.0
(799	3.0
(999	4.0
> 1000	5.0

0	Movement	Volume (1)	Lane Use Factor (2)	Lane Volume (1)x(2)	Opposing Lefts	Critical Lane Volume	*
1	NB	1333	.37	493	20	513	
2	SB	2804	.37	1037	26	1063	*
4	EB	46	1	46	63	109	*
8	WB	64	1	64	5	69	

Remarks: Of the 26 NBL, 10 are police cars making a U-turn

* Critical Volume TOTAL 1172 V/C .73

LEVEL OF SERVICE C

0	Movement	Volume (1)	Lane Use Factor (2)	Lane Volume (1)x(2)	Opposing Lefts	Critical Lane Volume	*
6	NB	2997	.37	1109	55	1164	*
2	SB	1584	.37	586	49	635	
4	EB	23	1	23	70	93	*
8	WB	70	1	70	2	72	

Of the 49 NBL, 13 are police cars making a U-turn

* Critical Volume TOTAL 1257 V/C .79

LEVEL OF SERVICE C

TURNING MOVEMENT SUMMARY AND LEVEL-OF-SERVICE

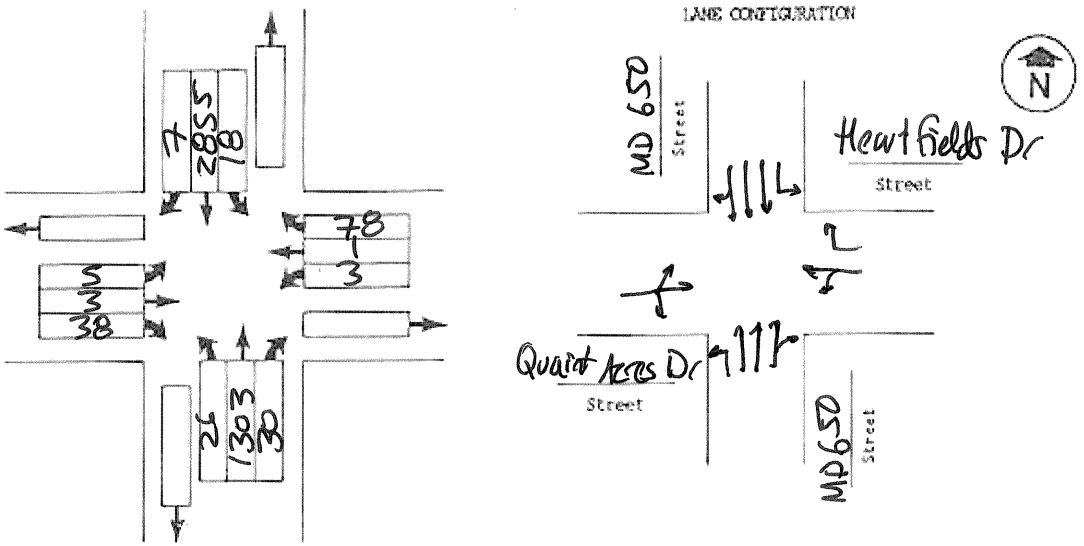
Count Date: _____
Conditions:
Design Year: _____
Computed By: _____ Date: _____

Location: MD 650 @ Heartfields Dr
NO signal
condo and police station traffic included

Morning Peak Hour _____

Evening Peak Hour _____

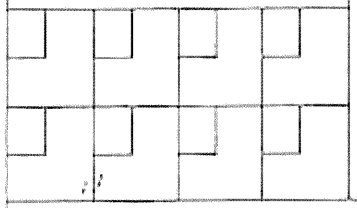
LANE CONFIGURATION



Intersection Control: Signal ____ Stop ✓ Ways 2

RTOR: NB ___ SB ___ EB ___ WB ___

Phasing [0]



No. of Lanes	Lane Use Factor
1	= 1.00
2	= .55
3	= .40
4	= .30
Uhle. L.T.	= .60

Service Level	Critical Lane Vol. Total
A (	1000
B (	1150
C (	1300
D (	1450
E (	1600
F)	1600

Opposing Volume (vph)	PCE
(199	1.1
(599	2.0
(799	3.0
(999	4.0
) 1000	5.0

0	Movement	Volume (1)	Lane Use Factor (2)	Lane Volume (1)x(2)	Opposing Lefts	Critical Lane Volume	*
	NB	1333	.37	493	18	511	
	SB	2862	.37	1059	26	1085	*
	EB	46	1	46	3	49	
	WB	78	1	78	5	83	*

Remarks: Of the 26 NBL, 10 are police cars making a U-turn

* Critical Volume TOTAL 1168 V/C .73

LEVEL OF SERVICE

0	Movement	Volume (1)	Lane Use Factor (2)	Lane Volume (1)x(2)	Opposing Lefts	Critical Lane Volume	*
	NB	2997	.37	1109	48	1157	*
	SB	1613	.37	597	49	646	
	EB	23	1	23		23	
	WB	55	1	55	2	57	*

Of the 49 NBL, 13 are police cars making a U-turn

* Critical Volume TOTAL 1214 V/C .76

LEVEL OF SERVICE C

APPENDIX E

SIGNAL WARRANT CALCULATIONS

Start Time	New Hampshire from north	New Hampshire from south	1-hr total from north	1-hr total from south	higher value	Heartfields Drive from east	Quaint Acres Dr. from west	1-hr total from east	1-hr total from west	higher value	4-hr warrant	8-hr warrant	Start Time	Library Count	If signal - would use Heartfields estimated 75% of library count	Projected Heartfields Total (with library traffic)	Projected 1-hr total	higher value	4-hr warrant	8-hr warrant
6:00	214	163				3	2						6:00			3				
6:15	343	180				0	4						6:15			0				
6:30	390	307				4	7						6:30			4				
6:45	491	330	1438	980	1438	9	11	16	24	24			6:45			9		24		
7:00	508	339	1732	1156	1732	7	5	20	27	27			7:00			7		27		
7:15	687	286	2076	1262	2076	6	6	26	29	29			7:15			6		29		
7:30	673	353	2359	1308	2359	10	10	32	32	32			7:30			10		32		
7:45	645	293	2513	1271	2513	8	7	31	28	31			7:45			8		31		
8:00	597	321	2602	1253	2602	4	11	28	34	34		34	8:00			4		34		
8:15	628	334	2543	1301	2543	7	18	29	46	46			8:15			7		46		
8:30	651	317	2521	1265	2521	15	10	34	46	46			8:30			15		46		
8:45	645	256	2521	1228	2521	6	12	32	51	51	51		8:45			6		51		
9:00	544	281	2468	1188	2468	3	11	31	51	51		51	9:00			3		51		
9:15	520	253	2360	1107	2360	6	5	30	38	38			9:15			6		38		
9:30	379	249	2088	1039	2088	8	7	23	35	35			9:30			8		35		
9:45	389	222	1832	1005	1832	2	9	19	32	32			9:45			2		32		
10:00	365	260	1653	984	1653	7	10	23	31	31			10:00	6	5	12	28	31		
10:15	325	233	1458	964	1458	8	8	25	34	34		34	10:15	9	7	15	37	37		
10:30	300	241	1379	956	1379	5	11	22	38	38			10:30	9	7	12	41	41		
10:45	310	230	1300	964	1300	3	9	23	38	38			10:45	9	7	10	49	49		
11:00	260	232	1195	936	1195	9	11	25	39	39			11:00	10	8	17	54	54		54
11:15	276	234	1146	937	1146	2	7	19	38	38		38	11:15	12	9	11	50	50		
11:30	283	241	1129	937	1129	5	6	19	33	33			11:30	12	9	14	52	52		
11:45	226	235	1045	942	1045	7	9	23	33	33			11:45	11	9	16	58	58		
12:00	275	288	1060	998	1060	7	5	21	27	27			12:00	21	16	23	64	64		64
12:15	257	291	1041	1055	1055	11	5	30	25	30			12:15	12	9	20	73	73		
12:30	277	286	1035	1100	1100	3	5	28	24	28			12:30	13	10	13	72	72		
12:45	269	296	1078	1161	1161	3	14	24	29	29			12:45	19	15	18	74	74		
1:00	261	293	1064	1166	1166	5	5	22	29	29			1:00	18	14	19	70	70		70
1:15	243	284	1050	1159	1159	3	5	14	29	29			1:15	13	10	13	63	63		
1:30	238	291	1011	1164	1164	8	8	19	32	32			1:30	14	11	19	69	69		
1:45	253	363	995	1231	1231	9	4	25	22	25			1:45	11	9	18	69	69		
2:00	264	364	998	1302	1302	14	9	34	26	34			2:00	13	10	24	74	74		74
2:15	302	393	1057	1411	1411	10	9	41	30	41	41	41	2:15	11	9	19	80	80		
2:30	307	389	1126	1509	1509	6	7	39	29	39			2:30	33	25	31	92	92		
2:45	317	521	1190	1667	1667	7	8	37	33	37			2:45	15	12	19	93	93	93	
3:00	311	474	1237	1777	1777	12	9	35	33	35			3:00	19	15	27	96	96		96
3:15	353	489	1288	1873	1873	5	8	30	32	32		32	3:15	21	16	21	98	98		
3:30	376	498	1357	1982	1982	12	2	36	27	36			3:30	12	9	21	88	88		
3:45	350	505	1390	1966	1966	12	10	41	29	41			3:45	18	14	26	95	95	95	
4:00	321	555	1400	2047	2047	11	7	40	27	40			4:00	11	9	20	88	88		88
4:15	374	601	1421	2159	2159	9	10	44	29	44	44	44	4:15	20	15	24	91	91		
4:30	385	581	1430	2242	2242	12	2	44	29	44			4:30	23	18	30	100	100		
4:45	360	638	1440	2375	2375	10	4	42	23	42			4:45	14	11	21	95	95	95	
5:00	356	586	1475	2406	2406	10	12	41	28	41			5:00	22	17	27	102	102		102
5:15	370	684	1471	2489	2489	10	2	42	20	42	42	42	5:15	18	14	24	102	102		
5:30	374	650	1460	2558	2558	4	8	34	26	34			5:30	16	12	16	88	88		
5:45	403	729	1503	2649	2649	10	5	34	27	34			5:45	8	6	16	83	83	83	
6:00	451	662	1598	2725	2725	6	8	30	23	30			6:00	11	9	15	71	71		71
6:15	384	588	1612	2629	2629	9	5	29	26	29			6:15	13	10	19	66	66		
6:30	416	521	1654	2500	2500	5	6	30	24	30			6:30					30		
6:45	388	507	1639	2278	2278	3	11	23	30	30			6:45					30		

Start Time	New Hampshire from north	New Hampshire from south	1-hr total from north	1-hr total from south	higher value	Heartfields Drive from east	Quaint Acres Dr. from west	1-hr total from east	1-hr total from west	higher value	% of peak	Condo Hourly Traffic peak coming out =	New Heartfields Total	4-hr warrant	8-hr warrant	Added Library Traffic	1-hr Library Total	New Heartfields Total	4-hr warrant	8-hr warrant	Start Time
6:00	214	163				3	2					60									6:00
6:15	343	180				0	4														6:15
6:30	390	307				4	7														6:30
6:45	491	330	1438	980	1438	9	11	16	24	24	0.47	29	45					45			6:45
7:00	508	339	1732	1156	1732	7	5	20	27	27	0.53	32	52					52			7:00
7:15	687	286	2076	1262	2076	6	6	26	29	29	0.57	35	61		61			61			7:15
7:30	673	353	2359	1308	2359	10	10	32	32	32	0.63	38	70					70			7:30
7:45	645	293	2513	1271	2513	8	7	31	28	31	0.55	33	64					64			7:45
8:00	597	321	2602	1253	2602	4	11	28	34	34	0.67	40	68					68			8:00
8:15	628	334	2543	1301	2543	7	18	29	46	46	0.90	55	84	84	84			84			8:15
8:30	651	317	2521	1265	2521	15	10	34	46	46	0.90	55	89					89			8:30
8:45	645	256	2521	1228	2521	6	12	32	51	51	1.00	60	92					92			8:45
9:00	544	281	2468	1188	2468	3	11	31	51	51	1.00	60	91					91			9:00
9:15	520	253	2360	1107	2360	6	5	30	38	38	0.75	45	75	75	75			75			9:15
9:30	379	249	2088	1039	2088	8	7	23	35	35	0.69	42	65					65			9:30
9:45	389	222	1832	1005	1832	2	9	19	32	32	0.63	38	57					57			9:45
10:00	365	260	1653	984	1653	7	10	23	31	31	0.61	37	60			5	5	65			10:00
10:15	325	233	1458	964	1458	8	8	25	34	34	0.67	40	65			7	12	77			10:15
10:30	300	241	1379	956	1379	5	11	22	38	38	0.75	45	67			7	19	86			10:30
10:45	310	230	1300	964	1300	3	9	23	38	38	0.75	45	68			7	26	94			10:45
11:00	260	232	1195	936	1195	9	11	25	39	39	0.76	46	71		71	8	29	100		100	11:00
11:15	276	234	1146	937	1146	2	7	19	38	38	0.75	45	64			9	31	95			11:15
11:30	283	241	1129	937	1129	5	6	19	33	33	0.65	39	58			9	33	91			11:30
11:45	226	235	1045	942	1045	7	9	23	33	33	0.65	39	62			9	35	97			11:45
12:00	275	288	1060	998	1060	7	5	21	27	27	0.53	32	53			16	43	96		96	12:00
12:15	257	291	1041	1055	1055	11	5	30	25	30	0.49	30	60			9	43	103			12:15
12:30	277	286	1035	1100	1100	3	5	28	24	28	0.47	29	57			10	44	101			12:30
12:45	269	296	1078	1161	1161	3	14	24	29	29	0.57	35	59			15	50	109			12:45
1:00	261	293	1064	1166	1166	5	5	22	29	29	0.57	35	57			14	48	105		105	1:00
1:15	243	284	1050	1159	1159	3	5	14	29	29	0.57	35	49			10	49	98			1:15
1:30	238	291	1011	1164	1164	8	8	19	32	32	0.63	38	57			11	50	107			1:30
1:45	253	363	995	1231	1231	9	4	25	22	25	0.43	26	51			9	44	95			1:45
2:00	264	364	998	1302	1302	14	9	34	26	34	0.51	31	65			10	40	105		105	2:00
2:15	302	393	1057	1411	1411	10	9	41	30	41	0.59	36	77	77	77	9	39	116			2:15
2:30	307	389	1126	1509	1509	6	7	39	29	39	0.57	35	74			25	53	127			2:30
2:45	317	521	1190	1667	1667	7	8	37	33	37	0.65	39	76			12	56	132	132		2:45
3:00	311	474	1237	1777	1777	12	9	35	33	35	0.65	39	74			15	61	135		135	3:00
3:15	353	489	1288	1873	1873	5	8	30	32	32	0.63	38	68		68	16	68	136			3:15
3:30	376	498	1357	1982	1982	12	2	36	27	36	0.53	32	68			9	52	120			3:30
3:45	350	505	1390	1966	1966	12	10	41	29	41	0.57	35	76			14	54	130	130		3:45
4:00	321	555	1400	2047	2047	11	7	40	27	40	0.53	32	72			9	48	120		120	4:00
4:15	374	601	1421	2159	2159	9	10	44	29	44	0.57	35	79			15	47	126			4:15
4:30	385	581	1430	2242	2242	12	2	44	29	44	0.57	35	79	79	79	18	56	135			4:30
4:45	360	638	1440	2375	2375	10	4	42	23	42	0.45	28	70			11	53	123	123		4:45
5:00	356	586	1475	2406	2406	10	12	41	28	41	0.55	33	74			17	61	135		135	5:00
5:15	370	684	1471	2489	2489	10	2	42	20	42	0.39	24	66			14	60	126			5:15
5:30	374	650	1460	2558	2558	4	8	34	26	34	0.51	31	65			12	54	119			5:30
5:45	403	729	1503	2649	2649	10	5	34	27	34	0.53	32	66		66	6	49	115	115		5:45
6:00	451	662	1598	2725	2725	6	8	30	23	30	0.45	28	58			9	41	99		99	6:00
6:15	384	588	1612	2629	2629	9	5	29	26	29	0.51	31	60			10	37	97			6:15
6:30	416	521	1654	2500	2500	5	6	30	24	30	0.47	29	59				25	84			6:30
6:45	388	507	1639	2278	2278	3	11	23	30	30	0.59	36	59				19	78			6:45