

January 12, 2018

Mr. Matt Baker, Regional Planner
Office of Preliminary Planning & Engineering
Maryland State Highway Administration
707 North Calvert Street
Baltimore, MD 21202-3601

RE: White Oak LATIP Supplemental Analysis - MD 650 at Powder Mill Rd & Elton Rd

Dear Mr. Baker:

On February 14, 2017, the Montgomery County Council passed the Local Area Transportation Improvement Program (LATIP) for the White Oak Science Gateway area. This program defines the transportation improvements needed to support the build-out of the master plan and is the basis for an impact fee to simplify development approvals while also accumulating funds for implementing necessary infrastructure¹.

The LATIP is structured to encourage developers to implement improvements concurrent with their development by providing LATIP credits up to the amount assigned by Council, and allowing Impact Tax credits beyond that amount (even for work at State intersections). As part of Council approval, \$5,000,000 for work was assigned to the MD 650/Powder Mill Road intersection for traffic operations improvements, but specific improvements were not identified.

Attached is a supplemental analysis conducted as an addendum to the White Oak LATIP which now identifies specific improvements to the MD 650/Powder Mill Road intersection, as well as the closely related intersection of MD 650 and Elton Road. Additionally, traffic calming treatments along Elton Road are recommended to be coordinated with local communities in order to reduce speeds and enhance safety along Elton Road.

¹ Additional information can be found in the White Paper online at:
<https://www.montgomerycountymd.gov/dot-dir/Resources/Files/LATR-WhitePaper.pdf>

We have reviewed this supplemental analysis addendum to the White Oak LATIP and concur with its findings. At this moment, we are asking for your review of the supplemental analysis and for your concurrence with the findings so that construction of the proposed improvements can move forward. Once we have your accord, we will work to determine the phasing & schedule of implementation and estimated costs of the proposed improvements.

Should you have any questions, please feel free to contact me or Andrew Bossi, Senior Engineer at, 240-777-7200.

Sincerely,



Christopher Conklin, P.E.
Deputy Director for Policy

CC:AB:kcf

Enclosure: White Oak LATIP Supplemental Analysis

cc: Andrew Bossi, Senior Engineer, Montgomery County Department of Transportation

bcc: Gary Erenrich, MCDOT
Greg Leck, MCDOT
Deepak Somarajan, MCDOT
Kandese Holford, SHA
Kwesi Woodroffe, SHA
Pamela Dunn, MNCPPC
Eric Graye, MNCPPC
Ed Axler, MNCPPC
Shane Pollin, Duffie
Bill Kominers, Lerch Early
Mike Lenhart, Lenhart Traffic Consulting
Nick Driban, Lenhart Traffic Consulting

Lenhart Traffic Consulting, Inc.

Transportation Planning & Traffic Engineering

Memorandum:

Date: January 12, 2018

TO: Mr. Chris Conklin
Montgomery County DOT
101 Monroe Street, #10
Rockville, MD 20850

FROM: Mike Lenhart

RE: White Oak LATIP Supplemental Analysis – MD 650 & Powder Mill Road

As part of this analysis, two scenarios were evaluated including:

- Total Conditions with no improvements to intersection geometry and timings.
- Total Conditions with the following improvements:
 1. An additional EB left-turn lane (including modifications to existing lane use) and WB right-turn lane at the intersection of MD 650 & Powder Mill Road. Note that a dedicated WB right-turn lane at the intersection of MD 650 & Powder Mill Road is present under Existing Conditions, however, the westbound right turn lane is only 50' long. This is far shorter than a typical turn lane and is completely unusable because access to the right turn lane is blocked by queues in the adjacent lanes. Therefore, this 50' lane was not treated as a right turn lane in the analysis of existing geometrics.
 2. A slip ramp at the intersection of MD 650 & Elton Road to provide direct access from Elton Road to I-495 WB.
 3. Traffic calming along Elton Road in order to reduce speeds and enhance safety.

The following intersections were analyzed as part of this analysis including:

1. MD 650 & Powder Mill Road
2. MD 650 & Elton Road

In addition to this memo, the following exhibits and appendices have been included:

- Exhibit 1 Presents a location map and shows the study intersections.
- Exhibit 2 Provides the existing lane use and traffic controls devices.
- Exhibit 3 Includes the existing peak hour traffic volumes at the intersections. Note that these counts were taken from SHA's ITMS website, and are the same counts used in the LATIP analysis. It should be noted however that the LATIP analysis had two errors in their existing traffic counts. The LATIP study failed to include northbound and southbound MD 650 U-turns, and had an incorrect through volume for northbound MD 650 in the morning peak hour.



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645 BALTIMORE ANNAPOLIS BLVD, SUITE 214
SEVERNA PARK, MD 21146
www.lenharttraffic.com

OFFICE: (410) 216-3333

FAX: (443) 782-2288

EMAIL: mlenhart@lenharttraffic.com

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- Exhibit 4 Provides the 2040 background peak hour traffic volumes which were taken from the White Oak LATIP with the exception of the background growth in traffic on the west leg of MD 650 at Powder Mill Road in and out of the Holly Hall apartments. The growth in traffic on the west leg is calculated in Exhibits 5 and 6 as follows.
- Exhibit 5 Contains the trip generation table for the Hillandale Gateway development. While the 2040 peak hour volumes from the White Oak LATIP generally accounted for traffic from planned developments in the area, in order to be conservative, trip generation and assignment were conducted separately for the Hillandale Gateway development as part of this study due to its immediate proximity to the study intersections and because it is one of the first sites planned for development in the White Oak LATIP area. Note that a trip credit was assumed for the existing 96 senior adult dwelling units. The proposed development is understood to consist of 146 senior adult dwelling units, 350 apartment units, and 24,500 square feet of shopping center.
- Exhibit 6a-c Exhibits 6a-6c detail the residential, retail, and pass-by trip assignments for the planned Hillandale Gateway development. The trip assignment is based on the net increase in trips over and above the existing use. It should be noted that a right-in/right-out driveway is planned for the site in addition to the access from the west leg of the MD 650 & Powder Mill Road intersection.
- Exhibit 7 Combines the 2040 background peak hour traffic volumes shown on Exhibit 4 with the trip assignments shown on Exhibits 6a-6c to provide total traffic volumes.
- Exhibits 8a Shows the assumed traffic diversions as a result of the construction of a slip ramp which would provide direct access from Elton Road to I-495 WB.
- Exhibit 8b Combines the total traffic volumes shown on Exhibit 7 with the traffic diversions shown on Exhibit 8a to provide total peak hour volumes with diversions. Note that these volumes were used in the “Total with Improvements” scenario.
- Exhibit 9 Provides a table showing Level of Service using the HCS methodology at the two study intersections. The LATIP uses an 80 second threshold for the determination of intersection adequacy.
- Exhibit 10 Shows the proposed lane use and traffic control devices under the “Total with Improvements” scenario.
- Appendix A Provides supplemental information and turning movement counts.
- Appendix B Provides Level of Service (HCS) worksheets.
- Appendix C Includes concept design plans for the proposed improvements.



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SEVERNA PARK, MD 21146

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OFFICE: (410) 216-3333

FAX: (443) 782-2288

EMAIL: mlenhart@lenharttraffic.com

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The following information is a summary of the results of our analyses:

- Under Total Conditions without any improvements to intersection geometry or timing, the signalized study intersection of MD 650 & Powder Mill Road will operate with an overall intersection delay of **greater than 80 seconds during the PM peak hour** (76.9 seconds and 125.0 seconds during the AM and PM peak hours respectively). As mentioned previously, the LATIP uses an 80 second threshold for the determination of intersection adequacy. Therefore, intersection improvements are required in order to meet the LATIP guidelines.
- The “Total with Improvements” scenario includes a portion of the Master Plan improvements (EB Left + WB Right at MD 650 & Powder Mill Road) and a slip ramp at the intersection of MD 650 & Elton Road to provide direct access from Elton Road to I-495 WB. Under this scenario, the signalized study intersection of MD 650 & Powder Mill Road will operate with an overall intersection delay of **less than 80 seconds** (55.8 seconds and 76.1 seconds during the AM and PM peak hours respectively) which satisfies the LATIP requirements. In addition, the intersection of MD 650 & Elton Road will operate with less than 10 seconds of delay during both the AM and PM peak hours.

Based on the results of this analysis, all signalized study intersections under the “Total with Improvements” scenario will operate with less than 80 seconds of delay and will satisfy LATIP requirements. If you have any questions regarding this matter, please do not hesitate to contact me at the number below. We look forward to your feedback and guidance in how you would like to proceed.

Thanks,
Mike



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SEVERNA PARK, MD 21146

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FAX: (443) 782-2288

EMAIL: mlenhart@lenharttraffic.com

Study Intersections:

1. MD 650 & Powder Mill Road
2. MD 650 & Elton Road

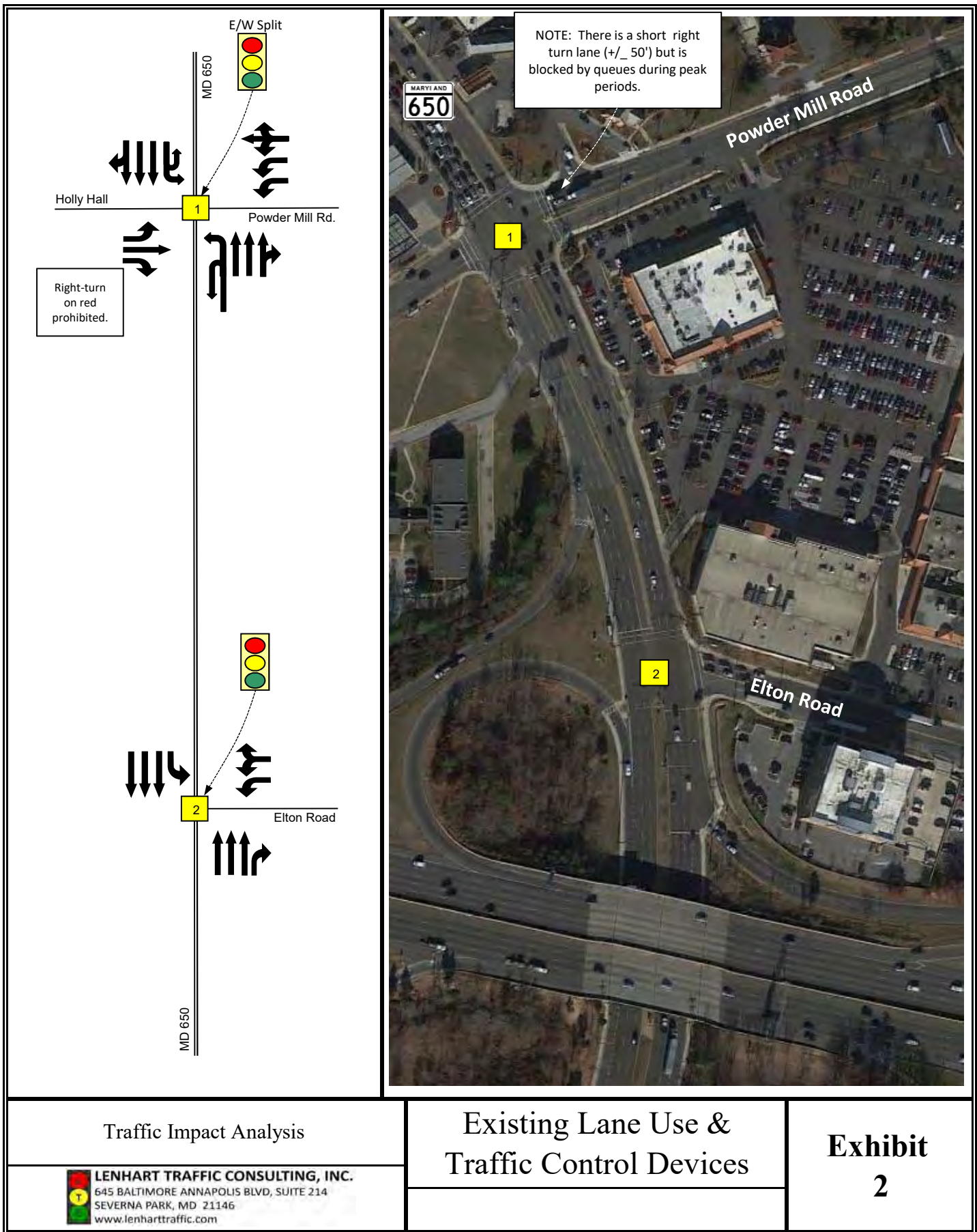


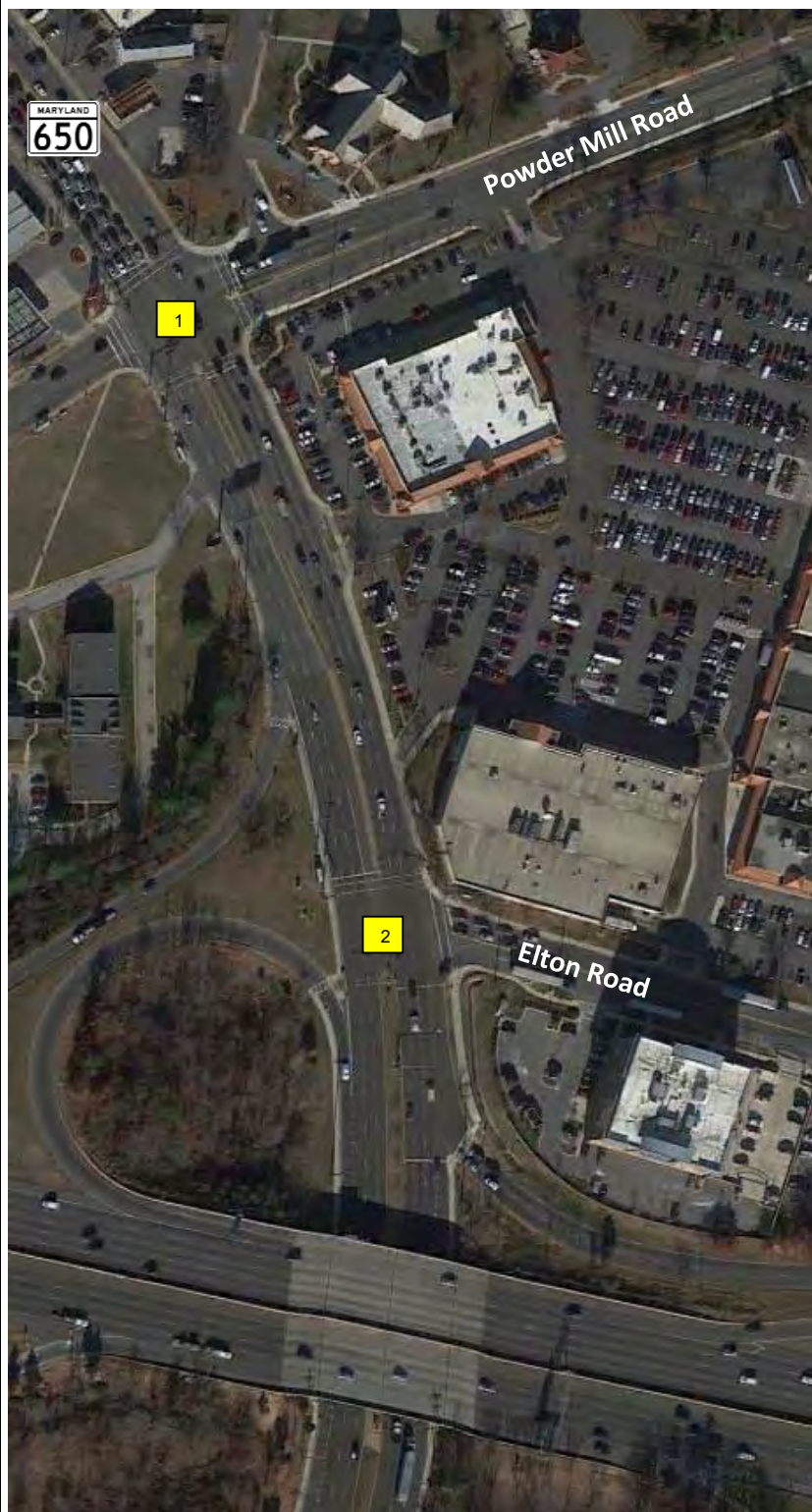
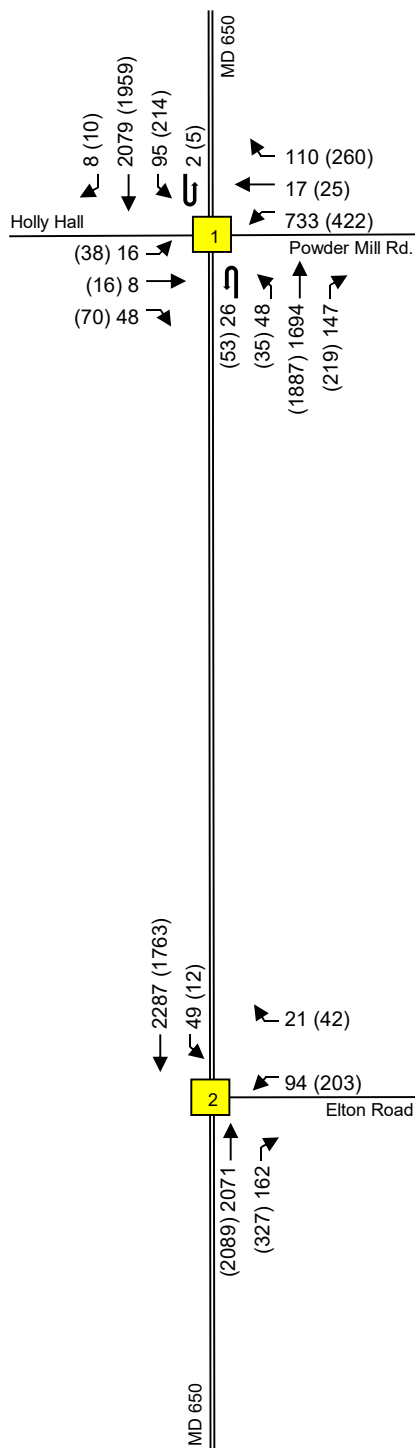
Traffic Impact Analysis

Location
Map

Exhibit
1

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Traffic Impact Analysis

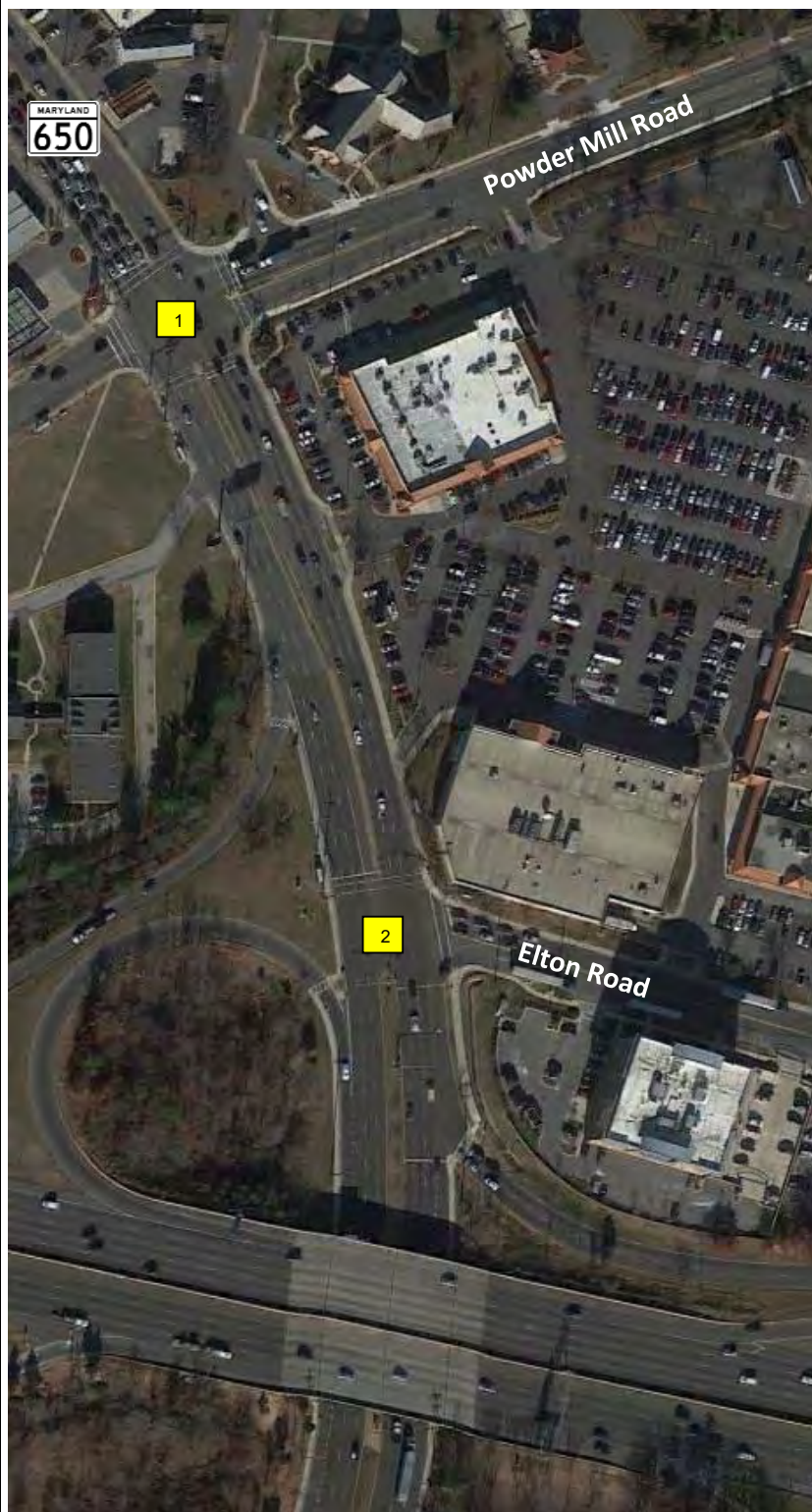
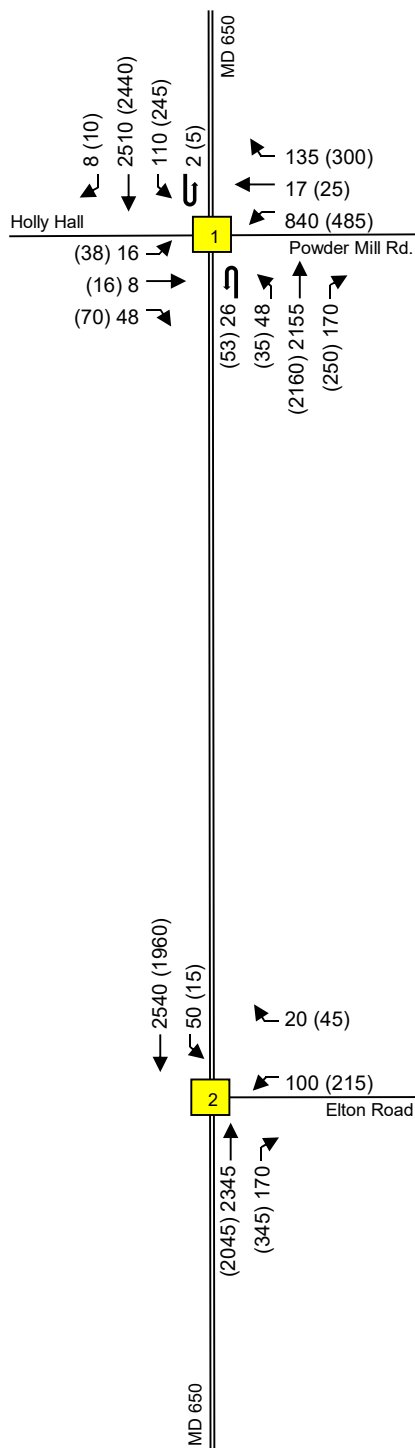


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Existing Peak Hour Volumes

Key: xx = AM Peak Vol's (xx) = PM Peak Vol's

Exhibit 3



Traffic Impact Analysis



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2040 Background Peak Hour Volumes

Key: xx = AM Peak Vol's (xx) = PM Peak Vol's

Exhibit 4

Trip Generation Rates

Apartment Units (ITE-220, Units)

Morning Trips = 0.51 x Units
 Evening Trips = 0.62 x Units
 Daily Trips = 6.65 x Units

Trip Distribution (In/Out)

20/80
 65/35
 50/50

Senior Adult Housing - Attached (ITE-252, Units)

Morning Trips = 0.20 x Units
 Evening Trips = 0.25 x Units
 Daily Trips = 3.44 x Units

Trip Distribution (In/Out)

34/66
 54/46
 50/50

Shopping Center (ksf, ITE-820)

Morning Trips = 0.96 x ksf
 Evening Trips = 3.71 x ksf
 Daily Trips = 42.70 x ksf

Trip Distribution (In/Out)

62/38
 48/52
 50/50

Trip Generation Totals

			AM Peak			PM Peak			Daily Total
			In	Out	Total	In	Out	Total	
Existing	Senior Adult Housing - Attached (ITE-252, Units)	96 units	6	13	19	13	11	24	330
Proposed	Senior Adult Housing - Attached (ITE-252, Units)	146 units	10	19	29	20	17	37	502
Proposed	Apartment Units (ITE-220, Units)	350 units	36	143	179	141	76	217	2328
Total New Residential Primary Trips			40	149	189	148	82	230	2500
Proposed	Shopping Center (ksf, ITE-820)	24,500 SF	15	9	24	44	47	91	1046
Shopping Center Pass-by (0% AM/34% PM)			0	0	0	-15	-16	-31	-356
Total New Retail Primary Trips			15	9	24	29	31	60	690

Notes:

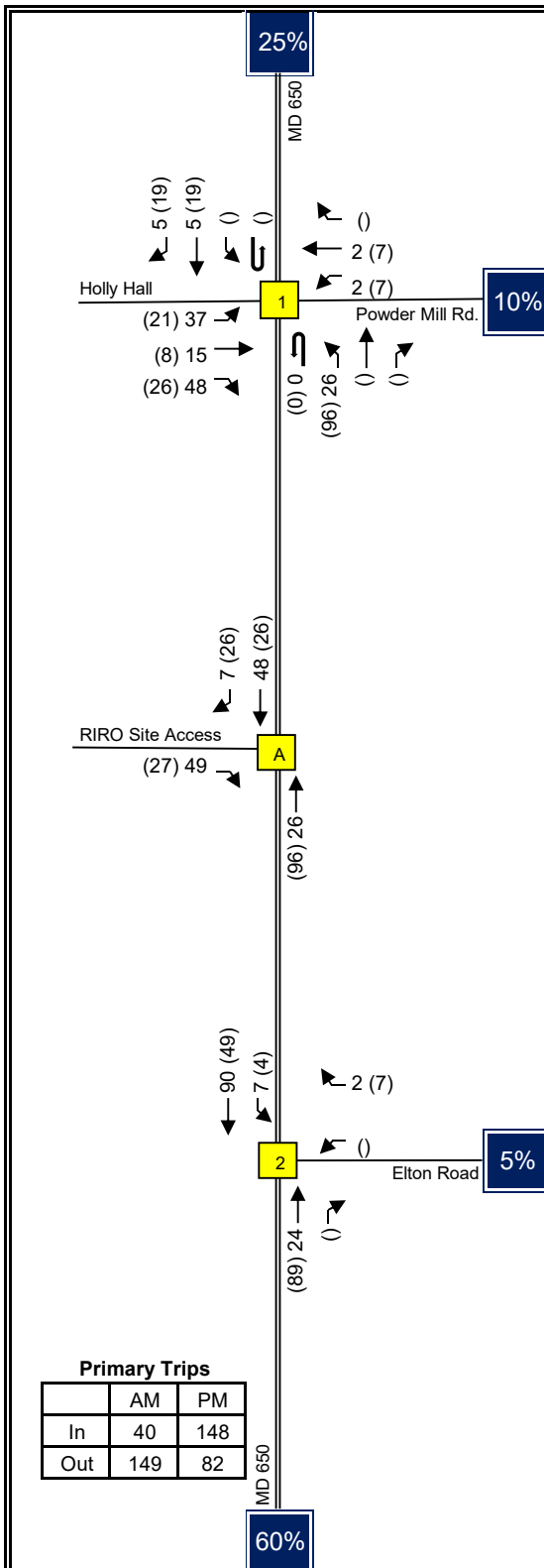
1. Trip Generation Rates obtained from the ITE Trip Generation Manual, 9th Edition

Traffic Impact Analysis



Trip Generation for
Hillandale Development

**Exhibit
5**



Traffic Impact Analysis

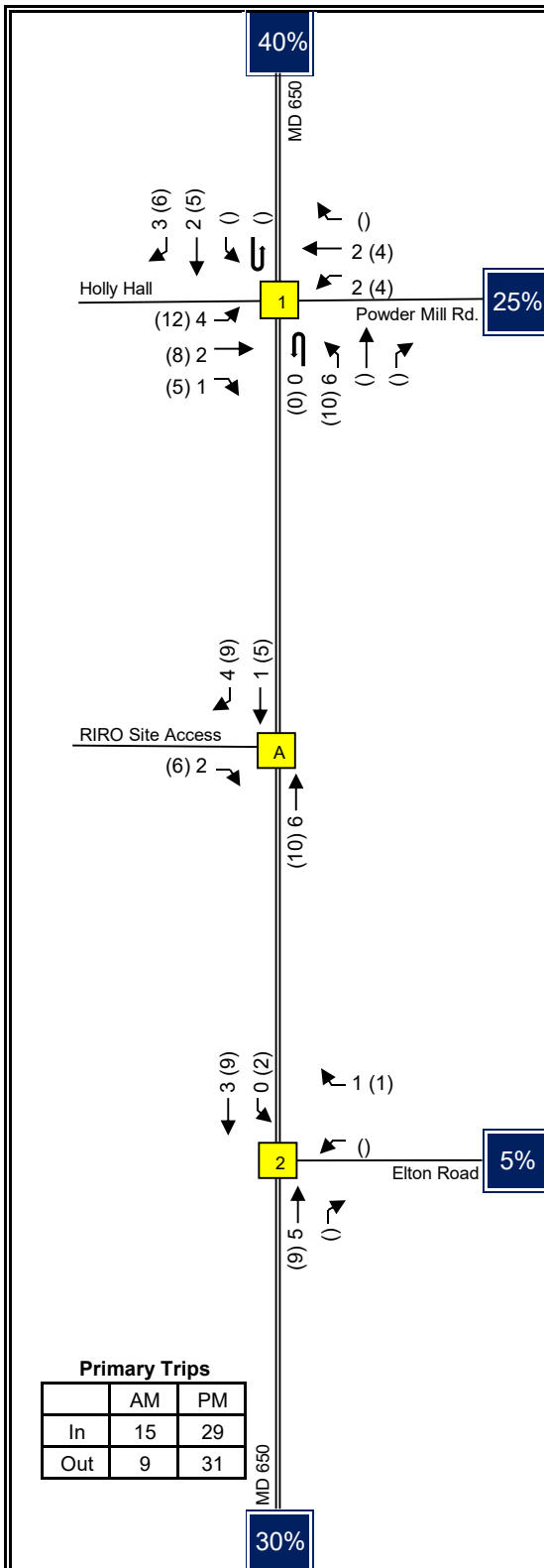


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Trip Assignment for Hillandale (Residential)

Key: xx = AM Peak Vol's (xx) = PM Peak Vol's

Exhibit 6a



Traffic Impact Analysis

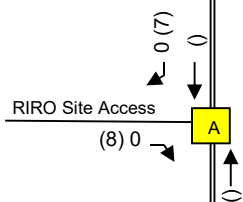
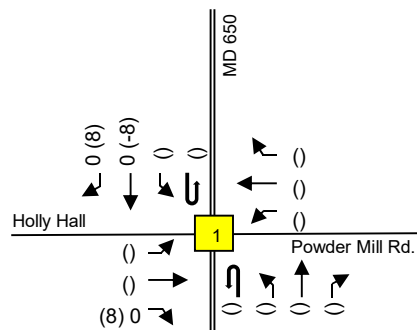


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Trip Assignment for Hillandale (Shopping Center)

Key: xx = AM Peak Vol's (xx) = PM Peak Vol's

Exhibit 6b



Pass-by Trips

	AM	PM
In	0	-15
Out	0	-16

MD 650



Traffic Impact Analysis

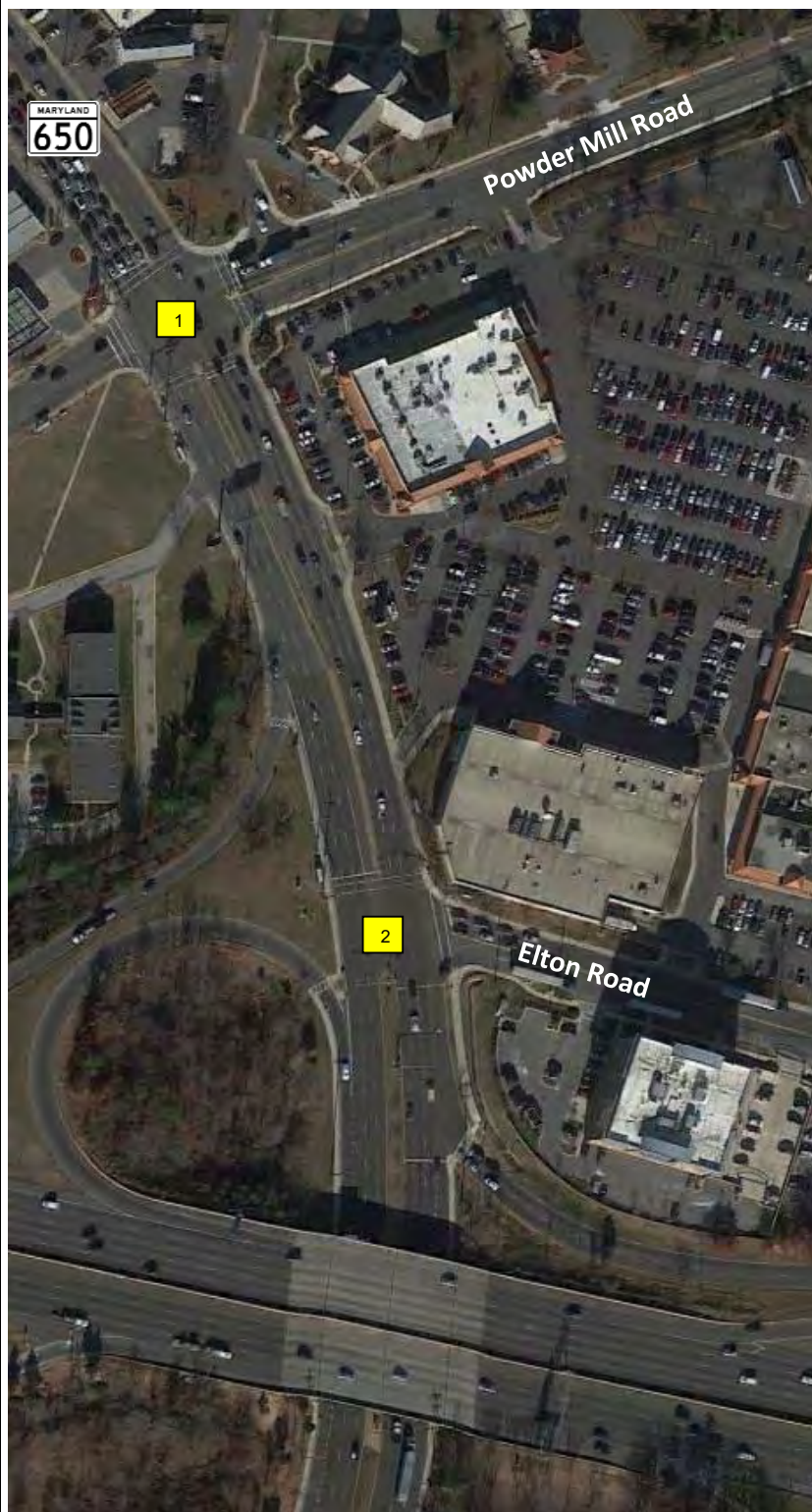
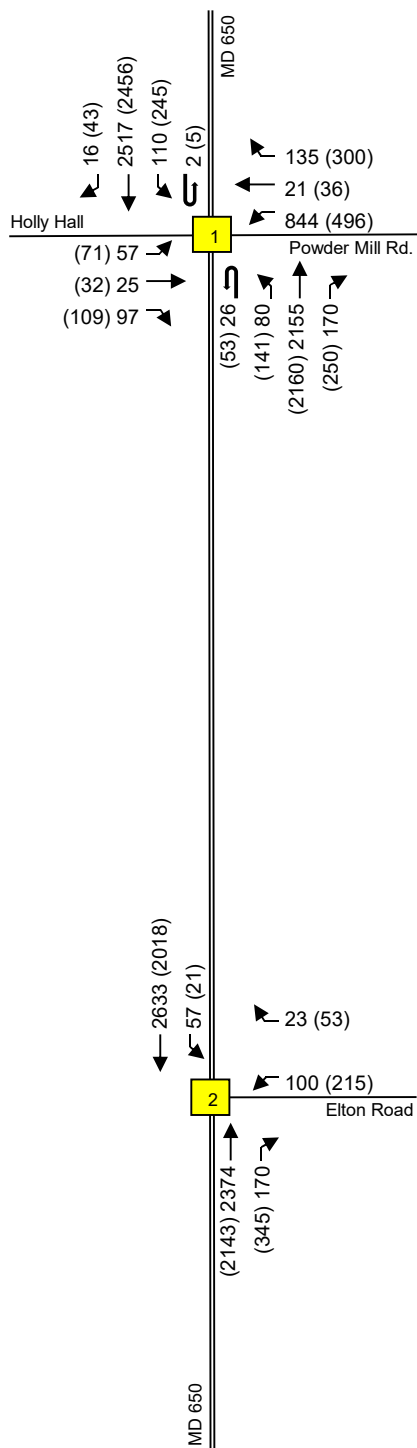


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Pass-by Trip for Hillandale (Shopping Center)

Key: xx = AM Peak Vol's (xx) = PM Peak Vol's

Exhibit 6c



Traffic Impact Analysis

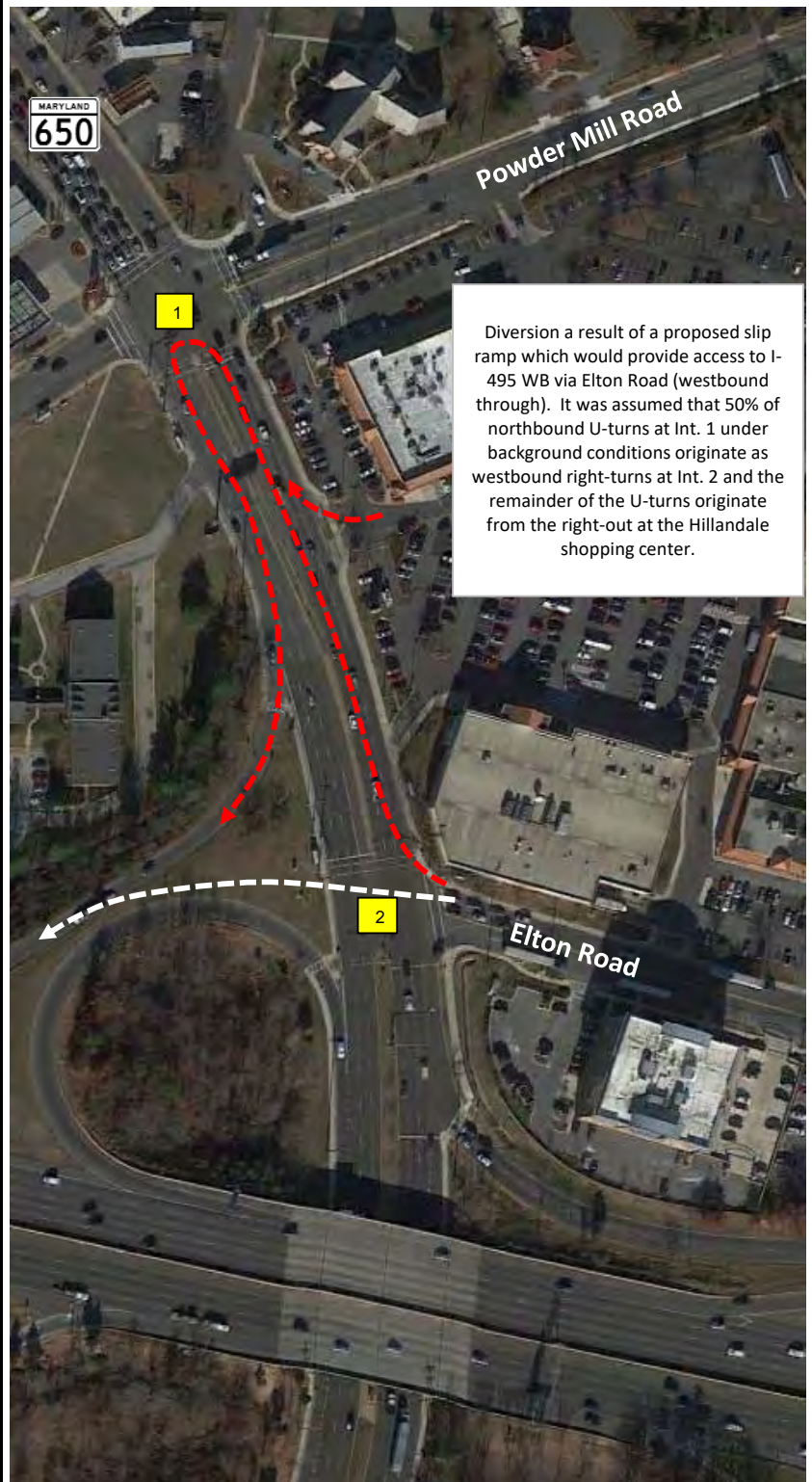
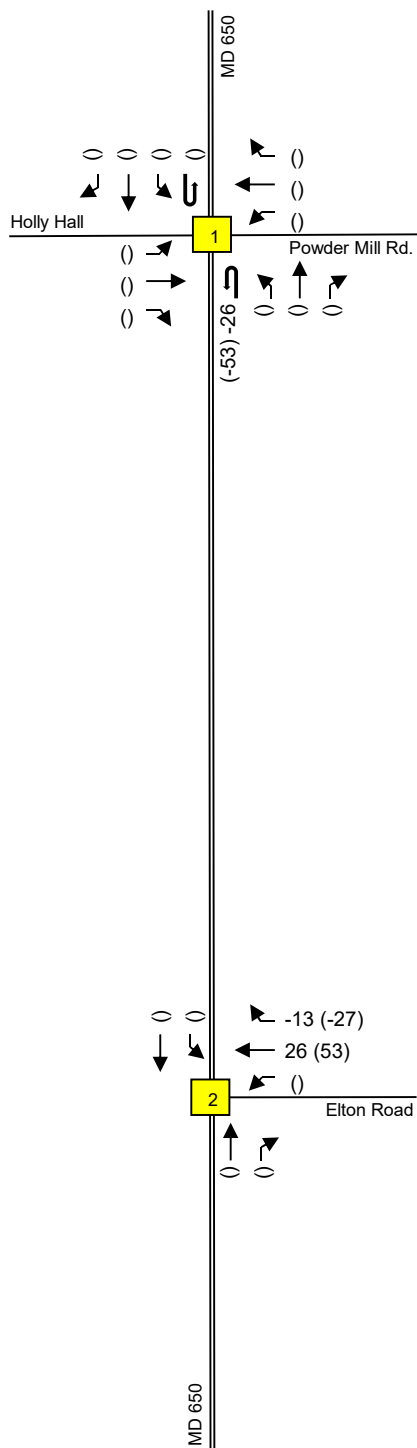


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Total Peak Hour Volumes

Key: xx = AM Peak Vol's (xx) = PM Peak Vol's

Exhibit 7



Diversion a result of a proposed slip ramp which would provide access to I-495 WB via Elton Road (westbound through). It was assumed that 50% of northbound U-turns at Int. 1 under background conditions originate as westbound right-turns at Int. 2 and the remainder of the U-turns originate from the right-out at the Hillandale shopping center.

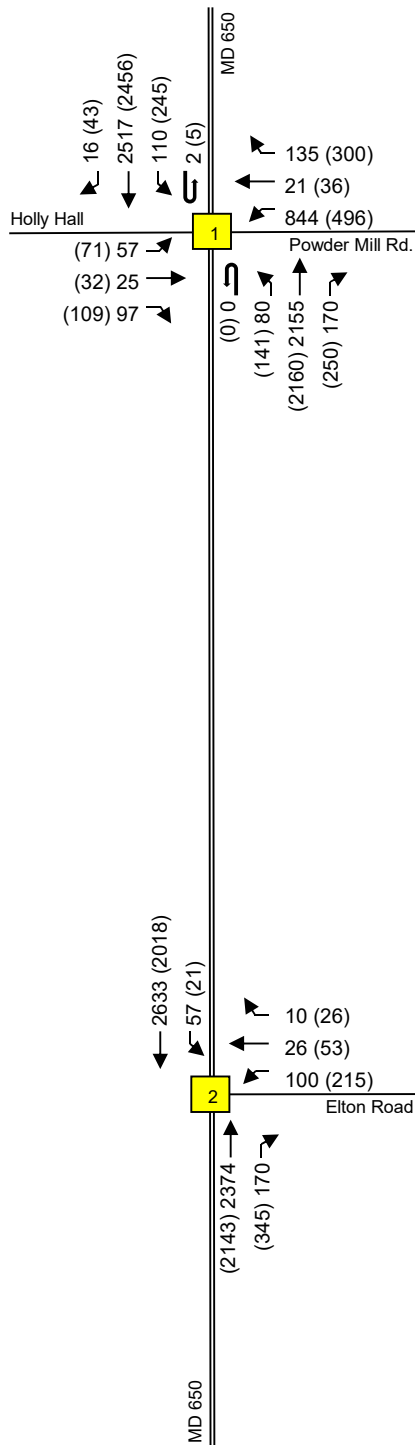
Traffic Impact Analysis



Potential Diversion at Intersection 3

Key: xx = AM Peak Vol's (xx) = PM Peak Vol's

Exhibit 8a



Traffic Impact Analysis



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Total Peak Hour Volumes with Diversions

Key: xx = AM Peak Vol's (xx) = PM Peak Vol's

Exhibit 8b

Level-of-Service Results

Morning Peak Hour	Total HCS	Total with Imps. HCS
1). MD 650 & Powder Mill Road 2). MD 650 & Elton Road	E / 76.9 A / 4.8	E / 55.8 A / 4.3
Evening Peak Hour	Total HCS	Total with Imps. HCS
1). MD 650 & Powder Mill Road 2). MD 650 & Elton Road	F / 125.0 A / 9.6	E / 76.1 A / 7.3

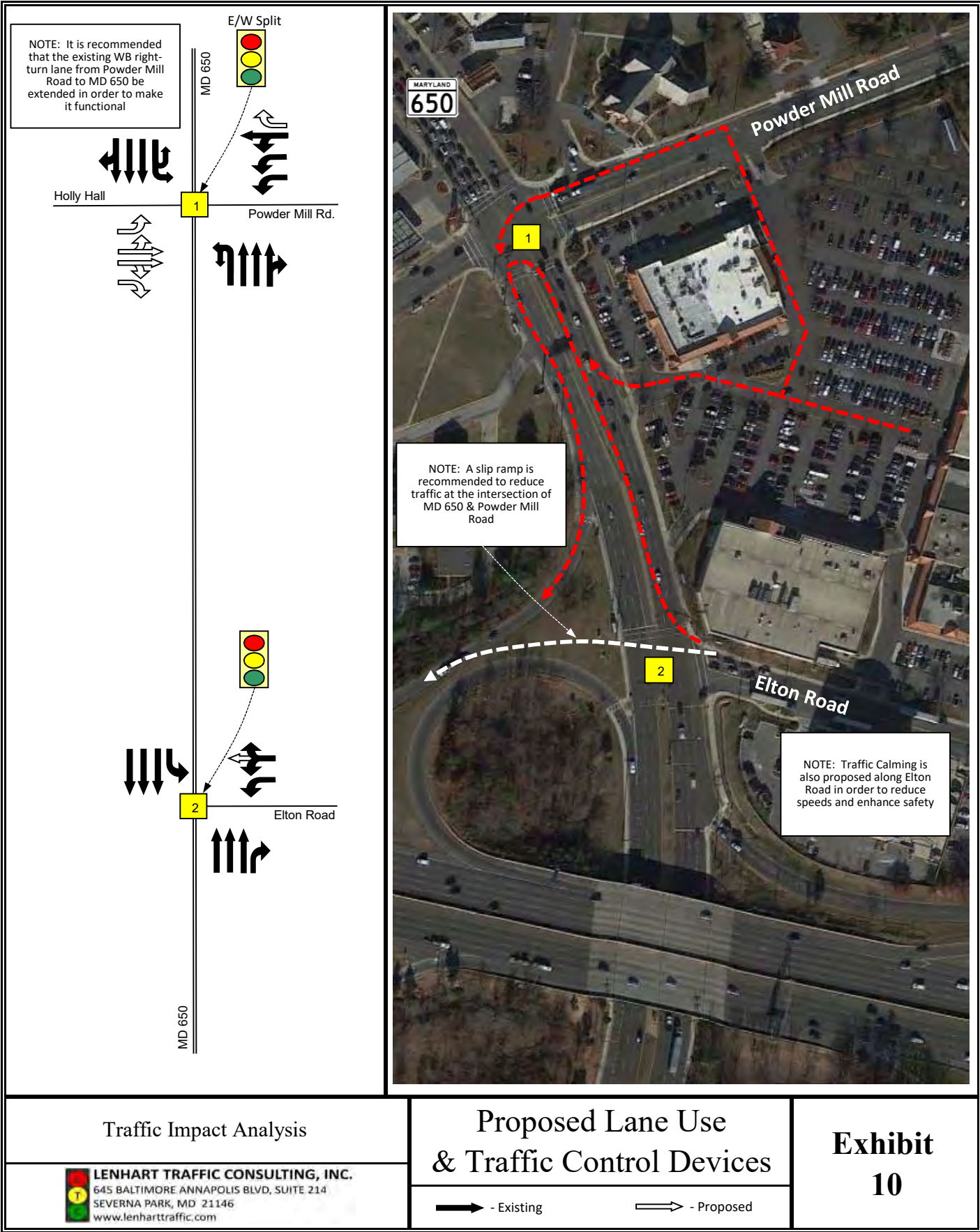
Traffic Impact Analysis



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Results of HCS
Level-of-Service Analyses

**Exhibit
9**



Appendix A

Supplemental Information
Turning Movement Counts

Maryland Department of Transportation
State Highway Administration Data Services Engineering Division
Turning Movement Count Study - Field Sheet

Station ID: S1999150073
Date: Tuesday 01/13/2015
Location: MD 650 at ELTON RD
Interval (dd): 15 min

County: Montgomery
Town: none
Weather: Sunny

Comments: LOS AM: A(0.62) PM: B(0.63)

PEAK HOURS	AM PERIOD 6:00AM-12:00PM	Start	End	Volume	LOS	V/C	PM PERIOD 12:00PM-19:00P	Start	End	Volume	LOS	V/C
		07:45	08:45	4684	A	0.62		17:15	18:15	4436	B	0.63

Hour Begin	MD 650					MD 650					Elton Rd					No Entrance					Grand Total
	U.Turn	Left	Through	Right	TOTAL	U.Turn	Left	Throug	Right	TOTAL	U.Turn	Left	From East Throug	RIGHT	TOTAL	U.Turn	Left	From West Through	Right	TOTAL	
6:00	0	1	340	0	341	0	0	207	11	218	0	6	0	2	8	0	0	0	0	0	567
6:15	0	1	367	0	368	0	0	304	15	319	0	15	0	2	17	0	0	0	0	0	704
6:30	0	14	488	0	502	0	0	341	38	379	0	15	0	4	19	0	0	0	0	0	900
6:45	0	4	492	0	496	0	0	425	23	448	0	31	0	4	35	0	0	0	0	0	979
7:00	0	2	540	0	542	0	0	475	30	505	0	24	0	8	32	0	0	0	0	0	1079
7:15	0	2	608	0	610	0	0	482	42	524	0	40	0	2	42	0	0	0	0	0	1176
7:30	0	10	573	0	583	2	0	530	34	564	0	32	0	7	39	0	0	0	0	0	1186
7:45	0	16	545	0	561	0	0	572	52	624	0	25	0	9	34	0	0	0	0	0	1219
8:00	0	9	520	0	529	0	0	500	35	535	0	19	0	4	23	0	0	0	0	0	1087
8:15	0	12	606	0	618	0	0	486	30	516	0	25	0	5	30	0	0	0	0	0	1164
8:30	0	12	616	0	628	0	0	513	45	558	0	25	0	3	28	0	0	0	0	0	1214
8:45	0	4	532	0	536	0	0	507	41	548	0	14	0	6	20	0	0	0	0	0	1104
9:00	1	5	393	0	398	0	0	506	41	547	0	28	0	6	34	0	0	0	0	0	979
9:15	0	10	409	0	419	0	0	495	42	537	0	29	0	7	36	0	0	0	0	0	992
9:30	0	16	397	0	413	0	0	366	65	431	0	26	0	6	32	0	0	0	0	0	876
9:45	0	3	387	0	390	0	0	305	70	375	0	28	0	15	43	0	0	0	0	0	808
10:00	0	2	384	0	386	0	0	336	74	410	0	27	0	9	36	0	0	0	0	0	832
10:15	0	2	382	0	384	0	0	286	78	364	0	33	0	10	43	0	0	0	0	0	791
10:30	0	2	293	0	295	0	0	302	62	364	0	52	0	17	69	0	0	0	0	0	728
10:45	0	1	338	0	339	0	0	279	58	337	0	25	0	14	39	0	0	0	0	0	715

Station ID: S1999150073

County: Montgomery

Comments: LOS AM: A(0.62) PM: B(0.63)

Date: Tuesday 01/13/2015

Town: none

Location: MD 650 at ELTON RD

Weather: Sunny

Interval (dd): 15 min

PEAK HOURS	AM PERIOD 6:00AM-12:00PM					Start	End	Volume	LOS	V/C	PM PERIOD 12:00PM-19:00P					Start	End	Volume	LOS	V/C	
						07:45	08:45	4684	A	0.62						17:15	18:15	4436	B	0.63	
11:00	0	4	265	0	269	0	0	300	61	361	0	32	0	9	41	0	0	0	0	0	671
11:15	0	14	318	0	332	0	0	279	71	350	0	34	0	18	52	0	0	0	0	0	734
11:30	0	5	336	0	341	0	0	301	59	360	0	38	0	15	53	0	0	0	0	0	754
11:45	0	16	308	0	324	0	0	288	73	361	0	32	0	10	42	0	0	0	0	0	727
12:00	2	12	374	0	386	0	0	303	78	381	0	47	0	17	64	0	0	0	0	0	831
12:15	2	12	411	0	423	0	0	300	123	423	0	54	0	11	65	0	0	0	0	0	911
12:30	1	8	402	0	410	1	0	272	112	384	0	62	0	12	74	0	0	0	0	0	868
12:45	0	16	322	0	338	0	0	322	131	453	0	43	0	8	51	0	0	0	0	0	842
13:00	0	9	316	0	325	0	0	329	104	433	0	40	0	6	46	0	0	0	0	0	804
13:15	0	6	311	0	317	0	0	302	118	420	0	36	0	10	46	0	0	0	0	0	783
13:30	0	5	289	0	294	0	0	343	97	440	0	34	0	2	36	0	0	0	0	0	770
13:45	1	5	267	0	272	0	0	327	84	411	0	29	0	3	32	0	0	0	0	0	715
14:00	0	0	260	0	260	0	0	315	85	400	0	35	0	4	39	0	0	0	0	0	699
14:15	0	7	322	0	329	0	0	348	105	453	0	43	0	3	46	0	0	0	0	0	828
14:30	0	4	353	0	357	0	0	302	136	438	0	36	0	10	46	0	0	0	0	0	841
14:45	0	15	315	0	330	0	0	298	149	447	0	22	0	2	24	0	0	0	0	0	801
15:00	0	8	293	0	301	0	0	388	137	525	0	17	0	0	17	0	0	0	0	0	843
15:15	0	5	344	0	349	0	0	406	64	470	0	23	0	1	24	0	0	0	0	0	843
15:30	0	12	397	0	409	0	0	417	58	475	0	43	0	4	47	0	0	0	0	0	931
15:45	0	7	341	0	348	0	0	509	72	581	0	43	0	15	58	0	0	0	0	0	987
16:00	2	13	369	0	382	0	0	486	87	573	0	39	0	12	51	0	0	0	0	0	1006
16:15	0	8	445	0	453	0	0	492	66	558	0	70	0	0	70	0	0	0	0	0	1081
16:30	1	2	399	0	401	0	0	516	65	581	0	47	0	9	56	0	0	0	0	0	1038
16:45	0	4	344	0	348	0	0	495	65	560	0	57	0	5	62	0	0	0	0	0	970
17:00	0	4	440	0	444	0	0	515	91	606	0	62	0	15	77	0	0	0	0	0	1127
17:15	0	3	462	0	465	0	0	561	58	619	0	64	0	11	75	0	0	0	0	0	1159

Station ID: S1999150073

Date: Tuesday 01/13/2015

Location: MD 650 at ELTON RD

Interval (dd): 15 min

County: Montgomery

Town: none

Weather: Sunny

Comments: LOS AM: A(0.62) PM: B(0.63)

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		07:45	08:45	4684	A	0.62		17:15	18:15	4436	B	0.63

17:30	0	0	346	0	346	0	0	510	91	601	0	43	0	15	58	0	0	0	0	0	1005
17:45	0	6	462	0	468	0	0	537	106	643	0	32	0	1	33	0	0	0	0	0	1144
18:00	0	3	493	0	496	0	0	481	72	553	0	64	0	15	79	0	0	0	0	0	1128
18:15	0	12	375	0	387	0	0	501	54	555	0	68	0	7	75	0	0	0	0	0	1017
18:30	0	11	328	0	339	0	0	472	56	528	0	32	0	4	36	0	0	0	0	0	903
18:45	0	5	257	0	262	0	0	459	31	490	0	18	0	0	18	0	0	0	0	0	770
TOTAL:	10	369	20474	0	20843	3	0	20891	3645	24536	0	1858	0	394	2252	0	0	0	0	0	47631
AM Peak:	0	49	2287	0	2336	0	0	2071	162	2233	0	94	0	21	115	0	0	0	0	0	4684
PM Peak:	0	12	1763	0	1775	0	0	2089	327	2416	0	203	0	42	245	0	0	0	0	0	4436

PEAK HOURS	AM PERIOD 6:00AM-12:00PM	Start	End	Volume	LOS	V/C	PM PERIOD 12:00PM-19:00P	Start	End	Volume	LOS	V/C
		07:45	08:45	4684	A	0.62		17:15	18:15	4436	B	0.63

Hour Ending	MD 650 North Leg			MD 650 South Leg			Elton Rd East Leg			No Entrance West Leg		
	School Children	Pedestrians	Bicycles	School Children	Pedestrains	Bicycles	School Children	Pedestrians	Bicycles	School Children	Pedestrians	Bicycles
6:00	0	0	0	0	0	0	0	2	0	0	0	0
6:15	0	0	0	0	1	0	0	0	0	0	0	0
6:30	0	0	0	0	1	0	0	0	0	0	0	0
6:45	0	0	0	0	0	0	0	3	0	0	0	0
7:00	0	0	0	0	0	0	0	0	0	0	0	0
7:15	0	0	0	0	1	0	0	1	0	0	0	0
7:30	0	0	0	0	0	0	0	1	0	0	0	0
7:45	0	0	0	0	0	0	0	1	0	0	0	0
8:00	0	0	0	0	0	0	0	0	0	0	0	0
8:15	0	0	0	0	0	0	0	2	0	0	0	0
8:30	0	0	0	0	0	0	0	0	0	0	0	0
8:45	0	0	0	0	1	0	0	2	0	0	0	0
9:00	0	0	0	0	0	0	0	0	0	0	0	0
9:15	0	0	0	0	0	0	0	2	0	0	0	0
9:30	0	0	0	0	1	0	0	2	0	0	0	0
9:45	0	0	0	0	0	0	0	0	0	0	0	0
10:00	0	0	0	0	0	0	0	2	0	0	0	0
10:15	0	0	0	0	0	0	0	2	0	0	0	0
10:30	0	0	0	0	0	0	0	0	0	0	0	0
10:45	0	0	0	0	1	0	0	1	0	0	0	0
11:00	0	0	0	0	0	0	0	1	0	0	0	0
11:15	0	0	0	0	0	0	0	3	0	0	0	0
11:30	0	0	0	0	0	0	0	0	0	0	0	0
11:45	0	0	0	0	0	0	0	0	0	0	0	0
12:00	0	0	0	0	0	0	0	2	0	0	0	0
12:15	0	0	0	0	1	0	0	1	0	0	0	0
12:30	0	0	0	0	0	0	0	0	0	0	0	0
12:45	0	0	0	0	0	0	0	2	0	0	0	0

Interval (dd): 15 min

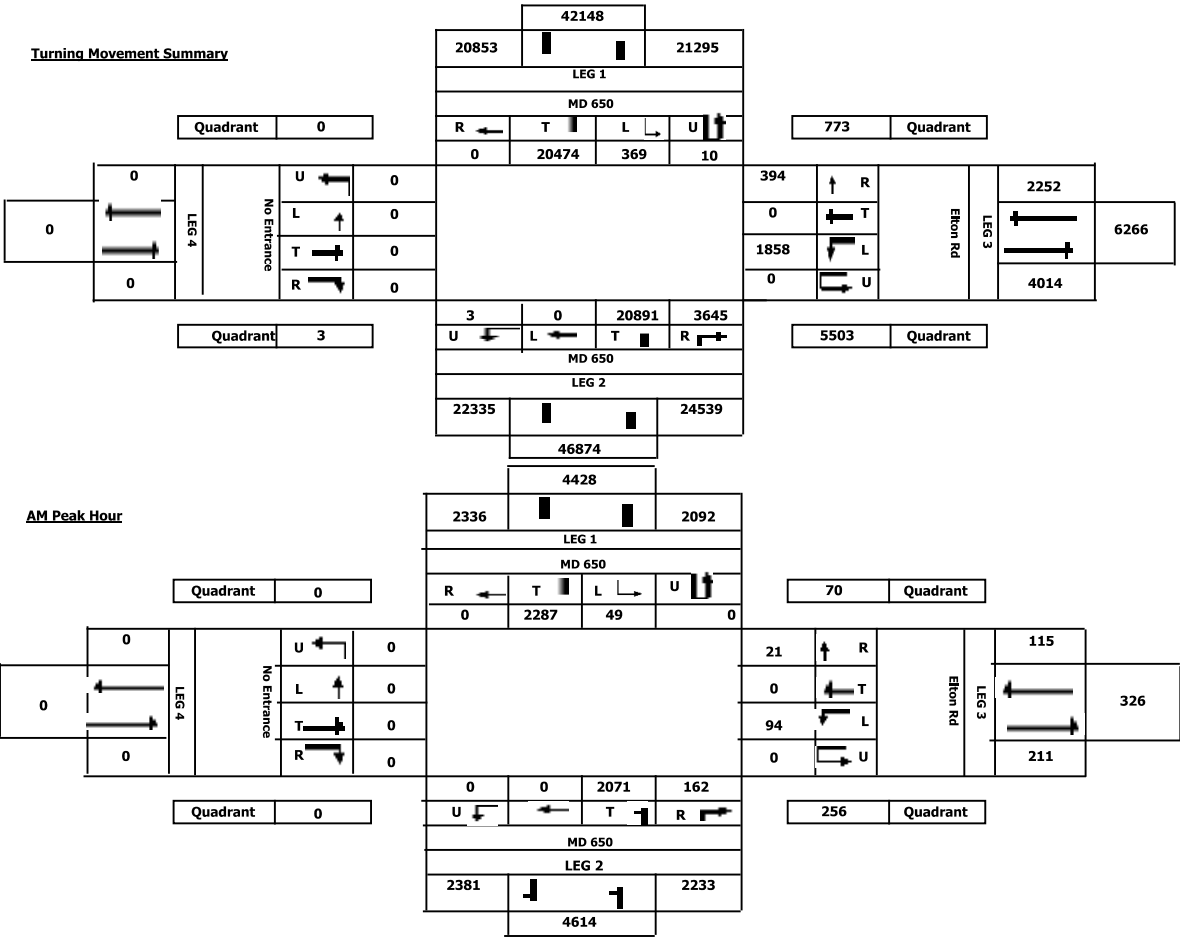
PEAK HOURS	AM PERIOD 6:00AM-12:00PM	Start	End	Volume	LOS	V/C	PM PERIOD 12:00PM-19:00P	Start	End	Volume	LOS	V/C
		07:45	08:45	4684	A	0.62		17:15	18:15	4436	B	0.63

13:00	0	0	0	0	0	0	0	0	0	0	0	0
13:15	0	0	0	0	0	0	0	0	0	0	0	0
13:30	0	0	0	0	0	0	0	0	0	0	0	0
13:45	0	0	0	0	0	0	0	0	0	0	0	0
14:00	0	0	0	0	0	0	0	0	0	0	0	0
14:15	0	0	0	0	1	0	0	0	0	0	0	0
14:30	0	0	0	0	0	0	0	0	0	0	0	0
14:45	0	0	0	0	1	0	0	0	0	0	0	0
15:00	0	0	0	0	0	0	0	1	0	0	0	0
15:15	0	0	0	0	1	0	0	0	0	0	0	0
15:30	0	0	0	0	0	0	0	0	0	0	0	0
15:45	0	0	0	0	0	0	0	0	0	0	0	0
16:00	0	0	0	0	0	0	0	0	0	0	0	0
16:15	0	0	0	0	1	0	0	0	0	0	0	0
16:30	0	0	0	0	0	0	0	0	0	0	0	0
16:45	0	0	0	0	0	0	0	0	0	0	0	0
17:00	0	0	0	0	0	0	0	0	0	0	0	0
17:15	0	0	0	0	0	0	0	0	0	0	0	0
17:30	0	0	0	0	1	0	0	0	0	0	0	0
17:45	0	0	0	0	0	0	0	0	0	0	0	0
18:00	0	0	0	0	0	0	0	0	0	0	0	0
18:15	0	0	0	0	1	0	0	0	0	0	0	0
18:30	0	0	0	0	0	0	0	0	0	0	0	0
18:45	0	0	0	0	0	0	0	0	0	0	0	0
Total:	0	0	0	0	13	0	0	31	0	0	0	0
AM Peak:	0	0	0	0	0	0	0	3	0	0	0	0
PM Peak:	0	0	0	0	1	0	0	0	0	0	0	0

Comments:

LOS AM: A(0.62) PM: B(0.63)

PEAK HOURS	AM PERIOD 6:00AM-12:00PM	Start	End	Volume	LOS	V/C	PM PERIOD 12:00PM-19:00P	Start	End	Volume	LOS	V/C
		07:45	08:45	4684	A	0.62		17:15	18:15	4436	B	0.63



3

0

20891

3645

U

L

T

R

MD 650

LEG 2

22335

46874

24539

4428

AM Peak Hour

0

0

0

0

LEG 4

No Entrance

U

L

T

R

0

0

0

0

Quadrant

0

2336

4428

2092

LEG 1

MD 650

R

T

L

U

0

2287

49

0

70

Quadrant

21

0

94

0

↑

←

↵

↻

R

T

L

U

Elton Rd

LEG 3

115

326

211

256

Quadrant

0

0

2071

162

U

L

T

R

MD 650

LEG 2

2381

4614

2233

Station ID:

S1999150073

Date:

Tuesday 01/13/2015

Location:

MD 650 at ELTON RD

Interval (dd):

15 min

County:

Montgomery

Town:

none

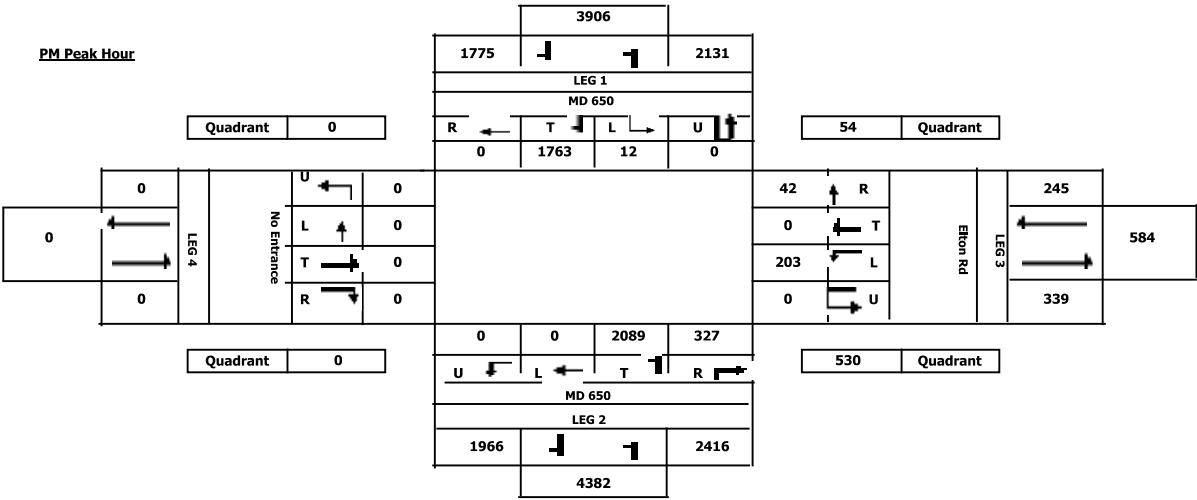
Weather:

Sunny

Comments:

LOS AM: A(0,62) PM: B(0,63)

PEAK HOURS	AM PERIOD 6:00AM-12:00PM	Start	End	Volume	LOS	V/C	PM PERIOD 12:00PM-19:00P	Start	End	Volume	LOS	V/C
		07:45	08:45	4684	A	0.62		17:15	18:15	4436	B	0.63



Maryland Department of Transportation
State Highway Administration Data Services Engineering Division
Turning Movement Count Study - Field Sheet

Station ID: S1998150181

County: Montgomery

Comments: LOS AM: D(0.85) PM: D(0.85)

Date: Thursday 01/22/2015

Town: none

Location: MD 650 at Powder Mill Rd

Weather: Sunny

Interval (dd): 15 min

PEAK HOURS	AM PERIOD 6:00AM-12:00PM	Start	End	Volume	LOS	V/C	PM PERIOD 12:00PM-19:00P	Start	End	Volume	LOS	V/C
		07:15	08:15	5003	D	0.85		17:00	18:00	5155	D	0.85

Hour Begin	MD 650					MD 650					Powder Mill Rd					Powder Mill Rd					Grand Total
	From North					From South					From East					From West					
	U,Tur	Left	Through	Right	TOTAL	U.Turn	Left	Throug	Right	TOTAL	U.Turn	Left	Throug	RIGHT	TOTAL	U.Turn	Left	Through	Right	TOTAL	
6:00	0	24	222	3	249	5	6	189	28	223	0	76	3	12	91	0	2	0	8	10	573
6:15	1	16	281	1	298	7	9	304	24	337	0	108	6	23	137	0	5	0	8	13	785
6:30	0	12	432	3	447	13	5	316	27	348	0	138	12	16	166	0	4	1	9	14	975
6:45	0	19	422	1	442	13	8	364	27	399	0	148	2	34	184	0	2	2	13	17	1042
7:00	2	19	466	2	487	6	11	346	41	398	0	191	4	44	239	0	2	0	11	13	1137
7:15	0	33	521	2	556	7	8	364	37	409	0	207	6	26	239	0	4	4	10	18	1222
7:30	0	25	581	1	607	6	9	427	31	467	0	222	5	26	253	0	3	0	13	16	1343
7:45	2	19	506	3	528	4	14	439	37	490	0	180	3	26	209	0	4	3	8	15	1242
8:00	0	18	471	2	491	9	17	464	42	523	0	124	3	32	159	0	5	1	17	23	1196
8:15	2	13	459	5	477	7	9	463	33	505	1	130	2	43	175	0	1	4	8	13	1170
8:30	0	25	429	0	454	7	8	467	31	506	0	143	5	34	182	0	8	3	12	23	1165
8:45	1	22	403	5	430	3	13	458	29	500	0	121	4	36	161	0	2	0	9	11	1102
9:00	3	28	411	3	442	4	7	420	31	458	0	102	3	29	134	0	1	2	11	14	1048
9:15	1	19	385	4	408	8	10	331	41	382	0	111	0	32	143	0	2	3	10	15	948
9:30	0	25	343	1	369	10	9	307	35	351	0	97	5	25	127	0	6	3	16	25	872
9:45	3	33	309	5	347	5	8	285	28	321	0	69	6	28	103	0	8	0	21	29	800
10:00	0	26	319	1	346	0	11	271	33	315	1	86	1	20	107	0	7	2	18	27	795
10:15	1	17	299	1	317	4	16	267	35	318	0	65	3	22	90	0	10	1	19	30	755
10:30	1	18	263	3	284	9	12	216	28	256	0	73	2	21	96	0	3	9	12	24	660
10:45	0	29	248	3	280	12	12	236	31	279	0	67	2	20	89	0	7	4	18	29	677

Station ID: S1998150181

County: Montgomery

Comments: LOS AM: D(0.85) PM: D(0.85)

Date: Thursday 01/22/2015

Town: none

Location: MD 650 at Powder Mill Rd

Weather: Sunny

Interval (dd): 15 min

PEAK HOURS	AM PERIOD 6:00AM-12:00PM					Start	End	Volume	LOS	V/C	PM PERIOD 12:00PM-19:00P					Start	End	Volume	LOS	V/C
						07:15	08:15	5003	D	0.85						17:00	18:00	5155	D	0.85

11:00	1	27	229	4	260	10	11	187	31	229	1	61	3	24	88	0	6	4	19	29	606
11:15	3	36	250	1	287	17	10	211	28	249	1	67	5	25	97	0	9	4	19	32	665
11:30	1	30	255	7	292	12	8	218	26	252	0	93	2	23	118	0	5	4	16	25	687
11:45	3	37	228	1	266	11	13	246	35	294	0	69	2	27	98	0	6	2	16	24	682
12:00	0	45	268	2	315	10	9	258	33	300	0	90	1	26	117	0	8	5	18	31	763
12:15	2	41	256	1	298	11	6	264	31	301	0	79	9	24	112	0	9	7	11	27	738
12:30	0	35	270	2	307	16	24	249	34	307	0	79	3	30	112	0	8	2	15	25	751
12:45	0	31	297	3	331	14	11	254	39	304	0	79	5	32	116	0	16	7	13	36	787
13:00	1	36	262	1	299	18	8	285	36	329	1	64	2	45	111	0	8	4	12	24	763
13:15	2	35	238	2	275	21	13	306	35	354	1	81	3	46	130	0	8	5	18	31	790
13:30	1	24	244	1	269	10	12	259	35	306	0	72	2	46	120	0	6	1	22	29	724
13:45	2	29	258	3	290	11	8	280	38	326	0	93	5	36	134	0	10	4	19	33	783
14:00	0	29	280	5	314	17	13	293	37	343	0	83	6	44	133	0	11	4	15	30	820
14:15	1	31	305	2	338	17	11	323	36	370	0	90	3	39	132	0	11	5	16	32	872
14:30	1	30	323	6	359	15	10	326	42	378	0	118	7	34	159	0	11	8	23	42	938
14:45	0	34	329	3	366	7	15	351	43	409	0	95	8	42	145	0	6	5	20	31	951
15:00	2	35	297	1	333	17	12	416	40	468	0	115	3	55	173	0	20	2	12	34	1008
15:15	2	43	399	0	442	12	11	401	59	471	1	113	1	61	175	0	7	6	18	31	1119
15:30	0	40	414	3	457	0	10	413	62	485	0	110	3	53	166	0	4	3	16	23	1131
15:45	5	35	449	4	488	13	9	456	65	530	0	131	2	46	179	0	7	5	18	30	1227
16:00	0	42	456	2	500	11	13	437	66	516	0	128	2	51	181	0	16	2	19	37	1234
16:15	0	49	462	2	513	8	8	479	57	544	0	124	1	63	188	0	4	6	10	20	1265
16:30	3	50	474	3	527	10	5	456	44	505	0	120	3	52	175	0	11	6	14	31	1238
16:45	0	41	485	1	527	15	10	477	57	544	0	111	6	58	175	0	4	6	20	30	1276
17:00	1	54	490	3	547	11	5	446	44	495	0	99	3	63	165	0	15	2	21	38	1245
17:15	2	56	515	4	575	11	9	493	64	566	0	122	5	60	187	0	8	4	15	27	1355

Station ID:

S1998150181

Date:

Thursday 01/22/2015

Location:

MD 650 at Powder Mill Rd

Interval (dd):

15 min

County:

Montgomery

Town:

none

Weather:

Sunny

Comments:

LOS AM: D(0.85) PM: D(0.85)

PEAK HOURS	AM PERIOD 6:00AM-12:00PM	Start	End	Volume	LOS	V/C	PM PERIOD 12:00PM-19:00P	Start	End	Volume	LOS	V/C
		07:15	08:15	5003	D	0.85		17:00	18:00	5155	D	0.85

17:30	1	49	486	1	536	20	11	457	49	517	0	109	7	62	178	0	8	6	21	35	1266
17:45	1	55	468	2	525	11	10	491	62	563	0	92	10	75	177	0	7	4	13	24	1289
18:00	0	34	409	2	445	12	14	480	55	549	0	118	4	58	180	0	10	2	9	21	1195
18:15	1	39	385	1	425	13	10	449	53	512	0	111	1	40	152	0	15	4	4	23	1112
18:30	2	26	414	1	441	7	11	431	55	497	0	82	4	59	145	0	9	4	11	24	1107
18:45	1	32	317	1	350	6	7	388	36	431	0	73	0	52	125	0	11	1	12	24	930
TOTAL:	56	1650	18982	124	20756	533	539	18414	2076	21029	7	5529	198	2000	7727	0	380	176	756	1312	50824
AM Peak:	2	95	2079	8	2182	26	48	1694	147	1889	0	733	17	110	860	0	16	8	48	72	5003
PM Peak:	5	214	1959	10	2183	53	35	1887	219	2141	0	422	25	260	707	0	38	16	70	124	5155

Station ID:

S1998150181

County:

Montgomery

Comments:

LOS AM: D(0.85) PM: D(0.85)

Date:

Thursday 01/22/2015

Town:

none

Location:

MD 650 at Powder Mill Rd

Weather:

Sunny

Interval

15 min

(dd):

PEAK HOURS	AM PERIOD 6:00AM-12:00PM	Start	End	Volume	LOS	V/C	PM PERIOD 12:00PM-19:00P	Start	End	Volume	LOS	V/C
		07:15	08:15	5003	D	0.85		17:00	18:00	5155	D	0.85

MD 650

MD 650

Powder Mill Rd

Powder Mill Rd

North Leg

South Leg

East Leg

West Leg

Hour Ending	School Children	Pedestrians	Bicycles	School Children	Pedestrains	Bicycles	School Children	Pedestrians	Bicycles	School Children	Pedestrians	Bicycles
6:00	0	0	0	0	4	0	0	0	0	0	0	0
6:15	0	0	0	0	7	0	0	4	0	0	5	0
6:30	0	1	0	0	5	0	0	2	0	0	1	0
6:45	0	0	0	0	5	0	0	2	0	0	1	0
7:00	0	1	0	0	10	0	0	4	0	0	4	0
7:15	0	1	0	0	6	0	0	6	0	0	8	0
7:30	0	1	0	0	7	0	0	3	0	0	5	0
7:45	0	0	0	0	7	0	0	4	0	0	4	0
8:00	0	0	0	0	1	0	0	0	0	0	1	0
8:15	0	1	0	0	3	0	0	3	0	0	7	0
8:30	0	0	0	0	3	0	0	0	0	0	1	0
8:45	0	0	0	0	6	0	0	2	0	0	6	0
9:00	0	1	0	0	12	0	0	6	0	0	5	0
9:15	0	0	0	0	8	0	0	0	0	0	5	0
9:30	0	2	0	0	6	0	0	0	0	0	3	0
9:45	0	4	0	0	14	0	0	0	0	0	12	0
10:00	0	2	0	0	6	0	0	0	0	0	9	0
10:15	0	4	0	0	7	0	0	2	0	0	6	0
10:30	0	1	0	0	3	0	0	3	0	0	13	0
10:45	0	3	0	0	5	0	0	1	0	0	4	0
11:00	0	2	0	0	7	0	0	4	0	0	6	0
11:15	0	2	0	0	7	0	0	0	0	0	7	0
11:30	0	6	0	0	4	0	0	1	0	0	2	0
11:45	0	1	0	0	6	0	0	0	0	0	1	0
12:00	0	3	0	0	4	0	0	0	0	0	3	0
12:15	0	0	0	0	3	0	0	0	0	0	1	0
12:30	0	1	0	0	11	0	0	0	0	0	7	0
12:45	0	1	0	0	9	0	0	0	0	0	5	0

Interval (dd):15 min

PEAK HOURS	AM PERIOD 6:00AM-12:00PM	Start	End	Volume	LOS	V/C	PM PERIOD 12:00PM-19:00P	Start	End	Volume	LOS	V/C
		07:15	08:15	5003	D	0.85		17:00	18:00	5155	D	0.85

13:00	0	0	0	0	16	0	0	6	0	0	8	0
13:15	0	1	0	0	10	0	0	2	0	0	0	0
13:30	0	0	0	0	12	0	0	0	0	0	2	0
13:45	0	2	0	0	4	0	0	3	0	0	4	0
14:00	0	0	0	0	23	0	0	11	0	0	6	0
14:15	0	1	0	0	16	0	0	4	0	0	4	0
14:30	0	1	0	0	5	0	0	1	0	0	4	0
14:45	0	1	0	0	11	0	0	3	0	0	1	0
15:00	0	0	0	0	6	0	0	1	0	0	2	0
15:15	0	1	0	0	5	0	0	1	0	0	8	0
15:30	0	5	0	0	4	0	0	1	0	0	3	0
15:45	0	1	0	0	5	0	0	0	0	0	1	0
16:00	0	0	0	0	7	0	0	1	0	0	2	0
16:15	0	1	0	0	12	0	0	0	0	0	1	0
16:30	0	0	0	0	8	0	0	4	0	0	8	0
16:45	0	2	0	0	6	0	0	4	0	0	3	0
17:00	0	3	0	0	7	0	0	1	0	0	2	0
17:15	0	3	0	0	6	0	0	8	0	0	1	0
17:30	0	3	0	0	12	0	0	3	0	0	3	0
17:45	0	2	0	0	8	0	0	1	0	0	2	0
18:00	0	0	0	0	6	0	0	2	0	0	0	0
18:15	0	0	0	0	8	0	0	2	0	0	2	0
18:30	0	0	0	0	4	0	0	1	0	0	1	0
18:45	0	0	0	0	3	0	0	0	0	0	1	0
Total:	0	65	0	0	380	0	0	107	0	0	201	0
AM Peak:	0	2	0	0	21	0	0	13	0	0	18	0
PM Peak:	0	11	0	0	33	0	0	13	0	0	8	0

Station ID:

S1998150181

County:

Montgomery

Comments:

LOS AM: D(0.85) PM: D(0.85)

Date:

Thursday 01/22/2015

Town:

none

Location:

MD 650 at Powder Mill Rd

Weather:

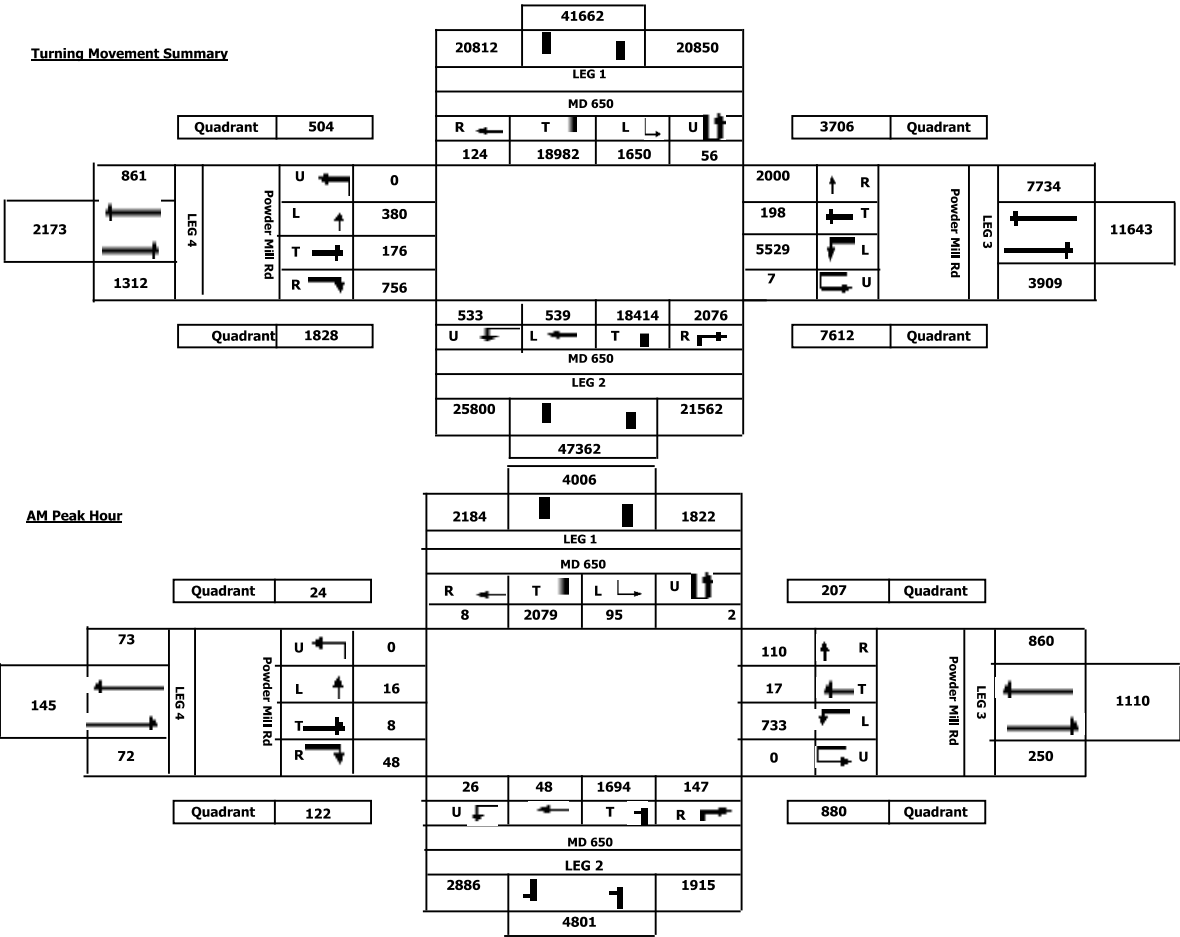
Sunny

Interval

15 min

(dd):

PEAK HOURS	AM PERIOD 6:00AM-12:00PM	Start	End	Volume	LOS	V/C	PM PERIOD 12:00PM-19:00P	Start	End	Volume	LOS	V/C
		07:15	08:15	5003	D	0.85		17:00	18:00	5155	D	0.85



Station ID:

S1998150181

Date:

Thursday 01/22/2015

Location:

MD 650 at Powder Mill Rd

Interval (dd):

15 min

County:

Montgomery

Town:

none

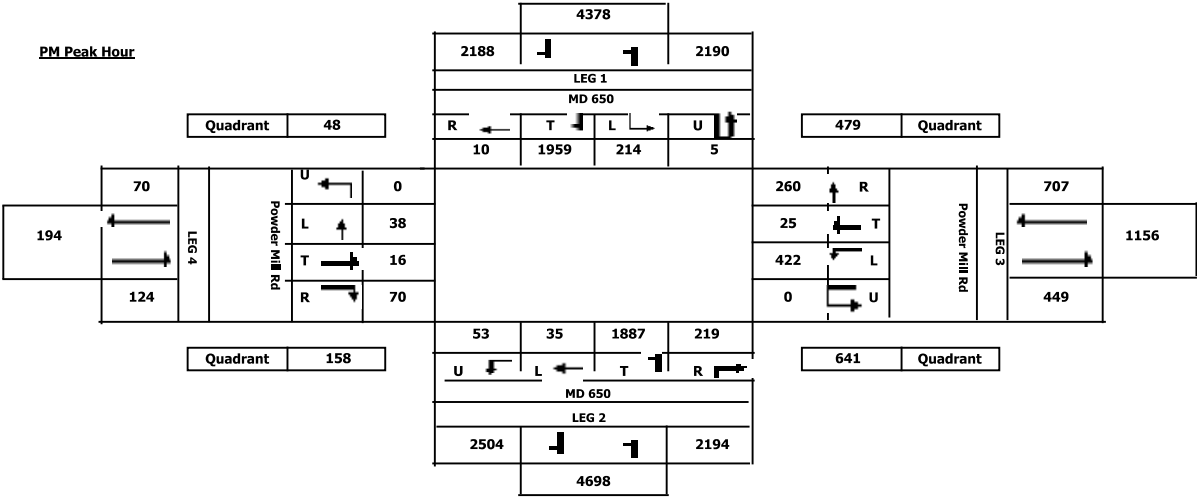
Weather:

Sunny

Comments:

LOS AM: D(0,85) PM: D(0,85)

PEAK HOURS	AM PERIOD 6:00AM-12:00PM	Start	End	Volume	LOS	V/C	PM PERIOD 12:00PM-19:00P	Start	End	Volume	LOS	V/C
		07:15	08:15	5003	D	0.85		17:00	18:00	5155	D	0.85



Appendix B

Synchro Level of Service Worksheets

HCM Signalized Intersection Capacity Analysis

1: MD 650 & Powder Mill Rd

08/07/2017

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	57	25	97	844	21	135	106	2155	170	112	2517	16
Future Volume (vph)	57	25	97	844	21	135	106	2155	170	112	2517	16
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1800	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	5.0	5.0		3.0	4.0		5.0	5.0	
Lane Util. Factor	1.00	1.00	1.00	0.91	0.91		1.00	0.91		1.00	0.91	
Frt	1.00	1.00	0.85	1.00	0.94		1.00	0.99		1.00	1.00	
Flt Protected	0.95	1.00	1.00	0.95	0.97		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1711	1801	1531	3113	1498		1711	4606		1711	4911	
Flt Permitted	0.95	1.00	1.00	0.95	0.97		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1711	1801	1531	3113	1498		1711	4606		1711	4911	
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	59	26	100	870	22	139	109	2222	175	115	2595	16
RTOR Reduction (vph)	0	0	0	0	13	0	0	5	0	0	0	0
Lane Group Flow (vph)	59	26	100	696	322	0	109	2392	0	115	2611	0
Turn Type	Split	NA	Perm	Split	NA		Prot	NA		Prot	NA	
Protected Phases	3	3		4	4		1	5		6	2	
Permitted Phases			3									
Actuated Green, G (s)	17.1	17.1	17.1	38.4	38.4		9.0	87.0		10.0	89.0	
Effective Green, g (s)	19.1	19.1	19.1	40.4	40.4		12.0	90.0		12.0	91.0	
Actuated g/C Ratio	0.11	0.11	0.11	0.22	0.22		0.07	0.50		0.07	0.51	
Clearance Time (s)	6.5	6.5	6.5	7.0	7.0		6.0	7.0		7.0	7.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	0.2		3.0	0.2	
Lane Grp Cap (vph)	181	191	162	698	336		114	2303		114	2482	
v/s Ratio Prot	0.03	0.01		c0.22	0.21		0.06	c0.52		0.07	c0.53	
v/s Ratio Perm			c0.07									
v/c Ratio	0.33	0.14	0.62	1.00	0.96		0.96	1.04		1.01	1.05	
Uniform Delay, d1	74.5	73.0	77.0	69.7	69.0		83.7	45.0		84.0	44.5	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.05	0.80		0.94	0.89	
Incremental Delay, d2	1.1	0.3	6.8	33.1	37.6		63.3	28.3		75.9	31.6	
Delay (s)	75.5	73.3	83.8	102.8	106.5		150.9	64.1		155.1	71.2	
Level of Service	E	E	F	F	F		F	E		F	E	
Approach Delay (s)		79.7			104.0			67.9			74.7	
Approach LOS		E			F			E			E	
Intersection Summary												
HCM 2000 Control Delay			76.9			HCM 2000 Level of Service				E		
HCM 2000 Volume to Capacity ratio			1.00									
Actuated Cycle Length (s)			180.0			Sum of lost time (s)				18.5		
Intersection Capacity Utilization			93.1%			ICU Level of Service				F		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

3: MD 650 & Elton Rd

08/07/2017

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	WY		AAA	A	A	AAA
Traffic Volume (vph)	100	23	2374	170	57	2633
Future Volume (vph)	100	23	2374	170	57	2633
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0		2.5	2.0	2.5	2.5
Lane Util. Factor	0.97		0.91	1.00	1.00	0.91
Frt	0.97		1.00	0.85	1.00	1.00
Flt Protected	0.96		1.00	1.00	0.95	1.00
Satd. Flow (prot)	3263		4916	1531	1711	4916
Flt Permitted	0.96		1.00	1.00	0.05	1.00
Satd. Flow (perm)	3263		4916	1531	83	4916
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	106	24	2526	181	61	2801
RTOR Reduction (vph)	6	0	0	0	0	0
Lane Group Flow (vph)	124	0	2526	181	61	2801
Turn Type	Prot		NA	pm+ov	Perm	NA
Protected Phases	3		2 4 9	3		6 4 9
Permitted Phases	3			2 4 9	6 4 9	
Actuated Green, G (s)	13.2		154.3	167.5	154.3	154.3
Effective Green, g (s)	16.2		158.3	170.5	158.3	158.3
Actuated g/C Ratio	0.09		0.88	0.95	0.88	0.88
Clearance Time (s)	6.0			6.0		
Vehicle Extension (s)	4.0			4.0		
Lane Grp Cap (vph)	293		4323	1467	72	4323
v/s Ratio Prot	c0.04		0.51	0.01		0.57
v/s Ratio Perm				0.11	c0.73	
v/c Ratio	0.42		0.58	0.12	0.85	0.65
Uniform Delay, d1	77.5		2.7	0.3	5.1	3.0
Progression Factor	1.00		1.33	1.00	1.04	0.61
Incremental Delay, d2	1.3		0.2	0.0	24.2	0.1
Delay (s)	78.8		3.8	0.3	29.5	2.0
Level of Service	E		A	A	C	A
Approach Delay (s)	78.8		3.5			2.5
Approach LOS	E		A			A
Intersection Summary						
HCM 2000 Control Delay			4.8		HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio			0.83			
Actuated Cycle Length (s)			180.0		Sum of lost time (s)	11.5
Intersection Capacity Utilization			61.1%		ICU Level of Service	B
Analysis Period (min)			15			
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis

1: MD 650 & Powder Mill Rd

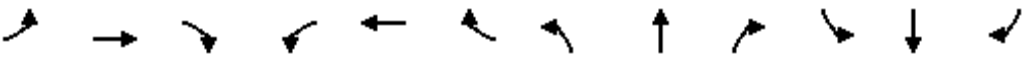
08/07/2017

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	57	25	97	844	21	135	80	2155	170	112	2517	16
Future Volume (vph)	57	25	97	844	21	135	80	2155	170	112	2517	16
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1800	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	5.0	5.0	5.0	3.0	4.0		5.0	5.0	
Lane Util. Factor	0.91	0.86	0.91	0.91	0.91	1.00	1.00	0.91		1.00	0.91	
Frt	1.00	0.91	0.85	1.00	1.00	0.85	1.00	0.99		1.00	1.00	
Flt Protected	0.95	0.99	1.00	0.95	0.96	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1557	2814	1393	3113	1566	1531	1711	4606		1711	4911	
Flt Permitted	0.95	0.99	1.00	0.95	0.96	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1557	2814	1393	3113	1566	1531	1711	4606		1711	4911	
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	59	26	100	870	22	139	82	2222	175	115	2595	16
RTOR Reduction (vph)	0	0	0	0	0	116	0	3	0	0	0	0
Lane Group Flow (vph)	47	88	50	592	300	23	82	2394	0	115	2611	0
Turn Type	Split	NA	Perm	Split	NA	Perm	Prot	NA		Prot	NA	
Protected Phases	3	3		4	4		1	5		6	2	
Permitted Phases			3			4						
Actuated Green, G (s)	12.0	12.0	12.0	28.0	28.0	28.0	3.0	94.9		17.6	110.5	
Effective Green, g (s)	14.0	14.0	14.0	30.0	30.0	30.0	6.0	97.9		19.6	112.5	
Actuated g/C Ratio	0.08	0.08	0.08	0.17	0.17	0.17	0.03	0.54		0.11	0.62	
Clearance Time (s)	6.5	6.5	6.5	7.0	7.0	7.0	6.0	7.0		7.0	7.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	0.2		3.0	0.2	
Lane Grp Cap (vph)	121	218	108	518	261	255	57	2505		186	3069	
v/s Ratio Prot	0.03	0.03		0.19	c0.19		c0.05	c0.52		0.07	c0.53	
v/s Ratio Perm			c0.04			0.02						
v/c Ratio	0.39	0.40	0.46	1.14	1.15	0.09	1.44	0.96		0.62	0.85	
Uniform Delay, d1	78.9	79.0	79.4	75.0	75.0	63.5	87.0	39.0		76.6	27.0	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.85	0.65		0.93	0.88	
Incremental Delay, d2	2.1	1.2	3.1	85.2	102.2	0.2	262.3	8.9		4.6	2.5	
Delay (s)	81.0	80.2	82.5	160.2	177.2	63.6	336.5	34.1		75.6	26.1	
Level of Service	F	F	F	F	F	E	F	C		E	C	
Approach Delay (s)		81.1			152.1			44.1			28.2	
Approach LOS		F			F			D			C	
Intersection Summary												
HCM 2000 Control Delay			55.8			HCM 2000 Level of Service		E				
HCM 2000 Volume to Capacity ratio			0.96									
Actuated Cycle Length (s)			180.0			Sum of lost time (s)		18.5				
Intersection Capacity Utilization			88.5%			ICU Level of Service		E				
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

3: MD 650 & Elton Rd

08/07/2017

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	100	26	10	0	2374	170	57	2633	0
Future Volume (vph)	0	0	0	100	26	10	0	2374	170	57	2633	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				3.0	6.0			2.5	2.0	2.5	2.5	
Lane Util. Factor				0.95	0.95			0.91	1.00	1.00	0.91	
Frt				1.00	0.98			1.00	0.85	1.00	1.00	
Flt Protected				0.95	0.98			1.00	1.00	0.95	1.00	
Satd. Flow (prot)				1625	1632			4916	1531	1711	4916	
Flt Permitted				0.95	0.98			1.00	1.00	0.05	1.00	
Satd. Flow (perm)				1625	1632			4916	1531	83	4916	
Peak-hour factor, PHF	1.00	1.00	1.00	0.94	1.00	0.94	1.00	0.94	0.94	0.94	0.94	1.00
Adj. Flow (vph)	0	0	0	106	26	11	0	2526	181	61	2801	0
RTOR Reduction (vph)	0	0	0	0	4	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	71	68	0	0	2526	181	61	2801	0
Turn Type				custom	NA			NA	pm+ov	Perm	NA	
Protected Phases				3	3			2 4 9	3		6 4 9	
Permitted Phases				3					2 4 9	6 4 9		
Actuated Green, G (s)				14.4	14.4			153.1	167.5	153.1	153.1	
Effective Green, g (s)				17.4	14.4			157.1	170.5	157.1	157.1	
Actuated g/C Ratio				0.10	0.08			0.87	0.95	0.87	0.87	
Clearance Time (s)				6.0	6.0				6.0			
Vehicle Extension (s)				4.0	4.0				4.0			
Lane Grp Cap (vph)				157	130			4290	1467	72	4290	
v/s Ratio Prot				c0.04	0.04			0.51	0.01		0.57	
v/s Ratio Perm									0.11	c0.74		
v/c Ratio				0.45	0.53			0.59	0.12	0.85	0.65	
Uniform Delay, d1				76.8	79.5			3.0	0.3	5.6	3.4	
Progression Factor				1.00	1.00			1.00	1.00	0.96	0.20	
Incremental Delay, d2				2.8	4.9			0.2	0.0	35.8	0.2	
Delay (s)				79.6	84.4			3.2	0.3	41.1	0.9	
Level of Service				E	F			A	A	D	A	
Approach Delay (s)		0.0			82.0			3.0			1.7	
Approach LOS		A			F			A			A	
Intersection Summary												
HCM 2000 Control Delay			4.3									
HCM 2000 Level of Service										A		
HCM 2000 Volume to Capacity ratio			0.84									
Actuated Cycle Length (s)			180.0									
Sum of lost time (s)										13.5		
Intersection Capacity Utilization			63.0%									
ICU Level of Service										B		
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

1: MD 650 & Powder Mill Rd

08/07/2017

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	71	32	109	496	36	300	194	2160	250	250	2456	43
Future Volume (vph)	71	32	109	496	36	300	194	2160	250	250	2456	43
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1800	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	5.0	5.0		3.0	4.0		5.0	5.0	
Lane Util. Factor	1.00	1.00	1.00	0.91	0.91		1.00	0.91		1.00	0.91	
Frt	1.00	1.00	0.85	1.00	0.88		1.00	0.98		1.00	1.00	
Flt Protected	0.95	1.00	1.00	0.95	0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1711	1801	1531	3113	1438		1711	4585		1711	4903	
Flt Permitted	0.95	1.00	1.00	0.95	0.99		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1711	1801	1531	3113	1438		1711	4585		1711	4903	
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	73	33	112	511	37	309	200	2227	258	258	2532	44
RTOR Reduction (vph)	0	0	0	0	66	0	0	8	0	0	1	0
Lane Group Flow (vph)	73	33	112	460	331	0	200	2477	0	258	2575	0
Turn Type	Split	NA	Perm	Split	NA		Prot	NA		Prot	NA	
Protected Phases	3	3		4	4		1	5		6	2	
Permitted Phases			3									
Actuated Green, G (s)	18.5	18.5	18.5	37.0	37.0		9.0	76.0		21.0	89.0	
Effective Green, g (s)	20.5	20.5	20.5	39.0	39.0		12.0	79.0		23.0	91.0	
Actuated g/C Ratio	0.11	0.11	0.11	0.22	0.22		0.07	0.44		0.13	0.51	
Clearance Time (s)	6.5	6.5	6.5	7.0	7.0		6.0	7.0		7.0	7.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	0.2		3.0	0.2	
Lane Grp Cap (vph)	194	205	174	674	311		114	2012		218	2478	
v/s Ratio Prot	0.04	0.02		0.15	c0.23		c0.12	c0.54		c0.15	0.53	
v/s Ratio Perm			c0.07									
v/c Ratio	0.38	0.16	0.64	0.68	1.06		1.75	1.23		1.18	1.04	
Uniform Delay, d1	73.8	72.0	76.3	64.8	70.5		84.0	50.5		78.5	44.5	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.15	0.66		1.19	1.33	
Incremental Delay, d2	1.2	0.4	7.9	2.9	69.3		370.0	108.2		112.3	27.1	
Delay (s)	75.1	72.4	84.2	67.7	139.8		466.2	141.6		205.7	86.3	
Level of Service	E	E	F	E	F		F	F		F	F	
Approach Delay (s)		79.3			101.1			165.8			97.2	
Approach LOS		E			F			F			F	
Intersection Summary												
HCM 2000 Control Delay			125.0			HCM 2000 Level of Service			F			
HCM 2000 Volume to Capacity ratio			1.14									
Actuated Cycle Length (s)			180.0			Sum of lost time (s)			18.5			
Intersection Capacity Utilization			99.3%			ICU Level of Service			F			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

3: MD 650 & Elton Rd

08/07/2017

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	WY		AAA	A	A	AAA
Traffic Volume (vph)	215	53	2143	345	21	2018
Future Volume (vph)	215	53	2143	345	21	2018
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0		2.5	2.0	2.5	2.5
Lane Util. Factor	0.97		0.91	1.00	1.00	0.91
Frt	0.97		1.00	0.85	1.00	1.00
Flt Protected	0.96		1.00	1.00	0.95	1.00
Satd. Flow (prot)	3259		4916	1531	1711	4916
Flt Permitted	0.96		1.00	1.00	0.06	1.00
Satd. Flow (perm)	3259		4916	1531	105	4916
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	229	56	2280	367	22	2147
RTOR Reduction (vph)	13	0	0	0	0	0
Lane Group Flow (vph)	272	0	2280	367	22	2147
Turn Type	Prot		NA	pm+ov	Perm	NA
Protected Phases	3		2 4 9	3		6 4 9
Permitted Phases	3			2 4 9	6 4 9	
Actuated Green, G (s)	22.3		145.2	167.5	145.2	145.2
Effective Green, g (s)	25.3		149.2	170.5	149.2	149.2
Actuated g/C Ratio	0.14		0.83	0.95	0.83	0.83
Clearance Time (s)	6.0			6.0		
Vehicle Extension (s)	4.0			4.0		
Lane Grp Cap (vph)	458		4074	1467	87	4074
v/s Ratio Prot	c0.08		c0.46	0.04		0.44
v/s Ratio Perm				0.20	0.21	
v/c Ratio	0.59		0.56	0.25	0.25	0.53
Uniform Delay, d1	72.5		4.9	0.3	3.3	4.7
Progression Factor	1.00		0.56	1.00	1.89	2.02
Incremental Delay, d2	2.4		0.1	0.1	0.8	0.1
Delay (s)	75.0		2.9	0.4	7.1	9.5
Level of Service	E		A	A	A	A
Approach Delay (s)	75.0		2.6			9.5
Approach LOS	E		A			A
Intersection Summary						
HCM 2000 Control Delay			9.6		HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio			0.58			
Actuated Cycle Length (s)			180.0		Sum of lost time (s)	11.5
Intersection Capacity Utilization			55.9%		ICU Level of Service	B
Analysis Period (min)			15			
c Critical Lane Group						

HCM Signalized Intersection Capacity Analysis

1: MD 650 & Powder Mill Rd

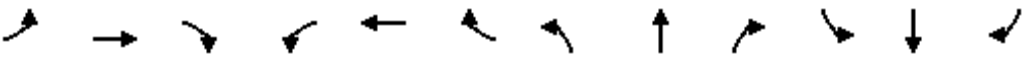
08/07/2017

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	71	32	109	496	36	300	141	2160	250	250	2456	43
Future Volume (vph)	71	32	109	496	36	300	141	2160	250	250	2456	43
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1800	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	5.0	5.0	5.0	3.0	4.0		5.0	5.0	
Lane Util. Factor	0.91	0.86	0.91	0.91	0.91	1.00	1.00	0.91		1.00	0.91	
Frt	1.00	0.92	0.85	1.00	1.00	0.85	1.00	0.98		1.00	1.00	
Flt Protected	0.95	0.99	1.00	0.95	0.96	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1557	2830	1393	3113	1576	1531	1711	4585		1711	4903	
Flt Permitted	0.95	0.99	1.00	0.95	0.96	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1557	2830	1393	3113	1576	1531	1711	4585		1711	4903	
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	73	33	112	511	37	309	145	2227	258	258	2532	44
RTOR Reduction (vph)	0	0	0	0	0	262	0	5	0	0	1	0
Lane Group Flow (vph)	55	107	56	363	185	47	145	2480	0	258	2575	0
Turn Type	Split	NA	Perm	Split	NA	Perm	Prot	NA		Prot	NA	
Protected Phases	3	3		4	4		1	5		6	2	
Permitted Phases			3			4						
Actuated Green, G (s)	13.0	13.0	13.0	25.1	25.1	25.1	6.0	81.1		33.3	109.4	
Effective Green, g (s)	15.0	15.0	15.0	27.1	27.1	27.1	9.0	84.1		35.3	111.4	
Actuated g/C Ratio	0.08	0.08	0.08	0.15	0.15	0.15	0.05	0.47		0.20	0.62	
Clearance Time (s)	6.5	6.5	6.5	7.0	7.0	7.0	6.0	7.0		7.0	7.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	0.2		3.0	0.2	
Lane Grp Cap (vph)	129	235	116	468	237	230	85	2142		335	3034	
v/s Ratio Prot	0.04	0.04		0.12	c0.12		c0.08	c0.54		0.15	c0.53	
v/s Ratio Perm			c0.04			0.03						
v/c Ratio	0.43	0.46	0.48	0.78	0.78	0.20	1.71	1.16		0.77	0.85	
Uniform Delay, d1	78.4	78.6	78.8	73.5	73.6	67.0	85.5	48.0		68.5	27.5	
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.79	0.62		0.95	0.89	
Incremental Delay, d2	2.3	1.4	3.1	7.9	15.3	0.4	358.5	76.1		8.1	2.4	
Delay (s)	80.7	80.0	81.9	81.4	88.8	67.4	426.0	105.8		72.9	27.0	
Level of Service	F	F	F	F	F	E	F	F		E	C	
Approach Delay (s)		80.7			78.0			123.4			31.2	
Approach LOS		F			E			F			C	
Intersection Summary												
HCM 2000 Control Delay			76.1									
HCM 2000 Volume to Capacity ratio			1.00									
Actuated Cycle Length (s)			180.0									
Intersection Capacity Utilization			91.9%									
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

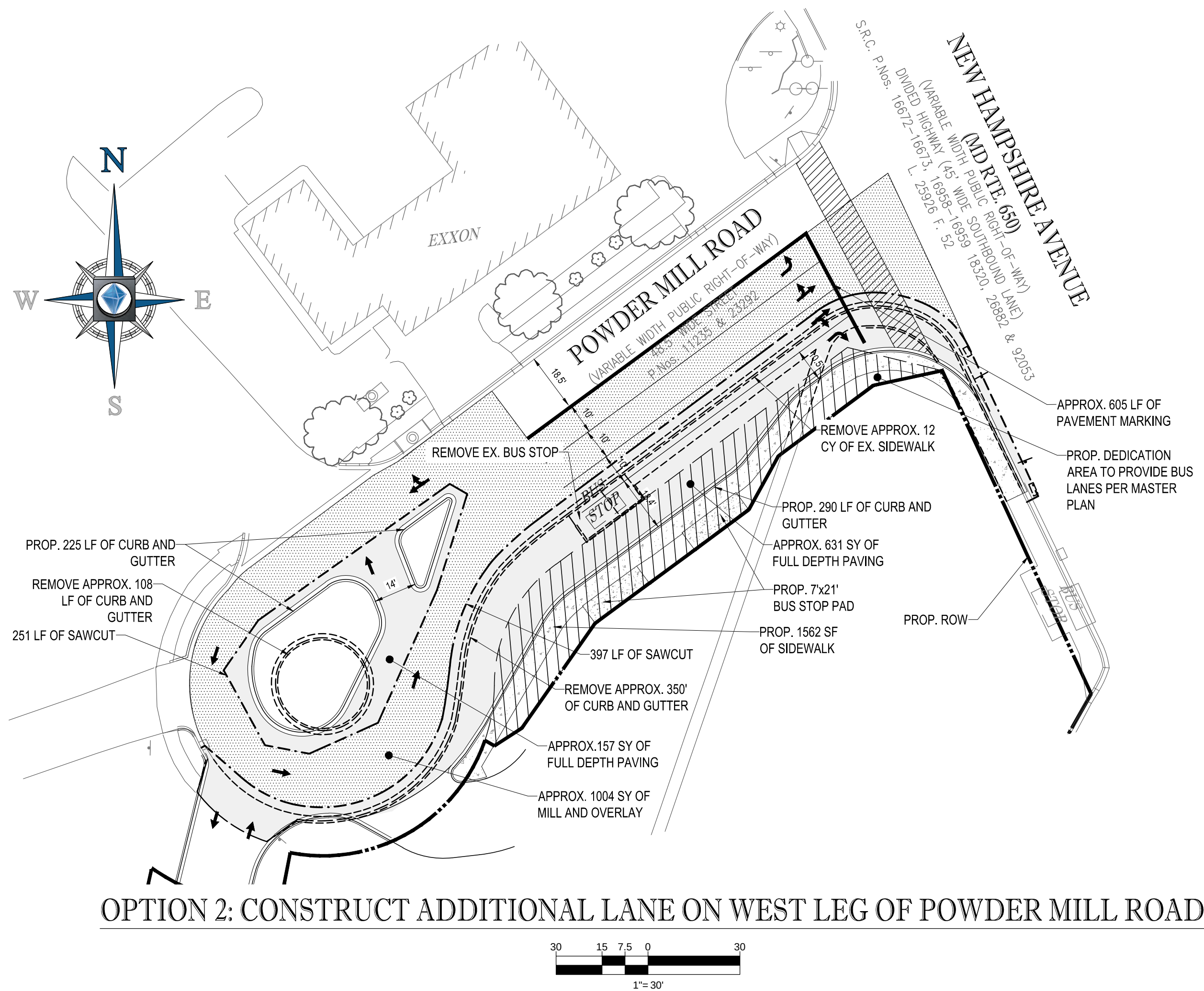
3: MD 650 & Elton Rd

08/07/2017

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	215	53	26	0	2143	345	21	2018	0
Future Volume (vph)	0	0	0	215	53	26	0	2143	345	21	2018	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				3.0	6.0			2.5	2.0	2.5	2.5	
Lane Util. Factor				0.95	0.95			0.91	1.00	1.00	0.91	
Frt				1.00	0.97			1.00	0.85	1.00	1.00	
Flt Protected				0.95	0.98			1.00	1.00	0.95	1.00	
Satd. Flow (prot)				1625	1625			4916	1531	1711	4916	
Flt Permitted				0.95	0.98			1.00	1.00	0.06	1.00	
Satd. Flow (perm)				1625	1625			4916	1531	103	4916	
Peak-hour factor, PHF	1.00	1.00	1.00	0.94	1.00	0.94	1.00	0.94	0.94	0.94	0.94	1.00
Adj. Flow (vph)	0	0	0	229	53	28	0	2280	367	22	2147	0
RTOR Reduction (vph)	0	0	0	0	4	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	156	150	0	0	2280	367	22	2147	0
Turn Type				custom	NA			NA	pm+ov	Perm	NA	
Protected Phases				3	3			2 4 9	3		6 4 9	
Permitted Phases				3					2 4 9	6 4 9		
Actuated Green, G (s)				25.0	25.0			142.5	167.5	142.5	142.5	
Effective Green, g (s)				28.0	25.0			146.5	170.5	146.5	146.5	
Actuated g/C Ratio				0.16	0.14			0.81	0.95	0.81	0.81	
Clearance Time (s)				6.0	6.0				6.0			
Vehicle Extension (s)				4.0	4.0				4.0			
Lane Grp Cap (vph)				252	225			4001	1467	83	4001	
v/s Ratio Prot				c0.10	0.09			c0.46	0.04		0.44	
v/s Ratio Perm									0.20	0.21		
v/c Ratio				0.62	0.67			0.57	0.25	0.27	0.54	
Uniform Delay, d1				71.0	73.5			5.8	0.3	4.0	5.5	
Progression Factor				1.00	1.00			0.57	1.00	0.39	0.39	
Incremental Delay, d2				5.1	7.9			0.2	0.1	1.5	0.1	
Delay (s)				76.1	81.4			3.5	0.4	3.0	2.3	
Level of Service				E	F			A	A	A	A	
Approach Delay (s)		0.0			78.8			3.1			2.3	
Approach LOS		A			E			A			A	
Intersection Summary												
HCM 2000 Control Delay			7.3									
HCM 2000 Level of Service										A		
HCM 2000 Volume to Capacity ratio			0.61									
Actuated Cycle Length (s)			180.0									
Sum of lost time (s)										13.5		
Intersection Capacity Utilization			57.9%									
ICU Level of Service										B		
Analysis Period (min)			15									
c Critical Lane Group												

Appendix C

Concept Improvement Plans



LEGEND

PROP. SAWCUT

FULL DEPTH PAVEMENT

MILL AND OVERLAY

PROP. SIDEWALK

DEMO CURB AND GUTTER

PROP. CURB AND GUTTER

PROP. ROW

DRAFT

MAJOR QUANTITIES COST ESTIMATES: ROADWAY AND SIGNAL IMPROVEMENTS					
CAT. CODE NO.	DESCRIPTION	QTY.	UNIT	UNIT COST	TOTAL COST
1000000	70% OF CATEGORIES 2-6	1	LS		\$196,808.16
CATEGORY 1: PRELIMINARY					
CATEGORY 2: GRADING					
210025	REMOVAL OF EXISTING PAVEMENT	60	CY	\$30.00	\$1,800.00
210011	REMOVAL OF EXISTING COMBINATION CURB AND GUTTER	458	LF	\$15.00	\$6,870.00
210019	SAWCUT	648	LF	\$10.00	\$6,480.00
210026	REMOVAL OF EXISTING SIDEWALK	12	CY	\$100.00	\$1,200.00
TOTAL CATEGORY 2 : GRADING COST					\$16,350.00
TOTAL CATEGORY 3 : STRUCTURES					
300000	40% OF CATEGORIES 2,4-6	1	LS		\$62,478.78
TOTAL CATEGORY 3 : STRUCTURES COST					\$62,478.78
TOTAL CATEGORY 4 : PAVING					
500000	GAP GRADED HMA SURFACE MIXES	246	TON	\$120.00	\$29,520.00
504296	HMA BASE MIXES	222	TON	\$120.00	\$26,640.00
520113	6 INCH GRADED AGGREGATE BASE COURSE	788	SY	\$15.00	\$11,820.00
530161	MILLING/GRINDING EXISTING PAVEMENT (0 -2 INCHES)	1004	SY	\$4.00	\$4,016.00
500000	THERMOPLASTIC PAVEMENT MARKINGS	605	LF	\$1.00	\$605.00
	PROPOSED BUS STOP	2	EA	\$10,000.00	\$20,000.00
TOTAL CATEGORY 4 : PAVING COST					\$92,601.00
TOTAL CATEGORY 5 : SHOULDERS					
634300	STANDARD TYPE A COMBO. CURB AND GUTTER	515	LF	\$50.00	\$25,750.00
655105	5 INCH CONCRETE SIDEWALK	1562	SF	\$9.00	\$14,058.00
TOTAL CATEGORY 5 : SHOULDERS COST					\$39,808.00
CATEGORY 6: LANDSCAPING					
700000	5% OF CATEGORIES 2,4,5	1	LS		\$7,437.95
SUBTOTAL					\$477,962.67
CONTINGENCIES (40%)					\$191,185.07
SUBTOTAL (NEAT CONSTRUCTION)					\$669,147.73
OVERHEAD & ADMINISTRATION (14.4%)					\$96,357.27
TOTAL PROJECT COST					\$765,505.01

BOHLER
ENGINEERING

SITE CIVIL AND CONSULTING ENGINEERING
LAND SURVEYING
SUSTAINABLE DESIGN
PROGRAM MANAGEMENT
LANDSCAPE ARCHITECTURE
CONSTRUCTION MANAGEMENT
CONSTRUCTION SERVICES

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NEW HAMPSHIRE
MASSACHUSETTS
CONNECTICUT
PENNSYLVANIA
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MARYLAND
VIRGINIA
NORTH CAROLINA
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FLORIDA
ALABAMA
LOUISIANA
MISSISSIPPI
ARKANSAS
OKLAHOMA
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OREGON
WASHINGTON
IDAHO

REVISIONS			
REV	DATE	COMMENT	BY

NO TOUCHING

THE FOLLOWING STATES REQUIRE NOTIFICATION BY EXCAVATORS, DESIGNERS, OR ANY PERSON PREPARING TO DISTURB THE EARTH'S SURFACE ANYWHERE IN THE STATE OF VIRGINIA, MARYLAND, THE DISTRICT OF COLUMBIA, AND DELAWARE CALL - 811
(VA 1-800-245-4848) (PA 1-800-242-1778) (DC 1-800-257-7777) (DE 1-800-282-8555)

PROJECT No.:	MB162046
DRAWN BY:	AK
CHECKED BY:	BF
DATE:	06/06/17
SCALE:	1" = 30'
CAD I.D.:	SWD

PROJECT:

HILLANDALE
GATEWAY

FOR

HILLANDALE
GATEWAY, LLC

LOCATION OF SITE
10110 NEW HAMPSHIRE AVE
MONTGOMERY COUNTY
SILVER SPRING, MD

BOHLER
ENGINEERING

16701 Melford Blvd., Suite 310
Bowie, Maryland 20715
Phone: (301) 809-4500
Fax: (301) 809-4501
MD@BohlerEng.com

CONCEPT PLAN
6/6/17

SHEET TITLE:

OFFSITE
ROADWAY
IMPROVEMENTS

SHEET NUMBER:

2
OF 4

