



MIDCAP

Maryland **I**ntersection/Interchange **D**esign & **C**apacity **A**nalysis **P**rogram

May 20, 2020




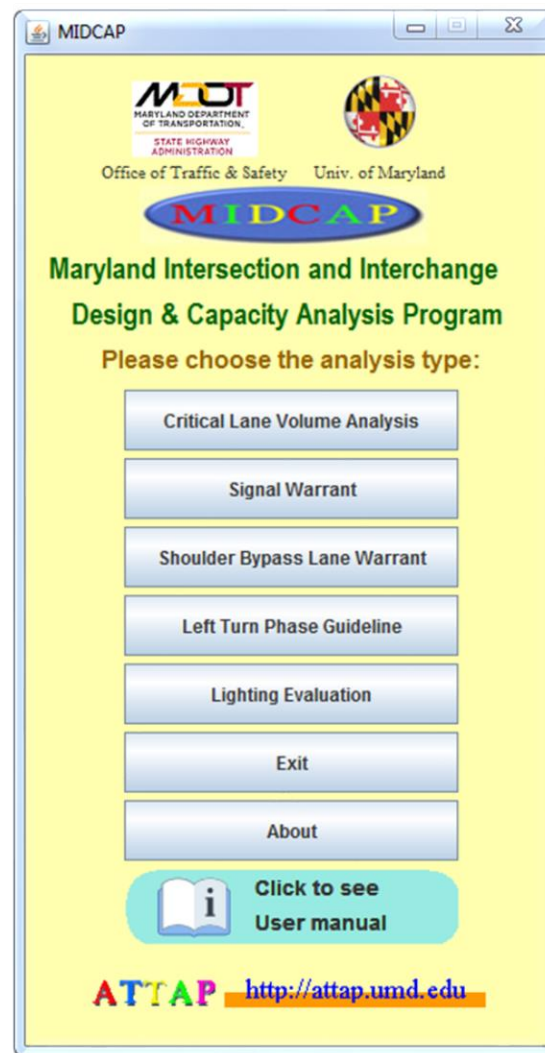
Traffic Development & Support Division
Office of Traffic & Safety
MDOT State Highway Administration



Traffic Safety & Operations Lab
Dept. of Civil & Environmental Engineering
University of Maryland, College Park

INTRODUCTION

- ❑ Software development by **UMCP**
- ❑ Sponsored by **MDOT SHA** through the Applied Technology & Traffic Analysis Program (ATTAP) funding
- ❑ **User-friendly** traffic engineering software for intersection analysis regarding
 - Capacity or queuing
 - Traffic signal warrant
 - Shoulder bypass lane warrant
 - Left turn phase selection 
 - Lighting recommendation



MAIN MODULES

1. Critical Lane Volume (CLV) Analysis
2. Signal Warrant
3. Shoulder Bypass Lanes Warrant
4. Left Turn Phase Guideline
5. Lighting Evaluation

MODULE 1: CRITICAL LANE VOLUME ANALYSIS

Critical Lane Volume (CLV) analysis module conducts a **sketch-level** capacity / queuing analysis for **signalized** intersection(s) or interchange ramp terminal(s) along an arterial.

MODULE 1: CRITICAL LANE VOLUME ANALYSIS

Procedure

INPUT

- Intersection type
- Turning movement volumes
- Lane configuration
- Right-turn restriction
- Split or non-split phase

Identify non-concurrent sets of movements



Determine CLV of each sets and sum



Calculate v/c and determine LOS




Calculate Max. queue length

- Intersection CLV
- Intersection v/c and LOS
- Maximum queue length

OUTPUT

MODULE 1: CRITICAL LANE VOLUME ANALYSIS

Submodules

1. Intersection (**Single or Multiple** locations up to 10)
 - 3-leg
 - 4-leg
 - Full **C**ontinuous **F**low Intersection (**CFI**)
 - CFI-T : Full signalization and Half signalization 
 - Partial CFI: Symmetric and Asymmetric
2. Interchange (**Single** location only for alternatives analysis)
 - Regular Diamond interchange
 - Partial Clover Leaf Interchange
 - Single Point Urban Interchange
 - Diverging Diamond Interchange
3. **Multi-hour** calculation

MODULE 1: CRITICAL LANE VOLUME ANALYSIS

Capacity (4-Leg Intersection)

- 1 Choose Intersection Type
- 2 Set Lane Configurations
- 3 Input Movement Volumes
- 4 Choose Right Turn Control Type
- 5 Click Calculate
- 6 Obtain LOS & V/C

MIDCAP
Office of Traffic & Safety Univ. of Maryland
ATTAP <http://attap.umd.edu>

Click on the arrows to change the lane group configuration.

Analyst: H.Kim
Department: ATTAP
Date: 03/21/2017
Intersection: MD 193 at West Park Dr.
Location: Prince George Co.

Type: 4 Leg
Scenario: 4 Leg
CFI
CFI T Full
CFI T Half
CFI Sym
CFI Asym

Phase Split:
☐ Split NB
☐ Split EB and WB

Calculate Clear

Print Open

Save Save As

Back Queue

Undo Redo

Factors And Criteria

AM Results

Mov.	Vol	Lane Fac	Lane Vol	Oppo Lefts	CLV	*
NB	27*	1.00	27	24	51	51
SB	29**	1.00	29	16	45	
WB	1827	0.55	1005	7	1012	1012
EB	741	0.55	408	42	450	
				AM Total	1063	AM V.
				AM LOS	B	0.66

PM Results

Mov.	Vol	Lane Fac	Lane Vol	Oppo Lefts	CLV	*
NB	50*	1.00	50	63	113	113
SB	74**	1.00	74	27	101	
WB	1642	0.55	903	17	920	920
EB	1371	0.55	754	30	784	
				PM Total	1033	PM V.
				PM LOS	B	0.65

Note

+: Volume subtracted by right turn overlap
+*: Volume adjusted by the PCE factor for permissive left

Maximum Queue Lengths

Num of Phases

2 phase

AM

PM

Cycle Length(sec)

90

90

Results

Queue Length(ft):

		AM	PM
Northbound	L	50	75
	T	N/A	N/A
	R	100	125
Southbound	L	50	100
	T	N/A	N/A
	R	25	50
Eastbound	L	25	50
	T	N/A	N/A
	R	400	650
Westbound	L	75	50
	T	N/A	N/A
	R	900	800

Storage Length(ft)

Calculate Queue Length

Save as Image

Exit

User Input

MODULE 1: CRITICAL LANE VOLUME ANALYSIS

Factors and Criteria

- **Editable** Lane Use Factors, LOS criteria, and Passenger Car Equivalent (PCE) values
- Applicable to each approach and AM / PM period

The screenshot displays the 'Factors and Criteria' window with a diagram of a four-way intersection. The diagram shows traffic flow for Southbound (SB), Northbound (NB), Westbound (WB), and Eastbound (EB) approaches. A red box highlights the left-turn lane of the Southbound approach.

Factors and Criteria

SB NB WB EB

Num of Lane	Factors	
	AM	PM
1	1.0	1.0
2	0.55	0.55
3	0.4	0.4
4	0.3	0.3
5	0.24	0.24
Dbl Left	0.6	0.6
Tpl Left	0.45	0.45

Default

Level of Service

Level	CLV
A <=	1000
B <=	1150
C <=	1300
D <=	1450
E <=	1600
F >	1600

Default

PCE

Opposing Volume	PCE
<=199	1.1
<=599	2.0
<=799	3.0
<=999	4.0
>=1000	5.0

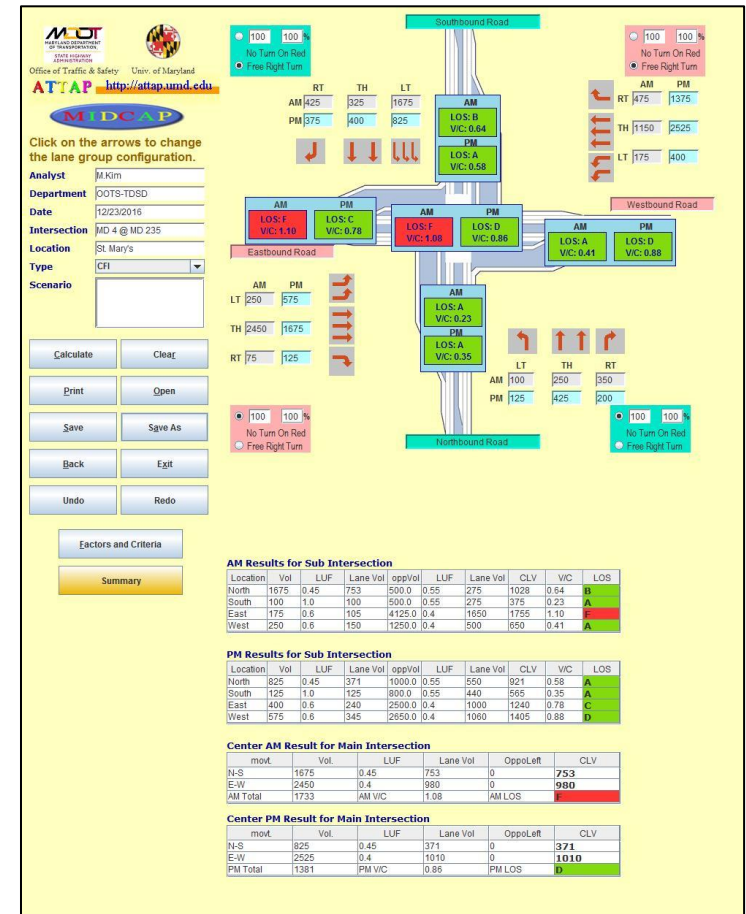
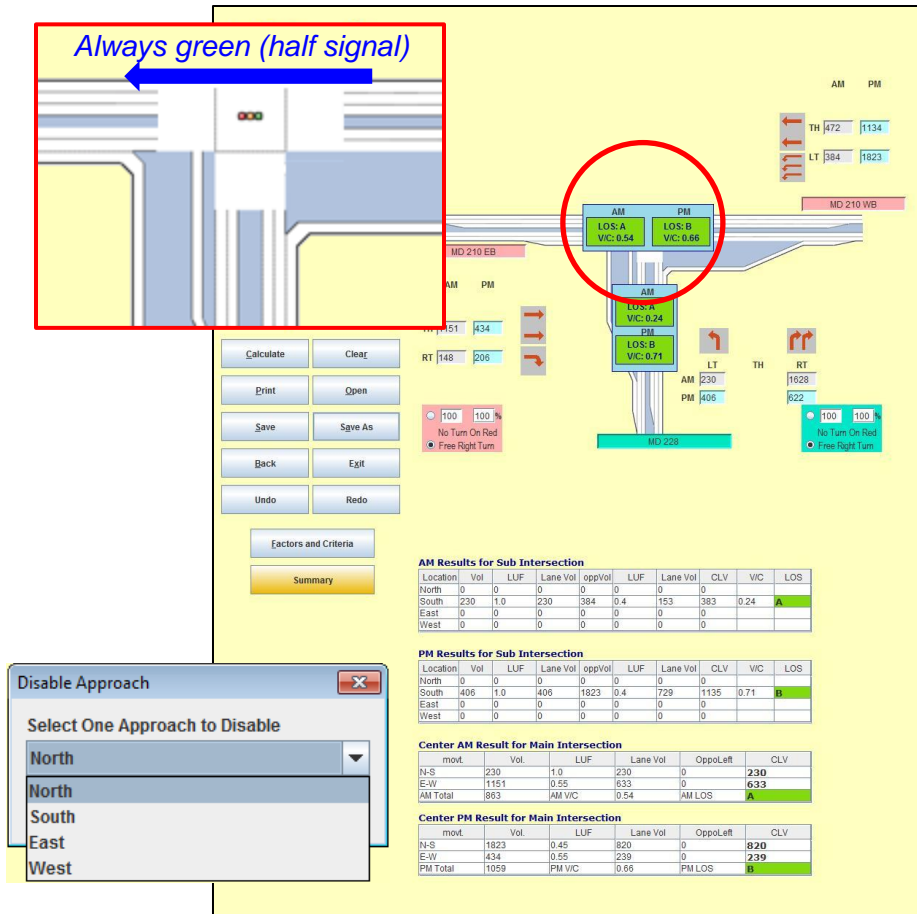
Default

MODULE 1: CRITICAL LANE VOLUME ANALYSIS

Continuous Flow (or **Displaced Left Turn**) Intersection

3-Leg CFI – **Half** signal

4-Leg **Full** CFI



MODULE 1: CRITICAL LANE VOLUME ANALYSIS

Continuous Flow (or **Displaced Left Turn**) Intersection

4-Leg Partial **Symmetric** CFI

Click on the arrows to change the lane group configuration.

Analyst: M Kim
Department: JOTS-TSDS
Date: 12/23/2016
Intersection: MD 4 @ MD 235
Location: St. Mary's
Type: CFI Sym
Scenario:

Calculate Clear
Print Open
Save Save As
Back Exit
Undo Redo

Factors and Criteria
Summary

AM Results for Sub Intersection

Location	Vol	LUF	Lane Vol	oppVol	LUF	Lane Vol	CLV	VIC	LOS
North	1675	0.45	753	500	0.55	275	1028	0.64	B
South	100	1.0	100	500	0.55	275	375	0.23	A
East	0	0	0	0	0	0	0	0	
West	0	0	0	0	0	0	0	0	

PM Results for Sub Intersection

Location	Vol	LUF	Lane Vol	oppVol	LUF	Lane Vol	CLV	VIC	LOS
North	325	0.45	371	1000	0.55	550	321	0.58	A
South	125	1.0	125	800	0.55	440	565	0.35	A
East	0	0	0	0	0	0	0	0	
West	0	0	0	0	0	0	0	0	

Center AM Result for Main Intersection

mov	Vol	LUF	Lane Vol	OppoLeft	CLV
N-S	425	1.0	425	100	525
E-W	2450	0.4	980	105	1085
AM Total	1610	AM VIC	1.01	AM LOS	

Center PM Result for Main Intersection

mov	Vol	LUF	Lane Vol	OppoLeft	CLV
N-S	375	1.0	375	125	500
E-W	2525	0.4	1010	345	1355
PM Total	1855	PM VIC	1.16	PM LOS	

4-Leg Partial **Asymmetric** CFI

Click on the arrows to change the lane group configuration.

Analyst: M Kim
Department: JOTS-TSDS
Date: 12/23/2016
Intersection: MD 4 @ MD 235
Location: St. Mary's
Type: CFI Asym
Scenario:

Calculate Clear
Print Open
Save Save As
Back Exit
Undo Redo

Factors and Criteria
Summary

AM Results for Sub Intersection

Location	Vol	LUF	Lane Vol	oppVol	LUF	Lane Vol	CLV	VIC	LOS
North	1675	0.45	753	500	0.55	275	1028	0.64	B
South	0	0	0	0	0	0	0	0	
East	175	0.6	105	4125	0.4	1650	1755	1.10	C
West	0	0	0	0	0	0	0	0	

PM Results for Sub Intersection

Location	Vol	LUF	Lane Vol	oppVol	LUF	Lane Vol	CLV	VIC	LOS
North	325	0.45	371	1000	0.55	550	321	0.58	A
South	0	0	0	0	0	0	0	0	
East	400	0.6	240	2500	0.4	1000	1240	0.78	C
West	0	0	0	0	0	0	0	0	

Center AM

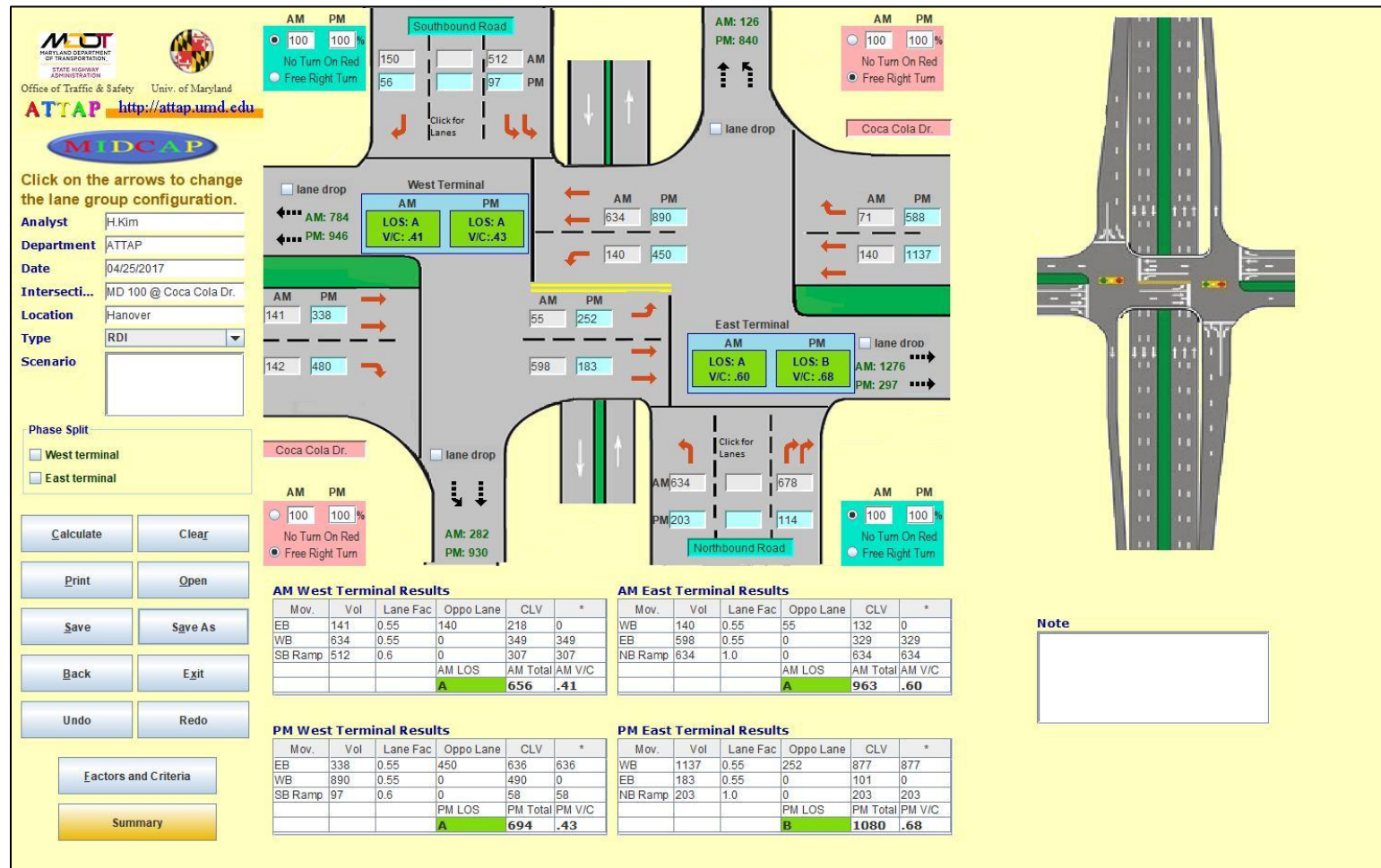
P1	P2	P3	P4	CLV	VIC	LOS
270	483	241	739	1733	1.08	F

Center PM

P1	P2	P3	P4	CLV	VIC	LOS
135	237	345	1010	1727	1.08	F

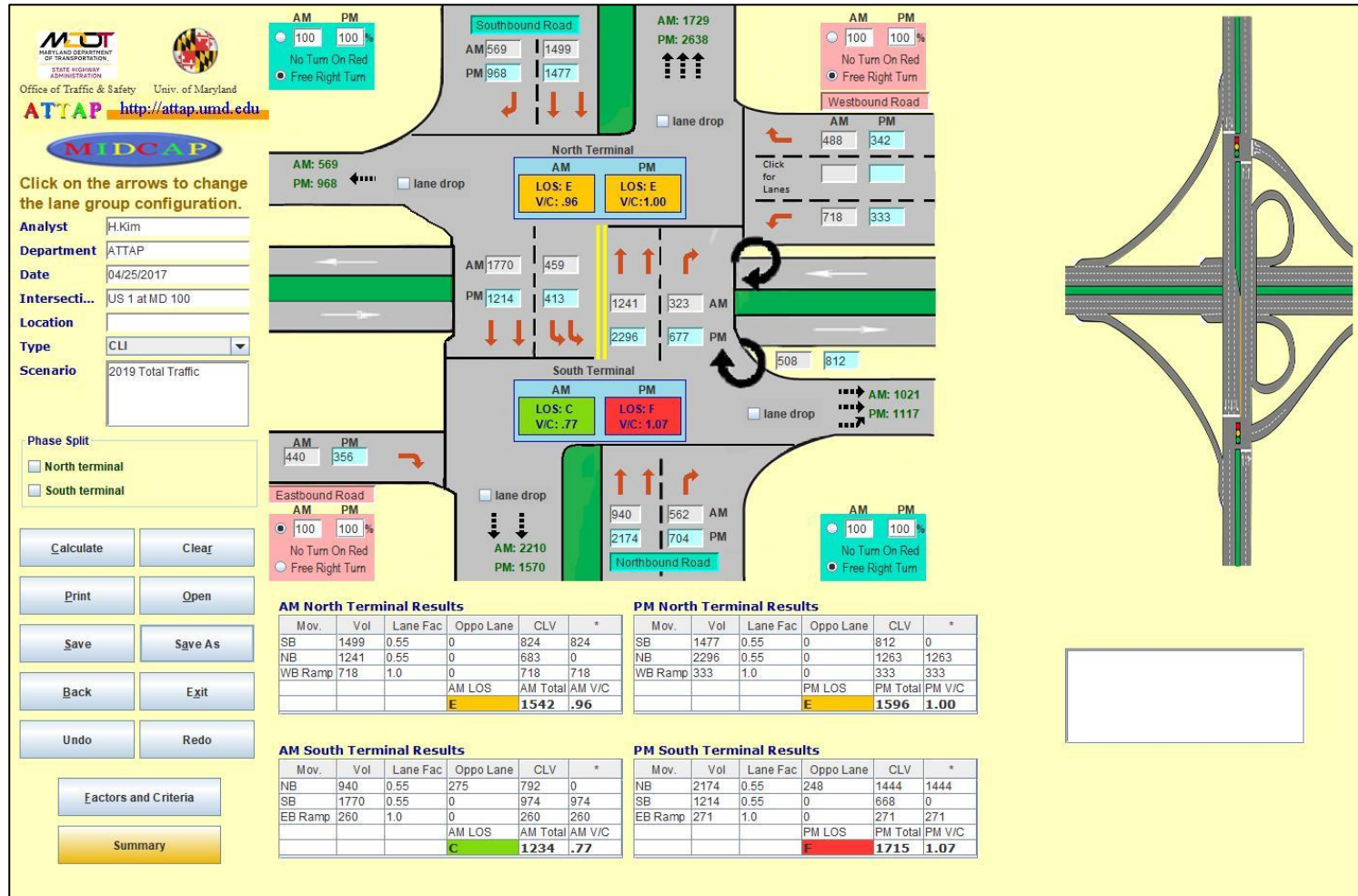
MODULE 1: CRITICAL LANE VOLUME ANALYSIS

Interchange Ramp Terminals (Regular Diamond)



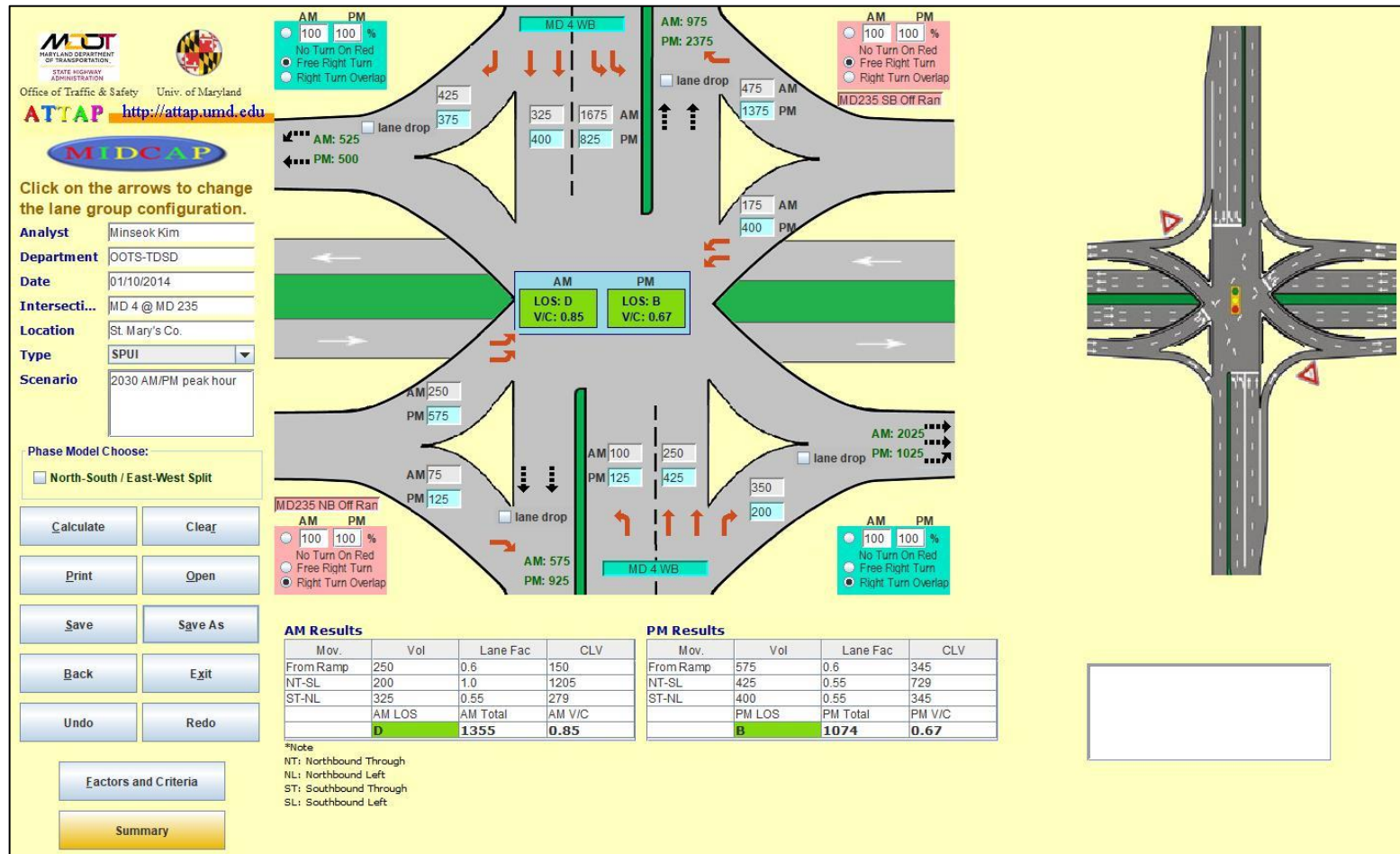
MODULE 1: CRITICAL LANE VOLUME ANALYSIS

Partial Clover Leaf Interchange



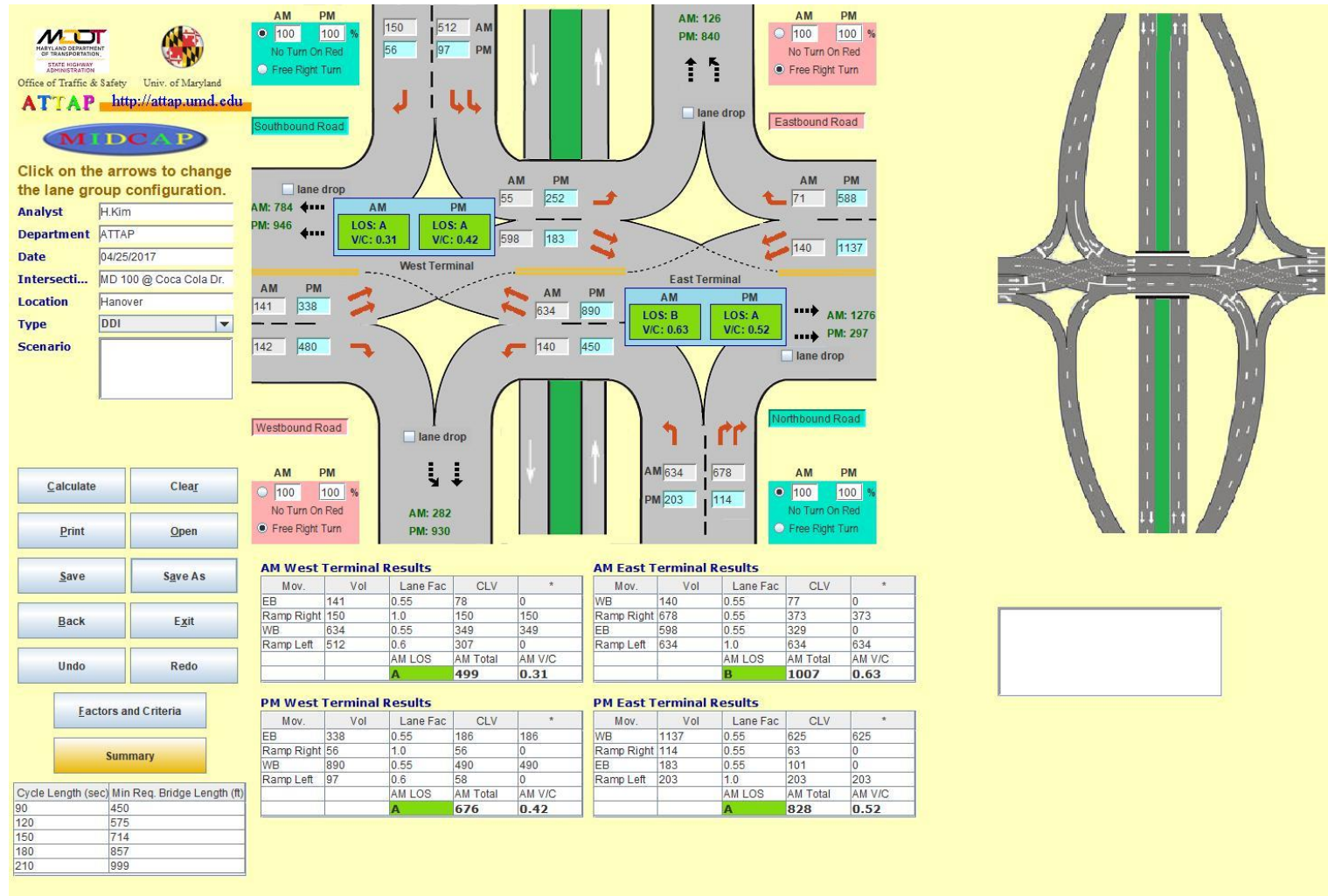
MODULE 1: CRITICAL LANE VOLUME ANALYSIS

Single Point Urban Interchange



MODULE 1: CRITICAL LANE VOLUME ANALYSIS

Diverging Diamond Interchange



MODULE 1: CRITICAL LANE VOLUME ANALYSIS

Arterial (Corridor) analysis

- **Multiple intersections**
- Up to 10 intersections

The screenshot shows the MIDCAP software window. At the top, it displays the logos for the Maryland Department of Transportation (MDOT) and the University of Maryland, along with the text "Office of Traffic & Safety" and "Univ. of Maryland". Below this is the "MIDCAP" logo. The main section is titled "Intersection Setup". It contains three labels: "Number of Intersections:", "Arterial Numbering Directions:", and "Number of Through Lanes on Arterial:". To the right of these labels is a vertical list of numbers from 3 to 10, with a red box highlighting the entire list. Below the list are two buttons: "OK" and "Back". At the bottom, the "ATTAP" logo is displayed next to the URL "http://attap.umd.edu".

MODULE 1: CRITICAL LANE VOLUME ANALYSIS

Arterial analysis

Arterial View

Click on the blue circle to input for an intersection.

Intersection Name	at Seek Ln.	at Carroll Ave	at Merrimac Dr.	at Lebanon St.	at W. S hop Center	at Takoma Langley	at MD 650
AM Peak	A: 0.54	D: 0.84	A: 0.53	A: 0.55	A: 0.59	A: 0.54	D: 0.90
LOS V/C							
PM Peak	A: 0.52	C: 0.78	A: 0.56	B: 0.63	C: 0.74	A: 0.50	D: 0.84
LOS V/C							
Type	3 leg	4 leg	4 leg	3 leg	4 leg	4 leg	4 leg

Buttons: Back, Print, Open, Save, Save As, Add, Remove, Summary

Individual Intersection View

Click on the arrows to change the lane group configuration.

Analyst: M. Kim
Department: DOTSD-TDSD
Date: 12/23/2016
Intersection: at Merrimac Dr.
Location: Montgomery & PG County
Type: 4 Leg
Scenario: 2020 Build, Purple Line

Phase Split:
☐ Split NB and SB
☐ Split EB and WB

Calculate, Clear, Print, Open, Save, Save As, Back, Queue, Undo, Redo, Factors And Criteria

AM Results

Mov.	Vol	Lane Fac	Lane Vol	Oppo Lefts	CLV	*
NB	0	0.00	0	0	0	
SB	1047	1.00	10	0	10	
WB	1437	0.55	790	52	842	842
EB	1005	0.55	553	107	660	
			AM Total	852	AM V/C	
			AM LOS	A	0.53	

PM Results

Mov.	Vol	Lane Fac	Lane Vol	Oppo Lefts	CLV	*
NB	0	0.00	0	0	0	
SB	0	0.00	0	0	0	
WB	1380	0.55	759	134	893	893
EB	1180	0.55	649	139	788	
			PM Total	893	PM V/C	
			PM LOS	A	0.56	

Note: *: Volume subtracted by right turn overlap

MODULE 1: CRITICAL LANE VOLUME ANALYSIS

Multi-hour analysis

Import or copy traffic counts in Excel from
MDOT SHA's Internet Traffic Monitoring System
(http://maps.roads.maryland.gov/itms_public/)

- 1 Set Lane Configurations
- 2 Choose Right Turn Control Type
- 3 Input Movement Volumes
- 4 Click Result

U-Turn

new

MDOT
MARYLAND DEPARTMENT OF TRANSPORTATION
Office of Traffic & Safety
ATTAP <http://attap.umd.edu>
Univ. of Maryland

MIDCAP

Click on the arrows to change the lane group configuration.

Analyst: H. Kim
Department: ATTAP
Date: 04/25/2017
Intersection: MD 97 at MD 192
Location: Montgomery Co.
Type: 4 Leg
Scenario:

Phase Split
☐ Split NB and SB
☐ Split EB and WB

Open Clear
Save Save As
Back Print
Factors And Criteria

100%
No Turn On Red
Free Right Turn
Right Turn Overlap

1. Select Lane configurations
2. Choose Right Turn control type
3. Input traffic count
4. Results

Load the .xls traffic count file or type into the table below.
(If Load fails, see Sample and compare file formats)

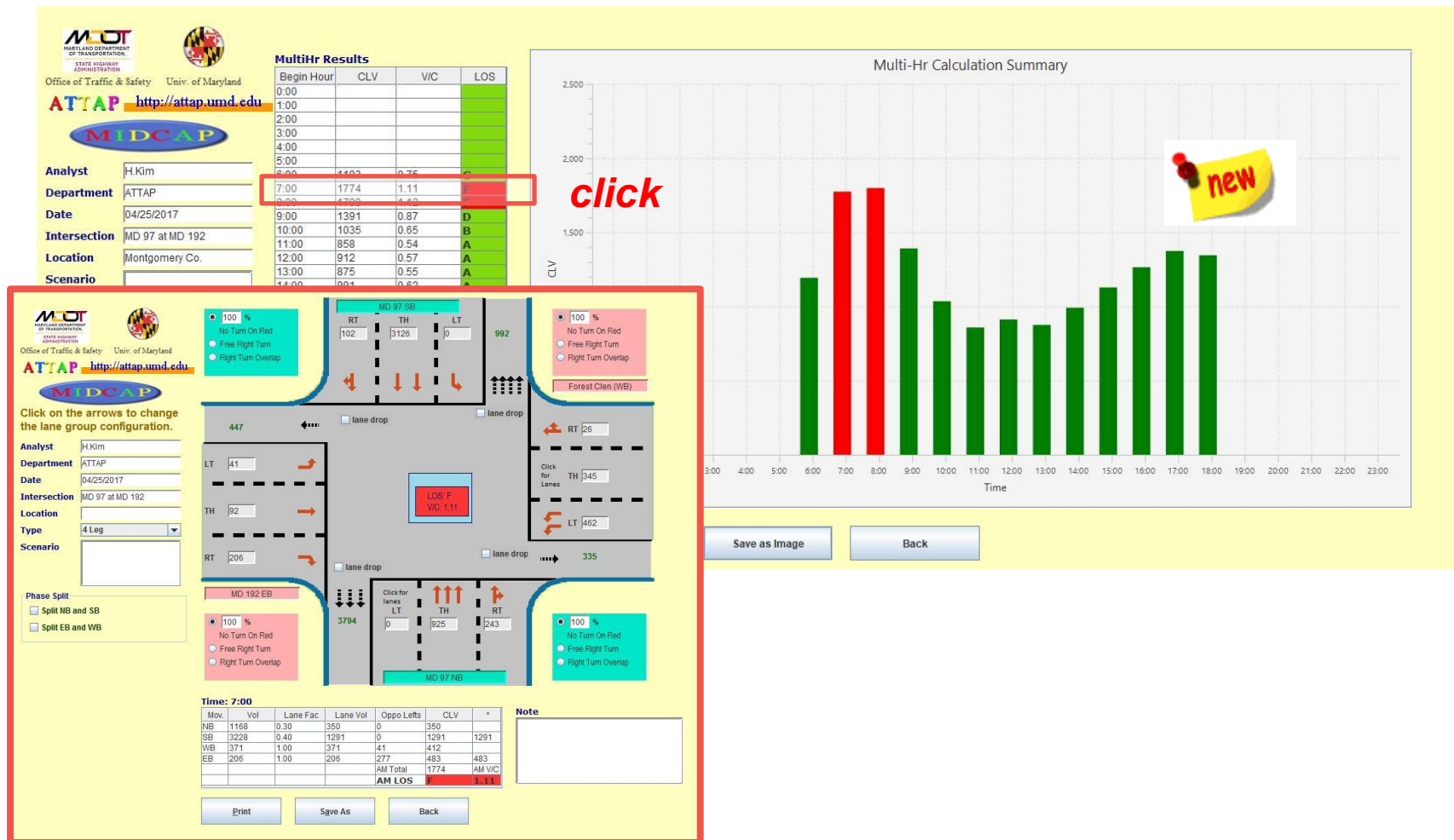
MD 97 SB MD 97 NB Forest Glen (WB) MD 192 EB

Start	UT	L	T	R	TOT	UT	L	T	R	TOT	UT	L	T	R	TOT	UT	L	T	R	TOT	ALL
0:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:00	0	5	2264	36	2305	0	20	552	301	873	0	267	198	48	513	0	16	47	113	176	3867
7:00	0	0	3126	102	3228	0	0	925	243	1168	0	462	345	26	833	0	41	92	205	339	5568
8:00	0	0	3049	100	3149	0	0	1000	252	1252	0	516	353	36	905	0	63	161	229	452	5758
9:00	0	11	2363	84	2458	0	12	992	254	1258	0	425	214	67	696	0	48	118	157	323	4735
10:00	0	42	1737	54	1833	0	32	1112	249	1393	0	351	164	94	609	0	45	66	108	219	4054
11:00	0	35	1496	53	1584	0	50	1429	241	1720	0	250	87	103	440	0	39	71	88	198	3942
12:00	0	48	1588	62	1688	0	52	1494	254	1800	0	266	73	102	441	0	49	74	96	219	4148
13:00	0	33	1586	0	1619	0	36	1501	254	1791	0	244	74	83	401	0	55	62	95	212	4023
14:00	0	38	1675	47	1760	0	37	1748	294	2079	0	286	91	114	491	0	54	98	130	282	4512
15:00	0	25	1757	76	1858	0	25	1834	317	2176	0	339	118	118	575	0	93	192	184	469	5078
16:00	0	1	1722	83	1806	0	0	2307	333	2640	0	319	153	106	578	0	138	280	226	644	5668
17:00	0	0	1818	89	1907	0	0	2406	375	2781	0	299	197	104	600	0	192	361	177	730	6018
18:00	0	0	1650	74	1724	0	0	2274	417	2691	0	308	165	75	548	0	143	353	150	646	5609
19:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Load See Sample Clear Back

MODULE 1: CRITICAL LANE VOLUME ANALYSIS

Multi-hour analysis: CLV, V/C and LOS for **each hour**



MODUE 2: SIGNAL WARRANT

- ❑ Uses the Maryland Manual on Uniform Traffic Control Devices (**MdMUTCD**) **2011** edition
- ❑ Investigates the need for a traffic control signal by analyzing related factors such as traffic conditions and physical characteristics of the location
- ❑ Provides whether the following traffic signal warrant is satisfied at a particular location or not
 - Warrant 1. **Eight-Hour** Vehicular Volume
 - Warrant 2. **Four-Hour** Vehicular Volume
 - Warrant 3. **Peak Hour**
 - Warrant 9. Intersection **Near a Grade Crossing**

MODUE 2: SIGNAL WARRANT

Able to import or copy a traffic counts report from MDOT SHA's Internet Traffic Monitoring System (I-TMS) as input

1

Load Traffic Volume Data

2

Set Location-specific Characteristics

3

Click Calculate

U-Turn

One can load the I-TMS traffic data in excel format or input manually into the volume table

1 **Calculate**

2 **Load**

3 **Calculate**

Analyst: HKim
 Department: ATTAP
 Date of Analysis: 11/26/2019
 Date of Traffic data: 06/10/2015
 Location: MD 187 at Cordell Ave
☐ Community Less Than 10,000
 Major Street: MD 187
 Num. of Approach Lane: 2 or more
 85th Percentile Speed: below 40 mph
 Direction: North-South
 Minor Street: Cordell Ave
 Num. of Approach Lanes: 1

Volume Table

Major Street MD 187												Minor Street Cordell Ave											
From North						From South						From East						From West					
Start	UT	L	T	R	TOT	Start	UT	L	T	R	TOT	Start	UT	L	T	R	TOT	Start	UT	L	T	R	TOT
5:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
6:00	0	20	371	10	401	0	7	188	11	206	0	10	6	11	27	0	3	6	1	10	0	0	
7:00	0	7	779	6	792	0	5	485	44	534	0	11	12	27	50	0	1	6	0	7	1383	0	
8:00	0	14	1080	12	1106	0	1	605	63	669	0	6	28	50	84	0	5	12	3	20	1879	0	
9:00	0	14	744	18	776	0	8	467	41	516	0	22	28	41	91	0	1	9	4	14	1397	0	
10:00	0	26	673	17	716	0	2	459	53	514	0	31	23	50	104	0	3	6	5	14	1348	0	
11:00	0	52	616	19	687	0	14	539	79	632	0	28	27	57	112	0	5	17	16	38	1469	0	
12:00	0	21	430	13	464	0	1	715	106	822	0	27	23	62	112	0	7	15	10	32	1430	0	
13:00	0	27	471	23	521	0	2	611	74	687	0	19	31	77	127	0	5	9	9	23	1358	0	
14:00	0	33	463	16	512	0	5	273	59	337	0	15	19	38	72	0	6	6	6	18	939	0	
15:00	0	34	550	12	596	0	3	1016	51	1070	0	20	28	78	126	0	8	4	6	18	1810	0	
16:00	0	26	590	19	635	0	7	1095	88	1190	0	29	18	99	146	0	2	6	7	15	1986	0	
17:00	0	16	725	48	789	0	4	1145	81	1230	0	18	21	75	114	0	9	9	13	31	2164	0	
18:00	0	27	638	31	696	0	6	782	79	867	0	9	21	61	91	0	9	15	8	32	1686	0	
19:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
20:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
21:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Summary

Warrants

- ☒ 1. Eight-hour vehicular volume
- ☒ 2. Four-hour vehicular volume
- ☒ 3. Peak Hour
- ☐ 9. Intersection Near a Grade Crossing




Warrants Satisfied

- YES
- YES
- YES
- N/A

Warrants analysis results

MODUE 2: SIGNAL WARRANT

Evaluation results for Warrant 1


Office of Traffic & Safety Univ. of Maryland
ATTAP <http://attap.umd.edu>


Analyst:
Department:
Date of Analysis:
Date of Traffic data:
Location:
Scenario:
☐ Community Less Than 10,000
Major Street:
Num. of Approach Lanes:
85th Percentile Speed:
Direction:
Minor Street:
Num. of Approach Lanes:

Input/Summary W9 Input W1A W1B W2 W3 W9

MUTCD Signal Warrant 1: Eight-hour Vehicular Volume
Table 4c-1. Warrant 1, Eight-Hour Vehicular Volume
Number of lanes for moving traffic on each approach Vehicles per hour on major street Vehicles per hour on higher-volume minor-street approach (one direction)
Condition A - Minimum Vehicular Volume

Major Street	Minor Street	100%	80%	70%	56%	100%	80%	70%	56%
1	1	500	400	350	280	150	120	105	84
2 or more	1	600	480	420	336	150	120	105	84
2 or more	2 or more	600	480	420	336	200	160	140	112
1	2 or more	500	400	350	280	200	160	140	112

Evaluation of Condition A

Evaluation of Condition A with the 100% columns (600, 150)					Evaluation of Condition A with the 80% columns (480, 120)				
Hour Start	Hour End	Major Volume	Minor Volume	Warrant	Hour Start	Hour End	Major Volume	Minor Volume	Warrant
5:00	6:00	0	0	no	5:00	6:00	0	0	no
6:00	7:00	607	27	no	6:00	7:00	607	27	no
7:00	8:00	1326	50	no	7:00	8:00	1326	50	no
8:00	9:00	1775	84	no	8:00	9:00	1775	84	no
9:00	10:00	1292	91	no	9:00	10:00	1292	91	no
10:00	11:00	1230	104	no	10:00	11:00	1230	104	no
11:00	12:00	1319	112	no	11:00	12:00	1319	112	no
12:00	13:00	1286	112	no	12:00	13:00	1286	112	no
13:00	14:00	1208	127	no	13:00	14:00	1208	127	yes
14:00	15:00	849	72	no	14:00	15:00	849	72	no
15:00	16:00	1666	126	no	15:00	16:00	1666	126	yes
16:00	17:00	1825	146	no	16:00	17:00	1825	146	yes
17:00	18:00	2019	114	no	17:00	18:00	2019	114	no
18:00	19:00	1563	91	no	18:00	19:00	1563	91	no
19:00	20:00	0	0	no	19:00	20:00	0	0	no
20:00	21:00	0	0	no	20:00	21:00	0	0	no
21:00	22:00	0	0	no	21:00	22:00	0	0	no

Condition A is not met
Total Number of Hours met: 0



Condition A is not met
Total Number of Hours met: 3

Evaluation
criteria


Evaluation
results

MODUE 2: SIGNAL WARRANT

Evaluation results for Warrant 2



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Analyst: HKim

Department: ATTAP

Date of Analysis: 07/05/2017

Date of Traffic data: 06/10/2015

Location: MD 187 at Cordell Ave

Scenario:

☐ Community Less Than 10,000

Major Street: MD 187

Num. of Approach Lanes: 2 or more

85th Percentile Speed: below 40 mph

Direction: North-South

Minor Street: Cordell Ave

Num. of Approach Lanes: 1

Calculate

Clear

Load

See Sample

Open

Print

Save

Save As

Back

Exit

Input/Summary

W9 Input

W1A

W1B

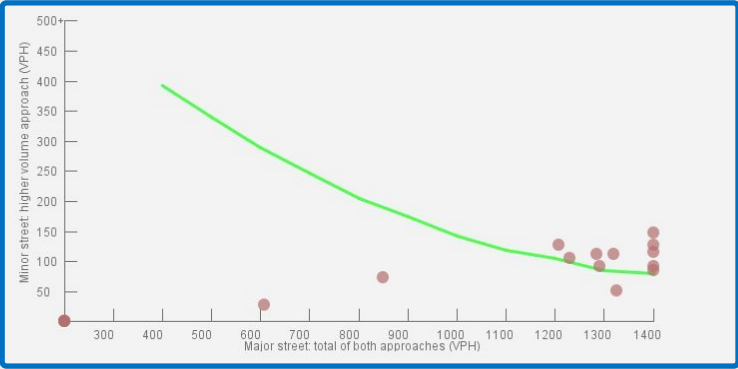
W2

W3

W9

MUTCD Signal Warrant 2: Four-hour Vehicular Volume

Figure 4C-1, Warrant 2 - Four-Hour Vehicular Volume



Hour	Major Volume	Minor Volume	Threshold	Warrant
5:00	0	0	n/a	no
6:00	607	27	285	no
7:00	1326	50	80	no
8:00	1775	84	80	yes
9:00	1292	91	86	yes
10:00	1230	104	98	yes
11:00	1319	112	80	yes
12:00	1286	112	87	yes
13:00	1208	127	102	yes
14:00	849	72	188	no
15:00	1666	126	80	yes
16:00	1825	146	80	yes
17:00	2019	114	80	yes
18:00	1563	91	80	yes
19:00	0	0	n/a	no
20:00	0	0	n/a	no
21:00	0	0	n/a	no

Warrant 2 is met
Total Number of Hours met: 10

Evaluation
criteria

Evaluation
results

Evaluation results for Warrant 9

Additional input for W9

Evaluation results

MODULE 3: SHOULDER BYPASS LANE WARRANT

- ❑ Uses the MDOT SHA's **Application and Design Guidelines for Shoulder Bypass Lanes**
- ❑ Investigates the need for shoulder bypass lanes versus left-turn lanes by analyzing related factors such as traffic conditions and physical characteristics of the location
- ❑ Provides whether the following shoulder bypass lane warrant is satisfied at **a two-lane, two-way unsignalized T-intersection** or not
 - Warrant 1. Vehicular **Volumes**
 - Warrant 2. Stopping **Sight Distance**
 - Warrant 3. **Accident** History

MODULE 3: SHOULDER BYPASS LANE WARRANT

How to Use

- 1 Input Traffic Volume Data
- 2 Set Location-specific Characteristics
- 3 Click Calculate

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ATTAP <http://attap.umd.edu>

MIDCAP

Analyst: H.Kim
Department: ATTAP
Date: 04/25/2017
Intersection: MD 355 at Old Baltimore
Location: Montgomery
Major Street: MD 355
Minor Street: West old Baltimore Rd.
Scenario: Traffic Data Date: Wednesday 04/13/2016

Calculate Clear
Open Print
Save Save As
Back Exit

Shoulder Bypass Lane Warrant

Input/Summary w1 w2/w3

1 **Input**

Traffic Volume (veh/hr)

Begin Hour	Advancing Left	Advancing Through	Opposing
6:00	32	194	748
7:00	41	379	974
8:00	50	374	1177
9:00	59	294	921
10:00	63	318	502
11:00	63	337	357
12:00	83	521	490
13:00	73	487	423
14:00	104	644	565
15:00	57	716	227
16:00	147	1248	623
17:00	198	1233	646
18:00	118	692	386
19:00	69	502	181
20:00			
21:00			

2

Prevailing Speed: mph
Design Speed: mph
Advancing Approach Sight Distance: ft

Crash Frequency (Rear-end & Left Turn Types):
 during a 12-month period
 during a 24-month period

Summary

warrants satisfied

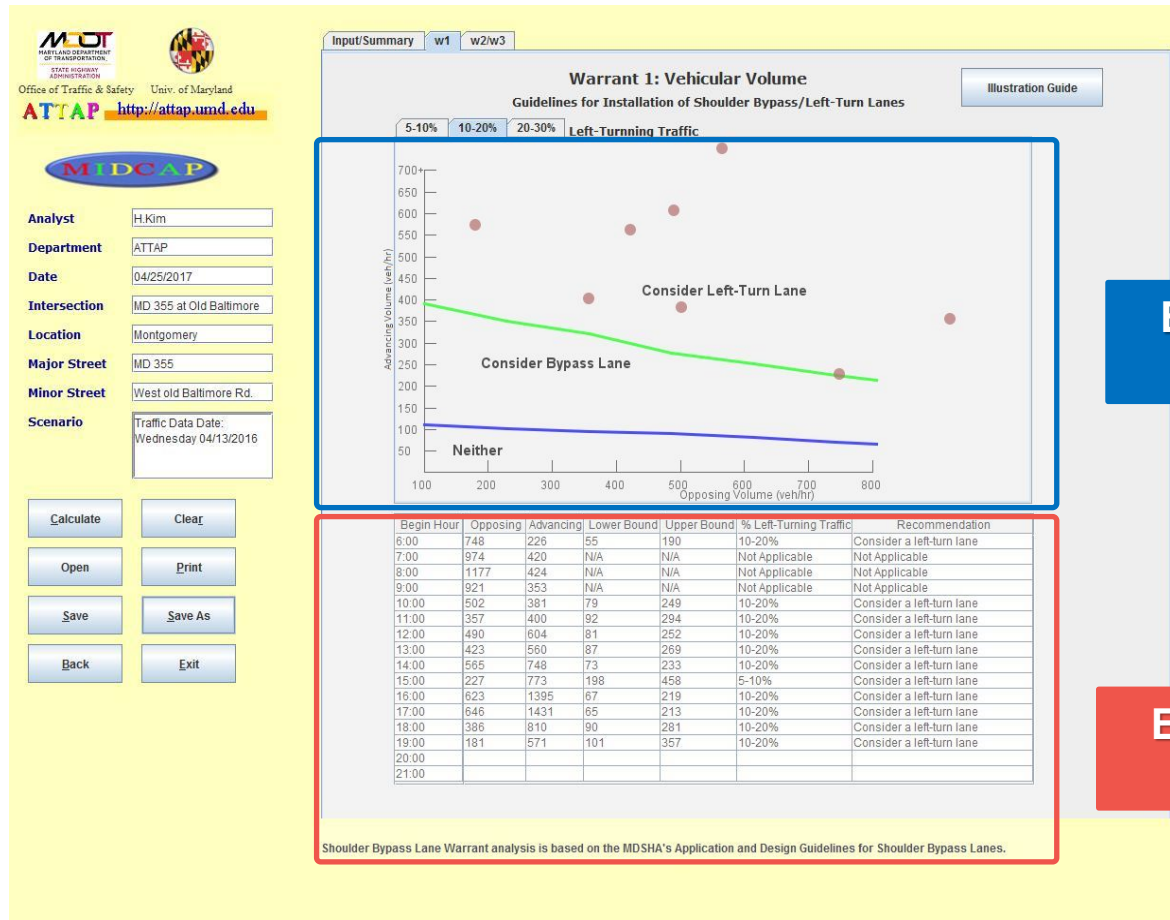
1. Vehicular Volume	No (Consider a left turn lane)
2. Stopping Sight Distance	N/A
3. Accident History	N/A

Warrants analysis results

Shoulder Bypass Lane Warrant analysis is based on the MDSHA's Application and Design Guidelines for Shoulder Bypass Lanes.

MODULE 3: SHOULDER BYPASS LANE WARRANT


Evaluation results for Warrant 1




Evaluation
criteria


Evaluation
results

MODULE 4: LEFT TURN PHASE GUIDELINE

- ❑ Use the **Left Turn Phase Guideline** from the MDOT SHA's Traffic Engineering & Safety Manual
- ❑ Provides a recommended type of left turn phase among exclusive, permissive and exclusive/permissive at a particular location given traffic demand, number of lanes, speed, and sight distance.
- ❑ Includes Exclusive Left Turn phase and  Permissive-exclusive Left Turn phase guidelines.

MODULE 4: LEFT TURN PHASE GUIDELINE


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Univ. of Maryland
MIDCAP

SHA Left Turn Phase Guide

Analyst: Minseok Kim

Department: OOTS-TDSD

Date: 2016/10/12

Intersecti...: MD 108 and Ten Oaks Rd

Location: Howard Co.

Scenario: WB Left with 2015/6/11 Volumes & Proposed Improvements


OpenClear

UndoRedo


SaveSave As

PrintBack


Legend




Previous and selected step




Next or unselected step



Current step



Unselected left turn phase



Recommended left turn phase

Note

- This procedure applies to locations that have a separate left turn lane
- Use Exclusive phasing with the understanding that non-left turn crashes may increase.
- Restrictive Sight Distance:
 - 250 ft. for speeds of 35 mph or less
 - 400 ft. for speeds \geq 40mph

Is left turn demand >2 per cycle?
(Average in highest hour)

☐ Yes ☒ No

How many opposing lanes?
(Thru plus unchannelized right)

☐ 1 or 2 Lanes ☐ 3 Lanes

1 or 2 lanes

If 1 lane, is volume cross-product >70,000?
If 2 lanes, is volume cross-product > 100,000?

☐ Yes ☐ No

Is opposing prevailing speed > 45 mph?

☐ Yes ☐ No

Is sight distance restricted?

☐ Yes ☐ No

Is there a severe left-turn crash problem
which could be corrected by exclusive phasing?

☐ Yes ☐ No

3 lanes

Is volume cross-product > 144,000?

☐ Yes ☐ No

Is opposing prevailing speed > 45 mph?

☐ Yes ☐ No

Is sight distance restricted?

☐ Yes ☐ No

Is there a severe left-turn crash problem
which could be corrected by exclusive phasing?

☐ Yes ☒ No

Consider EXCLUSIVE*

Consider EXCLUSIVE

Consider EXCLUSIVE

Consider EXCLUSIVE

Consider EXCLUSIVE

Consider EXCLUSIVE PERMISSIVE** (E-P)

Consider EXCLUSIVE

Consider EXCLUSIVE

Consider EXCLUSIVE PERMISSIVE

* An opposing speed >45 mph indicates a potential left turn crash problem. Consider exclusive phasing, realizing that non-left turn crashes may increase.

** See Exclusive Permissive Left Turn Phase Guidelines



*** See Exclusive Left Turn Phase Guidelines


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MODULE 4: LEFT TURN PHASE GUIDELINE





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SHA Left Turn Phase Guide

Analyst
Department
Date
Intersection
Location
Scenario

Exclusive Left Turn Phase Guidelines

Consider EXCLUSIVE
Is there sufficient time-of-day variation in left-turn or opposing demand that would justify E-P phasing?
☐ Yes ☐ No

☐ Yes ☐ No
Is opposing speed >45 MPH?
☐ Yes ☐ No

☐ Yes ☐ No
Is sight distance restricted?
☐ Yes ☐ No

☐ Yes ☐ No
Is there a severe left-turn crash problem that could be correctly by exclusive phasing?
☐ Yes ☐ No

Consider EXCLUSIVE

Consider EXCLUSIVE



Consider EXCLUSIVE

Consider PEAK-PERIOD EXCLUSIVE AND OFF-PEAK FLASHING RED ARROW**

**** Public outreach program recommended - motorists may interpret R10-12(2) sign to mean that flashing phase occurs during every cycle and not expect exclusive operation. Consider blank-out signs of VMS.**


MODULE 4: LEFT TURN PHASE GUIDELINE





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SHA Left Turn Phase Guide

Analyst

Department

Date

Intersection

Location

Scenario

Clear

Undo

Redo

Print

Save As

Save and Exit

Exclusive-Permissive Left Turn Phase Guidelines

Consider E-P

Is the left-turn movement on the main-road approach to a half-signal or Maryland-T?

☐ Yes ☐ No

Yes → Consider FLASHING RED ARROW

No → Are motorists able to safely judge gaps in oncoming traffic?
(Do drivers appropriately comprehend the circular green phase as permissive?)

☐ Yes ☐ No

Yes → Consider TRADITIONAL E-P

No → Is there severe crash pattern involving left turns within the intersection?

☐ Yes ☐ No


No → Consider TRADITIONAL E-P

Yes → Consider FLASHING RED ARROW


MODULE 5: LIGHTING EVALUATION

- ❑ Use the MDOT SHA's **evaluation form for intersection lighting**.
- ❑ Provides whether or not the intersection lighting is to be considered based on the weighted sum of scores (13 or more) for criteria, such as signalization, the existence of medians, the existence of left turn bays and/or other auxiliary lanes, etc.

MODULE 5: LIGHTING EVALUATION



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**MDSHA
EVALUATION FORM FOR
INTERSECTION LIGHTING**

Analyst Sam DeLaurence
Department District 7, Traffic Division
Date 07/25/2016
Intersection MD 26 at MD31
Location Frederick
Scenario

Open Clear

Save Save As

Print Back

Criteria		Score Met = 1 Not Met = 0 (a)	Weight (b)	Total (a x b)	
A	Is intersection signalized?	<input checked="" type="radio"/> 0 <input type="radio"/> 1	5	0	
B	Does intersection have medians on any approach?	<input checked="" type="radio"/> 0 <input type="radio"/> 1	4		
C	Does intersection have left turn bays and /or other auxiliary lanes?	<input type="radio"/> 0 <input checked="" type="radio"/> 1	3		
D	Is intersection a freeway ramp terminal?	<input checked="" type="radio"/> 0 <input type="radio"/> 1	4		
E	Is there significant pedestrian volume after dark?	<input checked="" type="radio"/> 0 <input type="radio"/> 1	3	0	
F	Does intersection involve two or more state maintained highways?	<input type="radio"/> 0 <input checked="" type="radio"/> 1	1	1	
G	Does ADT of state highway exceed 15,000?	<input checked="" type="radio"/> 0 <input type="radio"/> 1	2	0	
H	Ratio of Night to total accidents (Min 5 accidents)	0.35-0.40	<input checked="" type="radio"/> 0 <input type="radio"/> 1	1	0
		0.40-0.45	<input checked="" type="radio"/> 0 <input type="radio"/> 1	3	0
		0.45-0.50	<input checked="" type="radio"/> 0 <input type="radio"/> 1	5	0
		> 0.50	<input checked="" type="radio"/> 0 <input type="radio"/> 1	8	0
I	Is intersection at school entrance or children walking to school?	<input checked="" type="radio"/> 0 <input type="radio"/> 1	3	0	
J	Is operating speed on any road approach greater than 50 MPH?	<input type="radio"/> 0 <input checked="" type="radio"/> 1	4	4	
K	Is intersection sight distance restricted?	<input type="radio"/> 0 <input checked="" type="radio"/> 1	5	5	
L	Are there any brightly lighted areas, i.e., parking lots, commercial area, etc. within 300 feet of the intersection?	<input checked="" type="radio"/> 0 <input type="radio"/> 1	4	0	
M	Are any of the road approaches continuously lighted?	<input checked="" type="radio"/> 0 <input type="radio"/> 1	4	0	
Total				13	

1) Intersection lighting is to be considered by a score of 13 or more.
 2) Potential for intersection lighting will be prioritized based on score.

User input

Weighted sum



THANK YOU!

For questions or technical support, contact us at MIDCAP@umd.edu.

ATTAP research team
<http://attap.umd.edu>