

TRAFFIC IMPACT STUDY
MARPLE ASSOCIATES DEVELOPMENT
Marple Township, Delaware County

Prepared for
Marple Associates

July 11, 2011
Revised January 6, 2014

Prepared by
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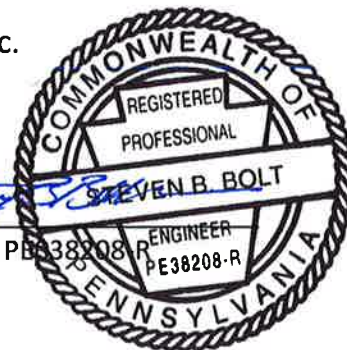


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Executive Summary

This study analyzes the traffic impact of the proposed development of a 26-acre site owned by Marple Associates located in the southwest quadrant of the I-476/West Chester Pike interchange in Marple Township, Delaware County. Two access points will be provided for the proposed development. The primary access point is a proposed new full-movement signalized intersection of West Chester Pike and Langford Run Road, located at the site's existing right-in, right-out only driveway. The second site access is located at the existing unsignalized intersection of South Lawrence Road and Langford Run Road, which provides left-and-right turn entry and right-turn-only exit.

The study area for this traffic impact study includes West Chester Pike from New Ardmore Avenue to Old West Chester Pike as well as two intersections on South Lawrence Road: Langford Run Road and Sussex Road. This TIS analysis projects peak hourly volumes to Opening Year 2015 as well as Design Horizon Year 2020, with and without the proposed development.

Proposed Development

The Marple Associates site is proposed to be developed with a mix of retail, office and residential uses, including 260,000 sq.ft. retail shopping center, a drive-in bank, fitness center, day care, 40,000 sq.ft. of office and 150 townhomes. The trips associated with the proposed development are summarized as follows. The detailed trip generation is shown in Appendix F.

	AM Peak Hour			PM Peak Hour			Saturday Peak Hour		
	In	Out	Total	In	Out	Total	In	Out	Total
Total Trips	355	254	609	822	889	1711	1020	936	1955
Internal Trips	0	0	0	50	39	89	34	36	70
Pass-by Trips *	0	0	0	175	195	370	243	220	463
New Trips	355	254	609	597	656	1253	743	681	1423

* Pass-by traffic after subtracting internal trips

Other Development

Other development in the vicinity includes an outpatient center by Crozer Keystone Health System on the site of the Pathmark supermarket on South Lawrence Road (along with the closing of that supermarket). A YMCA is proposed in Haverford Township at Eagle and N. Lawrence Road. A synagogue is proposed in the residential area north of West Chester Pike accessed by New Ardmore Avenue. Information on other development is included in Appendix E.

Proposed Improvements

Proposed improvements in conjunction with the development include creation of a full-movement signalized intersection at the intersection of Langford Run Road and West Chester Pike, so that Langford Run Road can serve as the main access to the Marple Associates development site. West Chester Pike

will be improved at the new intersection to add a westbound left turn lane and an eastbound right turn lane and additional eastbound through lane.

Langford Run Road will be extended through the development site to connect West Chester Pike and South Lawrence Road. Langford Run Road will serve a 'public' function by providing an attractive alternate for a number of motorists traveling between the west on West Chester Pike and the south on Lawrence Road -- diverting traffic from the heavily traveled section of West Chester Pike between the I-476 interchange and Lawrence Road.

Proposed modifications at the I-476 southbound off ramp (Ramp S-WC) include elimination of the existing channelized right-turn yield roadway, widening of other portions of the ramp to provide for additional lanes and storage length, and routing of all southbound off ramp traffic to the signalized intersection with West Chester Pike. The ramp will provide a double left turn, a through lane and a separate right turn lane at the West Chester Pike signal.

Other roadway improvements along West Chester Pike include adding a westbound right turn deceleration lane for Mather Avenue beginning just west of the pedestrian crossing at Langford Run Road and extending the sidewalks on West Chester Pike from New Ardmore Avenue to Langford Run Road.

At the three-lane approach of I-476 Northbound off ramp to West Chester Pike it is proposed to change the ramp's center lane from the existing shared left-and-through to a shared left, through and right turn lane and modify the existing overhead lane control signaling. The pedestrian operation at the signal will need to be modified for a double-right turn movement from the ramp.

On the I-476 Northbound on ramp, where the lanes from eastbound and westbound West Chester Pike meet it is proposed to restripe the ramp to extend the separate lanes and move the merge area further north along the ramp. This will reduce the conflict perceived by drivers and increase the rate of flow through this area, which should act to decrease backups on the ramp.

In addition to these roadway improvements, it is recommended that the timings and offsets of the signals along West Chester Pike included in the study area be adjusted and optimized. An interconnection by fiber-optic cable will be established between the two separate interconnected systems on West Chester Pike in Marple Township and Haverford Township, and the signals will operate off a single master.

The proposed roadway improvements are illustrated in the concept plan that follows. The total cost of design and construction of the improvements, including construction of Langford Run Road connecting West Chester Pike and Lawrence Road, modification to the southbound off ramp from I-476 at West Chester Pike, and road widening, signalization, and signing improvements to West Chester Pike, is approximately \$3 million.

Tables 1 – 6 which follow the Proposed Roadway Improvements Plan illustrate the comparisons of peak hour levels of service and queues with and without development. With the improvements described above, overall intersection delay with development remains within ten seconds of the no-build delay at all study intersections in both the Opening Year 2015 and Design Horizon Year 2020. Overall intersection levels of service with development are all 'D' or better except for the intersection of N. Lawrence Road which is LOS 'E' in the 2020 AM peak. Overall intersection levels of service with development remain the same as no-build levels of service at all intersections except for the intersections of North Lawrence Road (LOS 'C' to Level 'D') and Old West Chester Pike (LOS 'B' to LOS 'C') during the PM peak hour, as well as the intersection of I-476 Northbound Off-Ramp (LOS 'B' to LOS 'C') during the Saturday peak hour. All turn lane queues in the Future Horizon Year 2020 are within the available storage length, except the northbound right turn from South Lawrence Road at West Chester Pike, which is the existing condition.

Furthermore, if deemed beneficial by PennDOT and if supported by both Marple and Haverford Townships, Traffic Adaptive Control will be installed at all the signals from Old West Chester Pike to New Ardmore Avenue as part of the offsite improvements. Although no analysis was conducted to quantify the effects of Traffic Adaptive Control, there is little doubt that the traffic operation at the signalized intersections within the study area would benefit from this new technology. With the addition of Traffic Adaptive Control, the future intersection levels of service and the queue lengths would be better than what is shown in this report.

Point of Access Study

A Point of Access Study dated March 31, 2010 was prepared by ORA on behalf of Marple Township with analysis of the existing weekday AM and PM peak hours and the future PM peak hour to Year 2032. That study included the West Chester Pike intersections from New Ardmore Avenue to North Lawrence Road. The study demonstrated the feasibility of the proposed median opening and new traffic signal on West Chester Pike at Langford Run Road for Marple Associates site access, along with the proposed modifications to the I-476 southbound off ramp. It also demonstrated the advantages of the median opening and full movement signalized access to the highway network:

- By providing direct access, it prevents undesirable movements by drivers attempting to reach the development (such as a U turn from westbound West Chester Pike at the New Ardmore Ave. signal) or departing the development (such as a U turn from eastbound West Chester Pike at the I-476 NB on-ramp in order to proceed west on West Chester Pike).
- By providing direct access, it helps prevent overloading and capacity/queuing problems that would occur at other intersections resulting from drivers traveling to the development via indirect access.
- It provides a bypass (via Langford Run Road) of a congested area of West Chester Pike for non-development motorists traveling between the west and the south.

The PennDOT review letter for the POA Study is included in Appendix Q.



ADD RIGHT-TURN
DECELERATION
LANE FOR
MATHER AVENUE

MEDIAN BREAK
AND NEW
TRAFFIC SIGNAL

PROPOSED LANE
CONFIGURATION:
(1) LEFT-TURN
LANE AND (2)
THROUGH LANES

ELIMINATE I-476 SB
SLIP RAMP;
PROPOSED LANE
CONFIGURATION:
(2) LEFT-TURN LANES,
(1) THROUGH LANE, AND
(1) RIGHT-TURN LANE

PROPOSED LANE
CONFIGURATION:
(3) THROUGH LANES
AND (1) RIGHT-TURN
LANE

PROPOSED LANE
CONFIGURATION:
(2) LEFT-TURN
LANES AND (1)
RIGHT-TURN
LANE

RESTRIPE RAMP TO
EXTEND SEPARATE
LANES FROM EAST
AND WEST, TO MOVE
THE MERGE FURTHER
NORTH AND INCREASE
RAMP FLOW

PROPOSED LANE
CONFIGURATION:
(1) LEFT-TURN
LANE, (1) SHARED
LEFT/RIGHT-TURN
LANE, AND (1)
RIGHT-TURN LANE

MODIFY EXISTING
OVERHEAD LANE
CONTROL SIGN

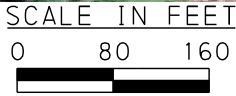


Table 1. AM Peak Hour Level of Service Comparison

intersection (node)	approach	movement	Existing (by move)	2015 No Build (move)	2015 Build (move)	2020 No Build (move)	2020 Build (move)
West Chester Pike & New Ardmore (3)	EB	Left	E(55)	E(66)	E(66)	E(66)	E(66)
		Thru/Right	B(15)	B(15)	B(14)	B(15)	B(14)
	WB	Left	D(52)	E(65)	E(69)	E(65)	E(68)
		Thru/Right	B(12)	A(5)	A(9)	A(5)	A(9)
	NB	Left/Thru	D(38)	D(37)	D(39)	D(37)	D(39)
		Right	D(36)	D(35)	D(37)	D(35)	D(37)
	SB	LTR	D(54)	D(51)	E(61)	D(51)	E(61)
Overall			B(17)	B(15)	B(17)	B(15)	B(17)
West Chester Pike & Langford (6)	EB	Thru			C(26)		C(26)
		Right			A(10)		A(10)
	WB	Left			C(25)		C(25)
		Thru			A(2)		A(2)
	NB	Left			D(44)		D(44)
		Right			C(28)		C(28)
	Overall				B(18)		B(18)
West Chester Pike & I-476 SB Ramps (10)	EB	Thru	B(18)	B(12)	B(17)	B(13)	B(17)
	WB	Thru	B(18)	A(6)	A(5)	A(7)	A(5)
	SB	Left	D(36)	D(36)	C(34)	D(36)	C(34)
		Thru	C(24)	C(24)	C(23)	C(24)	C(23)
		Right			D(37)		D(37)
	Overall		C(23)	B(16)	B(19)	B(16)	B(19)
West Chester Pike & I-476 NB Ramps (15)	EB	Left	E(61)	E(59)	D(44)	E(63)	D(46)
		Thru	A(9)	A(9)	A(9)	A(9)	A(10)
	WB	Thru	F(95)	E(66)	E(63)	E(71)	E(69)
		Left	C(32)	C(33)	D(41)	C(32)	D(41)
	NB	LT(R)	C(32)	C(33)	D(49)	C(32)	D(50)
		Right	D(51)	E(59)	D(50)	E(60)	D(49)
	Overall		D(52)	D(41)	D(38)	D(44)	D(40)
West Chester Pike & S Lawrence Rd (18)	EB	Thru	C(29)	B(13)	B(14)	B(13)	B(13)
		Right	B(13)	A(4)	A(5)	A(3)	A(5)
	WB	Left	D(54)	D(48)	D(47)	D(48)	D(47)
		Thru	F(89)	E(74)	E(72)	E(75)	E(77)
	NB	Left	D(37)	D(46)	D(47)	D(47)	D(48)
		Right	C(24)	C(26)	C(31)	C(27)	C(31)
	Overall		D(55)	D(45)	D(45)	D(45)	D(47)
West Chester Pike & N Lawrence Rd (2)	EB	Left	D(40)	D(46)	D(44)	D(46)	D(44)
		Thru	A(5)	A(9)	B(10)	A(9)	B(10)
	WB	Thru/Right	B(18)	C(34)	D(46)	D(36)	D(50)
	SB	Left	D(45)	C(34)	C(34)	C(34)	C(34)
		Right	F(264)	F(133)	F(142)	F(136)	F(144)
	Overall		E(64)	D(47)	D(54)	D(49)	E(56)
West Chester Pike & Old West Chester Pike (26)	EB	Thru/Right	B(12)	A(6)	A(7)	A(6)	A(7)
	WB	Left	D(47)	D(51)	D(53)	D(51)	D(53)
		Thru/Right	A(3)	A(3)	A(3)	A(3)	A(3)
	NB	Left/Thru	D(47)	D(47)	D(48)	D(47)	D(48)
		Right	D(44)	D(44)	D(44)	D(44)	D(44)
	SB	LTR	D(45)	D(45)	D(45)	D(45)	D(45)
	Overall		A(9)	A(7)	A(7)	A(7)	A(7)
S Lawrence Road & Langford Run Rd (#)	EB	R	b(12)	b(12)	b(13)	b(12)	b(13)
	NB	L	b(12)	b(12)	c(16)	b(12)	c(16)
S Lawrence Road & Sussex Blvd (#)	EB	LTR	D(53)	D(52)	D(53)	D(53)	D(53)
	WB	LTR	C(31)	C(31)	C(31)	C(31)	C(31)
	NB	LTR	C(25)	C(26)	C(28)	C(26)	C(28)
	SB	LTR	A(4)	A(4)	A(4)	A(4)	A(4)
	Overall		C(21)	C(21)	C(22)	C(21)	C(22)

Note: All analyses used revised timing and PHF by movement.

Table 2. PM Peak Hour Level of Service Comparison

intersection (node)	approach	movement	Existing (by move)	2015 No Build (move)	2015 Build (move)	2020 No Build (move)	2020 Build (move)
West Chester Pike & New Ardmore (3)	EB	Left	E(67)	E(75)	E(75)	E(75)	E(75)
		Thru/Right	A(9)	A(8)	A(9)	A(8)	A(9)
	WB	Left	E(77)	E(73)	E(79)	E(73)	E(79)
		Thru/Right	C(22)	B(12)	B(12)	B(13)	B(13)
	NB	Left/Thru	E(68)	E(77)	E(77)	E(77)	E(77)
		Right	D(50)	D(51)	D(51)	D(51)	D(51)
	SB	LTR	E(55)	E(58)	E(58)	E(58)	E(58)
Overall			B(20)	B(15)	B(15)	B(15)	B(15)
West Chester Pike & Langford (6)	EB	Thru			C(27)		C(27)
		Right			A(8)		A(8)
	WB	Left			D(40)		D(40)
		Thru			A(4)		A(4)
	NB	Left			D(51)		D(51)
		Right			C(32)		C(32)
	Overall				C(21)		C(21)
West Chester Pike & I-476 SB Ramps (10)	EB	Thru	D(37)	C(22)	C(24)	C(22)	C(24)
	WB	Thru	B(19)	C(31)	D(36)	C(32)	D(38)
	SB	Left	D(44)	D(43)	D(45)	D(44)	D(47)
		Thru	B(18)	B(17)	B(18)	B(17)	B(18)
		Right			C(33)		C(33)
	Overall		C(34)	C(32)	C(33)	C(33)	C(35)
West Chester Pike & I-476 NB Ramps (15)	EB	Left	F(107)	D(54)	D(39)	D(55)	D(40)
		Thru	B(16)	B(18)	B(14)	B(19)	B(14)
	WB	Thru	D(40)	D(36)	D(46)	D(37)	D(49)
		Left	C(32)	C(32)	D(52)	C(32)	D(52)
	NB	LT(R)	C(32)	C(32)	E(59)	C(32)	E(60)
		Right	F(106)	F(111)	E(59)	F(115)	E(59)
	Overall		D(39)	D(36)	C(31)	D(36)	C(32)
West Chester Pike & S Lawrence Rd (18)	EB	Thru	F(80)	D(41)	D(42)	D(47)	D(45)
		Right	B(12)	A(5)	A(5)	A(5)	A(5)
	WB	Left	D(52)	D(37)	D(46)	D(37)	D(49)
		Thru	C(25)	B(19)	C(20)	B(20)	C(20)
	NB	Left	D(38)	D(41)	D(44)	D(41)	D(44)
		Right	C(26)	C(29)	C(33)	C(29)	C(34)
	Overall		D(49)	C(30)	C(32)	C(33)	C(34)
West Chester Pike & N Lawrence Rd (2)	EB	Left	E(60)	C(23)	D(39)	C(23)	D(39)
		Thru	B(10)	A(6)	A(4)	A(6)	A(4)
	WB	Thru/Right	D(46)	D(46)	D(53)	D(47)	E(56)
	SB	Left	E(62)	E(62)	E(62)	E(63)	E(63)
		Right	D(47)	E(60)	F(80)	E(62)	F(83)
	Overall		D(37)	C(31)	D(38)	C(31)	D(39)
West Chester Pike & Old West Chester Pike (26)	EB	Thru/Right	B(19)	B(11)	C(25)	B(12)	C(27)
	WB	Left	E(63)	F(93)	F(93)	F(93)	F(93)
		Thru/Right	A(5)	A(6)	A(6)	A(6)	A(6)
	NB	Left/Thru	F(111)	F(82)	F(97)	F(83)	F(97)
		Right	D(47)	D(46)	D(47)	D(46)	D(47)
	SB	LTR	D(46)	D(44)	D(45)	D(44)	D(45)
	Overall		C(20)	B(16)	C(23)	B(16)	C(24)
S Lawrence Road & Langford Run Rd (#)	EB	R	b(13)	b(13)	c(20)	b(13)	c(20)
	NB	L	b(11)	b(11)	b(14)	b(11)	b(14)
S Lawrence Road & Sussex Blvd (#)	EB	LTR	D(37)	D(37)	D(37)	D(37)	D(37)
	WB	LTR	C(25)	C(25)	C(25)	C(25)	C(25)
	NB	LTR	B(20)	B(20)	C(21)	B(20)	C(21)
	SB	LTR	B(13)	B(13)	B(16)	B(13)	B(16)
	Overall		B(18)	B(18)	B(20)	B(18)	C(20)

Note: All analyses used revised timing and PHF by movement.

Table 3. Saturday Peak Hour Level of Service Comparison

intersection (node)	approach	movement	Existing (by move)	2015 No Build (move)	2015 Build (move)	2020 No Build (move)	2020 Build (move)
West Chester Pike & New Ardmore (3)	EB	Left	E(63)	E(61)	E(61)	E(61)	E(61)
		Thru/Right	B(11)	B(11)	B(12)	B(11)	B(12)
	WB	Left	E(66)	E(56)	D(53)	E(56)	D(53)
		Thru/Right	B(11)	A(5)	A(8)	A(5)	A(8)
	NB	Left/Thru	D(40)	D(40)	D(40)	D(40)	D(40)
		Right	D(39)	D(40)	D(40)	D(40)	D(40)
	SB	LTR	D(47)	D(51)	D(51)	D(51)	D(51)
Overall			B(15)	B(12)	B(13)	B(12)	B(13)
West Chester Pike & Langford (6)	EB	Thru			D(45)		D(47)
		Right			B(11)		B(11)
	WB	Left			C(22)		C(22)
		Thru			A(3)		A(3)
	NB	Left			D(43)		D(43)
		Right			B(15)		B(15)
	Overall				C(24)		C(24)
West Chester Pike & I-476 SB Ramps (10)	EB	Thru	B(15)	A(9)	A(8)	A(9)	A(8)
	WB	Thru	A(6)	A(2)	A(8)	A(2)	A(8)
	SB	Left	D(37)	D(36)	C(32)	D(36)	C(32)
		Thru	C(26)	C(26)	C(23)	C(25)	C(23)
		Right			D(42)		D(42)
	Overall		B(18)	B(14)	B(16)	B(14)	B(16)
West Chester Pike & I-476 NB Ramps (15)	EB	Left	E(62)	D(45)	D(53)	D(45)	D(53)
		Thru	A(2)	B(10)	A(6)	B(11)	A(6)
	WB	Thru	C(24)	B(15)	C(26)	B(15)	C(26)
		Left	C(32)	C(31)	D(47)	C(31)	D(47)
	NB	LT(R)	C(32)	C(31)	D(52)	C(31)	D(52)
		Right	E(58)	E(60)	D(52)	E(61)	D(52)
	Overall		B(19)	B(19)	C(22)	B(20)	C(22)
West Chester Pike & S Lawrence Rd (18)	EB	Thru	C(35)	B(20)	C(33)	C(20)	D(35)
		Right	A(4)	A(3)	A(4)	A(3)	A(4)
	WB	Left	D(48)	D(37)	D(52)	D(37)	D(53)
		Thru	C(21)	B(18)	B(15)	B(18)	B(15)
	NB	Left	C(32)	C(33)	C(32)	C(33)	C(32)
		Right	C(23)	C(25)	C(28)	C(26)	C(28)
	Overall		C(28)	C(21)	C(27)	C(21)	C(28)
West Chester Pike & N Lawrence Rd (2)	EB	Left	D(53)	C(24)	C(25)	C(24)	C(25)
		Thru	A(2)	A(6)	B(15)	A(6)	B(15)
	WB	Thru/Right	B(19)	B(17)	C(20)	B(17)	C(20)
	SB	Left	F(102)	F(104)	F(104)	F(106)	F(106)
		Right	F(85)	F(88)	F(102)	F(90)	F(103)
	Overall		C(29)	C(26)	C(32)	C(27)	C(32)
West Chester Pike & Old West Chester Pike (26)	EB	Thru/Right	A(8)	A(5)	A(8)	A(5)	A(8)
	WB	Left	D(46)	D(54)	D(54)	D(54)	D(54)
		Thru/Right	A(3)	A(3)	A(4)	A(3)	A(4)
	NB	Left/Thru	D(48)	D(51)	D(51)	D(51)	D(51)
		Right	D(42)	D(42)	D(42)	D(42)	D(42)
	SB	LTR	D(42)	D(43)	D(43)	D(43)	D(43)
	Overall		A(8)	A(7)	A(8)	A(7)	A(8)
S Lawrence Road & Langford Run Rd (#)	EB	R	b(10)	b(10)	b(13)	b(10)	b(13)
	NB	L	a(9)	a(9)	a(10)	a(9)	a(10)
S Lawrence Road & Sussex Blvd (#)	EB	LTR	C(31)	C(31)	C(31)	C(31)	C(31)
	WB	LTR	C(32)	C(32)	C(32)	C(32)	C(32)
	NB	LTR	B(17)	B(17)	B(18)	B(17)	B(18)
	SB	LTR	A(3)	A(3)	A(3)	A(3)	A(3)
	Overall		B(11)	B(11)	B(12)	B(11)	B(12)

Note: All analyses used revised timing and PHF by movement.

Table 4. AM Peak Hour Queue Length

Intersection (Node)	Approach	Movement	storage length	Existing (move)		2015 No Build (move)		2015 Build (move)		2020 No Build (move)		2020 Build (move)	
				Synchro		Synchro		Synchro		Synchro		Synchro	
				50th % Q length	95th % Q length	50th % Q length	95th % Q length	50th % Q length	95th % Q length	50th % Q length	95th % Q length	50th % Q length	95th % Q length
West Chester Pike & New Ardmore (3)	EB	L	180	15	24	15	24	15	24	15	24	15	24
		TTR		360	462	372	479	372	464	380	487	380	473
	WB	L	145	20	35	27	45	25	42	27	45	25	42
		TTR		257	537	47	104	185	255	47	118	188	257
	NB	LT		30	53	30	53	31	56	30	53	31	56
West Chester Pike & Langford (6)	EB	R		0	37	0	36	0	38	0	36	0	38
		LTR		103	150	103	148	104	#169	103	148	104	#169
	WB	TTT	450					354	416			360	420
		R						53	m73			53	m71
	NB	LL						106	147			106	147
West Chester Pike & I-476 SB Ramps (10)	WB	TT						46	64			47	65
		LL						48	77			48	77
	SB	T	180	2	2	2	2	2	2	2	2	2	2
		R						92	146			92	146
West Chester Pike & I-476 NB Ramps (15)	EB	TTT	510	306	368	133	204	379	491	133	208	384	498
		TT		195	m177	77	m175	47	m156	84	m192	53	m155
	WB	LL		242	281	250	288	243	284	250	288	245	288
		T											
West Chester Pike & S Lawrence Rd (18)	EB	TTT	600	354	408	124	198	228	256	125	205	220	249
		R		229	350	49	m64	55	71	50	m66	55	70
	WB	LL	460*	111	m121	117	m114	136	m126	118	m112	137	m127
		TT		~1051	m#912	~1004	m#970	~1062	m#536	~1006	m#946	~1082	m#536
West Chester Pike & N Lawrence Rd (2)	EB	LL	460*	187	243	200	247	201	255	202	250	203	258
		TT		87	184	168	190	176	253	169	195	177	259
	WB	TTTR		350	465	442	#630	~487	#698	452	#644	~512	#712
		L	325	37	73	33	65	33	65	33	65	33	65
West Chester Pike & Old West Chester Pike (26)	EB	TTT		~831	#1006	~741	#918	~777	#950	~752	#931	~787	#960
		R											
	WB	TTT	170	298	417	220	290	246	348	221	296	247	355
		L		44	81	45	85	45	85	45	85	45	85
S Lawrence Rd & Langford Run Rd (#)	WB	TTTR		109	160	112	156	125	158	115	159	127	161
		LT		15	11	15	11	17	12	15	11	17	12
	NB	R		0	9	0	9	0	9	0	9	0	9
		LTR		7	0	7	0	7	0	7	0	7	0
S Lawrence Rd & Sussex Blvd (#)	EB	R		-	1	-	1	-	17	-	1	-	17
		L	155	-	1	-	1	-	37	-	1	-	37
	WB	LTR		46	35	46	35	46	35	46	35	46	35
		LTR		14	42	14	42	14	42	14	42	14	42
S Lawrence Rd & Sussex Blvd (#)	NB	LTTR		212	275	218	284	236	305	222	288	239	310
		LTR		42	78	43	79	45	84	43	80	46	85

*Average length of dual left turn lanes

~: This indicates that the approach is above capacity and the queue length could be much longer.

#: This indicates that the volume for the 95th percentile cycle exceeds capacity.

m: This indicates that the volume for the 95th percentile queue is metered by an upstream signal.

In many cases, the 95th percentile queue will not be experienced due to upstream metering.

If the upstream intersection is at / near capacity, the 50th percentile queue represents the max. queue experienced.

The queue length reported is the one for the lane with the highest queue in the lane group.

Table 5. PM Peak Hour Queue Length

Intersection (Node)	Approach	Movement	storage length	Existing (move)		2015 No Build (move)		2015 Build (move)		2020 No Build (move)		2020 Build (move)	
				Synchro		Synchro		Synchro		Synchro		Synchro	
				50th % Q length	95th % Q length	50th % Q length	95th % Q length	50th % Q length	95th % Q length	50th % Q length	95th % Q length	50th % Q length	95th % Q length
West Chester Pike & New Ardmore (3)	EB	L	180	95	#188	98	#188	98	#188	98	#188	98	#188
		TTR		214	508	193	393	219	447	196	401	223	456
	WB	L	145	12	m18	13	m22	12	m23	13	m22	12	m23
		TTR		783	843	201	260	364	449	211	270	367	459
	NB	LT		57	88	58	99	58	#99	58	#99	58	#99
		R		0	6	0	7	0	7	0	7	0	7
	SB	LTR		46	76	47	80	47	80	47	80	47	80
West Chester Pike & Langford (6)	EB	TTT	450					380	469			386	475
		R						73	64			72	64
	WB	L						327	m365			327	m361
		TT						62	m332			64	m336
	NB	LL						114	155			114	155
		R						356	467			356	467
West Chester Pike & I-476 SB Ramps (10)	EB	TTT		353	499	335	252	220	#338	339	254	221	#347
		TT		111	#178	599	#699	~673	m713	606	m#704	~686	m#707
	SB	LL		578	#742	580	#745	590	#758	591	#760	602	#772
		T	180	2	3	2	2	2	3	2	2	2	3
		R						367	504			371	511
West Chester Pike & I-476 NB Ramps (15)	EB	L	510	314	#427	318	#396	437	m#480	321	#401	440	m#479
		TTT		541	574	432	502	478	m596	445	m517	498	m603
	WB	TT		431	396	414	#486	~461	#558	420	#495	~469	#563
		L	520	84	141	85	142	231	331	86	144	232	333
	NB	LT(R)	520	84	35	85	35	231	74	86	35	234	342
		R		~449	#667	~462	#681	220	323	~470	#690	222	326
West Chester Pike & S Lawrence Rd (18)	EB	TTT	600	~896	m#1020	~847	m#893	~882	#961	~863	m#908	~899	#978
		R		390	m462	158	m151	99	103	157	m152	99	104
	WB	LL	460*	226	m#248	194	m216	~265	m#261	193	m215	~269	m#260
		TT		570	m753	665	m742	728	m730	680	m751	739	m726
	NB	LL		115	130	120	147	85	112	121	148	87	114
		R	200	236	301	228	329	248	361	231	334	252	366
West Chester Pike & N Lawrence Rd (2)	EB	LL	460*	456	m414	183	m160	360	m352	169	m161	371	m356
		TT		156	m151	87	m78	66	m53	95	m77	74	m54
	WB	TTTR		483	m#624	516	557	581	#635	528	563	590	#646
		L	325	103	139	105	141	105	141	106	141	106	141
	SB	R		592	#818	612	#901	~765	#1014	618	#919	~782	#1032
West Chester Pike & Old West Chester Pike (26)	EB	TTR		386	#996	137	#328	~166	#1098	139	#963	~171	#1117
		L	170	60	96	63	#129	63	#129	63	#129	63	#129
	WB	TTTR		112	131	129	150	140	163	131	153	142	164
		LT		134	52	132	51	135	52	133	52	135	52
	NB	R		27	58	35	66	40	73	36	67	40	73
		LTR		5	4	5	4	5	4	5	4	5	4
S Lawrence Rd & Langford Run Rd (#)	EB	R		-	1	-	1	-	65	-	1	-	66
	NB	L		-	1	-	1	-	38	-	1	-	39
S Lawrence Rd & Sussex Blvd (#)	EB	LTR		106	39	106	39	106	39	106	39	106	39
	WB	LTR		22	23	22	23	22	23	22	23	22	23
	NB	LTTR		120	168	113	160	135	188	114	162	137	191
	SB	LTTR		163	#244	163	243	187	#345	165	246	190	#355

*Average length of dual left turn lanes

~: This indicates that the approach is above capacity and the queue length could be much longer.

#: This indicates that the volume for the 95th percentile cycle exceeds capacity.

m: This indicates that the volume for the 95th percentile queue is metered by an upstream signal.

In many cases, the 95th percentile queue will not be experienced due to upstream metering.

If the upstream intersection is at / near capacity, the 50th percentile queue represents the max. queue experienced.

The queue length reported is the one for the lane with the highest queue in the lane group.

Table 6. Saturday Peak Hour Queue Length

Intersection (Node)	Approach	Movement	storage length	Existing (move)		2015 No Build (move)		2015 Build (move)		2020 No Build (move)		2020 Build (move)	
				Synchro		Synchro		Synchro		Synchro		Synchro	
				50th % Q length	95th % Q length	50th % Q length	95th % Q length	50th % Q length	95th % Q length	50th % Q length	95th % Q length	50th % Q length	95th % Q length
West Chester Pike & New Ardmore (3)	EB	L	180	7	17	7	16	7	16	7	16	7	16
		TTR		242	303	249	312	293	365	253	317	297	371
	WB	L	145	38	71	51	78	43	71	51	78	44	71
		TTR		281	448	87	102	154	307	88	103	154	311
	NB	LT		9	8	9	8	9	8	9	8	9	8
West Chester Pike & Langford (6)	EB	R		0	24	0	24	0	24	0	24	0	24
		LTR		62	81	62	83	62	83	62	83	62	83
	WB	TTT	450					~298	#391			~304	#398
		R						92	146			90	144
	NB	L						397	441			397	431
West Chester Pike & I-476 SB Ramps (10)	WB	TT		209	275	94	113	52	m377	95	114	51	m378
		LL		69	81	15	27	71	95	15	27	72	96
	SB	L		236	274	240	276	222	267	242	278	224	271
		T	180	2	3	2	2	2	2	2	2	2	2
	R							239	261			241	264
West Chester Pike & I-476 NB Ramps (15)	EB	L	510	133	182	136	187	212	269	136	186	214	271
		TTT		22	26	222	206	108	164	228	210	112	169
	WB	TT		171	223	208	264	320	371	208	265	325	374
		L	520	49	90	50	91	143	214	51	92	144	216
	NB	LT(R)	520	50	25	50	25	143	53	51	25	145	54
West Chester Pike & S Lawrence Rd (18)	EB	R		195	#344	203	#359	132	#217	207	#367	134	#224
		TTT	600	448	#564	422	#540	~509	#617	427	#552	~579	#625
	WB	R		20	m29	14	m17	19	22	14	m17	19	23
		LL	460*	145	m170	144	m138	135	m#186	145	m140	137	m#200
	NB	TT		396	m562	500	m548	665	m208	505	m553	675	m191
West Chester Pike & N Lawrence Rd (2)	EB	LL	460*	73	104	81	114	51	78	82	115	52	79
		R	200	215	284	234	317	214	312	237	321	216	315
	WB	LL		217	m235	146	m132	242	m254	149	m129	247	m254
		TT		37	66	427	561	534	m543	432	566	541	m542
	NB	TTTR		279	374	267	360	340	454	272	367	345	461
West Chester Pike & Old West Chester Pike (26)	EB	L	325	65	#165	65	#166	65	#166	66	#169	66	#169
		R		~478	#622	~492	#637	~553	#702	~498	#643	~559	#709
	WB	L		107	m234	77	m101	127	126	78	m102	127	m126
		TTT	170	39	65	40	70	40	70	40	70	40	70
	NB	TTTR		86	131	89	117	110	145	90	119	112	146
S Lawrence Rd & Langford Run Rd (#)	EB	LT		42	21	42	22	42	22	42	22	42	22
		R		0	28	0	29	0	29	0	29	0	29
	WB	L		7	6	7	6	7	6	7	6	7	6
		LTR											
	NB	LT		-	1	-	0	-	37	-	0	-	37
S Lawrence Rd & Sussex Blvd (#)	EB	R		-	0	-	0	-	24	-	0	-	24
		L											
	WB	L		5	3	5	3	5	3	5	3	5	3
		LTR		12	14	12	14	12	14	12	14	12	14
	NB	LTTR		82	120	85	123	108	153	86	124	110	155
	EB	L		32	60	33	61	41	74	33	62	41	74
		LTR											
	WB	L											
		LTR											
	NB	LTTR											

*Average length of dual left turn lanes

~: This indicates that the approach is above capacity and the queue length could be much longer.

#: This indicates that the volume for the 95th percentile cycle exceeds capacity.

m: This indicates that the volume for the 95th percentile queue is metered by an upstream signal.

In many cases, the 95th percentile queue will not be experienced due to upstream metering.

If the upstream intersection is at / near capacity, the 50th percentile queue represents the max. queue experienced.

The queue length reported is the one for the lane with the highest queue in the lane group.

Introduction

The site location within the region is illustrated in Figure 1. The proposed development is of an approximate 26-acre site in Marple Township, Delaware County located in the southwest quadrant of the interchange of I-476 and West Chester Pike (PA Route 3). The site has been vacant for the past 30 years and is zoned as "O-1" according to the Township's zoning map. Fronted by West Chester Pike to the north and I-476 to the east, the site is otherwise surrounded by wooded areas plus a residential development of single-family detached houses to the west. Land use in the area adjacent to the site is mainly single-family detached homes.

A mixed use development of the site is proposed that could include up to 400,000 sq ft retail/office floor space plus about 150 residential units. Retail development would be located in the northern portion of the site near West Chester Pike, while the office and residential components would be located in the southern portion of the site. The anticipated opening year of the development is 2015.

The site currently has a right in, right out only access on West Chester Pike. The access was located as far west as possible within the site's West Chester Pike frontage, in order to maximize the distance from the I-476 interchange. This access is proposed to be converted to a full movement signalized intersection and will serve as the primary site access.

The site also has access to South Lawrence Road via Langford Run Road just south of the Lawrence Road overpass of I-476. Langford Run Road at South Lawrence Road provides both left turn and right turn entry movements. However, all exiting movements from the site must turn right to southbound South Lawrence Road. No change is proposed to this intersection.

The study area includes West Chester Pike from New Ardmore Avenue to Old West Chester Pike and the intersections of South Lawrence Road/Langford Run Road and South Lawrence Road/Sussex Boulevard (Figure 2). All intersections are located in Marple Township except the two eastern intersections on West Chester Pike (at North Lawrence Road and at Old West Chester Pike), which are in Haverford Township. The study performed capacity analysis and queue analysis for all intersections in the study area for existing, no-build and build conditions during the AM, PM, and Saturday peak hours for Opening Year 2015 and Design Horizon Year 2020.

Data Collection

Manual vehicle turning movement counts during weekday morning, evening, and Saturday midday peak periods were conducted at the following intersections:

- o West Chester Pike and New Ardmore Avenue
- o West Chester Pike and Mather Avenue
- o West Chester Pike and I-476 Southbound On/Off Ramp

- o West Chester Pike and I-476 Northbound On/Off Ramp
- o West Chester Pike and S. Lawrence Road
- o West Chester Pike and N. Lawrence Road
- o West Chester Pike and Old West Chester Pike
- o S. Lawrence Road and Langford Road
- o S. Lawrence Road and Sussex Road

The PM peak hour counts for West Chester Pike intersections except at Old West Chester Pike were conducted in March/April 2009. All other manual counts were conducted in 2010. School was in session during the June 2010 intersection counts on South Lawrence Road.

An Automatic Traffic Recorder count with vehicle classification was conducted on the I-476 southbound off ramp in January, 2010. ATR counts with speed classification were conducted on South Lawrence Road in both directions approaching Langford Run Road in June 2010.

The traffic count data is attached in Appendix C.

Crash history from Year 2005 to 2009 was requested and provided by PennDOT for the intersections and roadway segments within the study area. Overall, a total of 85 reportable crashes occurred at the six study intersections on West Chester Pike over the five-year period. The intersection of North Lawrence Road had the highest number of crashes (34), and the intersection of South Lawrence Road was second highest (19). On South Lawrence Road, six crashes occurred at Sussex Boulevard and there were no reportable crashes at the intersection of Langford Run Road. A crash analysis report is attached in Appendix D.

Existing Study Area Conditions

As illustrated in Figure 2, the study area for purposes of this TIS includes West Chester Pike intersections from New Ardmore Avenue to Old West Chester Pike, and the South Lawrence Road intersections of Langford Run Road and Sussex Boulevard. All intersections are in Marple Township except the intersections of West Chester Pike/North Lawrence Road and West Chester Pike/Old West Chester Pike, which are located in Haverford Township.

West Chester Pike (SR 0003) is PA State Route 3 and is an east-west principal arterial. The transportation context is a Community Arterial and the land use context is a Suburban Corridor. The posted speed limit in the area is 40 mph for both directions. The Average Daily Traffic volume of West Chester Pike (Year 2009 data) is 35,000 vehicles west of the I-476 interchange and 45,000 east of the interchange. In the road segment from South Lawrence Road to North Lawrence Road, the ADT on West Chester Pike rises to 52,000 vehicles and then further east is reduced to 37,000 vehicles.

Traffic signals are located at intersections of Old West Chester Pike, North Lawrence Road, South Lawrence Road, I-476 northbound on/off ramps, I-476 southbound off ramp, and New Ardmore Avenue.

These traffic signals fall into two separate interconnected systems located in two different townships. The signals at the intersections of New Ardmore Avenue, I-476 Ramps, and South Lawrence Road belong to a system of seven signals located Marple Township extending from Malin Road to South Lawrence Road, with master controller at Sproul Road. The signals at the intersections of North Lawrence Road and Old West Chester Pike are located in Haverford Township, and belong to a system of 12 signals stretching from North Lawrence Road to Kohl's Driveway, with master controller at Eagle Road.

In the westbound direction, West Chester Pike provides three through lanes through the intersections of Old West Chester Pike and North Lawrence Road and two through lanes further west. At the intersection of Old West Chester Pike, there are three lanes plus a 170-foot exclusive left turn lane. Those three westbound lanes continue through the intersection of North Lawrence Road. Between North and South Lawrence Road, West Chester Pike crosses a 108-foot wide, 200 foot long diagonal bridge structure over Darby Creek. Approaching the signalized intersection of South Lawrence Road, the left-most through lane becomes a left turn only lane, and westbound West Chester Pike provides a dual left turn lane and two through lanes. Just west of the South Lawrence Road signal, the channelized right turn for the on-ramp to I-476 North begins. There is no deceleration lane in advance of the ramp.

West Chester Pike has three westbound lanes plus shoulder on the bridge over I-476 main line approaching the signalized intersection of the I-476 southbound off ramp. The right-most lane is signed for I-476 South only, and exits to the loop ramp before the traffic signal. Two westbound through lanes continue on West Chester Pike through the signals at the I-476 South off ramp and at New Ardmore Avenue.

In the eastbound direction, West Chester Pike has two through lanes at New Ardmore Avenue and approaching the intersection of I-476 southbound off ramp. 325 feet before the I-476 southbound ramp signal, the eastbound approach widens within the median area to provide a third through lane through the signal. Also, a channelized right turn is provided for the eastbound West Chester Pike traffic to enter the I-476 southbound on ramp. No right turn deceleration lane is provided.

Continuing east, West Chester Pike provides three eastbound through lanes plus shoulder across the bridge over I-476 main line, plus one separate channelized left turn lane for left turns into the I-476 northbound on ramp. East of the I-476 North ramp signal, West Chester Pike carries four eastbound lanes --- three through lanes plus a right turn lane for turns into South Lawrence Road. When approaching the intersection of North Lawrence Road, two lanes continue as through lanes past the intersection while the left-most through lane turns into an exclusive left turn lane. In addition, a channelized exclusive left turn lane is provided to form dual eastbound left turn lanes at the intersection of North Lawrence Road. The two eastbound through lanes continue through the intersection of Old West Chester Pike. Left turns are prohibited in the eastbound direction at that intersection.

South Lawrence Road (SR 1020) is a four-lane minor arterial that extends from a signalized intersection with West Chester Pike at the north end to a signalized intersection with Sproul Road (PA Route 320) to the south. The roadway is classified as an arterial on Marple Township's Circulation Plan. There are

several signalized intersections along the route – at the Pathmark store driveway, at Sussex Boulevard and two other intersections to the south between Sussex Boulevard and Sproul Road. Sussex Boulevard is located within a school zone with flashing school speed limit signs for the St. Pius X school. The posted speed limit along South Lawrence Road is 45 mph. The Average Daily Traffic Volume on South Lawrence Road is 15,000 vehicles.

The intersection of Langford Road with South Lawrence Road is unsignalized. Entrance to Langford Road is permitted via right-turn and left-turn from South Lawrence Road. A 160-foot long left-turn lane is provided on northbound South Lawrence Road for motorists waiting for a gap in southbound traffic before turning left into Langford Road. Exit from Langford Road is restricted to right-turn-only by median channelization. The left turn exit is prohibited because of the grade along South Lawrence Road and associated sight distance limitations (from Langford Road looking right to the south on South Lawrence Road).

Public Transportation

Currently, three SEPTA bus routes operate along West Chester Pike through the study area. Two of the routes, Route 104 (69th Street Terminal to West Chester University) and Route 120 (69th Street Terminal to Cheyney University) travel straight through the study area on West Chester Pike. The Route 123 (69th Street Terminal to King of Prussia) travels between the east on West Chester Pike and the north on I-476. The total number of SEPTA buses on West Chester Pike during the peak hours totals 6 to 7 buses in each direction. There are no public transportation routes on South Lawrence Road.

Pedestrian Facilities

Sidewalk exists on the north side of West Chester Pike from New Ardmore Avenue to Mather Avenue, but otherwise there is no sidewalk on West Chester Pike in the study area. Shoulder of 8 - 10' in width exists on both sides of West Chester Pike from New Ardmore Avenue to the I-476 northbound off ramp. Further east, shoulder is narrower if present at all. There is no shoulder on the north side of West Chester Pike between Old West Chester Pike and North Lawrence Road. The northwest corner at North Lawrence Road has guiderail at the curb and is signed 'no pedestrian crossing' across North Lawrence Road and across West Chester Pike.

Signalized intersections on West Chester Pike provide at least one pedestrian crosswalk across West Chester Pike except at South Lawrence Road; crossing of West Chester Pike at South Lawrence Road is prohibited. The crossings of West Chester Pike have pushbuttons and pedestrian signal indications. Only the intersections of West Chester Pike at New Ardmore Avenue and Old West Chester Pike provide crossings of all four legs of the intersection. For pedestrians walking along West Chester Pike, street crossings on the north side are prohibited at the I-476 southbound off ramp and at North Lawrence Road.

At the signalized intersection of Sussex Boulevard, all four legs have crosswalks; pedestrians walk on the green indication. On South Lawrence Road, sidewalk exists south of Sussex Boulevard. Between Sussex

Boulevard and Langford Run Road, there is shoulder but not sidewalk on the western (site) side. Sidewalk exists on the eastern side but on the residential frontage road rather than on Lawrence Road. Sidewalk extends over the bridge structure over I-476, but then ends. Between I-476 and West Chester Pike, South Lawrence Road has no sidewalk but has paved shoulder.

Bicycle Facilities

There are no striped bicycle lanes in the study area, however there are shoulders throughout most of the corridor. In the westbound direction approaching Old West Chester Pike to South Lawrence Road, there is no shoulder and bicyclists use the right lane.

PennDOT is investigating the potential for adding bike lanes to West Chester Pike. No specific plan was available at the time of this TIS.

Existing Traffic Conditions

As mentioned previously, manual turning movement counts were conducted at the signalized intersections on West Chester Pike as well as two intersections on South Lawrence Road in the study area. The counts were balanced between intersections to equalize the volume departing an intersection and the volume entering the adjacent intersection. The existing AM, PM, and Saturday peak hour traffic volumes at the study area intersections are illustrated in Figures 3, 4, and 5.

Volume capacity analysis for each of the peak hours was conducted in Synchro using the HCM methodology. During the AM peak hour, N. Lawrence Road intersection on West Chester Pike operates at Level of Service 'E' with average vehicular delay of more than 60 seconds. During the PM and Saturday peak hours, all the intersections are currently operating acceptably with level of service 'D' or better. Existing service levels and delays at the intersections in the study area are illustrated in Figures 6, 7, and 8 and Tables 1 - 3. Queue analysis in Synchro was performed to compare average and 95th percentile queues against the available storage length. The queue results are shown in Tables 4 - 6. Tables 1 - 6 are located in the Executive Summary.

Other Planned Development

Other than the Marple Associates development, there are three planned developments in the vicinity of the study area.

1. A new "Outpatient Center" operated by Crozer Keystone is proposed to be constructed on South Lawrence Road at the site currently occupied by the Pathmark Supermarket. The supermarket closed in October 2010, after the traffic data for this study was collected. The proposed new "Outpatient Center" will provide a total of about 38,000 SF of floor space in a two-story building. Access to the site will be using the existing signalized intersection of Pathmark Drive. It is estimated that this development is going to generate 60 to 70 new vehicular trips during the peak hours. The proposed opening year is 2012.

2. The Havertown YMCA is proposed to be constructed on Eagle Road at North Lawrence Road. The proposed opening year is 2012. Based on the information provided by McMahon Associates, the traffic engineer for this development, the proposed YMCA will generate 220 vehicular trips (144 in and 76 out) during the morning peak hour and 341 trips (187 in and 154 out) during the evening peak hour. 15 percent of these trips are distributed to West Chester Pike via North Lawrence Road.
3. The former Gamma Swim Club property, located within the residential area north of West Chester Pike and between Brookthorpe Avenue and the I-476 southbound off ramp right of way, has been proposed for development with a 52,000 sq. ft. synagogue. The proposed development is going through the Marple Township review process. Access to the synagogue from the west on West Chester Pike would be via the signalized intersection of New Ardmore Avenue; access from the east would be via Mather Avenue.

Other Planned Transportation Improvements

According to the information provided from both PennDOT and Marple Township, currently there is no planned roadway improvement within the study area. However we are aware of the following study that may result in an improvement project by others:

The Feasibility Study of Transit Signal Priority on Route 3 West Chester Pike (2011) performed for Delaware County Transportation Management Association (DCTMA) studied Route 3 from Upper Darby Township through Edgemont Township. The study recommends improvements to bus stops and signal priority for approaching buses. A pilot transit signal priority project for Route 3 in Haverford and Marple Townships was recommended by the study, but a project has not yet been funded.

Year 2015 Traffic Conditions without the Proposed Development

In order to evaluate the impact on the roadway network of the newly generated traffic from the proposed Marple Associate development, the traffic conditions in the opening year 2015 are first analyzed without the development as a baseline condition.

The annual traffic growth rate in Delaware County is 0.21 percent in the most recent PennDOT Traffic Data Report. To project the no-build traffic in Year 2015, the existing peak hour traffic volumes were increased by about 1.3 percent, a compounded result of 0.21 percent annual growth rate over six years. In addition, the projected new trips generated by the proposed "Outpatient Center" were added while the new trips by the other two planned developments (YMCA and synagogue) were assumed to be already captured within the background growth. This is because the proposed new "Outpatient Center" is located on South Lawrence Road within the study area and its driveway (Pathmark Drive) is located north of Langford Run Road, one of two access points for the proposed Marple Associate development. The other two planned developments are located further outside the study area and their generated

trips through the studied intersections are minor. Since the “Outpatient Center” will take over the Pathmark site and the supermarket was closed after the traffic counts for this TIS were completed, the trips generated by Pathmark should be discounted from the future traffic volumes. However, to be conservative, the discount was only applied to the PM peak hour based on the traffic volume numbers presented in the intersection signal permit plan. Also, only half of those numbers were considered trips generated by the supermarket and discounted. The other half of supermarket trips were considered as pass-by trips that would remain on the roads.

With this process, the Year 2015 peak hour traffic volumes without the proposed Marple Associates development are established as illustrated in Figure 9, 10, and 11.

Capacity analysis as well as queue analysis was conducted in Synchro at the intersections with the projected Year 2015 peak hour traffic without the proposed Marple Associates development. The same cycle lengths as existing were used during three peak periods (100 seconds for AM and Saturday, 120 seconds for PM). Signal timings and offsets were optimized and HCM output was used. The Level of Service results for AM, PM and Saturday peak hours are illustrated in Figures 12, 13, and 14 and Tables 1 - 3 while the queue results are summarized in Tables 4 – 6.

Though the volumes are higher in 2015 than existing, it can be seen that with the optimized signal timings most of the intersections’ performance improve. All of the intersections will operate at LOS ‘D’ or better during all three peak hours. The queue analysis reveals that the northbound right turn on South Lawrence Road at West Chester Pike will have a queue longer than the available storage during all three peak periods. The eastbound West Chester Pike through movement at South Lawrence Road exceeds storage in the PM peak hour. These are existing conditions. Other than this, the available storages are sufficient to accommodate the queuing at each of the intersections during peak periods.

Year 2020 Traffic Conditions without the Proposed Development

The traffic volumes in the design horizon year 2020 without the proposed Marple Associates development were derived in the same way as the opening year 2015 traffic without the proposed development. The existing traffic volumes were increased by 2.33 percent, the trips generated by the proposed “Outpatient Center” were added and the adjustment was made in the PM peak for the loss of the supermarket. The projected Year 2020 traffic volumes without the proposed development are illustrated in Figures 15, 16, and 17.

Capacity analysis as well as queue analysis was conducted in Synchro at the intersections with the projected Year 2020 peak hour traffic without the proposed Marple Associate development. The same cycle lengths as existing were used during three peak periods (100 seconds for AM and Saturday, 120 seconds for PM). Signal timings and offsets were optimized and HCM output was used. The LOS results are illustrated in Figures 18, 19, and 20 and Tables 1 - 3 while the queue results are summarized in Tables 4 - 6. It can be seen that the results are very similar to no-build conditions in opening year 2015.

All of the intersections will operate at LOS 'D' or better during all three peak hours. The available storages are generally sufficient to accommodate the all the queuing traffic at each intersection during all peak periods except for the movements cited under 2015 No Build conditions.

Development Description

The proposed 26-acre development is located in the southwest quadrant of the interchange of I-476 and West Chester Pike (PA Route 3). A mixed use development of the site is proposed that could include up to 400,000 sq ft retail/office floor space plus about 150 residential units.

The site currently has a right in, right out only driveway on West Chester Pike. The driveway was located as far west as possible within the site's West Chester Pike frontage, in order to maximize the distance from the I-476 interchange. This driveway is proposed to be converted to a signalized full-movement access.

The site also has access to South Lawrence Road via Langford Run Road just south of the Lawrence Road overpass of I-476. Langford Run Road at South Lawrence Road provides both left turn and right turn entry movements. However, all exiting movements from the site must turn right to southbound South Lawrence Road. This unsignalized intersection will remain the same after the development of the proposed project. Allowing left turn exits would require a traffic signal. A feasibility study of signalizing the intersection was prepared (Appendix J). PennDOT has determined that the intersection should not be signalized due to the downgrade on South Lawrence Road approaching from the south.

Trip Generation

In order to estimate the new trips to be generated by the proposed Marple Associates development, the procedure used and assignment is summarized as follows:

- Trips for the individual uses were generated individually in accordance with ITE Trip Generation 8th Edition.
- Pass by trips were calculated. These trips were deducted from total trips to determine the New Trips added to the roadway network.
- Trips that could be expected to be generated by the other uses along Langford Run Road were estimated using the procedure for mixed use development internal trips in the Trip Generation Handbook, Second Edition.
- The 'internal' retail trips were deducted from the pass by trips.

Overall, the proposed development is projected to generate a total of 609 new vehicle trips on the roadway network in the morning peak hour (355 entering trips and 254 exiting trips), 1253 new vehicle trips in the evening peak hour (597 entering trips and 656 exiting trips), and 1423 new vehicle trips in the Saturday peak hour (743 entering trips and 681 exiting trips). Please refer to the worksheets in the Technical Appendix F for the detailed trip generation calculation.

Trip Distribution

The direction of approach and departure of new trips to the Marple Associates development was estimated based on two factors. For retail uses, the population distribution within five miles of the site was utilized. For residential and office/commercial, the existing traffic patterns on the road network during the peak hours were utilized. The resulting estimate is shown below and illustrated in Appendix G:

<u>Direction of Approach/Departure</u>	<u>Retail</u>	<u>Office/Residential</u>
East on West Chester Pike	32%	21%
East on North Lawrence Road	6%	11%
West on West Chester Pike	16%	22%
North on I-476	15%	26%
South on I-476	15%	10%
South on South Lawrence Road	16%	10%

For traffic approaching the development from the east on West Chester Pike or from the south on I-476, the site traffic was routed either to the West Chester Pike entrance or the Lawrence Road entrance based on the proposed location of the particular use within the site along Langford Run Road. All site traffic from the west on West Chester Pike and from the north on I-476 were routed to the West Chester Pike entrance, and all traffic from the south on Lawrence Road was routed to the Lawrence Road entrance.

Pass by trips were routed from the roadway network into and out of Langford Run Road (acting as diverted link trips rather than new trips on the roadway network). For the pass by trips entering via a left turn from northbound South Lawrence Road onto the Langford Run Road access, they cannot continue north by making a left turn from Langford Run Road onto South Lawrence Road since that left turn is prohibited. These pass by trips were routed to the access on West Chester Pike.

This results in a distribution of peak hour site traffic as illustrated in Figures 21, 22, and 23.

Diversion of Public Traffic

In addition, the effect of the “new” Langford Run Road on non-development traffic was considered in developing the future traffic with the proposed development. The extended Langford Run Road connects West Chester Pike and South Lawrence Road. It is expected that some drivers currently commuting on these two roads would use the “new” Langford Run Road as an alternative route to travel between the west on West Chester Pike and the south on South Lawrence Road. The maximum number of trips that could potentially divert to Langford Run Road as a bypass route is based solely on origin and destination. It was estimated that 67% of the motorists whose trip origin-destination could be served by

using Langford Run Road will actually divert to Langford Run Road. Regular commuters (and anyone navigating by GPS) will use the diversion route; infrequent travelers will tend to stay on the main roads. The diversion methodology is detailed in a memo dated February 9, 2010 which is included in the Technical Appendix H.

Proposed Improvements

The following changes are being proposed in order to improve access to the site and the traffic operation in the study area:

- Create a full-movement signalized intersection at the intersection of Langford Run Road and West Chester Pike, so that Langford Run Road can serve as the main access to the Marple Associates development site. Proposed modifications include:
 - a 'break' in the median along West Chester Pike at the site access drive so as to permit left-turn entry and exit in addition to right-turns,
 - construction of a westbound left-turn lane on West Chester Pike at the proposed median 'break',
 - construction of a third eastbound through lane and a right turn lane on West Chester Pike approaching the intersection, and
 - signalization of the modified intersection, with pedestrian crossing of West Chester Pike on the west side of the intersection.
- Extend Langford Run Road within the site southeastwardly to connect to the existing intersection with South Lawrence Road at a point about 0.35 miles south of PA Route 3.
- Utilize the existing intersection of Langford Run Road with South Lawrence Road, including the existing separate northbound left-turn lane but with no signalization and with left-turns prohibited from Langford Run Road to northbound South Lawrence Road – all of which are existing conditions. This location will serve as a secondary access point to the site.
- Eliminate the existing southbound yield right-turn off ramp from I-476 (Ramp S-WC) and direct all southbound off ramp traffic to the signalized intersection with West Chester Pike; the signalized ramp will be widened to add a separate right turn lane and necessary storage length.
- At the three-lane approach of I-476 Northbound off ramp on West Chester Pike, change the ramp's center lane from the existing shared left-and-through to a shared left, through and right turn lane and modify the existing overhead lane control signing. The pedestrian operation at the signal will need to be modified for a double-right turn movement from the ramp.

- On the I-476 Northbound on ramp, where the lanes from eastbound and westbound West Chester Pike meet, restripe the ramp to extend the separate lanes and move the merge area further north along the ramp. This will reduce the conflict perceived by drivers and increase the rate of flow through this area, which should act to decrease backups on the ramp.
- Provide a westbound right turn deceleration lane on West Chester Pike for Mather Avenue, beginning west of the pedestrian crosswalk at the new Langford Run Road signal.
- Extend the sidewalks on West Chester Pike from New Ardmore Avenue east to Langford Run Road.

The concept plan which illustrates these proposed improvements is included in the Executive Summary and in Appendix P.

In addition to these roadway improvements, it is recommended that the timings and offset of the signals along West Chester Pike included in the study area be adjusted and optimized. An interconnection by fiber-optic cable will be established between the two separate interconnected systems on West Chester Pike in Marple Township and Haverford Township, and the signals will operate off a single master. Township representatives indicated at a February 15, 2011 meeting at PennDOT that the two townships could reach an agreement on how to control a combined system.

Furthermore, if deemed beneficial by PennDOT and if supported by both Marple and Haverford Townships, Traffic Adaptive Control will be installed at all the signals from Old West Chester Pike to New Ardmore Avenue.

Year 2015 Traffic Conditions with the Proposed Development

To develop the opening year 2015 traffic with Marple Associates development, first the opening year 2015 traffic without the proposed development obtained earlier was adjusted to account for the traffic diversion due to the “new” extended Langford Run Road. Then these adjusted year 2015 background traffic volumes were further adjusted to reflect pass-by trips and the new trips associated with the proposed development were added. By going through this process, the opening year 2015 traffic volumes with the proposed development were obtained and are illustrated in Figure 24, 25, and 26.

Capacity analysis and queue analysis were conducted in Synchro with these volumes and with the proposed improvements. The same signal cycle lengths as existing were used for the three peak periods (100 seconds for AM and Saturday, 120 seconds for PM). Signal timings and offsets were optimized, but optimization was not based solely on overall intersection level of service. In accordance with a preliminary review (Appendix Q, letter of November 29, 2010) the side street green splits were adjusted closer to their existing values so that movement delays and queuing were comparable to existing. The

LOS results are illustrated in Figures 27, 28, and 29 and Tables 1- 3; the queue results are summarized in Tables 4 - 6.

With the additional traffic of the proposed Marple Associates development, the delay at each intersection generally increases. However, the results are comparable to those in Year 2015 without the development. All the intersection overall levels of service are 'D' or better and the differences in overall delay with or without the proposed development are all within 10 seconds. The queue results are similar to no-build conditions as well. Other than the two movements mentioned under no-build conditions, the available storages are sufficient to accommodate the queuing for all movements at each of the intersections during peak periods.

Year 2020 Traffic Conditions with the Proposed Development

The design horizon year 2020 traffic volumes with the proposed development were developed in a similar process as developing the opening year 2015 traffic. The Year 2020 volumes are illustrated in Figures 30, 31, and 32.

Capacity analysis and queue analysis were conducted with these volumes and with the proposed improvements in Synchro with optimized signal timings and offsets. As with the 2015 analysis, the optimization considered side street green splits. The same cycle lengths as existing were used for the three peak periods (100 seconds for AM and Saturday, 120 seconds for PM). The level of service results are illustrated in Figure 33, 34, and 35 and the queue results are summarized in Table 4-6.

The results are similar to those in Year 2015. Level of Service at each intersection is 'D' or better during all three periods, except for the intersection of N. Lawrence Road which is LOS 'E' in the AM peak. Intersection delays in Year 2020 with development increase by less than 10 seconds compared with Year 2020 delays without the proposed development. Queue results are comparable to the queues without the proposed development. Other than the two movements mentioned under no-build conditions, the available storages are sufficient to accommodate the queuing for all movements at each of the intersections during peak periods.

Recommendations and Conclusion

The roadway improvements described on pages 20-21 of this report and illustrated on the Concept Plan are recommended in order to provide access to the site and to accommodate projected site traffic. It is also recommended that the two separate signal systems in Marple Township and Haverford Township be connected by establishing a fiber optic cable connection across the Darby Creek bridge between the controllers at North Lawrence Road and South Lawrence Road, and operating the signals on a single master.

With the improvements described above, overall intersection delay with development remains within ten seconds of the no-build delay at all study intersections in both the Opening Year 2015 and Design Horizon Year 2020. Overall intersection levels of service with development remain the same as no-build levels of service at all intersections with the following exceptions: the intersection of North Lawrence Road (LOS 'D' to LOS 'E') in the 2020 AM peak hour; intersections of North Lawrence Road (LOS 'C' to LOS 'D') and Old West Chester Pike (LOS 'B' to LOS 'C') during the 2015 and 2020 PM peak hour; and the intersection of I-476 Northbound Off-Ramp (LOS 'B' to LOS 'C') during the 2015 and 2020 Saturday peak hour. Overall intersection levels of service with development are all 'D' or better in all peak hours except for the intersection of North Lawrence Road in the 2020 AM peak. All queues in the Future Horizon Year 2020 are within the available storage length, except two individual movements that exceed storage under existing and no-build conditions.

If deemed beneficial by PennDOT and if supported by both Marple and Haverford Townships, Traffic Adaptive Control will be installed at all the signals from Old West Chester Pike to New Ardmore Avenue as part of the offsite improvements. Although no analysis was conducted to quantify the effects of Traffic Adaptive Control, there is little doubt that the traffic operation at the signalized intersections within the study area would benefit from this new technology. With the addition of Traffic Adaptive Control, the future intersection levels of service and the queue lengths would be better than what is shown in this report.

Conclusion

The developer is seeking a full movement signalized access to the Marple Associates site at West Chester Pike and Langford Run Road in order to enhance access to the 26-acre site, making successful development feasible. However, full movement access will also provide a number of benefits to the road network operation when compared with the existing right in, right out access:

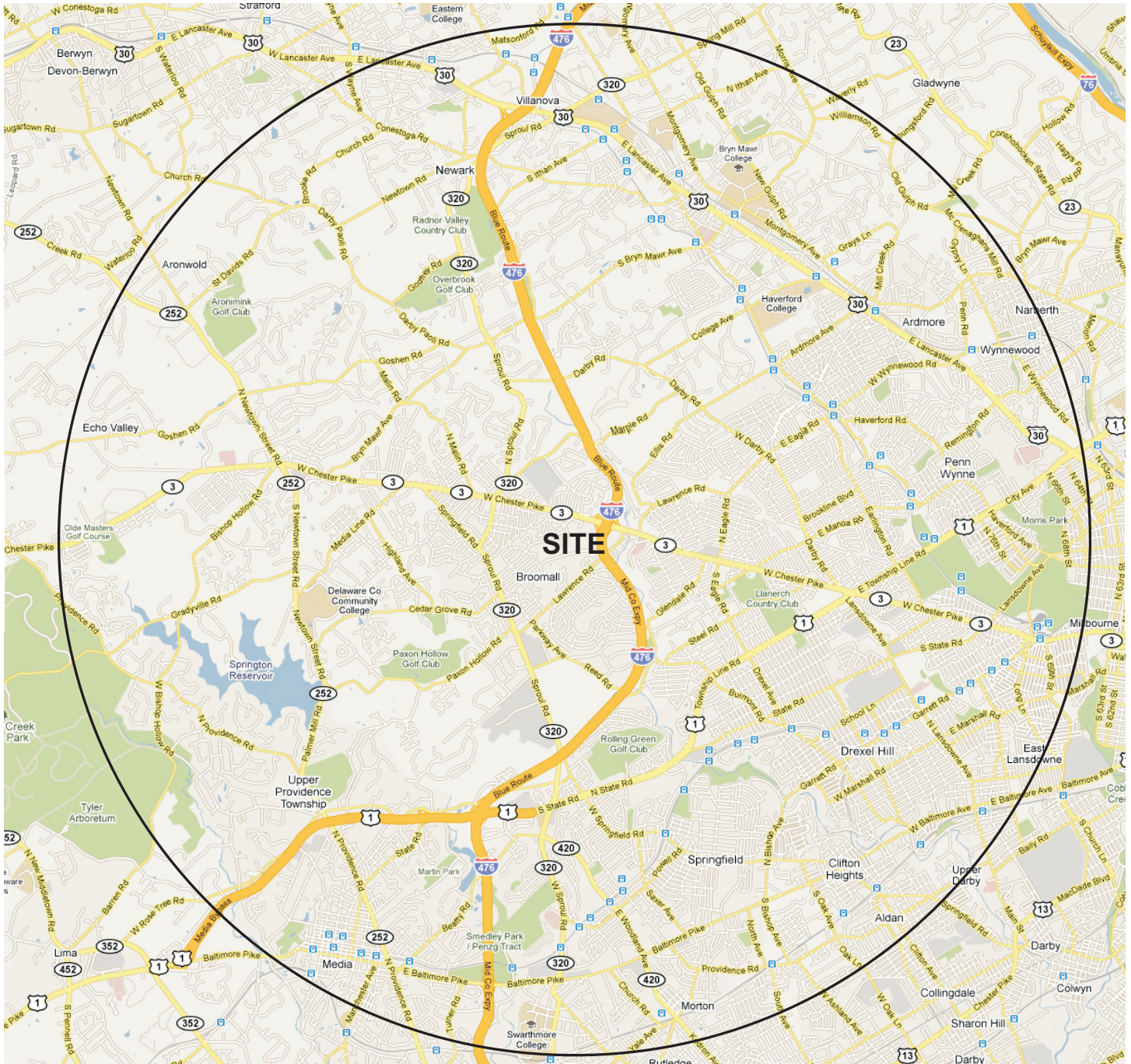
- By providing direct access, it prevents undesirable movements by drivers attempting to reach the development (such as a U turn from westbound West Chester Pike at the New Ardmore Avenue signal) or departing the development (such as a U turn from eastbound West Chester Pike at the I-476 NB on-ramp in order to proceed west on West Chester Pike).
- By providing direct access, it helps prevent overloading and capacity/queuing problems that would occur at other intersections resulting from drivers traveling to the development via indirect access.
- It provides a bypass (via Langford Run Road) of a congested area of West Chester Pike for non-development motorists traveling between the west and the south.

The proposed transportation improvements will accommodate future traffic sufficiently and safely without deteriorating the traffic operation at the adjacent intersections or roadway network in the project area.

Site Location Map

Traffic Impact Study - Marple Associates

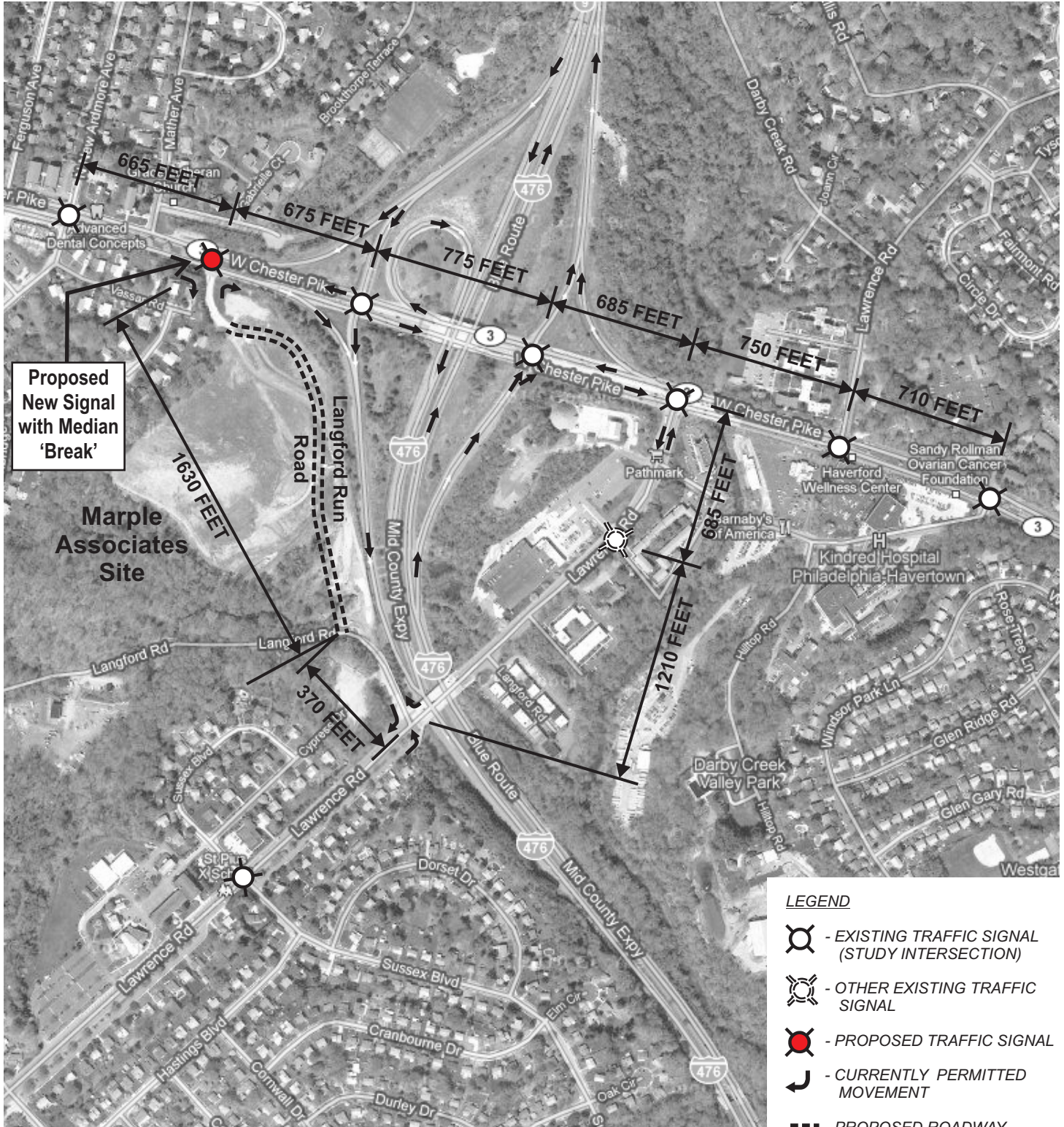
MARPLE TOWNSHIP, DELAWARE COUNTY, PENNSYLVANIA



Study Area

Traffic Impact Study - Marple Associates

MARPLE TOWNSHIP, DELAWARE COUNTY, PENNSYLVANIA



Existing AM Peak Hour Traffic Volumes

Traffic Impact Study - Marple Associates

MARPLE TOWNSHIP, DELAWARE COUNTY, PENNSYLVANIA

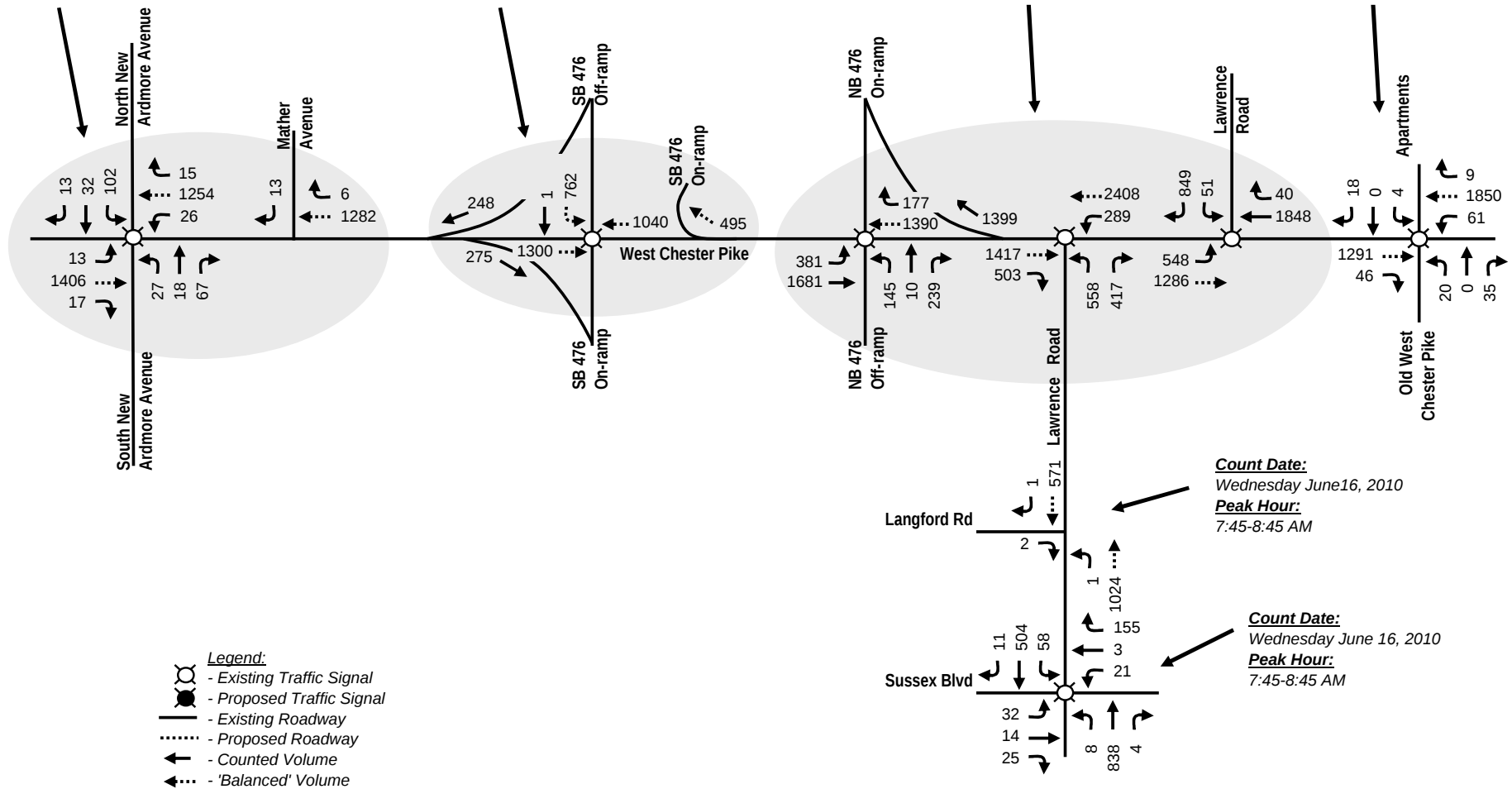


Count Date:
Tuesday January 26, 2010
Peak Hour:
7:15-8:15 AM

Count Date:
Thursday January 21, 2010
Peak Hour:
7:15-8:15 AM

Count Date:
Wednesday January 20, 2010
Peak Hour:
7:45-8:45 AM

Count Date:
Wednesday September 15, 2010
Peak Hour:
7:00-8:00 AM



Existing PM Peak Hour Traffic Volumes

Traffic Impact Study - Marple Associates

MARPLE TOWNSHIP, DELAWARE COUNTY, PENNSYLVANIA

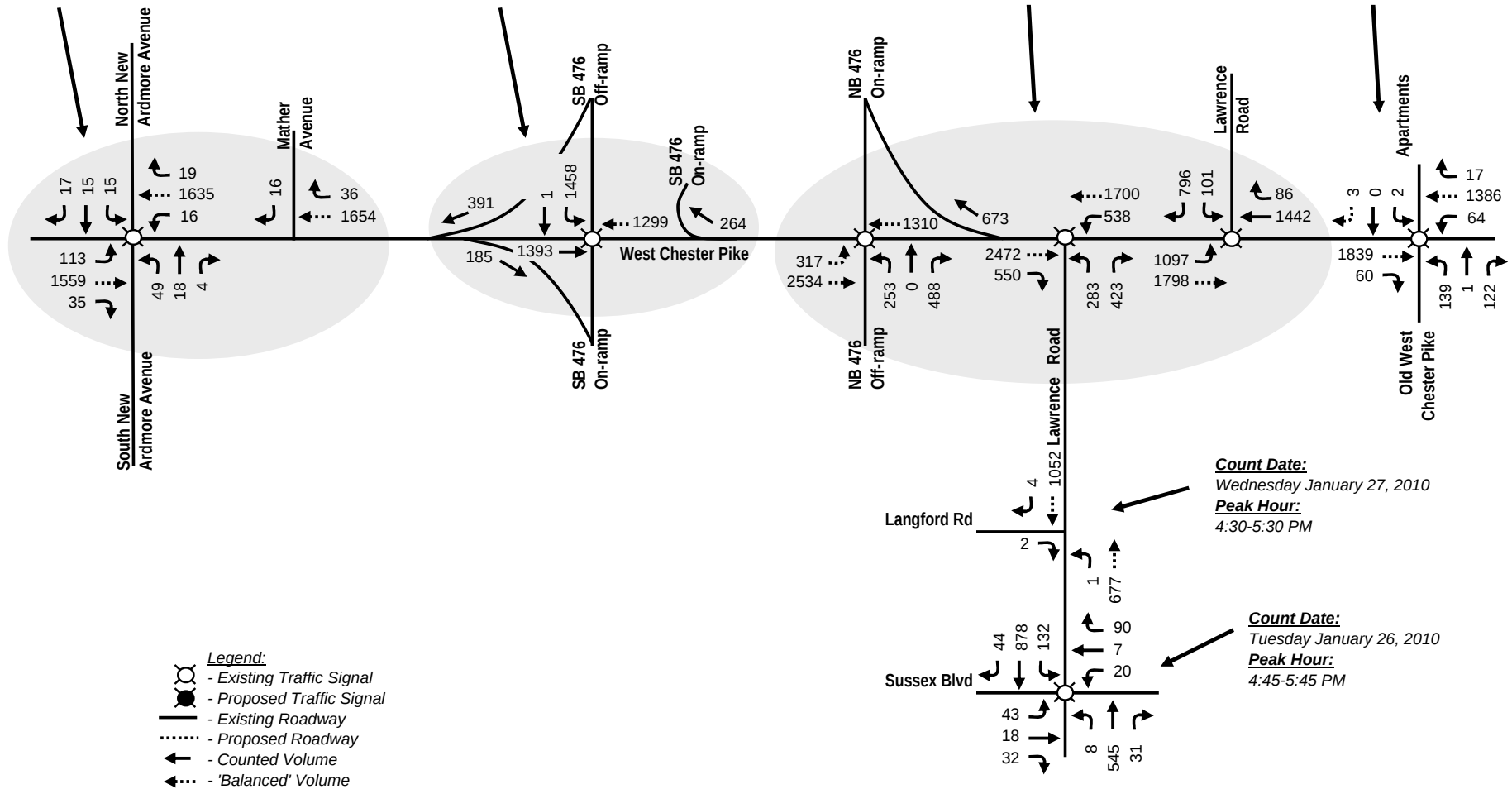


Count Date:
Tuesday April 7, 2009
Peak Hour:
4:15-5:15 PM

Count Date:
Thursday April 2, 2009
Peak Hour:
5:00-6:00 PM

Count Date:
Tuesday March 31, 2009
Peak Hour:
5:00-6:00 PM

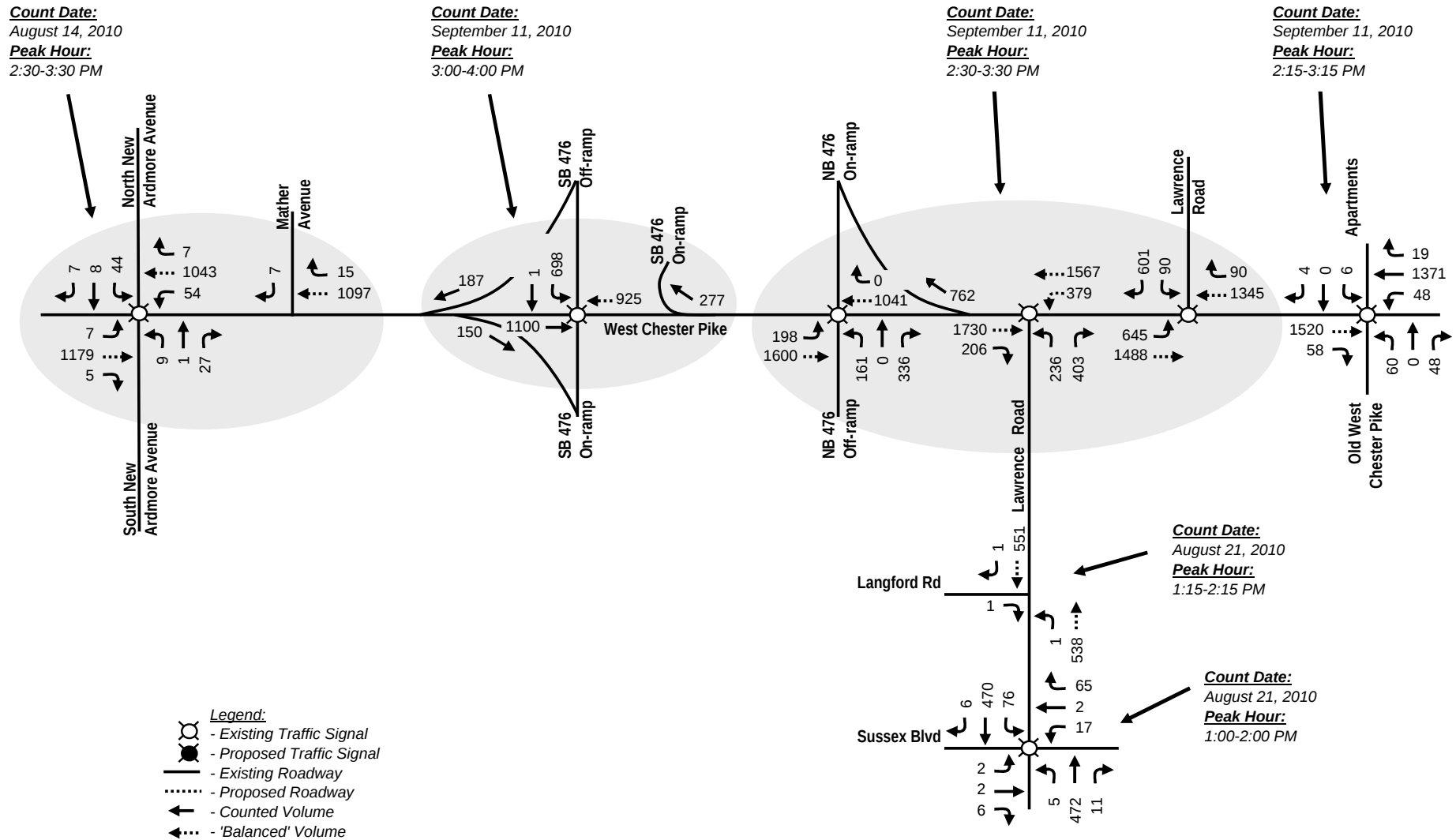
Count Date:
Wednesday January 20, 2010
Peak Hour:
4:15-5:15 PM



Existing Saturday Peak Hour Traffic Volumes

Traffic Impact Study - Marple Associates

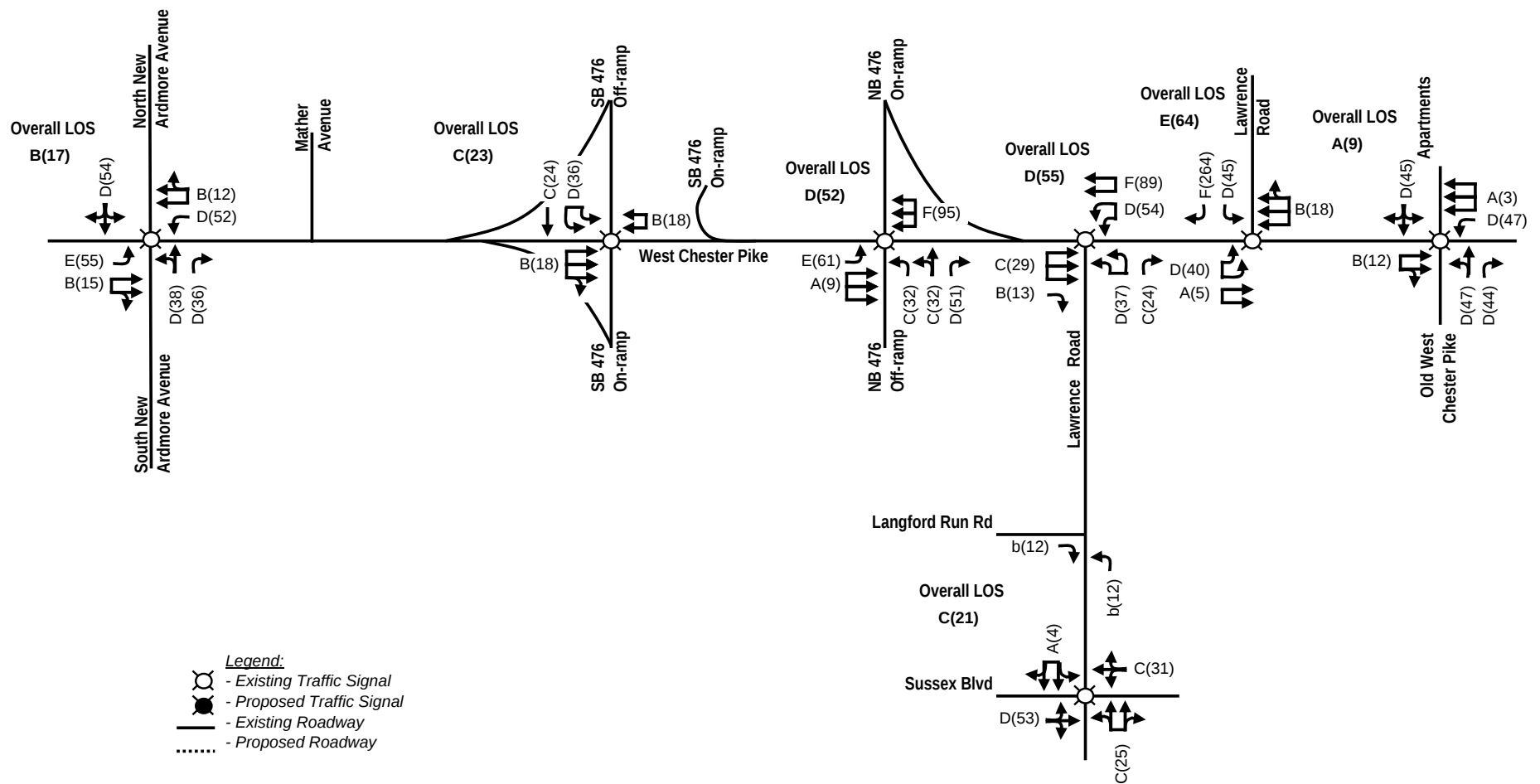
MARPLE TOWNSHIP, DELAWARE COUNTY, PENNSYLVANIA



Existing AM Peak Hour Levels of Service

Traffic Impact Study - Marple Associates

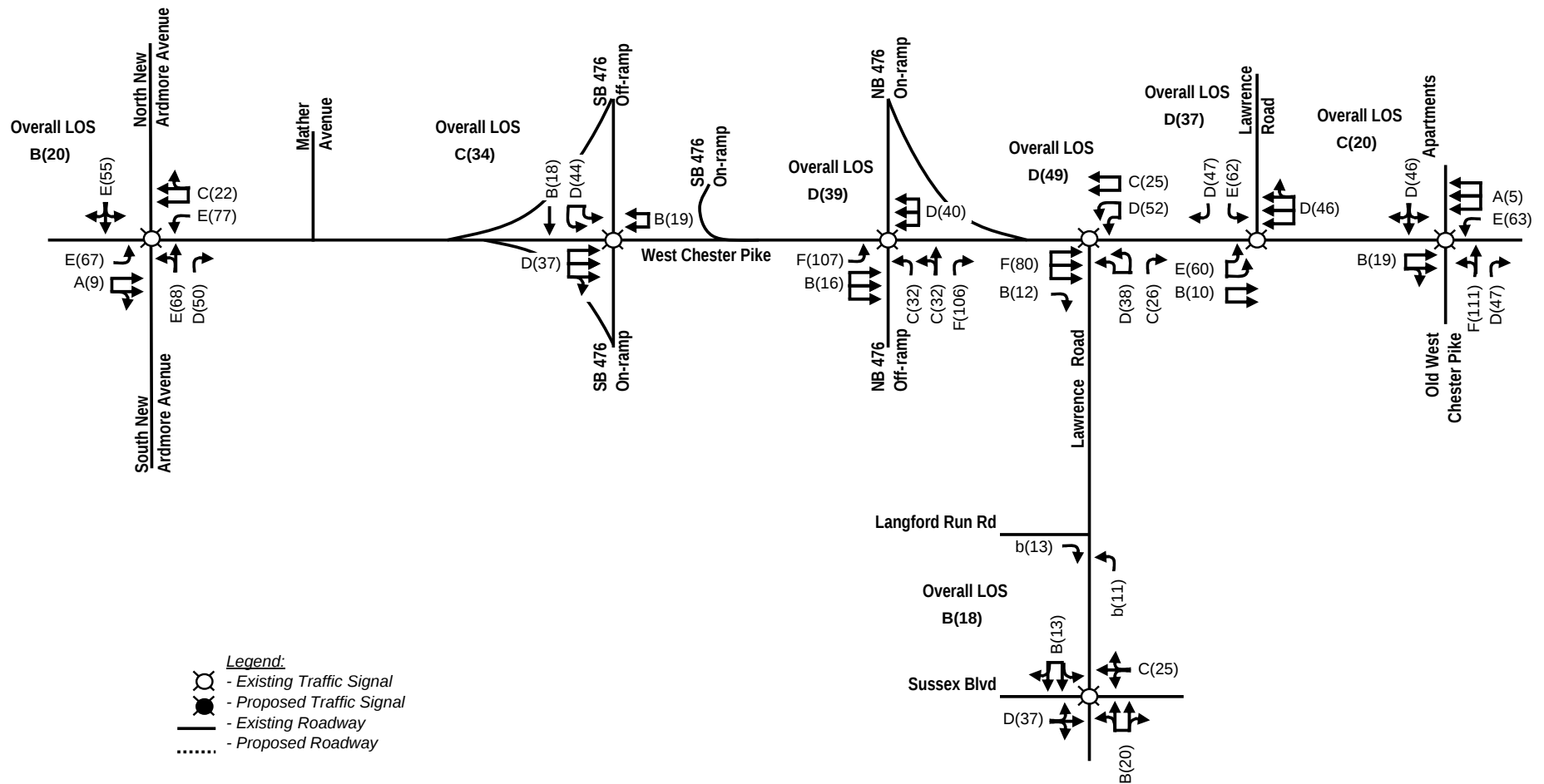
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Existing PM Peak Hour Levels of Service

Traffic Impact Study - Marple Associates

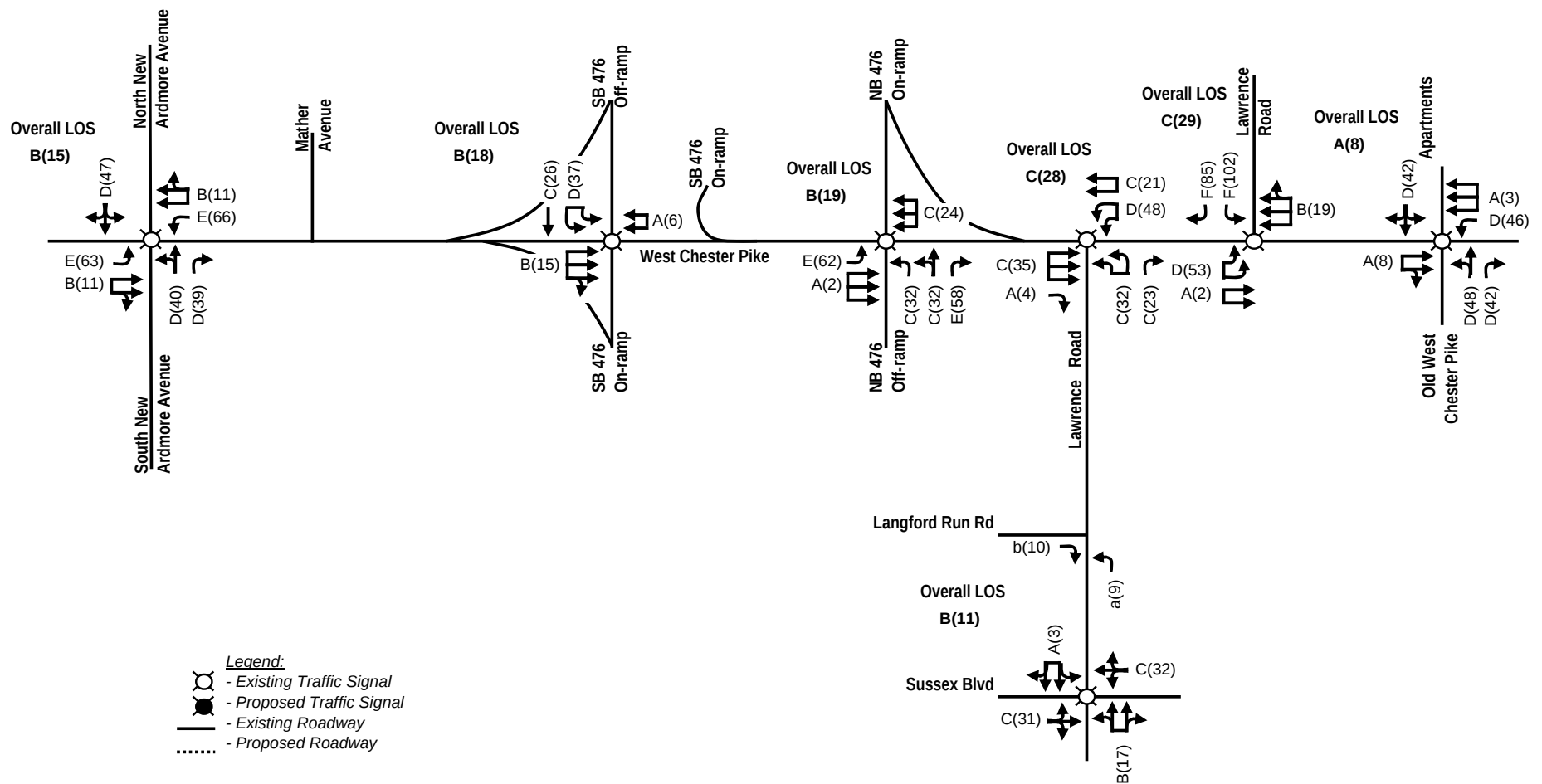
MARPLE TOWNSHIP, DELAWARE COUNTY, PENNSYLVANIA



Existing Saturday Peak Hour Levels of Service

Traffic Impact Study - Marple Associates

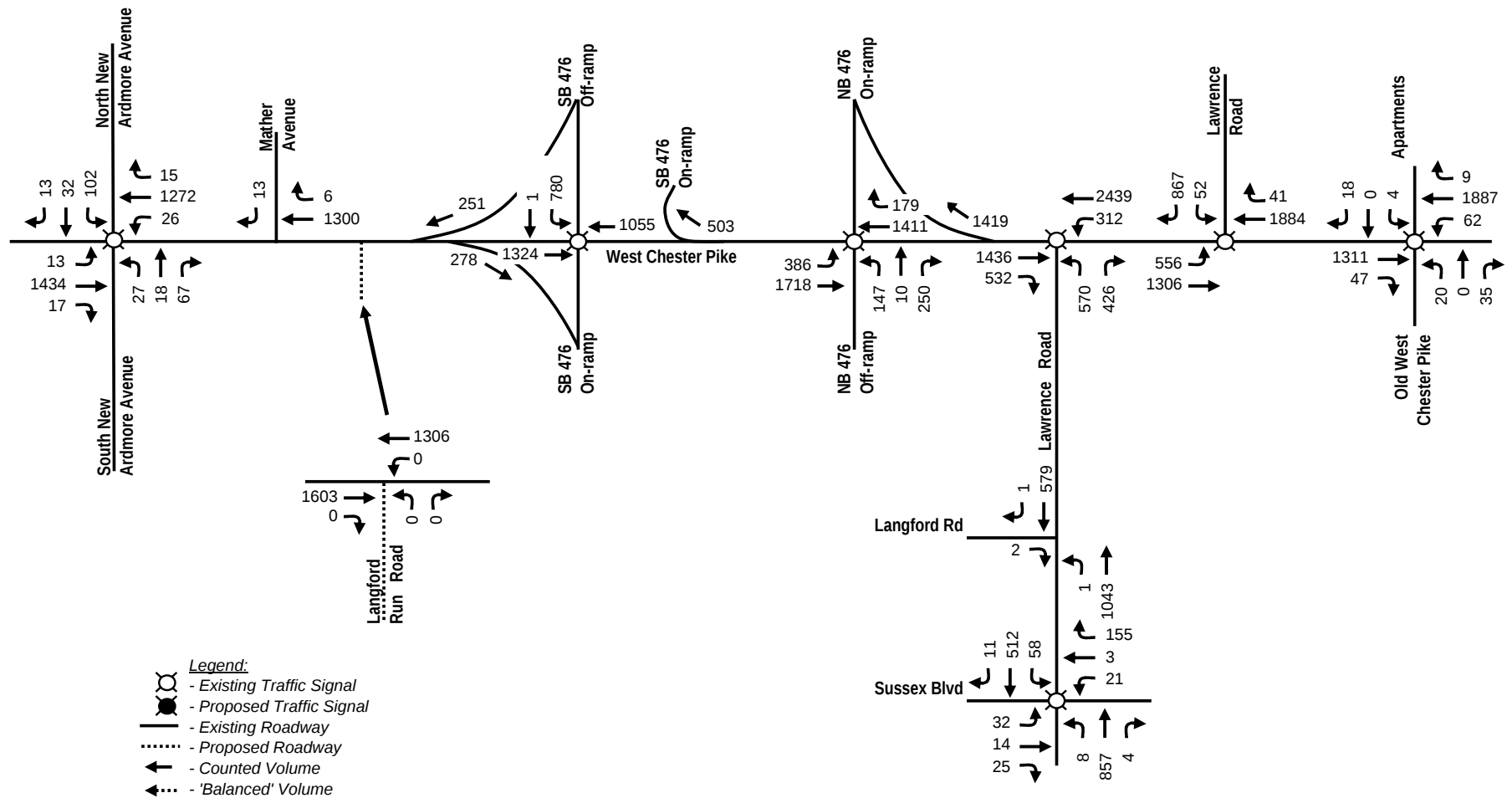
MARPLE TOWNSHIP, DELAWARE COUNTY, PENNSYLVANIA



2015 No Build AM Peak Hour Traffic Volumes

Traffic Impact Study - Marple Associates

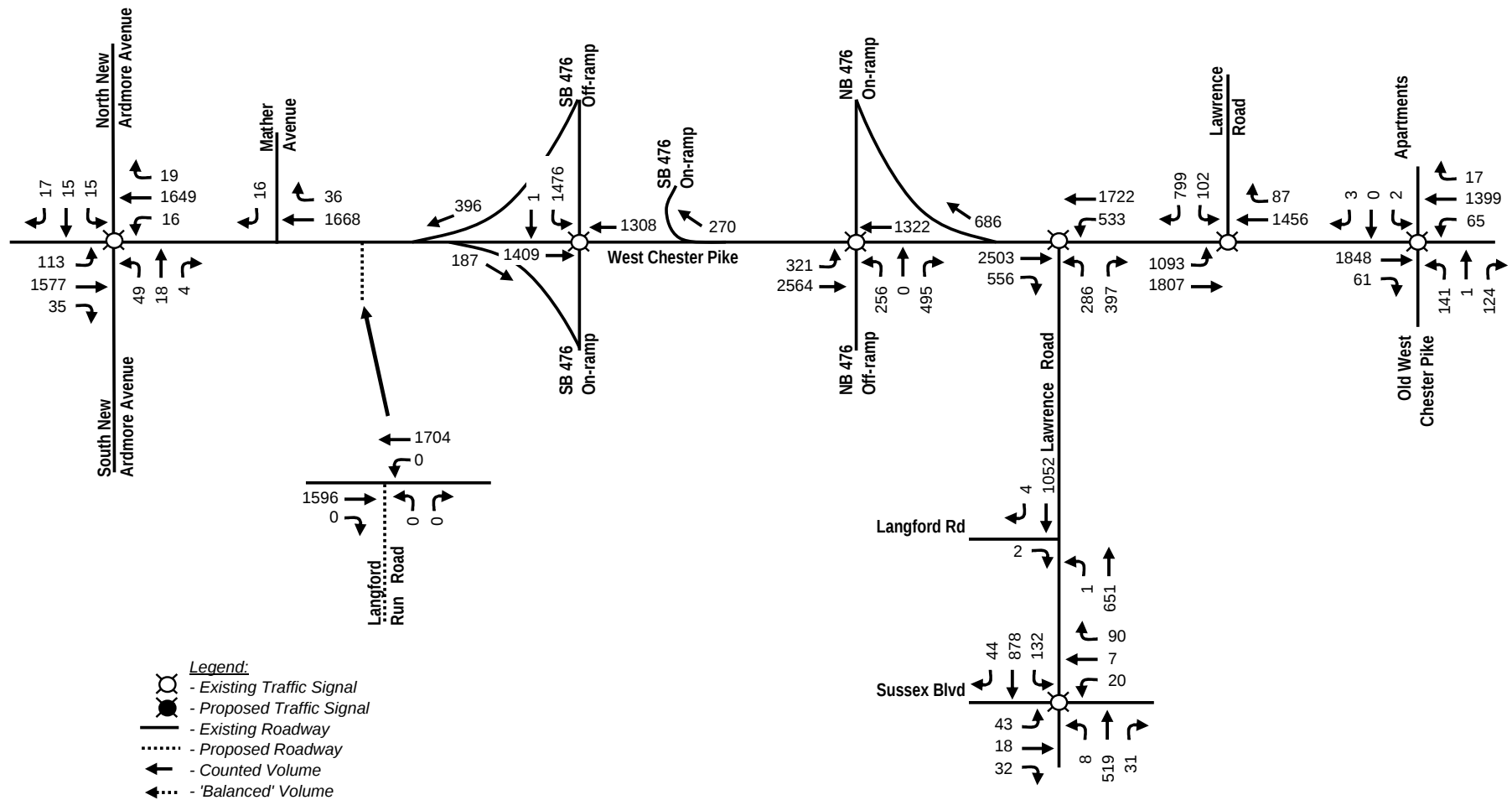
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2015 No Build PM Peak Hour Traffic Volumes

Traffic Impact Study - Marple Associates

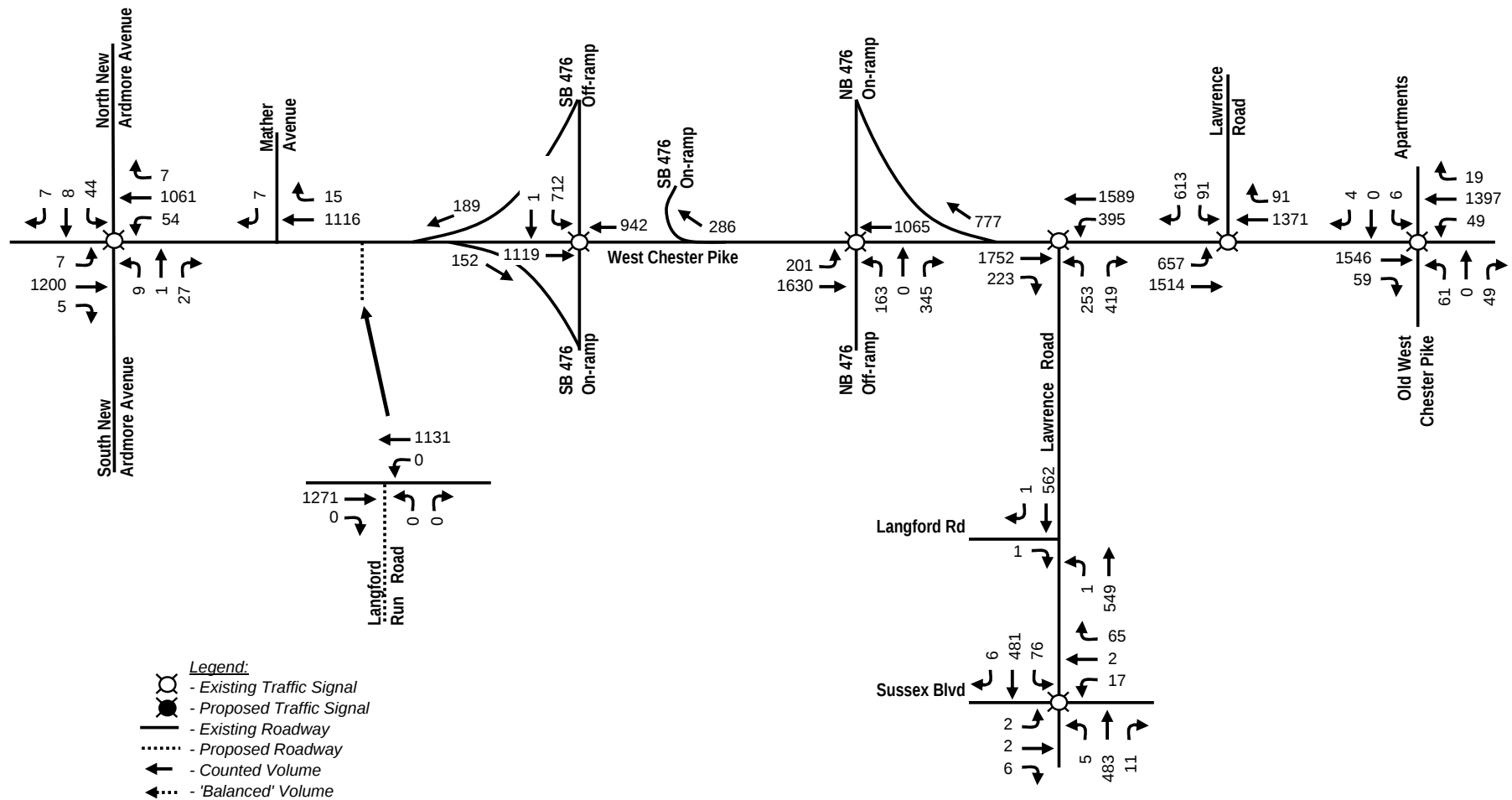
MARPLE TOWNSHIP, DELAWARE COUNTY, PENNSYLVANIA



2015 No Build Saturday Peak Hour Traffic Volumes

Traffic Impact Study - Marple Associates

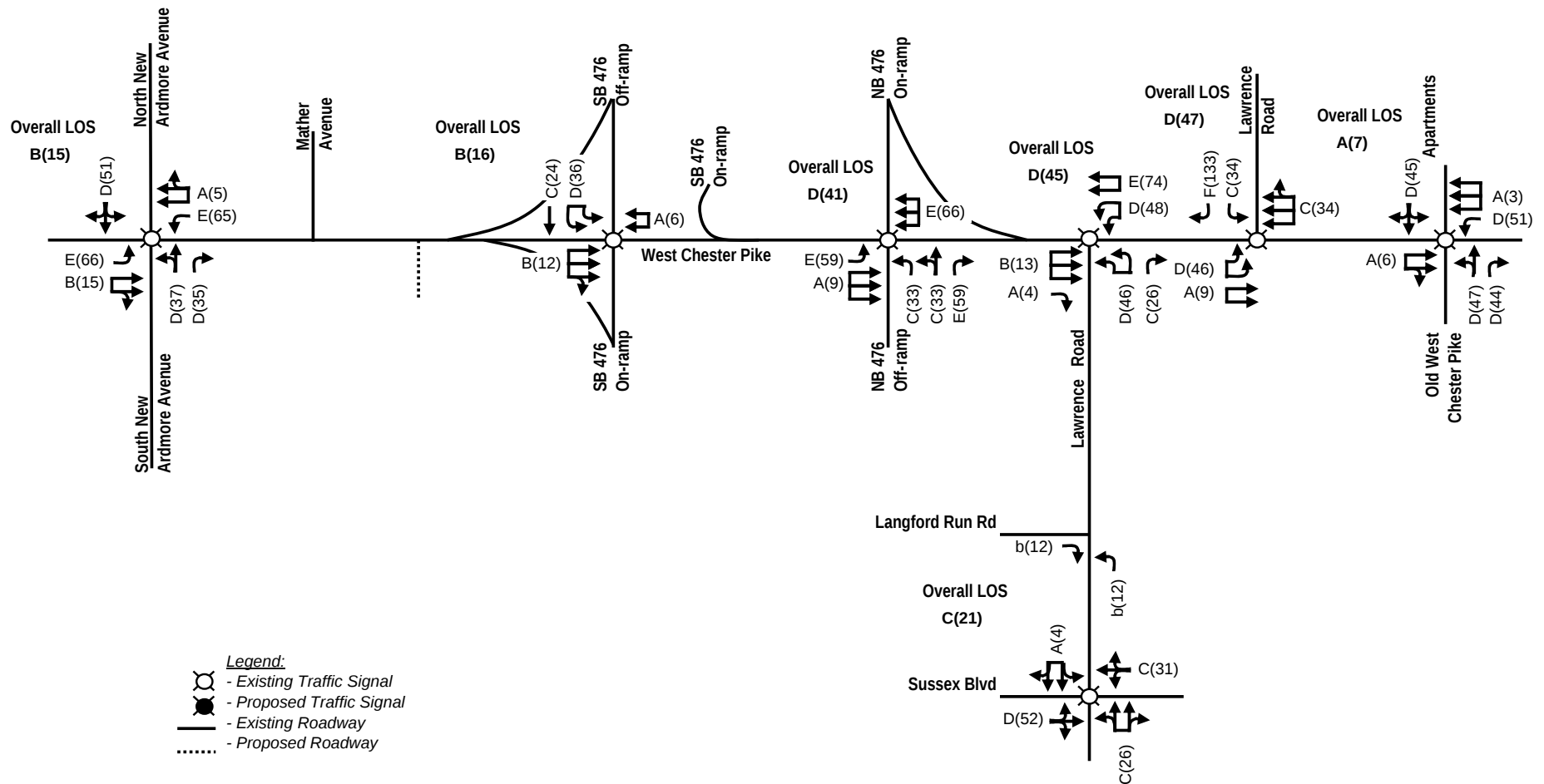
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2015 No Build AM Peak Hour Levels of Service

Traffic Impact Study - Marple Associates

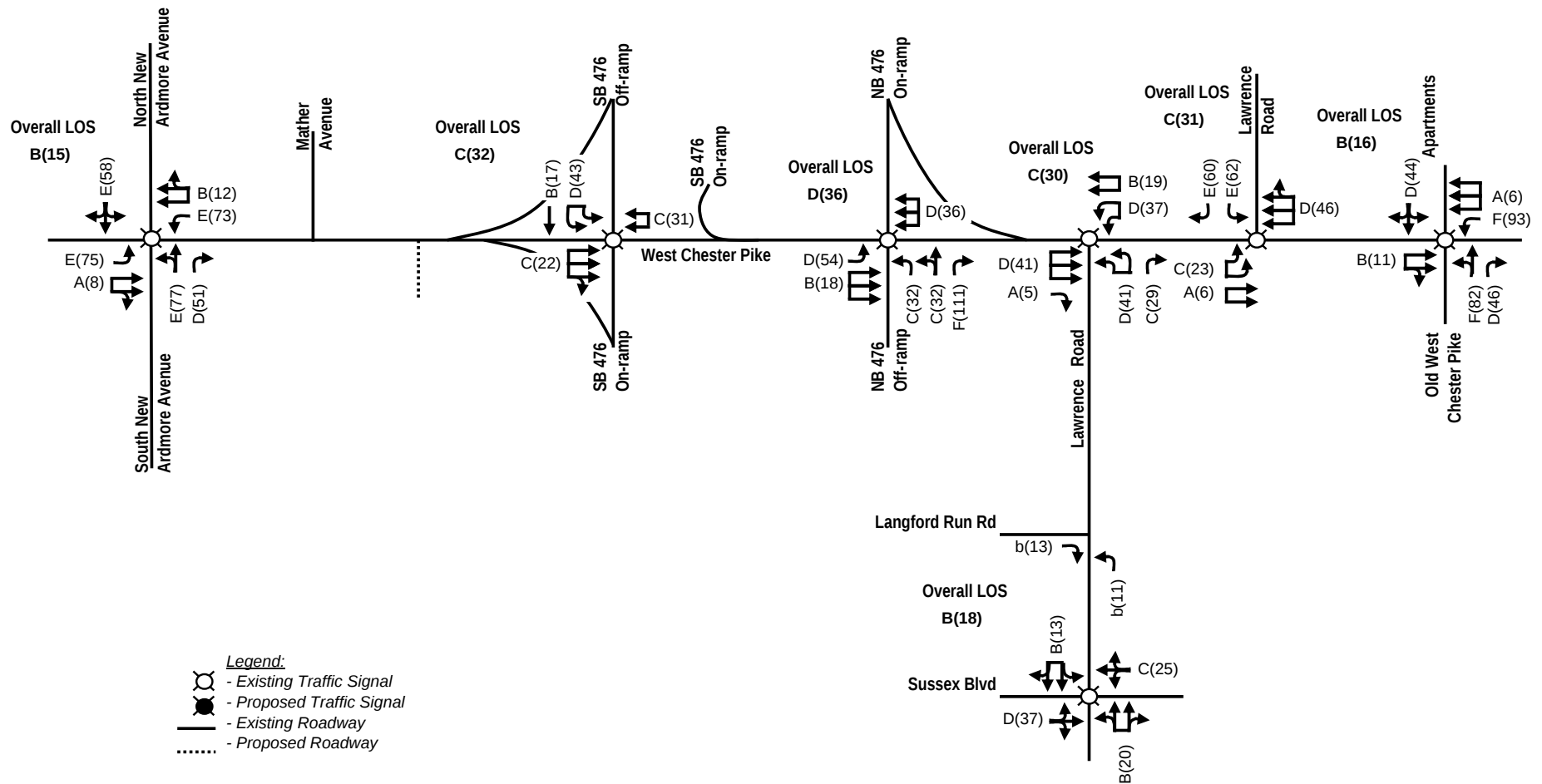
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2015 No Build PM Peak Hour Levels of Service

Traffic Impact Study - Marple Associates

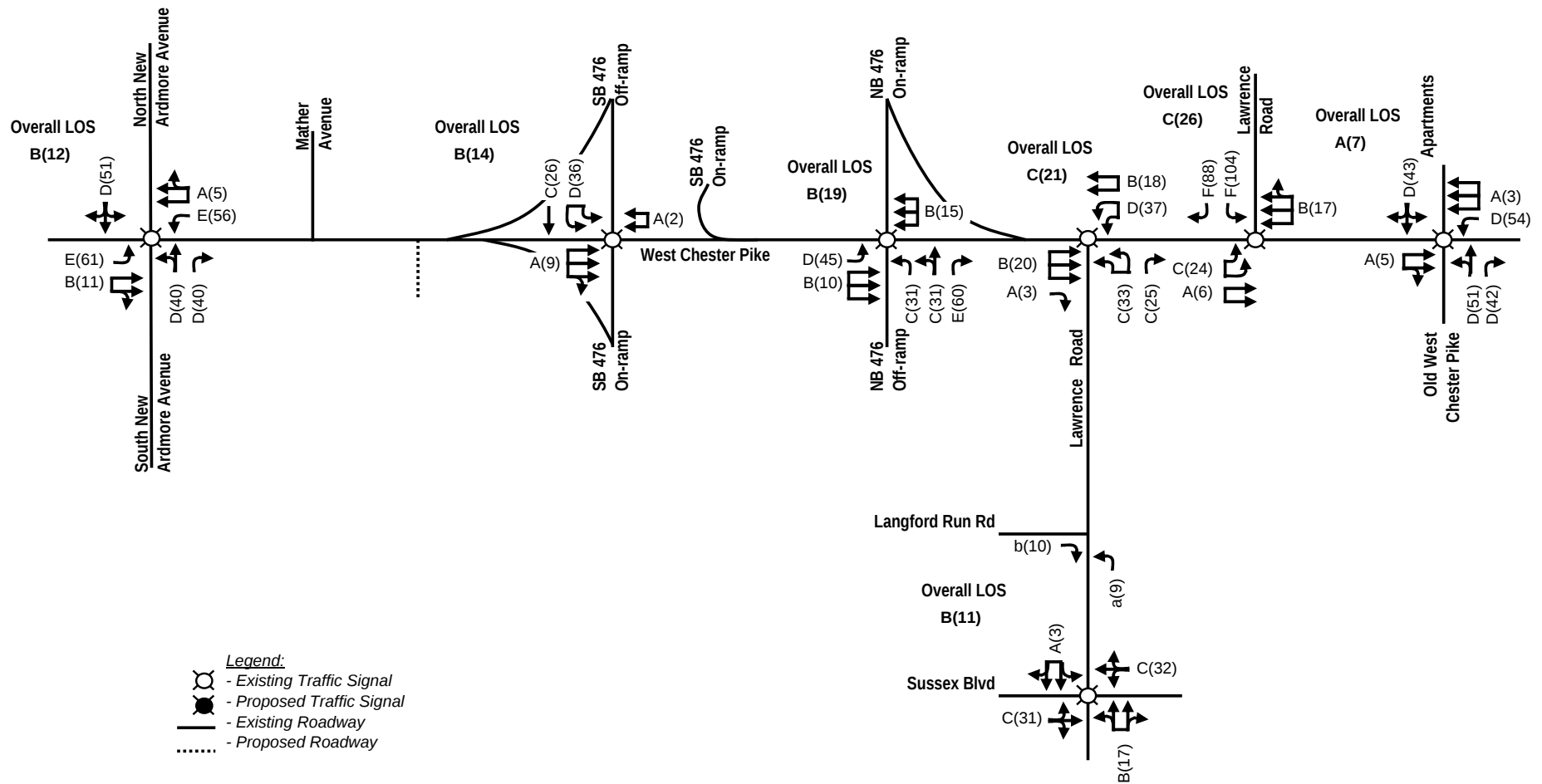
MARPLE TOWNSHIP, DELAWARE COUNTY, PENNSYLVANIA



2015 No Build Saturday Peak Hour Levels of Service

Traffic Impact Study - Marple Associates

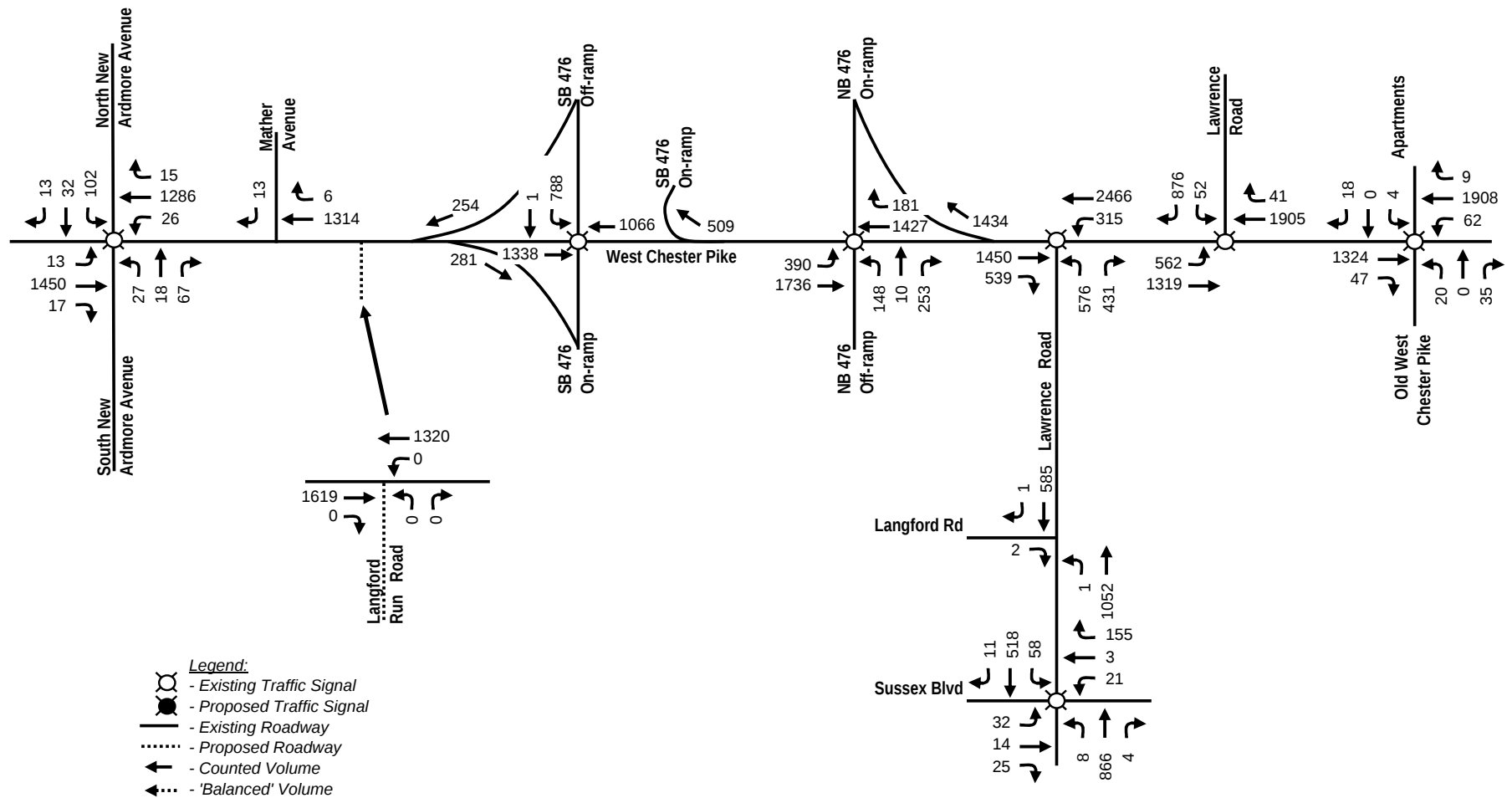
MARPLE TOWNSHIP, DELAWARE COUNTY, PENNSYLVANIA



2020 No Build AM Peak Hour Traffic Volumes

Traffic Impact Study - Marple Associates

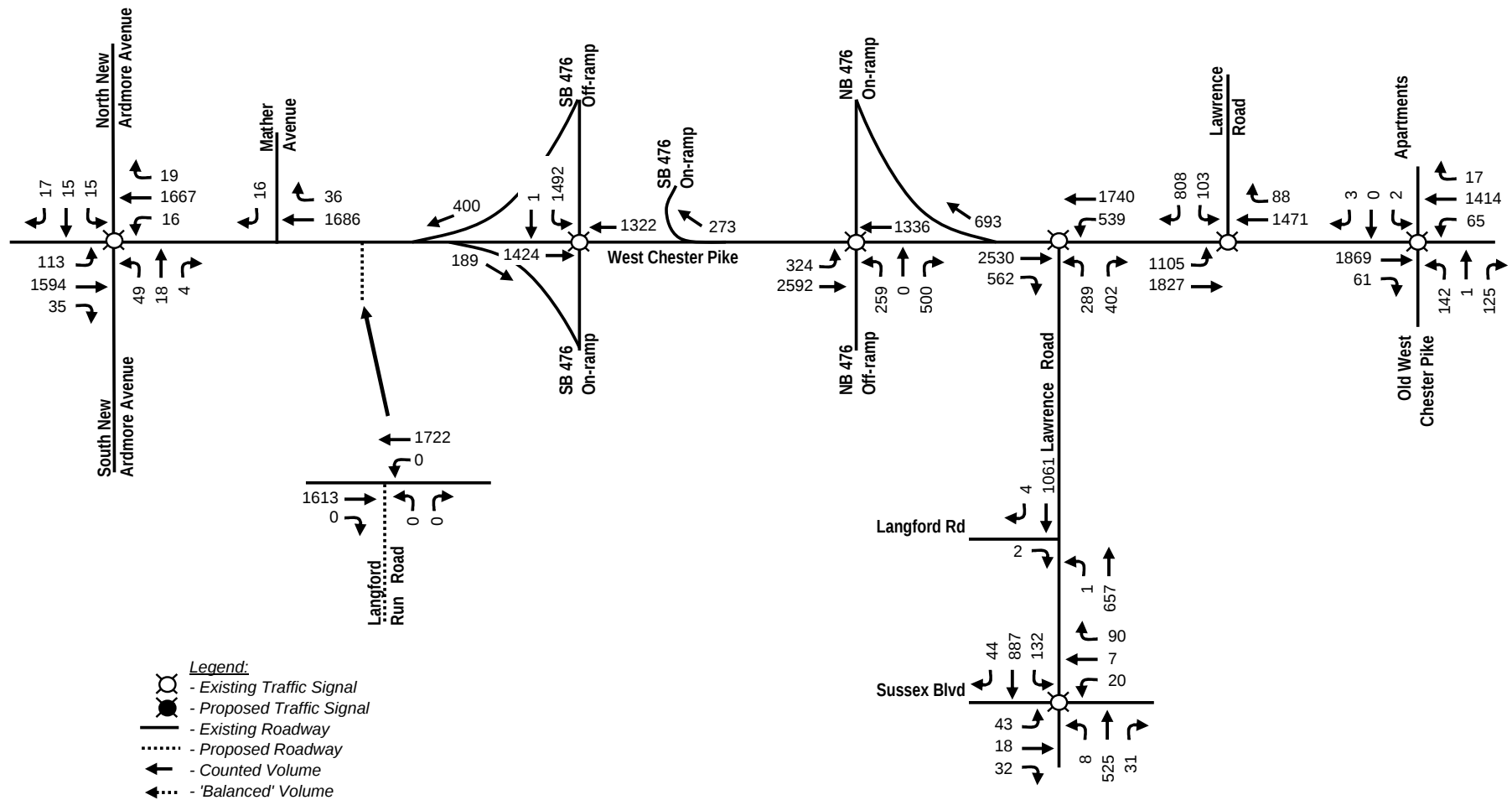
MARPLE TOWNSHIP, DELAWARE COUNTY, PENNSYLVANIA



2020 No Build PM Peak Hour Traffic Volumes

Traffic Impact Study - Marple Associates

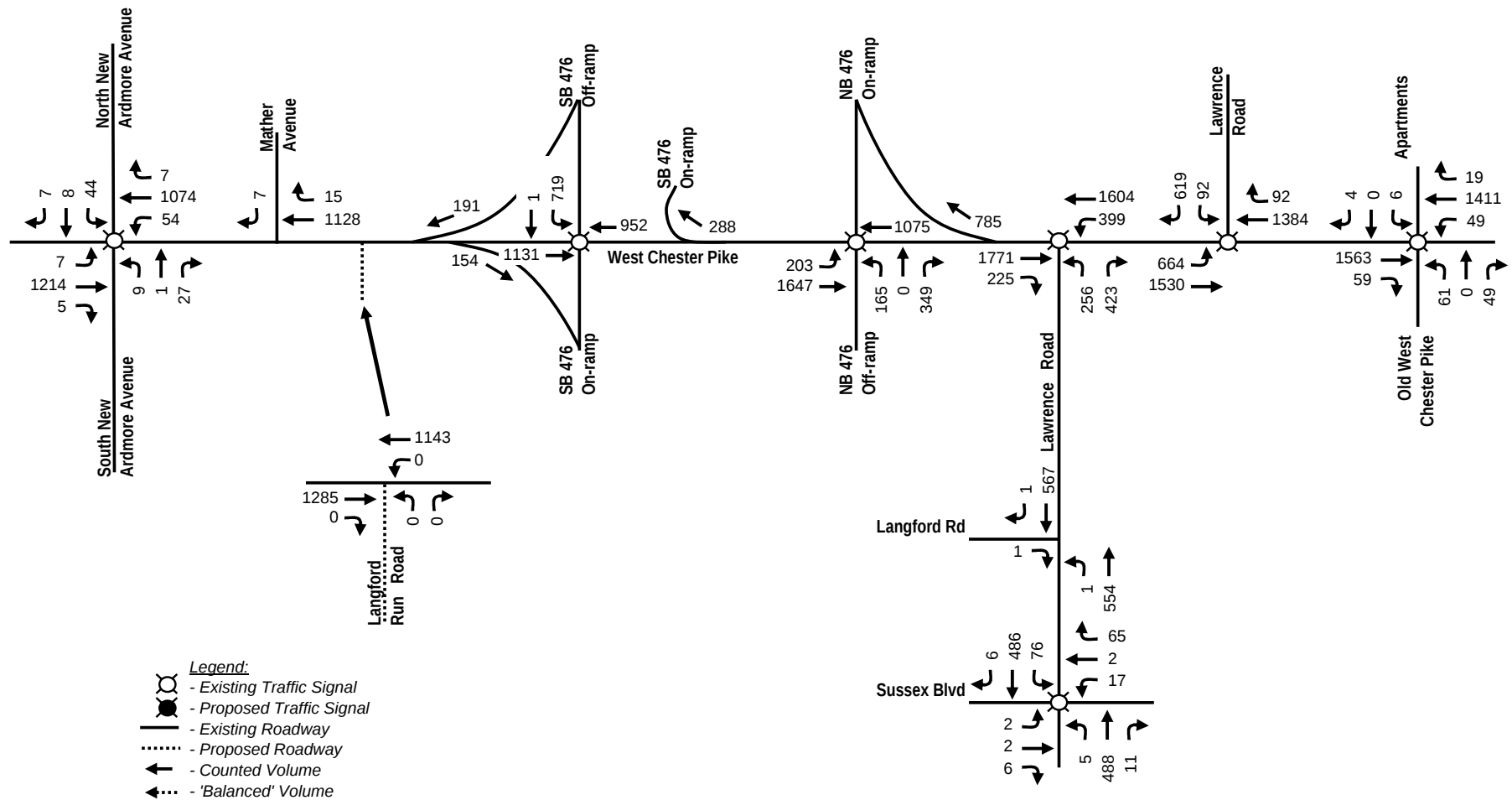
MARPLE TOWNSHIP, DELAWARE COUNTY, PENNSYLVANIA



2020 No Build Sat Peak Hour Traffic Volumes

Traffic Impact Study - Marple Associates

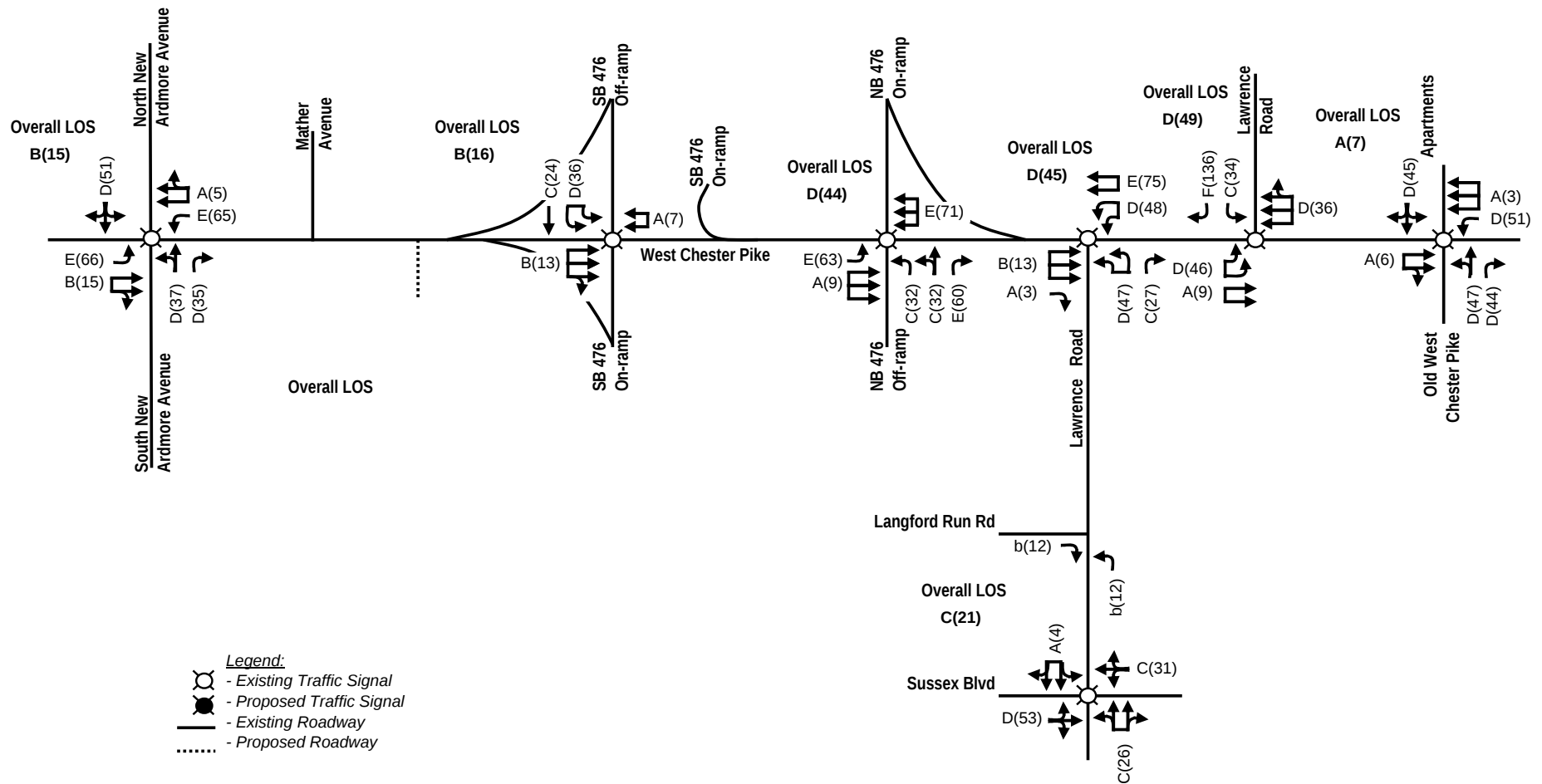
MARPLE TOWNSHIP, DELAWARE COUNTY, PENNSYLVANIA



2020 No Build AM Peak Hour Levels of Service

Traffic Impact Study - Marple Associates

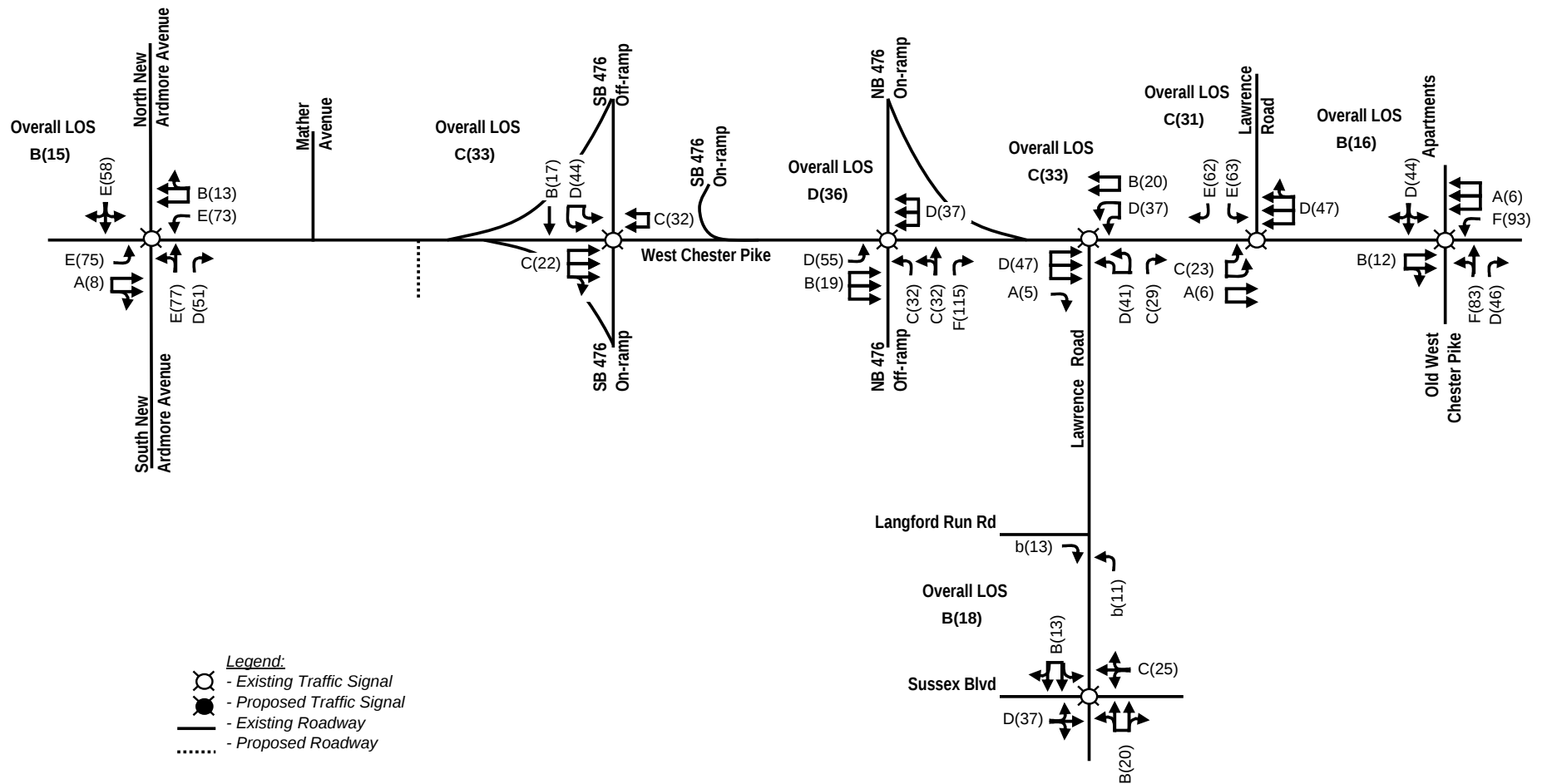
MARPLE TOWNSHIP, DELAWARE COUNTY, PENNSYLVANIA



2020 No Build PM Peak Hour Levels of Service

Traffic Impact Study - Marple Associates

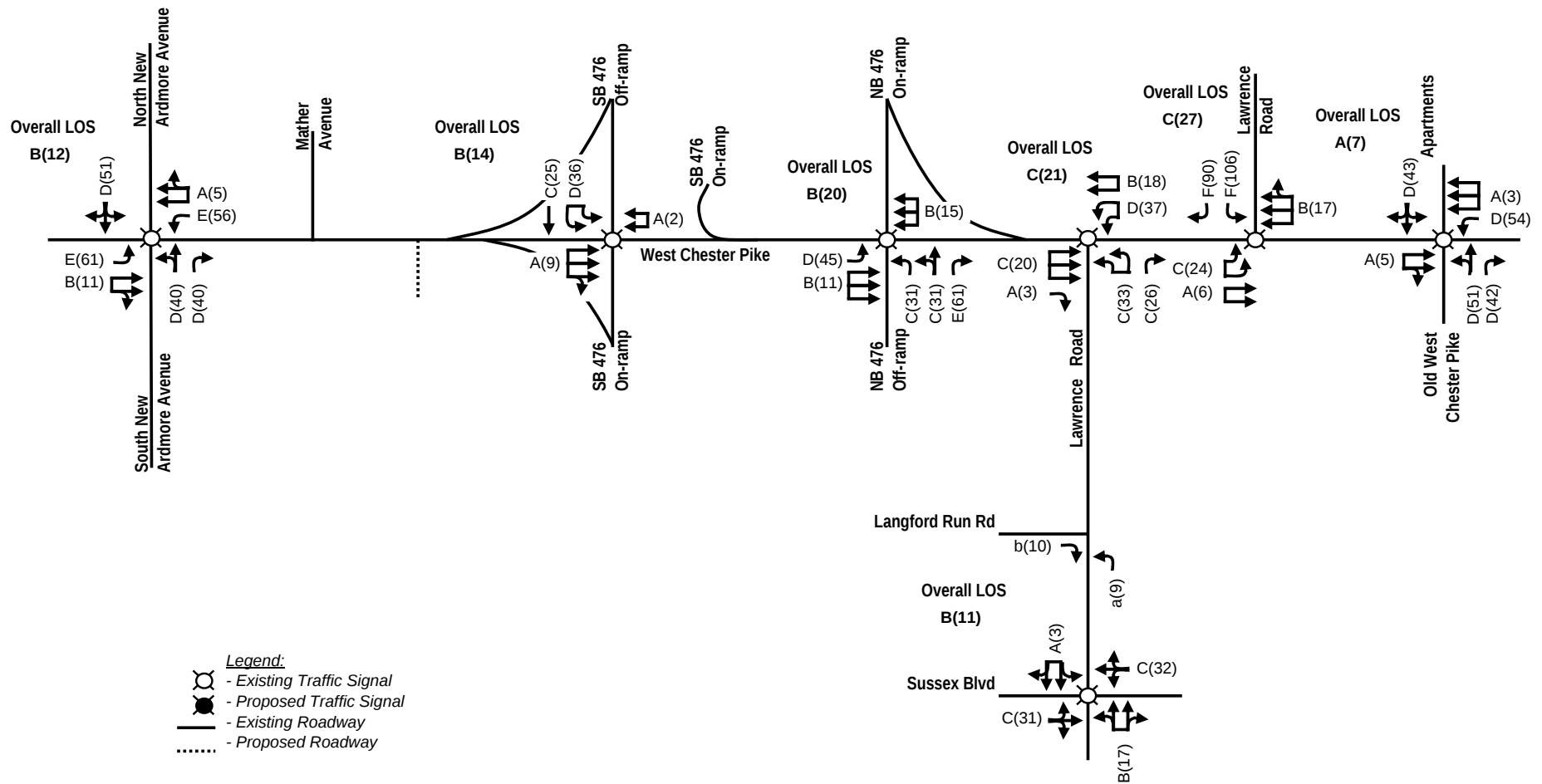
MARPLE TOWNSHIP, DELAWARE COUNTY, PENNSYLVANIA



2020 No Build Saturday Peak Hour Levels of Service

Traffic Impact Study - Marple Associates

MARPLE TOWNSHIP, DELAWARE COUNTY, PENNSYLVANIA



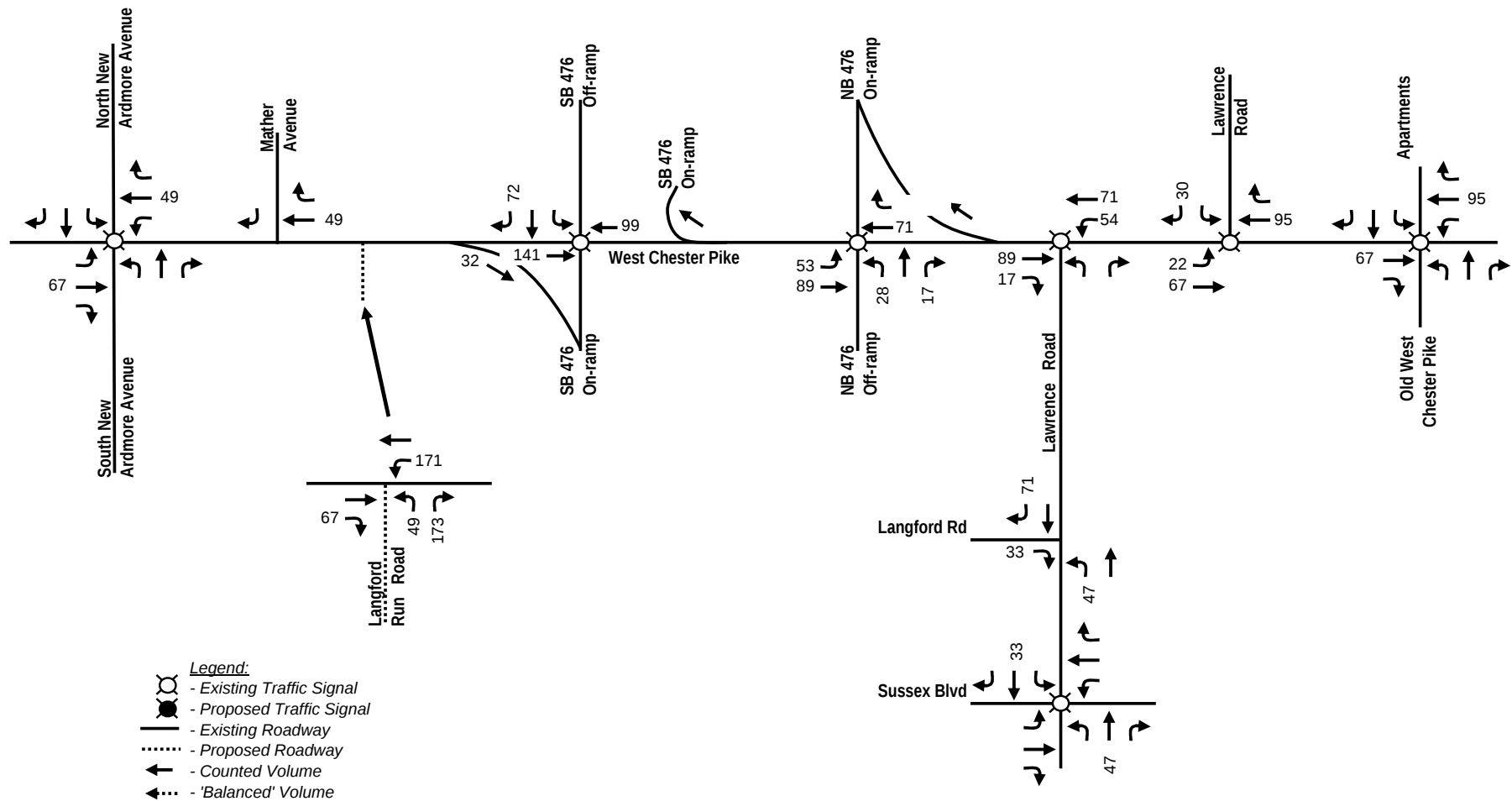
AM Peak Hour Site Generated Traffic Volumes

Traffic Impact Study - Marple Associates

MARPLE TOWNSHIP, DELAWARE COUNTY, PENNSYLVANIA



Note: All site traffic is new trips.



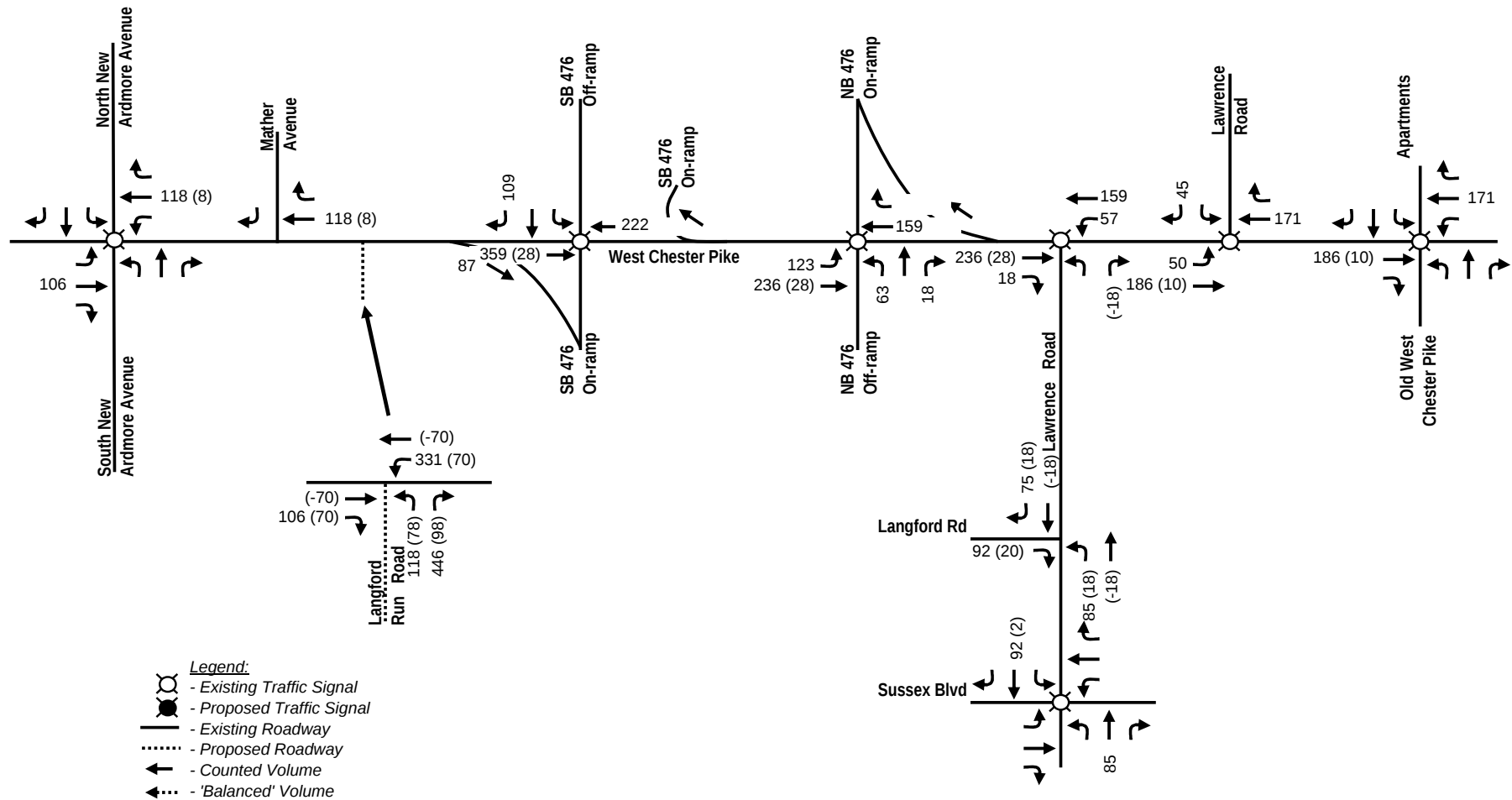
PM Peak Hour Site Generated Traffic Volumes

Traffic Impact Study - Marple Associates

MARPLE TOWNSHIP, DELAWARE COUNTY, PENNSYLVANIA



Note: New trips (passby adjustment)



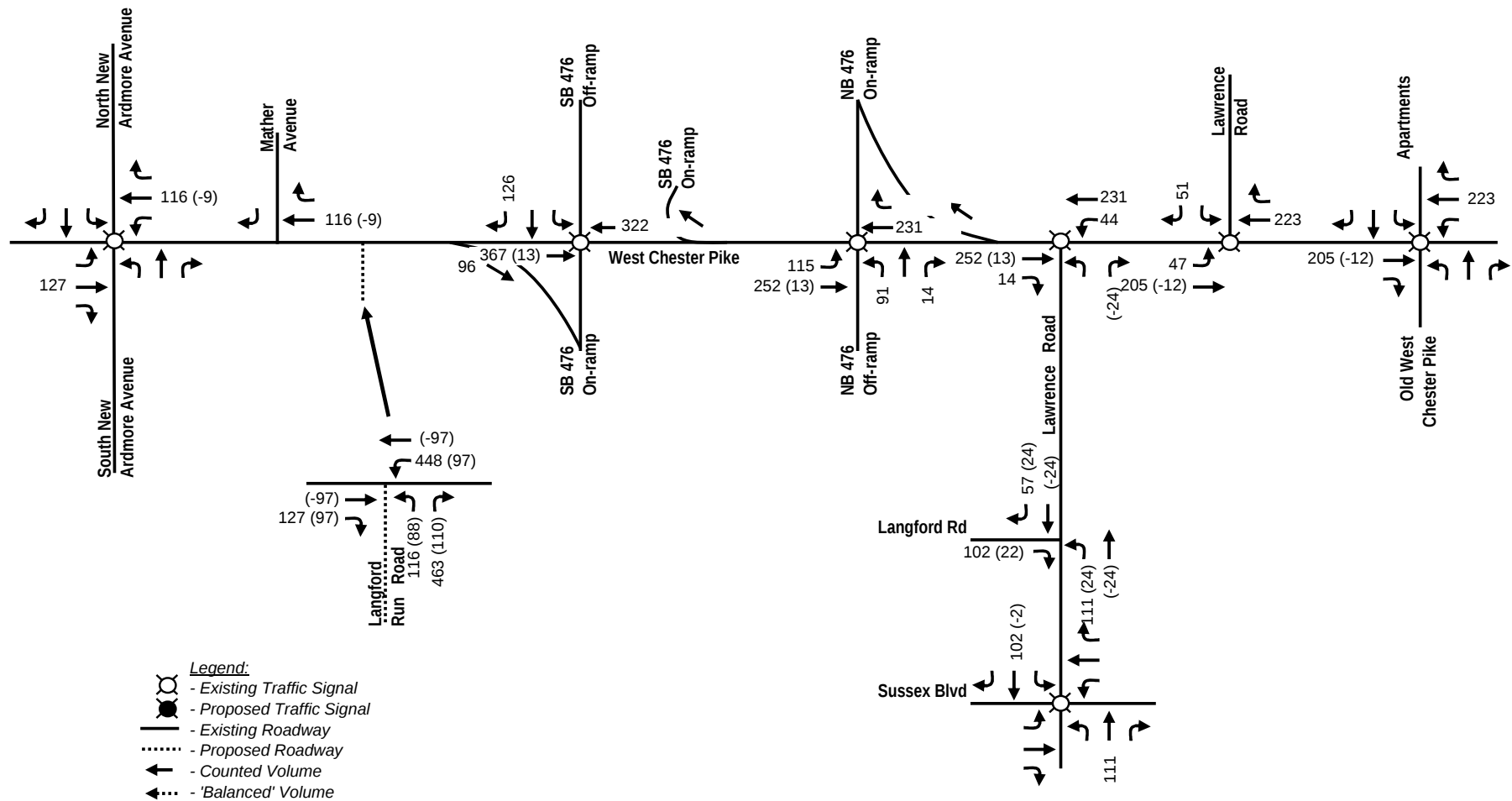
Saturday Peak Hour Site Generated Traffic Volumes

Traffic Impact Study - Marple Associates

MARPLE TOWNSHIP, DELAWARE COUNTY, PENNSYLVANIA



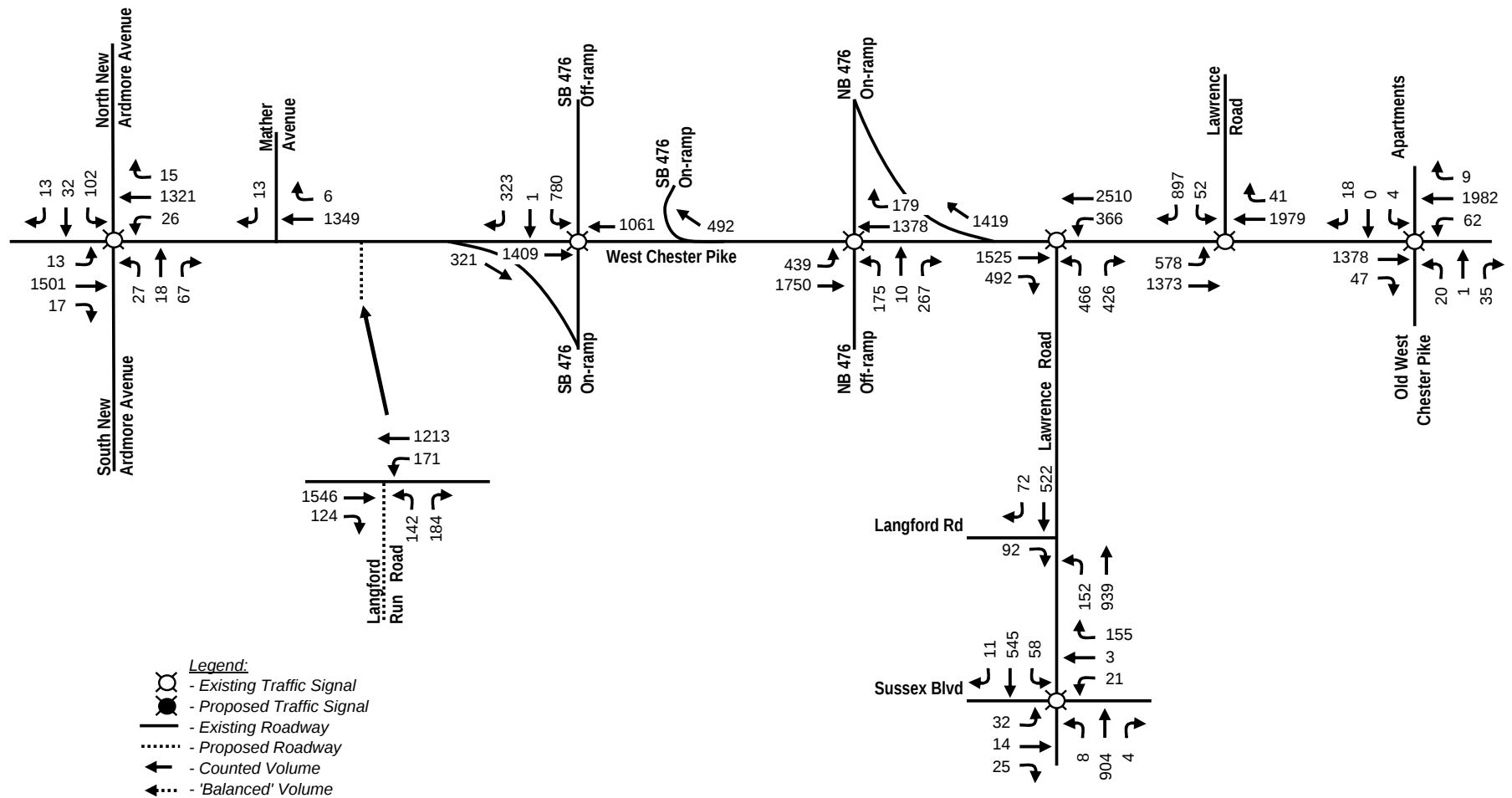
Note: New trips (passby adjustment)



2015 Build AM Peak Hour Traffic Volumes

Traffic Impact Study - Marple Associates

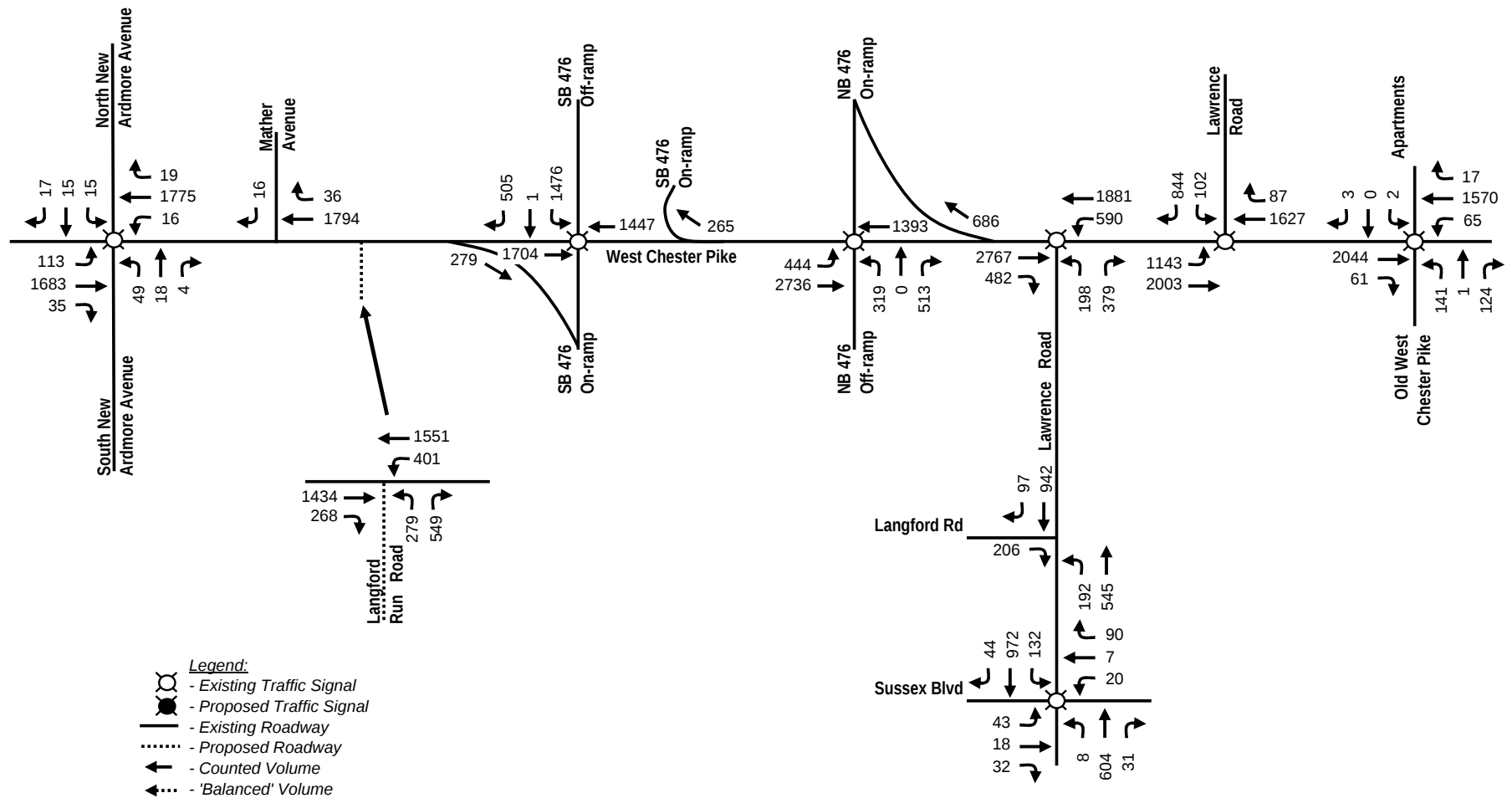
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2015 Build PM Peak Hour Traffic Volumes

Traffic Impact Study - Marple Associates

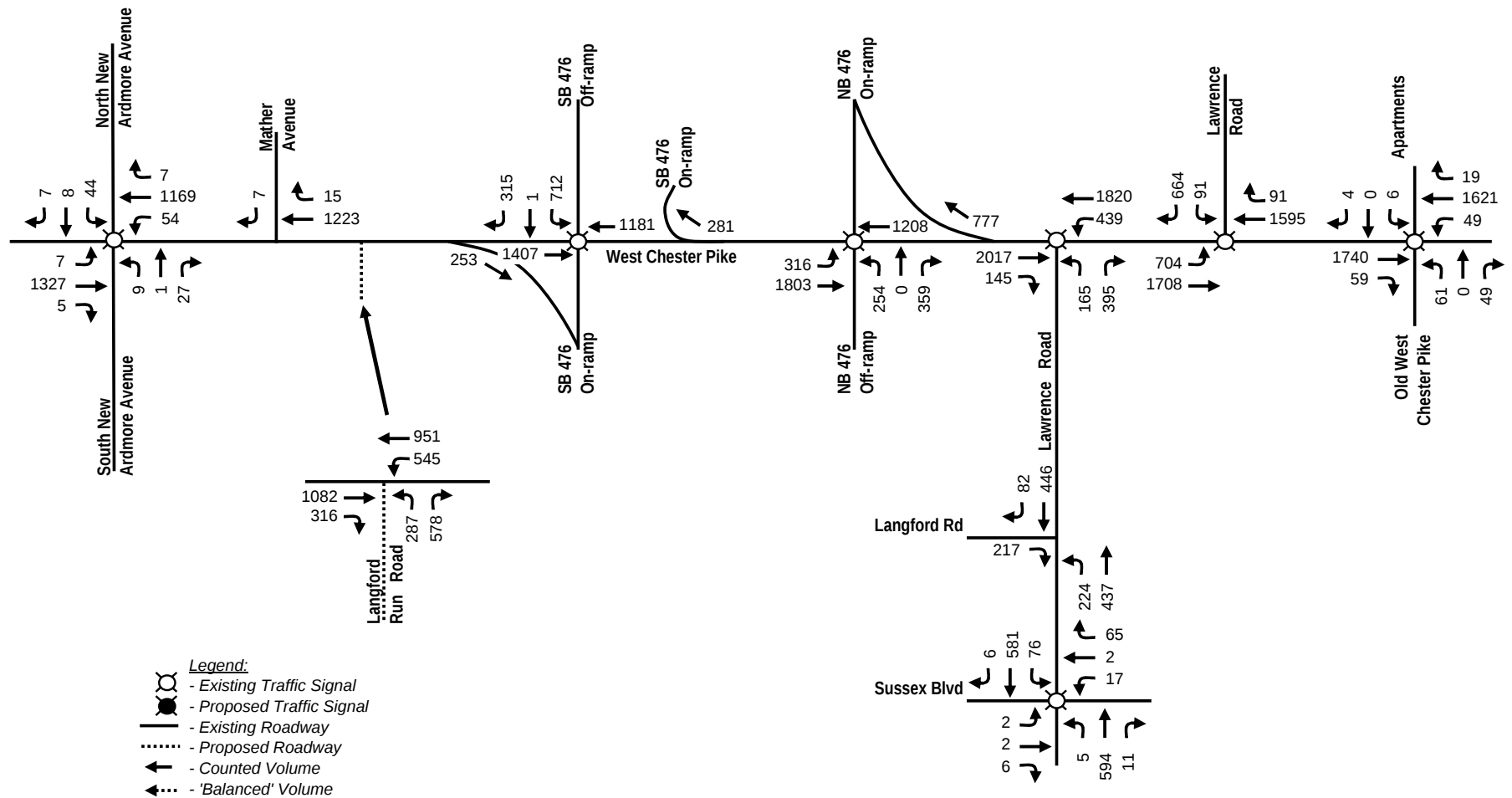
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2015 Build Saturday Peak Hour Traffic Volumes

Traffic Impact Study - Marple Associates

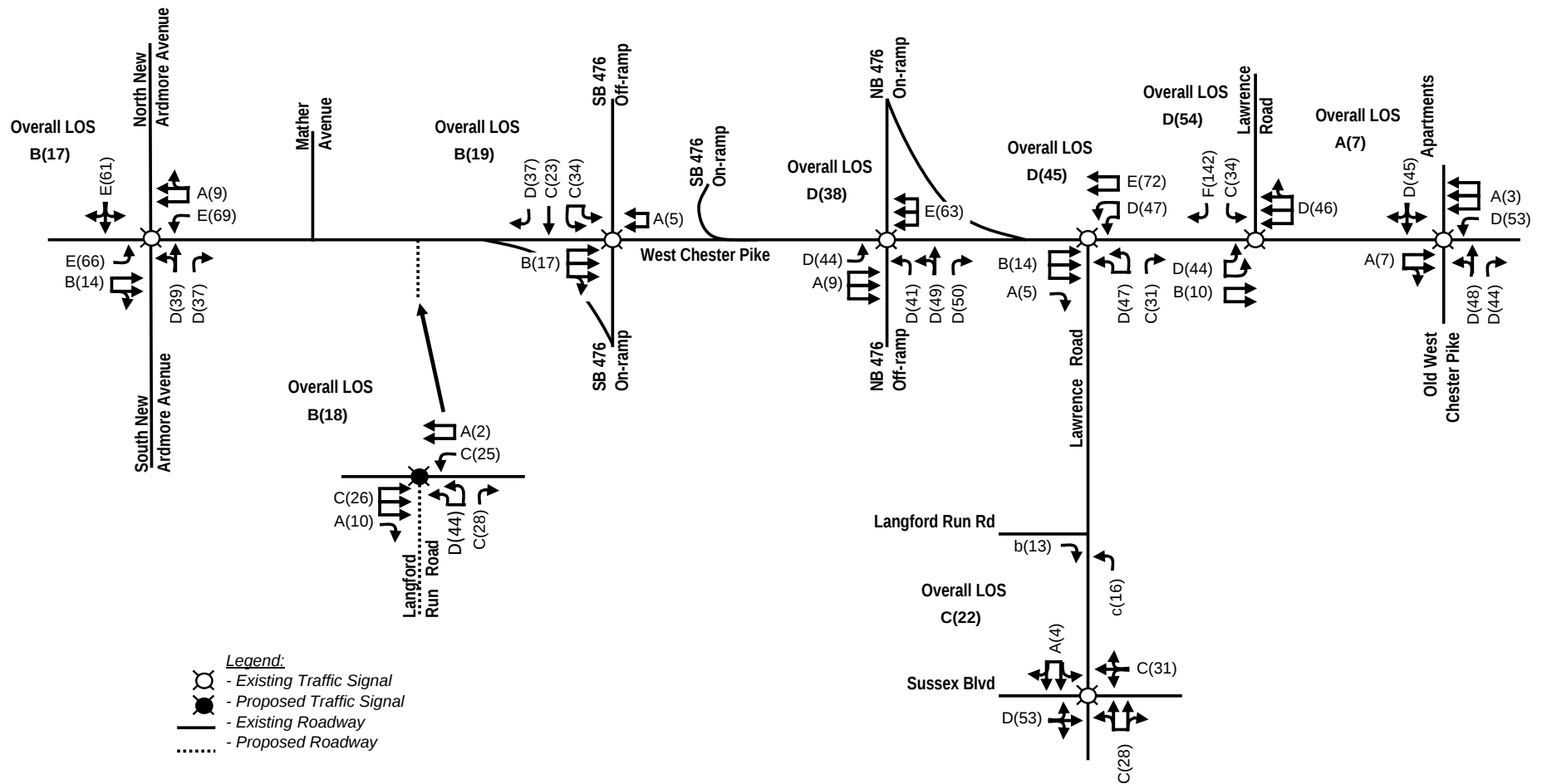
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2015 Build AM Peak Hour Levels of Service

Traffic Impact Study - Marple Associates

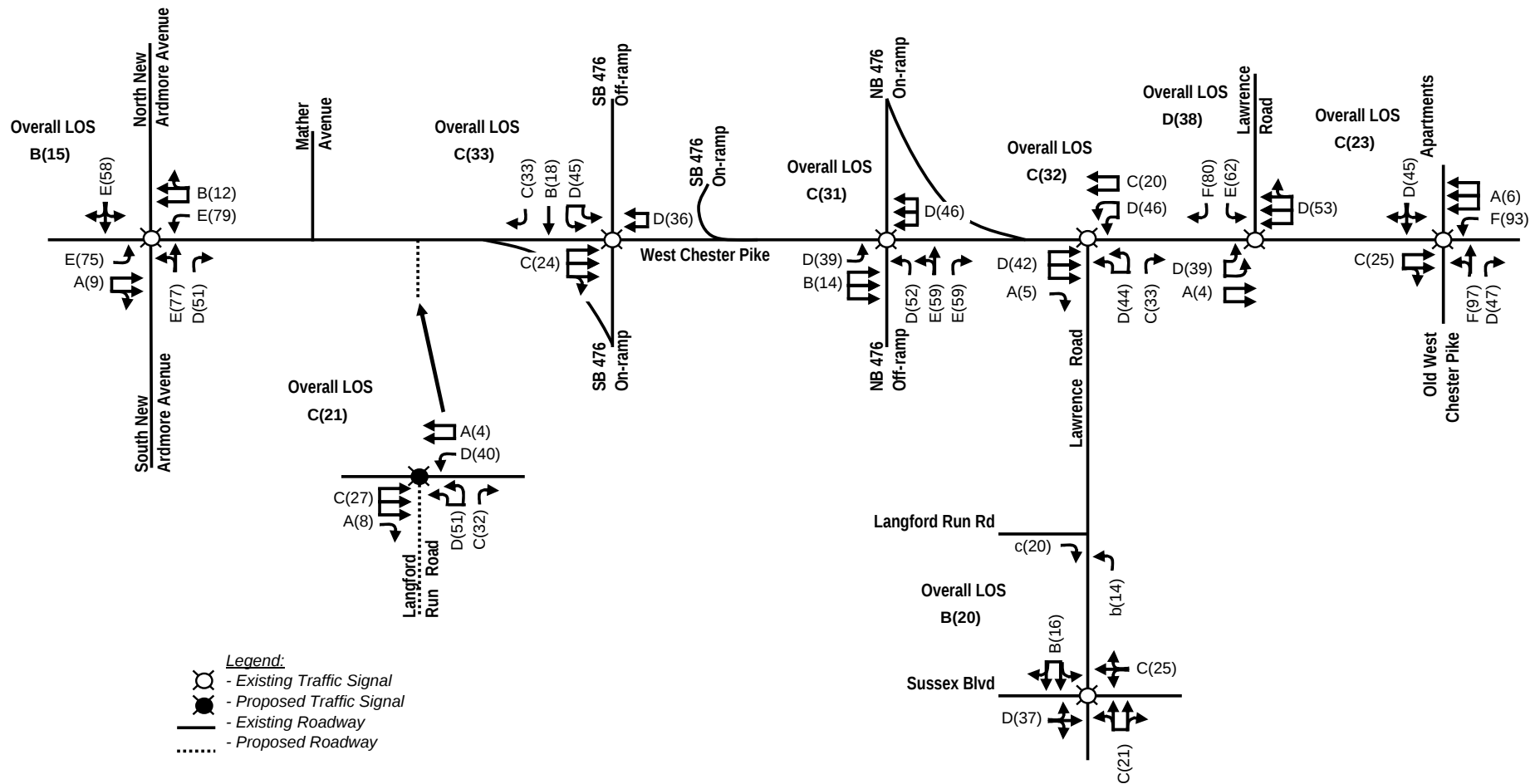
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2015 Build PM Peak Hour Levels of Service

Traffic Impact Study - Marple Associates

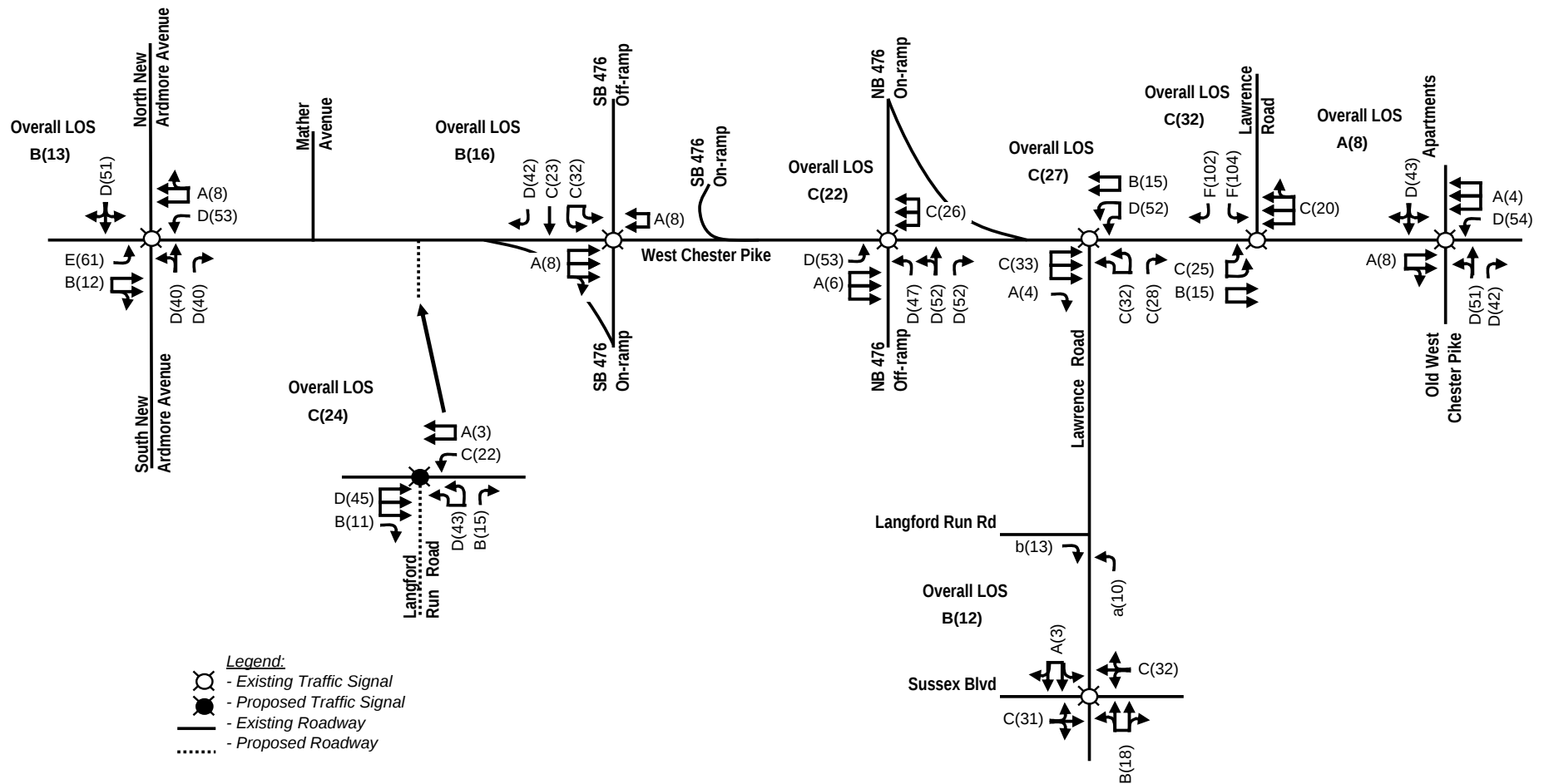
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2015 Build Saturday Peak Hour Levels of Service

Traffic Impact Study - Marple Associates

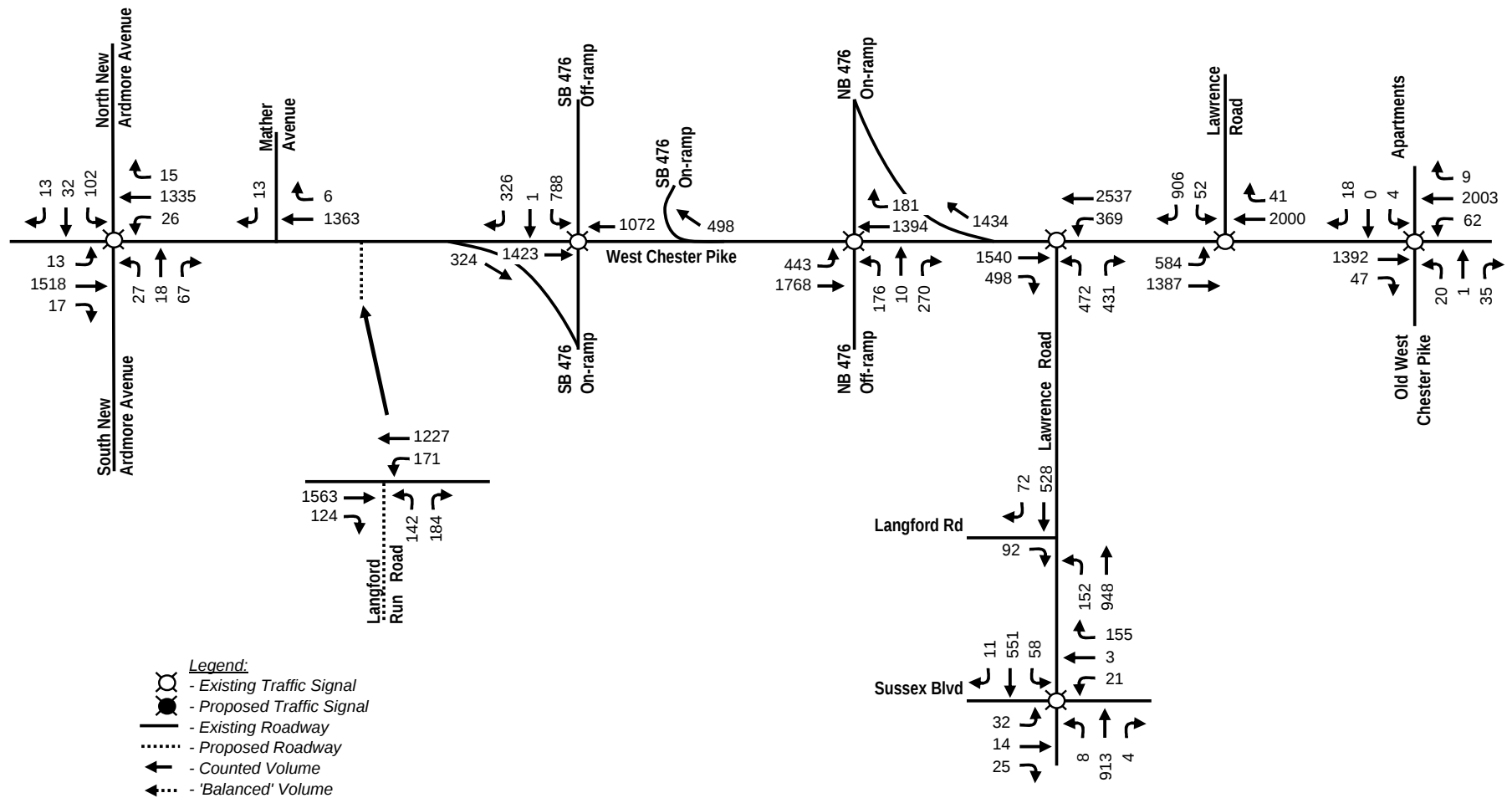
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2020 Build AM Peak Hour Traffic Volumes

Traffic Impact Study - Marple Associates

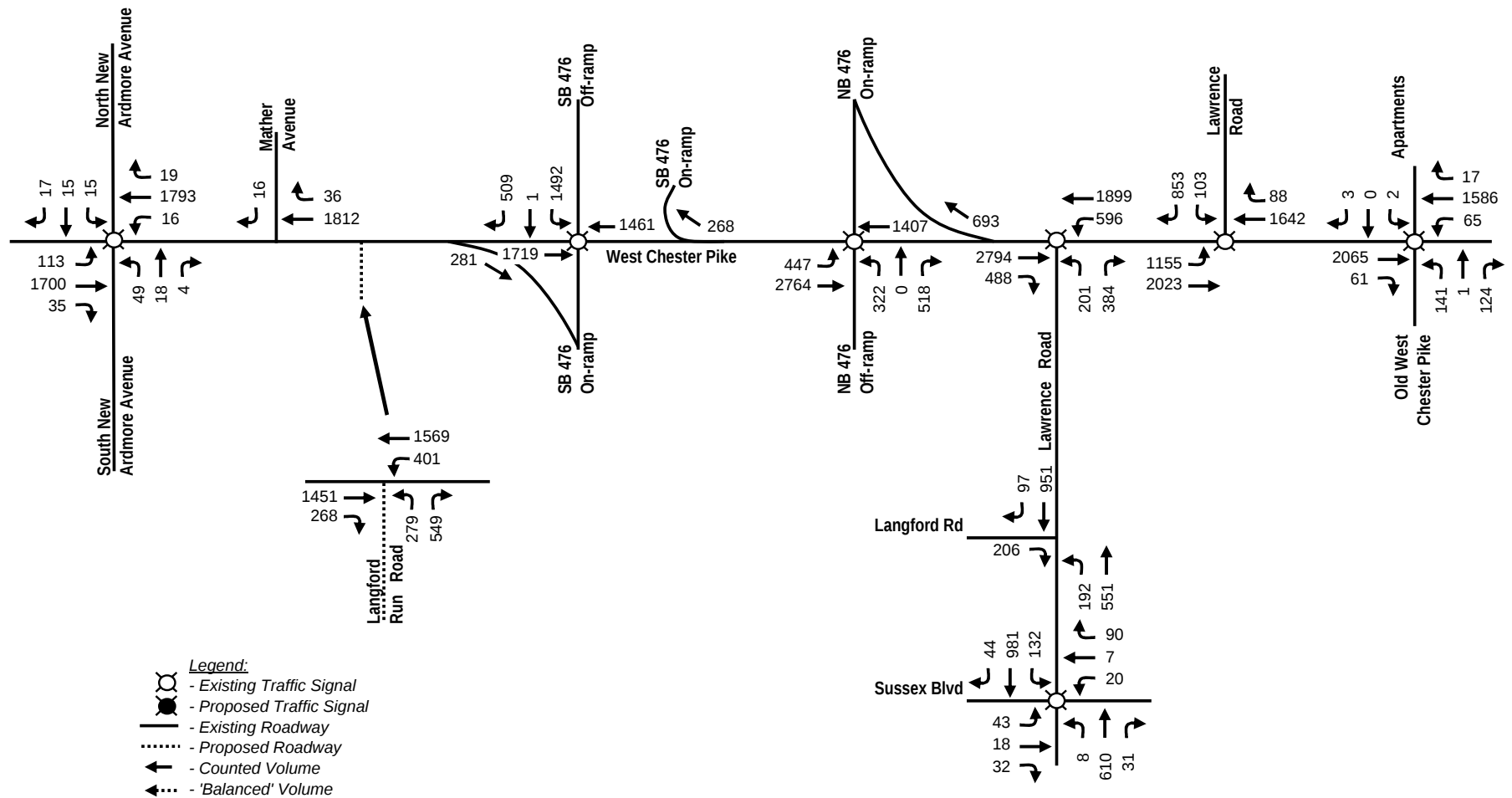
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2020 Build PM Peak Hour Traffic Volumes

Traffic Impact Study - Marple Associates

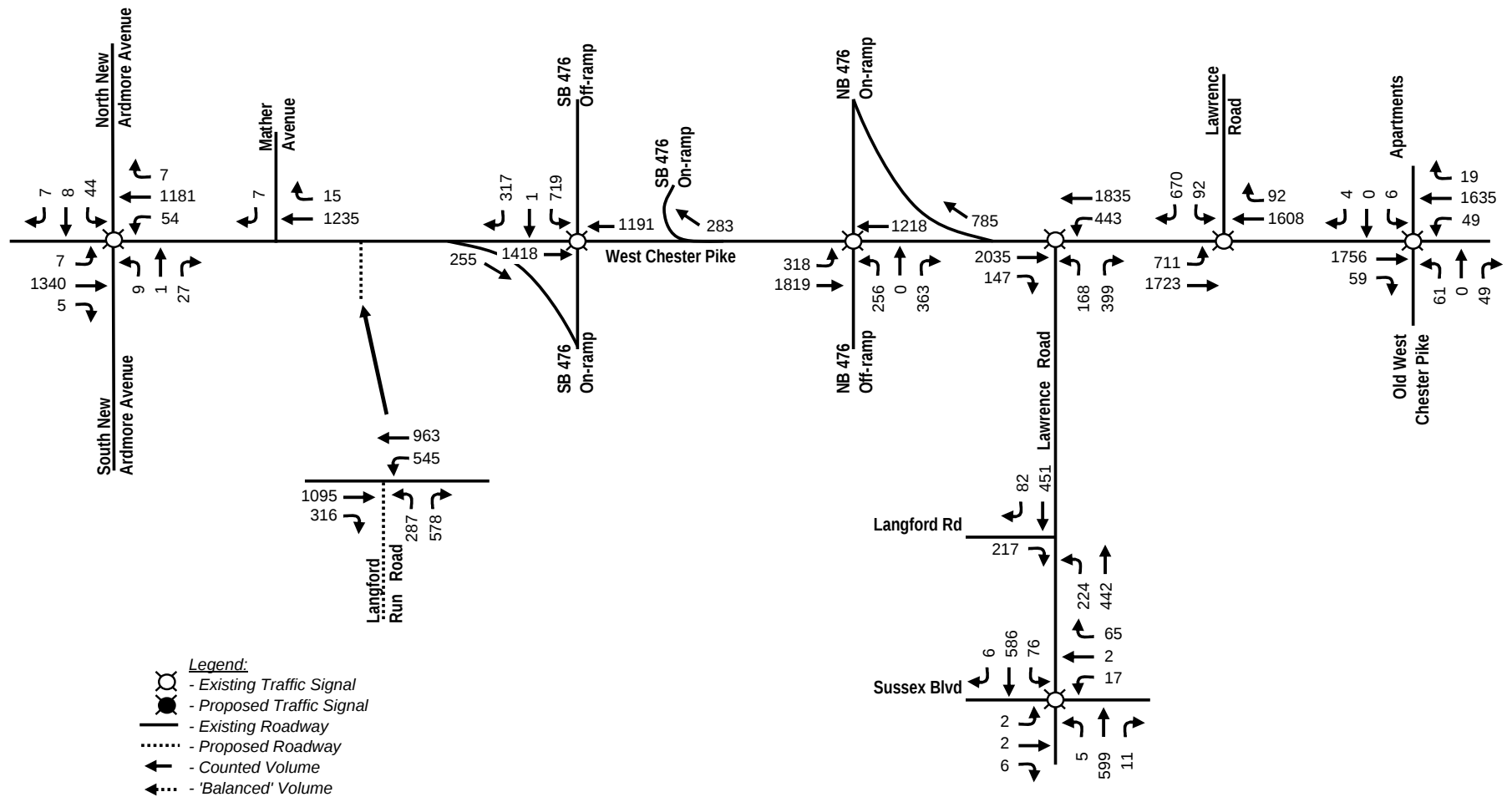
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2020 Build Saturday Peak Hour Traffic Volumes

Traffic Impact Study - Marple Associates

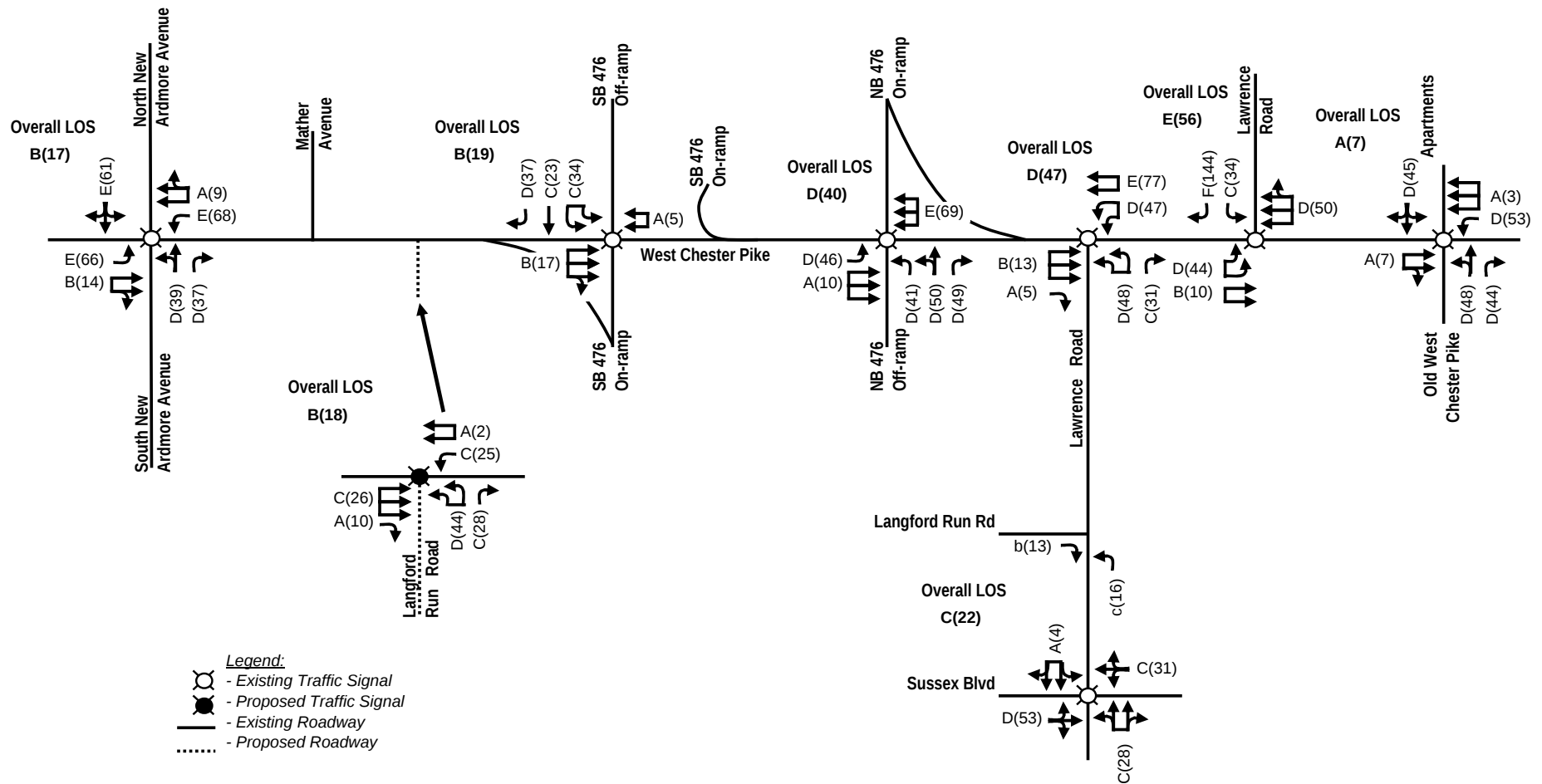
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2020 Build AM Peak Hour Levels of Service

Traffic Impact Study - Marple Associates

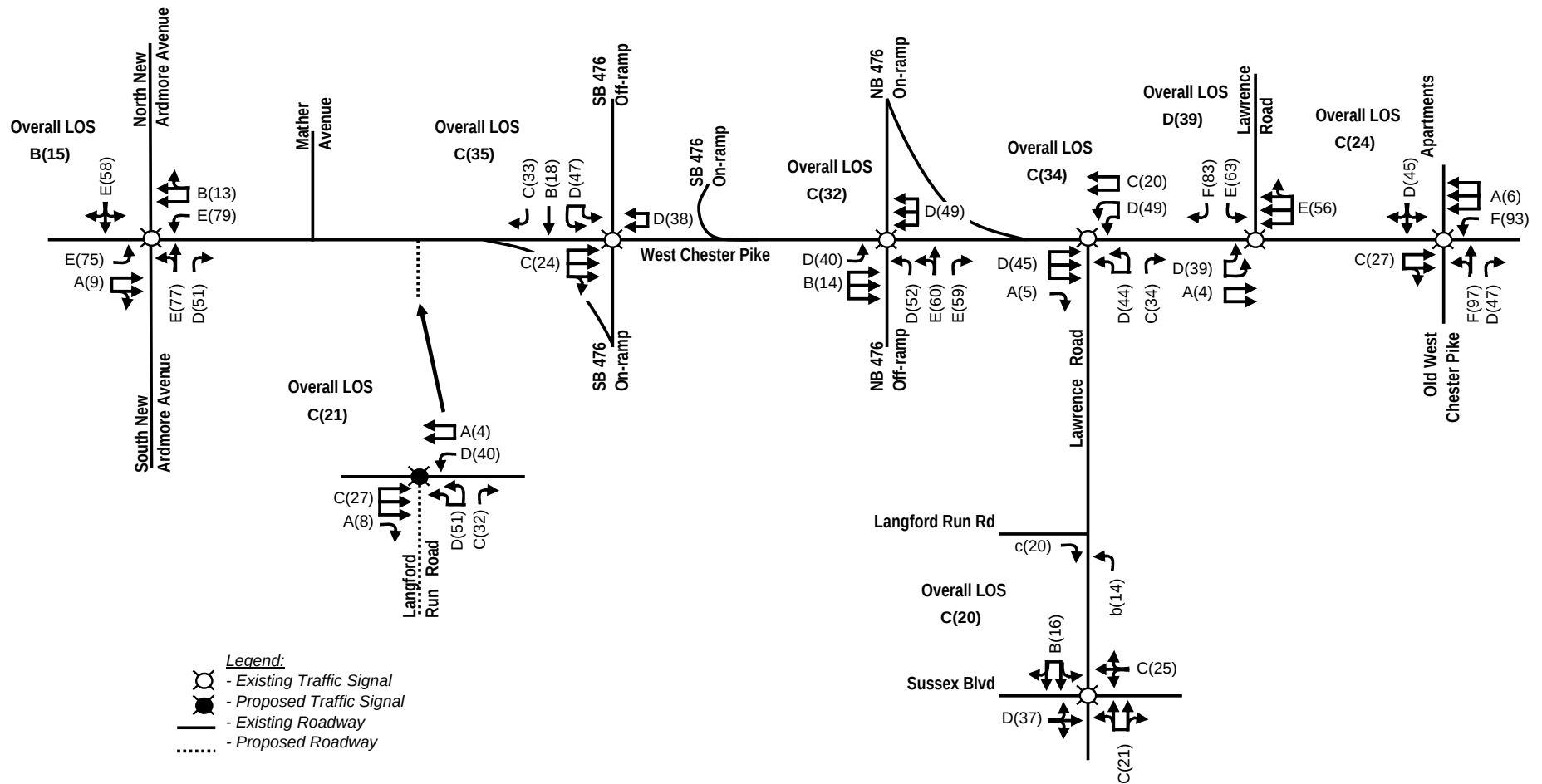
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2020 Build PM Peak Hour Levels of Service

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