



STATE ROUTE 4 AND COUNTY HOME ROAD INTERSECTION STUDY

CITY OF MARYSVILLE, OHIO

5/3/2011

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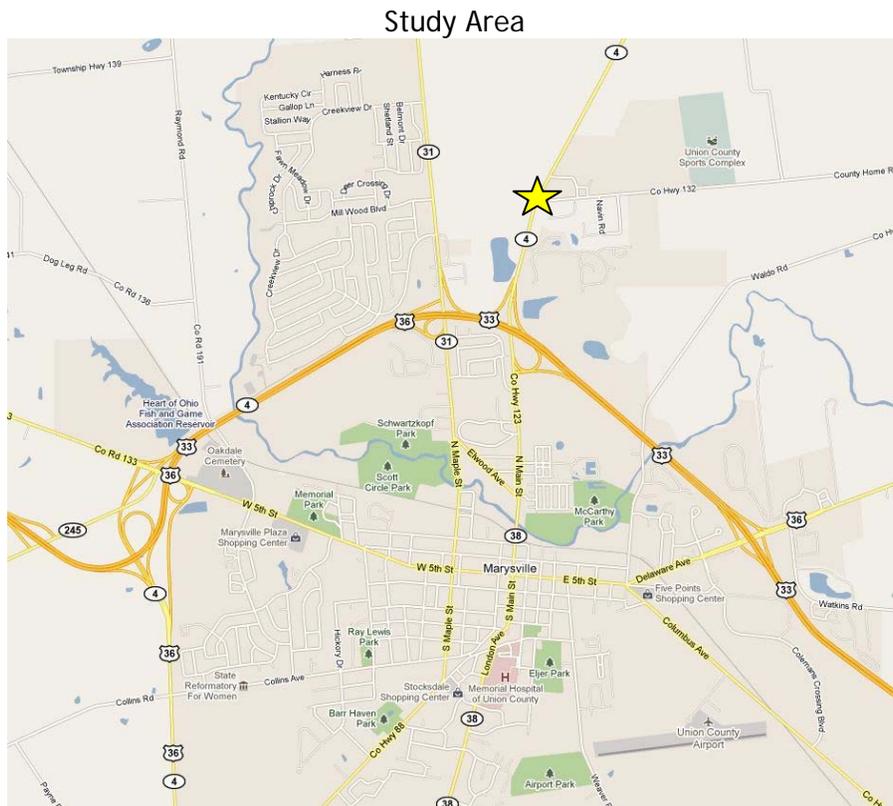
Introduction

At the request of the City of Marysville, Woolpert has conducted a traffic engineering study for the intersection of SR 4 and County Home Road in the City the Marysville. The purpose of the study is to identify deficiencies at the intersection related to the construction of a new fire station along County Home Road, and also to comply with the City's Traffic Impact Study (TIS) Standards.

The scope of this study was documented in a Memorandum of Understanding (MOU) dated 3/25/11 and approved by the City also on 3/25/2011.

The following bullets summarize the scope and methodology of the study:

- Data collection. Traffic counts were provided by the City and Woolpert. Field observations were conducted by Woolpert.
- Traffic Projections. Traffic projections were prepared for the subject intersection for an opening year of 2012 and a design year of 2032.
- Analysis. Signal warrant, intersection capacity, turn lane and sight distance analyses were performed.
- Report. This document presents the data, analysis, findings and recommendations of the study.



Existing Conditions

The existing intersection of SR 4 and County Home Road is a one-way stop controlled tee intersection with no auxiliary turn lanes. The intersection is located on the northeast side of the City of Marysville. The study area can be described as generally rural on the edge of suburban development. City emergency services have noted difficulty making turning movements from County Home Road onto SR 4, especially in heavy vehicles, due to traffic and visibility issues.

SR 4 is a rural, two lane state highway that connects Marysville northward to Marion and points beyond. SR 4 is classified by ODOT as Access Category III and carries approximately 10 percent heavy vehicles in the study area. County Home Road is a two-lane suburban city street serving residential and agricultural areas and various local government operations including a large sports complex.

Analysis

Traffic Projections - Opening Year 2012

PM peak hour traffic projections for opening year 2012 are based on count data factored to year 2012 at a growth rate of 1.5% per year in accordance with the MOU. Calculations and resulting volumes are shown in the next section.

Traffic Projections - Design Year 2032

PM peak hour traffic projections for the design year are based on the same counts as noted above, factored by the same growth rate of 1.5% per year, plus site generated traffic for an assumed developed condition of the adjacent Cook property to the west. The following table shows the trip generation for the assumed full-build out of the Cook property. This scenario includes about 700,000 sf of commercial space.

Assumed Trip Generation for Cook Property

Land Use	Sq Ft / Fueling Positions/Seats/Dwelling Units	ITE Land Use Code	Average Vehicle Trips vs.	Average Rate / Fitted Curve	Directional Distribution		Pass-By	Total Trips		Primary Trips		Pass-By Trips	
					In	Out		In	Out	In	Out	In	Out
Meijer Store	192,068	Free-Standing Discount Superstore (813)	1000 SF Gross Floor Area	$T = 4.23(X) - 57.47$	49%	51%	28%	370	385	264	279	106	106
945	10	Gasoline/Service Station with Convenience Store	Vehicle Fueling Positions	13.38	50%	50%	56%	67	67	29	29	38	38
912	4,000	Drive-in Bank	1000 SF Gross Floor Area	45.74	50%	50%	47%	91	91	48	48	43	43
932	6,000	High-Turnover (Sit-Down) Restaurant	1000 SF Gross Floor Area	10.92	61%	39%	43%	40	26	26	12	14	14
220	350	Apartment (220)	Dwelling Units	$T = 0.55(x) + 17.65$	65%	35%	0%	137	74	137	74	0	0
912	4,000	Drive-in Bank	1000 SF Gross Floor Area	45.74	50%	50%	47%	91	91	48	48	43	43
931	650	Quality Restaurant	Seats	$T = 0.40(x) - 31.48$	59%	41%	44%	135	94	85	44	50	50
932	6,000	High-Turnover (Sit-Down) Restaurant	1000 SF Gross Floor Area	10.92	61%	39%	43%	40	26	26	12	14	14
934	16,000	Fast-Food Restaurant with Drive-Through Window	1000 SF Gross Floor Area	34.64	52%	48%	50%	288	266	149	127	139	139
710	200,000	General Office Building	1000 SF Gross Floor Area	$T = 1.12(x) + 78.81$	17%	83%	0%	52	252	52	252	0	0
720	20,000	Medical-Dental Office Building (720)	1000 SF Gross Floor Area	$\ln(T) = 0.93 \ln(x) + 1.47$	27%	73%	0%	20	52	20	52	0	0
820	300,000	Shopping Center (820)	1000 SF Gross Floor Area	$\ln(T) = 0.66 \ln(x) + 3.40$	48%	52%	29%	621	673	433	485	188	188
TOTAL								3758		2575		1183	

Build-out projections were developed by adding the site generated traffic to the background traffic grown to the design year. The following trip distribution assumptions were used:

- 13% of the site traffic will be from/to SR 4 to the north.
- 7% of the site traffic will be from/to County Home Road to the east.
- 15% of the site traffic will be from/to SR 4 to the south.

The following table summarizes the 2012 and 2032 PM peak hour projections.

Traffic Projections

Movement	2007 Traffic Counts	2012 Backgro und Volumes	2023 Backgro und Volumes	Initial Development			Build-out Development			2012 Total Build Volumes	2032 Total Build Volumes
				Primary In	Primary Out	Pass-By	Primary In	Primary Out	Pass-By		
				Volume	Volume	Volume	Volume	Volume	Volume		
EBL					47	30		102	47	226	226
EBT					26	38		55	69	188	188
EBR					66	30		122	21	239	239
WBL	74	80	94				5			85	99
WBT				11		6	21		12	50	50
WBR	14	15	18			-6			-12	1	1
NBL				66		36	99		12	213	213
NBT	506	545	642			-36		19	-59	469	566
NBR	216	233	274					14		247	288
SBL	26	28	33			-16			-69	1	1
SBT	289	311	366			-30	32		-56	257	312
SBR				55		30	122		56	263	263

Growth Rate: 1.5%

Traffic Signal Warrants - Existing Conditions

Traffic signal warrants were evaluated for the intersection of SR 4 and County Home Road. Warrants 1, 2 and 3 were evaluated against existing volumes and geometry. Warrants 2 (Four Hour Volumes) and 3 (Peak Hour Volumes) are satisfied for existing conditions.

Volumes used in the signal warrants were all based on actual 24-hour counts which are included in the Appendix. PC Warrants software was used to perform the analysis and the summary results are shown below.

Traffic Signal Warrant Summary - SR 4 and County Home Road

Major Street Approaches	Minor Street Approaches
Northbound: SR 4 Number of Lanes: 1 Approach Speed: 50 Total Approach Volume: 4,438	Eastbound: Number of Lanes: 1 Total Approach Volume: 0
Southbound: SR 4 Number of Lanes: 1 Approach Speed: 50 Total Approach Volume: 4,599	Westbound: County Home Road Number of Lanes: 1 Total Approach Volume: 1,585
<hr/>	
Warrant Summary (Rural values apply.)	
Warrant 1 - Eight Hour Vehicular Volumes	Not Satisfied
Warrant 1A - Minimum Vehicular Volume Not Satisfied Required volumes reached for 6 hours, 8 are needed	
Warrant 1B - Interruption of Continuous Traffic Not Satisfied Required volumes reached for 6 hours, 8 are needed	
Warrant 1 A&B - Combination of Warrants Not Satisfied Required volumes reached for 5 hours, 8 are needed	
Warrant 2 - Four Hour Volumes	Satisfied
Number of hours (6) volumes exceed minimum >= minimum required (4).	
Warrant 3 - Peak Hour	Satisfied
Warrant 3A - Peak Hour Delay Not Satisfied Approach volumes on minor street don't exceed minimums for any hour. Delay data not evaluated.	
Warrant 3B - Peak Hour Volumes Satisfied Volumes exceed minimums for at least one hour.	

Capacity and Turn Lane Analysis - Design Year 2032

Intersection capacity analysis was performed for the design year to determine appropriate intersection control and lane configurations. The 2032 projected volumes were analyzed in Synchro. Synchro reports are included in the Appendix. Turn lane lengths were computed based on the ODOT Location and Design Manual and are also included in the Appendix. Based on these analyses, the following improvements are required to service the design year with a minimum intersection LOS of C and a minimum movement LOS of D:

- Traffic signal with protected/permitted phasing for the future eastbound approach.
- Westbound left turn lane: 275' (inc. 50' taper).
- Northbound left turn lane: 343' (inc. 50' taper).
- Southbound left turn lane: 225' (inc. 50' taper).

Traffic Signal Warrants - Opening Year and Design Year

Since the signal is warranted with existing volumes, it is not necessary to repeat the analysis with the higher future volumes. It is necessary, however, to address the potential proposed geometric conditions as they relate to the warrant criteria.

Approach speeds: There are no plans to lower posted speeds below 45 mph on any of the approaches. Warrants 2 and 3 are satisfied based on approach speeds of greater than 40 mph (70% criteria).

Number of lanes: All approaches are analyzed for existing conditions as single approach lanes. This will continue to be valid with any proposed turn lanes since the projected turning volumes are low (less than 50%).

As a result, the signal will be warranted with the proposed 2032 geometry and existing volumes.

Sight Distance Analysis

Stopping sight distance and intersection sight distance were evaluated for existing conditions at the study intersection. The following deficiencies were noted:

1. Stopping sight distance is not sufficient for the posted speed of 50mph (K = 84) at the intersection of County Home Road due to vertical curve geometry just south of the intersection. The computed K factor for the existing conditions is 51.26, which is sufficient for 42 mph. Plan/profile views showing the deficiency and the approximate area that would need to be improved to correct the deficiency are included in the Appendix.
2. The required intersection sight distance triangle (530' looking left) is obscured to the south of the intersection slightly by the terrain on the east side of SR 4. This could be remedied with only minor grading in a turf area. This work would be in the same area that would require work to correct the stopping sight distance as noted above. Plan/profile views showing the required sight triangles and the noted deficiency are included in the Appendix.

Recommendations

Based on the findings of this study, we would recommend the following improvements to accommodate current and future demand for the intersection of SR 4 and County Home Road.

Immediate Implementation: Install an actuated traffic signal at SR 4 and County Home Road.

Funding-Dependant Implementation: In order to accommodate design year demand and improve safety, it is recommended that the following improvements are implemented in one or more projects:

- Install an actuated traffic signal as noted above.
- Improve the profile of SR 4 to correct the stopping sight distance deficiency and regrade to remove the intersection sight distance obstruction.
- Install left turn lanes of the following lengths: Westbound 275' including taper; Northbound 343' including 50' taper; Southbound 225' including taper.
- Accommodate the future west leg of the intersection by constructing partial turnouts.

Appendix

Groups Printed- CARS - TRUCKS - BUSES

Start Time	COUNTY HOME ROAD										COUNTY HOME ROAD									
	SR 4 Southbound					Westbound					SR 4 Northbound					Eastbound				
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total
Factor	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
07:00 AM	0	108	1	0	109	1	0	15	0	16	13	48	0	0	61	0	0	0	0	0
07:15 AM	0	121	3	0	124	1	0	12	0	13	21	53	0	0	74	0	0	0	0	0
07:30 AM	0	142	16	0	158	1	0	13	0	14	34	37	0	0	71	0	0	0	0	0
07:45 AM	0	95	13	0	108	2	0	20	0	22	41	48	0	0	89	0	0	0	0	0
Total	0	466	33	0	499	5	0	60	0	65	109	186	0	0	295	0	0	0	0	0
08:00 AM	0	100	8	0	108	1	0	15	0	16	31	46	0	0	77	0	0	0	0	0
08:15 AM	0	62	6	0	68	4	0	16	0	20	22	35	0	0	57	0	0	0	0	0
08:30 AM	0	86	10	0	96	5	0	44	0	49	28	44	0	0	72	0	0	0	0	0
08:45 AM	0	80	9	0	89	14	0	65	0	79	27	48	0	0	75	0	0	0	0	0
Total	0	328	33	0	361	24	0	140	0	164	108	173	0	0	281	0	0	0	0	0
04:00 PM	0	59	3	0	62	3	0	34	0	37	27	144	0	0	171	0	0	0	0	0
04:15 PM	0	69	4	0	73	4	0	19	0	23	21	132	0	0	153	0	0	0	0	0
04:30 PM	0	97	2	0	99	3	0	19	0	22	33	138	0	0	171	0	0	0	0	0
04:45 PM	0	63	5	0	68	5	0	16	0	21	65	111	0	0	176	0	0	0	0	0
Total	0	288	14	0	302	15	0	88	0	103	146	525	0	0	671	0	0	0	0	0
05:00 PM	0	71	6	0	77	0	0	19	0	19	55	134	0	0	189	0	0	0	0	0
05:15 PM	0	58	13	0	71	6	0	20	0	26	63	123	0	0	186	0	0	0	0	0
05:30 PM	0	55	8	0	63	3	0	22	0	25	48	102	0	0	150	0	0	0	0	0
05:45 PM	0	61	9	0	70	0	0	20	0	20	66	99	0	0	165	0	0	0	0	0
Total	0	245	36	0	281	9	0	81	0	90	232	458	0	0	690	0	0	0	0	0
Grand Total	0	1327	116	0	1443	53	0	369	0	422	595	1342	0	0	1937	0	0	0	0	0
Apprch %	0.0	92.0	8.0	0.0		12.6	0.0	87.4	0.0		30.7	69.3	0.0	0.0		0.0	0.0	0.0	0.0	
Total %	0.0	34.9	3.1	0.0	38.0	1.4	0.0	9.7	0.0	11.1	15.6	35.3	0.0	0.0	50.9	0.0	0.0	0.0	0.0	0.0

Start Time	COUNTY HOME ROAD										COUNTY HOME ROAD										
	SR 4 Southbound					Westbound					SR 4 Northbound					Eastbound					
	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	
Peak Hour From 07:00 AM to 05:45 PM - Peak 1 of 1	0	466	33	0	499	0	140	140	0	164	0	506	0	0	722	0	0	0	0	0	
By Approach	0	93.4	6.6	0.0		0	0	85.4	0.0		216	70.1	0.0	0.0		0	-	-	-		
Volume	0	466	33	0	499	0	140	140	0	164	216	506	0	0	722	0	0	0	0	0	
Percent	0.0	93.4	6.6	0.0		0	0	85.4	0.0		29.9	70.1	0.0	0.0		-	-	-	-		
High Int.	07:30 AM	0	142	16	0	158	08:00 AM	0	65	0	79	04:30 PM	0	134	0	189	07:00 AM	0	0	0	0
Volume	0	142	16	0	158	14	0	65	0	79	55	134	0	0	189	-	-	-	-	-	
Peak Factor					0.790					0.519					0.955					-	

Southbound SR 4 North of County Home

Time Range Total

Thu, Sep/02/2010

[00:00-00:15]	6	
[00:15-00:30]	2	
[00:30-00:45]	1	
[00:45-01:00]	4	13
[01:00-01:15]	1	
[01:15-01:30]	2	
[01:30-01:45]	1	
[01:45-02:00]	5	9
[02:00-02:15]	2	
[02:15-02:30]	2	
[02:30-02:45]	1	
[02:45-03:00]	1	6
[03:00-03:15]	2	
[03:15-03:30]	1	
[03:30-03:45]	3	
[03:45-04:00]	8	14
[04:00-04:15]	9	
[04:15-04:30]	23	
[04:30-04:45]	17	
[04:45-05:00]	29	78
[05:00-05:15]	36	
[05:15-05:30]	49	
[05:30-05:45]	86	
[05:45-06:00]	99	270
[06:00-06:15]	108	
[06:15-06:30]	87	
[06:30-06:45]	103	
[06:45-07:00]	111	409
[07:00-07:15]	110	
[07:15-07:30]	109	
[07:30-07:45]	90	
[07:45-08:00]	134	443
[08:00-08:15]	71	
[08:15-08:30]	73	
[08:30-08:45]	87	
[08:45-09:00]	74	305
[09:00-09:15]	48	
[09:15-09:30]	79	
[09:30-09:45]	47	
[09:45-10:00]	54	228
[10:00-10:15]	66	
[10:15-10:30]	59	
[10:30-10:45]	51	
[10:45-11:00]	55	231
[11:00-11:15]	61	
[11:15-11:30]	44	
[11:30-11:45]	46	
[11:45-12:00]	4	155
[12:00-12:15]	65	
[12:15-12:30]	78	
[12:30-12:45]	55	
[12:45-13:00]	59	257

Southbound SR 4 North of County Home

Time Range Total

Thu, Sep/02/2010

[13:00-13:15]	61	
[13:15-13:30]	46	
[13:30-13:45]	50	
[13:45-14:00]	62	219
[14:00-14:15]	70	
[14:15-14:30]	68	
[14:30-14:45]	75	
[14:45-15:00]	70	283
[15:00-15:15]	72	
[15:15-15:30]	62	
[15:30-15:45]	88	
[15:45-16:00]	95	317
[16:00-16:15]	65	
[16:15-16:30]	61	
[16:30-16:45]	75	
[16:45-17:00]	93	294
[17:00-17:15]	82	
[17:15-17:30]	82	
[17:30-17:45]	67	
[17:45-18:00]	68	299
[18:00-18:15]	58	
[18:15-18:30]	68	
[18:30-18:45]	56	
[18:45-19:00]	37	219
[19:00-19:15]	48	
[19:15-19:30]	46	
[19:30-19:45]	38	
[19:45-20:00]	45	177
[20:00-20:15]	44	
[20:15-20:30]	46	
[20:30-20:45]	36	
[20:45-21:00]	31	157
[21:00-21:15]	22	
[21:15-21:30]	32	
[21:30-21:45]	22	
[21:45-22:00]	28	104
[22:00-22:15]	23	
[22:15-22:30]	25	
[22:30-22:45]	21	
[22:45-23:00]	15	84
[23:00-23:15]	5	
[23:15-23:30]	7	
[23:30-23:45]	11	
[23:45-00:00]	5	28
	4599	

Northbound SR 4 South of County Home

Time Range	Total	
Thu, Sep/02/2010		
[00:00-00:15]	16	
[00:15-00:30]	16	
[00:30-00:45]	14	
[00:45-01:00]	11	57
[01:00-01:15]	17	
[01:15-01:30]	30	
[01:30-01:45]	18	
[01:45-02:00]	7	72
[02:00-02:15]	10	
[02:15-02:30]	9	
[02:30-02:45]	6	
[02:45-03:00]	3	28
[03:00-03:15]	4	
[03:15-03:30]	3	
[03:30-03:45]	3	
[03:45-04:00]	2	12
[04:00-04:15]	4	
[04:15-04:30]	4	
[04:30-04:45]	10	
[04:45-05:00]	7	25
[05:00-05:15]	11	
[05:15-05:30]	8	
[05:30-05:45]	12	
[05:45-06:00]	24	55
[06:00-06:15]	26	
[06:15-06:30]	21	
[06:30-06:45]	27	
[06:45-07:00]	29	103
[07:00-07:15]	49	
[07:15-07:30]	53	
[07:30-07:45]	33	
[07:45-08:00]	21	156
[08:00-08:15]	41	
[08:15-08:30]	44	
[08:30-08:45]	54	
[08:45-09:00]	36	175
[09:00-09:15]	40	
[09:15-09:30]	48	
[09:30-09:45]	33	
[09:45-10:00]	58	179
[10:00-10:15]	42	
[10:15-10:30]	58	
[10:30-10:45]	54	
[10:45-11:00]	54	208
[11:00-11:15]	53	
[11:15-11:30]	50	
[11:30-11:45]	34	
[11:45-12:00]	0	137
[12:00-12:15]	28	
[12:15-12:30]	42	
[12:30-12:45]	30	
[12:45-13:00]	43	143

Northbound SR 4 South of County Home

Time Range	Total	
Thu, Sep/02/2010		
[13:00-13:15]	67	
[13:15-13:30]	88	
[13:30-13:45]	72	
[13:45-14:00]	44	271
[14:00-14:15]	60	
[14:15-14:30]	92	
[14:30-14:45]	78	
[14:45-15:00]	76	306
[15:00-15:15]	124	
[15:15-15:30]	153	
[15:30-15:45]	140	
[15:45-16:00]	120	537
[16:00-16:15]	102	
[16:15-16:30]	110	
[16:30-16:45]	134	
[16:45-17:00]	131	477
[17:00-17:15]	135	
[17:15-17:30]	121	
[17:30-17:45]	97	
[17:45-18:00]	96	449
[18:00-18:15]	97	
[18:15-18:30]	85	
[18:30-18:45]	76	
[18:45-19:00]	69	327
[19:00-19:15]	61	
[19:15-19:30]	46	
[19:30-19:45]	51	
[19:45-20:00]	65	223
[20:00-20:15]	50	
[20:15-20:30]	57	
[20:30-20:45]	40	
[20:45-21:00]	35	182
[21:00-21:15]	40	
[21:15-21:30]	31	
[21:30-21:45]	26	
[21:45-22:00]	25	122
[22:00-22:15]	30	
[22:15-22:30]	28	
[22:30-22:45]	20	
[22:45-23:00]	24	102
[23:00-23:15]	20	
[23:15-23:30]	27	
[23:30-23:45]	26	
[23:45-00:00]	19	92
	4438	

Station ID: WB County Home Road

Latitude: 0' 0.000 Undefined

Start Time	Mon 16-Apr-07	Tue 17-Apr-07	Wed 18-Apr-07	Thu 19-Apr-07	Fri 20-Apr-07	Average Day	Sat 21-Apr-07	Sun 22-Apr-07	Week Average
12:00 AM	*	4	1	1	1	2	*	*	2
01:00	*	3	2	1	2	2	*	*	2
02:00	*	2	1	0	0	1	*	*	1
03:00	*	0	1	4	0	1	*	*	1
04:00	*	3	2	2	9	4	*	*	4
05:00	*	23	28	24	24	25	*	*	25
06:00	*	35	37	33	40	36	*	*	36
07:00	*	54	67	62	73	64	*	*	64
08:00	*	116	174	166	115	143	*	*	143
09:00	*	48	57	60	64	57	*	*	57
10:00	*	37	40	43	52	43	*	*	43
11:00	46	34	47	46	44	43	*	*	43
12:00 PM	34	46	38	46	62	45	*	*	45
01:00	60	42	51	51	*	51	*	*	51
02:00	42	43	37	53	*	44	*	*	44
03:00	91	96	114	103	*	101	*	*	101
04:00	92	116	93	101	*	100	*	*	100
05:00	80	128	98	95	*	100	*	*	100
06:00	93	146	130	174	*	136	*	*	136
07:00	164	223	228	188	*	201	*	*	201
08:00	89	66	50	99	*	76	*	*	76
09:00	16	40	13	51	*	30	*	*	30
10:00	9	5	6	9	*	7	*	*	7
11:00	4	3	5	2	*	4	*	*	4
Day Total	820	1313	1320	1414	486	1316	0	0	1316
% Avg. WkDay	62.3%	99.8%	100.3%	107.4%	36.9%				
% Avg. Week	62.3%	99.8%	100.3%	107.4%	36.9%	100.0%	0.0%	0.0%	
AM Peak	11:00	08:00	08:00	08:00	08:00	08:00			08:00
Vol.	46	116	174	166	115	143			143
PM Peak	19:00	19:00	19:00	19:00	12:00	19:00			19:00
Vol.	164	223	228	188	62	201			201
Grand Total	820	1313	1320	1414	486	1316	0	0	1316
ADT		ADT 1,311		AADT 1,311					



Signal Warrants - Summary

Major Street Approaches

Northbound: SR 4

Number of Lanes: 1
Approach Speed: **50**
Total Approach Volume: **4,438**

Southbound: SR 4

Number of Lanes: 1
Approach Speed: **50**
Total Approach Volume: **4,599**

Minor Street Approaches

Eastbound:

Number of Lanes: 1

Total Approach Volume: **0**

Westbound: County Home Road

Number of Lanes: 1

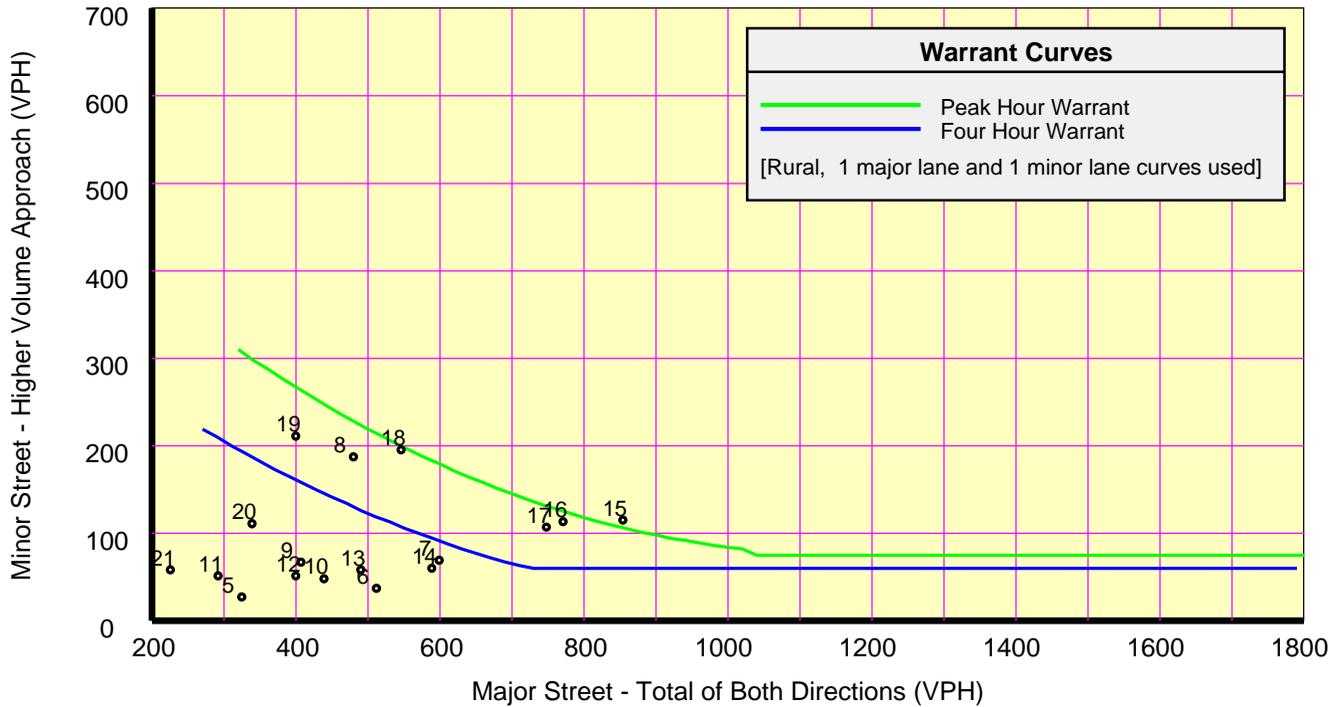
Total Approach Volume: **1,585**

Warrant Summary (Rural values apply.)

Warrant 1 - Eight Hour Vehicular Volumes	Not Satisfied
Warrant 1A - Minimum Vehicular Volume Not Satisfied	
Required volumes reached for 6 hours, 8 are needed	
Warrant 1B - Interruption of Continuous Traffic Not Satisfied	
Required volumes reached for 6 hours, 8 are needed	
Warrant 1 A&B - Combination of Warrants Not Satisfied	
Required volumes reached for 5 hours, 8 are needed	
Warrant 2 - Four Hour Volumes	Satisfied
Number of hours (6) volumes exceed minimum >= minimum required (4).	
Warrant 3 - Peak Hour	Satisfied
Warrant 3A - Peak Hour Delay Not Satisfied	
Approach volumes on minor street don't exceed minimums for any hour. Delay data not evaluated.	
Warrant 3B - Peak Hour Volumes Satisfied	
Volumes exceed minimums for at least one hour.	
Warrant 4 - Pedestrian Volumes	Not Evaluated
Warrant 5 - School Crossing	Not Evaluated
Warrant 6 - Coordinated Signal System	Not Evaluated
Warrant 7 - Crash Experience	Not Evaluated
Warrant 8 - Roadway Network	Not Evaluated



Signal Warrants - Summary



Analysis of 8-Hour Volume Warrants:

Hour Begin	Major Total	Higher Minor Vol	Dir	War-1A			War-1B			War-1A&B		
				Major Crit	Minor Crit	Meets?	Major Crit	Minor Crit	Meets?	Major Crit	Minor Crit	Meets?
00:00	70	1	WB	350-No	105-No	---	525-No	53-No	---	420-No	84-No	---
01:00	81	1	WB	350-No	105-No	---	525-No	53-No	---	420-No	84-No	---
02:00	34	0	EB	350-No	105-No	---	525-No	53-No	---	420-No	84-No	---
03:00	26	4	WB	350-No	105-No	---	525-No	53-No	---	420-No	84-No	---
04:00	103	2	WB	350-No	105-No	---	525-No	53-No	---	420-No	84-No	---
05:00	325	27	WB	350-No	105-No	---	525-No	53-No	---	420-No	84-No	---
06:00	512	37	WB	350-Yes	105-No	Major	525-No	53-No	---	420-Yes	84-No	Major
07:00	599	69	WB	350-Yes	105-No	Major	525-Yes	53-Yes	Both	420-Yes	84-No	Major
08:00	480	187	WB	350-Yes	105-Yes	Both	525-No	53-Yes	Minor	420-Yes	84-Yes	Both
09:00	407	67	WB	350-Yes	105-No	Major	525-No	53-Yes	Minor	420-No	84-No	---
10:00	439	48	WB	350-Yes	105-No	Major	525-No	53-No	---	420-Yes	84-No	Major
11:00	292	51	WB	350-No	105-No	---	525-No	53-No	---	420-No	84-No	---
12:00	400	51	WB	350-Yes	105-No	Major	525-No	53-No	---	420-No	84-No	---
13:00	490	58	WB	350-Yes	105-No	Major	525-No	53-Yes	Minor	420-Yes	84-No	Major
14:00	589	60	WB	350-Yes	105-No	Major	525-Yes	53-Yes	Both	420-Yes	84-No	Major
15:00	854	115	WB	350-Yes	105-Yes	Both	525-Yes	53-Yes	Both	420-Yes	84-Yes	Both
16:00	771	113	WB	350-Yes	105-Yes	Both	525-Yes	53-Yes	Both	420-Yes	84-Yes	Both
17:00	748	107	WB	350-Yes	105-Yes	Both	525-Yes	53-Yes	Both	420-Yes	84-Yes	Both
18:00	546	195	WB	350-Yes	105-Yes	Both	525-Yes	53-Yes	Both	420-Yes	84-Yes	Both
19:00	400	211	WB	350-Yes	105-Yes	Both	525-No	53-Yes	Minor	420-No	84-Yes	Minor
20:00	339	111	WB	350-No	105-Yes	Minor	525-No	53-Yes	Minor	420-No	84-Yes	Minor
21:00	226	58	WB	350-No	105-No	---	525-No	53-Yes	Minor	420-No	84-No	---
22:00	186	10	WB	350-No	105-No	---	525-No	53-No	---	420-No	84-No	---
23:00	120	2	WB	350-No	105-No	---	525-No	53-No	---	420-No	84-No	---

Lanes, Volumes, Timings
13: County Home Road & SR 4

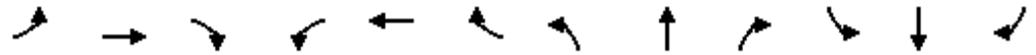
5/3/2011



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	226	188	239	99	50	1	213	556	288	1	312	263
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	361		125	300		0	361		0	50		0
Storage Lanes	1		0	1		0	1		0	1		0
Taper Length (ft)	25		25	25		25	25		25	25		25
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.916			0.997			0.949			0.931	
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	1706	0	1770	1857	0	1770	1768	0	1770	1734	0
Flt Permitted	0.721			0.151			0.279			0.087		
Satd. Flow (perm)	1343	1706	0	281	1857	0	520	1768	0	162	1734	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		67			1			49			80	
Link Speed (mph)		35			50			50			55	
Link Distance (ft)		534			2684			1204			5394	
Travel Time (s)		10.4			36.6			16.4			66.9	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	246	204	260	108	54	1	232	604	313	1	339	286
Shared Lane Traffic (%)												
Lane Group Flow (vph)	246	464	0	108	55	0	232	917	0	1	625	0
Enter Blocked Intersection	No											
Lane Alignment	Left	Left	Right									
Median Width(ft)		12			12			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Number of Detectors	1	1		1	1		1	1		1	1	
Detector Template												
Leading Detector (ft)	50	50		50	50		50	50		50	50	
Trailing Detector (ft)	0	0		0	0		0	0		0	0	
Detector 1 Position(ft)	0	0		0	0		0	0		0	0	
Detector 1 Size(ft)	50	50		50	50		50	50		50	50	
Detector 1 Type	Cl+Ex	Cl+Ex										
Detector 1 Channel												
Detector 1 Extend (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Queue (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Detector 1 Delay (s)	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Turn Type	Perm			pm+pt			Perm			Perm		
Protected Phases		4		3	8			2			6	
Permitted Phases	4			8			2			6		
Detector Phase	4	4		3	8		2	2		6	6	
Switch Phase												
Minimum Initial (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Minimum Split (s)	20.0	20.0		8.0	20.0		20.0	20.0		20.0	20.0	
Total Split (s)	26.0	26.0	0.0	8.0	34.0	0.0	56.0	56.0	0.0	56.0	56.0	0.0
Total Split (%)	28.9%	28.9%	0.0%	8.9%	37.8%	0.0%	62.2%	62.2%	0.0%	62.2%	62.2%	0.0%

Lanes, Volumes, Timings
 13: County Home Road & SR 4

5/3/2011



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Maximum Green (s)	22.0	22.0		4.0	30.0		52.0	52.0		52.0	52.0	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5		0.5	0.5		0.5	0.5		0.5	0.5	
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lead/Lag	Lag	Lag		Lead								
Lead-Lag Optimize?	Yes	Yes		Yes								
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Recall Mode	None	None		None	None		Min	Min		Min	Min	
Walk Time (s)	5.0	5.0			5.0		5.0	5.0		5.0	5.0	
Flash Dont Walk (s)	11.0	11.0			11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0			0		0	0		0	0	
Act Effect Green (s)	22.4	22.4		28.5	28.5		46.0	46.0		46.0	46.0	
Actuated g/C Ratio	0.27	0.27		0.35	0.35		0.56	0.56		0.56	0.56	
v/c Ratio	0.67	0.90		0.64	0.09		0.80	0.91		0.01	0.62	
Control Delay	40.8	51.1		41.0	20.5		38.7	30.6		9.0	13.9	
Queue Delay	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Total Delay	40.8	51.1		41.0	20.5		38.7	30.6		9.0	13.9	
LOS	D	D		D	C		D	C		A	B	
Approach Delay		47.6			34.1			32.2			13.9	
Approach LOS		D			C			C			B	

Intersection Summary

Area Type:	Other
Cycle Length:	90
Actuated Cycle Length:	82.6
Natural Cycle:	90
Control Type:	Actuated-Uncoordinated
Maximum v/c Ratio:	0.91
Intersection Signal Delay:	32.1
Intersection LOS:	C
Intersection Capacity Utilization:	93.5%
ICU Level of Service:	F
Analysis Period (min):	15

Splits and Phases: 13: County Home Road & SR 4



SR 4 and County Home Road Turn Lane Calculations per ODOT L & D Manual

Northbound Left

Condition B

Volume = 213 Design Speed = 50

Storage = $213 / 40 \text{ sec/cycle} = 5.3$, say 5 vehicles

Length = $200'$ (for 5 veh) + $143'$ (decel for 50mph) = $343'$ (including taper)

Southbound Left

Condition B

Volume = 1 Design Speed = 50

Decel only for 50mph = $225'$ (including taper)

Westbound Left

Condition C

Volume = 103 Design Speed = 40 (tee int, then assumed future design speed)

Storage = $104 / 40 \text{ sec/cycle} = 2.6$, say 3 vehicles

Length = $150'$ (for 3 veh) + $111'$ (decel for 40mph) = $275'$ (including taper)



PROJECT NO. 071260
 DATE 3/3/11
 DR. JDB
 SHT. #

2780 Airport Drive
 Suite 100
 Columbus, OH 43219
 614.476.6000
 FAX: 614.476.6225

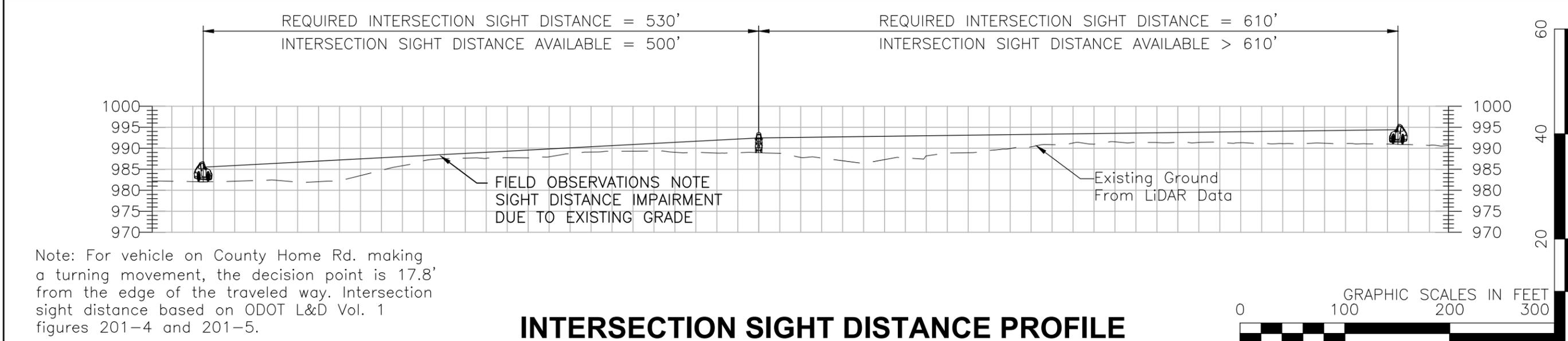


City of Marysville
 Intersection Study
 Intersection Sight Distance Exhibit



PLAN VIEW

Left Approach Sight Triangle
 Right Approach Sight Triangle
 Posted Speed Limit for State Route 4: 50 mph



INTERSECTION SIGHT DISTANCE PROFILE

Note: For vehicle on County Home Rd. making a turning movement, the decision point is 17.8' from the edge of the traveled way. Intersection sight distance based on ODOT L&D Vol. 1 figures 201-4 and 201-5.



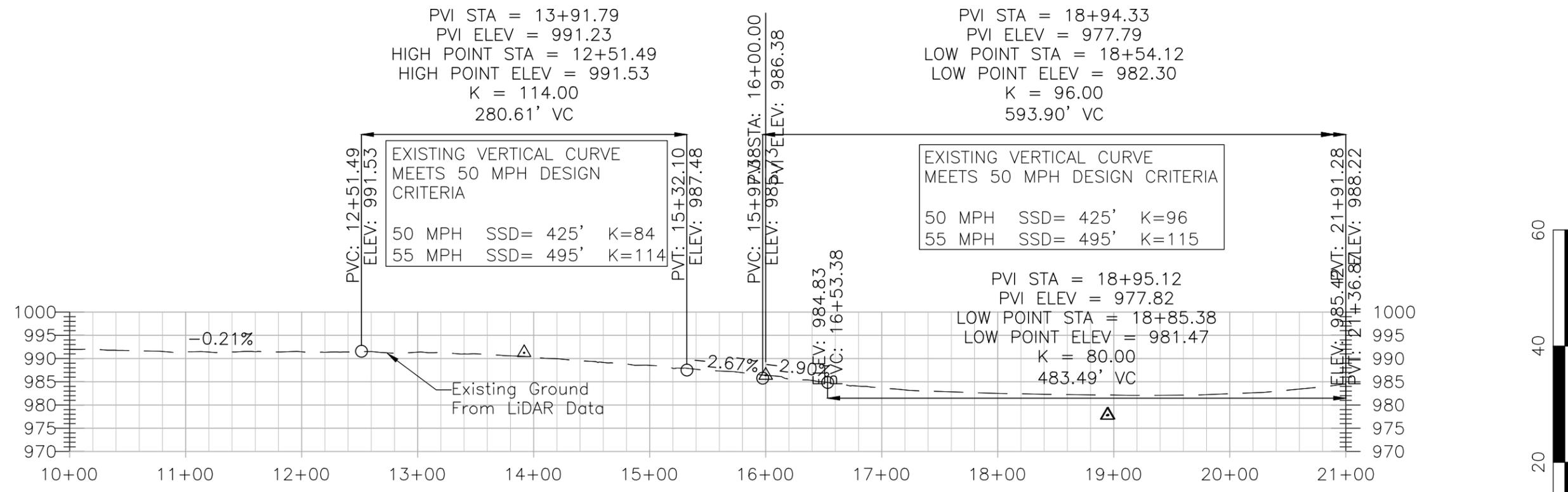
PLAN VIEW

PROJECT NO. 071260
 DATE 3/3/11
 DR. JDB
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2780 Airport Drive
 Suite 100
 Columbus, OH 43219
 614.476.6000
 FAX: 614.476.6225



Posted Speed Limit for State Route 4: 50 mph
 SSD - Stopping Sight Distance



STATE ROUTE 4 CENTERLINE PROFILE STA. 10+00 to STA. 21+00



**City of Marysville
 Intersection Study
 Sight Distance Exhibit**



PLAN VIEW

PROJECT NO. 071260
 DATE 3/3/11
 DR. JDB
 SHT. #

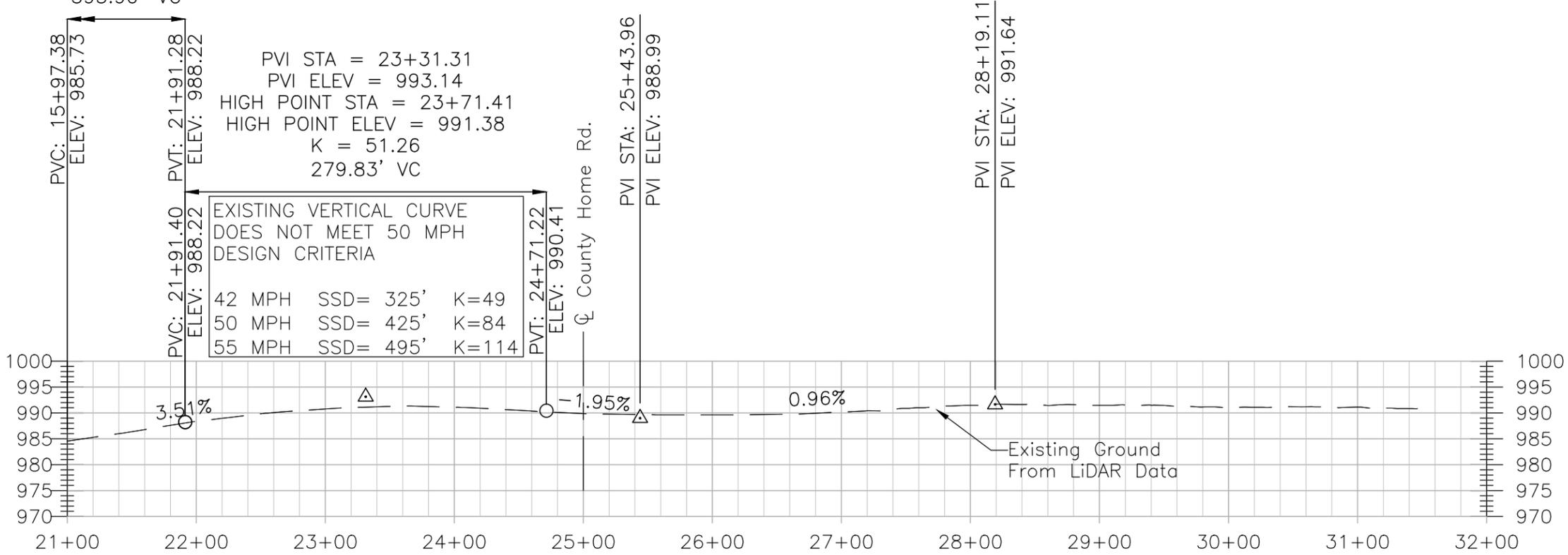
2780 Airport Drive
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**City of Marysville
 Intersection Study
 Sight Distance Exhibit**

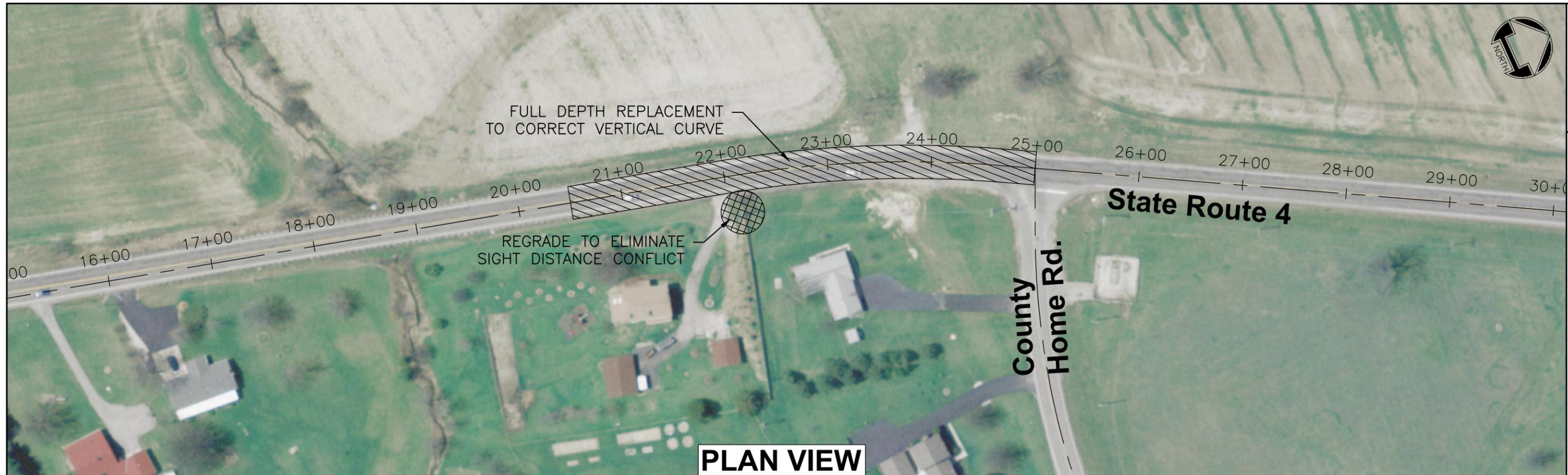
PVI STA = 18+94.33
 PVI ELEV = 977.79
 LOW POINT STA = 18+54.12
 LOW POINT ELEV = 982.30
 K = 96.00
 593.90' VC

Posted Speed Limit for State Route 4: 50 mph
 SSD - Stopping Sight Distance



STATE ROUTE 4 CENTERLINE PROFILE STA. 21+00 to STA. 31+46

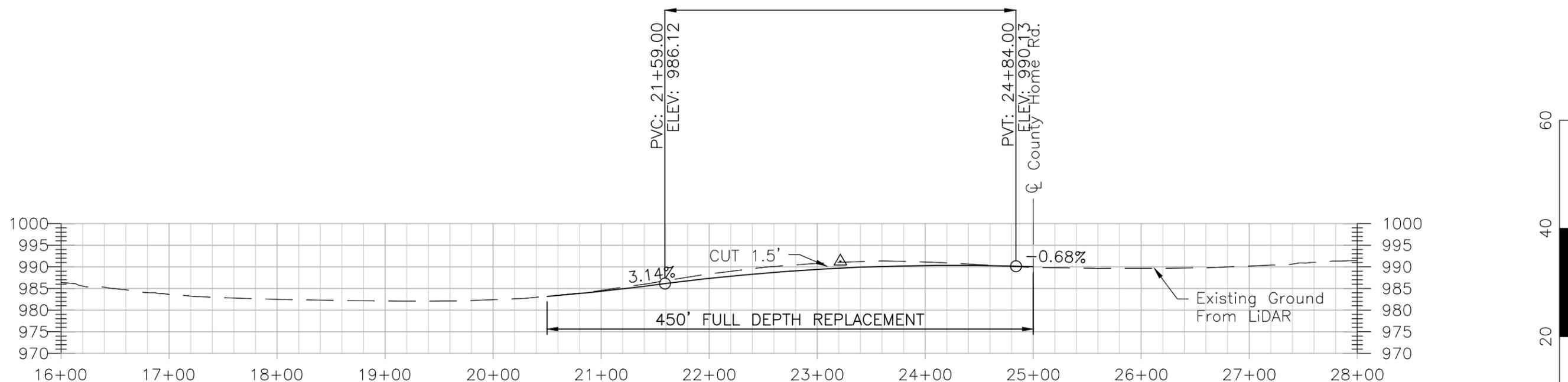




PLAN VIEW

Posted Speed Limit for State Route 4: 50 mph
SSD - Stopping Sight Distance

PVI STA = 23+21.50
PVI ELEV = 991.22
HIGH POINT STA = 24+26.53
HIGH POINT ELEV = 990.32
K = 85.10
325.00' VC



STATE ROUTE 4 CENTERLINE PROFILE



PROJECT NO. 071260
DATE 4/28/11
DR. JDB
SHT. #

2780 Airport Drive
Suite 100
Columbus, OH 43219
614.476.6000
FAX: 614.476.6225



**City of Marysville
Intersection Study
Recommended Sight Distance Improvements**



Memo

To: Valerie Klingman, PE, PS
City Engineer

Accepted: _____

From: Robert J. Kuederle, Jr., PE

Date: _____

Date: Rev. March 25, 2011

Subject: Memorandum of Understanding
Traffic Study for Proposed Fire Station
Marysville, Ohio

This memorandum of understanding is submitted to document the assumptions and methodologies related to the traffic study for proposed fire station in Marysville, Ohio, in accordance with the City of Marysville's *Traffic Impact Study (TIS) Standards*.

TIS Warrants

The proposed project will not generate the 100 peak hour trip ends that would typically require a traffic impact study. However, the City is having a study prepared to address existing and future conditions near the project due to the special nature of the project and its relation to health, safety and welfare of the public. This study includes items relevant to the project but outside of the typical scope due to the special circumstances.

Study Scope

The traffic engineering study will include the intersection of County Home Road and SR 4. The study will address one peak hour, either the Saturday peak or the weekday PM peak. The controlling peak hour will be the period with the greater volumes. Since the proposed development itself will generate very low volumes, the focus will be on the off-site conditions near the project and will pay special attention to design issues related to heavy fire trucks and other emergency equipment.

Analysis

The following analyses will be included in the study: signal warrants, intersection capacity, turn lanes and sight distance. Speed studies will also be conducted for SR 4 and SR 31 on the north side of Marysville.

Study Parameters

Growth rate: 1.5% per year
Design year: 20 years (2032)

Other Developments

The study will take into account potential development of the land known as the Cook Property. Trip generation estimates will be based on prior development proposals and will assume a connector road between SR 31 and SR 4/County Home Road for the design year.

Report Format

While this scope varies slightly from the normal TIS format which is focused on the development site, it will generally follow the "Report Contents" section of the City's TIS Standards. The following items will be specifically addressed in the report:

- Acceptable levels of service for intersections during the peak hour.
- Existing studies or documents used as inputs or as reference materials.

Exclusions

The following items are mentioned in the TIS Standards but are not included in the study:

- Trip generation and distribution for the fire station (covered in the growth rate).
- Crash analysis (research completed by the City shows that crashes have been very few over the past 5 years).

Schedule

The final report is due by 5/15/2011 to be available for a June OPWC application.