CUY-90-14.90

PID 77332/85531

APPENDIX TC-07

Signal Warrants
(Contract Document)

State of Ohio
Department of Transportation
Jolene M. Molitoris, Director

Innerbelt Bridge
Construction Contract Group 1 (CCG1)

Revision Date: November 4, 2009

November 4, 2009

SO#: 117124

PID 77332

TRAFFIC SIGNAL WARRANT ANALYSES

for

CENTRAL VIADUCT
OHIO DEPARTMENT OF TRANSPORTATION

Prepared for:

Ohio Department of Transportation

STATE OF OHIO DEPARTMENT OF TRANSPORTATION

Baker

Michael Baker Jr., Inc.
1228 Euclid Avenue
Suite 1050
Cleveland, Ohio 44115

Executive Summary

Traffic signal warrant analyses were conducted for the existing and future intersections that are included in CCG1 (Contract Group 1) of the Central Viaduct Innerbelt Bridge Construction Project. The Ohio Department of Transportation (ODOT) requested that Baker complete the signal warrant analyses in order for the results to be included with the bid package.

The *Ohio Manual on Uniform Traffic Control Devices* (OMUTCD) was utilized to conduct traffic signal warrants for eight (8) intersections associated with the Central Viaduct project. The intersections include existing signals as well as new intersections. The table below summarizes the results of the warrant analysis. Documentation of the methodologies and detailed analysis are provided.

Intersection		Recommendation
1	Carnegie Avenue @ Ontario Street	Maintain signalization; Replace/upgrade equipment as needed.
2	Carnegie Avenue @ E.4th Street-Commercial Road	Do not install signal; Remove existing equipment during intersection reconfiguration.
3	Eagle Avenue @ Ontario Street	Install pedestrian crossing signal (opening year).
4	E. 9th Street @ Carnegie Avenue	Maintain signalization; Replace/upgrade equipment as needed.
5	E. 9th Street @ Ontario Street-Orange Avenue	Maintain signalization with intersection relocation; replace/upgrade equipment as needed.
6	E. 9th Street @ Broadway Avenue	Do not install signal under current phase; monitor intersection for future signalization, particularly with respect to the operation of nearby signals and the potential for coordination in this area.
7	E. 14th Street @ Orange Avenue	Maintain signalization; Replace/upgrade equipment as needed.
8	E. 14th Street @ Broadway Avenue	Install signal at new intersection (opening year).

Methodology

Traffic signal warrants were conducted for the eight (8) intersections listed below:

1) Carnegie Avenue @ Ontario Street (existing signal)
2) Carnegie Avenue @ E. 4th Street / Commercial Road (existing signal, modified intersection with reduced number of movements to/from side street)
3) Eagle Avenue @ Ontario Street (modified intersection, potential signalized pedestrian crossing)
4) E. 9th Street @ Carnegie Avenue (existing signal)
5) E. 9th Street @ Ontario Street / Orange Avenue (existing signal, relocated intersection)
6) E. 9th Street @ Broadway Avenue (new intersection)
7) E. 14th Street @ Orange Avenue (existing signal)
8) E. 14th Street @ Broadway Avenue (new intersection)

The graphical representation of the intersection lane configurations is provided in Attachment A. The approach configuration at each intersection is based on the March 2009 Interchange Justification Study. Intersections in the area which are only affected by provision of signal interconnect were not analyzed, including E. 9th Street @ Bolivar Road, E. 22nd Street @ Orange Avenue and E. 30th Street @ Orange Avenue.

The signal warrant analyses were conducted in accordance with the 2005 Edition of the *Ohio Manual on Uniform Traffic Control Devices* (OMUTCD) and the ODOT *Traffic Engineering Manual* (TEM). The OMUTCD specifies eight (8) warrant criteria:

- Warrant 1, Eight-Hour Vehicular Volume
- Warrant 2, Four-Hour Vehicular Volume
- Warrant 3, Peak Hour
- Warrant 4, Pedestrian Volume
- Warrant 5, School Crossing
- Warrant 6, Coordinated Signal System
- Warrant 7, Crash Experience
- Warrant 8, Roadway Network

Peak hour traffic volumes were obtained from the Year 2015 and Year 2035 Build Certified Traffic Volumes (identified in the *Cleveland Innerbelt: Interchange Justification Study*, March 2009), as directed by ODOT. The certified peak hour traffic volumes are provided in Attachment B.

The highest eight hours of volumes for the Year 2015 and the Year 2035 were determined by utilizing the following methodology:

1) Determine the functional classification of each approach roadway.
2) Obtain the hourly percentages of the highest eight hours of volume, based on functional classification, from the ODOT *Hourly Percentage by Vehicle Type* Report.

3) Relate the available certified AM and PM peak hour volumes to the percentages.
4) Calculate the remaining six hours of data using proportions of the known hours to the percentages obtained in the ODOT report.

The Four-Hour and Eight-Hour volume development worksheets are provided in Attachment C. Of the eight hours of data, five hours were typical of the PM peak hour turn proportions and three hours were typical of the AM peak hour turn proportions, in most cases.

Pedestrian volume data was not available for each of the intersections. In order to assess the potential pedestrian-actuated signalized pedestrian crossing at Ontario Street @ Eagle Avenue, an estimate of pedestrian volumes was calculated based on the capacities of the Progressive Field and the Quicken Loans Arena in conjunction with the locations of parking lots and decks surrounding these facilities. The estimated pedestrian volumes are based on the existing entertainment venue capacities, which are expected to be the same in the year 2015. The pedestrian volume estimate is provided in Attachment D. Provision of a signalized, pedestrian-actuated crossing at Eagle Avenue is consistent with the City's Bikeway Master Plan and the Canal Basin District Plan.

The existing signalized intersections that will be reconstructed all meet the volume warrants. Based on that information and because accident data was not readily available and summarized, the Crash Experience warrant was not evaluated. The two new intersections (E.9th Street and E.14th Street @ Broadway) do not have crash data because those intersections do not currently exist, so the Crash Experience warrant is not applicable and was not evaluated at these locations.

Signal Warrant Analyses Results

Traffic signal warrants were conducted where data was available. Schools do not exist in the project area and thus the school crossing warrant (Warrant 5) does not apply. Crash data was not provided and thus Warrant 7, Crash Experience was not conducted. Warrant 6, Coordinated Signal System, and Warrant 8, Roadway Network, were not conducted if the intersection met the volume warrant requirements. If a signal was not warranted based on the Year 2015 traffic projections, the Year 2035 analysis was conducted. The signal analyses worksheets are included in Attachment E. The tables below summarize the results of the analysis.

Intersection 1: Carnegie Avenue @ Ontario Street

OMUTCD Warrant		Year 2015 Warrant Met?	Year 2035 Warrant Met?
Warrant 1	Eight-Hour Vehicular Volume	Yes	Warrant not conducted
Warrant 2	Four-Hour Vehicular Volume	Yes	Warrant not conducted
Warrant 3	Peak Hour	Yes	Warrant not conducted
Warrant 4	Pedestrian Volume	Warrant not conducted (data not provided)	
Warrant 5	School Crossing	Does not apply	
Warrant 6	Coordinated Signal System	Warrant not conducted	Warrant not conducted
Warrant 7	Crash Experience	Warrant not conducted (data not provided)	
Warrant 8	Roadway Network	Warrant not conducted	Warrant not conducted
Existing Condition: Signalized **Recommendation: Maintain signalization, replace/upgrade equipment as needed.**			

Intersection 2: Carnegie Avenue @ E. 4th Street-Commercial Road

OMUTCD Warrant		Year 2015 Warrant Met?	Year 2035 Warrant Met?
Warrant 1	Eight-Hour Vehicular Volume	Warrant not conducted (data not provided)	
Warrant 2	Four-Hour Vehicular Volume	Warrant not conducted (data not provided)	
Warrant 3	Peak Hour	Warrant not conducted (data not provided)	
Warrant 4	Pedestrian Volume	Warrant not conducted (data not provided)	
Warrant 5	School Crossing	Does not apply	
Warrant 6	Coordinated Signal System	No	Warrant not conducted
Warrant 7	Crash Experience	Warrant not conducted (data not provided)	
Warrant 8	Roadway Network	Warrant not conducted (data not provided)	
Existing Condition: Signalized Notes: Conflicting movements will be removed under the build condition; Commercial Road (to become Central Viaduct Way) will become a right in/right out only and E.4th Street will be converted to a pedestrian walkway. There will be no cross street traffic movements so a signal is not required. **Recommendation: Do not install signal, remove existing equipment .**			

Intersection 3: Eagle Avenue @ Ontario Street

OMUTCD Warrant		Year 2015 Warrant Met?	Year 2035 Warrant Met?
Warrant 1	Eight-Hour Vehicular Volume	Does not apply	
Warrant 2	Four-Hour Vehicular Volume	Does not apply	
Warrant 3	Peak Hour	Does not apply	
Warrant 4	Pedestrian Volume	Yes	Warrant not conducted
Warrant 5	School Crossing	Does not apply	
Warrant 6	Coordinated Signal System	Does not apply	
Warrant 7	Crash Experience	Warrant not conducted (data not provided)	
Warrant 8	Roadway Network	Does not apply	
Existing Condition: Signalized, but not in operation Notes: Side street vehicular movements removed; Eagle Avenue Viaduct was demolished and Eagle Avenue is closed to vehicular traffic. **Recommendation: Install pedestrian crossing signal (opening year).**			

Intersection 4: E. 9th Street @ Carnegie Avenue

OMUTCD Warrant		Year 2015 Warrant Met?	Year 2035 Warrant Met?
Warrant 1	Eight-Hour Vehicular Volume	Yes	Warrant not conducted
Warrant 2	Four-Hour Vehicular Volume	Yes	Warrant not conducted
Warrant 3	Peak Hour	Yes	Warrant not conducted
Warrant 4	Pedestrian Volume	Warrant not conducted (data not provided)	
Warrant 5	School Crossing	Does not apply	
Warrant 6	Coordinated Signal System	Warrant not conducted	Warrant not conducted
Warrant 7	Crash Experience	Warrant not conducted (data not provided)	
Warrant 8	Roadway Network	Warrant not conducted	Warrant not conducted
Existing: Signalized **Recommendation: Maintain signalization, replace/upgrade equipment as needed.**			

Intersection 5: E. 9th Street @ Ontario Street-Orange Avenue

OMUTCD Warrant		Year 2015 Warrant Met?	Year 2035 Warrant Met?
Warrant 1	Eight-Hour Vehicular Volume	Yes	Warrant not conducted
Warrant 2	Four-Hour Vehicular Volume	Yes	Warrant not conducted
Warrant 3	Peak Hour	Yes	Warrant not conducted
Warrant 4	Pedestrian Volume	Warrant not conducted (data not provided)	
Warrant 5	School Crossing	Does not apply	
Warrant 6	Coordinated Signal System	Warrant not conducted	Warrant not conducted
Warrant 7	Crash Experience	Warrant not conducted (data not provided)	
Warrant 8	Roadway Network	Warrant not conducted	Warrant not conducted
Existing Condition: Signalized **Recommendation: Maintain signalization, replace/upgrade equipment as needed.**			

Intersection 6: E. 9th Street @ Broadway Avenue

OMUTCD Warrant		Year 2015 Warrant Met?	Year 2035 Warrant Met?
Warrant 1	Eight-Hour Vehicular Volume	No	No
Warrant 2	Four-Hour Vehicular Volume	No	No
Warrant 3	Peak Hour	No	No
Warrant 4	Pedestrian Volume	Warrant not conducted (data not provided)	
Warrant 5	School Crossing	Does not apply	
Warrant 6	Coordinated Signal System	Warrant not conducted	Warrant not conducted
Warrant 7	Crash Experience	Warrant not conducted (new intersection)	
Warrant 8	Roadway Network	No	No
Existing Condition: Intersection does not exist Notes: Volume warrants are not met, however many analysis points were close. Multiple configurations and analysis scenarios were examined given the non-typical alignment compared to the volumes. **Recommendation: Do not install signal under current phase; monitor intersection for future signalization, particularly with respect to the operation of nearby signals and the potential for coordination in this area.**			

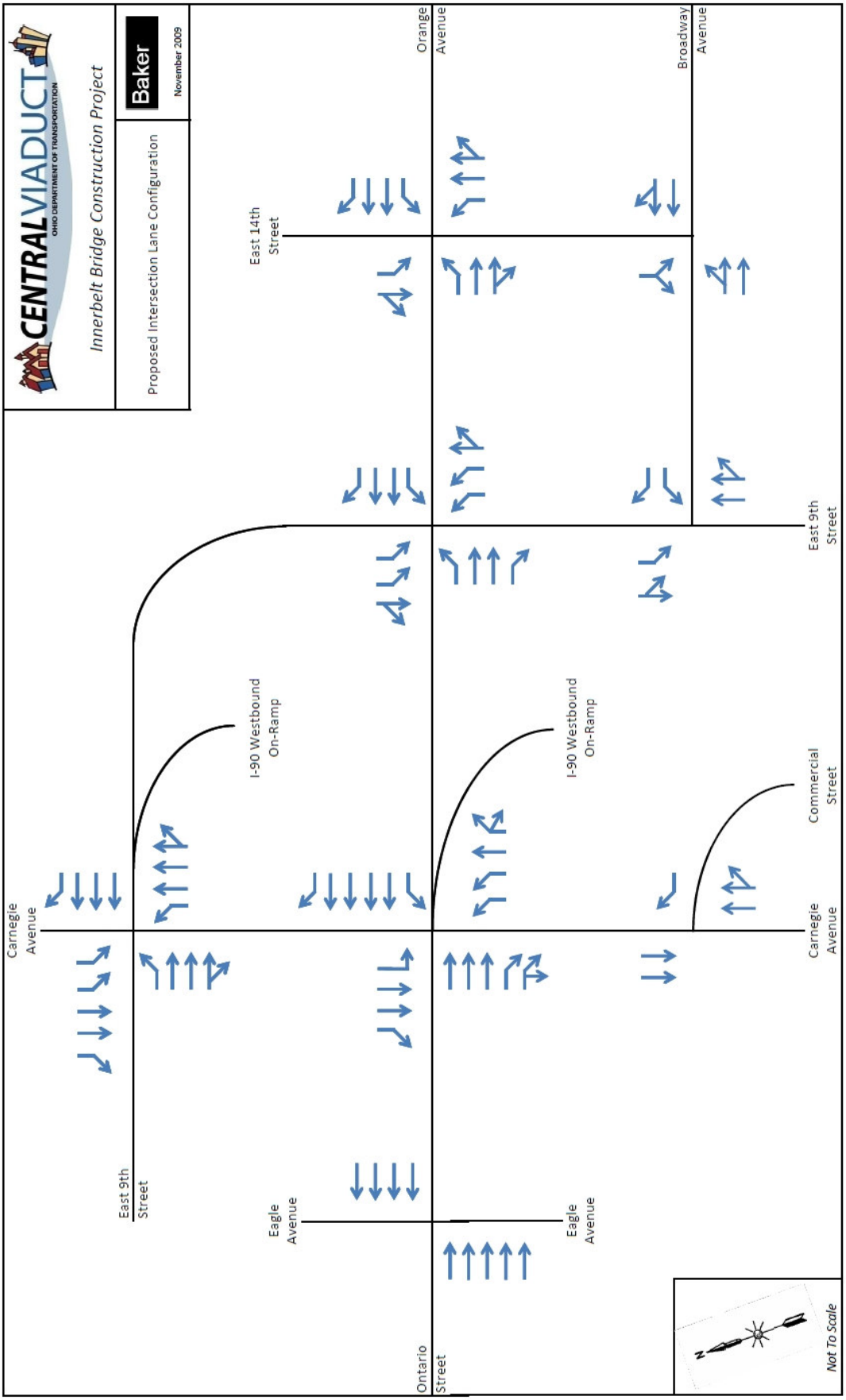
Intersection 7: E. 14th Street @ Orange Avenue

OMUTCD Warrant		Year 2015 Warrant Met?	Year 2035 Warrant Met?
Warrant 1	Eight-Hour Vehicular Volume	Yes	Warrant not conducted
Warrant 2	Four-Hour Vehicular Volume	Yes	Warrant not conducted
Warrant 3	Peak Hour	Yes	Warrant not conducted
Warrant 4	Pedestrian Volume	Warrant not conducted (data not provided)	
Warrant 5	School Crossing	Does not apply	
Warrant 6	Coordinated Signal System	Warrant not conducted	Warrant not conducted
Warrant 7	Crash Experience	Warrant not conducted (data not provided)	
Warrant 8	Roadway Network	Warrant not conducted	Warrant not conducted
Existing Condition: Signalized **Recommendation: Maintain signalization, replace/upgrade equipment as needed.**			

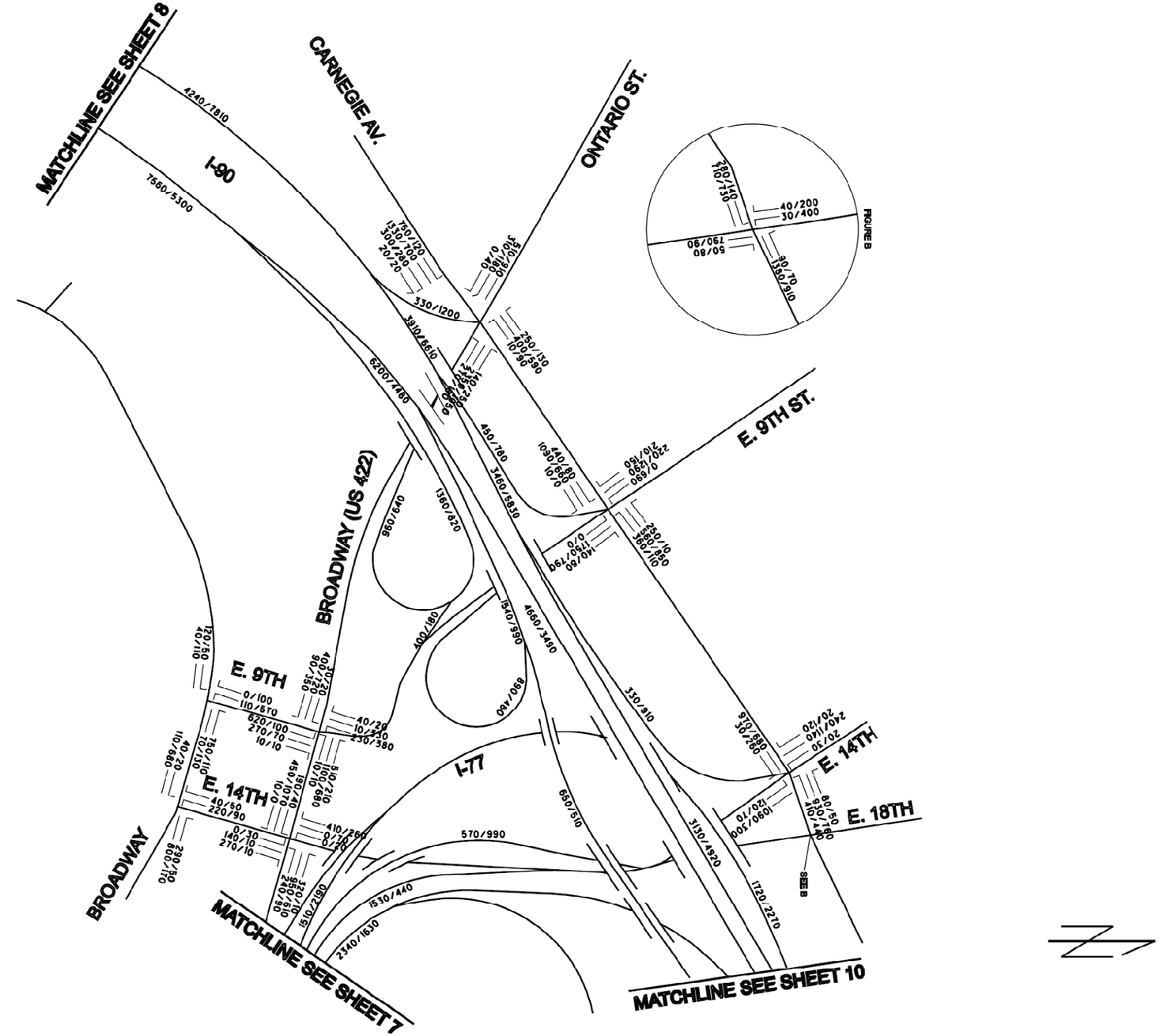
Intersection 8: E. 14th Street @ Broadway Avenue

OMUTCD Warrant		Year 2015 Warrant Met?	Year 2035 Warrant Met?
Warrant 1	Eight-Hour Vehicular Volume	Yes	Warrant not conducted
Warrant 2	Four-Hour Vehicular Volume	Yes	Warrant not conducted
Warrant 3	Peak Hour	Yes[(1)]	Warrant not conducted
Warrant 4	Pedestrian Volume	Warrant not conducted (data not provided)	
Warrant 5	School Crossing	Does not apply	
Warrant 6	Coordinated Signal System	Warrant not conducted	Warrant not conducted
Warrant 7	Crash Experience	Warrant not conducted (new intersection)	
Warrant 8	Roadway Network	Warrant not conducted	Warrant not conducted
Existing Condition: Intersection does not exist Notes: [(1)] AM peak is met, PM peak is not met. This intersection will carry more traffic than anticipated with the 2015 Build conditions; it will carry the traffic on E.9th Street between Broadway and Ontario-Orange until that connection is completed in a subsequent project phase. **Recommendation: Install signal at new intersection (opening year).**			

Attachment A
Lane Diagram


CENTRAL VIADUCT
OHIO DEPARTMENT OF TRANSPORTATION
Innerbelt Bridge Construction Project
Baker
November 2009
Proposed Intersection Lane Configuration
Carnegie Avenue
East 9th Street
Eagle Avenue
Ontario Street
I-90 Westbound On-Ramp
East 14th Street
Orange Avenue
Broadway Avenue
East 9th Street
Commercial Street
Not To Scale

Attachment B
Certified Peak Hour Traffic Volumes



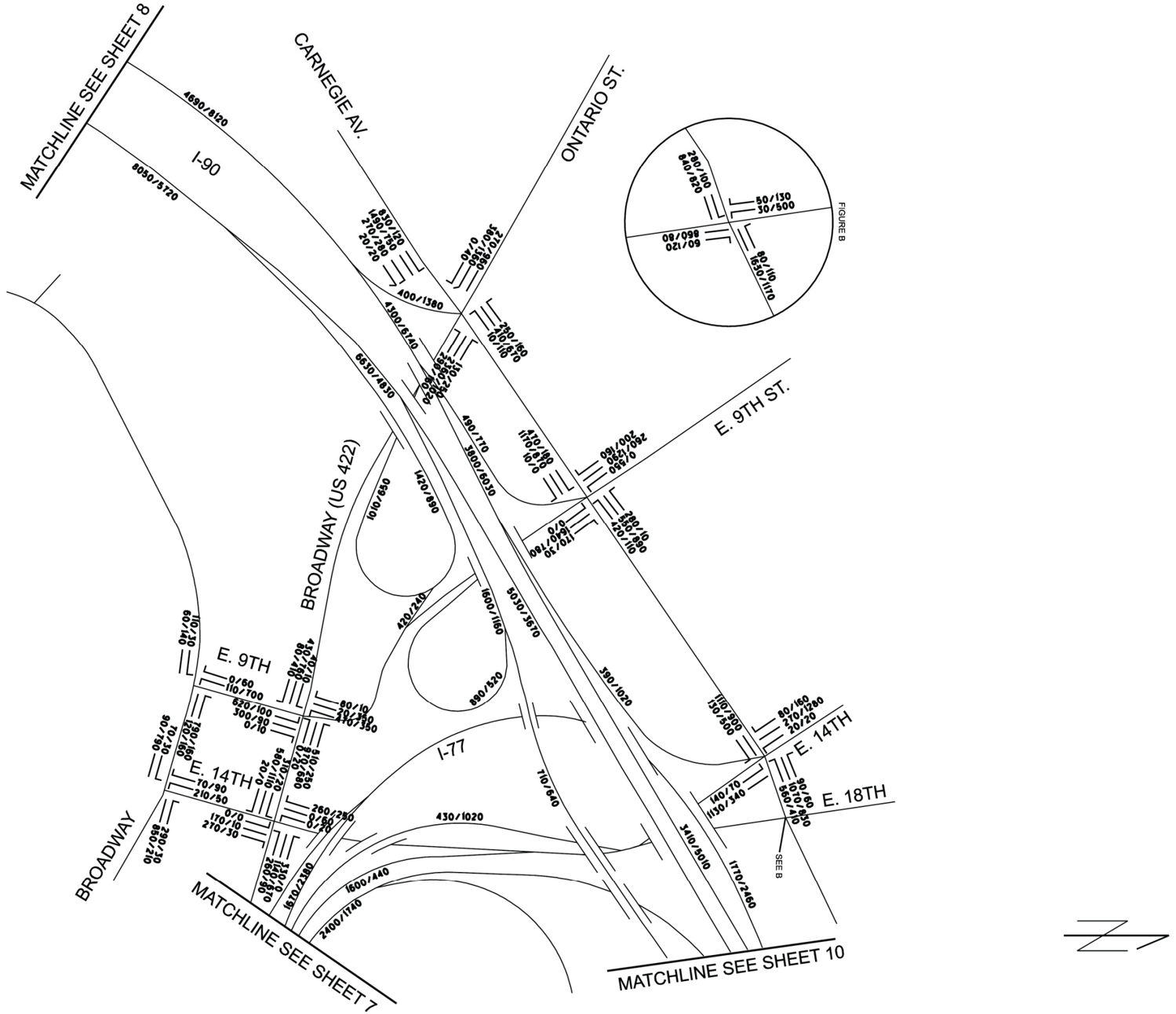
XXXX/XXXX = AM PEAK/PM PEAK
NOT TO SCALE

CLEVELAND, OHIO FEBRUARY 2009

FIGURE 9 0F 15
2015 BUILD
CERTIFIED TRAFFIC VOLUMES

CLEVELAND INNERBELT STUDY

BURGESS & NIPLE



XXXX/XXXX = AM PEAK/PM PEAK
NOT TO SCALE

CLEVELAND, OHIO FEBRUARY 2009

FIGURE 9 0F 15
2035 BUILD
CERTIFIED TRAFFIC VOLUMES

CLEVELAND INNERBELT STUDY

BURGESS & NIPLE

Attachment C

Four-Hour and Eight-Hour Volume Development Worksheets

Central Viaduct
Eight Hour Volume Development

Intersection: Carnegie Avenue @ Ontario Street

Available Peak Hour Data								
Movement	Roadway / Functional Classification			Direction	Year 2015 Build		Year 2035 Build	
					AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
Eastbound	Carnegie	16	Minor Arterial	Left	750	120	830	120
				Through	1,330	700	1490	750
				Right 1	300	280	270	280
				Right 2	20	20	20	20
Westbound	Carnegie	14	Principal Arterial	Left	10	90	10	110
				Through	400	590	410	670
				Right	250	130	250	160
Northbound	Ontario	14	Principal Arterial	Left	270	180	290	160
				Through	2,350	1,050	2360	1020
				Right	140	250	130	250
Southbound	Ontario	14	Principal Arterial	Through	510	910	270	960
				Right 1	310	1,180	380	1360
				Right 2	0	40	0	40
Total					6,640	5,540	6,710	5,900

Eight Hour Distribution & Relationship to Peak Hours Provided									
ODOT Data	Highest Hour	1st	2nd	3rd	4th	5th	6th	7th	8th
	Percentage of Total (ODOT Factor)	8.2%	7.9%	7.7%	6.8%	6.3%	6.2%	6.2%	5.9%
	Hour of the Day	4:00 PM	5:00 PM	3:00 PM	2:00 PM	Noon	7:00 AM	1:00 PM	6:00 PM
Year 2015	Total Entering Intersection *	**6,640**	6,397	6,235	**5,506**	5,101	5,020	5,020	4,778
	Peak Hour	AM	--	--	PM	--	--	--	--
Year 2035	Total Entering Intersection *	**6,710**	6,465	6,301	**5,564**	5,155	5,073	5,073	4,828
	Peak Hour	AM	--	--	PM	--	--	--	--

Year 2015 Eight Hour Volumes											
Movement	Roadway / Functional Classification			Direction	1st	2nd	3rd	4th	5th	6th	7th	8th
					AM Peak	--	--	PM Peak	--	--	--	--
Eastbound	Carnegie	16	Minor Arterial	Left	750	723	704	120	111	109	109	103
				Through	1,330	1,281	1,249	700	645	634	634	604
				Right 1	300	289	282	280	258	254	254	241
				Right 2	20	19	19	20	18	18	18	17
Westbound	Carnegie	14	Principal Arterial	Left	10	10	9	90	83	82	82	78
				Through	400	385	376	590	543	535	535	509
				Right	250	241	235	130	120	118	118	112
Northbound	Ontario	14	Principal Arterial	Left	270	260	254	180	166	163	163	155
				Through	2,350	2,264	2,207	1,050	967	952	952	905
				Right	140	135	131	250	230	227	227	216
Southbound	Ontario	14	Principal Arterial	Through	510	491	479	910	838	825	825	785
				Right 1	310	299	291	1,180	1,087	1,069	1,069	1,018
				Right 2	0	0	0	40	37	36	36	34
Total					6,640	6,397	6,236	5,540	5,103	5,022	5,022	4,777

Year 2035 Eight Hour Volumes											
Movement	Roadway / Functional Classification			Direction	1st	2nd	3rd	4th	5th	6th	7th	8th
					AM Peak	--	--	PM Peak	--	--	--	--
Eastbound	Carnegie	16	Minor Arterial	Left	830	800	779	120	105	103	103	98
				Through	1,490	1,435	1,399	750	655	645	645	614
				Right 1	270	260	254	280	245	241	241	229
				Right 2	20	19	19	20	17	17	17	16
Westbound	Carnegie	14	Principal Arterial	Left	10	10	9	110	96	95	95	90
				Through	410	395	385	670	585	576	576	548
				Right	250	241	235	160	140	138	138	131
Northbound	Ontario	14	Principal Arterial	Left	290	279	272	160	140	138	138	131
				Through	2,360	2,274	2,216	1,020	891	877	877	835
				Right	130	125	122	250	218	215	215	205
Southbound	Ontario	14	Principal Arterial	Through	270	260	254	960	839	826	826	786
				Right 1	380	366	357	1,360	1,188	1,169	1,169	1,113
				Right 2	0	0	0	40	35	34	34	33
Total					6,710	6,464	6,301	5,900	5,154	5,074	5,074	4,829

Note: Percentages for Functional Class 14 assumed on all approaches (percentages are similar).
Note: Highest hours excluding AM and PM peak calculated based on: AM Peak Hour, PM Peak Hour, 2nd and 3rd Highest Hours, 5th through 8th Highest Hours

Central Viaduct
Eight Hour Volume Development

Intersection: Carnegie Avenue @ East 9th Street

Available Peak Hour Data								
Movement	Roadway / Functional Classification			Direction	Year 2015 Build		Year 2035 Build	
					AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
Eastbound	Carnegie	14	Principal Arterial	Left	440	80	470	180
				Through	1,090	660	1170	870
				Right	10	0	10	0
Westbound	Carnegie	14	Principal Arterial	Left	360	110	420	110
				Through	560	850	550	890
				Right	250	10	280	10
Northbound	E 9th	14	Principal Arterial	--	0	0	0	0
				Through	1,750	790	1640	780
				Right	140	60	170	30
Southbound	E 9th	14	Principal Arterial	Left	0	690	0	550
				Through	220	1,290	260	1290
				Right	210	150	200	160
Total					5,030	4,690	5,170	4,870

Eight Hour Distribution & Relationship to Peak Hours Provided									
ODOT Data	Highest Hour	1st	2nd	3rd	4th	5th	6th	7th	8th
	Percentage of Total (ODOT Factor)	8.2%	7.9%	7.7%	6.8%	6.3%	6.2%	6.2%	5.9%
	Hour of the Day	4:00 PM	5:00 PM	3:00 PM	2:00 PM	Noon	7:00 AM	1:00 PM	6:00 PM
Year 2015	Total Entering Intersection *	**5,030**	4,846	**4,723**	4,171	3,865	3,803	3,803	3,619
	Peak Hour	AM	--	PM	--	--	--	--	--
Year 2035	Total Entering Intersection *	**5,170**	4,981	**4,855**	4,287	3,972	3,909	3,909	3,720
	Peak Hour	AM	--	PM	--	--	--	--	--

Year 2015 Eight Hour Volumes												
Movement	Roadway / Functional Classification			Direction	1st	2nd	3rd	4th	5th	6th	7th	8th
					AM Peak	--	PM Peak	--	--	--	--	--
Eastbound	Carnegie	14	Principal Arterial	Left	440	424	80	71	66	65	65	62
				Through	1,090	1,050	660	587	544	535	535	509
				Right	10	10	0	0	0	0	0	0
Westbound	Carnegie	14	Principal Arterial	Left	360	347	110	98	91	89	89	85
				Through	560	540	850	756	700	689	689	656
				Right	250	241	10	9	8	8	8	8
Northbound	E 9th	14	Principal Arterial	--	0	0	0	0	0	0	0	0
				Through	1,750	1,686	790	703	651	641	641	610
				Right	140	135	60	53	49	49	49	46
Southbound	E 9th	14	Principal Arterial	Left	0	0	690	614	569	560	560	532
				Through	220	212	1,290	1,147	1,063	1,046	1,046	995
				Right	210	202	150	133	124	122	122	116
Total					5,030	4,847	4,690	4,171	3,865	3,804	3,804	3,619

Year 2035 Eight Hour Volumes												
Movement	Roadway / Functional Classification			Direction	1st	2nd	3rd	4th	5th	6th	7th	8th
					AM Peak	--	PM Peak	--	--	--	--	--
Eastbound	Carnegie	14	Principal Arterial	Left	470	453	180	158	147	144	144	137
				Through	1,170	1,127	870	766	710	698	698	665
				Right	10	10	0	0	0	0	0	0
Westbound	Carnegie	14	Principal Arterial	Left	420	405	110	97	90	88	88	84
				Through	550	530	890	784	726	714	714	680
				Right	280	270	10	9	8	8	8	8
Northbound	E 9th	14	Principal Arterial	--	0	0	0	0	0	0	0	0
				Through	1,640	1,580	780	687	636	626	626	596
				Right	170	164	30	26	24	24	24	23
Southbound	E 9th	14	Principal Arterial	Left	0	0	550	484	449	441	441	420
				Through	260	250	1,290	1,136	1,052	1,035	1,035	985
				Right	200	193	160	141	130	128	128	122
Total					5,170	4,982	4,870	4,288	3,972	3,906	3,906	3,720

Note: Highest hours excluding AM and PM peak calculated based on: AM Peak Hour, PM Peak Hour, 2nd Highest Hour, 4th through 8th Highest Hours

Central Viaduct
Eight Hour Volume Development

Intersection: Ontario Street / Orange Avenue @ East 9th Street

Available Peak Hour Data								
Movement	Roadway / Functional Classification			Direction	Year 2015 Build		Year 2035 Build	
					AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
Eastbound	Ontario	14	Principal Arterial	Left	30	20	40	10
				Through	400	720	430	760
				Right	90	350	80	410
Westbound	Orange	14	Principal Arterial	Left	10	10	0	20
				Through	1,100	680	970	680
				Right	510	210	510	250
Northbound	E 9th	14	Principal Arterial	Left	620	100	620	100
				Through	270	70	300	90
				Right	10	10	0	10
Southbound	E 9th	14	Principal Arterial	Left	230	380	470	350
				Through	10	330	20	350
				Right	40	20	80	10
Total					3,320	2,900	3,520	3,040

Eight Hour Distribution & Relationship to Peak Hours Provided									
ODOT Data	Highest Hour	1st	2nd	3rd	4th	5th	6th	7th	8th
	Percentage of Total (ODOT Factor)	8.2%	7.9%	7.7%	6.8%	6.3%	6.2%	6.2%	5.9%
	Hour of the Day	4:00 PM	5:00 PM	3:00 PM	2:00 PM	Noon	7:00 AM	1:00 PM	6:00 PM
Year 2015	Total Entering Intersection *	**3,320**	3,199	3,118	**2,753**	2,551	2,510	2,510	2,389
	Peak Hour	AM	--	--	PM	--	--	--	--
Year 2035	Total Entering Intersection *	**3,520**	3,391	3,305	**2,919**	2,704	2,661	2,661	2,533
	Peak Hour	AM	--	--	PM	--	--	--	--

Year 2015 Eight Hour Volumes												
Movement	Roadway / Functional Classification			Direction	1st	2nd	3rd	4th	5th	6th	7th	8th
					AM Peak	--	--	PM Peak	--	--	--	--
Eastbound	Ontario	14	Principal Arterial	Left	30	29	28	20	18	17	17	16
				Through	400	385	376	720	633	623	623	593
				Right	90	87	85	350	308	303	303	288
Westbound	Orange	14	Principal Arterial	Left	10	10	9	10	9	9	9	8
				Through	1,100	1,060	1,033	680	598	589	589	560
				Right	510	491	479	210	185	182	182	173
Northbound	E 9th	14	Principal Arterial	Left	620	597	582	100	88	87	87	82
				Through	270	260	254	70	62	61	61	58
				Right	10	10	9	10	9	9	9	8
Southbound	E 9th	14	Principal Arterial	Left	230	222	216	380	334	329	329	313
				Through	10	10	9	330	290	286	286	272
				Right	40	39	38	20	18	17	17	16
Total					3,320	3,200	3,118	2,900	2,552	2,512	2,512	2,387

Year 2035 Eight Hour Volumes												
Movement	Roadway / Functional Classification			Direction	1st	2nd	3rd	4th	5th	6th	7th	8th
					AM Peak	--	--	PM Peak	--	--	--	--
Eastbound	Ontario	14	Principal Arterial	Left	40	39	38	10	9	9	9	8
				Through	430	414	404	760	676	665	665	633
				Right	80	77	75	410	365	359	359	342
Westbound	Orange	14	Principal Arterial	Left	0	0	0	20	18	18	18	17
				Through	970	935	911	680	605	595	595	567
				Right	510	491	479	250	222	219	219	208
Northbound	E 9th	14	Principal Arterial	Left	620	597	582	100	89	88	88	83
				Through	300	289	282	90	80	79	79	75
				Right	0	0	0	10	9	9	9	8
Southbound	E 9th	14	Principal Arterial	Left	470	453	441	350	311	306	306	292
				Through	20	19	19	350	311	306	306	292
				Right	80	77	75	10	9	9	9	8
Total					3,520	3,391	3,306	3,040	2,704	2,662	2,662	2,533

Note: Highest hours excluding AM and PM peak calculated based on: AM Peak Hour, PM Peak Hour, 2nd and 3rd Highest Hours, 5th through 8th Highest Hours

Central Viaduct
Eight Hour Volume Development

Intersection: Broadway Avenue @ East 9th Street

Available Peak Hour Data								
Movement	Roadway / Functional Classification			Direction	Year 2015 Build		Year 2035 Build	
					AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
Eastbound	Broadway	14	Principal Arterial	--	0	0	0	0
				--	0	0	0	0
				--	0	0	0	0
Westbound	Broadway	14	Principal Arterial	Left	70	130	120	160
				--	0	0	0	0
				Right	750	110	790	160
Northbound	E 9th	14	Principal Arterial	--	0	0	0	0
				Through	120	50	110	30
				Right	40	110	60	140
Southbound	E 9th	14	Principal Arterial	Left	110	570	110	700
				Through	0	100	0	60
				--	0	0	0	0
Total					1,090	1,070	1,190	1,250

Eight Hour Distribution & Relationship to Peak Hours Provided									
ODOT Data	Highest Hour	1st	2nd	3rd	4th	5th	6th	7th	8th
	Percentage of Total (ODOT Factor)	8.2%	7.9%	7.7%	6.8%	6.3%	6.2%	6.2%	5.9%
	Hour of the Day	4:00 PM	5:00 PM	3:00 PM	2:00 PM	Noon	7:00 AM	1:00 PM	6:00 PM
Year 2015	Total Entering Intersection *	**1,090**	**1,050**	1,024	904	837	824	824	784
	Peak Hour	AM	PM	--	--	--	--	--	--
Year 2035	Total Entering Intersection *	**1,250**	**1,204**	1,174	1,037	960	945	945	899
	Peak Hour	PM	AM	--	--	--	--	--	--

Year 2015 Eight Hour Volumes												
Movement	Roadway / Functional Classification			Direction	1st	2nd	3rd	4th	5th	6th	7th	8th
					AM Peak	PM Peak	--	--	--	--	--	--
Eastbound	Broadway	14	Principal Arterial	--	0	0	0	0	0	0	0	0
				--	0	0	0	0	0	0	0	0
				--	0	0	0	0	0	0	0	0
Westbound	Broadway	14	Principal Arterial	Left	70	130	66	58	102	100	100	95
				--	0	0	0	0	0	0	0	0
				Right	750	110	704	622	86	85	85	81
Northbound	E 9th	14	Principal Arterial	--	0	0	0	0	0	0	0	0
				Through	120	50	113	100	39	39	39	37
				Right	40	110	38	33	86	85	85	81
Southbound	E 9th	14	Principal Arterial	Left	110	570	103	91	446	439	439	418
				Through	0	100	0	0	78	77	77	73
				--	0	0	0	0	0	0	0	0
Total					1,090	1,070	1,024	904	837	825	825	785

Year 2035 Eight Hour Volumes												
Movement	Roadway / Functional Classification			Direction	1st	2nd	3rd	4th	5th	6th	7th	8th
					PM Peak	AM Peak	--	--	--	--	--	--
Eastbound	Broadway	14	Principal Arterial	--	0	0	0	0	0	0	0	0
				--	0	0	0	0	0	0	0	0
				--	0	0	0	0	0	0	0	0
Westbound	Broadway	14	Principal Arterial	Left	160	120	118	105	123	121	121	115
				--	0	0	0	0	0	0	0	0
				Right	160	790	779	688	123	121	121	115
Northbound	E 9th	14	Principal Arterial	--	0	0	0	0	0	0	0	0
				Through	30	110	109	96	23	23	23	22
				Right	140	60	59	52	108	106	106	101
Southbound	E 9th	14	Principal Arterial	Left	700	110	109	96	538	529	529	504
				Through	60	0	0	0	46	45	45	43
				--	0	0	0	0	0	0	0	0
Total					1,250	1,190	1,174	1,037	961	945	945	900

Note: Highest hours excluding AM and PM peak calculated based on: AM Peak Hour, PM Peak Hour, 3rd and 4th Highest Hours, 5th through 8th Highest Hours

Central Viaduct
Eight Hour Volume Development

Intersection: Orange Avenue @ East 14th Street

Available Peak Hour Data								
Movement	Roadway / Functional Classification			Direction	Year 2015 Build		Year 2035 Build	
					AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
Eastbound	Orange	14	Principal Arterial	Left	190	40	310	20
				Through	450	1,070	580	1110
				Right	10	0	20	0
Westbound	Orange	14	Principal Arterial	Left	240	90	260	90
				Through	950	610	1140	670
				Right	320	10	330	0
Northbound	E 14th	17	Collector	Left	0	30	0	0
				Through	140	10	170	10
				Right	270	10	270	30
Southbound	E 14th	17	Collector	Left	0	20	0	20
				Through	0	70	0	60
				Right	410	260	260	250
Total					2,980	2,220	3,340	2,260

Eight Hour Distribution & Relationship to Peak Hours Provided									
ODOT Data	Highest Hour	1st	2nd	3rd	4th	5th	6th	7th	8th
	Percentage of Total (ODOT Factor)	8.2%	7.9%	7.7%	6.8%	6.3%	6.2%	6.2%	5.9%
	Hour of the Day	4:00 PM	5:00 PM	3:00 PM	2:00 PM	Noon	7:00 AM	1:00 PM	6:00 PM
Year 2015	Total Entering Intersection *	**2,980**	2,871	2,798	2,471	2,290	2,253	**2,253**	2,144
	Peak Hour	AM	--	--	--	--	--	PM	--
Year 2035	Total Entering Intersection *	**3,340**	3,218	3,136	2,770	2,566	2,525	2,525	**2,403**
	Peak Hour	AM	--	--	--	--	--	--	PM

Year 2015 Eight Hour Volumes											
Movement	Roadway / Functional Classification			Direction	1st	2nd	3rd	4th	5th	6th	7th	8th
					AM Peak	--	--	--	--	--	PM Peak	--
Eastbound	Orange	14	Principal Arterial	Left	190	183	178	45	41	41	40	39
				Through	450	434	423	1,191	1,104	1,086	1,070	1,033
				Right	10	10	9	0	0	0	0	0
Westbound	Orange	14	Principal Arterial	Left	240	231	225	100	93	91	90	87
				Through	950	915	892	679	629	619	610	589
				Right	320	308	300	11	10	10	10	10
Northbound	E 14th	17	Collector	Left	0	0	0	33	31	30	30	29
				Through	140	135	131	11	10	10	10	10
				Right	270	260	254	11	10	10	10	10
Southbound	E 14th	17	Collector	Left	0	0	0	22	21	20	20	19
				Through	0	0	0	78	72	71	70	68
				Right	410	395	385	289	268	264	260	251
Total					2,980	2,871	2,797	2,470	2,289	2,252	2,220	2,145

Year 2035 Eight Hour Volumes												
Movement	Roadway / Functional Classification			Direction	1st	2nd	3rd	4th	5th	6th	7th	8th
					AM Peak	--	--	--	--	--	--	PM Peak
Eastbound	Orange	14	Principal Arterial	Left	310	299	291	25	23	22	22	20
				Through	580	559	545	1,360	1,260	1,240	1,240	1,110
				Right	20	19	19	0	0	0	0	0
Westbound	Orange	14	Principal Arterial	Left	260	250	244	110	102	101	101	90
				Through	1,140	1,098	1,070	821	761	749	749	670
				Right	330	318	310	0	0	0	0	0
Northbound	E 14th	17	Collector	Left	0	0	0	0	0	0	0	0
				Through	170	164	160	12	11	11	11	10
				Right	270	260	254	37	34	34	34	30
Southbound	E 14th	17	Collector	Left	0	0	0	25	23	22	22	20
				Through	0	0	0	74	68	67	67	60
				Right	260	250	244	306	284	279	279	250
Total					3,340	3,217	3,137	2,770	2,566	2,525	2,525	2,260

Note: Percentages for Functional Class 14 assumed on all approaches (percentages are similar).
Note: Highest hours excluding AM and PM peak calculated based on: AM Peak Hour, PM Peak Hour, 2nd and 3rd Highest Hours, 4th through 8th Highest Hours

Central Viaduct
Eight Hour Volume Development

Intersection: Broadway Avenue @ East 14th Street

Available Peak Hour Data								
Movement	Roadway / Functional Classification			Direction	Year 2015 Build		Year 2035 Build	
					AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
Eastbound	Broadway	14	Principal Arterial	Left	40	20	70	30
				Through	110	680	90	790
				--	0	0	0	0
Westbound	Broadway	14	Principal Arterial	--	0	0	0	0
				Through	800	170	850	210
				Right	290	50	290	30
Northbound	E 14th	17	Collector	--	0	0	0	0
				--	0	0	0	0
				--	0	0	0	0
Southbound	E 14th	17	Collector	Left	220	90	210	50
				--	0	0	0	0
				Right	40	50	70	90
Total					1,500	1,060	1,580	1,200

Eight Hour Distribution & Relationship to Peak Hours Provided									
ODOT Data	Highest Hour	1st	2nd	3rd	4th	5th	6th	7th	8th
	Percentage of Total (ODOT Factor)	8.2%	7.9%	7.7%	6.8%	6.3%	6.2%	6.2%	5.9%
	Hour of the Day	4:00 PM	5:00 PM	3:00 PM	2:00 PM	Noon	7:00 AM	1:00 PM	6:00 PM
Year 2015	Total Entering Intersection *	**1,500**	1,445	1,409	1,244	1,152	1,134	1,134	**1,079**
	Peak Hour	AM	--	--	--	--	--	--	PM
Year 2035	Total Entering Intersection *	**1,580**	1,522	1,484	1,310	1,214	**1,195**	1,195	1,137
	Peak Hour	AM	--	--	--	--	PM	--	--

Year 2015 Eight Hour Volumes										
Movement	Roadway / Functional Classification			Direction	1st	2nd	3rd	4th	5th	6th	7th	8th
					AM Peak	--	--	--	--	--	--	PM Peak
Eastbound	Broadway	14	Principal Arterial	Left	40	39	38	23	22	21	21	20
				Through	110	106	103	798	739	728	728	680
				--	0	0	0	0	0	0	0	0
Westbound	Broadway	14	Principal Arterial	--	0	0	0	0	0	0	0	0
				Through	800	771	751	199	185	182	182	170
				Right	290	279	272	59	54	53	53	50
Northbound	E 14th	17	Collector	--	0	0	0	0	0	0	0	0
				--	0	0	0	0	0	0	0	0
				--	0	0	0	0	0	0	0	0
Southbound	E 14th	17	Collector	Left	220	212	207	106	98	96	96	90
				--	0	0	0	0	0	0	0	0
				Right	40	39	38	59	54	53	53	50
Total					1,500	1,446	1,409	1,244	1,152	1,133	1,133	1,060

Year 2035 Eight Hour Volumes										
Movement	Roadway / Functional Classification			Direction	1st	2nd	3rd	4th	5th	6th	7th	8th
					AM Peak	--	--	--	--	PM Peak	--	--
Eastbound	Broadway	14	Principal Arterial	Left	70	67	66	33	30	30	30	28
				Through	90	87	85	863	799	790	786	748
				--	0	0	0	0	0	0	0	0
Westbound	Broadway	14	Principal Arterial	--	0	0	0	0	0	0	0	0
				Through	850	819	798	229	212	210	209	199
				Right	290	279	272	33	30	30	30	28
Northbound	E 14th	17	Collector	--	0	0	0	0	0	0	0	0
				--	0	0	0	0	0	0	0	0
				--	0	0	0	0	0	0	0	0
Southbound	E 14th	17	Collector	Left	210	202	197	55	51	50	50	47
				--	0	0	0	0	0	0	0	0
				Right	70	67	66	98	91	90	90	85
Total					1,580	1,521	1,484	1,311	1,213	1,200	1,195	1,135

Note: Percentages for Functional Class 14 assumed on all approaches (percentages are similar).
Note: Highest hours excluding AM and PM peak calculated based on: AM Peak Hour, PM Peak Hour, 2nd and 3rd Highest Hours, 4th through 8th Highest Hours

Attachment D

Ontario Street @ Eagle Avenue Pedestrian Volume Estimate

S.O. No. 117124 - 1.18

Subject: SIGNAL WARRANTS

PED VOLUME ESTIMATE Sheet No. 1 of

Drawing No.

Computed by NLS Checked By Date 10/16/09

Baker

PROGRESSIVE FIELD CAPACITY = 45,000 peds

ASSUME 10% PARK ALONG RIVER/WEST OF ONTARIO ⇒ 4,500 peds (probably ± 2000 vehs)

PED ACCESS VIA EAGLE AND (NEW) PED WALKWAY
↖ NOT ADA

ASSUME 25% OF "RIVER PARKERS" USE EAGLE X-WALK ⇒ 1125 peds

ASSUME 60-80% ARRIVE/DEPART IN 1 HR BEFORE/AFTER EVENT

⇒ 675 - 900 peds/hr

IF STADIUM IS 75% FULL → 33,750 total peds
→ 500 - 675 peds/hr

→ WILL LINK TO TOWPATH TRAIL & CANAL BASIN PARK

→ CONSISTENT W/ CANAL BASIN DISTRICT PLAN & CITY'S BIKE/PED TRAIL PLANS

CONFER W/ KNB - 10% MAY BE LOW, PERHAPS UP TO 20%

CAPACITY = 45,000

20% PARK ALONG RIVER → 9,000 peds

25% OF RIVER PARKERS USE EAGLE → 2,250 peds

60-80% ARRIVE/DEPART IN 1 HR → 1350 - 1800 peds/hr

IF STADIUM IS 75% FULL → 1000 - 1350 peds/hr

THE Q CAPACITY = 20,562

±10% PARK ALONG RIVER → 2100

25% USE EAGLE XING → 525

60-80% ARRIVE/DEPART IN 1 HR → 315 - 420 peds/hr

PED XING VOLUMES WILL LIKELY EXCEED 190 PEDS/HR FOR NUMEROUS EVENTS HELD AT PROGRESSIVE FIELD & THE "Q"

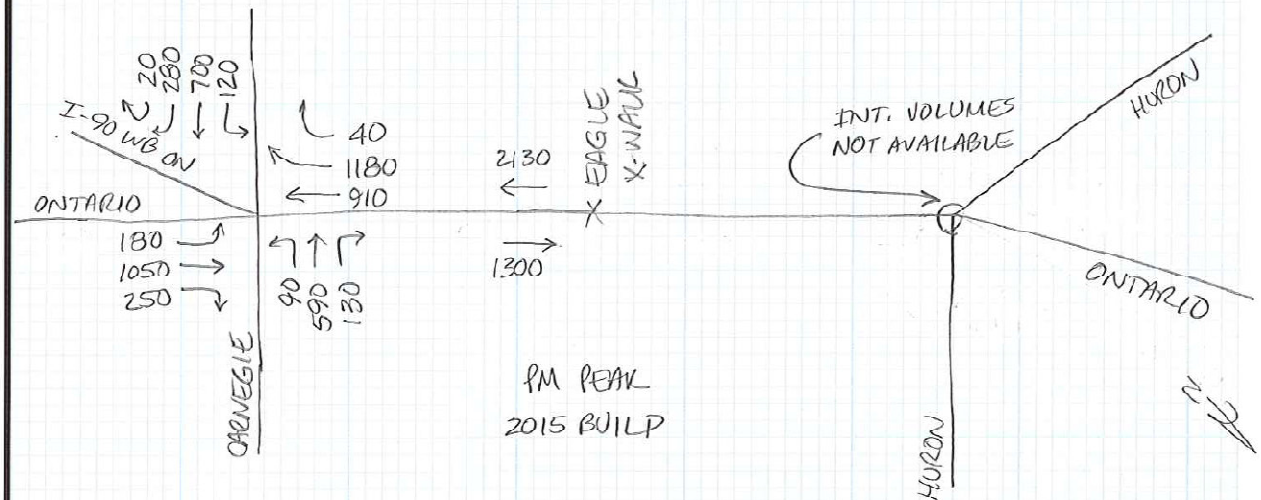
S.O. No. 117129 - 1.18
Subject: SIGNAL WARRANTS
Sheet No. 2 of
Drawing No.
Computed by NLS Checked By Date 10/16/09

Baker

ESTIMATED GAPS ON ONTARIO

SPECIAL EVENTS TYPICALLY OCCUR DURING/AFTER PM PEAK

EAGLE XING LOCATION IS BETW SIGNALS AT HURON AND AT CARNEGIE
- GAPS ARE FORMED BY THESE SIGNALS BUT NB & SB GAPS DO NOT COINCIDE
- THE MEDIAN IS NOT LARGE ENOUGH TO SHELTER PEDS
- ONTARIO IS AN 8-LANE ROAD (CONFIRM W/ B&N STEP 6 PLANS)



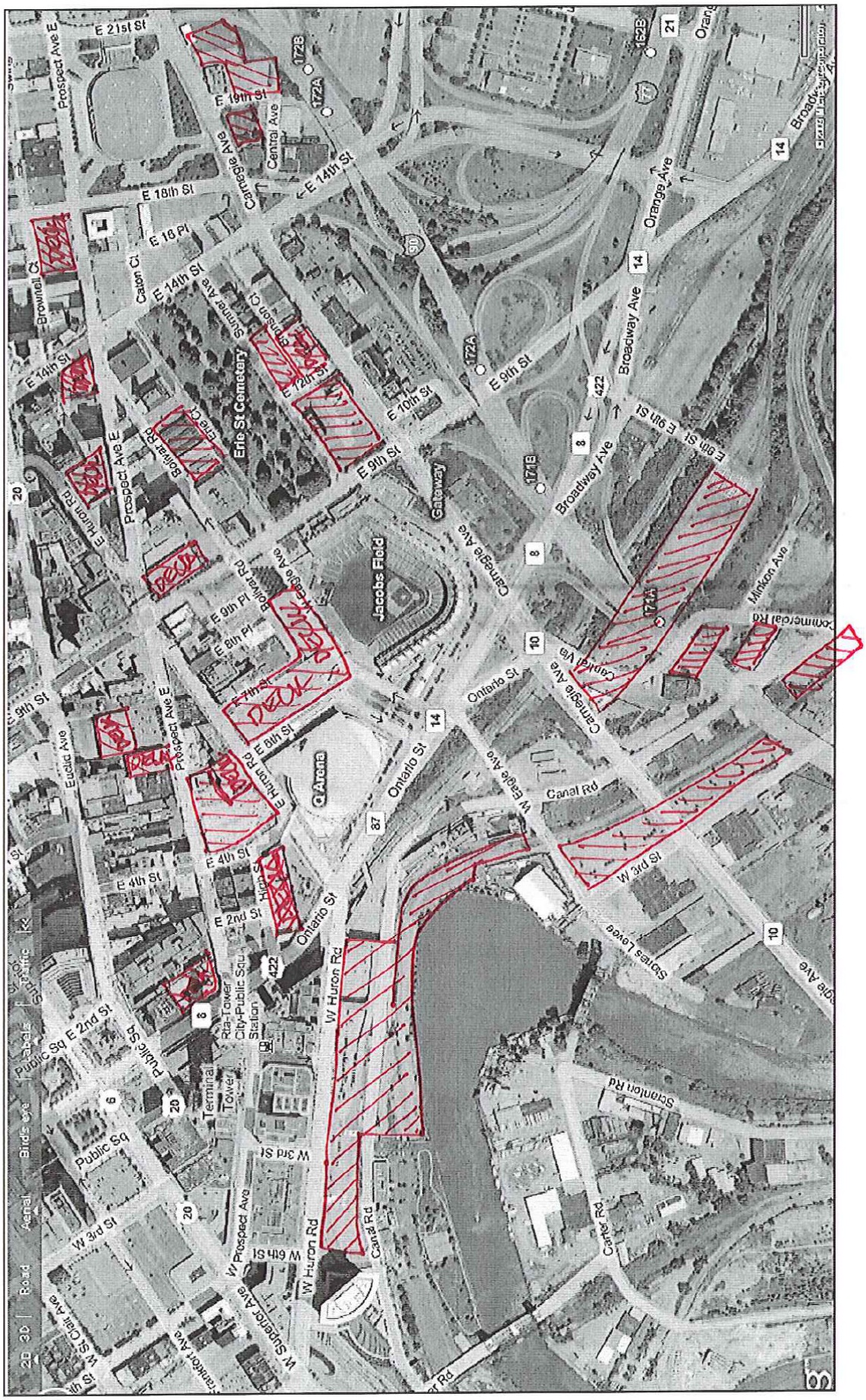
AVG GAP - NB ONTARIO: $1300 \frac{veh}{hr} \times \frac{1hr}{3600s} = 0.36 \Rightarrow$ 1 veh every 2.8 sec (avg)

AVG GAP - SB ONTARIO: $2130 \frac{veh}{hr} \times \frac{1hr}{3600s} = 0.59 \Rightarrow$ 1 veh every 1.7 sec (avg)

IF TRAFFIC IS 50% OF PM PHV ⇒ NB: 1 veh every 5.5 sec
SB: 1 veh every 3.4 sec

ROADWAY ≙ 100 ft
PED SPEED ≙ 4.0 ft/sec
} APPROX 25 sec TO CROSS STREET

Gateway Area – Parking Areas



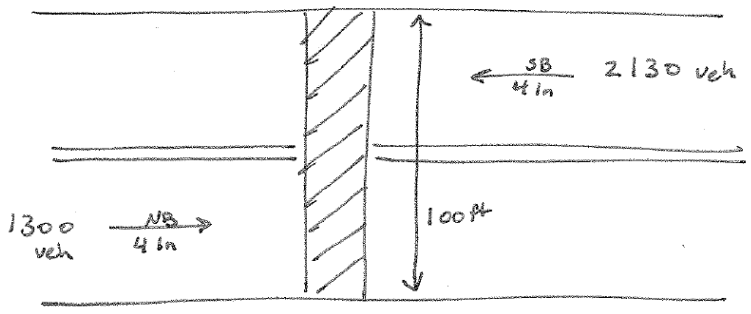
S.O. No. 117124 – 1.18

Subject: SIGNAL WARRANTS

Sheet No. 3 of

Drawing No.

Computed by PAS Checked By Date 10/19/2009



Speed ≈ 35 mph

$\frac{35 mi}{hr} \cdot \frac{1 hr}{3600 sec} \cdot \frac{5280 ft}{mi} = 51.3 \frac{ft}{sec}$

NB: $\frac{1300 veh}{hr} \cdot \frac{1 hr}{3600 sec} = 0.36 \frac{veh}{sec}$ ⇒ 2.8 sec btw vehicles (avg)

50% volume = 5.54 sec

SB: $\frac{2130 veh}{hr} \cdot \frac{1 hr}{3600 sec} = 0.59 \frac{veh}{sec}$ ⇒ 1.7 sec btw vehicles (avg)

50% volume = 3.38 sec

Peds: $100 ft \cdot \frac{1 sec}{4 ft}$ + 3 sec buffer = 28 sec gap needed

(b/c no ped refuge on island)

assume 1.5 sec following vehicles

SB is critical movement: if 4 together ⇒ 4 veh / 13.52 sec gap

if 8 together ⇒ 8 veh / 25.5 sec gap

if 16 together ⇒ 16 veh / 51.1 sec gap

⇒ 1 gap per minute, but 16 vehicle platoon is UNLIKELY

⇒ **Number of adequate gaps per hour < 60**

CRS

Attachment E
Signal Warrant Analyses Worksheets

Carnegie Avenue @ Ontario Street
Signal Warrant Analysis Worksheets
(Attachment E)

WARRANT 1 - EIGHT-HOUR VOLUME WARRANT

Baker

Project: Central Viaduct Innerbelt Bridge Construction Date: 10/20/2009
Intersection: Ontario Street and Carnegie Avenue
Time Period: 2015 Build
County: Cuyahoga Computed By: PAS
Location: City of Cleveland

Major Street: Ontario Street		**Minor Street:** Carnegie Avenue	
Number of Lanes:	3/4	**Number of Lanes:**	2
1st Highest Hour Volume:	3,580	**1st Highest Hour Volume:**	2,400
2nd Highest Hour Volume:	3,449	**2nd Highest Hour Volume:**	2,312
3rd Highest Hour Volume:	3,362	**3rd Highest Hour Volume:**	2,254
4th Highest Hour Volume:	3,610	**4th Highest Hour Volume:**	1,120
5th Highest Hour Volume:	3,325	**5th Highest Hour Volume:**	1,032
6th Highest Hour Volume:	3,272	**6th Highest Hour Volume:**	1,015
7th Highest Hour Volume:	3,272	**7th Highest Hour Volume:**	1,015
8th Highest Hour Volume:	3,113	**8th Highest Hour Volume:**	965
(Volumes are total of both approaches)		(Volumes are total of high volume approach)	

The intersection meets the Eight Hour Volume Warrant

Table 4C-1. Warrant 1, Eight-Hour Vehicular Volume

Condition A—Minimum Vehicular Volume									
Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%[a]	80%[b]	70%[c]	56%[d]	100%[a]	80%[b]	70%[c]	56%[d]
1	1	500	400	350	280	150	120	105	84
2 or more	1	600	480	420	336	150	120	105	84
2 or more	2 or more	600	480	420	336	200	160	140	112
1	2 or more	500	400	350	280	200	160	140	112

Condition B—Interruption of Continuous Traffic									
Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%[a]	80%[b]	70%[c]	56%[d]	100%[a]	80%[b]	70%[c]	56%[d]
1	1	750	600	525	420	75	60	53	42
2 or more	1	900	720	630	504	75	60	53	42
2 or more	2 or more	900	720	630	504	100	80	70	56
1	2 or more	750	600	525	420	100	80	70	56

[a] Basic minimum hourly volume.
[b] Used for combination of Conditions A and B after adequate trial of other remedial measures.
[c] May be used when the major-street speed exceeds 70 km/h or exceeds 40 mph or in an isolated community with a population of less than 10,000.
[d] May be used for combination of Conditions A and B after adequate trial of other remedial measures when the major-street speed exceeds 70 km/h or exceeds 40 mph or in an isolated community with a population of less than 10,000.

WARRANT 2 - FOUR-HOUR VOLUME WARRANT

Baker

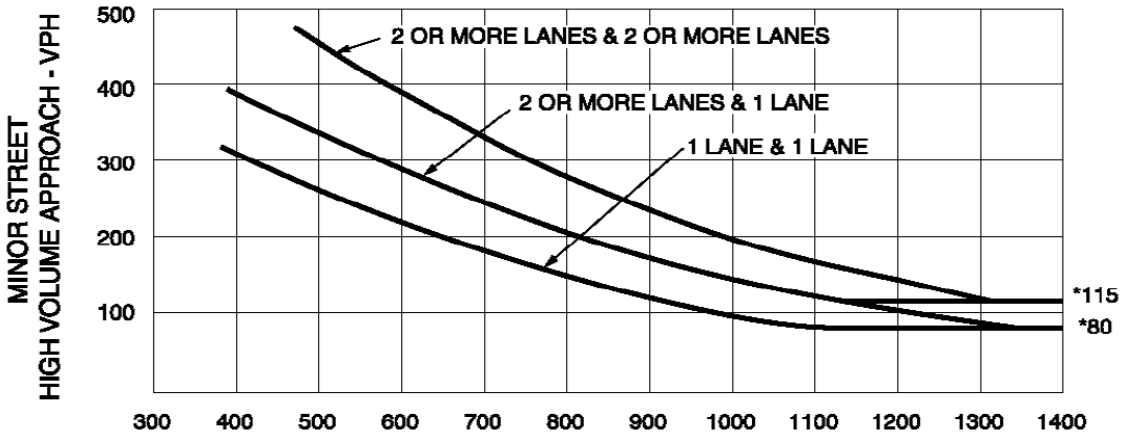
Project:	Central Viaduct Innerbelt Bridge Construction	Date:	10/20/2009
Intersection:	Ontario Street and	Carnegie Avenue	
Time Period:	2015 Build		
County:	Cuyahoga	Computed By:	PAS
Location:	City of Cleveland		

Major Street:	**Ontario Street**	**Minor Street:**	**Carnegie Avenue**
Number of Lanes:	**3/4**	**Number of Lanes:**	**2**
1st Highest Hour Volume:	**3,580**	**1st Highest Hour Volume:**	**2,400**
2nd Highest Hour Volume:	**3,449**	**2nd Highest Hour Volume:**	**2,312**
3rd Highest Hour Volume:	**3,362**	**3rd Highest Hour Volume:**	**2,254**
4th Highest Hour Volume:	**3,610**	**4th Highest Hour Volume:**	**1,120**
(Volumes are total of both approaches)		(Volumes are total of high volume approach)	

The intersection meets the Four Hour Volume Warrant

Note: points are off the chart.

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



*Note: 115 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 80 vph applies as the lower threshold volume for a minor-street approach with one lane.

WARRANT 3 - PEAK HOUR VOLUME WARRANT

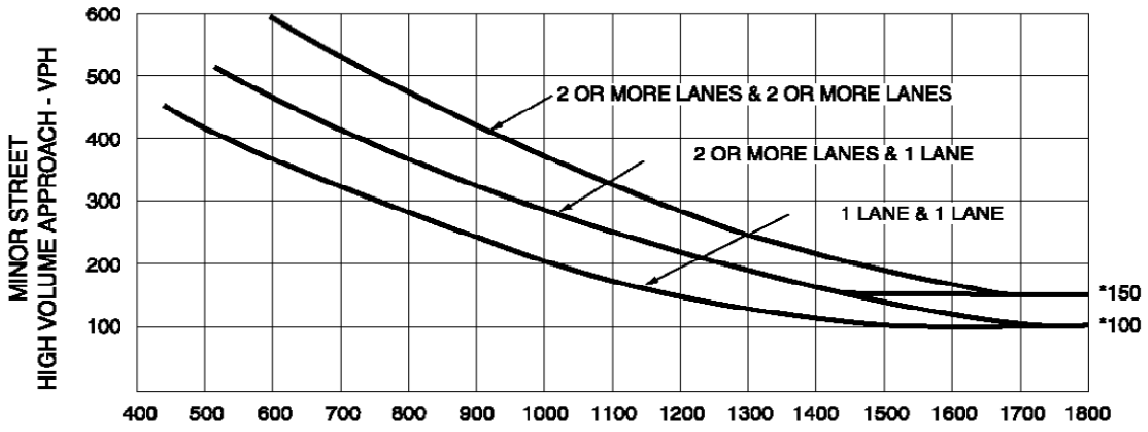
Project: Central Viaduct Innerbelt Bridge Construction Date: 10/20/2009
Intersection: Ontario Street and Carnegie Avenue
Time Period: 2015 Build
County: Cuyahoga Computed By: PAS
Location: City of Cleveland

Major Street:	**Ontario Street**	**Minor Street:**	**Carnegie Avenue**
Number of Lanes:	**3/4**	**Number of Lanes:**	**2**
AM Peak Hour Volume:	**3,580**	**AM Peak Hour Volume:**	**2,400**
PM Peak Hour Volume:	**3,610**	**PM Peak Hour Volume:**	**1,120**
(Volumes are total of both approaches)		(Volumes are total of high volume approach)	

The intersection <u>meets</u> both the AM and PM Peak Hour Volume Warrant

Note: points are off the chart.

Figure 4C-3. Warrant 3, Peak Hour



*Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

Carnegie Avenue @ E.4th Street- Commercial Road
Signal Warrant Analysis Worksheets
(Attachment E)

WARRANT 6 - COORDINATED SIGNAL SYSTEM

Baker

Project: Central Viaduct Innerbelt Bridge Construction Date: 10/23/2009
Intersection: Carnegie Avenue and Commercial Street
Time Period: 2015 Build
County: Cuyahoga Computed By: PAS
Location: City of Cleveland

Major Street: Carnegie Avenue **Minor Street:** Commercial Street

Number of Lanes: 2 **Number of Lanes:** 1

Data:

One-way or Two-way Street:	**two-way**		
Distance to Adjacent Signal/Direction:	**300'**	to the	**north (Broadway)**
Distance to Adjacent Signal/Direction:	**5300'**	to the	**south (W. 20th)**
Adequate Platooning (yes or no):	**yes**		

The intersection does not meet the Coordinated Signal System Warrant

Note: Spacing is less than 1000'; therefore, warrant is not met.
Intersection has only one conflicting movement (right turn from Commercial).

Eagle Avenue @ Ontario Street
Signal Warrant Analysis Worksheets
(Attachment E)

WARRANT 4 - PEDESTRIAN VOLUME

Baker

Project: Central Viaduct Innerbelt Bridge Construction Date: 10/19/2009
Intersection: Ontario Street and Eagle Avenue
Time Period: 2015 Build
County: Cuyahoga Computed By: PAS
Location: City of Cleveland

Major Street: Ontario Street **Minor Street:** Eagle Avenue

Number of Lanes: 4/5 **Number of Lanes:** ____

Volume Data:

1st Highest Hour Crossing Volume:	**315**
2nd Highest Hour Crossing Volume:	**n/a**
3rd Highest Hour Crossing Volume:	**n/a**
4th Highest Hour Crossing Volume:	**n/a**

(Crossing major street)

Gap Data:

Number of adequate gaps per hour: **< 60**

The intersection meets the Pedestrian Volume Warrant

Note: Highest hourly volume represents lowest volume estimated based on potential activity from Progressive Field and Quicken Loans Center.

E. 9th Street @ Carnegie Avenue
Signal Warrant Analysis Worksheets
(Attachment E)

WARRANT 1 - EIGHT-HOUR VOLUME WARRANT

Baker

Project: Central Viaduct Innerbelt Bridge Construction Date: 10/20/2009
Intersection: East 9th Street and Carnegie Avenue
Time Period: 2015 Build
County: Cuyahoga Computed By: PAS
Location: City of Cleveland

Major Street: East 9th Street		**Minor Street:** Carnegie Avenue	
Number of Lanes:	3	**Number of Lanes:**	2/3
1st Highest Hour Volume:	2,320	**1st Highest Hour Volume:**	1,540
2nd Highest Hour Volume:	2,235	**2nd Highest Hour Volume:**	1,484
3rd Highest Hour Volume:	2,980	**3rd Highest Hour Volume:**	970
4th Highest Hour Volume:	2,650	**4th Highest Hour Volume:**	863
5th Highest Hour Volume:	2,456	**5th Highest Hour Volume:**	799
6th Highest Hour Volume:	2,418	**6th Highest Hour Volume:**	786
7th Highest Hour Volume:	2,418	**7th Highest Hour Volume:**	786
8th Highest Hour Volume:	2,299	**8th Highest Hour Volume:**	749
(Volumes are total of both approaches)		(Volumes are total of high volume approach)	

The intersection <u>meets</u> the Eight Hour Volume Warrant

Table 4C-1. Warrant 1, Eight-Hour Vehicular Volume

Condition A—Minimum Vehicular Volume									
Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%[a]	80%[b]	70%[c]	56%[d]	100%[a]	80%[b]	70%[c]	56%[d]
1	1	500	400	350	280	150	120	105	84
2 or more	1	600	480	420	336	150	120	105	84
2 or more	2 or more	600	480	420	336	200	160	140	112
1	2 or more	500	400	350	280	200	160	140	112

Condition B—Interruption of Continuous Traffic									
Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%[a]	80%[b]	70%[c]	56%[d]	100%[a]	80%[b]	70%[c]	56%[d]
1	1	750	600	525	420	75	60	53	42
2 or more	1	900	720	630	504	75	60	53	42
2 or more	2 or more	900	720	630	504	100	80	70	56
1	2 or more	750	600	525	420	100	80	70	56

[a] Basic minimum hourly volume.
[b] Used for combination of Conditions A and B after adequate trial of other remedial measures.
[c] May be used when the major-street speed exceeds 70 km/h or exceeds 40 mph or in an isolated community with a population of less than 10,000.
[d] May be used for combination of Conditions A and B after adequate trial of other remedial measures when the major-street speed exceeds 70 km/h or exceeds 40 mph or in an isolated community with a population of less than 10,000.

WARRANT 2 - FOUR-HOUR VOLUME WARRANT

Baker

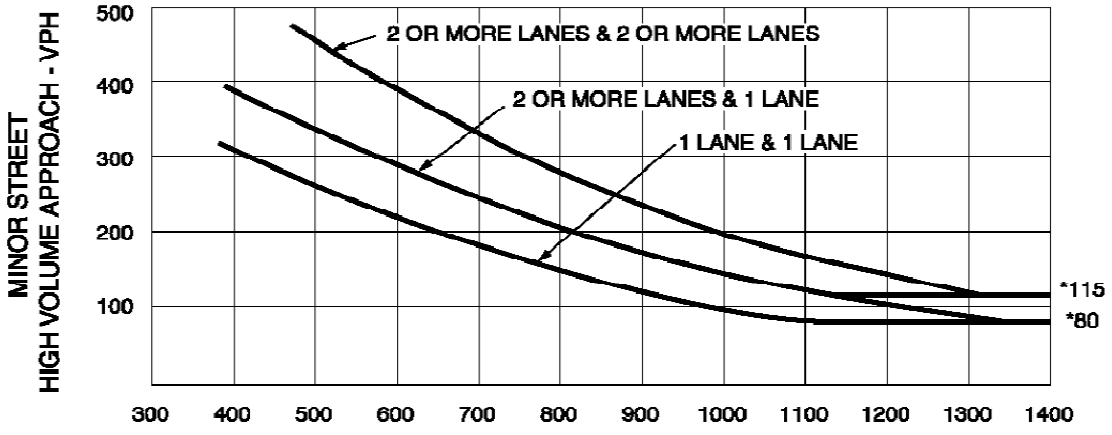
Project: Central Viaduct Innerbelt Bridge Construction Date: 10/20/2009
Intersection: East 9th Street and Carnegie Avenue
Time Period: 2015 Build
County: Cuyahoga Computed By: PAS
Location: City of Cleveland

	Major Street: East 9th Street		Minor Street: Carnegie Avenue
Number of Lanes:	3	Number of Lanes:	2/3
1st Highest Hour Volume:	2,320	1st Highest Hour Volume:	1,540
2nd Highest Hour Volume:	2,235	2nd Highest Hour Volume:	1,484
3rd Highest Hour Volume:	2,980	3rd Highest Hour Volume:	970
4th Highest Hour Volume:	2,650	4th Highest Hour Volume:	863
(Volumes are total of both approaches)		(Volumes are total of high volume approach)	

The intersection meets the Four Hour Volume Warrant

Note: points are off the chart.

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



*Note: 115 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 80 vph applies as the lower threshold volume for a minor-street approach with one lane.

WARRANT 3 - PEAK HOUR VOLUME WARRANT

Baker

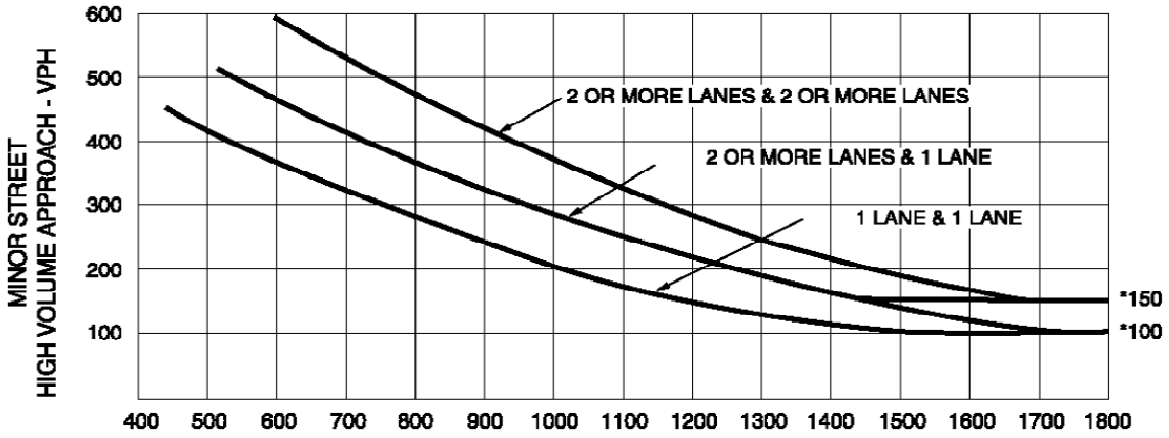
Project: Central Viaduct Innerbelt Bridge Construction Date: 10/20/2009
Intersection: East 9th Street and Carnegie Avenue
Time Period: 2015 Build
County: Cuyahoga Computed By: PAS
Location: City of Cleveland

Major Street:	**East 9th Street**	**Minor Street:**	**Carnegie Avenue**
Number of Lanes:	**3**	**Number of Lanes:**	**2/3**
AM Peak Hour Volume:	**2,320**	**AM Peak Hour Volume:**	**1,540**
PM Peak Hour Volume:	**2,980**	**PM Peak Hour Volume:**	**970**
(Volumes are total of both approaches)		(Volumes are total of high volume approach)	

The intersection <u>meets</u> both the AM and PM Peak Hour Volume Warrant

Note: points are off the chart.

Figure 4C-3. Warrant 3, Peak Hour



***Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.**

E. 9th Street @ Ontario Street- Orange Avenue
Signal Warrant Analysis Worksheets
(Attachment E)

WARRANT 1 - EIGHT-HOUR VOLUME WARRANT

Baker

Project: Central Viaduct Innerbelt Bridge Construction Date: 10/20/2009
Intersection: Ontario St / Orange Ave and East 9th Street
Time Period: 2015 Build
County: Cuyahoga Computed By: PAS
Location: City of Cleveland

Major Street:	**Ontario St / Orange Ave**	**Minor Street:**	**East 9th Street**
Number of Lanes:	**2**	**Number of Lanes:**	**2**
1st Highest Hour Volume:	**2,140**	**1st Highest Hour Volume:**	**900**
2nd Highest Hour Volume:	**2,062**	**2nd Highest Hour Volume:**	**867**
3rd Highest Hour Volume:	**2,010**	**3rd Highest Hour Volume:**	**845**
4th Highest Hour Volume:	**1,990**	**4th Highest Hour Volume:**	**730**
5th Highest Hour Volume:	**1,751**	**5th Highest Hour Volume:**	**642**
6th Highest Hour Volume:	**1,723**	**6th Highest Hour Volume:**	**632**
7th Highest Hour Volume:	**1,723**	**7th Highest Hour Volume:**	**632**
8th Highest Hour Volume:	**1,638**	**8th Highest Hour Volume:**	**601**
(Volumes are total of both approaches)		(Volumes are total of high volume approach)	

The intersection meets the Eight Hour Volume Warrant

Table 4C-1. Warrant 1, Eight-Hour Vehicular Volume

Condition A—Minimum Vehicular Volume									
Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%[a]	80%[b]	70%[c]	56%[d]	100%[a]	80%[b]	70%[c]	56%[d]
1	1	500	400	350	280	150	120	105	84
2 or more	1	600	480	420	336	150	120	105	84
2 or more	2 or more	600	480	420	336	200	160	140	112
1	2 or more	500	400	350	280	200	160	140	112

Condition B—Interruption of Continuous Traffic									
Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%[a]	80%[b]	70%[c]	56%[d]	100%[a]	80%[b]	70%[c]	56%[d]
1	1	750	600	525	420	75	60	53	42
2 or more	1	900	720	630	504	75	60	53	42
2 or more	2 or more	900	720	630	504	100	80	70	56
1	2 or more	750	600	525	420	100	80	70	56

[a] Basic minimum hourly volume.
[b] Used for combination of Conditions A and B after adequate trial of other remedial measures.
[c] May be used when the major-street speed exceeds 70 km/h or exceeds 40 mph or in an isolated community with a population of less than 10,000.
[d] May be used for combination of Conditions A and B after adequate trial of other remedial measures when the major-street speed exceeds 70 km/h or exceeds 40 mph or in an isolated community with a population of less than 10,000.

WARRANT 2 - FOUR-HOUR VOLUME WARRANT

Baker

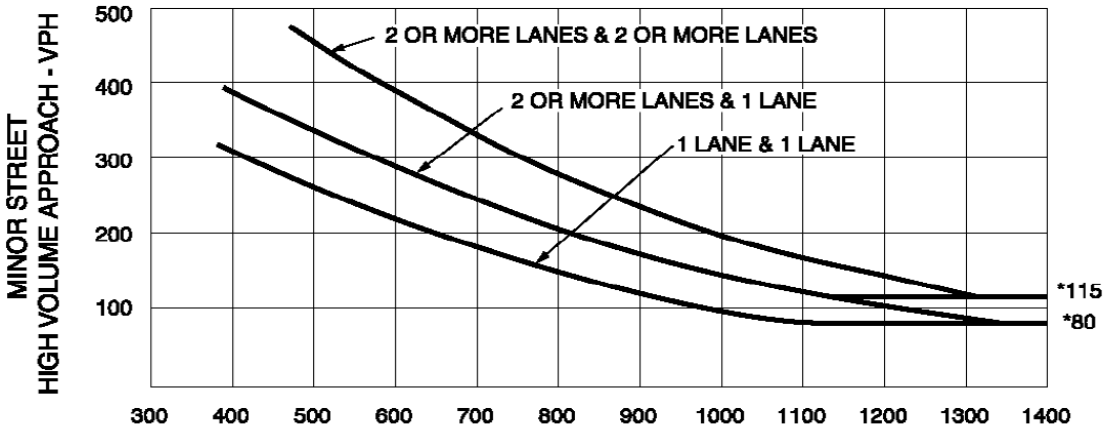
Project: Central Viaduct Innerbelt Bridge Construction Date: 10/20/2009
Intersection: Ontario St / Orange Ave and East 9th Street
Time Period: 2015 Build
County: Cuyahoga Computed By: PAS
Location: City of Cleveland

	Major Street: Ontario St / Orange Ave		Minor Street: East 9th Street
Number of Lanes:	2	Number of Lanes:	2
1st Highest Hour Volume:	2,140	1st Highest Hour Volume:	900
2nd Highest Hour Volume:	2,062	2nd Highest Hour Volume:	867
3rd Highest Hour Volume:	2,010	3rd Highest Hour Volume:	845
4th Highest Hour Volume:	1,990	4th Highest Hour Volume:	730
(Volumes are total of both approaches)		(Volumes are total of high volume approach)	

The intersection meets the Four Hour Volume Warrant

Note: points are off the chart.

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



*Note: 115 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 80 vph applies as the lower threshold volume for a minor-street approach with one lane.

WARRANT 3 - PEAK HOUR VOLUME WARRANT

Baker

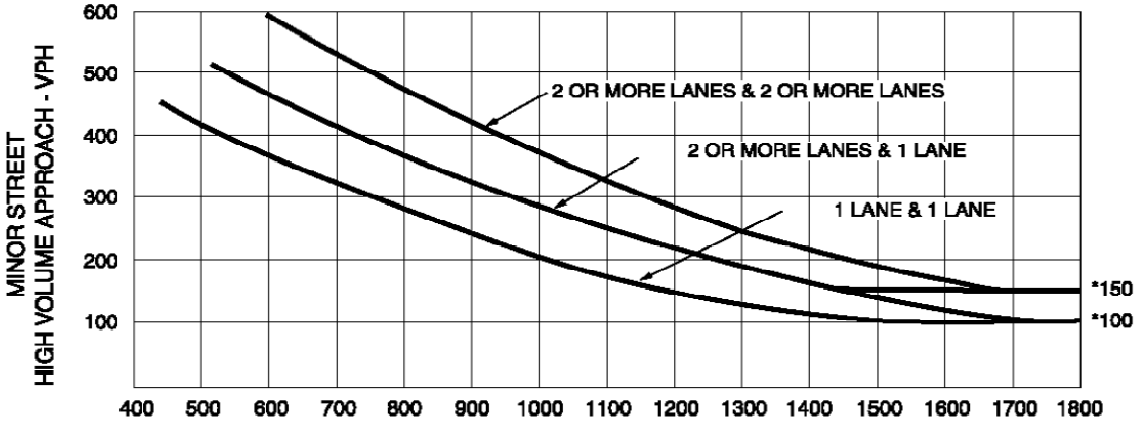
Project: Central Viaduct Innerbelt Bridge Construction Date: 10/20/2009
Intersection: Ontario St / Orange Ave and East 9th Street
Time Period: 2015 Build
County: Cuyahoga Computed By: PAS
Location: City of Cleveland

Major Street:	**Ontario St / Orange Ave**	**Minor Street:**	**East 9th Street**
Number of Lanes:	**2**	**Number of Lanes:**	**2**
AM Peak Hour Volume:	**2,140**	**AM Peak Hour Volume:**	**900**
PM Peak Hour Volume:	**1,990**	**PM Peak Hour Volume:**	**730**
(Volumes are total of both approaches)		(Volumes are total of high volume approach)	

The intersection meets both the AM and PM Peak Hour Volume Warrant

Note: points are off the chart.

Figure 4C-3. Warrant 3, Peak Hour



***Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.**

E. 9th Street @ Broadway Avenue Signal Warrant Analysis Worksheets (Attachment E)

WARRANT 1 - EIGHT-HOUR VOLUME WARRANT

Baker

Project: Central Viaduct Innerbelt Bridge Construction Date: 10/29/2009
Intersection: East 9th Street and Broadway Avenue
Time Period: 2015 Build
County: Cuyahoga Computed By: PAS
Location: City of Cleveland

Major Street: East 9th Street		**Minor Street:** Broadway Avenue	
Number of Lanes:	**2**	**Number of Lanes:**	**2**
1st Highest Hour Volume:	**820**	**1st Highest Hour Volume:**	**160**
2nd Highest Hour Volume:	**830**	**2nd Highest Hour Volume:**	**240**
3rd Highest Hour Volume:	**770**	**3rd Highest Hour Volume:**	**151**
4th Highest Hour Volume:	**680**	**4th Highest Hour Volume:**	**133**
5th Highest Hour Volume:	**649**	**5th Highest Hour Volume:**	**188**
6th Highest Hour Volume:	**640**	**6th Highest Hour Volume:**	**185**
7th Highest Hour Volume:	**640**	**7th Highest Hour Volume:**	**185**
8th Highest Hour Volume:	**609**	**8th Highest Hour Volume:**	**176**
(Volumes are total of both approaches)		(Volumes are total of high volume approach)	

The intersection does <u>not meet</u> the Eight Hour Volume Warrant

Table 4C-1. Warrant 1, Eight-Hour Vehicular Volume

Condition A—Minimum Vehicular Volume									
Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%[a]	80%[b]	70%[c]	56%[d]	100%[a]	80%[b]	70%[c]	56%[d]
1.....	1.....	500	400	350	280	150	120	105	84
2 or more...	1.....	600	480	420	336	150	120	105	84
2 or more...	2 or more ...	600	480	420	336	200	160	140	112
1.....	2 or more	500	400	350	280	200	160	140	112

Condition B—Interruption of Continuous Traffic									
Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%[a]	80%[b]	70%[c]	56%[d]	100%[a]	80%[b]	70%[c]	56%[d]
1.....	1.....	750	600	525	420	75	60	53	42
2 or more...	1.....	900	720	630	504	75	60	53	42
2 or more...	2 or more ...	900	720	630	504	100	80	70	56
1.....	2 or more	750	600	525	420	100	80	70	56

[a] Basic minimum hourly volume.
[b] Used for combination of Conditions A and B after adequate trial of other remedial measures.
[c] May be used when the major-street speed exceeds 70 km/h or exceeds 40 mph or in an isolated community with a population of less than 10,000.
[d] May be used for combination of Conditions A and B after adequate trial of other remedial measures when the major-street speed exceeds 70 km/h or exceeds 40 mph or in an isolated community with a population of less than 10,000.

Note: Roadway defined as major street varies based on volume.

WARRANT 2 - FOUR-HOUR VOLUME WARRANT

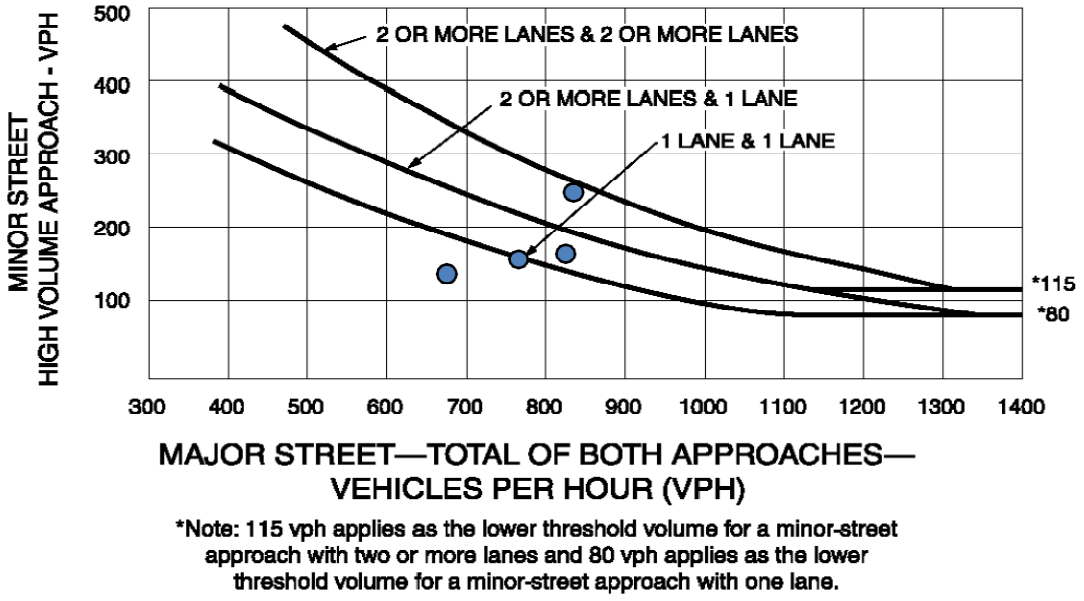
Baker

Project: Central Viaduct Innerbelt Bridge Construction Date: 10/29/2009
Intersection: East 9th Street and Broadway Avenue
Time Period: 2015 Build
County: Cuyahoga Computed By: PAS
Location: City of Cleveland

Major Street: East 9th Street		Minor Street: Broadway Avenue	
Number of Lanes:	2	Number of Lanes:	2
1st Highest Hour Volume:	820	1st Highest Hour Volume:	160
2nd Highest Hour Volume:	830	2nd Highest Hour Volume:	240
3rd Highest Hour Volume:	770	3rd Highest Hour Volume:	151
4th Highest Hour Volume:	680	4th Highest Hour Volume:	133
(Volumes are total of both approaches)		(Volumes are total of high volume approach)	

The intersection does <u>not meet</u> the Four Hour Volume Warrant

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



*Note: 115 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 80 vph applies as the lower threshold volume for a minor-street approach with one lane.

Note: Roadway defined as major street varies based on volume.

WARRANT 3 - PEAK HOUR VOLUME WARRANT

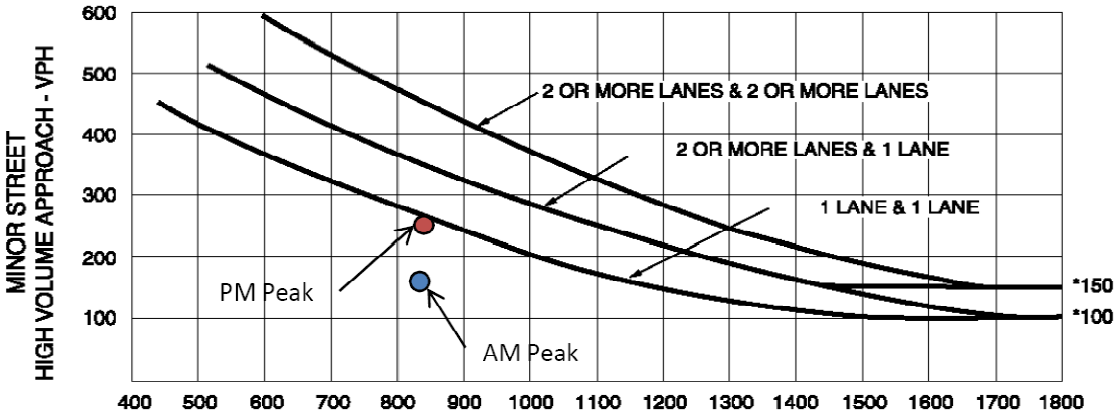
Baker

Project: Central Viaduct Innerbelt Bridge Construction Date: 10/29/2009
Intersection: East 9th Street and Broadway Avenue
Time Period: 2015 Build
County: Cuyahoga Computed By: PAS
Location: City of Cleveland

	Major Street: East 9th Street	Minor Street: Broadway Avenue
Number of Lanes:	2	2
AM Peak Hour Volume:	820	160
PM Peak Hour Volume:	830	240
	(Volumes are total of both approaches)	(Volumes are total of high volume approach)

The intersection does not meet either the AM or PM Peak Hour Volume Warrant

Figure 4C-3. Warrant 3, Peak Hour



***Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.**

Note: Roadway defined as major street varies based on volume.

WARRANT 8 - ROADWAY NETWORK

Baker

Project: Central Viaduct Innerbelt Bridge Construction Date: 10/29/2009
Intersection: East 9th Street and Broadway Avenue
Time Period: 2015 Build
County: Cuyahoga Computed By: PAS
Location: City of Cleveland

Major Street: East 9th Street **Minor Street:** Broadway Avenue

Number of Lanes: 2 **Number of Lanes:** 2

Data:

Total entering peak hour volume:	**1,090**
Warrant 1 Met (yes or no):	**No**
Warrant 2 Met (yes or no):	**No**
Warrant 3 Met (yes or no):	**No**

The intersection does not meet the Roadway Network Warrant

WARRANT 1 - EIGHT-HOUR VOLUME WARRANT

Baker

Project: Central Viaduct Innerbelt Bridge Construction Date: 10/29/2009
Intersection: East 9th Street and Broadway Avenue
Time Period: 2035 Build
County: Cuyahoga Computed By: PAS
Location: City of Cleveland

	Major Street: East 9th Street		Minor Street: Broadway Avenue
Number of Lanes:	2	**Number of Lanes:**	2
1st Highest Hour Volume:	930	**1st Highest Hour Volume:**	320
2nd Highest Hour Volume:	910	**2nd Highest Hour Volume:**	170
3rd Highest Hour Volume:	897	**3rd Highest Hour Volume:**	168
4th Highest Hour Volume:	793	**4th Highest Hour Volume:**	148
5th Highest Hour Volume:	715	**5th Highest Hour Volume:**	246
6th Highest Hour Volume:	703	**6th Highest Hour Volume:**	242
7th Highest Hour Volume:	703	**7th Highest Hour Volume:**	242
8th Highest Hour Volume:	670	**8th Highest Hour Volume:**	230
(Volumes are total of both approaches)		(Volumes are total of high volume approach)	

The intersection does <u>not meet</u> the Eight Hour Volume Warrant

Table 4C-1. Warrant 1, Eight-Hour Vehicular Volume

Condition A—Minimum Vehicular Volume									
Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%[a]	80%[b]	70%[c]	56%[d]	100%[a]	80%[b]	70%[c]	56%[d]
1	1	500	400	350	280	150	120	105	84
2 or more	1	600	480	420	336	150	120	105	84
2 or more	2 or more	600	480	420	336	200	160	140	112
1	2 or more	500	400	350	280	200	160	140	112

Condition B—Interruption of Continuous Traffic									
Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%[a]	80%[b]	70%[c]	56%[d]	100%[a]	80%[b]	70%[c]	56%[d]
1	1	750	600	525	420	75	60	53	42
2 or more	1	900	720	630	504	75	60	53	42
2 or more	2 or more	900	720	630	504	100	80	70	56
1	2 or more	750	600	525	420	100	80	70	56

[a] Basic minimum hourly volume.
[b] Used for combination of Conditions A and B after adequate trial of other remedial measures.
[c] May be used when the major-street speed exceeds 70 km/h or exceeds 40 mph or in an isolated community with a population of less than 10,000.
[d] May be used for combination of Conditions A and B after adequate trial of other remedial measures when the major-street speed exceeds 70 km/h or exceeds 40 mph or in an isolated community with a population of less than 10,000.

Note: Roadway defined as major street varies based on volume.

WARRANT 2 - FOUR-HOUR VOLUME WARRANT

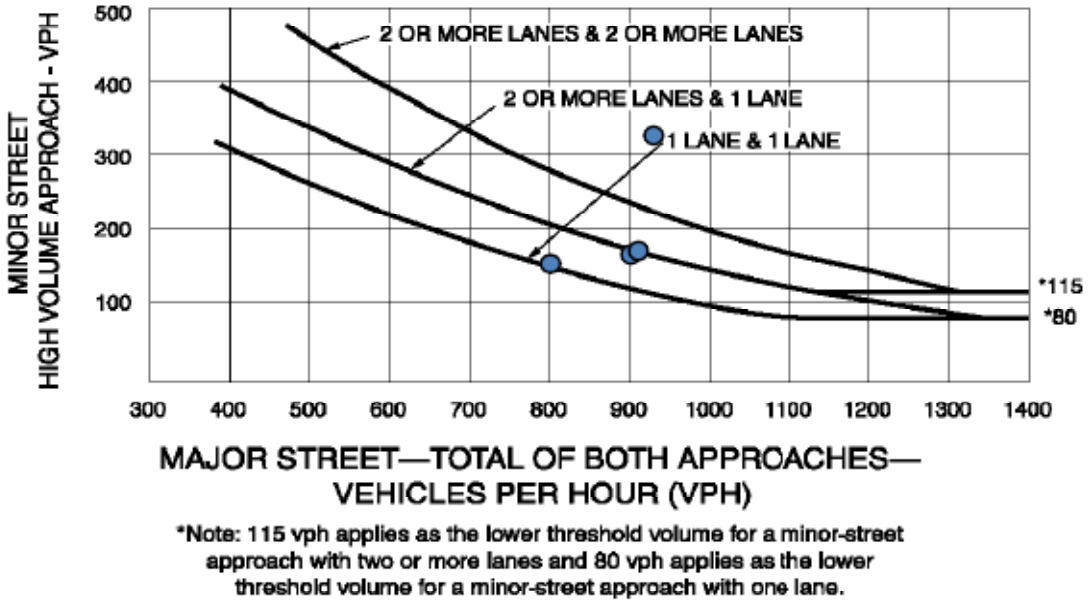
Baker

Project:	Central Viaduct Innerbelt Bridge Construction	Date:	10/29/2009
Intersection:	East 9th Street and	Broadway Avenue	
Time Period:	2035 Build		
County:	Cuyahoga	Computed By:	PAS
Location:	City of Cleveland		

Major Street:	**East 9th Street**	**Minor Street:**	**Broadway Avenue**
Number of Lanes:	**2**	**Number of Lanes:**	**2**
1st Highest Hour Volume:	**930**	**1st Highest Hour Volume:**	**320**
2nd Highest Hour Volume:	**910**	**2nd Highest Hour Volume:**	**170**
3rd Highest Hour Volume:	**897**	**3rd Highest Hour Volume:**	**168**
4th Highest Hour Volume:	**793**	**4th Highest Hour Volume:**	**148**
(Volumes are total of both approaches)		(Volumes are total of high volume approach)	

The intersection does <u>not meet</u> the Four Hour Volume Warrant

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



*Note: 115 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 80 vph applies as the lower threshold volume for a minor-street approach with one lane.

Note: Roadway defined as major street varies based on volume.

WARRANT 3 - PEAK HOUR VOLUME WARRANT

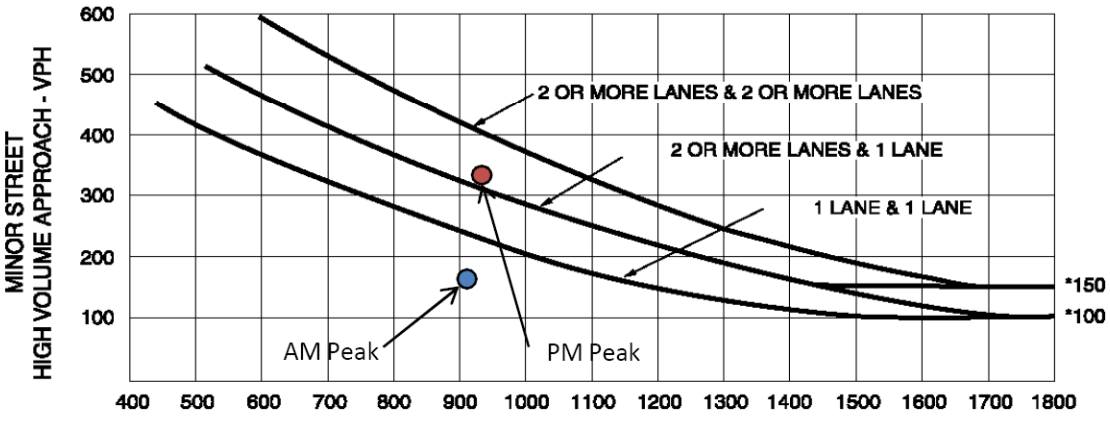
Baker

Project: Central Viaduct Innerbelt Bridge Construction Date: 10/29/2009
Intersection: East 9th Street and Broadway Avenue
Time Period: 2035 Build
County: Cuyahoga Computed By: PAS
Location: City of Cleveland

	Major Street: East 9th Street	Minor Street: Broadway Avenue
Number of Lanes:	2	2
AM Peak Hour Volume:	910	170
PM Peak Hour Volume:	930	320
	(Volumes are total of both approaches)	(Volumes are total of high volume approach)

The intersection does not meet either the AM or PM Peak Hour Volume Warrant

Figure 4C-3. Warrant 3, Peak Hour



***Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.**

Note: Roadway defined as major street varies based on volume.

WARRANT 8 - ROADWAY NETWORK

Project: Central Viaduct Innerbelt Bridge Construction Date: 10/29/2009
Intersection: East 9th Street and Broadway Avenue
Time Period: 2035 Build
County: Cuyahoga Computed By: PAS
Location: City of Cleveland

Major Street: East 9th Street **Minor Street:** Broadway Avenue

Number of Lanes: 2 **Number of Lanes:** 2

Data:

Total entering peak hour volume:	1,250
Warrant 1 Met (yes or no):	No
Warrant 2 Met (yes or no):	No
Warrant 3 Met (yes or no):	No

The intersection does not meet the Roadway Network Warrant

E. 14th Street @ Orange Avenue
Signal Warrant Analysis Worksheets
(Attachment E)

WARRANT 1 - EIGHT-HOUR VOLUME WARRANT

Baker

Project: Central Viaduct Innerbelt Bridge Construction Date: 10/20/2009
Intersection: Orange Avenue and East 14th Street
Time Period: 2015 Build
County: Cuyahoga Computed By: PAS
Location: City of Cleveland

Major Street: Orange Avenue		**Minor Street:** East 14th Street	
Number of Lanes:	2	**Number of Lanes:**	2
1st Highest Hour Volume:	2,160	**1st Highest Hour Volume:**	410
2nd Highest Hour Volume:	2,081	**2nd Highest Hour Volume:**	395
3rd Highest Hour Volume:	2,027	**3rd Highest Hour Volume:**	385
4th Highest Hour Volume:	2,026	**4th Highest Hour Volume:**	389
5th Highest Hour Volume:	1,877	**5th Highest Hour Volume:**	361
6th Highest Hour Volume:	1,847	**6th Highest Hour Volume:**	355
7th Highest Hour Volume:	1,820	**7th Highest Hour Volume:**	350
8th Highest Hour Volume:	1,758	**8th Highest Hour Volume:**	338
(Volumes are total of both approaches)		(Volumes are total of high volume approach)	

The intersection meets the Eight Hour Volume Warrant

Table 4C-1. Warrant 1, Eight-Hour Vehicular Volume

Condition A—Minimum Vehicular Volume									
Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%[a]	80%[b]	70%[c]	56%[d]	100%[a]	80%[b]	70%[c]	56%[d]
1.....	1.....	500	400	350	280	150	120	105	84
2 or more...	1.....	600	480	420	336	150	120	105	84
2 or more...	2 or more ...	600	480	420	336	200	160	140	112
1.....	2 or more	500	400	350	280	200	160	140	112

Condition B—Interruption of Continuous Traffic									
Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%[a]	80%[b]	70%[c]	56%[d]	100%[a]	80%[b]	70%[c]	56%[d]
1.....	1.....	750	600	525	420	75	60	53	42
2 or more...	1.....	900	720	630	504	75	60	53	42
2 or more...	2 or more ...	900	720	630	504	100	80	70	56
1.....	2 or more	750	600	525	420	100	80	70	56

[a] Basic minimum hourly volume.
[b] Used for combination of Conditions A and B after adequate trial of other remedial measures.
[c] May be used when the major-street speed exceeds 70 km/h or exceeds 40 mph or in an isolated community with a population of less than 10,000.
[d] May be used for combination of Conditions A and B after adequate trial of other remedial measures when the major-street speed exceeds 70 km/h or exceeds 40 mph or in an isolated community with a population of less than 10,000.

WARRANT 2 - FOUR-HOUR VOLUME WARRANT

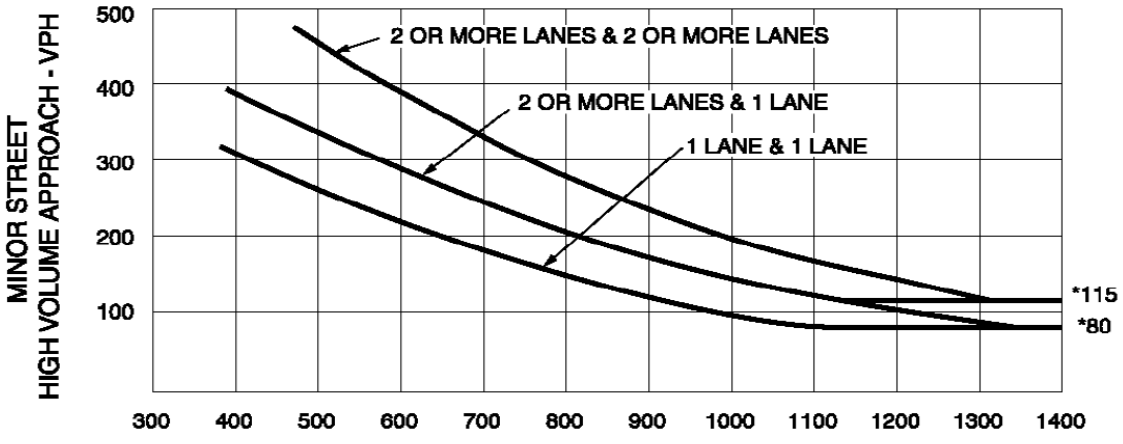
Project: Central Viaduct Innerbelt Bridge Construction Date: 10/20/2009
Intersection: Orange Avenue and East 14th Street
Time Period: 2015 Build
County: Cuyahoga Computed By: PAS
Location: City of Cleveland

Major Street: Orange Avenue		Minor Street: East 14th Street	
Number of Lanes:	2	Number of Lanes:	2
1st Highest Hour Volume:	2,160	1st Highest Hour Volume:	410
2nd Highest Hour Volume:	2,081	2nd Highest Hour Volume:	395
3rd Highest Hour Volume:	2,027	3rd Highest Hour Volume:	385
4th Highest Hour Volume:	2,026	4th Highest Hour Volume:	389
(Volumes are total of both approaches)		(Volumes are total of high volume approach)	

The intersection meets the Four Hour Volume Warrant

Note: points are off the chart.

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



***Note: 115 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 80 vph applies as the lower threshold volume for a minor-street approach with one lane.**

WARRANT 3 - PEAK HOUR VOLUME WARRANT

Baker

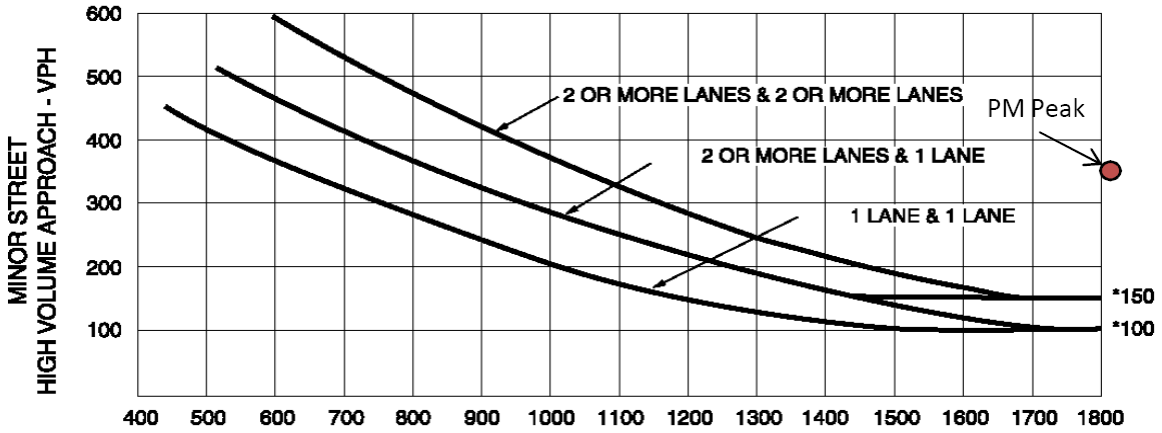
Project: Central Viaduct Innerbelt Bridge Construction Date: 10/20/2009
Intersection: Orange Avenue and East 14th Street
Time Period: 2015 Build
County: Cuyahoga Computed By: PAS
Location: City of Cleveland

Major Street:	**Orange Avenue**	**Minor Street:**	**East 14th Street**
Number of Lanes:	**2**	**Number of Lanes:**	**2**
AM Peak Hour Volume:	**2,160**	**AM Peak Hour Volume:**	**410**
PM Peak Hour Volume:	**1,820**	**PM Peak Hour Volume:**	**350**
(Volumes are total of both approaches)		(Volumes are total of high volume approach)	

The intersection meets both the AM and PM Peak Hour Volume Warrant

Note: AM point is off the chart.

Figure 4C-3. Warrant 3, Peak Hour



***Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.**

E. 14th Street @ Broadway Avenue
Signal Warrant Analysis Worksheets
(Attachment E)

WARRANT 1 - EIGHT-HOUR VOLUME WARRANT

Baker

Project: Central Viaduct Innerbelt Bridge Construction Date: 10/20/2009
Intersection: Broadway Avenue and East 14th Street
Time Period: 2015 Build
County: Cuyahoga Computed By: PAS
Location: City of Cleveland

Major Street: Broadway Avenue		**Minor Street:** East 14th Street	
Number of Lanes:	2	**Number of Lanes:**	1
1st Highest Hour Volume:	1,240	**1st Highest Hour Volume:**	260
2nd Highest Hour Volume:	1,195	**2nd Highest Hour Volume:**	251
3rd Highest Hour Volume:	1,164	**3rd Highest Hour Volume:**	245
4th Highest Hour Volume:	1,079	**4th Highest Hour Volume:**	165
5th Highest Hour Volume:	1,000	**5th Highest Hour Volume:**	152
6th Highest Hour Volume:	984	**6th Highest Hour Volume:**	149
7th Highest Hour Volume:	984	**7th Highest Hour Volume:**	149
8th Highest Hour Volume:	920	**8th Highest Hour Volume:**	140
(Volumes are total of both approaches)		(Volumes are total of high volume approach)	

The intersection meets the Eight Hour Volume Warrant

Table 4C-1. Warrant 1, Eight-Hour Vehicular Volume

Condition A—Minimum Vehicular Volume									
Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%[a]	80%[b]	70%[c]	56%[d]	100%[a]	80%[b]	70%[c]	56%[d]
1	1	500	400	350	280	150	120	105	84
2 or more	1	600	480	420	336	150	120	105	84
2 or more	2 or more	600	480	420	336	200	160	140	112
1	2 or more	500	400	350	280	200	160	140	112

Condition B—Interruption of Continuous Traffic									
Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%[a]	80%[b]	70%[c]	56%[d]	100%[a]	80%[b]	70%[c]	56%[d]
1	1	750	600	525	420	75	60	53	42
2 or more	1	900	720	630	504	75	60	53	42
2 or more	2 or more	900	720	630	504	100	80	70	56
1	2 or more	750	600	525	420	100	80	70	56

[a] Basic minimum hourly volume.
[b] Used for combination of Conditions A and B after adequate trial of other remedial measures.
[c] May be used when the major-street speed exceeds 70 km/h or exceeds 40 mph or in an isolated community with a population of less than 10,000.
[d] May be used for combination of Conditions A and B after adequate trial of other remedial measures when the major-street speed exceeds 70 km/h or exceeds 40 mph or in an isolated community with a population of less than 10,000.

Note: Condition B is met, however Condition A is not met.

WARRANT 2 - FOUR-HOUR VOLUME WARRANT

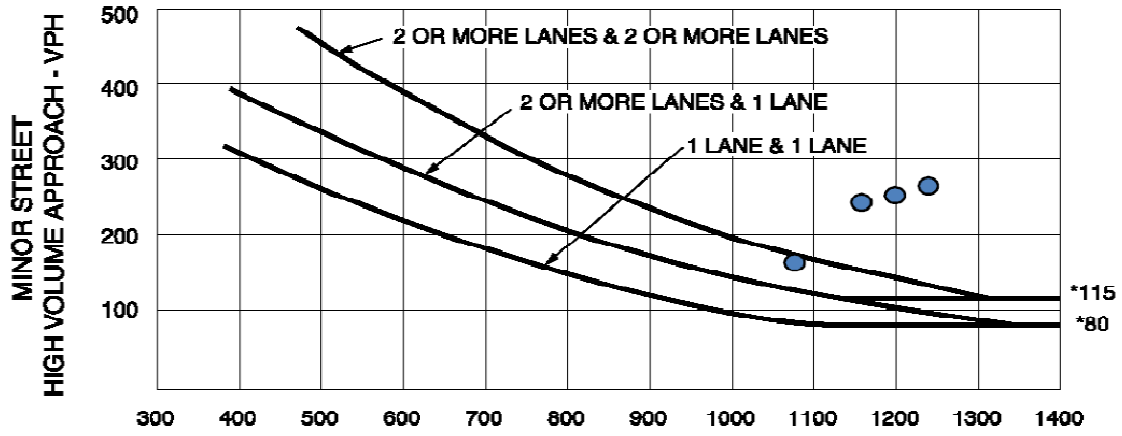
Baker

Project:	Central Viaduct Innerbelt Bridge Construction	Date:	10/20/2009
Intersection:	Broadway Avenue and	East 14th Street	
Time Period:	2015 Build		
County:	Cuyahoga	Computed By:	PAS
Location:	City of Cleveland		

Major Street:	**Broadway Avenue**	**Minor Street:**	**East 14th Street**
Number of Lanes:	**2**	**Number of Lanes:**	**1**
1st Highest Hour Volume:	**1,240**	**1st Highest Hour Volume:**	**260**
2nd Highest Hour Volume:	**1,195**	**2nd Highest Hour Volume:**	**251**
3rd Highest Hour Volume:	**1,164**	**3rd Highest Hour Volume:**	**245**
4th Highest Hour Volume:	**1,079**	**4th Highest Hour Volume:**	**165**
(Volumes are total of both approaches)		(Volumes are total of high volume approach)	

The intersection meets the Four Hour Volume Warrant

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



***Note: 115 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 80 vph applies as the lower threshold volume for a minor-street approach with one lane.**

WARRANT 3 - PEAK HOUR VOLUME WARRANT

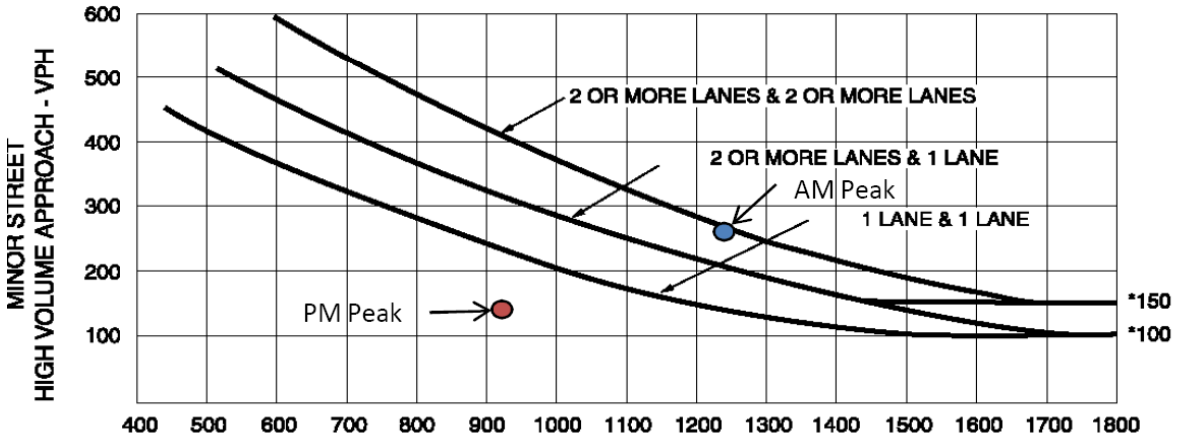
Baker

Project: Central Viaduct Innerbelt Bridge Construction Date: 10/20/2009
Intersection: Broadway Avenue and East 14th Street
Time Period: 2015 Build
County: Cuyahoga Computed By: PAS
Location: City of Cleveland

	Major Street: Broadway Avenue		Minor Street: East 14th Street
Number of Lanes:	**2**	**Number of Lanes:**	**1**
AM Peak Hour Volume:	**1,240**	**AM Peak Hour Volume:**	**260**
PM Peak Hour Volume:	**920**	**PM Peak Hour Volume:**	**140**
(Volumes are total of both approaches)		(Volumes are total of high volume approach)	

The intersection <u>meets</u> the AM Peak Hour Volume Warrant but does <u>not meet</u> the PM Peak Hour Volume Warrant

Figure 4C-3. Warrant 3, Peak Hour



*Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.