Michigan METSIM/MOTSIM Projects: Advances in Practice
&
I-465 West Leg Reconstruction: Work Zone Mobility

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Traffic Models Workshop
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Southeast Michigan Metro Simulation
(METSIM)

- System-Level Planning/Operational Analysis Tool
- Freight Mobility
- METSIM Model
  - ⇨ 10 mi x 30 mi
  - ⇨ 3500 nodes & 7200 links
  - ⇨ 310 zones
  - ⇨ 3/4 hours in AM/PM
  - ⇨ 200,000 trips in PM peak
  - ⇨ 3 Vehicle Classes

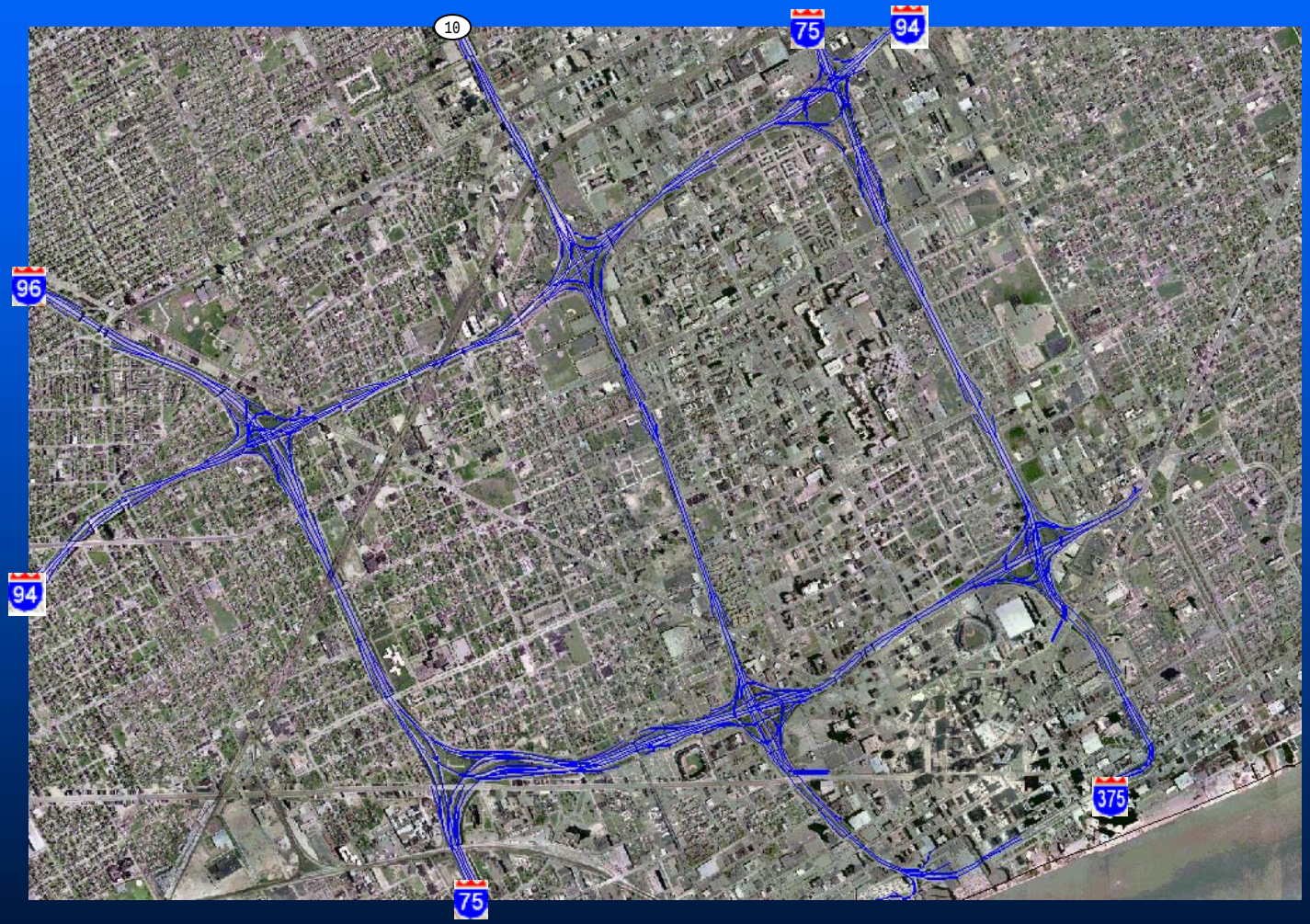
Ambassador Gateway MOT Simulation
(MOTSIM)

- System-Level Maintenance of Traffic Analysis Tool
- Ambassador Gateway Reconstruction
- MOTSIM Model
  - ⇨ 15 mi x 20 mi
  - ⇨ 12,000 nodes & 11,000 links
  - ⇨ 440 zones
  - ⇨ 3/4 hours in AM/PM
  - ⇨ 220,000 trips in PM peak
  - ⇨ 4 Vehicle Classes

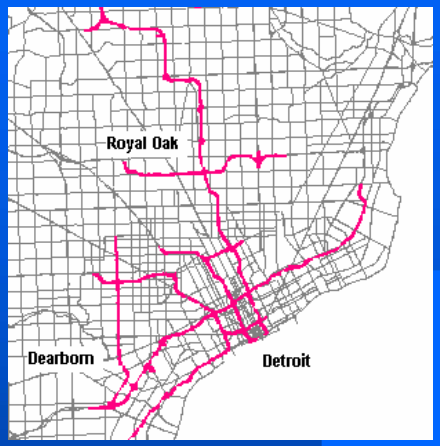
I-96/M-39 Interchange

Typical Peak-Period Traffic

Central Detroit Freeway Network



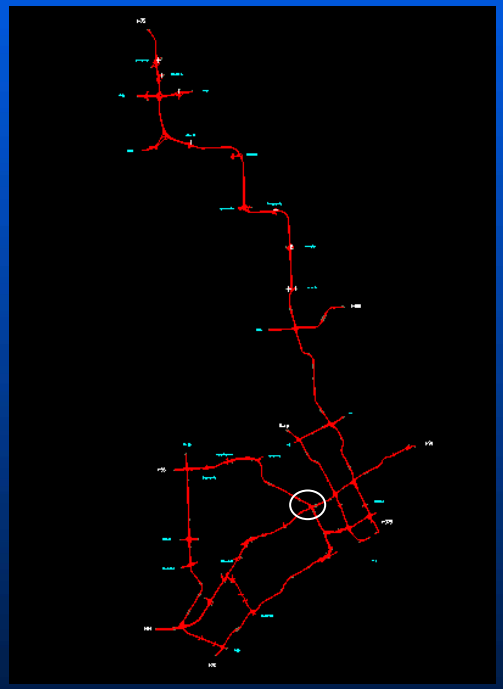
#1: Compatibility w/ MDOT Resources



GIS
Framework

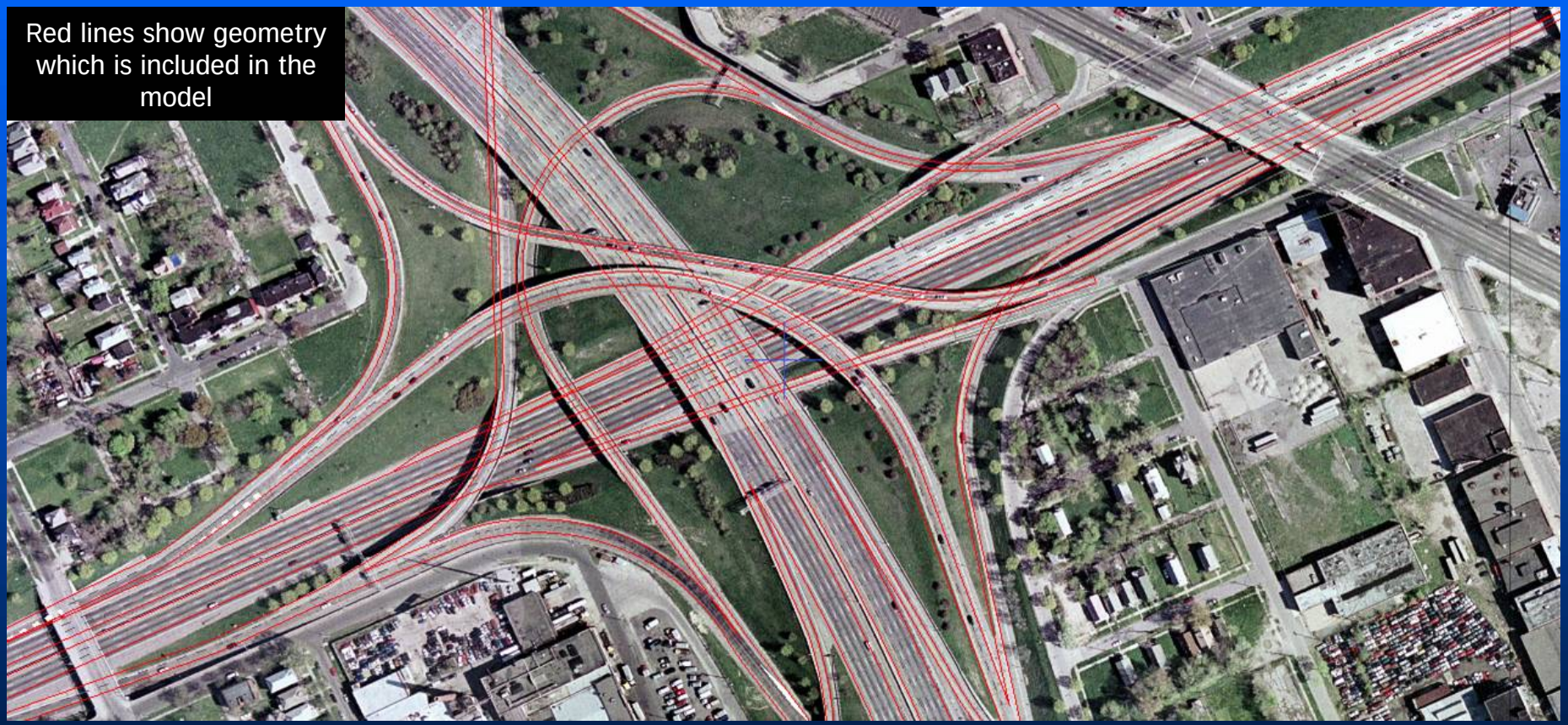
State Plane
Coordinates

METSIM



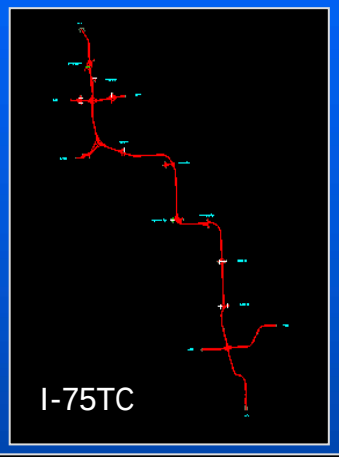
Ortho
Imageries

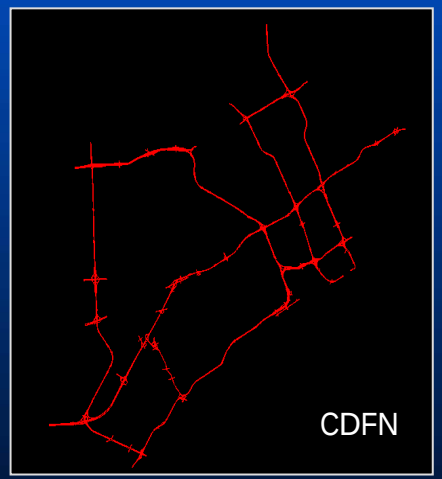
Network Coding Quality



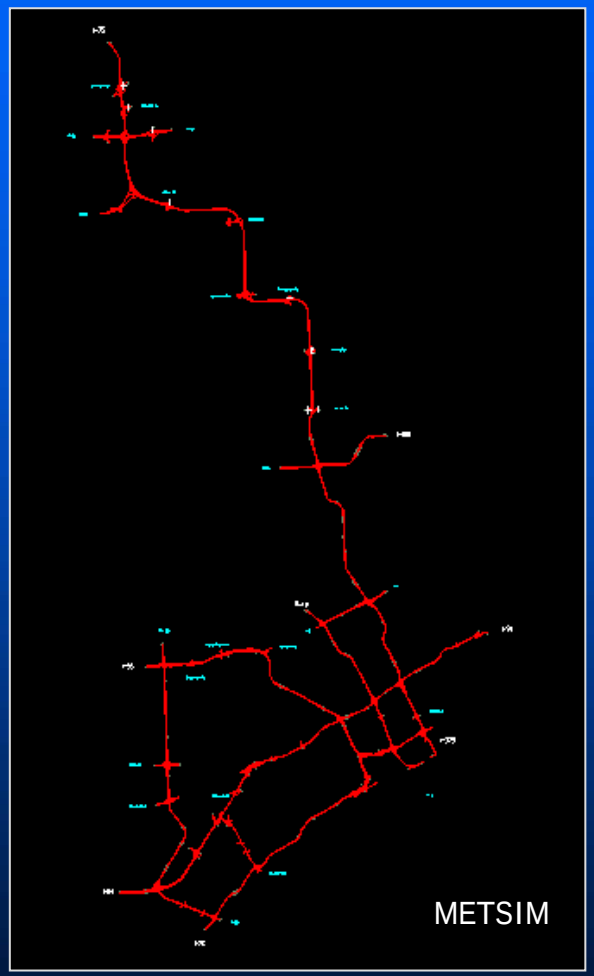
I-94/I-96 Interchange

Network Scalability

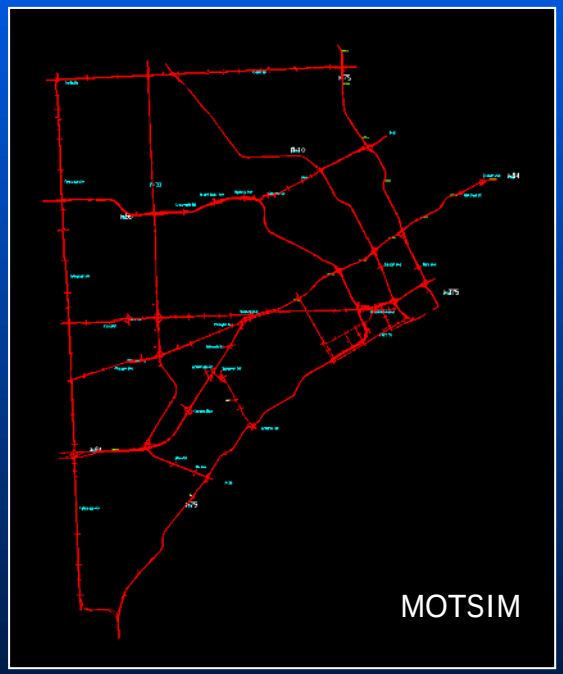




Regional



Subarea



#2 – Data Processing using BalT

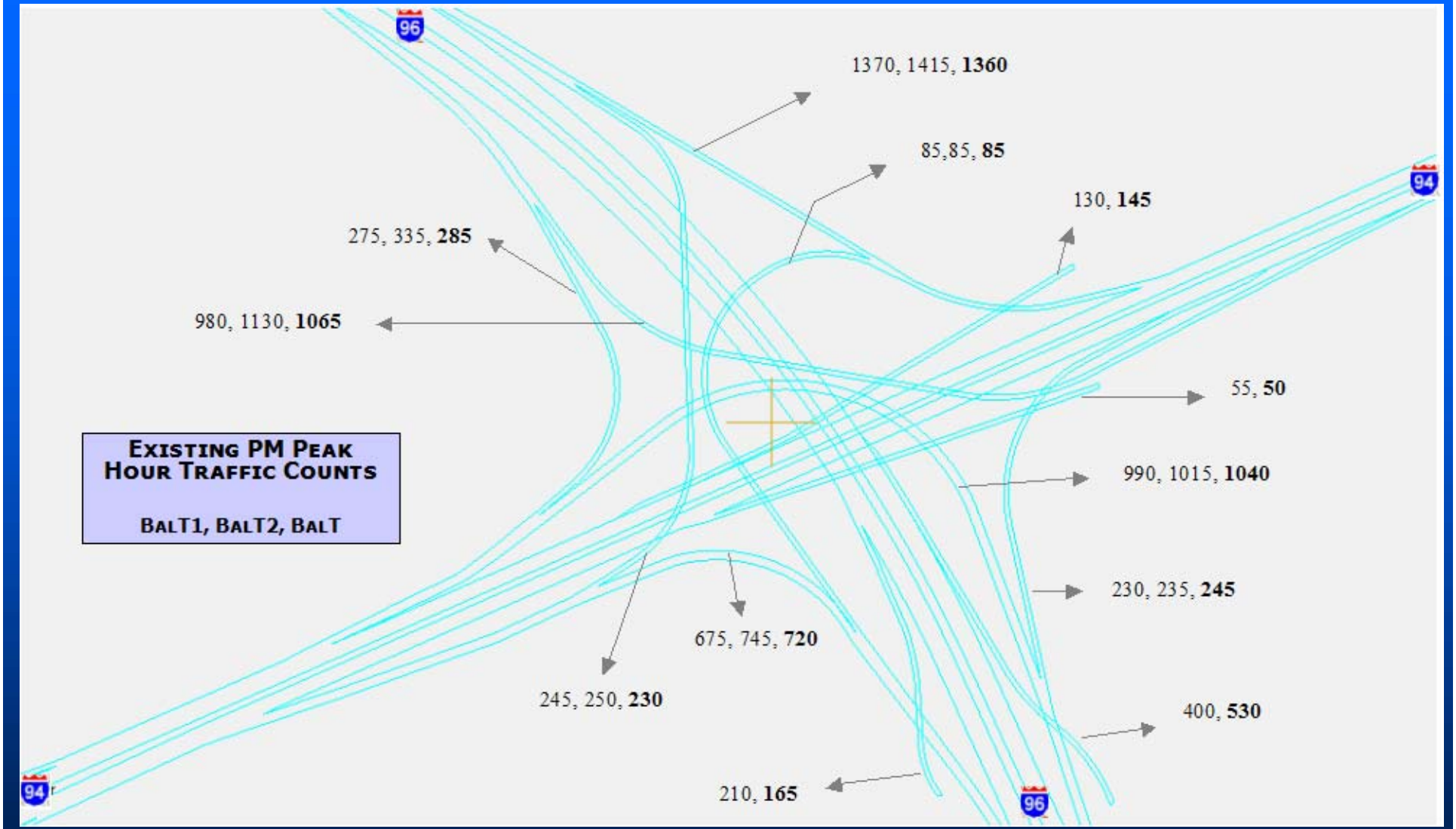
- Issues
  - ⇨ Difficult to Exactly Locate Stations
  - ⇨ Collected over Different Months/Years
  - ⇨ No information about field conditions
- Needs
  - ⇨ Systematic Data Processing Tools
  - ⇨ Data QA/QC

BalT (Balancing Tool)

- Excel Spreadsheet with Macros Originally Developed for Balancing Traffic Counts along the Corridor
- Upstream/Downstream Mainline Stations and Ramps in Order Following the Direction of Travel
- Added Module for System Interchanges

I-94 EB			AM			
ID		SEGMENT	Unbalanced	Balanced	DIFF	GEH
TAZ 3	A	Through traffic between Grand Blvd Off and Grand Blvd	4910	4910		0.00
16	1	On Ramp from Grand Blvd	120	115	-5	0.45
	0	Off Ramp to I-96 WB	170	175	5	0.38
	0	Off Ramp to I-96 EB	800	830	30	1.05
18	0	Off Ramp to Grand River Ave	225	235	10	0.66
	1	On Ramp from I-96 WB	410	395	-15	0.75
	1	On Ramp from I-96 EB	1400	1340	-60	1.62
20	1	On Ramp from Linwood St	210	200	-10	0.70
TAZ 4	A	Through traffic between On Ramp from Linwood and O	5720	5720		0.00

Sample BalT



Balanced Traffic Counts at I-94/I96 System Interchange

#3: Calibration Processing using LiVE

- Extension of BalT Approach
- Extracts Assigned Link Volumes Offline and Summarizes Results with Various Stats
- Making Calibration/Validation Process Much More Efficient
- Enhanced Quality of Deliverables

Model: METSIM
Traffic Data: 2006 AM Peak-Hour (7:00 am-8:00 am)
Scenario: Base Conditions

Summary of Traffic Volumes

	Production					Attraction				
Zone	Target	Model	Diff	GEH	Error (%)	Target	Model	Diff	GEH	Error (%)
1		2,268	-	-	-		1,300	-	-	-
2	4,840	5,275	435	6.12	9.0	1,980	2,145	165	3.64	8.4
3	6,020	5,957	-63	0.81	1.0	4,650	4,665	15	0.22	0.3
4	4,000	3,822	-178	2.85	4.5	2,800	2,469	-331	6.45	11.8
5	4,830	5,085	255	3.62	5.3	4,200	4,266	66	1.01	1.6
6	5,500	5,475	-25	0.34	0.5		4,595	-	-	-
7	1,406	1,565	159	4.11	11.3	1,775	1,778	3	0.08	0.2
8	1,000	991	-9	0.29	0.9	1,600	1,524	-76	1.92	4.8
9		5,806	-	-	-	3,800	4,188	388	6.14	10.2
10	1,600	1,530	-70	1.77	4.4	2,000	1,886	-114	2.59	5.7
11	5,140	5,100	-40	0.56	0.8	3,330	3,455	125	2.15	3.8
12		2,464	-	-	-		1,457	-	-	-
13		990	-	-	-		2,111	-	-	-
14		1,925	-	-	-		3,160	-	-	-
15	1,035	1,035	0	0.00	0.0	285	262	-23	1.39	8.1
16	310	312	2	0.11	0.6	n/a	n/a	-	-	-
17	7400	7,321	-79	0.92	1.1		7,607	-	-	-
18	5740	5,760	20	0.26	0.3	6780	6,667	-113	1.38	1.7
19		1,974	-	-	-		2,136	-	-	-
20		3,310	-	-	-		2,101	-	-	-
21		2,406	-	-	-		2,134	-	-	-
22	5800	6,139	339	4.39	5.8	3430	3,321	-109	1.88	3.2
23		686	-	-	-		1,205	-	-	-
24		1,225	-	-	-		945	-	-	-
25		398	-	-	-		1,577	-	-	-
26		0	-	-	-		0	-	-	-
27		338	-	-	-		134	-	-	-
28		276	-	-	-		1,107	-	-	-
29		1,005	-	-	-		1,210	-	-	-
30		371	-	-	-		777	-	-	-
31		223	-	-	-		116	-	-	-
32		115	-	-	-		0	-	-	-
33	n/a	n/a	-	-	-		894	-	-	-
34		787	-	-	-		142	-	-	-
35	452	427	-25	1.19	5.5	322	343	21	1.16	6.5
36		659	-	-	-		589	-	-	-
37		812	-	-	-		672	-	-	-
38		0	-	-	-		84	-	-	-

Trip Ends Summary

Target vs. Model

	A	B	C	D	F	G	H	I
1	1	I-75 SB						
2		STATION ID		MAINLINE/RAMP LOCATION	Balanced	Simulated	GEH	Diff
3		166		North of Lapeer Rd	5800	6140	4.4	340
4		492	0	University Drive off-ramp	567	675	4.4	108
5		491	1	University Drive WB on-ramp	1152	965	-5.8	-187
6		489	1	University Drive EB on-ramp	437	505	3.1	68
7		519	0	Chrysler Drive off-ramp	551	635	3.5	84
8		165	1	Chrysler Drive on-ramp	607	375	-10.5	-232
9		11		North of I-75/M-59 Interchange	6878	6725	-1.9	
10		581	0	M-59 WB off-ramp	779	585	-7.4	-194
11		580	1	M-59 WB on-ramp	473	815	13.5	342
12		576	0	M-59 EB off-ramp	1039	1390	10.1	351
13		499	1	M-59 EB on-ramp	607	550	-2.4	-57
14		365/MI075400		0.3 Mile of North of I-75 Business Interch	6140	6105	-0.4	-35
15		392	0	E Sq Lake Rd Business Loop I-75 off-ra	1753	1680	-1.8	-73
16		908		Over I-75/Business I-75 Interchange	4387	4415	0.4	
17		389	1	E Sq Lake Rd Business Loop I-75 on-ra	1223	1310	2.4	87
18		MI075380		0.6 Mile of South of I-75/M-59 Interchang	5610	5750	1.9	140
19		387	0	E Sq Lake Rd and N Adams Rd off-ramp	322	340	1.0	18
20		385	1	E Sq Lake Rd and N Adams Rd on-ramp	452	425	-1.3	-27
21		MI075360		0.6 Mile of South of Adams Rd	5740	5830	1.2	90
22		163/MI075340		0.7 Mile of South of Coolidge Highway	5300	5840	7.2	540
23		7665	0	Crooks Rd off-ramp	956	1195	7.3	239
24		7663	1	Crooks Rd on-ramp	786	525	-10.2	-261
25		9979/MI075320		0.1 Mile of South of Long Lake Rd	5130	5190	0.8	60
26		MI075300		Just South of Wattles Rd	5120	5190	1.0	70
27		7660	0	Big Beaver Rd WB off-ramp	752	815	2.2	63
28		7693	1	Big Beaver Rd WB on-ramp	173	140	-2.6	-33
29		7691	0	Big Beaver Rd EB off-ramp	323	340	0.9	17
30		7659	1	Big Beaver Rd EB on-ramp	692	620	-2.8	-72
31		161/MI075280		0.2 Mile of South of Livernois Rd	4910	4800	-1.6	-110
32		7655	0	Rochester Road off-ramp	1282	1350	1.9	68
33		7654	1	Rochester Road on-ramp	1022	1135	3.4	113
34		MI075260		0.4 Mile of South of Rochester Rd	4650	4660	0.1	10
35		MI075240		0.7 Mile of South of Maple Rd	4650	4700	0.7	
36		7656	0	14 Mile Rd WB off-ramp	131	140	0.8	9
37		3705	0	14 Mile Rd EB off-ramp	1097	705	-13.1	-392
38		3733	1	14 Mile Rd on-ramp	1058	795	-8.6	-263
39		MI075220		0.75 Mile of South of 14 Mile Rd	4480	4655	2.6	175
40		3732	0	12 Mile Rd off-ramp	277	305	1.7	28
41		3730	1	12 Mile Rd WB on-ramp	418	420	0.1	2
42		3728	1	12 Mile Rd EB on-ramp	648	540	-4.4	-108
43		9989/MI075200		0.5 Mile of South of 12 Mile Rd	5270	5235	-0.5	-35
44		5733	0	11 Mile Rd off-ramp	121	160	3.3	39
45		5609	1	11 Mile Rd on-ramp	1411	1375	-1.0	-36
46		5758/MI075180		0.3 Mile North of I-75/I-696 Interchange	6560	6425	-1.7	-135
47		3140	0	I-696 WB off-ramp	900	830	-2.4	-70
48		3160	0	I-696 EB off-ramp	700	1140	14.5	440
49		3154		Over I-75/I-696 Interchange	4960	4470		

Ramp Volumes Summary

Target vs. Model

System Interchange Volumes Summary

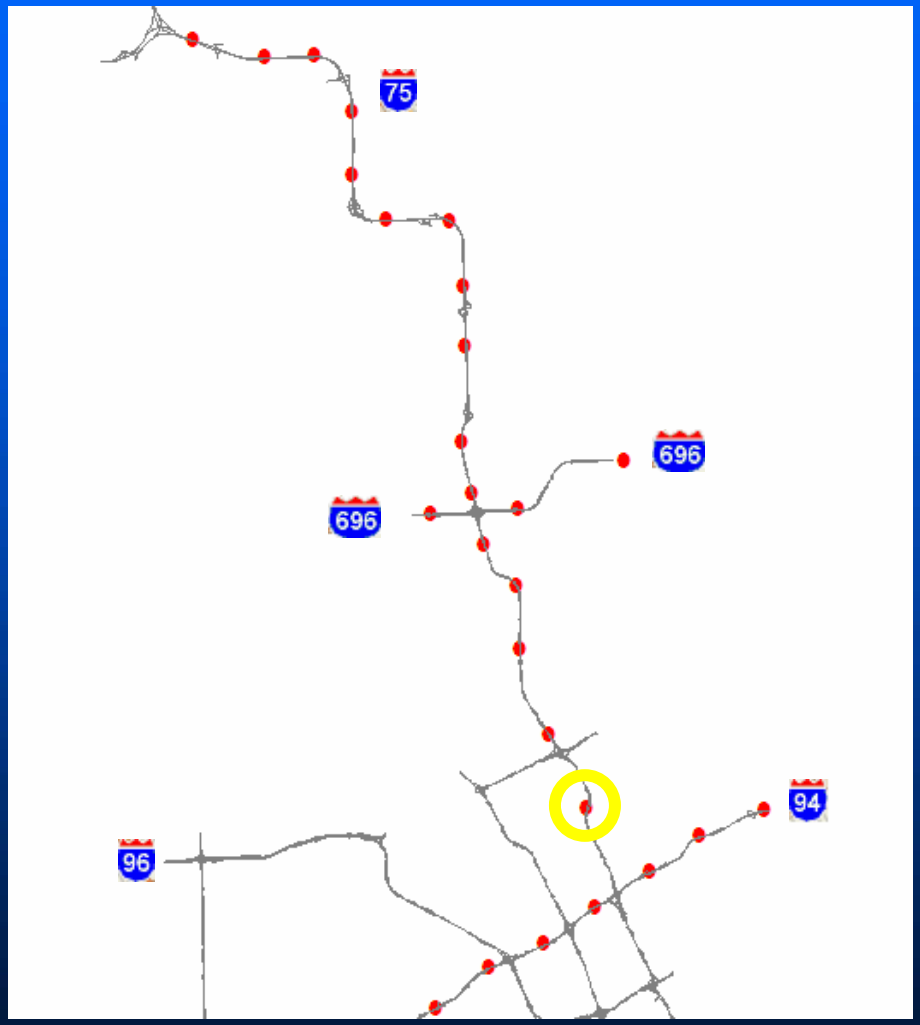
Target vs. Model

Other ramps		Balanced	Simulated	Diff
SB	Warren Ave off-ramp	456	480	24
NB	Warren Ave on-ramp	147	220	73
EB	Grand River Ave off-ramp	117	100	-17
WB	Grand River Ave on-ramp	54	60	6

I96 & I94 Interchange

91							counts	5930	2855					
92							Sim	5805	3665					
93								-125	810					
95						Bal	182	4233	1059					
96						**Sim**	**35**	**3885**	**1405**					
97							-147	-348	346					
98		MOBILITY			Bal	**Sim**				**Sim**	Bal			
99	Counts	Sim			293	**285**	-8		110	**1080**	970		counts	Sim	
100	4480	4220	-260		3463	**3210**	-253		-15	**3610**	3625		4734	5065	331
101	4720	4345	-375		846	**750**	-96		236	**375**	139		5019	5420	401
104							-113	625	378						
105						**Sim**	**505**	**2070**	**875**						
106						Bal	618	1445	497						
109							counts	5218	2560						
110							Sim	5065	3450						
111								-153	890						

Model Validation Data Set



- Total 27 Stations
  - ⇨ I-75: 16
  - ⇨ I-94: 8
  - ⇨ I-696: 3
- Month of Sept. 2006
  - ⇨ 12 Days of Tues-Thurs
  - ⇨ Hourly Counts
  - ⇨ Speeds

- Michigan Mobility Station

Validation Data Set QA/QC

LOCATION: MI075080
DIRECTION: SB

	VOLUMES							SPEEDS						
	AM			PM				AM			PM			
	6-7	7-8	8-9	3-4	4-5	5-6	6-7	6-7	7-8	8-9	3-4	4-5	5-6	6-7
5-Sep	4526	5933	5327	4763	4328	4746	4637	62.9	63.6	54.3	64.1	65.5	62.6	62.6
6-Sep	4620	5893	5530	4233	2149	2073	3479	63.7	63.5	51.9	44.7	22.8	17.7	23.0
7-Sep	4400	6020	5670	4810	4477	4476	3927	63.5	63.8	56.8	64.1	64.4	62.9	65.3
12-Sep	4512	6172	6083	4649	4388	5155	5113	61.4	55.9	49.9	60.8	61.0	57.1	60.8
13-Sep	4467	5666	5511	4427	4715	5352	4788	57.4	55.9	44.4	57.1	59.8	60.9	63.4
14-Sep	4512	5782	5462	4381	3754	4661	4115	64.5	62.6	52.9	63.1	62.8	62.6	65.2
19-Sep	4621	5832	5417	4525	4260	4275	3711	63.4	61.0	52.3	64.8	63.9	64.4	64.6
20-Sep	4529	5794	5524	4604	4230	4315	3843	63.6	61.8	53.2	64.0	64.7	63.9	65.6
21-Sep	4312	5814	5582	4742	4260	4547	4307	63.7	62.3	51.3	65.3	63.5	63.2	63.5
26-Sep	4684	4804	4531	4391	4408	4905	4747	63.5	49.8	38.1	64.3	62.7	61.8	63.5
27-Sep	4714	5805	5740	4546	4617	4843	5390	63.1	61.9	54.0	63.3	63.9	61.2	62.0
28-Sep	4098	5910	5742	4583	4300	3796	3944	47.9	59.6	52.4	64.3	64.3	35.6	60.7
AVERAGE	4500	5790	5510	4550	4160	4430	4330	61.5	60.1	51.0	61.6	59.9	56.2	60.0
STDEV	170	334	365	174	675	849	596	4	4	5	5	11	14	11
%	3.8%	5.8%	6.6%	3.8%	16.2%	19.2%	13.8%	6.5%	6.7%	9.8%	8.1%	18.4%	24.9%	18.3%
AVERAGE				*4580*	*4340*	*4730*	*4460*				*63.1*	*63.2*	*62.1*	*63.7*
STDEV				*156*	*260*	*348*	*565*				*2*	*1*	*2*	*1*
%				*3.4%*	*6.0%*	*7.4%*	*12.7%*				*3.2%*	*1.6%*	*3.2%*	*1.6%*

AM Model Calibration Results

				6-7				7-8				8-9			
2	1	I-75 SB													
3		STATION ID	MAINLINE/RAMP LOCATION	Measured	Simulated	GEH	Diff	Measured	Simulated	GEH	Diff	Measured	Simulated	GEH	Diff
4		MI075400	0.3 Mile of North of I-75 Business Interchange	4820	5220	5.6	400	5810	6105	3.8	295	5190	5225	0.5	35
5		MI075380	0.6 Mile of South of I-75/M-59 Interchange	4750	4800	0.7	50	5610	5750	1.9	140	5320	4930	-5.4	-390
6		MI075360	0.6 Mile of South of Adams Rd	4750	4835	1.2	85	5740	5830	1.2	90	5420	5035	-5.3	-385
7		MI075340	0.7 Mile of South of Coolidge Highway	4640	4700	0.9	60	5560	5840	3.7	280	5250	5035	-3.0	-215
8		MI075320	0.1 Mile of South of Long Lake Rd	4540	4555	0.2	15	5130	5190	0.8	60	4530	4495	-0.5	-35
9		MI075300	Just South of Wattles Rd	4530	4555	0.4	25	5120	5190	1.0	70	4340	4495	2.3	155
10		MI075280	0.2 Mile of South of Livernois Rd	4530	4625	1.4	95	4910	4800	-1.6	-110	4080	4250	2.6	170
11		MI075260	0.4 Mile of South of Rochester Rd	4920	4785	-1.9	-135	4650	4660	0.1	10	3940	4085	2.3	145
12		MI075220	0.75 Mile of South of 14 Mile Rd	4760	4575	-2.7	-185	4480	4655	2.6	175	4020	4070	0.8	50
13		MI075200	0.5 Mile of South of 12 Mile Rd	5420	5095	-4.5	-325	5270	5235	-0.5	-35	4490	4855	5.3	365
14		MI075180	0.3 Mile North of I-75/I-696 Interchange	5890	5980	1.2	90	6560	6425	-1.7	-135	5960	6270	4.0	310
15		MI075160	1.6 Mile North of 8 Mile Rd	6180	6040	-1.8	-140	6640	6500	-1.7	-140	5970	6025	0.7	55
16		MI075140	0.5 Mile North of 8 Mile Rd	5920	5440	-6.4	-480	6150	6045	-1.3	-105	5700	5600	-1.3	-100
17		MI075120	0.6 Mile South of 8 Mile Rd	6220	6075	-1.8	-145	7500	7315	-2.1	-185	7170	6815	-4.2	-355
18		MI075100	2.5 Mile South of SR 102	5920	5825	-1.2	-95	7440	7305	-1.6	-135	7060	6805	-3.1	-255
33															
34	3	I-94 EB		6-7				7-8				8-9			
35		STATION ID	MAINLINE/RAMP LOCATION	Measured	Simulated	GEH	Diff	Measured	Simulated	GEH	Diff	Measured	Simulated	GEH	Diff
36		MI094580	0.9 Mile East of Telegraph Rd	4340	4630	4.3	290	6020	5955	-0.8	-65	5330	5585	3.5	255
37		MI094660	1.2 Mile East of Addison St	3590	3370	-3.7	-220	4240	4010	-3.6	-230	3950	4090	2.2	140
38		MI094700	0.4 Mile West of I-96/I-94 Interchange	3960	3620	-5.5	-340	4720	4345	-5.6	-375	4310	4395	1.3	85
39		MI094720	0.5 Mile West of John Lodge Freeway	4240	4600	5.4	360	5200	5635	5.9	435	5130	5535	5.5	405
40		MI094740	0.5 Mile West of I-94/I-75 Interchange	3400	3650	4.2	250	4230	4640	6.2	410	3850	4585	11.3	735
41		MI094760	0.25 Mile West of Grand Blvd	2790	2780	-0.2	-10	3910	3535	-6.1	-375	3850	3665	-3.0	-185
42		MI094780	0.25 Mile West of Van Pike Rd	2770	2780	0.2	10	3950	3580	-6.0	-370	3920	3690	-3.7	-230
43		MI094800	0.7 Mile West of Conner St	2350	2630	5.6	280	3330	3455	2.1	125	3440	3550	1.9	110
44															
45	4	I-94 WB		6-7				7-8				8-9			
46		STATION ID	MAINLINE/RAMP LOCATION	Measured	Simulated	GEH	Diff	Measured	Simulated	GEH	Diff	Measured	Simulated	GEH	Diff
47		MI094800	0.7 Mile West of Conner St	5480	5385	-1.3	-95	5140	5100	-0.6	-40	4450	4420	-0.5	-30
48		MI094780	0.25 Mile West of Van Pike Rd	5770	5620	-2.0	-150	5940	5975	0.5	35	5270	5315	0.6	45
49		MI094760	0.25 Mile West of Grand Blvd	n/a	5820	n/a	n/a	n/a	6315	n/a	n/a	n/a	5650	n/a	n/a
50		MI094740	0.5 Mile West of I-94/I-75 Interchange	5020	4925	-1.3	-95	5600	5645	0.6	45	5260	5100	-2.2	-160
51		MI094720	0.5 Mile West of John Lodge Freeway	4170	4375	3.1	205	4860	5240	5.3	380	4340	4790	6.7	450
52		MI094700	0.4 Mile West of I-96/I-94 Interchange	3630	3405	-3.8	-225	4480	4220	-3.9	-260	3920	3805	-1.9	-115
53		MI094660	1.2 Mile East of Addison St	3730	3425	-5.1	-305	4530	4350	-2.7	-180	4080	3880	-3.2	-200
54		MI094580	0.9 Mile East of Telegraph Rd	3940	3505	-7.1	-435	4650	4665	0.2	15	3760	4100	5.4	340
55															
56	5	I-696 EB		6-7				7-8				8-9			
57		STATION ID	MAINLINE/RAMP LOCATION	Measured	Simulated	GEH	Diff	Measured	Simulated	GEH	Diff	Measured	Simulated	GEH	Diff
58		MI696240	0.8 Mile of West of Chrysler Freeway	4900	5350	6.3	450	6700	6415	-3.5	-285	6120	6370	3.2	250
59		MI696260	0.75 Mile of West of Dequindre Rd	5360	5020	-4.7	-340	6450	6485	0.4	35	6000	6490	6.2	490
60		MI696280	0.5 Mile West of Mound Rd	5070	5055	-0.2	-15	6780	6665	-1.4	-115	6030	6700	8.4	670

AM Model Congestion Pattern

8:00 AM

AM Model Validation Results

				6:00 - 7:00									7:00 - 8:00									8:00 - 9:00								
		ID	MOBILITY	Target	Run #1	Run #2	Run #3	Run #4	Run #5	Run #6	Run #7	Ave	Target	Run #1	Run #2	Run #3	Run #4	Run #5	Run #6	Run #7	Ave	Target	Run #1	Run #2	Run #3	Run #4	Run #5	Run #6	Run #7	Ave
I-75 SB	1	MI075400	0.3 Mile of North of I-	4820	5230	5135	5150	5095	5100	5095	5060	5124	5810	6095	6125	5980	6135	6095	5970	6140	6077	5190	5225	5295	5280	5310	5270	5370	5405	5308
	2	MI075380	0.6 Mile of South of I-	4750	4795	4730	4765	4715	4690	4685	4670	4721	5610	5745	5755	5640	5695	5760	5505	5785	5698	5320	4955	5040	4935	4990	4865	5025	5000	4973
	3	MI075360	0.6 Mile of South of A	4750	4830	4775	4820	4780	4715	4730	4675	4761	5740	5835	5835	5750	5795	5860	5615	5830	5789	5420	5055	5125	4990	5055	4960	5115	5110	5059
	4	MI075340	0.7 Mile of South of C	4640	4715	4620	4630	4640	4575	4590	4505	4611	5560	5815	5825	5760	5795	5865	5605	5855	5789	5250	5040	5165	5075	5080	4985	5185	5145	5096
	5	MI075320	0.1 Mile of South of L	4540	4570	4400	4520	4485	4445	4505	4345	4467	5130	5180	5190	5195	5205	5275	5110	5250	5201	4530	4450	4710	4605	4605	4495	4595	4650	4587
	6	MI075300	Just South of Wattles	4530	4570	4400	4520	4485	4445	4505	4345	4467	5120	5180	5190	5195	5205	5275	5110	5250	5201	4340	4450	4710	4605	4605	4495	4595	4650	4587
	7	MI075280	0.2 Mile of South of L	4530	4625	4355	4520	4430	4455	4535	4385	4472	4910	4800	4880	4830	4855	4870	4900	4910	4864	4080	4255	4355	4380	4340	4180	4270	4370	4307
	8	MI075260	0.4 Mile of South of R	4920	4820	4655	4775	4665	4650	4785	4635	4712	4650	4645	4650	4610	4630	4650	4720	4700	4658	3940	4095	4195	4225	4070	4045	4070	4030	4104
	9	MI075220	0.75 Mile of South of	4760	4610	4495	4600	4350	4525	4595	4535	4530	4480	4625	4645	4605	4770	4705	4725	4655	4676	4020	4070	4055	4090	4130	4055	4080	4010	4070
	10	MI075200	0.5 Mile of South of 1	5420	5130	4895	5085	4710	4985	5140	4995	4991	5270	5345	5325	5225	5420	5355	5410	5360	5349	4490	4715	4905	4760	4870	4775	4675	4710	4773
	11	MI075180	0.3 Mile North of I-75/	5890	6005	5910	6100	5705	5985	6135	5925	5966	6560	6580	6535	6600	6620	6620	6645	6740	6620	5960	6080	6240	5985	6125	6120	5980	5925	6065
	12	MI075160	1.6 Mile North of 8 Mi	6180	6080	5995	6130	5885	6070	6145	5995	6043	6640	6575	6615	6740	6645	6505	6670	6635	6626	5970	5905	5995	5825	5840	5905	5755	5625	5836
	13	MI075140	0.5 Mile North of 8 Mi	5920	5515	5370	5490	5260	5480	5535	5455	5444	6150	6120	6175	6265	6235	6120	6280	6175	6196	5700	5455	5590	5420	5385	5480	5310	5205	5406
	14	MI075120	0.6 Mile South of 8 M	6220	6125	6130	6215	5980	6055	6165	6195	6124	7500	7370	7420	7465	7505	7435	7500	7510	7458	7170	6705	6790	6610	6665	6690	6595	6440	6642
	15	MI075100	2.5 Mile South of SR	5920	5845	5855	5975	5750	5815	5860	5905	5858	7440	7410	7420	7545	7465	7420	7580	7435	7468	7060	6680	6885	6625	6705	6710	6635	6545	6684
I-75 NB	16	MI075100	2.5 Mile South of SR	3140	3275	3340	3330	3400	3475	3430	3495	3392	3900	4295	4265	4310	4280	4245	4335	4310	4291	3680	4090	3955	3920	3945	3940	4025	3980	3979
	17	MI075120	0.6 Mile South of 8 M	3870	3510	3575	3605	3690	3805	3665	3725	3654	4790	4650	4645	4675	4655	4595	4685	4790	4671	4360	4515	4360	4335	4235	4400	4435	4415	4385
	18	MI075160	1.6 Mile North of 8 Mi	4200	4210	4335	4290	4445	4495	4425	4440	4377	5310	5505	5400	5570	5495	5470	5400	5640	5497	4880	5260	5115	5035	4970	5135	5065	5125	5101
	19	MI075200	0.5 Mile of South of 1	4180	4365	4500	4520	4570	4645	4640	4645	4555	5360	5765	5735	5755	5750	5850	5680	5935	5781	5280	5630	5425	5495	5505	5560	5565	5540	5531
	20	MI075220	0.75 Mile of South of	4740	4405	4425	4505	4540	4575	4600	4620	4524	6020	5715	5655	5685	5665	5765	5610	5840	5705	5990	5555	5495	5515	5505	5500	5615	5570	5536
	21	MI075260	0.4 Mile of South of R	4050	4220	4115	4220	4265	4295	4380	4375	4267	5990	5825	5810	5805	5805	5930	5745	5985	5844	5940	5855	5710	5710	5730	5655	5770	5740	5739
	22	MI075280	0.2 Mile of South of L	3390	3540	3470	3570	3550	3570	3680	3670	3579	5240	5100	5075	5085	5070	5205	5025	5245	5115	5340	5135	5015	5010	4945	4975	4990	5040	5016
	23	MI075300	Just South of Wattles	3210	3320	3300	3410	3425	3435	3485	3400	3396	4810	4925	5000	4980	5015	5100	5040	5140	5029	4580	4820	4665	4720	4655	4615	4600	4740	4688
	24	MI075320	0.1 Mile of South of L	3280	3275	3255	3365	3390	3395	3455	3345	3354	4940	4920	4995	4965	4985	5090	5010	5140	5015	4720	4835	4680	4735	4690	4635	4605	4765	4706
	25	MI075340	0.7 Mile of South of C	2760	2670	2720	2805	2805	2825	2870	2775	2781	4140	4130	4105	4095	4185	4170	4120	4280	4155	3700	3875	3755	3780	3795	3795	3705	3885	3799
	26	MI075360	0.6 Mile of South of A	2740	2625	2685	2735	2735	2765	2805	2710	2723	4130	4105	4060	4090	4185	4165	4160	4290	4151	3700	3880	3785	3785	3805	3785	3685	3865	3799
	27	MI075380	0.6 Mile of South of I-	2720	2775	2805	2780	2860	2835	2880	2785	2817	4240	4280	4170	4245	4380	4305	4295	4455	4304	3800	4065	3905	3880	4005	3915	3795	4000	3938
I-94 EB	28	MI094580	0.9 Mile East of Teleg	4340	4630	4645	4625	4595	4675	4515	4605	4613	6020	5950	5855	5925	5960	6000	6015	5980	5955	5330	5590	5545	5540	5570	5580	5565	5520	5559
	29	MI094660	1.2 Mile East of Addis	3590	3375	3315	3300	3440	3315	3280	3320	3335	4240	4025	4045	4105	4025	3980	3980	4060	4031	3950	4095	4075	4040	4225	4030	4115	4095	4096
	30	MI094700	0.4 Mile West of I-96/	3960	3620	3560	3565	3610	3570	3485	3535	3564	4720	4360	4365	4395	4405	4265	4315	4350	4351	4310	4410	4365	4355	4525	4355	4380	4415	4401
	31	MI094720	0.5 Mile West of John	4240	4580	4450	4500	4490	4515	4430	4530	4499	5200	5615	5535	5725	5620	5460	5520	5590	5581	5130	5560	5500	5495	5590	5585	5560	5565	5551
	32	MI094740	0.5 Mile West of I-94/	3400	3640	3510	3625	3655	3535	3475	3560	3571	4230	4535	4480	4585	4445	4455	4450	4485	4491	3850	4610	4485	4475	4560	4520	4500	4640	4541
	33	MI094760	0.25 Mile West of Gra	2790	2760	2660	2805	2780	2760	2685	2690	2734	3910	3520	3385	3565	3490	3485	3505	3485	3491	3850	3710	3635	3630	3625	3735	3675	3595	3658
	34	MI094780	0.25 Mile West of Va	2770	2780	2720	2795	2785	2815	2715	2800	2773	3950	3565	3450	3640	3545	3515	3575	3570	3551	3920	3725	3680	3665	3655	3755	3690	3605	3682
	35	MI094800	0.7 Mile West of Con	2350	2650	2560	2700	2645	2640	2605	2680	2640	3330	3410	3360	3455	3320	3310	3380	3345	3369	3440	3565	3415	3495	3490	3490	3430	3415	3471
I-94 WB	36	MI094800	0.7 Mile West of Con	5480	5375	5410	5405	5395	5295	5355	5370	5372	5140	4985	4670	4625	4925	4375	4645	4745	4710	4450	4545	4700	4825	4395	4835	4710	4775	4684
	37	MI094780	0.25 Mile West of Va	5770	5630	5460	5475	5525	5440	5440	5505	5496	5940	5655	5640	5665	5855	5520	5650	5645	5661	5270	5580	5655	5495	5410	5555	5495	5690	5554
	38	MI094760	0.25 Mile West of Gra	n/a	5740	5500	5610	5650	5500	5510	5590	5586	n/a	6080	6065	5940	6120	5870	5970	6040	6012	n/a	5800	5780	5815	5745	5825	5890	6020	5839
	39	MI094740	0.5 Mile West of I-94/	5020	4860	4705	4730	4710	4675	4640	4730	4721	5600	5500	5570	5440	5655	5405	5440	5510	5503	5260	5210	5310	5290	5245	5340	5355	5445	5314
	40	MI094720	0.5 Mile West of John	4170	4300	4150	4195	4155	4155	4080	4205	4177	4860	5130	5190	5140	5260	5025	5130	5140	5145	4340	4815	4895	4815	4895	4970	4850	5155	4914
	41	MI094700	0.4 Mile West of I-96/	3630	3400	3245	3235	3250	3285	3235	3315	3281	4480	4120	4170	4020	4230	4040	4110	4090	4111	3920	3810	3895	3855	3875	4020	3905	4100	3923
	42	MI094660	1.2 Mile East of Addis	3730	3425	3270	3285	3310	3310	3350	3365	3331	4530	4265	4265	4210	4365	4145	4225	4200	4239	4080	3895	4030	3975	3980	4080	3990	4140	4013
	43	MI094580	0.9 Mile East of Teleg	3940	3515	3515	3490	3520	3480	3360	3495	3482	4650	4620	4525	4515	4490	4490	4535	4480	4522	3760	4080	4060	4050	4075	4065	4115	4035	4069
I-696EB	44	MI696240	0.8 Mile of West of C	4900	5350	5370	5510	5385	5325	5405	5465	5401	6700	6415	6555	6465	6580	6545	6575	6570	6529	6120	6370	6410	6255	6250	6325	6380	6255	6321
	45	MI696260	0.75 Mile of West of I	5360	5010	5085	5170	4990	5075	5080	5035	5064	6450	6495	6535	6480	6590	6590	6565	6655	6559	6000	6480	6545	6345	6340	6370	6550	6455	6441
	46	MI696280	0.5 Mile West of Mou	5070	5050	5105	5230	5040	5120	5065	5100	5101	6780	6680	6725	6685	6725	6760	6805	6790	6739	6030	6680	6655	6560	6490	6625	6685	6640	6619
I-696WB	47	MI696280	0.5 Mile West of Mou	6220	5695	5800	5840	5730	5770	5790	5820	5778	5740	5760	5735	5705	5705	5600	5685	5650	5691	5120	5000	4970	4865	4910	4940	4955	4860	4929
	48	MI696260	0.75 Mile of West of I	6670	6390	6490	6450	6400	6430	6445	6440	6435	6430	6520	6635	6545	6605	6410	6560	6570	6549	5370	5590	5590	5500	5545	5630	5605	5490	5564
	49	MI696240	0.8 Mile of West of C	6080	5795	5845	5885	5850	5875	5830	5930	5859	7160	6920	6950	6855	6970	6790	7015	6920	6917	6730	6335	6250	6195	6220	6365	6295	6350	6287
	50											4.6%									3.4%									4.8%
	51				GEH>10.0																									

PM Model Calibration Results

		3-4				4-5				5-6				6-7			
4	1 I-75 SB																
5	STATION ID	Measured	Simulated	GEH	Diff	Measured	Simulated	GEH	Diff	Measured	Simulated	GEH	Diff	Measured	Simulated	GEH	Diff
6	MI075400	n/a	3635	n/a	n/a	n/a	3950	n/a	n/a	n/a	3705	n/a	n/a	n/a	3335	n/a	n/a
7	MI075380	3860	3835	-0.4	-25	4140	4110	-0.5	-30	4430	3870	-8.7	-560	3000	3445	7.8	445
8	MI075360	3870	3880	0.2	10	4110	4115	0.1	5	4380	3905	-7.4	-475	2980	3475	8.7	495
9	MI075340	3840	3835	-0.1	-5	4060	4125	1.0	65	4290	3880	-6.4	-410	2940	3525	10.3	585
10	MI075320	3980	3810	-2.7	-170	4230	4110	-1.9	-120	4450	3850	-9.3	-600	3090	3640	9.5	550
11	MI075300	3970	3810	-2.6	-160	4270	4110	-2.5	-160	4520	3850	-10.4	-670	3160	3640	8.2	480
12	MI075280	4510	4390	-1.8	-120	4850	4650	-2.9	-200	4930	4460	-6.9	-470	3710	4105	6.3	395
13	MI075260	4430	4130	-4.6	-300	4510	4325	-2.8	-185	4310	4170	-2.2	-140	3670	3865	3.2	195
14	MI075220	4800	4270	-7.9	-530	4630	4600	-0.4	-30	4480	4335	-2.2	-145	4070	4025	-0.7	-45
15	MI075200	5790	5065	-9.8	-725	5620	5405	-2.9	-215	5570	5205	-5.0	-365	5190	4855	-4.7	-335
16	MI075180	6560	5905	-8.3	-655	6420	6250	-2.1	-170	6450	6020	-5.4	-430	5850	5505	-4.6	-345
17	MI075160	6120	5470	-8.5	-650	6020	5680	-4.4	-340	6160	5680	-6.2	-480	5590	5040	-7.5	-550
18	MI075140	5700	4730	-13.4	-970	5530	5085	-6.1	-445	5790	4955	-11.4	-835	5280	4540	-10.6	-740
19	MI075120	6340	5645	-9.0	-695	6080	6065	-0.2	-15	6380	5945	-5.5	-435	5780	5200	-7.8	-580
20	MI075100	5930	4700	-16.9	-1230	5620	5090	-7.2	-530	5810	5030	-10.6	-780	5310	4425	-12.7	-885
21	MI075080	4580	3770	-12.5	-810	4340	4145	-3.0	-195	4730	3845	-13.5	-885	4460	3750	-11.1	-710
22																	
23	2 I-75 NB	3-4				4-5				5-6				6-7			
24	STATION ID	Measured	Simulated	GEH	Diff	Measured	Simulated	GEH	Diff	Measured	Simulated	GEH	Diff	Measured	Simulated	GEH	Diff
25	MI075080	6580	6070	-6.4	-510	6770	6430	-4.2	-340	6390	6460	0.9	70	5270	5405	1.8	135
26	MI075100	5960	5670	-3.8	-290	5970	6005	0.5	35	5930	5990	0.8	60	4990	5055	0.9	65
27	MI075120	6330	5705	-8.1	-625	5930	6055	1.6	125	5550	5930	5.0	380	5410	5135	-3.8	-275
28	MI075160	6290	5595	-9.0	-695	5960	6040	1.0	80	5620	5855	3.1	235	5560	5205	-4.8	-355
29	MI075200	4990	4800	-2.7	-190	4910	5190	3.9	280	5130	4975	-2.2	-155	5090	4445	-9.3	-645
30	MI075220	5730	4985	-10.2	-745	5810	5480	-4.4	-330	5860	5275	-7.8	-585	5660	4800	-11.9	-860
31	MI075260	4980	4845	-1.9	-135	5150	5310	2.2	160	5090	5085	-0.1	-5	4390	4660	4.0	270
32	MI075280	4650	4635	-0.2	-15	4820	5120	4.3	300	4730	4860	1.9	130	3920	4420	7.7	500
33	MI075300	4760	5030	3.9	270	5250	5525	3.7	275	5150	5190	0.6	40	3960	4630	10.2	670
34	MI075320	4800	5010	3.0	210	5230	5520	4.0	290	5250	5205	-0.6	-45	4010	4635	9.5	625
35	MI075340	4570	4970	5.8	400	4990	5385	5.5	395	5020	5210	2.7	190	3780	4625	13.0	845
36	MI075360	4690	4925	3.4	235	5270	5385	1.6	115	5410	5225	-2.5	-185	3980	4645	10.1	665
37	MI075380	4740	5090	5.0	350	5360	5475	1.6	115	5490	5385	-1.4	-105	4010	4825	12.3	815
38																	
50	4 I-94 WB	3-4				4-5				5-6				6-7			
51	STATION ID	Measured	Simulated	GEH	Diff	Measured	Simulated	GEH	Diff	Measured	Simulated	GEH	Diff	Measured	Simulated	GEH	Diff
52	MI094800	4490	3835	-10.2	-655	3980	3985	0.1	5	4060	3755	-4.9	-305	3930	3185	-12.5	-745
53	MI094780	4980	4350	-9.2	-630	4350	4650	4.5	300	4430	4390	-0.6	-40	4300	3810	-7.7	-490
54	MI094760	4780	4480	-4.4	-300	5050	4790	-3.7	-260	5150	4585	-8.1	-565	4050	3950	-1.6	-100
55	MI094740	4610	4105	-7.7	-505	4260	4330	1.1	70	4040	3925	-1.8	-115	4120	3965	-2.4	-155
56	MI094720	4980	5055	1.1	75	4830	5160	4.7	330	4760	5100	4.8	340	4400	5020	9.0	620
57	MI094700	4870	4340	-7.8	-530	4990	4495	-7.2	-495	4920	4455	-6.8	-465	3930	4045	1.8	115
58	MI094660	5010	4710	-4.3	-300	5120	4985	-1.9	-135	5200	4770	-6.1	-430	4100	4315	3.3	215
59	MI094580	5930	5945	0.2	15	6520	6435	-1.1	-85	6370	6150	-2.8	-220	4700	5425	10.2	725
60																	
61	5 I-696 EB	3-4				4-5				5-6				6-7			
62	STATION ID	Measured	Simulated	GEH	Diff	Measured	Simulated	GEH	Diff	Measured	Simulated	GEH	Diff	Measured	Simulated	GEH	Diff
63	MI696240	6860	7260	4.8	400	7410	7525	1.3	115	7470	7230	-2.8	-240	6360	6060	-3.8	-300
64	MI696260	7460	7560	1.2	100	7920	7955	0.4	35	7820	7680	-1.6	-140	6670	6610	-0.7	-60
65	MI696280	7900	8380	5.3	480	8530	8945	4.4	415	8490	8470	-0.2	-20	7080	7505	5.0	425

Evolution of Computer Technology

Based on CDFN Model Runtime

	Laptop Specs	Batch Run	Display
2003	Intel Pentium 4 2.8 GHz 1 GB RAM 64 MB Video Memory (shared)	2:26:00	0:32:00
	Intel Pentium M 2.13 GHz 2 GB RAM 128 MB Video Memory (shared)	0:42:00	0:08:00
	AMD Turion 1.81 GHz 2 GB RAM 256 MB Video Memory	0:62:00	0:06:00
2006	Intel Core2 2 GHz 2 GB RAM 512 MB Video Memory	0:38:00	0:03:00

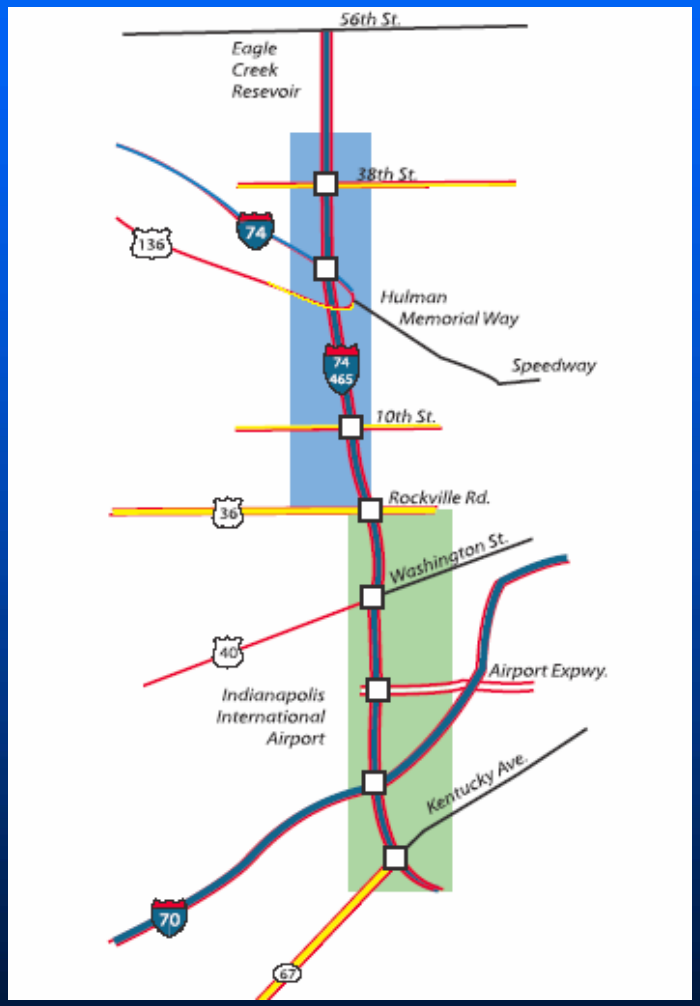
What's Next?

- METSIM
  - ⇨ Hotspot Review with MITS Staff
  - ⇨ Freight Mobility Analysis
- MOTSIM
  - ⇨ Construction Stages Analyses
  - ⇨ Maintenance of Traffic Plan Development

I-465 West Leg Reconstruction

Indianapolis, IN for InDOT

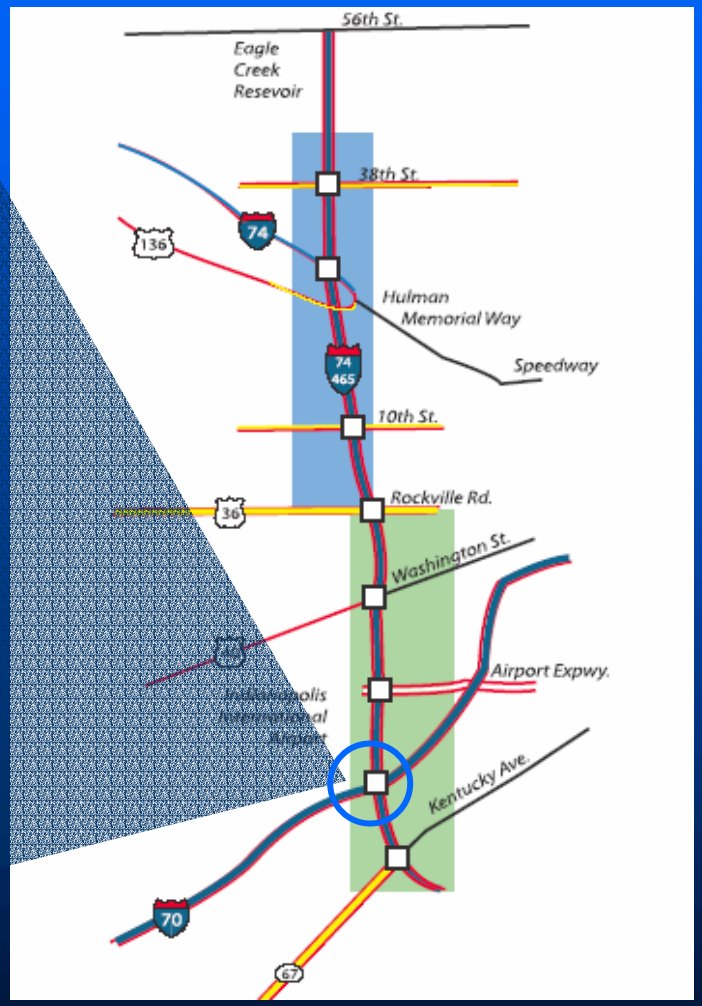
- Capacity Expansion with Modernization
- Simulation Applications
  - ⇨ Interchange Design Alternatives
  - ⇨ Interchange Construction Options
  - ⇨ CS/MOT Plan
  - ⇨ After-Construction Corridor Performance



I-465 West Leg Reconstruction

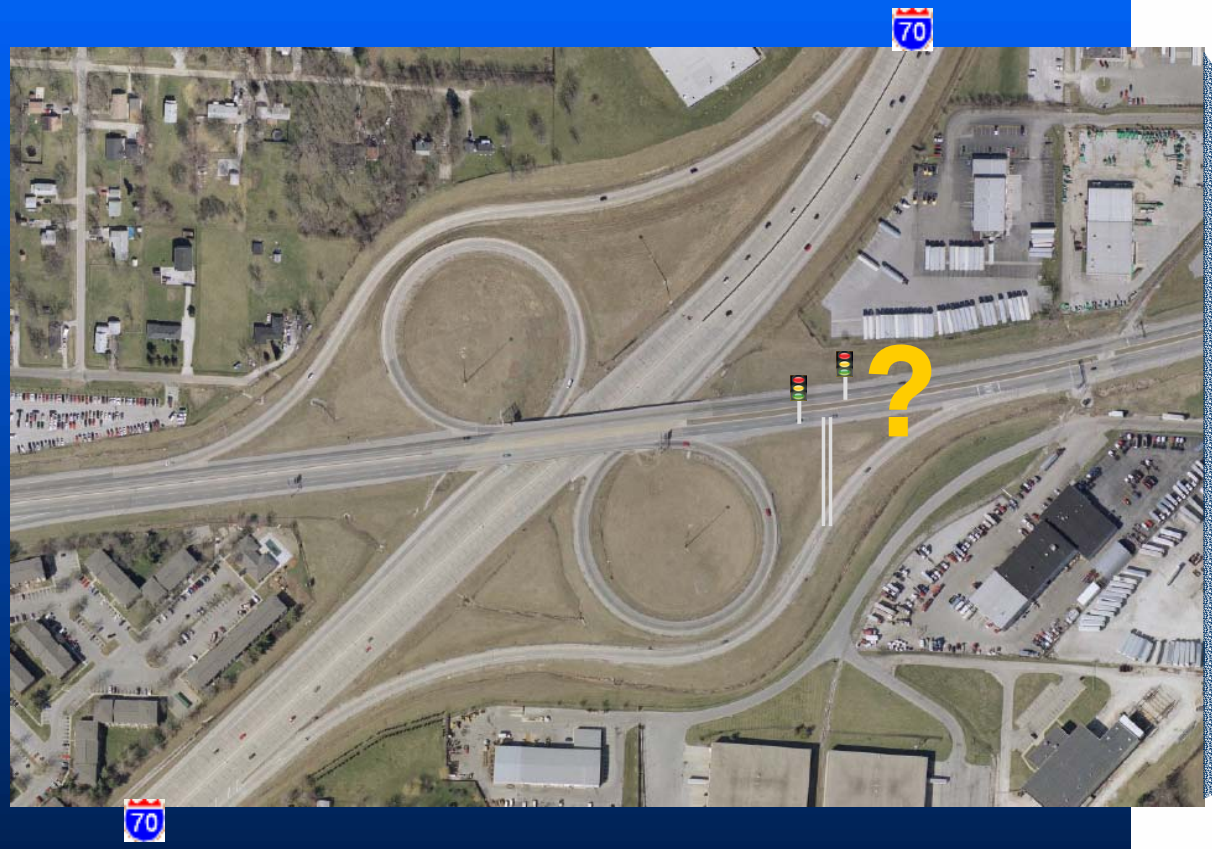
Indianapolis, IN for InDOT

I-70 EB to I-465 NB Traffic



I-465 West Leg Reconstruction

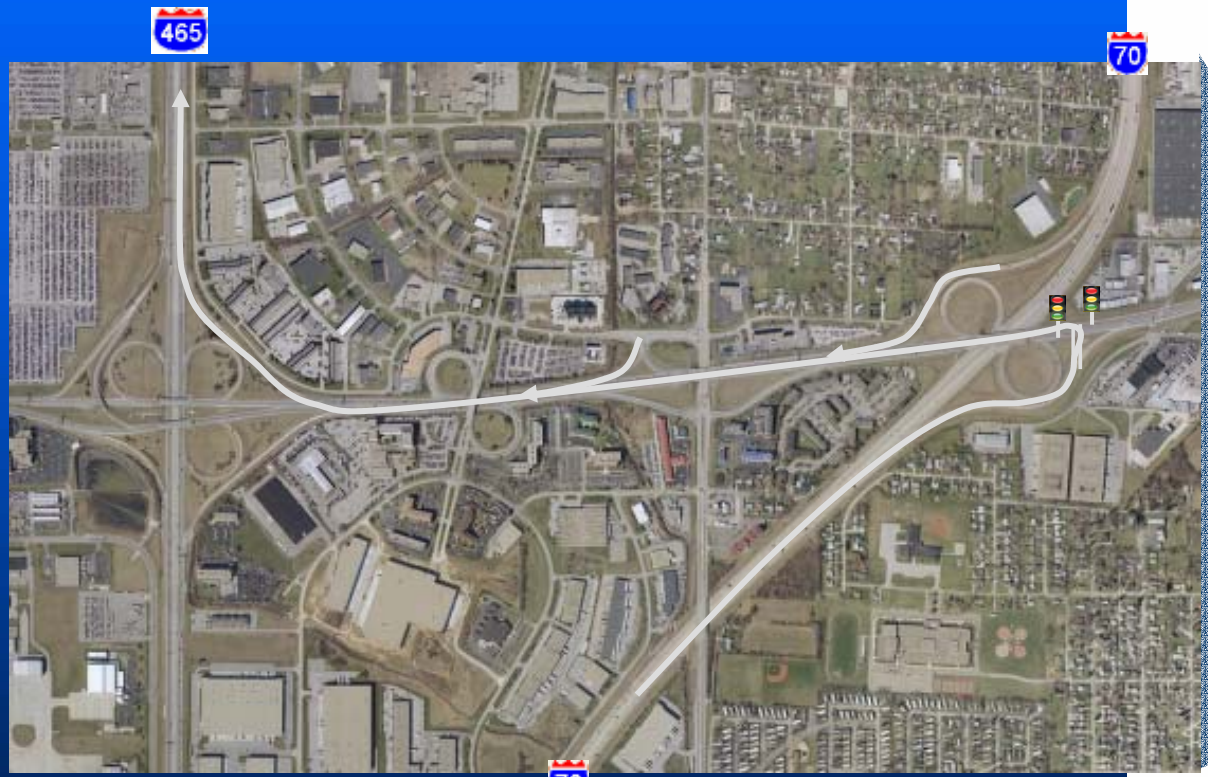
Indianapolis, IN for InDOT



Temporal Off-Ramp with Intersection

I-465 West Leg Reconstruction

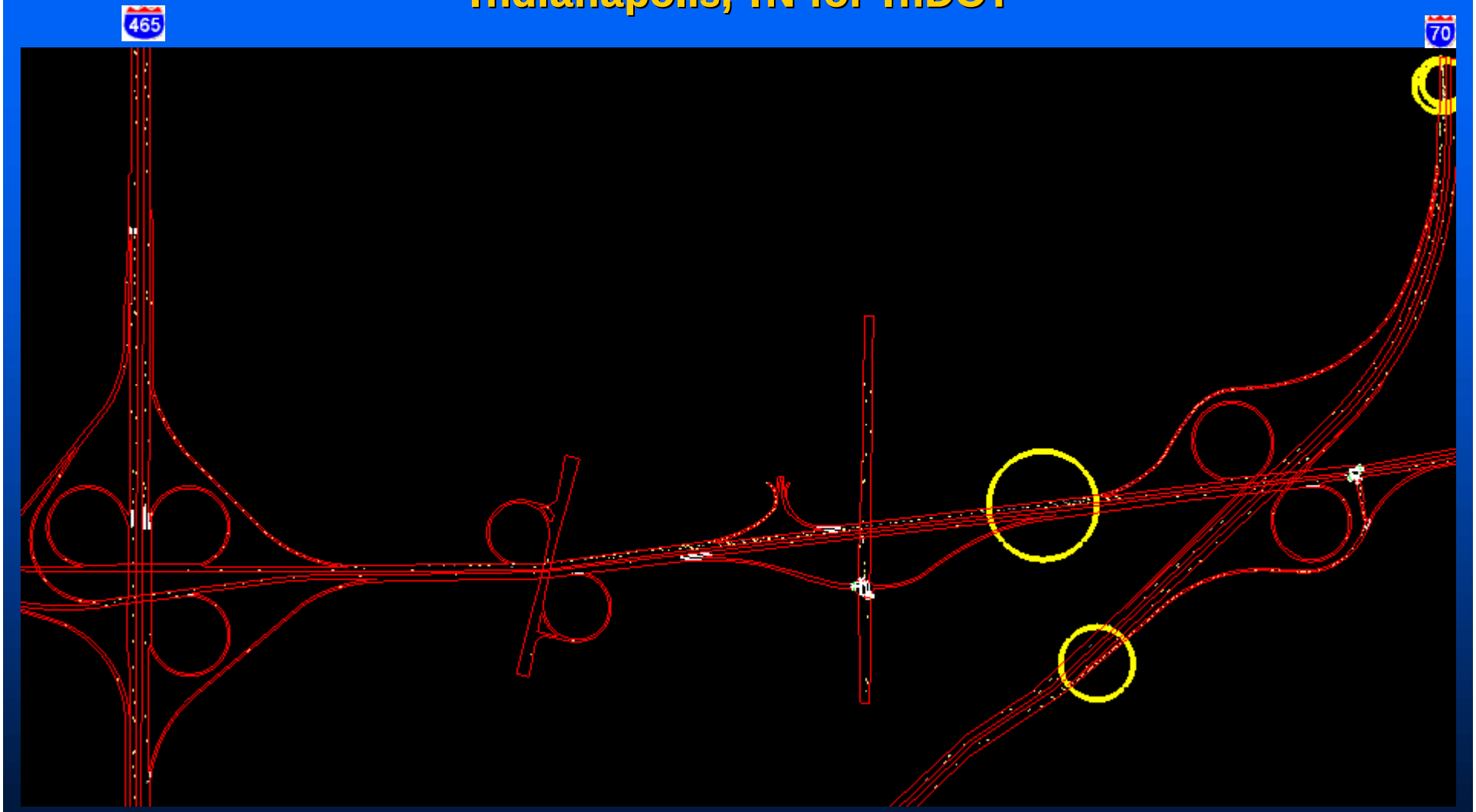
Indianapolis, IN for InDOT



Airport Expwy WB Traffic

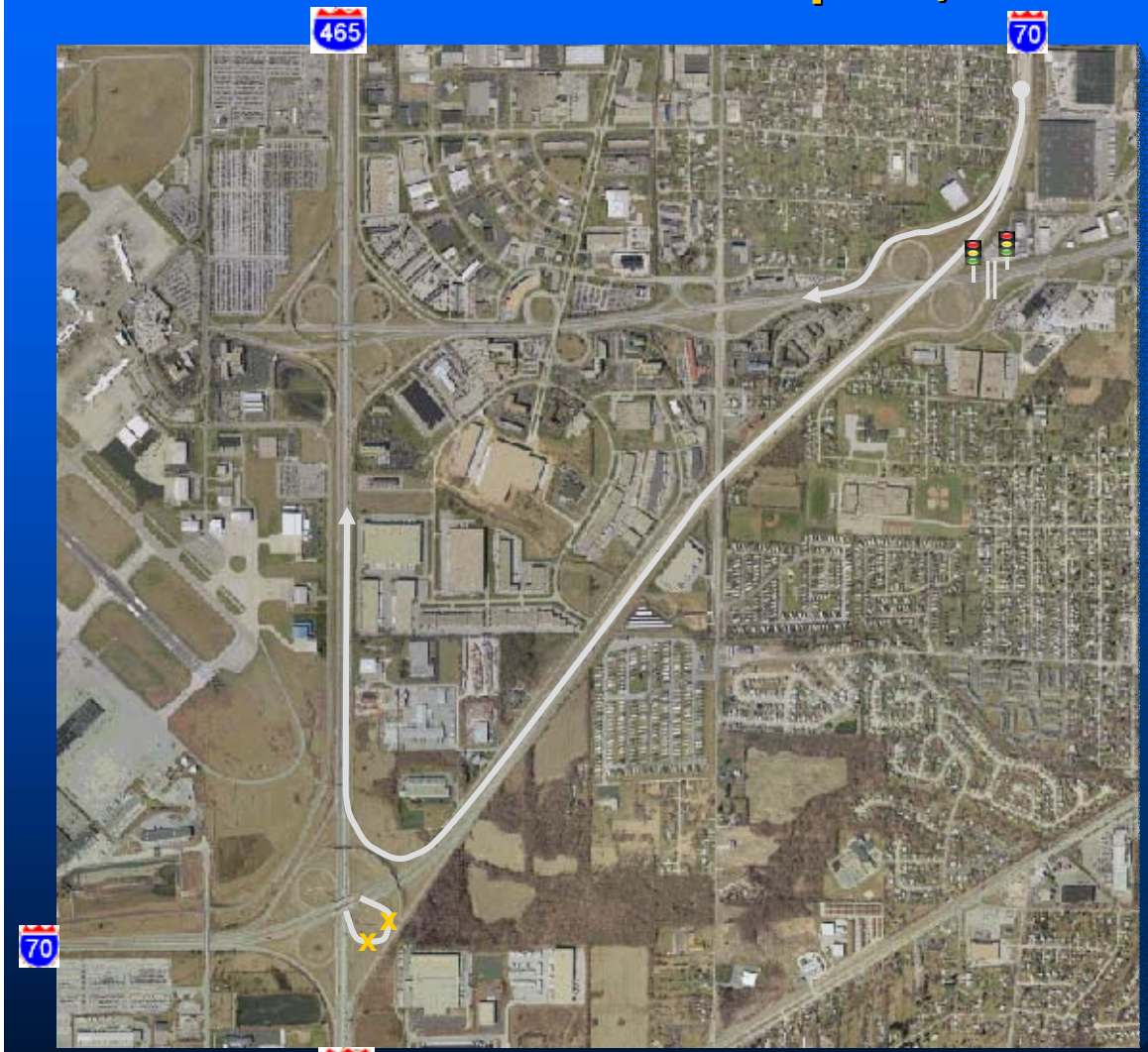
I-465 West Leg Reconstruction

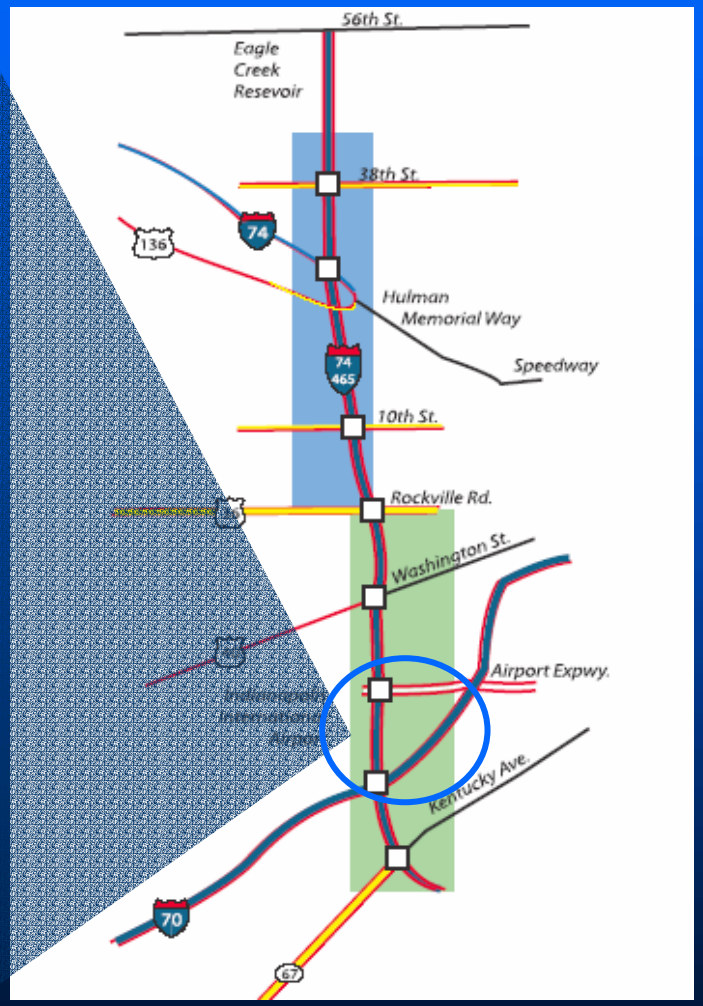
Indianapolis, IN for InDOT



I-465 West Leg Reconstruction

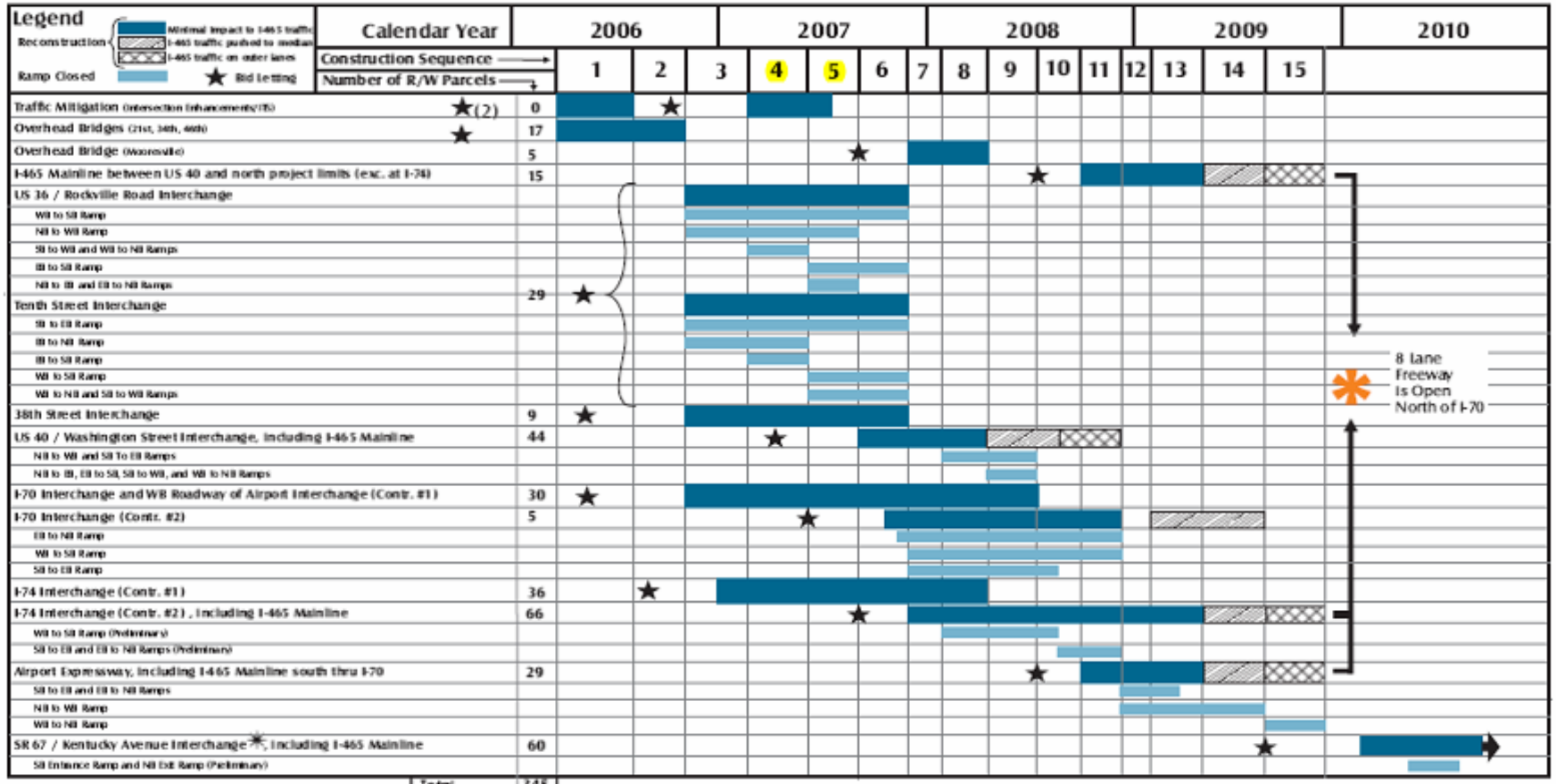
Indianapolis, IN for InDOT





I-465 Construction Timeline for August 2010 Completion (No Crossroad Closures and Select Ramp Closures at Most Interchanges)

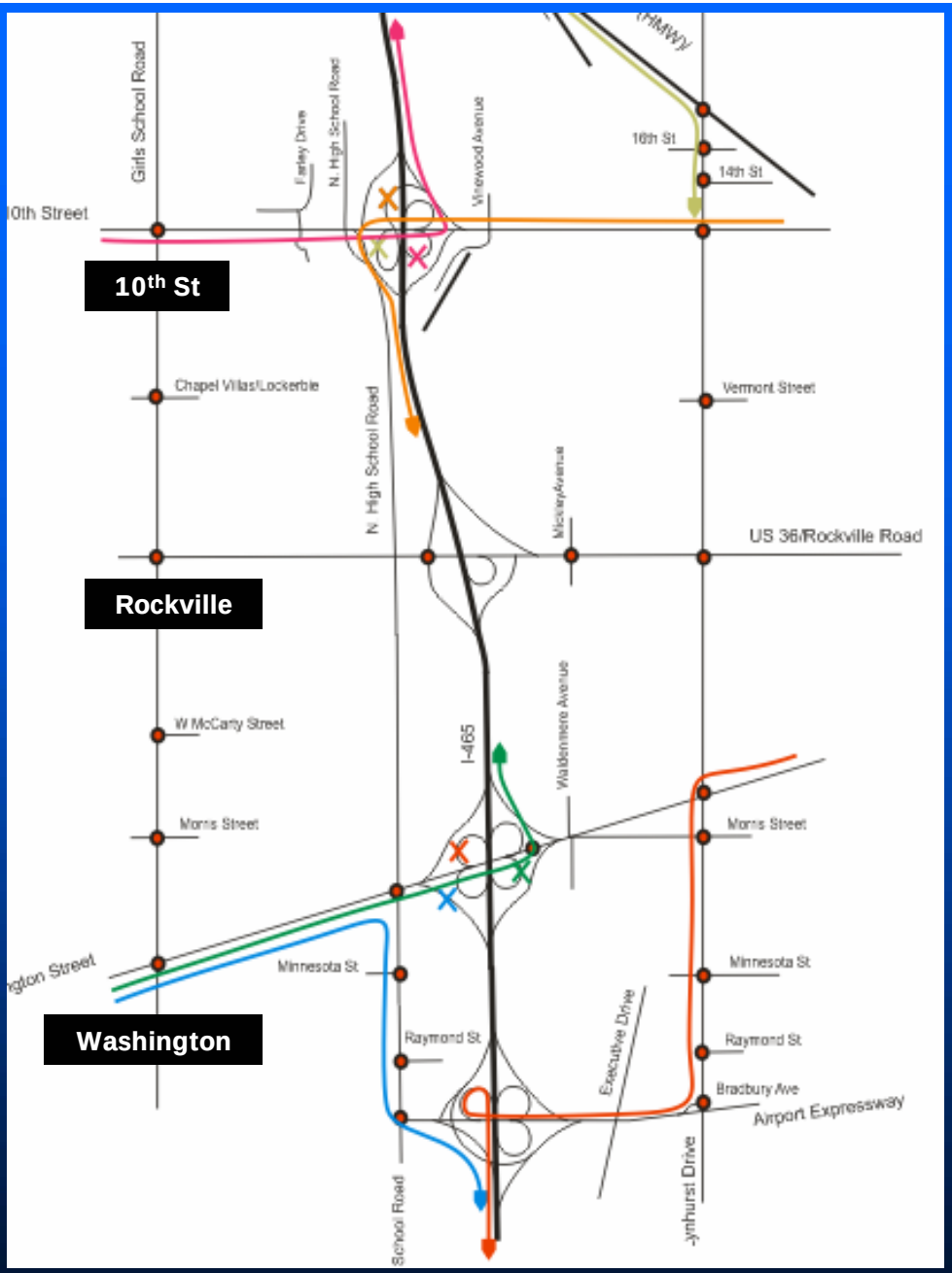
I-465 Construction Timeline for August 2009 Completion (No Crossroad Closures and Select Ramp Closures at Most Interchanges)



Includes contingencies and excludes engineering and right of way costs. Costs are millions of 2003 dollars.

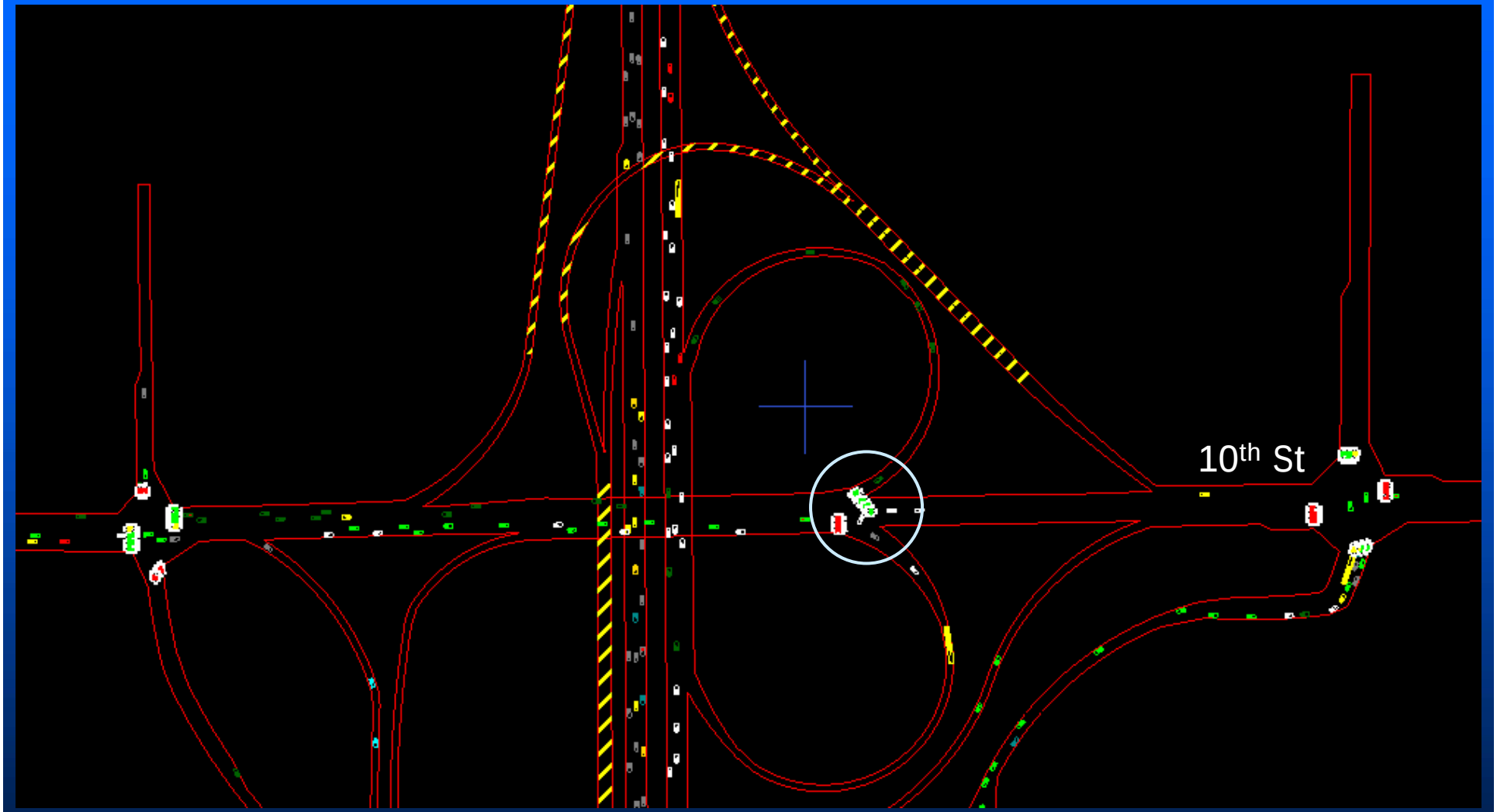
	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	Total
Construction Cost	125	83	99	92	68	467

* The fiscal year costs assume reconstruction of the folded diamond interchange at SR 67 / Kentucky Avenue with no impacts to the adjacent railroad. Reconstruction alternatives for this interchange are under consideration which require the relocation of the railroad along Hanna Avenue, with both features passing under the freeway roadways. An alternative interchange with railroad relocation may require additional R/W parcels and greater construction costs.



Detour Routes
2010 Plan Construction Stage 3
03/08-04/08

- Ramp Closures
  - EB 10th St to NB 465
  - EB Washington to NB 465
  - WB Washington to SB 465
  - SB 465 to EB 10th St
  - WB 10th St to SB 465
  - EB Washington to SB 465



Temporal Signal for WB 10th to NB 465

Lessons Learned

- Simulation is an excellent tool for system modeling and work zone mobility analysis
- Simulation requires multi-disciplined experience
- Simulation lacks practice guidelines
- Simulation needs institutional support