cityofnovi.org

CITY of NOVI CITY COUNCIL

Agenda Item N
August 11, 2014

SUBJECT: Approval to award an amendment to the engineering services agreement with URS Corporation for construction engineering services for the Grand River Avenue– Westbound Right Turn Lane Extension at Beck Road project in the amount of $33,196.

SUBMITTING DEPARTMENT: Department of Public Services, Engineering Division BJC

CITY MANAGER APPROVAL:

EXPENDITURE REQUIRED	**$ 33,196**
AMOUNT BUDGETED	**$ 37,024**
LINE ITEM NUMBER	**204-204.00-805.623**

BACKGROUND INFORMATION:

A traffic analysis was completed by Birchler Arroyo in December 2011 to study the traffic and crash history of the Grand River Avenue and Beck Road intersection. The study recommends that the existing right turn lane for westbound Grand River Avenue to northbound Beck Road be extended several hundred feet to increase the capacity of the intersection. This project would alleviate the traffic back-ups that occur for westbound Grand River during the afternoon peak hours.

The project has received a federal congestion mitigation/air quality (CMAQ) improvement grant for 2014 construction. The grant covers up to $115,000 of the construction cost with the remaining construction and all of the engineering and right-of-way costs to be the City's responsibility. The City's share of the project costs was included in the approved FY2013-14 budget. The study and a map of the area are attached for reference. Concurrent with the design, Engineering staff acquired the temporary and permanent easements required for the project.

Since the project is receiving Federal grant funds, MDOT is responsible for administering the project on the City's behalf. MDOT will award the construction contract to a contractor and administer the contract. A cost agreement with MDOT was approved on July 21, 2014 and was based on the estimated construction costs for the project. Based on the contractor bids opened by MDOT on August 1, 2014, the allocation of costs per the agreement and based on actual bids is as follows:

	Per Agreement	Per Contractor's Bid
City Share of Construction Costs	$25,300	$57,788
Federal Grant Funds Provided to MDOT	$114,000	$115,000
Construction Total	**$139,300**	**$172,788**

The costs for design and construction engineering services are not grant eligible and therefore the construction phase engineering fees are to be paid directly by the City. The construction engineering fees are being calculated based on the bid price of the low bidder and is determined using two components: 1) the contract administration fee, which is determined using the fee percentage in Exhibit B of the Agreement For Professional Engineering Services for Public Projects, and 2) the construction inspection fee determined using a cost per inspection day from Exhibit B of the consultant's agreement that is then multiplied by the estimated number of inspection days. Estimated inspection days are used for this project because (as a Federally funded project) the project is administered by MDOT which does not allow the use of crew days (i.e., the contractor provides the number of working days expected). The construction phase fees for this project include a contract administration fee of $13,996 (8.1% of the $172,788.44 construction bid) and an inspection fee of $19,200 ($640 per inspection day, multiplied by an estimated 30 days to complete the work) for a total fee of $33,196.

It is anticipated that MDOT will award the project to Hart and Associates Construction, LLC (an MDOT pre-qualified contractor) in August 2014 with substantial completion of the project in fall 2014.

RECOMMENDED ACTION: Approval to award an amendment to the engineering services agreement with URS Corporation for construction engineering services for the Grand River Avenue – WB Right Turn Lane Extension at Beck Road project in the amount of $33,196.

	1	2	Y	N
Mayor Gatt				
Mayor Pro Tem Staudt				
Council Member Casey				
Council Member Fischer				

	1	2	Y	N
Council Member Markham				
Council Member Mutch				
Council Member Wrobel				

Grand River/Beck Right Turn Lane Extension

Westbound Grand River Ave at Beck Rd

Map Author: Croy
Date: 9/25/2013
Project: GR/Beck RT Trn Lane Ext
Version #: v2.0

MAP INTERPRETATION NOTICE

Map information depicted is not intended to replace or substitute for any official or primary source. This map was intended to meet National Map Accuracy Standards and use the most recent, accurate sources available to the people of the City of Novi. Boundary measurements and area calculations are approximate and should not be construed as survey measurements performed by a licensed Michigan Surveyor as defined in Michigan Public Act 132 of 1970 as amended. Pleased contact the City GIS Manager to confirm source and accuracy information related to this map.

Feet

0 50 100 200 300 400

1 inch = 250 feet

City of Novi
Engineering Division
Department of Public Services
26300 Lee BeGole Drive
Novi, MI 48375
cityofnovi.org

FIRST AMENDMENT TO THE
SUPPLEMENTAL PROFESSIONAL ENGINEERING SERVICES AGREEMENT

WESTBOUND GRAND RIVER AT BECK RIGHT TURN
LANE EXTENSION PROJECT

First Amended Agreement between the City of Novi, 45175 W. Ten Mile Road, Novi, MI 48375-3024, hereafter, “City,” and URS Corporation – Great Lakes., whose address is 27777 Franklin Road, Suite 2000, Southfield, MI 48034, hereafter, “Consultant.” relating to modifications of the fee basis for engineering services. The following sections of the Supplemental Professional Engineering Services Agreement, as made and entered into on July 22, 2013 shall be amended as follows:

Section 2. Payment for Professional Engineering Services, The following Paragraphs shall be amended as follows:

1. Basic Fee.

a. *Unchanged*

b. Delete 1.b. in its entirety and replace with the following language: Construction Phase Services: The Consultant shall complete the construction phase services as described herein according to the fee schedule as described below:

i. Contract Administration: The Consultant shall complete Contract Administration services for a lump sum fee of $13,995.86, which is 8.1% (includes 0.6% for LAP projects) of the awarded construction cost ($172,788.44) as indicated on the Design and Construction Engineering Fee Curve.

ii. Construction Inspection: The Consultant shall complete Construction Inspection services for $640 per crew day as described in the request for proposals. “Crew days” shall be defined by the construction contract documents as an 8 hour day. Crew days shall be billed in 4 hour increments rounded to the next half day, therefore a 10 hour day shall be 1.5 crew days, a 3 hour day is 0.5 crew days, a 6 hour day shall be 1.0 crew days. The minimum crew day charged for a no-show by the contractor shall be 2 hours (0.25 crew days) which is reflective of the actual cost to the Consultant for traveling to the site and traveling back to the office. There will be no payment to the consultant for extra crew days that were not charged to the contractor. The Consultant acknowledges that intent of using crew days for inspection services is to provide a method for the consultant to recoup costs associated with slow progress by the contractor.

2. Unchanged

Except as specifically set forth in this First Amendment, the Supplemental Professional Engineering Services Agreement remains in full force and effect.

WITNESSES

____

____

URS Corporation—Great Lakes

____
By:
Its:

The foregoing __________ was acknowledged before me this ____ day of __________, 20___, by ________________________ on behalf of ____________________________________.

____
Notary Public
___________ County, Michigan
My Commission Expires: ___________

WITNESSES

____

____

CITY OF NOVI

____
By: Robert J. Gatt
Its: Mayor

The foregoing __________ was acknowledged before me this ____ day of __________, 20___, by ________________________ on behalf of the City of Novi.

____
Notary Public
Oakland County, Michigan
My Commission Expires: ___________

MEMORANDUM

BIRCHLER ARROYO ASSOCIATES, INC.

DATE: December 16, 2011

TO: Brian T. Coburn, P.E.
Nathan Bouvy
Engineering Division, City of Novi

FROM: Rodney L. Arroyo
William A. Stimpson, P.E.

SUBJECT: Grand River and Beck: Traffic Analysis of Extended WB Right-Turn-0nly Lane

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Birchler Arroyo Associates has completed both traffic modeling and crash analysis in support of the City's request for CMAQ funding to extend the existing westbound right-turn-only lane (see existing geometrics in Figures 1-2). This memo summarizes the study's recommendation and supporting analyses and findings.

Recommendations

The existing 175-ft-long westbound right-turn-only lane should be lengthened by 260 ft and equipped with a 150-ft-long entry taper. Since the lane extension will require at least a partial reconstruction of the bank driveway, the City should consider rebuilding the entire driveway to more effectively deter illegal entering and exiting left turns (a proposed driveway redesign has been provided you under separate cover).

Traffic Modeling

Data Collection – Due to the intersection's proximity to both the Suburban Collection Showplace and the I-96 / Beck Road interchange, traffic operations on any given day are sensitive to the level of activity at the Showplace. To investigate this sensitivity, we examined two days in late April 2011 – when there were no significant events at the Showplace – as well as two days in late October 2011 – when both the Testing Expo and Battery Show (with a combined total of up to 2,500 delegates attending) were underway. We also evaluated potential redesign requirements under the assumption that the movements most impacted by Showplace event traffic – the southbound left turn (for approaching traffic) and all westbound movements (for departing traffic) hypothetically could be as much as 20% higher than it was in October.

Lane-specific traffic counts from the SCATS signal system were obtained from the Road Commission for Oakland County. We have summarized RCOC's raw data in appendix Tables A-1 through A-4.

Since the curb lane on the eastbound and northbound approaches serves both through and right-turn traffic, the SCATS counts were split into through and right-turn movements based on the average splits observed in two previous sets of manual turning-movement counts (for the USA 2 Go impact study in February 2010 and for the Corradino study in April 2010). The resulting through and turning-movement volumes for the selected PM peak and late-AM off-peak analysis hours are summarized in appendix Tables B-1 through B-4, and the average hourly volumes are illustrated in Figures 3-6 (below).

Figure 1. Aerial Photo of Subject Intersection

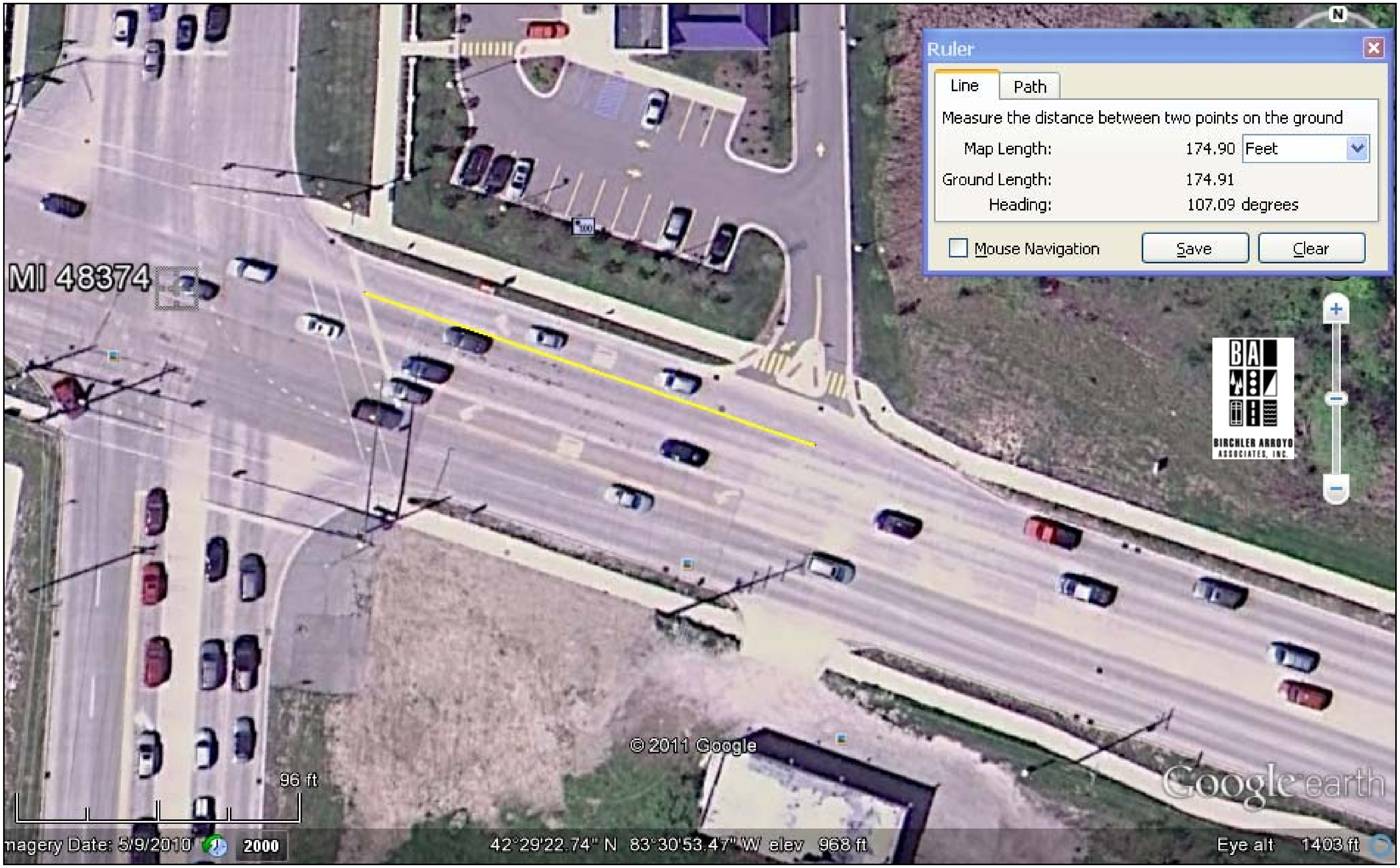

Figure 2. Aerial Photo of Subject Approach

Grand River & Beck
PM Peak Hour in April 2011

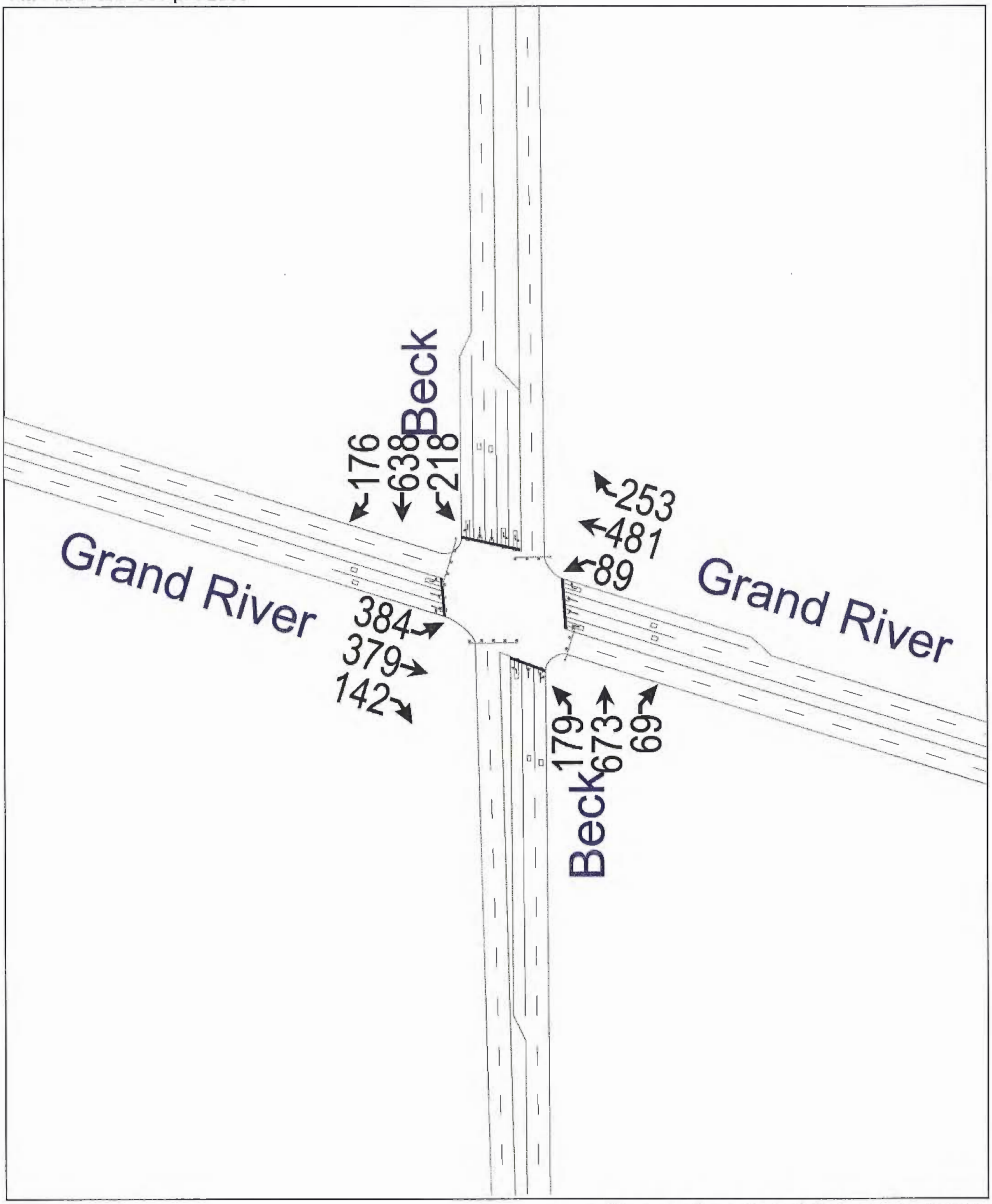

Figure 3. Peak-Hour Volumes in April 2011

Grand River & Beck
Late-AM Off-Peak Hour in April 2011

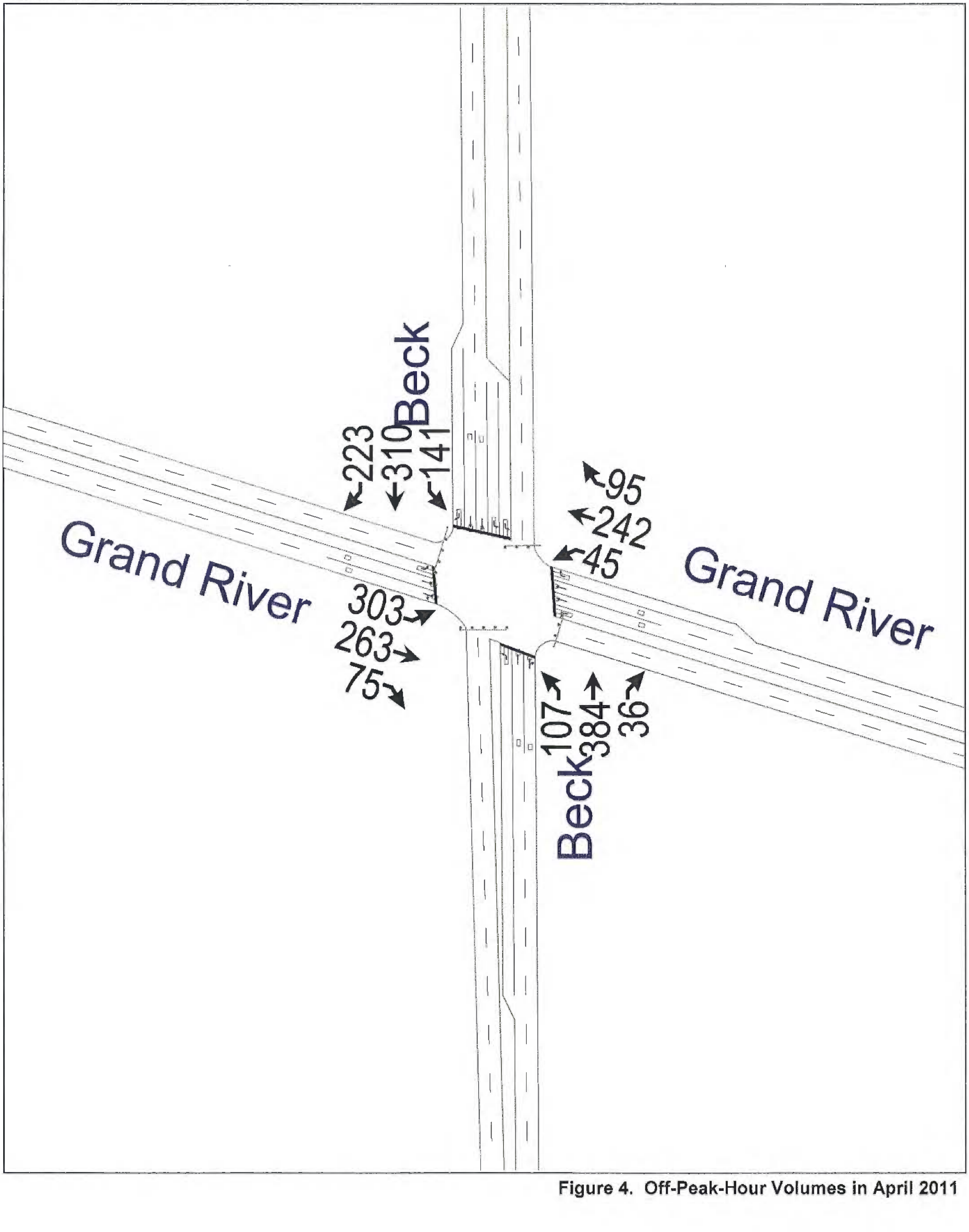

Figure 4. Off-Peak-Hour Volumes in April 2011

Grand River & Beck
PM Peak Hour in October 2011

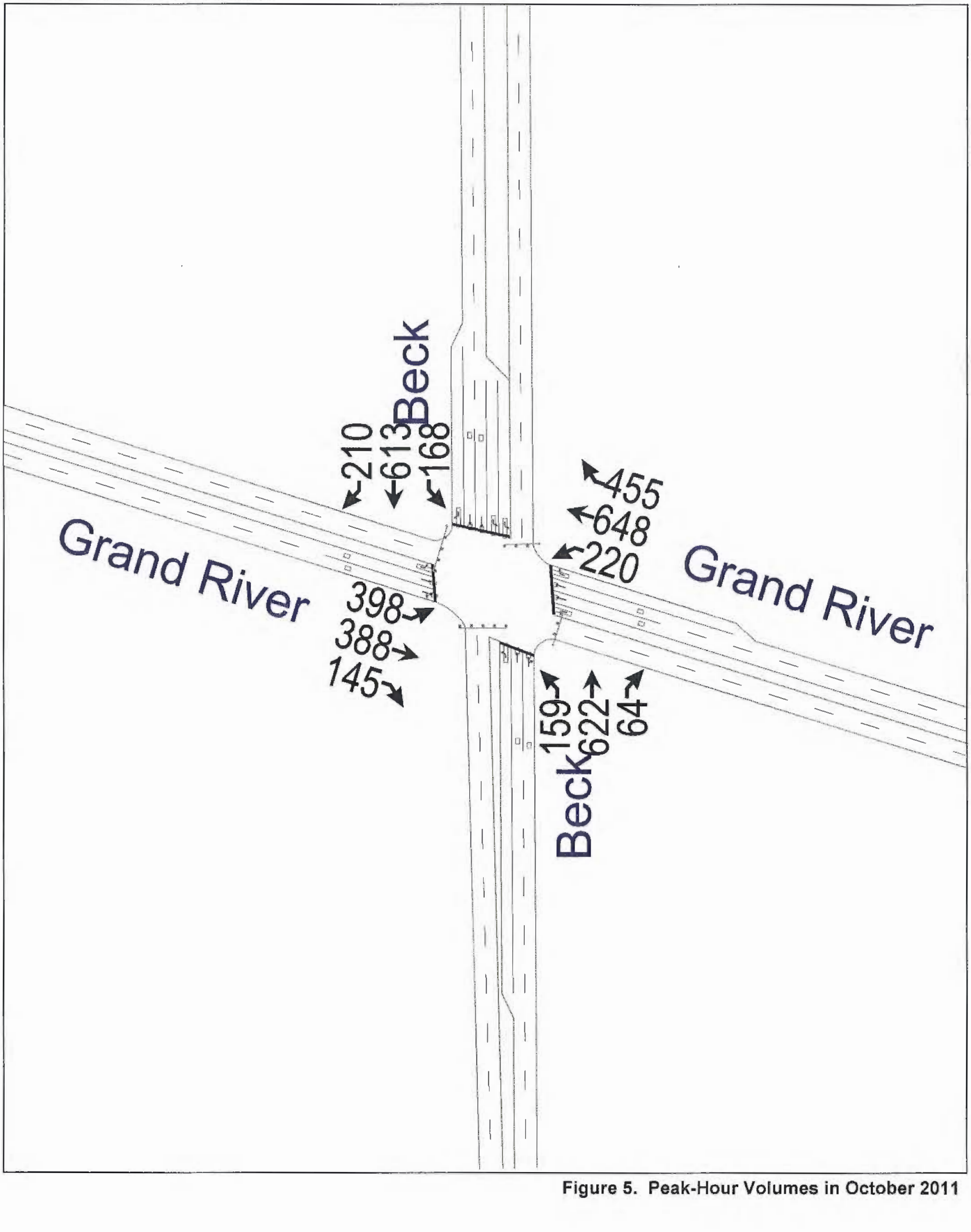

Figure 5. Peak-Hour Volumes in October 2011

Grand River & Beck
Late-AM Off-Peak Hour in October 2011

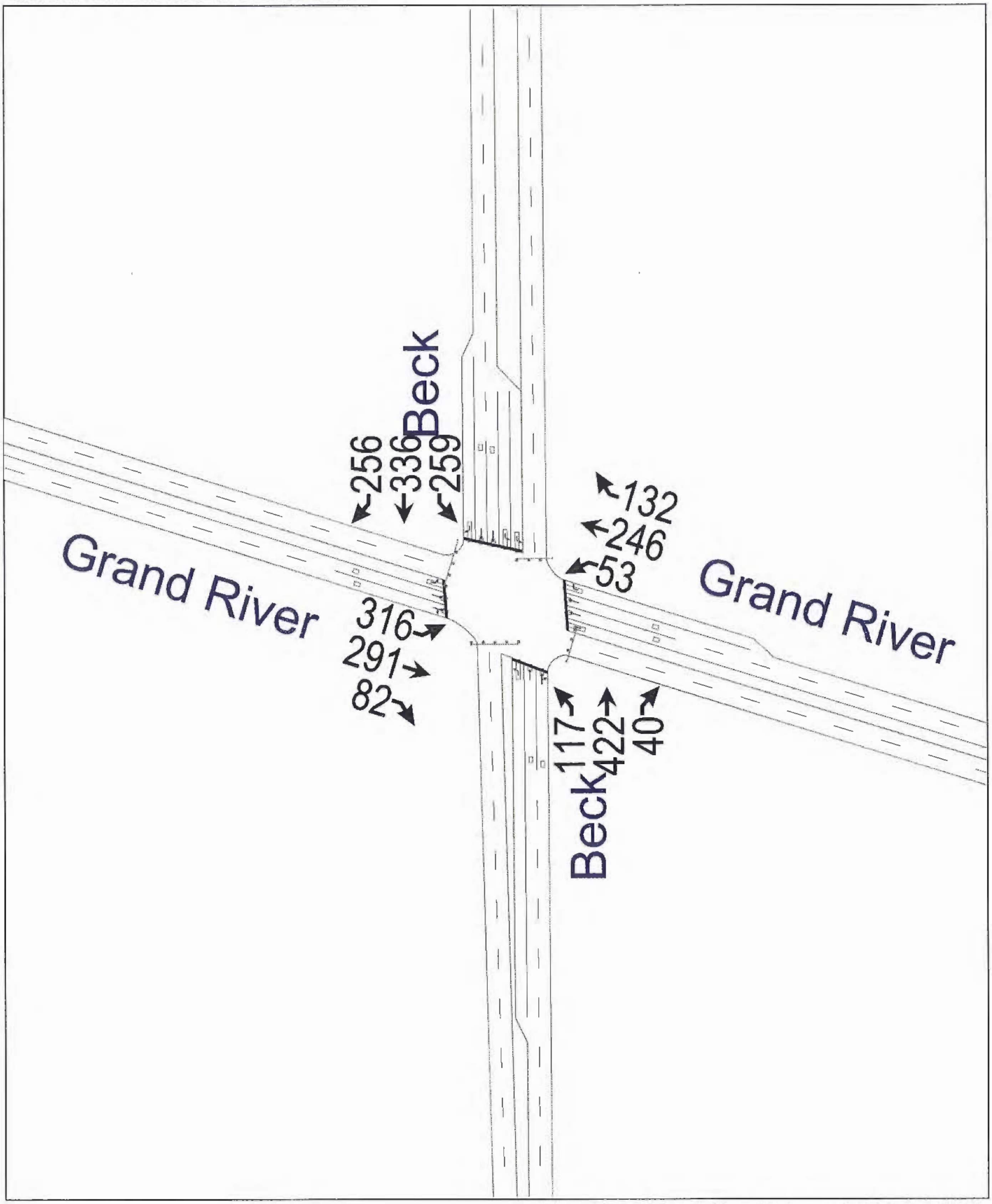

Figure 6. Off-Peak-Hour Volumes in October 2011

Also needed for the traffic modeling were the timing parameters for the existing fully-actuated (SCATS) signal operation; these were also obtained from RCOC. In addition, we measured the existing lengths of all dedicated turn lanes in the field; these included 175-ft and 185-ft-long right-turn-only lanes on the westbound and southbound approaches, respectively, and 350-ft and 150-ft-long left-turn-only lanes on the northbound and southbound approaches, respectively (the latter being dual). The left-turn lanes on the eastbound and westbound approaches were considered as long as the link coded in the traffic model (600 ft), since the dedicated left-turn lane in each case transitions to a two-way left-turn lane generally available to left turns approaching the signal during the busiest times.

Modeling Methodology – The above information was input to our Synchro 7 / SimTraffic software. Synchro 7 provides macroscopic analysis based on nationally recognized methodology found in the *Highway Capacity Manual (HCM).* Synchro also serves as the input platform for SimTraffic, a more detailed traffic simulation/analysis application. Synchro typically is relied upon for estimating average delay per vehicle and the associated level of service (on a grading scale of A-F), for individual movements, approaches, and the overall intersection. SimTraffic – on the other hand – creates an animated view of traffic moving through the intersection, typically provides more realistic estimates of vehicle queuing, and gives outputs relevant to an environmental assessment, such as average speed.

Modeling Results – Included in Appendix C of this report are selected Synchro and SimTraffic printouts for existing traffic conditions. Grouped by analysis hour (PM peak v. late-AM off-peak) and timeframe (average day in late April 2011 v. average day in late October 2011) are the following output pages:

- ❑ Synchro's "HCM Signals" analysis summary, providing numerous input and output variables, among them volume and capacity by movement, key signal timing values (such as clearance intervals), average delay, and level of service.

- ❑ SimTraffic's "Performance Report" for the "Entire Run." To improve the realism of the simulation, it was repeated three times using different random number "seeds"; the average results from the three iterations are provided on this page. The most important single output is average speed, pre-selected to be reported by movement, from which we manually computed a weighted-average speed for the westbound approach (see handwritten annotation).

- ❑ SimTraffic's "Queuing and Blocking Report" for "All Intervals" (equivalent to the Entire Run). Of greatest interest is the Maximum Queue length observed during the simulation.

Table 1 (on the next page) summarizes key results of the traffic modeling.

Length of Extended Right-Turn Lane and Taper – To ensure unimpeded access to the future westbound right-turn lane, mitigated conditions were modeled assuming a 310-ft extension of the existing lane. This would be the maximum feasible extension given existing and planned road conditions (it would bring the upstream end of an assumed 100-ft-long entry taper to within 100 ft of the exiting curb return of a planned new side street; by ordinance, 100 ft is the minimum distance permitted between tapers). However, <u>the simulation results in Table 1 suggest that a 260-ft extension of the existing right-turn-only lane would be adequate and appropriate</u>, reasoned as follows:

Table 1. Key Results of Traffic Modeling

Analysis Month	Analysis Hour	Westbound Approach			Westbound Right Turns		
		Volume (veh)	Avg Speed (mph)	Maximum Queue (ft)[1]	Volume (veh)	Avg Speed (mph)	Maximum Queue (ft)
Existing Conditions							
April 2011	Peak	823	7.6	360	253	13	200
	Off-Peak	382	10.5	95	95	19	64
October 2011	Peak	1323	6.4	545	455	9	200
	Off-Peak	431	10.8	138	132	18	49
With Amply Extended WB Right-Turn-Only Lane							
April 2011	Peak	823	8.8	331	253	15	136
	Off-Peak	382	10.7	95	95	20	64
October 2011	Peak	1323	7.9	**357**	455	13	239
	Off-Peak	431	11.1	139	132	19	47
Oct 2011 Expanded[2]	Peak	1588	-	**420**	546	-	305
	Off-Peak	-	-	-	-	-	-

[1] The longer queue within the two through-traffic lanes, which would have to be cleared by vehicles intending to turn right, if the latter are to be unimpeded in their access to the right-turn-only lane (volume and speed are for all approach movements combined, however).

[2] Assuming additional event traffic increases the SB left and WB approach volumes by 20%.

- ❑ Access to the right-turn lane would generally not be impeded by stopped westbound through traffic if the right-turn lane extended east to a point defined by through traffic's "Maximum Queue." Per Table 1, the modeling predicted the worst-case Maximum Queue to be 357 ft long for the mitigated October peak hour and 420 ft long for the mitigated October peak hour with selected movement volumes hypothetically increased by 20% (bolded values).

- ❑ Scaled along the south edge of the westbound right-turn lane, it appears that that lane extends about 18 ft closer to the intersection than the westbound inner through lane. Hence, to conservatively satisfy the preceding objective, the right-turn lane would have to be at least (357+18=) 375 ft long or – preferably – (420+18=) 438 ft long. This indicates a minimum lane lengthening of (375-175=) 200 ft and a preferred lane lengthening of (438-175=) 263 ft.

- ❑ Given the 50-mph speed limit on Grand River, the entry taper for the westbound right-turn lane should be significantly longer than the existing 75-ft taper. The RCOC's maximum standard entry taper of 150 ft should be used.

- ❑ In summary – given the simulation findings and the 410 ft available between the existing right-turn lane and the easternmost point at which improvements should end relative to the future side street – <u>it would be appropriate to extend the existing lane 260 ft and equip it with a 150-ft-long entry taper</u>.

Unimpeded access to the right-turn-only lane would:

- ❑ Maximize use of the signal's right-turn overlap (where this movement is provided a green arrow simultaneous with those displayed to southbound left-turn traffic), or alternatively – when the overlap arrow is not displayed – maximize the use of right-turn-on-red. Expediting right-turn traffic at the stop bar reduces motorist delay and the associated fuel use and emissions.

- ❑ Shorten the queue lengths in the through lanes by removing right-turn traffic earlier. As can be seen in Table 1, this reduction would be especially notable in the October peak hour (with its maximum predicted through-traffic queues of 357 ft mitigated v. 545 ft unmitigated).

- ❑ Minimize conflicts and potential crashes between right-turn and through traffic.

As can be seen in Figures 1-2, extending the existing right-turn lane would provide a deceleration lane for the bank driveway. It would also provide an opportunity to reconstruct the bank driveway to more effectively deter entering and exiting left turns (the existing curb returns and island are too small, and numerous violations of the signed turn restrictions have been observed).

Emissions Worksheets

Following on the next four pages are partially completed Emissions Worksheets for the April 2011 and October 2011 traffic conditions simulated (two pages for each timeframe). Electronic versions will be emailed to you so that you can complete lines 23 and 24 with respect to project design life and cost. To comply with the expected evaluation process, you may have to select one scenario (April or October) or the other to include in your application.

Evaluation of Crash History

As documented in a recent report for the City of Novi (now in draft form), our application of methodology found in the *SEMCOG Traffic Safety Manual – 2nd Edition* found that over the years 2006-2010, the intersection of Grand River and Beck was a High-Crash Intersection (i.e., its overall crash rate was significantly higher than the average rate for comparable intersections in Southeast Michigan). It is reasonable to conclude that a physical improvement of the type proposed in this CMAQ application, by improving traffic flow, will also improve safety at an intersection clearly in need of crash mitigation.

Individual (UD-10) reports were obtained and reviewed for all 2006-2010 crashes involving at least one westbound vehicle. The resulting 34 crashes are summarized in Table 2 (below, following the Emissions Worksheets). As can be seen, the 14 rear-end crashes tied with angle crashes as the most predominate (at 41% of the total), and it appears that at least four crashes (those in shaded rows) involved the westbound right-turn lane or attempted entry to that lane.

WORKSHEET 1

INTERSECTION IMPROVEMENTS (AT ONE APPROACH ONLY)

updated 10/2009

Project Name:	Extension of Westbound Right-Turn-Only Lane
Intersection:	Grand River at Beck
Submitter:	City of Novi
Fiscal Year:	2012

Directions: (1) Copy this file to your hard drive and rename it with the project name. (2) Fill in yellow highlighted cells with the appropriate measurements obtained from your field data, models, or the emissions factors tables provided (Grayed in cells will auto calculate). You may manually calculate using the printed formulas in the "Description of Data Items/Formula" cell spaces. (3) Attach the completed worksheet to the reuired application form along with any diagrams or additional worksheets used. (4) The project name and the values shown in the brown boxes should match values on the required application. (5) If you have multiple intersections in your project, complete and save this worksheet, giving it a different name for each intersection. Complete all worksheets, and add up ALL the "Changes in Emissions" (Kg/day). This total is used to calculate "Cost per Kilogram over the life of the project" by using worksheet "W00_cost module for multiple worksheet projects.xls". Emissions on the application will be the total of VOC and/or NOx emissions totaled respectively from all appliable worksheets.

NOTE: This is not an application form, this is only a tool used to calculate emissions that are needed for the CMAQ application. You must fill in all the required/highlighted fields. (if this is a part of a series in a corridor, the total sum must be reported on the application)

Contact: If you should have any trouble with these worksheets please contact Pete Porciello (517-335-2603).

EMISSION CALCULATIONS

Line No.	Description of Data Item/Formula	VOC	NOx	CO
1	Length of improvement on approach (miles)	0.111	0.111	0.111
2	24-hour, 2-way traffic volume:	8,286	8,286	8,286
3	Decimal equivalent of travel in peak periods (cannot exceed 1)	0.0992	0.0992	0.0992
4	Peak period VMT = L1*L2*L3 (miles/day)	91.239	91.239	91.239
5	Off-peak period VMT = L1*L2*(1-L3) (miles/day)	828.507	828.507	828.507
6	BEFORE IMPLEMENTATION: Average peak travel speed (mph)	7.6	7.6	7.6
7	BEFORE IMPLEMENTATION: Average off-peak travel speed (mph)	10.5	10.5	10.5
8	Expected increase in peak period speed (mph)	1.2	1.2	1.2
9	Expected increase in off-peak period speed (mph)	0.2	0.2	0.2
10	AFTER IMPLEMENTATION: Average peak speed (mph) = L6+L8	8.800	8.800	8.800
11	AFTER IMPLEMENTATION: Average off-peak speed (mph) = L7+L9	10.700	10.700	10.700
12	BEFORE IMPLEMENTATION: Peak emission factor for speed on L6 (g/mi)	0.744	0.711	10.69
13	AFTER IMPLEMENTATION: Peak emission factor for speed on line 10 (g/mi)	0.683	0.693	10.2
14	Change in peak emission factor=L13-L12 (g/mi)	-0.061	-0.018	-0.490
15	BEFORE IMPLEMENTATION: Off-peak emission factor for speed on line 7 (g/mi)	0.635	0.678	9.8
16	AFTER IMPLEMENTATION: Off-peak emission factor for speed on line 11 (g/mi)	0.597	0.653	9.47
17	Change in off-peak emission factor=L16-L15 (g/mi)	-0.038	-0.025	-0.330

Apr 2011 volumes, overall WB approach

12/14/2011

18	Change in peak daily emissions=L4*L14 (g/day)	-5.566	-1.642	-44.707
19	Change in off-peak daily emissions=L5*L17 (g/day)	-31.483	-20.713	-273.407
20	Total change in emissions=L18+L19 (g/day) [(-)=Reduction; (+)=Increase]	-37.049	-22.355	-318.114
21	For compairative purpose only: Conversion to Tons/year=(L22*.0011Tons)*340 (Tons/Yr)	-0.014	-0.008	-0.119
22	Change in emissions for this approach=[(L20)/(1Kg/1000g))] (Kg/day)	**-0.037**	**-0.022**	**-0.318**

Comments: Insert any additional comments you feel are necessary here.

23	Project design life in years (Yrs)			
24	Total project cost for this application (CMAQ plus Match) ($)			
25	Emission **reduction** over the life of the project=L21*L23 (Tons/Life)	0.000	0.000	0.000
26	Emission **reduction** over the life of the project=(L22*240)*L23 (Kg/Life)	0.000	0.000	0.000
27	Cost per Ton over the life of the project=(L24/L25) ($/Tons/Life)	#DIV/0!	#DIV/0!	#DIV/0!
28	Cost per Kilogram over the life of the project=(L24/L26) ($/Kg/Life)	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**

WORKSHEET 1 updated 10/2009

INTERSECTION IMPROVEMENTS (AT ONE APPROACH ONLY)

Project Name: Extension of Westbound Right-Turn-Only Lane

Intersection: Grand River at Beck

Submitter: City of Novi

Fiscal Year: 2012

Directions: **(1)** Copy this file to your hard drive and rename it with the project name. **(2)** Fill in yellow highlighted cells with the appropriate measurements obtained from your field data, models, or the emissions factors tables provided (Grayed in cells will auto calculate). You may manually calculate using the printed formulas in the "Description of Data Items/Formula" cell spaces. **(3)** Attach the completed worksheet to the reuired application form along with any diagrams or additional worksheets used. **(4)** The project name and the values shown in the brown boxes should match values on the required application. **(5)** If you have multiple intersections in your project, complete and save this worksheet, giving it a different name for each intersection. Complete all worksheets, and add up ALL the "Changes in Emissions" (Kg/day). This total is used to calculate "Cost per Kilogram over the life of the project" by using worksheet "W00_cost module for multiple worksheet projects.xls". Emissions on the application will be the total of VOC and/or NOx emissions totaled respectively from all appliable worksheets.

NOTE: This is not an application form, this is only a tool used to calculate emissions that are needed for the CMAQ application. You must fill in all the required/highlighted fields. (if this is a part of a series in a corridor, the total sum must be reported on the application)

Contact: If you should have any trouble with these worksheets please contact Pete Porciello (517-335-2603).

EMISSION CALCULATIONS

Line No.	Description of Data Item/Formula	VOC	NOx	CO
1	Length of improvement on approach (miles)	0.111	0.111	0.111
2	24-hour, 2-way traffic volume:	10,779	10,779	10,779
3	Decimal equivalent of travel in peak periods (cannot exceed 1)	0.123	0.123	0.123
4	Peak period VMT = L1*L2*L3 (miles/day)	147.166	147.166	147.166
5	Off-peak period VMT = L1*L2*(1-L3) (miles/day)	1,049.303	1,049.303	1,049.303
6	BEFORE IMPLEMENTATION: Average peak travel speed (mph)	6.4	6.4	6.4
7	BEFORE IMPLEMENTATION: Average off-peak travel speed (mph)	10.8	10.8	10.8
8	Expected increase in peak period speed (mph)	1.5	1.5	1.5
9	Expected increase in off-peak period speed (mph)	0.3	0.3	0.3
10	AFTER IMPLEMENTATION: Average peak speed (mph) = L6+L8	7.900	7.900	7.900
11	AFTER IMPLEMENTATION: Average off-peak speed (mph) = L7+L9	11.100	11.100	11.100
12	BEFORE IMPLEMENTATION: Peak emission factor for speed on L6 (g/mi)	0.925	0.768	12.17
13	AFTER IMPLEMENTATION: Peak emission factor for speed on line 10 (g/mi)	0.744	0.711	10.69
14	Change in peak emission factor=L13-L12 (g/mi)	-0.181	-0.057	-1.480
15	BEFORE IMPLEMENTATION: Off-peak emission factor for speed on line 7 (g/mi)	0.597	0.653	9.47
16	AFTER IMPLEMENTATION: Off-peak emission factor for speed on line 11 (g/mi)	0.597	0.653	9.47
17	Change in off-peak emission factor=L16-L15 (g/mi)	0.000	0.000	0.000

18	Change in peak daily emissions=L4*L14 (g/day)	-26.637	-8.388	-217.805
19	Change in off-peak daily emissions=L5*L17 (g/day)	0.000	0.000	0.000
20	Total change in emissions=L18+L19 (g/day) [(-)=Reduction; (+)=Increase]	-26.637	-8.388	-217.805
21	For compairative purpose only: Conversion to Tons/year=(L22*.0011Tons)*340 (Tons/Yr)	-0.010	-0.003	-0.081
22	Change in emissions for this approach=[(L20)/(1Kg/1000g))] (Kg/day)	**-0.027**	**-0.008**	**-0.218**

Comments: Insert any additional comments you feel are necessary here.

23	Project design life in years (Yrs)			
24	Total project cost for this application (CMAQ plus Match) ($)			
25	Emission **reduction** over the life of the project=L21*L23 (Tons/Life)	0.000	0.000	0.000
26	Emission **reduction** over the life of the project=(L22*240)*L23 (Kg/Life)	0.000	0.000	0.000
27	Cost per Ton over the life of the project=(L24/L25) ($/Tons/Life)	#DIV/0!	#DIV/0!	#DIV/0!
28	Cost per Kilogram over the life of the project=(L24/L26) ($/Kg/Life)	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**

Table 2. Summary of 2006-2010 Crashes at Grand River and Beck Involving at Least One Westbound Vehicle

Year	Date	Time	Distance from Beck Rd	Crash Type						Crash Severity (# Persons)					Contributing Factors / Comments
				Angle	Head-On	Sideswipe		Rear-End	Single-Vehicle	Fatal	Personal Injury			Property Damage Only	
						Opposite Direction	Same Direction				A	B	C		
2010 (3)	06/25	17:43	10’ E					WB						2	In RT pocket; V#2 stopped for bicyclist
	05/30	02:38	0’	WB-NB										5	V#1 failed to yield while making RTOR
	03/08	07:51	75’ E					WB						2	In inner thru lane; V#2 stopped for yellow
2009 (6)	12/28	16:45	100’ E					WB						2	D#1 foot slipped from brake to gas; snow
	12/17	15:46	20’ E					WB						2	D#1 thought V#2 was making a RTOR
	10/02	06:38	200’ W		WB-EB									1	In LT lane; V#2 unoccupied; dark & rainy
	09/25	18:12	20’ E					WB					1	1	V#2 slowing for red, rear-ended in RT ln
	06/05	17:45	100’ E					WB						4	3-veh crash in outer thru lane; hit rt-rear
	01/24	13:20	40’ E					WB						2	Both waiting to turn right; V#1 started 1st
2008 (6)	08/29	13:40	50’ E				WB							2	V#1 changing from right to left thru lane
	05/09	22:13	0’	WB-EBL										2	V#1 ran red, into V#2 turning on green
	04/05	19:12	0’	WBT-SBL									2	7	V#2 started on red as V#2 started on grn
	03/12	15:22	50’ W					WB						2	V#2 probably slowing for driveway
	03/05	17:14	100’ E					WB						2	Stopped V#2 not entirely in RT lane
	02/02	23:45	0’	SB-NBL										3	SB V#1 ran red; UD-10 narrative illegible
2007 (9)	10/25	15:30	100’ E					WB						2	Apparently in RT lane; causation unclear
	10/01	10:08	0’	SB-NBL										4	SB V#1 ran red; V#2 had green arrow
	08/25	18:47	200’ W	SB-WB										2	V#1 pulling out of driveway west of Beck

Table 2. Summary of 2006-2010 Crashes at Grand River and Beck Involving at Least One Westbound Vehicle, cont'd

Year	Date	Time	Distance from Meadow-brook	Crash Type						Crash Severity (# Persons)					Contributing Factors / Comments
				Angle	Head-On	Sideswipe Opposite Direction	Sideswipe Same Direction	Rear-End	Single-Vehicle	Fatal	Personal Injury A	Personal Injury B	Personal Injury C	Property Damage Only	
2007	07/08	18:00	50' E					WB						3	89-yr-old D#1 unable to stop; not RT lane
	05/18	23:01	0'	WB-SB										3	V#1, WB thru, ran red light
	03/03	10:52	0'	WBL-EB										2	V#1, LT on flashing red and didn't yield
	02/27	21:14	0'	WB-SB										2	V#1, WB thru, ran red light
	02/13	17:30	60' E			NBR-WB						2		2	V#1, RT too fast on snow, 2 WB veh hit
	01/24	09:58	0'	EBL-WB							3			1	LT hit by WBT; latter rebounded into V#3
2006 (10)	10/21	00:04	0'	EBL-WB								1	1	1	V#1, LT on flashing red and didn't yield
	09/29	20:18	0'	EBL-WB										5	WB V#1 ran light; V#2 had green arrow
	09/12	19:03	200' E				WB							2	V#1 changing from inner to outer thru ln
	09/04	21:15	0'					WB						5	V#1 didn't stop for V#2,#3; lane unclear
	08/19	05:38	0'						WB					1	Too fast / wet; slid into curb, NW corner
	05/06	13:55	20' E					WB						4	V#2 changed lanes, then signal changed
	04/28	08:10	0'	WB-SBL									1	1	WB V#1 ran red: V#2 had green arrow
	03/09	13:20	0'	NB-WB										2	NB V#! ran red and fled scene after crash
	01/30	14:20	40' W						WB					1	Vehicle under tow, lost control on SB RT
	01/04	17:25	30' E					WB						2	V#1 in outer thru lane, on wet pavement
Totals				14	1	1	2	14	2	0	3	3	5	84	