TOWN BOARD WORK SESSION MEETING
June 8, 2015 – 5:30 P.M.
First Floor Conference Room
301 Walnut Street, Windsor, CO 80550

The Town of Windsor will make reasonable accommodations for access to Town services, programs, and activities and will make special communication arrangements for persons with disabilities. Please call (970) 674-2400 by noon on the Thursday prior to the meeting to make arrangements.

GOAL of this Work Session is to have the Town Board receive information on topics of Town business from the Town Manager, Town Attorney and Town staff in order to exchange ideas and opinions regarding these topics.

Members of the public in attendance who have a question related to an agenda item are requested to allow the Town Board to discuss the topic and then be recognized by the Mayor prior to asking their question.

AGENDA

1. Town Board/Manager/Attorney Monthly Meeting
2. Boardwalk Park Master Plan Update
3. Traffic Study Report
4. Future meetings agenda

M E M O R A N D U M

Date: June 8, 2015
To: Mayor, Town Board & Parks, Recreation & Culture Advisory Board
Via: Kelly Arnold, Town Manager
From: Wade Willis, CPRP, Parks and Open Space Manager
Andrew Dunehoo, Art & Heritage Manager
Re: Boardwalk Park Master Plan Update
Item #: Work Session - 2

Background / Discussion:

At the April 27, 2015 work session regarding the Boardwalk Park Redesign, Root House Studio (RHS) provided information and conceptual designs for developing a permanent structure for performances. RHS also presented concepts for the central plaza, AKA old fire museum pad. Based on feedback from Town Board and the Parks, Recreation and Culture Board, RHS is providing planning level cost estimates for two concepts tonight. The concepts include utilizing the existing show stage pad location and an orientation placing the venue adjacent to the restroom concessions building.

Tonight will be an opportunity to further discuss the merits of each location with RHS and to select which concept or which elements from the proposed concepts should be implemented and to determine next steps.

Financial Impact:

N/A at this time

Relationship to Strategic Plan:

Goal 2.A.

Recommendation:

For discussion and provide direction to staff regarding further development and implementation of part or all of the presented master plan concepts.

Attachments:

b. BP Stage Concepts and Planning Level Cost Estimates
c. BP Stage Cost Exhibits

CONCEPT 1

0' 40' 80' 120'
SCALE: 1" = 40'-0"

NORTH

PRIMARY BENEFITS OF CONCEPT 1

Utilizes existing park features and landscaping.

Offers the largest capacity and best viewing for the concert venue.

Offers the best views of lake for concert attendees.

Provides the best location for a multi-use corporate picnic pavilion.

Lowest cost.

ROOT HOUSE studio

Boardwalk Park
Master Plan Revisions

Windsor, CO

June 2, 2015

WINDSOR COLO

Boardwalk Park Revised Master Plan

Planning Level Cost Estimate

2-Jun-15

The following cost estimate provides general costs for the major park elements. These estimates are intended for planning purposes and should not be construed as actual costs. Final costs will determined when design and engineering tasks have been completed.

CONCEPT 1

FIRE MUSEUM PLAZA	Unit	Unit Cost	Quantity	Cost
PRECONSTRUCTION				
Park DD, CDs and Engineering 7% of Construction Costs	LS	7%	of total	$ 7,538.30
Geotechnical Testing	LS	$ 1,050.00	1	$ 1,050.00
SUBTOTAL				**$ 8,588.30**
MOBILIZATION				
Mobilization	LS	$ 8,500.00	1	$ 8,500.00
SUBTOTAL				**$ 8,500.00**
DEMOLITION & GRADING				
Demolition and Removal of Fire Museum Pad	SF	$ 1.75	5000	$ 8,750.00
Earth Work - Fine Grading	SY	$ 0.50	5,000	$ 2,500.00
SUBTOTAL				**$ 11,250.00**
IRRIGATION & LANDSCAPING				
Irrigation Modifications	SF	$ 0.75	2,200	$ 1,650.00
Soil Amendments	CY	$ 35.00	15	$ 525.00
Turf (Sod)	SF	$ 0.95	2,200	$ 2,090.00
Trees	EA	$ 750.00	8	$ 6,000.00
SUBTOTAL				**$ 10,265.00**
HARDSCAPE IMPROVEMENTS				
Decorative Paving	SF	$ 11.00	4200	$ 46,200.00
Seat Walls	LF	$ 185.00	35	$ 6,475.00
Monument Feature	LS	$ 25,000.00	1	$ 25,000.00
SUBTOTAL				**$ 77,675.00**
TOTAL				**$ 116,278.30**

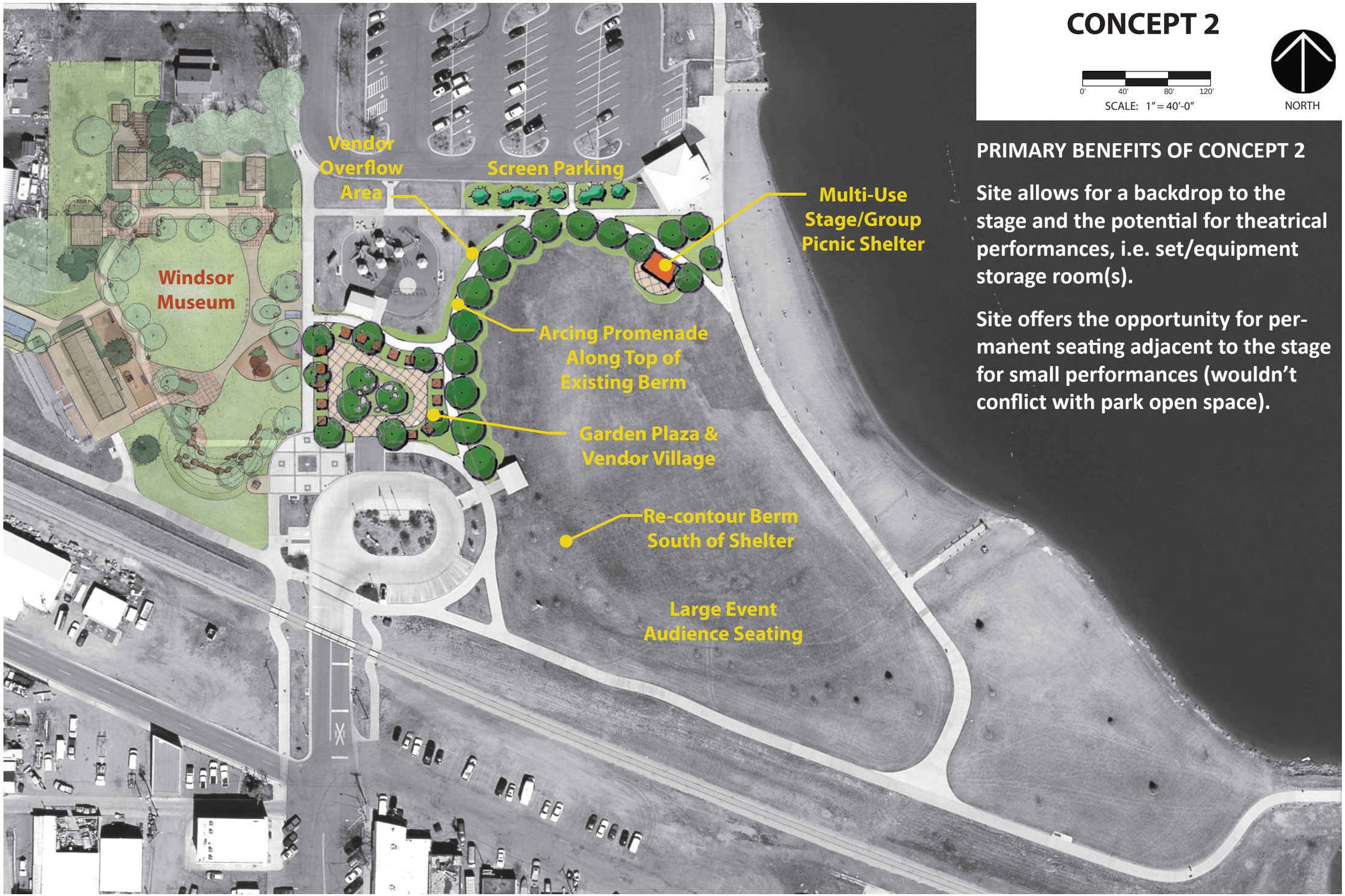
VENDOR AREA	Unit	Unit Cost	Quantity	Cost
PRECONSTRUCTION				
Park DD, CDs and Engineering 7% of Construction Costs	LS	7%	of total	$ 1,645.00
SUBTOTAL				**$ 1,645.00**
MOBILIZATION				
Mobilization	LS	3000.00	1	$ 3,000.00
SUBTOTAL				**$ 3,000.00**
GRADING				
Earth Work - Fine Grading	SY	$ 0.50	2,000	$ 1,000.00
SUBTOTAL				**$ 1,000.00**
IRRIGATION & LANDSCAPING				
Irrigation Modifications	SF	$ 0.40	1,000	$ 400.00
Soil Amendments	CY	$ 35.00	10	$ 350.00
Turf (Sod)	SF	$ 0.95	1,500	$ 1,425.00
Trees	EA	$ 750.00	12	$ 9,000.00
SUBTOTAL				**$ 11,175.00**
HARDSCAPE IMPROVEMENTS				
Decorative Paving	SF	$ 11.00	525	$ 5,775.00
Widen Concrete Path (4")	LF	$ 8.50	300	$ 2,550.00
SUBTOTAL				**$ 8,325.00**

TOTAL				**$ 25,145.00**
PERFORMANCE STAGE				
	Unit	Unit Cost	Quantity	Cost
PRECONSTRUCTION				
Park DD, CDs and Engineering 7% of Construction Costs	LS	7%	of total	$ 15,542.80
Geotechnical Testing	LS	$ 1,050.00	1	$ 1,050.00
SUBTOTAL				**$ 16,592.80**
MOBILIZATION				
Mobilization	LS	8000.00	1	$ 8,000.00
SUBTOTAL				**$ 8,000.00**
DEMOLITION & GRADING				
Removal of Dance Pad	SF	$ 3.50	1500	$ 5,250.00
Earth Work - Fine Grading	SY	$ 0.50	2,000	$ 1,000.00
SUBTOTAL				**$ 6,250.00**
IRRIGATION & LANDSCAPING				
Irrigation Modifications	SF	$ 0.40	1,200	$ 480.00
Soil Amendments	CY	$ 35.00	10	$ 350.00
Turf (Sod)	SF	$ 0.95	800	$ 760.00
Trees	EA	$ 750.00	2	$ 1,500.00
SUBTOTAL				**$ 3,090.00**
HARDSCAPE IMPROVEMENTS				
Decorative Paving	SF	$ 11.00	1200	$ 13,200.00
SUBTOTAL				**$ 13,200.00**
PERFORMANCE STAGE				
Prefabricated Poligon Performance Stage	LS	$ 185,000.00	1	$ 185,000.00
Retractable Backdrop Screening	LS	$ 6,500.00	1	$ 6,500.00
SUBTOTAL				**$ 191,500.00**
TOTAL				**$ 238,632.80**
TOTAL COSTS				**$ 380,056.10**
Contingency 30%				**$ 114,016.83**
TOTAL COSTS WITH 30% CONTINGENCY				**$ 494,072.93**

CONCEPT 2

0' 40' 80' 120'
SCALE: 1" = 40'-0"

NORTH



PRIMARY BENEFITS OF CONCEPT 2

Site allows for a backdrop to the stage and the potential for theatrical performances, i.e. set/equipment storage room(s).

Site offers the opportunity for permanent seating adjacent to the stage for small performances (wouldn't conflict with park open space).

ROOT HOUSE studio

Boardwalk Park
Master Plan Revisions
Windsor, CO
June 2, 2015

WINDSOR COLO

Boardwalk Park Revised Master Plan

Planning Level Cost Estimate

2-Jun-15

The following cost estimate provides general costs for the major park elements. These estimates are intended for planning purposes and should not be construed as actual costs. Final costs will determined when design and engineering tasks have been completed.

CONCEPT 2

FIRE MUSEUM PLAZA & VENDOR AREA

	Unit	Unit Cost	Quantity	Cost
PRECONSTRUCTION				
Park DD, CDs and Engineering 7% of Construction Costs	LS	7%	of total	$ 5,356.40
Geotechnical Testing	LS	$ 1,050.00	1	$ 1,050.00
SUBTOTAL				**$ 6,406.40**
MOBILIZATION				
Mobilization	LS	7000.00	1	$ 7,000.00
SUBTOTAL				**$ 7,000.00**
DEMOLITION & GRADING				
Demolition and Removal of Fire Museum Pad	SF	$ 1.75	5000	$ 8,750.00
Earth Work - Fine Grading	SY	$ 0.50	5,000	$ 2,500.00
SUBTOTAL				**$ 11,250.00**
IRRIGATION & LANDSCAPING				
Irrigation Modifications	SF	$ 0.75	2,200	$ 1,650.00
Soil Amendments	CY	$ 35.00	20	$ 700.00
Turf (Sod)	SF	$ 0.95	2,600	$ 2,470.00
Trees	EA	$ 750.00	10	$ 7,500.00
SUBTOTAL				**$ 12,320.00**
HARDSCAPE IMPROVEMENTS				
Decorative Paving	SF	$ 11.00	3700	$ 40,700.00
Boulders	EA	$ 350.00	35	$ 12,250.00
SUBTOTAL				**$ 52,950.00**
TOTAL				**$ 89,926.40**

PERFORMANCE STAGE

	Unit	Unit Cost	Quantity	Cost
PRECONSTRUCTION				
Park DD, CDs and Engineering 10% of Construction Costs	LS	10%	of total	$ 43,140.00
Geotechnical Testing	LS	$ 950.00	1	$ 950.00
SUBTOTAL				**$ 44,090.00**
MOBILIZATION				
Construction Surveying	LS	$ 450.00	1	$ 450.00
Mobilization	LS	8000.00	1	$ 8,000.00
SUBTOTAL				**$ 8,450.00**
DEMOLITION & GRADING				
Removal of Dance Pad	SF	$ 3.50	1500	$ 5,250.00
Fill Material	CY	$ 4.50	600	$ 2,700.00
Earth Work - Rough Grading	CY	$ 15.00	120	$ 1,800.00
Earth Work - Fine Grading	SY	$ 0.50	2,000	$ 1,000.00
SUBTOTAL				**$ 10,750.00**
IRRIGATION & LANDSCAPING				
Irrigation Modifications	SF	$ 0.40	14,000	$ 5,600.00
Soil Amendments	CY	$ 35.00	100	$ 3,500.00
Turf (Sod)	SF	$ 0.65	24,000	$ 15,600.00
Trees	EA	$ 750.00	24	$ 18,000.00
SUBTOTAL				**$ 42,700.00**

HARDSCAPE IMPROVEMENTS				
Decorative Paving	SF	$ 11.00	800	$ 8,800.00
New Concrete Sidewalk	SF	$ 8.50	4200	$ 35,700.00
SUBTOTAL				**$ 44,500.00**
PERFORMANCE STAGE				
Custom Performance Stage w/Adjoining Rooms	LS	$ 325,000.00	1	$ 325,000.00
SUBTOTAL				**$ 325,000.00**
TOTAL				**$ 475,490.00**
TOTAL COSTS				**$ 565,416.40**
Contingency 30%				**$ 169,624.92**
TOTAL COSTS WITH 30% CONTINGENCY				**$ 735,041.32**

CONCEPT 1

CONCEPT 2

ROOT HOUSE studio

Boardwalk Park
Master Plan Revisions

June 2, 2015

Windsor, CO

WINDSOR 1890 COLO

FOCAL FEATURE

0' 40' 80' 120'
SCALE: 1" = 40'-0"

NORTH

ROOT HOUSE studio

Boardwalk Park
Master Plan Revisions

June 2, 2015

Windsor, CO

WINDSOR COLO

Boardwalk Park Revised Master Plan

Planning Level Cost Estimate

2-Jun-15

The following cost estimate provides general costs for the major park elements. These estimates are intended for planning purposes and should not be construed as actual costs. Final costs will determined when design and engineering tasks have been completed.

FOCAL FEATURE

FOCAL FEATURE in FIRE MUSEUM PLAZA	Unit	Unit Cost	Quantity	Cost
PRECONSTRUCTION				
Park DD, CDs and Engineering 15% of Construction Costs	LS	15%	of total	$ 94,101.00
Geotechnical Testing	LS	$ 2,500.00	1	$ 2,500.00
SUBTOTAL				**$ 96,601.00**
MOBILIZATION				
Mobilization	LS	$ 20,000.00	1	$ 20,000.00
SUBTOTAL				**$ 20,000.00**
DEMOLITION & GRADING				
Demolition and Removal of Fire Museum Pad	SF	$ 3.50	5000	$ 17,500.00
Earth Work - Fine Grading	SY	$ 0.50	5,000	$ 2,500.00
SUBTOTAL				**$ 20,000.00**
IRRIGATION & LANDSCAPING				
Irrigation Modifications	SF	$ 0.40	1,800	$ 720.00
Soil Amendments	CY	$ 35.00	20	$ 700.00
Turf (Sod)	SF	$ 0.95	1,600	$ 1,520.00
Trees	EA	$ 750.00	12	$ 9,000.00
SUBTOTAL				**$ 11,940.00**
HARDSCAPE IMPROVEMENTS				
Decorative Paving	SF	$ 11.00	6400	$ 70,400.00
40 Foot Masonry Clock Tower	LS	$ 525,000.00	1	$ 525,000.00
SUBTOTAL				**$ 595,400.00**
TOTAL				**$ 743,941.00**
Contingency 30%				**$ 223,182.30**
TOTAL COSTS WITH 30% CONTINGENCY				**$ 967,123.30**

CONCEPT 1

$ 95,000

$ 125,000

$ 145,000

$ 165,000

$ 215,000

Prefabricated Shelter Style Band Shells

CONCEPT 2

$ 240,000

$ 275,000

$ 310,000

$ 425,000

$ 530,000

Custom Band Shells w/ Backdrop or Rooms

Combined 2015 Traffic Study Projects

Report 1

Harmony Road/WCR 15 and Crossroads Boulevard/WCR 13

Prepared by:

Interwest Consulting Group
1218 West Ash, Suite C
Windsor, Colorado 80550
Phone: 970.674.3300
Fax: 970.674.3303

And

ELB Engineering, LLC
5401 Taylor Lane
Fort Collins, Colorado 80528
Phone: 970.988.7551

Prepared for:

Town of Windsor
Office of the Town Engineer
301 Walnut Street
Windsor, Colorado 80550
Phone: 970.674.2437

May 15, 2015

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ELB Engineering, LLC.
Transportation Engineering Solutions

Memorandum

TO: Omar Herrera, PE, Town of Windsor
Mike Oberlander, PE, Interwest Consulting

FROM: Eric L. Bracke, P.E., P.T.O.E

DATE: May 15, 2015

SUBJECT: ***Windsor Combined 2015 Traffic Studies – Report #1***

The Town of Windsor has secured the services of Interwest Consulting Group and ELB Engineering, LLC to conduct the *Combined 2015 Traffic Study Projects*. This project will look at three specific intersections; Harmony Road/WCR15, Crossroads Boulevard/WCR 13, and Walnut Street/7th Street. Each of these three intersections is experiencing various issues regarding congestion, delay and safety and this project will evaluate the intersections and make recommendations for improvement. This first report will examine the intersections of Harmony Road/WCR 15 and Crossroads Boulevard/WCR 13. The intersection of Walnut/7th Street will be forthcoming and evaluated in a separate report. A Vicinity Map of the two intersections is displayed in Figure 1 on the following page.

Traffic Data

The intersection of Harmony Road and WCR 15 is in a rural setting with agricultural uses as the principle land use in the area. The developed portions of the Town of Windsor are to the south of the intersection. Harmony Road is a major east-west roadway in the region and carries a significant amount of commuter traffic between Larimer and Weld Counties. The speed limit is posted at 55 mph. Weld County Road 15 is a north-south arterial and still maintains a rural cross section with one lane of travel in each direction and a posted speed limit of 55 mph. The intersection of Harmony/WCR 15 is a two-way stop controlled intersection with WCR 15 being controlled. There are auxiliary turn lanes on Harmony Road (left-thru-right) and auxiliary turn lanes on WCR 15 (left- combination thru/rights).

The intersection of Crossroads Blvd. and WCR 13 is in an area that is transitioning from rural to urban. Crossroads is a major east-west connector between Loveland, Windsor, and Greeley. The Regional Plan for the area has Crossroads connecting to O Street in Greeley in the future. Crossroads Blvd has a posted speed limit of 55 mph east of WCR13 and 45 mph west of WCR13, has a travel lane in each direction and auxiliary left turn lanes at the

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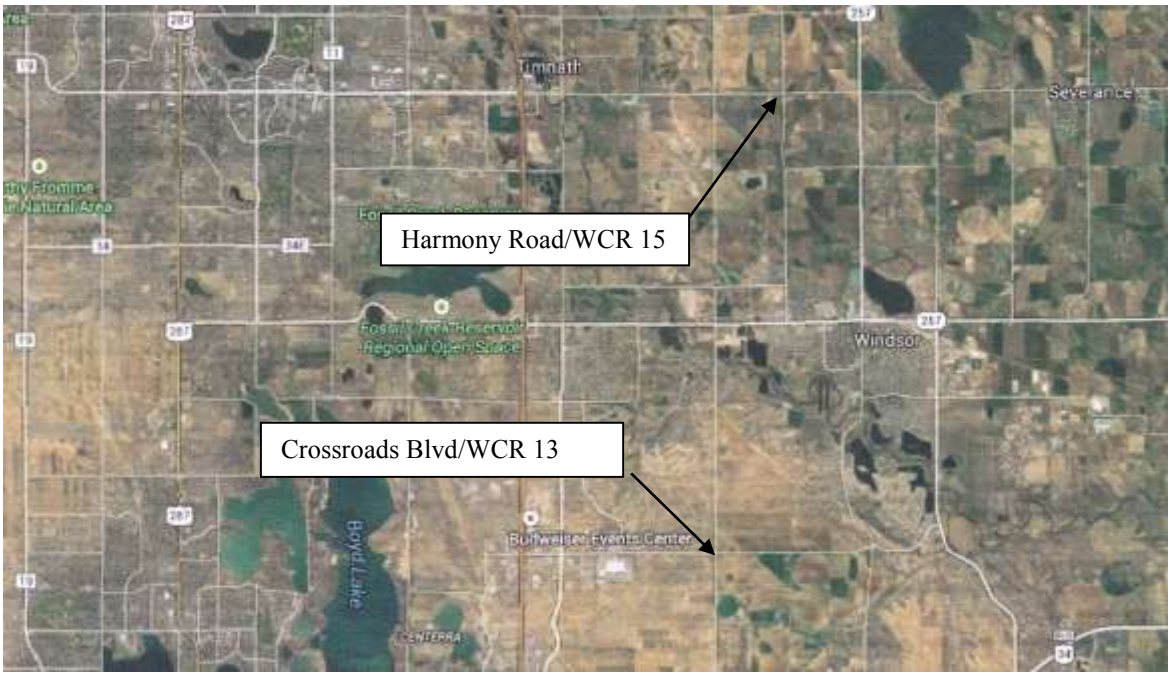
subject intersection. Weld County Road 13 is a north-south arterial with a posted speed limit of 45 mph north of Crossroads and 50 mph south of Crossroads, one travel lane in each direction and auxiliary left turn lanes at the subject intersection.



North

Figure 1: Vicinity Map

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Peak hour turning movements were obtained during the AM and PM peak hours at both intersections. Two-hour counts were taken in order to find the highest 60-minute period that would be used in the capacity analysis of the intersections. The team also collected 24-hour approach volumes that will be used in the analysis and as part of the traffic signal warrant portion of the study. The raw data is provided in **Appendix B**.

The intersection of Harmony/WCR 15 has approximately 14,200 vehicles enter it on a daily basis. Currently, the intersection of Crossroads Blvd./WCR 13 has approximately 12,000 vehicles enter it per day. Figure 2 below displays the turning movement and approach volumes of the key intersections.

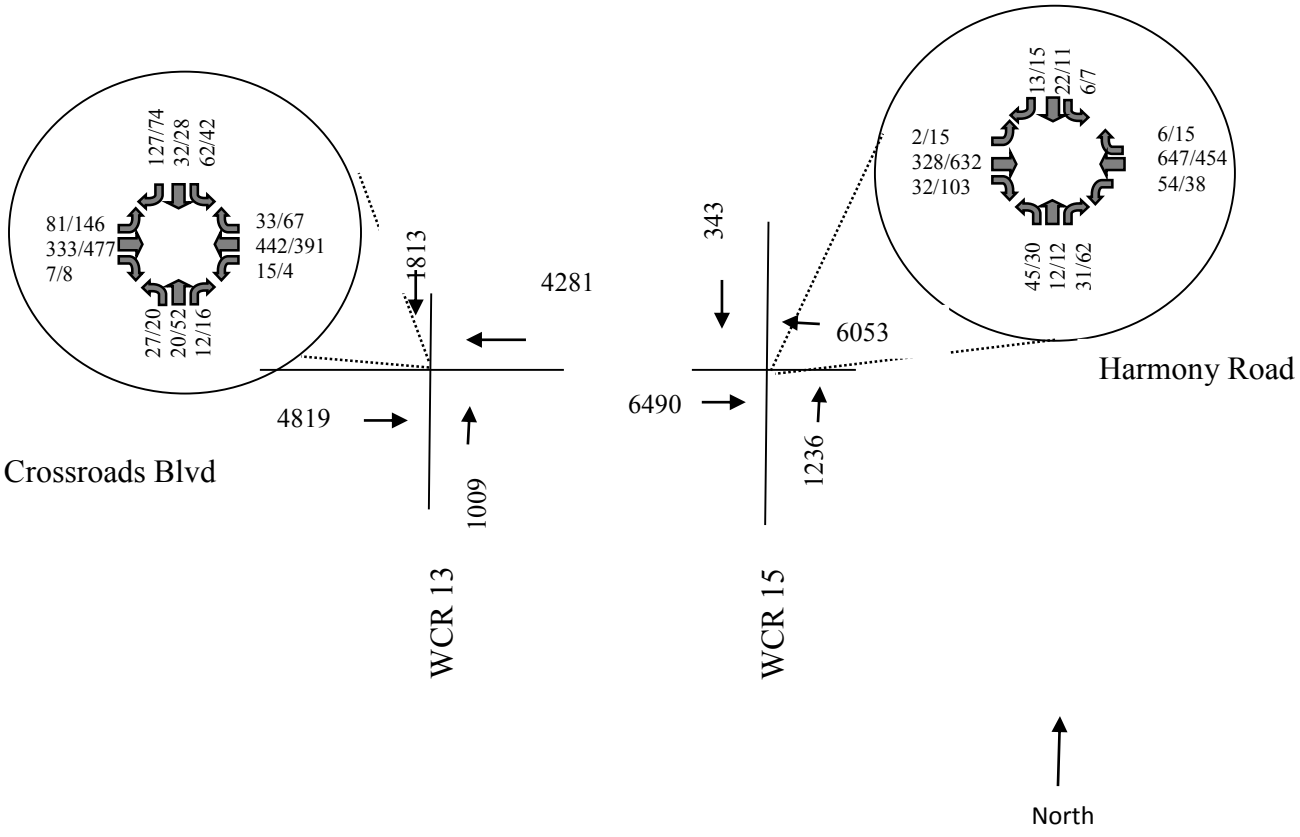

Figure 2: Existing Peak Hour Turning Movements (AM/PM)

24-Hour Approach Volumes - (#### ⟶)

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Capacity analyses were performed at the key intersections to determine if existing deficiencies exist on the roadway network. The analyses followed the procedures of the *Highway Capacity Manual 2010*.

Level of Service (LOS) is a qualitative term describing operating conditions and expressed in terms of delay. Table 1 below provides the definitions of LOS for both signalized and unsignalized intersections. Table 2 displays the results of the analyses. Both key intersections operate at acceptable levels of service from an overall perspective. However, in both intersections, the minor street (WCR13 and WCR 15) have severe delay issues in the peak hours in terms of through movements and left turns. The worksheets from the analyses can be found in **Appendix C.**

Table 1

Level of Service Definitions

Level of Service	Signalized Intersection Average Total Delay (seconds/vehicle)	Unsignalized Intersection Average Total Delay (seconds/vehicle)
A	<10	<10
B	>10 and ≤20	>10 and ≤15
C	>20 and ≤35	>15 and ≤25
D	>35 and ≤55	>25 and ≤ 35
E	>55 and≤ 80	>35 and ≤50
F	>80	>50

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Table 2 – Year 2015 – Existing Operations

		AM		PM	
Intersection	Movement	LOS	Delay(sec/vehicle)	LOS	Delay(sec/vehicle)
Crossroads/WCR 13	NBT/L	E	49.6	F	95.8
STOP Sign (TWSC)	NBR	B	10.4	B	11.7
	NB APPROACH	E	41.6	F	80.5
	EBL	A	8.7	A	9.0
	WBL	A	8.1	A	8.5
	SBL	E	42.6	F	112.1
	SBT/R	C	19.8	C	23.2
	SB APPROACH	D	26.2	E	49.1
Harmony/WCR 15	NBL	E	46.1	E	46.3
STOP Sign (TWSC)	NBT/R	C	15.6	C	18.8
	NB APPROACH	D	31.2	D	26.7
	EBL	A	9.0	A	8.4
	WBL	A	8.1	A	9.2
	SBL	D	32.2	E	44.4
	SBT/R	C	23.7	C	20.3
	SB APPROACH	C	24.9	D	25.4

Traffic crash data was requested from the Windsor Police Department, the Colorado State Patrol, and the Weld County Sheriff's Department for the years 2012, 2013, and 2014. All of the law enforcement agencies responded to the request for information. There was also considerable time spent searching the accident data base due to naming conventions by the Police Officers that responded to a crash. For example, Crossroads Boulevard may also have been reported as LCR 26 or WCR 62. Also, Harmony Road may also be known as WCR 74. Nevertheless, the data that was gathered is summarized in the Table 3 below:

Table 3 – Year 2012-2014 Summary of Traffic Crashes

Intersection	Year	Number of Crashes	Preventable with Signal
Crossroads/WCR 13	2012	5	2
	2013	3	2
	2014	13	7
Harmony/WCR 15	2012	1	0
	2013	7	2
	2014	2	0

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The Manual on Uniform Traffic Control Devices (MUTCD) provides the evaluation techniques to determine if an intersection requires a traffic signal. Traffic signals are never installed until a warrant is satisfied under the MUTCD. Traffic signals should not be installed unless one or more of these eight warrants are satisfied. Because these are minimum requirements, satisfaction of a warrant is not necessarily justification or a mandate for a traffic signal. Delay, congestion, crash experience, confusion, or other evidence of the need for right-of-way assignment must be shown. Geometric changes which may eliminate the need for a signal should be considered. A warrant is a set of criteria which can be used to define the relative need for, and appropriateness of, a particular traffic control device (i.e., STOP or YIELD sign, traffic signal, etc.).

Warrants are usually expressed in the form of numerical requirements such as the volume of vehicular or pedestrian traffic. A warrant normally carries with it a means of assigning priorities among several alternative choices. There are two fundamental concepts involved in this determination:

> **(a)** The most effective traffic control device is that which is the least restrictive while still accomplishing the intended purpose. For instance, geometric changes alone may negate the need for a traffic signal.
> **(b)** Driver response to the influences of a traffic control device has been previously identified by observation, field experience, and laboratory tests under a variety of traffic and driver conditions.

Warrants should be viewed as guidelines, not as absolute values. Satisfaction of a warrant is not a guarantee that the device is needed. The warrant analysis process is just one of the tools to be used in determining if a traffic signal is warranted.

Engineering judgement should be exercised in making the final determination. The application of warrants is effective only when combined with knowledgeable engineering judgement considering all pertinent facts. A description of the eight possible warrants follow:

1. **Warrant 1: Eight Hour Vehicular Volume** -The Minimum Vehicular Volume, Condition A is intended where a large volume of intersecting traffic is the principal reason to consider installing a traffic signal. The Interruption of Continuous Traffic, Condition B is intended where the traffic volume on a major street is so heavy that traffic on a minor intersecting street suffers excessive delay or conflict in entering or crossing the major street.

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2. **Warrant 2: Four-Hour Vehicular Volumes** - The Four-Hour Vehicular Volume signal warrant is intended to be applied where the volume of intersecting traffic is the principal reason to consider installing a traffic control signal.

3. **Warrant 3: Peak Hour** - The Peak Hour signal warrant is intended for use at a location where traffic conditions are such that for a minimum of 1 hour of an average day, the minor street traffic suffers undue delay when entering or crossing the major street.

4. **Warrant 4: Pedestrian Volume** – The Pedestrian Volume signal warrant is intended where the traffic volumes on a major experience excessive delays in crossing the major street.

5. **Warrant 5: School Crossing** - The School Crossing signal warrant is intended for application where the fact that school children cross the major street is the principal reason to consider installing a traffic control signal.

6. **Warrant 6: Coordinated Signal System** – Progressive movement in a coordinated signal system sometimes necessitates installing traffic signal at intersections where they would not otherwise be needed in order to maintain proper platooning of vehicles.

7. **Warrant 7: Crash Experience** – The Crash Experience signal warrant conditions are intended for applications where the severity and frequency of crashes are the principal reasons to consider installing a traffic control signal.

8. **Warrant 8: Roadway Network** - Installing a traffic signal at some intersections might be justified to encourage concentration and organization of traffic flow on a roadway network.

A traffic signal warrant study was conducted on both intersections using the Federal mandated process for evaluating intersections. Both intersections currently meet the criteria for traffic signalization and the results are summarized below in Table 4. The Warrant Study can be found in **Appendix D**.

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Table 4 – Year 2015 – Traffic Signal Warrant Summary

Intersection	Warrant1	Warrant 2	Warrant 3	Warrant 4	Warrant 5	Warrant 6	Warrant 7	Warrant 8
Crossroads/WCR 13		X	X				X	
Harmony/WCR 15	X	X	X					
X = Satisfies Warrant								

Under the existing traffic conditions, a traffic signal was modelled at the key intersection to determine operations. The analysis is referred to as a capacity analysis and follows the procedures in the Highway Capacity Manual. As can be seen in Table 5 below, traffic operations under today conditions would operate at acceptable levels of service. For reader convenience, Table 2 (stop sign analysis) is attached to Table 5 for easier comparison. A traffic signal greatly improves the operation of the minor streets, but however, introduces more delay on the mainline roadway that didn't exist previously.

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Table 5 – Year 2015 – Traffic Signal Operations Analysis

		AM		PM	
Intersection	**Movement**	**LOS**	**Delay(sec/vehicle)**	**LOS**	**Delay(sec/vehicle)**
Crossroads/WCR 13	NBT/L	E	49.6	F	95.8
STOP Sign (TWSC)	NBR	B	10.4	B	11.7
	NB APPROACH	E	41.6	F	80.5
	EBL	A	8.7	A	9.0
	WBL	A	8.1	A	8.5
	SBL	E	42.6	F	112.1
	SBT/R	C	19.8	C	23.2
	SB APPROACH	D	26.2	E	49.1
Harmony/WCR 15	NBL	E	46.1	E	46.3
STOP Sign (TWSC)	NBT/R	C	15.6	C	18.8
	NB APPROACH	D	31.2	D	26.7
	EBL	A	9.0	A	8.4
	WBL	A	8.1	A	9.2
	SBL	D	32.2	E	44.4
	SBT/R	C	23.7	C	20.3
	SB APPROACH	C	24.9	D	25.4
		AM		**PM**	
Intersection	**Movement**	**LOS**	**Delay(sec/vehicle)**	**LOS**	**Delay(sec/vehicle)**
Crossroads/WCR 13	EBL	B	13.1	B	12.9
SIGNAL	EBT/R	B	14.0	B	16.1
	EB APPROACH	B	13.8	B	15.4
	WBL	B	12.1	B	12.9
	WBT/R	C	25.1	C	23.0
	WB APPROACH	C	24.7	C	23.4
	NBL	B	15.0	B	14.3
	NBT/R	B	11.9	B	13.0
	NB APPROACH	B	13.3	B	13.3
	SBL	B	13.0	B	13.9
	SBT/R	B	14.2	B	13.7
	SB APPROACH	B	13.8	B	13.8
	OVERALL	B	18.3	B	17.9
Harmony/WCR 15	EBL	B	18.6	B	13.0
SIGNAL	EBT/R	A	9.2	B	13.1
	EBR	A	7.4	A	7.5
	EB APPROACH	A	9.1	B	12.3
	WBL	B	11.8	B	18.6
	WBT	B	14.4	A	9.8
	WBR	A	7.2	A	7.0
	WB APPROACH	B	14.1	B	10.4
	NBL	B	12.3	B	13.0
	NBT/R	B	11.7	B	13.3
	NB APPROACH	B	12.0	B	13.2
	SBL	B	11.8	B	13.5
	SBT/R	B	11.5	B	12.5
	SB APPROACH	B	11.6	B	12.7
	OVERALL	B	12.4	B	11.7

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The consulting team met with the North Front Range MPO staff to discuss the traffic projections for both intersections. The NFRMPO is currently in the process of updating the regional transportation plan and has recently constructed a new travel demand model. All of the cities within the NFRMPO region participated in the development of the model and provided all of the relevant data needed for the model – projections of land use, households, and future employment. Based on the model results, the intersection volumes at Harmony/WCR15 can expect to increase 35% by the year 2040. The intersection of Crossroads/WCR 13 can expect to see increases in the neighborhood of 130% in the same time frame.

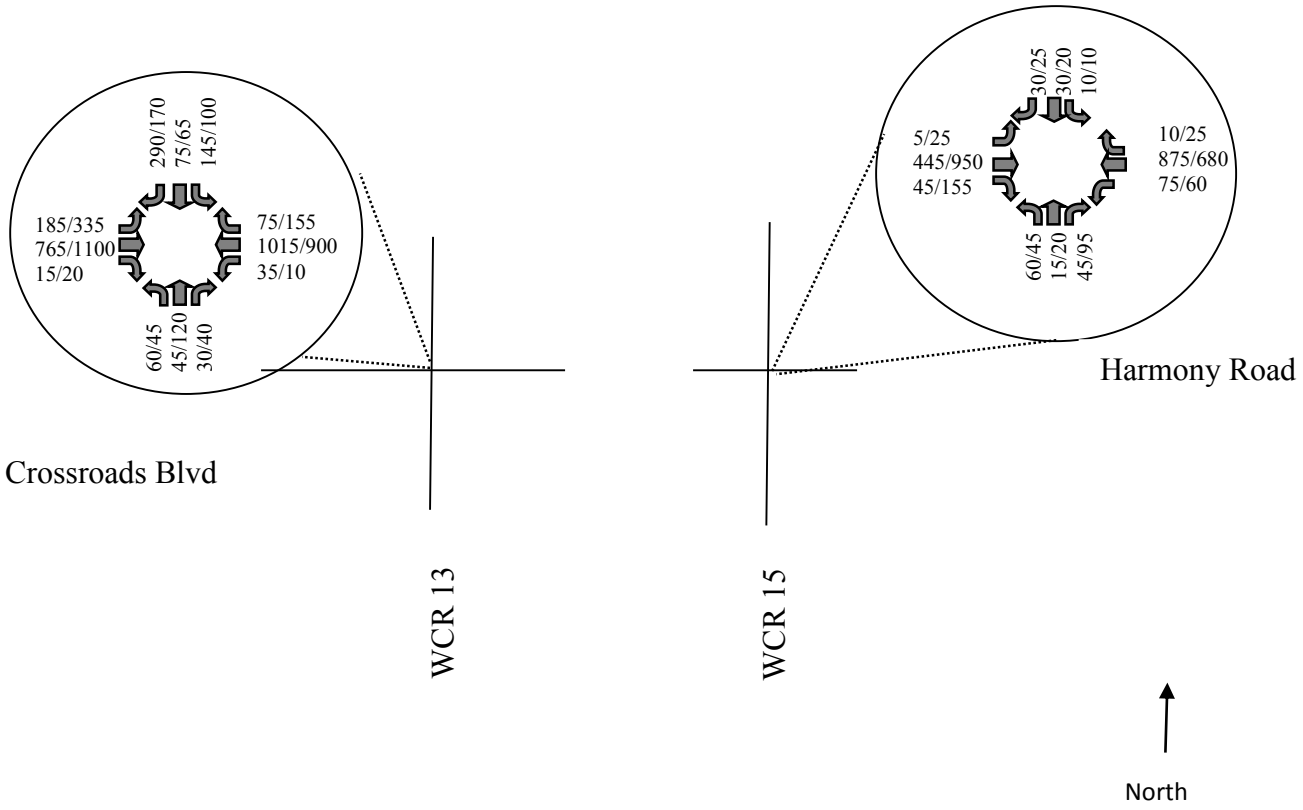

Figure 3: 2035 Projected peakk hour turning movemets (AM/ PM)

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Capacity analysis was performed on the intersections under signal operation with the existing geometry in place. Adjustments were made to signal timing plans in terms of cycle lengths and splits to try and achieve optimum traffic movements. The results of the analysis is shown in Table 6.

The intersection of Harmony Road/WCR 15 will continue to operate at acceptable levels of service in 2040 with only changes to signal timing.

The intersection of Crossroads/WCR 13 fails under the existing geometry. In order to achieve acceptable operations, Crossroads Boulevard will need to be improved to a four-lane facility. Capacity worksheets for the existing geometry are found in **Appendix E**.

Table 6 – Year 2040 – Traffic Signal Operations Analysis

Year 2040		AM		PM	
Intersection	**Movement**	**LOS**	**Delay(sec/vehicle)**	**LOS**	**Delay(sec/vehicle)**
Crossroads/WCR 13	EBL	E	71.5	F	13.7
SIGNAL	EBT/R	B	14.4	C	32.8
	EB APPROACH	C	25.3	D	53.7
	WBL	B	11.1	C	27.5
	WBT/R	F	80.0	F	113.1
	WB APPROACH	E	77.9	F	112.3
	NBL	F	131.2	F	182.3
	NBT/R	D	35.5	D	55.0
	NB APPROACH	E	77.8	F	83.1
	SBL	D	48.5	E	74.1
	SBT/R	E	169.2	F	129.7
	SB APPROACH	F	134.9	F	116.9
	OVERALL	E	70.0	F	84.1
Harmony/WCR 15	EBL	C	22.2	B	11.8
SIGNAL	EBT/R	A	7.3	B	11.9
	EBR	A	5.4	A	4.7
	EB APPROACH	A	7.3	B	10.9
	WBL	B	10.7	C	24.7
	WBT	B	12.6	A	7.2
	WBR	A	5.3	A	4.2
	WB APPROACH	B	12.4	A	8.5
	NBL	C	25.1	C	33.4
	NBT/R	C	23.3	D	35.3
	NB APPROACH	C	24.2	C	34.7
	SBL	C	23.7	D	35.2
	SBT/R	C	22.9	C	31.2
	SB APPROACH	C	23.0	C	31.9
	OVERALL	B	12.1	B	12.4

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The two intersections were then modelled with the Year 2040 projected traffic volumes as a modern roundabout. The main concern with a modern roundabout at these intersections is the unbalanced flows between the main street and the minor streets. As stated earlier the intersection of Crossroads/WCR13 has approximately a 75%-25% balance between mainline and Minor Street. The intersection of Harmony/WCR 15 has an approximate balance of 90%-10%. Good design on the mainline roadways will compensate for the flow imbalance.

The intersections were modeled with RODEL software which is an acceptable analysis tool for designing modern roundabouts.

Using the 20-year traffic projections, modern roundabout designs were considered and modelled to determine operation. Based on the findings:

- Harmony Road/WCR 15 will operate well as a single lane roundabout into the future. Level of service is at A and all legs have acceptable operation. The intersection was modelled with a 48 meter (155 foot) inscribed circle.
- The intersection of Crossroads/WCR 13 can also have acceptable operations into the future but the roundabout will need a minimum of a 175-foot inscribed circle. The roundabout will also offer some design challenges because it will require dual lane entries for the east and westbound directions in the long-term. This intersection would be very similar to the current Crossroads/7th Street roundabout.

Table 7 on the following page displays the operational characteristics of the two key intersections under modern roundabout control. The capacity worksheets for the modern roundabout control are found in **Appendix F** and the RODEL analysis is found in **Appendix G**.

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Table 7 – Year 2040 – Roundabout Operations

Intersection/Approach	Average Delay (sec)	Average Queue(vehicle)
Harmony/WCR15 AM		
NB WCR 15	4.1	0.1
WB Harmony	6.7	1.8
SB WCR15	5.6	0.1
EB Harmony	3.6	0.5
Harmony/WCR15 PM		
NB WCR 15	6.5	0.3
WB Harmony	4.8	1.1
SB WCR15	4.6	0.1
EB Harmony	10.4	3.4
Crossroads		
Crossroads/WCR 13 AM		
NB WCR 13	3.7	0.1
WB Crossroads	6	2.1
SB WCR 13	11	1.6
EB Crossroads	3.4	0.9
Crossroads/WCR 13 PM		
NB WCR 13	6	0.4
WB Crossroads	5.9	1.8
SB WCR 13	5.3	0.5
EB Crossroads	6	2.5

The modern roundabout is clearly the appropriate solution to the intersection if delay was the only criteria in the analysis. However, other factors must go into consideration prior to making any recommendation for intersection geometric changes.

From a safety perspective, a modern roundabout is a much safer intersection. By most statistics nationwide, the modern roundabout will reduce crashes by approximately 75%. On the other hand, traffic signals are the location of most accidents in an urban area; most of which can be minor. A signal can reduce the broadside type of accident which is the most severe and generally results in injury to the drivers.

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Another factor to consider in selecting an alternative is maintenance. The town of Windsor does not currently own or operate traffic signals. The skill required to operate the traffic signal is not currently available within the current work force of the local government. However, this is a service that can be contracted out to the private sector at a reasonable cost.

The roundabout solution is costly, although long-term maintenance is not excessively expensive. Due to the size of the intersections and the amount of transition required to reduce speeds on the main streets, the construction costs will be significantly higher than the current roundabouts constructed within the Town. It has been estimated, as shown in **Appendix A**, the cost of a modern roundabout at these two locations would be approximately:

- Harmony Road and WCR 15: $1,029,398
- Crossroads Boulevard and WCR 13: $1,682,650

The cost of placing traffic signals at these locations are approximately $250,000 each with an annual operation cost of approximately $5,000/year/signal.

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APPENDIX A –

CONCEPTUAL ROUNDABOUTS &

COST ESTIMATES

DATE:	04/24/15
SCALE (H):	1"=50'
SCALE (V):	N/A
DESIGNED BY:	MPO
CHECKED BY:	MPO

PROJ. NO. 1228-075-00

1

Combined 2015 Traffic Study Projects

Harmony Road and WCR 15 Conceptual Roundabout

PREPARED FOR

TOWN OF WINDSOR
301 WALNUT STREET
WINDSOR, COLORADO 80550
PHONE: 970.674.2437
FAX: 970.674.2456

INTERWEST CONSULTING GROUP
1218 W. Ash, Suite C
Windsor , Colorado 80550
Phone: (970) 674-3300
Fax: (970) 674-3303

Conceptual Cost Estimate
Town of Windsor Combined 2015 Traffic Study
5/15/15

Contract Item	Unit	Estimated Quantities	Unit Price	Total Cost
Harmony Road & Weld County Road 15 Conceptual Roundabout				
Clearing and Grubbing	LS	1	$ 20,000.00	$ 20,000
Removal of Asphalt Mat	SY	8750	$ 5.00	$ 43,750
Aggregate Base Course (Class 5 or 6) (Assumed 10")	TON	3718	$ 25.00	$ 92,950
Hot Mix Asphalt (Full Depth) (Assumed 8")	TON	2976	$ 100.00	$ 297,600
Curb and Gutter	LF	2322	$ 25.00	$ 58,050
Concrete Truck Apron (Assumed 8")	SY	357	$ 70.00	$ 24,990
Hardscape Median Cover Material (4" Patterned Conc.)	SF	14372	$ 6.00	$ 86,232
Center Island (Landscape)	SF	6648	$ 5.00	$ 33,240
				$ 656,812
50% Contingency/Allowance - Survey, Design, Utilities, Storm Drainage, Earthwork, Traffic Control:				***$ 328,406***
Parcels with ROW Impacts (Allowance for Acquisition Services)	EA	1	$ 25,000.00	*$ 25,000*
ROW Acquisition	SF	1918	$ 10.00	*$ 19,180*
Total Conceptual Estimate with Contingency and Land Cost Allowance:				***$ 1,029,398***

2	PROJ. NO. 1228-075-00	DATE: 04/24/15 SCALE (H): 1"=60' SCALE (V): N/A DESIGNED BY: MPO CHECKED BY: MPO	**COMBINED 2015 TRAFFIC STUDY PROJECTS** **CROSSROADS BLVD. AND WCR 13 CONCEPTUAL ROUNDABOUT**	PREPARED FOR **TOWN OF WINDSOR** 301 WALNUT STREET WINDSOR, COLORADO 80550 PHONE: 970.674.2437 FAX: 970.674.2456	INTERWEST CONSULTING GROUP 1218 W. Ash, Suite C Windsor , Colorado 80550 Phone: (970) 674-3300 Fax: (970) 674-3303

Conceptual Cost Estimate
Town of Windsor Combined 2015 Traffic Study
5/15/15

Contract Item	Unit	Estimated Quantities	Unit Price	Total Cost
Crossroads Blvd. & Weld County Road 13 Conceptual Roundabout				
Clearing and Grubbing	LS	1	$ 20,000.00	$ 20,000
Removal of Asphalt Mat	SY	10195	$ 5.00	$ 50,975
Aggregate Base Course (Class 5 or 6) (Assumed 10")	TON	5877	$ 25.00	$ 146,925
Hot Mix Asphalt (Full Depth) (Assumed 8")	TON	4704	$ 100.00	$ 470,400
Curb and Gutter	LF	2693	$ 25.00	$ 67,325
Concrete Truck Apron (Assumed 8")	SY	343	$ 70.00	$ 24,010
Hardscape Median Cover Material (4" Patterned Conc.)	SF	8745	$ 6.00	$ 52,470
Center Island (Landscape)	SF	6083	$ 5.00	$ 30,415
				$ 862,520
50% Contingency/Allowance - Survey, Design, Utilities, Storm Drainage, Earthwork, Traffic Control:				***$ 431,260***
Parcels with ROW Impacts (Allowance for Acquisition Services)	EA	3	$ 25,000.00	*$ 75,000*
ROW Acquisition	SF	31387	$ 10.00	*$ 313,870*
Total Conceptual Estimate with Contingency and Land Cost Allowance:				***$ 1,682,650***

Combined 2015 Traffic Study Projects

Report 2

Walnut Street and 7th Street

Prepared by:

Interwest Consulting Group
1218 West Ash, Suite C
Windsor, Colorado 80550
Phone: 970.674.3300
Fax: 970.674.3303

And

ELB Engineering, LLC
5401 Taylor Lane
Fort Collins, Colorado 80528
Phone: 970.988.7551

Prepared for:

Town of Windsor
Office of the Town Engineer
301 Walnut Street
Windsor, Colorado 80550
Phone: 970.674.2437

May 15, 2015

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Appendix B – Existing Traffic Counts	8
Appendix C – Existing Capacity and Operational Analysis	4
Appendix D – Year 2035 Capacity and Operational Analysis	4

ELB Engineering, LLC.
Transportation Engineering Solutions

Memorandum

TO: Omar Herrera, PE, Town of Windsor
Mike Oberlander, PE, Interwest Consulting

FROM: Eric L. Bracke, P.E., P.T.O.E

DATE: May 15, 2015

SUBJECT: ***Windsor Combined 2015 Traffic Studies – Report #2***
7th Street and Walnut Intersection

The Town of Windsor has secured the services of Interwest Consulting Group and ELB Engineering, LLC to conduct the *Combined 2015 Traffic Study Projects*. This project will look at three specific intersections; Harmony Road/WCR15, Crossroads Boulevard/WCR 13, and Walnut Street/7th Street. This memorandum addresses the analysis and findings for the intersection of 7th Street and Walnut. During the peak hours, this intersection becomes congested due to backups resulting from the signal at Main Street(SH392) and 7th Street (north leg is SH 257)which is located one block to the north. When congestion occurs, Walnut becomes blocked and motorists are unable to conduct through or left turn movements without experiencing unreasonable delay. A Vicinity Map of 7th and Walnut is displayed in Figure 1 on the following page.

Traffic Data

Morning and afternoon peak hour turning movements and 24-hour approach volumes were collected at the intersection of 7th Street and Walnut. The intersection is the beginning of the older residential area of Windsor but is only one block south of Main Street (SH392) commercial corridor. Seventh Street is a north-south roadway that is also SH 257 on the north leg and provides a major route for traffic within the community as well as a commuter route through the community

The traffic data for the intersection is displayed in Figure 2. The raw data can be found in **Appendix B**.

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North

Figure 1: Vicinity Map

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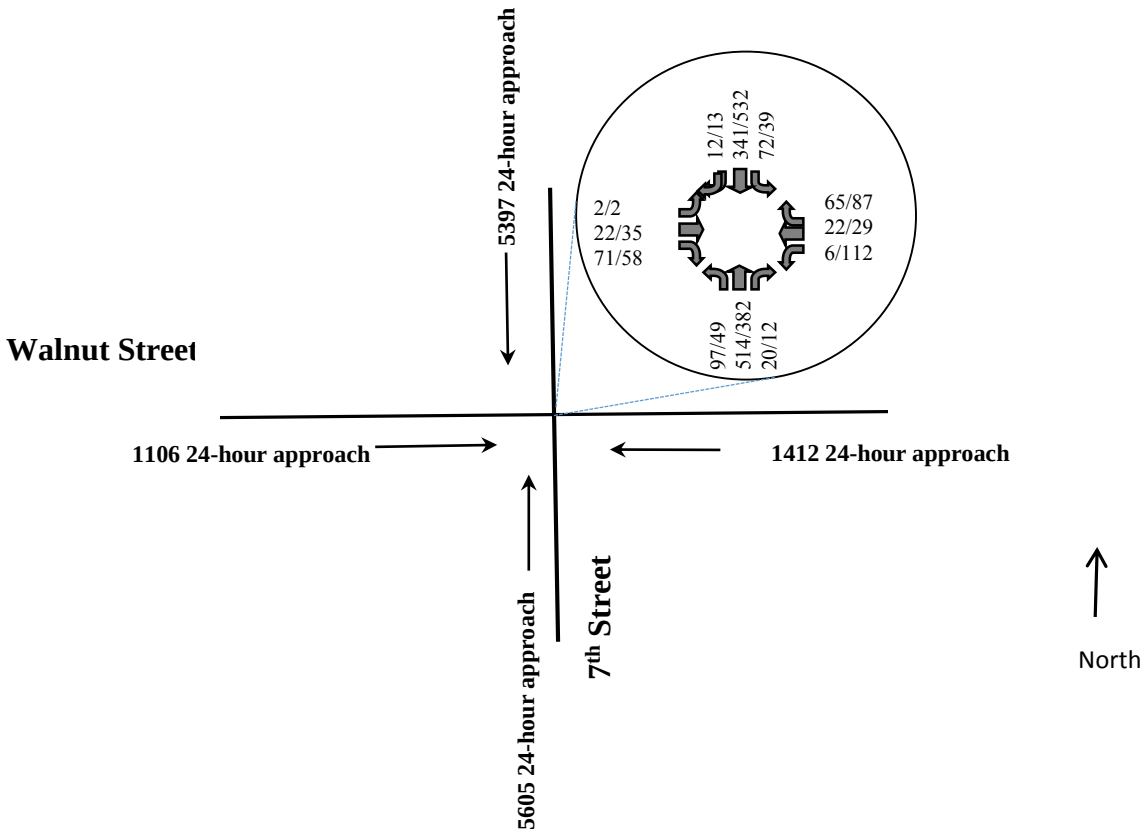

Figure 2: Existing Peak Hour Turning Movements (AM/PM)

24-Hour Approach Volumes - (#### ⟶)

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Capacity analyses were performed at the key intersection to determine if existing deficiencies exist on the roadway network. The analyses followed the procedures of the *Highway Capacity Manual 2010*.

Level of Service (LOS) is a qualitative term describing operating conditions and expressed in terms of delay. Table 1 below provides the definitions of LOS for both signalized and unsignalized intersections. Table 2 displays the results of the analyses. The intersection as a whole operates very well but there is significant delay for motorists on Walnut during the peak hours. The analysis software used in the analysis also does not take into account the blocking of the intersection which happens on a frequent basis.

The Town of Windsor is also interested in exploring the operations of a mini-roundabout as a possible solution to the issues the intersection experiences. For comparative purposes, a mini-roundabout was modeled with the existing traffic. The mini-roundabout operates very well under current conditions.

The worksheets from the analyses can be found in **Appendix C.**

Table 1

Level of Service Definitions

Level of Service	Signalized Intersection Average Total Delay (seconds/vehicle)	Unsignalized Intersection Average Total Delay (seconds/vehicle)
A	<10	<10
B	>10 and ≤20	>10 and ≤15
C	>20 and ≤35	>15 and ≤25
D	>35 and ≤55	>25 and ≤ 35
E	>55 and≤ 80	>35 and ≤50
F	>80	>50

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Table 2 – Year 2015 – Existing Operations

		AM		PM	
Intersection	Movement	LOS	Delay(sec/vehicle)	LOS	Delay(sec/vehicle)
7th Street & Walnut	NBL	A	8.4	A	8.9
STOP Sign (TWSC)	EBT/L	F	50.1	E	41.8
	EBR	C	21.4	C	24.0
	WBL/T	E	49.2	E	45.9
	WBR	C	22.5	C	19.4
	SBL	A	8.9	A	8.3
7th Street & Walnut	EB LEG	A	6.2	A	8.4
Mini Roundabout Operation	WB LEG	A	8.7	A	7.6
Existing Volumes	NB LEG	B	14.6	A	9.0
	SB LEG	A	9.5	B	12.7

Traffic crash data was requested from the Windsor Police Department, the Colorado State Patrol, and the Weld County Sheriff's Department for the past three years. Table 3 below lists the accidents that were collected. Based on the data, the intersection is not suffering from an accident history and is currently not considered unsafe.

Table 3 – Year 2012-2014 Summary of Traffic Crashes

Intersection	Year	Number of Crashes	Preventable with Signal
7th Street/Walnut	2013	3	1
	2014	1	0
	2015	1	1
March 20, 2012 thru March 20, 2015			

The need for a traffic signal is determined by the methodologies as described in the MUTCD and are never installed until a warrant is satisfied. Traffic signals should not be installed unless one or more of these eight warrants are satisfied. Because these are minimum requirements, satisfaction of a warrant is not necessarily justification or a mandate for a traffic signal. Delay, congestion, crash experience, confusion, or other evidence of the need for right-of-way assignment must be shown. Geometric changes which may eliminate the need for a signal should be considered. A warrant is a set of criteria which can be used to

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define the relative need for, and appropriateness of, a particular traffic control device (i.e., STOP or YIELD sign, traffic signal, etc.).

Warrants are usually expressed in the form of numerical requirements such as the volume of vehicular or pedestrian traffic. A warrant normally carries with it a means of assigning priorities among several alternative choices. There are two fundamental concepts involved in this determination:

> **(a)** The most effective traffic control device is that which is the least restrictive while still accomplishing the intended purpose. For instance, geometric changes alone may negate the need for a traffic signal.
> **(b)** Driver response to the influences of a traffic control device has been previously identified by observation, field experience, and laboratory tests under a variety of traffic and driver conditions.

Warrants should be viewed as guidelines, not as absolute values. Satisfaction of a warrant is not a guarantee that the device is needed. The warrant analysis process is just one of the tools to be used in determining if a traffic signal is warranted.

Engineering judgement should be exercised in making the final determination. The application of warrants is effective only when combined with knowledgeable engineering judgement considering all pertinent facts. A description of the eight possible warrants follow:

1. **Warrant 1: Eight Hour Vehicular Volume** -The Minimum Vehicular Volume, Condition A is intended where a large volume of intersecting traffic is the principal reason to consider installing a traffic signal. The Interruption of Continuous Traffic, Condition B is intended where the traffic volume on a major street is so heavy that traffic on a minor intersecting street suffers excessive delay or conflict in entering or crossing the major street.

2. **Warrant 2: Four-Hour Vehicular Volumes** - The Four-Hour Vehicular Volume signal warrant is intended to be applied where the volume of intersecting traffic is the principal reason to consider installing a traffic control signal.

3. **Warrant 3: Peak Hour** - The Peak Hour signal warrant is intended for use at a location where traffic conditions are such that for a minimum of 1 hour of an average day, the minor street traffic suffers undue delay when entering or crossing the major street.

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4. **Warrant 4: Pedestrian Volume** – The Pedestrian Volume signal warrant is intended where the traffic volumes on a major experience excessive delays in crossing the major street.

5. **Warrant 5: School Crossing** - The School Crossing signal warrant is intended for application where the fact that school children cross the major street is the principal reason to consider installing a traffic control signal.

6. **Warrant 6: Coordinated Signal System** – Progressive movement in a coordinated signal system sometimes necessitates installing traffic signal at intersections where they would not otherwise be needed in order to maintain proper platooning of vehicles.

7. **Warrant 7: Crash Experience** – The Crash Experience signal warrant conditions are intended for applications where the severity and frequency of crashes are the principal reasons to consider installing a traffic control signal.

8. **Warrant 8: Roadway Network** - Installing a traffic signal at some intersections might be justified to encourage concentration and organization of traffic flow on a roadway network.

A traffic signal warrant study was conducted on the intersection of 7th Street and Walnut utilizing the techniques described above. Based on the analysis, none of the warrants described in the MUTCD are met. In other words, a traffic signal is not an appropriate action at the intersection.

Mini- Roundabouts

The Town Engineering staff requested the consulting staff to review and analyze the possible use of a mini-roundabout at the intersection of 7th Street and Walnut. Mini-roundabouts are distinguished from traditional roundabouts primarily by their smaller size and more compact geometry. Mini-roundabouts are typically designed for speeds of 15 mph and have inscribed circles between 45-80 feet. For most mini-roundabouts, peak hours are not an issue since they are generally constructed on residential or collector roadways. However, peak hours will be a concern for 7th Street/Walnut since peak hour volumes are fairly significant on 7th Street. A capacity analysis will be performed to determine operations. In the first sections

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of this report, an analysis was conducted under current conditions and it was found to operate well.

Because of their mountable nature, mini-roundabouts do not provide the same degree of visibility and channelization provided by larger roundabouts with raised islands. As a result, mini-roundabouts have some significant limitations in applications:

- Mini-roundabouts are recommended primarily for areas in which all approaching roadways have an 85th-percentile speed of less than 30 miles per hour.
- Mini-roundabouts are not recommended in locations in which high U-turn traffic is expected. However, the mini-roundabout should be designed to accommodate a passenger vehicle conducting an occasional U-turn.
- Mini-roundabouts are not suited for traffic that have a high percentage of trucks.

An important consideration for the Town of Windsor will be the volume of traffic within the mini-roundabout. The FHWA Roundabout Design Guide recommends that mini-roundabouts be used at intersections that carry under 15,000 vehicles per day. Currently the intersection carries 13,500 vpd. The implications of this is that the future traffic can grow approximately 18% before the threshold of traffic is met. Assuming an approximately 1.75% growth per year in traffic, this gives a mini-roundabout 10 years. If the traffic on 7th continues to grow faster as in the past 5 years, then this time frame is reduced. On a 20-year time frame, the intersection could be approximately at 18,200 vpd. However, on the other side of the argument for a mini-roundabout, the mini-roundabout may operate quite well at higher volumes. The reason FHWA has recommended a 15,000 vpd threshold is only because the United States has very limited experience with high volume mini-roundabouts.

Using a 20-year horizon with an annual growth rate of approximately 1.75%, the turning movements at the intersection were increased. The 20-year projections are shown in Figure 3 on the following page.

Utilizing the Highway Capacity Method for roundabouts (planning level analysis only), the intersection was modelled with the higher volumes to analyze future performance. The intersection was also modelled under the existing configuration for comparison purposes. The results of the analysis is shown below in Table 4 and the capacity worksheets can be found in **Appendix D**.

Under the existing traffic control and future traffic conditions, the stop sign control intersection fails for the east and westbound movements. There is very high delay for this movement and would be considered unacceptable for most. The majority of people making this maneuver, would most likely find alternative routes.

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The mini-roundabout operates better than stop sign control but could also experience some issues under the full growth scenario. In the morning operation, the NB leg goes to LOS F with over 50 seconds of delay. In the PM, the SB leg will go to LOS E. The side street movements are significantly improved.

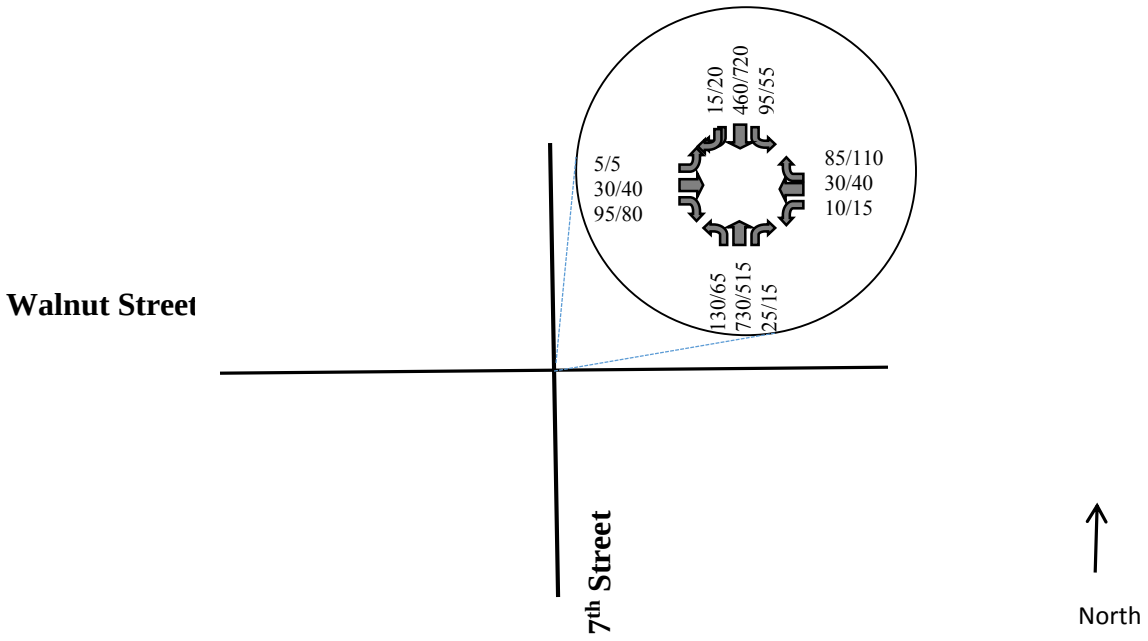

Figure 3: 20-Year Projected Turning Movements (AM/PM)

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Table 4 – Year 2035 Capacity Analysis

		AM		PM	
Intersection	**Movement**	**LOS**	**Delay(sec/vehicle)**	**LOS**	**Delay(sec/vehicle)**
7th Street & Walnut	NBL	A	9.8	A	9.0
STOP Sign (TWSC)	EBT/L	F	149.9	F	257.9
	EBR	F	74.9	F	64.7
	WBL/T	F	233.4	F	295.3
	WBR	F	54.8	F	83.7
	SBL	A	8.8	B	10.1
7th Street & Walnut	EB LEG	A	9.2	B	12.7
Mini Roundabout Operation	WB LEG	B	14.0	B	10.5
	NB LEG	F	50.5	B	13.6
	SB LEG	C	15.0	D	29.3

Discussion and Conclusion

The traffic signal is controlled by the Colorado Department of Transportation and will likely continue to cause backups on Main Street. Over time, it is likely that cycle lengths of the traffic signal will increase and delays will continue to increase and become worse for the residents of Windsor.

Whether the intersection of 7th Street and Walnut is controlled with a mini-roundabout or a stop sign, the backup will occur. Backed up traffic is still a problem regardless of intersection control type.

The construction of a mini-roundabout appears to be a good idea on face value. However, the solution to the problem may be short-lived and the Town may be addressing the same issue in only a few short years.

The consulting team of Interwest Consulting and ELB Engineering recommend the following actions by the Town of Windsor to address the existing issues at the intersection:

- In the short-term, the Town of Windsor should paint a white box in the northbound lane of 7th Street and stencil "DO NOT BLOCK INTERSECTION". This painted

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5401 Taylor Lane
Fort Collins, CO 80528
970-988-7551
ELBEngineering@lpbroadband.net

box should be the width of 7th Street. This action is likely to solve the blocking issues during the peak hours and ease the eastbound and westbound movements at the intersection.

- If the short-term solution fails, the Town should consider modifying the turning movements at the intersection to a ¾ movement. The east and westbound through movements and left turn movements would be eliminated and controlled through raised medians. The movements that are being eliminated are relatively minor movements and those drivers will find alternative routes.

- The third option to consider is the "Do Nothing" alternative. The movements experiencing the most delay are very minor movements and eventually, drivers will find alternative routes. The intersection is not considered unsafe, but only experiencing delay problems. The Town should weight the expense of intersection modification against the benefit of improving a minor movement.

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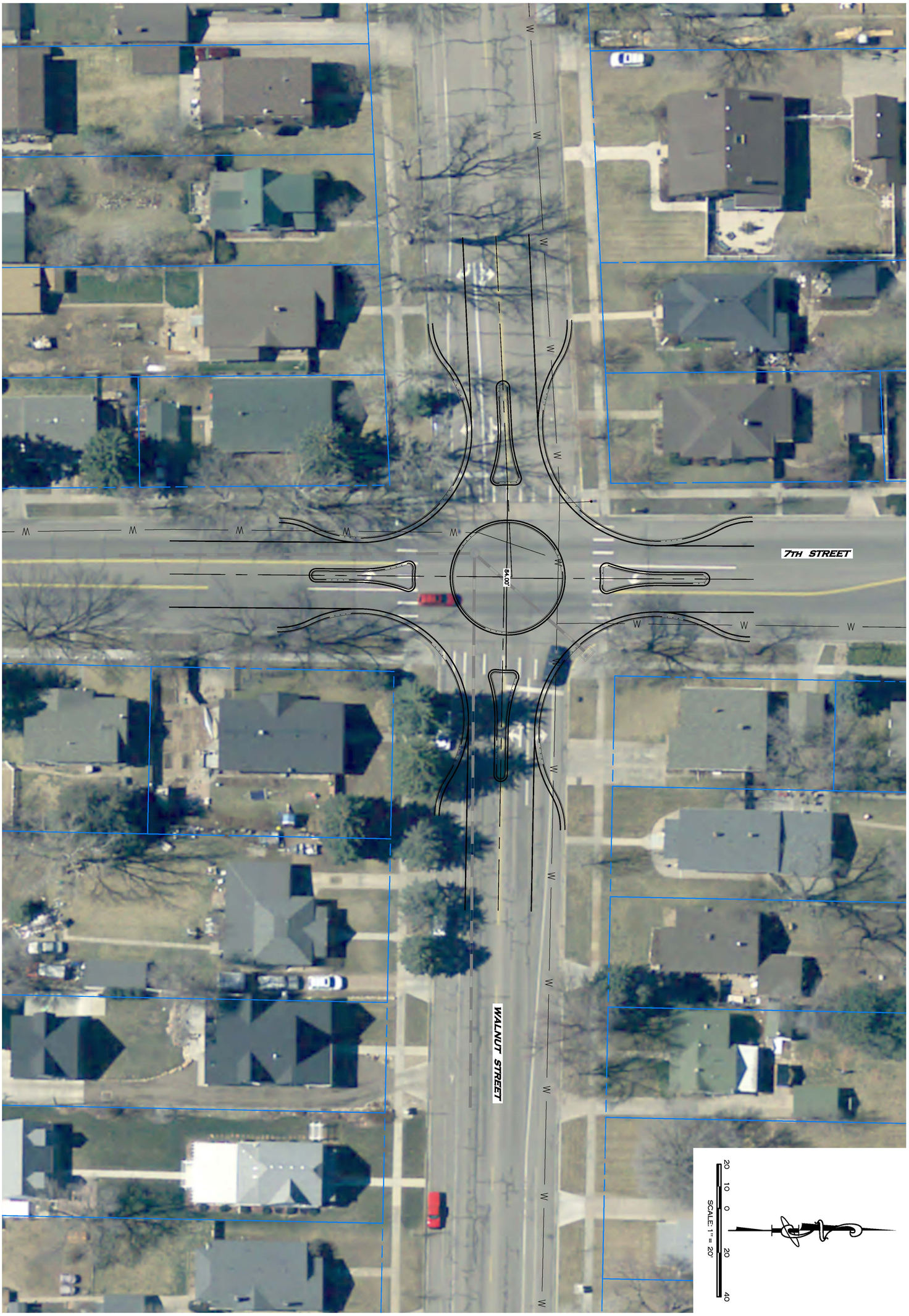
APPENDIX A –

CONCEPTUAL MINI-ROUNDABOUT &

COST ESTIMATE



DATE: 04/24/15	**COMBINED 2015 TRAFFIC STUDY PROJECTS**	**PREPARED FOR**
SCALE (H): 1"=20'		**TOWN OF WINDSOR**
SCALE (V): N/A	**WALNUT STREET AND 7TH STREET CONCEPTUAL MINI-ROUNDABOUT**	301 WALNUT STREET
DESIGNED BY: MPO		WINDSOR, COLORADO 80550
CHECKED BY: MPO		PHONE: 970.674.2437
		FAX: 970.674.2456

PROJ. NO. 1228-075-00

1

INTERWEST CONSULTING GROUP
1218 W. Ash, Suite C
Windsor , Colorado 80550
Phone: (970) 674-3300
Fax: (970) 674-3303

Conceptual Cost Estimate
Town of Windsor Combined 2015 Traffic Study
5/15/15

Contract Item	Unit	Estimated Quantities	Unit Price	Total Cost
Walnut Street & 7th Street Conceptual Mini-Roundabout				
Clearing and Grubbing	LS	1	$ 5,000.00	$ 5,000
Removal of Asphalt Mat	SY	2517	$ 5.00	$ 12,585
Aggregate Base Course (Class 5 or 6) (Assumed 10")	TON	914	$ 25.00	$ 22,850
Hot Mix Asphalt (Full Depth) (Assumed 8")	TON	732	$ 100.00	$ 73,200
Curb and Gutter	LF	1264	$ 25.00	$ 31,600
Hardscape Median Cover Material (8" Conc.)	SF	2714	$ 10.00	$ 27,140
Concrete Curb Ramp	SY	129	$ 90.00	$ 11,610
				$ 183,985
50% Contingency/Allowance - Survey, Design, Utilities, Storm Drainage, Earthwork, Traffic Control:				***$ 91,993***
Total Conceptual Estimate with Contingency:				***$ 275,978***

Windsor Town Board Work Session

June 8, 2015

Combined

2015 Traffic Study Projects

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TOWN OF WINDSOR
COLORADO

Purpose of the Study:

Examine and Review Current Traffic Conditions:

- **Harmony Road and WCR 15**
- **Crossroads Boulevard and WCR 13**
- **7th Street and Walnut**

Prepare Long-Range Traffic Projections

Recommend Improvements

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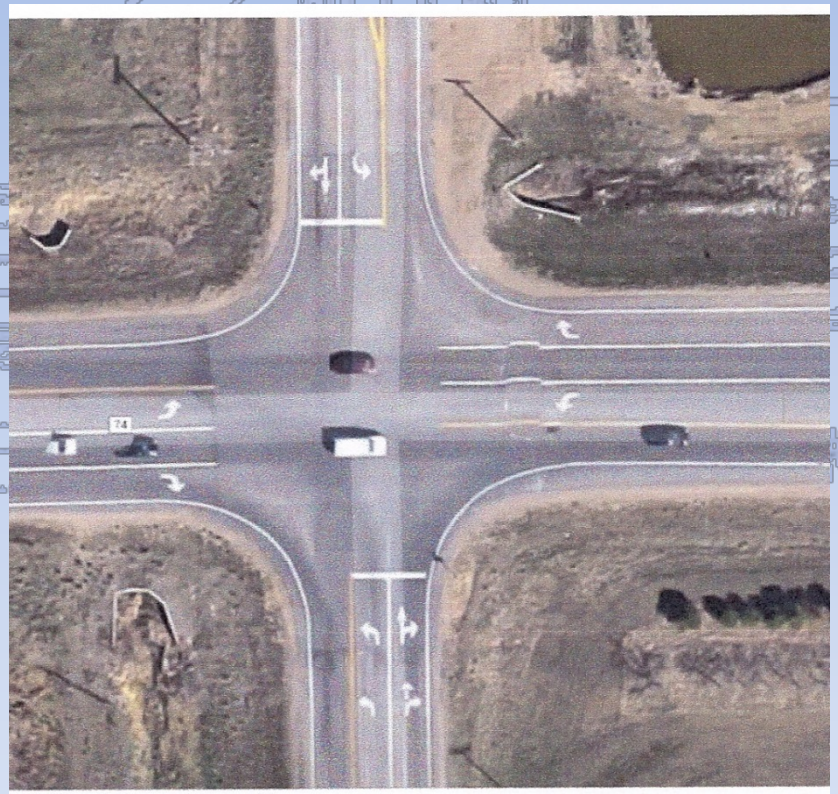
Harmony Road and Weld County Road 15



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Existing Conditions:

- **Approximately 14,000 vehicles enter/day**
- **1,200 veh/AM Peak**
- **1,400 veh/PM Peak**
- **Flow Imbalance of 89% - 11%**

Level of Service

		AM		PM	
Intersection	**Movement**	**LOS**	**Delay(sec/vehicle)**	**LOS**	**Delay(sec/vehicle)**
Harmony/WCR 15	NBL	E	46.1	E	46.3
STOP Sign (TWSC)	NBT/R	C	15.6	C	18.8
	NB APPROACH	D	31.2	D	26.7
	EBL	A	9.0	A	8.4
	WBL	A	8.1	A	9.2
	SBL	D	32.2	E	44.4
	SBT/R	C	23.7	C	20.3
	SB APPROACH	C	24.9	D	25.4

Traffic Crashes

Intersection	Year	Number of Crashes	Preventable with Signal
Harmony/WCR 15	2012	1	0
	2013	7	2
	2014	2	0

Traffic Signal Warrant Evaluation

- **Evaluation Based on the *Manual on Uniform Traffic Control Devices***
- **8 Warrants are evaluated – only 1 needs to be satisfied**
- **Harmony Road/WCR 15 met Warrants:**
  - **4-Hour Vehicular Volume**
  - **Peak Hour Warrant**
  - **8-hour Vehicular volume**

Future Traffic Projections – Year 2040

- **Based on the Regional Travel Model – traffic is expected to increase by 35%**
- **Evaluated under both traffic signal and modern roundabout for future conditions**

Results of Evaluation – Traffic Signal

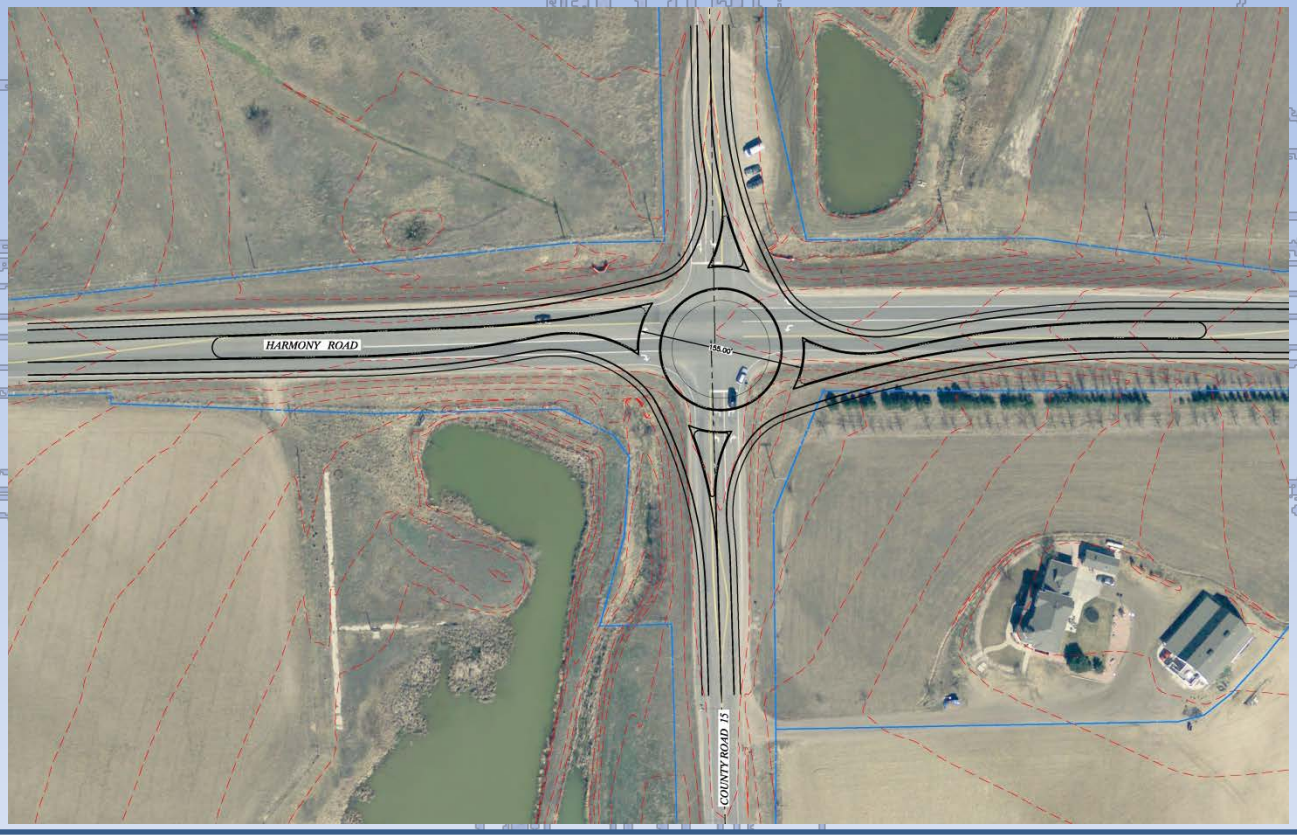
		AM		PM	
Intersection	Movement	LOS	Delay(sec/vehicle)	LOS	Delay(sec/vehicle)
Harmony/WCR 15	EBL	C	22.2	B	11.8
SIGNAL	EBT/R	A	7.3	B	11.9
	EBR	A	5.4	A	4.7
	EB APPROACH	A	7.3	B	10.9
	WBL	B	10.7	C	24.7
	WBT	B	12.6	A	7.2
	WBR	A	5.3	A	4.2
	WB APPROACH	B	12.4	A	8.5
	NBL	C	25.1	C	33.4
	NBT/R	C	23.3	D	35.3
	NB APPROACH	C	24.2	C	34.7
	SBL	C	23.7	D	35.2
	SBT/R	C	22.9	C	31.2
	SB APPROACH	C	23.0	C	31.9
	OVERALL	B	12.1	B	12.4

Results of Evaluation – Modern Roundabout

Intersection/Approach	Average Delay (sec)	Average Queue(vehicle)
Harmony/WCR15 AM		
NB WCR 15	4.1	0.1
WB Harmony	6.7	1.8
SB WCR15	5.6	0.1
EB Harmony	3.6	0.5
Harmony/WCR15 PM		
NB WCR 15	6.5	0.3
WB Harmony	4.8	1.1
SB WCR15	4.6	0.1
EB Harmony	10.4	3.4

TOWN OF WINDSOR
COLORADO

Harmony / WCR 15 – Modern Roundabout Conceptual Layout



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Combined
2015 Traffic Study Projects

ELB Engineering, LLC

Harmony Road/WCR 15 Conclusions

- **Traffic Signal and the Roundabout both operate very well in the long-range future – roundabout has better operation**
- **Traffic Signal costs approximately $250,000 to construct and approximately $5,000/year to operate**
- **Modern Roundabout construction cost estimated at $1.0 million**

TOWN OF WINDSOR
COLORADO

Crossroads Boulevard and Weld County Road 13

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Existing Conditions

- **Approximately 12,000 vehicles enter/day**
- **1,200 veh/AM Peak**
- **1,300 veh/PM Peak**
- **Flow Imbalance of 76% - 24%**

Level of Service

		AM		PM	
Intersection	**Movement**	**LOS**	**Delay(sec/vehicle)**	**LOS**	**Delay(sec/vehicle)**
Crossroads/WCR 13	NBT/L	E	49.6	F	95.8
STOP Sign (TWSC)	NBR	B	10.4	B	11.7
	NB APPROACH	E	41.6	F	80.5
	EBL	A	8.7	A	9.0
	WBL	A	8.1	A	8.5
	SBL	E	42.6	F	112.1
	SBT/R	C	19.8	C	23.2
	SB APPROACH	D	26.2	E	49.1

Traffic Crashes

Intersection	Year	Number of Crashes	Preventable with Signal
Crossroads/WCR 13	2012	5	2
	2013	3	2
	2014	13	7

Combined

2015 Traffic Study Projects

Traffic Signal Warrant Evaluation

- **Evaluation Based on the *Manual on Uniform Traffic Control Devices***
- **8 Warrants are evaluated – only 1 needs to be satisfied**
- **Harmony Road/WCR 13 met Warrants:**
  - **4-Hour Vehicular Volume**
  - **Peak Hour Warrant**
  - **8-hour Vehicular volume**
  - **Crash Experience**

Future Traffic Projections – Year 2040

- **Based on the Regional Travel Model – traffic is expected to increase by 130% -- This will be an issue**
- **Evaluated under both traffic signal and modern roundabout for future conditions**

Results of Evaluation – Traffic Signal – Existing Geometry

Year 2040		AM		PM	
Intersection	Movement	LOS	Delay(sec/vehicle)	LOS	Delay(sec/vehicle)
Crossroads/WCR 13	EBL	E	71.5	A	13.7
SIGNAL	EBT/R	B	14.4	C	32.8
	EB APPROACH	C	25.3	D	53.7
	WBL	B	11.1	C	27.5
	WBT/R	F	80.0	F	113.1
	WB APPROACH	E	77.9	F	112.3
	NBL	F	131.2	F	182.3
	NBT/R	D	35.5	D	55.0
	NB APPROACH	E	77.8	F	83.1
	SBL	D	48.5	E	74.1
	SBT/R	E	169.2	F	129.7
	SB APPROACH	F	134.9	F	116.9
	OVERALL	E	70.0	F	84.1

Results of Evaluation – Modern Roundabout

Intersection/Approach	Average Delay (sec)	Average Queue(vehicle)
Crossroads/WCR 13 AM		
NB WCR 13	3.7	0.1
WB Crossroads	6	2.1
SB WCR 13	11	1.6
EB Crossroads	3.4	0.9
Crossroads/WCR 13 PM		
NB WCR 13	6	0.4
WB Crossroads	5.9	1.8
SB WCR 13	5.3	0.5
EB Crossroads	6	2.5

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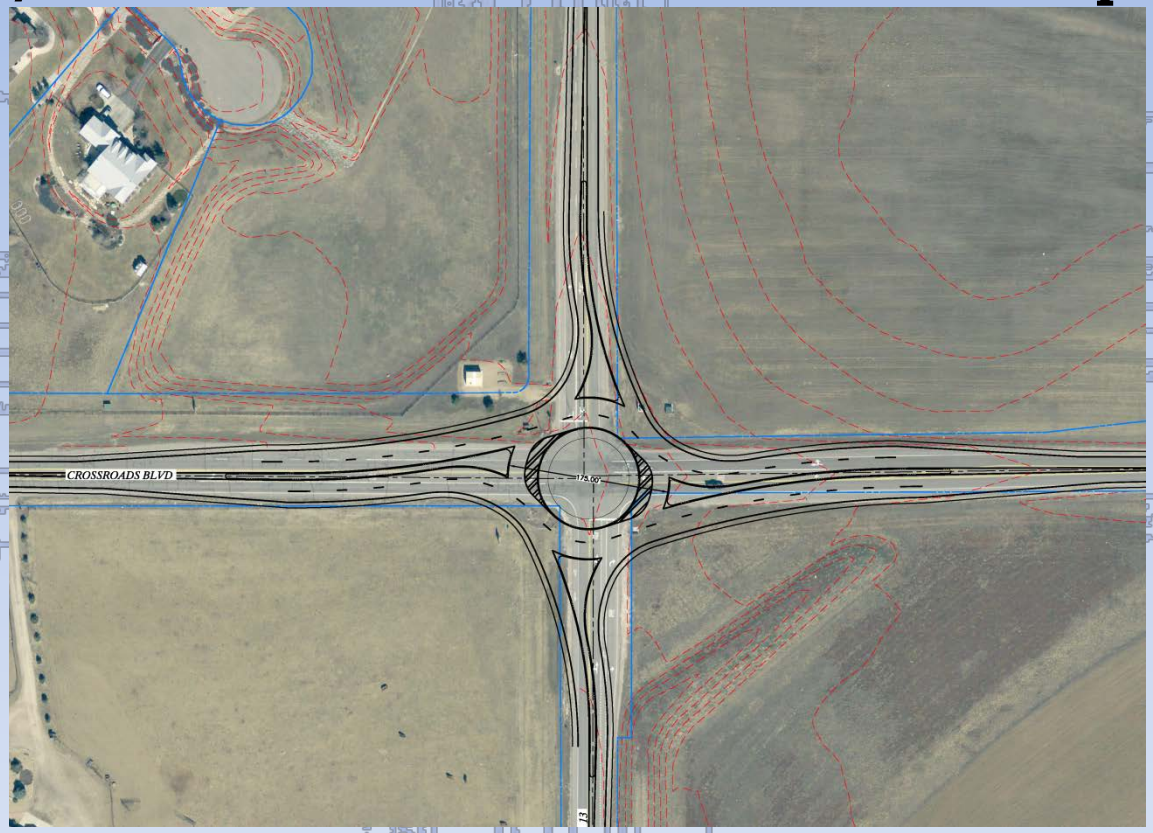
COLORADO

Crossroads/ WCR 13 – Modern Roundabout Conceptual Layout



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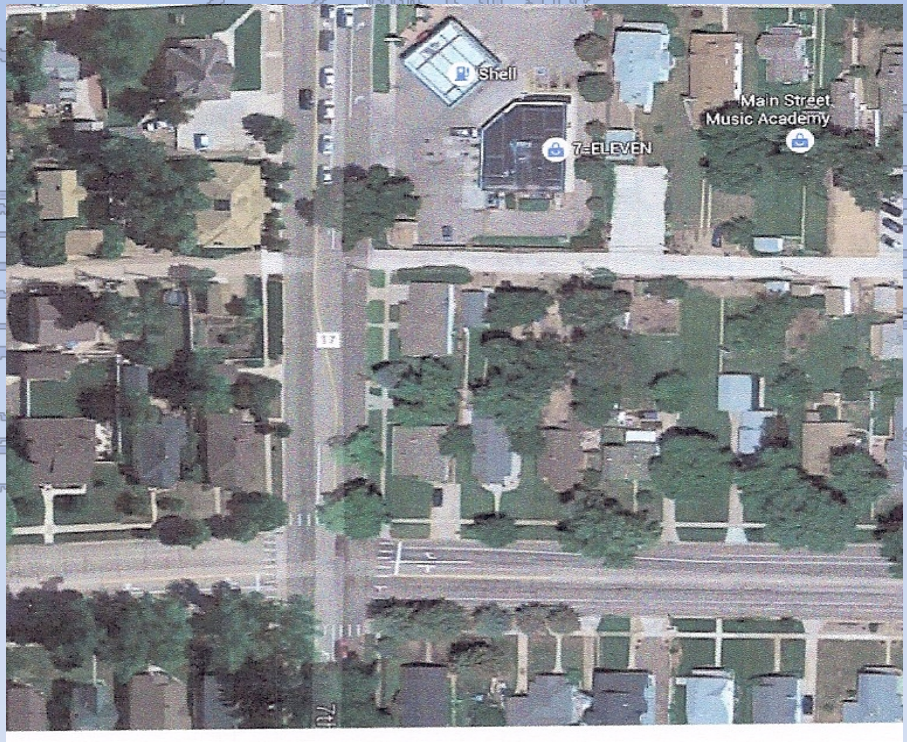
Crossroads/WCR13 Conclusions

- **Short-term solution is a traffic signal.**
- **Long-term solution requires geometric. improvements: separate lanes for left, through, and right. Crossroads will need to be a 4-lane facility.**
- **Modern roundabout will be large but can operate effectively.**
- **Traffic Signal costs approximately $250,000 to construct and approximately $5,000/year to operate**
- **Modern Roundabout construction cost estimated at $1.7 million**

TOWN OF WINDSOR
COLORADO

7th Street and Walnut



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TOWN OF WINDSOR
COLORADO

Existing Conditions

- Approximately 13,000 vehicles/day enter the intersection
- A flow imbalance of 82% -18%
- Backups from 7th/Main frequently block the Walnut intersection
- No significant accident history – 5 crashes in past 3 years
- Side Street Delay – primarily left turns have significant delay
- Side street movements are minimal during peak hours – drivers finding alternative routes
- Intersection operates well during off-peak times

Current Operations

- **Intersection as a whole operates well**
- **Team evaluated mini-round alternative**

		AM		PM	
Intersection	**Movement**	**LOS**	**Delay(sec/vehicle)**	**LOS**	**Delay(sec/vehicle)**
7th Street & Walnut	NBL	A	8.4	A	8.9
STOP Sign (TWSC)	EBT/L	F	50.1	E	41.8
	EBR	C	21.4	C	24.0
	WBL/T	E	49.2	E	45.9
	WBR	C	22.5	C	19.4
	SBL	A	8.9	A	8.3
7th Street & Walnut	EB LEG	A	6.2	A	8.4
Mini Roundabout Operation	WB LEG	A	8.7	A	7.6
Existing Volumes	NB LEG	B	14.6	A	9.0
	SB LEG	A	9.5	B	12.7

Future Operations

- Intersection does not meet traffic signal warrants.
- FHWA recommends mini-roundabouts only up to intersections that have 15,000 vpd. 7th/Walnut very close to the maximum limit.
- Mini-roundabout does not operate well in the long-term.
- A mini-roundabout will function no differently than current conditions when traffic is backed up at 7th/Main.

Recommended Alternatives

- **"Do Not Block Intersection" signage – with enforcement.**

Recommended Alternatives continued….

- **Modify intersection to a ¾ movement – allow right-in/right-out on Walnut with a southbound left turn to Walnut allowed – this option removes through movements on Walnut.**

- **Do Nothing – very common for minor street left turns to be at LOS F during peak hours. The movement is low volume and alternatives are available.**

FUTURE TOWN BOARD MEETINGS

Work Sessions & Regular Meetings will be held in the Board Chambers unless otherwise noted.

June 15, 2015 6:00 p.m. Aspen Room / CRC	Town Board Work Session Discussion with Owners of Property in the Northeast Quadrant of the I-25/392 Corridor Activity Center
June 22, 2015 6:00 p.m.	Town Board Work Session Downtown Parking Regulations Minimum Exterior Standards for Non-Residential Metal Buildings Food Cart as Accessory Use Regulations
June 22, 2015 7:00 p.m.	Town Board Meeting
June 29, 2015	5th Monday
July 6, 2015 6:00 p.m.	Town Board Work Session
July 13, 2015 5:30 p.m./1st floor conference room	Board/Manager/Attorney Monthly Meeting
July 13, 2015 7:00 p.m.	Town Board Meeting Kern Board Meeting
July 20, 2015 6:00 p.m.	Town Board Work Session Parks, Recreation and Culture Legacy Plan
July 27, 2015 6:00 p.m.	Town Board Work Session
July 27, 2015 7:00 p.m.	Town Board Meeting
August 3, 2015 6:00 p.m.	Town Board Work Session
August 10, 2015 5:30 p.m./1st floor conference room	Board/Manager/Attorney Monthly Meeting
August 10, 2015 7:00 p.m.	Town Board Meeting
August 17, 2015 6:00 p.m.	Town Board Work Session Capital Improvement Plan
August 24, 2015 6:00 p.m.	Town Board Work Session

August 24, 2015 7:00 p.m.	Town Board Meeting
August 31, 2015	Fifth Monday

Additional Events

Comprehensive Plan Meetings

June 9, 2015; 6 pm	Kristie Melendez - District 4 at Mountain View Elementary School Gym
June 11, 2015; 6 pm	Robert Bishop-Cotner - District 5 at Windsor Town Hall
June 16-19	Colorado Municipal League; Breckenridge – attending Vazquez, Baker, Melendez, Adams, Morgan, Rose, Arnold

Future Work Session Topics

Development Review Discussion of Commercial/Industrial Preference vs. Residential
Construction Defects