



LSC TRANSPORTATION CONSULTANTS, INC.

1889 York Street
Denver, CO 80206
(303) 333-1105
FAX (303) 333-1107
E-mail: lsc@lscdenver.com

EPC 5/23/2018

May 4, 2018

Mr. Jeff Mark
The Landhuis Company
212 N. Wahsatch Avenue, Suite 301
Colorado Springs, CO 80903

Re: Lorson Ranch East
Roundabout Report
El Paso County, CO
LSC #164360

Dear Mr. Mark:

We are pleased to submit this updated roundabout design report for the intersection of Fontaine Boulevard and Lamprey Drive in El Paso County, Colorado to address County comments.

Roundabout Layout

Figure 1 and Table 1 show the conceptual roundabout design parameters. The overall diameter is 150 feet and the entry phi angles are between 18.5 and 20.0 degrees on each of the approaches.

Design Vehicle

Figures 2 through 5 show WB-67 truck paths through the proposed roundabout for the various approaches. A minimum of one foot of clearance is maintained between all wheel paths and vertical curbs.

Design Speeds

Figures 6 through 9 show the estimated fastest path radii for each of the approaches to the proposed roundabout. These paths are drawn in accordance with the methodology outlined in the *Roundabout Informational Guide* (NCHRP 672). The fastest entry path should generally be no more than about 25 mph for single-lane approaches and 30 mph for two-lane approaches. The fastest entry path for each of the four approaches meets this criteria.

Pedestrian Safety and Accessibility

Pedestrian crossings with pedestrian refuge areas on the splitter islands have been provided on all four approaches. The *Roundabout Informational Guide* (NCHRP 672) gives recommendations for placement and design of pedestrian crossings. The recommendations given in the

dations for placement and design of pedestrian crossings. The recommendations given in the *Roundabout Informational Guide* (NCHRP 672) were followed in the proposed design including the following:

- Pedestrian refuge widths are a minimum of 6 feet;
- Pedestrian refuge widths that will accommodate bicycles should be increased to a minimum of ten feet;
- Pedestrian crossings are generally set back 25 feet from the yield line.

In addition, detached sidewalks should be provided on the corners of the roundabout that provide pedestrian crossings. The following recommendations are given when designing the vertical aspects of the proposed roundabout:

- Pedestrian refuge areas should be designed at street level rather than elevated to the height of the splitter island;
- Ramps should be provided and designed in accordance with ADA standards on each end of the crosswalk;
- Detectable warning surfaces in accordance with ADA standards should be provided at ramps and the pedestrian refuge area of the splitter islands.
- The truck apron should be textured and raised above the circulating roadway. The specific design will be determined as part of the construction plans.

Bike Lanes

There are on-street bike lanes proposed along Fontaine Boulevard. As on-street cyclists approach the roundabout, they will enter the vehicle lane and traverse the roundabout as a vehicle or use the bike lane ramps to exit the bike lane onto the adjacent multi-use path and traverse the roundabout as a pedestrian.

Sight Triangles

Figure 10 shows the sight triangles in which no items taller than two feet that would restrict sight distance should be located. Entering intersection sight triangles are based on the average of R1 and R2. The approach sight triangles are based on 50 mph for Fontaine Boulevard and 35 mph for Lamprey Drive.

CAPACITY ANALYSIS

The 2040 total traffic volumes were evaluated using Rodel. The results show acceptable operations are expected through 2040. The Rodel reports are attached for reference.

* * * * *

We trust that our findings and recommendations will assist in the planning and design of the proposed roundabout. Please call if we can be of further assistance.

Respectfully submitted,

LSC Transportation Consultants, Inc.

By: _____

Christopher S. McGranahan, P.E. BTOE
Principal



CSM/wc

Enclosures: Table 1
Figures 1 - 10
Rodel Reports

Z:\LSC\Projects\2016\164360-LorsonRanch\May-2018\RoundaboutReport-050418.wpd

County report review is provided only for general conformance with County standards and design criteria. The County is not responsible for the accuracy and adequacy of the data, analysis, or conclusions. The County through the approval of this document assumes no responsibility for completeness and/or accuracy of this document.

Table 1
Lorson Ranch East Roundabout
Fontaine Boulevard/Lamprey Drive
El Paso County, CO
LSC #164360; May, 2018

ROUNDABOUT CRITICAL DESIGN PARAMETERS

Design Parameters	Leg 1	Leg 2	Leg 3	Leg 4
Approach Width, FT	14.0	14.0	14.0	14.0
Entry Width, FT	16.0	16.0	16.0	16.0
Entry Angle, PHI ϕ , DEG	18.5	20.0	18.5	20.0
Inscribed Circle Diameter, FT	150.0	150.0	150.0	150.0
Exit Width, FT	20.0	20.0	20.0	20.0
Circulating Roadway Width Upstream of Entry, FT	20.0	20.0	20.0	20.0

Fastest Speed Path

R ₁ - Radius/Speed, FT/MPH	135	22	169	24	133	22	169	24
R ₂ - Radius/Speed, FT/MPH	92	20	94	20	96	20	100	20
R ₃ - Radius/Speed, FT/MPH	524	36	423	33	408	33	406	33
R ₄ - Radius/Speed, FT/MPH	62	17	63	17	73	18	62	17
R ₅ - Radius/Speed, FT/MPH	97	20	97	20	98	20	97	20
Bypass R ₅ - Radius/Speed, FT/MPH								

Minimum Sight Parameters

Approach Design Speed, MPH	35		50		35		50	
Horizontal Stopping Sight Distance, FT	248		427		248		427	
Circulating Intersection Sight Distance, FT/MPH	113	20	113	20	113	20	113	20
Entering Intersection Sight Distance, FT/MPH	123	22	135	23	123	22	135	23

Design Vehicle: WB-67

Truck Apron Width: 12

OSOW Accommodations: WB-67 is maximum vehicle that can be accommodated.

Circulating Roadway Cross-Slope: 2%

Access Control: There is no access proposed within the limits of the roundabout.

Parking Control: No on-street parking on any of the intersecting roads.

Bicycle & Pedestrian Accommodations: Bike lanes are transitioned through the roundabout for the east-west direction. Pedestrian refuges are provided within each of the four splitter islands.

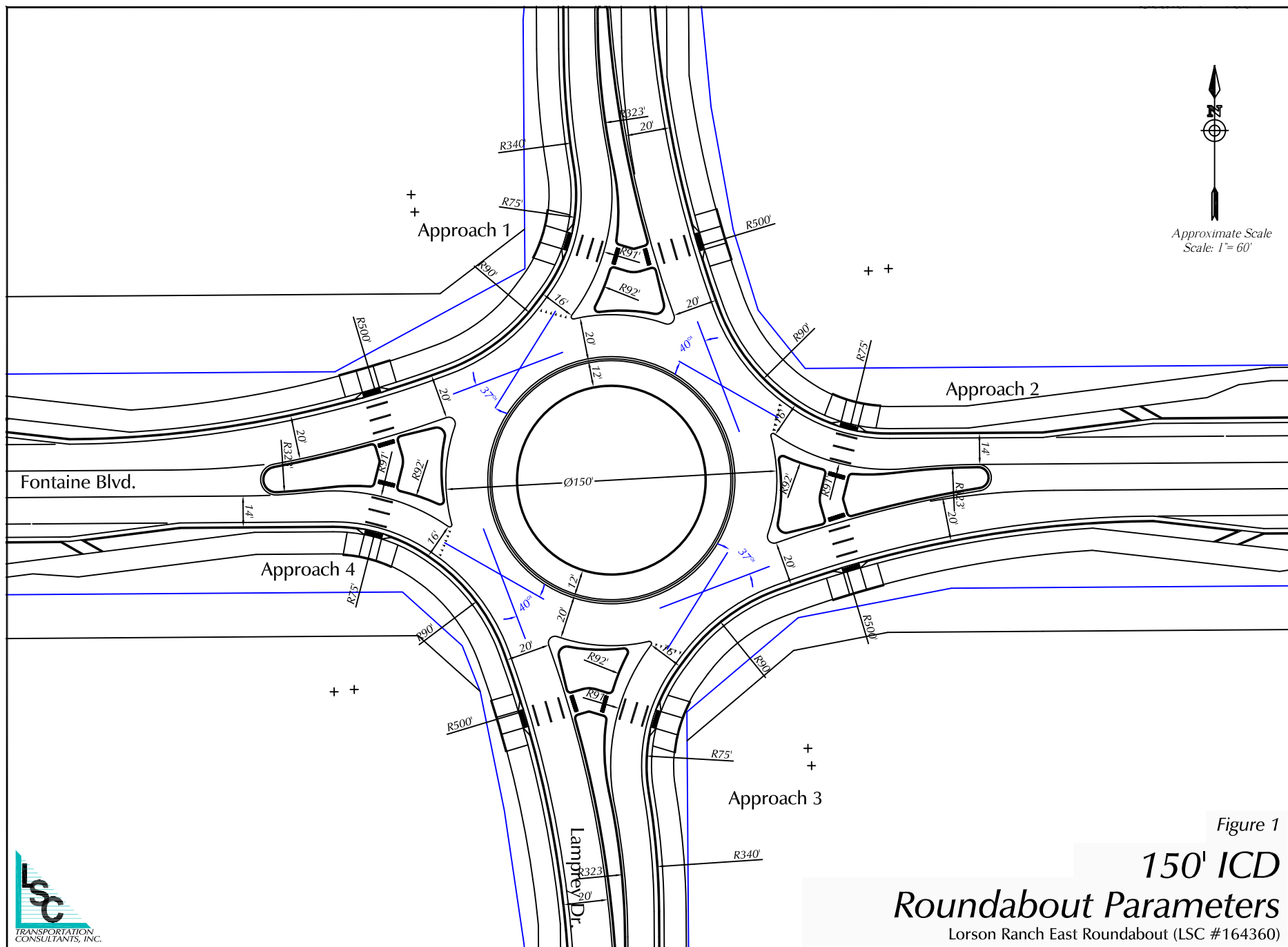
Designer: Matt Romero/Chris McGranahan
Reviewer:

SIGNATURE: _____

DATE: _____

NAME: _____

The reviewer's signature on this document indicates that the design has been reviewed and is in general compliance with good roundabout principals. The critical design elements have been addressed. The project design engineer in responsible charge of final plan development will stamp the plans when applicable.



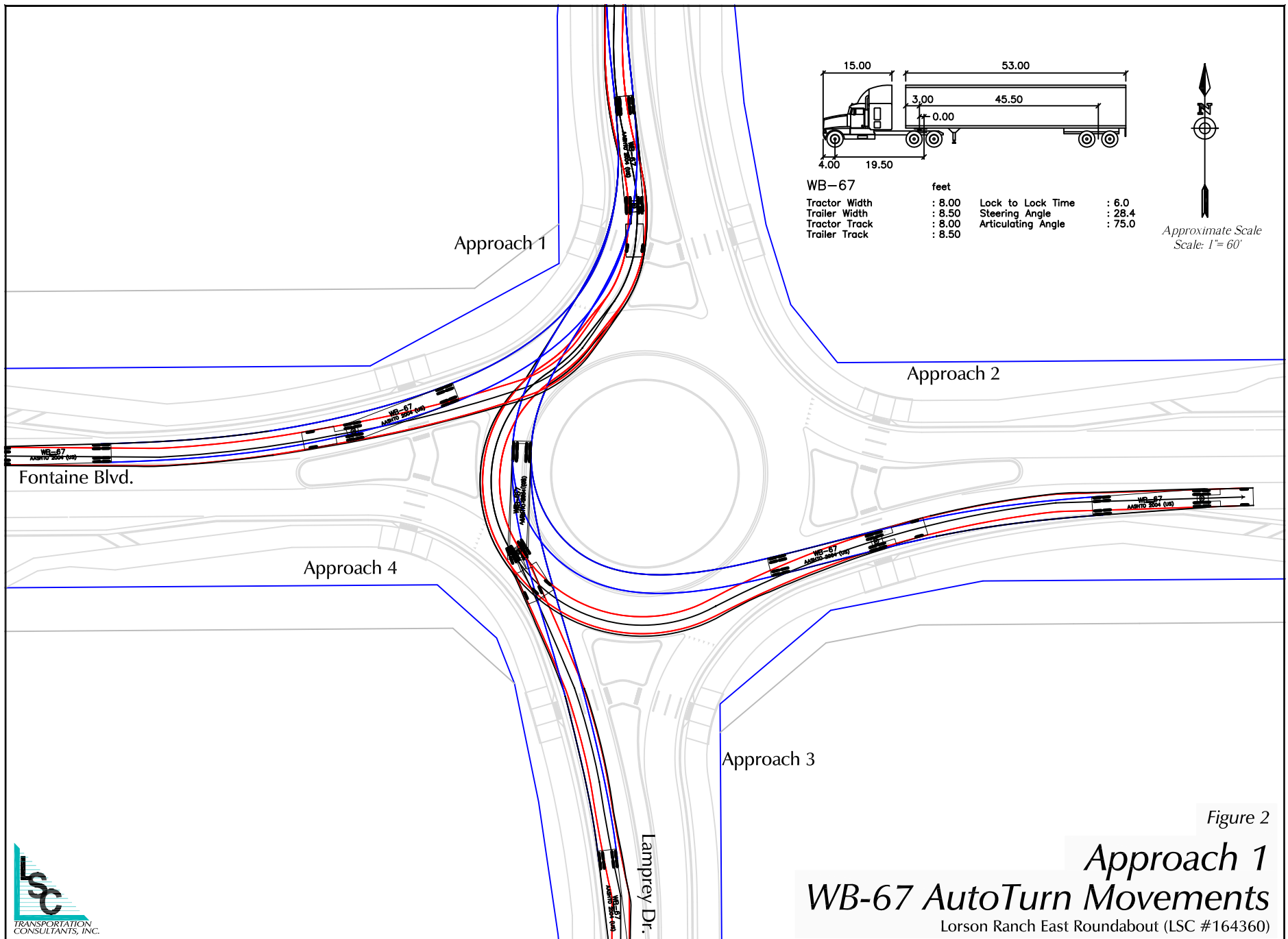


Figure 2

Approach 1
WB-67 AutoTurn Movements
Lorson Ranch East Roundabout (LSC #164360)

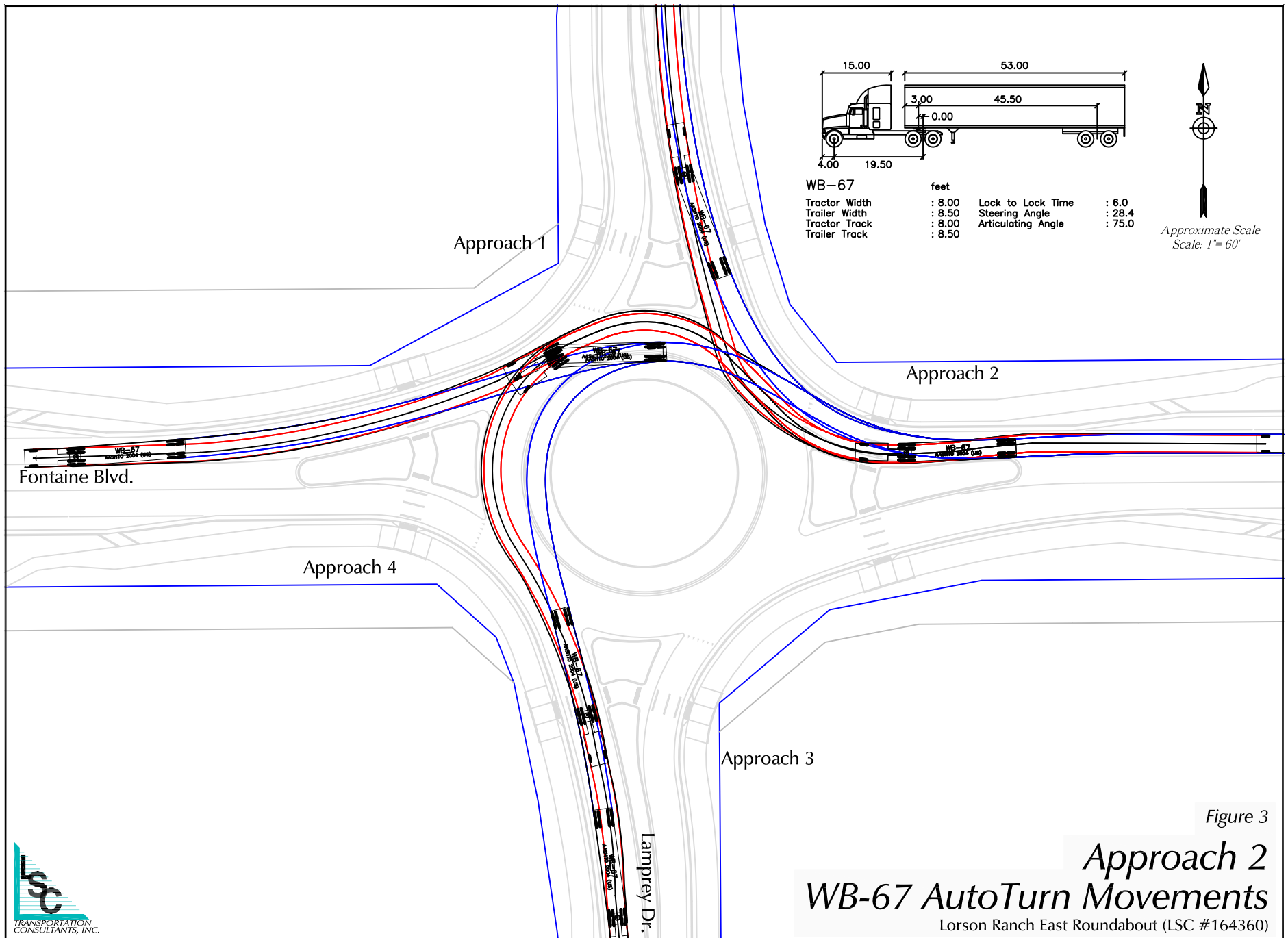


Figure 3

Approach 2 WB-67 AutoTurn Movements

Lorson Ranch East Roundabout (LSC #164360)

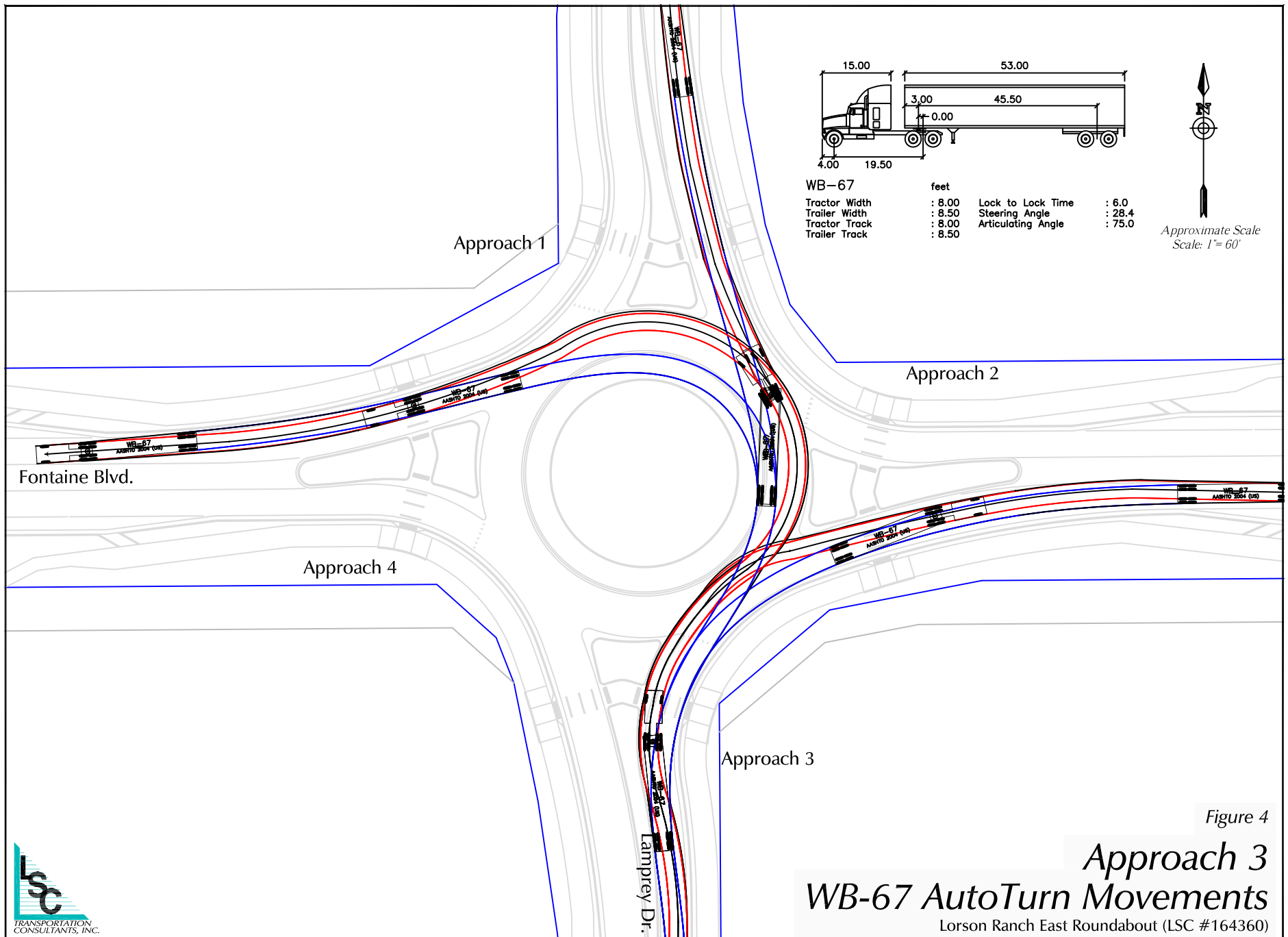


Figure 4

Approach 3 **WB-67 AutoTurn Movements** Lorson Ranch East Roundabout (LSC #164360)

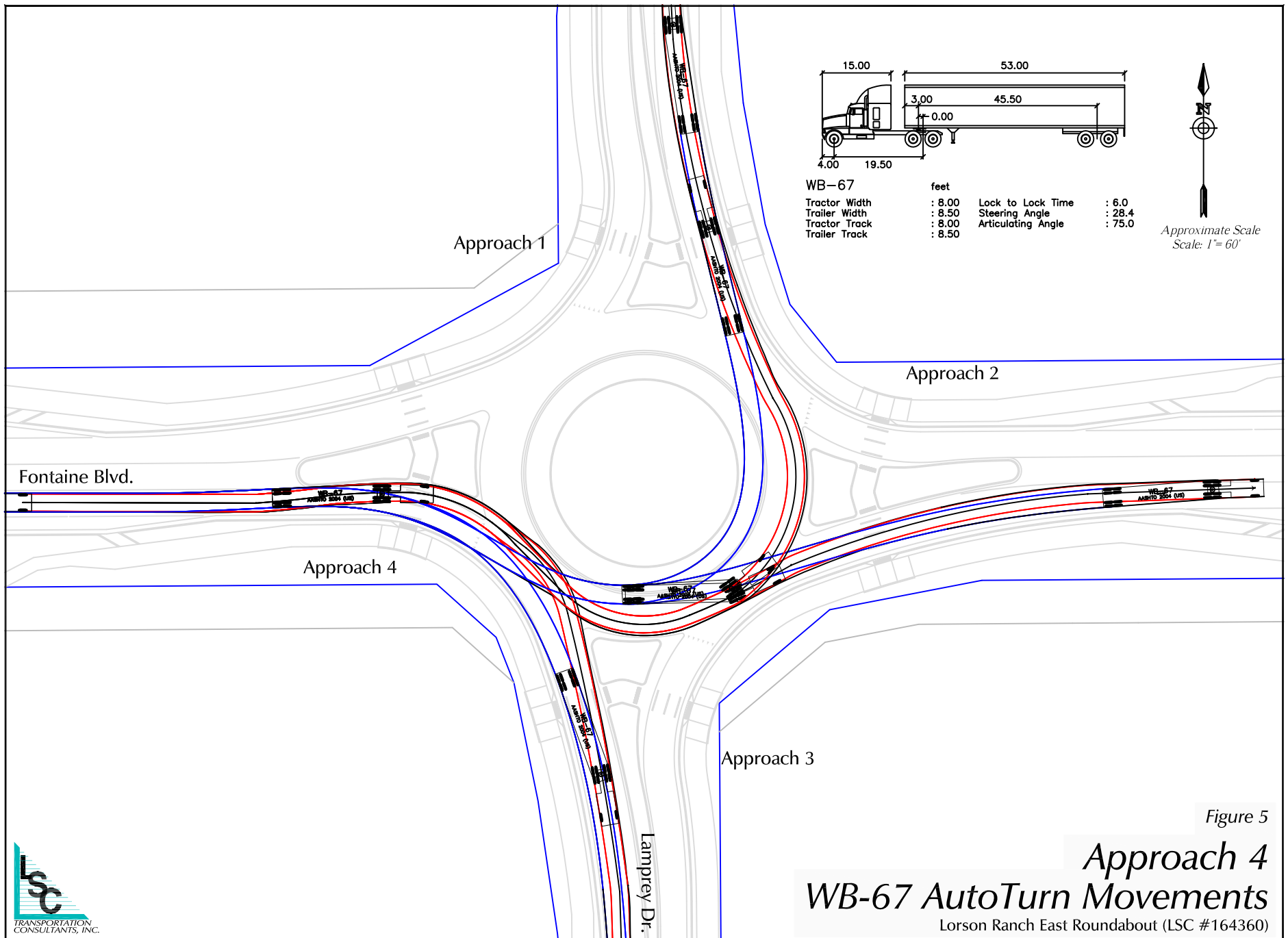


Figure 5

Approach 4 WB-67 AutoTurn Movements

Lorson Ranch East Roundabout (LSC #164360)

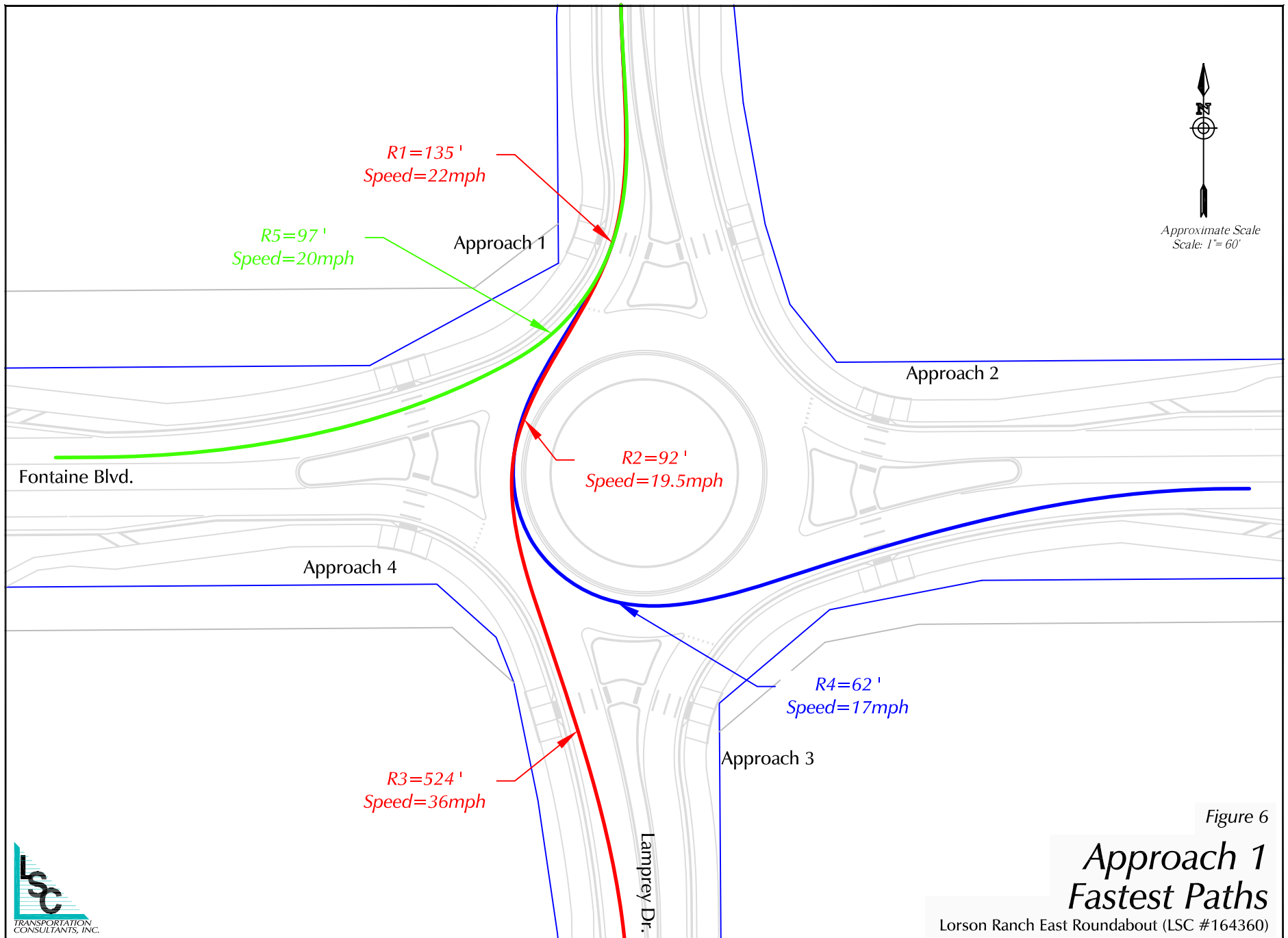


Figure 6

Approach 1 Fastest Paths

Lorson Ranch East Roundabout (LSC #164360)

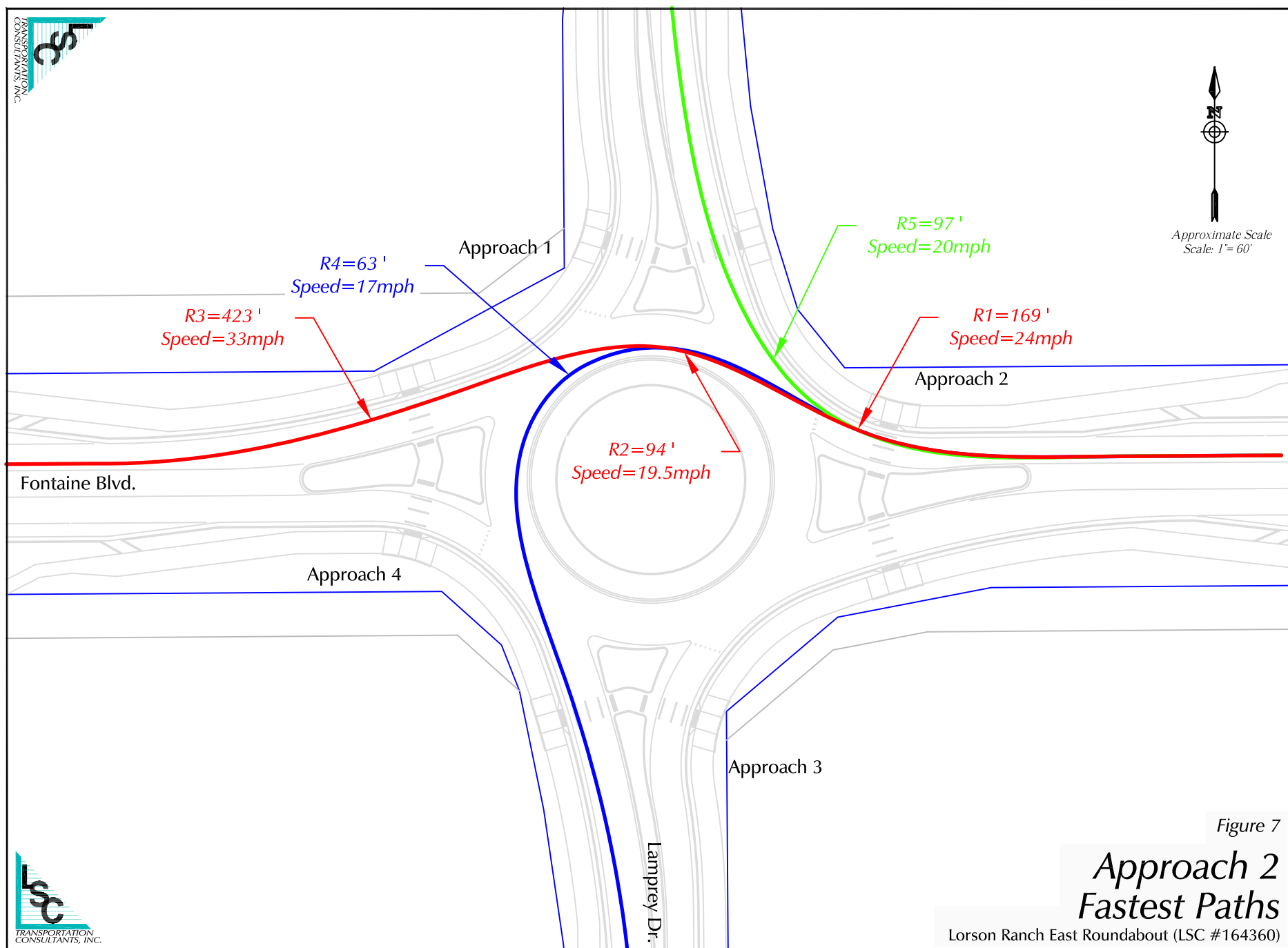


Figure 7

Approach 2 Fastest Paths

Lorson Ranch East Roundabout (LSC #164360)

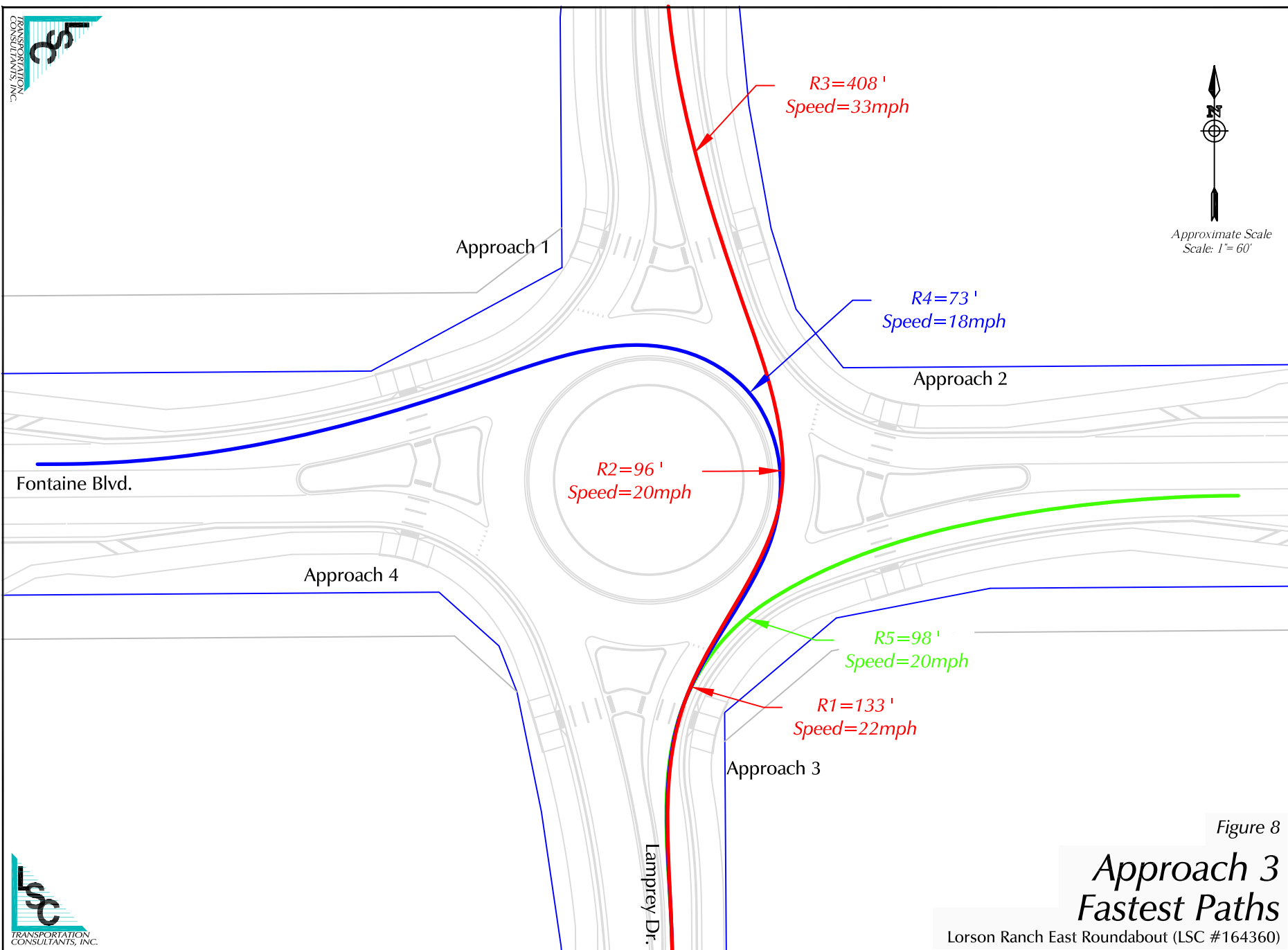


Figure 8

Approach 3 Fastest Paths

Lorson Ranch East Roundabout (LSC #164360)



Approximate Scale
Scale: 1" = 60'

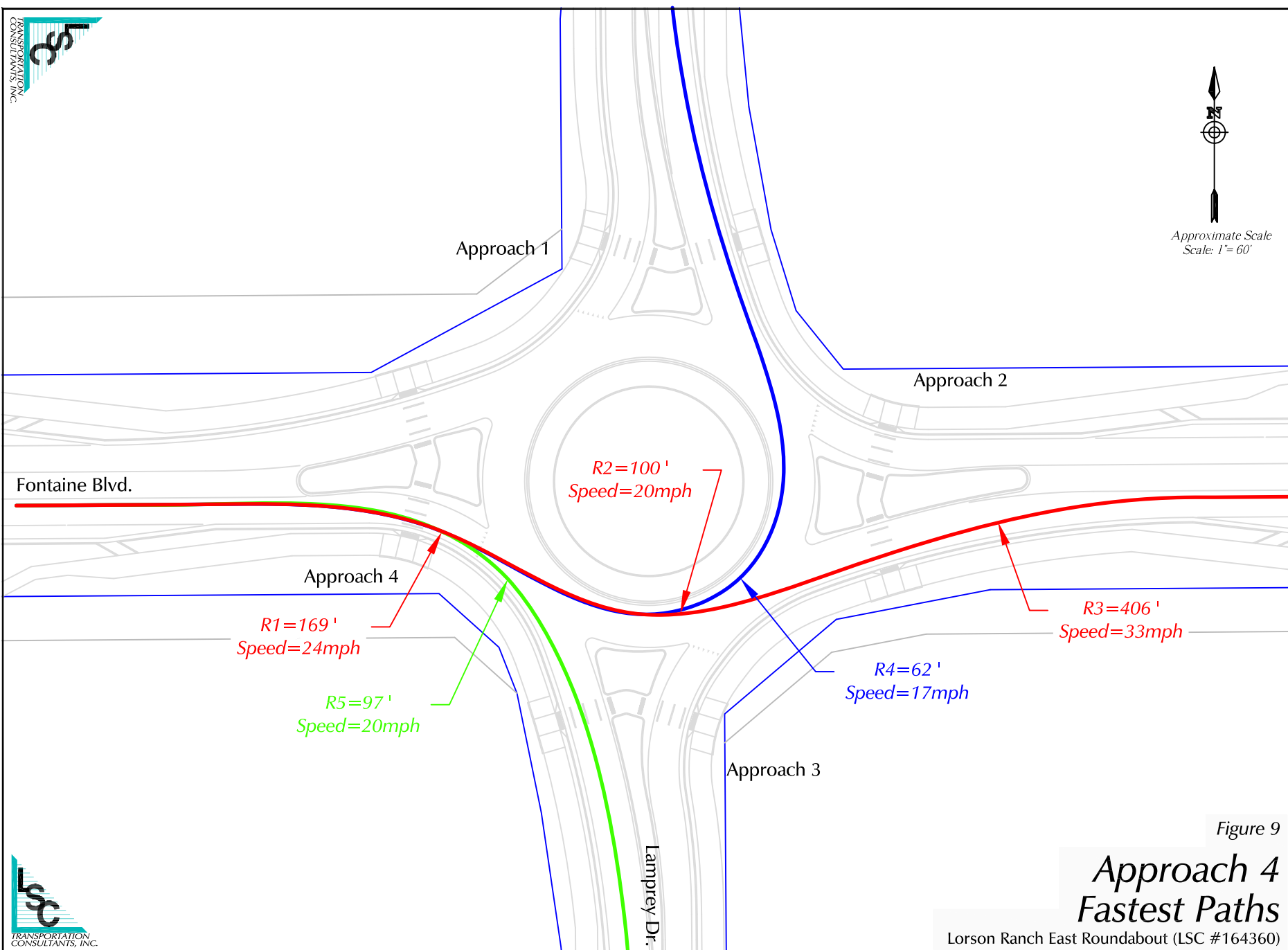


Figure 9

Approach 4 Fastest Paths

Lorson Ranch East Roundabout (LSC #164360)

- Notes:
1. Entering intersection sight distance based on the average of R1 and R2 per WisDOT standards which currently reference NCHRP Report 672.
 2. Approach intersection sight distance conservatively assumed to be 50mph east/west and 35mph north/south.
 3. Items taller than two feet that would restrict sight distance should not be located within the shaded/hatched areas.

Approximate Scale
Scale: 1"= 100'

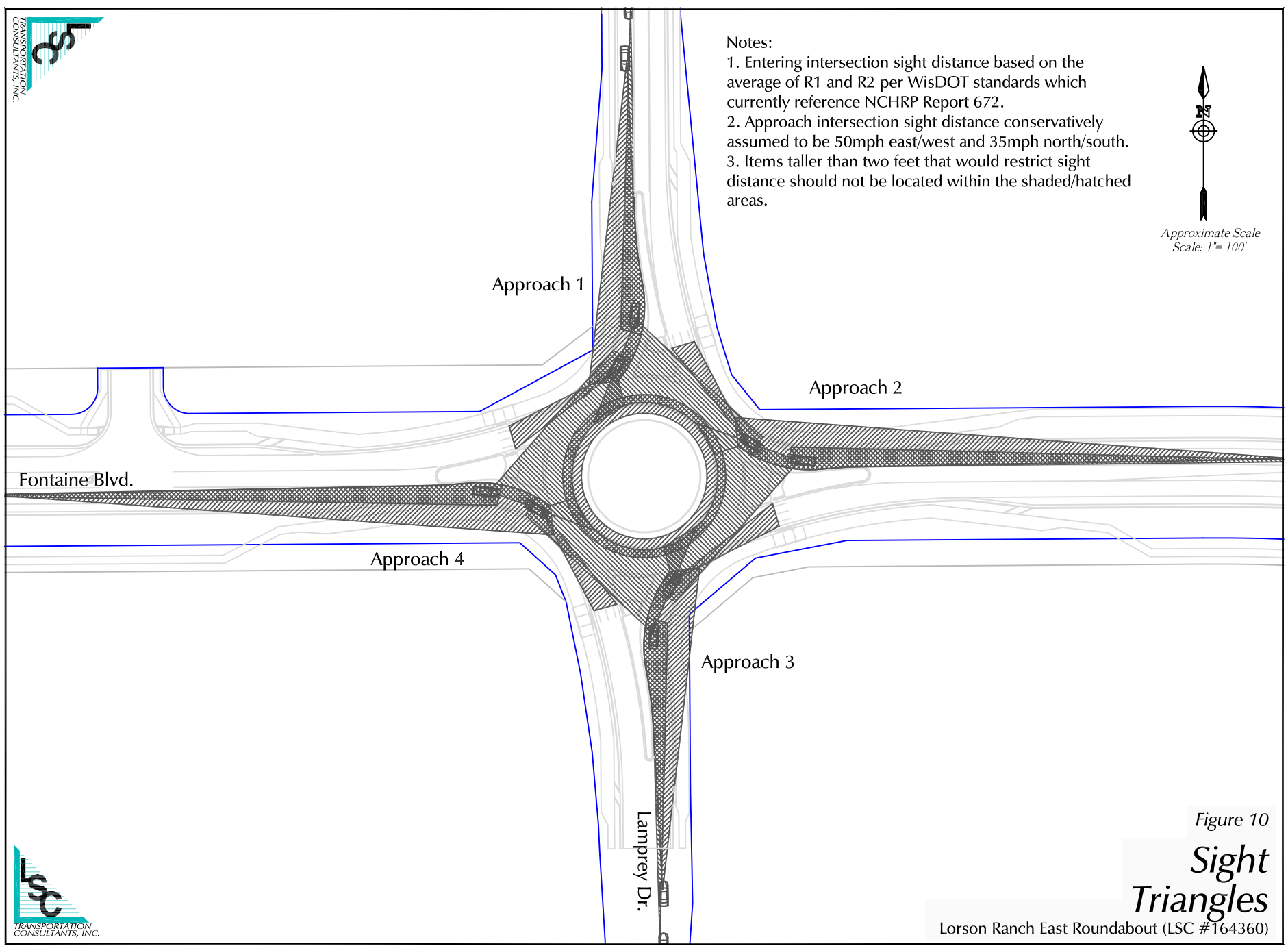


Figure 10
**Sight
Triangles**

Lorson Ranch East Roundabout (LSC #164360)

Operational Data

Main Geometry (ft)

Approach and Entry Geometry

Leg	Leg Names	Approach Bearing (deg)	Grade Separation G	Half Width V	Approach Lanes n	Entry Width E	Entry Lanes n	Flare Length L'	Entry Radius R	Entry Angle ?
1	Lamprey Drive	0	0	14.00	1	16.00	1	120.00	90.00	18.50
2	Fontaine Blvd.	90	0	14.00	1	16.00	1	75.00	90.00	20.00
3	Lamprey Drive	180	0	14.00	1	16.00	1	120.00	90.00	18.50
4	Fountain Blvd.	270	0	14.00	1	16.00	1	75.00	90.00	20.00

Circulating and Exit Geometry

Leg	Leg Names	Inscribed Diameter D	Circulating Width C	Circulating Lanes nc	Exit Width Ex	Exit Lanes nex	Exit Half Width Vx	Exit Half Width Lanes nvx
1	Lamprey Drive	150.00	20.00	1	20.00	1	14.00	1
2	Fontaine Blvd.	150.00	20.00	1	20.00	1	14.00	1
3	Lamprey Drive	150.00	20.00	1	20.00	1	14.00	1
4	Fountain Blvd.	150.00	20.00	1	20.00	1	14.00	1

Capacity Modifiers and Capacity Calibration (veh/hr)

Leg	Leg Names	Entry Capacity		Entry Calibration		Approach Road			Exit Road		
		Capacity + or -	XWalk Factor	Intercept + or -	Slope Factor	V (ft)	Default Capacity	Calib Capacity	V (ft)	Default Capacity	Calib Capacity
1	Lamprey Drive	0	1.000	0	1.000	20.00	2091	0	14.00	2091	0
2	Fontaine Blvd.	0	1.000	0	1.000	20.00	2091	0	14.00	2091	0
3	Lamprey Drive	0	1.000	0	1.000	20.00	2091	0	14.00	2091	0
4	Fountain Blvd.	0	1.000	0	1.000	20.00	2091	0	14.00	2091	0

Traffic Flow Data (veh/hr)

2040 AM Peak Peak Hour Flows

Leg	Leg Names	Turning Flows					Flow Modifiers		
		U-Turn	Exit-3	Exit-2	Exit-1	Bypass	Trucks %	Flow Factor	Peak Hour Factor
1	Lamprey Drive	0	5	29	254	0	2.0	1.00	0.9
2	Fontaine Blvd.	0	129	229	54	0	2.0	1.00	0.9
3	Lamprey Drive	0	176	62	5	0	2.0	1.00	0.9
4	Fountain Blvd.	0	2	557	10	0	2.0	1.00	0.9

Operational Results

2040 AM Peak - 60 minutes

Flows and Capacity

Leg	Leg Names	Bypass Type	Flows (veh/hr)				Capacity (veh/hr)			
			Arrival Flow		Opposing Flow		Capacity		Average VCR	
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass
1	Lamprey Drive	None	288		735		201		765	0.3846
2	Fontaine Blvd.	None	412		36		987		1153	0.3619
3	Lamprey Drive	None	243		363		85		975	0.2527
4	Fountain Blvd.	None	569		367		239		967	0.6013

Delays, Queues and Level of Service

Leg	Leg Names	Bypass Type	Average Delay (sec)			95% Queue (veh)		Level of Service		
			Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Leg
1	Lamprey Drive	None	10.08		10.08	1.85		B		B
2	Fontaine Blvd.	None	7.41		7.41	1.59		A		A
3	Lamprey Drive	None	6.96		6.96	0.96		A		A
4	Fountain Blvd.	None	12.39		12.39	4.32		B		B

2040 AM Peak - 15 minutes

Flows and Capacity

Leg	Leg Names	Bypass Type	Flows (veh/hr)					Capacity (veh/hr)			
			Arrival Flow		Opposing Flow		Exit Flow	Capacity		Average VCR	
			Entry	Bypass	Entry	Bypass		Entry	Bypass	Entry	Bypass
1	Lamprey Drive	None	313		798		218	730		0.4358	
2	Fontaine Blvd.	None	448		39		1071	1151		0.3928	
3	Lamprey Drive	None	264		394		92	957		0.2787	
4	Fountain Blvd.	None	618		399		260	950		0.6636	

Delays, Queues and Level of Service

Leg	Leg Names	Bypass Type	Average Delay (sec)			95% Queue (veh)		Level of Service		
			Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Leg
1	Lamprey Drive	None	8.66		8.66	1.85		A		A
2	Fontaine Blvd.	None	5.69		5.69	1.59		A		A
3	Lamprey Drive	None	5.79		5.79	0.96		A		A
4	Fountain Blvd.	None	10.17		10.17	4.32		B		B

Global Results

Performance and Accidents

2040 AM Peak Global Performance

Parameter	Units	Entries	Bypasses	Total
Arrive Flows	veh/hr	1512		1512
Capacity	veh/hr	3861		3861
Average Delay	sec/veh	8.72		8.72
L.O.S. (Signal)	A – F	A		A
L.O.S. (Unsig)	A – F	A		A
Total Delay	veh.hrs	3.66		3.66

Operational Data

Main Geometry (ft)

Approach and Entry Geometry

Leg	Leg Names	Approach Bearing (deg)	Grade Separation G	Half Width V	Approach Lanes n	Entry Width E	Entry Lanes n	Flare Length L'	Entry Radius R	Entry Angle ?
1	Lamprey Drive	0	0	14.00	1	16.00	1	120.00	90.00	18.50
2	Fontaine Blvd.	90	0	14.00	1	16.00	1	75.00	90.00	20.00
3	Lamprey Drive	180	0	14.00	1	16.00	1	120.00	90.00	18.50
4	Fountain Blvd.	270	0	14.00	1	16.00	1	75.00	90.00	20.00

Circulating and Exit Geometry

Leg	Leg Names	Inscribed Diameter D	Circulating Width C	Circulating Lanes nc	Exit Width Ex	Exit Lanes nex	Exit Half Width Vx	Exit Half Width Lanes nvx
1	Lamprey Drive	150.00	20.00	1	20.00	1	14.00	1
2	Fontaine Blvd.	150.00	20.00	1	20.00	1	14.00	1
3	Lamprey Drive	150.00	20.00	1	20.00	1	14.00	1
4	Fountain Blvd.	150.00	20.00	1	20.00	1	14.00	1

Capacity Modifiers and Capacity Calibration (veh/hr)

Leg	Leg Names	Entry Capacity		Entry Calibration		Approach Road			Exit Road		
		Capacity + or -	XWalk Factor	Intercept + or -	Slope Factor	V (ft)	Default Capacity	Calib Capacity	V (ft)	Default Capacity	Calib Capacity
1	Lamprey Drive	0	1.000	0	1.000	20.00	2091	0	14.00	2091	0
2	Fontaine Blvd.	0	1.000	0	1.000	20.00	2091	0	14.00	2091	0
3	Lamprey Drive	0	1.000	0	1.000	20.00	2091	0	14.00	2091	0
4	Fountain Blvd.	0	1.000	0	1.000	20.00	2091	0	14.00	2091	0

Traffic Flow Data (veh/hr)

2040 PM Peak Peak Hour Flows

Leg	Leg Names	Turning Flows					Flow Modifiers		
		U-Turn	Exit-3	Exit-2	Exit-1	Bypass	Trucks %	Flow Factor	Peak Hour Factor
1	Lamprey Drive	0	3	19	146	0	2.0	1.00	0.9
2	Fontaine Blvd.	0	238	586	203	0	2.0	1.00	0.9
3	Lamprey Drive	0	125	10	1	0	2.0	1.00	0.9
4	Fountain Blvd.	0	1	359	1	0	2.0	1.00	0.9

Operational Results

2040 PM Peak - 60 minutes

Flows and Capacity

Leg	Leg Names	Bypass Type	Flows (veh/hr)				Capacity (veh/hr)			
			Arrival Flow		Opposing Flow		Exit Flow		Average VCR	
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass
1	Lamprey Drive	None	168		485		249		906	0.1881
2	Fontaine Blvd.	None	1027		23		630		1161	0.9293
3	Lamprey Drive	None	136		826		223		714	0.1942
4	Fountain Blvd.	None	361		373		589		964	0.3805

Delays, Queues and Level of Service

Leg	Leg Names	Bypass Type	Average Delay (sec)			95% Queue (veh)		Level of Service		
			Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Leg
1	Lamprey Drive	None	6.55		6.55	0.66		A		A
2	Fontaine Blvd.	None	27.28		27.28	22.45		D		D
3	Lamprey Drive	None	7.89		7.89	0.71		A		A
4	Fountain Blvd.	None	8.55		8.55	1.75		A		A

2040 PM Peak - 15 minutes

Flows and Capacity

Leg	Leg Names	Bypass Type	Flows (veh/hr)				Capacity (veh/hr)			
			Arrival Flow		Opposing Flow		Exit Flow		Average VCR	
			Entry	Bypass	Entry	Bypass	Entry	Bypass	Entry	Bypass
1	Lamprey Drive	None	183		527		268		883	0.2090
2	Fontaine Blvd.	None	1116		25		684		1159	1.0103
3	Lamprey Drive	None	148		890		240		678	0.2209
4	Fountain Blvd.	None	392		403		635		947	0.4193

Delays, Queues and Level of Service

Leg	Leg Names	Bypass Type	Average Delay (sec)			95% Queue (veh)		Level of Service		
			Entry	Bypass	Leg	Entry	Bypass	Entry	Bypass	Leg
1	Lamprey Drive	None	5.76		5.76	0.66		A		A
2	Fontaine Blvd.	None	27.65		27.65	22.45		D		D
3	Lamprey Drive	None	7.20		7.20	0.71		A		A
4	Fountain Blvd.	None	6.87		6.87	1.75		A		A

Global Results

Performance and Accidents

2040 PM Peak Global Performance

Parameter	Units	Entries	Bypasses	Total
Arrive Flows	veh/hr	1692		1692
Capacity	veh/hr	3745		3745
Average Delay	sec/veh	18.68		18.68
L.O.S. (Signal)	A – F	B		B
L.O.S. (Unsig)	A – F	C		C
Total Delay	veh.hrs	8.78		8.78