MEMORANDUM

DATE: October 10, 2012

TO: Todd Sherman
Sherman Building Company, LLC

FROM: Chris Forster, P.E. / Chris Bicket, P.E.
TENW

SUBJECT: SR-202 Access Assessment
Betrozoff Property Residential Development
TENW Project No. 4628

This memorandum documents the SR-202 access assessment conducted for the proposed Betrozoff property residential development in Redmond, Washington. The proposed development is located on the west side of Red-Wood Rd (SR-202) between NE 116th St and NE 124th St. Please see the *Betrozoff Property Access Memorandum* (9/26/12) by ESM Consulting Engineers for information regarding access to 154th Place NE (included as Attachment A).

Findings & Conclusions

We conducted a detailed site access assessment to determine what roadway improvements would be required in order to provide a safe full access to the Betrozoff property along SR-202. The following summarizes our findings:

- The proposed site access on SR-202 serving up to 35 single-family lots is expected to operate at acceptable levels in 2016 (all movements at LOS C or better during the AM and PM peak hours).
- Available intersection and stopping sight distances were observed to exceed (i.e. meet) the applicable standards at the proposed site access location on SR-202 (approximately 700-900 feet north of NE 116th Street). This assumes on-site obstructions (grades, vegetation, etc) within the sight triangles are cleared to maintain visibility.
- A center left-turn lane on SR-202 for use as a refuge lane is recommended and would enhance safety and efficiency for outbound left-turns from the site.
- An exclusive northbound (inbound) left-turn lane is recommended on SR-202 at the site access based on our analysis and review of WSDOT guidelines.
- An exclusive southbound (inbound) right-turn lane/pocket/taper on SR-202 is not needed based on our analysis and review of WSDOT guidelines.
- An acceleration lane on SR-202 for outbound right-turns is not needed based on our analysis and review of WSDOT guidelines.
- Our overall conclusion is that with the above mentioned improvements, a safe and efficient full access roadway connection serving 35 single-family lots can be provided on SR-202 at the proposed location.

Introduction

We conducted a detailed site access assessment to determine what roadway improvements would be required in order to provide a safe full access to the Betrozoff property along SR-202. The following items are addressed in this access analysis:

- Project description
- Trip generation
- Traffic volume forecasts
- Site access analysis, including:
  - Intersection LOS & Queues
  - Sight Distance
    - Intersection Sight Distance
    - Stopping Sight Distance
  - Turn Lane Analysis
    - Inbound Left-Turn Lane Analysis
    - Inbound Right-Turn Lane Analysis
    - Outbound Right-Turn Acceleration Lane

Project Description

Based on the site plan you provided (see Attachment B), the development of the Betrozoff property would include up to 17 single-family residential lots. The development of the adjacent parcels would result in up to 18 additional lots, for a full buildout total of 35 lots. Our access analysis for this project assumes full buildout with 35 single-family lots. At full buildout, 2 existing homes would be demolished. A single vehicular access to the development is being proposed via a new public road on the west side of SR-202. A preliminary location for site access was identified approximately 800 feet north of NE 116th Street, but we understand that the ultimate location will likely fall within a range of 700-900 feet. We understand that this new roadway is proposed to provide full vehicular access onto SR-202.

Trip Generation

The trip generation estimates for the Betrozoff property development were based on the Institute of Transportation Engineers (ITE) *Trip Generation* Manual, 8th Edition, 2008 for Land Use Code (LUC) 210, Single Family Detached Housing.

The weekday AM peak hour, PM peak hour, and daily trip generation estimates are shown in Table 1. Please note that for the purposes of this access analysis, no credit is being taken for the 2 existing homes that would be demolished.

Table 1
Betrozoff Trip Generation Summary

	Trips Generated		
Time Period	In	Out	Total
Weekday Daily	198	198	396
Weekday AM Peak Hour	8	26	34
Weekday PM Peak Hour	26	15	41

As shown in Table 1, the proposed full buildout of Betrozoff (35 lots including adjacent parcels) is estimated to generate a total of 396 weekday daily trips, of which 34 are estimated to be generated during the weekday AM peak hour (8 entering, 26 exiting), and 41 are estimated to be generated during the weekday PM peak hour (26 entering, 15 exiting). Trip generation calculations are included in Attachment C.

Traffic Volume Forecasts

Existing weekday AM and PM peak hour traffic counts were obtained at Red-Wood Road (SR-202)/NE 116th Street in November 2011 (PM peak) and October 2012 (AM peak). Based on these counts, the existing northbound and southbound through volumes at the site access location could be determined.

The project is anticipated to be fully constructed and occupied by the year 2016. Year 2016 baseline peak hour traffic volume forecasts were estimated based on an assumption of a 2 percent annual growth rate consistent with other recent studies in Redmond.

New project-generated traffic from the Betrozoff site was distributed north and south on SR-202 based on existing travel patterns. Based on the counts at SR-202/NE 116th Street, project traffic was distributed 60 percent north and 40 percent south on SR-202. The 2012 existing, 2016 baseline, project trip assignment, and 2016 with-project volumes at the site access are shown on Figure 1.

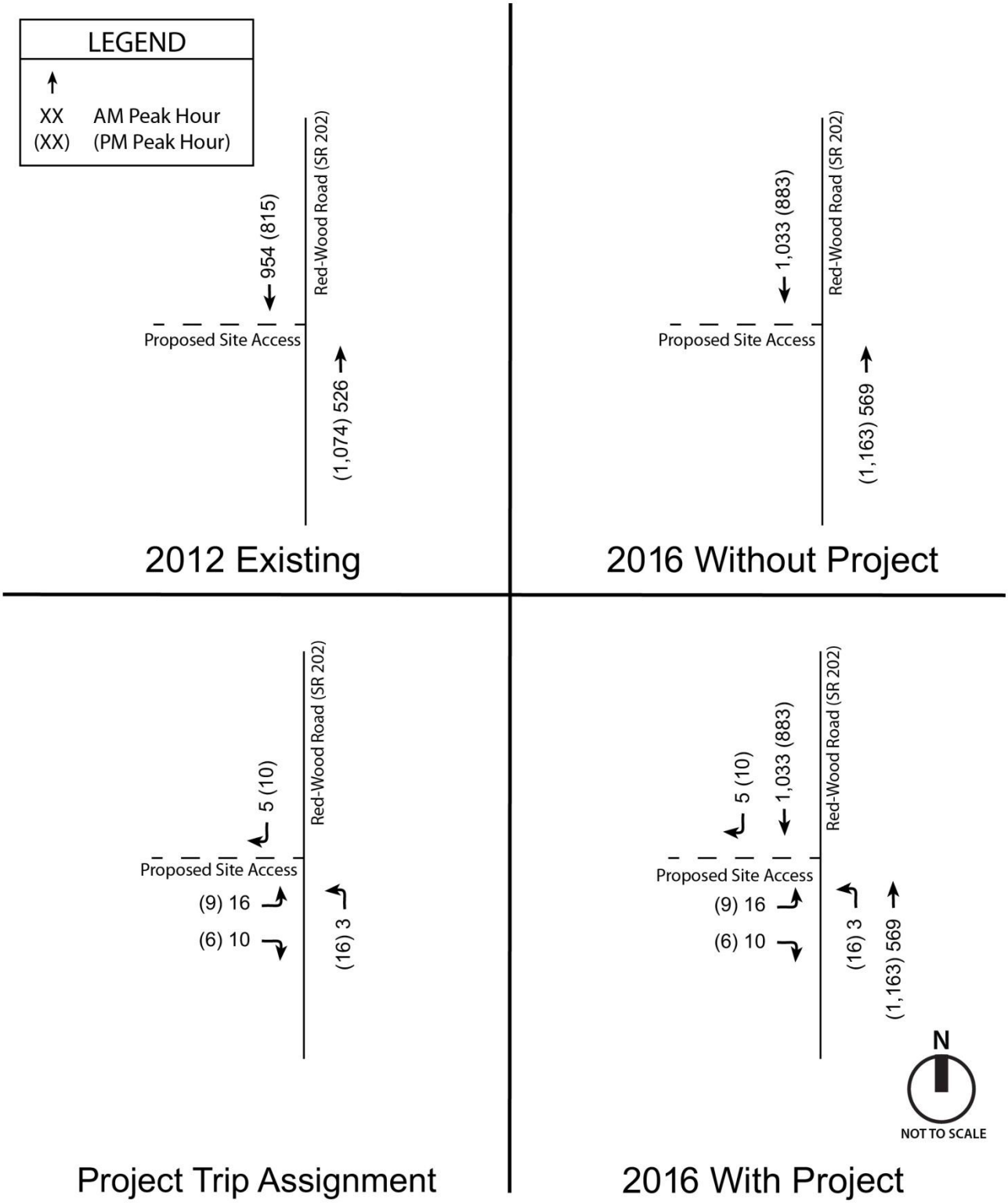


Figure 1: AM and PM Peak Hour Traffic Volumes

Site Access Assessment

LOS/Queue Analysis

The level of service and queue calculations were conducted using Synchro 8 Software. This program is based on methodology outlined in the *Highway Capacity Manual*, Special Report 209, 2000 Edition.

The reported queues are estimated 95th percentile queues that are exceeded only 5 percent of the time.

The LOS analysis assumed the following geometry at the proposed site access on SR-202: 1 southbound through-right lane, 1 northbound left-turn lane, 1 northbound through lane, a center refuge lane on SR-202 for left-turns exiting the site, and 1 shared left-right lane exiting the site.

Table 2 summarizes the results of the 2016 with-project LOS and queue analyses. The LOS and queue calculation sheets are included in Attachment D.

Table 2
2016 AM and PM Peak Hour Site Access LOS and Queue Summary

		2016 With Project	
Time Period / Movement	LOS[1]	Delay (sec)	Queue (ft)[2]
AM Peak			
SR-202 / Site Driveway			
EB Shared Left-Right (exiting)	C	19.9	<25'
NB Left (entering)	B	10.8	<25'
PM Peak			
SR-202 / Site Driveway			
EB Shared Left-Right (exiting)	C	20.8	<25'
NB Left (entering)	B	10.1	<25'

[1] LOS = Level of Service, reported by movement for unsignalized intersections.
[2] Queues are 95th Percentile queues. <25' indicates 95th Percentile queue statistically less than 1 vehicle.

The LOS results shown in Table 2 show that all stop controlled movements at the proposed site access on SR-202 are expected to operate at LOS C or better in 2016, with 95th percentile queues less than one vehicle during the peak hours. It should be noted that without a center refuge lane for left turns exiting the site, the eastbound (outbound) approach would be estimated to operate at LOS F during the PM peak hour. Therefore, to improve both operations and safety for the outbound left turn, we recommend that a center refuge lane be provided to accommodate storage for at least one left-turn vehicle exiting the site. This will allow left-turns to exit the site more efficiently since they would only need to yield to one direction at a time.

Sight Distance

Existing intersection (entering) sight distance (ISD) and stopping sight distance (SSD) were evaluated in the field at the location of the proposed site access road on SR-202 on October 4, 2012. A preliminary location for the proposed site access was shown at a location approximately 800 feet north of NE 116th Street (see site plan). However, our sight distance evaluation is valid for a site access located in an approximate range of 700-900 feet north of NE 116th Street.

The sight distance measurements were based on the standards outlined in the Redmond Zoning Code (RZC), *Appendix 2. Construction Specification and Design Standards for Streets and Access.* Since Red-Wood Road (SR-202) is a state highway, we also reviewed the Washington State Department of Transportation (WSDOT) *Design Manual* sight distance standards. Based on our review, we believe that the RZC standards are generally equal to or more restrictive than the WSDOT standards. Therefore, we followed the RZC standards for this assessment.

Intersection (Entering) Sight Distance (ISD)

The RZC specifies the use of a driver's eye height of 3.5 feet and object height of 2.0 feet for ISD. Since no setback measurement was specified in the RZC, we believe the use of AASHTO standards are appropriate (14.5 feet back from the edge of travelled way). The RZC specifies use of a design speed of 10 mph over the posted speed limit (40 mph posted on SR-202). Therefore the design speed used was 50 mph.

At the location of the proposed site access, it was not possible to stand in a location 14.5 feet back from the edge of the travelled way due to topography. Therefore our assessment of ISD was based on our clear view from the shoulder of the roadway, which is sufficient to confirm whether the SR-202 roadway geometry/profile would limit the ISD. We were also able to note obstructions that would likely be within the sight triangle had we been able to stand 14.5 feet back.

Based on a 50 mph design speed on SR-202, the recommended ISD from RZC Appendix 2 Table 9 is 555 feet. Using the AASHTO methodology, adjustments were made to this value to account for crossing 2 lanes (one center left-turn refuge lane and one southbound through lane). The adjusted value for ISD used in this assessment was 588 feet. Looking to the north and south along SR-202 from the roadway shoulder, the available ISD was observed to be in excess of 588 feet.

Two probable sight obstructions were noted to be within the sight triangles, both of which appeared to be located either within right-of-way or on the Betrozoff property: 1 large weeping willow tree overhanging the roadway and one small alder tree, both located in the northern sight triangle. The southern sight triangle did not contain any obvious obstructions, but if any existed they would be within the Betrozoff property frontage and could be removed with the project.

Assuming all obstructions with the sight triangles are trimmed or removed with the project, the intersection sight distance at the proposed site access location on SR-202 meets the applicable standards. Photos looking north and south on SR-202 as well as photos of the probable sight obstructions are included below.

View from site access location looking north on SR-202

View from site access location looking south on SR-202

Probable sight obstruction looking north (large willow tree)

Probable sight obstruction looking north (alder tree)

Stopping Sight Distance (SSD)

RZC standards specify use of a driver's eye height of 3.5 feet and an object height of 0.5 feet for SSD. For SSD on an arterial street, the RZC specifies use of a design speed of 10 mph over the posted speed limit (40 mph posted on SR-202). Therefore the design speed used was 50 mph.

Based on a 50 mph design speed on SR-202, the recommended SSD from RZC Appendix 2 Table 6 is 425 feet. Using the AASHTO methodology, adjustments were made to this value to account for grades (NB = -5.8 percent, SB = +3.6 percent). The adjusted value for northbound SSD was 471 feet, and the adjusted value for SSD southbound was 401 feet. Based on our field observations, the available stopping sight distance on both approaches to the site access location is in excess of these standards.

Turn Lane Analysis

Inbound Left-Turn Lane Analysis

The WSDOT *Design Manual* outlines the following guidelines to determine whether or not to consider left-turn lanes at unsignalized intersections:

- A traffic analysis indicates congestion reduction with a left-turn lane. On two-lane highways, use Exhibit 1310-15a (*Design Manual*) based on total traffic volume (DHV) for both directions and percent left-turn traffic, to determine whether further investigation is needed.
- A study indicates crash reduction with a left-turn lane.
- Restrictive geometrics require left-turning vehicles to slow greatly below the speed of the through traffic.
- There is less than decision sight distance for traffic approaching a vehicle stopped at the intersection to make a left-turn.

Based on our analysis of year 2016 with-project AM and PM peak hour volume conditions at the site access location on SR-202 using *Exhibit 1310-15a*, the need for an inbound left-turn lane is unclear as the DHV is well beyond the limits of the graph (see Attachment E). However, considering the relatively high volumes on SR-202 at this location and the downhill (-5.8 percent) grade on the northbound approach, an inbound left-turn lane is recommended to enhance both traffic operations and safety. In addition, since a center refuge lane for outbound left-turns is also recommended, the inbound left-turn lane would take advantage of roadway widening that will be necessary for the outbound left-turn refuge (and vice-versa). Based on WSDOT guidelines, the inbound left-turn lane should be a minimum of 100 feet in length.

Inbound Right-Turn Lane Analysis

The WSDOT *Design Manual* outlines the following guidelines to determine whether or not to consider right-turn lanes at unsignalized intersections:

- Recommendation from Exhibit 1310-19 (*Design Manual*).
- A collision study indicates an overall crash reduction with a right-turn lane.
- The presence of pedestrians requires right-turning vehicles to stop.

- Restrictive geometrics require right-turning vehicles to slow greatly below the speed of the through traffic.
- There is less than decision sight distance for traffic approaching the intersection.

Based on our analysis of the estimated year 2016 with-project AM and PM peak hour traffic volumes at the site access location on SR-202 using *Exhibit 1310-19,* the southbound through and right-turn volumes do not indicate the need for a right-turn lane, pocket, or taper (see Attachment E). Although the through+right volumes are located outside the limits of the graph, the WSDOT guidelines do not indicate a need for a right-turn lane, pocket, or taper when the peak hour right-turn volume is below 20. The peak hour right-turn volume is only estimated to be 10 (PM Peak Hour). In addition, the uphill (+3.6 percent) grade is advantageous as it will help vehicles slow down when following a vehicle turning right. There is no crash history, there will not be a significant number of pedestrians crossing the access, and there is adequate sight distance. Based on our analysis, we believe an inbound right-turn lane is not needed at this location.

Outbound Right-Turn Acceleration Lane

An acceleration lane on SR-202 to accommodate right-turns exiting the site was considered. The WSDOT *Design Manual* does not have well defined guidelines on when acceleration lanes are recommended. The *Design Manual* states that acceleration lanes are "not as advantageous [as deceleration lanes] because entering drivers can wait for an opportunity to merge without disrupting through traffic." One should also consider the degree of conflict between the outbound right-turns and through vehicles, and whether any sight distance issues exist. Since the volume of right turns exiting the site is expected to be low (10 vehicles during the AM peak hour and 6 vehicles during the PM peak hour), and since sight distance is expected to meet or exceed standards, we do not believe a right-turn acceleration lane for outbound traffic at the proposed site access is needed.

If you have any questions regarding the information presented in this memo, please contact me at forster@tenw.com or Chris Bicket at bicket@tenw.com.

cc: Eric LaBrie, ESM Consulting Engineers, LLC
Jeff Haynie, P.E., Principal, TENW

Attachments

ATTACHMENT A

~~Betrozoff Property 154th Place NE Access Assessment~~

~~By ESM Consulting Engineers~~

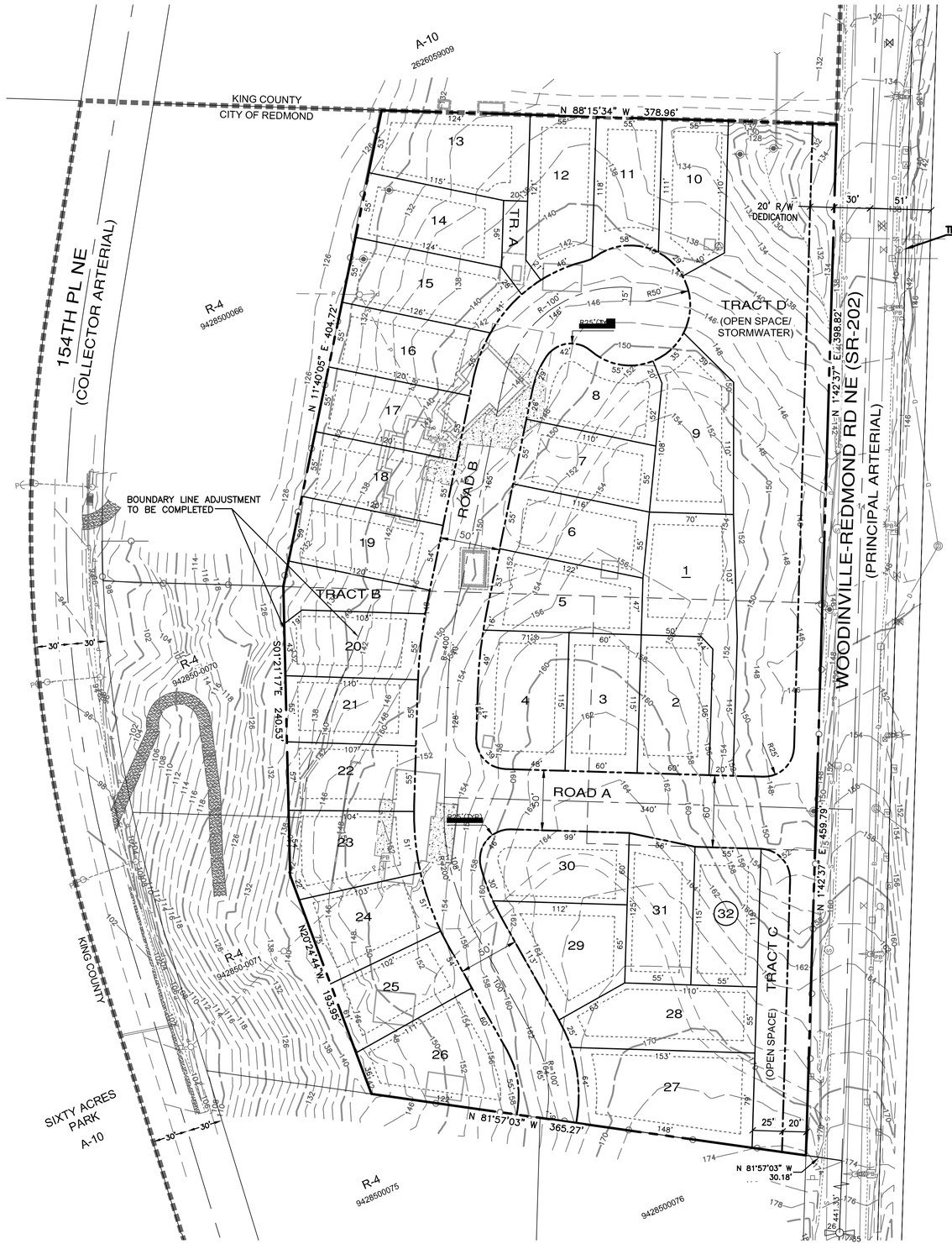
This Attachment has been removed as it is no longer required. The project no longer abuts 154th PL NE and cannot gain access off of this roadway.

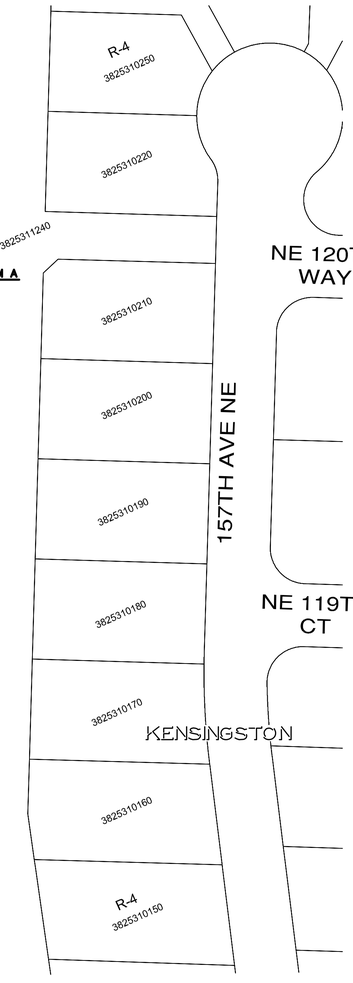
ATTACHMENT B

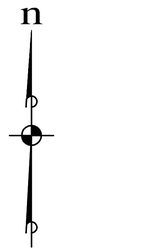
Preliminary Site Plan

BETROZOFF JONES PRELIMINARY PLAT

CITY OF REDMOND, KING COUNTY WASHINGTON

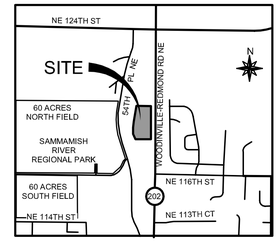






SCALE: 1" = 50'

50 25 0 50 100



VICINITY MAP N.T.S.

SITE DATA

SITE ADDRESS:	11845 AND 11818 WOODINVILLE–REDMOND RD NE REDMOND, WA 98052
PARCEL NUMBERS:	942850–0072, 942850–0073 & 942850–0065
SITE AREA GROSS:	350,366 S.F. = 8.04 AC.
SITE AREA NET:	
ZONING:	R–4 (RESIDENTIAL – 4 D.U./AC.)
NEIGHBORHOOD:	NORTH REDMOND, WEDGE AREA
EXISTING USE:	TWO SINGLE–FAMILY RESIDENCES
PROPOSED USE:	32–LOT SINGLE–FAMILY RESIDENTIAL SUBDIVISION

DEVELOPMENT STANDARDS (R-4)

DENSITY:	BASE: 8.04 AC. x 4 DU/AC – 32 DWELLINGS MINIMUM: 32 DU x 80% = 26 DWELLINGS PROPOSED: 32 DWELLINGS
MIN. AVERAGE LOT SIZE:	7,000 SF
MINIMUM LOT WIDTH:	40' DIAMETER CIRCLE
BUILDING SETBACKS:	FRONT AND SIDE STREET: 15' SIDE INTERIOR: 5'/10' (15') REAR: 10' GARAGE: 18' ARTERIAL (WOOD–RED ROAD): 35'
BUILDING HEIGHT:	30' (LIMITED BY RZC 21.08.180(E)(2)(A))
OPEN SPACE:	REQUIRED: 20% OF LOT AREA (45,522 S.F.) PROVIDED: 51,422 S.F.
IMPERVIOUS COVERAGE:	MAXIMUM: 60% OF LOT AREA (136,565 S.F.) PROVIDED: TBD
PARKING:	REQUIRED: 2.0 PER DU (64) PROVIDED: 128

UTILITY PROVIDERS

SEWER: CITY OF REDMOND

WATER: CITY OF REDMOND

POWER: PUGET SOUND ENERGY

TELEPHONE: VERIZON

SCHOOL: ISSAQUAH SCHOOL DISTRICT #411

FIRE: KING COUNTY FIRE PROTECTION DISTRICT NO. 25

LEGAL DESCRIPTION

ADAMS (942850–0065)
PARCEL B, KING COUNTY SHORT PLAT NUMBER 474082. AS RECORDED UNDER RECORDING NUMBER 7408270357.

BETROZOFF (942850–0072 and 942850–0073)
LOTS 3 AND 4 OF KING COUNTY SHORT PLAT NUMBER 1181034. AS RECORDED UNDER RECORDING NUMBER 8301060563.

BENCHMARKS

ORIGINAL BM: CITY OF REDMOND BENCHMARK NO. 9189. FOUND 3" DIAMETER BRASS DISC IN CONC MON IN CASE ON THE SOUTH SIDE OF THE ASPHALT DRIVEWAY TO HOUSE #11650 OFF OF 154TH PL. NE. ELEV.=121.51

TBM – A: SET X IN ROADSIDE TOP BONNET BOLT OF FIRE HYDRANT LOCATED ON THE EAST SIDE OF WOODINVILLE REDMOND ROAD APPROXIMATELY 105' SOUTH OF THE NORTHWEST BOUNDARY CORNER. ELEV.=141.97

DATUM

NAVD 88

SHEET INDEX

SHEET NO.	DESCRIPTION
PP–01	COVER SHEET & SITE PLAN
PP–02	EXISTING CONDITIONS
PP–03	TRANSPORTATION/FIRE PLAN
PP–04	PRELIMINARY UTILITY PLAN
PP–05	PRELIMINARY GRADING PLAN
PP–06	PRELIMINARY LANDSCAPE PLAN
PP–07	LANDSCAPE NOTES AND DETAILS
PP–08	TREE PRESERVATION PLAN

LOT AREA TABLE

LOT #	AREA (S.F.)	LOT #	AREA (S.F.)	LOT #	AREA (S.F.)
1	10,113	12	6991	23	6663
2	6850	13	8210	24	6373
3	6900	14	6568	25	6076
4	8399	15	7395	26	8788
5	7318	16	6678	27	10,426
6	6532	17	6600	28	8010
7	6211	18	6600	29	7231
8	6698	19	6600	30	7114
9	8544	20	6149	31	6600
10	6584	21	5987	32	6325
11	5997	22	5905		

TOTAL LOT AREA: 227,434 SF = 5.22 AC
SMALLEST LOT AREA: 5900 S.F. (LOT 22)
LARGEST LOT AREA: 10,426 S.F. (LOT 27)
AVERAGE LOT AREA: 7113 S.F.

TRACT TABLE

TRACT	USE	AREA (S.F.)
A	ACCESS, JOINT USE DRIVE	1,530
B	OPEN SPACE / UTILITIES	3,715
C	OPEN SPACE	6,124
D	OPEN SPACE / STORMWATER	34,808
TOTAL TRACT AREA:	51,422 S.F. = 1.18 AC.	

OWNERS

942850-0072 AND 942850-0073
BETROZOFF FAMILY TRUST
2559 EL MAR ST
COUPVILLE, WA 98239

942850-0065
ADAM JONES
17415 41ST AVE NE #D
ARLINGTON, WA 98223
(360) 403–7779

APPLICANT

BETROZOFF JONES, L.L.C.
2100 124TH AVENUE NE, SUITE 100
BELLEVUE, WA 98005
(425) 822–1444
CONTACT: TODD SHERMAN

PLANNER/ENGINEER

ESM CONSULTING ENGINEERS, L.L.C.
33400 8TH AVENUE S, SUITE 205
FEDERAL WAY, WA 98003
(425) 838–6113
CONTACT: ERIC LaBRIE, A.I.C.P.

SURVEYOR

MEAD GILMAN AND ASSOCIATES
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WOODINVILLE, WA 9872
(425) 486–1252
CONTACT: SHANE BARNES

WETLAND BIOLOGIST

MARK RIGOS, P.E.
CERTIFIED WETLAND BIOLOGIST
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ISSAQUAH, WA 98027
(425) 652–6013

GEOTECH ENGINEER

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17625 130TH AVENUE NE, #102
WOODINVILLE, WA 98027
(425) 488–0599
CONTACT: RICK POWELL, P.E.

ARBORIST

WASHINGTON FORESTRY CONSULTANTS, INC.
1919 YELM HIGHWAY, S.E.
OLYMPIA, WA 98501
(360) 943–1723
CONTACT: GALEN WRIGHT, ACF, ASCA

REVISIONS		
NO.	DESCRIPTION/DATE	BY
0		
1		

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Civil Engineering | Land Surveying | Land Planning
Public Works | Project Management | Landscape Architecture

BETROZOFF JONES, L.L.C.

BETROZOFF JONES

COVER SHEET & SITE PLAN

CITY OF REDMOND WASHINGTON

JOB NO.:	1426–002–012
DWG. NAME:	PP–01
DESIGNED BY:	LGB
DRAWN BY:	DCL
CHECKED BY:	
DATE:	05/03/2013
DATE OF PRINT:	

PP-01

1 OF 8 SHEETS

File: \\esm8\engr\ESM–JOBS\1426\002\012\PP–plot\Plots\PP–01.dwg
Plotted: 5/13/2013 12:04 PM
Plotted By: Eric LaBrie

ATTACHMENT C

Trip Generation Calculations

Betrozoff
Trip Generation Summary

Land Use	Area	Units [1]	ITE LUC [2]	Directional Distribution In	Directional Distribution Out	Trip Rate	Trips Generated In	Trips Generated Out	Trips Generated Total
Daily									
Single Family	35	DU	210	50%	50%	Equation	198	198	396
AM Peak Hour									
Single Family	35	DU	210	25%	75%	Equation	8	26	34
PM Peak Hour									
Single Family	35	DU	210	63%	37%	Equation	26	15	41

Notes:

[1] DU = Dwelling Units

[2] Institute of Transportation Engineers, *Trip Generation* Manual, 8th edition Land Use Code.

ATTACHMENT D

LOS & Queue Calculations

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	16	10	3	569	1033	5
Sign Control	Stop			Free	Free	
Grade	0%			-6%	4%	
Peak Hour Factor	0.92	0.92	0.84	0.84	0.95	0.95
Hourly flow rate (vph)	17	11	4	677	1087	5
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	TWLTL	
Median storage veh)					2	
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1775	1090	1093			
vC1, stage 1 conf vol	1090					
vC2, stage 2 conf vol	685					
vCu, unblocked vol	1775	1090	1093			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)	5.4					
tF (s)	3.5	3.3	2.2			
p0 queue free %	94	96	99			
cM capacity (veh/h)	276	262	628			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	28	4	677	1093
Volume Left	17	4	0	0
Volume Right	11	0	0	5
cSH	270	628	1700	1700
Volume to Capacity	0.10	0.01	0.40	0.64
Queue Length 95th (ft)	9	0	0	0
Control Delay (s)	19.9	10.8	0.0	0.0
Lane LOS	C	B		
Approach Delay (s)	19.9	0.1		0.0
Approach LOS	C			

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	64.7%	ICU Level of Service	C
Analysis Period (min)	15		

ATTACHMENT 36

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	9	6	16	1163	883	10
Sign Control	Stop			Free	Free	
Grade	0%			-6%	4%	
Peak Hour Factor	0.92	0.92	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	10	7	17	1237	939	11
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	TWLTL	
Median storage veh)					2	
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2216	945	950			
vC1, stage 1 conf vol	945					
vC2, stage 2 conf vol	1271					
vCu, unblocked vol	2216	945	950			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)	5.4					
tF (s)	3.5	3.3	2.2			
p0 queue free %	95	98	98			
cM capacity (veh/h)	211	318	727			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1
Volume Total	16	17	1237	950
Volume Left	10	17	0	0
Volume Right	7	0	0	11
cSH	243	727	1700	1700
Volume to Capacity	0.07	0.02	0.73	0.56
Queue Length 95th (ft)	5	2	0	0
Control Delay (s)	20.8	10.1	0.0	0.0
Lane LOS	C	B		
Approach Delay (s)	20.8	0.1		0.0
Approach LOS	C			

Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	71.2%	ICU Level of Service	C
Analysis Period (min)	15		

ATTACHMENT 36

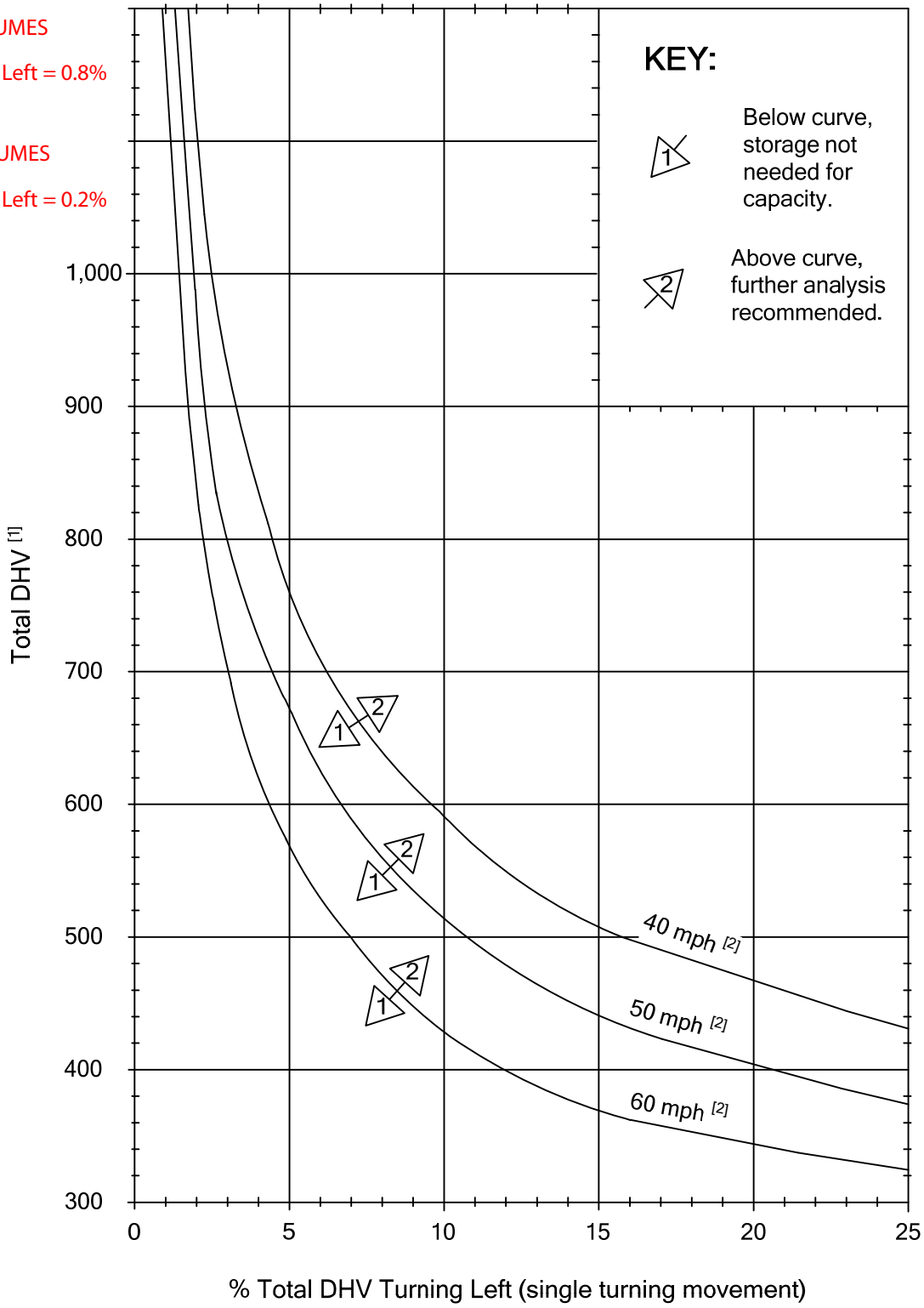
ATTACHMENT E

WSDOT Turn Lane Guidelines

BETROZOFF PROPERTY
2016 PEAK HOUR VOLUMES

PM PEAK HOUR VOLUMES
Total DHV = 2,072
% Total DHV Turning Left = 0.8%

AM PEAK HOUR VOLUMES
Total DHV = 1,610
% Total DHV Turning Left = 0.2%



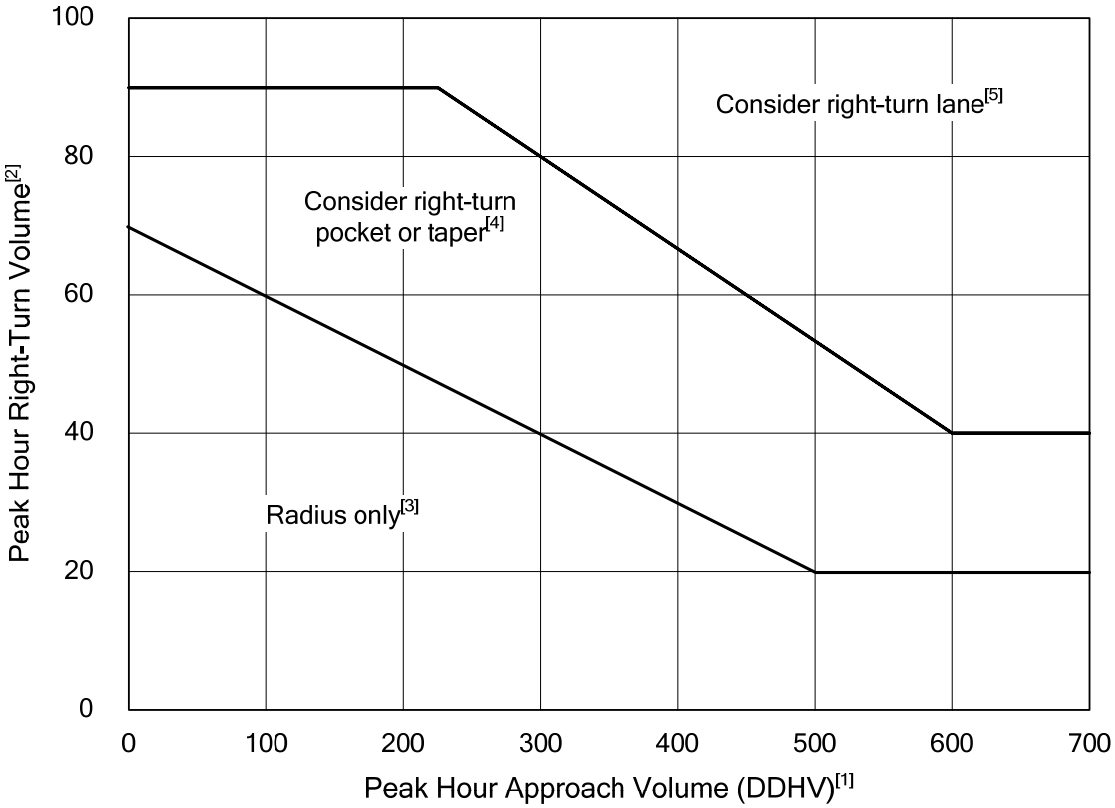
Notes:

[1] DHV is total volume from both directions.

[2] Speeds are posted speeds.

Left-Turn Storage Guidelines: Two-Lane, Unsignalized

Exhibit 1310-15a



Notes:

[1] For two-lane highways, use the peak hour DDHV (through + right-turn).
For multilane, high-speed highways (posted speed 45 mph or above), use the right-lane peak hour approach volume (through + right-turn).

[2] When all three of the following conditions are met, reduce the right-turn DDHV by 20:
- The posted speed is 45 mph or below
- The right-turn volume is greater than 40 VPH
- The peak hour approach volume (DDHV) is less than 300 VPH

[3] For right-turn corner design, see Exhibit 1310-14 .

[4] For right-turn pocket or taper design, see Exhibit 1310-20 .

[5] For right-turn lane design, see Exhibit 1310-21 .

PM PEAK HOUR VOLUMES
DDHV = 893
SB RIGHT-TURN VOLUME = 10

AM PEAK HOUR VOLUMES
DDHV = 1,038
SB RIGHT-TURN VOLUME = 5

General:

For additional guidance, see 1310.07(3) .

Right-Turn Lane Guidelines[6]
Exhibit 1310-19

(4) Speed Change Lanes

A speed change lane is an auxiliary lane primarily for the acceleration or deceleration of vehicles entering or leaving the through traveled way. Speed change lanes are normally provided for at-grade intersections on multilane divided highways with access control. Where roadside conditions and right of way allow, speed change lanes may be provided on other through roadways. Justification for a speed change lane depends on many factors, including speed; traffic volumes; capacity; type of highway; design and frequency of intersections; and collision history.