



MEMORANDUM

Date: December 2, 2015

Project #: 17808.0

To: Mike Peebles, PE, OTAK

From: Anais Malinge and Marc Butorac, PE, PTOE

Project: South Cooper Mountain Heights PUD

Subject: Supplemental Analysis

The supplemental analysis provided herein addresses completeness review comments and facility review comments for the South Cooper Mountain Heights Traffic Impact Analysis (May 2015) received from City of Beaverton staff on September 25, 2015 and November 4, 2015, respectively. The two completeness review comments addressed herein include:

- 1. Phasing plan for the street improvements. The traffic analysis will need to show how the internal and external circulation system will perform at each stage of development.*
- 2. For any local street not designed to the L1 standard, that applicant's traffic engineer will have to show that the expected traffic volumes will be below the 500 trip threshold.*
- 3. Determine if a Transportation Demand Management Plan for SW Oystercatcher Lane is necessary based on the a additional peak hour trip threshold.*

In addition to addressing the above completeness review comments, this supplemental analysis also provides an updated 2016 total traffic conditions analysis assuming an updated trip generation estimate per the final South Cooper Mountain Heights site plan.

PHASING PLAN

The following section summarizes the assumed site access phasing, recommended improvements under 2016 full build-out, and the proposed phased development scheme.

Site Access Phasing

The proposed South Cooper Mountain Heights development assumes three new site access points along SW 175th Avenue upon full build-out in year 2016:

- SW 175th Avenue/Planned Collector 6b, 6c – the planned collector provides full access to the proposed South Cooper Mountain Heights development and is stop-controlled in the

near-term build-out year 2016. This intersection is anticipated to be signalized in the longer term as the South Cooper Mountain Concept Plan area develops, particularly to the west of SW 175th Avenue, and when a connection to SW Loon Drive is realized. The warrants for this signal will not be met without future development to the west of SW 175th Avenue.

- SW 175th Avenue/High School Site Access – South Site Access – the proposed South Cooper Mountain Heights south site access provides full signalized access and shares access with the proposed Beaverton High School. The South Cooper Mountain Heights development will necessitate the activation of the westbound approach to the signal. In the near-term build-out year 2016, a majority of trips bound for the SW Roy Rogers Road/SW Scholls Ferry Road intersection travel through this intersection; however, vehicles will be more evenly distributed to the other two site-access points (SW 175th Avenue/Planned Collector 6b, 6c and SW Loon Drive/Planned Collector 6b, 6c) in the longer term.
- SW Loon Drive/Planned Collector 6b, 6c – the City of Beaverton is constructing the portion of the Planned Collector 6b, 6c that lies east of the proposed South Cooper Mountain Heights development. Upon construction, a site access will be provided via the SW Loon Drive/Planned Collector 6b, 6c.¹

Figures 1 and 2 show the trip distribution and assignment for both the weekday AM and PM peak hours, with access to SW Loon Drive. The trip assignment assumes a cumulative approach to the phased development, assuming Phase 1 is constructed first.

Recommended Improvements

Per the May 2015 Transportation Impact Analysis, the following improvements are proposed upon 2016 full build-out:

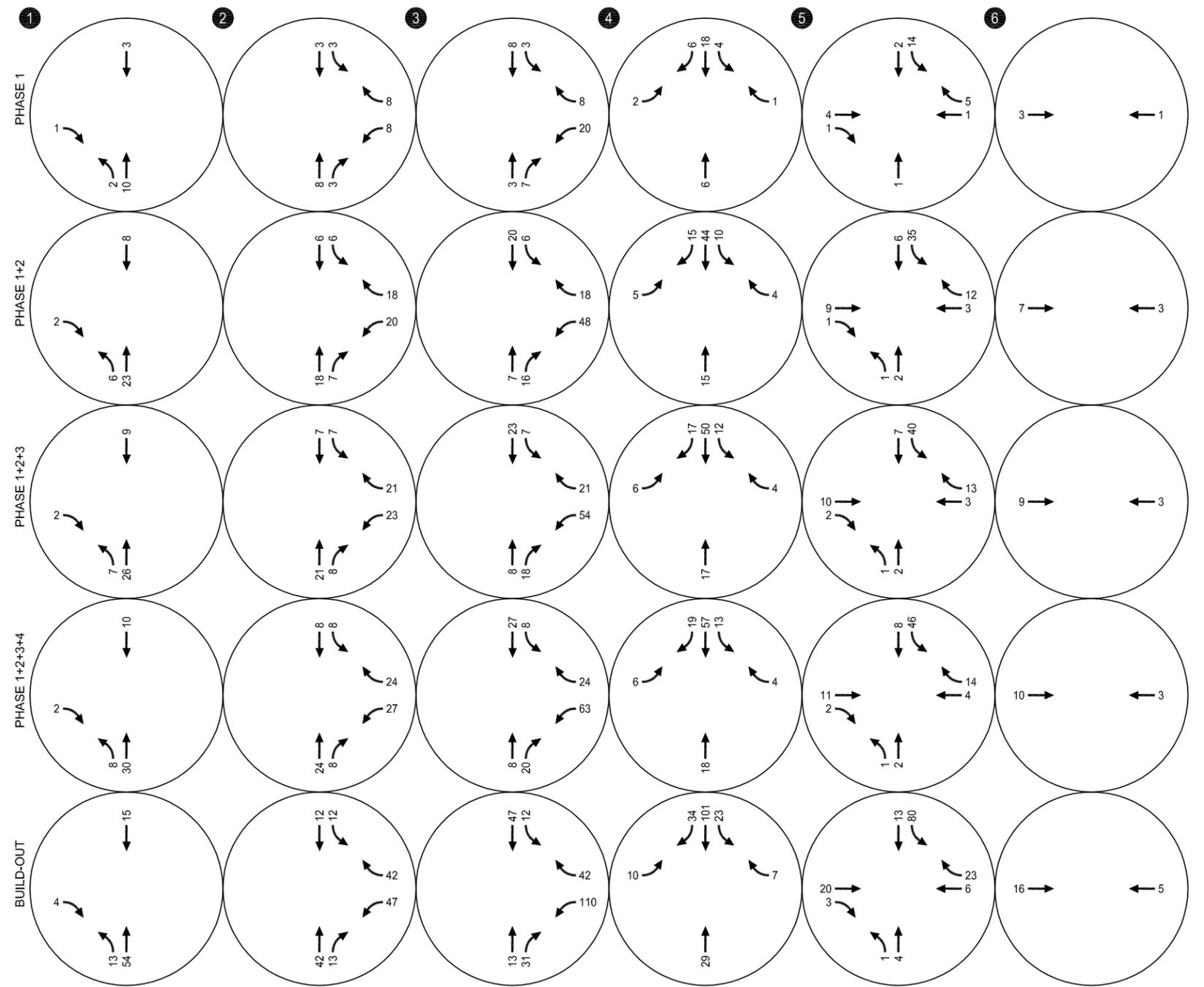
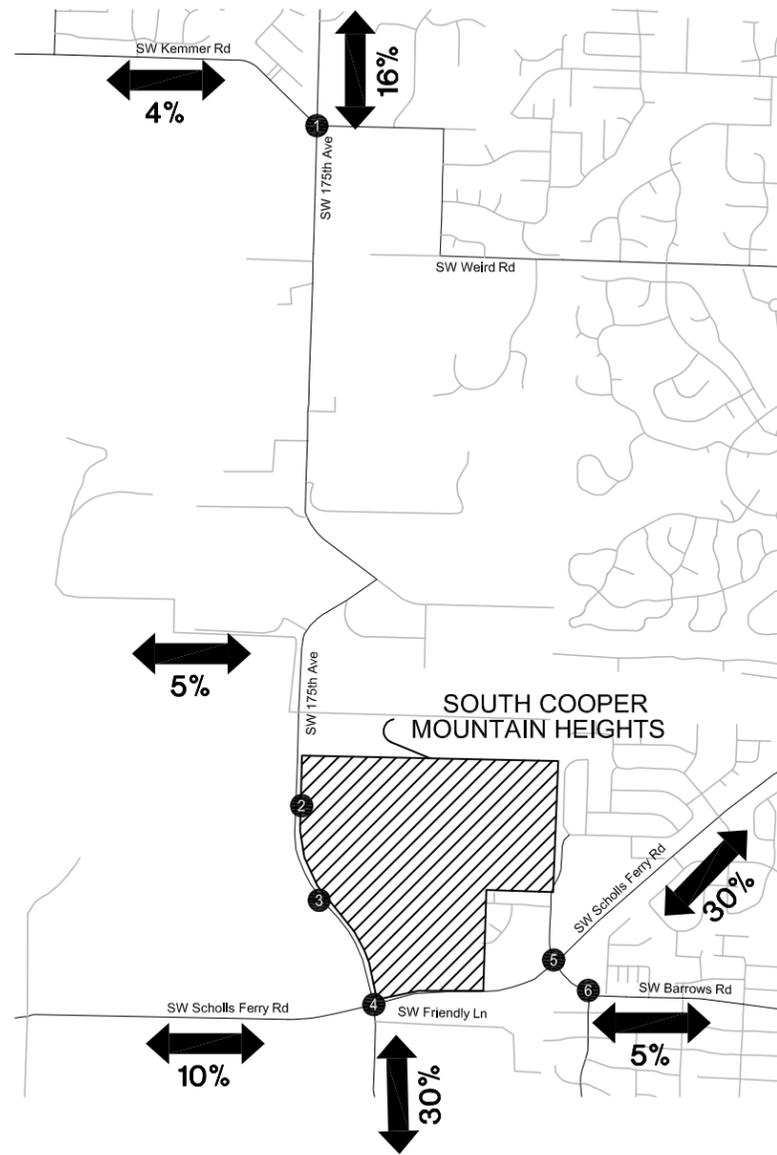
- SW 175th Avenue/SW Kemmer Road – Provide a proportional share contribution per the 2017 Cumulative Impact Analysis to the Washington County MSTIP-led project which will result in the installation of a new traffic signal and exclusive northbound and southbound left-turn lanes with protected phasing. (MSTIP – Years 1-3). The proportional share contribution is \$214,302 per the methodology agreed to by Washington County². *Attachment “A” includes the proportional share calculations for all proposed developments in the River Terrace and South Cooper Mountain Planning areas.*

¹ Under City of Beaverton staff direction, the May 2015 Transportation Impact Analysis did not include the SW Loon Drive connection for the 2016 build-out analysis. However, based on recent developments, this supplemental analysis was conducted with the SW Loon Drive connection.

² The proportional share contribution reflects the most up to date trip generation estimate for the South Cooper Mountain Heights site.

- SW 175th Avenue/Planned Collector 6b, 6c – Provide a stop-controlled intersection with a new 100-foot southbound left-turn lane and exclusive westbound right- and left-turn lanes. (MSTIP – Years 1-3)
- SW 175th Avenue/High School – South Site Access – Install a traffic signal (or modify the conditioned High School Site-Access traffic signal) with a 100-foot southbound left-turn lane and westbound shared through-right and left-turn lanes. (MSTIP – Years 1-3)
- SW Roy Rogers Road-SW 175th Avenue/SW Scholls Ferry Road – Optimize signal timing to provide additional green time to the northbound and southbound movements.
- Any future landscaping, above-ground utilities, and site signage should be located and maintained such that they provide minimum required sight lines in either direction at all access locations.

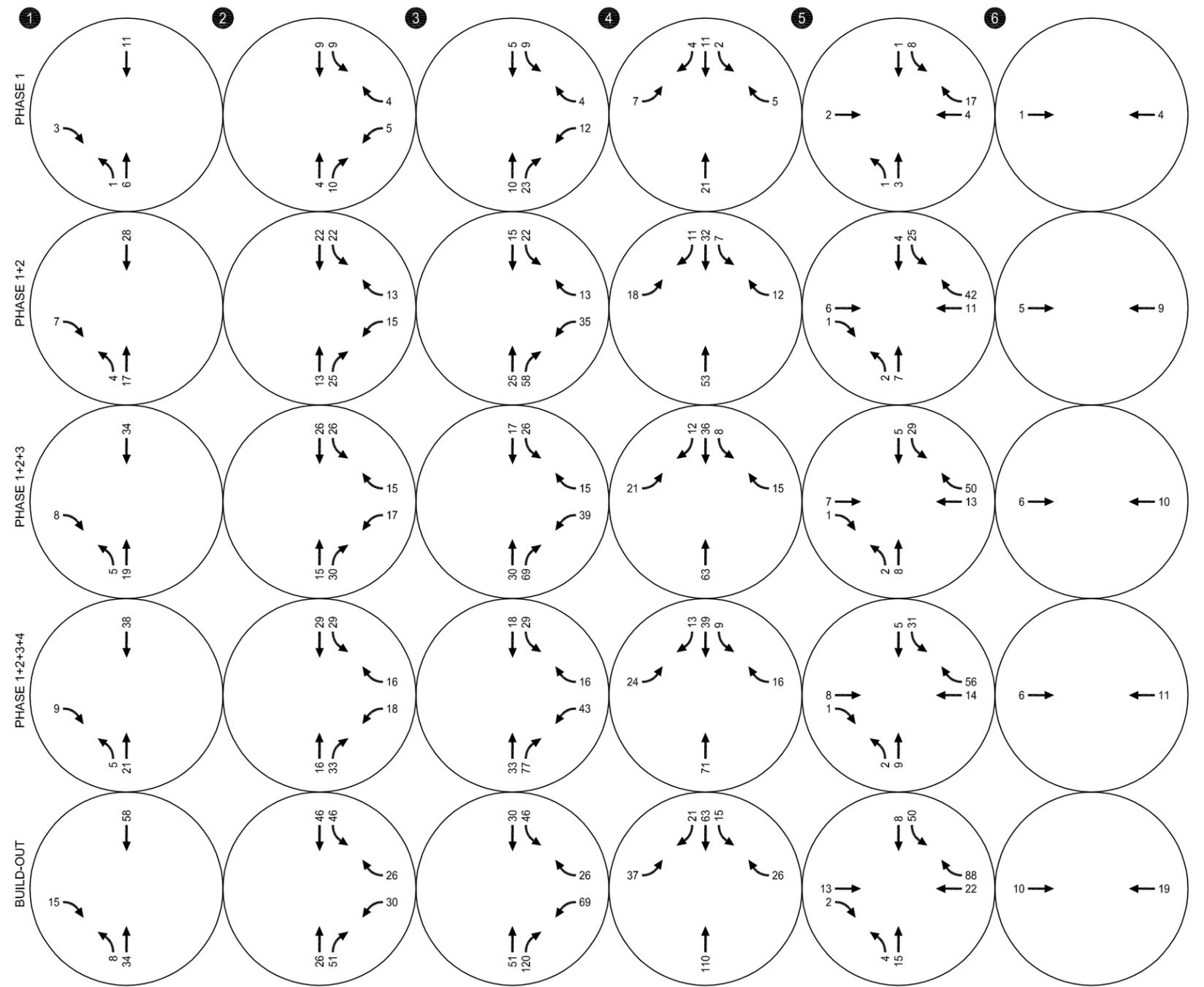
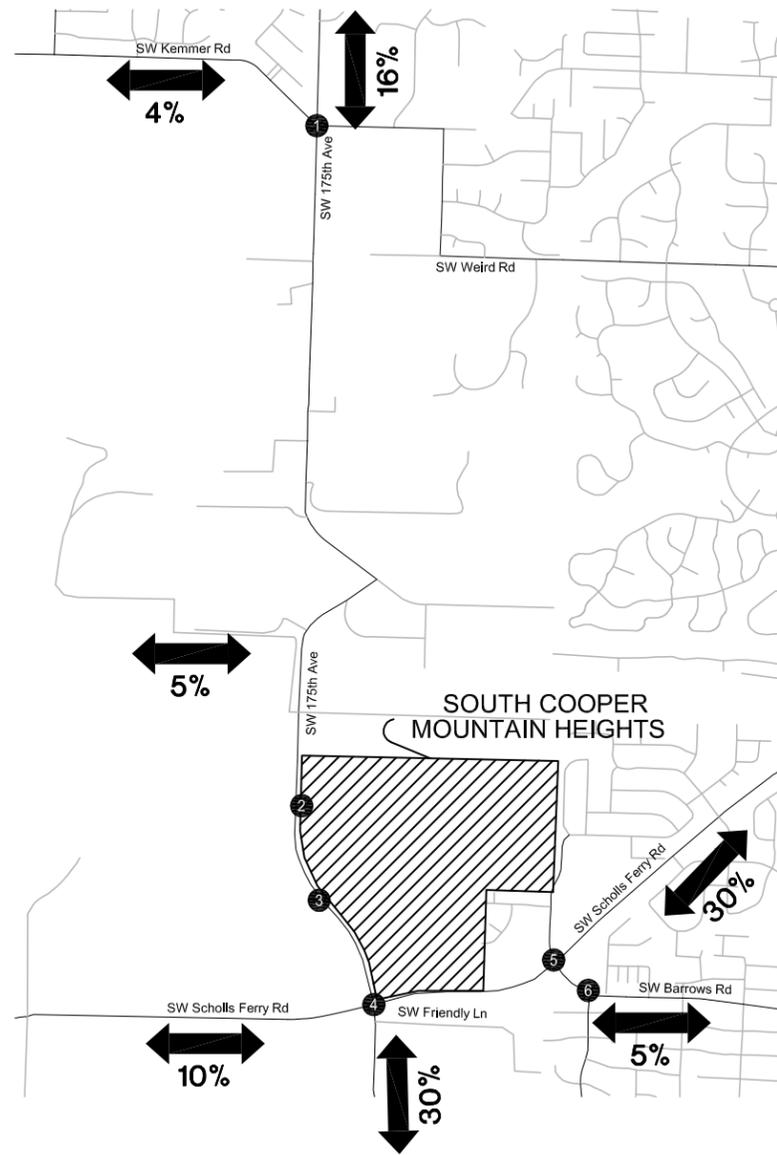
Based on a draft MSTIP High Growth Project list published in June 2015, the SW 175th Avenue/SW Kemmer Road intersection and the SW 175th Avenue segment between the Planned Collected 6b, 6c and SW Scholls Ferry Road are both planned within one to three years (Attachment “B”).



Trip Generation - With Access to SW Loon Drive
Weekday AM Peak Hour
Beaverton, OR

Figure 1

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Trip Generation - With Access to SW Loon Drive
Weekday PM Peak Hour
Beaverton, OR

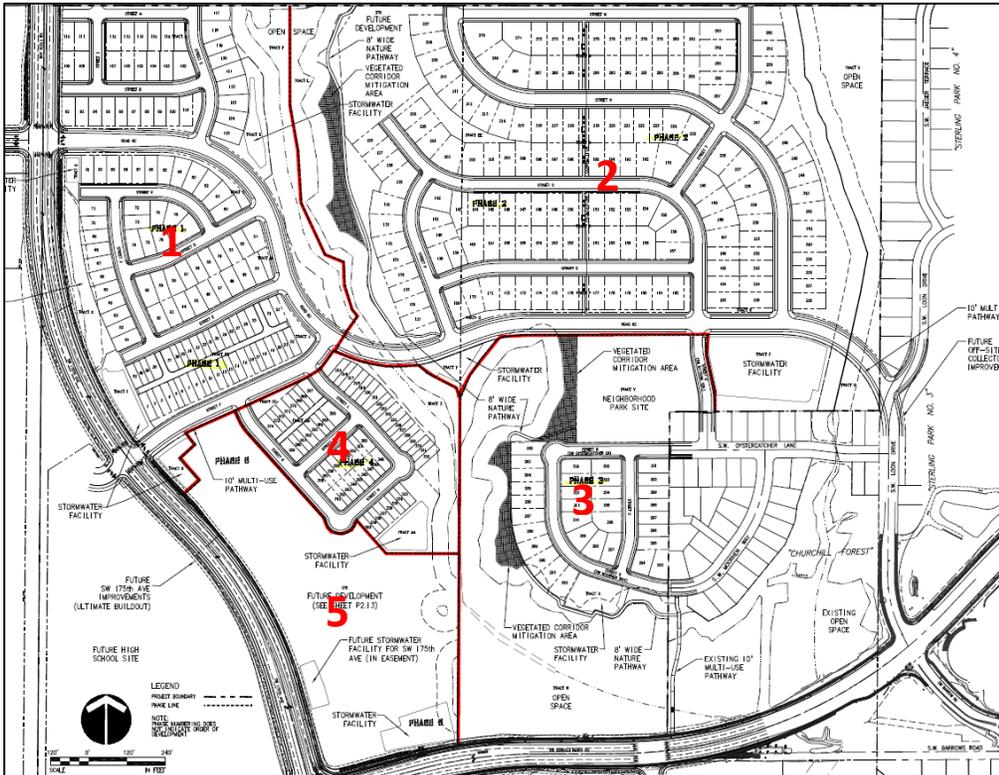
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Phased Development

Exhibit 1 below shows the proposed phased development plan for South Cooper Mountain Heights.

Exhibit 1: Site Phasing



As shown in Exhibit 1, the South Cooper Mountain Heights development is proposed to develop in five phases. Phase 1 abuts SW 175th Avenue. Access to Phase 1 will be provided through the two main access points along SW 175th Avenue. Phase 2 is in the northern quadrant of the site and abuts SW Loon Drive. Phase 3 is west of the existing neighborhood and feeds in to SW Moorhen Way and SW Oystercatcher Lane. Phase 4 is southeast of Phase 1 and is dependent on Phase 1 to develop in order to gain access to the larger transportation network. Phase 5 represents the multi-family portion of the development and sits on the northeast quadrant of the SW Roy Rogers Road/SW Scholls Ferry Road intersection. Table 1 summarizes the cumulative trip generation assuming sequential phased development.

Table 1: Estimated Cumulative Trip Generation

Land Use	ITE Code	Size (Units)	Total Daily Trips	Weekday AM Peak Hour			Weekday PM Peak Hour		
				Total	In	Out	Total	In	Out
Phase 1									
Single Family Detached	210	83	790	60	15	45	110	70	30
Townhome	230	43	250	20	5	15	25	15	10
Apartments	220	0	0	0	0	0	0	0	0
Total Net-New Trips		126	1,040	80	20	60	135	85	40
Phase 1+2									
Single Family Detached	210	239	2,280	175	45	130	265	160	95
Townhome	230	43	250	20	5	15	25	15	10
Apartments	220	0	0	0	0	0	0	0	0
Total Net-New Trips		282	2,530	195	50	145	290	175	105
Phase 1+2+3									
Single Family Detached	210	272	2,590	200	50	150	310	195	110
Townhome	230	43	250	20	5	15	20	15	10
Apartments	220	0	0	0	0	0	0	0	0
Total Net-New Trips		315	2,840	220	55	165	330	210	120
Phase 1+2+3+4									
Single Family Detached	210	272	2,590	200	50	150	310	195	110
Townhome	230	110	640	50	10	40	55	40	20
Apartments	220	0	0	0	0	0	0	0	0
Total Net-New Trips		382	3,230	250	60	190	365	235	130
Full Build-Out									
Single Family Detached	210	272	2,590	205	50	155	310	195	115
Townhome	230	110	640	50	10	40	55	35	20
Apartments	220	340	2,260	175	35	140	210	135	75
Total Net-New Trips		722	5,490	430	95	335	575	365	210

As required by City of Beaverton staff, the following analysis identifies when each proposed street improvement is needed based on the previously summarized phasing plan.

SW 175th Avenue/SW Kemmer Road (2019-2023 MSTIP – Years 1-3)

The intersection improvements are in the 1-3 year planning horizon per the 2019-2023 MSTIP draft project list. Per the May 2015 TIA, the proposed South Cooper Mountain Heights development is to provide proportional share contribution per the 2017 Cumulative Impact Analysis to the Washington County led MSTIP project which will result in the installation of a new traffic signal and exclusive northbound and southbound left-turn lanes with protected phasing. This contribution should be submitted either as a lump sum or proportion to the trips generated by each phase, as shown in Table 2.

Table 2: SW 175th Avenue/SW Kemmer Road Proportional Share

Phase	AM Peak Hour Trips	PM Peak Hour Trips	Avg. Peak Hour Trips	Share of Build-Out Trips	Proportional Share
Phase 1	16	21	18	19%	\$39,767
Phase 2	23	31	27	28%	\$59,651
Phase 3	5	7	6	6%	\$13,256
Phase 4	6	7	7	7%	\$15,465
Phase 5	36	41	39	40%	\$86,162
Build-Out	86	107	97	100%	\$214,302

SW 175th Avenue/Planned Collector 6b, 6c

The SW 175th Avenue/Planned Collector 6b, 6c is proposed as a stop-controlled intersection including a new 100-foot southbound left-turn lane and exclusive westbound right- and left-turn lanes. The intersection does not meet signal warrants without planned development on the west of SW 175th Avenue. The intersection is within the 2019-2023 MSTIP draft project list. However, assuming the proposed development develops before improvements are made along SW 175th Avenue, the southbound left-turn lane would be warranted upon construction of Phase 1. *Attachment “C” includes the left-turn lane warrant.*

SW 175th Avenue/High School–South Site Access

The intersection improvements for the SW 175th Avenue/High School-South Site Access includes the installation of a traffic signal (or modify the conditioned High School Site-Access traffic signal) with a 100-foot southbound left-turn lane and westbound shared through-right and left-turn lanes. The intersection is within the 2019-2023 MSTIP draft project list. Based on the development context³, there are three scenarios in the overall development scheme, including:

1. South Cooper Mountain Heights develops before the High School and before the completion of the MSTIP project.
2. South Cooper Mountain Heights develops after the High School and before the completion of the MSTIP project.
3. South Cooper Mountain Heights develops after both the High School and the MSTIP project.

No matter the scenario, the southbound left-turn lane is warranted and the westbound approach should be developed upon build-out of Phase 1. Assuming Scenario 1, the intersection does not meet signal warrants until full 2016 build-out of the site. As such, the west approach would be stop-

³ The full intersection improvement is contingent on the High School development, the Washington County MSTIP project along SW 175th Avenue, and the proposed South Cooper Mountain Heights development. It is unknown which of these will materialize first.

controlled, with one through travel lane in each direction, a southbound left-turn lane, and a westbound shared through-right and exclusive left-turn lane until full build-out of the development. Attachment “D” includes the left-turn lane warrant and signal warrant assuming Scenario 1.

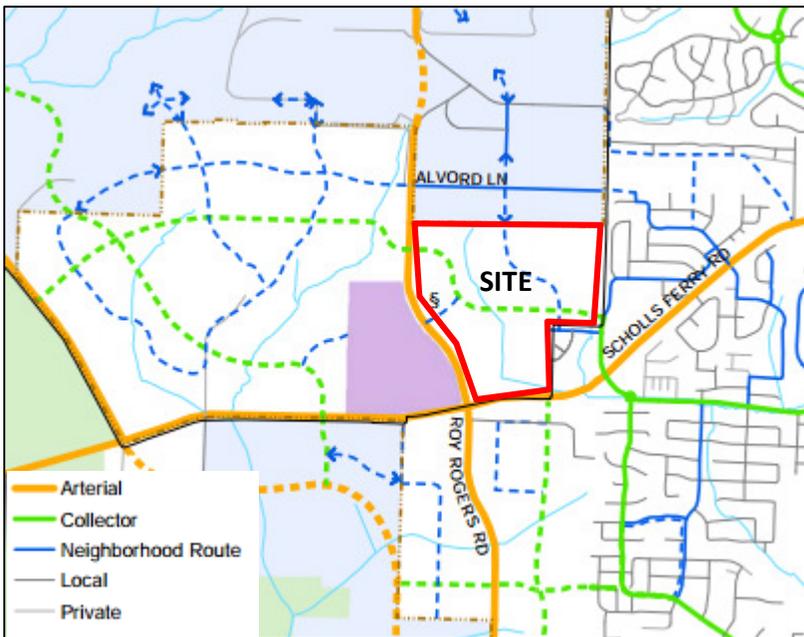
SW Roy Rogers Road-SW 175th Avenue/SW Scholls Ferry Road

Per the May 2015 TIA, full build-out of the South Cooper Mountain Heights development will likely necessitate the optimization of signal timing to provide additional green time to the northbound and southbound movements. The phasing scheme does not impact the need for optimization – signal timing should be optimized following the completion of Phase 5.

LOCAL STREET STANDARDS

Exhibit 2 shows the transportation network for the South Cooper Mountain Concept Plan. As shown, a east-west collector (Collector 6c) is proposed through the South Cooper Mountain Heights development along with a north-south neighborhood route. Development to the north of the proposed South Cooper Mountain Height’s site will be served by Alvord Lane, a proposed east-west neighborhood route. To this end, there are relatively limited trips anticipated to travel south through the site as those residents are likely to experience faster travel times along Alvord Lane to SW 175th Avenue.

Exhibit 2: South Cooper Mountain Concept Plan Transportation Network

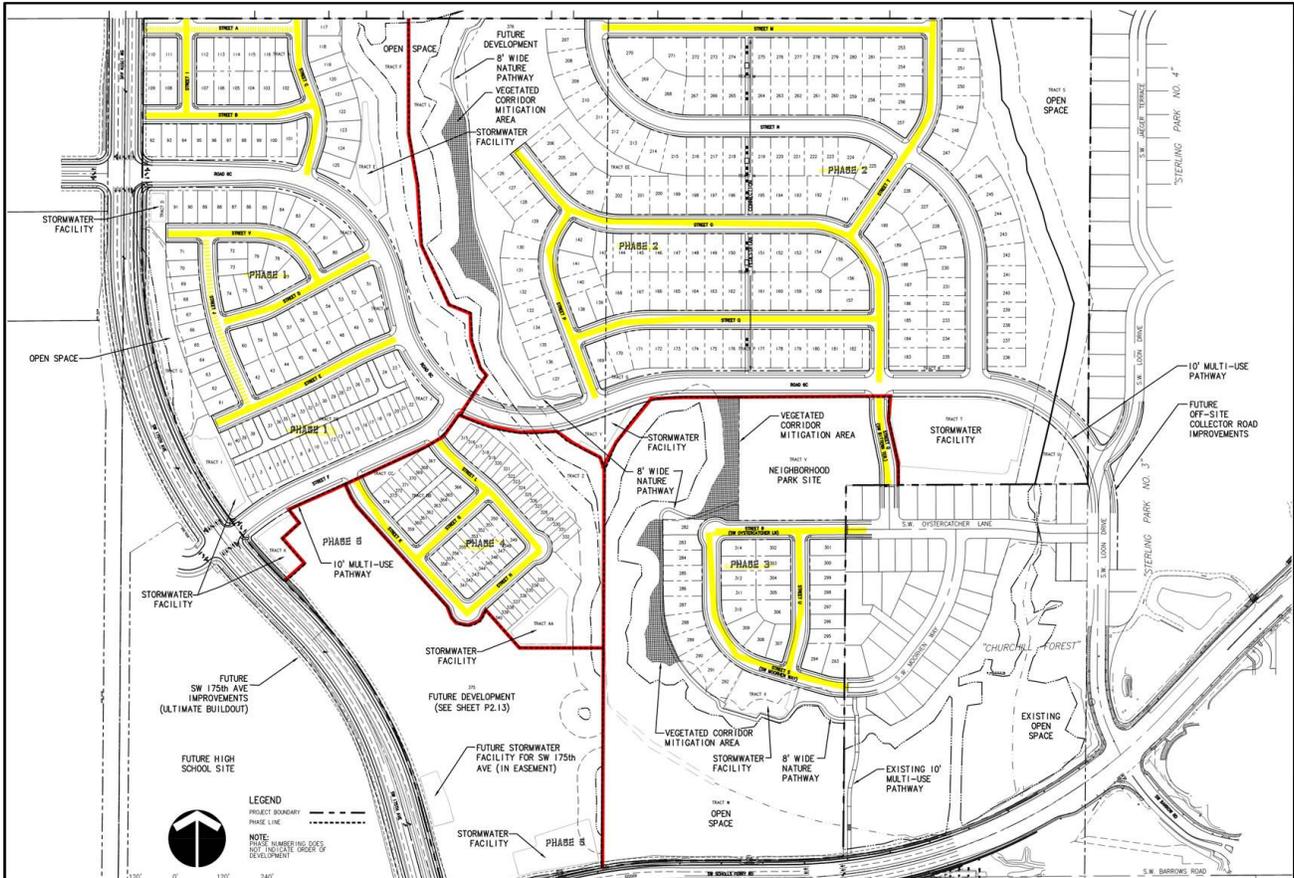


Source: City of Beaverton, South Cooper Mountain Concept Plan, ES-11

The local streets within the proposed development will likely only serve residences that abut those streets. Exhibit 3 shows the local streets within the site with a L2 standard (the streets highlighted in yellow are those proposed as L2 streets). Per City of Beaverton code, traffic along a L2 street should not

exceed 500 vehicles per day. The following analysis demonstrates that none of the streets with the L2 designation will exceed the 500 ADT threshold.

Exhibit 3: L2 Street Standard



The following local streets are designated as L2 and are direct access points to the larger street network:

- Street C will connect 35 single family detached homes to Collector 6c, or 330 daily trips.
- Street D will connect 35 single family detached homes to Collector 6c, or 330 daily trips.
- Street E will connect 13 single family detached homes and 43 single family attached homes to Collector 6c, or 370 daily trips.
- Street P will connect 51 single family detached homes to Collector 6c, or 490 daily trips.
- Street O will connect 30 single family detached homes to Collector 6c, or 290 daily trips.
- Street T will connect 18 single family detached homes to the north-south neighborhood route, or 170 daily trips.
- Street R and Street S connect 33 single family detached homes to SW Moorhen Way and SW Oystercatcher Lane, or 310 daily trips.

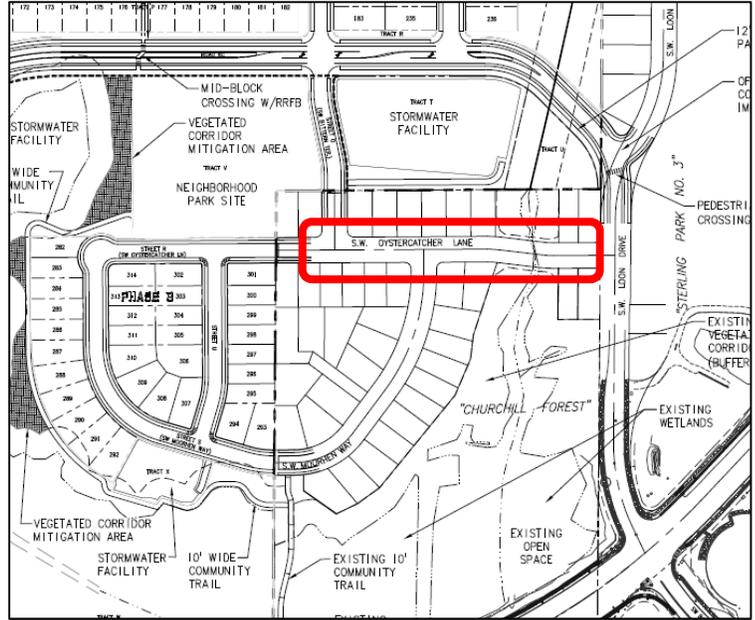
- Street L and Street K connect 67 single family attached homes to Street F, or 390 daily trips.

Anticipated Peak Hour Trip Impact to SW Oystercatcher Lane

Exhibit 4 highlights the location of SW Oystercatcher Lane and the proposed Phase 3 development of South Cooper Mountain Heights, which represents the additional potential residences to use SW Oystercatcher Lane at full build-out. Per the City of Beaverton, a Transportation Demand Management Plan is required for SW Oysertcatcher Lane if 20 or more additional peak hour trips are anticipated to travel along SW Oystercatcher Lane.

Phase 3 proposes 33 single family homes which represents 25 a.m. peak hour trips and 33 p.m. peak hour trips. Based on the proposed trip distribution documented in the May 2015 TIA and the three available access points to the transportation system, approximately 65 percent of these residences would travel through the SW Loon Drive/SW Scholls Ferry Road intersection. As such, approximately 16 a.m. peak hour trips and 22 p.m. peak hour trips from Phase 3 are anticipated to travel through the intersection. However, trips associated with Phase 3 development can travel along both Street O to the north and SW Oystercatcher Lane; as such, it is anticipated that a 50/50 split of these anticipated trips use these roadways. Therefore, approximately 8 a.m. peak hour trips and 11 p.m. peak hour trips are anticipated along SW Oystercatcher Lane.

Exhibit 4: SCM Heights Phase 3



2016 TOTAL TRAFFIC CONDITIONS UPDATE

The following section serves as an amendment to the May 2015 TIA. Since submittal of the May 2015 TIA, the trip generation estimates have changed due to updates to the site layout. Table 3 provides a summary of the May 2015 and October 2015 trip generation estimates and the associated difference. As shown, there are an estimated 160 additional daily trips, 15 additional weekday AM peak hour trips (-5 in, +20 out), and 45 additional weekday PM peak hour trips (+30 in, +15 out).

Table 3: Trip Generation Estimate Difference

Land Use	ITE Code	Size (Units)	Total Daily Trips	Weekday AM Peak Hour			Weekday PM Peak Hour		
				Total	In	Out	Total	In	Out
May 2015 TIA									
Single Family Detached	210	308	2,930	230	60	170	319	195	115
Townhome	230	104	600	45	10	35	55	35	20
Apartments	220	270	1,800	140	30	110	165	105	60
Total Net New Trips	682	5,330	415	100	315	530	335	195	195
October 2015 Update									
Single Family Detached	210	272	2,590	205	50	155	310	195	115
Townhome	230	110	640	50	10	40	55	35	20
Apartments	220	340	2,260	175	35	140	210	135	75
Total Net New Trips	722	5,490	430	95	335	575	365	210	210
Difference (October 2015 Update - May 2015 TIA)									
Total Net New Trips	+40	+160	+15	-5	+20	+45	+30	+15	+15

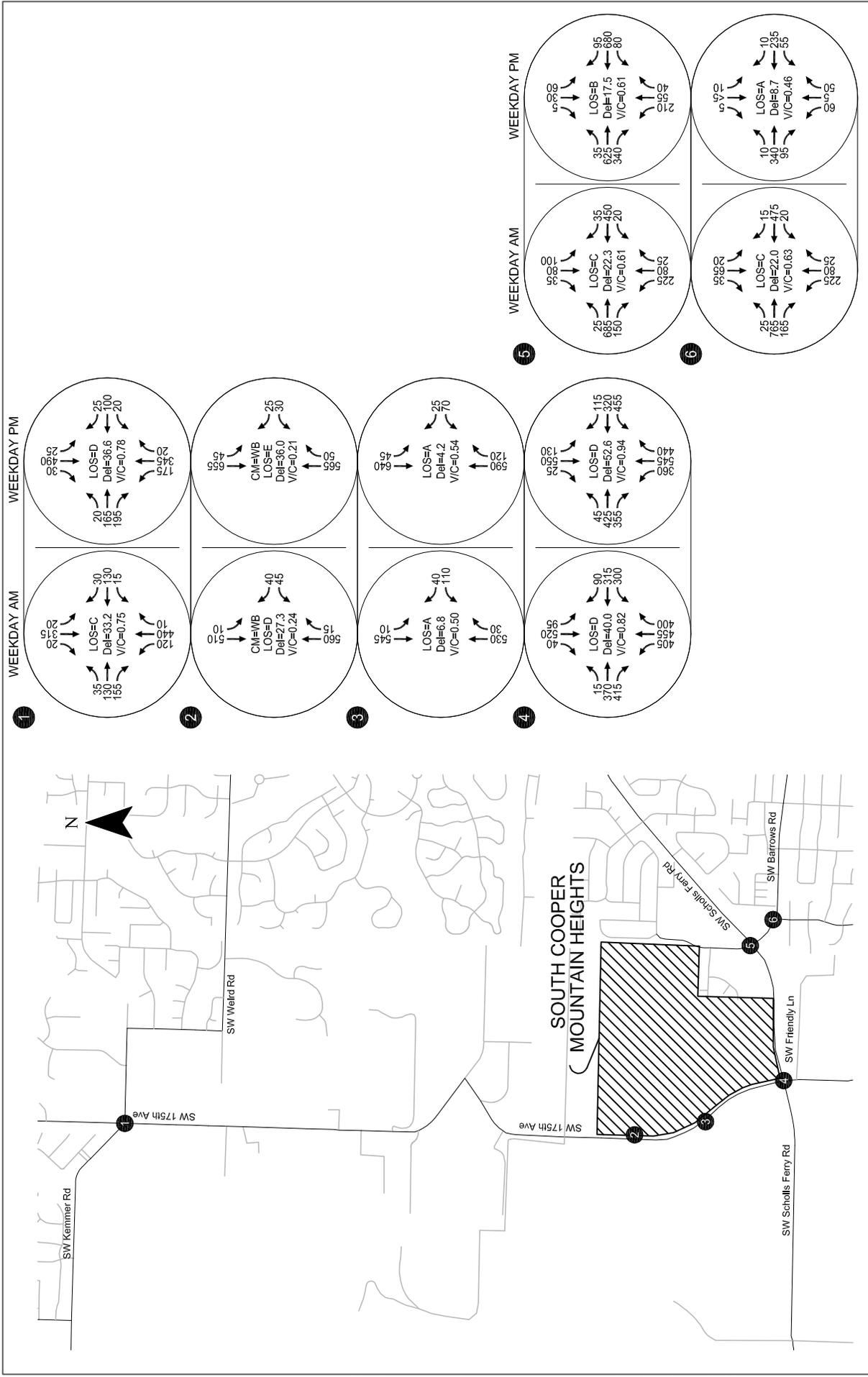
Figure 3 shows the 2016 total traffic conditions assuming the updated trip generation estimate and mitigations documented in the May 2015 TIA⁴. Figures 1 and 2 includes the trips distribution and assignment. As shown, all study intersections continue to operate acceptably assuming the provision of the May 2015 mitigations, as listed below:

- SW 175th Avenue/SW Kemmer Road – Provide a proportional share contribution per the 2017 Cumulative Impact Analysis to the Washington County led project which will result in the installation of a new traffic signal and exclusive northbound and southbound left-turn lanes with protected phasing.
- SW 175th Avenue/Planned Collector 6b, 6c – Provide a stop-controlled intersection with a new 100-foot southbound left-turn lane and exclusive westbound right- and left-turn lanes.
- SW 175th Avenue/High School–South Site Access – Install a traffic signal (or modify the conditioned High School Site-Access traffic signal) with a 100-foot southbound left-turn lane and exclusive westbound shared through-right and left-turn lanes.

⁴ Consistent with the May 2015 TIA, the 2016 total traffic conditions assumes no connection to SW Loon Drive.

- SW Roy Rogers Road-SW 175th Avenue/SW Scholls Ferry Road – Optimize signal timing to provide additional green time to the northbound and southbound movements.
- Any future landscaping, above-ground utilities, and site signage should be located and maintained such that they provide minimum required sight lines in either direction at all access locations.

Attachment "E" includes the 2016 Total Traffic Conditions worksheets.



2016 Total Traffic Conditions
 Weekday AM and PM Peak Hours
 Beaverton, OR

Figure 3

FINDINGS

The following findings are a result of the analysis provided herein:

- All street improvements documented in the May 2015 TIA will be triggered as part of Phase 1 of the South Cooper Mountain Heights development.
- None of the streets with the L2 designation will exceed the 500 ADT threshold.
- The South Cooper Mountain Heights development will not impact SW Oystercatcher Lane with 20 or more peak hour trips.
- The updated site layout results in an estimated 160 additional daily trips, 15 additional weekday AM peak hour trips (-5 in, +20 out), and 45 additional weekday PM peak hour trips (+30 in, +15 out).
- All study intersections continue to operate acceptably under 2016 total traffic conditions assuming the updated trip generation estimate and the provision of the recommendations documented in the May 2015 TIA.

Please contact us at (503) 228-5230 if you have any questions regarding this study.

Attachment A Proportional Share Calculation

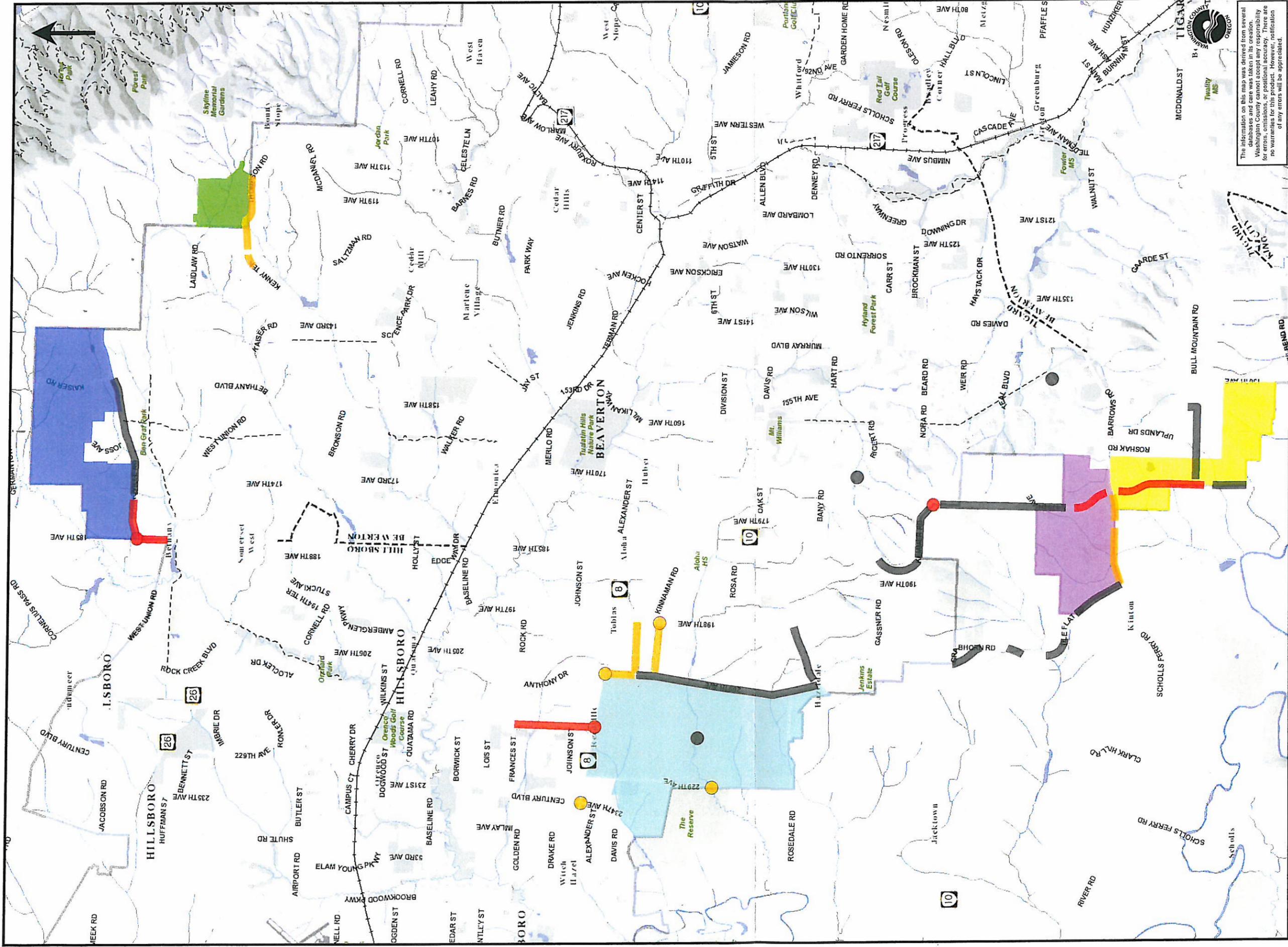
Development	Size	AM Peak Hour Trips	PM Peak Hour Trips	Avg Peak Hour Trips	% of Avg. Peak Hour Trips to 2016 total trips	% of Avg. Peak Hour Trips to total added trips	Full Share of \$2.5 Million Improvement at 175th/Kemmer	1/3 of Full Share 175th/Kemmer Improvements
Beaverton School District	1,700	272	84	178	10.0%	47.4%	1,185,876	395,292
South Cooper Mountain Heights	722	86	107	97	5.4%	25.7%	642,905	214,302
River Terrace Northwest	175	12	15	14	0.8%	3.6%	89,940	29,980
River Terrace East	286	20	25	23	1.3%	6.0%	149,900	49,967
West River Terrace	138	9	11	10	0.6%	2.7%	66,622	22,207
Roshak Ridge	244	16	20	18	1.0%	4.8%	119,920	39,973
South River Terrace	190	12	16	14	0.8%	3.7%	93,271	31,090
Bull Mountain Dickson	82	7	8	8	0.4%	2.0%	49,967	16,656
Metropolitan Land Group	173	13	18	15	0.9%	4.1%	101,599	33,866

Attachment B Draft MSTIP List

DRAFT - MSTIP High Growth Project List

Road	Extent	Project*	Total Cost	County Cost (2/3)	Local Cost (1/3)	TDT Project #	Area**
Years 1-3							
Springville Rd	185th - west of PCC entrance	Widen to 5 lanes, realign	\$ 11,750,000	\$ 7,833,333	\$ 3,916,667	1069 (WC)	NB/BSW
185th Ave	Springville - West Union	Widen to 5 lanes, intersection improvements at termini	\$ 6,000,000	\$ 4,000,000	\$ 2,000,000	1013 (WC)	NB/BSW
Cornelius Pass Rd	Frances - TV Hwy	Widen to 5 lanes	\$ 14,000,000	\$ 9,333,333	\$ 4,666,667	1030 (WC)	SH
TV Hwy	Cornelius Pass Rd	Westbound right turn lane	\$ 3,107,000	\$ 2,071,333	\$ 1,035,667	3054 (H)	SH
175th Ave	Kemmer Rd	Intersection improvement	\$ 5,000,000	\$ 3,333,333	\$ 1,666,667	1010 (WC)	SCM
Roy Rogers Rd	E-W collector - Scholls Ferry	Widen to 5 lanes	\$ 6,345,000	\$ 4,230,000	\$ 2,115,000	Not on list	SCM
	Scholls Ferry - S of Bull Mountain	Widen to 5 lanes	\$ 24,900,000	\$ 16,600,000	\$ 8,300,000	Not on list	RT
		Year 1-3 total	\$ 71,102,000	\$ 47,401,333	\$ 23,700,667		
Years 4-6							
Thompson Rd	Kenny - Saltzman	Realign, widen to 3 lanes	\$ 6,000,000	\$ 4,000,000	\$ 2,000,000	Not on list	NB/BSW
TV Hwy	209th Ave	Intersection & railroad improvement	\$ 14,794,000	\$ 9,862,667	\$ 4,931,333	1020 (WC)	SH
Blanton St	TV Hwy - Blanton	Widen to 5 lanes, signal at Blanton	\$ 4,333,000	\$ 2,888,667	\$ 1,444,333	1020 (WC)	SH
Kinnaman Rd	209th - 198th	Sidewalks, turn lanes as needed	\$ 3,261,000	\$ 2,174,000	\$ 1,087,000	Not on list	SH
Kinnaman Rd	209th - 198th	Sidewalks, bike lanes, turn lanes	\$ 3,261,000	\$ 2,174,000	\$ 1,087,000	1053 (WC)	SH
Scholls Ferry Rd	198th Ave	Realign & signalize offset intersection	\$ 4,917,000	\$ 3,278,000	\$ 1,639,000	1054 (WC)	SH
	N-S Collector - Roy Rogers	Widen to 5 lanes	\$ 2,750,000	\$ 1,833,333	\$ 916,667	Not on list	SCM/RT
		Year 4-6 total	\$ 39,316,000	\$ 26,210,667	\$ 13,105,333		
Years 7-10							
Thompson Rd	Saltzman - Marcolite	Widen to 3 lanes	\$ 4,000,000	\$ 2,666,667	\$ 1,333,333	1072 (WC)	NB/BSW
TV Hwy	Century Blvd	Widen NB/SB approaches to 5-lanes, EB Bus Pullout	\$ 10,473,000	\$ 6,982,000	\$ 3,491,000	Not on list	SH
229th Ave	Butternut Creek	Replace bridge, widen to 3 lanes	\$ 5,827,000	\$ 3,884,667	\$ 1,942,333	3020 (H)	SH
Scholls Ferry Rd	Tile Flat - N-S Collector	Interim 3-lane and north side half street	\$ 5,500,000	\$ 3,666,667	\$ 1,833,333	Not on list	SCM/RT
		Year 7-10 total	\$ 25,800,000	\$ 17,200,000	\$ 8,600,000		
Year 11+ or other funding sources							
Springville Rd	PCC entrance - Kaiser	Widen to 3 lanes	\$ 8,000,000	\$ 5,333,333	\$ 2,666,667	1070 (WC)	NB/BSW
Cornelius Pass Rd	Butternut Creek	Construct new 5-lane bridge	\$ 9,423,000	\$ 6,282,000	\$ 3,141,000	3055 (H)	SH
209th Ave	Blanton - Farmington	Widen to 5 lanes	\$ 35,130,000	\$ 23,420,000	\$ 11,710,000	1020 (WC)	SH
Farmington Rd	209th - 198th	Widen to 5 lanes (partial funding)	\$ 4,051,000	\$ 2,700,667	\$ 1,350,333	1036 (WC)	SH
170th Ave	Rigent Rd	Intersection improvement	\$ 2,000,000	\$ 1,333,333	\$ 666,667	Not on list	SCM
175th Ave	Kemmer - E-W collector	Realign, widen to 3 lanes	\$ 11,275,000	\$ 7,516,667	\$ 3,758,333	1011 (WC-part)	SCM
185th Ave	Kemmer - Kemmer	Construct new 3-lane roadway	\$ 5,760,000	\$ 3,840,000	\$ 1,920,000	Not on list	SCM
Kemmer Rd	Gassner - Kemmer	Widen to 3 lanes	\$ 2,590,000	\$ 1,726,667	\$ 863,333	Not on list	SCM
Grabhorn / Tile Flat	185th - 175th	Realign curves	\$ 12,215,000	\$ 8,143,333	\$ 4,071,667	Not on list	SCM
Tile Flat Rd	Leonardo - Tile Flat	Widen to 3 lanes	\$ 3,025,000	\$ 2,016,667	\$ 1,008,333	Not on list	SCM
Scholls Ferry Rd	UGB - Scholls Ferry	Intersection improvement	\$ 500,000	\$ 333,333	\$ 166,667	Not on list	SCM
Roy Rogers Rd	Teal / Horizon	Widen to 5 lanes	\$ 15,000,000	\$ 10,000,000	\$ 5,000,000	Not on list	RT
Bull Mountain Rd	Bull Mountain - UGB	Widen to 3 lanes	\$ 4,000,000	\$ 2,666,667	\$ 1,333,333	1027 (WC)	RT
	Roy Rogers - Roshak	Widen to 3 lanes	\$ 4,000,000	\$ 2,666,667	\$ 1,333,333		
		Year 11+ total	\$ 112,969,000	\$ 75,312,667	\$ 37,656,333		
		Grand total	\$ 249,187,000	\$ 166,124,667	\$ 83,062,333		

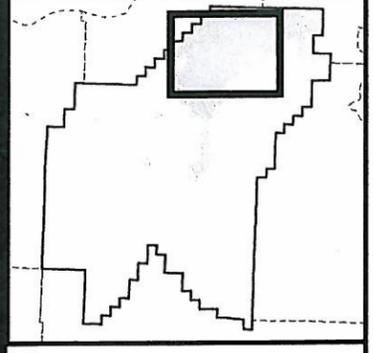
* "Widening" projects include pedestrian/bicycle facilities, lighting, stormwater, etc.
 **NB/BSW = North Bethany / Bonny Slope West (unincorporated Washington County)
 SH = South Hillsboro (City of Hillsboro)
 SCM = South Cooper Mountain (City of Beaverton)
 RT = River Terrace (City of Tigard)



The information on this map was derived from several databases and care was taken in its creation. Washington County cannot accept any responsibility for errors, omissions, or positional inaccuracies. There are no warranties or guarantees of accuracy. There are no warranties or guarantees of any errors will be appreciated.

Washington County- Long Range Planning

DRAFT MSTIP High Growth Project List



- 1-3
- 4-6
- 11+
- South Hillsboro
- South Cooper Mountain
- River Terrace
- Bonny Slope West
- North Bethany

Attachment C SW 175th Ave/Collector 6b, 6c
Left Turn Lane Warrant

Left-Turn Lane Warrant Analysis

Project #: 17808
 Project Name: S Cooper Mtn Heights
 Analyst: axm
 Intersection: North Access/175th Ave
 Scenario: 2016 Phase 1
 Date: 10/13/2015
 File: K:\H_Portland\projfile\17808 - South Cooper Mountain\report\9 29 15 supplemental analysis\analysis\warrants\[LT_warr

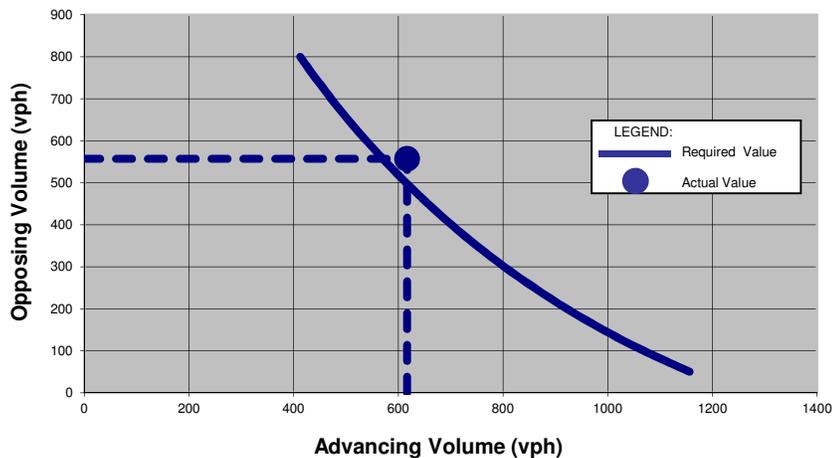


KITTELSON & ASSOCIATES, INC.
 610 SW Alder, Suite 700
 Portland, Oregon 97205
 (503) 228-5230
 Fax: (503) 273-8169

Input Data:

Advancing Volume (vph) =	617
Left-turning Vehicles (vph) =	9
Opposing Volume (vph) =	557
Speed (mph) =	40
Number of Approach Lanes =	2 (not applicable for two lanes)
% Left-Turning Vehicles	1%
Critical Gap (sec) =	6
Maneuver Time (sec) =	4
Exit Time (sec) =	1.9
Utilization Factor =	0.02

Left-Turn Lane Warrant Analysis Results



* Based on *Volume Warrants for Left-Turn Storage Lanes at Unsignalized Grade Intersections* (D. Harmelink)

Attachment D SW 175th Ave/S. Access Left
Turn Lane Warrant

Left-Turn Lane Warrant Analysis

Project #: 17808
 Project Name: S Cooper Mtn Heights
 Analyst: axm
 Intersection: South Access/175th Ave
 Scenario: 2016 Phase 1
 Date: 10/13/2015
 File: K:\H_Portland\projfile\17808 - South Cooper Mountain\report\9 29 15 supplemental analysis\analysis\warrants\[LT_warr

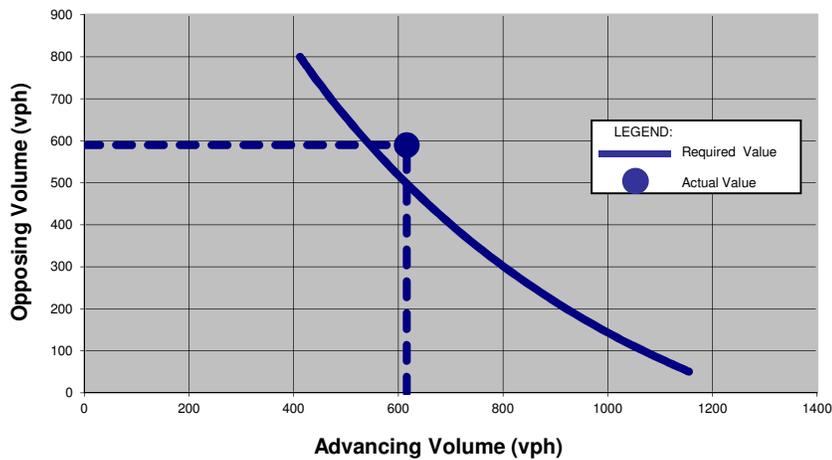


KITTELSON & ASSOCIATES, INC.
 610 SW Alder, Suite 700
 Portland, Oregon 97205
 (503) 228-5230
 Fax: (503) 273-8169

Input Data:

Advancing Volume (vph) =	616
Left-turning Vehicles (vph) =	9
Opposing Volume (vph) =	590
Speed (mph) =	40
Number of Approach Lanes =	2 (not applicable for two lanes)
% Left-Turning Vehicles	1%
Critical Gap (sec) =	6
Maneuver Time (sec) =	4
Exit Time (sec) =	1.9
Utilization Factor =	0.02

Left-Turn Lane Warrant Analysis Results



* Based on *Volume Warrants for Left-Turn Storage Lanes at Unsignalized Grade Intersections* (D. Harmelink)

Attachment E 2016 Total Traffic Conditions

2016 Total Traffic Conditions (Mitigated)
101: SW 175th Ave & SW Kemmer Rd

Weekday AM Peak
12/2/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↕	↕		↕	↕	↕
Volume (vph)	35	131	156	15	131	32	121	442	11	20	316	19
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	1.00
Frbp, ped/bikes		1.00			1.00		1.00	1.00		1.00	1.00	1.00
Flpb, ped/bikes		1.00			1.00		1.00	1.00		1.00	1.00	1.00
Frt		0.93			0.98		1.00	1.00		1.00	1.00	0.85
Flt Protected		0.99			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1727			1800		1719	1852		1805	1827	1538
Flt Permitted		0.99			1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)		1727			1800		1719	1852		1805	1827	1538
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	40	149	177	17	149	36	138	502	12	23	359	22
RTOR Reduction (vph)	0	38	0	0	9	0	0	1	0	0	0	16
Lane Group Flow (vph)	0	328	0	0	193	0	138	513	0	23	359	6
Confl. Bikes (#/hr)									1			
Heavy Vehicles (%)	0%	2%	3%	7%	2%	3%	5%	2%	9%	0%	4%	5%
Turn Type	Split	NA		Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	2	2		6	6		3	8		7	4	
Permitted Phases												4
Actuated Green, G (s)		18.8			12.9		9.6	30.7		1.4	22.5	22.5
Effective Green, g (s)		18.8			12.9		9.6	30.7		1.4	22.5	22.5
Actuated g/C Ratio		0.24			0.16		0.12	0.38		0.02	0.28	0.28
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		406			290		206	712		31	515	433
v/s Ratio Prot		c0.19			c0.11		c0.08	c0.28		0.01	0.20	
v/s Ratio Perm												0.00
v/c Ratio		0.81			0.66		0.67	0.72		0.74	0.70	0.01
Uniform Delay, d1		28.8			31.4		33.6	20.9		39.0	25.6	20.7
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2		11.2			5.6		8.0	3.6		64.1	4.1	0.0
Delay (s)		40.0			37.1		41.6	24.5		103.1	29.7	20.7
Level of Service		D			D		D	C		F	C	C
Approach Delay (s)		40.0			37.1			28.1			33.4	
Approach LOS		D			D			C			C	

Intersection Summary

HCM 2000 Control Delay	33.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	79.8	Sum of lost time (s)	16.0
Intersection Capacity Utilization	63.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

2016 Total Traffic Conditions (Mitigated)
 104: north-south street name & east-west street name

Weekday AM Peak
 12/2/2015



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	110	42	532	31	12	547
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frt	1.00	0.85	0.99		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1805	1615	1851		1805	1863
Flt Permitted	0.95	1.00	1.00		0.38	1.00
Satd. Flow (perm)	1805	1615	1851		721	1863
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	116	44	560	33	13	576
RTOR Reduction (vph)	0	36	3	0	0	0
Lane Group Flow (vph)	116	8	590	0	13	576
Heavy Vehicles (%)	0%	0%	2%	0%	0%	2%
Turn Type	Prot	Perm	NA		Perm	NA
Protected Phases	6		8			4
Permitted Phases		6			4	
Actuated Green, G (s)	7.4	7.4	25.5		25.5	25.5
Effective Green, g (s)	7.4	7.4	25.5		25.5	25.5
Actuated g/C Ratio	0.17	0.17	0.59		0.59	0.59
Clearance Time (s)	5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	311	278	1100		428	1107
v/s Ratio Prot	c0.06		c0.32			0.31
v/s Ratio Perm		0.00			0.02	
v/c Ratio	0.37	0.03	0.54		0.03	0.52
Uniform Delay, d1	15.7	14.8	5.2		3.6	5.1
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	0.8	0.0	0.5		0.0	0.4
Delay (s)	16.5	14.8	5.7		3.6	5.6
Level of Service	B	B	A		A	A
Approach Delay (s)	16.0		5.7			5.5
Approach LOS	B		A			A

Intersection Summary

HCM 2000 Control Delay	6.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	42.9	Sum of lost time (s)	10.0
Intersection Capacity Utilization	44.3%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

2016 Total Traffic Conditions (Mitigated)
105: SW Roy Rogers Rd & SW Scholls Ferry Rd

Weekday AM Peak
12/2/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↘	↕	↗	↘↗	↕		↘	↕	↗	↘	↕↗	
Volume (vph)	15	370	415	302	314	92	405	457	399	93	522	42
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.5	4.0	4.0	5.5		4.0	5.5	4.0	4.0	5.5	
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95		1.00	1.00	1.00	1.00	0.95	
Frt	1.00	1.00	0.85	1.00	0.97		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1805	3574	1538	3467	3419		1770	1863	1568	1703	3475	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1805	3574	1538	3467	3419		1770	1863	1568	1703	3475	
Peak-hour factor, PHF	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Adj. Flow (vph)	18	435	488	355	369	108	476	538	469	109	614	49
RTOR Reduction (vph)	0	0	48	0	21	0	0	0	140	0	5	0
Lane Group Flow (vph)	18	435	440	355	456	0	476	538	329	109	658	0
Heavy Vehicles (%)	0%	1%	5%	1%	2%	2%	2%	2%	3%	6%	2%	12%
Turn Type	Prot	NA	pm+ov	Prot	NA		Prot	NA	pm+ov	Prot	NA	
Protected Phases	5	2	3	1	6		3	8	1	7	4	
Permitted Phases			2						8			
Actuated Green, G (s)	2.9	21.7	55.3	14.5	33.3		33.6	46.6	61.1	12.6	25.6	
Effective Green, g (s)	2.9	21.7	55.3	14.5	33.3		33.6	46.6	61.1	12.6	25.6	
Actuated g/C Ratio	0.03	0.19	0.48	0.13	0.29		0.29	0.41	0.53	0.11	0.22	
Clearance Time (s)	4.0	5.5	4.0	4.0	5.5		4.0	5.5	4.0	4.0	5.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	45	677	743	439	995		519	758	837	187	777	
v/s Ratio Prot	0.01	c0.12	0.17	c0.10	0.13		c0.27	0.29	0.05	0.06	c0.19	
v/s Ratio Perm			0.11						0.16			
v/c Ratio	0.40	0.64	0.59	0.81	0.46		0.92	0.71	0.39	0.58	0.85	
Uniform Delay, d1	54.9	42.8	21.4	48.6	33.2		39.1	28.3	15.7	48.4	42.5	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	5.7	2.1	1.3	10.5	0.3		21.0	3.1	0.3	4.6	8.5	
Delay (s)	60.6	44.9	22.7	59.1	33.5		60.1	31.3	16.0	53.0	51.0	
Level of Service	E	D	C	E	C		E	C	B	D	D	
Approach Delay (s)		33.7			44.4			35.7			51.3	
Approach LOS		C			D			D			D	

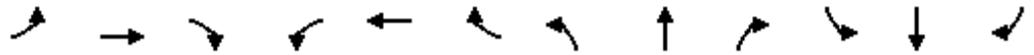
Intersection Summary

HCM 2000 Control Delay	40.0	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	114.4	Sum of lost time (s)	19.0
Intersection Capacity Utilization	72.9%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

2016 Total Traffic Conditions (Mitigated)
106: SW Barrows Rd & SW Scholls Ferry Rd

Weekday AM Peak
12/2/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	24	687	152	18	451	37	223	82	24	101	79	33
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0	4.0	4.0	5.0		5.0	5.0		4.0	4.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	0.99		1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	0.97		1.00	0.96	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1612	3539	1538	1703	3504		1787	1745		1641	1739	
Flt Permitted	0.33	1.00	1.00	0.19	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	562	3539	1538	346	3504		1787	1745		1641	1739	
Peak-hour factor, PHF	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Adj. Flow (vph)	29	838	185	22	550	45	272	100	29	123	96	40
RTOR Reduction (vph)	0	0	0	0	5	0	0	7	0	0	11	0
Lane Group Flow (vph)	29	838	185	22	590	0	272	122	0	123	125	0
Confl. Peds. (#/hr)									12	12		
Heavy Vehicles (%)	12%	2%	5%	6%	2%	0%	1%	6%	0%	10%	5%	3%
Turn Type	pm+pt	NA	Free	pm+pt	NA		Split	NA		Split	NA	
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases	2		Free	6								
Actuated Green, G (s)	29.6	27.4	79.2	29.2	27.2		21.4	21.4		10.4	10.4	
Effective Green, g (s)	29.6	27.4	79.2	29.2	27.2		21.4	21.4		10.4	10.4	
Actuated g/C Ratio	0.37	0.35	1.00	0.37	0.34		0.27	0.27		0.13	0.13	
Clearance Time (s)	4.0	5.0		4.0	5.0		5.0	5.0		4.0	4.0	
Vehicle Extension (s)	2.6	3.1		2.4	3.1		1.4	1.4		1.4	1.4	
Lane Grp Cap (vph)	239	1224	1538	161	1203		482	471		215	228	
v/s Ratio Prot	0.00	c0.24		0.00	0.17		c0.15	0.07		c0.07	0.07	
v/s Ratio Perm	0.04		c0.12	0.05								
v/c Ratio	0.12	0.68	0.12	0.14	0.49		0.56	0.26		0.57	0.55	
Uniform Delay, d1	16.1	22.2	0.0	16.9	20.5		24.9	22.7		32.3	32.2	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.2	1.6	0.2	0.3	0.3		0.9	0.1		2.3	1.4	
Delay (s)	16.2	23.8	0.2	17.1	20.9		25.8	22.8		34.6	33.6	
Level of Service	B	C	A	B	C		C	C		C	C	
Approach Delay (s)		19.4			20.7			24.8			34.1	
Approach LOS		B			C			C			C	

Intersection Summary

HCM 2000 Control Delay	22.3	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	79.2	Sum of lost time (s)	18.0
Intersection Capacity Utilization	47.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

2016 Total Traffic Conditions (Mitigated)
101: 175th Avenue & SW Kemmer Rd

Weekday PM Peak
12/2/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↕	↕		↕	↕	↕
Volume (vph)	18	164	196	20	99	27	177	345	19	25	488	29
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	1.00
Frbp, ped/bikes		1.00			1.00		1.00	1.00		1.00	1.00	0.98
Flpb, ped/bikes		1.00			1.00		1.00	1.00		1.00	1.00	1.00
Frt		0.93			0.97		1.00	0.99		1.00	1.00	0.85
Flt Protected		1.00			0.99		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)		1736			1832		1805	1883		1805	1900	1579
Flt Permitted		1.00			0.99		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)		1736			1832		1805	1883		1805	1900	1579
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	18	167	200	20	101	28	181	352	19	26	498	30
RTOR Reduction (vph)	0	44	0	0	10	0	0	2	0	0	0	20
Lane Group Flow (vph)	0	341	0	0	139	0	181	369	0	26	498	10
Confl. Peds. (#/hr)	1						1	1		1	1	
Heavy Vehicles (%)	0%	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Turn Type	Split	NA		Split	NA		Prot	NA		Prot	NA	Perm
Protected Phases	2	2		6	6		3	8		7	4	
Permitted Phases												4
Actuated Green, G (s)		19.4			11.4		10.1	34.2		2.8	26.9	26.9
Effective Green, g (s)		19.4			11.4		10.1	34.2		2.8	26.9	26.9
Actuated g/C Ratio		0.23			0.14		0.12	0.41		0.03	0.32	0.32
Clearance Time (s)		4.0			4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		401			249		217	768		60	609	506
v/s Ratio Prot		c0.20			c0.08		c0.10	0.20		0.01	c0.26	
v/s Ratio Perm												0.01
v/c Ratio		0.85			0.56		0.83	0.48		0.43	0.82	0.02
Uniform Delay, d1		30.8			33.9		36.0	18.3		39.7	26.2	19.4
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2		15.8			2.9		23.2	0.5		5.0	8.4	0.0
Delay (s)		46.6			36.7		59.2	18.7		44.7	34.6	19.5
Level of Service		D			D		E	B		D	C	B
Approach Delay (s)		46.6			36.7			32.0			34.2	
Approach LOS		D			D			C			C	

Intersection Summary

HCM 2000 Control Delay	36.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	83.8	Sum of lost time (s)	16.0
Intersection Capacity Utilization	69.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	30	26	563	51	46	654
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	32	27	593	54	48	688
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (ft)			1282			
pX, platoon unblocked						
vC, conflicting volume	1405	619			646	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1405	619			646	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	79	94			95	
cM capacity (veh/h)	147	492			949	
Direction, Lane #	WB 1	WB 2	NB 1	SB 1	SB 2	
Volume Total	32	27	646	48	688	
Volume Left	32	0	0	48	0	
Volume Right	0	27	54	0	0	
cSH	147	492	1700	949	1700	
Volume to Capacity	0.21	0.06	0.38	0.05	0.40	
Queue Length 95th (ft)	12	3	0	3	0	
Control Delay (s)	36.0	12.7	0.0	9.0	0.0	
Lane LOS	E	B		A		
Approach Delay (s)	25.2		0.0	0.6		
Approach LOS	D					
Intersection Summary						
Average Delay			1.3			
Intersection Capacity Utilization			48.2%		ICU Level of Service	A
Analysis Period (min)			15			

2016 Total Traffic Conditions (Mitigated)
104: 175th Avenue & S Access Road

Weekday PM Peak
12/2/2015



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	69	26	588	120	46	638
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00
Frt	1.00	0.85	0.98		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1805	1615	1857		1805	1881
Flt Permitted	0.95	1.00	1.00		0.33	1.00
Satd. Flow (perm)	1805	1615	1857		618	1881
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	73	27	619	126	48	672
RTOR Reduction (vph)	0	24	8	0	0	0
Lane Group Flow (vph)	73	3	737	0	48	672
Heavy Vehicles (%)	0%	0%	0%	0%	0%	1%
Turn Type	Prot	Perm	NA		Perm	NA
Protected Phases	6		8			4
Permitted Phases		6			4	
Actuated Green, G (s)	4.3	4.3	31.3		31.3	31.3
Effective Green, g (s)	4.3	4.3	31.3		31.3	31.3
Actuated g/C Ratio	0.10	0.10	0.72		0.72	0.72
Clearance Time (s)	4.0	4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	178	159	1333		443	1350
v/s Ratio Prot	c0.04		c0.40			0.36
v/s Ratio Perm		0.00			0.08	
v/c Ratio	0.41	0.02	0.55		0.11	0.50
Uniform Delay, d1	18.5	17.7	2.9		1.9	2.7
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	1.5	0.0	0.5		0.1	0.3
Delay (s)	20.0	17.8	3.4		2.0	3.0
Level of Service	B	B	A		A	A
Approach Delay (s)	19.4		3.4			2.9
Approach LOS	B		A			A

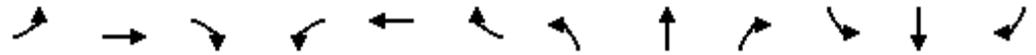
Intersection Summary

HCM 2000 Control Delay	4.2	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	43.6	Sum of lost time (s)	8.0
Intersection Capacity Utilization	48.7%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

2016 Total Traffic Conditions (Mitigated)
 106: SW Barrows Rd/SW Loon Dr & Scholls Ferry Road

Weekday PM Peak
 12/2/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↘	↑↑	↗	↘	↑↑		↘	↗		↘	↗	
Volume (vph)	37	623	338	78	680	97	209	53	38	62	29	6
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0	4.0	4.0	5.0		5.0	5.0		4.0	4.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	1.00		1.00	1.00	
Frbp, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	0.99		1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.98		1.00	0.94		1.00	0.97	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1805	3574	1566	1805	3500		1805	1715		1583	1828	
Flt Permitted	0.22	1.00	1.00	0.26	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	409	3574	1566	490	3500		1805	1715		1583	1828	
Peak-hour factor, PHF	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
Adj. Flow (vph)	43	716	389	90	782	111	240	61	44	71	33	7
RTOR Reduction (vph)	0	0	0	0	9	0	0	18	0	0	6	0
Lane Group Flow (vph)	43	716	389	90	884	0	240	87	0	71	34	0
Confl. Peds. (#/hr)	2						2		10	10		
Confl. Bikes (#/hr)			1				2					
Heavy Vehicles (%)	0%	1%	1%	0%	1%	0%	0%	5%	0%	14%	0%	7%
Turn Type	pm+pt	NA	Free	pm+pt	NA		Split	NA		Split	NA	
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases	2		Free	6								
Actuated Green, G (s)	31.1	27.6	74.7	35.1	29.6		17.4	17.4		6.2	6.2	
Effective Green, g (s)	31.1	27.6	74.7	35.1	29.6		17.4	17.4		6.2	6.2	
Actuated g/C Ratio	0.42	0.37	1.00	0.47	0.40		0.23	0.23		0.08	0.08	
Clearance Time (s)	4.0	5.0		4.0	5.0		5.0	5.0		4.0	4.0	
Vehicle Extension (s)	2.6	3.1		2.4	3.1		1.4	1.4		1.4	1.4	
Lane Grp Cap (vph)	235	1320	1566	327	1386		420	399		131	151	
v/s Ratio Prot	0.01	0.20		0.02	c0.25		c0.13	0.05		c0.04	0.02	
v/s Ratio Perm	0.07		c0.25	0.11								
v/c Ratio	0.18	0.54	0.25	0.28	0.64		0.57	0.22		0.54	0.22	
Uniform Delay, d1	13.6	18.6	0.0	11.7	18.2		25.4	23.2		32.9	32.0	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.3	0.5	0.4	0.3	1.0		1.2	0.1		2.4	0.3	
Delay (s)	13.9	19.0	0.4	12.0	19.2		26.5	23.3		35.3	32.3	
Level of Service	B	B	A	B	B		C	C		D	C	
Approach Delay (s)		12.5			18.5			25.5			34.2	
Approach LOS		B			B			C			C	

Intersection Summary

HCM 2000 Control Delay	17.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	74.7	Sum of lost time (s)	18.0
Intersection Capacity Utilization	56.7%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group



MEMORANDUM

Date: November 17, 2015

Project #: 11057.3

To: Ken Rencher and Jabra Kasho, PE, City of Beaverton
Jinde Zhu, PE and Naomi Vogel, Washington County

Mike Peebles, OTAK
Dan Grimberg, West Hills Development

From: Marc Butorac, PE, PTOE, Anais Malinge, and Shing Tsoi, PE

Project: River Terrace Community/South Cooper Mountain Concept Plans

Subject: Year 2017 Cumulative Impact Analysis – South Cooper Mountain Heights Development

The year 2017 Cumulative Impact Analysis contained herein is intended to provide the City of Beaverton with a holistic understanding of the impacts and necessary improvements to support the proposed nine near-term development projects within the River Terrace Community Plan and South Cooper Mountain Concept Plan areas. Based on this understanding, the City of Beaverton, City of Tigard, the County (agencies) and developers can work together to develop an implementation plan and set of coordinated conditions of approvals to cost effectively address the near-term safety and operational needs while aligning with the long-term 2035 design plans for the SW Scholls Ferry Road and SW 175th Avenue-SW-Roy Rogers Road corridors. The nine near-term proposed development projects evaluated in this analysis include:

- *Beaverton New High School* – the new high school will be located in the northwest corner of the SW Scholls Ferry Road/SW 175th Avenue-SW Roy Rogers Road intersection in the recently annexed South Cooper Mountain area in Beaverton, Oregon. In the near-term, the proposed high school is estimated to enroll 1,700 students, with a maximum enrollment of 2,200 students in the long-term. The site will also house multiple athletic facilities including a football stadium, tennis courts, softball/baseball fields, basketball gymnasium, and practice fields. The site will be served by three proposed access points including: 1) A full signalized access to SW 175th Avenue which will serve the student and visitor parking lot; 2) A right-in only along SW Scholls Ferry Road to serve bus ingress movements and emergency vehicles; and 3) A westerly signalized access via the planned north-south collector (8, 8c). This access will serve staff and bus egress movements and in the long-term this access will also serve future residential and commercial developments.
- *South Cooper Mountain Heights* – this subdivision proposed by West Hills Development will be located in the northeast corner of the SW Scholls Ferry Road/SW 175th Avenue-SW Roy Rogers Road intersection. The proposed development includes 722 residential units,

including 272 detached single-family homes, 110 townhomes, and 340 apartment units. Access is proposed via three roadway connections along SW 175th Avenue, including: 1) A full unsignalized access via the planned east-west collector (6b, 6c); (2) A full signalized access south of the planned east-west collector (6b, 6c) and directly across the proposed Beaverton High School access; and, (3) Access to SW Scholls Ferry Road via SW Loon Drive.

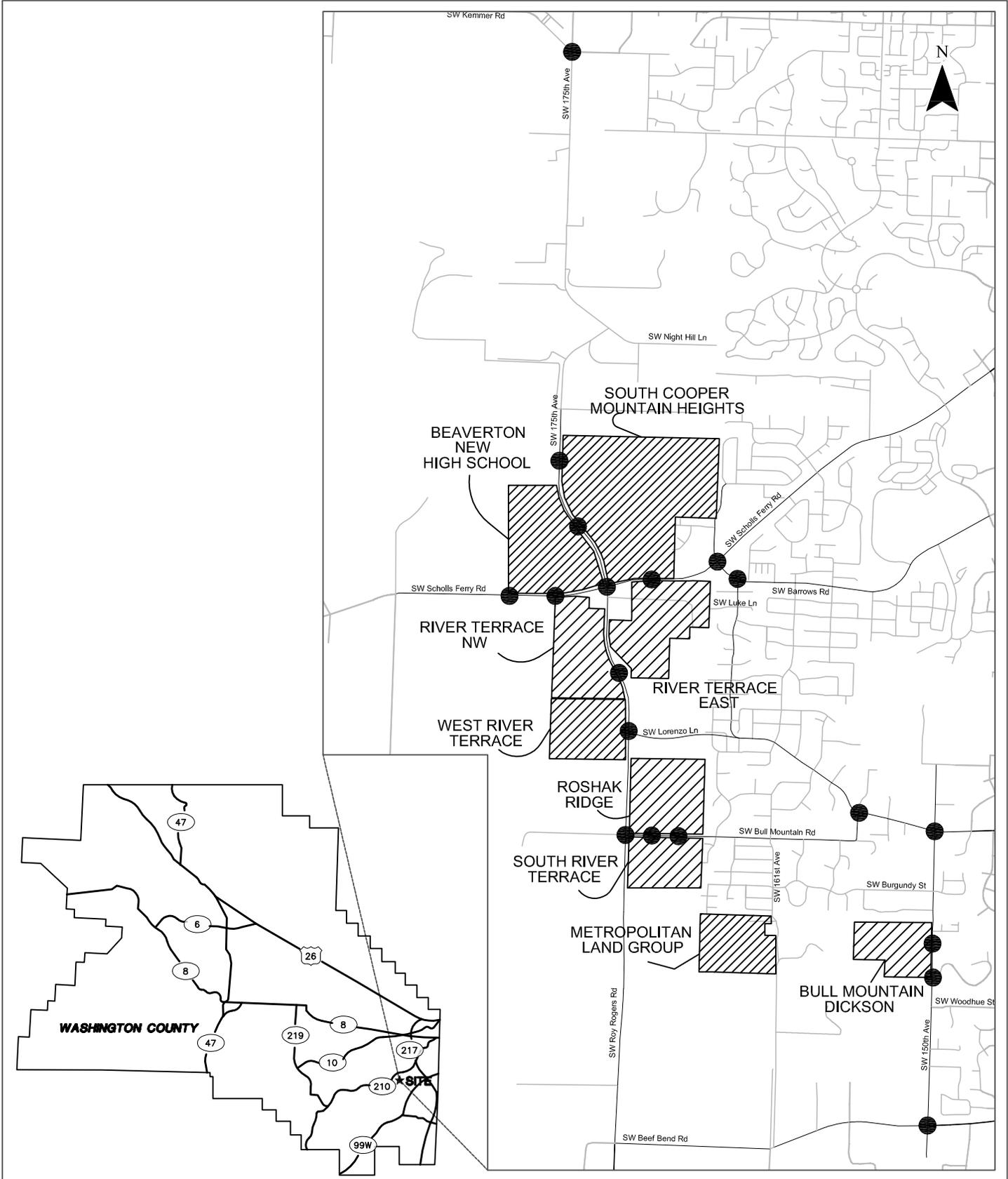
- *River Terrace Northwest* – this subdivision proposed by Polygon Northwest will be located along the west side of SW Roy Rogers Road immediately south of SW Scholls Ferry Road. The current proposal calls for 152 detached single-family homes and 63 townhomes. Access is proposed via two accesses: (1) an interim unsignalized full site access on SW Roy Rogers Road approximately 1,200 feet south of the SW Scholls Ferry Road signalized intersection, and (2) an interim unsignalized full site access on SW Scholls Ferry Road approximately 1,000 feet west of the SW Roy Rogers Road signalized intersection as proposed in the River Terrace Community Plan.
- *River Terrace East* – this subdivision proposed by Polygon Northwest will be located along the east side of SW Roy Rogers Road to the south of SW Scholls Ferry Road, and north of the proposed SW Lorenzo Lane collector. The current proposal calls for 361 residential units including 157 detached-single family homes, 54 townhomes, and 150 apartment units. Access is proposed via two accesses: (1) an interim unsignalized full site access on SW Roy Rogers Road approximately 1,200 feet south of the SW Scholls Ferry Road signalized intersection, and (2) an interim unsignalized full site access on SW Scholls Ferry Road approximately 1,000 feet west of the SW Roy Rogers Road signalized intersection as proposed in the River Terrace Community Plan.
- *West River Terrace* – this subdivision proposed by Polygon Northwest will be located along the west side of SW Roy Rogers Road to the north of SW Bull Mountain Road and northwest of the proposed Roshak Ridge development. The proposal calls for 138 residential units including 46 attached- and 92 detached-single family homes. Access is proposed via Jean Louise Road, a full unsignalized access along SW Roy Rogers Road, opposite the planned east-west collector, SW Lorenzo Lane.
- *South River Terrace* – this subdivision proposed by Polygon Northwest will be located on the south side of SW Bull Mountain Road and east side of SW Roy Rogers Road. The proposal calls for 190 residential units including 63 attached- and 127 detached single-family homes. Access is proposed via River Terrace Boulevard, an unsignalized full access along SW Bull Mountain Road.
- *Roshak Ridge* – this subdivision proposed by Polygon Northwest will be located on the north side of SW Bull Mountain Road and east side of SW Roy Rogers Road. The proposal calls for 244 residential units including 78 attached- and 166 detached- single-family homes. Access is proposed via River Terrace Boulevard, an unsignalized full access along SW Bull Mountain Road.
- *Bull Mountain Dickson* – this subdivision proposed by Polygon Northwest will be located on the west side of SW 150th Avenue opposite the SW Hawks Ridge Road. The proposal calls

for 82 detached single-family homes. The site will be served via two accesses along SW 150th Avenue, including: 1) A full unsignalized access via SW Danube Drive; and, 2) A full unsignalized access via SW Colorado Street.

- *Metropolitan Land Group Residential Subdivision* – this subdivision proposed by Metropolitan Land Group will be located on two tracts of land currently containing one single-family home on each parcel south of SW Bull Mountain Road and west of SW 161st Avenue. The current proposal calls for a maximum of 173 detached single-family homes. The proposed development site fronts the south side of an existing residential subdivision, which is in unincorporated Washington County. Once complete, the site development will take access to the two dead-end street stubs on SW 163rd Avenue and SW 161st Avenue within the adjacent subdivision. These accesses will serve as the primary site accesses until such time that adjacent lands to the west and south develop and a street connection is made to Roy Rogers Road.

Figure 1 shows the location of the nine proposed developments. Individual transportation impact analyses have been prepared under separate cover for these proposed developments. This report presents the year 2017 findings and recommendations associated with the cumulative transportation impacts of these nine proposed developments.

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● - Study Intersections

Tigard, OR | Beaverton, OR | Washington County, OR

Site Vicinity

Figure 1

STUDY SCOPE

The cumulative impact analysis includes the study intersections and site accesses analyzed in each individual transportation impact analysis, including:

1. SW 175th Avenue/SW Kemmer Road
2. SW 175th Avenue/Planned East-West Collector (6b, 6c)
3. SW 175th Avenue/South Site Access-School Access
4. SW Scholls Ferry Road/Future North-South Collector (8b, 8c)
5. SW Scholls Ferry Road/Interim Full Site Access-Right-in Only Access
6. SW Scholls Ferry Road/SW 175th Avenue-SW Roy Rogers Road
7. SW Scholls Ferry Road/River Terrace Boulevard
8. SW Scholls Ferry Road/SW Barrows Road
9. SW Barrows Road/SW Roshak Road
10. SW Roy Rogers Road/Interim Full Site Access
11. SW Roy Rogers Road/SW Lorenzo Lane (SW Jean Louise Road)
12. SW Roy Rogers Road/SW Bull Mountain Road
13. SW Bull Mountain Road/SW River Terrace Boulevard
14. SW Bull Mountain Road/SW Darwin Avenue
15. SW Bull Mountain Road/SW Roshak Road
16. SW Bull Mountain Road/SW 150th Avenue
17. SW 150th Avenue/SW Danube Drive
18. SW 150th Avenue/SW Hawk Ridge Road
19. SW 150th Avenue/SW Beef Bend Road

This report addresses the following transportation issues:

- Trip generation and assignment summary for each of the nine proposed developments in cumulative analysis;
- Forecast year 2017 total traffic conditions during the weekday AM and PM peak periods with build-out of all nine proposed developments; and,
- Relation with the South Cooper Mountain Heights development.

It should be noted that all the proposed mitigations identified in the cumulative analysis are consistent with the *175th Avenue – Roy Rogers Road 15% Design Report* (Reference 1).

ANALYSIS METHODOLOGY

All level of service analyses described in this report were performed in accordance with the procedures stated in the *2000 Highway Capacity Manual* (Reference 2). A description of level of service and the criteria by which they are determined is presented in *Appendix "A"*. *Appendix "A"* also indicates how level of service is measured and what is generally considered the acceptable range of level of service.

Synchro 8 software was used for all intersection operations analyses, in accordance with the *2000 Highway Capacity Manual*. To ensure that this analysis was based on a reasonable worst-case scenario, the peak 15-minute flow rate during the peak hour analysis periods was used in the evaluation of all intersection levels of service. For this reason, the analysis reflects conditions that are only likely to occur for 15 minutes out of each average peak hour. Traffic conditions during other weekday hours and throughout the weekend will likely be better than those described in this report.

Operating Standards

The City of Tigard's code and requirements are still being developed through the River Terrace Community Planning. Based on prior analyses and direction from city staff, this report assumes that the standard for the city intersections is a volume-to-capacity (v/c) ratio of 0.95 with no movements over capacity.

The City of Beaverton's *Development Code* sets operating standards for signalized and unsignalized intersections, found in Section 60.55.10. The standards require an average control delay of no more than 65 seconds per vehicle for signalized intersections. In addition, the volume-to-capacity ratio for each lane group must not exceed 0.98. For two-way and all-way stop controlled intersections, the City of Beaverton standards require an average control delay of no more than 45 seconds per vehicle.

Washington County requires that all intersections operate with a v/c ratio of less than 0.99. Within the study area, Washington County maintains jurisdiction over SW 175th Avenue, SW Scholls Ferry Road and SW Roy Rogers Road.

TRIP GENERATION AND ASSIGNMENT

Trip estimates for the proposed nine developments were obtained from either the submitted individual transportation impact studies or the scoping memoranda available at the time of this analysis. Each development's status in the land use process is summarized in Table 1.

Table 1 Proposed Development Land Use Process Status

Development	Scoping Memorandum Submitted?	Transportation Impact Analysis Submitted?
Beaverton New High School	Yes (submittal date not available)	Yes (2/5/15)
South Cooper Mountain Heights	Yes (2/16/15)	Yes (7/13/15)
River Terrace Northwest	Yes (2/16/15)	Yes (3/27/15)
River Terrace East	Yes (2/16/15)	Yes (3/27/15)
West River Terrace	Yes (12/11/14) ¹	Yes (3/12/15)
South River Terrace	Yes (12/11/14) ¹	Yes (3/12/15)
Roshak Ridge	Yes (12/11/14) ¹	Yes (3/9/15)
Bull Mountain Dickson	Yes (12/11/14) ¹	Yes (3/5/15)
MLG Residential Subdivision	Yes (3/10/15)	No

¹ Amended scoping memoranda submitted on January 27, 2015 and February 16, 2015.

Table 2 summarizes the trip generation estimates of each of the nine developments used in this cumulative analysis, as estimated per the standard reference manual, Institute of Transportation Engineers, *Trip Generation Manual, 9th Edition* (Reference 3). The site-generated trip assignment to the study intersections during the weekday AM and PM peak hours are shown in Figures 2 and 3, respectively.

The trip generation and assignments and mode split are conservative in nature as they do not account for trips between the proposed Beaverton High School development and the eight residential developments. Furthermore, the lack of commercial uses in the River Terrace Community Plan and South Cooper Mountain Concept Plan areas in the near-term will result in additional and longer vehicle-based trips. In parallel, the planned transportation network within both areas is not anticipated to be built out in the near-term. As such, upon the build out of commercial uses and the associated transportation network, the overall number of vehicle trips and mode split will change in the study area resulting in less vehicle trips than reported herein, as well as different trip assignment.

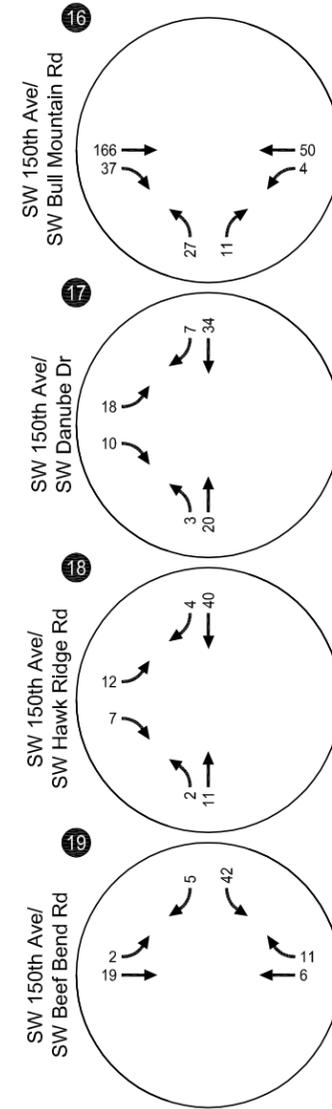
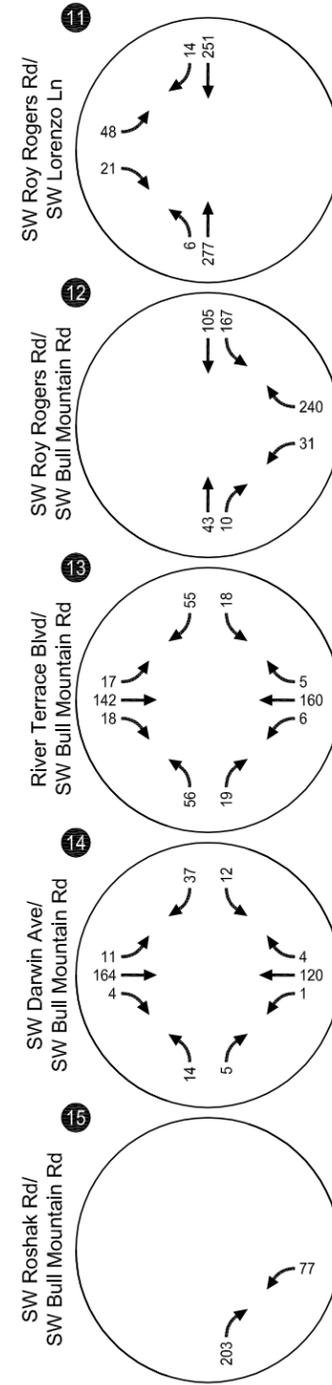
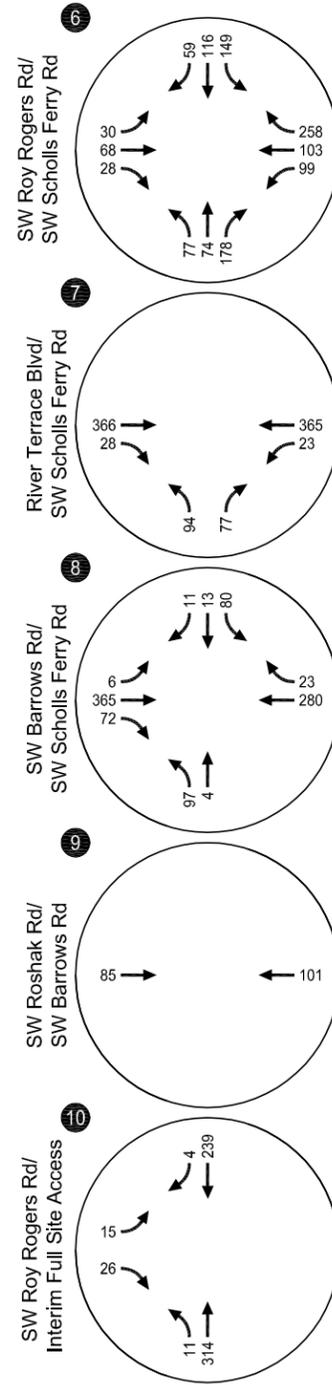
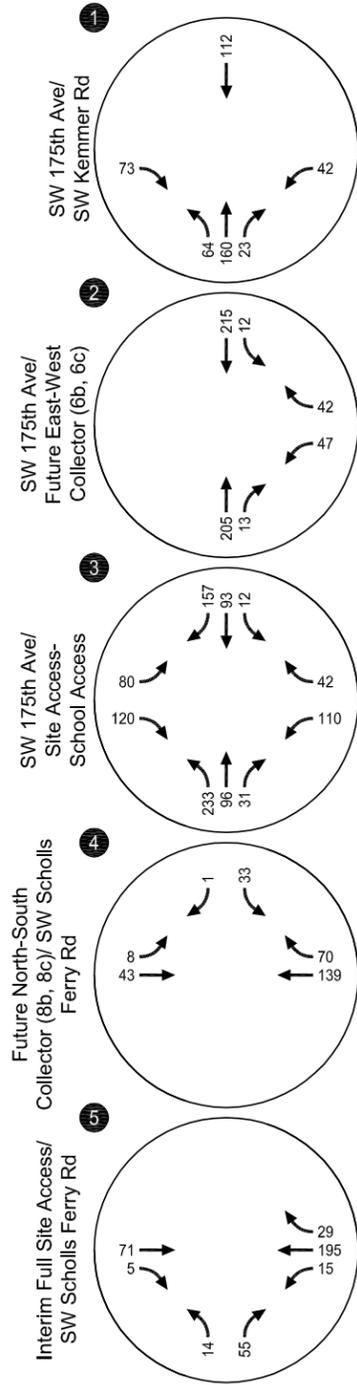
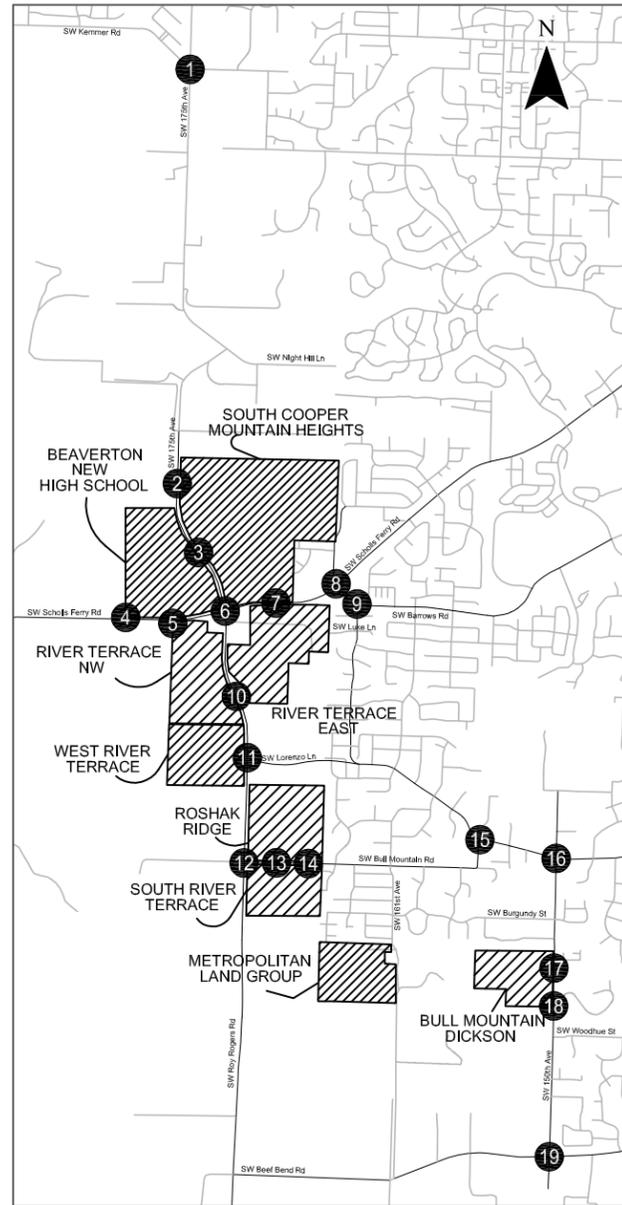
Table 2 Estimated Trip Generation

Development	Total Daily Trips	Weekday AM Peak Hour			Weekday PM Peak Hour		
		Total Trips	In	Out	Total Trips	In	Out
Beaverton New High School	N/A	731	497	234	221	104	117
South Cooper Mountain Heights	5,490	430	95	335	575	365	210
River Terrace Northwest	1,820	145	35	110	185	120	65
River Terrace East	2,810	220	50	170	285	180	105
West River Terrace	1,144	89	20	69	116	74	42
South River Terrace	1,576	123	29	94	160	102	58
Roshak Ridge	2,034	159	37	122	207	133	74
Bull Mountain Dickson	780	62	15	47	82	52	30
Residential Subdivision	1,647	130	30	100	175	110	65
Total	17,301+²	2,089	808	1,281	2,006	1,240	766

¹ Includes site-generated trips associated with Phases 3A/3B

² Total daily trips do not include trips from Beaverton New High School because information is not documented in the individual traffic study.

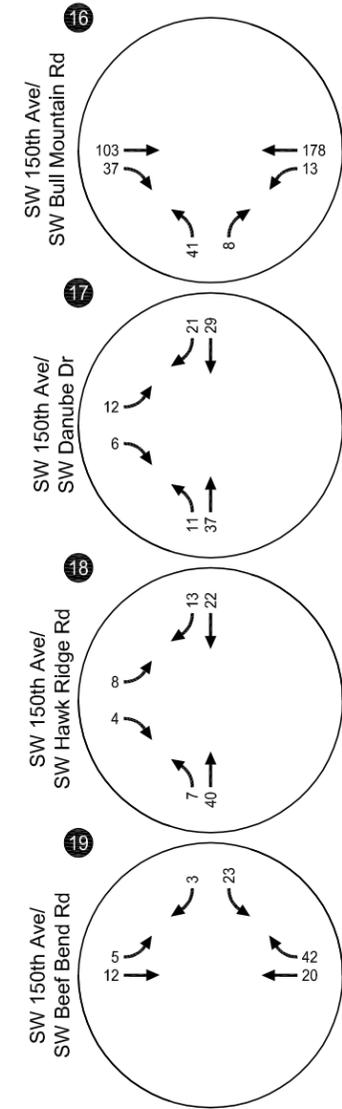
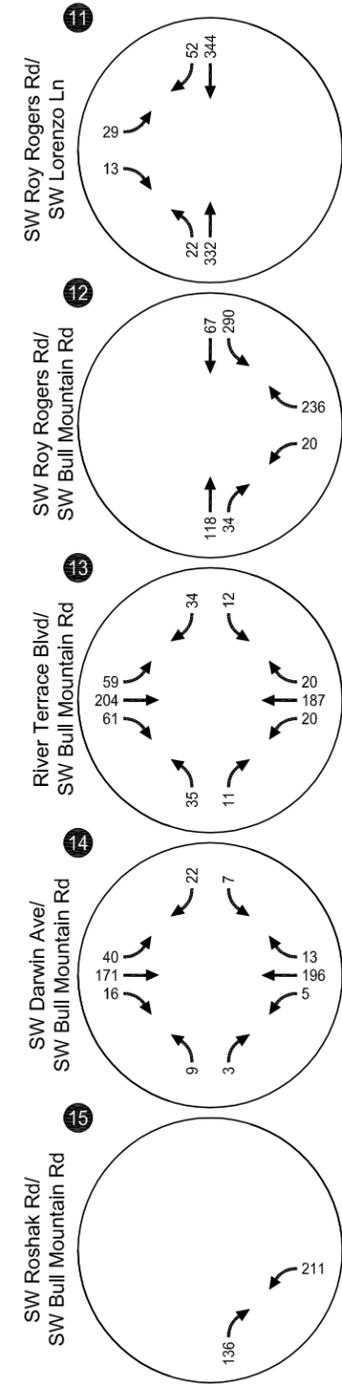
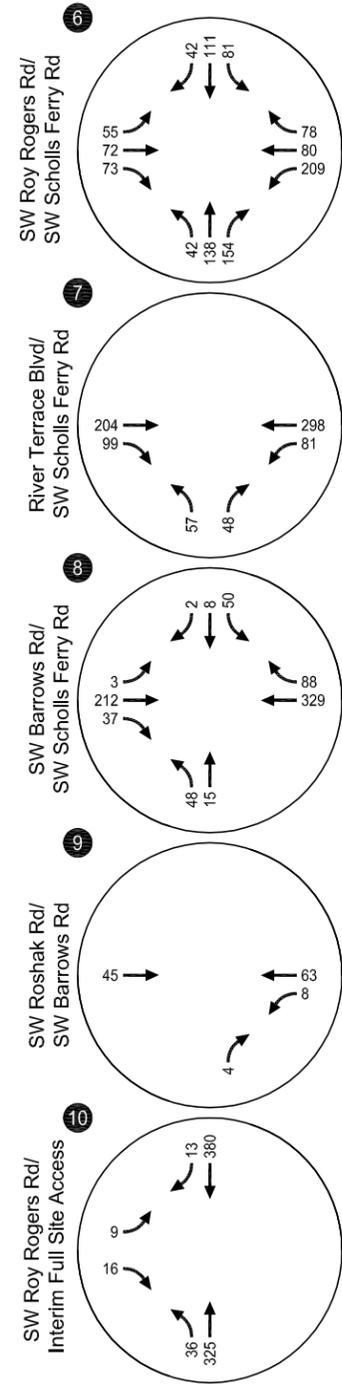
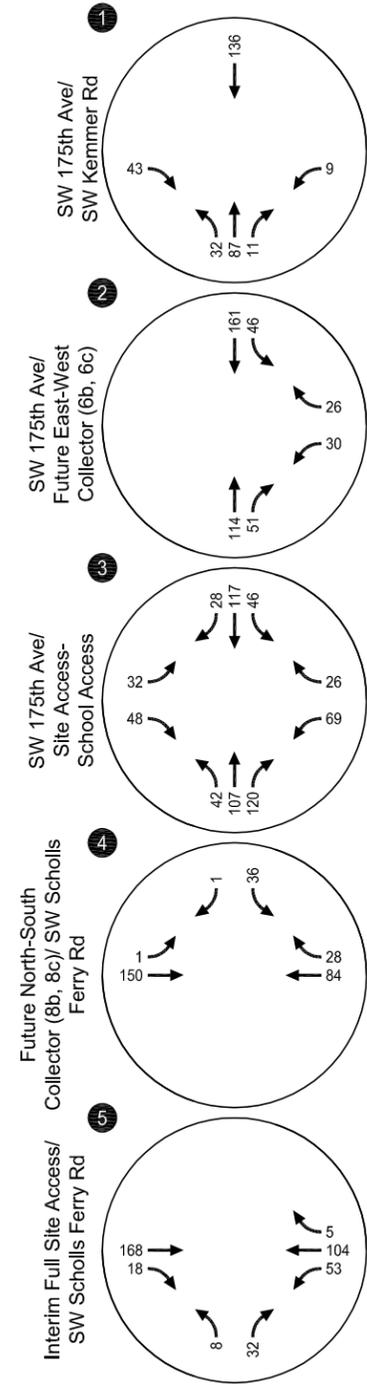
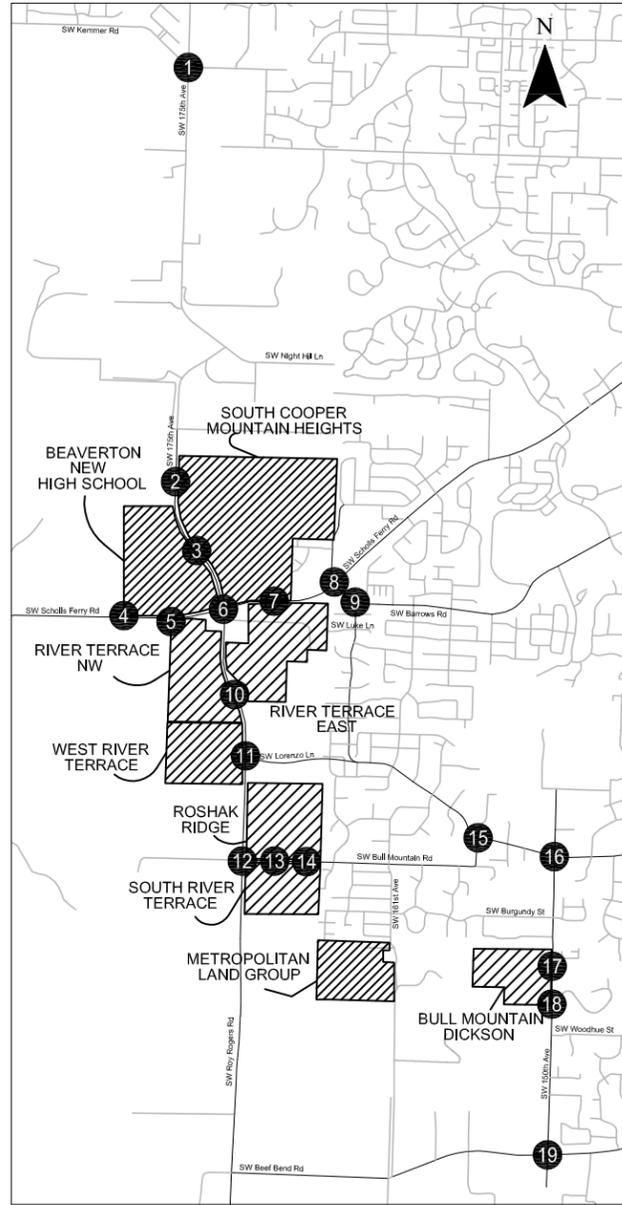
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Proposed Site-Generated Trips
Weekday AM Peak Hour
Tigard, OR | Beaverton, OR | Washington County, OR

Figure
2

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Proposed Site-Generated Trips
 Weekday PM Peak Hour
 Tigard, OR | Beaverton, OR | Washington County, OR

Figure
 3

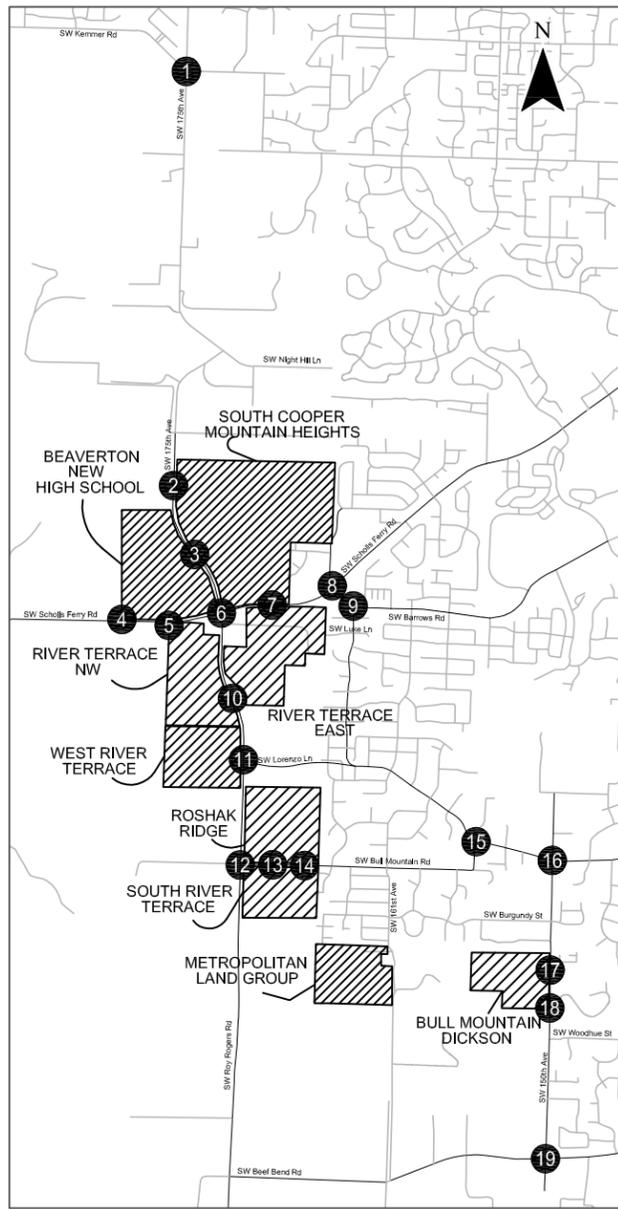
Year 2017 Total Traffic Conditions

The 2017 total traffic conditions analysis forecasts how the study intersections will operate with the traffic generated by the proposed nine developments. Figure 4 illustrates the recommended lane configurations and traffic control devices at the study intersections, and Figures 5 and 6 summarize the total traffic operational conditions, with recommended improvements, during the weekday AM and PM peak hours respectively. All study intersections, with the provision of the recommended improvements, are forecast to operate within applicable standards.

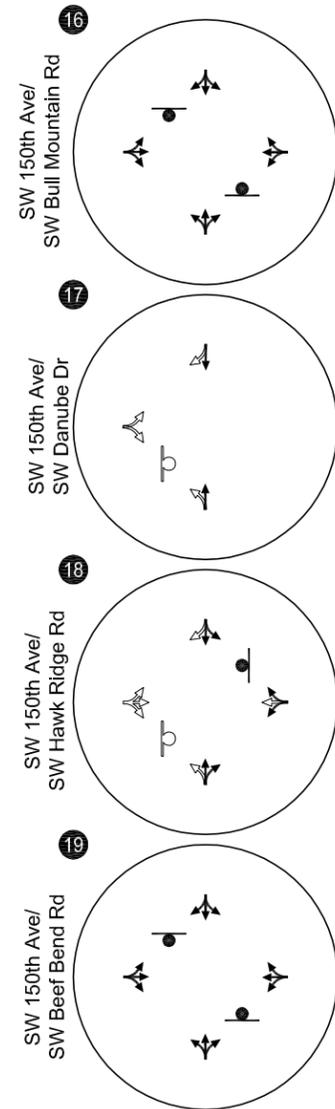
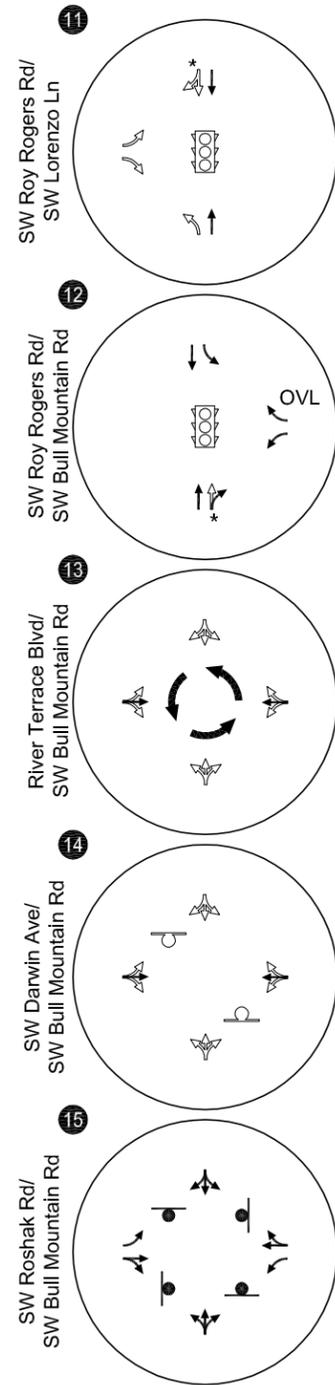
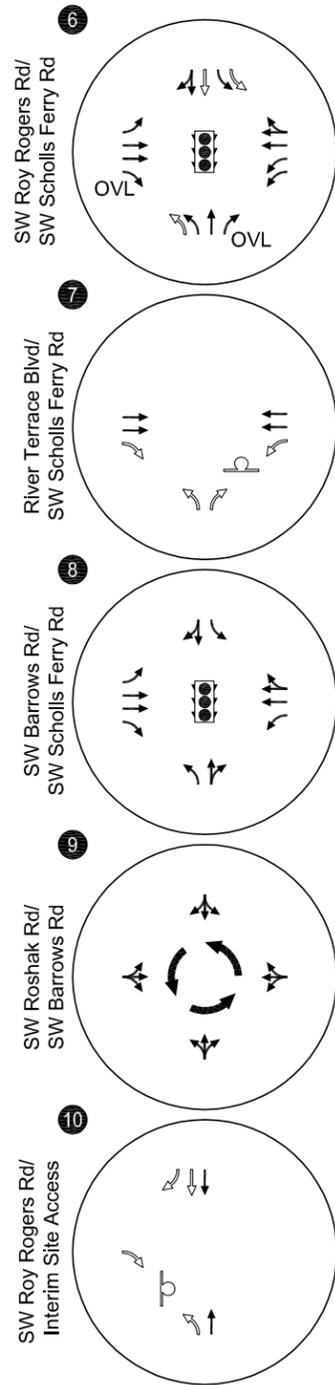
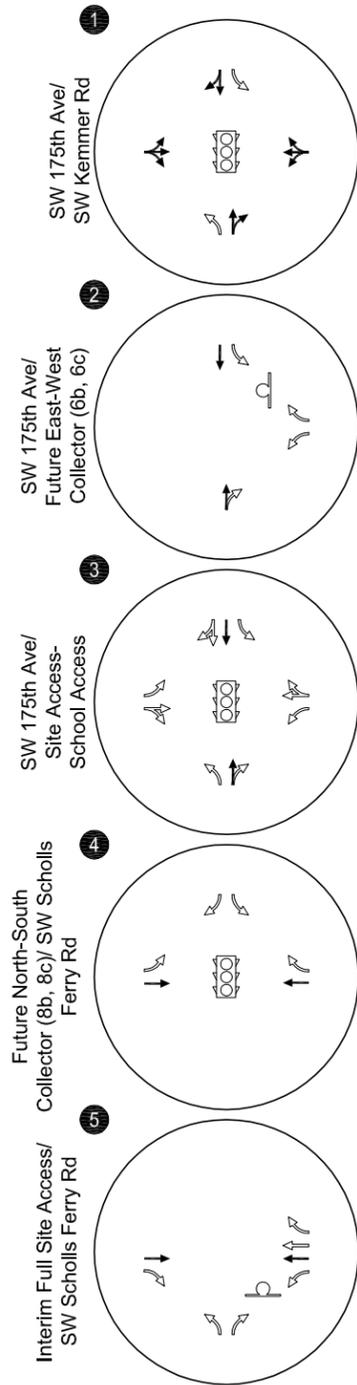
Appendix "B" includes the year 2017 total traffic operations worksheets.

Year 2017 Proposed Mitigations

Each study intersection and associated proposed mitigations upon full build-out of the nine developments are discussed below. The proposed mitigation is consistent with the *175th Avenue – Roy Rogers Road 15% Design Report*. This report identifies the roadway cross-section along the corridor, including lane configurations and traffic control devices, and right-of-way dedication requirements to accommodate year 2017 full build-out conditions. Table 3 summarizes the recommended mitigations at the study intersections under the cumulative impact analysis, and cross references those recommended mitigations with the transportation impact analyses for each of the nine developments to determine which mitigations are proposed within each.



* Through lanes 300 feet north/south of intersection



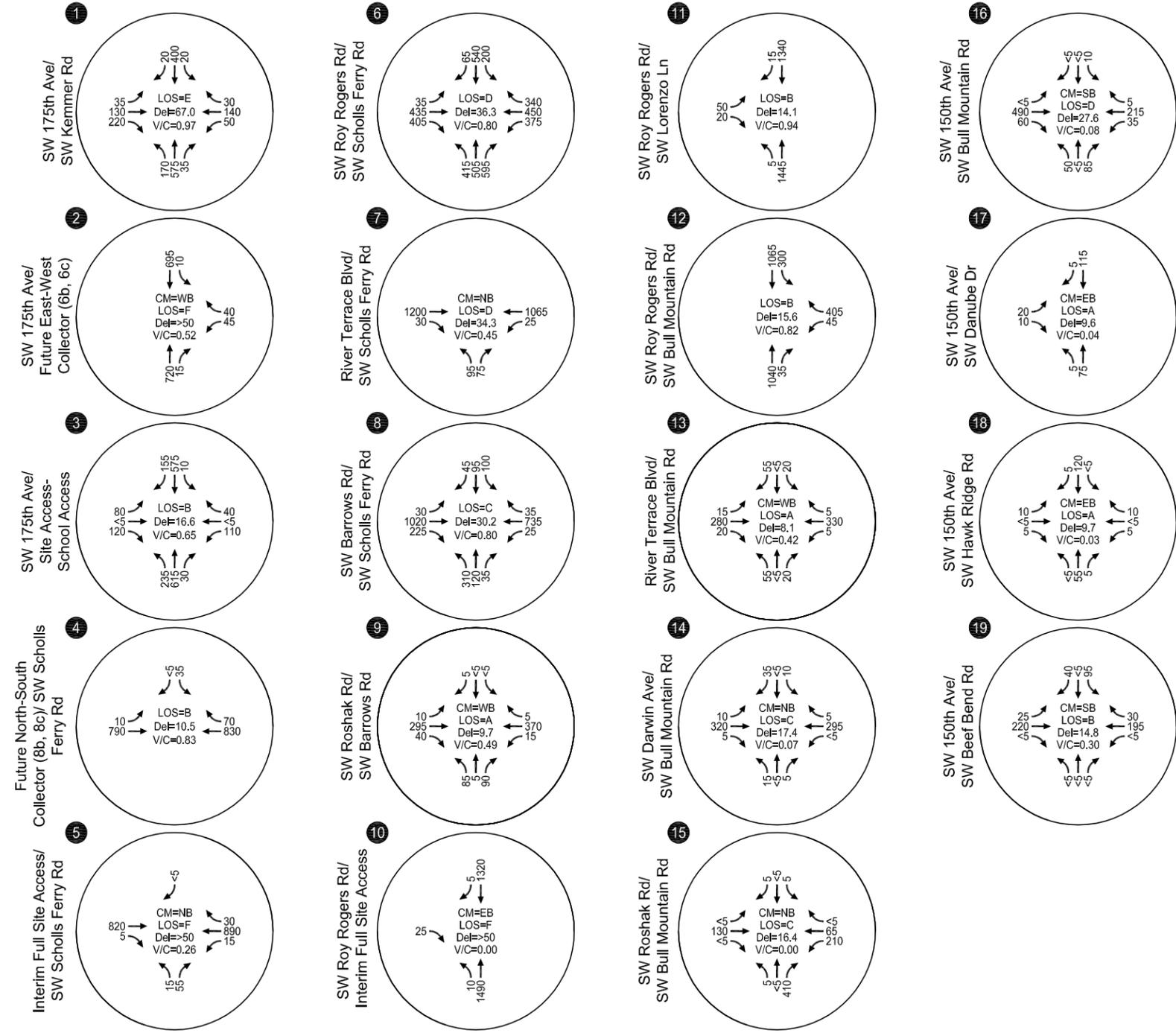
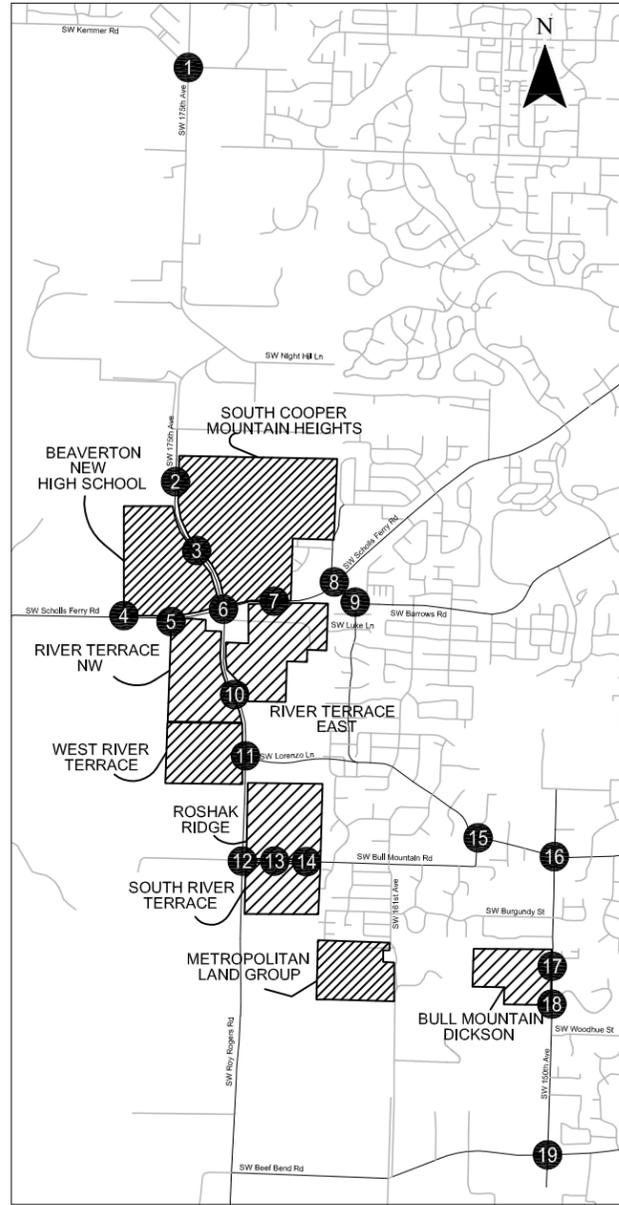
- OVL - OVERLAP
- STOP SIGN - STOP SIGN
- TRAFFIC SIGNAL - TRAFFIC SIGNAL
- IMPROVEMENT - IMPROVEMENT
- ROUNDBOUNT - ROUNDBOUNT

2017 Total Traffic Conditions
Lane Configurations & Traffic Control Devices
Tigard, OR | Beaverton, OR | Washington County, OR

Figure 4

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CM = CRITICAL MOVEMENT (UNSIGNALIZED)
 LOS = CRITICAL MOVEMENT LEVEL OF SERVICE (SIGNALIZED)/CRITICAL MOVEMENT LEVEL OF SERVICE (UNSIGNALIZED)
 Del = INTERSECTION AVERAGE CONTROL DELAY (SIGNALIZED)/CRITICAL MOVEMENT CONTROL DELAY (UNSIGNALIZED)
 V/C = CRITICAL CRITICAL VOLUME-TO-CAPACITY RATIO

2017 Total Traffic Conditions
 Weekday AM Peak Hour
 Tigard, OR | Beaverton, OR | Washington County, OR

Figure 5

Table 3 Summary of Proposed Mitigation

Node #	Intersection	Proposed Mitigation	Near-Term 2017 Improvements									Cumulative Analysis
			Beaverton High School	South Cooper Mountain Heights	River Terrace Northwest	River Terrace East	West River Terrace	South River Terrace	Roshak Ridge	Bull Mountain Dickson	MLG Residential Subdivision	
1	SW 175th Avenue/SW Kemmer Road	Signal	X	X	X	X	X	X	X	X	X	X
		Exclusive NB Left	X	X	X	X	X	X	X	X	X	X
		Exclusive SB Left	X	X	X	X	X	X	X	X	X	X
2	SW 175th Avenue/Planned East-West Collector (6b, 6c)	Exclusive SB Left		X								X
		WB Approach (Right & Left)		X								X
		Convert to Shared NB Right		X								X
3	SW 175th Avenue/Site Access-High School Access	Signal	X	X								X
		Exclusive NB Left	X									X
		Exclusive SB Left		X								X
		Second SB Through Lane	X									X
		WB Approach (Right & Left)		X								X
		EB Approach (Right & Left)	X									X
		Convert to Shared NB Right		X								X
4	SW Scholls Ferry Road/Future North-South Collector (8b, 8c)	Convert to Shared SB Right	X									X
		Signal	X									X
		Exclusive EB Left	X									X
		Exclusive WB Right (Drop Lane)	X									X
5	SW Scholls Ferry Road/Interim Full Site Access	SB Approach (Right & Left)	X									X
		Second WB Through Lane	X									X
		Exclusive WB Right	X									X
		Exclusive WB Left			X							X
		Exclusive EB Right			X							X
6	SW Scholls Ferry Road/SW Roy Rogers Road-SW 175th Avenue	NB Approach (Right & Left)			X							X
		Signal Timing Optimization	X	X	X	X	X	X	X			X
		Signal Modification	X									X
		Second NB Left										X
		Second SB Through Lane	X									X
7	SW Scholls Ferry Road/ River Terrace Boulevard	Second SB Left										X
		Exclusive EB Right				X						X
		Exclusive WB Left				X						X
10	SW Roy Rogers Road/Interim Site Access	NB Approach (Right & Left)				X						X
		Second SB Through Lane			X							X
		EB Approach (Right & Left)			X							X
		Exclusive NB Left			X							X
11	SW Roy Rogers Road/ SW Lorenzo Lane (SW Jean Louise Rd)	Exclusive SB Right			X							X
		EB Approach (Right & Left)					X					X
		Exclusive NB Left					X					X
		Exclusive SB Right					X					X

		Signal					X					X
12	SW Roy Rogers Road/SW Bull Mountain Road	Signal					X	X	X			X
		Second NB Through Lane						X	X			X
13	River Terrace Blvd/SW Bull Mountain Road	Roundabout						X	X			X

FINDINGS AND RECOMMENDATIONS

Based on the results of this transportation impact analysis, the nine proposed developments can be developed while maintaining acceptable levels of service at the study intersections, with the provision of the recommended improvements, as listed below by intersection.

South Cooper Mountain Heights

The following provides the improvements specific to the proposed South Cooper Mountain Heights development, in order to condition proper staging for the ultimate crosssection and lane configurations of SW 175th Avenue while meeting operational thresholds.

The proposed three-lane cross section along the South Cooper Mountain Heights development site frontage (i.e., one northbound through lane, one southbound through lane, and left-turn lane) accommodates the projected 2017 traffic volumes along SW 175th Avenue. The South Cooper Mountain Heights development will dedicate right-of-way along the site frontage to accommodate the ultimate five-lane cross section, which will be funded and installed through the County MSTIP project.

SW 175th Avenue/Future East-West Collector (6b, 6c)

The intersection of SW 175th Avenue/Future East-West Collector (6b, 6c) does not meet signal warrants in the near-term. As such, the intersection is proposed as a two-way-stop-controlled intersection with an exclusive southbound left-turn lane to the proposed South Cooper Mountain Heights development. Upon full build out of the South Cooper Mountain Concept Plan area, including developments to the west of SW 175th Avenue, an eastbound approach will be provided along with a traffic signal.

SW 175th Avenue/Site Access-High School Access

The proposed mitigation at the intersection of SW 175th Avenue/Site Access-High School Access is consistent with the Beaverton High School and South Cooper Mountain Heights traffic studies. A signal is recommended at this intersection with exclusive left-turn lanes at the northbound and southbound approaches. Additionally, the Beaverton High School will construct a second southbound through lane along the site frontage to accommodate school traffic as documented in the Beaverton High School traffic study.

SW Loon Drive (between Collector 6c and SW Scholls Ferry Road)

The City of Beaverton has negotiated right-of-way to provide connectivity of Collector 6c from the South Cooper Mountain Heights property to SW Loon Drive. Table 4 shows the estimated site-generated trips from the proposed South Cooper Mountain Heights development to SW Loon Drive between Collector 6c and SW Scholls Ferry Road.

Table 4 Site-Generated Trips on SW Loon Drive (between Collector 6c and SW Scholls Ferry Road)

Peak Period	Site-Generated Trips	2017 Background Trips ¹
AM Peak Hour	120	425
PM Peak Hour	160	280

¹ The 2017 Background Trips along SW Loon Drive were derived from the volumes at the SW Barrows Road/SW Scholls Ferry Road intersection.

As shown in Table 4, the proposed South Cooper Mountain Heights Development would contribute an estimated 120 trips in the AM peak hour and 160 trips in the PM peak hour along SW Loon Drive between Collector 6c and SW Scholls Ferry Road. Based on the projected 2017 vehicular volume along SW Loon Drive and the estimated site-generated trips, the SW Loon Drive roadway and intersections along the segment would continue to operate acceptably.

Other Proposed Developments

SW 175th Avenue/SW Kemmer Road

The recommended improvements at the SW 175th Avenue/SW Kemmer Road intersection are consistent with the Beaverton High School and South Cooper Mountain Heights traffic studies. A signal is recommended at this intersection with exclusive left-turn lanes on the northbound and southbound approaches. Due to the vertical profile of the intersection, protected left-turn phasing is recommended north/south and split phasing is recommended east/west.

As indicated in the existing conditions assessment of the individual traffic studies, the intersection does not meet standards under existing conditions and thus the need for this improvement cannot be attributed entirely to the nine proposed developments. To address the individual impacts of each development, a proportional share methodology has been developed in conjunction with Washington County staff to help fund the future County-led project at this intersection. *The detail of the proportional share analysis is included in Appendix "C".*

SW Scholls Ferry Road/Future North-South Collector (8b, 8c)

The proposed mitigation at the intersection of SW Scholls Ferry Road/Future North-South Collector (8b, 8c) is consistent with the Beaverton High School traffic study. A signal is recommended at this intersection with an exclusive eastbound left-turn lane. A second westbound through lane is recommended along the site frontage and terminates at the intersection as an exclusive right-turn drop lane.

SW Scholls Ferry Rd/Interim Full Site Access

The proposed mitigation at the intersection of SW Scholls Ferry Rd/Interim Full Site Access is consistent with the Beaverton High School and River Terrace Northwest traffic studies. A second westbound through lane is proposed along the site frontage of the Beaverton High School development. An

exclusive westbound right-turn lane, an exclusive westbound left-turn lane, and an eastbound right-turn lane are proposed at this intersection.

SW Scholls Ferry Road/SW Roy Rogers Road-SW 175th Avenue

A second southbound through lane is proposed as part of the Beaverton High School development, and signal timing optimization is proposed under most proposed developments. With the cumulative impacts from the nine proposed developments, a second northbound left-turn lane is recommended in order for this intersection to operate within applicable standards. In addition, in order to shadow the northbound and southbound approaches, a second southbound left-turn lane is also recommended.

SW Scholls Ferry Road/River Terrace Boulevard

With the full build out of the East River Terrace development, SW River Terrace Boulevard will be extended to SW Scholls Ferry Road. Consistent with the River Terrace Community Plan, an exclusive eastbound right-turn lane and an exclusive westbound left-turn lane should be provided at the intersection of SW Scholls Ferry Road/River Terrace Boulevard.

Left-Turn Lane Warrant Analysis

A left-turn lane warrant analysis was conducted for the SW Scholls Ferry Road/SW River Terrace Boulevard intersection using the model developed by M.D. Harmelink. The procedure takes into account left-turn arrival rates, the volume of advancing and opposing traffic, and the time interval required in making a left-turn maneuver. Based on the warrant analysis, the SW Scholls Ferry Road/SW River Terrace Boulevard intersection meets the warrant for a westbound left-turn lane on SW Scholls Ferry Road under year 2017 total traffic conditions. *Appendix "E" includes the left-turn lane warrant analysis worksheet.*

Right-Turn Lane Warrant Analysis

An exclusive right-turn lane analysis was conducted under year 2017 total traffic conditions at the SW Scholls Ferry Road/SW River Terrace Boulevard intersection. This analysis used the right-turn lane volume criterion guidelines from ODOT's Analysis Procedure Manual. Based on this criterion, the intersection meets the right-turn lane volume criterion to install a right-turn lane. *Appendix "E" includes the right-turn lane criterion analysis worksheet.*

SW Roy Rogers Road/Interim Site-Access

The River Terrace Northwest traffic study recommends an exclusive northbound left-turn lane and an exclusive southbound right-turn lane be provided at the SW Roy Rogers Road/Interim Full Site Access intersection.

With the cumulative impacts from the nine proposed developments, the eastbound left-turn movement is forecast to be over capacity; however, the alternative access routes for the development

are likely to be provided. Therefore, it is recommended that the left-turn movement be monitored and restricted if safety issues develop prior to alternative access.

In addition, the single lane southbound approach on SW Roy Rogers Road is forecast to be at or over capacity, with southbound traffic volumes approaching approximately 1,815 vph during weekday P.M. peak hour. Therefore, it is recommended that a second southbound through lane be provided along the site frontage of the River Terrace Northwest and West River Terrace developments, which is consistent with the *175th Avenue – Roy Rogers Road 15% Design Report*.

SW Roy Rogers Road/ SW Lorenzo Lane (SW Jean Louise Road)

In addition to the northbound left-turn lane recommended in the West River Terrace traffic study, a second southbound through lane is recommended at this intersection to address the capacity issues on the southbound approach. As mentioned previously, it is recommended that a second southbound through lane be provided along the site frontage of the River Terrace Northwest and West River Terrace developments. In addition, a traffic signal should be installed consistent with the River Terrace Community Plan TSP Addendum and the *175th Avenue – Roy Rogers Road 15% Design Report*.

SW Roy Rogers Road/SW Bull Mountain Road

A signal is required at the SW Roy Rogers Road/SW Bull Mountain Road intersection to meet future traffic demands, as recommended in the West River Terrace, Roshak Ridge and South River Terrace traffic studies. This signal is also identified as a needed improvement in the River Terrace Community Plan TSP Addendum. In addition, a second northbound through lane should be installed 300 feet north and south of the intersection to accommodate northbound through volume.

Once River Terrace Boulevard is connected between SW Scholls Ferry Road and SW Bull Mountain Road as identified in the River Terrace Community Plan TSP Addendum, portions of the site-generated traffic are expected to access SW Bull Mountain Road via River Terrace Boulevard, and therefore relieving the traffic demand at the SW Roy Rogers Road/SW Bull Mountain Road intersection. As a result, no additional improvements are recommended under the cumulative analysis.

Please contact us at (503) 228-5230 if you have any questions regarding this study or the findings and recommendations presented.

REFERENCES

1. Kittelson & Associates, Inc. *175th Avenue – Roy Rogers Road 15% Design*. April 2015.
2. Transportation Research Board. *2000 Highway Capacity Manual*. 2000.
3. Institute of Transportation Engineers. *Trip Generation, 9th Edition*. 2012.

APPENDICES

- A. Description of LOS Methods and Criteria
- B. Year 2017 Total Traffic Conditions Worksheets
- C. SW 175th Ave/SW Kemmer Rd Proportional Share Analysis
- D. SW Roy Rogers Rd/SW Scholls Ferry Rd Proportional Share Analysis
- E. Left- and Right-Turn Lane Warrants

Appendix A Description of Level-of-Service Methods and Criteria

APPENDIX A LEVEL-OF-SERVICE CONCEPT

Level of service (LOS) is a concept developed to quantify the degree of comfort (including such elements as travel time, number of stops, total amount of stopped delay, and impediments caused by other vehicles) afforded to drivers as they travel through an intersection or roadway segment. Six grades are used to denote the various level of service from “A” to “F”.¹

SIGNALIZED INTERSECTIONS

The six level-of-service grades are described qualitatively for signalized intersections in Table A1. Additionally, Table A2 identifies the relationship between level of service and average control delay per vehicle. Control delay is defined to include initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay. Using this definition, Level of Service “D” is generally considered to represent the minimum acceptable design standard.

Table A-1 Level-of-Service Definitions (Signalized Intersections)

Level of Service	Average Delay per Vehicle
A	Very low average control delay, less than 10 seconds per vehicle. This occurs when progression is extremely favorable, and most vehicles arrive during the green phase. Most vehicles do not stop at all. Short cycle lengths may also contribute to low delay.
B	Average control delay is greater than 10 seconds per vehicle and less than or equal to 20 seconds per vehicle. This generally occurs with good progression and/or short cycle lengths. More vehicles stop than for a level of service A, causing higher levels of average delay.
C	Average control delay is greater than 20 seconds per vehicle and less than or equal to 35 seconds per vehicle. These higher delays may result from fair progression and/or longer cycle lengths. Individual cycle failures may begin to appear at this level. The number of vehicles stopping is significant at this level, although many still pass through the intersection without stopping.
D	Average control delay is greater than 35 seconds per vehicle and less than or equal to 55 seconds per vehicle. The influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable progression, long cycle length, or high volume/capacity ratios. Many vehicles stop, and the proportion of vehicles not stopping declines. Individual cycle failures are noticeable.
E	Average control delay is greater than 55 seconds per vehicle and less than or equal to 80 seconds per vehicle. This is usually considered to be the limit of acceptable delay. These high delay values generally (but not always) indicate poor progression, long cycle lengths, and high volume/capacity ratios. Individual cycle failures are frequent occurrences.
F	Average control delay is in excess of 80 seconds per vehicle. This is considered to be unacceptable to most drivers. This condition often occurs with oversaturation. It may also occur at high volume/capacity ratios below 1.0 with many individual cycle failures. Poor progression and long cycle lengths may also contribute to such high delay values.

¹ Most of the material in this appendix is adapted from the Transportation Research Board, *2000 Highway Capacity Manual*, (2000).

Table A-2 Level-of-Service Criteria for Signalized Intersections

Level of Service	Average Control Delay per Vehicle (Seconds)
A	<10.0
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

UNSIGNALIZED INTERSECTIONS

Unsignalized intersections include two-way stop-controlled (TWSC) and all-way stop-controlled (AWSC) intersections. The *2000 Highway Capacity Manual* (HCM) provides models for estimating control delay at both TWSC and AWSC intersections. A qualitative description of the various service levels associated with an unsignalized intersection is presented in Table A3. A quantitative definition of level of service for unsignalized intersections is presented in Table A4. Using this definition, Level of Service “E” is generally considered to represent the minimum acceptable design standard.

Table A-3 Level-of-Service Criteria for Unsignalized Intersections

Level of Service	Average Delay per Vehicle to Minor Street
A	<ul style="list-style-type: none"> Nearly all drivers find freedom of operation. Very seldom is there more than one vehicle in queue.
B	<ul style="list-style-type: none"> Some drivers begin to consider the delay an inconvenience. Occasionally there is more than one vehicle in queue.
C	<ul style="list-style-type: none"> Many times there is more than one vehicle in queue. Most drivers feel restricted, but not objectionably so.
D	<ul style="list-style-type: none"> Often there is more than one vehicle in queue. Drivers feel quite restricted.
E	<ul style="list-style-type: none"> Represents a condition in which the demand is near or equal to the probable maximum number of vehicles that can be accommodated by the movement. There is almost always more than one vehicle in queue. Drivers find the delays approaching intolerable levels.
F	<ul style="list-style-type: none"> Forced flow. Represents an intersection failure condition that is caused by geometric and/or operational constraints external to the intersection.

Table A-4 Level-of-Service Criteria for Unsignalized Intersections

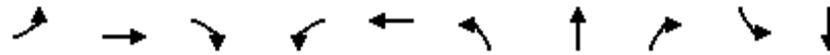
Level of Service	Average Control Delay per Vehicle (Seconds)
A	<10.0
B	>10.0 and ≤ 15.0
C	>15.0 and ≤ 25.0
D	>25.0 and ≤ 35.0
E	>35.0 and ≤ 50.0
F	>50.0

It should be noted that the level-of-service criteria for unsignalized intersections are somewhat different than the criteria used for signalized intersections. The primary reason for this difference is that drivers expect different levels of performance from different kinds of transportation facilities. The expectation is that a signalized intersection is designed to carry higher traffic volumes than an unsignalized intersection. Additionally, there are a number of driver behavior considerations that combine to make delays at signalized intersections less galling than at unsignalized intersections. For example, drivers at signalized intersections are able to relax during the red interval, while drivers on the minor street approaches to TWSC intersections must remain attentive to the task of identifying acceptable gaps and vehicle conflicts. Also, there is often much more variability in the amount of delay experienced by individual drivers at unsignalized intersections than signalized intersections. For these reasons, it is considered that the control delay threshold for any given level of service is less for an unsignalized intersection than for a signalized intersection. While overall intersection level of service is calculated for AWSC intersections, level of service is only calculated for the minor approaches and the major street left turn movements at TWSC intersections. No delay is assumed to the major street through movements. For TWSC intersections, the overall intersection level of service remains undefined: level of service is only calculated for each minor street lane.

In the performance evaluation of TWSC intersections, it is important to consider other measures of effectiveness (MOEs) in addition to delay, such as v/c ratios for individual movements, average queue lengths, and 95th-percentile queue lengths. By focusing on a single MOE for the worst movement only, such as delay for the minor-street left turn, users may make inappropriate traffic control decisions. The potential for making such inappropriate decisions is likely to be particularly pronounced when the HCM level-of-service thresholds are adopted as legal standards, as is the case in many public agencies.

Appendix B Total Traffic Conditions Output
Sheets

River Terrace and South Cooper Mountain Development (Cumulative) Weekday AM Peak Hour
 1: Roy Rogers Road/175th Avenue & Scholls Ferry Road 11/16/2015

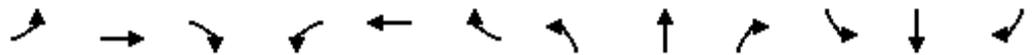


Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	37	456	427	393	830	437	533	628	208	637
v/c Ratio	0.49	0.70	0.58	0.68	0.68	0.71	0.86	0.69	0.56	0.70
Control Delay	76.8	46.8	21.5	49.0	28.1	48.2	47.4	19.2	53.3	39.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	76.8	46.8	21.5	49.0	28.1	48.2	47.4	19.2	53.3	39.4
Queue Length 50th (ft)	16	101	111	83	136	93	217	160	45	131
Queue Length 95th (ft)	#55	147	186	135	200	144	#346	287	79	194
Internal Link Dist (ft)		509			1036		433			651
Turn Bay Length (ft)	175		300	300		275		275	200	
Base Capacity (vph)	75	956	814	681	1505	794	815	954	438	1164
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.49	0.48	0.52	0.58	0.55	0.55	0.65	0.66	0.47	0.55

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

River Terrace and South Cooper Mountain Development (Cumulative) Weekday AM Peak Hour
 1: Roy Rogers Road/175th Avenue & Scholls Ferry Road 11/16/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↘	↑↑	↗	↘↗	↑↑		↘↗	↑	↗	↘↗	↑↑	
Volume (vph)	35	433	406	373	450	338	415	506	597	198	538	67
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.5	4.0	4.0	5.5		4.0	5.5	4.0	4.0	5.5	
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95		0.97	1.00	1.00	0.97	0.95	
Frt	1.00	1.00	0.85	1.00	0.94		1.00	1.00	0.85	1.00	0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1504	3471	1583	3400	3307		3303	1827	1553	3367	3442	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1504	3471	1583	3400	3307		3303	1827	1553	3367	3442	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	37	456	427	393	474	356	437	533	628	208	566	71
RTOR Reduction (vph)	0	0	57	0	111	0	0	0	35	0	8	0
Lane Group Flow (vph)	37	456	370	393	719	0	437	533	593	208	629	0
Heavy Vehicles (%)	20%	4%	2%	3%	3%	1%	6%	4%	4%	4%	2%	12%
Turn Type	Prot	NA	pm+ov	Prot	NA		Prot	NA	pm+ov	Prot	NA	
Protected Phases	5	2	3	1	6		3	8	1	7	4	
Permitted Phases			2						8			
Actuated Green, G (s)	3.8	20.6	39.8	17.7	34.5		19.2	35.2	52.9	11.3	27.3	
Effective Green, g (s)	3.8	20.6	39.8	17.7	34.5		19.2	35.2	52.9	11.3	27.3	
Actuated g/C Ratio	0.04	0.20	0.38	0.17	0.33		0.18	0.34	0.51	0.11	0.26	
Clearance Time (s)	4.0	5.5	4.0	4.0	5.5		4.0	5.5	4.0	4.0	5.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	55	688	606	579	1099		610	619	791	366	905	
v/s Ratio Prot	0.02	0.13	0.11	0.12	c0.22		c0.13	c0.29	c0.13	0.06	0.18	
v/s Ratio Perm			0.12						0.25			
v/c Ratio	0.67	0.66	0.61	0.68	0.65		0.72	0.86	0.75	0.57	0.69	
Uniform Delay, d1	49.4	38.4	25.8	40.4	29.6		39.7	32.0	20.2	43.9	34.5	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	27.8	2.4	1.8	3.2	1.4		4.0	11.8	3.9	2.0	2.3	
Delay (s)	77.2	40.8	27.6	43.5	31.0		43.7	43.8	24.1	46.0	36.8	
Level of Service	E	D	C	D	C		D	D	C	D	D	
Approach Delay (s)		36.1			35.0			36.0			39.1	
Approach LOS		D			D			D			D	

Intersection Summary			
HCM 2000 Control Delay	36.3	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	103.8	Sum of lost time (s)	19.0
Intersection Capacity Utilization	75.6%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

River Terrace and South Cooper Mountain Road Interchange (Cumulative) Weekday AM Peak Hour
 2: Roy Rogers Road & SW Jean Louise Rd 11/16/2015



Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	51	22	6	1535	1438
v/c Ratio	0.39	0.16	0.02	0.96	0.46
Control Delay	60.6	21.4	1.7	24.4	2.5
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	60.6	21.4	1.7	24.4	2.5
Queue Length 50th (ft)	25	0	0	488	61
Queue Length 95th (ft)	50	17	2	#975	95
Internal Link Dist (ft)	556			354	427
Turn Bay Length (ft)			100		
Base Capacity (vph)	242	236	288	1597	3119
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.21	0.09	0.02	0.96	0.46

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

River Terrace and South Cooper Mountain Development (Cumulative) Weekday AM Peak Hour
 2: Roy Rogers Road & SW Jean Louise Rd 11/16/2015



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	48	21	6	1443	1338	14
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95	
Frt	1.00	0.85	1.00	1.00	1.00	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1805	1615	1805	1810	3534	
Flt Permitted	0.95	1.00	0.17	1.00	1.00	
Satd. Flow (perm)	1805	1615	326	1810	3534	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	51	22	6	1535	1423	15
RTOR Reduction (vph)	0	21	0	0	0	0
Lane Group Flow (vph)	51	1	6	1535	1438	0
Heavy Vehicles (%)	0%	0%	0%	5%	2%	0%
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	7.6	7.6	104.2	104.2	104.2	
Effective Green, g (s)	7.6	7.6	104.2	104.2	104.2	
Actuated g/C Ratio	0.06	0.06	0.87	0.87	0.87	
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	114	102	283	1574	3073	
v/s Ratio Prot	c0.03			c0.85	0.41	
v/s Ratio Perm		0.00	0.02			
v/c Ratio	0.45	0.01	0.02	0.98	0.47	
Uniform Delay, d1	54.1	52.6	1.0	6.7	1.7	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	2.8	0.1	0.0	17.0	0.1	
Delay (s)	56.9	52.6	1.1	23.7	1.8	
Level of Service	E	D	A	C	A	
Approach Delay (s)	55.6			23.6	1.8	
Approach LOS	E			C	A	

Intersection Summary				
HCM 2000 Control Delay		14.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio		0.94		
Actuated Cycle Length (s)		119.8	Sum of lost time (s)	8.0
Intersection Capacity Utilization		85.9%	ICU Level of Service	E
Analysis Period (min)		15		

c Critical Lane Group

River Terrace and South Cooper Mountain Development (Cumulative) Weekday AM Peak Hour
 3: Roy Rogers Road & SW Bull Mountain Rd

11/16/2015



Lane Group	WBL	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	47	430	1139	319	1131
v/c Ratio	0.24	0.67	0.72	0.61	0.69
Control Delay	43.0	23.9	21.0	32.8	6.8
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	43.0	23.9	21.0	32.8	6.8
Queue Length 50th (ft)	14	93	154	91	152
Queue Length 95th (ft)	44	199	254	186	293
Internal Link Dist (ft)	605		357		391
Turn Bay Length (ft)	140			300	
Base Capacity (vph)	561	845	2492	812	1769
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.08	0.51	0.46	0.39	0.64

Intersection Summary

River Terrace and South Cooper Mountain Development (Cumulative) Weekday AM Peak Hour
 3: Roy Rogers Road & SW Bull Mountain Rd 11/16/2015

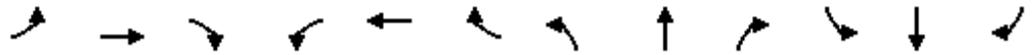


Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	44	404	1038	33	300	1063
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	1.00	0.95		1.00	1.00
Frt	1.00	0.85	1.00		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1805	1599	3409		1770	1863
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1805	1599	3409		1770	1863
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	47	430	1104	35	319	1131
RTOR Reduction (vph)	0	24	2	0	0	0
Lane Group Flow (vph)	47	406	1137	0	319	1131
Heavy Vehicles (%)	0%	1%	5%	18%	2%	2%
Turn Type	Perm	pm+ov	NA		Prot	NA
Protected Phases		1	2		1	6
Permitted Phases	8	8				
Actuated Green, G (s)	4.5	27.9	35.4		23.4	63.8
Effective Green, g (s)	4.5	27.9	35.4		23.4	63.8
Actuated g/C Ratio	0.06	0.36	0.45		0.30	0.81
Clearance Time (s)	5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	103	671	1541		528	1518
v/s Ratio Prot		c0.18	0.33		0.18	c0.61
v/s Ratio Perm	0.03	0.07				
v/c Ratio	0.46	0.60	0.74		0.60	0.75
Uniform Delay, d1	35.7	20.7	17.6		23.5	3.4
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	3.2	1.5	1.9		2.0	2.0
Delay (s)	38.9	22.2	19.5		25.4	5.4
Level of Service	D	C	B		C	A
Approach Delay (s)	23.9		19.5			9.8
Approach LOS	C		B			A

Intersection Summary			
HCM 2000 Control Delay		15.6	HCM 2000 Level of Service B
HCM 2000 Volume to Capacity ratio		0.82	
Actuated Cycle Length (s)		78.3	Sum of lost time (s) 15.0
Intersection Capacity Utilization		67.6%	ICU Level of Service C
Analysis Period (min)		15	

c Critical Lane Group

River Terrace and South Cooper Mountain Development (Cumulative) Weekday AM Peak Hour
 4: SW River Terrace Blvd & SW Bull Mountain Rd 11/16/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (veh/h)	17	298	18	6	337	5	56	0	19	18	0	55
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Hourly flow rate (vph)	21	368	22	7	416	6	69	0	23	22	0	68
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)		685										
pX, platoon unblocked												
vC, conflicting volume	422			390			923	858	379	878	866	419
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	422			390			923	858	379	878	866	419
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	98			99			69	100	97	91	100	89
cM capacity (veh/h)	1148			1179			221	289	672	256	286	638

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	411	430	93	90
Volume Left	21	7	69	22
Volume Right	22	6	23	68
cSH	1148	1179	267	467
Volume to Capacity	0.02	0.01	0.35	0.19
Queue Length 95th (ft)	1	0	24	11
Control Delay (s)	0.6	0.2	25.5	14.6
Lane LOS	A	A	D	B
Approach Delay (s)	0.6	0.2	25.5	14.6
Approach LOS			D	B

Intersection Summary			
Average Delay		3.9	
Intersection Capacity Utilization		43.6%	ICU Level of Service A
Analysis Period (min)		15	

River Terrace and South Cooper Mountain Development (Cumulative) Weekday AM Peak Hour
 5: SW Darwin Ave & SW Bull Mountain Rd 11/16/2015

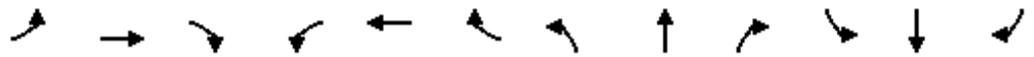


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (veh/h)	11	320	4	1	297	4	14	0	5	12	0	37
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Hourly flow rate (vph)	14	395	5	1	367	5	17	0	6	15	0	46
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)		1141										
pX, platoon unblocked												
vC, conflicting volume	372			400			842	799	398	802	799	369
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	372			400			842	799	398	802	799	369
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			100			93	100	99	95	100	93
cM capacity (veh/h)	1198			1170			265	317	656	299	317	681

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	414	373	23	60
Volume Left	14	1	17	15
Volume Right	5	5	6	46
cSH	1198	1170	314	518
Volume to Capacity	0.01	0.00	0.07	0.12
Queue Length 95th (ft)	1	0	4	6
Control Delay (s)	0.4	0.0	17.4	12.9
Lane LOS	A	A	C	B
Approach Delay (s)	0.4	0.0	17.4	12.9
Approach LOS			C	B

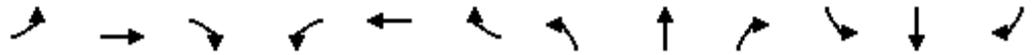
Intersection Summary			
Average Delay		1.6	
Intersection Capacity Utilization		35.2%	ICU Level of Service
Analysis Period (min)		15	A

River Terrace and South Cooper Mountain Development (Cumulative) Weekday AM Peak Hour
 6: SW Bull Mountain Rd & SW Roshak Rd & 155th Terrace 11/16/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	0	130	1	208	63	1	4	1	410	3	0	3
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
Hourly flow rate (vph)	0	155	1	248	75	1	5	1	488	4	0	4
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1						
Volume Total (vph)	0	156	248	76	494	7						
Volume Left (vph)	0	0	248	0	5	4						
Volume Right (vph)	0	1	0	1	488	4						
Hadj (s)	0.00	0.05	0.53	0.11	-0.56	-0.20						
Departure Headway (s)	6.4	6.4	6.6	6.2	4.8	6.0						
Degree Utilization, x	0.00	0.28	0.45	0.13	0.65	0.01						
Capacity (veh/h)	531	518	517	549	723	512						
Control Delay (s)	8.2	10.7	13.8	8.9	16.4	9.1						
Approach Delay (s)	10.7		12.6		16.4	9.1						
Approach LOS	B		B		C	A						
Intersection Summary												
Delay			14.2									
Level of Service			B									
Intersection Capacity Utilization			54.2%	ICU Level of Service	A							
Analysis Period (min)			15									

River Terrace and South Cooper Mountain Development (Cumulative) Weekday AM Peak Hour
 7: SW 150th Ave & SW Bull Mountain Rd 11/16/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (veh/h)	0	489	58	37	215	3	48	0	84	10	0	2
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Hourly flow rate (vph)	0	589	70	45	259	4	58	0	101	12	0	2
Pedestrians												3
Lane Width (ft)												10.0
Walking Speed (ft/s)												4.0
Percent Blockage												0
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	266			659			977	979	624	1078	1012	264
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	266			659			977	979	624	1078	1012	264
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			95			74	100	79	92	100	100
cM capacity (veh/h)	1307			924			223	239	484	150	229	778

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	659	307	159	14
Volume Left	0	45	58	12
Volume Right	70	4	101	2
cSH	1307	924	339	174
Volume to Capacity	0.00	0.05	0.47	0.08
Queue Length 95th (ft)	0	2	38	4
Control Delay (s)	0.0	1.8	24.7	27.6
Lane LOS		A	C	D
Approach Delay (s)	0.0	1.8	24.7	27.6
Approach LOS			C	D

Intersection Summary			
Average Delay		4.3	
Intersection Capacity Utilization		57.1%	ICU Level of Service
Analysis Period (min)		15	B

River Terrace and South Cooper Mountain Development (Cumulative) Weekday AM Peak Hour
 8: SW 150th Ave & SW Danube Dr 11/16/2015



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	18	10	3	76	113	7
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86
Hourly flow rate (vph)	21	12	3	88	131	8
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type						
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	231	135	140			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	231	135	140			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	97	99	100			
cM capacity (veh/h)	760	919	1456			
Direction, Lane #						
	EB 1	NB 1	SB 1			
Volume Total	33	92	140			
Volume Left	21	3	0			
Volume Right	12	0	8			
cSH	810	1456	1700			
Volume to Capacity	0.04	0.00	0.08			
Queue Length 95th (ft)	2	0	0			
Control Delay (s)	9.6	0.3	0.0			
Lane LOS	A	A				
Approach Delay (s)	9.6	0.3	0.0			
Approach LOS	A					
Intersection Summary						
Average Delay			1.3			
Intersection Capacity Utilization			16.4%	ICU Level of Service		A
Analysis Period (min)			15			

River Terrace and South Cooper Mountain Development (Cumulative) Weekday AM Peak Hour
 9: SW 150th Ave & SW Colorado St/SW Hawk Ridge Rd 11/16/2015

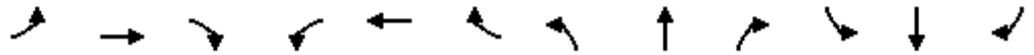


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (veh/h)	12	0	7	5	0	10	2	56	3	0	119	4
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	14	0	8	6	0	12	2	66	4	0	140	5
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	226	216	142	223	217	68	145			69		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	226	216	142	223	217	68	145			69		
tC, single (s)	7.1	6.5	6.2	7.3	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.7	4.0	3.3	2.2			2.2		
p0 queue free %	98	100	99	99	100	99	100			100		
cM capacity (veh/h)	724	684	911	689	683	1001	1450			1544		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	22	18	72	145
Volume Left	14	6	2	0
Volume Right	8	12	4	5
cSH	783	870	1450	1544
Volume to Capacity	0.03	0.02	0.00	0.00
Queue Length 95th (ft)	1	1	0	0
Control Delay (s)	9.7	9.2	0.3	0.0
Lane LOS	A	A	A	
Approach Delay (s)	9.7	9.2	0.3	0.0
Approach LOS	A	A		

Intersection Summary			
Average Delay		1.6	
Intersection Capacity Utilization		16.5%	ICU Level of Service A
Analysis Period (min)		15	

River Terrace and South Cooper Mountain Development (Cumulative) Weekday AM Peak Hour
 10: SW 150th Ave & SW Beef Bend Rd 11/16/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (veh/h)	24	221	0	0	196	32	0	0	0	97	0	41
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	27	246	0	0	218	36	0	0	0	108	0	46
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	253			246			580	552	246	534	534	236
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	253			246			580	552	246	534	534	236
tC, single (s)	4.2			4.1			7.1	6.5	6.2	7.1	6.5	6.3
tC, 2 stage (s)												
tF (s)	2.3			2.2			3.5	4.0	3.3	3.5	4.0	3.4
p0 queue free %	98			100			100	100	100	76	100	94
cM capacity (veh/h)	1267			1332			398	435	798	452	445	794
Direction, Lane #	EB 1	WB 1	NB 1	SB 1								
Volume Total	272	253	0	153								
Volume Left	27	0	0	108								
Volume Right	0	36	0	46								
cSH	1267	1332	1700	519								
Volume to Capacity	0.02	0.00	0.00	0.30								
Queue Length 95th (ft)	1	0	0	20								
Control Delay (s)	0.9	0.0	0.0	14.8								
Lane LOS	A		A	B								
Approach Delay (s)	0.9	0.0	0.0	14.8								
Approach LOS			A	B								
Intersection Summary												
Average Delay			3.7									
Intersection Capacity Utilization			43.1%		ICU Level of Service				A			
Analysis Period (min)			15									

River Terrace and South Cooper Mountain Development (Cumulative) Weekday AM Peak Hour
 11: Roy Rogers Road & Roy Rogers Rd Site Access 11/16/2015

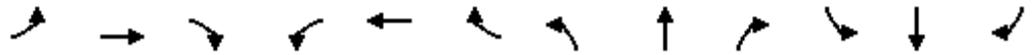


Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations		↗	↖	↑	↑↓	
Volume (veh/h)	15	26	11	1488	1322	4
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	16	28	12	1583	1406	4
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (ft)				1037		
pX, platoon unblocked	0.14					
vC, conflicting volume	3015	705	1411			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	11950	705	1411			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	0	93	98			
cM capacity (veh/h)	0	383	490			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	44	12	1583	938	473
Volume Left	16	12	0	0	0
Volume Right	28	0	0	0	4
cSH	0	490	1700	1700	1700
Volume to Capacity	Err	0.02	0.93	0.55	0.28
Queue Length 95th (ft)	Err	1	0	0	0
Control Delay (s)	Err	12.5	0.0	0.0	0.0
Lane LOS	F	B			
Approach Delay (s)	Err	0.1		0.0	
Approach LOS	F				

Intersection Summary					
Average Delay			143.1		
Intersection Capacity Utilization			Err%	ICU Level of Service	H
Analysis Period (min)			15		

River Terrace and South Cooper Mountain Development (Cumulative) Weekday AM Peak Hour
 12: NW RT Scholls Ferry Rd Site Access/East School Site Access & Scholls Ferry Road 11/16/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↗		↖	↕	↗	↖		↗			↖
Volume (veh/h)	0	819	5	15	888	29	14	0	55	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
Hourly flow rate (vph)	0	941	6	17	1021	33	16	0	63	0	0	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)		770			924							
pX, platoon unblocked				0.71			0.71	0.71	0.71	0.71	0.71	0.71
vC, conflicting volume	1054			947			1489	2033	944	2063	2002	510
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1054			722			1485	2249	718	2291	2206	510
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			97			74	100	76	100	100	100
cM capacity (veh/h)	668			632			61	29	267	12	31	514

Direction, Lane #	EB 1	WB 1	WB 2	WB 3	WB 4	NB 1	NB 2	SB 1
Volume Total	947	17	510	510	33	16	63	0
Volume Left	0	17	0	0	0	16	0	0
Volume Right	6	0	0	0	33	0	63	0
cSH	1700	632	1700	1700	1700	61	267	1700
Volume to Capacity	0.56	0.03	0.30	0.30	0.02	0.26	0.24	0.00
Queue Length 95th (ft)	0	1	0	0	0	15	14	0
Control Delay (s)	0.0	10.9	0.0	0.0	0.0	83.3	22.6	0.0
Lane LOS		B				F	C	A
Approach Delay (s)	0.0	0.2				34.9		0.0
Approach LOS						D		A

Intersection Summary		
Average Delay		1.4
Intersection Capacity Utilization	53.5%	ICU Level of Service
Analysis Period (min)		15
		A

River Terrace and South Cooper Mountain Development (Cumulative) Weekday AM Peak Hour
 13: River Terrace Blvd & Scholls Ferry Road 11/16/2015

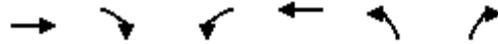


Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↑	↓	↑↑	↓	↑
Volume (veh/h)	1199	28	23	1066	94	77
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	1262	29	24	1122	99	81
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	Raised			Raised		
Median storage veh	1			1		
Upstream signal (ft)	1116			852		
pX, platoon unblocked	0.91			0.88	0.91	
vC, conflicting volume	1292			1872	631	
vC1, stage 1 conf vol				1262		
vC2, stage 2 conf vol				609		
vCu, unblocked vol	1124			1260	399	
tC, single (s)	4.1			6.8	6.9	
tC, 2 stage (s)				5.8		
tF (s)	2.2			3.5	3.3	
p0 queue free %	96			55	85	
cM capacity (veh/h)	573			219	552	

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2
Volume Total	631	631	29	24	561	561	99	81
Volume Left	0	0	0	24	0	0	99	0
Volume Right	0	0	29	0	0	0	0	81
cSH	1700	1700	1700	573	1700	1700	219	552
Volume to Capacity	0.37	0.37	0.02	0.04	0.33	0.33	0.45	0.15
Queue Length 95th (ft)	0	0	0	2	0	0	35	8
Control Delay (s)	0.0	0.0	0.0	11.6	0.0	0.0	34.3	12.6
Lane LOS				B				B
Approach Delay (s)	0.0			0.2			24.5	
Approach LOS							C	

Intersection Summary			
Average Delay	1.8		
Intersection Capacity Utilization	45.0%	ICU Level of Service	
Analysis Period (min)	15		
A			

River Terrace and South Cooper Mountain Development (Cumulative) Weekday AM Peak Hour
 14: SW 163rd Ave & SW Bull Mountain Rd 11/16/2015

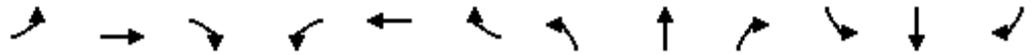


Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	→			←	←	←
Volume (veh/h)	172	9	6	95	30	20
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.25	0.25	0.25	0.25	0.25	0.25
Hourly flow rate (vph)	688	36	24	380	120	80
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None		None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			724		1134	706
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			724		1134	706
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			97		45	82
cM capacity (veh/h)			888		220	439

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	724	404	200
Volume Left	0	24	120
Volume Right	36	0	80
cSH	1700	888	275
Volume to Capacity	0.43	0.03	0.73
Queue Length 95th (ft)	0	1	83
Control Delay (s)	0.0	0.8	46.5
Lane LOS		A	E
Approach Delay (s)	0.0	0.8	46.5
Approach LOS			E

Intersection Summary			
Average Delay		7.3	
Intersection Capacity Utilization		19.9%	ICU Level of Service A
Analysis Period (min)		15	

River Terrace and South Cooper Mountain Development (Cumulative) Weekday AM Peak Hour
 15: SW 161st Ave & SW Bull Mountain Rd 11/16/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (veh/h)	0	183	9	6	71	0	30	0	20	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Hourly flow rate (vph)	0	732	36	24	284	0	120	0	80	0	0	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	284			768			1082	1082	750	1162	1100	284
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	284			768			1082	1082	750	1162	1100	284
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			97			38	100	81	100	100	100
cM capacity (veh/h)	1290			855			193	213	415	137	208	760

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	768	308	200	0
Volume Left	0	24	120	0
Volume Right	36	0	80	0
cSH	1290	855	245	1700
Volume to Capacity	0.00	0.03	0.82	0.00
Queue Length 95th (ft)	0	1	101	0
Control Delay (s)	0.0	1.0	62.6	0.0
Lane LOS		A	F	A
Approach Delay (s)	0.0	1.0	62.6	0.0
Approach LOS			F	A

Intersection Summary			
Average Delay		10.1	
Intersection Capacity Utilization	20.2%		ICU Level of Service A
Analysis Period (min)		15	

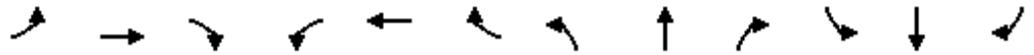


Lane Group	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	440	249	194	692	24	477
v/c Ratio	0.96	0.84	0.93	0.95	0.22	0.91
Control Delay	72.2	70.4	97.7	58.8	57.6	61.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	72.2	70.4	97.7	58.8	57.6	61.5
Queue Length 50th (ft)	~200	117	97	~350	12	221
Queue Length 95th (ft)	#327	#192	#187	#509	29	#322
Internal Link Dist (ft)	282	680		2741		622
Turn Bay Length (ft)			100		100	
Base Capacity (vph)	459	330	209	728	142	591
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.96	0.75	0.93	0.95	0.17	0.81

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

River Terrace and South Cooper Mountain Drive Interchange (Cumulative) Weekday AM Peak Hour
 101: 175th Avenue & SW Kemmer Rd 11/16/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↗	↘		↗	↘	
Volume (vph)	36	131	220	52	139	28	171	573	36	21	402	18
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frbp, ped/bikes		1.00			1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.92			0.98		1.00	0.99		1.00	0.99	
Flt Protected		1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1712			1767		1703	1857		1805	1814	
Flt Permitted		1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1712			1767		1703	1857		1805	1814	
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	41	149	250	59	158	32	194	651	41	24	457	20
RTOR Reduction (vph)	0	39	0	0	4	0	0	2	0	0	1	0
Lane Group Flow (vph)	0	401	0	0	245	0	194	690	0	24	476	0
Confl. Bikes (#/hr)						1						
Heavy Vehicles (%)	3%	0%	3%	10%	2%	4%	6%	1%	8%	0%	4%	6%
Turn Type	Split	NA		Split	NA		Prot	NA		Prot	NA	
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)		28.1			18.9		14.1	44.8		4.6	35.3	
Effective Green, g (s)		28.1			18.9		14.1	44.8		4.6	35.3	
Actuated g/C Ratio		0.24			0.16		0.12	0.38		0.04	0.30	
Clearance Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		413			286		206	714		71	550	
v/s Ratio Prot		c0.23			c0.14		c0.11	c0.37		0.01	0.26	
v/s Ratio Perm												
v/c Ratio		0.97			0.86		0.94	0.97		0.34	0.86	
Uniform Delay, d1		43.8			47.4		50.7	35.1		54.4	38.3	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		36.7			21.4		46.2	25.4		2.8	13.3	
Delay (s)		80.5			68.8		97.0	60.5		57.2	51.6	
Level of Service		F			E		F	E		E	D	
Approach Delay (s)		80.5			68.8		68.5	68.5		51.9	51.9	
Approach LOS		F			E		E	E		D	D	

Intersection Summary		
HCM 2000 Control Delay	67.0	HCM 2000 Level of Service
HCM 2000 Volume to Capacity ratio	0.97	E
Actuated Cycle Length (s)	116.4	Sum of lost time (s)
Intersection Capacity Utilization	72.8%	20.0
Analysis Period (min)	15	ICU Level of Service
c Critical Lane Group		C

River Terrace and South Cooper Mountain Development (Cumulative) Weekday AM Peak Hour
 103: 175th Avenue & N Access Road 11/16/2015

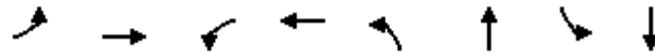


Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	47	42	722	13	12	695
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95
Hourly flow rate (vph)	49	44	760	14	13	732
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (ft)			648			
pX, platoon unblocked	0.75	0.75			0.75	
vC, conflicting volume	1524	767			774	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1532	523			532	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	48	89			98	
cM capacity (veh/h)	96	419			785	

Direction, Lane #	WB 1	WB 2	NB 1	SB 1	SB 2
Volume Total	49	44	774	13	732
Volume Left	49	0	0	13	0
Volume Right	0	44	14	0	0
cSH	96	419	1700	785	1700
Volume to Capacity	0.52	0.11	0.46	0.02	0.43
Queue Length 95th (ft)	37	6	0	1	0
Control Delay (s)	77.1	14.6	0.0	9.7	0.0
Lane LOS	F	B		A	
Approach Delay (s)	47.6		0.0	0.2	
Approach LOS	E				

Intersection Summary					
Average Delay			2.8		
Intersection Capacity Utilization			48.8%	ICU Level of Service	A
Analysis Period (min)			15		

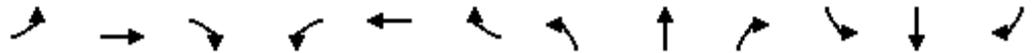
River Terrace and South Cooper Mountain Development (Cumulative) Weekday AM Peak Hour
 104: 175th Avenue & School Site Access (175th)/S Access Road 11/16/2015



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	84	126	116	44	245	678	13	768
v/c Ratio	0.31	0.17	0.45	0.07	0.55	0.54	0.06	0.64
Control Delay	27.5	0.5	31.1	0.2	27.6	10.8	31.8	20.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	27.5	0.5	31.1	0.2	27.6	10.8	31.8	20.1
Queue Length 50th (ft)	17	0	25	0	51	73	3	75
Queue Length 95th (ft)	48	0	64	0	113	250	15	144
Internal Link Dist (ft)		469		616		651		366
Turn Bay Length (ft)					100		100	
Base Capacity (vph)	663	1044	615	958	865	1323	311	1673
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.13	0.12	0.19	0.05	0.28	0.51	0.04	0.46

Intersection Summary

River Terrace and South Cooper Mountain Development (Cumulative) Weekday AM Peak Hour
 104: 175th Avenue & School Site Access (175th)/S Access Road 11/16/2015



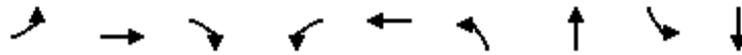
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗		↖	↗		↖	↗	↖
Volume (vph)	80	0	120	110	0	42	233	613	31	12	573	157
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	0.95	
Frt	1.00	0.85		1.00	0.85		1.00	0.99		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1805	1615		1805	1615		1805	1817		1805	3413	
Flt Permitted	0.73	1.00		0.68	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1384	1615		1285	1615		1805	1817		1805	3413	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	84	0	126	116	0	44	245	645	33	13	603	165
RTOR Reduction (vph)	0	108	0	0	38	0	0	2	0	0	23	0
Lane Group Flow (vph)	84	18	0	116	6	0	245	676	0	13	745	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	4%	0%	0%	3%	0%
Turn Type	Perm	NA		Perm	NA		Prot	NA		Prot	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8								
Actuated Green, G (s)	9.1	9.1		9.1	9.1		14.5	38.3		1.1	24.9	
Effective Green, g (s)	9.1	9.1		9.1	9.1		14.5	38.3		1.1	24.9	
Actuated g/C Ratio	0.14	0.14		0.14	0.14		0.23	0.60		0.02	0.39	
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	198	231		184	231		412	1095		31	1338	
v/s Ratio Prot		0.01			0.00		c0.14	c0.37		0.01	0.22	
v/s Ratio Perm	0.06			c0.09								
v/c Ratio	0.42	0.08		0.63	0.03		0.59	0.62		0.42	0.56	
Uniform Delay, d1	24.8	23.6		25.6	23.4		21.9	8.0		30.9	15.0	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.5	0.1		6.9	0.0		2.3	1.0		8.9	0.5	
Delay (s)	26.3	23.7		32.5	23.4		24.2	9.0		39.8	15.5	
Level of Service	C	C		C	C		C	A		D	B	
Approach Delay (s)		24.7			30.0			13.0			15.9	
Approach LOS		C			C			B			B	

Intersection Summary

HCM 2000 Control Delay	16.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	63.5	Sum of lost time (s)	15.0
Intersection Capacity Utilization	62.7%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

River Terrace and South Cooper Mountain Development (Cumulative) Weekday AM Peak Hour
 106: SW Barrows Rd/SW Loon Dr & Scholls Ferry Road 11/16/2015



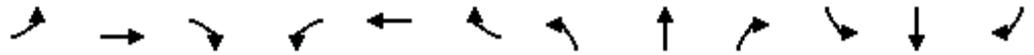
Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	35	1230	273	31	932	373	188	122	166
v/c Ratio	0.14	0.79	0.18	0.18	0.60	0.92	0.47	0.58	0.69
Control Delay	13.8	28.9	0.3	15.0	23.9	71.2	41.9	56.9	57.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	13.8	28.9	0.3	15.0	23.9	71.2	41.9	56.9	57.2
Queue Length 50th (ft)	6	224	0	6	152	~176	68	49	62
Queue Length 95th (ft)	17	298	0	16	208	#310	127	94	114
Internal Link Dist (ft)		772			903		399		653
Turn Bay Length (ft)	165		500	300		215		125	
Base Capacity (vph)	378	2242	1538	328	2231	405	402	346	383
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.09	0.55	0.18	0.09	0.42	0.92	0.47	0.35	0.43

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

River Terrace and South Cooper Mountain Development (Cumulative) Weekday AM Peak Hour
 106: SW Barrows Rd/SW Loon Dr & Scholls Ferry Road 11/16/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↘	↑↑	↗	↘	↑↑		↘	↗		↘	↗	
Volume (vph)	29	1021	227	26	736	37	310	120	36	101	95	43
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0	4.0	4.0	5.0		5.0	5.0		4.0	4.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	0.99		1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	0.97		1.00	0.95	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1656	3539	1538	1719	3517		1787	1743		1641	1758	
Flt Permitted	0.19	1.00	1.00	0.09	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	333	3539	1538	163	3517		1787	1743		1641	1758	
Peak-hour factor, PHF	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Adj. Flow (vph)	35	1230	273	31	887	45	373	145	43	122	114	52
RTOR Reduction (vph)	0	0	0	0	3	0	0	7	0	0	13	0
Lane Group Flow (vph)	35	1230	273	31	929	0	373	181	0	122	153	0
Confl. Peds. (#/hr)									13	13		
Heavy Vehicles (%)	9%	2%	5%	5%	2%	0%	1%	6%	0%	10%	3%	3%
Turn Type	pm+pt	NA	Free	pm+pt	NA		Split	NA		Split	NA	
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases	2		Free	6								
Actuated Green, G (s)	48.2	44.6	101.8	47.6	44.3		22.9	22.9		13.0	13.0	
Effective Green, g (s)	48.2	44.6	101.8	47.6	44.3		22.9	22.9		13.0	13.0	
Actuated g/C Ratio	0.47	0.44	1.00	0.47	0.44		0.22	0.22		0.13	0.13	
Clearance Time (s)	4.0	5.0		4.0	5.0		5.0	5.0		4.0	4.0	
Vehicle Extension (s)	2.6	3.1		2.4	3.1		1.4	1.4		1.4	1.4	
Lane Grp Cap (vph)	204	1550	1538	126	1530		401	392		209	224	
v/s Ratio Prot	0.01	c0.35		0.01	0.26		c0.21	0.10		0.07	c0.09	
v/s Ratio Perm	0.08		c0.18	0.11								
v/c Ratio	0.17	0.79	0.18	0.25	0.61		0.93	0.46		0.58	0.68	
Uniform Delay, d1	15.9	24.6	0.0	18.5	22.1		38.7	34.1		41.8	42.4	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.3	2.9	0.3	0.7	0.7		27.8	0.3		2.7	6.7	
Delay (s)	16.2	27.5	0.3	19.2	22.8		66.4	34.4		44.5	49.1	
Level of Service	B	C	A	B	C		E	C		D	D	
Approach Delay (s)		22.4			22.7			55.7			47.2	
Approach LOS		C			C			E			D	

Intersection Summary		
HCM 2000 Control Delay	30.2	HCM 2000 Level of Service C
HCM 2000 Volume to Capacity ratio	0.80	
Actuated Cycle Length (s)	101.8	Sum of lost time (s) 18.0
Intersection Capacity Utilization	64.7%	ICU Level of Service C
Analysis Period (min)	15	
c Critical Lane Group		

River Terrace and South Cooper Mountain Development (Cumulative) Weekday AM Peak Hour
 107: SW Roshak Rd/Driveway & SW Barrows Rd 11/16/2015

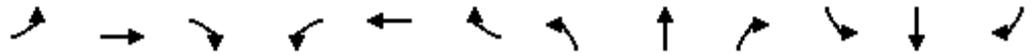


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (veh/h)	12	297	38	11	373	4	89	3	84	1	1	5
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Hourly flow rate (vph)	15	367	47	14	460	5	110	4	104	1	1	6
Pedestrians		1			2			1			5	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		4.0			4.0			4.0			4.0	
Percent Blockage		0			0			0			0	
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)		479										
pX, platoon unblocked				0.97			0.97	0.97	0.97	0.97	0.97	
vC, conflicting volume	470			415			919	918	393	1022	939	469
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	470			377			899	898	355	1006	920	469
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			99			55	99	84	99	100	99
cM capacity (veh/h)	1097			1152			243	263	664	174	256	595

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	428	479	217	9
Volume Left	15	14	110	1
Volume Right	47	5	104	6
cSH	1097	1152	349	388
Volume to Capacity	0.01	0.01	0.62	0.02
Queue Length 95th (ft)	1	1	64	1
Control Delay (s)	0.4	0.4	30.9	14.5
Lane LOS	A	A	D	B
Approach Delay (s)	0.4	0.4	30.9	14.5
Approach LOS			D	B

Intersection Summary			
Average Delay		6.4	
Intersection Capacity Utilization	48.0%		ICU Level of Service A
Analysis Period (min)		15	

River Terrace and South Cooper Mountain Development (Cumulative) Weekday AM Peak Hour
 108: SW Roshak Rd & SW Luke Ln 11/16/2015



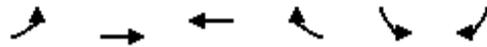
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (veh/h)	5	0	1	1	0	4	0	167	0	1	47	2
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
Hourly flow rate (vph)	6	0	1	1	0	5	0	214	0	1	60	3
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	283	278	62	279	279	214	63			214		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	283	278	62	279	279	214	63			214		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	99	100	100	100	100	99	100			100		
cM capacity (veh/h)	668	633	1009	676	631	831	1553			1368		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	8	6	214	64
Volume Left	6	1	0	1
Volume Right	1	5	0	3
cSH	708	794	1553	1368
Volume to Capacity	0.01	0.01	0.00	0.00
Queue Length 95th (ft)	1	0	0	0
Control Delay (s)	10.1	9.6	0.0	0.2
Lane LOS	B	A		A
Approach Delay (s)	10.1	9.6	0.0	0.2
Approach LOS	B	A		

Intersection Summary			
Average Delay		0.5	
Intersection Capacity Utilization		18.8%	ICU Level of Service A
Analysis Period (min)		15	

River Terrace and South Cooper Mountain Development (Cumulative) Weekday AM Peak Hour
 109: Scholls Ferry Road & West School Site Access

11/16/2015

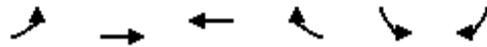


Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Group Flow (vph)	9	909	956	80	38	1
v/c Ratio	0.03	0.56	0.80	0.07	0.30	0.00
Control Delay	2.9	5.2	18.0	2.8	33.0	21.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	2.9	5.2	18.0	2.8	33.0	21.0
Queue Length 50th (ft)	0	0	88	1	8	0
Queue Length 95th (ft)	3	194	#400	12	26	2
Internal Link Dist (ft)		591	690		1069	
Turn Bay Length (ft)	50					
Base Capacity (vph)	426	1633	1194	1067	386	650
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.02	0.56	0.80	0.07	0.10	0.00

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

River Terrace and South Cooper Mountain Development (Cumulative) Weekday AM Peak Hour
 109: Scholls Ferry Road & West School Site Access 11/16/2015



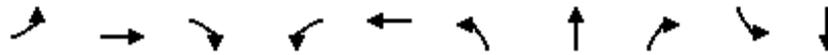
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	8	791	832	70	33	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1805	1845	1810	1583	960	1615
Flt Permitted	0.13	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	241	1845	1810	1583	960	1615
Peak-hour factor, PHF	0.87	0.87	0.87	0.87	0.87	0.87
Adj. Flow (vph)	9	909	956	80	38	1
RTOR Reduction (vph)	0	0	0	25	0	1
Lane Group Flow (vph)	9	909	956	55	38	0
Heavy Vehicles (%)	0%	3%	5%	2%	88%	0%
Turn Type	pm+pt	NA	NA	Perm	Prot	Perm
Protected Phases	5	2	6		4	
Permitted Phases	2			6		4
Actuated Green, G (s)	52.5	52.5	41.7	41.7	3.8	3.8
Effective Green, g (s)	52.5	52.5	41.7	41.7	3.8	3.8
Actuated g/C Ratio	0.79	0.79	0.63	0.63	0.06	0.06
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	327	1460	1138	995	55	92
v/s Ratio Prot	0.00	c0.49	c0.53		c0.04	
v/s Ratio Perm	0.02			0.03		0.00
v/c Ratio	0.03	0.62	0.84	0.06	0.69	0.00
Uniform Delay, d1	7.4	2.8	9.7	4.7	30.7	29.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.0	0.8	5.7	0.0	31.3	0.0
Delay (s)	7.4	3.7	15.4	4.8	62.0	29.5
Level of Service	A	A	B	A	E	C
Approach Delay (s)		3.7	14.6		61.1	
Approach LOS		A	B		E	

Intersection Summary

HCM 2000 Control Delay	10.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	66.3	Sum of lost time (s)	15.0
Intersection Capacity Utilization	55.5%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

River Terrace and South Cooper Mountain Development (Cumulative) Weekday PM Peak Hour
 1: Roy Rogers Road/175th Avenue & Scholls Ferry Road 11/16/2015

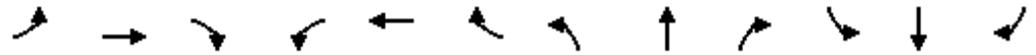


Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	64	480	524	714	575	410	578	607	227	717
v/c Ratio	0.53	0.78	0.81	0.93	0.49	0.75	0.92	0.60	0.60	0.71
Control Delay	71.4	58.1	39.3	65.9	32.8	58.6	61.0	15.8	58.7	43.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	71.4	58.1	39.3	65.9	32.8	58.6	61.0	15.8	58.7	43.4
Queue Length 50th (ft)	31	120	192	179	114	100	277	148	56	170
Queue Length 95th (ft)	66	170	307	#288	165	146	#454	255	87	226
Internal Link Dist (ft)		504			1036		433			651
Turn Bay Length (ft)	175		300	300		275		275	200	
Base Capacity (vph)	144	727	679	769	1196	627	627	1017	604	1123
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.44	0.66	0.77	0.93	0.48	0.65	0.92	0.60	0.38	0.64

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

River Terrace and South Cooper Mountain Development (Cumulative) Weekday PM Peak Hour
 1: Roy Rogers Road/175th Avenue & Scholls Ferry Road 11/16/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↘	↑↑	↗	↘↗	↑↑		↘↗	↑	↗	↘↗	↑↑	
Volume (vph)	62	466	508	693	413	145	398	561	589	220	637	58
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.5	4.0	4.0	5.5		4.0	5.5	4.0	4.0	5.5	
Lane Util. Factor	1.00	0.95	1.00	0.97	0.95		0.97	1.00	1.00	0.97	0.95	
Frt	1.00	1.00	0.85	1.00	0.96		1.00	1.00	0.85	1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1583	3574	1568	3433	3377		3433	1863	1615	3467	3501	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1583	3574	1568	3433	3377		3433	1863	1615	3467	3501	
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	64	480	524	714	426	149	410	578	607	227	657	60
RTOR Reduction (vph)	0	0	58	0	25	0	0	0	43	0	5	0
Lane Group Flow (vph)	64	480	466	714	550	0	410	578	564	227	712	0
Heavy Vehicles (%)	14%	1%	3%	2%	3%	2%	2%	2%	0%	1%	2%	0%
Turn Type	Prot	NA	pm+ov	Prot	NA		Prot	NA	pm+ov	Prot	NA	
Protected Phases	5	2	3	1	6		3	8	1	7	4	
Permitted Phases			2						8			
Actuated Green, G (s)	7.9	21.6	40.8	27.1	40.8		19.2	40.7	67.8	13.3	34.8	
Effective Green, g (s)	7.9	21.6	40.8	27.1	40.8		19.2	40.7	67.8	13.3	34.8	
Actuated g/C Ratio	0.06	0.18	0.34	0.22	0.34		0.16	0.33	0.56	0.11	0.29	
Clearance Time (s)	4.0	5.5	4.0	4.0	5.5		4.0	5.5	4.0	4.0	5.5	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	102	634	525	764	1132		541	623	899	378	1001	
v/s Ratio Prot	0.04	0.13	c0.14	c0.21	0.16		0.12	c0.31	0.14	0.07	0.20	
v/s Ratio Perm			0.16						0.21			
v/c Ratio	0.63	0.76	0.89	0.93	0.49		0.76	0.93	0.63	0.60	0.71	
Uniform Delay, d1	55.5	47.6	38.3	46.4	32.1		49.0	39.1	18.3	51.7	38.9	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	11.5	5.2	16.5	18.4	0.3		6.0	20.0	1.4	2.7	2.4	
Delay (s)	66.9	52.7	54.8	64.8	32.4		55.0	59.1	19.7	54.3	41.4	
Level of Service	E	D	D	E	C		E	E	B	D	D	
Approach Delay (s)		54.6			50.4			43.1			44.5	
Approach LOS		D			D			D			D	

Intersection Summary

HCM 2000 Control Delay	47.8	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	121.7	Sum of lost time (s)	19.0
Intersection Capacity Utilization	84.3%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group



Lane Group	EBL	EBR	NBL	NBT	SBT
Lane Group Flow (vph)	30	13	23	1596	1883
v/c Ratio	0.26	0.11	0.13	0.93	0.58
Control Delay	58.4	25.8	2.9	18.7	2.6
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	58.4	25.8	2.9	18.7	2.6
Queue Length 50th (ft)	14	0	1	469	88
Queue Length 95th (ft)	34	13	4	#998	135
Internal Link Dist (ft)	556			323	975
Turn Bay Length (ft)			100		
Base Capacity (vph)	244	230	181	1708	3235
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.12	0.06	0.13	0.93	0.58

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

River Terrace and South Cooper Mountain Development (Cumulative) Weekday PM Peak Hour
 2: Roy Rogers Road & SW Jean Louise Rd 11/16/2015



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	29	13	22	1548	1774	52
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95	
Frt	1.00	0.85	1.00	1.00	1.00	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1805	1615	1805	1863	3526	
Flt Permitted	0.95	1.00	0.10	1.00	1.00	
Satd. Flow (perm)	1805	1615	197	1863	3526	
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	30	13	23	1596	1829	54
RTOR Reduction (vph)	0	12	0	0	1	0
Lane Group Flow (vph)	30	1	23	1596	1882	0
Heavy Vehicles (%)	0%	0%	0%	2%	2%	0%
Turn Type	Prot	Perm	Perm	NA	NA	
Protected Phases	4			2	6	
Permitted Phases		4	2			
Actuated Green, G (s)	5.1	5.1	106.6	106.6	106.6	
Effective Green, g (s)	5.1	5.1	106.6	106.6	106.6	
Actuated g/C Ratio	0.04	0.04	0.89	0.89	0.89	
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	76	68	175	1659	3140	
v/s Ratio Prot	c0.02			c0.86	0.53	
v/s Ratio Perm		0.00	0.12			
v/c Ratio	0.39	0.01	0.13	0.96	0.60	
Uniform Delay, d1	55.8	54.9	0.8	5.0	1.5	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	3.4	0.0	0.3	14.1	0.3	
Delay (s)	59.2	54.9	1.2	19.1	1.8	
Level of Service	E	D	A	B	A	
Approach Delay (s)	57.9			18.8	1.8	
Approach LOS	E			B	A	

Intersection Summary			
HCM 2000 Control Delay	10.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	119.7	Sum of lost time (s)	8.0
Intersection Capacity Utilization	91.5%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

River Terrace and South Cooper Mountain Road Aligned (Cumulative) Weekday PM Peak Hour
 3: Roy Rogers Road & SW Bull Mountain Rd 11/16/2015



Lane Group	WBL	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	30	349	1350	479	1357
v/c Ratio	0.22	0.51	0.83	0.76	0.81
Control Delay	49.6	22.7	27.6	40.0	10.1
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	49.6	22.7	27.6	40.0	10.1
Queue Length 50th (ft)	13	97	266	186	250
Queue Length 95th (ft)	32	160	317	#328	#532
Internal Link Dist (ft)	605		329		337
Turn Bay Length (ft)	140			300	
Base Capacity (vph)	411	690	1981	634	1673
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.07	0.51	0.68	0.76	0.81

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

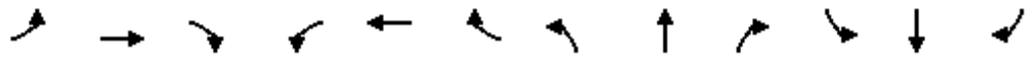
River Terrace and South Cooper Mountain Development (Cumulative) Weekday PM Peak Hour
 3: Roy Rogers Road & SW Bull Mountain Rd 11/16/2015



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	29	339	1231	79	465	1316
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0		5.0	5.0
Lane Util. Factor	1.00	1.00	0.95		1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	0.85	0.99		1.00	1.00
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1805	1583	3507		1787	1863
Flt Permitted	0.95	1.00	1.00		0.95	1.00
Satd. Flow (perm)	1805	1583	3507		1787	1863
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	30	349	1269	81	479	1357
RTOR Reduction (vph)	0	12	4	0	0	0
Lane Group Flow (vph)	30	337	1346	0	479	1357
Confl. Bikes (#/hr)				1		
Heavy Vehicles (%)	0%	2%	2%	0%	1%	2%
Turn Type	Perm	pm+ov	NA		Prot	NA
Protected Phases		1	2		1	6
Permitted Phases	8	8				
Actuated Green, G (s)	4.4	38.0	44.1		33.6	82.7
Effective Green, g (s)	4.4	38.0	44.1		33.6	82.7
Actuated g/C Ratio	0.05	0.39	0.45		0.35	0.85
Clearance Time (s)	5.0	5.0	5.0		5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	81	701	1592		618	1586
v/s Ratio Prot		c0.17	0.38		0.27	c0.73
v/s Ratio Perm	0.02	0.05				
v/c Ratio	0.37	0.48	0.85		0.78	0.86
Uniform Delay, d1	45.0	22.2	23.5		28.4	3.9
Progression Factor	1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	2.8	0.5	4.3		6.0	4.8
Delay (s)	47.9	22.7	27.8		34.4	8.7
Level of Service	D	C	C		C	A
Approach Delay (s)	24.7		27.8			15.4
Approach LOS	C		C			B

Intersection Summary			
HCM 2000 Control Delay		21.1	HCM 2000 Level of Service C
HCM 2000 Volume to Capacity ratio		0.90	
Actuated Cycle Length (s)		97.1	Sum of lost time (s) 15.0
Intersection Capacity Utilization		80.9%	ICU Level of Service D
Analysis Period (min)		15	
c Critical Lane Group			

River Terrace and South Cooper Mountain Development (Cumulative) Weekday PM Peak Hour
 4: SW River Terrace Blvd & SW Bull Mountain Rd 11/16/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (veh/h)	59	424	61	20	299	20	35	0	11	12	0	34
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
Hourly flow rate (vph)	70	505	73	24	356	24	42	0	13	14	0	40
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)		685										
pX, platoon unblocked												
vC, conflicting volume	380			577			1138	1109	541	1110	1133	368
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	380			577			1138	1109	541	1110	1133	368
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	94			98			74	100	98	92	100	94
cM capacity (veh/h)	1190			1006			159	194	545	172	188	682

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	648	404	55	55
Volume Left	70	24	42	14
Volume Right	73	24	13	40
cSH	1190	1006	192	385
Volume to Capacity	0.06	0.02	0.29	0.14
Queue Length 95th (ft)	3	1	18	8
Control Delay (s)	1.5	0.8	31.2	15.9
Lane LOS	A	A	D	C
Approach Delay (s)	1.5	0.8	31.2	15.9
Approach LOS			D	C

Intersection Summary			
Average Delay		3.3	
Intersection Capacity Utilization		58.5%	ICU Level of Service
Analysis Period (min)		15	B

River Terrace and South Cooper Mountain Development (Cumulative) Weekday PM Peak Hour
 5: SW Darwin Ave & SW Bull Mountain Rd 11/16/2015

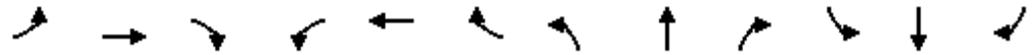


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (veh/h)	40	391	16	5	308	13	9	0	3	7	0	22
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
Hourly flow rate (vph)	48	465	19	6	367	15	11	0	4	8	0	26
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)		1141										
pX, platoon unblocked												
vC, conflicting volume	382			485			983	964	475	960	966	374
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	382			485			983	964	475	960	966	374
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	96			99			95	100	99	96	100	96
cM capacity (veh/h)	1187			1089			213	245	594	229	245	676

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	532	388	14	35
Volume Left	48	6	11	8
Volume Right	19	15	4	26
cSH	1187	1089	254	459
Volume to Capacity	0.04	0.01	0.06	0.08
Queue Length 95th (ft)	2	0	3	4
Control Delay (s)	1.1	0.2	20.0	13.5
Lane LOS	A	A	C	B
Approach Delay (s)	1.1	0.2	20.0	13.5
Approach LOS			C	B

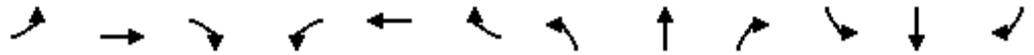
Intersection Summary			
Average Delay		1.5	
Intersection Capacity Utilization		54.4%	ICU Level of Service
Analysis Period (min)		15	A

River Terrace and South Cooper Mountain Development (Cumulative) Weekday PM Peak Hour
 6: SW Bull Mountain Rd & SW Roshak Rd & 155th Terrace 11/16/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗			↕			↕	
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	4	87	3	350	176	5	5	4	295	4	0	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	4	95	3	380	191	5	5	4	321	4	0	0
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	SB 1						
Volume Total (vph)	4	98	380	197	330	4						
Volume Left (vph)	4	0	380	0	5	4						
Volume Right (vph)	0	3	0	5	321	0						
Hadj (s)	0.50	0.01	0.52	0.00	-0.53	0.20						
Departure Headway (s)	6.7	6.2	6.1	5.6	5.0	6.3						
Degree Utilization, x	0.01	0.17	0.64	0.30	0.46	0.01						
Capacity (veh/h)	496	540	577	630	687	504						
Control Delay (s)	8.6	9.3	18.2	9.8	12.1	9.4						
Approach Delay (s)	9.2		15.3		12.1	9.4						
Approach LOS	A		C		B	A						
Intersection Summary												
Delay			13.6									
Level of Service			B									
Intersection Capacity Utilization			51.3%	ICU Level of Service								A
Analysis Period (min)			15									

River Terrace and South Cooper Mountain Development (Cumulative) Weekday PM Peak Hour
 7: SW 150th Ave & SW Bull Mountain Rd 11/16/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (veh/h)	3	302	77	70	462	7	75	1	38	4	1	1
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	3	336	86	78	513	8	83	1	42	4	1	1
Pedestrians		4						1			1	
Lane Width (ft)		12.0						10.0			10.0	
Walking Speed (ft/s)		4.0						4.0			4.0	
Percent Blockage		0						0			0	
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	522			422			1064	1064	379	1102	1103	522
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	522			422			1064	1064	379	1102	1103	522
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.3	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.7	4.0	3.3
p0 queue free %	100			93			56	99	94	97	99	100
cM capacity (veh/h)	1054			1147			189	209	665	151	198	556

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	424	599	127	7
Volume Left	3	78	83	4
Volume Right	86	8	42	1
cSH	1054	1147	249	179
Volume to Capacity	0.00	0.07	0.51	0.04
Queue Length 95th (ft)	0	3	42	2
Control Delay (s)	0.1	1.8	33.6	25.8
Lane LOS	A	A	D	D
Approach Delay (s)	0.1	1.8	33.6	25.8
Approach LOS			D	D

Intersection Summary			
Average Delay		4.8	
Intersection Capacity Utilization	66.9%		ICU Level of Service C
Analysis Period (min)		15	

River Terrace and South Cooper Mountain Development (Cumulative) Weekday PM Peak Hour
 8: SW 150th Ave & SW Danube Dr 11/16/2015



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	12	6	11	110	104	21
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.71	0.71	0.71	0.71	0.71	0.71
Hourly flow rate (vph)	17	8	15	155	146	30
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type None None						
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	347	161	176			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	347	161	176			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	97	99	99			
cM capacity (veh/h)	647	889	1412			
Direction, Lane #	EB 1	NB 1	SB 1			
Volume Total	25	170	176			
Volume Left	17	15	0			
Volume Right	8	0	30			
cSH	711	1412	1700			
Volume to Capacity	0.04	0.01	0.10			
Queue Length 95th (ft)	2	1	0			
Control Delay (s)	10.2	0.8	0.0			
Lane LOS	B	A				
Approach Delay (s)	10.2	0.8	0.0			
Approach LOS	B					
Intersection Summary						
Average Delay			1.1			
Intersection Capacity Utilization		24.9%		ICU Level of Service		A
Analysis Period (min)			15			

River Terrace and South Cooper Mountain Development (Cumulative) Weekday PM Peak Hour
 9: SW 150th Ave & SW Colorado St/SW Hawk Ridge Rd 11/16/2015

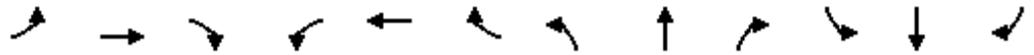


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (veh/h)	8	0	4	3	0	4	7	109	6	5	92	13
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74
Hourly flow rate (vph)	11	0	5	4	0	5	9	147	8	7	124	18
Pedestrians					1							
Lane Width (ft)					12.0							
Walking Speed (ft/s)					4.0							
Percent Blockage					0							
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	322	322	133	323	327	152	142			156		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	322	322	133	323	327	152	142			156		
tC, single (s)	7.1	6.5	6.2	7.4	6.5	6.2	4.1			4.3		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.8	4.0	3.3	2.2			2.4		
p0 queue free %	98	100	99	99	100	99	99			99		
cM capacity (veh/h)	625	591	921	565	588	898	1453			1320		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	16	9	165	149
Volume Left	11	4	9	7
Volume Right	5	5	8	18
cSH	700	717	1453	1320
Volume to Capacity	0.02	0.01	0.01	0.01
Queue Length 95th (ft)	1	1	0	0
Control Delay (s)	10.3	10.1	0.5	0.4
Lane LOS	B	B	A	A
Approach Delay (s)	10.3	10.1	0.5	0.4
Approach LOS	B	B		

Intersection Summary			
Average Delay		1.2	
Intersection Capacity Utilization	18.8%		ICU Level of Service A
Analysis Period (min)		15	

River Terrace and South Cooper Mountain Development (Cumulative) Weekday PM Peak Hour
 10: SW 150th Ave & SW Beef Bend Rd 11/16/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (veh/h)	25	286	0	0	321	101	0	0	0	57	0	41
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Hourly flow rate (vph)	29	336	0	0	378	119	0	0	0	67	0	48
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	496			336			881	892	336	832	832	437
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	496			336			881	892	336	832	832	437
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	97			100			100	100	100	76	100	92
cM capacity (veh/h)	1078			1234			244	276	710	281	299	624

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	366	496	0	115
Volume Left	29	0	0	67
Volume Right	0	119	0	48
cSH	1078	1234	1700	365
Volume to Capacity	0.03	0.00	0.00	0.32
Queue Length 95th (ft)	1	0	0	21
Control Delay (s)	0.9	0.0	0.0	19.4
Lane LOS	A		A	C
Approach Delay (s)	0.9	0.0	0.0	19.4
Approach LOS			A	C

Intersection Summary			
Average Delay		2.6	
Intersection Capacity Utilization	48.1%		ICU Level of Service A
Analysis Period (min)		15	

River Terrace and South Cooper Mountain Development (Cumulative) Weekday PM Peak Hour
 11: Roy Rogers Road & Roy Rogers Rd Site Access

11/16/2015

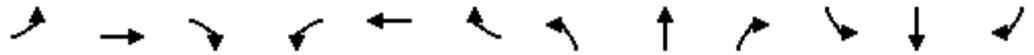


Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations		↗	↖	↑	↑↓	
Volume (veh/h)	9	16	36	1540	1815	13
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	9	16	37	1588	1871	13
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage (veh)						
Upstream signal (ft)				1055		
pX, platoon unblocked	0.12					
vC, conflicting volume	3540	942	1885			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	18067	942	1885			
tC, single (s)	6.8	6.9	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	0	94	88			
cM capacity (veh/h)	0	268	322			

Direction, Lane #	EB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	26	37	1588	1247	637
Volume Left	9	37	0	0	0
Volume Right	16	0	0	0	13
cSH	0	322	1700	1700	1700
Volume to Capacity	Err	0.12	0.93	0.73	0.37
Queue Length 95th (ft)	Err	6	0	0	0
Control Delay (s)	Err	17.6	0.0	0.0	0.0
Lane LOS	F	C			
Approach Delay (s)	Err	0.4		0.0	
Approach LOS	F				

Intersection Summary					
Average Delay			73.1		
Intersection Capacity Utilization			Err%	ICU Level of Service	H
Analysis Period (min)			15		

River Terrace and South Cooper Mountain Development (Cumulative) Weekday PM Peak Hour
 12: NW RT Scholls Ferry Rd Site Access/East School Site Access & Scholls Ferry Road
 11/16/2015

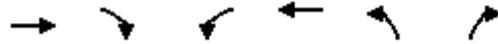


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↗		↖	↕	↗	↖		↗			↖
Volume (veh/h)	0	1004	18	53	810	5	8	0	32	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	0	1068	19	56	862	5	9	0	34	0	0	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)		750			924							
pX, platoon unblocked	0.95			0.24			0.26	0.26	0.24	0.26	0.26	0.95
vC, conflicting volume	867			1087			1621	2057	1078	2086	2062	431
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	761			0			1282	2950	0	3060	2967	303
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			86			71	100	87	100	100	100
cM capacity (veh/h)	820			389			29	3	259	1	3	666

Direction, Lane #	EB 1	WB 1	WB 2	WB 3	WB 4	NB 1	NB 2	SB 1
Volume Total	1087	56	431	431	5	9	34	0
Volume Left	0	56	0	0	0	9	0	0
Volume Right	19	0	0	0	5	0	34	0
cSH	1700	389	1700	1700	1700	29	259	1700
Volume to Capacity	0.64	0.14	0.25	0.25	0.00	0.29	0.13	0.00
Queue Length 95th (ft)	0	8	0	0	0	15	7	0
Control Delay (s)	0.0	15.8	0.0	0.0	0.0	174.8	21.0	0.0
Lane LOS		C				F	C	A
Approach Delay (s)	0.0	1.0				51.7		0.0
Approach LOS						F		A

Intersection Summary		
Average Delay		1.5
Intersection Capacity Utilization	63.9%	ICU Level of Service
Analysis Period (min)		15
		B

River Terrace and South Cooper Mountain Development (Cumulative) Weekday PM Peak Hour
 13: River Terrace Blvd & Scholls Ferry Road 11/16/2015



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑	↑	↓	↑↑	↓	↑
Volume (veh/h)	1172	99	81	1182	57	48
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97
Hourly flow rate (vph)	1208	102	84	1219	59	49
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	Raised			Raised		
Median storage veh	1			1		
Upstream signal (ft)	1116			852		
pX, platoon unblocked	0.90			0.81	0.90	
vC, conflicting volume	1310			1985	604	
vC1, stage 1 conf vol				1208		
vC2, stage 2 conf vol				776		
vCu, unblocked vol	1123			1184	338	
tC, single (s)	4.1			6.8	6.9	
tC, 2 stage (s)				5.8		
tF (s)	2.2			3.5	3.3	
p0 queue free %	85			74	92	
cM capacity (veh/h)	567			226	597	

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	NB 2
Volume Total	604	604	102	84	609	609	59	49
Volume Left	0	0	0	84	0	0	59	0
Volume Right	0	0	102	0	0	0	0	49
cSH	1700	1700	1700	567	1700	1700	226	597
Volume to Capacity	0.36	0.36	0.06	0.15	0.36	0.36	0.26	0.08
Queue Length 95th (ft)	0	0	0	8	0	0	16	4
Control Delay (s)	0.0	0.0	0.0	12.4	0.0	0.0	26.5	11.6
Lane LOS				B				B
Approach Delay (s)	0.0			0.8			19.7	
Approach LOS							C	

Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	50.2%	ICU Level of Service	A
Analysis Period (min)	15		

River Terrace and South Cooper Mountain Development (Cumulative) Weekday PM Peak Hour
 14: SW 163rd Ave & SW Bull Mountain Rd 11/16/2015

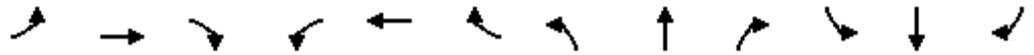


Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↻			↻	↻	
Volume (veh/h)	148	33	22	195	19	13
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.25	0.25	0.25	0.25	0.25	0.25
Hourly flow rate (vph)	592	132	88	780	76	52
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			724		1614	658
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			724		1614	658
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			90		27	89
cM capacity (veh/h)			888		104	468

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	724	868	128
Volume Left	0	88	76
Volume Right	132	0	52
cSH	1700	888	152
Volume to Capacity	0.43	0.10	0.84
Queue Length 95th (ft)	0	5	89
Control Delay (s)	0.0	2.5	93.9
Lane LOS		A	F
Approach Delay (s)	0.0	2.5	93.9
Approach LOS			F

Intersection Summary			
Average Delay		8.3	
Intersection Capacity Utilization		34.6%	ICU Level of Service A
Analysis Period (min)		15	

River Terrace and South Cooper Mountain Development (Cumulative) Weekday PM Peak Hour
 15: SW 161st Ave & SW Bull Mountain Rd 11/16/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (veh/h)	0	128	33	22	197	0	20	0	13	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Hourly flow rate (vph)	0	512	132	88	788	0	80	0	52	0	0	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	788			644			1542	1542	578	1594	1608	788
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	788			644			1542	1542	578	1594	1608	788
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			91			9	100	90	100	100	100
cM capacity (veh/h)	840			951			88	105	519	73	96	394

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	644	876	132	0
Volume Left	0	88	80	0
Volume Right	132	0	52	0
cSH	840	951	131	1700
Volume to Capacity	0.00	0.09	1.01	0.00
Queue Length 95th (ft)	0	5	114	0
Control Delay (s)	0.0	2.3	145.9	0.0
Lane LOS		A	F	A
Approach Delay (s)	0.0	2.3	145.9	0.0
Approach LOS			F	A

Intersection Summary			
Average Delay		12.9	
Intersection Capacity Utilization		33.7%	ICU Level of Service
Analysis Period (min)		15	A

River Terrace and South Cooper Mountain Development (Cumulative) Weekday PM Peak Hour
 101: 175th Avenue & SW Kemmer Rd 11/16/2015

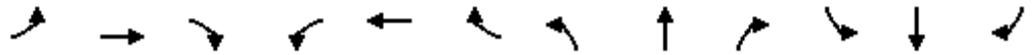


Lane Group	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	418	168	212	445	32	615
v/c Ratio	0.96	0.68	0.90	0.55	0.28	0.98
Control Delay	73.0	59.3	87.2	29.0	58.1	69.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	73.0	59.3	87.2	29.0	58.1	69.9
Queue Length 50th (ft)	174	73	100	162	15	285
Queue Length 95th (ft)	#323	120	#202	256	37	#471
Internal Link Dist (ft)	282	680		2741		622
Turn Bay Length (ft)			100		100	
Base Capacity (vph)	436	335	236	813	142	628
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.96	0.50	0.90	0.55	0.23	0.98

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

River Terrace and South Cooper Mountain Drive Interchange (Cumulative) Weekday PM Peak Hour
 101: 175th Avenue & SW Kemmer Rd 11/16/2015



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↗	↘		↗	↘	
Volume (vph)	15	152	234	31	102	29	204	397	30	31	563	28
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frbp, ped/bikes		1.00			0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.92			0.98		1.00	0.99		1.00	0.99	
Flt Protected		1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1737			1788		1805	1846		1805	1887	
Flt Permitted		1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1737			1788		1805	1846		1805	1887	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	16	158	244	32	106	30	212	414	31	32	586	29
RTOR Reduction (vph)	0	42	0	0	7	0	0	2	0	0	1	0
Lane Group Flow (vph)	0	376	0	0	161	0	212	443	0	32	614	0
Confl. Peds. (#/hr)	3					3						
Heavy Vehicles (%)	0%	0%	1%	5%	2%	0%	0%	2%	0%	0%	0%	0%
Turn Type	Split	NA		Split	NA		Prot	NA		Prot	NA	
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)		26.0			15.3		15.0	50.3		4.9	40.2	
Effective Green, g (s)		26.0			15.3		15.0	50.3		4.9	40.2	
Actuated g/C Ratio		0.22			0.13		0.13	0.43		0.04	0.35	
Clearance Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		387			234		232	797		75	651	
v/s Ratio Prot		c0.22			c0.09		c0.12	0.24		0.02	c0.33	
v/s Ratio Perm												
v/c Ratio		0.97			0.69		0.91	0.56		0.43	0.94	
Uniform Delay, d1		44.9			48.3		50.1	24.7		54.4	37.0	
Progression Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		38.1			8.2		36.3	0.8		3.9	22.1	
Delay (s)		83.0			56.5		86.5	25.6		58.3	59.2	
Level of Service		F			E		F	C		E	E	
Approach Delay (s)		83.0			56.5		45.2			59.1		
Approach LOS		F			E		D			E		

Intersection Summary		
HCM 2000 Control Delay	59.3	HCM 2000 Level of Service
HCM 2000 Volume to Capacity ratio	0.90	E
Actuated Cycle Length (s)	116.5	Sum of lost time (s)
Intersection Capacity Utilization	79.5%	20.0
Analysis Period (min)	15	ICU Level of Service
c Critical Lane Group		D

River Terrace and South Cooper Mountain Development (Cumulative) Weekday PM Peak Hour
 103: 175th Avenue & N Access Road 11/16/2015



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	30	26	611	51	46	843
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	32	28	650	54	49	897
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (ft)			648			
pX, platoon unblocked	0.72	0.72			0.72	
vC, conflicting volume	1672	677			704	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1740	351			389	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	51	94			94	
cM capacity (veh/h)	65	499			846	

Direction, Lane #	WB 1	WB 2	NB 1	SB 1	SB 2
Volume Total	32	28	704	49	897
Volume Left	32	0	0	49	0
Volume Right	0	28	54	0	0
cSH	65	499	1700	846	1700
Volume to Capacity	0.49	0.06	0.41	0.06	0.53
Queue Length 95th (ft)	31	3	0	3	0
Control Delay (s)	104.5	12.6	0.0	9.5	0.0
Lane LOS	F	B		A	
Approach Delay (s)	61.8		0.0	0.5	
Approach LOS	F				

Intersection Summary					
Average Delay			2.4		
Intersection Capacity Utilization			54.4%	ICU Level of Service	A
Analysis Period (min)			15		

River Terrace and South Cooper Mountain Development (Cumulative) Weekday PM Peak Hour
 104: 175th Avenue & School Site Access (175th)/S Access Road 11/16/2015



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	34	51	73	28	45	771	49	880
v/c Ratio	0.16	0.11	0.35	0.05	0.20	0.65	0.22	0.38
Control Delay	29.4	0.5	32.9	0.2	32.5	14.9	32.6	9.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.4	0.5	32.9	0.2	32.5	14.9	32.6	9.0
Queue Length 50th (ft)	8	0	18	0	11	148	12	68
Queue Length 95th (ft)	25	0	45	0	32	#292	34	114
Internal Link Dist (ft)		464		616		651		354
Turn Bay Length (ft)					100		100	
Base Capacity (vph)	629	873	616	909	291	1272	291	2456
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.05	0.06	0.12	0.03	0.15	0.61	0.17	0.36

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

River Terrace and South Cooper Mountain Development (Cumulative) Weekday PM Peak Hour
 104: 175th Avenue & School Site Access (175th)/S Access Road 11/16/2015



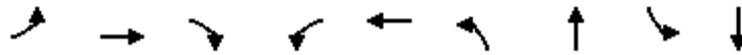
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗		↖	↗		↖	↗	↖
Volume (vph)	32	0	48	69	0	26	42	604	120	46	799	28
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	0.95	
Frt	1.00	0.85		1.00	0.85		1.00	0.98		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1805	1615		1805	1615		1805	1822		1805	3523	
Flt Permitted	0.74	1.00		0.72	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1404	1615		1375	1615		1805	1822		1805	3523	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	34	0	51	73	0	28	45	643	128	49	850	30
RTOR Reduction (vph)	0	45	0	0	25	0	0	6	0	0	2	0
Lane Group Flow (vph)	34	6	0	73	3	0	45	765	0	49	878	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	2%	0%
Turn Type	Perm	NA		Perm	NA		Prot	NA		Prot	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8								
Actuated Green, G (s)	7.3	7.3		7.3	7.3		4.0	38.3		4.1	38.4	
Effective Green, g (s)	7.3	7.3		7.3	7.3		4.0	38.3		4.1	38.4	
Actuated g/C Ratio	0.11	0.11		0.11	0.11		0.06	0.59		0.06	0.59	
Clearance Time (s)	5.0	5.0		5.0	5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	158	182		155	182		111	1078		114	2090	
v/s Ratio Prot		0.00			0.00		0.02	c0.42		c0.03	0.25	
v/s Ratio Perm	0.02			c0.05								
v/c Ratio	0.22	0.03		0.47	0.02		0.41	0.71		0.43	0.42	
Uniform Delay, d1	26.1	25.6		26.9	25.5		29.2	9.3		29.2	7.1	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.7	0.1		2.3	0.0		2.4	2.2		2.6	0.1	
Delay (s)	26.8	25.6		29.1	25.6		31.6	11.5		31.8	7.3	
Level of Service	C	C		C	C		C	B		C	A	
Approach Delay (s)		26.1			28.1			12.6			8.6	
Approach LOS		C			C			B			A	

Intersection Summary

HCM 2000 Control Delay	12.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	64.7	Sum of lost time (s)	15.0
Intersection Capacity Utilization	57.9%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

River Terrace and South Cooper Mountain Development (Cumulative) Weekday PM Peak Hour
 106: SW Barrows Rd/SW Loon Dr & Scholls Ferry Road 11/16/2015

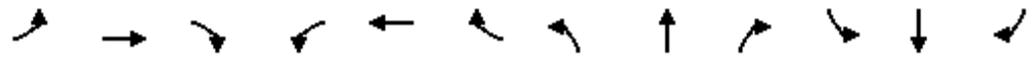


Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	38	877	383	82	1160	276	94	65	43
v/c Ratio	0.16	0.59	0.24	0.26	0.74	0.60	0.21	0.38	0.24
Control Delay	11.6	21.8	0.4	12.3	23.7	41.3	28.0	51.5	40.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	11.6	21.8	0.4	12.3	23.7	41.3	28.0	51.5	40.0
Queue Length 50th (ft)	6	126	0	13	184	95	21	23	12
Queue Length 95th (ft)	17	195	0	31	280	#205	61	61	39
Internal Link Dist (ft)		772			903		399		653
Turn Bay Length (ft)	165		500	300		215		125	
Base Capacity (vph)	416	2548	1581	469	2492	466	462	451	465
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.09	0.34	0.24	0.17	0.47	0.59	0.20	0.14	0.09

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

River Terrace and South Cooper Mountain Development (Cumulative) Weekday PM Peak Hour
 106: SW Barrows Rd/SW Loon Dr & Scholls Ferry Road 11/16/2015

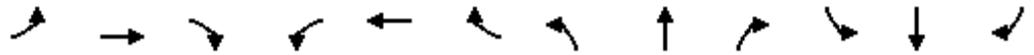


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↘	↑↑	↗	↘	↑↑		↘	↗		↘	↗	
Volume (vph)	36	824	360	77	994	97	259	51	38	61	31	9
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0	4.0	4.0	5.0		5.0	5.0		4.0	4.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		1.00	1.00		1.00	1.00	
Frbp, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	0.99		1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	0.94		1.00	0.97	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1805	3574	1581	1805	3491		1805	1726		1805	1834	
Flt Permitted	0.12	1.00	1.00	0.20	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	229	3574	1581	387	3491		1805	1726		1805	1834	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	38	877	383	82	1057	103	276	54	40	65	33	10
RTOR Reduction (vph)	0	0	0	0	6	0	0	18	0	0	9	0
Lane Group Flow (vph)	38	877	383	82	1154	0	276	76	0	65	34	0
Confl. Peds. (#/hr)	1		1	1		1			9	9		
Confl. Bikes (#/hr)			1			1						
Heavy Vehicles (%)	0%	1%	0%	0%	2%	0%	0%	0%	5%	0%	0%	0%
Turn Type	pm+pt	NA	Free	pm+pt	NA		Split	NA		Split	NA	
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases	2		Free	6								
Actuated Green, G (s)	41.3	37.6	89.4	44.7	39.3		22.3	22.3		6.1	6.1	
Effective Green, g (s)	41.3	37.6	89.4	44.7	39.3		22.3	22.3		6.1	6.1	
Actuated g/C Ratio	0.46	0.42	1.00	0.50	0.44		0.25	0.25		0.07	0.07	
Clearance Time (s)	4.0	5.0		4.0	5.0		5.0	5.0		4.0	4.0	
Vehicle Extension (s)	2.6	3.1		2.4	3.1		1.4	1.4		1.4	1.4	
Lane Grp Cap (vph)	171	1503	1581	279	1534		450	430		123	125	
v/s Ratio Prot	0.01	0.25		0.02	c0.33		c0.15	0.04		c0.04	0.02	
v/s Ratio Perm	0.09		c0.24	0.13								
v/c Ratio	0.22	0.58	0.24	0.29	0.75		0.61	0.18		0.53	0.27	
Uniform Delay, d1	15.4	19.9	0.0	13.1	21.0		29.7	26.3		40.3	39.5	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.5	0.6	0.4	0.4	2.1		1.7	0.1		1.9	0.4	
Delay (s)	15.9	20.5	0.4	13.5	23.1		31.5	26.4		42.1	40.0	
Level of Service	B	C	A	B	C		C	C		D	D	
Approach Delay (s)		14.4			22.5			30.2			41.3	
Approach LOS		B			C			C			D	

Intersection Summary		
HCM 2000 Control Delay	20.6	HCM 2000 Level of Service C
HCM 2000 Volume to Capacity ratio	0.68	
Actuated Cycle Length (s)	89.4	Sum of lost time (s) 18.0
Intersection Capacity Utilization	67.4%	ICU Level of Service C
Analysis Period (min)	15	

c Critical Lane Group

River Terrace and South Cooper Mountain Development (Cumulative) Weekday PM Peak Hour
 107: SW Roshak Rd/Driveway & SW Barrows Rd 11/16/2015

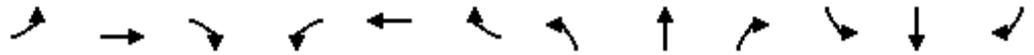


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (veh/h)	8	367	93	56	296	8	46	6	62	9	3	6
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	9	399	101	61	322	9	50	7	67	10	3	7
Pedestrians		1			6						6	
Lane Width (ft)		12.0			12.0						12.0	
Walking Speed (ft/s)		4.0			4.0						4.0	
Percent Blockage		0			1						1	
Right turn flare (veh)												
Median type		None			None							
Median storage (veh)												
Upstream signal (ft)		479										
pX, platoon unblocked												
vC, conflicting volume	336			500			924	925	455	997	971	333
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	336			500			924	925	455	997	971	333
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	99			94			79	97	89	95	99	99
cM capacity (veh/h)	1228			1075			234	253	606	184	237	709

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	509	391	124	20
Volume Left	9	61	50	10
Volume Right	101	9	67	7
cSH	1228	1075	353	257
Volume to Capacity	0.01	0.06	0.35	0.08
Queue Length 95th (ft)	0	3	25	4
Control Delay (s)	0.2	1.8	20.6	20.2
Lane LOS	A	A	C	C
Approach Delay (s)	0.2	1.8	20.6	20.2
Approach LOS			C	C

Intersection Summary			
Average Delay		3.6	
Intersection Capacity Utilization		63.7%	ICU Level of Service B
Analysis Period (min)		15	

River Terrace and South Cooper Mountain Development (Cumulative) Weekday PM Peak Hour
 108: SW Roshak Rd & SW Luke Ln 11/16/2015



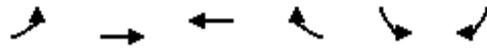
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Volume (veh/h)	6	0	6	2	0	1	12	107	3	2	139	11
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Hourly flow rate (vph)	7	0	7	2	0	1	15	132	4	2	172	14
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage (veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	348	349	178	354	354	134	185			136		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	348	349	178	354	354	134	185			136		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	99	100	99	100	100	100	99			100		
cM capacity (veh/h)	604	571	870	594	568	920	1402			1461		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	15	4	151	188
Volume Left	7	2	15	2
Volume Right	7	1	4	14
cSH	713	673	1402	1461
Volume to Capacity	0.02	0.01	0.01	0.00
Queue Length 95th (ft)	1	0	1	0
Control Delay (s)	10.2	10.4	0.8	0.1
Lane LOS	B	B	A	A
Approach Delay (s)	10.2	10.4	0.8	0.1
Approach LOS	B	B		

Intersection Summary			
Average Delay		0.9	
Intersection Capacity Utilization	23.2%		ICU Level of Service A
Analysis Period (min)	15		

River Terrace and South Cooper Mountain Development (Cumulative) Weekday PM Peak Hour
 109: Scholls Ferry Road & West School Site Access

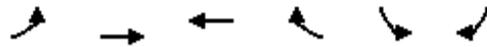
11/16/2015



Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Group Flow (vph)	1	1049	840	30	38	1
v/c Ratio	0.00	0.66	0.54	0.02	0.21	0.01
Control Delay	2.0	6.6	6.9	2.1	34.5	25.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	2.0	6.6	6.9	2.1	34.5	25.0
Queue Length 50th (ft)	0	123	79	0	11	0
Queue Length 95th (ft)	1	242	258	6	28	3
Internal Link Dist (ft)		611	670		968	
Turn Bay Length (ft)	50					
Base Capacity (vph)	572	1599	1478	1287	651	665
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.00	0.66	0.57	0.02	0.06	0.00

Intersection Summary

River Terrace and South Cooper Mountain Development (Cumulative) Weekday PM Peak Hour
 109: Scholls Ferry Road & West School Site Access 11/16/2015



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	1	986	790	28	36	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1805	1863	1863	1615	1583	1615
Flt Permitted	0.24	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	457	1863	1863	1615	1583	1615
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	1	1049	840	30	38	1
RTOR Reduction (vph)	0	0	0	8	0	1
Lane Group Flow (vph)	1	1049	840	22	38	0
Heavy Vehicles (%)	0%	2%	2%	0%	14%	0%
Turn Type	pm+pt	NA	NA	Perm	Prot	Perm
Protected Phases	5	2	6		4	
Permitted Phases	2			6		4
Actuated Green, G (s)	57.4	57.4	51.5	51.5	4.3	4.3
Effective Green, g (s)	57.4	57.4	51.5	51.5	4.3	4.3
Actuated g/C Ratio	0.80	0.80	0.72	0.72	0.06	0.06
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	382	1491	1338	1160	94	96
v/s Ratio Prot	0.00	c0.56	0.45		c0.02	
v/s Ratio Perm	0.00			0.01		0.00
v/c Ratio	0.00	0.70	0.63	0.02	0.40	0.00
Uniform Delay, d1	3.6	3.3	5.2	2.9	32.5	31.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.0	1.5	0.9	0.0	2.8	0.0
Delay (s)	3.6	4.8	6.1	2.9	35.3	31.7
Level of Service	A	A	A	A	D	C
Approach Delay (s)		4.8	6.0		35.2	
Approach LOS		A	A		D	

Intersection Summary				
HCM 2000 Control Delay		5.9	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio		0.74		
Actuated Cycle Length (s)		71.7	Sum of lost time (s)	15.0
Intersection Capacity Utilization		63.6%	ICU Level of Service	B
Analysis Period (min)		15		

c Critical Lane Group

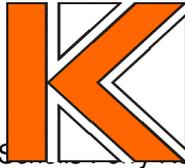
Appendix C Proportional Share Analysis

Development	Size	AM Peak Hour Trips	PM Peak Hour Trips	Avg Peak Hour Trips	% of Avg. Peak Hour Trips to 2016 total trips	% of Avg. Peak Hour Trips to total added trips	Full Share of \$2.5 Million Improvement at 175th/Kemmer	1/3 of Full Share 175th/Kemmer Improvements
Beaverton School District	1,700	272	84	178	10.0%	47.4%	1,185,876	395,292
South Cooper Mountain Heights	722	86	107	97	5.4%	25.7%	642,905	214,302
River Terrace Northwest	175	12	15	14	0.8%	3.6%	89,940	29,980
River Terrace East	286	20	25	23	1.3%	6.0%	149,900	49,967
West River Terrace	138	9	11	10	0.6%	2.7%	66,622	22,207
Roshak Ridge	244	16	20	18	1.0%	4.8%	119,920	39,973
South River Terrace	190	12	16	14	0.8%	3.7%	93,271	31,090
Bull Mountain Dickson	82	7	8	8	0.4%	2.0%	49,967	16,656
Metropolitan Land Group	173	13	18	15	0.9%	4.1%	101,599	33,866

Appendix D Turn Lane Warrants

Left-Turn Lane Warrant Analysis

Project #:
 Project Name: Cumulative Impact Analysis
 Analyst: axm
 Intersection: E Scholls Ferry Rd Site Access/S
 Scenario: 2016 Total PM Peak Hour
 Date: 11/16/2015
 File: K:\H_Portland\projfile\11057 - West Bull Mountain Concept Plan Review\LT and RT warrant\[Cumulative_LTwarrant_Eas

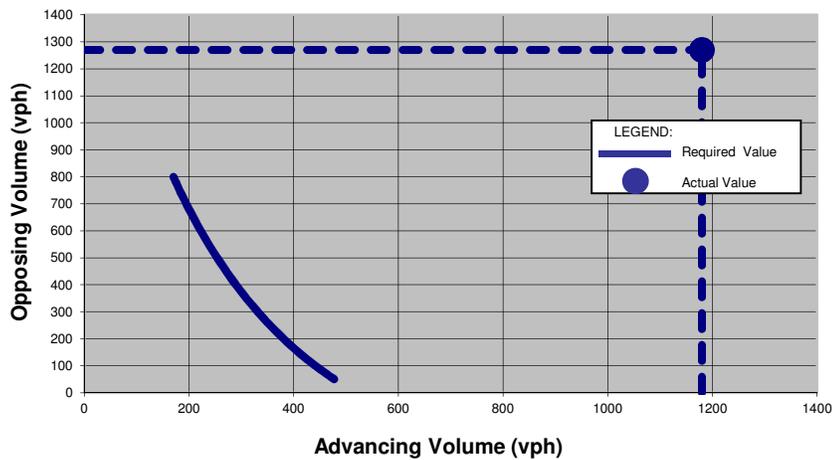


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 610 SW Alder, Suite 700
 Portland, Oregon 97205
 (503) 228-5230
 Fax: (503) 273-8169

Input Data:

Advancing Volume (vph) =	1180
Left-turning Vehicles (vph) =	80
Opposing Volume (vph) =	1270
Speed (mph) =	45
Number of Approach Lanes =	2 (not applicable for two lanes)
% Left-Turning Vehicles	7%
Critical Gap (sec) =	6
Maneuver Time (sec) =	4
Exit Time (sec) =	1.9
Utilization Factor =	0.015

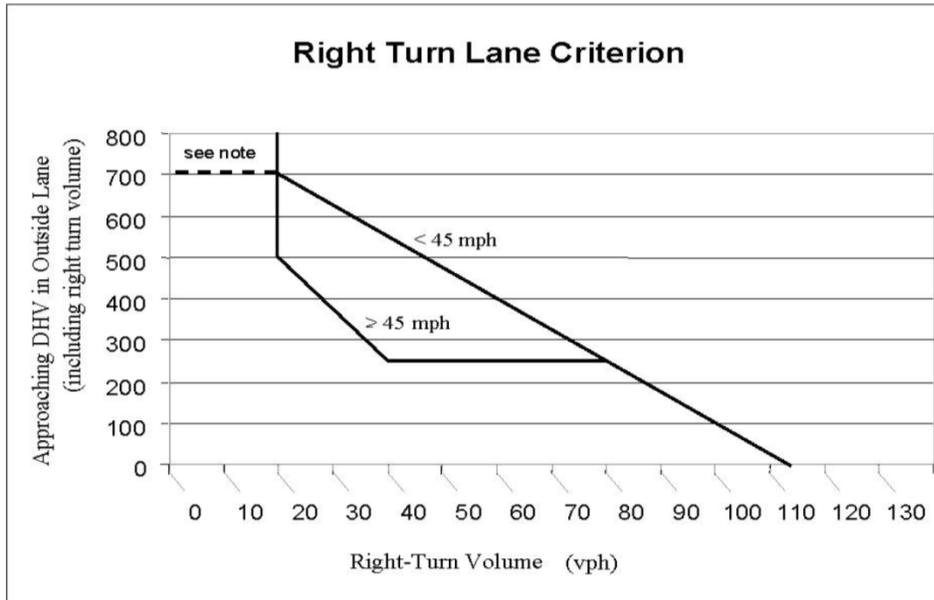
Left-Turn Lane Warrant Analysis Results



* Based on *Volume Warrants for Left-Turn Storage Lanes at Unsignalized Grade Intersections* (D. Harmelink)

Right-turn Lane Criteria at East Scholls Ferry Rd (East River Terrace) Site Access

Right Turn Lane Criterion – ODOT Analysis Procedures Manual



Note: If there is no right turn lane, a shoulder needs to be provided. If this intersection is in a rural area and is a connection to a public street, a right turn lane is needed.

Intersection	Speed Limit (mph)	Greater of AM or PM Peak Right-Turn Volume (vph)	Approaching DHV in Outside Lane (vph)	Right-Turn Lane Criteria Met?
SW Scholls Ferry Rd/Scholls Ferry Rd Site Access (EB)	45	100(PM)	685	Yes