Exhibit 23

transpogroup
WHAT TRANSPORTATION CAN BE.

MEMORANDUM

Date:	August 30, 2018	**TG:**	1.18029.00
To:	Christi Amrine – City of Mill Creek		
From:	Mike Swenson PE, PTOE & Kassi Leingang PE – Transpo Group		
cc:	Ryan Patterson and Carl Dominguez – Vintage Housing		
Subject:	The Farm at Mill Creek – Traffic Impact Analysis		

This Transportation Impact Analysis (TIA) summarizes the potential transportation-related impacts associated with the proposed Farm at Mill Creek development located in the East Gateway Urban Village (EGUV) in Mill Creek, Washington. This analysis summarizes the proposed development, estimates the project's weekday PM peak hour trip generation, distribution and assignment of trips to the roadway network, reviews the proposed parking supply and estimated demand, and estimates the project's transportation impact fee and mitigation offer to Snohomish County. This scope is consistent with the Vintage at Mill Creek TIA[1] and satisfies the TIA requirements for projects developed in the EGUV area.

Project Description

The proposed Farm at Mill Creek development would construct apartments and commercial space within the EGUV on the Penny Creek Partners Parcel evaluated in the September 2012 *Traffic Analysis and Development Standards* which is located south of the 39th Avenue SE/132nd Street SE/State Route (SR) 96. The project would construct 298 apartment units and up to 26 live/work units totaling approximately 34,800 square feet (sf) as well as approximately 13,700 sf of retail, 41,200 sf of office, 13,700 sf of restaurant and a 16,600 sf medical office, and include a total of 1,053 parking stalls (430 spaces surface parking stalls and 623 spaces in parking garages). Figure 1 shows a preliminary site plan, project access, and adjacent roadways.

Figure 1 – Preliminary Site Plan

[1] *Vintage at Mill Creek – Traffic Impact Analysis* (Transpo Group, 2016).

As shown in Figure 1, two connections to 32nd Street SE (SR 96) are proposed. The eastern access point exists and was constructed with the first phase of development. The western access would be constructed with the proposed project. The primary access will be provided as a new south leg of the existing 39th Avenue SE signalized intersection. A concept of the updated channelization at the 39th Avenue SE/132nd Street SE (SR 96) is shown in Figure 2 below. As shown, the changes to the channelization at the intersection includes the addition of a westbound left-turn lane, an eastbound right-turn lane, a northbound left, through, and right-turn lane, and modifying the southbound right-turn lane to a shared southbound through right turn lane. This configuration is consistent with the recommendations included in the original study completed for the site by the City.

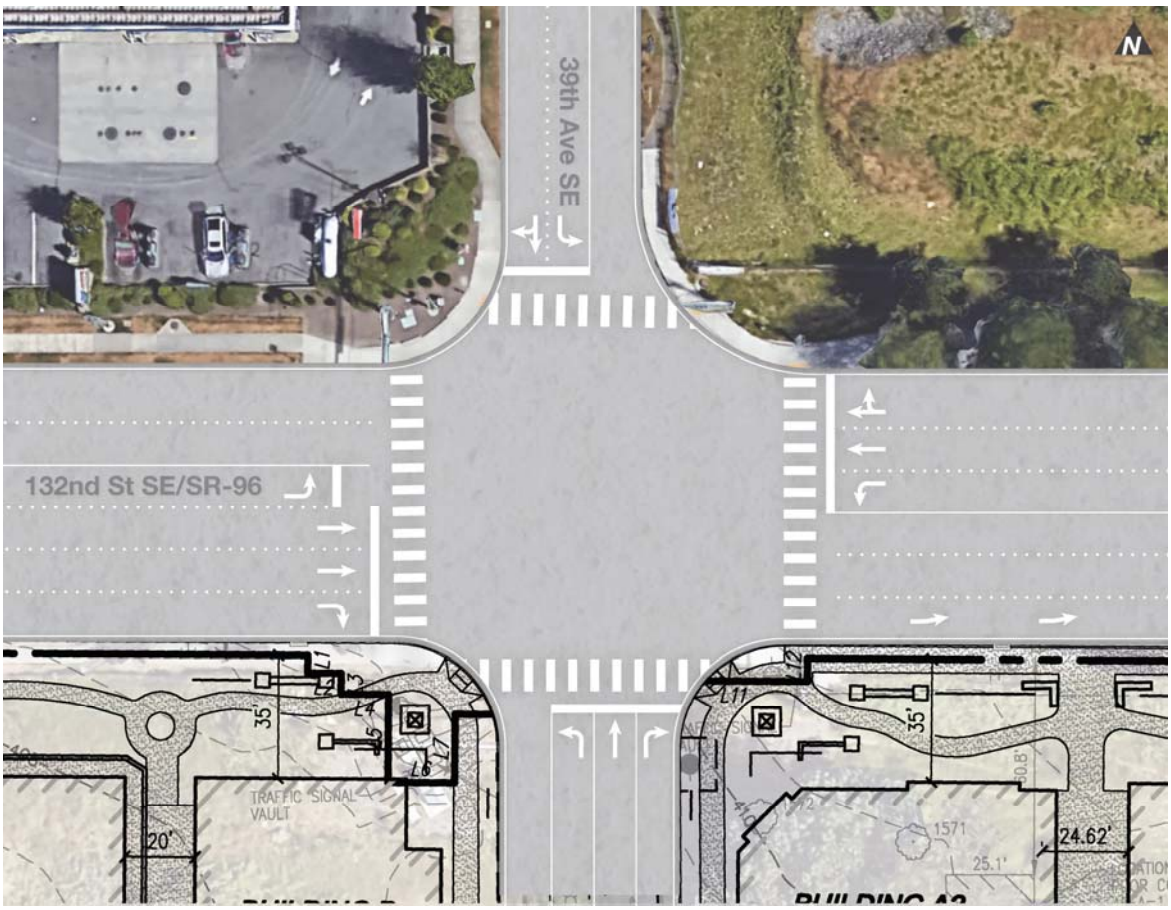


Figure 2 –39th Avenue SE/132nd Street SE (SR 96) channelization Concept

A secondary access will be provided along the eastern side of the site via an existing stop-controlled access along 132nd Street SE with access limited to right-in/right-out (RIRO) movements. Additional accesses with internal roadway connections to the site are provided at the 44th Avenue SE/132nd Street SE and Seattle Hill Road/136th Street SE intersections.

Trip Generation

Consistent with the EGUV TIA requirements, project trip generation estimates were developed for the Farm at Mill Creek based on the preceding trip generation study and information contained in the Institute of Transportation Engineers' (ITE) *Trip Generation* (10th Edition, 2017) and *Trip Generation Handbook* (3rd Edition, 2017). Trip Generation is a nationally recognized and locally accepted method for determining trip generation for private and public developments. The ITE land uses assumed in the analysis include Multifamily Housing (Mid-Rise) (LU #221), Medical Office (LU #720), General Office (LU #710), High-Turnover Sit-Down Restaurant (LU #932), and Shopping

Center (LU #820).[2] No credit was taken for the removal of the existing single-family resident located on the project site. In addition, a deduction of 25 percent to reflect trips that travel between uses within the EGUV site was also deducted consistent with previous studies.[3] Table 1 summarizes the estimated trip generation for the site.

Table 1. Weekday Trip Generation

Land Use	Size	Gross Trips[1]	Internal Trips[2]	Pass-by Trips[3]	Project Trips		
					In	Out	Total
Weekday Daily							
Multifamily Housing (LU #221)	298 units	1,622	406	0	608	608	1,216
Live/Work (LU #221 & LU #820)	26 units	142	36	0	53	53	106
	34.8 ksf	1,314	328	336	325	325	650
Retail (LU #820)	13.7 ksf	518	130	132	128	128	256
Office (LU #710)	41.2 ksf	402	100	0	151	151	302
Restaurant (LU #932)	13.7 ksf	1,536	384	496	328	328	656
Medical Office (LU #720)	16.6 ksf	578	144	0	217	217	434
Total Trips		***6,112***	***1,528***	***964***	***1,810***	***1,810***	***3,620***
Weekday AM Peak Hour							
Multifamily Housing (LU #221)	298 units	107	28	0	21	58	79
Live/Work (LU #221 & LU #820)	26 units	9	2	0	2	5	7
	34.8 ksf	33	9	8	11	5	16
Retail (LU #820)	13.7 ksf	13	2	4	5	2	7
Office (LU #710)	41.2 ksf	48	12	0	31	5	36
Restaurant (LU #932)	13.7 ksf	136	34	44	35	23	58
Medical Office (LU #720)	16.6 ksf	46	11	0	28	7	35
Total Trips		**392**	**98**	**56**	**133**	**105**	**238**
Weekday PM Peak Hour							
Multifamily Housing (LU #221)	298 units	131	33	0	60	38	98
Live/Work (LU #221 & LU #820)	26 units	11	3	0	5	3	8
	34.8 ksf	133	33	34	31	35	66
Retail (LU #820)	13.7 ksf	52	12	14	13	13	26
Office (LU #710)	41.2 ksf	47	12	0	6	29	35
Restaurant (LU #932)	13.7 ksf	134	34	44	40	16	56
Medical Office (LU #720)	16.6 ksf	57	14	0	12	31	43
Total Trips		**565**	**141**	**92**	**167**	**165**	**332**

Notes: ksf = one thousand square-feet

1. Trips based on ITE *Trip Generation Manual* (10th Edition, 2017).
2. Internal trip reduction of 25 percent per East Gateway Urban Village (EGUV) TIA requirements (page A2) and consistent with the *Vintage at Mill Creek TIA.*
3. Pass-by trip rates for retail uses are for ITE *Trip Generation Handbook* (3rd Edition, 2017). Weekday PM peak hour pass-by rate assumed for AM and daily pass-by.

As shown, the overall project is anticipated to generate 6,112 gross daily trips at the site access driveways with 392 during the morning peak commute hour and 565 during the evening peak commute hour. When accounting for the trips between EGUV land uses and pass-by trips of the retail use, the new trips associated with the project total 3,620 daily, 238 AM peak hour, and 332 PM peak hour trips.

[2] The live/work units were assumed to include both multifamily housing as well as shopping center land uses.

[3] Consistent with both the *Traffic Analysis and Development Standards for the East Gateway Urban Village (*DKS Associates*,* September 2012) and *Vintage at Mill Creek – Traffic Impact Analysis* (Transpo Group, 2016).

Trip Distribution & Assignment

Project trips were distributed throughout the roadway network consistent with the weekday PM peak hour primary trip distribution shown in Figure A-1 in the *Developer Requirements for Traffic Impact Analyses*.[4] Projects trips were assigned to the roadway network based on the distribution and are shown in Figure 3. Per Snohomish County requirements, detailed trip distribution and assignment information for key intersections, is provided in Attachments A and B, respectively.

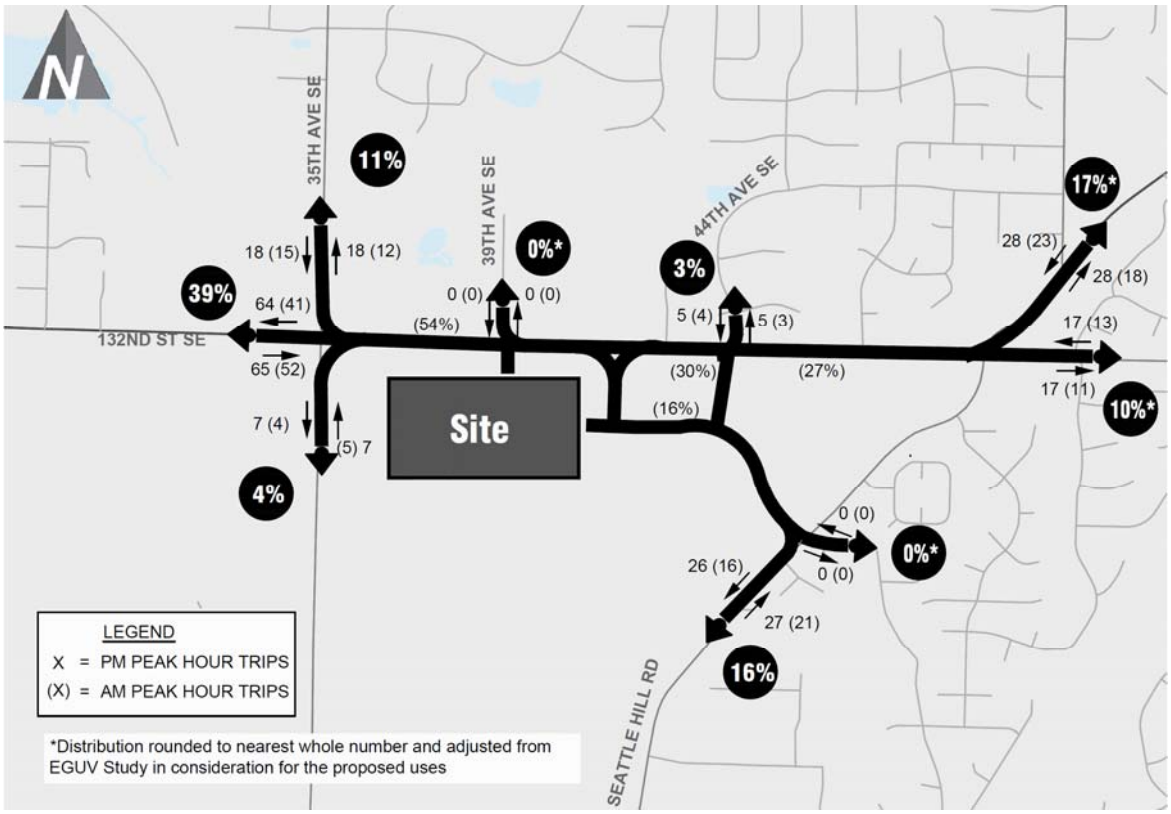


Figure 3 – Project Vicinity Off-Site Trip Distribution & Assignment

Traffic Volumes and Operations

The following section summarizes weekday PM peak hour traffic volumes and operations within the study area. The study area for the analysis was determined based on coordination with City of Mill Creek staff and available weekday PM peak hour traffic counts.[6] The study intersections included in the analysis are:

1. 35th Avenue SE/132nd Street SE (SR 96)
2. 39th Avenue SE/132nd Street SE (SR 96)
3. Seattle Hill Road/132nd Street SE (SR 96)

Traffic Volumes

Existing turning movement counts at the study intersections were counted in September 2016 and May 2018 during the weekday PM peak period (4:00 to 6:00 p.m.). The detailed intersection turning

[4] East Gateway Urban Village - Update *Traffic Analysis and Development Standards*, DKS Associates, September 2012

[6] Study intersections were based on available data as updated counts were unable to be collected during the summer months in order to not under estimate traffic volumes within the vicinity of the project. No recent traffic counts were available at the 44th Avenue SE/132nd Street SE intersection and as such was not included in the analysis.

movement traffic volumes are provided in Attachment C. The 2016 traffic volumes were grown to existing 2018 traffic volume conditions based on an annual growth rate of 2 percent per year.[7] Existing weekday PM peak hour traffic volumes used to establish existing traffic conditions were rounded to the nearest five vehicles to account for daily fluctuations and are summarized in Attachment D.

Future (2021) without-project traffic volumes are comprised of the existing traffic volumes and background traffic growth and pipeline projects. An annual growth rate of 2.0 percent was applied to existing study intersection traffic volumes consistent with the growth applied for the existing conditions. Pipeline project traffic volumes were provided by Snohomish County staff at the study intersections. The assigned project generated traffic was added to the future without-project weekday PM peak hour traffic volumes at the study intersections. The future without and with-project 2021 traffic volumes are included in Attachment D.

Traffic Operations

The operational characteristics of an intersection are determined by calculating the intersection level of service (LOS). At signalized intersections, LOS is measured in average control delay per vehicle and is typically reported using the intersection delay. Traffic operations and average vehicle delay for an intersection can be described qualitatively with a range of levels of service (LOS A through LOS F), with LOS A indicating free-flowing traffic and LOS F indicating extreme congestion and long vehicle delays. Attachment E contains a detailed explanation of LOS criteria and definitions.

For the operations analysis of existing conditions at the signalized study intersections, signal timing and phasing information was obtained from Washington State Department of Transportation (WSDOT). Analysis parameters including lane channelization were maintained for future (2021) without-project conditions from existing conditions. Signal timing splits and offsets were optimized under future (2021) conditions. Additionally, under future with-project conditions, the southern leg of the 39th Avenue SE/312nd Street SE intersection is included in the analysis reflecting the channelization shown in Figure 2.

Weekday PM peak hour traffic operations for existing and future conditions were evaluated at the study intersections based on the procedures identified in the *Highway Capacity Manual* (2010) and were evaluated using *Synchro 9.1*. *Synchro 9.1* is a software program that uses *HCM* methodology to evaluate intersection LOS and average vehicle delays. Results for the existing and future operations analyses are summarized in Table 2. Detailed LOS worksheets for each intersection analysis are included in Attachment F.

Table 2. Existing and Future PM Peak Hour Intersection LOS Summary

	Existing		2021 Without-Project		2021 With-Project	
Intersection	**LOS[1]**	**Delay[2]**	**LOS**	**Delay**	**LOS**	**Delay**
1. 35th Avenue SE/132nd Street SE	E	73	E	69	E	72
2. 39th Avenue SE/132nd Street SE	C	22	C	23	D	48
3. Seattle Hill Road/132nd Street SE	D	55	F	80	F	96

1. Level of Service (A – F) as defined by the 2010 *Highway Capacity Manual* (HCM) (TRB)
2. Average delay per vehicle in seconds.

The study intersections along SR 96 have a LOS E standard as SR 96 is designated as a regionally significant state highway (a.k.a. non-highway of statewide significance (HSS)).[8]

As shown in Table 2, the study intersections currently operate at LOS E or better, meeting the LOS standard. Under future without-project conditions, the study intersections are forecast to continue to

[7] The 2 percent annual growth rate was based on the Snohomish Transportation Element.

[8] Per House Bill 1487, the Puget Sound Regional Council (PSRC) adopted a LOS E or better standard for SR 96 as it is a Tier 1 LOS E Mitigated Facility.

meet LOS standards, operating at LOS E or better with the exception of the Seattle Hill Road/132nd Street SE intersection. The Seattle Hill Road/132nd Street SE intersection is forecast to degrade to LOS F under future without-project conditions with approximately 15 seconds of added delay relative to existing conditions.

With the addition of the project, the 35th Avenue SE/132nd Street SE intersection is forecast to continue to operate at LOS E with approximately 3 seconds of added delay relative to without-project conditions, meeting the LOS standard. The 39th Avenue SE/132nd Street SE intersection is forecast to operate at LOS D with the addition of the south leg of the intersection providing the primary access to the site, meeting the LOS standard. The Seattle Hill Road/132nd Street SE intersection is forecast to continue to operate at LOS F with the addition of the project with an addition of approximately 16 seconds of added delay relative to without project conditions. Mitigation strategies for this intersection are discussed in the mitigation section below.

In addition to the level of service analysis, the queueing at each of the study intersections was evaluated using Synchro and is summarized in Table 3 below. The queue worksheets are included in Attachment G.

As shown in Table 3, the 50th and 95th percentile queues for all movements of the 39th Avenue SE/132nd Street SE intersection are forecast to be contained within the available storage during both existing and future conditions. At 35th Avenue SE and Seattle Hill Road along 132nd Street SE, the queues for all movements for forecast to be contained within the available storage with the following exceptions:

35th Avenue SE/132nd Street SE intersection movements:

- *Eastbound Right-Turn* – This movement would exceed the 95th percentile queue by approximately 3 vehicles under existing conditions. Under future without-project conditions the 95th percentile queue is forecast to be approximately 5 vehicles greater than the storage. With the addition of the project, the increase in the 95th percentile queue is forecast to be less than 1 vehicle.
- *Westbound Right-Turn* – With the addition of the project, the 95th percentile queue is forecast to exceed the available storage by approximately 2 vehicles.
- *Northbound Left-Turn* – This movement would exceed the 50th and 95th percentile queue 2 and 8 vehicles, respectively, under both existing and future conditions.
- *Southbound Left-Turn* – This movement would exceed the 95th percentile queue by approximately 4 vehicles under existing conditions. Under future without and with-project conditions the 95th percentile queue is forecast to be approximately 5 vehicles greater than the storage, an increase of approximately 1 vehicle relative to existing conditions.
- *Southbound Through* – Under future without-project conditions, the 95th percentile queue is forecast to exceed the available storage by less than 1 vehicle. With the addition of the project, the 95th percentile queue is forecast to exceed the available storage by approximately 3 vehicles, 2 additional vehicles relative to without-project conditions.

Seattle Hill Road/132nd Street SE intersection movements:

- *Eastbound Left-Turn* – This movement would exceed available storage for the 50th and 95th percentile queues by 2 and 8 vehicles, respectively, under existing conditions. Under future without-project conditions, the 50th and 95th percentile queues are forecast to be approximately 9 vehicles and 18 vehicles, respectively, greater than the storage. With the addition of the project, the increase in the 50th and 95th percentile queues are forecast to be 13 vehicles and 22 vehicles, respectively.
- *Westbound Through-Right-Turn* – Under future without and with-project conditions, the 95th percentile queue is forecast to exceed the available storage by approximately 1 vehicle.
- *Northbound Left-Turn* – This movement would exceed the 50th and 95th percentile queue by approximately 1 vehicle and 4 vehicles, respectively, under existing conditions. Under future without and with-project conditions, the 50th and 95th percentile queues are forecast to be approximately 2 vehicles and 5 vehicles, respectively.

- *Northbound Through* – This movement would exceed the 95th percentile queue by approximately 1 vehicle under existing conditions. Under future without and with-project conditions, the 95th percentile queue is forecast to be approximately 5 vehicles greater than the storage.
- *Southbound Left-Turn* – This movement would exceed the 95th percentile queue by approximately 3 vehicles under existing conditions. Under future without and with-project conditions, the 95th percentile queue is forecast to be approximately 6 vehicles greater than the storage.

Table 3. Existing and Future PM Peak Hour Intersection Queueing Summary

		Existing		2021 Without-Project		2021 With-Project	
Intersection/Movement	**Storage[1] (feet)**	**50th Percentile (feet)**	**95th Percentile (feet)**	**50th Percentile (feet)**	**95th Percentile (feet)**	**50th Percentile (feet)**	**95th Percentile (feet)**
1. 35th Avenue SE/132nd Street SE							
Eastbound Left	350	165	320	210	335	208	290
Eastbound Through	1,900	565	630	810	945	885	1,035
Eastbound Right	100	100	175	130	220	130	225
Westbound Left	600	210	370	390	560	395	540
Westbound Through	1,155	190	380	430	560	500	715
Westbound Right	200	0	120	35	135	155	250
Northbound Left	250	280	460	295	450	295	390
Northbound Through	900	365	550	400	540	410	580
Northbound Right	170	0	20	0	0	0	0
Southbound Left	250	230	350	270	385	265	370
Southbound Through	825	475	695	595	830	585	900
Southbound Right	170	20	60	20	60	0	60
2. 39th Avenue SE/132nd Street SE							
Eastbound Left	250	60	70	60	60	60	55
Eastbound Through	1,155	210	20	40	20	1,040	970
Eastbound Right	200	-	-	-	-	10	5
Westbound Left	250	-	-	-	-	100	220
Westbound Through-Right	1,545	240	365	340	510	550	640
Northbound Left	175	-	-	-	-	125	275
Northbound Through	175	-	-	-	-	5	20
Northbound Right	175	-	-	-	-	0	0
Southbound Left	585	135	200	150	215	125	195
Southbound Through-Right	585	-	-	-	-	245	420
Southbound Right	585	0	100	20	130	-	-
3. Seattle Hill Road/132nd Street SE							
Eastbound Left	280	345	510	500	725	610	840
Eastbound Through-Right	1,690	475	570	575	680	640	830
Westbound Left	140	45	90	70	150	70	125
Westbound Through-Right	550	345	450	410	560	435	585
Northbound Left	100	115	190	145	225	145	230
Northbound Through	420	265	455	350	545	355	550
Northbound Right	215	0	0	0	20	0	10
Southbound Left	290	225	375	255	430	260	420
Southbound Through	575	175	285	220	385	130	205
Southbound Right	180	0	75	0	80	0	95

Note: Shading indicates queue exceeds storage.
1. Storage represents the turn lane storage length or distance to the adjacent intersection.

Traffic Safety

The Washington State Department of Transportation (WSDOT) provided the collision data for the most recent three-year period for intersections within the study area. Specifically, the data was summarized between January 1, 2015 and December 31, 2017. Table 4 provides a summary of collision history at the signalized intersections along SR 96 between 35th Avenue SE and Seattle Hill Road.

Table 4. Three-Year Collision Summary – 2015 to 2017

Location	Number of Collisions			Total	Annual Average
	2015	2016	2017		
1. 35th Avenue SE/132nd Street SE	12	10	5	27	9.0
2. 39th Avenue SE/132nd Street SE	4	9	3	16	5.3
3. 44th Avenue SE/132nd Street SE	5	5	3	13	4.3
4. Seattle Hill Road/132nd Street SE	5	6	6	17	5.7

Source: WSDOT, 2018

As shown in Table 4, the intersections from 39th Avenue SE to Seattle Hill Road along SR 96 have an average of less than 6 collisions per year and an average of 9 collisions per year at the 35th Avenue SE intersection. The majority of collisions resulted in property damage only and the most frequent collision types at the four intersections along SR 96 were rear-end and sideswipe collisions, which are consistent with signalized intersections. There were no reported fatalities or bicyclist collisions within the study period; however, there were 4 reported pedestrian collisions. The pedestrian collisions occurred along SR 96 at 35th Avenue SE, 39th Avenue SE, and 44th Avenue SE.

Parking Code Evaluation

Parking requirements are identified in Mill Creek Municipal Code MCMC 17.27.020.C.5, D.1, D.5, and D.6. Table 5 provides the calculation of the required parking based on City code requirements.

Table 5. Parking Code Requirements

Land Use	Size	Minimum Parking Supply Rate[1]	Required Parking
Commercial			
Retail	13,700 sf	1 stall / 250 sf	55 stalls
Office	41,200 sf	1 stall / 800 sf	52 stalls
Restaurant	13,700 sf	20 stalls plus 1 stall / 100 sf over 4,000 sf	20 + 97 = 117 stalls
Medical Office	16,600 sf	1 stall / 200 sf	83
Live/Work	34,800 sf	1 stall / 250 sf	139
Total Commercial Space	***120,000 sf***		***446 stalls***
Residential			
One-Bedroom	78 du	1.5 stalls/du	117 stalls
Two/Three Bedroom	220 du	2.5 stalls/du	550 stalls
Guest Parking	298 du	0.25 stalls/du	75 stalls
Total Residential	***324 du***		***742 stalls***
Total Required Spaces			***1,188 stalls***
Total Proposed Parking Supply			***1,053 stalls***
Proposed Surface Parking Supply			430 stalls
Proposed Garage Parking Supply			623 stalls

Notes: du = dwelling unit, sf = square feet
1. City of Mill Creek Municipal Code

As shown in Table 5, the project would be required to provide a minimum of 1,188 parking stalls and exceeds the proposed parking supply of 1,053 stalls by 135 stalls. Consistent with the Phase 1

development a share parking analysis was conducted to determine the actual peak parking demand given ITE parking demand rates and the shared parking arrangements possible on this site. This mixed-use shared parking is further evaluated in the following sections.

Mill Creek's municipal code allows for a reduction in parking requirements of up to 10 percent of the total on-site parking for mixed-use developments (MCMC 17.27.020.G) such as the proposed Farm at Mill Creek project. Based on the required supply of 1,188 stalls, a reduction of up to 119 stalls could be applied to this development, resulting in a parking supply of 1,069 stalls. The proposed supply is less than this reduced code requirement by 16 vehicles. A separate parking modification memorandum has been prepared.[9]

Parking Demand Evaluation

The peak parking demand rates for the proposed land uses were based on the ITE *Parking Generation* suburban rates for Low/Mid-Rise Apartment (LU #221), Shopping Center (LU #820), High Turnover (Sit-Down) Restaurant (LU #932), General Office Building (LU #710), and Medical Office (LU # 720) and are summarized in Table 6. These rates represent the peak demand rates for the individual uses and do not consider the respective daily demand patterns for each. The table includes the estimated parking demands based on both the average parking demand rate and the equations of the uses provided in ITE *Parking Generation*.

Table 6. Weekday Peak Parking Demand

Land Use	Size	Peak Parking Demand Rate[1]	Peak Parking Demand
Low/Mid-Rise Apartment (LU #221)	298 units	1.23 stalls/du	367 vehicles
Live/Work (LU #221 & LU #820)[2]	26 units	1.23 stalls/du	32 vehicles
	34.8 ksf	2.55 stalls/ksf	89 vehicles
Retail (LU #820)	13.7 ksf	2.55 stalls/ksf	35 vehicles
Office (LU #701)	41.2 ksf	2.84 stalls/ksf	117 vehicles
Restaurant (LU #932)	13.7 ksf	13.30 stalls/ksf	182 vehicles
Medical Office (LU #720)	16.6 ksf	3.2 stalls/ksf	53 vehicles
Total Demand			875 vehicles

Note: du = dwelling units, ksf = thousand square feet

1. Trip rates per ITE *Parking Generation,* 4th Generation. These rates are the respective peaks for the indivudal uses and do not consider the respective daily demand patterns for each.
2. The parking demand associated with the live/work units was estimated based on both the residential and retail components, consistent with the trip generation methodology, and results in a conservative estimate of parking demand.
3. No equation available and so the average rate was assumed.

As shown in Table 6, the total peak demand for the proposed development for the residential and commercial uses is anticipated to be 875 vehicles which could be accommodated by the proposed parking supply.

Although the proposed parking supply can be accommodated, given an overlap of the peak demands for each use, the actual demand will be less than that noted as the peak demands for all uses do not overlap at the same time throughout the day. Residential uses peak in the overnight hours while the commercial uses peak during the day. *Parking Generation* provides additional information regarding how parking demands for each of these uses vary during a typical weekday. Figure 3 shows the total anticipated parking demand by time of day based on the proposed land uses for the entire proposed project. The detailed time of day parking demand calculations are included in Attachment H.

[9] *The Farm at Mill Creek – Parking Modification* (Transpo Group, August 2018)

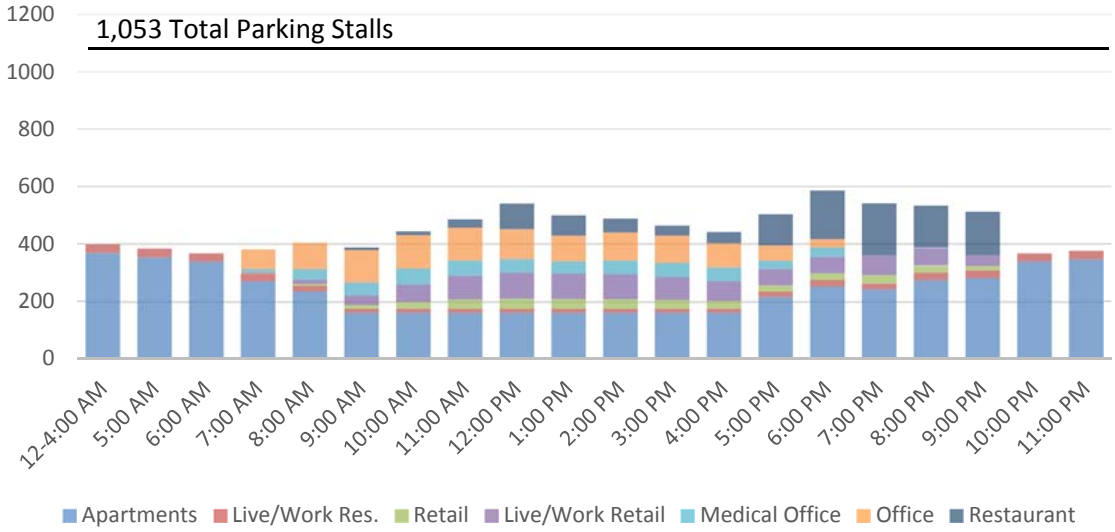


Figure 4 – Total Cumulative Parking Demand

As shown in Figure 3, the cumulative peak parking demand is estimated to be approximately 587 vehicles occurring at 6 p.m. when the greatest overlap between the retail, restaurant, and residential uses is anticipated and can be accommodated within the proposed parking supply of 1,053 stalls.[10]

The parking supply is likely to be designated for the two uses (i.e. residential and commercial) such that the proposed garage spaces are primarily for residential and the proposed surface stalls are primarily for commercial. The cumulative demands are shown below in Figures 4 and 5 for the residential and commercial uses, respectively, relative to the proposed parking supply for each use.

Figure 5 – Residential Cumulative Parking Demand

Figure 4 shows that the parking demand associated with the residential uses are forecast to peak overnight with a peak cumulative parking demand of up to 399 vehicles which can be accommodated by the proposed 623 parking stalls within the garages.

[10] The cumulative parking demand estimates are based on ITE *Parking Generation* (4th Edition). The detailed parking demand is included in Attachment H.

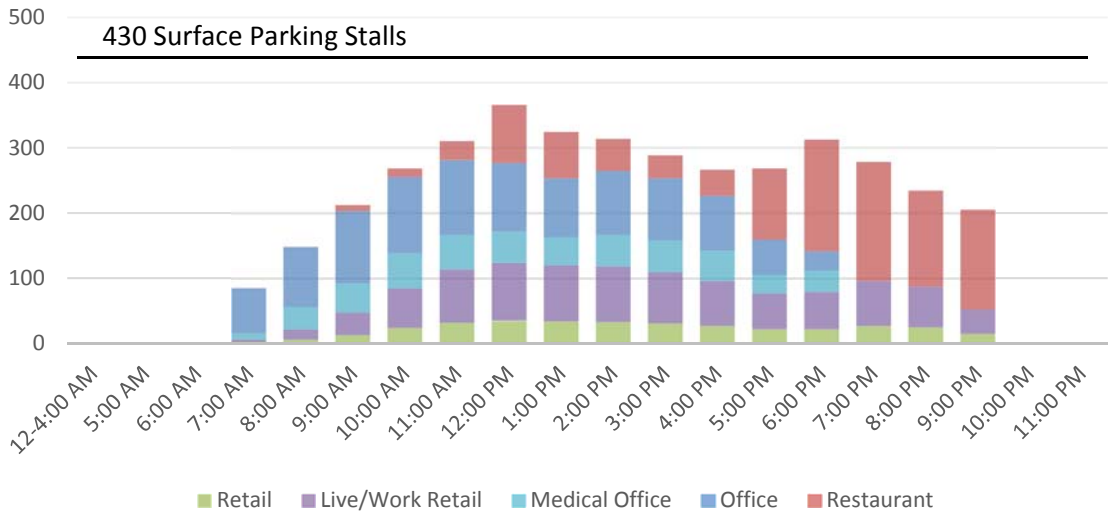


Figure 6 – Commercial Cumulative Parking Demand

The parking demand associated with the commercial uses (see Figure 5) are forecast to peak during the day with a peak cumulative parking demand of up to 365 vehicles which can be accommodated by the proposed 430 surface parking stalls.

Mitigation

This section summarizes recommended mitigation measures at the study intersections and reviews the Transportation Impact Fees.

Operational Mitigation

The Seattle Hill Road/132nd Street SE intersection is forecast to operate at LOS F under both without and with-project conditions with approximately 17 seconds of added delay with the addition of the project relative to without project conditions. This intersection operates with split phasing.

This split phasing is in place to support the dual southbound right-turn to provide increased capacity and separated pedestrian phase to minimize conflicts with the southbound right-turn movement. The proposed mitigation would alter the phasing to allow the northbound and southbound approaches to run concurrently, changing the southbound approach channelization from dual southbound right-turn to separate southbound right, through, and left-turn lanes, and provide right-turn overlap to the southbound movement.

With the proposed mitigation, the Seattle Hill Road/132nd Street SE intersection is forecast to operate at LOS E with approximately 78 seconds of delay. In addition to the level of service, the queues are summarized in Table 7. As shown in Table 7, of the dedicated turn lanes which have restricted available storage, the 50th and 95th percentile queues are forecast to increase by 1 vehicle or less with the proposed mitigation relative to the with-project condition. The queues of the through movements of each approach are forecast to increase with the proposed mitigation relative to the with-project condition; however, these extended queues can be contained within the roadways without spilling back into any adjacent signalized intersections.

The proposed mitigation would allow for similar capacity for the southbound right-turn movement while improving the delay at the intersection.

Table 7. Mitigated Future PM Peak Hour Intersection Queueing Summary

Intersection/Movement	Storage[1] (feet)	2021 With-Project 50th Percentile (feet)	2021 With-Project 95th Percentile (feet)	2021 With-Project (Mitigated) 50th Percentile (feet)	2021 With-Project (Mitigated) 95th Percentile (feet)
3. Seattle Hill Road/132nd Street SE					
Eastbound Left	280	610	840	590	840
Eastbound Through-Right	1,690	640	830	695	860
Westbound Left	140	70	125	85	140
Westbound Through-Right	550	435	585	580	735
Northbound Left	100	145	230	165	245
Northbound Through	420	355	550	490	710
Northbound Right	215	0	10	0	0
Southbound Left	290	260	420	305	440
Southbound Through	575	130	205	175	305
Southbound Right	180	0	95	60	110

Note: Shading indicates queue exceeds storage.
1. Storage represents the turn lane storage length or distance to the adjacent intersection.

Transportation Impact Fee

To mitigate general transportation related impacts of the proposed development, the project would be required to pay City of Mill Creek transportation impact fees and Snohomish County traffic mitigation fee. These fees provide funding for transportation-related projects throughout the City and County. Fees would be assessed when building permits for the project are issued.

The City's current Transportation Impact Fee[12] is $3,000 per weekday PM peak hour trip. Based on the proposed development's 332 total estimated new weekday PM peak hour off-site trips, this results in a transportation impact fee of **$996,000**.

The Snohomish County traffic mitigation fee was estimated separately for the proposed land uses. Consistent with the interlocal agreement between the City of Mill Creek and Snohomish County, the standard 70 percent of project trips were assumed to impact county roads. This percentage was applied to the calculated trip generation. Snohomish County impact fees applied to the project were $227 per ADT for the residential uses and $267 per ADT for the commercial uses (retail, office, restaurant, and medical office). This results in an estimated residential mitigation fee of $300,094 and a commercial mitigation fee of $613,566, and a total Snohomish County mitigation fee of **$967,232**.[13]

Summary

This TIA summarizes the transportation impacts associated with the Woodinville Village development in Woodinville. General findings and recommendations include:

- The project is anticipated to generate 3,620 weekday daily trips with 238 trips occurring during the AM peak hour and 332 trips occurring during the PM peak hour.
- The intersections along SR 96 are forecast to meet WSDOT LOS standards during the existing and future without and with-project conditions during the weekday PM peak hour with the exception of the Seattle Hill Road/132nd Street SE intersection which is forecast to operate at LOS F under future without and with project conditions. All study intersections are forecast to meet standards during the weekday AM peak hours under existing and future conditions. Mitigation at Seattle Hill Road/132nd Street SE intersection

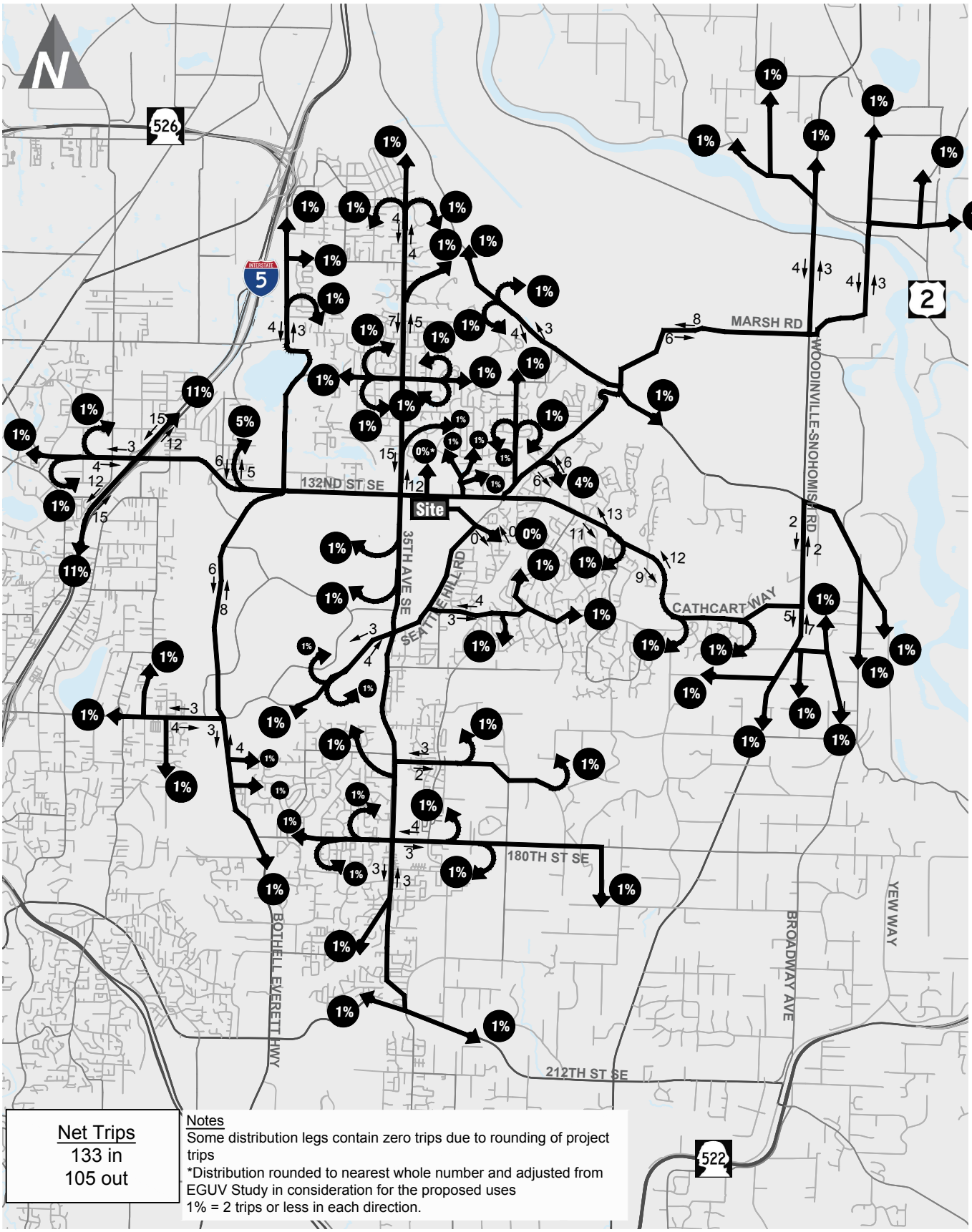
[12] City of Mill Creek Ordinance 2011-735

[13] After the 70 percent reduction of net new daily trips, the fee is estimated to be:
(2,298 commercial ADT x $267 / ADT) + (1,322 residential ADT x $227 / ADT) = $913,660.

was reviewed and a change in the existing split phasing is proposed to allow the northbound and southbound approaches to run concurrently, changing the southbound approach channelization from dual southbound right-turn to separate southbound right, through, and left-turn lanes, and provide right-turn overlap to the southbound movement. The proposed mitigation would allow for similar capacity for the southbound right-turn movement while improving the delay at the intersection.

- A project is proposing to provide 1,053 total parking stalls with 623 garage stalls and 430 surface stalls. It is anticipated that the surface stalls would be available for the commercial uses while the garage stalls would be available for the residential uses. The cumulative parking demand was estimated to peak for the commercial uses in the afternoon with 365 vehicles, while the cumulative residential demand is estimated to peak overnight with 399 vehicles. Both parking demand can be accommodated within the respective parking supplies for the commercial and residential uses.

Attachment A: Detailed Trip Distribution



Net Trips
133 in
105 out

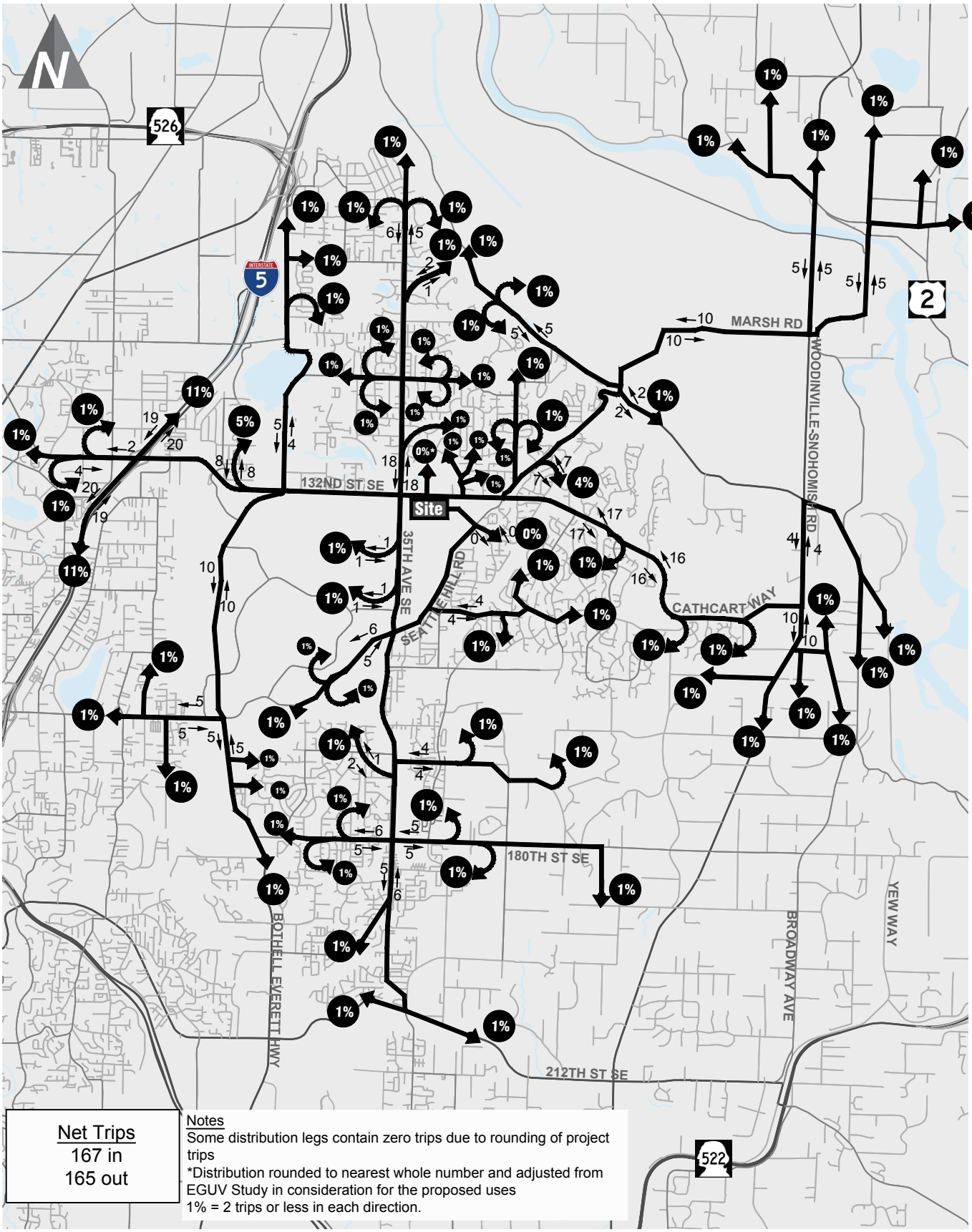
Notes
Some distribution legs contain zero trips due to rounding of project trips
*Distribution rounded to nearest whole number and adjusted from EGUV Study in consideration for the proposed uses
1% = 2 trips or less in each direction.

AM Peak Hour Trip Distribution & Assignment

ATTACHMENT
A1

Vintage at Mill Creek

transpogroup



Net Trips
167 in
165 out

Notes
Some distribution legs contain zero trips due to rounding of project trips
*Distribution rounded to nearest whole number and adjusted from EGUV Study in consideration for the proposed uses
1% = 2 trips or less in each direction.

PM Peak Hour Trip Distribution & Assignment

ATTACHMENT
A2

Vintage at Mill Creek

transpogroup

Attachment B: Detailed Trip Assignment

Weekday AM Peak Hour Trip Assignment

Intersection Name NB/SB	Intersection Name EB/WB	Int ID#	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	TEV[1]
35th Ave SE	132nd St SE	177	0	52	0	4	41	12	0	0	5	15	0	0	129
35th Ave SE	116th St SE	176	0	0	4	4	0	0	3	5	3	0	7	0	26
Seattle Hill Rd	132nd St SE	179	18	11	0	0	13	0	0	0	0	0	0	23	65
Puget Park Dr	134th Pl SE	194	0	11	0	0	13	0	0	0	0	0	0	0	24
N Sno Cascade Rd	134th Pl SE	121	0	11	0	0	13	0	0	0	0	0	0	0	24
Snohomish Cascade Dr	134th Pl SE	193	0	9	2	1	12	0	2	0	0	0	0	0	26
Puget Park Dr	Cathcart Way	527	0	7	2	0	10	0	2	0	0	0	0	0	21
SR 9	Cathcart Way	123	2	0	5	0	0	0	7	0	0	0	0	2	16
SR 9	164th St SE	317	0	0	0	0	0	0	0	2	0	0	2	0	4
51st Ave SE	Seattle Hill Rd	471	2	16	0	0	19	0	0	0	0	0	0	4	41
Marsh Rd	Lowell-Larimer Rd	170	0	0	4	0	0	0	3	6	0	0	8	0	21
Seattle Hill Rd	Lowell-Larimer Rd	171	9	0	1	0	1	0	0	0	0	0	0	12	23
SR 9	Marsh Rd	169	3	3	0	0	4	0	0	0	0	0	0	4	14
35th Ave SE	Seattle Hill Rd	178	4	0	0	12	1	0	0	1	17	0	0	2	37
Seattle Hill Rd	148th St SE	180	0	0	0	0	0	4	0	17	0	3	13	0	37
35th Ave SE	156th St SE	182	0	0	0	0	0	0	0	16	0	0	12	0	28
35th Ave SE	164th St SE	524	0	0	0	0	0	0	0	16	0	0	12	0	28
35th Ave SE	168th St SE	181	0	0	0	0	0	0	0	16	0	0	12	0	28
35th Ave SE	169th St SE	187	0	0	0	0	0	3	0	13	0	2	10	0	28
35th Ave SE	180th St SE	183	4	0	0	0	0	4	0	3	0	3	3	3	20
SR 527	164th St SE	231	4	0	0	0	0	0	0	4	0	0	3	3	14
Elgin Way	132nd St SE	352	0	34	0	0	27	5	0	0	0	6	0	0	72
3rd Ave SE	128th St SE	351	0	34	0	0	27	0	0	0	0	0	0	0	61
I5 Ramps NB	128th St SE	428	0	19	0	0	15	12	0	0	15	0	0	0	61
I5 Ramps SB	128th St SE	272	0	4	0	12	3	0	0	0	0	15	0	0	34

Note: TEV = total entering volume

Weekday PM Peak Hour Trip Assignment

Intersection Name NB/SB	Intersection Name EB/WB	Int ID#	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	TEV[1]
35th Ave SE	132nd St SE	177	0	65	0	7	64	18	0	0	7	18	0	0	179
35th Ave SE	116th St SE	176	0	0	4	4	0	0	5	6	5	0	8	0	32
Seattle Hill Rd	132nd St SE	179	28	17	0	0	17	0	0	0	0	0	0	28	90
Puget Park Dr	134th Pl SE	194	0	17	0	0	17	0	0	0	0	0	0	0	34
N Sno Cascade Rd	134th Pl SE	121	0	17	0	0	17	0	0	0	0	0	0	0	34
Snohomish Cascade Dr	134th Pl SE	193	0	16	1	0	16	0	1	0	0	0	0	0	34
Puget Park Dr	Cathcart Way	527	0	15	1	0	15	0	1	0	0	0	0	0	32
SR 9	Cathcart Way	123	4	0	10	0	0	0	10	0	0	0	0	4	28
SR 9	164th St SE	317	0	0	0	0	0	0	0	2	0	0	2	0	4
51st Ave SE	Seattle Hill Rd	471	4	24	0	0	24	0	0	0	0	0	0	4	56
Marsh Rd	Lowell-Larimer Rd	170	0	0	5	0	0	0	5	10	0	0	10	0	30
Seattle Hill Rd	Lowell-Larimer Rd	171	0	0	0	2	0	0	0	15	2	0	0	15	34
SR 9	Marsh Rd	169	5	5	0	0	5	0	0	0	0	0	0	5	20
35th Ave SE	Seattle Hill Rd	178	5	5	0	21	1	0	0	5	18	0	0	5	60
Seattle Hill Rd	148th St SE	180	0	0	0	0	0	4	0	23	0	4	22	0	53
35th Ave SE	156th St SE	182	0	0	0	0	0	0	0	22	0	0	21	0	43
35th Ave SE	164th St SE	524	0	0	0	0	0	0	0	22	0	0	21	0	43
35th Ave SE	168th St SE	181	0	0	0	0	0	0	0	22	0	0	21	0	43
35th Ave SE	169th St SE	187	0	0	0	0	0	4	0	18	0	4	17	0	43
35th Ave SE	180th St SE	183	5	0	0	0	0	5	0	6	0	5	5	6	32
SR 527	164th St SE	231	5	0	0	0	0	0	0	5	0	0	5	5	20
Elgin Way	132nd St SE	352	0	42	0	0	42	8	0	0	0	8	0	0	100
3rd Ave SE	128th St SE	351	0	42	0	0	42	0	0	0	0	0	0	0	84
I5 Ramps NB	128th St SE	428	0	23	0	0	2	20	0	0	19	0	0	0	64
I5 Ramps SB	128th St SE	272	0	4	0	20	2	0	0	0	0	19	0	0	45

Note: TEV = total entering volume

Attachment C: Traffic Counts

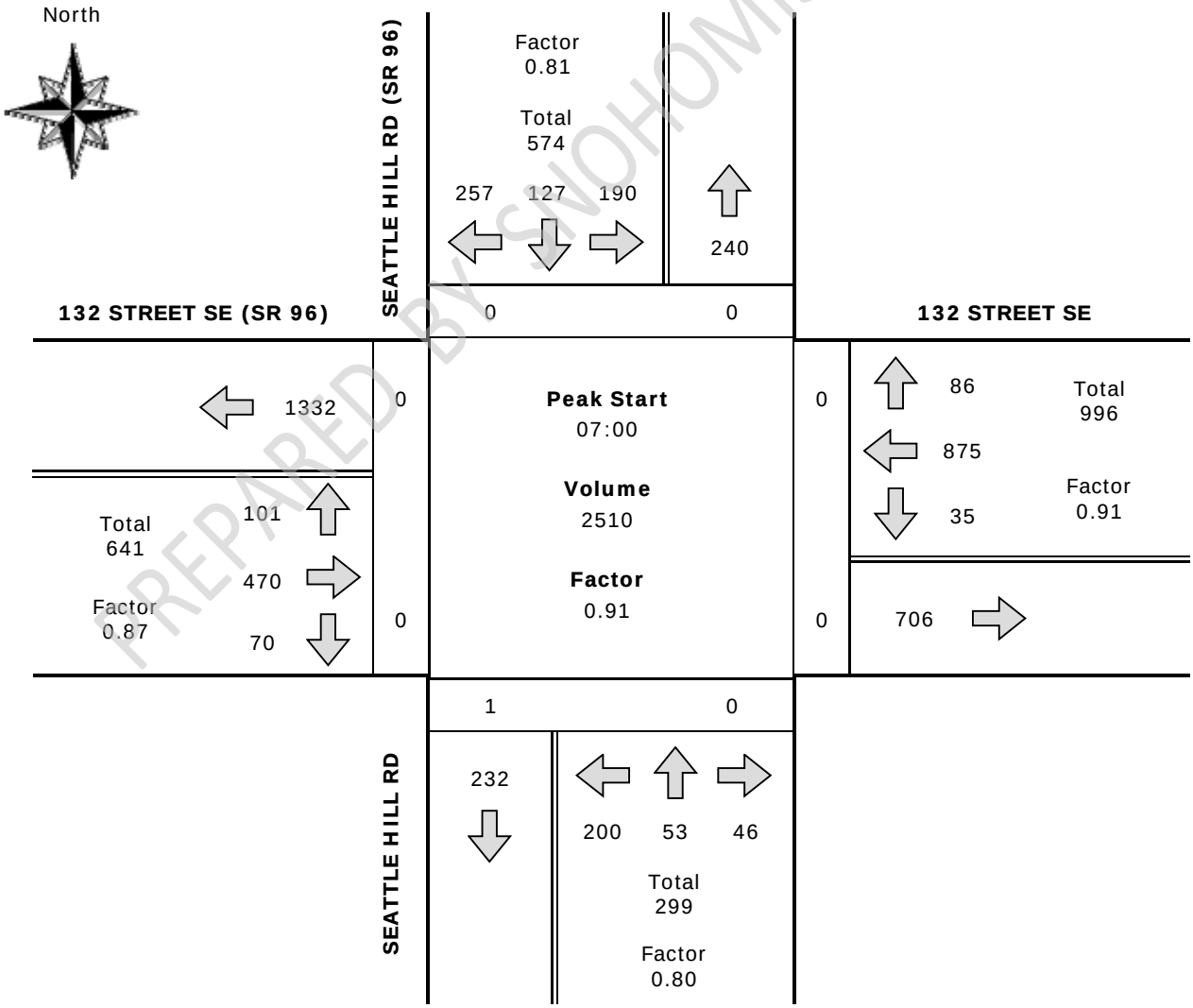
SNOHOMISH COUNTY TRAFFIC OPERATIONS
3000 Rockefeller Ave
Everett, WA 98201

LOCATION: : SEATTLE HILL RD_SR 96 @ 132 ST SE_SR 96 Site: 33009@1.600
REQUESTOR: : FORECAST 1/10/2017
Tuesday

Intersection Peak Hour

Location 132 STREET SE (SR 96) at SEATTLE HILL RD (SR 96)
Weather DRY **Counted by** DS
File Number 01101723aA037K179 **Prepared by** DS

	North	East	South	West
Total	814	1702	531	1973
Estimated ADT	8140	17020	5310	19730
Autos	555 96.7 %	962 96.6 %	292 97.7 %	618 96.4 %
Light Trucks	11 1.9 %	12 1.2 %	4 1.3 %	10 1.6 %
Heavy Trucks	2 0.3 %	7 0.7 %	0 0.6 %	4 0.6 %
Buses	6 1.0 %	15 1.5 %	3 1.0 %	9 1.4 %



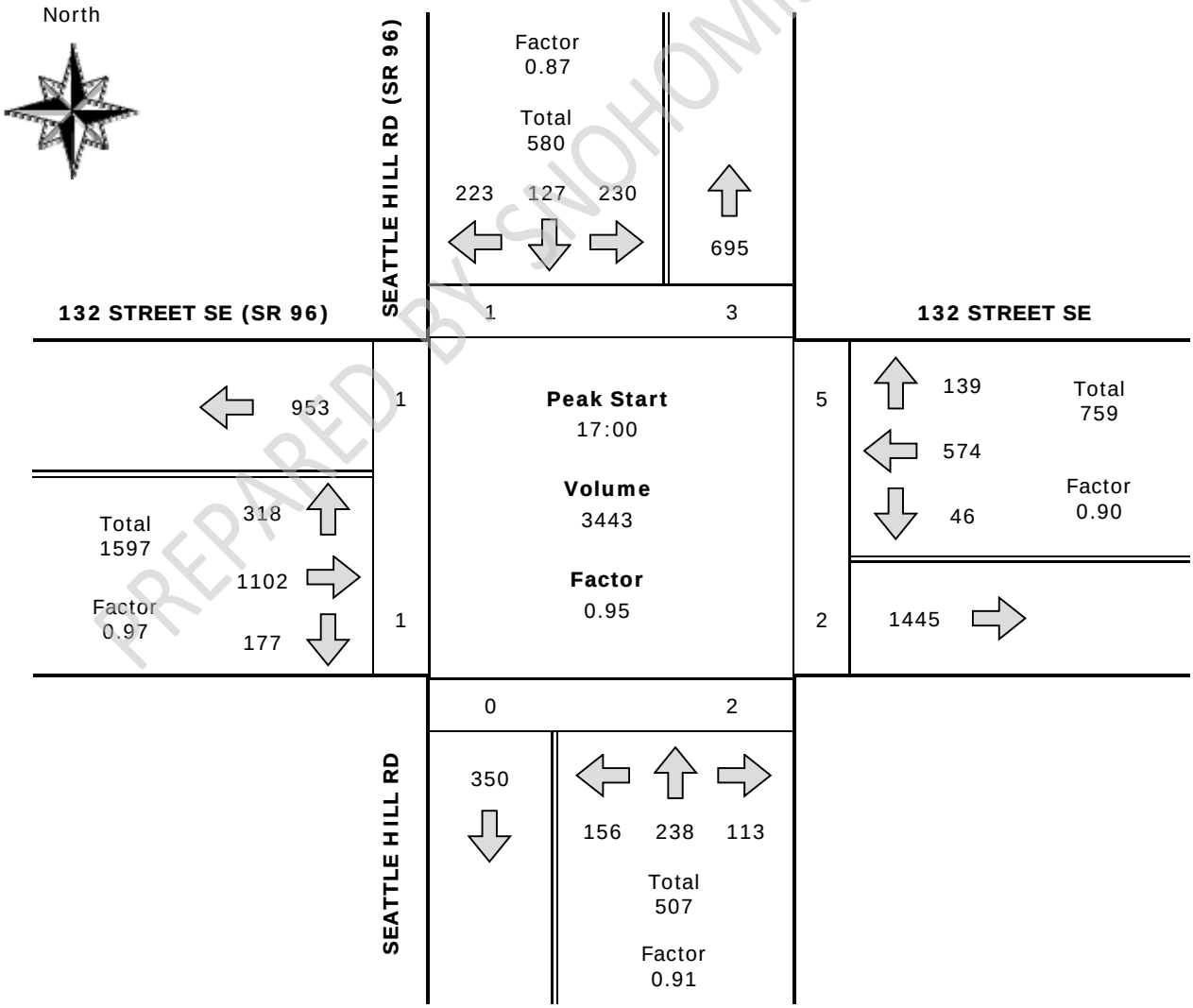
SNOHOMISH COUNTY TRAFFIC OPERATIONS
3000 Rockefeller Ave
Everett, WA 98201

LOCATION: : SEATTLE HILL RD (SR 96) @ 132 ST SE (SR 96) Site: 33009@1.600
REQUESTOR: : FORECAST 1/10/2017
Tuesday

Intersection Peak Hour

Location 132 STREET SE (SR 96) at SEATTLE HILL RD (SR 96)
Weather DRY **Counted by** DS
File Number 01101723pA037K179 **Prepared by** DS

	North	East	South	West
Total	1275	2204	857	2550
Estimated ADT	12750	22040	8570	25500
Autos	573 98.8 %	742 97.8 %	501 98.8 %	1581 99.0 %
Light Trucks	4 0.7 %	6 0.8 %	5 1.0 %	6 0.4 %
Heavy Trucks	3 0.5 %	2 0.3 %	0 0.3 %	4 0.3 %
Buses	0	9 1.2 %	1 0.2 %	6 0.4 %



SNOHOMISH COUNTY TRAFFIC OPERATIONS

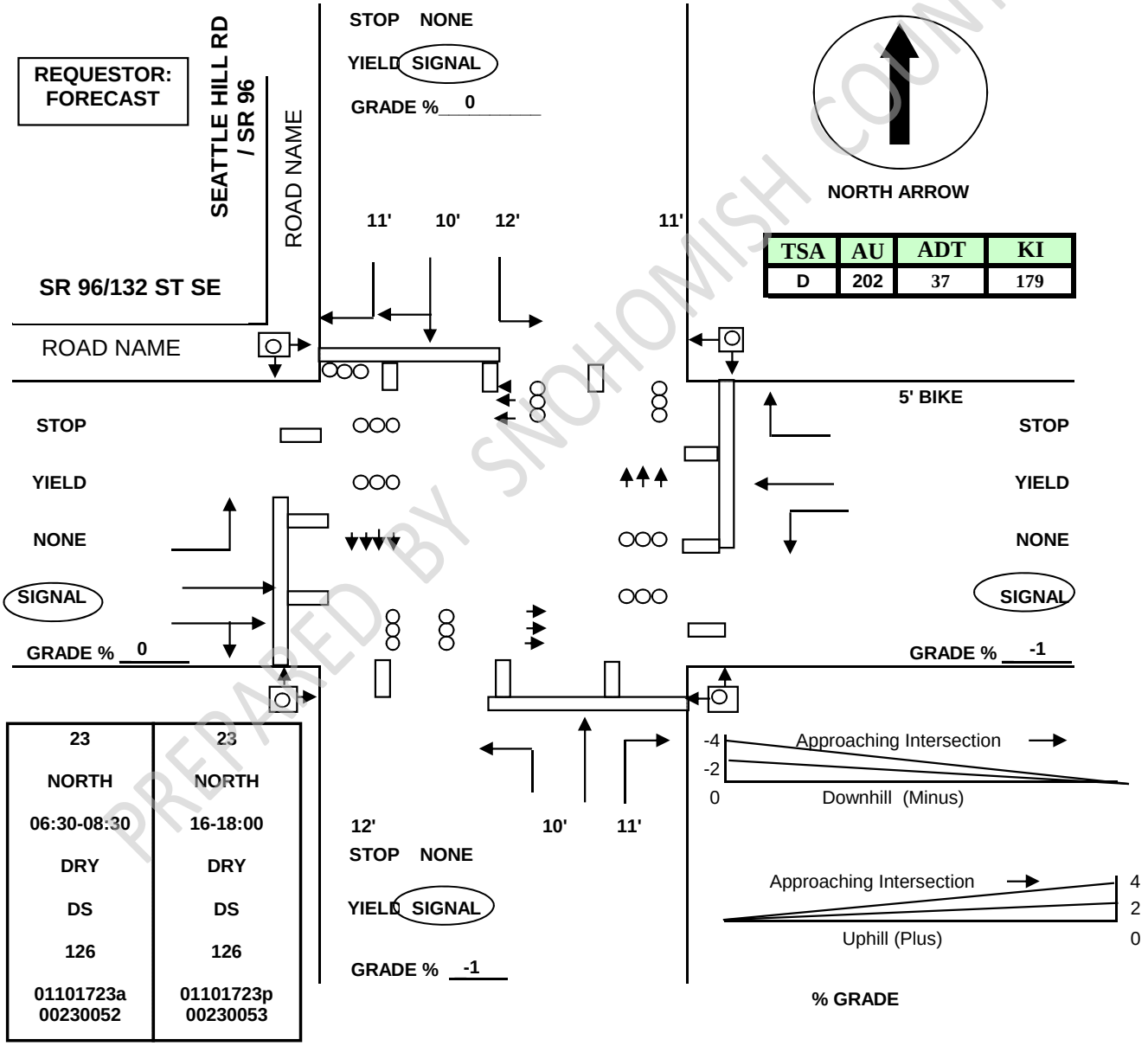
LOS DATA SHEET - ALL INTERSECTIONS

PRIMARY RD SEATTLE HILL RD/ SR96 RD LOG 33009 MP 1.600 DATE 01/10/2017

SECONDARY RD 132 ST SE / SR96 RD LOG 93680 MP 0.0 SPEED LIMIT ON PRIMARY RD 45 MPH

INDICATE LANES FOR EACH APPROACH USING ARROWS

LANE WIDTHS & SIGNAL INDICATIONS REQUIRED FOR SIGNALIZED INTERSECTIONS



COMMENTS

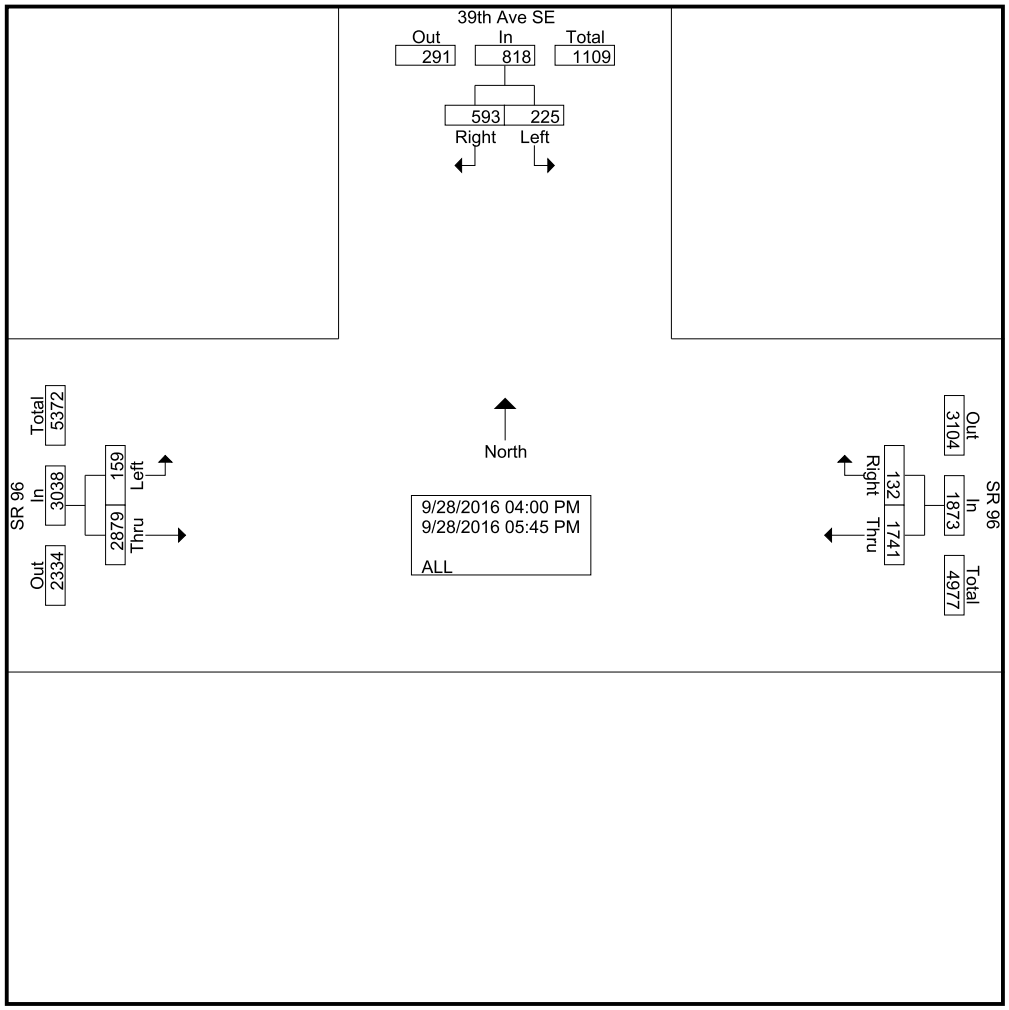
WASHINGTON STATE DEPT. OF TRANSPORTATION
Northwest Region - Traffic Studies

SR 96
Jct 39th Ave SE
Milepost 2.61

File Name : 09602613_(PM)2016-09-28-_SM
Site Code : 09602613
Start Date : 9/28/2016
Page No : 1

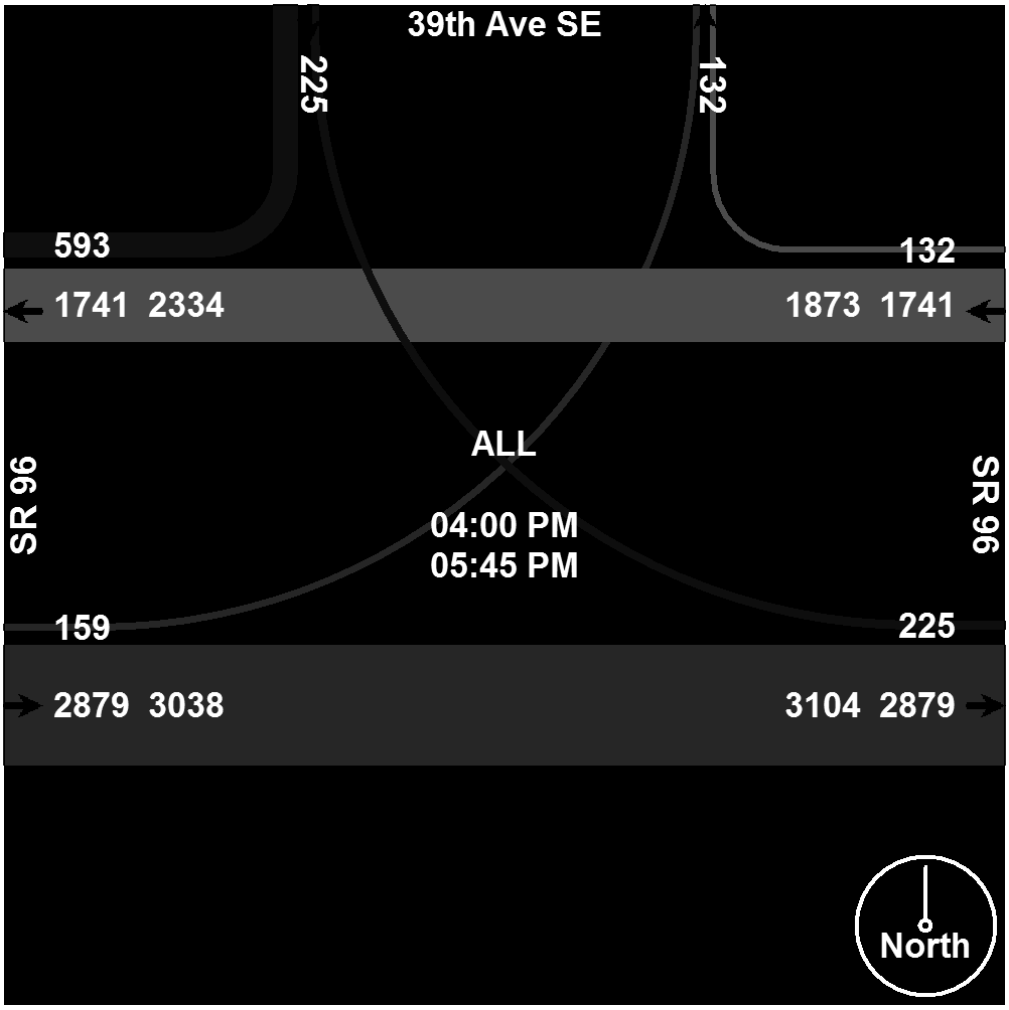
Groups Printed- ALL

	39th Ave SE From North			SR 96 From East			SR 96 From West			
Start Time	Right	Left	App. Total	Right	Thru	App. Total	Thru	Left	App. Total	Int. Total
04:00 PM	85	41	126	15	249	264	391	15	406	796
04:15 PM	86	32	118	14	229	243	335	10	345	706
04:30 PM	81	28	109	52	176	228	362	8	370	707
04:45 PM	76	24	100	7	253	260	300	17	317	677
Total	328	125	453	88	907	995	1388	50	1438	2886
05:00 PM	70	22	92	14	241	255	385	28	413	760
05:15 PM	72	28	100	16	202	218	364	37	401	719
05:30 PM	74	32	106	6	235	241	339	29	368	715
05:45 PM	49	18	67	8	156	164	403	15	418	649
Total	265	100	365	44	834	878	1491	109	1600	2843
Grand Total	593	225	818	132	1741	1873	2879	159	3038	5729
Apprch %	72.5	27.5		7	93		94.8	5.2		
Total %	10.4	3.9	14.3	2.3	30.4	32.7	50.3	2.8	53	



SR 96
Jct 39th Ave SE
Milepost 2.61

File Name : 09602613_(PM)2016-09-28-_SM
Site Code : 09602613
Start Date : 9/28/2016
Page No : 2

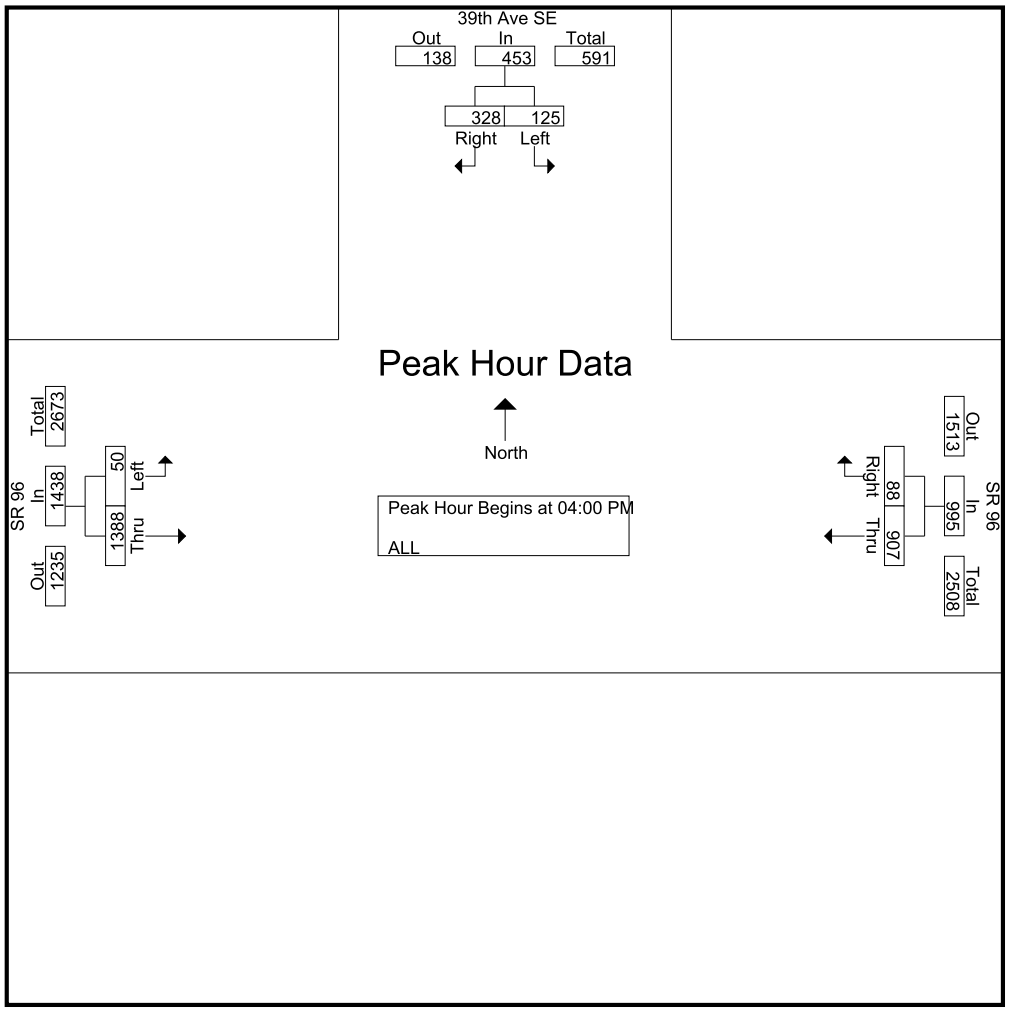


WASHINGTON STATE DEPT. OF TRANSPORTATION
Northwest Region - Traffic Studies

SR 96
Jct 39th Ave SE
Milepost 2.61

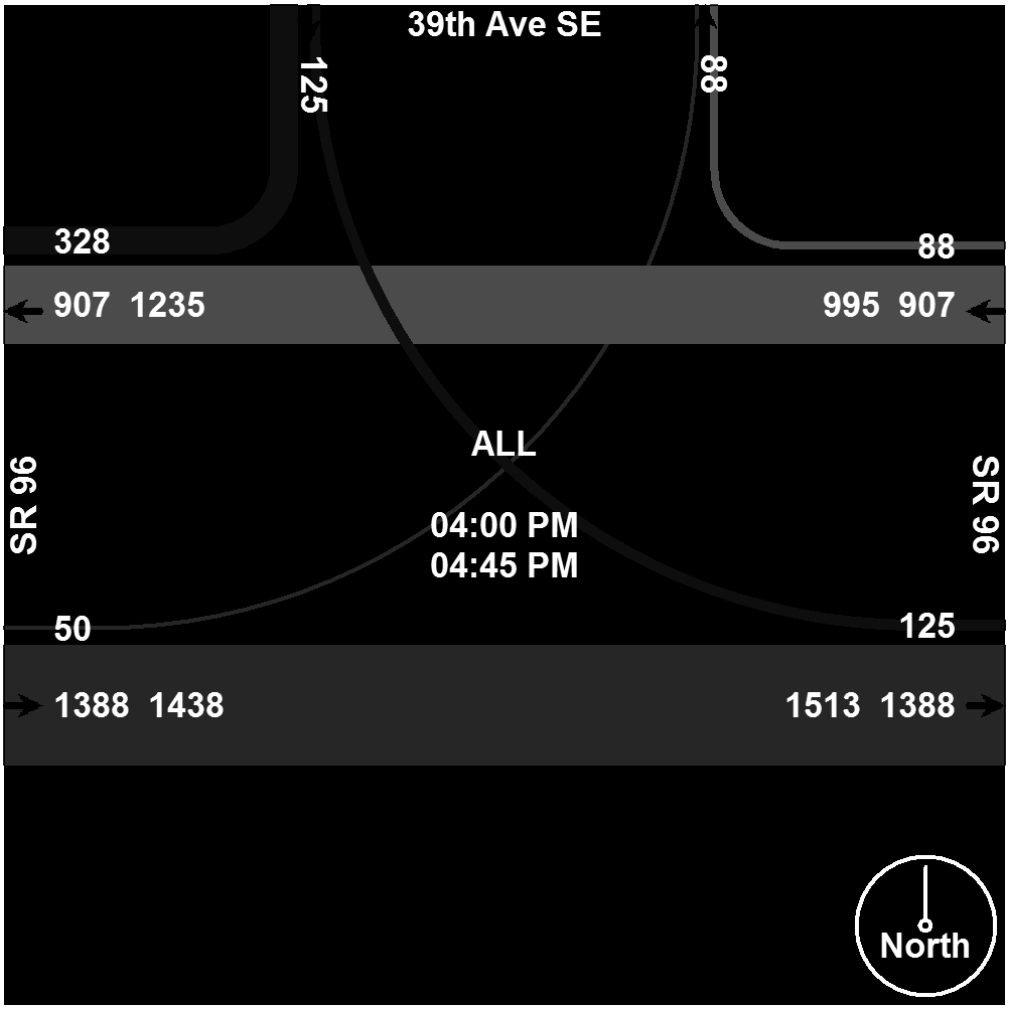
File Name : 09602613_(PM)2016-09-28-_SM
Site Code : 09602613
Start Date : 9/28/2016
Page No : 3

	39th Ave SE From North			SR 96 From East			SR 96 From West			
Start Time	Right	Left	App. Total	Right	Thru	App. Total	Thru	Left	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 04:00 PM										
04:00 PM	85	**41**	**126**	15	249	**264**	**391**	15	**406**	**796**
04:15 PM	**86**	32	118	14	229	243	335	10	345	706
04:30 PM	81	28	109	**52**	176	228	362	8	370	707
04:45 PM	76	24	100	7	**253**	260	300	**17**	317	677
Total Volume	328	125	453	88	907	995	1388	50	1438	2886
% App. Total	72.4	27.6		8.8	91.2		96.5	3.5		
PHF	.953	.762	.899	.423	.896	.942	.887	.735	.885	.906



SR 96
Jct 39th Ave SE
Milepost 2.61

File Name : 09602613_(PM)2016-09-28-_SM
Site Code : 09602613
Start Date : 9/28/2016
Page No : 4



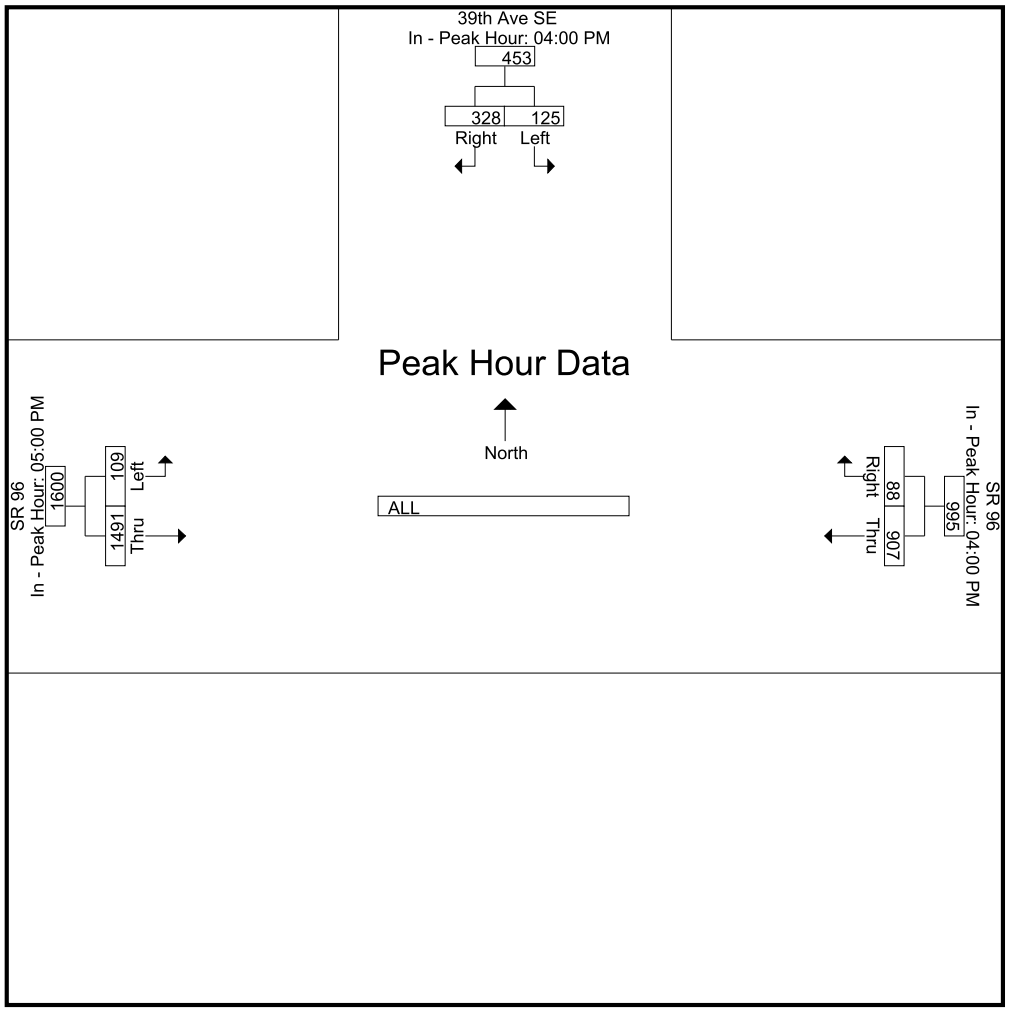
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1

Peak Hour for Each Approach Begins at:

	04:00 PM			04:00 PM			05:00 PM		
+0 mins.	85	**41**	**126**	15	249	**264**	385	28	413
+15 mins.	**86**	32	118	14	229	243	364	**37**	401
+30 mins.	81	28	109	**52**	176	228	339	29	368
+45 mins.	76	24	100	7	**253**	260	**403**	15	**418**
Total Volume	328	125	453	88	907	995	1491	109	1600
% App. Total	72.4	27.6		8.8	91.2		93.2	6.8	
PHF	.953	.762	.899	.423	.896	.942	.925	.736	.957

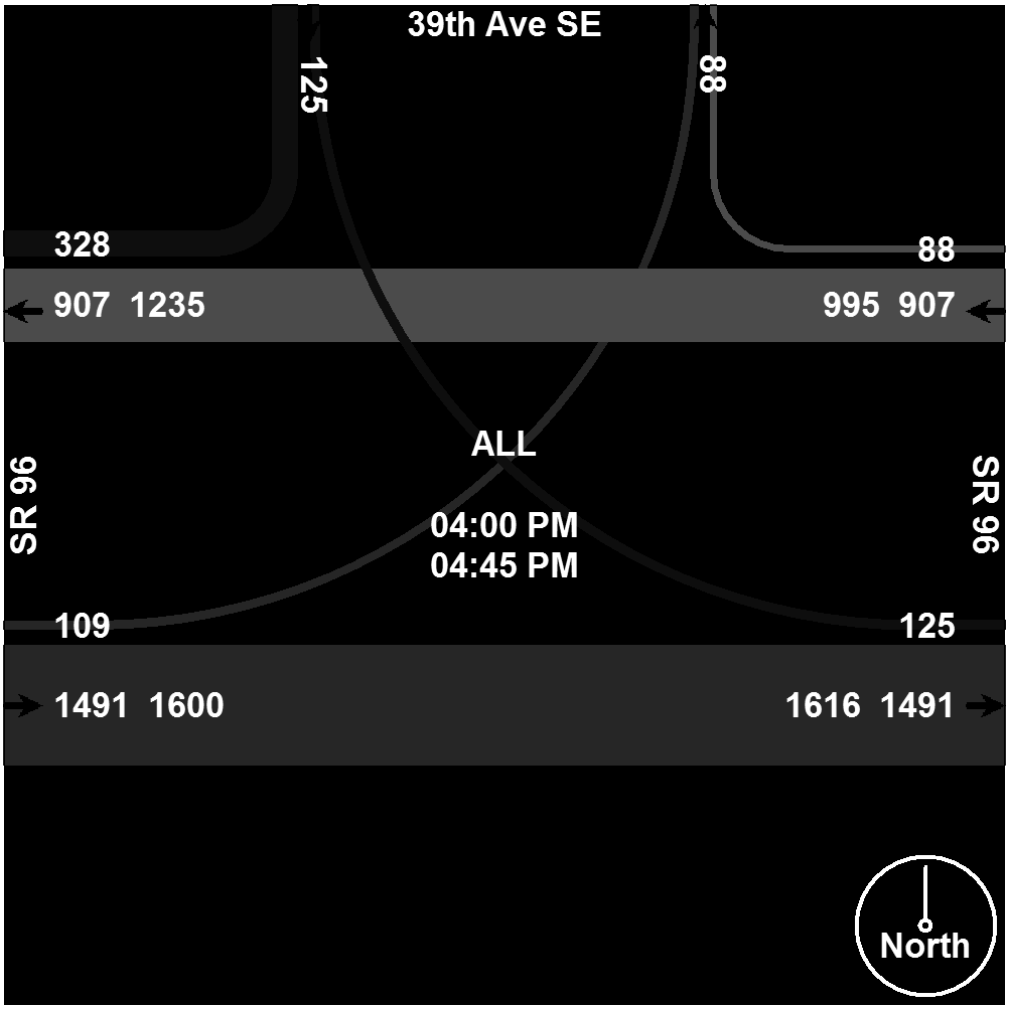
SR 96
Jct 39th Ave SE
Milepost 2.61

File Name : 09602613_(PM)2016-09-28-_SM
Site Code : 09602613
Start Date : 9/28/2016
Page No : 5



SR 96
Jct 39th Ave SE
Milepost 2.61

File Name : 09602613_(PM)2016-09-28-_SM
Site Code : 09602613
Start Date : 9/28/2016
Page No : 6



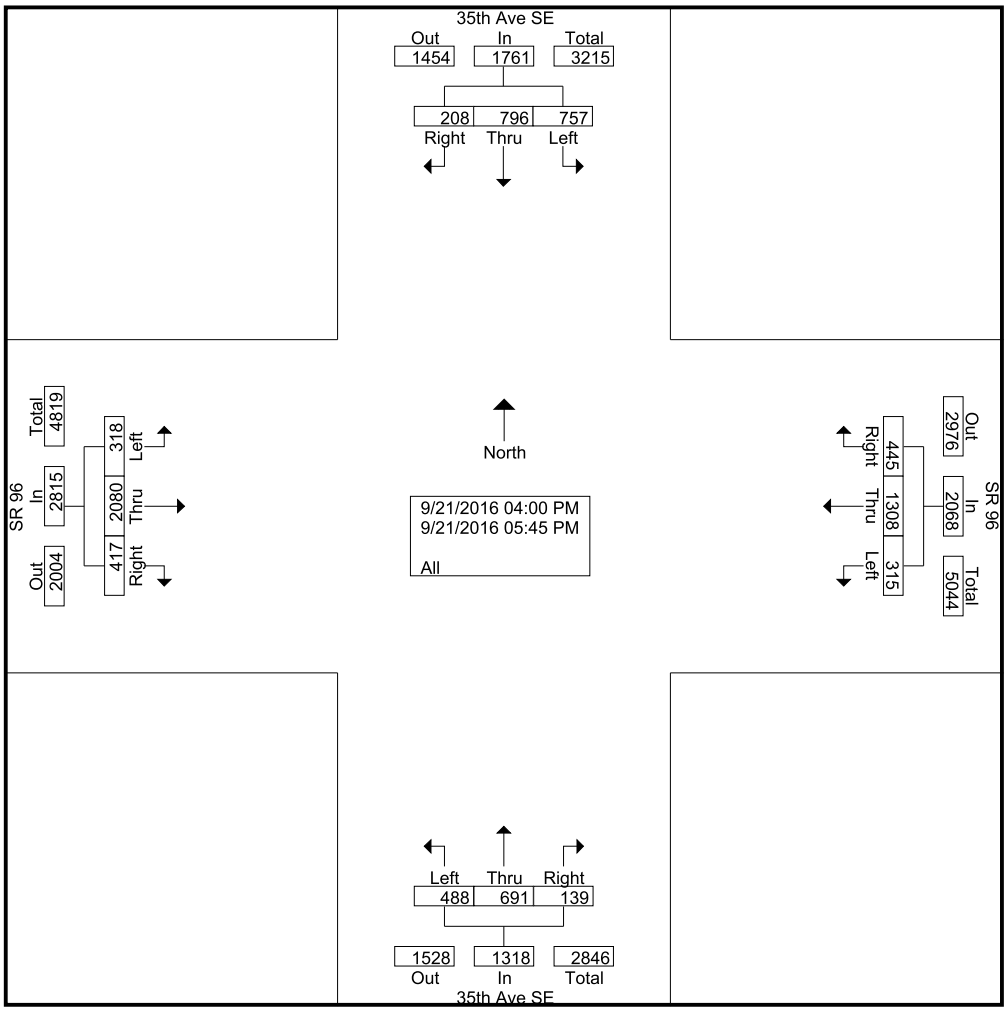
WASHINGTON STATE DEPT. OF TRANSPORTATION
Northwest Region - Traffic Studies

SR 96
Jct 35th Ave SE
MILEPOST 2.38

File Name : 09602383_(PM)2016-09-21_SM
Site Code : 09602383
Start Date : 9/21/2016
Page No : 1

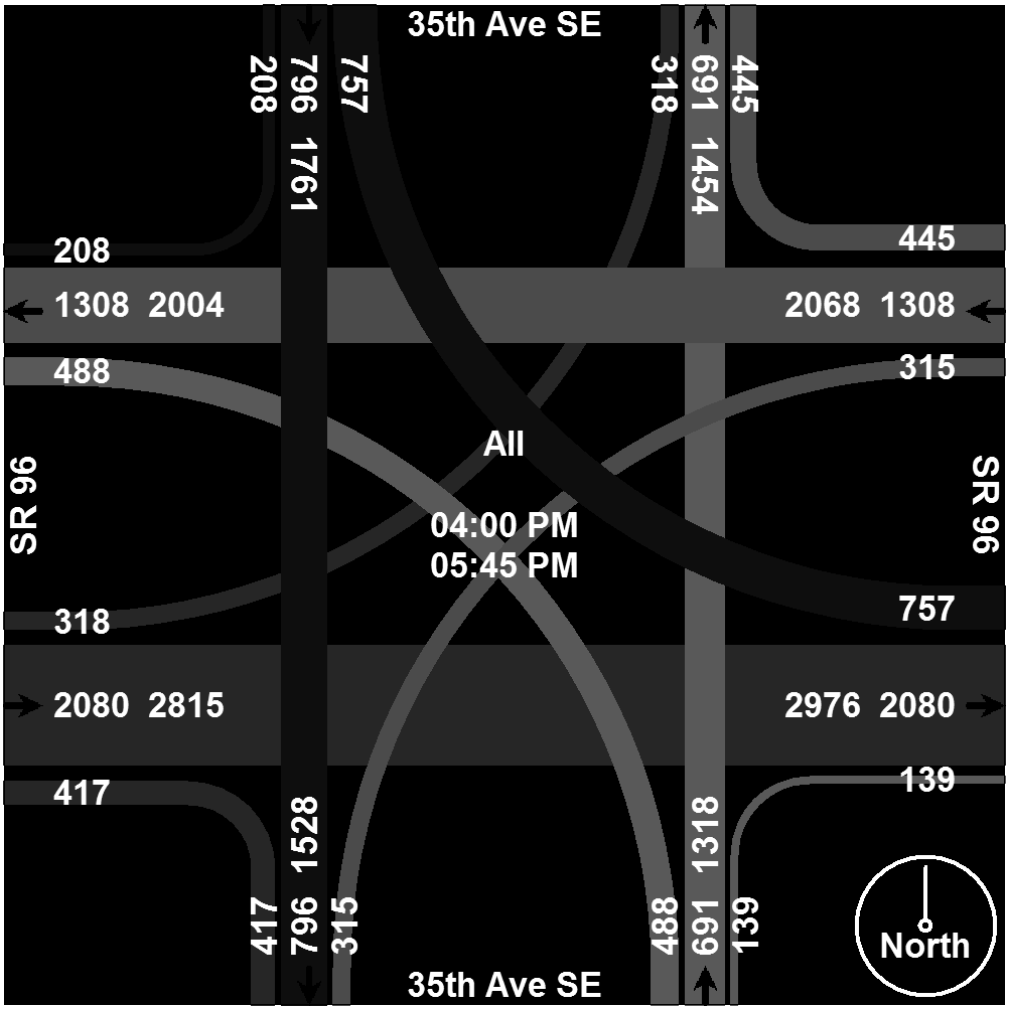
Groups Printed- All

	35th Ave SE From North				SR 96 From East				35th Ave SE From South				SR 96 From West				
Start Time	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
04:00 PM	27	67	78	172	82	208	54	344	27	89	66	182	36	227	45	308	1006
04:15 PM	22	100	73	195	35	145	39	219	26	87	65	178	43	257	44	344	936
04:30 PM	30	102	101	233	51	184	23	258	13	68	57	138	57	262	35	354	983
04:45 PM	24	107	89	220	58	148	25	231	19	90	63	172	52	255	40	347	970
Total	103	376	341	820	226	685	141	1052	85	334	251	670	188	1001	164	1353	3895
05:00 PM	29	99	122	250	61	130	49	240	22	71	55	148	61	261	34	356	994
05:15 PM	26	117	101	244	46	163	35	244	13	96	60	169	48	294	45	387	1044
05:30 PM	19	97	107	223	63	181	49	293	9	85	65	159	61	271	40	372	1047
05:45 PM	31	107	86	224	49	149	41	239	10	105	57	172	59	253	35	347	982
Total	105	420	416	941	219	623	174	1016	54	357	237	648	229	1079	154	1462	4067
Grand Total	208	796	757	1761	445	1308	315	2068	139	691	488	1318	417	2080	318	2815	7962
Apprch %	11.8	45.2	43		21.5	63.2	15.2		10.5	52.4	37		14.8	73.9	11.3		
Total %	2.6	10	9.5	22.1	5.6	16.4	4	26	1.7	8.7	6.1	16.6	5.2	26.1	4	35.4	



SR 96
Jct 35th Ave SE
MILEPOST 2.38

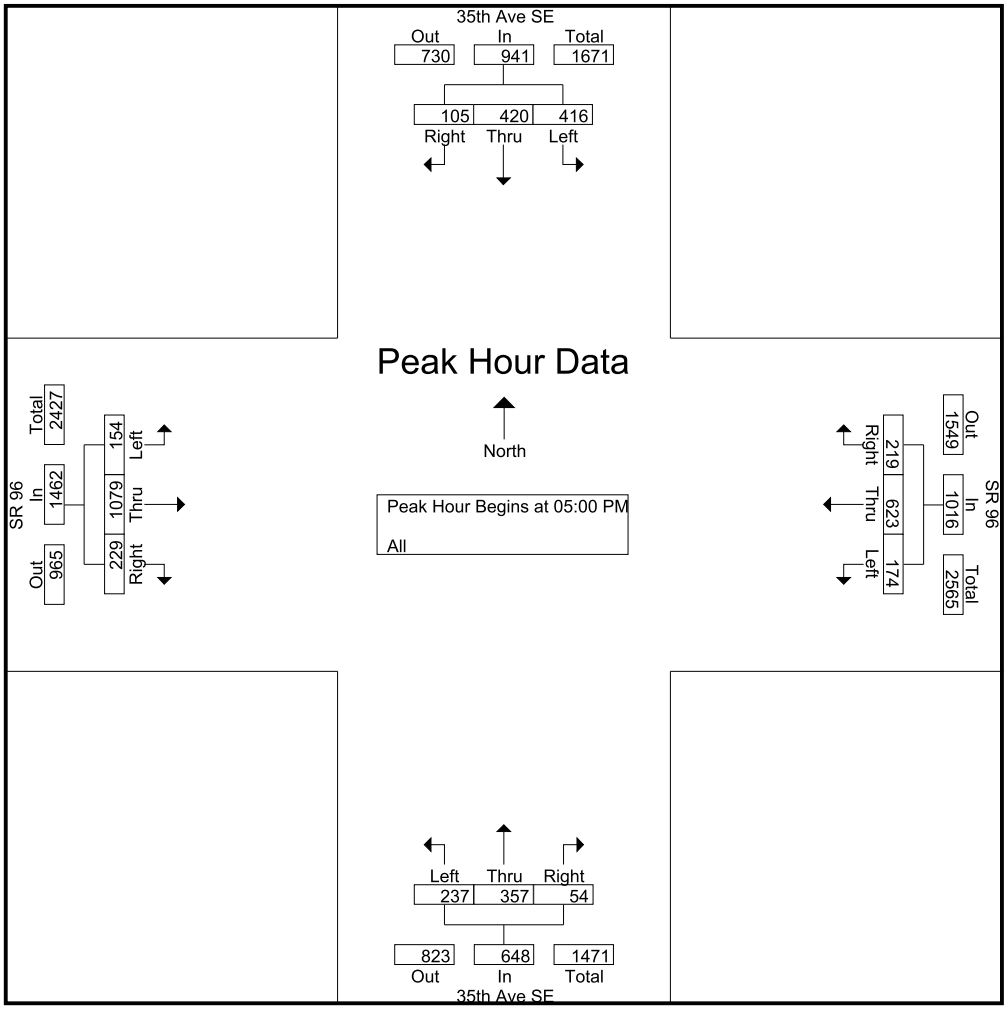
File Name : 09602383_(PM)2016-09-21_SM
Site Code : 09602383
Start Date : 9/21/2016



SR 96
Jct 35th Ave SE
MILEPOST 2.38

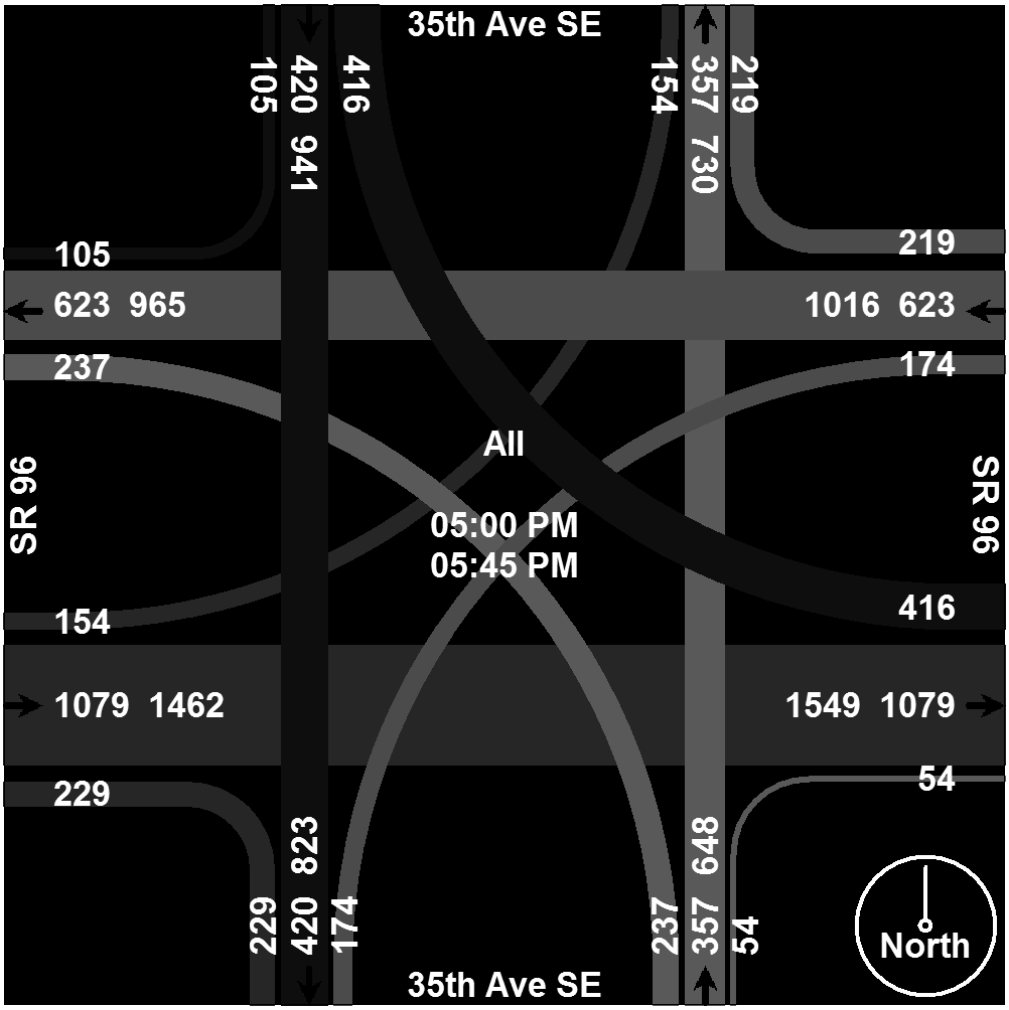
File Name : 09602383_(PM)2016-09-21_SM
Site Code : 09602383
Start Date : 9/21/2016

	35th Ave SE From North				SR 96 From East				35th Ave SE From South				SR 96 From West				
Start Time	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Right	Thru	Left	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 05:00 PM																	
05:00 PM	29	99	**122**	**250**	61	130	**49**	240	**22**	71	55	148	**61**	261	34	356	994
05:15 PM	26	**117**	101	244	46	163	35	244	13	96	60	169	48	**294**	**45**	**387**	1044
05:30 PM	19	97	107	223	**63**	**181**	49	**293**	9	85	**65**	159	61	271	40	372	**1047**
05:45 PM	**31**	107	86	224	49	149	41	239	10	**105**	57	**172**	59	253	35	347	982
Total Volume	105	420	416	941	219	623	174	1016	54	357	237	648	229	1079	154	1462	4067
% App. Total	11.2	44.6	44.2		21.6	61.3	17.1		8.3	55.1	36.6		15.7	73.8	10.5		
PHF	.847	.897	.852	.941	.869	.860	.888	.867	.614	.850	.912	.942	.939	.918	.856	.944	.971



SR 96
Jct 35th Ave SE
MILEPOST 2.38

File Name : 09602383_(PM)2016-09-21_SM
Site Code : 09602383
Start Date : 9/21/2016
Page No : 4



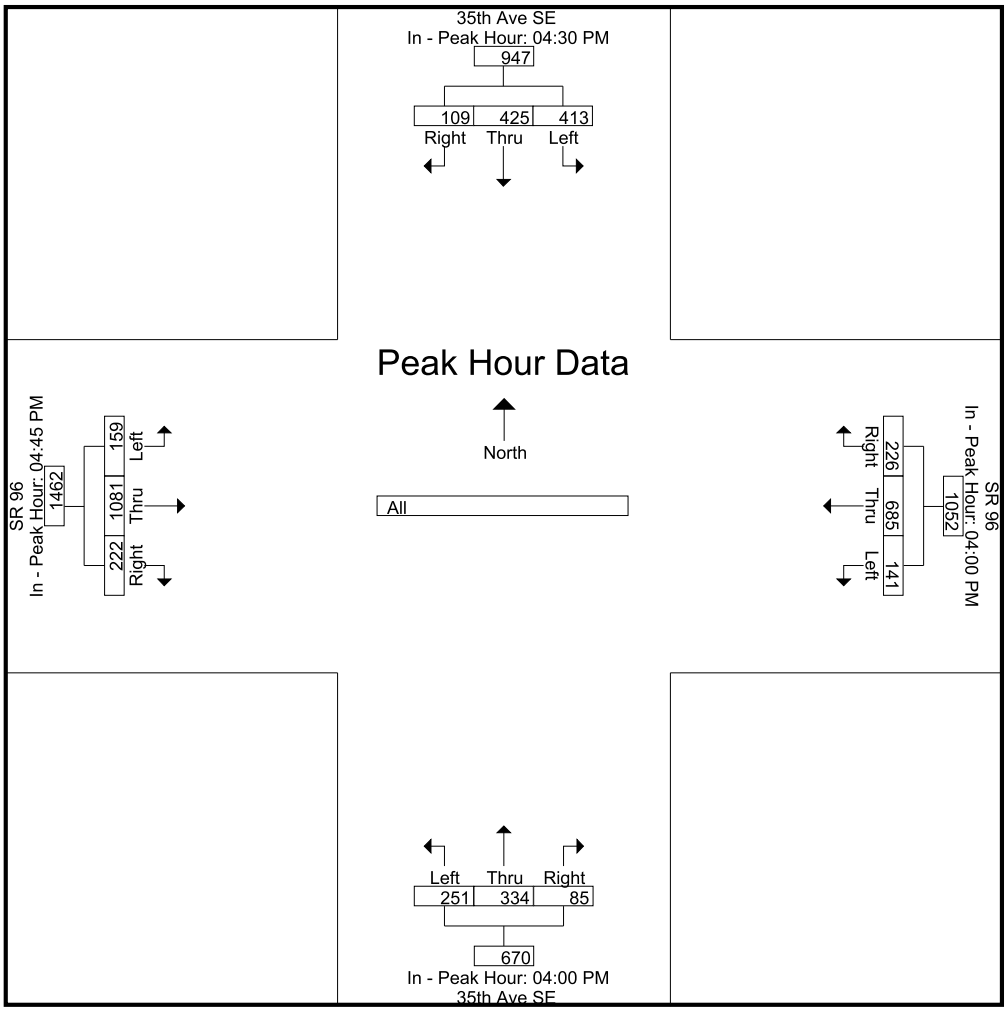
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1

Peak Hour for Each Approach Begins at:

	04:30 PM				04:00 PM				04:00 PM				04:45 PM			
+0 mins.	**30**	102	101	233	**82**	**208**	**54**	**344**	**27**	89	**66**	**182**	52	255	40	347
+15 mins.	24	107	89	220	35	145	39	219	26	87	65	178	**61**	261	34	356
+30 mins.	29	99	**122**	**250**	51	184	23	258	13	68	57	138	48	**294**	**45**	**387**
+45 mins.	26	**117**	101	244	58	148	25	231	19	**90**	63	172	61	271	40	372
Total Volume	109	425	413	947	226	685	141	1052	85	334	251	670	222	1081	159	1462
% App. Total	11.5	44.9	43.6		21.5	65.1	13.4		12.7	49.9	37.5		15.2	73.9	10.9	
PHF	.908	.908	.846	.947	.689	.823	.653	.765	.787	.928	.951	.920	.910	.919	.883	.944

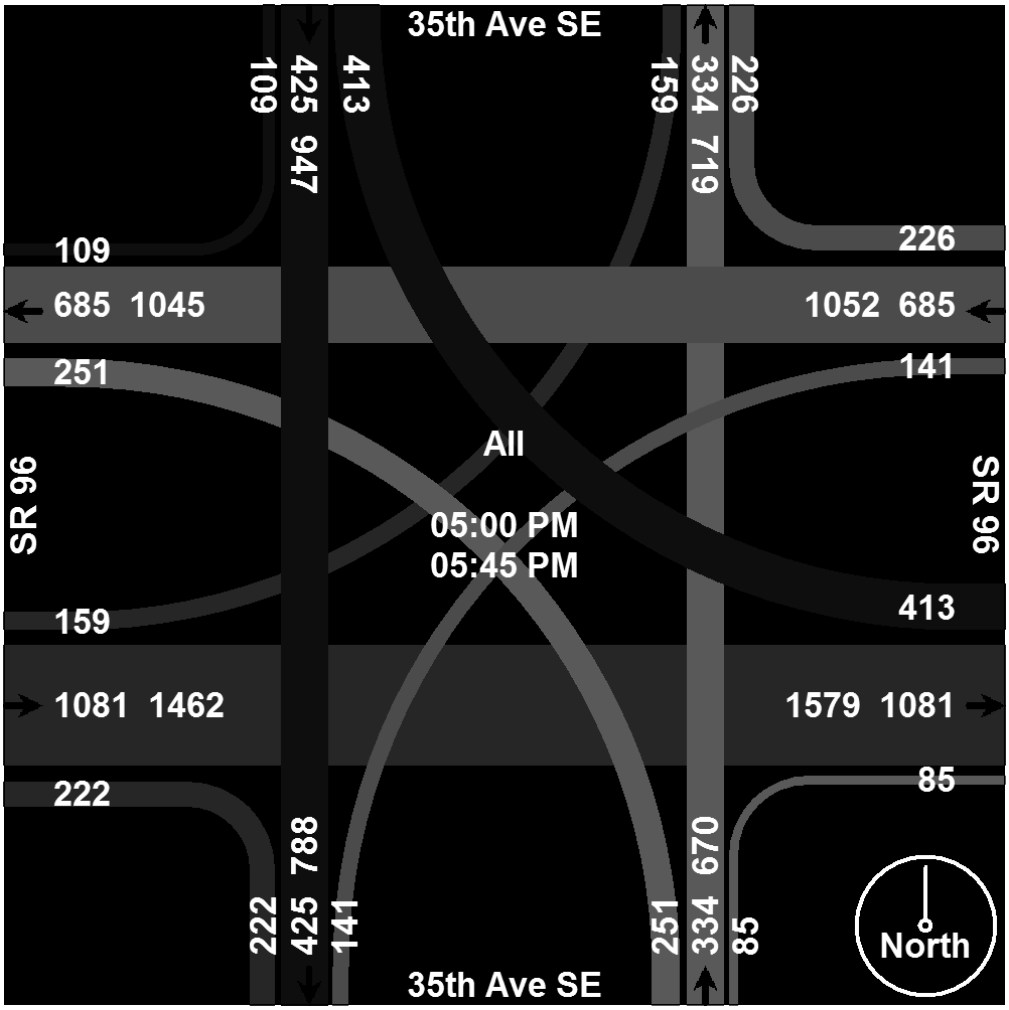
SR 96
Jct 35th Ave SE
MILEPOST 2.38

File Name : 09602383_(PM)2016-09-21_SM
Site Code : 09602383
Start Date : 9/21/2016
Page No : 5

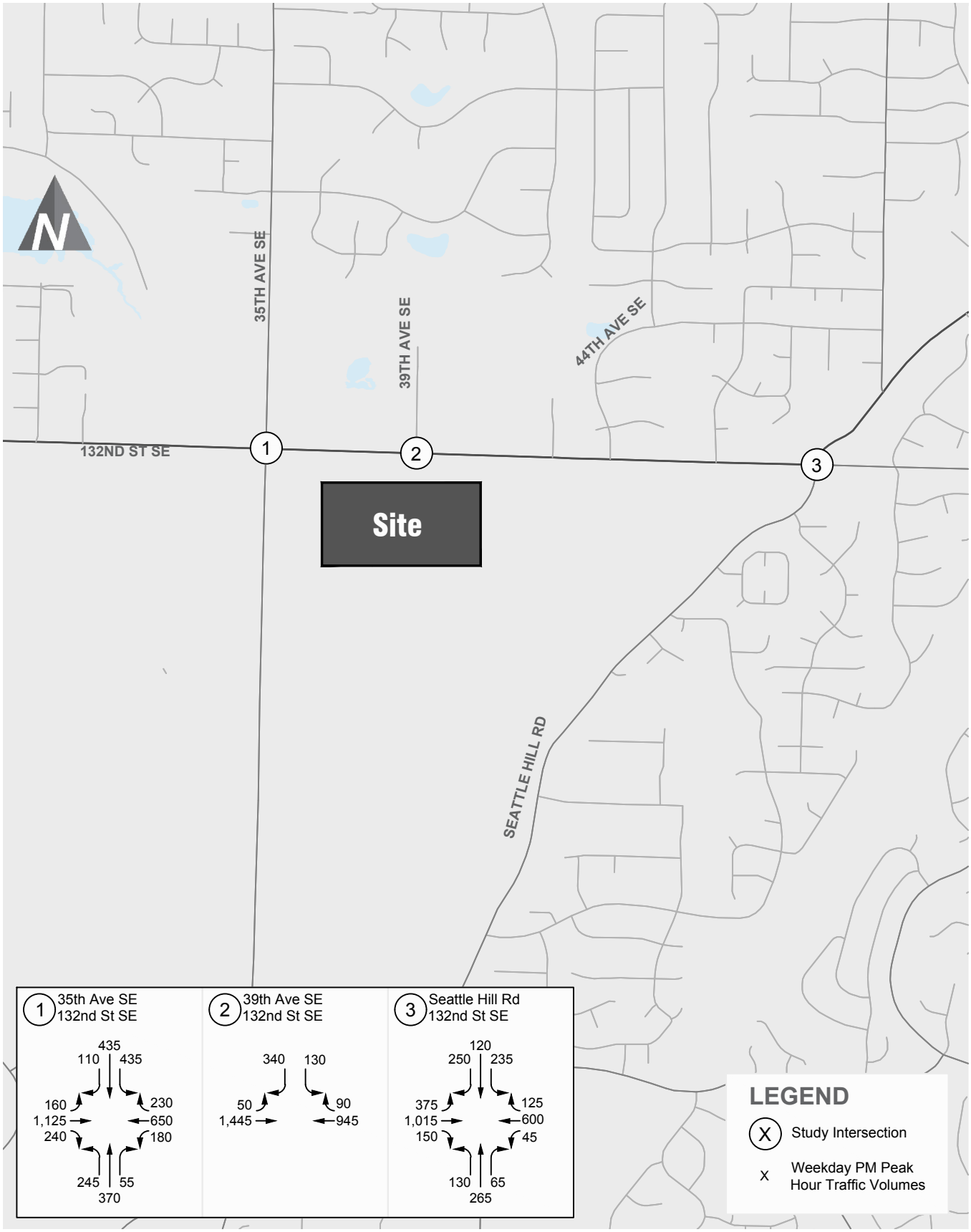


SR 96
Jct 35th Ave SE
MILEPOST 2.38

File Name : 09602383_(PM)2016-09-21_SM
Site Code : 09602383
Start Date : 9/21/2016
Page No : 6



Attachment D: Weekday PM Peak Hour Existing and Future Traffic Volumes



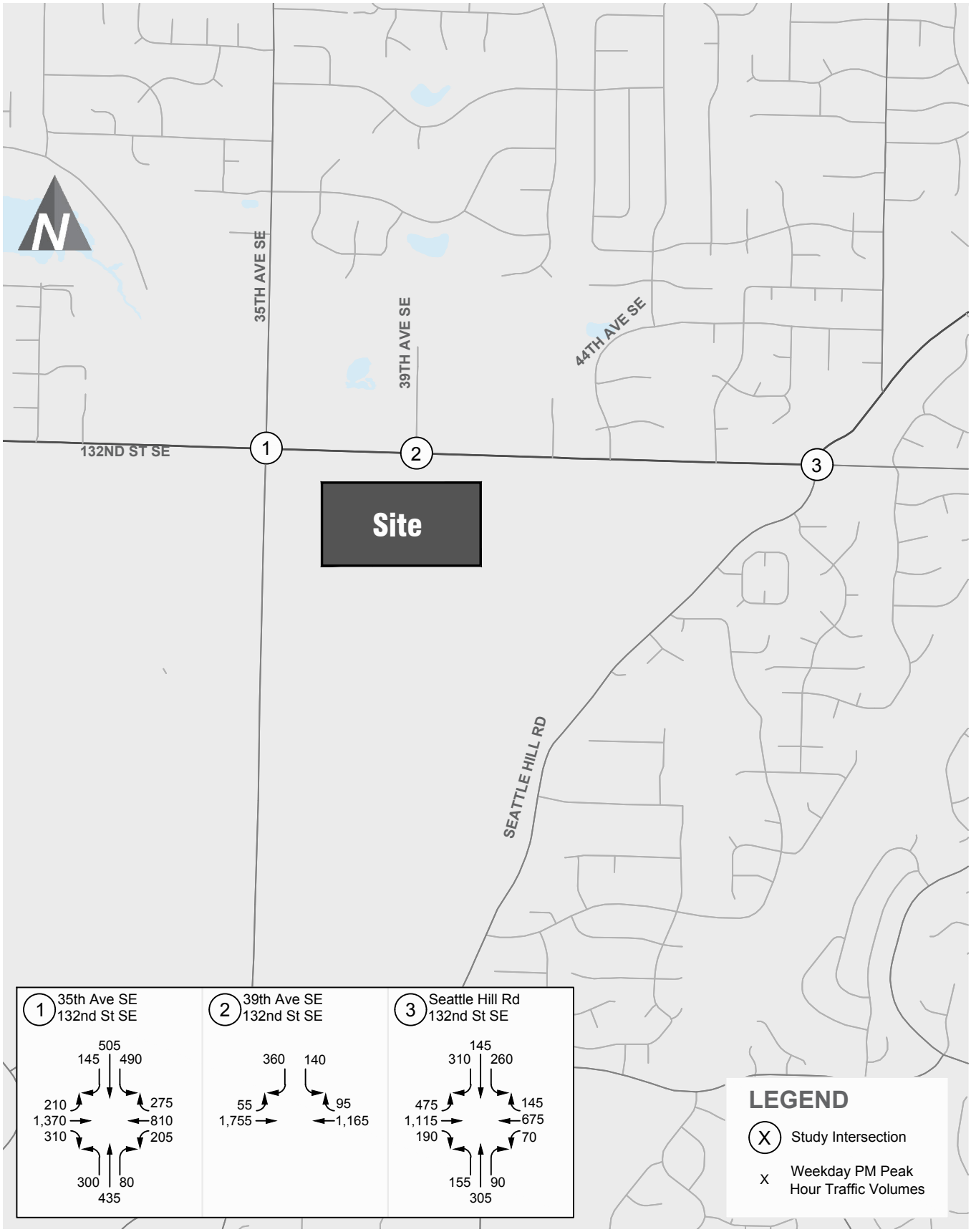
Existing PM Peak Hour Volumes

The Farm at Mill Creek

FIGURE **D1**

transpogroup

Aug 30, 2018 - 11:21am kassil M:\18\1.18029.00 - Eastgate Village at Mill Creek\Graphics\Graphics_18029 - Update.dwg Layout: Ex Vols



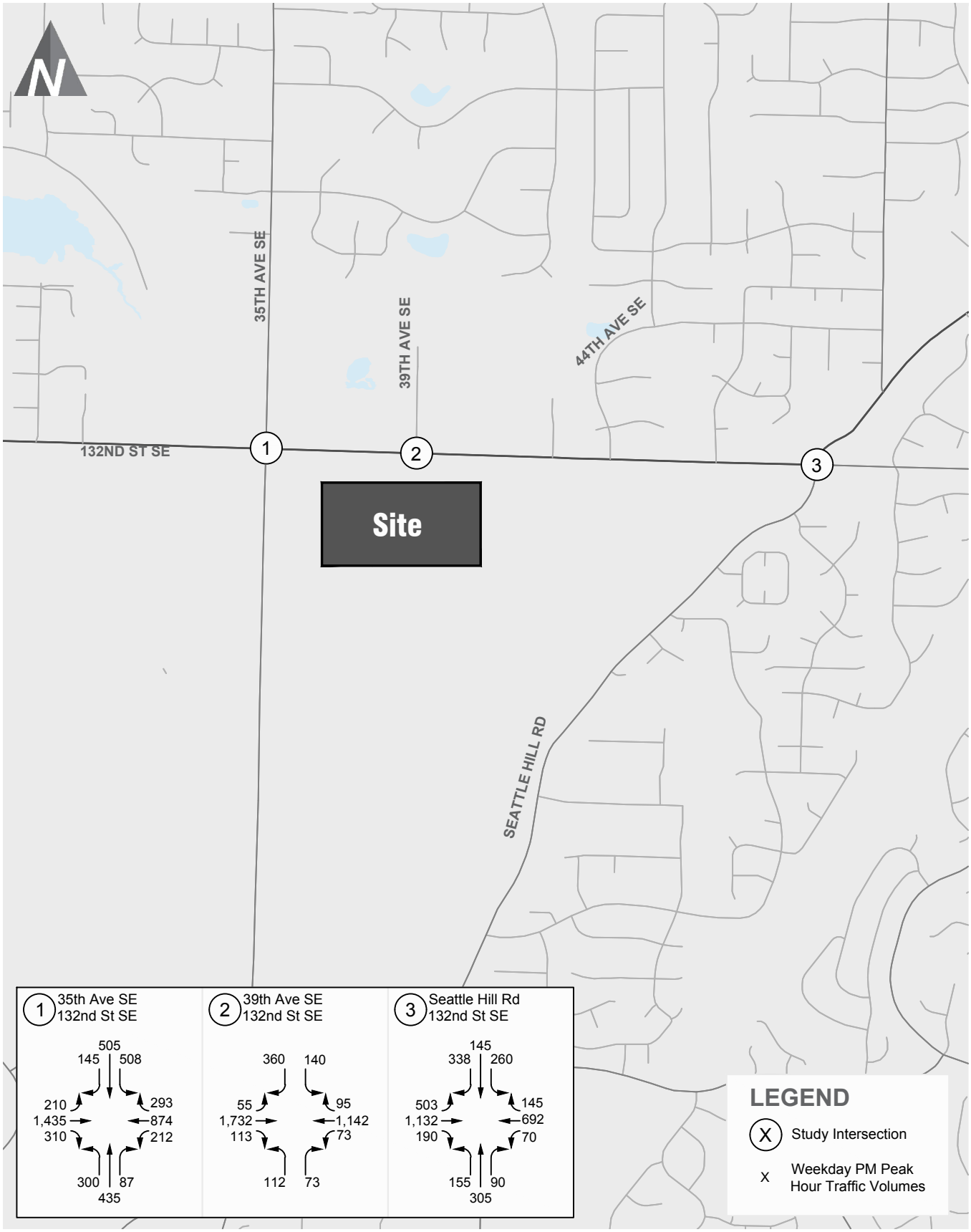
Future (2021) Without-Project PM Peak Hour Volumes

The Farm at Mill Creek

FIGURE **D2**

transpogroup

Aug 30, 2018 - 11:21am kassil M:\18\1.18029.00 - Eastgate Village at Mill Creek\Graphics\Graphics_18029 - Update.dwg Layout: Baseline Vols



Future (2021) With-Project PM Peak Hour Volumes

The Farm at Mill Creek

FIGURE **D3**

transpogroup

Attachment E: LOS Definitions

Highway Capacity Manual 2010

Signalized intersection level of service (LOS) is defined in terms of a weighted average control delay for the entire intersection. Control delay quantifies the increase in travel time that a vehicle experiences due to the traffic signal control as well as provides a surrogate measure for driver discomfort and fuel consumption. Signalized intersection LOS is stated in terms of average control delay per vehicle (in seconds) during a specified time period (e.g., weekday PM peak hour). Control delay is a complex measure based on many variables, including signal phasing and coordination (i.e., progression of movements through the intersection and along the corridor), signal cycle length, and traffic volumes with respect to intersection capacity and resulting queues. Table 1 summarizes the LOS criteria for signalized intersections, as described in the *Highway Capacity Manual 2010* (Transportation Research Board, 2010).

Table 1. Level of Service Criteria for Signalized Intersections

Level of Service	Average Control Delay (seconds/vehicle)	General Description
A	≤10	Free Flow
B	>10 – 20	Stable Flow (slight delays)
C	>20 – 35	Stable flow (acceptable delays)
D	>35 – 55	Approaching unstable flow (tolerable delay, occasionally wait through more than one signal cycle before proceeding)
E	>55 – 80	Unstable flow (intolerable delay)
F[1]	>80	Forced flow (congested and queues fail to clear)

Source: *Highway Capacity Manual 2010*, Transportation Research Board, 2010.

1. If the volume-to-capacity (v/c) ratio for a lane group exceeds 1.0 LOS F is assigned to the individual lane group. LOS for overall approach or intersection is determined solely by the control delay.

Unsignalized intersection LOS criteria can be further reduced into two intersection types: all-way stop and two-way stop control. All-way stop control intersection LOS is expressed in terms of the weighted average control delay of the overall intersection or by approach. Two-way stop-controlled intersection LOS is defined in terms of the average control delay for each minor-street movement (or shared movement) as well as major-street left-turns. This approach is because major-street through vehicles are assumed to experience zero delay, a weighted average of all movements results in very low overall average delay, and this calculated low delay could mask deficiencies of minor movements. Table 2 shows LOS criteria for unsignalized intersections.

Table 2. Level of Service Criteria for Unsignalized Intersections

Level of Service	Average Control Delay (seconds/vehicle)
A	0 – 10
B	>10 – 15
C	>15 – 25
D	>25 – 35
E	>35 – 50
F[1]	>50

Source: *Highway Capacity Manual 2010*, Transportation Research Board, 2010.

1. If the volume-to-capacity (v/c) ratio exceeds 1.0, LOS F is assigned an individual lane group for all unsignalized intersections, or minor street approach at two-way stop-controlled intersections. Overall intersection LOS is determined solely by control delay.

Attachment F: LOS Worksheets

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	160	1125	240	180	650	230	245	370	55	435	435	110
Future Volume (veh/h)	160	1125	240	180	650	230	245	370	55	435	435	110
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863
Adj Flow Rate, veh/h	165	1160	247	186	670	237	253	381	57	448	448	113
Adj No. of Lanes	1	2	1	1	2	1	1	1	1	2	1	1
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	171	1390	622	171	1390	622	231	428	364	447	428	364
Arrive On Green	0.10	0.39	0.39	0.10	0.39	0.39	0.13	0.23	0.23	0.13	0.23	0.23
Sat Flow, veh/h	1774	3539	1583	1774	3539	1583	1774	1863	1583	3442	1863	1583
Grp Volume(v), veh/h	165	1160	247	186	670	237	253	381	57	448	448	113
Grp Sat Flow(s),veh/h/ln	1774	1770	1583	1774	1770	1583	1774	1863	1583	1721	1863	1583
Q Serve(g_s), s	13.9	44.4	16.8	14.5	21.3	16.0	19.5	29.7	4.3	19.5	34.5	8.9
Cycle Q Clear(g_c), s	13.9	44.4	16.8	14.5	21.3	16.0	19.5	29.7	4.3	19.5	34.5	8.9
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	171	1390	622	171	1390	622	231	428	364	447	428	364
V/C Ratio(X)	0.96	0.83	0.40	1.08	0.48	0.38	1.10	0.89	0.16	1.00	1.05	0.31
Avail Cap(c_a), veh/h	171	1390	622	171	1390	622	231	428	364	447	428	364
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	0.84	0.84	0.84	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	67.5	41.2	32.8	67.8	34.1	32.5	65.3	55.9	46.1	65.3	57.8	47.9
Incr Delay (d2), s/veh	57.1	6.0	1.9	87.4	1.0	1.5	87.6	23.1	0.9	42.9	55.9	0.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	9.5	22.9	7.7	11.3	10.6	7.2	15.2	18.0	2.0	11.9	24.4	3.9
LnGrp Delay(d),s/veh	124.5	47.2	34.7	155.1	35.1	34.0	152.9	79.0	47.0	108.1	113.7	48.2
LnGrp LOS	F	D	C	F	D	C	F	E	D	F	F	D
Approach Vol, veh/h		1572			1093			691			1009	
Approach Delay, s/veh		53.3			55.3			103.4			103.9	
Approach LOS		D			E			F			F	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	20.0	65.0	25.0	40.0	20.0	65.0	25.0	40.0
Change Period (Y+Rc), s	5.5	* 6.1	5.5	5.5	5.5	* 6.1	5.5	5.5
Max Green Setting (Gmax), s	14.5	* 59	19.5	34.5	14.5	* 59	19.5	34.5
Max Q Clear Time (g_c+I1), s	16.5	46.4	21.5	36.5	15.9	23.3	21.5	31.7
Green Ext Time (p_c), s	0.0	11.2	0.0	0.0	0.0	27.6	0.0	1.4

Intersection Summary	
HCM 2010 Ctrl Delay	73.4
HCM 2010 LOS	E

Notes

User approved pedestrian interval to be less than phase max green.

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	50	1445	945	90	130	340
Future Volume (veh/h)	50	1445	945	90	130	340
Number	5	2	6	16	7	14
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00			1.00	1.00	1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1863	1900	1863	1863
Adj Flow Rate, veh/h	55	1588	1038	99	143	374
Adj No. of Lanes	1	2	2	0	1	1
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	71	2451	2011	192	408	364
Arrive On Green	0.08	1.00	0.62	0.62	0.23	0.23
Sat Flow, veh/h	1774	3632	3359	311	1774	1583
Grp Volume(v), veh/h	55	1588	562	575	143	374
Grp Sat Flow(s),veh/h/ln	1774	1770	1770	1808	1774	1583
Q Serve(g_s), s	4.6	0.0	26.8	26.9	10.1	34.5
Cycle Q Clear(g_c), s	4.6	0.0	26.8	26.9	10.1	34.5
Prop In Lane	1.00			0.17	1.00	1.00
Lane Grp Cap(c), veh/h	71	2451	1090	1113	408	364
V/C Ratio(X)	0.77	0.65	0.52	0.52	0.35	1.03
Avail Cap(c_a), veh/h	384	2451	1090	1113	408	364
HCM Platoon Ratio	2.00	2.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.40	0.40	0.57	0.57	1.00	1.00
Uniform Delay (d), s/veh	68.3	0.0	16.2	16.2	48.4	57.8
Incr Delay (d2), s/veh	8.3	0.5	1.0	1.0	0.6	54.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.4	0.2	13.4	13.7	5.0	32.2
LnGrp Delay(d),s/veh	76.6	0.5	17.2	17.2	49.0	112.0
LnGrp LOS	E	A	B	B	D	F
Approach Vol, veh/h		1643	1137		517	
Approach Delay, s/veh		3.1	17.2		94.6	
Approach LOS		A	B		F	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4	5	6		
Phs Duration (G+Y+Rc), s		110.0		40.0	11.5	98.5		
Change Period (Y+Rc), s		* 6.1		5.5	5.5	* 6.1		
Max Green Setting (Gmax), s		* 1E2		34.5	32.5	* 66		
Max Q Clear Time (g_c+I1), s		2.0		36.5	6.6	28.9		
Green Ext Time (p_c), s		78.9		0.0	0.1	33.5		

Intersection Summary	
HCM 2010 Ctrl Delay	22.3
HCM 2010 LOS	C

Notes

* HCM 2010 computational engine requires equal clearance times for the phases crossing the barrier.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	375	1015	150	45	600	125	130	265	65	235	120	250
Future Volume (veh/h)	375	1015	150	45	600	125	130	265	65	235	120	250
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.97	1.00		0.96	1.00		0.98	1.00		0.97
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1881	1881	1900	1845	1845	1900	1863	1863	1863	1881	1881	1881
Adj Flow Rate, veh/h	399	1080	160	48	638	133	138	282	69	250	232	197
Adj No. of Lanes	1	2	0	1	2	0	1	1	1	1	1	1
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
Percent Heavy Veh, %	1	1	1	3	3	3	2	2	2	1	1	1
Cap, veh/h	428	1471	217	62	771	160	282	296	246	287	302	248
Arrive On Green	0.24	0.47	0.47	0.04	0.27	0.27	0.16	0.16	0.16	0.16	0.16	0.16
Sat Flow, veh/h	1792	3110	460	1757	2868	597	1774	1863	1550	1792	1881	1545
Grp Volume(v), veh/h	399	620	620	48	389	382	138	282	69	250	232	197
Grp Sat Flow(s),veh/h/ln	1792	1787	1783	1757	1752	1712	1774	1863	1550	1792	1881	1545
Q Serve(g_s), s	28.7	36.8	37.1	3.6	27.5	27.6	9.3	19.8	5.2	17.9	15.6	16.2
Cycle Q Clear(g_c), s	28.7	36.8	37.1	3.6	27.5	27.6	9.3	19.8	5.2	17.9	15.6	16.2
Prop In Lane	1.00		0.26	1.00		0.35	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	428	845	843	62	471	460	282	296	246	287	302	248
V/C Ratio(X)	0.93	0.73	0.74	0.78	0.83	0.83	0.49	0.95	0.28	0.87	0.77	0.80
Avail Cap(c_a), veh/h	510	881	879	113	478	467	282	296	246	312	327	269
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	49.1	28.0	28.1	63.0	45.3	45.3	50.5	54.9	48.8	54.0	53.0	53.2
Incr Delay (d2), s/veh	22.0	3.4	3.4	7.7	11.8	12.2	1.0	39.8	0.5	20.8	9.3	13.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	16.8	18.9	19.1	1.9	14.8	14.6	4.7	13.5	2.3	10.5	8.9	7.9
LnGrp Delay(d),s/veh	71.1	31.4	31.5	70.7	57.0	57.5	51.5	94.7	49.2	74.7	62.3	66.8
LnGrp LOS	E	C	C	E	E	E	D	F	D	E	E	E
Approach Vol, veh/h		1639			819			489			679	
Approach Delay, s/veh		41.1			58.1			76.1			68.2	
Approach LOS		D			E			E			E	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	10.1	68.4		26.7	37.0	41.5		26.5
Change Period (Y+Rc), s	5.5	* 6.1		5.6	5.5	* 6.1		5.6
Max Green Setting (Gmax), s	8.5	* 65		22.9	37.5	* 36		20.9
Max Q Clear Time (g_c+I1), s	5.6	39.1		19.9	30.7	29.6		21.8
Green Ext Time (p_c), s	0.0	20.1		0.8	0.8	5.7		0.0

Intersection Summary	
HCM 2010 Ctrl Delay	54.7
HCM 2010 LOS	D

Notes

User approved pedestrian interval to be less than phase max green.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	210	1370	310	205	810	275	300	435	80	490	505	145
Future Volume (veh/h)	210	1370	310	205	810	275	300	435	80	490	505	145
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863
Adj Flow Rate, veh/h	216	1412	320	211	835	284	309	448	82	505	521	149
Adj No. of Lanes	1	2	1	1	2	1	1	1	1	2	1	1
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	238	1319	590	276	1409	630	330	575	489	498	498	423
Arrive On Green	0.13	0.37	0.37	0.31	0.80	0.80	0.19	0.31	0.31	0.14	0.27	0.27
Sat Flow, veh/h	1774	3539	1583	1774	3539	1583	1774	1863	1583	3442	1863	1583
Grp Volume(v), veh/h	216	1412	320	211	835	284	309	448	82	505	521	149
Grp Sat Flow(s),veh/h/ln	1774	1770	1583	1774	1770	1583	1774	1863	1583	1721	1863	1583
Q Serve(g_s), s	18.0	55.9	19.0	16.1	13.7	7.3	25.7	32.8	5.7	21.7	40.1	11.4
Cycle Q Clear(g_c), s	18.0	55.9	19.0	16.1	13.7	7.3	25.7	32.8	5.7	21.7	40.1	11.4
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	238	1319	590	276	1409	630	330	575	489	498	498	423
V/C Ratio(X)	0.91	1.07	0.54	0.77	0.59	0.45	0.94	0.78	0.17	1.01	1.05	0.35
Avail Cap(c_a), veh/h	271	1319	590	276	1409	630	373	575	489	498	498	423
HCM Platoon Ratio	1.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	0.76	0.76	0.76	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	64.0	47.0	23.5	49.2	10.6	7.4	60.1	47.2	37.8	64.1	55.0	44.5
Incr Delay (d2), s/veh	28.1	46.0	3.6	8.6	1.4	1.8	27.7	10.0	0.7	44.0	53.3	0.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	10.7	35.7	8.8	8.5	6.8	3.3	15.2	18.5	2.6	13.3	28.0	5.0
LnGrp Delay(d),s/veh	92.1	93.1	27.0	57.8	12.0	9.2	87.8	57.2	38.5	108.1	108.2	44.8
LnGrp LOS	F	F	C	E	B	A	F	E	D	F	F	D
Approach Vol, veh/h		1948			1330			839			1175	
Approach Delay, s/veh		82.1			18.7			66.7			100.1	
Approach LOS		F			B			E			F	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	30.0	62.0	33.4	45.6	25.6	66.4	27.2	51.8
Change Period (Y+Rc), s	* 6.1	* 6.1	5.5	5.5	5.5	* 6.1	5.5	5.5
Max Green Setting (Gmax), s	* 3.5	* 56	31.5	36.5	22.9	* 37	21.7	46.3
Max Q Clear Time (g_c+I1), s	18.1	57.9	27.7	42.1	20.0	15.7	23.7	34.8
Green Ext Time (p_c), s	0.0	0.0	0.2	0.0	0.1	9.9	0.0	2.0

Intersection Summary	
HCM 2010 Ctrl Delay	67.7
HCM 2010 LOS	E

Notes

User approved pedestrian interval to be less than phase max green.

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	55	1755	1165	95	140	360
Future Volume (veh/h)	55	1755	1165	95	140	360
Number	5	2	6	16	7	14
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00			1.00	1.00	1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1863	1900	1863	1863
Adj Flow Rate, veh/h	60	1929	1280	104	154	396
Adj No. of Lanes	1	2	2	0	1	1
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91
Percent Heavy Veh, %	2	2	2	2	2	2
Cap, veh/h	77	2451	2031	165	408	364
Arrive On Green	0.09	1.00	0.61	0.61	0.23	0.23
Sat Flow, veh/h	1774	3632	3409	269	1774	1583
Grp Volume(v), veh/h	60	1929	682	702	154	396
Grp Sat Flow(s),veh/h/ln	1774	1770	1770	1815	1774	1583
Q Serve(g_s), s	5.0	0.0	36.4	36.7	11.0	34.5
Cycle Q Clear(g_c), s	5.0	0.0	36.4	36.7	11.0	34.5
Prop In Lane	1.00			0.15	1.00	1.00
Lane Grp Cap(c), veh/h	77	2451	1084	1112	408	364
V/C Ratio(X)	0.78	0.79	0.63	0.63	0.38	1.09
Avail Cap(c_a), veh/h	384	2451	1084	1112	408	364
HCM Platoon Ratio	2.00	2.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.09	0.09	0.40	0.40	1.00	1.00
Uniform Delay (d), s/veh	67.7	0.0	18.3	18.4	48.7	57.8
Incr Delay (d2), s/veh	1.8	0.2	1.1	1.1	0.7	72.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.5	0.1	18.1	18.7	5.5	34.1
LnGrp Delay(d),s/veh	69.6	0.2	19.4	19.5	49.4	130.4
LnGrp LOS	E	A	B	B	D	F
Approach Vol, veh/h		1989	1384		550	
Approach Delay, s/veh		2.3	19.5		107.7	
Approach LOS		A	B		F	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4	5	6		
Phs Duration (G+Y+Rc), s		110.0		40.0	12.0	98.0		
Change Period (Y+Rc), s		* 6.1		5.5	5.5	* 6.1		
Max Green Setting (Gmax), s		* 1E2		34.5	32.5	* 66		
Max Q Clear Time (g_c+I1), s		2.0		36.5	7.0	38.7		
Green Ext Time (p_c), s		93.5		0.0	0.2	26.5		

Intersection Summary	
HCM 2010 Ctrl Delay	23.2
HCM 2010 LOS	C

Notes

* HCM 2010 computational engine requires equal clearance times for the phases crossing the barrier.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	475	1115	190	70	675	145	155	305	90	260	145	310
Future Volume (veh/h)	475	1115	190	70	675	145	155	305	90	260	145	310
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.97	1.00		0.96	1.00		0.98	1.00		0.97
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1881	1881	1900	1845	1845	1900	1863	1863	1863	1881	1881	1881
Adj Flow Rate, veh/h	505	1186	202	74	718	154	165	324	96	277	286	242
Adj No. of Lanes	1	2	0	1	2	0	1	1	1	1	1	1
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
Percent Heavy Veh, %	1	1	1	3	3	3	2	2	2	1	1	1
Cap, veh/h	480	1435	243	93	731	157	265	278	231	293	308	253
Arrive On Green	0.27	0.47	0.47	0.05	0.26	0.26	0.15	0.15	0.15	0.16	0.16	0.16
Sat Flow, veh/h	1792	3043	515	1757	2850	611	1774	1863	1548	1792	1881	1546
Grp Volume(v), veh/h	505	693	695	74	441	431	165	324	96	277	286	242
Grp Sat Flow(s),veh/h/ln	1792	1787	1771	1757	1752	1708	1774	1863	1548	1792	1881	1546
Q Serve(g_s), s	37.5	46.9	47.7	5.8	35.1	35.1	12.2	20.9	7.9	21.4	21.0	21.7
Cycle Q Clear(g_c), s	37.5	46.9	47.7	5.8	35.1	35.1	12.2	20.9	7.9	21.4	21.0	21.7
Prop In Lane	1.00		0.29	1.00		0.36	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	480	843	835	93	449	438	265	278	231	293	308	253
V/C Ratio(X)	1.05	0.82	0.83	0.80	0.98	0.98	0.62	1.17	0.42	0.95	0.93	0.96
Avail Cap(c_a), veh/h	480	843	835	107	449	438	265	278	231	293	308	253
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	51.3	32.0	32.2	65.6	51.7	51.7	55.9	59.5	54.0	57.9	57.8	58.1
Incr Delay (d2), s/veh	55.5	6.9	7.5	26.0	37.8	38.5	4.0	106.2	0.9	37.9	33.2	44.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	25.9	24.7	25.1	3.5	21.6	21.2	6.3	18.9	3.4	13.7	13.7	12.4
LnGrp Delay(d),s/veh	106.8	38.9	39.6	91.5	89.5	90.3	59.9	165.8	54.9	95.8	91.0	102.6
LnGrp LOS	F	D	D	F	F	F	E	F	D	F	F	F
Approach Vol, veh/h		1893			946			585			805	
Approach Delay, s/veh		57.3			90.0			117.7			96.1	
Approach LOS		E			F			F			F	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	12.9	72.1		28.5	43.0	42.0		26.5
Change Period (Y+Rc), s	5.5	* 6.1		5.6	5.5	* 6.1		5.6
Max Green Setting (Gmax), s	8.5	* 65		22.9	37.5	* 36		20.9
Max Q Clear Time (g_c+I1), s	7.8	49.7		23.7	39.5	37.1		22.9
Green Ext Time (p_c), s	0.0	13.6		0.0	0.0	0.0		0.0

Intersection Summary	
HCM 2010 Ctrl Delay	80.3
HCM 2010 LOS	F

Notes

User approved pedestrian interval to be less than phase max green.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	210	1435	310	212	874	293	300	435	87	508	505	145
Future Volume (veh/h)	210	1435	310	212	874	293	300	435	87	508	505	145
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863	1863
Adj Flow Rate, veh/h	216	1479	320	219	901	302	309	448	90	524	521	149
Adj No. of Lanes	1	2	1	1	2	1	1	1	1	2	1	1
Peak Hour Factor	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	239	1295	580	287	1406	629	332	540	459	562	496	422
Arrive On Green	0.13	0.37	0.37	0.32	0.79	0.79	0.19	0.29	0.29	0.16	0.27	0.27
Sat Flow, veh/h	1774	3539	1583	1774	3539	1583	1774	1863	1583	3442	1863	1583
Grp Volume(v), veh/h	216	1479	320	219	901	302	309	448	90	524	521	149
Grp Sat Flow(s),veh/h/ln	1774	1770	1583	1774	1770	1583	1774	1863	1583	1721	1863	1583
Q Serve(g_s), s	18.0	54.9	19.2	16.6	16.0	7.8	25.7	33.7	6.4	22.5	39.9	11.4
Cycle Q Clear(g_c), s	18.0	54.9	19.2	16.6	16.0	7.8	25.7	33.7	6.4	22.5	39.9	11.4
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	239	1295	580	287	1406	629	332	540	459	562	496	422
V/C Ratio(X)	0.90	1.14	0.55	0.76	0.64	0.48	0.93	0.83	0.20	0.93	1.05	0.35
Avail Cap(c_a), veh/h	336	1295	580	287	1406	629	438	540	459	562	496	422
HCM Platoon Ratio	1.00	1.00	1.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	0.60	0.60	0.60	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	64.0	47.5	24.0	48.1	10.9	7.0	60.0	49.8	40.1	61.9	55.0	44.6
Incr Delay (d2), s/veh	17.4	73.5	3.8	6.4	1.4	1.6	20.4	13.7	1.0	22.5	54.3	0.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	10.0	40.0	8.9	8.5	7.8	3.6	14.5	19.4	2.9	12.5	28.0	5.1
LnGrp Delay(d),s/veh	81.4	121.1	27.8	54.5	12.3	8.6	80.4	63.5	41.0	84.4	109.3	44.9
LnGrp LOS	F	F	C	D	B	A	F	E	D	F	F	D
Approach Vol, veh/h		2015			1422			847			1194	
Approach Delay, s/veh		102.0			18.0			67.3			90.3	
Approach LOS		F			B			E			F	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	31.0	61.0	33.6	45.4	25.7	66.3	30.0	49.0
Change Period (Y+Rc), s	* 6.1	* 6.1	5.5	5.5	5.5	* 6.1	5.5	5.5
Max Green Setting (Gmax), s	* 4.5	* 55	37.0	31.0	28.4	* 31	24.5	43.5
Max Q Clear Time (g_c+I1), s	18.6	56.9	27.7	41.9	20.0	18.0	24.5	35.7
Green Ext Time (p_c), s	0.0	0.0	0.3	0.0	0.2	7.9	0.0	1.6

Intersection Summary	
HCM 2010 Ctrl Delay	72.3
HCM 2010 LOS	E

Notes

User approved pedestrian interval to be less than phase max green.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	55	1732	113	73	1142	95	112	5	73	140	5	360
Future Volume (veh/h)	55	1732	113	73	1142	95	112	5	73	140	5	360
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1863	1863	1863	1900	1863	1863	1863	1863	1863	1900
Adj Flow Rate, veh/h	60	1903	124	80	1255	104	123	5	80	154	5	396
Adj No. of Lanes	1	2	1	1	2	0	1	1	1	1	1	0
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	77	1921	859	684	2942	243	112	120	102	406	4	350
Arrive On Green	0.03	0.36	0.36	0.39	0.89	0.89	0.06	0.06	0.06	0.23	0.22	0.22
Sat Flow, veh/h	1774	3539	1583	1774	3310	274	1774	1863	1583	1774	20	1567
Grp Volume(v), veh/h	60	1903	124	80	670	689	123	5	80	154	0	401
Grp Sat Flow(s),veh/h/ln	1774	1770	1583	1774	1770	1814	1774	1863	1583	1774	0	1586
Q Serve(g_s), s	5.0	80.2	7.9	4.4	10.2	10.2	9.5	0.4	7.5	11.0	0.0	33.5
Cycle Q Clear(g_c), s	5.0	80.2	7.9	4.4	10.2	10.2	9.5	0.4	7.5	11.0	0.0	33.5
Prop In Lane	1.00		1.00	1.00		0.15	1.00		1.00	1.00		0.99
Lane Grp Cap(c), veh/h	77	1921	859	684	1573	1613	112	120	102	406	0	354
V/C Ratio(X)	0.78	0.99	0.14	0.12	0.43	0.43	1.09	0.04	0.78	0.38	0.00	1.13
Avail Cap(c_a), veh/h	112	1921	859	684	1573	1613	112	342	290	406	0	354
HCM Platoon Ratio	0.67	0.67	0.67	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	0.09	0.09	0.09	0.41	0.41	0.41	1.00	1.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	72.1	47.4	24.3	29.7	1.5	1.5	70.3	65.8	69.1	48.8	0.0	58.3
Incr Delay (d2), s/veh	2.3	4.4	0.0	0.0	0.3	0.3	112.7	0.1	12.3	0.6	0.0	88.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.5	40.5	3.5	2.1	5.0	5.1	8.2	0.2	3.6	5.5	0.0	23.4
LnGrp Delay(d),s/veh	74.4	51.8	24.4	29.7	1.8	1.8	182.9	66.0	81.4	49.4	0.0	146.8
LnGrp LOS	E	D	C	C	A	A	F	E	F	D		F
Approach Vol, veh/h		2087			1439			208			555	
Approach Delay, s/veh		50.8			3.4			141.1			119.8	
Approach LOS		D			A			F			F	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	65.5	87.5	14.0	39.0	12.0	141.0	38.8	14.2
Change Period (Y+Rc), s	* 6.1	* 6.1	4.5	5.5	5.5	* 6.1	4.5	4.5
Max Green Setting (Gmax), s	* 5	* 81	9.5	33.5	9.5	* 76	16.5	27.5
Max Q Clear Time (g_c+I1), s	6.4	82.2	11.5	35.5	7.0	12.2	13.0	9.5
Green Ext Time (p_c), s	0.0	0.0	0.0	0.0	0.0	23.4	0.3	0.2

Intersection Summary	
HCM 2010 Ctrl Delay	48.2
HCM 2010 LOS	D

Notes

* HCM 2010 computational engine requires equal clearance times for the phases crossing the barrier.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	503	1132	190	70	692	145	155	305	90	260	145	338
Future Volume (veh/h)	503	1132	190	70	692	145	155	305	90	260	145	338
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.97	1.00		0.96	1.00		0.98	1.00		0.97
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1881	1881	1900	1845	1845	1900	1863	1863	1863	1881	1881	1881
Adj Flow Rate, veh/h	535	1204	202	74	736	154	165	324	96	277	154	360
Adj No. of Lanes	1	2	0	1	2	0	1	1	1	1	1	1
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
Percent Heavy Veh, %	1	1	1	3	3	3	2	2	2	1	1	1
Cap, veh/h	451	1404	234	93	749	157	274	288	239	314	330	271
Arrive On Green	0.25	0.46	0.46	0.05	0.26	0.26	0.15	0.15	0.15	0.18	0.18	0.18
Sat Flow, veh/h	1792	3051	508	1757	2864	599	1774	1863	1550	1792	1881	1548
Grp Volume(v), veh/h	535	702	704	74	450	440	165	324	96	277	154	360
Grp Sat Flow(s),veh/h/ln	1792	1787	1772	1757	1752	1711	1774	1863	1550	1792	1881	1548
Q Serve(g_s), s	36.5	50.6	51.6	6.0	37.0	37.1	12.6	22.4	8.1	21.9	10.7	25.4
Cycle Q Clear(g_c), s	36.5	50.6	51.6	6.0	37.0	37.1	12.6	22.4	8.1	21.9	10.7	25.4
Prop In Lane	1.00		0.29	1.00		0.35	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	451	823	816	93	458	447	274	288	239	314	330	271
V/C Ratio(X)	1.19	0.85	0.86	0.80	0.98	0.98	0.60	1.13	0.40	0.88	0.47	1.33
Avail Cap(c_a), veh/h	451	823	816	164	458	447	274	288	239	314	330	271
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	54.3	34.8	35.0	67.9	53.2	53.2	57.1	61.3	55.3	58.3	53.7	59.8
Incr Delay (d2), s/veh	104.3	8.9	9.7	5.8	37.5	38.2	3.2	91.4	0.8	23.9	0.8	170.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	31.1	27.0	27.4	3.1	22.7	22.2	6.4	18.8	3.5	12.9	5.6	23.7
LnGrp Delay(d),s/veh	158.5	43.7	44.8	73.7	90.8	91.4	60.4	152.7	56.1	82.2	54.5	230.3
LnGrp LOS	F	D	D	E	F	F	E	F	E	F	D	F
Approach Vol, veh/h		1941			964			585			791	
Approach Delay, s/veh		75.7			89.7			110.8			144.2	
Approach LOS		E			F			F			F	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	13.2	72.8		31.0	42.0	44.0		28.0
Change Period (Y+Rc), s	5.5	* 6.1		5.6	5.5	* 6.1		5.6
Max Green Setting (Gmax), s	13.5	* 61		25.4	36.5	* 38		22.4
Max Q Clear Time (g_c+I1), s	8.0	53.6		27.4	38.5	39.1		24.4
Green Ext Time (p_c), s	0.0	6.9		0.0	0.0	0.0		0.0

Intersection Summary	
HCM 2010 Ctrl Delay	96.3
HCM 2010 LOS	F

Notes

User approved pedestrian interval to be less than phase max green.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	503	1132	190	70	692	145	155	305	90	260	145	338
Future Volume (veh/h)	503	1132	190	70	692	145	155	305	90	260	145	338
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.97	1.00		0.96	1.00		0.97	1.00		0.96
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1881	1881	1900	1845	1845	1900	1863	1863	1863	1881	1881	1881
Adj Flow Rate, veh/h	535	1204	202	74	736	154	165	324	96	277	154	360
Adj No. of Lanes	1	2	0	1	2	0	1	1	1	1	1	1
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
Percent Heavy Veh, %	1	1	1	3	3	3	2	2	2	1	1	1
Cap, veh/h	558	1574	262	92	735	154	333	244	202	300	197	658
Arrive On Green	0.31	0.52	0.52	0.05	0.26	0.26	0.19	0.13	0.13	0.17	0.10	0.10
Sat Flow, veh/h	1792	3052	509	1757	2864	599	1774	1863	1543	1792	1881	1527
Grp Volume(v), veh/h	535	702	704	74	450	440	165	324	96	277	154	360
Grp Sat Flow(s),veh/h/ln	1792	1787	1773	1757	1752	1711	1774	1863	1543	1792	1881	1527
Q Serve(g_s), s	47.8	51.1	52.1	6.8	41.9	41.9	13.6	21.4	9.4	24.8	13.0	14.8
Cycle Q Clear(g_c), s	47.8	51.1	52.1	6.8	41.9	41.9	13.6	21.4	9.4	24.8	13.0	14.8
Prop In Lane	1.00		0.29	1.00		0.35	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	558	922	915	92	450	439	333	244	202	300	197	658
V/C Ratio(X)	0.96	0.76	0.77	0.80	1.00	1.00	0.50	1.33	0.47	0.92	0.78	0.55
Avail Cap(c_a), veh/h	609	922	915	253	450	439	419	244	202	379	201	661
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	55.1	31.5	31.7	76.5	60.6	60.6	59.4	70.9	65.7	66.9	71.3	14.4
Incr Delay (d2), s/veh	25.5	4.0	4.3	6.0	42.5	43.2	1.1	172.3	1.3	24.3	17.2	0.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	27.6	26.2	26.5	3.5	25.6	25.0	6.8	22.7	4.1	14.3	7.7	6.3
LnGrp Delay(d),s/veh	80.7	35.5	36.0	82.5	103.2	103.8	60.5	243.2	66.9	91.2	88.4	15.2
LnGrp LOS	F	D	D	F	F	F	E	F	E	F	F	B
Approach Vol, veh/h		1941			964			585			791	
Approach Delay, s/veh		48.1			101.9			162.7			56.1	
Approach LOS		D			F			F			E	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	14.1	90.3	36.2	22.6	56.3	48.0	31.8	27.0
Change Period (Y+Rc), s	5.5	* 6.1	5.6	* 5.6	5.5	* 6.1	4.5	5.6
Max Green Setting (Gmax), s	23.5	* 74	38.5	* 17	55.5	* 42	34.5	21.4
Max Q Clear Time (g_c+I1), s	8.8	54.1	15.6	16.8	49.8	43.9	26.8	23.4
Green Ext Time (p_c), s	0.1	17.5	2.3	0.1	1.0	0.0	0.5	0.0

Intersection Summary	
HCM 2010 Ctrl Delay	77.4
HCM 2010 LOS	E

Notes

User approved pedestrian interval to be less than phase max green.

Attachment G: Queue Worksheets

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	165	1160	247	186	670	237	253	381	57	448	448	113
v/c Ratio	0.96	0.85	0.37	1.09	0.49	0.31	1.04	0.89	0.13	0.96	1.05	0.26
Control Delay	126.3	49.3	20.7	151.3	38.5	9.2	128.7	78.5	0.7	95.1	110.8	11.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	126.3	49.3	20.7	151.3	38.5	9.2	128.7	78.5	0.7	95.1	110.8	11.6
Queue Length 50th (ft)	164	536	99	~208	186	0	~280	364	0	~230	~474	8
Queue Length 95th (ft)	#317	632	174	#369	378	120	#462	#547	2	#348	#695	61
Internal Link Dist (ft)		457			1214			650			714	
Turn Bay Length (ft)	350		125	275		200	175		175	250		200
Base Capacity (vph)	171	1389	681	171	1389	765	244	430	445	469	428	443
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.96	0.84	0.36	1.09	0.48	0.31	1.04	0.89	0.13	0.96	1.05	0.26

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.

Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	55	1588	1137	143	374
v/c Ratio	0.44	0.56	0.46	0.67	0.72
Control Delay	77.6	5.0	11.3	77.9	13.7
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	77.6	5.0	11.3	77.9	13.7
Queue Length 50th (ft)	57	207	241	136	0
Queue Length 95th (ft)	m68	m6	366	202	99
Internal Link Dist (ft)		1214	3413	561	
Turn Bay Length (ft)	250				
Base Capacity (vph)	383	2838	2487	407	652
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	0.14	0.56	0.46	0.35	0.57

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	399	1240	48	771	138	282	69	250	208	186
v/c Ratio	0.89	0.75	0.51	0.87	0.49	0.96	0.18	0.87	0.73	0.47
Control Delay	71.7	32.7	82.1	58.5	60.1	98.4	1.1	83.8	64.9	11.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	71.7	32.7	82.1	58.5	60.1	98.4	1.1	83.8	64.9	11.0
Queue Length 50th (ft)	344	476	43	347	117	~263	0	223	173	0
Queue Length 95th (ft)	#510	570	88	#452	189	#455	0	#374	#283	73
Internal Link Dist (ft)		3413		1123		880			918	
Turn Bay Length (ft)	375		175		125		200	250		200
Base Capacity (vph)	508	1727	112	937	280	295	374	310	306	413
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	0.79	0.72	0.43	0.82	0.49	0.96	0.18	0.81	0.68	0.45

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.

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	216	1412	320	211	835	284	309	448	82	505	521	149
v/c Ratio	0.87	1.07	0.47	5.15	0.92	0.52	0.91	0.78	0.14	1.02	1.07	0.29
Control Delay	95.3	90.8	21.5	1921.8	63.6	18.2	89.1	58.0	0.5	107.1	113.0	8.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	95.3	90.8	21.5	1921.8	63.6	18.2	89.1	58.0	0.5	107.1	113.0	8.3
Queue Length 50th (ft)	207	~803	128	~391	430	34	293	400	0	~268	~595	2
Queue Length 95th (ft)	#336	#944	221	#557	#556	135	#447	539	0	#385	#828	59
Internal Link Dist (ft)		457			1214			650			714	
Turn Bay Length (ft)	350		125	275		200	175		175	250		200
Base Capacity (vph)	270	1318	679	41	908	543	371	575	590	496	486	521
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.80	1.07	0.47	5.15	0.92	0.52	0.83	0.78	0.14	1.02	1.07	0.29

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.

Lane Group	EBL	EBT	WBT	SBL	SBR
Lane Group Flow (vph)	60	1929	1384	154	396
v/c Ratio	0.47	0.69	0.56	0.68	0.75
Control Delay	85.6	3.5	13.8	77.0	16.5
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	85.6	3.5	13.8	77.0	16.5
Queue Length 50th (ft)	62	38	339	147	19
Queue Length 95th (ft)	m62	m8	510	215	128
Internal Link Dist (ft)		1214	3413	561	
Turn Bay Length (ft)	250				
Base Capacity (vph)	383	2812	2457	407	652
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	0.16	0.69	0.56	0.38	0.61

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	505	1388	74	872	165	324	96	277	253	231
v/c Ratio	1.05	0.85	0.73	0.99	0.62	1.17	0.27	0.96	0.88	0.53
Control Delay	105.1	38.8	102.4	77.9	67.2	156.9	2.4	100.0	81.9	10.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	105.1	38.8	102.4	77.9	67.2	156.9	2.4	100.0	81.9	10.9
Queue Length 50th (ft)	~502	575	67	412	143	~349	0	253	222	0
Queue Length 95th (ft)	#725	680	#147	#556	223	#544	5	#431	#386	81
Internal Link Dist (ft)		3413		1123		880			918	
Turn Bay Length (ft)	375		175		125		200	250		200
Base Capacity (vph)	479	1634	106	883	264	278	361	292	290	437
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	1.05	0.85	0.70	0.99	0.63	1.17	0.27	0.95	0.87	0.53

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.

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	216	1479	320	219	901	302	309	448	90	524	521	149
v/c Ratio	0.82	1.14	0.48	4.13	1.03	0.58	0.87	0.83	0.16	0.94	1.11	0.29
Control Delay	86.0	116.5	22.0	1453.3	100.8	43.6	82.1	64.1	0.9	86.6	123.4	8.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	86.0	116.5	22.0	1453.3	100.8	43.6	82.1	64.1	0.9	86.6	123.4	8.9
Queue Length 50th (ft)	208	~887	130	~394	~501	154	295	412	0	264	~586	2
Queue Length 95th (ft)	291	#1027	223	m#542	#717	m257	392	#582	1	#372	#898	62
Internal Link Dist (ft)		457			1214			650			714	
Turn Bay Length (ft)	350		125	275		200	175		175	250		200
Base Capacity (vph)	335	1295	670	53	876	522	436	540	563	560	471	510
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.64	1.14	0.48	4.13	1.03	0.58	0.71	0.83	0.16	0.94	1.11	0.29

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.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	EBR	WBL	WBT	NBL	NBT	NBR	SBL	SBT
Lane Group Flow (vph)	60	1903	124	80	1359	123	5	80	154	401
v/c Ratio	0.57	0.98	0.13	1.36	0.73	0.80	0.07	0.34	0.35	0.92
Control Delay	89.9	18.5	1.0	288.4	30.6	100.7	70.8	3.9	49.0	63.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	89.9	18.5	1.0	288.4	30.6	100.7	70.8	3.9	49.0	63.0
Queue Length 50th (ft)	60	1042	8	~102	549	123	5	0	124	245
Queue Length 95th (ft)	m56	m968	m6	#218	642	#274	20	0	195	#419
Internal Link Dist (ft)		1214			3413		561			561
Turn Bay Length (ft)	250		250	250						
Base Capacity (vph)	112	1938	925	59	1863	153	341	437	438	475
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	0.54	0.98	0.13	1.36	0.73	0.80	0.01	0.18	0.35	0.84

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.

m Volume for 95th percentile queue is metered by upstream signal.

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	535	1406	74	890	165	324	96	277	154	360
v/c Ratio	1.18	0.90	0.60	0.98	0.60	1.12	0.26	0.92	0.49	0.64
Control Delay	148.8	46.1	84.7	77.8	67.0	143.1	3.0	92.9	59.8	10.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	148.8	46.1	84.7	77.8	67.0	143.1	3.0	92.9	59.8	10.5
Queue Length 50th (ft)	~608	640	69	437	147	~353	0	259	132	0
Queue Length 95th (ft)	#839	#828	123	#585	228	#551	8	#422	207	95
Internal Link Dist (ft)		3413		1123		880			918	
Turn Bay Length (ft)	375		175		125		200	250		200
Base Capacity (vph)	452	1560	164	905	275	289	365	315	331	574
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	1.18	0.90	0.45	0.98	0.60	1.12	0.26	0.88	0.47	0.63

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.

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	535	1406	74	890	165	324	96	277	154	360
v/c Ratio	0.95	0.81	0.62	1.04	0.45	1.36	0.29	0.87	0.85	0.47
Control Delay	83.9	41.1	98.9	99.6	63.1	239.0	2.5	94.1	110.6	10.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	83.9	41.1	98.9	99.6	63.1	239.0	2.5	94.1	110.6	10.1
Queue Length 50th (ft)	591	693	83	~579	165	~489	0	306	174	62
Queue Length 95th (ft)	#840	861	141	#735	246	#708	1	#439	#305	109
Internal Link Dist (ft)		3413		1123		880			918	
Turn Bay Length (ft)	375		175		125		200	250		200
Base Capacity (vph)	592	1731	245	858	407	238	328	368	195	792
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	0.90	0.81	0.30	1.04	0.41	1.36	0.29	0.75	0.79	0.45

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.

Attachment H: Detailed Parking Demand Calculations

Weekday Shared Parking Demand Estimate - East Gate Village at Mill Creek

Use	Residential (382 units total)				Retail (48,500 sf total)				Medical Office (LU #720)		Office (LU #701)		Restaurant (LU #932)		
	Apartments (LU #221)		Live/Work (LU #221)		Retail (LU #820)		Live/Work (LU #820)								
Size	298 DUs		26 DUs		13,700 sf		34,800 sf		16,600 sf		41,200 sf		13,700 sf		
Rate[1]	1.23 Vehicles per DUs		1.23 Vehicles per DUs		2.55 vehicles per 1,000 sf		2.55 vehicles per 1,000 sf		3.20 vehicles per 1,000 sf		2.84 vehicles per 1,000 sf		13.30 vehicles per 1,000 sf		
Peak Demand	367		32		35		89		53		117		182		
Time of Day[2]	% Hourly Demand	Hourly Demand	% Hourly Demand	Hourly Demand	% Hourly Demand	Hourly Demand	% Hourly Demand	Hourly Demand	% Hourly Demand	Staff Hourly Demand	% Hourly Demand	Hourly Demand	% Hourly Demand	Hourly Demand	Total
12-4:00 AM	100%	367	100%	32	0%	0	0%	0	0%	0	0%	0	0%	0	*399*
5:00 AM	96%	352	96%	31	0%	0	0%	0	0%	0	0%	0	0%	0	*383*
6:00 AM	92%	337	92%	29	0%	0	0%	0	0%	0	0%	0	0%	0	*366*
7:00 AM	74%	271	74%	24	5%	2	5%	4	18%	10	59%	69	0%	0	*380*
8:00 AM	64%	235	64%	20	18%	6	18%	16	64%	34	79%	92	0%	0	*403*
9:00 AM	44%	161	44%	14	38%	13	38%	34	85%	45	95%	111	5%	9	*387*
10:00 AM	44%	161	44%	14	68%	24	68%	61	100%	53	100%	117	7%	13	*443*
11:00 AM	44%	161	44%	14	91%	32	91%	81	100%	53	98%	115	16%	29	*485*
12:00 PM	44%	161	44%	14	100%	35	100%	89	88%	47	90%	105	49%	89	*540*
1:00 PM	44%	161	44%	14	97%	34	97%	86	81%	43	77%	90	39%	71	*499*
2:00 PM	44%	161	44%	14	95%	33	95%	85	90%	48	84%	98	27%	49	*488*
3:00 PM	44%	161	44%	14	88%	31	88%	78	93%	49	81%	95	19%	35	*463*
4:00 PM	44%	161	44%	14	78%	27	78%	69	86%	46	72%	84	22%	40	*441*
5:00 PM	59%	216	59%	19	62%	22	62%	55	52%	28	46%	54	60%	109	*503*
6:00 PM	69%	253	69%	22	64%	22	64%	57	63%	33	25%	29	94%	171	*587*
7:00 PM	66%	242	66%	21	77%	27	77%	69	0%	0	0%	0	100%	182	*541*
8:00 PM	75%	275	75%	24	70%	25	70%	62	0%	0	0%	0	81%	147	*533*
9:00 PM	77%	282	77%	25	42%	15	42%	37	0%	0	0%	0	84%	153	*512*
10:00 PM	92%	337	92%	29	0%	0	0%	0	0%	0	0%	0	0%	0	*366*
11:00 PM	94%	345	94%	30	0%	0	0%	0	0%	0	0%	0	0%	0	*375*
														Peak Demand	**587**

Note: sf = square-feet, DU = dwelling units

1. Parking demand based on the ITE Parking Generation, 4th Edition.

2. Time of day percentages based on ITE Parking Generation, 4th Edition. No data is available for residential from 9:00 AM to 3:00 PM so the 44% demand for 4:00 PM was assumed.

transpogroup
WHAT TRANSPORTATION CAN BE.

MEMORANDUM

Date:	October 16, 2018	**TG:**	1.18029.00
To:	Christi Amrine – City of Mill Creek		
From:	Mike Swenson PE, PTOE & Kassi Leingang PE – Transpo Group		
CC:	Ryan Patterson and Carl Dominguez – Vintage Housing		
Subject:	The Farm at Mill Creek TIA – Response to Comments		

This memorandum provides responses to the City of Mill Creek Traffic Impact Analysis and Parking Modification Review Comments for the Farm at Mill Creek dated October 5, 2018. The comments and responses are summarized below.

Comment 1: General note: responses were provided for previous comments from May of 2018.

Comment noted.

Comment 2: Figure 2 on Page 2 shows conceptual channelization with an eastbound right-turn lane on the west approach and an eastbound acceleration lane on the east approach. Please confirm if the eastbound lane on the east approach is a receiving lane or an acceleration lane. Also, please show the continuation of the existing bike lanes and the interaction with the right-turn lane.

The eastbound lane on the east leg is intended to accommodate a transit stop in the future if desired. The current plan is consistent with the concept included in the original plan developed for this site. The continuation of the bicycle lanes will be included in the design channelization submittal to WSDOT.

Comment 3: We concur with the ITE trip generation evaluation.

Comment noted.

Comment 4: On page 5, the Seattle Hill Road and 132nd Street SE intersection has the level of service tables including the 2021 without project, and 2021 analysis with project. The 2021 analysis with project includes the project volumes as well as partial proposed mitigation improvements (elimination of the southbound through-right lane as found in the Synchro reports). What is the 2021 analysis with project volumes and the existing channelization/phasing?

The traffic volumes at the study intersections for the existing and future without and wit-project conditions are included in Attachment D of the TIA. The channelization and phasing are for the Seattle Hill Road/132nd Street SE intersection are summarized below in Figures 1 and 2 respectively, for the existing and proposed with mitigation conditions.

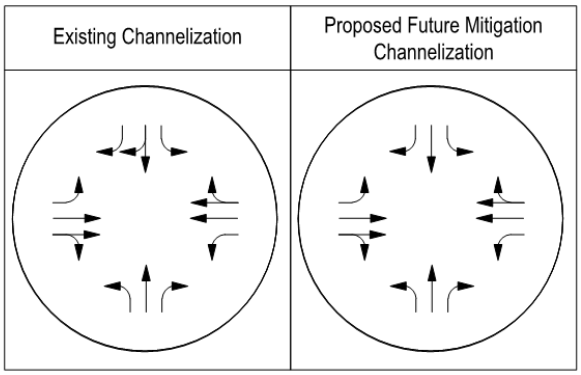


Figure 1 *– Channelization at the Seattle Hill Road/132nd Street SE Intersection*

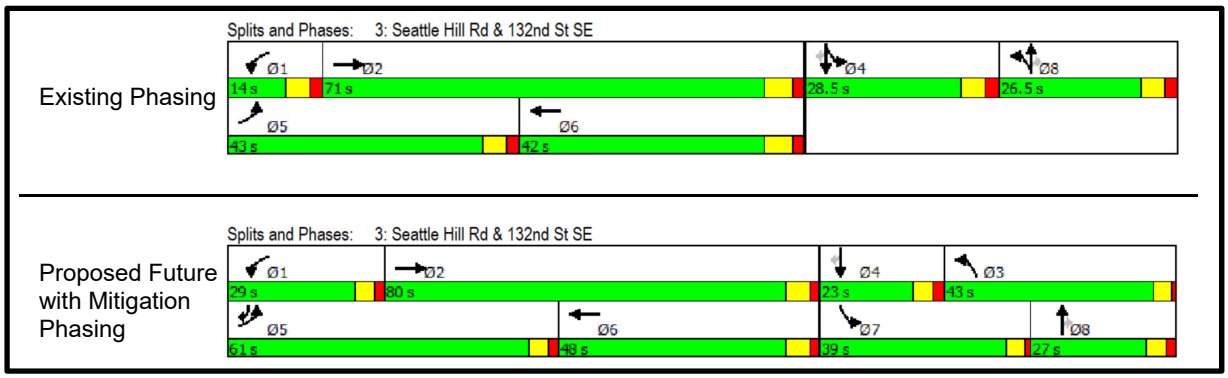


Figure 2 *– Phasing at the Seattle Hill Road/132nd Street SE Intersection*

Comment 5: Traffic mitigation suggests replacing the signal phasing from a split phase to concurrent left turns. Please provide truck turning analysis showing concurrent left-turns can complete the turn with WSDOT required clearance.

Attachment A shows the concurrent northbound and southbound left-turn movements of WB-67s with a clearance of 14 feet of clearance between the truck maneuvers.

Comment 6: Traffic mitigation suggests eliminating the southbound right/shared through right. This will require channelization plans to be submitted with permit review.

We concur. Channelization plans will be submitted for review.

Comment 7: Please provide the Simtraffic worksheets for queuing.

The Simtraffic queuing worksheets for the future with project conditions is included in Attachment A for both the existing phasing and channelization and the proposed phasing and channelization scenarios.

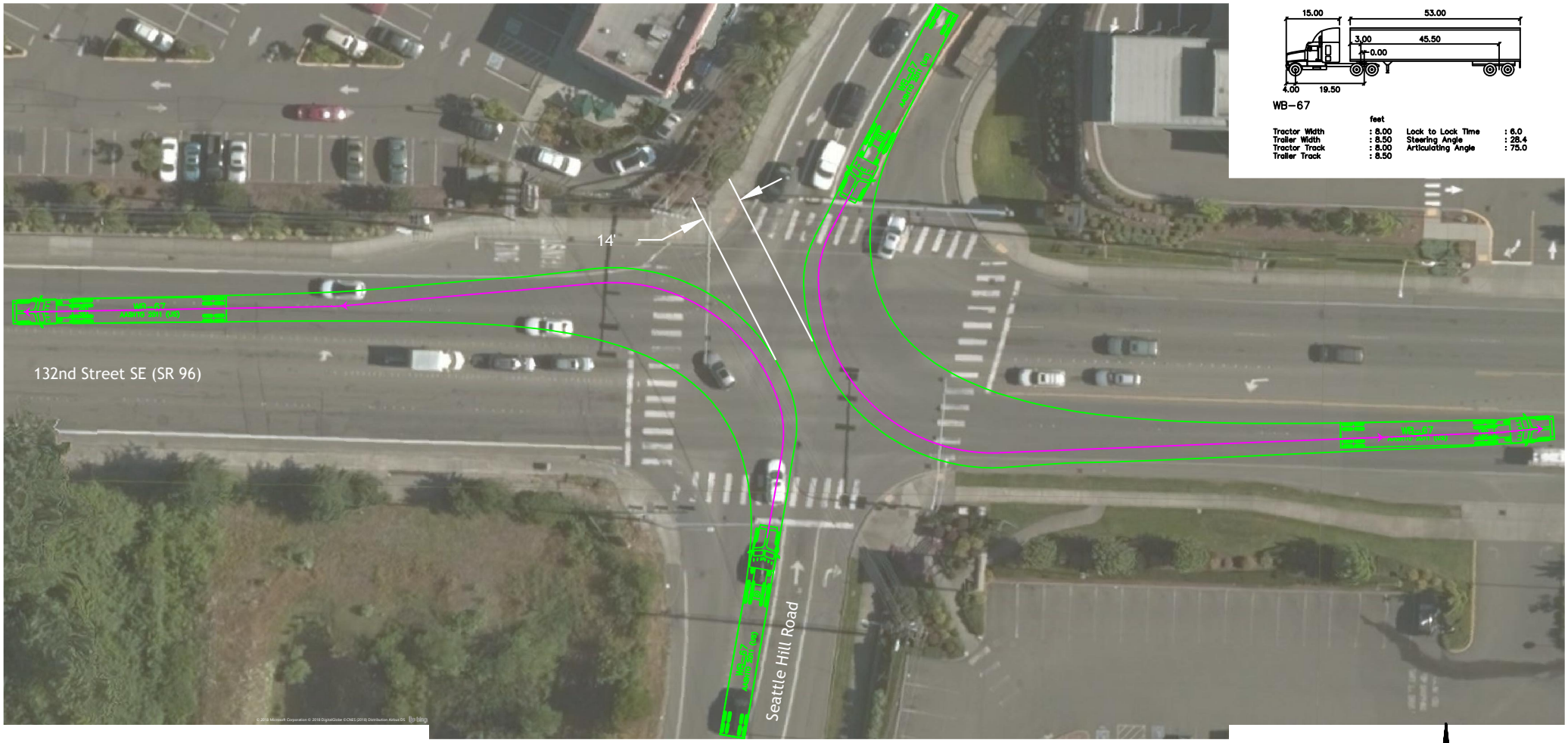
Comment 8: Thank you for providing the Traffic Safety Section.

Comment noted.

Comment 9: Thank you for updating the Parking Code Evaluation.

Comment noted.

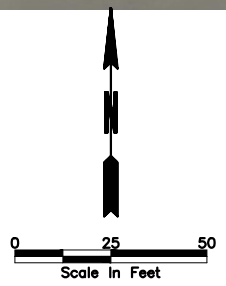
Attachment A:
Concurrent Truck Maneuvers



WB-67

feet

Tractor Width	: 8.00	Lock to Lock Time	: 6.0
Trailer Width	: 8.50	Steering Angle	: 28.4
Tractor Track	: 8.00	Articulating Angle	: 75.0
Trailer Track	: 8.50		



Seattle Hill Road/132nd Street SE (SR 96) - Turning Maneuvers

The Farm at Mill Creek

transpogroup
WHAT TRANSPORTATION CAN BE.

Oct 10, 2018 – 9:11am justinc M:\18\1.18029.00 – Eastgate Village at Mill Creek\Engineering\CAD\Conceptual\132nd St SE and Seattle Hill Road – AutoTURN.dwg Layout: AT

Attachment B:
SimTraffic Reports

Intersection: 1: 35th Ave SE & 132nd St SE

Movement	EB	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB	SB
Directions Served	L	T	T	R	L	T	T	R	L	T	R	L
Maximum Queue (ft)	375	521	524	150	300	1232	1266	225	200	723	250	262
Average Queue (ft)	296	497	501	114	299	1181	793	102	195	683	84	158
95th Queue (ft)	481	526	513	200	300	1395	1630	235	214	764	249	261
Link Distance (ft)		485	485			1213	1213			672		
Upstream Blk Time (%)		44	54			68	16			63		
Queuing Penalty (veh)		0	0			516	123			0		
Storage Bay Dist (ft)	350			125	275			200	175		175	250
Storage Blk Time (%)	1	54	57	1	100	2	16	0	50	31	0	0
Queuing Penalty (veh)	9	112	176	6	403	3	44	1	258	117	1	2

Intersection: 1: 35th Ave SE & 132nd St SE

Movement	SB	SB	SB
Directions Served	L	T	R
Maximum Queue (ft)	275	779	225
Average Queue (ft)	248	753	132
95th Queue (ft)	343	765	292
Link Distance (ft)		735	
Upstream Blk Time (%)		53	
Queuing Penalty (veh)		0	
Storage Bay Dist (ft)	250		200
Storage Blk Time (%)	4	53	0
Queuing Penalty (veh)	29	337	1

Intersection: 2: 132nd St SE & 39th Ave SE

Movement	EB	EB	EB	WB	WB	SB	SB
Directions Served	L	T	T	T	TR	L	R
Maximum Queue (ft)	166	262	274	3446	3449	613	622
Average Queue (ft)	52	27	38	2254	2269	318	490
95th Queue (ft)	117	158	171	4407	4409	751	787
Link Distance (ft)		1213	1213	3409	3409	595	595
Upstream Blk Time (%)				19	24	35	61
Queuing Penalty (veh)				107	136	0	0
Storage Bay Dist (ft)	250						
Storage Blk Time (%)		1					
Queuing Penalty (veh)		0					

Intersection: 3: Seattle Hill Rd & 132nd St SE

Movement	EB	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	L	T	TR	L	T	TR	L	T	R	L	TR	R
Maximum Queue (ft)	400	656	639	200	1189	1182	150	941	225	275	917	225
Average Queue (ft)	336	370	344	109	705	692	127	794	92	239	511	181
95th Queue (ft)	462	704	627	243	1284	1279	191	1132	253	331	995	275
Link Distance (ft)		3409	3409		1155	1155		900			940	
Upstream Blk Time (%)					25	25		52			15	
Queuing Penalty (veh)					0	0		0			0	
Storage Bay Dist (ft)	375			175			125		200	250		200
Storage Blk Time (%)	19	2		1	71		30	57	0	19	32	8
Queuing Penalty (veh)	105	11		3	50		118	140	0	87	130	46

Network Summary

Network wide Queuing Penalty: 3073

Intersection: 1: 35th Ave SE & 132nd St SE

Movement	EB	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB	SB
Directions Served	L	T	T	R	L	T	T	R	L	T	R	L
Maximum Queue (ft)	375	526	532	150	300	1230	1268	225	200	710	250	262
Average Queue (ft)	270	499	503	109	298	1192	878	121	192	688	94	163
95th Queue (ft)	476	517	517	202	304	1361	1654	261	223	718	263	266
Link Distance (ft)		485	485			1213	1213			672		
Upstream Blk Time (%)		43	55			71	16			65		
Queuing Penalty (veh)		0	0			572	127			0		
Storage Bay Dist (ft)	350			125	275			200	175		175	250
Storage Blk Time (%)	0	54	57	1	100	1	21	0	46	36	0	1
Queuing Penalty (veh)	0	114	178	9	436	2	61	2	243	139	0	4

Intersection: 1: 35th Ave SE & 132nd St SE

Movement	SB	SB	SB
Directions Served	L	T	R
Maximum Queue (ft)	275	784	225
Average Queue (ft)	256	753	133
95th Queue (ft)	327	768	292
Link Distance (ft)		735	
Upstream Blk Time (%)		52	
Queuing Penalty (veh)		0	
Storage Bay Dist (ft)	250		200
Storage Blk Time (%)	4	52	0
Queuing Penalty (veh)	26	340	1

Intersection: 2: Site Access/39th Ave SE & 132nd St SE

Movement	EB	EB	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB
Directions Served	L	T	T	R	L	T	TR	L	T	R	L	TR
Maximum Queue (ft)	138	460	473	112	275	3425	3429	596	190	133	564	623
Average Queue (ft)	48	114	131	12	148	2359	2370	430	70	21	236	520
95th Queue (ft)	104	311	331	67	354	4367	4371	759	376	91	678	779
Link Distance (ft)		1213	1213			3395	3395	583	583	583	595	595
Upstream Blk Time (%)						16	21	55	5	0	26	72
Queuing Penalty (veh)						93	122	0	0	0	0	0
Storage Bay Dist (ft)	250			250	250							
Storage Blk Time (%)		1	1	0	0	83						
Queuing Penalty (veh)		1	2	0	0	61						

Intersection: 3: Seattle Hill Rd & 132nd St SE

Movement	EB	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	L	T	TR	L	T	TR	L	T	R	L	TR	R
Maximum Queue (ft)	400	878	855	200	1194	1186	150	942	225	275	812	225
Average Queue (ft)	371	534	475	104	792	776	124	715	105	234	403	183
95th Queue (ft)	467	949	862	243	1353	1342	191	1096	270	327	812	266
Link Distance (ft)		3395	3395		1155	1155		900			940	
Upstream Blk Time (%)					31	30		34			7	
Queuing Penalty (veh)					0	0		0			0	
Storage Bay Dist (ft)	375			175			125		200	250		200
Storage Blk Time (%)	39	3		1	74		26	59	0	15	25	3
Queuing Penalty (veh)	224	17		4	52		100	145	0	71	107	20

Network Summary

Network wide Queuing Penalty: 3274

Intersection: 1: 35th Ave SE & 132nd St SE

Movement	EB	EB	EB	EB	WB	WB	WB	WB	NB	NB	NB	SB
Directions Served	L	T	T	R	L	T	T	R	L	T	R	L
Maximum Queue (ft)	375	529	530	150	300	1232	1265	225	200	720	250	261
Average Queue (ft)	280	498	501	108	298	1189	832	123	193	690	87	168
95th Queue (ft)	474	523	519	201	303	1355	1637	263	222	705	254	270
Link Distance (ft)		485	485			1213	1213			672		
Upstream Blk Time (%)		44	55			67	12			66		
Queuing Penalty (veh)		0	0			540	101			0		
Storage Bay Dist (ft)	350			125	275			200	175		175	250
Storage Blk Time (%)	0	54	58	1	100	2	24	1	47	34	0	1
Queuing Penalty (veh)	0	114	179	4	436	3	71	3	246	131	0	5

Intersection: 1: 35th Ave SE & 132nd St SE

Movement	SB	SB	SB
Directions Served	L	T	R
Maximum Queue (ft)	275	787	225
Average Queue (ft)	254	753	141
95th Queue (ft)	330	769	298
Link Distance (ft)		735	
Upstream Blk Time (%)		52	
Queuing Penalty (veh)		0	
Storage Bay Dist (ft)	250		200
Storage Blk Time (%)	5	51	0
Queuing Penalty (veh)	35	335	1

Intersection: 2: Site Access/39th Ave SE & 132nd St SE

Movement	EB	EB	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB
Directions Served	L	T	T	R	L	T	TR	L	T	R	L	TR
Maximum Queue (ft)	143	320	332	189	275	3420	3426	603	236	134	530	617
Average Queue (ft)	50	148	161	20	175	2119	2134	400	86	23	312	489
95th Queue (ft)	106	291	301	104	370	4195	4206	746	426	90	756	790
Link Distance (ft)		1213	1213			3395	3395	583	583	583	595	595
Upstream Blk Time (%)						9	14	44	14	0	38	67
Queuing Penalty (veh)						53	81	0	0	0	0	0
Storage Bay Dist (ft)	250			250	250							
Storage Blk Time (%)		1	1	0	0	80						
Queuing Penalty (veh)		0	1	0	0	58						

Intersection: 3: Seattle Hill Rd & 132nd St SE

Movement	EB	EB	EB	WB	WB	WB	NB	NB	NB	SB	SB	SB
Directions Served	L	T	TR	L	T	TR	L	T	R	L	T	R
Maximum Queue (ft)	400	574	579	200	1183	1185	150	943	225	275	849	225
Average Queue (ft)	319	312	315	103	752	734	114	864	98	229	374	124
95th Queue (ft)	451	576	561	230	1316	1303	193	1094	261	318	865	248
Link Distance (ft)		3395	3395		1155	1155		900			940	
Upstream Blk Time (%)					23	22		63			5	
Queuing Penalty (veh)					0	0		0			0	
Storage Bay Dist (ft)	375			175			125		200	250		200
Storage Blk Time (%)	8	5		1	71		19	68	0	15	8	8
Queuing Penalty (veh)	48	27		3	50		74	167	0	72	46	34

Network Summary

Network wide Queuing Penalty: 2921

transpogroup
WHAT TRANSPORTATION CAN BE.

MEMORANDUM

Date:	October 24, 2018	**TG:**	1.18029.00
To:	Christi Amrine – City of Mill Creek		
From:	Mike Swenson PE, PTOE & Kassi Leingang PE – Transpo Group		
CC:	Ryan Patterson and Carl Dominguez – Vintage Housing		
Subject:	The Farm at Mill Creek TIA – Response to Comments		

This memorandum provides a response to Comment 4 of the City of Mill Creek Traffic Impact Analysis and Parking Modification Review Comments for the Farm at Mill Creek dated October 5, 2018. The comment and response are summarized below.

Comment 4: On page 5, the Seattle Hill Road and 132nd Street SE intersection has the level of service tables including the 2021 without project, and 2021 analysis with project. The 2021 analysis with project includes the project volumes as well as partial proposed mitigation improvements (elimination of the southbound through-right lane as found in the Synchro reports). What is the 2021 analysis with project volumes and the existing channelization/phasing?

The operations of the Seattle Hill Road/132nd Street SE intersection reflecting the existing phasing and channelization for the with and without project volumes are summarized in Table below as well as the future with-project volumes with the proposed mitigated channelization and phasing. As shown in the table, the project is anticipated to result in an increase of approximately 7 seconds of delay relative to without project conditions with the existing channelization and phasing. With the proposed mitigated channelization and phasing, the project is anticipated to operate at LOS E with 77 seconds of delay. The traffic operation worksheets are included in Attachment A.

Table 1. Future PM Peak Hour Intersection LOS Summary

	2021 Without-Project		2021 With-Project		2021 With-Project – *Mitigated*	
Intersection	**LOS[1]**	**Delay[2]**	**LOS**	**Delay**	**LOS**	**Delay**
3. Seattle Hill Road/132nd Street SE	F	80	F	87	E	77

1. Level of Service (A – F) as defined by the 2010 *Highway Capacity Manual* (HCM) (TRB)
2. Average delay per vehicle in seconds.

The channelization and phasing are for the Seattle Hill Road/132nd Street SE intersection are summarized below in Figures 1 and 2 respectively, for the existing and proposed with mitigation conditions.

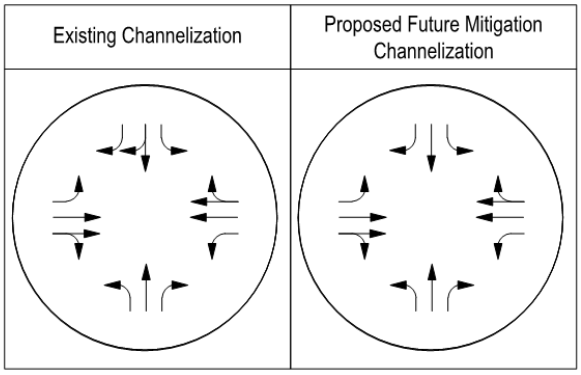


***Figure 1** – Channelization at the Seattle Hill Road/132nd Street SE Intersection*

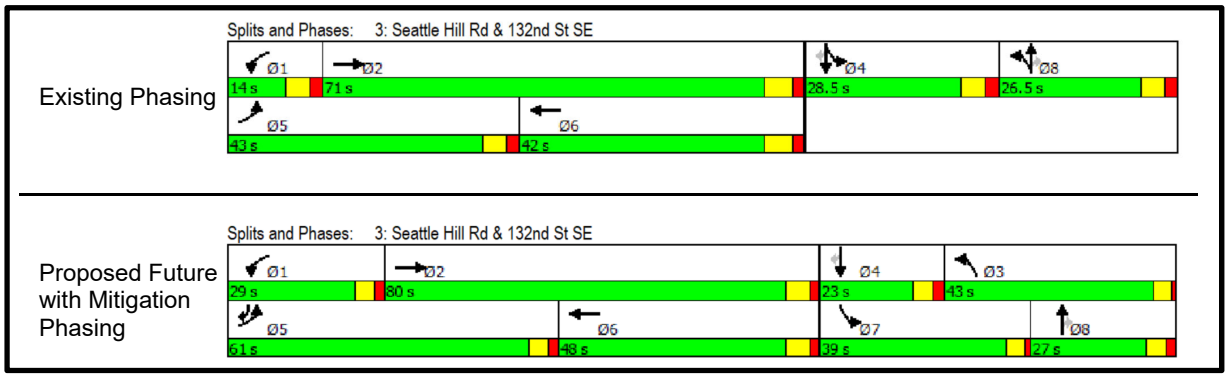
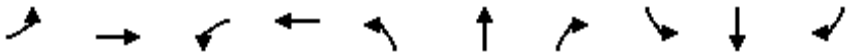


Figure 2 *– Phasing at the Seattle Hill Road/132nd Street SE Intersection*

Attachment A:
LOS Worksheets



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	505	1388	74	872	165	324	96	277	253	231
v/c Ratio	1.05	0.85	0.73	0.99	0.62	1.17	0.27	0.96	0.88	0.53
Control Delay	105.1	38.8	102.4	77.9	67.2	156.9	2.4	100.0	81.9	10.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	105.1	38.8	102.4	77.9	67.2	156.9	2.4	100.0	81.9	10.9
Queue Length 50th (ft)	~502	575	67	412	143	~349	0	253	222	0
Queue Length 95th (ft)	#725	680	#147	#556	223	#544	5	#431	#386	81
Internal Link Dist (ft)		3413		1123		880			918	
Turn Bay Length (ft)	375		175		125		200	250		200
Base Capacity (vph)	479	1634	106	883	264	278	361	292	290	437
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	1.05	0.85	0.70	0.99	0.63	1.17	0.27	0.95	0.87	0.53

Intersection Summary

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

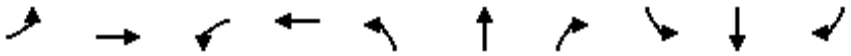
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	475	1115	190	70	675	145	155	305	90	260	145	310
Future Volume (veh/h)	475	1115	190	70	675	145	155	305	90	260	145	310
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.97	1.00		0.96	1.00		0.98	1.00		0.97
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1881	1881	1900	1845	1845	1900	1863	1863	1863	1881	1881	1881
Adj Flow Rate, veh/h	505	1186	202	74	718	154	165	324	96	277	286	242
Adj No. of Lanes	1	2	0	1	2	0	1	1	1	1	1	1
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
Percent Heavy Veh, %	1	1	1	3	3	3	2	2	2	1	1	1
Cap, veh/h	480	1435	243	93	731	157	265	278	231	293	308	253
Arrive On Green	0.27	0.47	0.47	0.05	0.26	0.26	0.15	0.15	0.15	0.16	0.16	0.16
Sat Flow, veh/h	1792	3043	515	1757	2850	611	1774	1863	1548	1792	1881	1546
Grp Volume(v), veh/h	505	693	695	74	441	431	165	324	96	277	286	242
Grp Sat Flow(s),veh/h/ln	1792	1787	1771	1757	1752	1708	1774	1863	1548	1792	1881	1546
Q Serve(g_s), s	37.5	46.9	47.7	5.8	35.1	35.1	12.2	20.9	7.9	21.4	21.0	21.7
Cycle Q Clear(g_c), s	37.5	46.9	47.7	5.8	35.1	35.1	12.2	20.9	7.9	21.4	21.0	21.7
Prop In Lane	1.00		0.29	1.00		0.36	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	480	843	835	93	449	438	265	278	231	293	308	253
V/C Ratio(X)	1.05	0.82	0.83	0.80	0.98	0.98	0.62	1.17	0.42	0.95	0.93	0.96
Avail Cap(c_a), veh/h	480	843	835	107	449	438	265	278	231	293	308	253
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	51.3	32.0	32.2	65.6	51.7	51.7	55.9	59.5	54.0	57.9	57.8	58.1
Incr Delay (d2), s/veh	55.5	6.9	7.5	26.0	37.8	38.5	4.0	106.2	0.9	37.9	33.2	44.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	25.9	24.7	25.1	3.5	21.6	21.2	6.3	18.9	3.4	13.7	13.7	12.4
LnGrp Delay(d),s/veh	106.8	38.9	39.6	91.5	89.5	90.3	59.9	165.8	54.9	95.8	91.0	102.6
LnGrp LOS	F	D	D	F	F	F	E	F	D	F	F	F
Approach Vol, veh/h		1893			946			585			805	
Approach Delay, s/veh		57.3			90.0			117.7			96.1	
Approach LOS		E			F			F			F	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	12.9	72.1		28.5	43.0	42.0		26.5
Change Period (Y+Rc), s	5.5	* 6.1		5.6	5.5	* 6.1		5.6
Max Green Setting (Gmax), s	8.5	* 65		22.9	37.5	* 36		20.9
Max Q Clear Time (g_c+I1), s	7.8	49.7		23.7	39.5	37.1		22.9
Green Ext Time (p_c), s	0.0	13.6		0.0	0.0	0.0		0.0

Intersection Summary		
HCM 2010 Ctrl Delay		80.3
HCM 2010 LOS		F

Notes



Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	535	1406	74	890	165	324	96	277	269	245
v/c Ratio	1.12	0.86	0.73	1.01	0.62	1.17	0.27	0.96	0.93	0.55
Control Delay	123.9	39.5	102.4	82.5	67.2	156.9	2.4	100.0	90.7	10.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	123.9	39.5	102.4	82.5	67.2	156.9	2.4	100.0	90.7	10.9
Queue Length 50th (ft)	~559	588	67	~428	143	~349	0	253	236	0
Queue Length 95th (ft)	#785	694	#147	#575	223	#544	5	#431	#418	84
Internal Link Dist (ft)		3413		1123		880			918	
Turn Bay Length (ft)	375		175		125		200	250		200
Base Capacity (vph)	479	1634	106	883	264	278	361	292	290	449
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	1.12	0.86	0.70	1.01	0.63	1.17	0.27	0.95	0.93	0.55

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.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	503	1132	190	70	692	145	155	305	90	260	145	338
Future Volume (veh/h)	503	1132	190	70	692	145	155	305	90	260	145	338
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.97	1.00		0.96	1.00		0.98	1.00		0.97
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1881	1881	1900	1845	1845	1900	1863	1863	1863	1881	1881	1881
Adj Flow Rate, veh/h	535	1204	202	74	736	154	165	324	96	277	308	257
Adj No. of Lanes	1	2	0	1	2	0	1	1	1	1	1	1
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
Percent Heavy Veh, %	1	1	1	3	3	3	2	2	2	1	1	1
Cap, veh/h	480	1438	240	93	734	154	265	278	231	293	308	253
Arrive On Green	0.27	0.47	0.47	0.05	0.26	0.26	0.15	0.15	0.15	0.16	0.16	0.16
Sat Flow, veh/h	1792	3051	508	1757	2864	599	1774	1863	1548	1792	1881	1546
Grp Volume(v), veh/h	535	702	704	74	450	440	165	324	96	277	308	257
Grp Sat Flow(s),veh/h/ln	1792	1787	1772	1757	1752	1711	1774	1863	1548	1792	1881	1546
Q Serve(g_s), s	37.5	47.9	48.8	5.8	35.9	35.9	12.2	20.9	7.9	21.4	22.9	22.9
Cycle Q Clear(g_c), s	37.5	47.9	48.8	5.8	35.9	35.9	12.2	20.9	7.9	21.4	22.9	22.9
Prop In Lane	1.00		0.29	1.00		0.35	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	480	843	836	93	449	439	265	278	231	293	308	253
V/C Ratio(X)	1.11	0.83	0.84	0.80	1.00	1.00	0.62	1.17	0.42	0.95	1.00	1.02
Avail Cap(c_a), veh/h	480	843	836	107	449	439	265	278	231	293	308	253
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	51.3	32.2	32.4	65.6	52.0	52.1	55.9	59.5	54.0	57.9	58.5	58.5
Incr Delay (d2), s/veh	76.3	7.5	8.1	26.0	42.9	43.6	4.0	106.2	0.9	37.9	51.5	60.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
%ile BackOfQ(50%),veh/ln	28.7	25.3	25.7	3.5	22.7	22.2	6.3	18.9	3.4	13.7	16.3	14.0
LnGrp Delay(d),s/veh	127.6	39.7	40.5	91.5	95.0	95.6	59.9	165.8	54.9	95.8	110.1	119.5
LnGrp LOS	F	D	D	F	F	F	E	F	D	F	F	F
Approach Vol, veh/h		1941			964			585			842	
Approach Delay, s/veh		64.2			95.0			117.7			108.3	
Approach LOS		E			F			F			F	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	12.9	72.1		28.5	43.0	42.0		26.5
Change Period (Y+Rc), s	5.5	* 6.1		5.6	5.5	* 6.1		5.6
Max Green Setting (Gmax), s	8.5	* 65		22.9	37.5	* 36		20.9
Max Q Clear Time (g_c+I1), s	7.8	50.8		24.9	39.5	37.9		22.9
Green Ext Time (p_c), s	0.0	12.8		0.0	0.0	0.0		0.0

Intersection Summary		
HCM 2010 Ctrl Delay		86.9
HCM 2010 LOS		F

Notes

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	535	1406	74	890	165	324	96	277	154	360
v/c Ratio	0.95	0.81	0.62	1.04	0.45	1.36	0.29	0.87	0.85	0.47
Control Delay	83.9	41.1	98.9	99.6	63.1	239.0	2.5	94.1	110.6	10.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	83.9	41.1	98.9	99.6	63.1	239.0	2.5	94.1	110.6	10.1
Queue Length 50th (ft)	591	693	83	~579	165	~489	0	306	174	62
Queue Length 95th (ft)	#840	861	141	#735	246	#708	1	#439	#305	109
Internal Link Dist (ft)		3413		1123		880			918	
Turn Bay Length (ft)	375		175		125		200	250		200
Base Capacity (vph)	592	1731	245	858	407	238	328	368	195	792
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	0.90	0.81	0.30	1.04	0.41	1.36	0.29	0.75	0.79	0.45

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.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	503	1132	190	70	692	145	155	305	90	260	145	338
Future Volume (veh/h)	503	1132	190	70	692	145	155	305	90	260	145	338
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.97	1.00		0.96	1.00		0.97	1.00		0.96
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1881	1881	1900	1845	1845	1900	1863	1863	1863	1881	1881	1881
Adj Flow Rate, veh/h	535	1204	202	74	736	154	165	324	96	277	154	360
Adj No. of Lanes	1	2	0	1	2	0	1	1	1	1	1	1
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
Percent Heavy Veh, %	1	1	1	3	3	3	2	2	2	1	1	1
Cap, veh/h	558	1574	262	92	735	154	333	244	202	300	197	658
Arrive On Green	0.31	0.52	0.52	0.05	0.26	0.26	0.19	0.13	0.13	0.17	0.10	0.10
Sat Flow, veh/h	1792	3052	509	1757	2864	599	1774	1863	1543	1792	1881	1527
Grp Volume(v), veh/h	535	702	704	74	450	440	165	324	96	277	154	360
Grp Sat Flow(s),veh/h/ln	1792	1787	1773	1757	1752	1711	1774	1863	1543	1792	1881	1527
Q Serve(g_s), s	47.8	51.1	52.1	6.8	41.9	41.9	13.6	21.4	9.4	24.8	13.0	14.8
Cycle Q Clear(g_c), s	47.8	51.1	52.1	6.8	41.9	41.9	13.6	21.4	9.4	24.8	13.0	14.8
Prop In Lane	1.00		0.29	1.00		0.35	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	558	922	915	92	450	439	333	244	202	300	197	658
V/C Ratio(X)	0.96	0.76	0.77	0.80	1.00	1.00	0.50	1.33	0.47	0.92	0.78	0.55
Avail Cap(c_a), veh/h	609	922	915	253	450	439	419	244	202	379	201	661
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	55.1	31.5	31.7	76.5	60.6	60.6	59.4	70.9	65.7	66.9	71.3	14.4
Incr Delay (d2), s/veh	25.5	4.0	4.3	6.0	42.5	43.2	1.1	172.3	1.3	24.3	17.2	0.8
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	27.6	26.2	26.5	3.5	25.6	25.0	6.8	22.7	4.1	14.3	7.7	6.3
LnGrp Delay(d),s/veh	80.7	35.5	36.0	82.5	103.2	103.8	60.5	243.2	66.9	91.2	88.4	15.2
LnGrp LOS	F	D	D	F	F	F	E	F	E	F	F	B
Approach Vol, veh/h		1941			964			585			791	
Approach Delay, s/veh		48.1			101.9			162.7			56.1	
Approach LOS		D			F			F			E	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	14.1	90.3	36.2	22.6	56.3	48.0	31.8	27.0
Change Period (Y+Rc), s	5.5	* 6.1	5.6	* 5.6	5.5	* 6.1	4.5	5.6
Max Green Setting (Gmax), s	23.5	* 74	38.5	* 17	55.5	* 42	34.5	21.4
Max Q Clear Time (g_c+I1), s	8.8	54.1	15.6	16.8	49.8	43.9	26.8	23.4
Green Ext Time (p_c), s	0.1	17.5	2.3	0.1	1.0	0.0	0.5	0.0

Intersection Summary	
HCM 2010 Ctrl Delay	77.4
HCM 2010 LOS	E

Notes

MEMORANDUM

Date:	March 6, 2019	**TG:**	1.18029.00
To:	Christi Amrine – City of Mill Creek		
From:	Mike Swenson PE, PTOE & Kassi Leingang PE – Transpo Group		
cc:	Ryan Patterson and Carl Dominguez – Vintage Housing		
Subject:	The Farm at Mill Creek – Mitigation Summary		

The following memorandum summarizes the traffic mitigation elements identified for The Farm at Mill Creek project. The recommended operational mitigation measures to address the impacts of the proposed project and a review of the Transportation Impact Fees are provided below. The mitigation summaried below is consistent with the mitigation identified in *The Farm at Mill Creek – Traffic Impact Analysis* (Transpo Group, August 2018) and the October 24, 2018 Response to Comments.

Operational Mitigation

The recommended operational mitigation measures to address the impacts of the proposed project include the following:

132nd Street SE (SR 96)/39th Avenue SE Intersection Modifications

The south leg of the 132nd Street SE (SR 96)/39th Avenue SE signalized intersection will be constructed with the project. The traffic signal and channelization will be modified to accommodate this improvement. In addition to the addition of the south leg of the intersection, an eastbound right-turn lane will be constructed at the intersection. This will reduce congestion created by eastbound vehicles turning into the south leg of the intersection.

Spine Road Construction in the Farm

A spine road is proposed within The Farm at Mill Creek development connecting to the proposed south leg of the 132nd Street SE (SR 96)/39th Avenue SE signalized intersection. The spine road is shown in Figure 1.

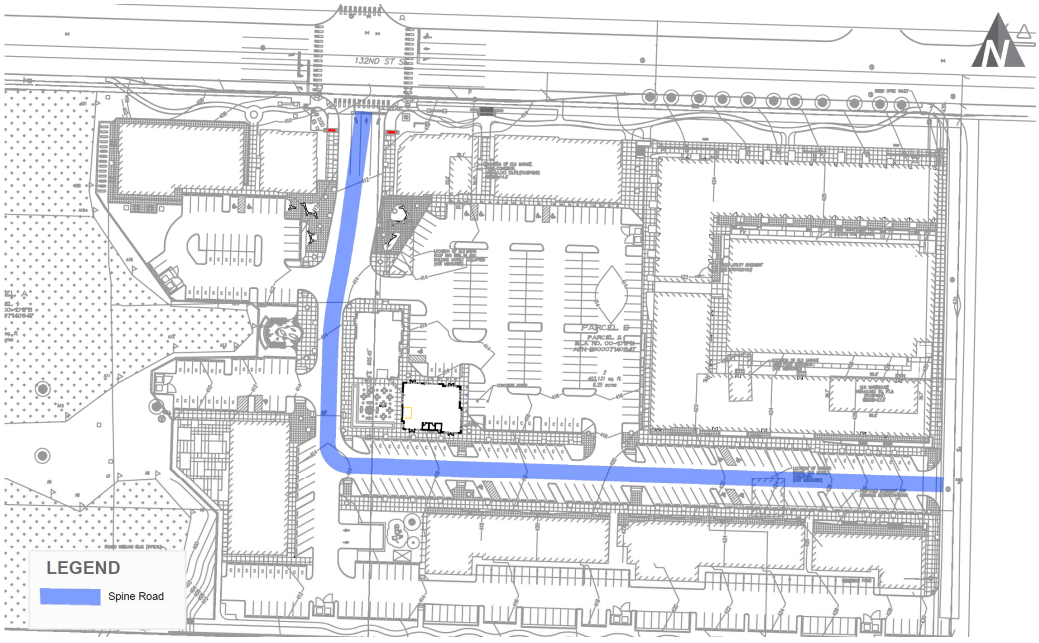


***Figure 1** – Spine Road*

Signal Modifications at the Seattle Hill Road/132nd Street SE Intersection

With WSDOT approval, the applicant is proposing to modify the intersection phasing and southbound channelization according to the image shown below.

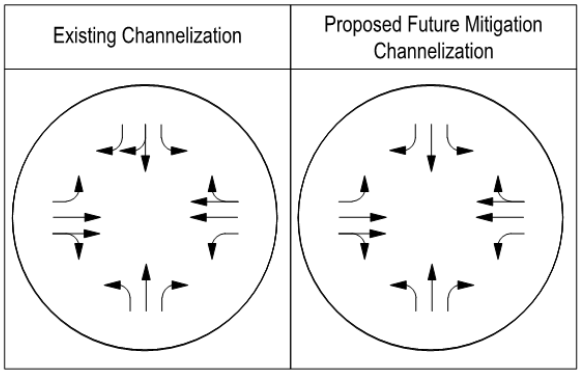


Figure 2 *– Channelization at the Seattle Hill Road/132nd Street SE Intersection*

With the removal of the shared through/right lane in the southbound direction, the operations of the Seattle Hill Road/132nd Street SE intersection reflecting the existing phasing and channelization for the with and without project volumes are summarized in the table below.

Table 1. Future PM Peak Hour Intersection LOS Summary

	2021 Without-Project		2021 With-Project		2021 With-Project – *Mitigated*	
Intersection	**LOS[1]**	**Delay[2]**	**LOS**	**Delay**	**LOS**	**Delay**
Seattle Hill Road/132nd Street SE	F	80	F	87	E	77

1. Level of Service (A – F) as defined by the 2010 *Highway Capacity Manual* (HCM) (TRB)
2. Average delay per vehicle in seconds.

The TIA assumed optimized signal timing to account for the County's adaptive signal project; however, limitations to the software used in the analysis do not fully capture the improvements associated with adaptive signal timing. Actual implementation of adaptive signal timing would result in further improvements associated with vehicular progression that are not captured in the analysis. In addition, the TIA did not include adjustments to mode split to account for increased transit usage with future Bus Rapid Transit or transit expansion, resulting in a conservative operational analysis.

Transportation Impact Fees

To mitigate general transportation related impacts of the proposed development, the project would be required to pay City of Mill Creek transportation impact fees. These fees provide funding for transportation-related projects throughout the City accommodating future growth in traffic. Fees would be assessed when building permits for the project are issued.