heffron transportation, inc.

TECHNICAL MEMORANDUM

Project: Emerald Heights – Redmond, WA

Subject: Traffic Impact Analysis

Date: June 4, 2010

Author: Michelle M. Brown
Marni C. Heffron, P.E., P.T.O.E.

This memorandum presents the transportation impact analysis for the proposed Emerald Heights expansion project in Redmond, Washington. It documents the expected increase in site-generated trips and evaluates the impact to the local transportation system. The overall analysis approach and scope were coordinated with City of Redmond staff. This memorandum also includes information relating to parking, transit, safety, and site access operations.

1. Site and Project Description

Emerald Heights is a "life-care community" located in the Education Hill neighborhood of Redmond. It is located just north of Redmond High School, west of 176th Avenue NE, south of Abbey Road, and east of a residential community. The site currently has 401 units that are a mix of independent living units for seniors, as well as different types of assisted living and skilled nursing units for seniors who need continuing care. There is one main access to and from the Emerald Heights community, off of 176th Avenue NE on the east side of the property. This driveway is manned 24-hours a day by a security guard, and visitors are required to sign in and out at this location. There is an emergency-only gated access driveway located on the north side of the property along Abbey Road.

Emerald Heights proposes to expand the size of its facility to accommodate future growth. To accommodate the proposed future growth the 38-acre property must be rezoned from Residential-4 (R4) to Residential-6 (R6) to expand the existing life care retirement community. Since the facility is a retirement facility, the allowed density is three times the zoning limit.[1] Therefore, the existing zoning allows for 456 residential units (38-acres x 4 units per acre x 3 bonus allotment for retired residences). The proposed facility would provide up to 608 units (the R6 zoning would allow up to 684 units). In addition, the proposal would construct a new auditorium, and wellness (fitness) center for the residences, along with remodeling existing facilities. The existing driveway along 176th Avenue NE would be retained as the main access where the guard booth is located for visitor registration. The existing emergency-only driveway on Abbey Road would be relocated southeast and improved to provide a secondary access for residents and employees of Emerald Heights.

The proposed expansion would occur in phases, with Phase I occurring within the next five years and up to 15-plus years for Phase II. This analysis represents conditions for both Phases I and II of the project, with details of Phase I conditions described as necessary. A summary of the existing and proposed on-site facilities is shown in Table 1. The proposed site plan is shown on Figure 1 (attached).

[1] City of Redmond Development Guide, Section 20C.30.85030

Table 1. Existing and Proposed Uses – Emerals Heights

Type of Use	Existing	Phase I Expansion	Completion of Phase II Expansion	Full Net Change from Existing
Independent Living Units	290 units	374 units (+84)	420 units (+46)	+130 units
Health Center Units				
Assisted Living	56 units	72 units (+16)	86 units (+14)	+30 units
Skilled Nurses Care	55 units	77 units (+22)	102 units (+25)	+47 units
Total Residential Units	*401 units*	*523 units (+122)*	*608 units (+85)*	*+207 units*
Wellness (Fitness) Center	5,570 sf[1]	12,500 sf (+6,390)		+6,390 sf
Auditorium	0 sf	8,170 sf (+8,170)		+8,170 sf
Parking	503 spaces	661 spaces (+158)	850 spaces (+189)	+ 347 spaces

Source: Rice Fergus Miller Architecture & Planning, and Emerald Heights, March 2010.
1. Square feet = sf.

2. Study Area and Methodology

The purpose of this transportation analysis is to document the potential impacts of the proposed expansion. Since the Emerald Heights site is so unique, existing vehicle counts and visitor log information were collected at the existing main site access driveway in December 2009. These counts were used to estimate future project traffic volumes associated with the project expansion.

The estimated project trip generation was assigned to the roadway network using trip distribution patterns specifically related to Emerald Heights (March 2010 traffic counts) and background traffic volumes within the project vicinity. The trip generation and trip distribution pattern was reviewed and approved by City of Redmond staff. Based on this review, City staff requested that operational analyses be performed for the site access driveways. The process for each of these elements is described within this memorandum.

3. Background Conditions

This section of the report presents the existing and future conditions without the proposed Emerald Heights expansion project. It describes the existing vicinity transportation facilities, the existing traffic generation, site access operations, parking supply, transit, and safety.

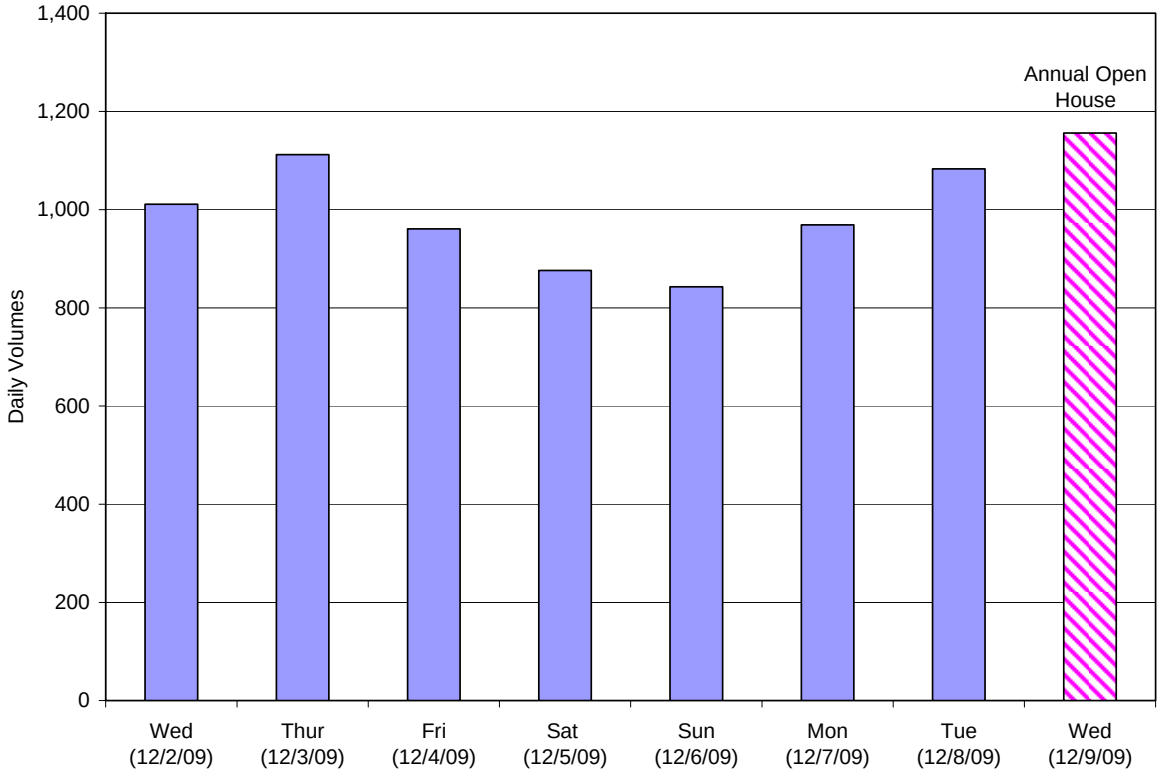
3.1. Transportation Network

176th Avenue NE is a local access street that begins at NE 104th Street as 179th Avenue NE and continues around the Emerald Heights community to the north where it continues as **Abbey Road**, then 111th Street SE. This is a two lane roadway with curbs, gutters, and sidewalks on both sides of the street for much of its entirety. North of Emerald Heights, a path replaces the sidewalk on the northeast side of the road. On-street parking is not allowed along this section of roadway. The posted speed limit is 25 mph.

3.2. Traffic Volumes

New seven-day traffic counts were performed at the Emerald Heights site access. The counts were conducted during the month of December, which is typically the month with the highest traffic volumes during the year. The counts were performed between December 2 and December 9, 2009. The Emerald Heights' Annual Open House occurred during these count dates on December 9, 2009, which Emerald Heights identifies as the highest traffic generator during the year. During this annual event, off-site parking is provided along with shuttles to and from the remote parking locations, as has been done for over the past 10 years. Figure 2 shows the total traffic on each day during the count. This includes both entering and exiting traffic at the site driveway. The counts show that the daily volumes fluctuate between 845 trips per day on a Friday to about 1,100 trips per day on a Thursday. Excluding the day of the Open House, the average weekday trip generation was 1,030 (515 enter and 515 exit). On Wednesday December 9, 2009, the day of the annual Open House, there were about 1,160 daily trips (about 13% above average).

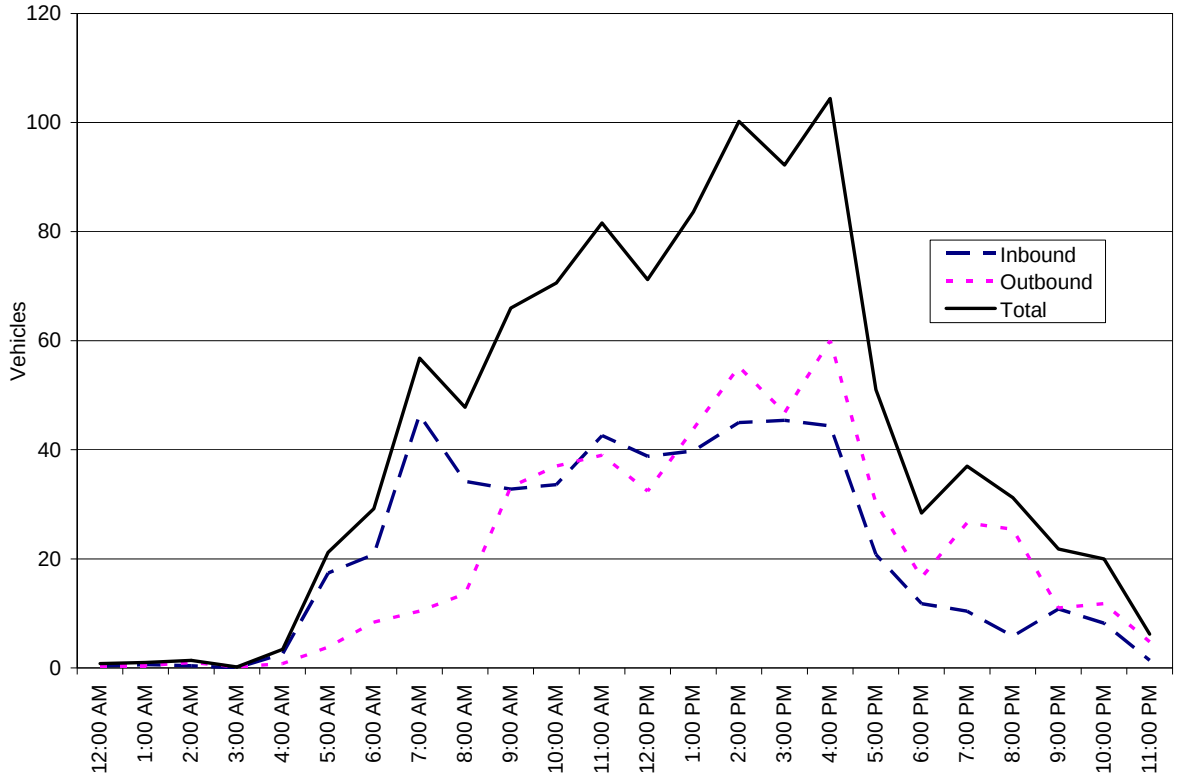
Figure 2 – Emerald Heights Trips per Day (Enter plus Exit) – Existing Conditions



Source: All Traffic Data December 2, 2009 to December 9, 2009. Summarized by Heffron Transportation, Inc., December 2009.

The average weekday counts were compiled to show the traffic volumes by time of day, which are shown on Figure 3. The weekday peak hour occurs from 4:00 to 5:00 P.M., with the second highest hour occurring between 2:00 and 3:00 P.M. During the AM peak hour, the site's traffic is about half of the PM peak hour traffic. The PM peak hour volumes were used for this analysis, which is consistent with the City of Redmond requirements.

Figure 3 – Average Weekday Trips by Time of Day – Existing Conditions



Source: All Traffic Data December 2, 2009 to December 9, 2009. Summarized by Heffron Transportation, Inc., December 2009.

In order to evaluate traffic operating conditions at the site driveway, a turning movement count was also conducted at the Emerald Heights driveway on 176th Avenue NE on Wednesday March 24, 2010. The volumes counted were consistent with the volumes counted in December 2009. The existing PM peak hour volumes are shown on Figure 4 (attached).

The Emerald Heights expansion project is planned to have Phase I complete within five years and the Phase II complete in possibly 15 years. The City of Redmond recommends using a 2% annual growth rate for background traffic growth. This rate was applied to the existing traffic volumes along 176th Avenue NE at the site driveway for year 2025 (Phase II, full build-out in 15 years). These future without-project PM peak hour volumes are also shown on Figure 4 (attached).

3.3. Site Access Operations

Levels of service (LOS) analyses were performed for the Emerald Heights driveway for the existing (2010) and future (2025) without-project PM peak hour conditions. Level of service is a qualitative measure used to characterize traffic operating conditions. Six letter designations, "A" through "F," are used to define level of service. Level of service (LOS) A is the best and represents good traffic operations with little or no delay to motorists. LOS F is the worst and indicates poor traffic operations with long delays. The level of service criteria from the *Highway Capacity Manual 2000* (Transportation Research Board, 2000) for unsignalized intersections was used. Trafficware's *Synchro 7.0* traffic operations analysis software was used to calculate the levels of

service. The results were determined and reported using the *Highway Capacity Manual 2000* methodology. Existing intersection geometry and traffic control conditions were used for existing and future without-project conditions.

The level of service results show that existing site access driveway operates at LOS A during the PM peak hour and would continue to operate at this same level in the future (2025) without the proposed expansion.

3.4. Parking

The existing Emerald Heights community has 503 parking spaces for residents, employees, and visitors. The City of Redmond requires one parking space be provided per independent residential unit (applied to apartment style unit), two spaces for each duplex, and about 1.25 parking spaces be provided for each Health Center staff member. Based on these requirements, the existing site would need to provide a minimum of 363 spaces; the on-site supply of 503 exceeds this requirement, and adequately meets the everyday parking demand. During special events when additional parking supply is required, Emerald Heights provides shuttle service to off-site parking. These locations can include parking lots at Redmond High School and local churches.

3.5. Transit

The Emerald Heights site is directly served by King County Metro (Route 221) with a stop located adjacent to the site driveway on 176th Avenue NE. Route 221 provides service between Overlake and Education Hill with 30-minute headways (time between consecutive buses). It operates on weekdays between 5:30 A.M. and 11:45 P.M., with a shorter duration for both Saturday and Sunday.

3.6. Traffic Safety

Historical collision data were obtained from the City of Redmond for 176th Avenue NE and Abbey Road, the roads that border much of the Emerald Heights community. This information was used to determine if any safety conditions exist along the site's frontage that could affect or be affected by the proposed project. Three years of the most recent data available (January 1, 2007 to present – May 14, 2010) were obtained. During the three-year period, one collision occurred along 176th Avenue NE near the existing or proposed site access driveway locations. This collision involved a driver making a northbound left-turn and striking an illegally parked vehicle.

3.7. Non-Motorized Facilities

Sidewalks are provided along both sides of 176th Avenue NE until the northeast section of the roadway where 176th Avenue NE transitions to Abbey Road, a path replaces the sidewalk on the northeast side of the street. West of the Emerald Heights community, Abbey Road has a sidewalk on the south side of the roadway only.

4. Project Impacts

This section of the memorandum describes the conditions that would exist when the proposed Emerald Heights expansion (Phases I and II) is complete. The analysis includes the increased trip generation from the expansion, the site access analysis, and transit, safety, and parking impacts.

4.1. Transportation Network

The proposed Emerald Heights expansion would not change the roadway network in the site vicinity.

4.2. Traffic Volumes

During the weekday PM peak hour, Emerald Heights currently generates 104 trips per hour (44 entering and 60 exiting). A trip generation rate was derived using the number of residential units as the variable. The traffic counts determined that the daily trip rate is 2.56 trips per day, and the PM peak hour trip rate is 0.26 trips per hour.

These rates are similar to rates in the Institute of Transportation Engineers' (ITE) *Trip Generation Manual*, 8th Edition, 2008 for other senior housing uses. The various senior housing rates in ITE along with the Emerald Heights rates are summarized in Table 2.

Table 2. Trip Generation Rates for Various Senior Housing Land Uses [a]

Land Use (ITE Code)	Description	Average Weekday Trip Rate (trips/unit)	PM Peak Hour Trip Rate (trips/unit)
Senior Adult Housing – Detached (Land Use 251)	Detached independent living developments, including retirement communities, age-restricted housing, and active adult communities. May include recreational services, but generally lack centralized dining and on-site medical facilities.	3.71	0.27
Senior Adult Housing – Attached (Land Use 252)	Attached independent living developments, including retirement communities, age-restricted housing and active adult communities. May include limited social or recreational services, but generally lack centralized dining and on-site medical facilities.	3.48	0.16
Congregate Care Facility (Land Use 253)	Independent living developments with centralized amenities such as dining, housekeeping, transportation, and organized social/recreational activities.	2.02	0.17
Assisted Living (Land Use 254)	Provide routine general protective oversight or assistance with activities necessary to independent living.	2.74 (per bed)	0.38 (per bed)
Continuing Care Retirement Community (Land Use 255)	Provide multiple elements of senior adult living, combining aspects of independent living with increased care, as lifestyle needs change with time. Housing options may include combinations of senor adult detached, attached, congregate care, assisted living and skilled nursing care aimed at allowing the residents to live in one community as their medical needs change.	2.81 (per occupied units)	0.29 (per occupied units)
Emerald Heights [b]	A mix of independent assisted living, and conjugate care facilities. Medical, limited dining, social, and recreational facilities are provided.	2.56	0.26

a. Source: Institute of Transportation Engineers' (ITE) Trip Generation Manual, 8th Edition, 2008.

b. Based on Emerald Heights facility and traffic counts conducted at the site.

As shown above, there are many different types of senior housing land use types. The one most closely related to Emerald Heights, in terms of the description, is the Continuing Care Retirement Community (ITE Land Use Code 255). The rates derived for Emerald Heights are slightly lower than the ITE rates, which were derived from studies at nine facilities in Illinois, Pennsylvania and Virginia. The difference in rates may also be related to the fact that the ITE rate is based on "occupied units," whereas the Emerald Heights rate was based on total units. Because future trip estimates for Emerald Heights will also be based on total units, this is an appropriate variable. Since the data were obtained directly from the Emerald Heights site, and the proposed project will expand on the existing facility

with the same uses and the approximately the same proportion for independent living and care units, the existing rates were used to determine the future trips.

Trip Generation for Proposed Project

Emerald Heights proposes to provide up to 523 units for the Phase I expansion, with a total of up to 608 residential units with the completion of Phase II. This would be a total increase of 207 units compared to existing conditions. The additional auditorium and expanded fitness center would be for residents' usage. If special events were to occur in the auditorium, then off-site parking arrangements would occur similar to the annual Open House event. These types of events would occur infrequently, and were not included in the average trip generation estimates. However, a discussion relating to special events is presented later in this section.

The fitness center would be for the existing residents. However, Emerald Heights is considering the option to open this venue up to potential residents that are on their waiting list for a fee. Emerald Heights has estimated that about 40% of their existing residents use the fitness center. The waiting list has about 200 potential residents. Therefore, as an estimate, 40% of these potential residents were assumed to use the facility, with 10% using it during the PM peak hour. Therefore, 8 PM peak hour project trips were added to the average trip generation to account for off-site residents using the fitness center.

The rates derived for the existing Emerald Heights were applied to the future expansion, as summarized in Table 3. The proposed project's expansion of 207 additional residential units would generate about 610 additional trips per day with 62 trips during the weekday PM peak hour. This includes trips by residents, staff, visitors, as well as any off-site traffic that the fitness center may generate.

Table 3. Trip Generation Summary – Emerald Heights (Phases I and II)

Land Use	Size	Daily Trips[1]	PM Peak Hour Trips[1]		
			In	Out	Total
Proposed Residential Units	608 units	1,560	67	91	158
Proposed Fitness Center[2]	12,500 sf[3]	80	4	4	8
Existing Residential Units	401 units	1,030	44	60	104
Net Change in trips to site.	207 units	610	27	35	62

Source: Heffron Transportation, February 2010.

1. Trip generation based on existing 24-hour traffic counts at Emerald Heights, in December 2009.

2. Trips associated with non-resident who are on Emerald Heights wait list and may be allowed to fitness center for a fee.

3. Square feet = sf.

Special events generate trips in addition to typical day-to-day operations. As discussed, the annual Open House which occurs in December is considered the busiest day of the year. The traffic counts show that this day generates about 13% more daily and 28% more PM peak hour trips compared to an average weekday, which is about 130 daily and 30 PM peak hour trips, respectively. This increase could be from additional employees on site during the day, shuttle trips to and from the remote parking locations and additional visitors viewing the facility. If the special event traffic were to

increase in proportion to the number of units, then the proposed facility could generate an additional 200 daily and 45 PM peak hour trips during the Open House, which is the peak day of the year.

Project Trip Distribution

Historically, the City of Redmond's traffic model was used for the Concurrency Analysis of a new development project. The model information was then used to determine the project trip distribution. However, the City no longer uses the model to evaluate concurrency within the City, and is in the processes of determining the most appropriate method of evaluating project trip distributions for new developments.

The proposed project would generate a relatively low number of PM peak hour trips, and would be expanding an established-existing use with the same uses on the site. This type of use (retirement community) would not be accurately represented in a typical gravity traffic model since the trip patterns associated with a retirement community do not correlate with typical residential communities. Therefore, in consultation with City staff, the trip distribution pattern for the Emerald Heights expansion was based on an existing PM peak count that was performed at the site access driveway along 176th Avenue NE, on Wednesday March 24, 2010. The count shows that about 33% of the inbound and 39% of the outbound trips are to/from the north; about 67% of the inbound and 61% of the outbound are to/from the south. The distribution beyond the site driveway was determined using historic PM peak hour City traffic counts for intersections near the site.

The trip distribution pattern and PM peak hour project trip assignment are shown on Figure 5 (attached). The City of Redmond recommends that signalized intersections impacted by 20 or more PM peak hour project trips be evaluated for operational impacts. The trip assignment shows that no signalized intersection would be affected by more than 20 project trips. Based on this analysis, the City of Redmond requested analysis of the site driveways only. The net increase in project trips would not adversely affect off-site intersections or neighborhood streets in the project vicinity.

The net increase in site-generated trips were added to the future (2025) without-project traffic volumes to estimate the future (2025) with-project PM peak hour driveway volumes, shown on Figure 6 (attached).

4.3. Site Access Operations and Safety

The project proposes to create a new driveway for residents and staff on 176th Avenue NE. This driveway would be created by relocating the existing emergency-access driveway on the north side of the site. The existing main driveway along 176th Avenue NE would remain, and would continue to be the primary driveway for employees and staff as well as the only point of access for visitors. Use of the secondary driveway to 176th Avenue NE was determined based on the distribution pattern and visitor counts.

Levels of service for the site access driveways were calculated using the 2025 with-project traffic volumes and the methodology described previously in this memorandum. With the proposed expansion, the main site access driveway (existing location) would operate at LOS B and the proposed second access driveway would operate at LOS A during an average day PM peak hour. These are acceptable operating conditions. During the peak special event of the year (Open House), the main site access driveways would continue to operate at LOS B.

The existing emergency-only driveway along Abbey Road is located along a horizontal curve, with a vertical curve located to the west of the driveway. Since the proposed secondary driveway will be opened to residents and visitors (as opposed to the current emergency access only restriction), it will be required to have adequate sight lines for both entering and stopping sight distances. The proposed new driveway would be located along 176th Avenue NE, which has a posted speed limit of 25 mph. As stated in the *Redmond Community Development Guide*[2], the required stopping sight distance for a local public street (using a design speed of 5 mph above the posted speed limit) is 200 feet. The required entering sight distance (using a design speed of 10 mph above the posted speed limit) is 390 feet. In order to meet these sight distance requirements, some re-grading of a berm on the inside of the horizontal curve west of the driveway will be required. An attached graphic shows the plan and profile of the driveway along with the grading required to meet the sight distance requirements (plan by Triad Associates, May 2010).

4.4. Parking

The City of Redmond requires one parking space be provided per independent residential unit (applied to apartment style unit), two spaces for each duplex, and 1.25 parking spaces be provided for each Health Center staff member. Based on these requirements, the proposed Phase I expansion would require 451 spaces, and the completion with Phase II would require 482 spaces. Emerald Heights would exceed these minimum parking requirements by providing 661 spaces for Phase I and 850 spaces at the completion of Phase II.

During special events that require addition parking, Emerald Heights would continue to provide a shuttle to off-site parking locations.

4.5. Traffic Safety

The collision data provided for the study area do not indicate any traffic safety conditions. Since the project is redeveloping an existing site with the same uses and with relatively minimal traffic increases, the project is not expected to result in any new adverse impacts to traffic safety conditions.

4.6. Transit

The project is not expected to adversely affect transit service. Any new transit riders generated from the Emerald Heights community would be considered a positive affect on the roadway network.

4.7. Non-Motorized Facilities

The existing non-motorized facilities surrounding the project site will remain unchanged with the proposed project.

[2] Appendix 20D-3, Tables 1-F (Stopping Sight Distance) and 1-I (Entering Sight Distance) Reprinted April 2009. As based on American Association of State Highways and Transportation Officials (AASHTO).

4.8. Mitigation

The City of Redmond has adopted Transportation Impact Fees per the City of Redmond Community Development Code (20D.210.10-120). The two related land uses on the Fee Schedule are "Retirement Community" and "Congregate Care/Assisted Living," which are based on the number of residential units. For the additional 207 units proposed, the related fees are as follows:

- A proportionate assessment = $270,505.60
  Retirement Community fee – (130 independent units) x $1,530.44/unit = $198,957.20 +
  Congregate Care/Assisted Living – (77 assisted units) x $929.20/unit = $71,548.40.

As the City updates it Community Development Guide, these fees could change, as they would be recalculated by the City with the most current fees. In addition, the City of Redmond has an interlocal agreement with King County to collect fees for project trips using unincorporated King County roadways. These fees are calculated by the City using the King County Mitigated Payment System (MPS). The Washington State Department of Transportation (WSDOT) may also have transportation related improvements in the area that could impose a fee. All of these fees will be estimated prior to building permit issuance.

Based on the analysis presented in this memorandum, the only other mitigation measure needed is to re-grade near the proposed secondary site access driveway in order to meet minimum entering sight distance requirements. The re-grading plan is attached.

Attachments: Figure 1. Proposed Site Plan
Figure 4. Existing (2010) and Future (2025) Without Project – PM Peak Hour Traffic Volumes
Figure 5. Net New Project Trip Distribution and Assignment – PM Peak Hour
Figure 6. Future (2025) With-Project – PM Peak Hour Traffic Volumes
Level of Service Worksheets
Secondary Access Plan and Profile Sight Distance Summary – Triad Associates
Traffic Count Data

MMB/mch

N

EMERALD HEIGHTS MASTER PLAN

Figure 1

Proposed Site Plan

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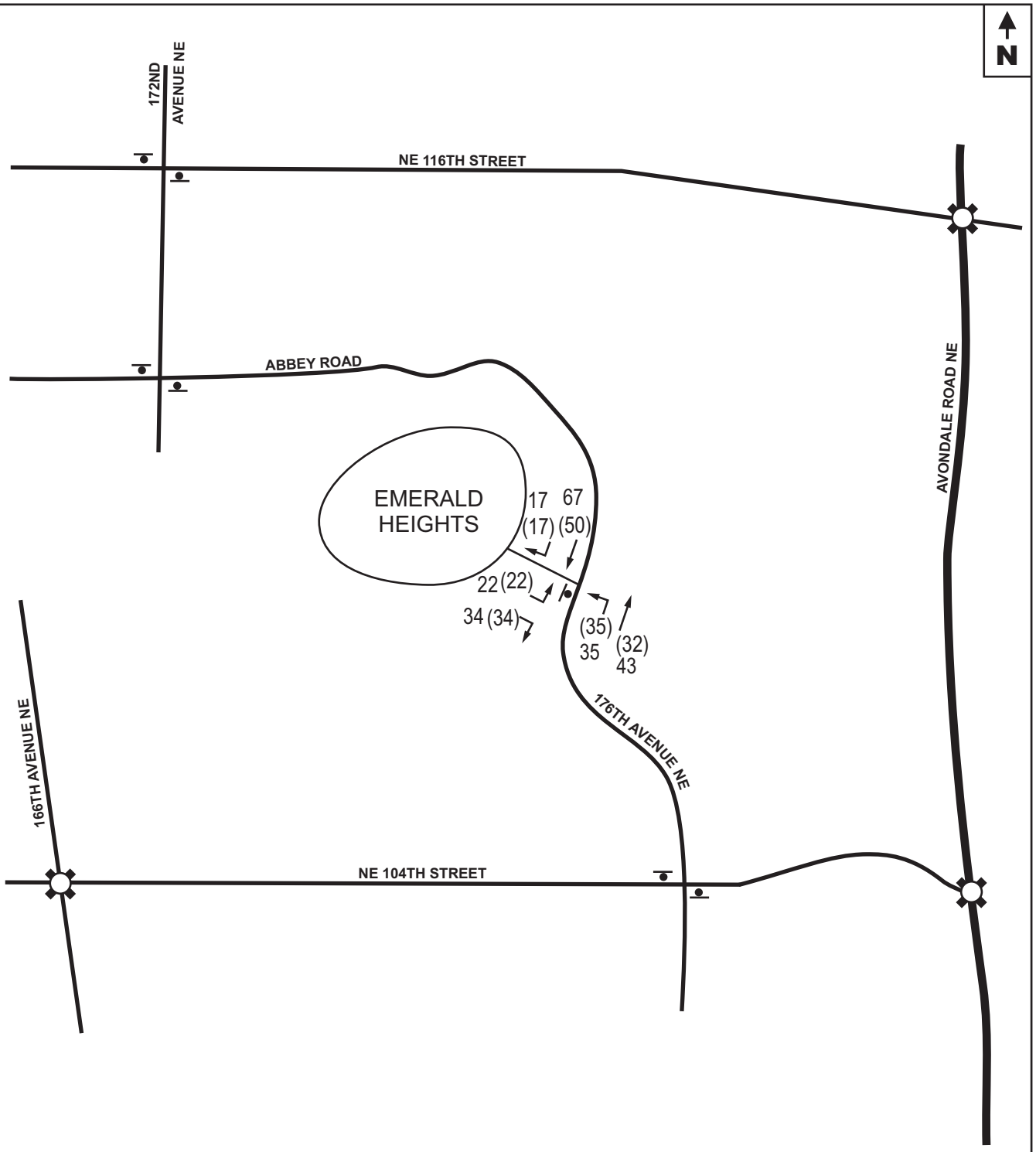

Legend

(X) → Existing (2010) Driveway Volumes

X → Future (2025) Without-Project Driveway Volumes

Traffic Signal Stop Sign

EMERALD HEIGHTS MASTER PLAN

Figure 4

Existing (2010) and Future (2025) Without-Project PM Peak Hour Traffic Volumes

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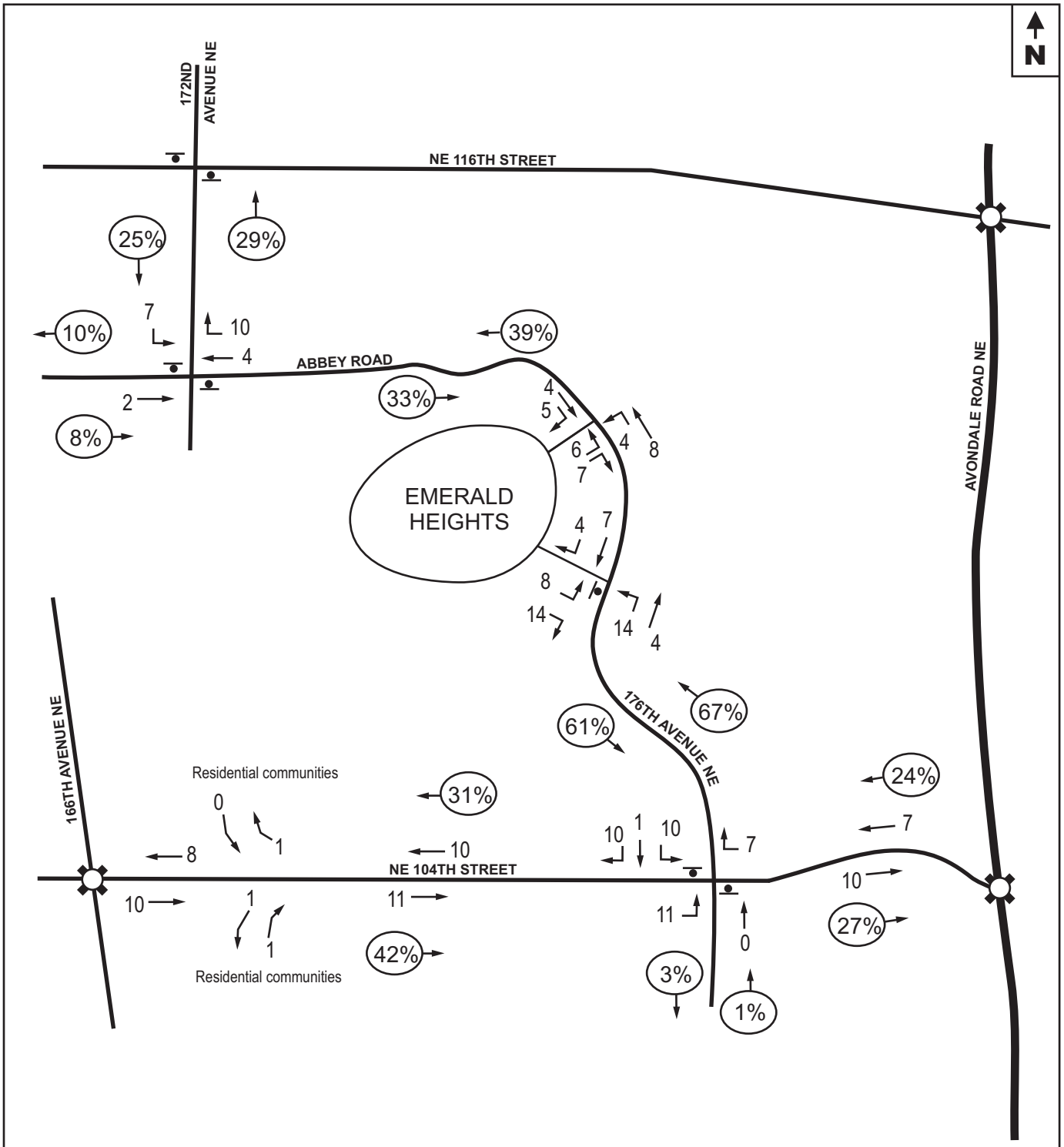

Legend

X → Net New (Full Build) Project Volumes

1% → Project Trip Distribution

Traffic Signal Stop Sign

EMERALD HEIGHTS MASTER PLAN

Figure 5

Net New Project Trip Distribution and Assignment
PM Peak Hour Traffic Volumes

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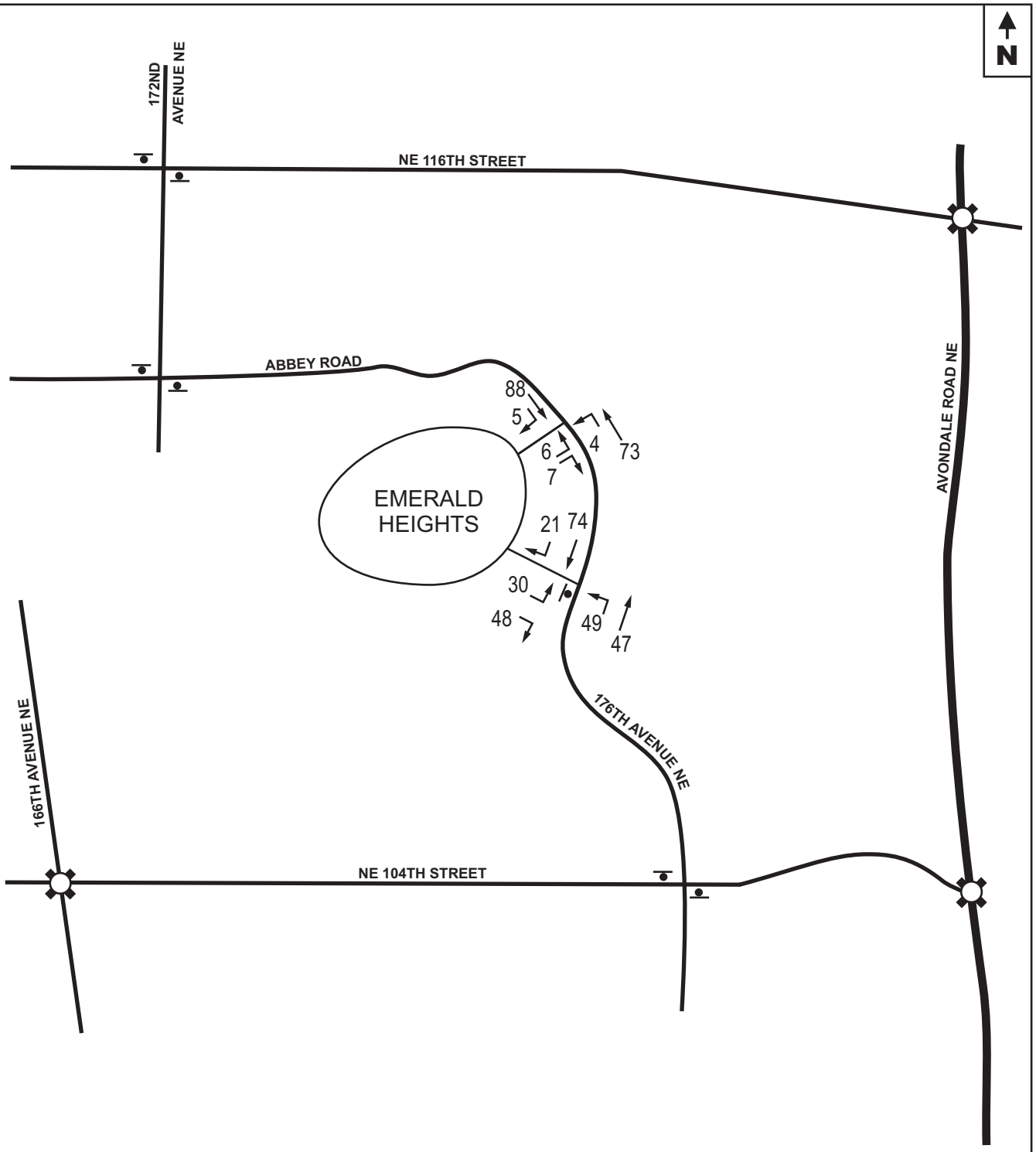

Legend

(X) → Existing (2010) Driveway Volumes

X → Net New (Full Build) Project Volumes

(1%) → Project Trip Distribution

Traffic Signal

Stop Sign

EMERALD HEIGHTS MASTER PLAN

Figure 6

Future (2025) With-Project PM Peak Hour Traffic Volumes

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Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	22	34	35	32	50	17
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.70	0.70	0.73	0.73	0.67	0.67
Hourly flow rate (vph)	31	49	48	44	75	25
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	227	87	100			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	227	87	100			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	96	95	97			
cM capacity (veh/h)	741	977	1505			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	80	92	100
Volume Left	31	48	0
Volume Right	49	0	25
cSH	868	1505	1700
Volume to Capacity	0.09	0.03	0.06
Queue Length 95th (ft)	8	2	0
Control Delay (s)	9.6	4.0	0.0
Lane LOS	A	A	
Approach Delay (s)	9.6	4.0	0.0
Approach LOS	A		

Intersection Summary			
Average Delay	4.2		
Intersection Capacity Utilization	20.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	22	34	35	43	67	17
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.70	0.70	0.73	0.73	0.67	0.67
Hourly flow rate (vph)	31	49	48	59	100	25
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	267	113	125			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	267	113	125			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	96	95	97			
cM capacity (veh/h)	702	946	1474			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	80	107	125
Volume Left	31	48	0
Volume Right	49	0	25
cSH	832	1474	1700
Volume to Capacity	0.10	0.03	0.07
Queue Length 95th (ft)	8	3	0
Control Delay (s)	9.8	3.5	0.0
Lane LOS	A	A	
Approach Delay (s)	9.8	3.5	0.0
Approach LOS	A		

Intersection Summary			
Average Delay	3.7		
Intersection Capacity Utilization	20.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	30	48	49	47	74	21
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.70	0.70	0.73	0.73	0.67	0.67
Hourly flow rate (vph)	43	69	67	64	110	31
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	325	126	142			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	325	126	142			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	93	93	95			
cM capacity (veh/h)	642	930	1454			

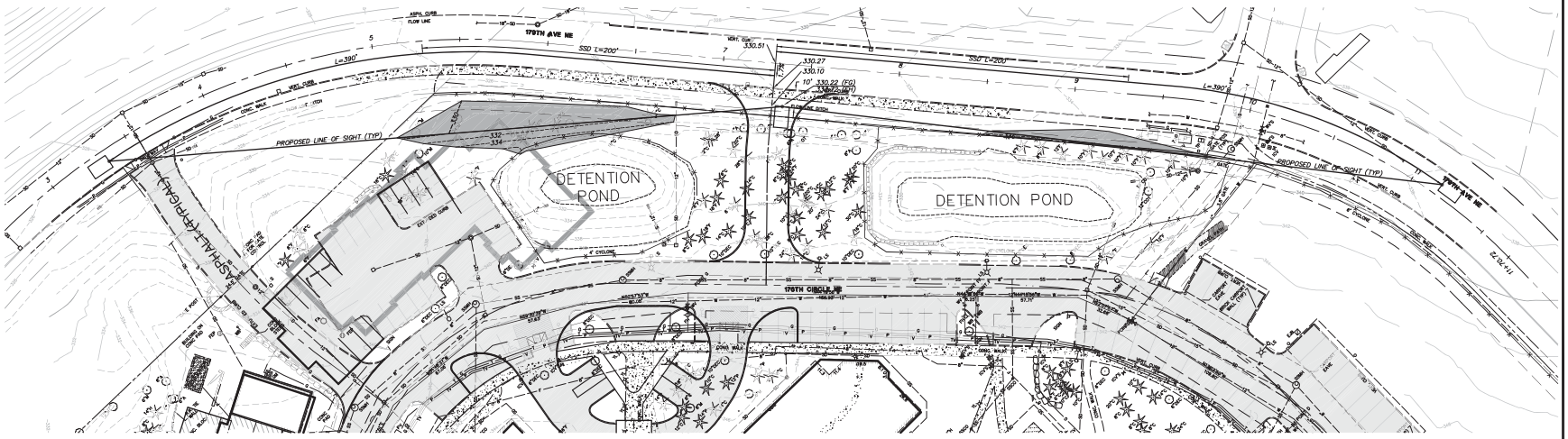
Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	111	132	142
Volume Left	43	67	0
Volume Right	69	0	31
cSH	793	1454	1700
Volume to Capacity	0.14	0.05	0.08
Queue Length 95th (ft)	12	4	0
Control Delay (s)	10.3	4.1	0.0
Lane LOS	B	A	
Approach Delay (s)	10.3	4.1	0.0
Approach LOS	B		

Intersection Summary			
Average Delay	4.4		
Intersection Capacity Utilization	23.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (veh/h)	6	7	4	73	88	5
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.70	0.70	0.73	0.73	0.67	0.67
Hourly flow rate (vph)	9	10	5	100	131	7
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	246	135	139			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	246	135	139			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	99	99	100			
cM capacity (veh/h)	744	919	1457			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	19	105	139
Volume Left	9	5	0
Volume Right	10	0	7
cSH	829	1457	1700
Volume to Capacity	0.02	0.00	0.08
Queue Length 95th (ft)	2	0	0
Control Delay (s)	9.4	0.4	0.0
Lane LOS	A	A	
Approach Delay (s)	9.4	0.4	0.0
Approach LOS	A		

Intersection Summary			
Average Delay	0.8		
Intersection Capacity Utilization	17.1%	ICU Level of Service	A
Analysis Period (min)	15		


179TH AVE NE
179TH CIRCLE NE
DETENTION POND
DETENTION POND
PROPOSED LINE OF SIGHT (TYP)
PROPOSED LINE OF SIGHT (TYP)
ASPHALT APPROACH
L=390'
S50 L=200'
330.51
330.27
330.10
330.22 (FG)
330.25 (BF)
332
334
4' CYCLONE
CONC. WALK
ASPH. CURB
FLOW LINE
EX. RED CURB
PEDESTRIAN RAMP
CONC. CURB
CONC. WALK
EXISTING CURB
EXISTING CURB
EXISTING CURB

All Traffic Data Services Inc.
2225 NE 27th St
Renton, WA 98056
Ph. 206-251-0300

Site Code: 01

EMERALD HEIGHTS ENTRANCE

Start Time	30-Nov-09 Mon		01-Dec-09 IN	OUT	02-Dec-09 IN	OUT	03-Dec-09 IN	OUT	04-Dec-09 Fri		05-Dec-09 Sat		06-Dec-09 Sun		Week Average IN	OUT
12:00 AM	*	*	*	*	1	0	0	2	0	0	1	1	0	3	0	1
01:00	*	*	*	*	1	1	0	0	2	1	2	0	1	0	1	0
02:00	*	*	*	*	0	1	1	1	1	1	0	1	0	1	0	1
03:00	*	*	*	*	0	1	0	0	0	0	0	0	0	0	0	0
04:00	*	*	*	*	2	0	2	1	3	1	2	0	3	0	2	0
05:00	*	*	*	*	16	4	16	2	21	3	13	4	10	1	15	3
06:00	*	*	*	*	19	8	22	10	15	8	13	8	17	8	17	8
07:00	*	*	*	*	**48**	14	44	7	**46**	12	16	5	10	5	33	9
08:00	*	*	*	*	38	16	36	18	36	9	13	10	3	25	25	16
09:00	*	*	*	*	30	**40**	**46**	38	28	22	39	13	18	19	32	26
10:00	*	*	*	*	37	30	30	**39**	36	43	**40**	26	**76**	**36**	**44**	**35**
11:00	*	*	*	*	43	37	44	34	42	**46**	28	**30**	42	13	40	32
12:00 PM	*	*	*	*	38	36	37	34	38	30	32	**67**	**56**	26	40	39
01:00	*	*	*	*	43	36	44	46	29	47	27	36	38	54	36	44
02:00	*	*	*	*	40	56	**56**	54	43	48	35	34	28	51	40	49
03:00	*	*	*	*	49	40	46	48	**46**	50	**46**	37	22	**62**	**42**	47
04:00	*	*	*	*	**54**	**68**	38	**67**	36	**53**	36	32	32	36	39	**51**
05:00	*	*	*	*	14	32	24	38	21	31	34	28	10	17	21	29
06:00	*	*	*	*	4	22	16	16	10	10	10	20	18	11	12	16
07:00	*	*	*	*	7	26	19	32	8	21	8	23	10	17	10	24
08:00	*	*	*	*	2	18	10	44	2	14	8	19	8	14	6	22
09:00	*	*	*	*	14	6	12	12	11	11	18	19	14	6	14	11
10:00	*	*	*	*	4	7	7	10	10	13	16	15	6	12	9	11
11:00	*	*	*	*	3	5	3	6	1	2	4	7	0	4	2	5
Total	0	0	0	0	507	504	553	559	485	476	441	435	422	421	480	479
Day	0		0		1011		1112		961		876		843		959	
AM Peak					07:00	09:00	09:00	10:00	07:00	11:00	10:00	11:00	10:00	10:00	10:00	10:00
Vol.					48	40	46	39	46	46	40	30	76	36	44	35
PM Peak					16:00	16:00	14:00	16:00	15:00	16:00	15:00	12:00	12:00	15:00	15:00	16:00
Vol.					54	68	56	67	46	53	46	67	56	62	42	51

All Traffic Data Services Inc.
2225 NE 27th St
Renton, WA 98056
Ph. 206-251-0300

Site Code: 01

EMERALD HEIGHTS ENTRANCE

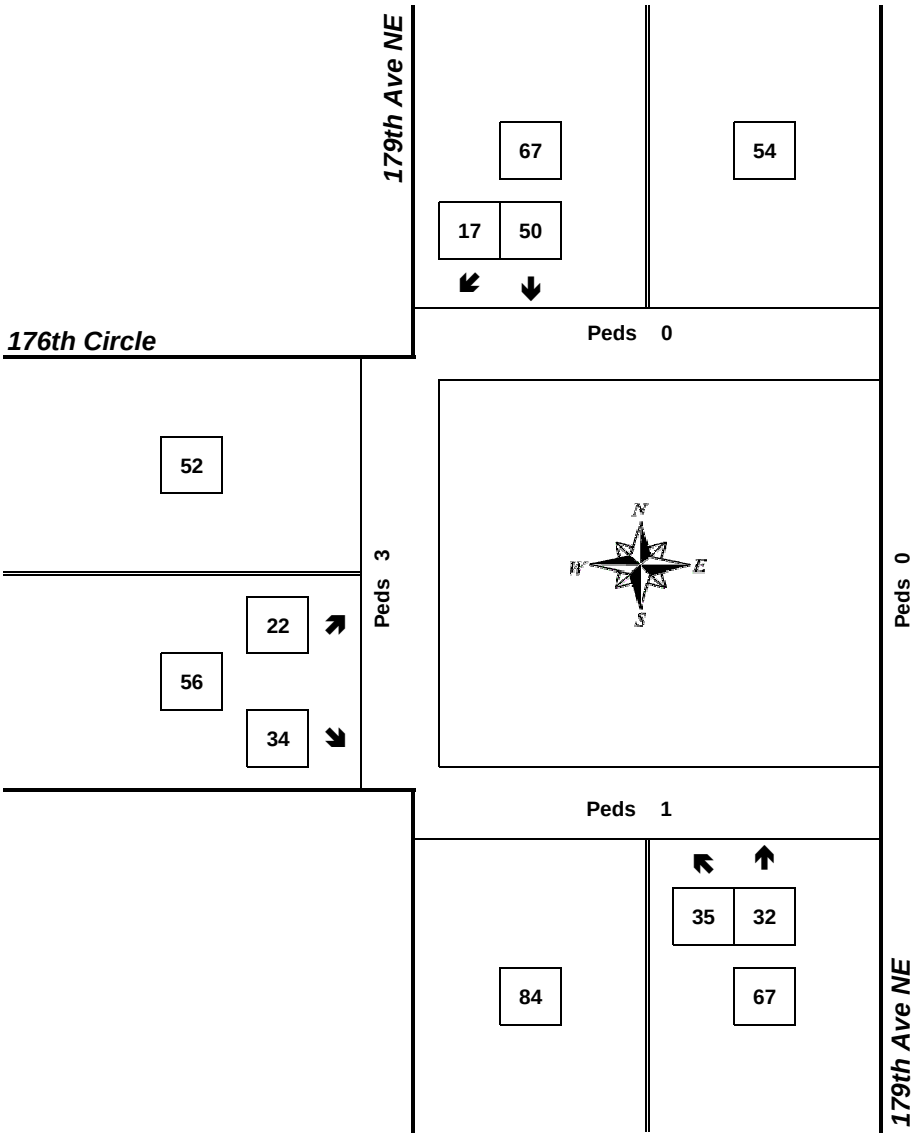
Start Time	07-Dec-09 Mon		08-Dec-09		09-Dec-09		10-Dec-09		11-Dec-09 Fri		12-Dec-09 Sat		13-Dec-09 Sun		Week Average	
			IN	OUT	IN	OUT	IN	OUT							IN	OUT
12:00 AM	0	0	1	0	0	0	*	*	*	*	*	*	*	*	0	0
01:00	0	0	0	0	0	0	*	*	*	*	*	*	*	*	0	0
02:00	0	1	0	1	0	1	*	*	*	*	*	*	*	*	0	1
03:00	0	0	0	0	0	0	*	*	*	*	*	*	*	*	0	0
04:00	3	1	3	1	3	1	*	*	*	*	*	*	*	*	3	1
05:00	16	5	18	5	15	3	*	*	*	*	*	*	*	*	16	4
06:00	22	7	26	9	20	9	*	*	*	*	*	*	*	*	23	8
07:00	**44**	15	**50**	4	46	8	*	*	*	*	*	*	*	*	**47**	9
08:00	30	6	31	19	39	16	*	*	*	*	*	*	*	*	33	14
09:00	28	30	32	36	**48**	34	*	*	*	*	*	*	*	*	36	33
10:00	31	**33**	34	40	27	**50**	*	*	*	*	*	*	*	*	31	41
11:00	43	31	41	**47**	41	48	*	*	*	*	*	*	*	*	42	**42**
12:00 PM	43	28	38	34	**60**	42	*	*	*	*	*	*	*	*	47	35
01:00	34	52	**49**	38	52	45	*	*	*	*	*	*	*	*	45	45
02:00	44	**58**	42	**60**	54	72	*	*	*	*	*	*	*	*	47	**63**
03:00	40	56	46	40	56	55	*	*	*	*	*	*	*	*	47	50
04:00	**54**	54	40	58	58	**76**	*	*	*	*	*	*	*	*	**51**	63
05:00	14	23	31	27	18	22	*	*	*	*	*	*	*	*	21	24
06:00	12	14	17	21	5	18	*	*	*	*	*	*	*	*	11	18
07:00	6	24	12	30	10	32	*	*	*	*	*	*	*	*	9	29
08:00	4	22	11	29	11	20	*	*	*	*	*	*	*	*	9	24
09:00	9	11	8	15	11	12	*	*	*	*	*	*	*	*	9	13
10:00	7	10	13	19	5	7	*	*	*	*	*	*	*	*	8	12
11:00	0	4	0	7	2	4	*	*	*	*	*	*	*	*	1	5
Total	484	485	543	540	581	575	0	0	0	0	0	0	0	0	536	534
Day	969		1083		1156		0		0		0		0		1070	
AM Peak	07:00	10:00	07:00	11:00	09:00	10:00									07:00	11:00
Vol.	44	33	50	47	48	50									47	42
PM Peak	16:00	14:00	13:00	14:00	12:00	16:00									16:00	14:00
Vol.	54	58	49	60	60	76									51	63
Comb. Total	969		1083		2167		1112		961		876		843		2029	
ADT	Not Calculated															

Peak Hour Summary

Mark Skaggs
(206) 251-0300

179th Ave NE & 176th Circle

4:00 PM to 5:00 PM
Wednesday, March 24, 2010

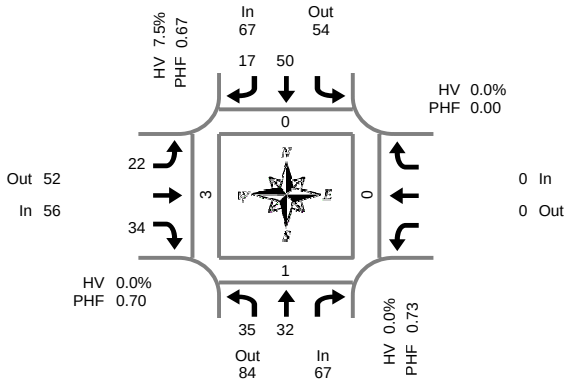


Approach	PHF	HV%	Volume
EB	0.70	0.0%	56
WB	0.00	0.0%	0
NB	0.73	0.0%	67
SB	0.67	7.5%	67
Intersection	0.78	2.6%	190

Count Period: 4:00 PM to 6:00 PM

Total Vehicle Summary

Mark Skaggs
(206) 251-0300



Peak Hour Summary
4:00 PM to 5:00 PM

179th Ave NE & 176th Circle

Wednesday, March 24, 2010
4:00 PM to 6:00 PM

15-Minute Interval Summary
4:00 PM to 6:00 PM

Interval Start Time	Northbound 179th Ave NE				Southbound 179th Ave NE				Eastbound 176th Circle				Westbound 176th Circle				Interval Total	Pedestrians Crosswalk			
	L	T		HV		T	R	HV	L		R	HV						North	South	East	West
4:00 PM	12	8		0		17	8	2	7		9	0					61	0	0	0	1
4:15 PM	16	7		0		10	4	0	6		8	0					51	0	0	0	1
4:30 PM	2	9		0		6	3	1	7		13	0					40	0	0	0	0
4:45 PM	5	8		0		17	2	2	2		4	0					38	0	1	0	1
5:00 PM	5	10		0		8	1	1	1		2	0					27	0	0	0	1
5:15 PM	2	8		1		11	1	1	1		3	0					26	1	1	0	0
5:30 PM	2	9		1		17	0	1	0		6	0					34	0	0	0	1
5:45 PM	4	10		0		4	2	2	5		4	0					29	0	0	0	3
Total Survey	48	69		2		90	21	10	29		49	0					306	1	2	0	8

Peak Hour Summary
4:00 PM to 5:00 PM

By Approach	Northbound 179th Ave NE				Southbound 179th Ave NE				Eastbound 176th Circle				Westbound 176th Circle				Total
	In	Out	Total	HV	In	Out	Total	HV	In	Out	Total	HV	In	Out	Total		
Volume	67	84	151	0	67	54	121	5	56	52	108	0	0	0	0		190
%HV	0.0%				7.5%				0.0%				0.0%				2.6%
PHF	0.73				0.67				0.70				0.00				0.78

Pedestrians Crosswalk			
North	South	East	West
0	1	0	3

By Movement	Northbound 179th Ave NE				Southbound 179th Ave NE				Eastbound 176th Circle				Westbound 176th Circle				Total
	L	T		Total		T	R	Total	L		R	Total				Total	
Volume	35	32		67		50	17	67	22		34	56				0	190
PHF	0.55	0.89		0.73		0.74	0.53	0.67	0.79		0.65	0.70				0.00	0.78

Rolling Hour Summary
4:00 PM to 6:00 PM

Interval Start Time	Northbound 179th Ave NE				Southbound 179th Ave NE				Eastbound 176th Circle				Westbound 176th Circle				Interval Total	Pedestrians Crosswalk			
	L	T		HV		T	R	HV	L		R	HV						North	South	East	West
4:00 PM	35	32		0		50	17	5	22		34	0					190	0	1	0	3
4:15 PM	28	34		0		41	10	4	16		27	0					156	0	1	0	3
4:30 PM	14	35		1		42	7	5	11		22	0					131	1	2	0	2
4:45 PM	14	35		2		53	4	5	4		15	0					125	1	2	0	3
5:00 PM	13	37		2		40	4	5	7		15	0					116	1	1	0	5

Year	Mo	Day	Day_of Week	Peak Period	Northbound Left	Northbound Thru	Northbound Right	Southbound Left	Southbound Thru	Southbound Right	Eastbound Left	Eastbound Thru	Eastbound Right	Westbound Left	Westbound Thru	Westbound Right	Source
2007	12	06	THU	PM	0	1102	187	18	532	0	0	0	0	39	0	9	RED
2007	4	18	WED	PM	0	1126	130	14	565	0	0	0	0	31	0	10	RED
104166	***NE 104 St and 166 Ave NE***																
1999	7	28	WED	PM	80	215	242	23	107	11	21	107	61	105	39	17	RED
2000	10	26	THU	PM	89	279	364	27	130	16	24	125	57	169	69	19	RED
2003	11	12	TUE	PM	93	206	239	20	108	11	16	137	81	108	66	27	RED
2003	12	2	TUE	PM	105	253	281	21	79	12	29	137	58	105	30	12	DEV
2005	1	25	TUE	AM	67	83	223	68	269	13	12	96	121	277	180	38	RED
2007	12	13	THU	AM	159	67	126	11	349	27	9	59	119	346	203	12	RED
2007	03	14	WED	PM	95	359	355	20	92	11	16	106	64	110	51	11	RED
2007	12	13	THU	PM	123	358	361	14	106	6	32	123	58	140	58	20	RED
2007	3	14	WED	PM	95	359	355	20	92	11	16	106	64	110	51	11	RED
104179	***NE 104 St and 179 Ave NE***																
2007	12	13	THU	PM	8	2	3	32	4	36	60	299	38	4	160	34	RED
104AVR	***NE 104 St and Avondale Rd***																
1994				PM	365	935	0	0	559	67	82	0	359	0	0	0	RED
1995				PM	154	1043	0	0	648	31	63	0	201	0	0	0	RED
1996				PM	172	1064	0	0	702	47	75	0	190	0	0	0	RED
1997				PM	224	1418	0	0	708	41	76	0	174	0	0	0	RED
1998	9	3	THU	PM	220	1502	0	0	744	42	96	0	205	0	0	0	RED
1999	7	13	TUE	PM	148	1627	0	0	755	50	82	0	170	0	0	0	RED
2004	1	14	WED	PM	0	0	0	96	0	248	153	1416	0	0	695	39	RED
2005	11	08	Tues	PM	151	1202	0	0	689	82	115	0	260	0	0	0	RED
2007	11	14	WED	AM	180	454	0	0	1135	146	45	0	100	0	0	0	RED
2007	11	14	WED	PM	111	1481	0	0	748	41	125	0	208	0	0	0	RED
109RWR	***NE 109 St and Red-Wood Rd***																
1998	7	1	WED	PM	66	810	167	79	416	8	21	82	48	80	32	51	RED
2000	10	18	WED	PM	109	802	159	95	387	19	39	118	124	70	33	55	RED
2005	09	29	Thurs	PM	98	775	138	154	475	46	63	67	70	78	71	107	RED
2007	12	6	THU	AM	11	235	48	38	980	42	3	46	104	229	63	112	RED

Year	Mo	Day	Day_of Week	Peak Period	Northbound Left	Northbound Thru	Northbound Right	Southbound Left	Southbound Thru	Southbound Right	Eastbound Left	Eastbound Thru	Eastbound Right	Westbound Left	Westbound Thru	Westbound Right	Source
2007	4	18	WED	AM	0	1192	156	61	356	8	26	12	16	15	1	9	RED
2007	4	18	WED	MID	16	392	69	39	436	9	11	14	22	64	13	58	RED
2007	12	06	THU	PM	27	911	90	104	442	4	21	38	27	52	30	62	RED
2007	4	18	WED	PM	0	1192	156	61	356	8	26	12	16	15	1	9	RED
2007	3	15	THU	PM	30	934	114	101	449	14	17	55	29	80	13	72	RED
116162			***NE 116 St and 162 Ave NE***														
2006	01	12	Thurs	PM	56	0	17	0	0	0	0	264	38	16		0	RED
2007	12	06		PM	44	0	14	0	0	0	0	409	33	12		0	RED
116172			***NE 116 St and 172 Ave NE***														
1998	7	30	THU	PM	13	27	42	19	14	1	9	301	20	23			RED
1999	6	30	WED	PM	68	39	13	20	11	2	16	302	19	33		17	RED
2003	11	18	TUE	AM	44	12	54	7	32	9	2	81	36	150	329	6	RED
2003	11	5	WED	PM	24	67	126	9	7	3	15	357	31	24	120	6	DEV
2003	11	13	THU	PM	12	54	97	6	15	1	9	387	34	28	122	11	RED
2006	3	1	WED	AM	36	13	34	20	55	30	7	82	32	172	385	27	RED
2006	3	1	WED	MD	15	28	40	20	21	7	14	118	10	45	103	19	RED
2006	01	12	Thurs	PM	30	53	126	21	13	4	6	238	28	35	80	11	RED
2007	12	06	THU	AM	33	19	45	20	65	37	16	73	39	197	392	24	RED
2007	12	06	THU	PM	24	52	130	24	9		26	395	31	47	154	8	RED
116AVR			***NE 116 St and Avondale Rd***														
1994				PM	74	802	13	19	525	20	121	43	181	24	25	44	RED
1995				PM	78	916		33	423	24	93	51	230	26	22	30	RED
1996				PM	96	1085	29	31	516	25	161	42	201	30	18	42	RED
1997				PM	57	1225	30	43	560	25	92	32	173	31	14	36	RED
1998	7	28	TUE	AM	116	351	9	43	1177	101	13	12	70	21	20	22	RED
1998	7	28	TUE	PM	73	1275	29	26	488	17	116	45	168	25	15	44	RED
1999	8	12	THU	AM	91	338	13	48	1225	91	16	11	55	21	26	24	RED
1999	8	12	THU	PM	34	561	7	72	1414	22	132	47	185	31	24	29	RED
2000	10	31	TUE	AM	172	361	25	174	1369	324	35	23	49	23	50	41	RED
2000	10	31	TUE	PM	86	1480	32	27	501	26	250	43	181	36		71	RED

Year	Mo	Day	Day_of Week	Peak Period	Northbound Left	Northbound Thru	Northbound Right	Southbound Left	Southbound Thru	Southbound Right	Eastbound Left	Eastbound Thru	Eastbound Right	Westbound Left	Westbound Thru	Westbound Right	Source
2003	10	22	WED	AM	185	329	24	141	1315	300	36	32	73	36	44	22	RED
2003	10	22	WED	PM	100	1322	30	57	539	38	211	39	159	38	28	73	RED
2007	11	14	WED	AM	179	264	17	148	1029	357	48	49	81	39	58	42	RED
2007	11	14	WED	PM	110	1224	24	31	533	35	294	49	214	50	27	40	RED
116RWR	***NE 116 St and Red-Wood Rd***																
1994				PM	0	727	135	261	505	0	0	0	0	42	0	100	RED
1995				PM	0	597	119	283	475	0	0	0	0	29	0	126	RED
1996				PM	0	665	147	268	493	0	0	0	0	18	0	115	RED
1997				PM	0	690	115	193	494	0	0	0	0	18	0	77	RED
1998				PM	0	729	140	229	507	0	0	0	0	17	0	108	RED
1998	7	30	THU	PM	0	729	140	229	507	0	0	0	0	17	0	108	RED
2003	11	6	THU	PM	0	784	189	214	441	0	0	0	0	53	1	150	RED
2005	09	29	Thurs	PM	0	896	37	109	639	0	0	0	0	19	0	65	RED
2006	3	1	WED	AM	0	373	40	84	853	0	0	0	0	307	0	210	RED
2007	12	06	THU	AM	0	269	51	95	647	0	0	0	0	327	0	230	RED
2007	3	15	THU	PM	0	823	191	256	472	0	0	0	0	62	0	114	RED
2007	12	06	THU	PM	0	781	180	262	399	0	0	0	0	54	0	146	RED
116WIL	***NE 116 St and Willows Rd***																
1994				PM	9	916	205	174	533	1	97	29	73	50	3	72	RED
1995				PM	12	981	167	111	474	6	90	27	100	54	3	48	RED
1996				PM	17	1014	110	54	496	6	121	39	107	27	1	17	RED
1997				PM	0	1017	152	59	438	0	0	0	0	46	0	30	RED
1998				PM	21	1047	170	103	409	7	64	47	104	60	2	50	RED
1998	11	18	WED	PM	21	1047	170	103	409	7	64	47	104	60	2	50	RED
2000	9	13	WED	AM	60	341	33	15	1171	97	13	0	15	253	30	44	RED
2000	10	18	WED	PM	4	1129	144	86	408	11	151	37	57	17	2	77	RED
2003	10	22	WED	AM	72	320	13	22	1061	165	13	2	21	127	26	38	RED
2003	10	22	WED	PM	7	1059	81	108	476	18	193	35	51	16	3	45	RED
2007	12	13	THU	AM	40	362	7	4	1221	126	13	0	9	65	19	14	RED
2007	4	18	WED	AM	61	356	8	0	1192	156	15	1	9	26	12	16	RED