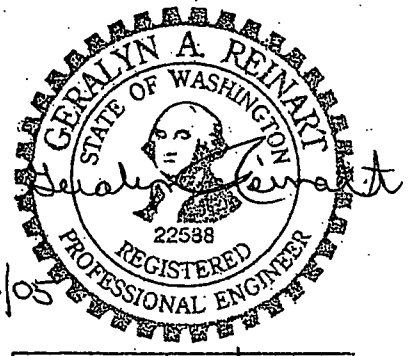
TECHNICAL MEMORANDUM

VISTA VIEW ESTATES
TRAFFIC IMPACT ASSESSMENT
KITTITAS COUNTY, WASHINGTON

February 2005



02/24/05

EXPIRES: 07/29/07

Prepared for:
Rick Wade

GERALYN REINART, P.E.
1319 DEXTER AVENUE NORTH, SUITE 103
SEATTLE, WASHINGTON 98109
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29

TECHNICAL MEMORANDUM

February 24, 2005

To: Rick Wade

From: Geralyn Reinart, P.E.

Subject: Vista View Estates

Introduction

The purpose of this memorandum is to summarize the anticipated transportation impacts resulting from the development of Vista View Estates in Kittitas County. This report has reviewed the current traffic conditions in the vicinity of the site, the proposed action and its impacts to the transportation system, and developed appropriate mitigation, as necessary.

Although the project is located within unincorporated Kittitas County, it is located within the Urban Growth Area and the majority of its traffic would impact the City of Ellensburg street system. Discussions with John Akers, P.E., at the City of Ellensburg indicated a need to review the intersection of Mountain View Road/Bull Road and to review the project frontage along Kittitas Highway, including the need for turn storage and improvements. Specific details on the project and the analysis of its impacts can be found in the subsequent sections.

Project Description

Vista View Estates is located on the north side of Kittitas Highway east of Bull Road/Willow Street. The parcel totals approximately 42 acres in size, and is currently undeveloped and consists primarily of pastureland. The proposed action would include the development of 167 single-family residential lots on the site. The project proponent is Rick Wade (contact number: 425-417-3548).

Access to the project would be from two locations along Kittitas Highway approximately one-quarter mile (plus or minus) east of Bull Road. A future connection to Seattle Avenue has also been included in the plat layout near the northwesterly

corner of the property. Additionally, street stubs have been incorporated into the design to serve future development(s) to the north and east. A series of public roads internal to the site will provide access to the individual lots. No direct access from Kittitas Highway to any individual lot is proposed.

The area near the site includes a mix of single-family residences and undeveloped parcels. The site was re-zoned to residential use in 1999 and 2000, and no change in zoning is planned. No specific conditions related to transportation associated with the re-zone were noted by the County. Build-out of the project is planned by 2008. Therefore, for purposes of the traffic impact analysis, the year 2008 has been used for the future build-out condition. A vicinity map of the area is shown on Figure 1 and a reduced copy of the site plan has been attached.

The remainder of this report analyzes the effects of the development of the subject property and the traffic-related impacts that can be expected on the adjacent intersections.

Existing Conditions

The proposed Vista View Estates development will primarily impact Kittitas Highway/ Mountain View Avenue, with lesser impacts to Willow Street and Chestnut Street. Seattle Avenue would be impacted in the future when connected. The following describes these roadways, existing traffic volumes, and current operating conditions.

1. Roadways

Kittitas Highway/Mountain View Avenue is an east-west arterial that provides a connection between Canyon Road and Kittitas. The roadway is striped for three lanes between Canyon Road and Ruby Street with curb, gutter, sidewalk and bike lanes. The street then transitions to two lanes, with the bicycle lane continuing on the south side of the street for several hundred feet. The section of Mountain View Avenue east of Ruby Street has curb, gutter, and sidewalk constructed along much of the south side of the street along the frontages of new development. The north side of the street consists mostly of gravel shoulder. East of Bull Road, Kittitas Highway is primarily two lanes with two to three foot paved shoulders and open ditches. The entire section of roadway is straight and flat and the speed limit varies from 25 mph east from Canyon Road to Chestnut Street, increasing to 35 mph east of Chestnut Street, and increasing to 50 mph east of Bull Road. Streets intersecting Mountain View Avenue/Kittitas Highway are required to stop, with traffic signals installed at the Canyon Road, Ruby Street, and Chestnut Street intersections. The adjacent land use is primarily commercial east of Canyon Road, transitioning to residential (single- and multi-family) further to the east, with several undeveloped parcels. The area east of Bull Road becomes increasingly rural in nature.

Chestnut Street is a north-south City arterial that connects Mountain View Avenue with

8th Avenue. Chestnut Street is striped for two lanes, although a left-turn storage lane has been striped on the approach to Mountain View Avenue. The street cross-section includes curb, gutter, and sidewalk on both sides of the street except for a one-block section north of Hobert Avenue where no sidewalk has been constructed. On-street parking is allowed along most sections of the street. The adjacent land use is predominantly single-family residential, with the hospital located north of Spokane Avenue.

Willow Street is a north-south two-lane City street that provides a connection between Mountain View Avenue and Capitol Avenue. Some sidewalk or curb, gutter, and sidewalk have been installed along the frontages of new development on the west side of the street, with gravel shoulder on the east side. The posted speed is 25 mph, with a 20-mph school zone posted near the approach to Capitol Avenue. The adjacent land use is primarily single-family residential and a church.

Seattle Avenue is an east-west local access street that currently dead-ends a few hundred feet east of Locust Street. The section of street between Willow Street and Locust Street is a two-lane impervious roadway with no shoulder. The section east of Locust Street is a dirt lane that serves a single-family residence. The adjacent land use is mainly pasture/ undeveloped property.

2. Traffic Volumes

A PM peak hour turning movement count was conducted for this analysis at the intersection of Kittitas Highway/Bull Road/Willow Street. These volumes are shown on Figure 2. The weekday PM peak hour (the highest 60-minute interval between 4:00 and 6:00 PM) is typically considered the most critical time period with respect to both the traffic volumes on the adjacent streets and of a residential development. Daily traffic volumes provided by the City of Ellensburg are also shown on Figure 2.

3. Level of Service

A capacity analysis for the PM peak hour was conducted at the intersection of Kittitas Highway/Bull Road/Willow Street in order to determine the current level of service. This intersection is controlled by stop signs in the north and south directions, consists of one lane on all approaches, and is located within the city limits.

"Level of service" (LOS) is a common term used in the Traffic Engineering profession that is defined as a qualitative measure describing operational conditions within a traffic stream, and its perception by motorists and/or passengers. These conditions are usually described in terms of such factors as speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience, and safety. Six levels of service are designated, ranging from "A" to "F", with level of service "A" representing the best operating

conditions and level of service "F" the worst. The City of Ellensburg considers LOS "D" acceptable along major arterials such as Canyon Road, whereas LOS "C" is considered acceptable along Mountain View Avenue, and LOS "B" acceptable along local access streets.

Calculations for the level of service analyses were conducted using the McTrans Highway Capacity Software version 4.1d based on the *2000 Highway Capacity Manual.* The manual traffic count described earlier was used in this analysis. The following table shows the current levels of service for the critical movements on the approaches. The critical movements are typically those movements that are controlled by a stop or yield sign, or left-turn movements from the major street. For this specific intersection, the left-turns from Kittitas Highway and the north/south approaches are critical movements. Calculations for the level of service analyses have been attached.

TABLE 1
EXISTING LEVELS OF SERVICE

	NORTH-BOUND	SOUTH-BOUND	EAST-BOUND	WEST-BOUND	OVERALL
Kittitas Highway/Bull Road/Willow Street	LOS B 12.4 sec.	LOS B 11.2 sec.	LOS A 7.7 sec.	LOS A 7.9 sec.	N.A.

Note: Bull Road/Willow Street considered the north/south approaches and Kittitas Highway considered the east/west approaches in the capacity analyses.
N.A. – not applicable/available (i.e., calculation not provided for specific analysis)

Where:

LOS	Delay
A	$\leq$ 10 seconds
B	> 10 & $\leq$ 15 seconds
C	> 15 & $\leq$ 25 seconds
D	> 25 & $\leq$ 35 seconds
E	> 35 & $\leq$ 50 seconds
F	> 50 seconds

Table 1 shows the level of service results for the PM peak hour indicating that all movements at the intersection are operating at level of service "B" or better. The values shown in Table 1 are the total approach delay for the critical movement(s).

4. Non-Motorized Facilities

No pedestrian facilities are currently found in the vicinity of the proposed project due to the rural/semi-rural conditions of the area. Kittitas Highway has limited shoulder area that has inherent limitations for both pedestrian and bicycle use. Sidewalk can be found

further to the west along the frontages of new developments within the City of Ellensburg. A short section of bike lane has been installed along Mountain View Avenue between Canyon Road and Ruby Street, which continues eastward for several hundred additional feet on the south side only.

Project Traffic

The development of Vista View Estates into residential lots will generate new traffic onto the adjacent transportation system. The following sections summarize the impacts associated with the proposed action.

1. Trip Generation

The proposed subdivision would generate new traffic onto the adjacent roadways. The *ITE Trip Generation Manual* (published by the Institute of Transportation Engineers, 2003, 7th Edition) is typically used to estimate the number of trips expected to be generated by a development. Land Use Code 210, Single-Family Detached Housing, best represents the proposed use. Table 2 shows the estimated number of trips for the development using the average trip rates, with the number of lots as the independent variable.

TABLE 2
VISTA VIEW ESTATES
TRIP GENERATION
(167 LOTS)

Time Period	Trip Rate	In	Out	Total
Daily	9.57 trips/lot	799	799	1598
AM peak	0.75 trips/lot	31	94	125
PM peak	1.01 trips/lot	106	63	169

2. Trip Distribution/Assignment

New traffic generated by the development of Vista View Estates would be distributed onto the adjacent roadways to gain access to other arterials, into the core of Ellensburg, or to the regional transportation system. Traffic generated by the development of the site will initially use Kittitas Highway, with further distribution onto north-south streets such as Willow Street, Chestnut Street, Ruby Street, or Canyon Road. *(Note: All traffic from the site has been routed to Kittitas Highway for the near term. A future connection to Seattle Avenue will divert some of the site traffic from Kittitas Highway,*

but until improvements are provided to Seattle Avenue west of the site, all impacts will be to Kittitas Highway.)

The trip distribution/assignment has assumed that the majority of the site traffic would travel to and from Ellensburg, with a minor percentage traveling to and from the east. Figure 3 summarizes the daily trip distribution/assignment for the project by percent and daily volume. Figures 4 and 5 summarize the AM and PM peak hour trip assignments. A review of the figures shows that the project would have its greatest impact on Kittitas Highway to the west of the site.

3. Traffic Volumes

Figures 6 and 7 show the projected daily and PM peak hour traffic volumes for the year 2008 with and without the project trips. The existing peak hour volumes were increased 3% annually for the 2008 volumes to account for miscellaneous background growth in the area over the next three years, at which time the project is expected to be complete and occupied. This growth rate is noted in the City's Comprehensive Plan, and therefore considered a reasonable value for projecting future growth. Additionally, the estimated trips associated with a manufactured housing development on Bull Road south of Kittitas Highway were added into the turning movements to and from Bull Road.

4. Level of Service

Level of service calculations were conducted again for the intersection of Kittitas Highway/Bull Road/Willow Street using the volumes shown on Figures 6 and 7. It was assumed for purposes of analysis that no changes in the geometric conditions or traffic control at the intersection would occur. The results of the future conditions with and without the site trips are shown in Table 3.

TABLE 3
2008 LEVELS OF SERVICE

W/Out Project	NORTH-BOUND	SOUTH-BOUND	EAST-BOUND	WEST-BOUND	OVERALL
Kittitas Highway/Bull Road/Willow Street	LOS C 16.6 sec.	LOS B 12.8 sec.	LOS A 7.8 sec.	LOS A 8.0 sec.	N.A.
With Project					
Kittitas Highway/Bull Road/Willow Street	LOS C 20.2 sec.	LOS C 17.2 sec.	LOS A 7.9 sec.	LOS A 8.2 sec.	N.A.

Note: Bull Road/Willow Street considered the north/south approaches and Kittitas Highway considered the east/west approaches in the capacity analyses.
N.A. – not applicable/available (i.e., calculation not provided for specific analysis)

Where:

LOS	Delay
A	≤ 10 seconds
B	> 10 & ≤ 15 seconds
C	> 15 & ≤ 25 seconds
D	> 25 & ≤ 35 seconds
E	> 35 & ≤ 50 seconds
F	> 50 seconds

The results of the capacity analyses show minor increases in the delay from the existing conditions to the 2008 conditions. All of the critical approaches at the intersection are expected to operate at level of service "C" or better in the future, with or without the project. The proposed project could add up to 4.4 seconds of delay to the 2008 "without project" conditions. As noted in the existing conditions, the values shown in the table are the total approach delay for the critical movement(s). (See attached calculations.)

5. Site Access

The current site plan shows access to the project from Kittitas Highway at two locations east of Bull Road. These accesses are separated from each other by a distance of approximately 1100 feet. The estimated peak hour volumes at the site accesses are shown on Figure 8. *(Note: the trips assigned to each access were estimated as follows – 55% of the site trips to/from the west were assigned to the west access and the remaining 45% to the east access. Fifteen percent of the site trips to/from the east were assigned to the west access and 85% to the east access. This estimated assignment was based simply on the internal street layout and number of lots that would likely use the more convenient access to/from the east or west.)*

A level of service analysis was completed for the accesses to determine the expected operating conditions. A single-lane approach in all directions was assumed for the analyses. The results of these analyses are shown in Table 4.

TABLE 4
FUTURE LEVELS OF SERVICE – SITE ACCESSES

	NORTH-BOUND	SOUTH-BOUND	EAST-BOUND	WEST-BOUND	OVERALL
Kittitas Highway/ West Site Access	N.A.	LOS A 9.9 sec.	LOS A 7.8 sec.	N.A.	N.A.
Kittitas Highway/ East Site Access	N.A.	LOS B 10.4 sec.	LOS A 7.8 sec.	N.A.	N.A.

N.A. – not applicable (i.e., calculation not provided for specific analysis or not a critical/conflicting movement)

Where:

LOS	Delay
A	$\leq$ 10 seconds
B	> 10 & $\leq$ 15 seconds
C	> 15 & $\leq$ 25 seconds
D	> 25 & $\leq$ 35 seconds
E	> 35 & $\leq$ 50 seconds
F	> 50 seconds

The results of the capacity analyses indicate that all of the critical movements at the intersection will operate at level of service "B" or better during the PM peak hour.

The need for left-turn storage on Kittitas Highway at the site accesses has also been reviewed using Figure 910-9a from the *WSDOT Design Manual* (figure has been attached in the Appendix). Based on the anticipated volume of left-turns from Kittitas Highway Road at the west site access and the volume of through traffic, the intersection of these two points falls above the curve, indicating that further analysis is recommended. This typically implies the need for turn storage. At the east site access, the intersection of these two points falls below the curve, indicating that storage is not needed. *(See further discussion of this issue in subsequent section.)*

The project site plan has shown a 10-foot right-of-way dedication along Kittitas Highway along the project frontage. Furthermore, an 80-foot right-of-way has been shown for the north-south street that will serve as the east site access. This street will eventually continue to the north and provide another north-south corridor to serve the expanding urban area. The City of Ellensburg has indicated that a condition associated with requesting city water and sewer would be the signing of a pre-annexation agreement and constructing all street improvements to urban standards. This would include not only the internal streets but also frontage improvements along Kittitas highway.

The site plan has also shown future connections to the east and west that will serve as the extension of Seattle Avenue to serve future development of properties. Until these properties are re-developed, access to the property would be solely from Kittitas Highway.

Project Impacts/Conclusions/Recommendations

The development of Vista View Estates would generate approximately 1600 daily trips, with 169 new trips during the PM peak hour. The majority of site traffic will be destined to and from Ellensburg for employment, social, educational, and shopping opportunities. The intersections reviewed in this analysis show that they would operate at acceptable levels of service upon completion of the proposed project. The additional

traffic generated by Vista View Estates would not result in a significant impact to these intersections such that the level of service standards would be exceeded.

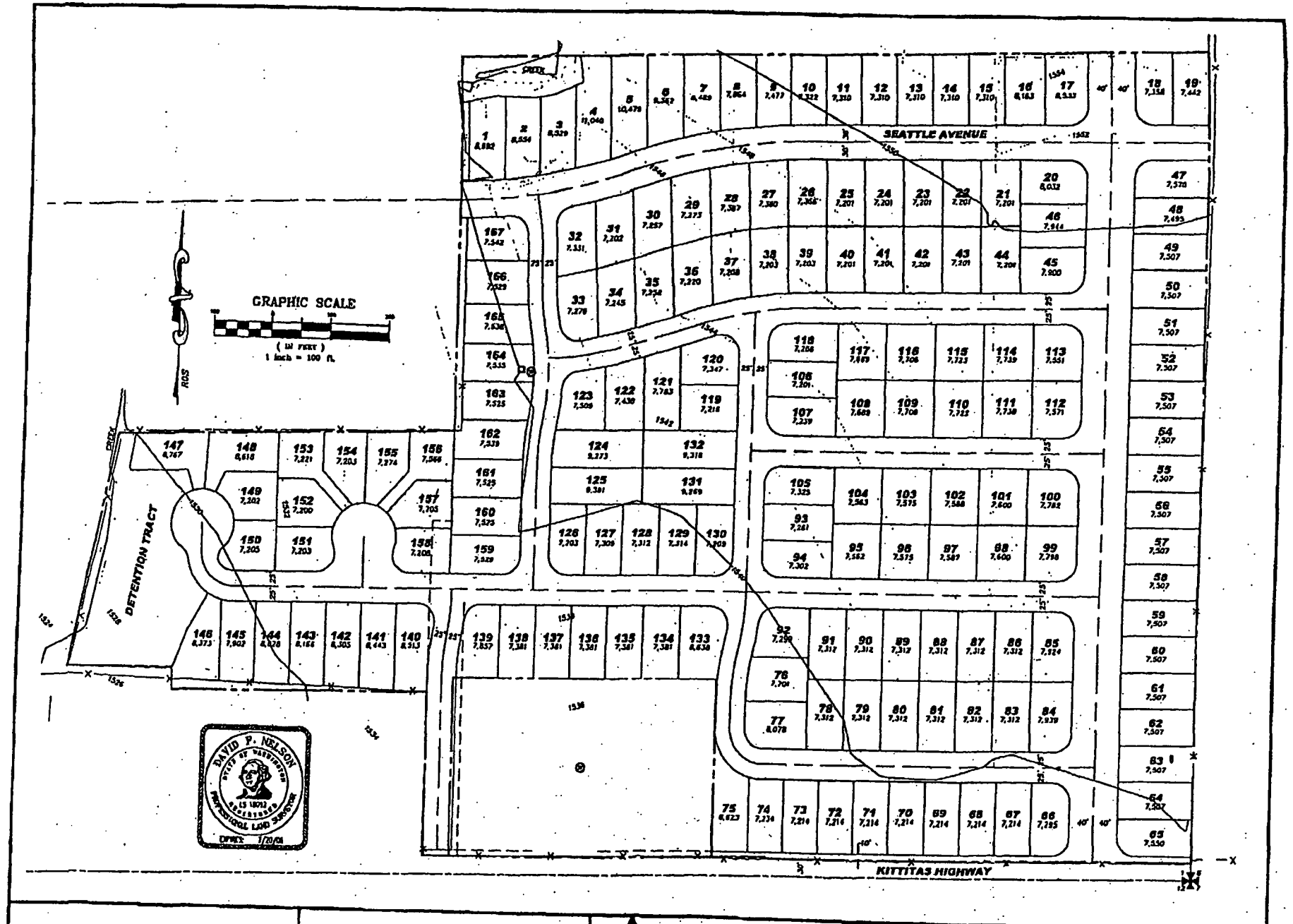
The main traffic impact associated with the proposed project would be to Kittitas Highway. Although the section of roadway adjacent to the project is located within the County, the project site will eventually be annexed into the City of Ellensburg and Kittitas Highway will ultimately be constructed to urban standards. The project site plan has shown a 10-foot right-of-way dedication along its Kittitas Highway frontage. The City of Ellensburg has indicated that a condition associated with requesting city water and sewer would be the signing of a pre-annexation agreement and the construction of all street improvements to urban standards. This would include not only the internal streets but also frontage improvements along Kittitas highway.

The need for left-turn storage on Kittitas Highway at the site accesses was reviewed as part of this assessment. Based on the anticipated volume of left-turns from Kittitas Highway at the west site access and the volume of through traffic, the intersection of these two points falls above the curve, indicating that further analysis is recommended. This typically implies the need for turn storage. At the east site access, the intersection of these two points falls below the curve, indicating that storage is not needed.

Although the analyses have indicated that left-turn storage is warranted at the west site access, and not at the east access, a possible alternative would be the installation of the left-turn storage at the east access, with right-turn only access at the west access. *(Note: the right-turn only restriction could be an interim measure until such time that Kittitas Highway is brought up to an urban standard east of Bull Road, including a two-way left-turn lane.)* This alternative would better serve future transportation needs since the east access will eventually extend to the north beyond the project site and ultimately serve additional left-turn volumes. Additionally, the east access could be a better location, from a feasibility perspective, to physically construct the left-turn lane. Roadway widening would be necessary to install the left-turn lane and much of this widening could be incorporated into the frontage improvements that the City of Ellensburg has indicated will be required. *(Note: with either alternative, roadway widening beyond the project frontage would likely be needed to accommodate transitions and tapers.)* Discussions with Eastside Consultants have indicated that there may be difficulties in providing improvements along Kittitas Highway due to the current construction of the roadway, so further investigation is needed to determine the feasibility of all alternatives (west access versus east access, and symmetrical versus asymmetrical widening), along with discussions with City and County Staff to determine actual requirements.

Frontage improvements and street construction per the current City of Ellensburg road standards should be provided. Due to the limited off-site impacts associated with the project, no other mitigation is recommended.

FIGURES/ATTACHMENTS



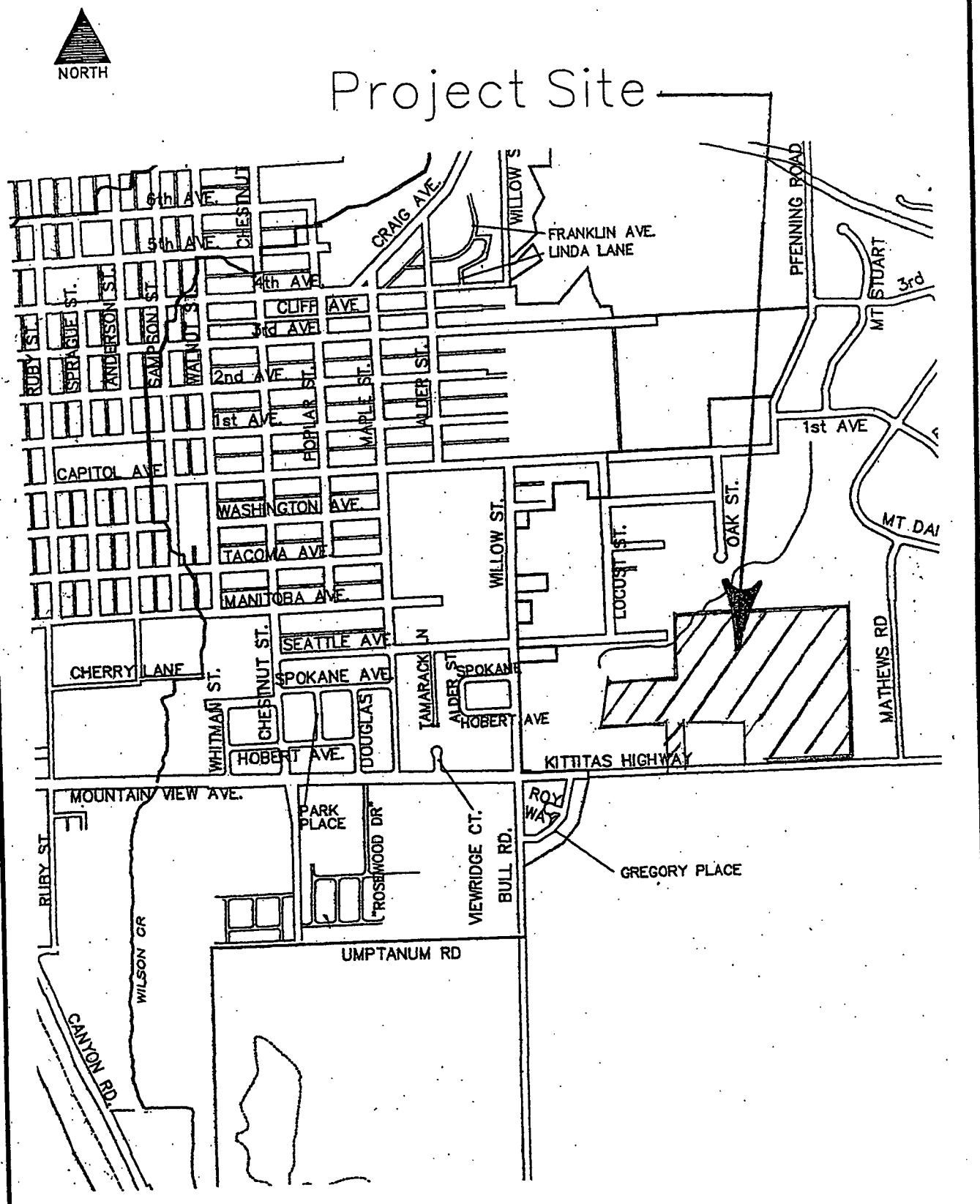
PRELIMINARY PLAT LAYOUT

IN THE S.E.1/4 SEC. 1, T.17N., R.18E., W.M.

KITTITAS COUNTY WASHINGTON

EASTSIDE CONSULTANTS, INC.
ENGINEERS-SURVEYORS
814 PENNSYLVANIA AVENUE
CLE ELUM, WASHINGTON 98922
PHONE: (509)674-7433
FAX: (509)674-7439

DWN BY	DATE	JOB NO.
S. KITZ	12/04	04683
CHKD BY	SCALE	SHEET
D. NELSON	1"=100'	1 OF 1

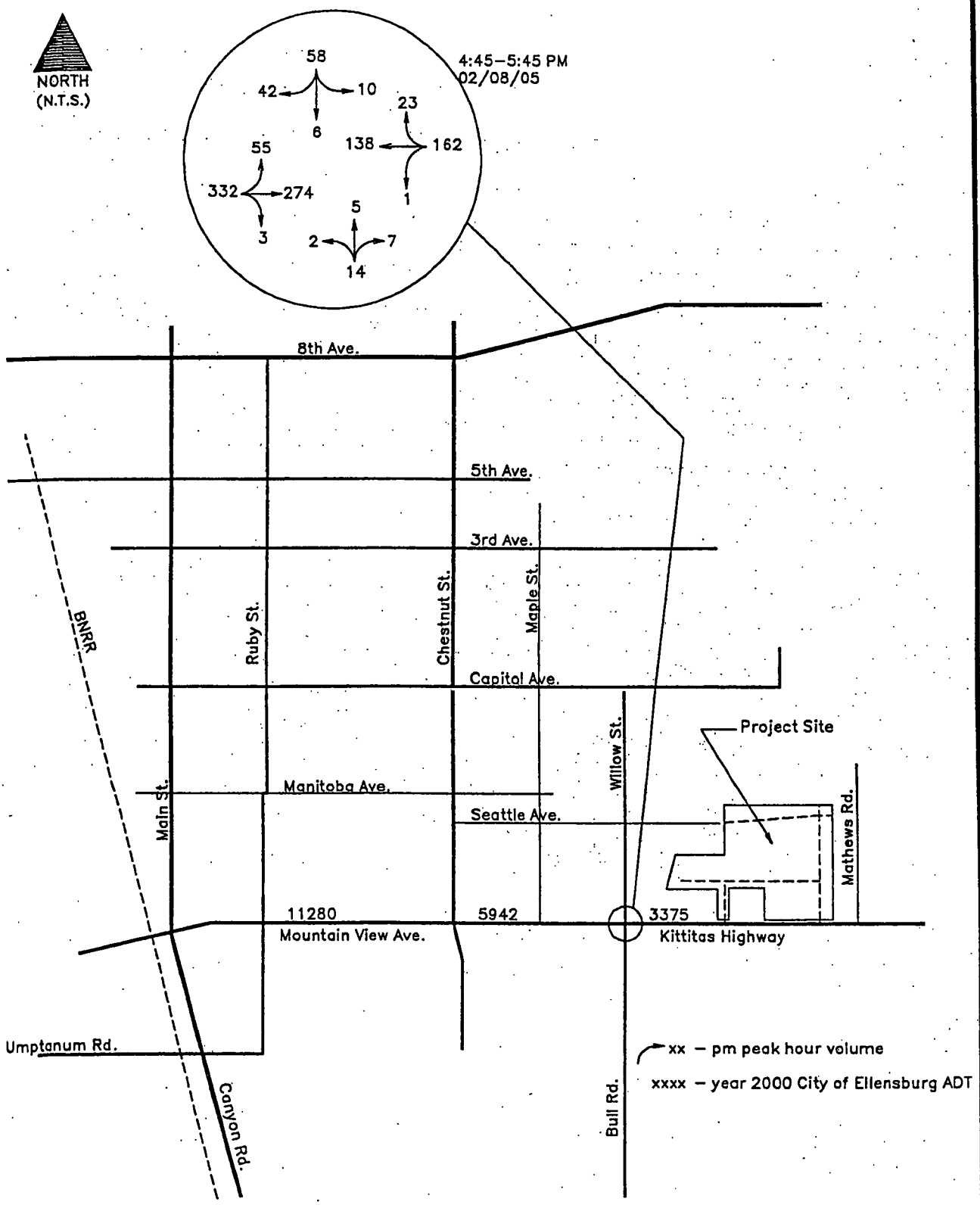


PROJECT VICINITY MAP

FIGURE 1

Geralyn Reinart, P.E.
1319 Dexter Ave. N., #103
Seattle, WA.

Vista View Estates
Kittitas County, WA.

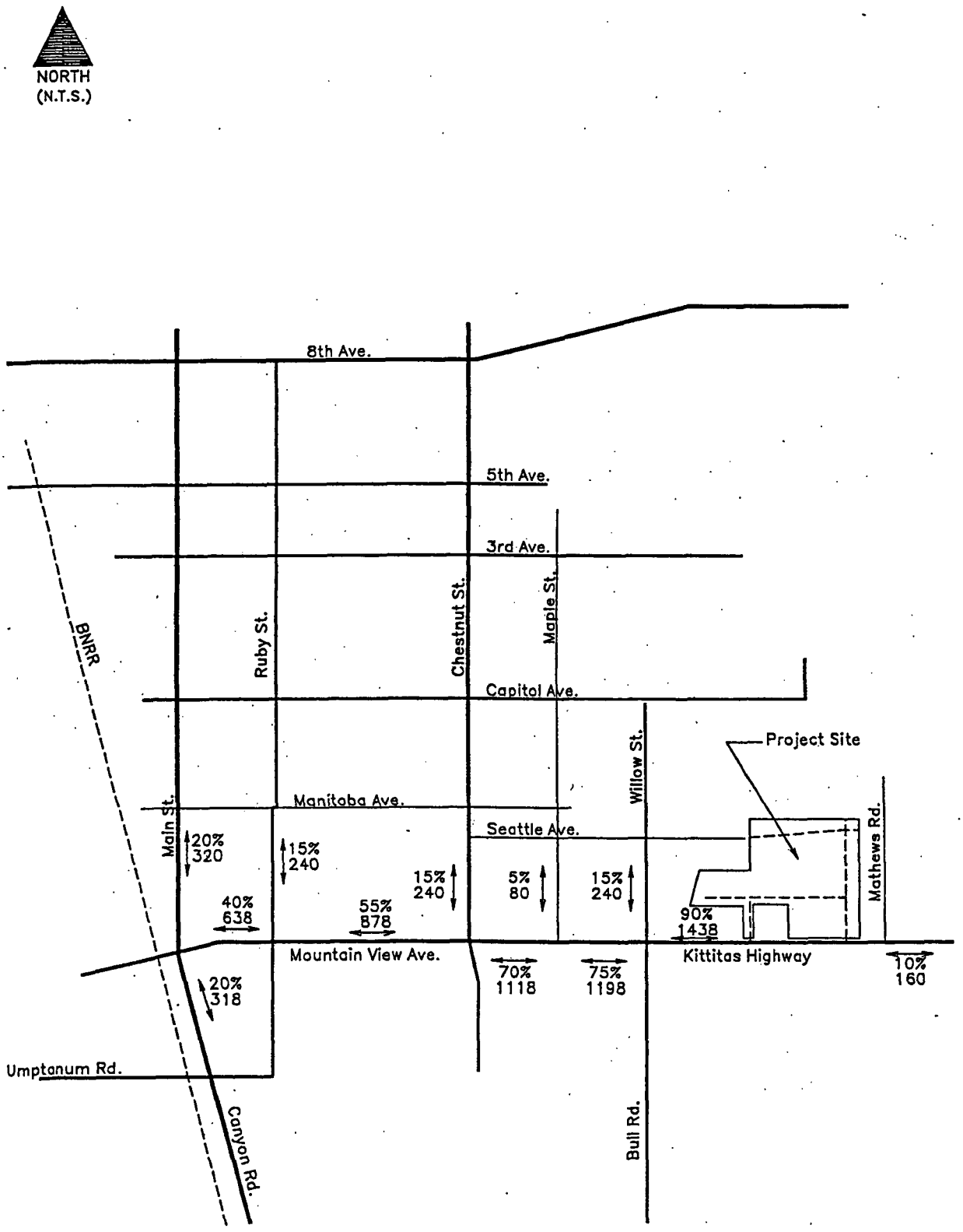


EXISTING DAILY & PM PEAK HOUR VOLUMES

FIGURE 2

Geralyn Reinart, P.E.
1319 Dexter Ave. N., #103
Seattle, WA.

Vista View Estates
Kittitas County, WA.

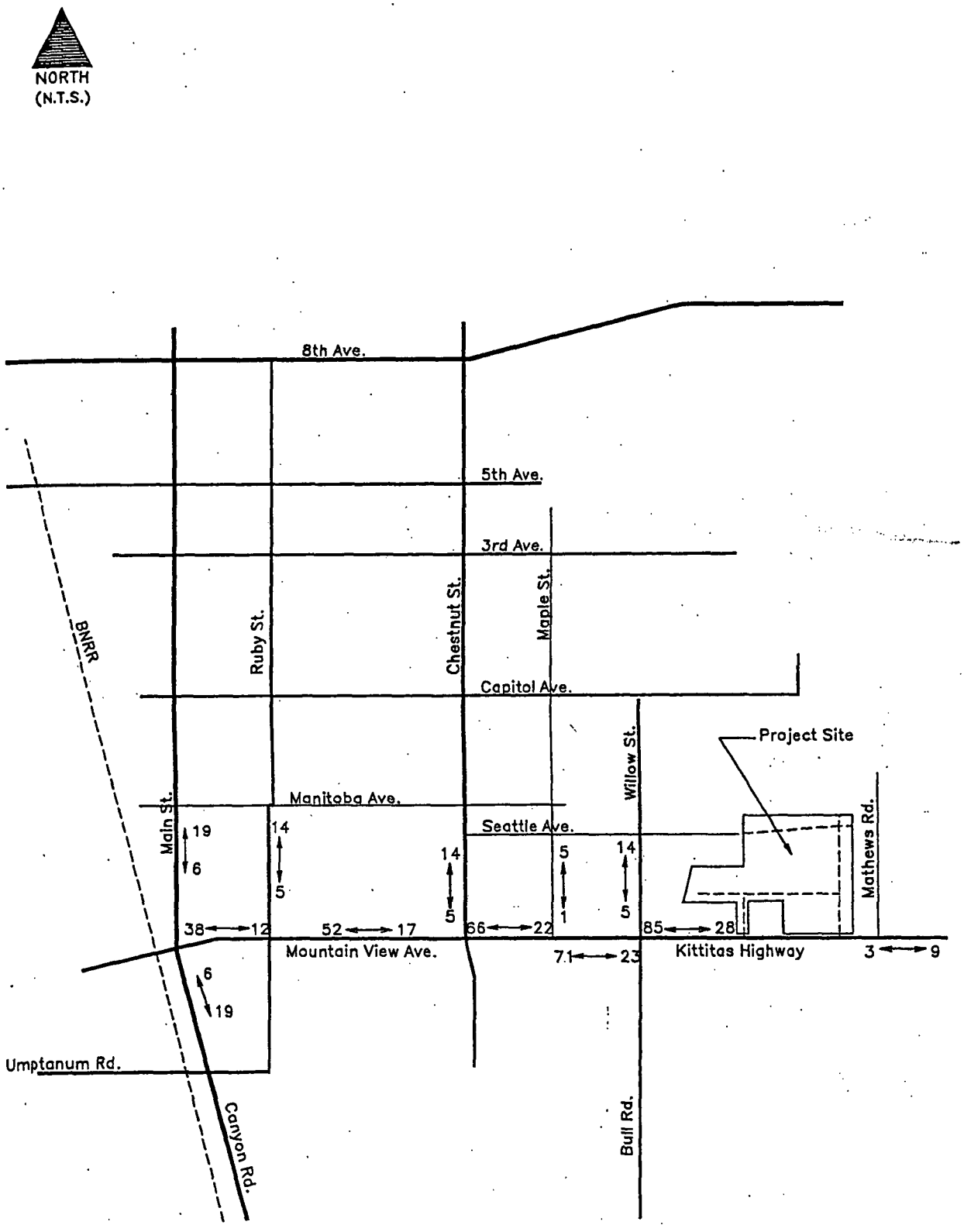


ESTIMATED DAILY TRIP DISTRIBUTION/ASSIGNMENT

FIGURE 3

Geralyn Reinart, P.E.
1319 Dexter Ave. N., #103
Seattle, WA.

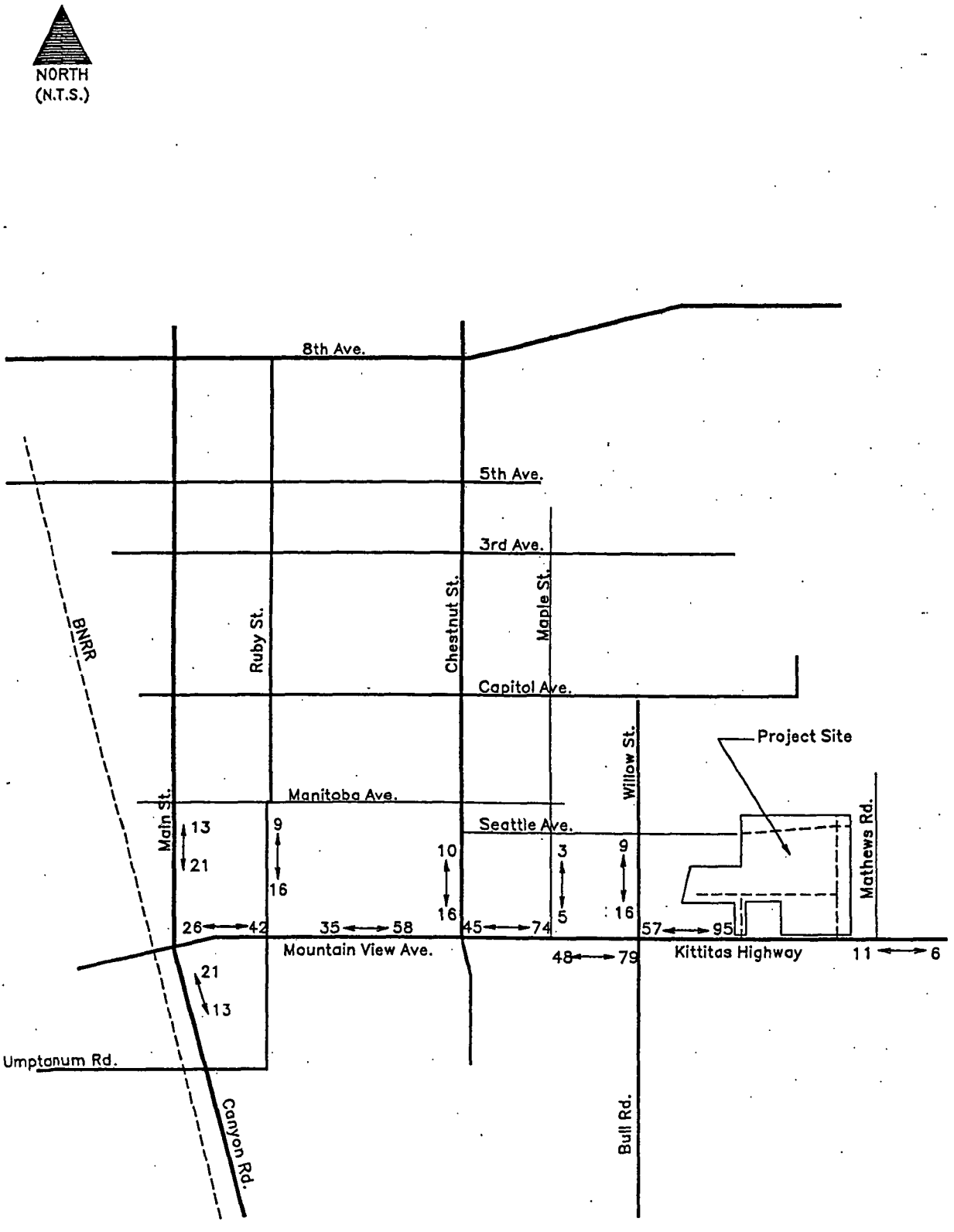
Vista View Estates
Kittitas County, WA.



ESTIMATED AM PEAK HOUR TRIP ASSIGNMENT

FIGURE 4

Geralyn Reinart, P.E.
1319 Dexter Ave. N., #103
Seattle, WA.

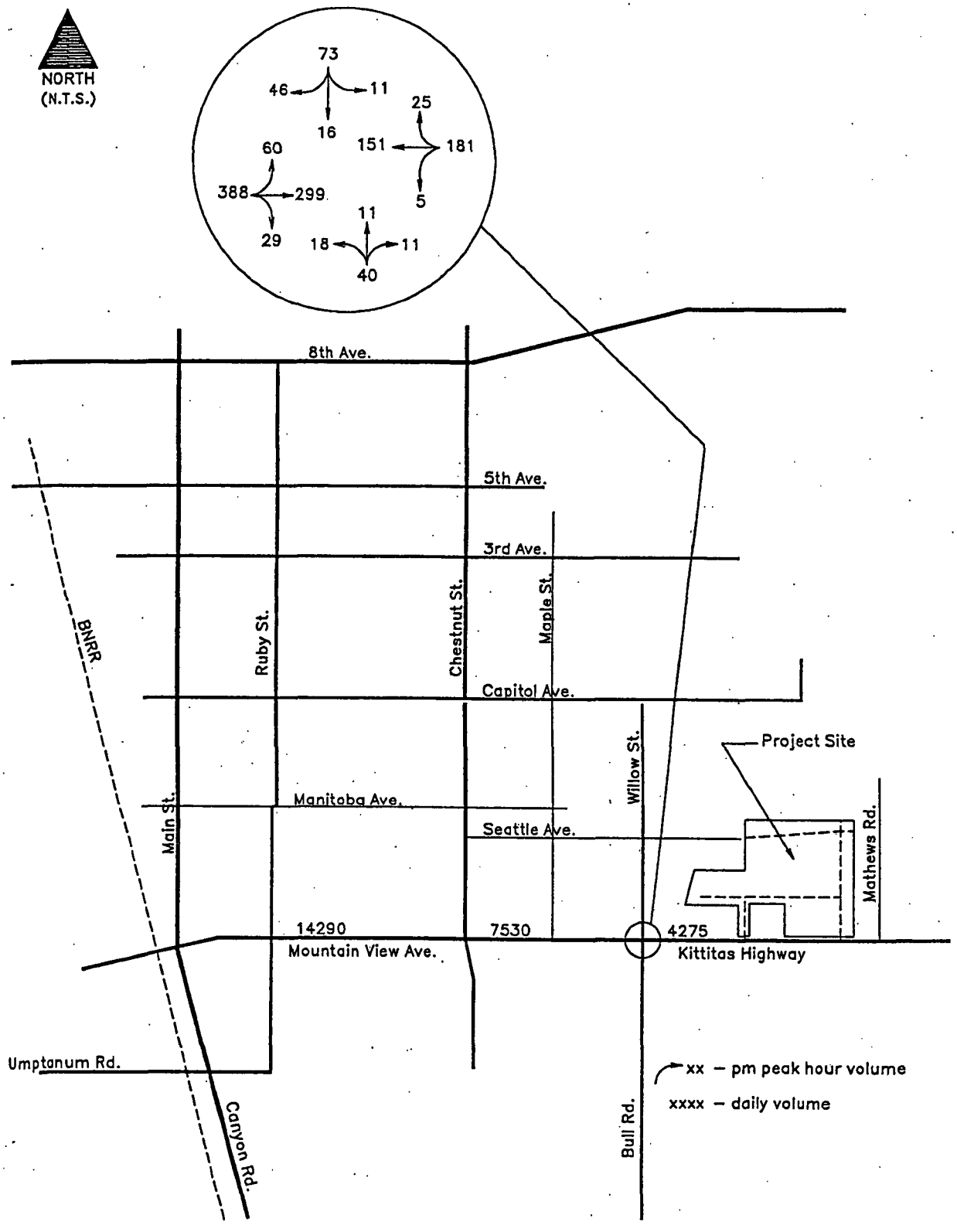


ESTIMATED PM PEAK HOUR TRIP ASSIGNMENT

FIGURE 5

Geralyn Reinart, P.E.
1319 Dexter Ave. N., #103
Seattle, WA.

Vista View Estates
Kittitas County, WA.

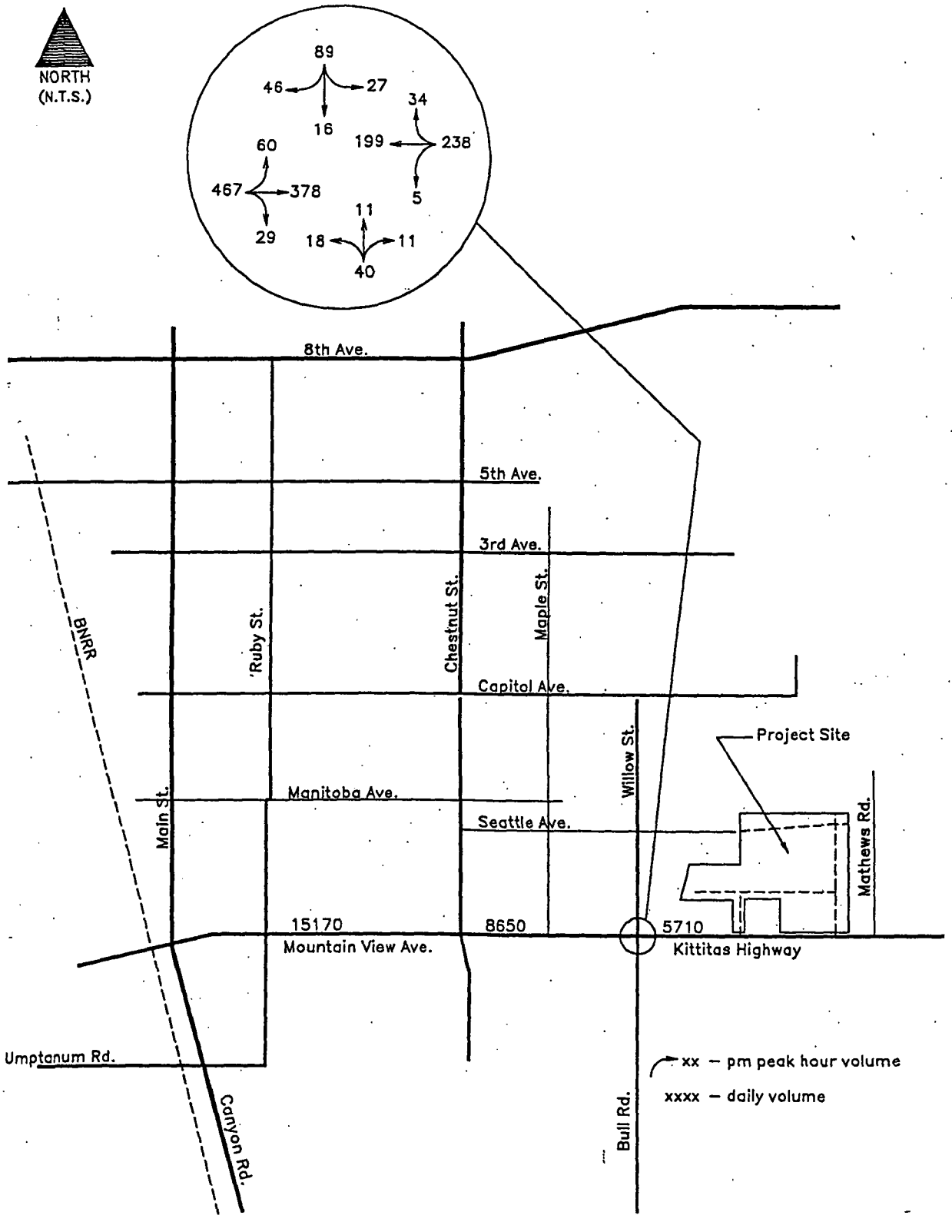


2008 ESTIMATED DAILY & PM PEAK HOUR VOLUMES (WITHOUT PROJECT)

FIGURE 6

Geralyn Reinart, P.E.
1319 Dexter Ave. N., #103
Seattle, WA.

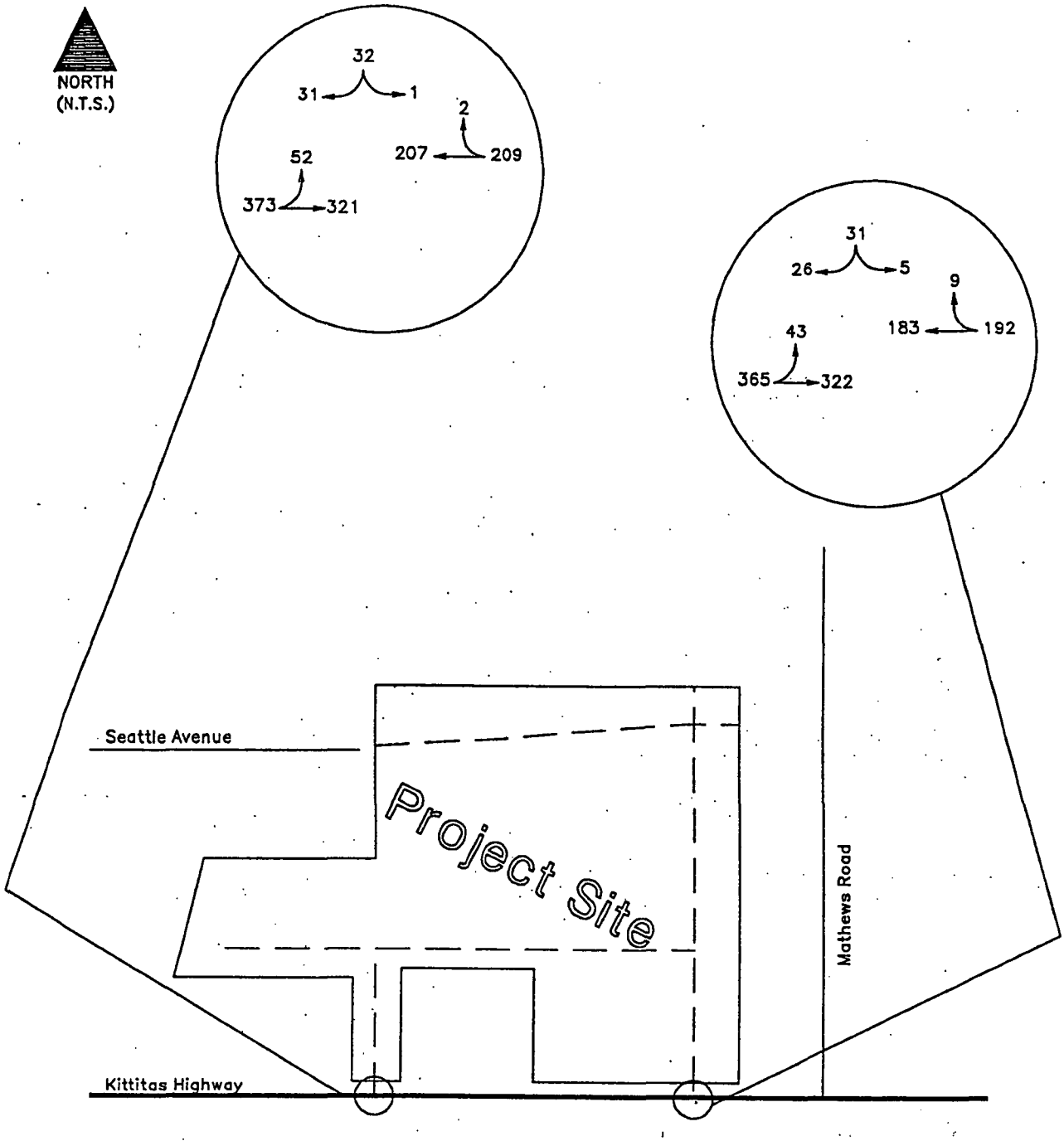
Vista View Estates
Kittitas County, WA.



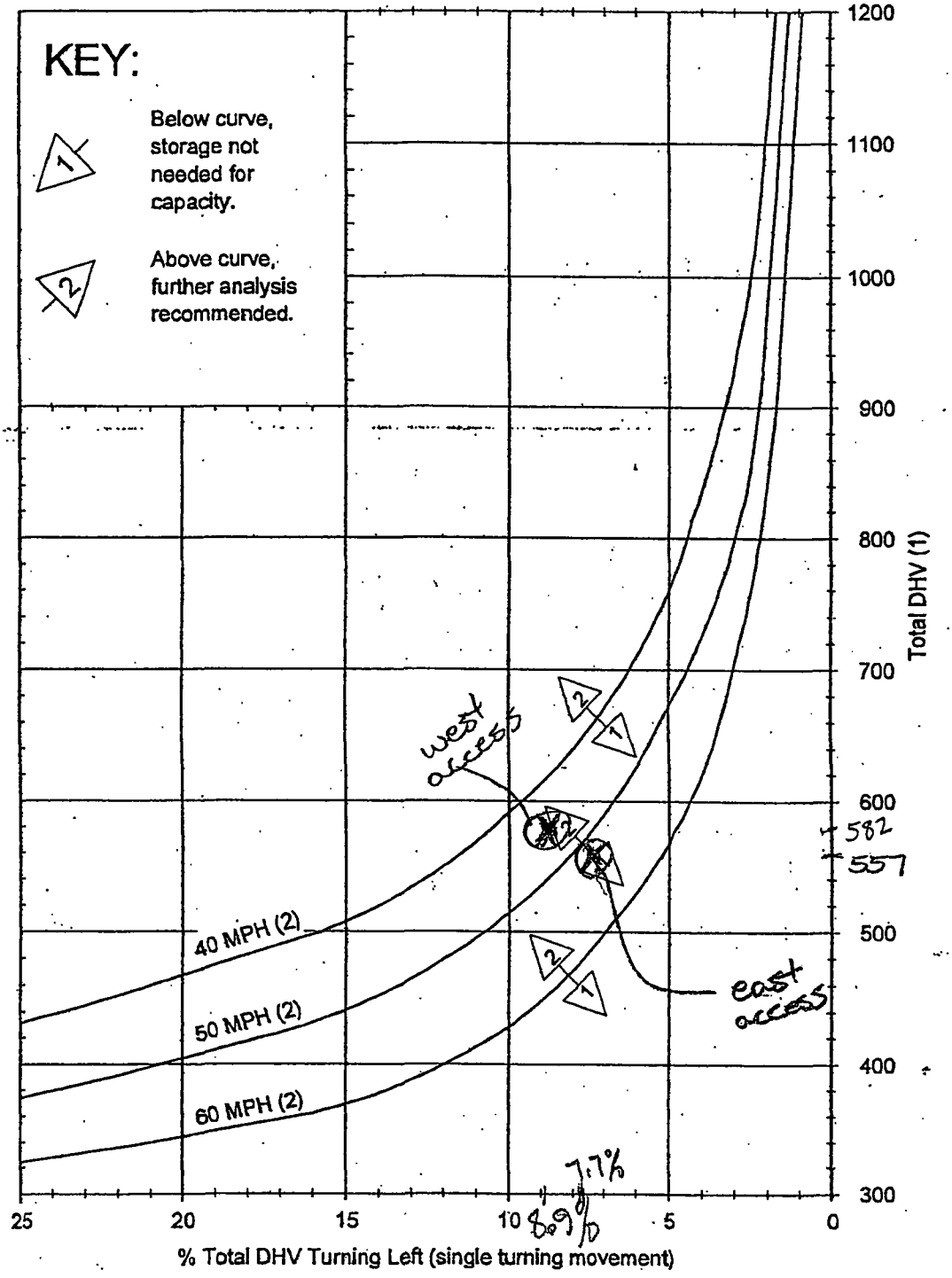
2008 ESTIMATED DAILY & PM PEAK HOUR VOLUMES (WITH PROJECT)
FIGURE 7

Geralyn Reinart, P.E.
1319 Dexter Ave. N., #103
Seattle, WA.

Vista View Estates
Kittitas County, WA.



2008 ESTIMATED PM PEAK HOUR VOLUMES AT SITE ACCESSES
FIGURE 8



(1) DHV is total volume from both directions.

(2) Speeds are posted speeds.

Left-Turn Storage Guidelines (Two-Lane, Unsignalized)

Figure 910-9a

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: gr
Agency/Co.:
Date Performed: 2/17/05
Analysis Time Period: pm peak hour
Intersection: Kittitas Highway/Willow Street
Jurisdiction: City of Ellensburg
Units: U. S. Customary
Analysis Year: existing
Project ID: Vista View Estates
East/West Street: Kittitas Highway
North/South Street: Willow Street/Bull Road
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach	Eastbound			Westbound		
	Movement	1	2	3	4	5	6
		L	T	R	L	T	R
Volume		55	274	3	1	138	23
Peak-Hour Factor, PHF		0.90	0.90	0.90	0.83	0.83	0.83
Hourly Flow Rate, HFR		61	304	3	1	166	27
Percent Heavy Vehicles		0	--	--	1	--	--
Median Type/Storage		Undivided		/			
RT Channelized?							
Lanes		0	1	0	0	1	0
Configuration			LTR			LTR	
Upstream Signal?			No			No	

Minor Street:	Approach	Northbound			Southbound		
	Movement	7	8	9	10	11	12
		L	T	R	L	T	R
Volume		2	5	7	10	6	42
Peak Hour Factor, PHF		0.70	0.70	0.70	0.85	0.85	0.85
Hourly Flow Rate, HFR		2	7	10	11	7	49
Percent Heavy Vehicles		0	0	0	0	0	0
Percent Grade (%)			0			0	
Flared Approach:	Exists?/Storage		No	/		No	/
Lanes		0	1	0	0	1	0
Configuration			LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR		LTR			LTR	
v (vph)	61	1		19			67	
C(m) (vph)	1392	1259		506			647	
v/c	0.04	0.00		0.04			0.10	
95% queue length	0.14	0.00		0.12			0.34	
Control Delay	7.7	7.9		12.4			11.2	
LOS	A	A		B			B	
Approach Delay				12.4			11.2	
Approach LOS				B			B	

HCS2000: Unsignalized Intersections Release 4.1d

GERALYN REINART, P.E.

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: gr
Agency/Co.:
Date Performed: 2/17/05
Analysis Time Period: pm peak hour
Intersection: Kittitas Highway/Willow Street
Jurisdiction: City of Ellensburg
Units: U. S. Customary
Analysis Year: existing
Project ID: Vista View Estates
East/West Street: Kittitas Highway
North/South Street: Willow Street/Bull Road
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	55	274	3	1	138	23
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.83	0.83	0.83
Peak-15 Minute Volume	15	76	1	0	42	7
Hourly Flow Rate, HFR	61	304	3	1	166	27
Percent Heavy Vehicles	0	--	--	1	--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	2	5	7	10	6	42
Peak Hour Factor, PHF	0.70	0.70	0.70	0.85	0.85	0.85
Peak-15 Minute Volume	1	2	2	3	2	12
Hourly Flow Rate, HFR	2	7	10	11	7	49
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage		No	/		No	/
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	304	166
Shared ln volume, major rt vehicles:	3	27
Sat flow rate, major th vehicles:	1700	1700
Sat flow rate, major rt vehicles:	1700	1700
Number of major street through lanes:	1	1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)	4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)	0	1	0	0	0	0	0	0
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Grade/100			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0	1	0	0	0	0	0	0
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)	
Arrival Type	
Effective Green, g (sec)	
Cycle Length, C (sec)	
Rp (from Exhibit 16-11)	
Proportion vehicles arriving on green P	
g(q1)	
g(q2)	
g(q)	

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	193	307	638	623	306	618	611	180
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process				
	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500		1500		1500		1500
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	306	180
Potential Capacity	739	868
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	739	868
Probability of Queue free St.	0.99	0.94
Step 2: LT from Major St.	**4**	**1**
Conflicting Flows	307	193
Potential Capacity	1259	1392
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1259	1392
Probability of Queue free St.	1.00	0.96
Maj L-Shared Prob Q free St.	1.00	0.95
Step 3: TH from Minor St.	**8**	**11**
Conflicting Flows	623	611
Potential Capacity	405	411
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.95	0.95
Movement Capacity	383	389
Probability of Queue free St.	0.98	0.98
Step 4: LT from Minor St.	**7**	**10**
Conflicting Flows	638	618
Potential Capacity	392	404
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.93	0.93
Maj. L, Min T Adj. Imp Factor.	0.95	0.95
Cap. Adj. factor due to Impeding mvmnt	0.89	0.93
Movement Capacity	350	377

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	623	611
Potential Capacity	405	411
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.95	0.95
Movement Capacity	383	389
Result for 2 stage process:		
a		
y		
C t	383	389
Probability of Queue free St.	0.98	0.98
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	638	618
Potential Capacity	392	404
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.93	0.93
Maj. L, Min T Adj. Imp Factor.	0.95	0.95
Cap. Adj. factor due to Impeding mvmnt	0.89	0.93
Movement Capacity	350	377
Results for Two-stage process:		
a		
y		
C t	350	377

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	2	7	10	11	7	49
Movement Capacity (vph)	350	383	739	377	389	868
Shared Lane Capacity (vph)		506			647	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	350	383	739	377	389	868
Volume	2	7	10	11	7	49
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		506			647	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR		LTR			LTR	
v (vph)	61	1		19			67	
C(m) (vph)	1392	1259		506			647	
v/c	0.04	0.00		0.04			0.10	
95% queue length	0.14	0.00		0.12			0.34	
Control Delay	7.7	7.9		12.4			11.2	
LOS	A	A		B			B	
Approach Delay				12.4			11.2	
Approach LOS				B			B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.96	1.00
v(i1), Volume for stream 2 or 5	304	166
v(i2), Volume for stream 3 or 6	3	27
s(i1), Saturation flow rate for stream 2 or 5	1700	1700
s(i2), Saturation flow rate for stream 3 or 6	1700	1700
P*(oj)	0.95	1.00
d(M,LT), Delay for stream 1 or 4	7.7	7.9
N, Number of major street through lanes	1	1
d(rank,1) Delay for stream 2 or 5	0.4	0.0

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: gr
Agency/Co.:
Date Performed: 2/17/05
Analysis Time Period: pm peak hour
Intersection: Kittitas Highway/Willow Street
Jurisdiction: City of Ellensburg
Units: U. S. Customary
Analysis Year: 2008 w/out project
Project ID: Vista View Estates
East/West Street: Kittitas Highway
North/South Street: Willow Street/Bull Road
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	60	299	29	5	151	25
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.83	0.83	0.83
Hourly Flow Rate, HFR	66	332	32	6	181	30
Percent Heavy Vehicles	0	--	--	1	--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	18	11	11	11	16	46
Peak Hour Factor, PHF	0.70	0.70	0.70	0.85	0.85	0.85
Hourly Flow Rate, HFR	25	15	15	12	18	54
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage		No	/		No	/
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR		LTR			LTR	
v (vph)	66	6		55			84	
C(m) (vph)	1372	1200		365			545	
v/c	0.05	0.00		0.15			0.15	
95% queue length	0.15	0.02		0.53			0.54	
Control Delay	7.8	8.0		16.6			12.8	
LOS	A	A		C			B	
Approach Delay				16.6			12.8	
Approach LOS				C			B	

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: gr
Agency/Co.:
Date Performed: 2/17/05
Analysis Time Period: pm peak hour
Intersection: Kittitas Highway/Willow Street
Jurisdiction: City of Ellensburg
Units: U. S. Customary
Analysis Year: 2008 w/out project
Project ID: Vista View Estates
East/West Street: Kittitas Highway
North/South Street: Willow Street/Bull Road
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	60	299	29	5	151	25
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.83	0.83	0.83
Peak-15 Minute Volume	17	83	8	2	45	8
Hourly Flow Rate, HFR	66	332	32	6	181	30
Percent Heavy Vehicles	0	--	--	1	--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	18	11	11	11	16	46
Peak Hour Factor, PHF	0.70	0.70	0.70	0.85	0.85	0.85
Peak-15 Minute Volume	6	4	4	3	5	14
Hourly Flow Rate, HFR	25	15	15	12	18	54
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No /			No /
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0	
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0	
Percent Blockage	0	0	0	0	

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	332	181
Shared ln volume, major rt vehicles:	32	30
Sat flow rate, major th vehicles:	1700	1700
Sat flow rate, major rt vehicles:	1700	1700
Number of major street through lanes:	1	1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)	4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)	0	1	0	0	0	0	0	0
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Grade/100			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0	1	0	0	0	0	0	0
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)	
Arrival Type	
Effective Green, g (sec)	
Cycle Length, C (sec)	
Rp (from Exhibit 16-11)	
Proportion vehicles arriving on green P	
g(q1)	
g(q2)	
g(q)	

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	211	364	724	703	348	703	704	196
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process

7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s	1500		1500		1500		1500	
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	348	196
Potential Capacity	700	850
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	700	850
Probability of Queue free St.	0.98	0.94
Step 2: LT from Major St.	4	1
Conflicting Flows	364	211
Potential Capacity	1200	1372
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1200	1372
Probability of Queue free St.	1.00	0.95
Maj L-Shared Prob Q free St.	0.99	0.94
Step 3: TH from Minor St.	8	11
Conflicting Flows	703	704
Potential Capacity	364	364
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.93	0.93
Movement Capacity	340	340
Probability of Queue free St.	0.96	0.95
Step 4: LT from Minor St.	7	10
Conflicting Flows	724	703
Potential Capacity	344	355
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.88	0.89
Maj. L, Min T Adj. Imp Factor.	0.91	0.92
Cap. Adj. factor due to Impeding mvmnt	0.85	0.90
Movement Capacity	294	319

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	703	704
Potential Capacity	364	364
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.93	0.93
Movement Capacity	340	340
Result for 2 stage process:		
a		
y		
C t	340	340
Probability of Queue free St.	0.96	0.95
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	724	703
Potential Capacity	344	355
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.88	0.89
Maj. L, Min T Adj. Imp Factor.	0.91	0.92
Cap. Adj. factor due to Impeding mvmnt	0.85	0.90
Movement Capacity	294	319
Results for Two-stage process:		
a		
y		
C t	294	319

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	25	15	15	12	18	54
Movement Capacity (vph)	294	340	700	319	340	850
Shared Lane Capacity (vph)		365			545	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	294	340	700	319	340	850
Volume	25	15	15	12	18	54
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		365			545	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR		LTR			LTR	
v (vph)	66	6		55			84	
C(m) (vph)	1372	1200		365			545	
v/c	0.05	0.00		0.15			0.15	
95% queue length	0.15	0.02		0.53			0.54	
Control Delay	7.8	8.0		16.6			12.8	
LOS	A	A		C			B	
Approach Delay				16.6			12.8	
Approach LOS				C			B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.95	1.00
v(il), Volume for stream 2 or 5	332	181
v(i2), Volume for stream 3 or 6	32	30
s(il), Saturation flow rate for stream 2 or 5	1700	1700
s(i2), Saturation flow rate for stream 3 or 6	1700	1700
P*(oj)	0.94	0.99
d(M,LT), Delay for stream 1 or 4	7.8	8.0
N, Number of major street through lanes	1	1
d(rank,1) Delay for stream 2 or 5	0.5	0.0

HCS2000: Unsignalized Intersections Release 4.1d

TWO-WAY STOP CONTROL SUMMARY

Analyst: gr
Agency/Co.:
Date Performed: 2/17/05
Analysis Time Period: pm peak hour
Intersection: Kittitas Highway/Willow Street
Jurisdiction: City of Ellensburg
Units: U. S. Customary
Analysis Year: 2008 with project
Project ID: Vista View Estates
East/West Street: Kittitas Highway
North/South Street: Willow Street/Bull Road
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	60	378	29	5	199	34
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.83	0.83	0.83
Hourly Flow Rate, HFR	66	420	32	6	239	40
Percent Heavy Vehicles	0	--	--	1	--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume	18	11	11	27	16	46
Peak Hour Factor, PHF	0.70	0.70	0.70	0.85	0.85	0.85
Hourly Flow Rate, HFR	25	15	15	31	18	54
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage		No	/		No	/
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR		LTR			LTR	
v (vph)	66	6		55			103	
C(m) (vph)	1295	1114		291			398	
v/c	0.05	0.01		0.19			0.26	
95% queue length	0.16	0.02		0.68			1.02	
Control Delay	7.9	8.2		20.2			17.2	
LOS	A	A		C			C	
Approach Delay				20.2			17.2	
Approach LOS				C			C	

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: gr
Agency/Co.:
Date Performed: 2/17/05
Analysis Time Period: pm peak hour
Intersection: Kittitas Highway/Willow Street
Jurisdiction: City of Ellensburg
Units: U. S. Customary
Analysis Year: 2008 with project
Project ID: Vista View Estates
East/West Street: Kittitas Highway
North/South Street: Willow Street/Bull Road
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	60	378	29	5	199	34
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.83	0.83	0.83
Peak-15 Minute Volume	17	105	8	2	60	10
Hourly Flow Rate, HFR	66	420	32	6	239	40
Percent Heavy Vehicles	0	--	--	1	--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	18	11	11	27	16	46
Peak Hour Factor, PHF	0.70	0.70	0.70	0.85	0.85	0.85
Peak-15 Minute Volume	6	4	4	8	5	14
Hourly Flow Rate, HFR	25	15	15	31	18	54
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage		No	/		No	/
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration		LTR			LTR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data

		Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2	Left-Turn							
	Through							
S5	Left-Turn							
	Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	420	239
Shared ln volume, major rt vehicles:	32	40
Sat flow rate, major th vehicles:	1700	1700
Sat flow rate, major rt vehicles:	1700	1700
Number of major street through lanes:	1	1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		0	1	0	0	0	0	0	0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
	2-stage								

Follow-Up Time Calculations

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)		0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		0	1	0	0	0	0	0	0
t(f)		2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)	
Arrival Type	
Effective Green, g (sec)	
Cycle Length, C (sec)	
Rp (from Exhibit 16-11)	
Proportion vehicles arriving on green P	
g(q1)	
g(q2)	
g(q)	

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	279	452	875	859	436	854	855	259
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process				
	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s	1500		1500		1500		1500	
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	436	259
Potential Capacity	625	785
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	625	785
Probability of Queue free St.	0.98	0.93
Step 2: LT from Major St.	**4**	**1**
Conflicting Flows	452	279
Potential Capacity	1114	1295
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1114	1295
Probability of Queue free St.	0.99	0.95
Maj L-Shared Prob Q free St.	0.99	0.93
Step 3: TH from Minor St.	**8**	**11**
Conflicting Flows	859	855
Potential Capacity	296	298
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.92	0.92
Movement Capacity	274	276
Probability of Queue free St.	0.95	0.93
Step 4: LT from Minor St.	**7**	**10**
Conflicting Flows	875	854
Potential Capacity	272	281
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.86	0.87
Maj. L, Min T Adj. Imp Factor.	0.90	0.90
Cap. Adj. factor due to Impeding mvmnt	0.83	0.88
Movement Capacity	227	248

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	859	855
Potential Capacity	296	298
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.92	0.92
Movement Capacity	274	276
Result for 2 stage process:		
a		
y		
C t	274	276
Probability of Queue free St.	0.95	0.93
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows	875	854
Potential Capacity	272	281
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.86	0.87
Maj. L, Min T Adj. Imp Factor.	0.90	0.90
Cap. Adj. factor due to Impeding mvmnt	0.83	0.88
Movement Capacity	227	248
Results for Two-stage process:		
a		
y		
C t	227	248

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	25	15	15	31	18	54
Movement Capacity (vph)	227	274	625	248	276	785
Shared Lane Capacity (vph)		291			398	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	227	274	625	248	276	785
Volume	25	15	15	31	18	54
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		291			398	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR		LTR			LTR	
v (vph)	66	6		55			103	
C(m) (vph)	1295	1114		291			398	
v/c	0.05	0.01		0.19			0.26	
95% queue length	0.16	0.02		0.68			1.02	
Control Delay	7.9	8.2		20.2			17.2	
LOS	A	A		C			C	
Approach Delay				20.2			17.2	
Approach LOS				C			C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.95	0.99
v(i1), Volume for stream 2 or 5	420	239
v(i2), Volume for stream 3 or 6	32	40
s(i1), Saturation flow rate for stream 2 or 5	1700	1700
s(i2), Saturation flow rate for stream 3 or 6	1700	1700
P*(oj)	0.93	0.99
d(M,LT), Delay for stream 1 or 4	7.9	8.2
N, Number of major street through lanes	1	1
d(rank,1) Delay for stream 2 or 5	0.6	0.1

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TWO-WAY STOP CONTROL SUMMARY

Analyst: gr
Agency/Co.:
Date Performed: 2/17/05
Analysis Time Period: pm peak hour
Intersection: Kittitas Highway/West Access
Jurisdiction: Kittitas County
Units: U. S. Customary
Analysis Year: 2008 with project
Project ID: Vista View Estates
East/West Street: Kittitas Highway
North/South Street: West Site Access
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	52	321			207	2
Peak-Hour Factor, PHF	0.90	0.90			0.83	0.83
Hourly Flow Rate, HFR	57	356			249	2
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes	0	1			1	0
Configuration		LT				TR
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				1		31
Peak Hour Factor, PHF				0.80		0.80
Hourly Flow Rate, HFR				1		38
Percent Heavy Vehicles				0		0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			No /
Lanes				0		0
Configuration					LR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LR	
v (vph)	57						39	
C(m) (vph)	1326						773	
v/c	0.04						0.05	
95% queue length	0.13						0.16	
Control Delay	7.8						9.9	
LOS	A						A	
Approach Delay							9.9	
Approach LOS							A	

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: gr
Agency/Co.:
Date Performed: 2/17/05
Analysis Time Period: pm peak hour
Intersection: Kittitas Highway/West Access
Jurisdiction: Kittitas County
Units: U. S. Customary
Analysis Year: 2008 with project
Project ID: Vista View Estates
East/West Street: Kittitas Highway
North/South Street: West Site Access
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	52	321			207	2
Peak-Hour Factor, PHF	0.90	0.90			0.83	0.83
Peak-15 Minute Volume	14	89			62	1
Hourly Flow Rate, HFR	57	356			249	2
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1			1	0
Configuration	LT					TR
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume				1		31
Peak Hour Factor, PHF				0.80		0.80
Peak-15 Minute Volume				0		10
Hourly Flow Rate, HFR				1		38
Percent Heavy Vehicles				0		0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		No /
RT Channelized?						
Lanes				0		0
Configuration					LR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0	
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0	
Percent Blockage	0	0	0	0	

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	356	
Shared ln volume, major rt vehicles:	0	
Sat flow rate, major th vehicles:	1700	
Sat flow rate, major rt vehicles:	1700	
Number of major street through lanes:	1	

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement		1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1					7.1		6.2
t(c,hv)		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		0					0		0
t(c,g)				0.20	0.20	0.10	0.20	0.20	0.10
Grade/100				0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00					0.70		0.00
t(c,T):	1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c)	1-stage	4.1					6.4		6.2
	2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50		3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0					0		0
t(f)	2.2					3.5		3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)	
Arrival Type	
Effective Green, g (sec)	
Cycle Length, C (sec)	
Rp (from Exhibit 16-11)	
Proportion vehicles arriving on green P	
g(q1)	
g(q2)	
g(q)	

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(1,prot)	V(t)	V(1,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Two-Stage Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	251					720		250
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process				
	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s						1500		
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.					9		12	
Conflicting Flows							250	
Potential Capacity							794	
Pedestrian Impedance Factor					1.00		1.00	
Movement Capacity							794	
Probability of Queue free St.					1.00		0.95	
Step 2: LT from Major St.					4		1	
Conflicting Flows							251	
Potential Capacity							1326	
Pedestrian Impedance Factor					1.00		1.00	
Movement Capacity							1326	
Probability of Queue free St.					1.00		0.96	
Maj L-Shared Prob Q free St.							0.95	
Step 3: TH from Minor St.					8		11	
Conflicting Flows								
Potential Capacity								
Pedestrian Impedance Factor					1.00		1.00	
Cap. Adj. factor due to Impeding mvmnt					0.95		0.95	
Movement Capacity								
Probability of Queue free St.					1.00		1.00	
Step 4: LT from Minor St.					7		10	
Conflicting Flows							720	
Potential Capacity							398	
Pedestrian Impedance Factor					1.00		1.00	
Maj. L, Min T Impedance factor					0.95			
Maj. L, Min T Adj. Imp Factor.					0.96			
Cap. Adj. factor due to Impeding mvmnt					0.91		0.96	
Movement Capacity							381	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.					8		11	
Part 1 - First Stage								
Conflicting Flows								
Potential Capacity								
Pedestrian Impedance Factor								
Cap. Adj. factor due to Impeding mvmnt								
Movement Capacity								
Probability of Queue free St.								

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.95	0.95
Movement Capacity		
Result for 2 stage process:		
a		
y		
C t		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		720
Potential Capacity		398
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.95	
Maj. L, Min T Adj. Imp Factor.	0.96	
Cap. Adj. factor due to Impeding mvmnt	0.91	0.96
Movement Capacity		381
Results for Two-stage process:		
a		
y		
C t		381

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)				1		38
Movement Capacity (vph)				381		794
Shared Lane Capacity (vph)					773	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep				381		794
Volume				1		38
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh					773	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LR	
v (vph)	57						39	
C(m) (vph)	1326						773	
v/c	0.04						0.05	
95% queue length	0.13						0.16	
Control Delay	7.8						9.9	
LOS	A						A	
Approach Delay							9.9	
Approach LOS							A	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.96	1.00
v(i1), Volume for stream 2 or 5	356	
v(i2), Volume for stream 3 or 6	0	
s(i1), Saturation flow rate for stream 2 or 5	1700	
s(i2), Saturation flow rate for stream 3 or 6	1700	
P*(oj)	0.95	
d(M,LT), Delay for stream 1 or 4	7.8	
N, Number of major street through lanes	1	
d(rank,1) Delay for stream 2 or 5	0.4	

TWO-WAY STOP CONTROL SUMMARY

Analyst: gr
Agency/Co.:
Date Performed: 2/17/05
Analysis Time Period: pm peak hour
Intersection: Kittitas Highway/East Access
Jurisdiction: Kittitas County
Units: U. S. Customary
Analysis Year: 2008 with project
Project ID: Vista View Estates
East/West Street: Kittitas Highway
North/South Street: East Access
Intersection Orientation: EW
Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street: Approach	Eastbound			Westbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	43	322			183	9
Peak-Hour Factor, PHF	0.90	0.90			0.83	0.83
Hourly Flow Rate, HFR	47	357			220	10
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes	0	1			1	0
Configuration	LT					TR
Upstream Signal?		No			No	

Minor Street: Approach	Northbound			Southbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume				5		26
Peak Hour Factor, PHF				0.80		0.80
Hourly Flow Rate, HFR				6		32
Percent Heavy Vehicles				0		0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			/			No /
Lanes				0		0
Configuration					LR	

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LR	
v (vph)	47						38	
C(m) (vph)	1350						706	
v/c	0.03						0.05	
95% queue length	0.11						0.17	
Control Delay	7.8						10.4	
LOS	A						B	
Approach Delay							10.4	
Approach LOS							B	

HCS2000: Unsignalized Intersections Release 4.1d

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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: gr
Agency/Co.:
Date Performed: 2/17/05
Analysis Time Period: pm peak hour
Intersection: Kittitas Highway/East Access
Jurisdiction: Kittitas County
Units: U. S. Customary
Analysis Year: 2008 with project
Project ID: Vista View Estates
East/West Street: Kittitas Highway
North/South Street:
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	43	322			183	9
Peak-Hour Factor, PHF	0.90	0.90			0.83	0.83
Peak-15 Minute Volume	12	89			55	3
Hourly Flow Rate, HFR	47	357			220	10
Percent Heavy Vehicles	0	--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1			1	0
Configuration	LT					TR
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume				5		26
Peak Hour Factor, PHF				0.80		0.80
Peak-15 Minute Volume				2		8
Hourly Flow Rate, HFR				6		32
Percent Heavy Vehicles				0		0
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		No /
RT Channelized?						
Lanes				0		0
Configuration					LR	

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0	
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0	
Percent Blockage	0	0	0	0	

Upstream Signal Data

	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn							
Through							
S5 Left-Turn							
Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	357	
Shared ln volume, major rt vehicles:	0	
Sat flow rate, major th vehicles:	1700	
Sat flow rate, major rt vehicles:	1700	
Number of major street through lanes:	1	

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)	4.1					7.1		6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)	0					0		0
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Grade/100			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00					0.70		0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.1					6.4		6.2
2-stage								

Follow-Up Time Calculations

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20					3.50		3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	0					0		0
t(f)	2.2					3.5		3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal

	Movement 2		Movement 5	
	V(t)	V(1,prot)	V(t)	V(1,prot)
V prog				

Total Saturation Flow Rate, s (vph)	
Arrival Type	
Effective Green, g (sec)	
Cycle Length, C (sec)	
Rp (from Exhibit 16-11)	
Proportion vehicles arriving on green P	
g(q1)	
g(q2)	
g(q)	

Computation 2-Proportion of TWSC Intersection Time blocked	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p	0.000		0.000	

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	230					676		225
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process				
	7	8	10	11

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s						1500		
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.			9			12		
Conflicting Flows						225		
Potential Capacity						819		
Pedestrian Impedance Factor			1.00			1.00		
Movement Capacity						819		
Probability of Queue free St.			1.00			0.96		
Step 2: LT from Major St.			**4**			**1**		
Conflicting Flows						230		
Potential Capacity						1350		
Pedestrian Impedance Factor			1.00			1.00		
Movement Capacity						1350		
Probability of Queue free St.			1.00			0.97		
Maj L-Shared Prob Q free St.						0.96		
Step 3: TH from Minor St.			**8**			**11**		
Conflicting Flows								
Potential Capacity								
Pedestrian Impedance Factor			1.00			1.00		
Cap. Adj. factor due to Impeding mvmnt			0.96			0.96		
Movement Capacity								
Probability of Queue free St.			1.00			1.00		
Step 4: LT from Minor St.			**7**			**10**		
Conflicting Flows						676		
Potential Capacity						422		
Pedestrian Impedance Factor			1.00			1.00		
Maj. L, Min T Impedance factor			0.96					
Maj. L, Min T Adj. Imp Factor.			0.97					
Cap. Adj. factor due to Impeding mvmnt			0.93			0.97		
Movement Capacity						407		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.			8			11		
Part 1 - First Stage								
Conflicting Flows								
Potential Capacity								
Pedestrian Impedance Factor								
Cap. Adj. factor due to Impeding mvmnt								
Movement Capacity								
Probability of Queue free St.								

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.96	0.96
Movement Capacity		
Result for 2 stage process:		
a		
y		
C t		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Part 3 - Single Stage		
Conflicting Flows		676
Potential Capacity		422
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.96	
Maj. L, Min T Adj. Imp Factor.	0.97	
Cap. Adj. factor due to Impeding mvmnt	0.93	0.97
Movement Capacity		407
Results for Two-stage process:		
a		
y		
C t		407

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)				6		32
Movement Capacity (vph)				407		819
Shared Lane Capacity (vph)					706	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep				407		819
Volume				6		32
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh					706	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LT						LR	
v (vph)	47						38	
C(m) (vph)	1350						706	
v/c	0.03						0.05	
95% queue length	0.11						0.17	
Control Delay	7.8						10.4	
LOS	A						B	
Approach Delay							10.4	
Approach LOS							B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.97	1.00
v(il), Volume for stream 2 or 5	357	
v(i2), Volume for stream 3 or 6	0	
s(il), Saturation flow rate for stream 2 or 5	1700	
s(i2), Saturation flow rate for stream 3 or 6	1700	
P*(oj)	0.96	
d(M,LT), Delay for stream 1 or 4	7.8	
N, Number of major street through lanes	1	
d(rank,1) Delay for stream 2 or 5	0.3	