



KITTELSON & ASSOCIATES, INC.

TRANSPORTATION PLANNING/TRAFFIC ENGINEERING

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MEMORANDUM

Date: September 28, 2004

Project #: 4539

To: Rob Kissler, City of Keizer & Dick Woelk, ATEP Inc.

From: Christopher Stanley, P.E.
Hermanus Steyn, Pr.Eng., P.E.

Project: Keizer Station Master Plan

Subject: **Additional Information 2**

The purpose of this memorandum is to provide additional information for the Keizer Station development located at the Interstate 5 (I-5)/Chemawa Road interchange in Keizer, Oregon. This memorandum is consistent with the April 2004 *Keizer Station Master Plan* Transportation Impact Analysis (TIA). The items addressed in this memorandum are listed below.

- TIA Applicability
- Movie Theater Evening Impact
- Rail Crossing Sensitivity Analysis
- Internal/Onsite Intersection Traffic Signal Timing
- Offsite Intersection Traffic Signal Timing
- Phase 1 (Year 2008) - Vehicle Queues & Signal Progression
- Area "B" Access
- Area "C" Access

TRANSPORTATION IMPACT ANALYSIS APPLICABILITY

It is common for the specific uses in large developments like Keizer Station to change as the site develops. This was anticipated in the transportation impact analysis. As long as the actual uses generate comparable or less trips, the traffic study will remain valid.

Northwest National, LLC proposes to add a 14-screen, 40,000 square-foot movie theater to Area A. The original traffic study assumed 800,000 square feet of retail and a 75,000 square-foot

aquatic/recreation center. The current site plan proposes 750,000 square feet of retail and a 50,000 square-foot aquatic/recreation center. This shift in uses will not result in a measurable change in site trip generation during the weekday p.m. peak hour. Therefore, the traffic study accurately identifies the impacts of Keizer Station.

}? True

MOVIE THEATER EVENING IMPACT

Movie theaters tend to peak in the evening with the highest trip generation occurring Friday and Saturday nights. Although the trip generation associated with the movie theater during the typical Tuesday through Thursday weekday p.m. peak hour is expected to be consistent with the original traffic study, the theater will likely generate significantly more trips in the later evening when traffic volumes on the surrounding roadways are lower. The movie theater trip generation may add up to an additional 200 trips an hour in each direction on busy Friday and Saturday nights. Except for time periods when other events are occurring, such as a Volcano baseball games, there is adequate capacity to accommodate this additional traffic.

} True?

Is this local within Area A or does it also mean Highway system?

CHEMAWA ROAD RAIL CROSSING SENSITIVITY ANALYSIS

Trains traveling on the Portland & Western Railroad track currently stop traffic as they travel across Chemawa Road. Westbound vehicles have the potential to stack back onto I-5. Therefore, a sensitivity analysis was conducted to determine how long vehicle queues would be with development of the site when a train crosses Chemawa Road.

The rail crossing sensitivity analysis was based on information provided by the railroad and refined through observations made in the field. Currently, there are four train crossings a day, two northbound and two southbound. There are no current plans to increase or change train activity in this area. The time of day that the trains cross Chemawa Road and the lengths of the trains vary. The most significant impact will likely occur when a train with 70 cars crosses Chemawa Road during the weekday p.m. peak hour. Based on information provided by the railroad, a 70-car train will close Chemawa Road for approximately two minutes and 45 seconds.

} True?

A site visit was conducted on Tuesday, September 15, 2004 during the midday timeframe to obtain empirical data. The observations made at the time of a southbound train (2 p.m.) are listed below. *Attachment A contains the field observation notes.*

- The observed train consisted of 56 cars and two engines (58 total). The train traveled at approximately 15 to 20 mph.
- The gates lowered approximately 29 seconds in advance of the train and rose 9 seconds after the train had passed. The total gate closure time was approximately 3 minutes and 20 seconds;
- The total vehicle queue measured was approximately 55 vehicles, 44 of which stacked on Chemawa Road between the railroad and I-5, two stacked on the I-5 southbound to westbound off-ramp, and nine stacked on the Chemawa Road overpass to I-5.

The field observations indicated that the gates are actually down for a longer period of time than the information provided by the railroad; therefore, the sensitivity analysis was based on the field data. The sensitivity analysis was also based on the worst-case scenario, during the weekday p.m.

peak hour when traffic volumes are highest. In addition, the gate closure time was increased to represent a 70-car train. Adjusting the field data to represent existing conditions during the weekday p.m. peak hour with a 70-car train resulted in vehicle queues shown in Figure 1.

Year 2008 with site traffic conditions will result in queues extending back to approximately 1,650 feet on Chemawa Road, 320 feet on the southbound I-5 off-ramp to westbound, and 415 feet on the northbound I-5 off-ramp to westbound. Figure 2 shows the expected queues for 2008 future conditions with Phase 1 development.

Year 2020 traffic volumes with development of the site and a 70-car train crossing Chemawa Road during the weekday p.m. peak hour will result in vehicle queues of approximately 1,850 feet on Chemawa Road, 450 feet on the southbound I-5 off-ramp to westbound, and 700 feet on the northbound I-5 off-ramp to westbound. Figure 3 shows the expected queues for 2020 future conditions with Keizer Station Master Plan development. As shown in Figure 3, these queues remain on the ramps and do not spill into the interstate travel lanes.

Development of the site will increase the storage and capacity in the area. Although the railroad crossing will remain at grade, the site will include a roadway connection under the railroad. Unlike existing conditions where all east-west travel in the site vicinity is blocked, this will provide east-west travel for site traffic, emergency vehicles, and a portion of the ambient traffic on Chemawa Road.

INTERNAL INTERSECTION TRAFFIC SIGNAL INSTALLATION TIMING

Six onsite traffic signals are planned as part of the development. Figure 4 shows the locations of these anticipated signals in Areas A and D. During peak time periods with full buildout of the site, side-street motorists making left-turn movements will have increased delays. Traffic signals at these locations will create gaps for side-street motorists, but will also increase delays for the other movements at the intersections that operate well without traffic signals.

Although side-street motorists may experience delays, these movements operate within capacity during the weekday p.m. peak hour. Operations will degrade during the Saturday peak hour with the side-street movements approaching or exceeding capacity. Alternative routes are available for most of these movements. Since the traffic signals will not be needed until the majority of the site is developed and only during peak time periods, the installation of the onsite traffic signals can be delayed and the site monitored to determine when signal warrants are met and operations indicate a need for traffic signals. Monitoring will also identify if the site develops in a way that eliminates the need for a traffic signal at an intersection. *Figure B-1 in Attachment B summarizes the weekday p.m. peak hour and Saturday midday peak hour traffic operations for these intersections without traffic signals. The analysis worksheets are also included in Attachment B.*

At this stage, we recommend the signals be designed and the underground infrastructure installed so that the signal installations can easily and cost effectively be completed if warranted.



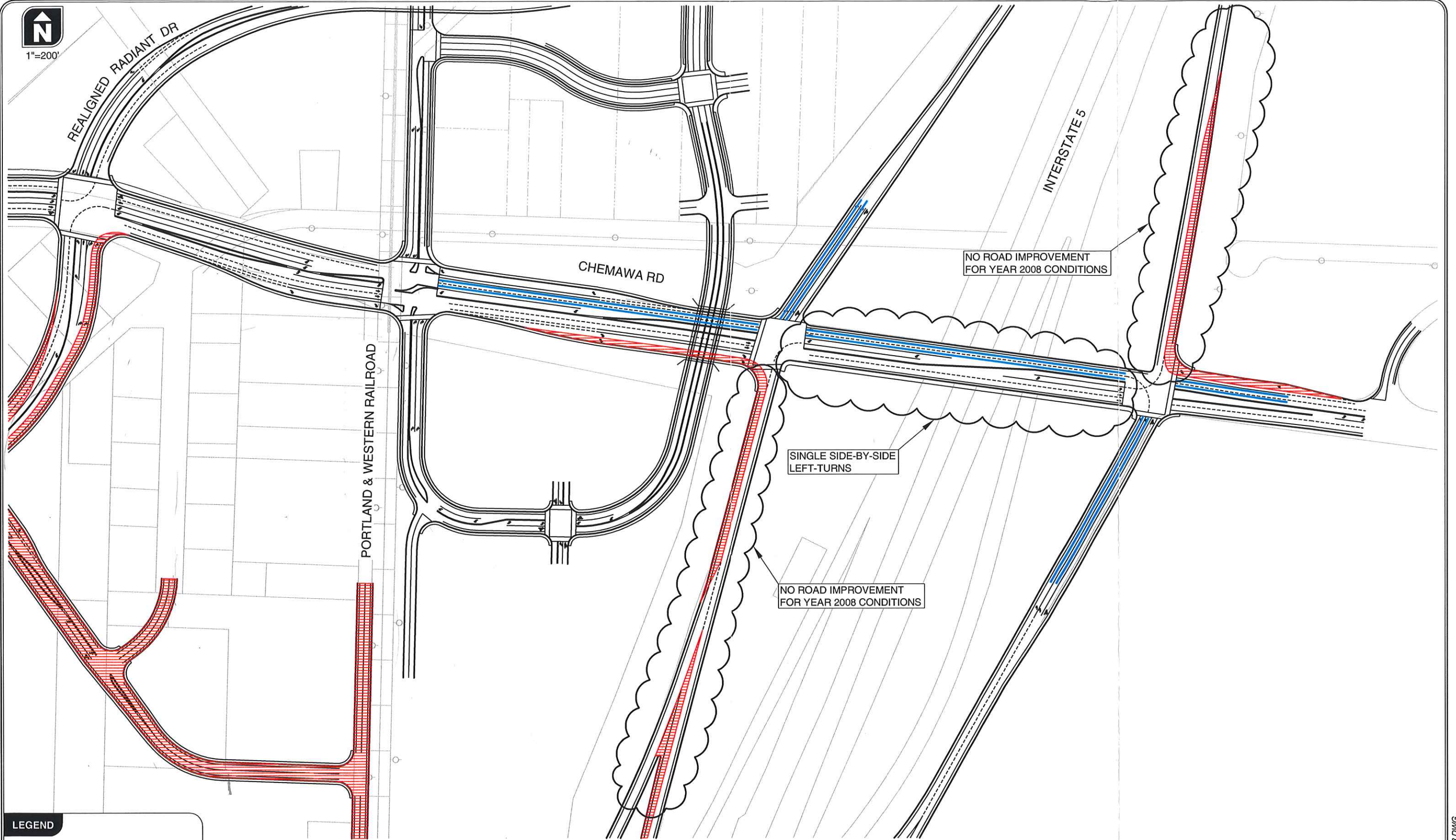
**RAILROAD SENSITIVITY ANALYSIS: EXISTING CONDITIONS
70-CAR TRAIN DURING PM PEAK HOUR
KEIZER, OREGON**

**FIGURE
1**

4539FD08.DWG



1"=200'



LEGEND

TO BE CONSTRUCTED BY 2020

RAILROAD SENSITIVITY ANALYSIS: EXPECTED QUEUES FOR 2008 FUTURE CONDITIONS WITH PHASE 1 DEVELOPMENT KEIZER, OREGON

FIGURE 2



1"=200'

REALIGNED RADIANT DR

CHEMAWA RD

INTERSTATE 5

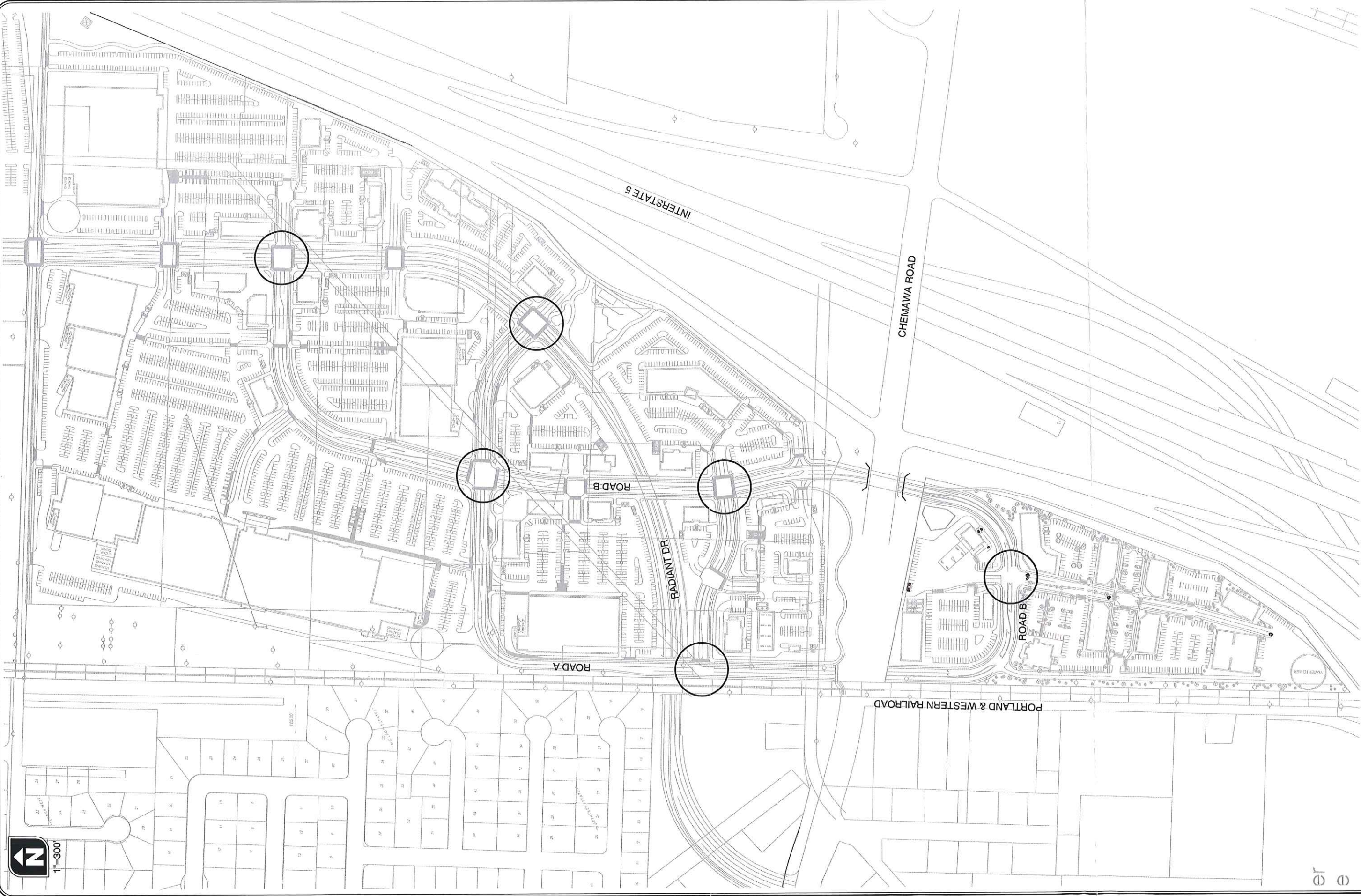
PORTLAND & WESTERN RAILROAD

RAILROAD SENSITIVITY ANALYSIS: EX
WITH

D QUEUES FOR 2020 FUTURE CONDITIONS
ER STATION MASTER PLAN DEVELOPMENT
KEIZER, OREGON

FIGURE

3



PROPOSED SITE PLAN FOR AREAS "A" & "D" AND POTENTIAL ON-SITE SIGNAL LOCATIONS KEIZER, OREGON

OFFSITE INTERSECTION TRAFFIC SIGNAL INSTALLATION TIMING

There are two new offsite traffic signals planned as part of the 2008 infrastructure recommended in the Keizer Station Master Plan Phase 1 analysis. The operational and signal warrant analyses indicate that traffic signals need to be installed at the Lockhaven Drive/Chemawa Road/Realigned Radiant Drive and Chemawa Road/Road A/Road B (Right-In/Right-Out/Left-In Access) intersections. *The Phase 1 operational and signal warrant worksheets for these intersections are included as part of Attachment C (Appendix A).*

PHASE 1 – VEHICLE QUEUES AND SIGNAL PROGRESSION

Northwest National, LLC and the Chemawa LLC are developing approvals for Phase 1 of Keizer Station, the land east of the railroad. Our May 17th Technical Memorandum identifies the infrastructure required for Phase 1. In addition, a progression analysis has been conducted to maximize flow and reduce delays for the through movements on the Chemawa Road-Lockhaven Drive corridor. This analysis is part of a formal process in accordance with OAR 743-020-0440 through OAR 743-020-0480 obtaining approval from ODOT. *The documentation and analyses are included in Attachment C.*

Figure 5 illustrates the Phase 1 weekday p.m. peak hour 95th-percentile vehicle queues along the Chemawa Road-Lockhaven Drive corridor as calculated through the progression analysis. The queues are shown for a 110-second cycle length coordinating the signals to achieve maximum green-time (bandwidth) for the through movements along the Chemawa Road-Lockhaven Drive corridor. It should be noted that these queues are based on a maximum bandwidth optimization as required by OAR 734-020-0440 through 734-020-0480 and not flow rates. Optimizing for flow rate will result in shorter queues, especially at the Chemawa Road/Lockhaven Drive/Realigned Radiant Drive intersection where the westbound through queue extends close to the Chemawa Road/Road A/Road B (Right-In/Right-Out/Left-In Access) intersection. A realistic coordination plan will optimize for flows and therefore result in shorter queue lengths. The progression analysis showed that this westbound queue reaches a maximum during the green phase, and clears out before the end of green. In other words, the duration of this maximum westbound through queue is relatively short with the vehicle platoon arriving and departing after a brief delay.

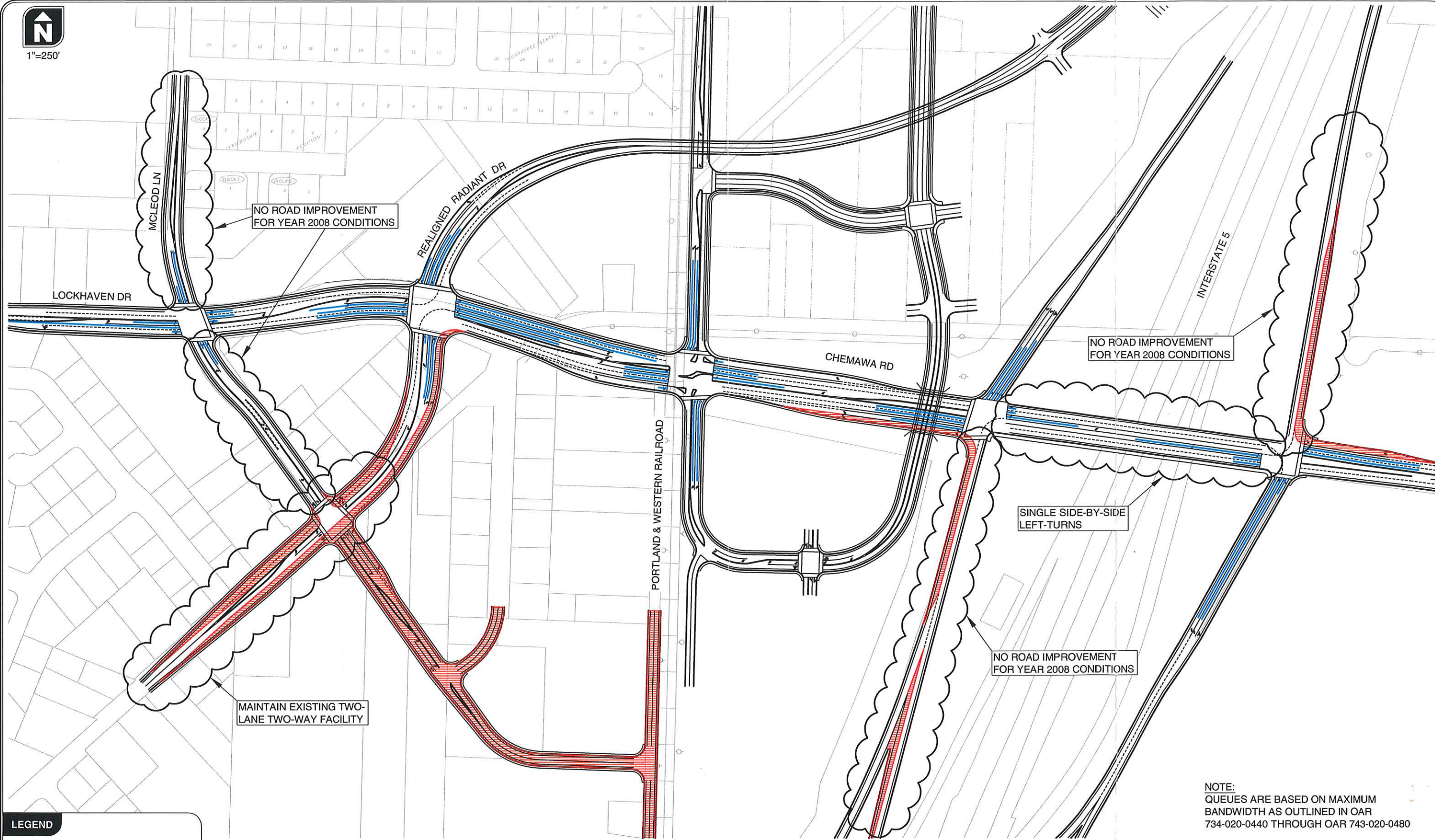
AREA “B” ACCESS

The April 2004 traffic study and proposed infrastructure assumes limited development of the land north of Chemawa Road and west of the railroad. The realigned Radiant Drive will be designed so that this land can be accessed in the future with right-in/right-out driveways only.





1"=250'



LEGEND

TO BE CONSTRUCTED BY 2020

NOTE:
QUEUES ARE BASED ON MAXIMUM BANDWIDTH AS OUTLINED IN OAR 734-020-0440 THROUGH OAR 743-020-0480

PROPOSED ROAD IMPROVEMENTS IN THE VICINITY OF THE INTERSTATE 5 INTERCHANGE (AND EXPECTED 2008 95TH PERCENTILE QUEUES) KEIZER, OREGON

FIGURE 5

AREA "C" ACCESS

The April 2004 traffic study assumes that access to Area "C" will be via a new southeast leg to the existing Chemawa Road/McLeod Lane intersection. Ridge Drive currently provides access to Area "C" on a portion of Chemawa Road that will be rebuilt to provide sufficient capacity and intersection spacing. As part of the Phase 1 infrastructure, the existing Ridge Drive access on Chemawa Road will be closed and realigned to connect to Chemawa Road south of Lockhaven Drive, where traffic volumes are lower. This connection will be temporary and the location finalized during the design stage of the proposed road improvements associated with Phase 1.

The ultimate roadway plan for the area prohibits access along Chemawa Road from the Portland & Western Railroad to the Chemawa Road/McLeod Lane intersection to the southwest. When Area "C" develops, the temporary Ridge Drive connection will be closed, and access will be provided at the existing Chemawa Road/McLeod Lane intersection. We recommend that a traffic study be prepared with development of Area "C" to determine what roadway improvements and traffic control be constructed in the immediate area to accommodate the additional traffic.

*What
assumptions
in April
STIA for
area "C"?*

CONCLUSIONS

We trust that this supplemental memorandum adequately addresses those transportation related concerns raised as part of the formal process. Please contact us if you have any questions or comments regarding the contents of this memorandum or the additional analysis performed within.

Attachment A

Railway Sensitivity
Analysis Field
Calculations



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DATE Sept 21, 04 PROJECT # 4539
 PROJECT NAME Keizer station
 BY PML SHEET # 1 OF 1

SUBJECT Railroad sensitivity.

	Existing (04)*	Existing p.m.	2008	2020
1) Train crossing time (seconds)	162	196	196	196
2) # Train Cars	58	70	70	70
3) # Vehicles per hour per lane	444	752	985	1,228
4) Maximum queue	890'	1,819'	2,385'	2,970'

* Note - All existing values measured during field visit

$$\rightarrow 444 = \left(\frac{60 \times 60}{223} \times 55 \right) / 2 \text{ - lanes}$$

vehicles
time of gate closure

$$= \text{Vehicles per lane per hour}$$

Calculations:

1) Considering a future 70-car train

$$\rightarrow \text{Future train crossing time} = \text{Ex. time} \times \frac{\text{Future cars}}{\text{Ex. cars}}$$

$$= 162 \times \frac{70}{58}$$

$$= \underline{196 \text{ seconds}}$$

4) Queue lengths

$$\rightarrow \text{Future queue} = \frac{\text{Future cars}}{\text{Ex. cars}} \times \frac{\text{Future vehicles arriving}}{\text{Ex. vehicles arriving}} \times \text{Ex. queue}$$

$$= \frac{70}{58} \times \frac{752 \text{ or } 985 \text{ or } 1,228}{444} \times 890'$$

$$= \underline{1,819'} \quad \text{- Existing p.m.}$$

$$= \underline{2,385'} \quad \text{- Future 2008}$$

$$= \underline{2,970'} \quad \text{- Future 2020}$$

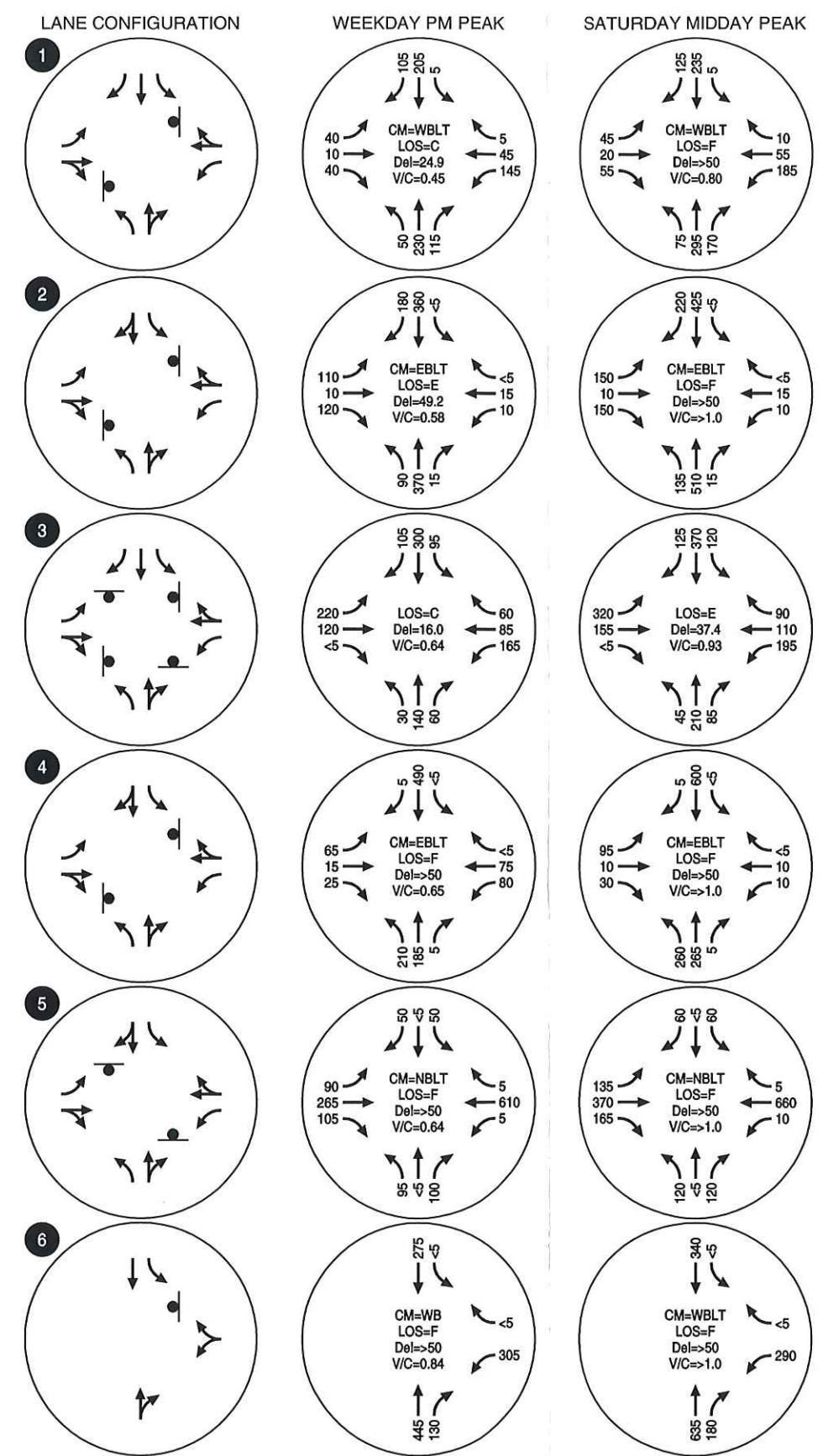
Attachment B

Internal Intersection
Analysis



LEGEND

- STOP SIGN
- CM = CRITICAL MOVEMENT
- LOS = CRITICAL MOVEMENT LEVEL OF SERVICE
- Del = CRITICAL MOVEMENT CONTROL DELAY
- V/C = CRITICAL VOLUME-TO-CAPACITY RATIO



ONSITE TRAFFIC CONDITIONS WITH NO SIGNALS
KEIZER, OREGON

FIGURE
B-1

Weekday Wed Sep 22, 2004 16:08:55 Page 1-1
 Kittelson & Associates, Inc. - Project #: 4539
 Keizer Station Master Plan - Keizer, Oregon
 Buildout On-site Conditions Weekday PM Peak Hour

Weekday Wed Sep 22, 2004 16:08:55 Page 2-1
 Kittelson & Associates, Inc. - Project #: 4539
 Keizer Station Master Plan - Keizer, Oregon
 Buildout On-site Conditions Weekday PM Peak Hour

Scenario: Weekday
 Command: Weekday
 Volume: Weekday
 Geometry: Default Geometry
 Impact Fee: Default Impact Fee
 Trip Generation: Default Trip Generation
 Trip Distribution: Default Trip Distribution
 Paths: Default Paths
 Routes: Default Routes
 Configuration: Default Configuration

Impact Analysis Report
 Level Of Service

Intersection	Base Del/V/C	Future Del/V/C	Change in
# 3	D 30.1 0.000	D 30.1 0.000	+ 0.000 D/V
# 5	C 16.0 0.640	C 16.0 0.640	+ 0.000 V/C
# 11	F 69.6 0.000	F 69.6 0.000	+ 0.000 D/V
# 13	E 39.0 0.000	E 39.0 0.000	+ 0.000 D/V
# 15	F 59.7 0.000	F 59.7 0.000	+ 0.000 D/V
# 17			

Intersection	Base Del/V/C	Future Del/V/C	Change in
# 3	D 30.1 0.000	D 30.1 0.000	+ 0.000 D/V
# 5	C 16.0 0.640	C 16.0 0.640	+ 0.000 V/C
# 11	F 69.6 0.000	F 69.6 0.000	+ 0.000 D/V
# 13	E 39.0 0.000	E 39.0 0.000	+ 0.000 D/V
# 15	F 59.7 0.000	F 59.7 0.000	+ 0.000 D/V
# 17			

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Keizer Station Master Plan - Keizer, Oregon
Buildout On-site Conditions Weekday PM Peak Hour

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

***** Intersection #13 *****
***** Worst Case Level Of Service: F [69.6] *****

Average Delay (sec/veh): 14.9
Approach: North Bound South Bound East Bound West Bound

Table with columns for L, T, R, L, T, R, L, T, R and rows for Control, Rights, Lanes, Volume Module, Base Vol, Growth Adj, Initial Bse, Added Vol, PasserByVol, Initial Fut, User Adj, PHF Adj, PHF Volume, Reduct Vol, Final Vol, Critical Gap, FollowUp Tim, Capacity Module, Conflict Vol, Move Cap, Volume/Cap, Queue, Stopped Del, LOS by Move, Movement, Shared Cap, Shared Queue, Shrd StpDel, Shared LOS, ApproachDel, ApproachLOS.

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Keizer Station Master Plan - Keizer, Oregon
Buildout On-site Conditions Weekday PM Peak Hour

Level Of Service Computation Report
2000 HCM 4-Way Stop Method (Future Volume Alternative)

***** Intersection #11 *****
***** Critical Vol./Cap. (X): 0.640 *****
***** Average Delay (sec/veh): 16.0 *****

Cycle (sec): 60
Loss Time (sec): 16 (Y+R = 4 sec)
Optimal Cycle: 0
Level Of Service: C

Table with columns for L, T, R, L, T, R, L, T, R and rows for Approach, Movement, Control, Rights, Lanes, Volume Module, Base Vol, Growth Adj, Initial Bse, Added Vol, PasserByVol, Initial Fut, User Adj, PHF Adj, PHF Volume, Reduct Vol, Final Vol, Saturation, Adjustment, Lanes, Final Sat, Capacity Analysis Module, Vol/Sat, Crit Moves, Delay/Veh, Delay Adj, AdjDel/Veh, LOS by Move, ApproachDel, Delay Adj, ApprAdjDel, LOS by Appr.

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Keizer Station Master Plan - Keizer, Oregon
Buildout On-site Conditions Weekday PM Peak Hour

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #15

Average Delay (sec/veh): 8.3 Worst Case Level Of Service: E[39.0]

Approach: North Bound South Bound East Bound West Bound
Movement: L - T - R L - T - R L - T - R L - T - R

Control: Stop Sign Uncontrolled Uncontrolled
Rights: Include Include Include
Lanes: 1 0 0 1 0 1 0 0 1 0 1 0 1 0 0 1 0

Volume Module:
Base Vol: 96 1 99 50 1 48 88 263 105 5 609 3

Growth Adj: 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00

Initial Bse: 96 1 99 50 1 48 88 263 105 5 609 3

Added Vol: 0 0 0 0 0 0 0 0 0 0 0 0

PasserByVol: 0 0 0 0 0 0 0 0 0 0 0 0

Initial Fut: 96 1 99 50 1 48 88 263 105 5 609 3

User Adj: 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00

PHF Adj: 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00

PHF Volume: 96 1 99 50 1 48 88 263 105 5 609 3

Reduct Vol: 0 0 0 0 0 0 0 0 0 0 0 0

Final Vol.: 96 1 99 50 1 48 88 263 105 5 609 3

Critical Gap Module:
Critical Gap: 7.1 6.5 6.2 7.1 6.5 6.2 4.1 xxxxx 4.1 xxxxx

FollowUpTim: 3.5 4.0 3.3 3.5 4.0 3.3 2.2 xxxxx 2.2 xxxxx

Capacity Module:
Conflict Vol: 1137 1114 316 1162 1165 611 612 xxxxx 368 xxxxx

Potent Cap.: 181 210 730 174 196 498 977 xxxxx 1202 xxxxx

Move Cap.: 151 190 730 139 178 498 977 xxxxx 1202 xxxxx

Volume/Cap: 0.64 0.01 0.14 0.36 0.01 0.10 0.09 xxxxx 0.00 xxxxx

Level Of Service Module:
Queue: 4.5 xxxxx 1.6 xxxxx 0.3 xxxxx 0.0 xxxxx

Stopped Del: 68.2 xxxxx 45.4 xxxxx 9.0 xxxxx 8.0 xxxxx

LOS by Move: F * * * * * E * * * * * A * * * * *

Movement: LT - LTR - RT LT - LTR - RT LT - LTR - RT

Shared Cap.: xxx xxx 710 xxx xxx 480 xxx xxx xxx xxx xxx

SharedQueue: xxx xxx 0.5 xxx xxx 0.3 xxx xxx xxx xxx xxx

Shrd StpDel: xxx xxx 10.9 xxx xxx 13.4 xxx xxx xxx xxx xxx

Shared LOS: * * * * * B * * * * * A * * * * *

ApproachDel: 39.0 * * * * * 29.5 * * * * *

ApproachLOS: E * * * * * D * * * * *

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Keizer Station Master Plan - Keizer, Oregon
Buildout On-site Conditions Weekday PM Peak Hour

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #17

Average Delay (sec/veh): 15.7 Worst Case Level Of Service: F[59.7]

Approach: North Bound South Bound East Bound West Bound
Movement: L - T - R L - T - R L - T - R L - T - R

Control: Uncontrolled Uncontrolled Uncontrolled
Rights: Include Include Include
Lanes: 0 0 0 1 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0

Volume Module:
Base Vol: 0 446 132 1 275 0 0 0 0 0 303 0 1

Growth Adj: 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00

Initial Bse: 0 446 132 1 275 0 0 0 0 0 303 0 1

Added Vol: 0 0 0 0 0 0 0 0 0 0 0 0 0

PasserByVol: 0 0 0 0 0 0 0 0 0 0 0 0 0

Initial Fut: 0 446 132 1 275 0 0 0 0 0 303 0 1

User Adj: 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00

PHF Adj: 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00

PHF Volume: 0 446 132 1 275 0 0 0 0 0 303 0 1

Reduct Vol: 0 0 0 0 0 0 0 0 0 0 0 0 0

Final Vol.: 0 446 132 1 275 0 0 0 0 0 303 0 1

Critical Gap Module:
Critical Gap: xxxxx xxx xxx xxx 4.1 xxx xxx xxx xxx xxx

FollowUpTim: xxxxx xxx xxx xxx 2.2 xxx xxx xxx xxx xxx

Capacity Module:
Conflict Vol: xxx xxx xxx xxx 578 xxx xxx xxx xxx

Potent Cap.: xxx xxx xxx xxx 1006 xxx xxx xxx xxx

Move Cap.: xxx xxx xxx xxx 1006 xxx xxx xxx xxx

Volume/Cap: xxx xxx xxx xxx 0.00 xxx xxx xxx xxx

Level Of Service Module:
Queue: xxxxx xxx xxx xxx 0.0 xxx xxx xxx xxx

Stopped Del: xxxxx xxx xxx xxx 8.6 xxx xxx xxx xxx

LOS by Move: * * * * * A * * * * * * * * * *

Movement: LT - LTR - RT LT - LTR - RT LT - LTR - RT

Shared Cap.: xxx xxx xxx xxx xxx xxx xxx xxx

SharedQueue: xxx xxx xxx xxx xxx xxx xxx xxx

Shrd StpDel: xxx xxx xxx xxx xxx xxx xxx xxx

Shared LOS: * * * * * * * * * * * * * * * *

ApproachDel: xxxxxx * * * * * xxxxxx

ApproachLOS: * * * * * * * * * * * * * * * *

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 Keizer Station Master Plan - Keizer, Oregon
 Buildout On-site Conditions Saturday Midday Peak Hour

Scenario Report
 Level Of Service

Intersection	Base Del/V/ LOS Veh C	Future Del/V/ LOS Veh C	Change in
# 3	F 62.7 0.000	F 62.7 0.000	+ 0.000 D/V
# 5	F 420.4 0.000	F 420.4 0.000	+ 0.000 D/V
# 11	E 37.4 0.925	E 37.4 0.925	+ 0.000 V/C
# 13	F 300.0 0.000	F 339.5 0.000	+39.538 D/V
# 15	F 401.4 0.000	F 439.7 0.000	+38.314 D/V
# 17	F 395.3 0.000	F 430.5 0.000	+35.117 D/V

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 Keizer Station Master Plan - Keizer, Oregon
 Buildout On-site Conditions Saturday Midday Peak Hour

Scenario Report

Command: Saturday
 Volume: Saturday
 Geometry: Saturday
 Impact Fee: Default Impact Fee
 Trip Generation: Default Trip Generation
 Trip Distribution: Default Trip Distribution
 Paths: Default Paths
 Routes: Default Routes
 Configuration: Default Configuration

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Keizer Station Master Plan - Keizer, Oregon
Buildout On-site Conditions Saturday Midday Peak Hour

Level Of Service Computation Report

2000 HCM Unsignalized Method (Future Volume Alternative)

***** Intersection #15 *****

Average Delay (sec/veh): 72.0 Worst Case Level Of Service: F[439.7]

***** Approach: North Bound South Bound East Bound West Bound *****

Movement: L - T - R L - T - R L - T - R L - T - R

Control: Stop Sign Stop Sign Uncontrolled Uncontrolled

Rights: Include Include Include Include

Lanes: 1 0 0 1 0 1 0 0 1 0 1 0 1 0 0 1 0

Volume Module: Base Vol: 118 0 122 61 0 59 137 368 164 8 658 4

Growth Adj: 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00

Initial Bse: 118 0 122 61 0 59 137 368 164 8 658 4

Added Vol: 0 0 0 0 0 0 0 0 0 0 0 0

PasserByVol: 0 5 0 0 5 0 0 0 0 0 0 0

Initial Fut: 118 5 122 61 5 59 137 368 164 8 658 4

User Adj: 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00

PHF Adj: 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00

PHF Volume: 118 5 122 61 5 59 137 368 164 8 658 4

Reduct Vol: 0 0 0 0 0 0 0 0 0 0 0 0

Final Vol.: 118 5 122 61 5 59 137 368 164 8 658 4

Critical Gap Module: Critical Gap: 7.1 6.5 6.2 7.1 6.5 6.2 4.1 xxxxx 4.1 xxxxx

FollowUpTim: 3.5 4.0 3.3 3.5 4.0 3.3 2.2 xxxxx 2.2 xxxxx

Capacity Module: Cnflct Vol: 1432 1402 450 1464 1482 660 662 xxxxx 532 xxxxx

Potent Cap.: 115 141 613 108 126 467 936 xxxxx 1046 xxxxx

Move Cap.: 84 120 613 74 107 467 936 xxxxx 1046 xxxxx

Volume/Cap: 1.40 0.04 0.20 0.83 0.05 0.13 0.15 xxxxx 0.01 xxxxx

Level Of Service Module: Queue: 24.2 xxxxx 6.9 xxxxx 210.0 xxxxx 0.5 xxxxx

Stopped Del: 897.9 xxxxx 210.0 xxxxx 9.5 xxxxx 8.5 xxxxx

LOS by Move: F A F A

Movement: LT - LTR - RT LT - LTR - RT LT - LTR - RT

Shared Cap.: xxxxx 528 xxxxx 370 xxxxx xxxxx xxxxx xxxxx

SharedQueue: xxxxx 0.9 xxxxx 0.6 xxxxx xxxxx xxxxx xxxxx

Shrd StpDel: xxxxx 14.0 xxxxx 16.8 xxxxx xxxxx xxxxx xxxxx

Shared LOS: B C

ApproachDel: 439.7 111.1

ApproachLOS: F F

Kittelton & Associates, Inc. - Project #: 4539
Keizer Station Master Plan - Keizer, Oregon
Buildout On-site Conditions Saturday Midday Peak Hour

Level Of Service Computation Report

2000 HCM Unsignalized Method (Future Volume Alternative)

***** Intersection #17 *****

Average Delay (sec/veh): 85.8 Worst Case Level Of Service: F[430.5]

***** Approach: North Bound South Bound East Bound West Bound *****

Movement: L - T - R L - T - R L - T - R L - T - R

Control: Uncontrolled Uncontrolled Uncontrolled Uncontrolled

Rights: Include Include Include Include

Lanes: 0 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0

Volume Module: Base Vol: 0 636 182 0 339 0 0 0 0 0 289 0 0

Growth Adj: 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00

Initial Bse: 0 636 182 0 339 0 0 0 0 0 289 0 0

Added Vol: 0 0 0 0 0 0 0 0 0 0 0 0 0

PasserByVol: 0 0 0 5 0 0 0 0 0 0 0 0 0

Initial Fut: 0 636 182 5 339 0 0 0 0 0 289 0 0

User Adj: 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00

PHF Adj: 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.00

PHF Volume: 0 636 182 5 339 0 0 0 0 0 289 0 0

Reduct Vol: 0 0 0 0 0 0 0 0 0 0 0 0 0

Final Vol.: 0 636 182 5 339 0 0 0 0 0 289 0 0

Critical Gap Module: Critical Gap: 4.1 xxxxx 4.1 xxxxx xxxxx xxxxx

FollowUpTim: xxxxx xxxxx xxxxx xxxxx 2.2 xxxxx xxxxx xxxxx

Capacity Module: Cnflct Vol: xxxxx xxxxx xxxxx xxxxx 818 xxxxx xxxxx

Potent Cap.: xxxxx xxxxx xxxxx xxxxx 819 xxxxx xxxxx

Move Cap.: xxxxx xxxxx xxxxx xxxxx 819 xxxxx xxxxx

Volume/Cap: xxxxx xxxxx xxxxx xxxxx 0.01 xxxxx xxxxx

Level Of Service Module: Queue: xxxxx xxxxx xxxxx xxxxx 0.0 xxxxx xxxxx

Stopped Del: xxxxx xxxxx xxxxx xxxxx 9.4 xxxxx xxxxx

LOS by Move: A * A * A * A *

Movement: LT - LTR - RT LT - LTR - RT LT - LTR - RT

Shared Cap.: xxxxx xxxxx xxxxx xxxxx xxxxx xxxxx xxxxx

SharedQueue: xxxxx xxxxx xxxxx xxxxx xxxxx xxxxx xxxxx

Shrd StpDel: xxxxx xxxxx xxxxx xxxxx xxxxx xxxxx xxxxx

Shared LOS: * * * * *

ApproachDel: xxxxxx xxxxxx

ApproachLOS: * * 430.5 F

Attachment C

OAR 743-020-0440
through
OAR 743-020-0480
Documentation



KITTELSON & ASSOCIATES, INC.

TRANSPORTATION PLANNING/TRAFFIC ENGINEERING

610 SW ALDER, SUITE 700 • PORTLAND, OR 97205 • (503) 228-5230 • FAX (503) 273-8169

MEMORANDUM

Date: September 28, 2004

Project #: 4539

To: Craig Black, ODOT Region 2 & Massoud Saberian, State Traffic Engineer Office

cc: Rob Kissler, City of Keizer & Dick Woelk, ATEP Inc.

From: Chris Stanley, P.E., Peter Koonce, P.E. & Hermanus Steyn, Pr.Eng., P.E.

Project: Keizer Station Master Plan

Subject: Phase 1 Signal Progression

INTRODUCTION

In accordance with OAR 743-020-0440 through OAR 743-020-0480, this memorandum documents the need for the installation of a new traffic signal on Chemawa Road at the Portland & Western Railroad and signal modifications at the Interstate 5 (I-5)/Chemawa Road interchange ramp terminals. A second signal that is not part of the State Highway is proposed at the Chemawa Road/Lockhaven Drive/Realigned Radiant Drive intersection. The traffic analysis performed as part of the Keizer Station Master Plan development (April, 2004) has shown the need for the new traffic signals and the two signal modifications.

As requested by ODOT staff, this memorandum outlines the project background and analysis assumptions and specifies how the three intersections within ODOT right-of-way meet the specific OAR requirements for the approval of the proposed traffic signal. In particular, it is the goal of this memorandum to show that the installation of a traffic signal at the Chemawa Road/Road A/Road B (Right-In/Right-Out/Left-In Access) intersection does not negatively impact traffic operations and traffic progression along the Chemawa Road-Lockhaven Drive corridor.

PROJECT BACKGROUND

Northwest National, the Chemawa LLC and the City of Keizer are proposing to develop the majority of the 225.2 acres located west of the Chemawa/I-5 interchange in Keizer, Oregon. There has been a strong interest to develop the site from the City and community. Consequently, much of the site has been identified as part of an Urban Renewal District.

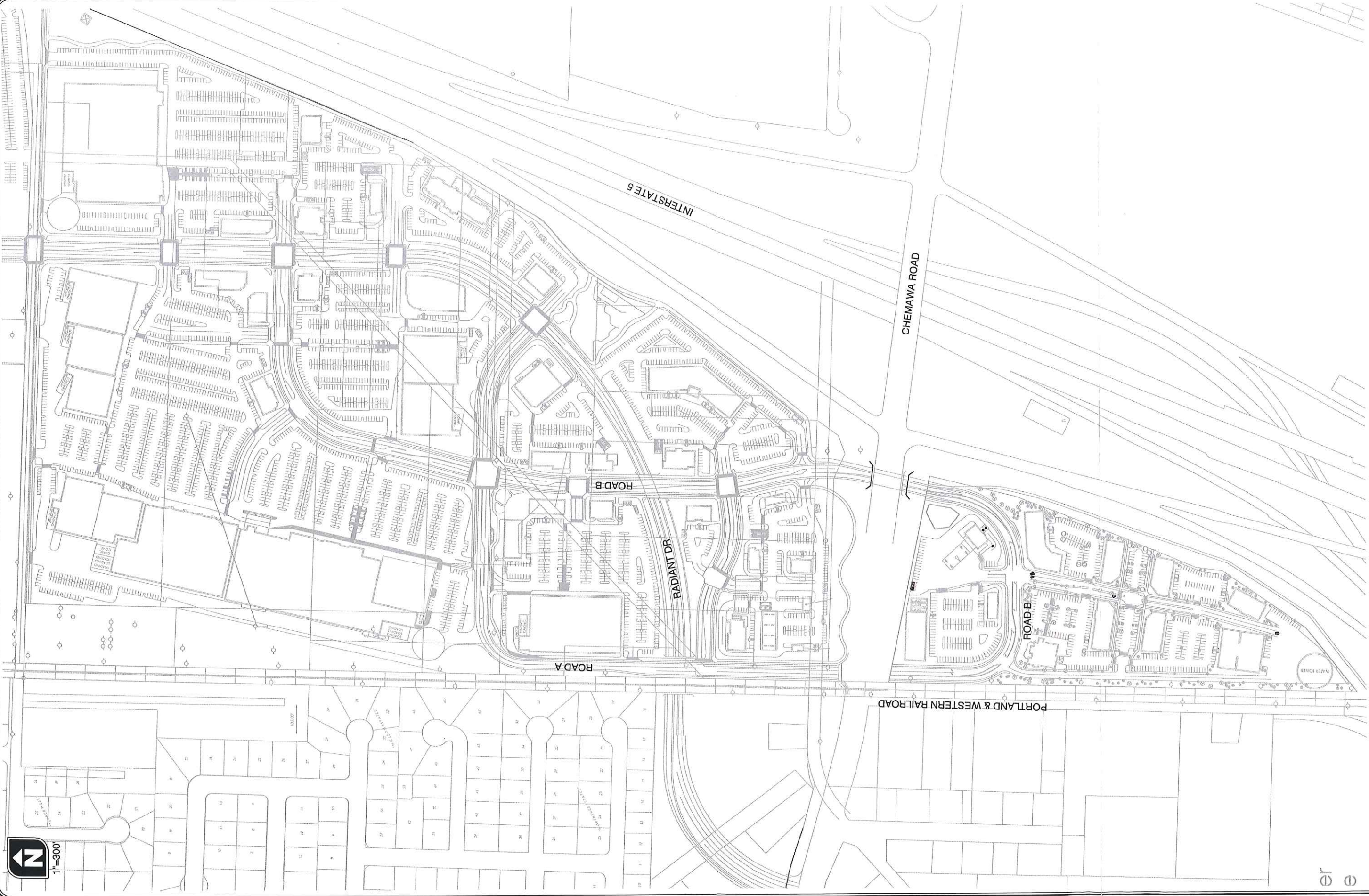
Due to surrounding constraints, access to the site is limited. The site is bordered on the north by the Salem-Keizer Urban Growth Boundary, on the east by I-5, and the south by the Salem

Parkway. Existing residential neighborhoods surround the site to the south and west. The site is bisected by a north-south running Portland & Western Railroad track. Due to these constraints, the majority of the site can only be accessed via Chemawa Road. Significant effort has been invested to develop a site plan and roadway network that provides safe and efficient traffic operations to the development and on the surrounding infrastructure, including the I-5 interchange ramps. In addition, the April 2004 traffic study analyzed 2020 traffic conditions to ensure that the surrounding infrastructure will continue to operate acceptably in the long-term future.

The entire master plan is unlikely to develop at the same time. The project team has identified Phase 1 to be built out by the Year 2008. The near-term 2008 component will involve the development of Area A [Village Center] and Area D [Commerce Center]. Figure 1 shows preliminary site plans for these two areas. To accommodate this initial development, a series of capacity improvements were identified to meet the operating thresholds. The improvements associated with the capacity scenario are conceptually illustrated in Figure 2 and include the following component shown in Table 1 below:

Table 1
Recommended Capacity Improvements (Existing - 2008)

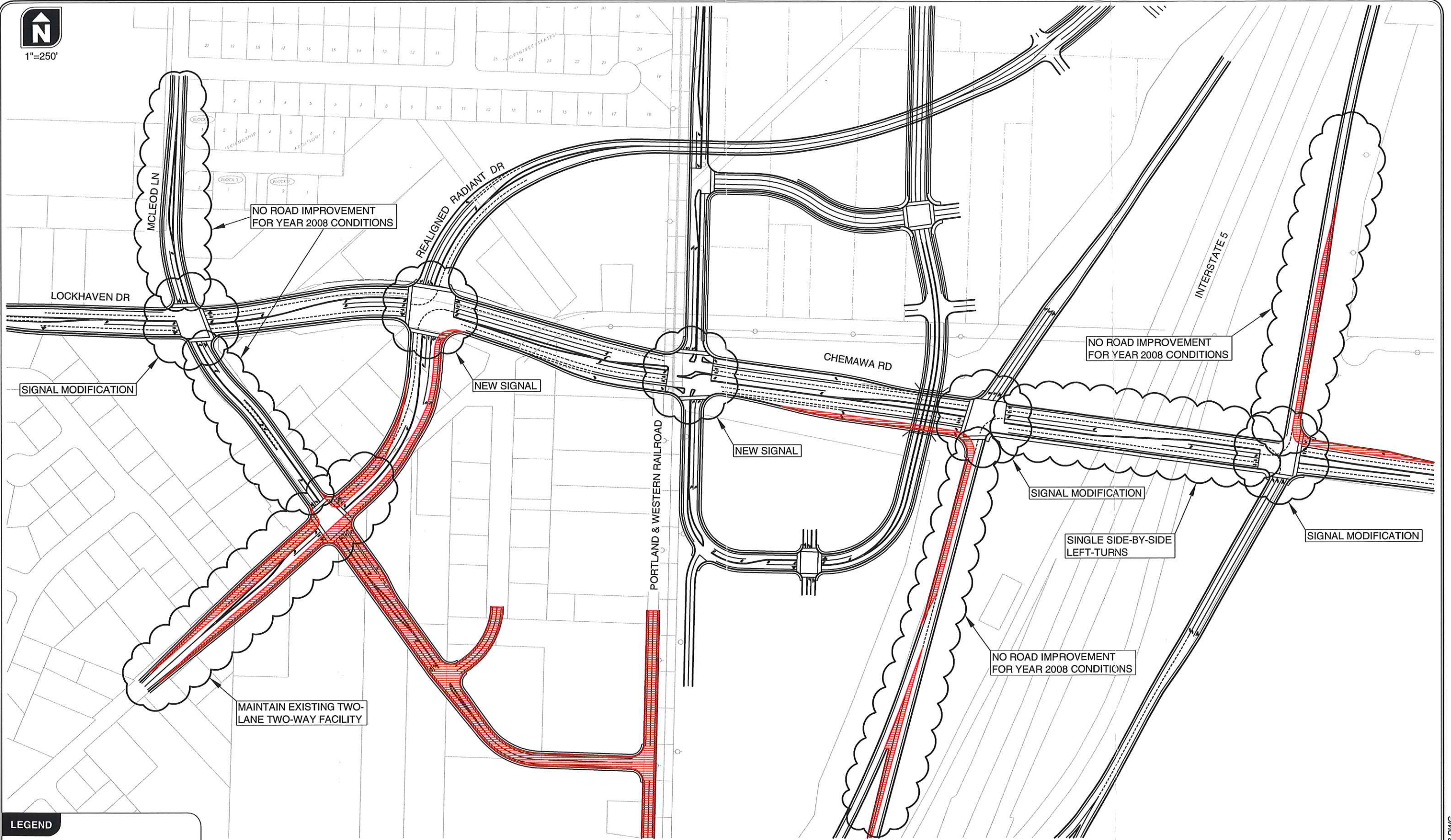
Intersection/Road Segment	Recommended Improvement
Lockhaven Drive/McLeod Lane	<ul style="list-style-type: none"> ▪ Change existing westbound right-turn lane into a through/right lane
Lockhaven Drive/Chemawa Road/Realigned Radiant Drive	<ul style="list-style-type: none"> ▪ Realign Chemawa Road south of Lockhaven Drive ▪ Signalize intersection ▪ Add additional eastbound and westbound through lanes ▪ Provide single eastbound left-turn lane ▪ Provide dual westbound left-turn lanes ▪ Provide northbound left, through and right-turn lanes ▪ Provide southbound left-turn, through and right-turn lanes ▪ Run northbound and southbound right-turns with overlap phasing
Chemawa Road/Road A/Road B (Right-In/Right-Out/Left-In Access)	<ul style="list-style-type: none"> ▪ Signalize intersection due to insufficient gaps ▪ Provide dual northbound and southbound right-turn lanes and run with overlap phasing ▪ Add eastbound and westbound right-turn lanes ▪ Add eastbound and westbound left-turn lanes ▪ Construct a raised median in Chemawa Road to prohibit northbound and southbound through and left-turn movements ▪ Run the traffic signal with two-phases for optimum capacity and minimal impact on Chemawa Road through traffic
Chemawa Road/I-5 Southbound Ramp Terminal	<ul style="list-style-type: none"> ▪ Add an additional southbound right-turn lane ▪ Provide an eastbound right-turn lane
Chemawa Road/I-5 Northbound Ramp Terminal	<ul style="list-style-type: none"> ▪ Provide dual northbound left-turn lanes and a shared through/right lane
East-West Lockhaven Drive-Chemawa Road Corridor	<ul style="list-style-type: none"> ▪ Provide two through lanes in both directions from just east of the Chemawa Road/I-5 Northbound Ramp Terminal intersection to just west of the Lockhaven Drive/Chemawa Road intersection ▪ Interconnect all traffic signals from the I-5 Northbound Terminal to McLeod



PROPOSED SITE PLAN FOR AREAS "A" & "D" KEIZER, OREGON **FIGURE 1**



1"=250'



LEGEND

TO BE CONSTRUCTED BY 2020

PROPOSED ROAD IMPROVEMENTS IN THE VICINITY OF THE INTERSTATE 5 INTERCHANGE
KEIZER, OREGON

FIGURE
2

4539FD08.DWG

NEED FOR INTERIM SAFETY AND CAPACITY IMPROVEMENTS

As required under OAR 734-020-0440, the approval of a new traffic signal on a State Highway must meet certain technical and administrative requirements. As described in the previous section, the capacity improvements include two new traffic signals on Chemawa Road at the Chemawa Road/Lockhaven Drive/Realigned Radiant Drive intersection (non State Highway section) and Chemawa Road/Road A/Road B (Right-In/Right-Out/Left-In Access) intersection (State Highway section) east of Portland & Western Railroad. The following section outlines the technical need for the traffic signal in order to comply with OAR 734-020-0440 (1)(a)(A&B).

Anticipated Initial Demand

With construction of the Phase 1 development, KAI evaluated whether the existing transportation system could safely and efficiently accommodate the anticipated near-term traffic growth. The Phase 1 development is anticipated to generate approximately 2,020 (895 in, 1,125 out) additional weekday p.m. peak hour trips (primary trips). Under this initial vehicular demand, a traffic analysis investigation was undertaken to determine if improvements were needed.

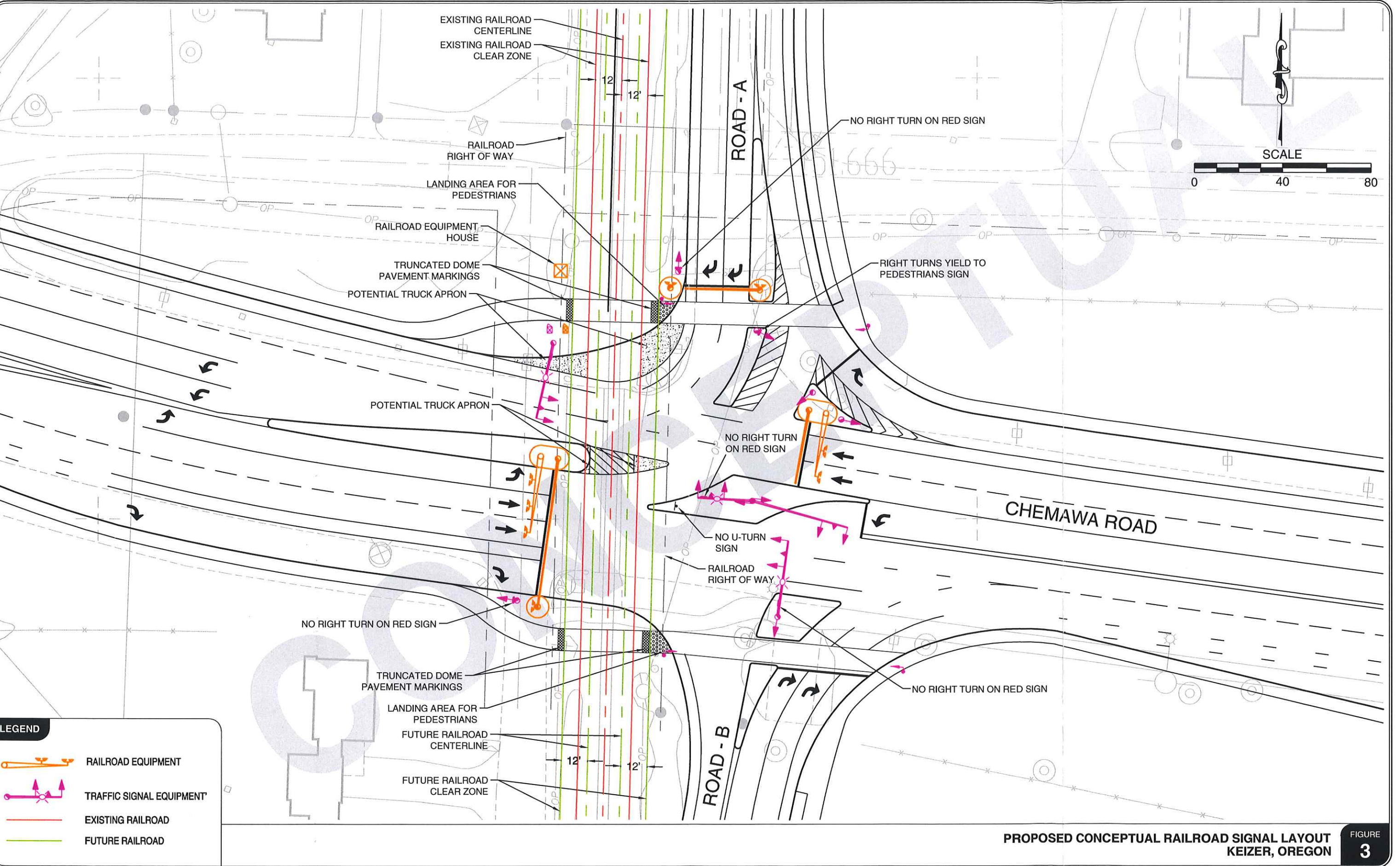
Chemawa Road Access Scenarios

The City's Transportation System Plan (TSP) identifies a new signalized intersection (full access) on Chemawa Road serving properties to the north (Area A) and south (Area D) of Chemawa Road just east of railroad tracks. As discussed previously, the site is constrained and due to the proximity of this access point to the I-5 interchange, a range of scenarios was evaluated as part of the Keizer Station Master Plan (April 2004 traffic study) to find the best option to serve the public while maintaining safe and efficient traffic conditions along the Chemawa Road corridor.

It was concluded that a signalized right-in/right-out/left-in at the railroad (Scenario #3 in April 2004 Traffic Study) provides a flexible transportation system with safe and efficient operations on-site and on the surrounding transportation system. Motorists accessing the site will have alternative routes, enabling traffic loads to distribute and shift with peak activities. This signal operates better than the required operating standards and the two-phase traffic signal has minimal impact on capacity and progression on Chemawa Road. It also provides for flexibility of signal interconnection and timing. Figure 3 illustrates the conceptual intersection geometry at the new signal. There are on-going discussions with railroad authorities to refine and finalize the intersection geometry.

Signal Warrant Analysis - Capacity Improvement

In order to comply with OAR 734-020-0460, signal warrant analyses were conducted at the Chemawa Road/Lockhaven Drive/Realigned Radiant Drive and Chemawa Road/Road A/Road B (Right-In/Right-Out/Left-In) intersections. These warrant analyses were conducted based on MUTCD Warrant #1 Case A and Case B, as outlined by ODOT's approved methodology. *Based on this methodology, both intersections meet MUTCD Warrants #1, 2 and 3, as summarized in the warrant analysis worksheets shown in Appendix "A".*



H:\projfile\6580\dwg\Railroad\6580RR_9-28-04.dwg Sep 28, 2004 - 11:34am - nwohle Layout Tab: RR-layout-Proposed_FIG01

PROPOSED CONCEPTUAL RAILROAD SIGNAL LAYOUT
KEIZER, OREGON

SIGNAL PROGRESSION ANALYSIS

In accordance with OAR 734-020-0480, a transportation operations analysis was performed along the Chemawa Road-Lockhaven Drive corridor at the intersections listed below.

- Chemawa Road/I-5 Northbound Ramp Terminal intersection
- Chemawa Road/I-5 Southbound Ramp Terminal intersection
- Chemawa Road/Road A/Road B (Right-In/Right-Out/Left-In Access)
- Chemawa Road/Lockhaven Drive/Realigned Radiant Drive
- Lockhaven Drive/McLeod Lane

Typically, traffic signals are interconnected and timed to progress through movements on a corridor. On this corridor, the movement with the highest volume at the easternmost intersection (Chemawa Road/I-5 Northbound Ramp Terminal) is the northbound left turn. In addition, a large percentage (approximately 30%) of westbound through vehicles make a left-turn at the Chemawa Road/I-5 Southbound Ramp Terminal intersection. For this reason, it was decided to perform an additional progression analysis coordinating the northbound to westbound left-turn movement at the Chemawa Road/I-5 Northbound Ramp Terminal to the corridor intersections. This resulted in two scenarios related to progression along the Chemawa Road-Lockhaven Drive corridor:

1. *Scenario 1* is a progression analysis based on east west through volumes on Chemawa Road-Lockhaven Drive throughout the corridor.
2. *Scenario 2* is a progression analysis that coordinates the northbound to westbound left-turn movement at the Chemawa Road/I-5 Northbound Ramp Terminal intersection with the westbound through volumes along Chemawa Road-Lockhaven Drive.

To complete the analyses, the steps and assumptions described below were used.

- The forecast 2008 weekday p.m. peak hour traffic volumes were utilized for the four study intersections. This period represents the most critical traffic volumes along the study corridor.
- A Synchro model was developed for the critical study period using Synchro 5.0. *Appendix "B" contains the Synchro output files from the analyses.*
- Total lost time was assumed as 4 seconds per phase at the signalized intersections.
- A peak hour factor (PHF) of 1.0 was applied to all movements at the study intersections.
- The ideal saturation flow rate for each study intersections was set at 1,900 passenger cars per hour per lane.
- Existing signal timing parameters were obtained from the City of Salem at the Chemawa Road-Lockhaven Drive corridor intersections.

General Signal Operations and Timing Parameters

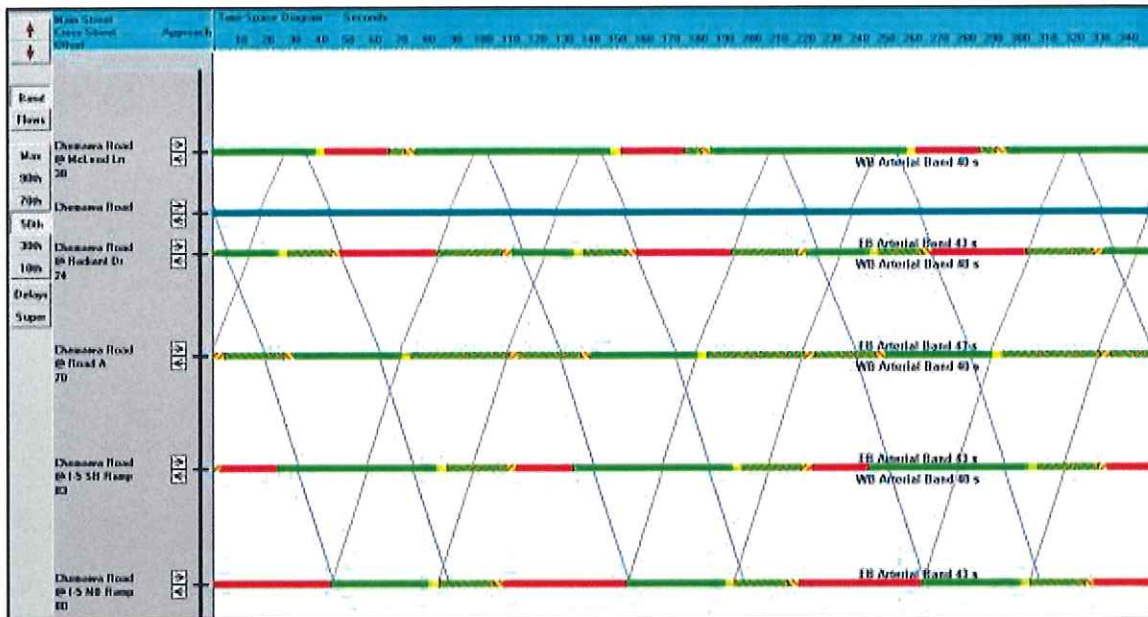
The cycle length for the study intersections along the Chemawa Road-Lockhaven Drive corridor is 110 seconds. The 130-second cycle length was based on conversations with the City of Salem Signal Engineering staff wanting this corridor to match the signal timing on the River Road corridor. The bandwidth solution may result from a different optimal cycle length that was studied in this evaluation, however due to the City's interest in remaining consistent we have not conducted an exhaustive study.

Appendix "B" contains the results of the operational analysis (v/c ratio, LOS, and 95th percentile queues) for the coordinated signals along the Chemawa Road-Lockhaven Drive corridor. It should be noted that adequate pedestrian crossing times have been provided at all intersections.

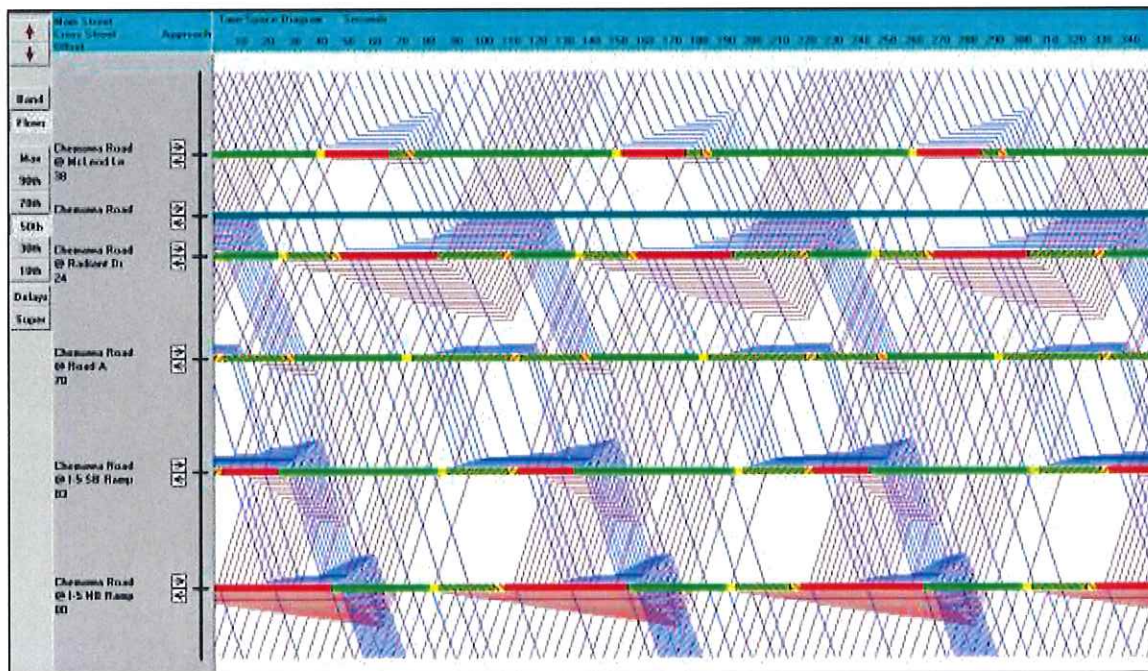
Based on the results presented in Appendix "B", a 110- or 130-second cycle length throughout the corridor results in acceptable traffic operations and 95th percentile queues that can be accommodated by available storage.

Screen captures of the Maximum Band width and 50th percentile flows are provided below for the two cycle length and progression scenarios. As noted for the *Scenario 2* analyses, the bandwidths are based on the northbound to westbound left-turn movement at the Chemawa Road/I-5 Northbound Ramp Terminal intersection. The 50th percentile flow represents the average vehicle flow expected at the intersections.

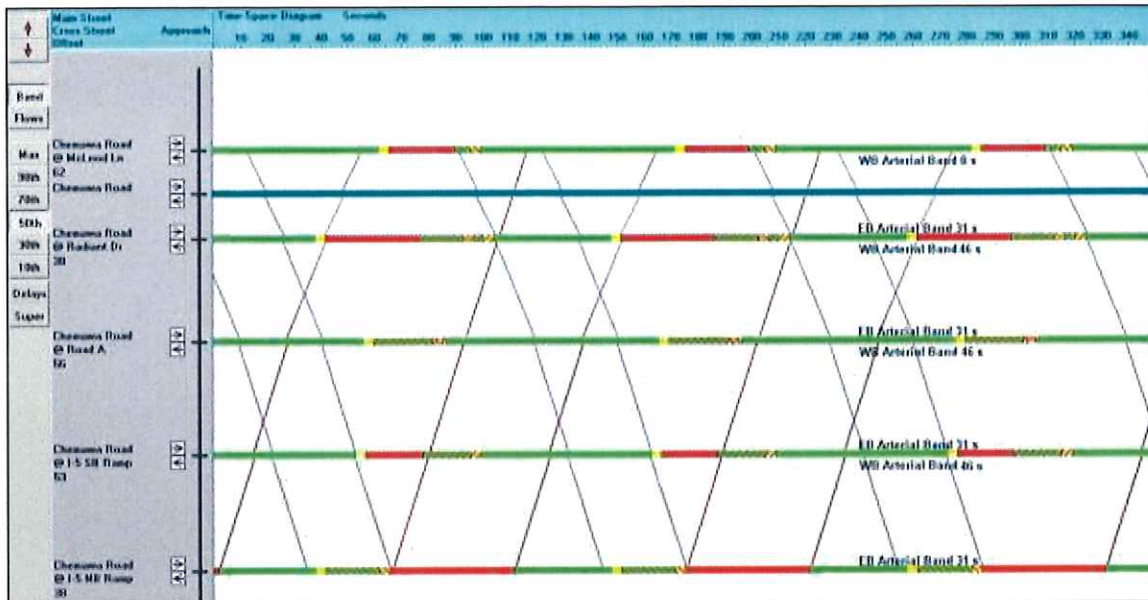
Weekday PM Peak Hour Max Band Width: 110-second cycle length (Scenario 1)



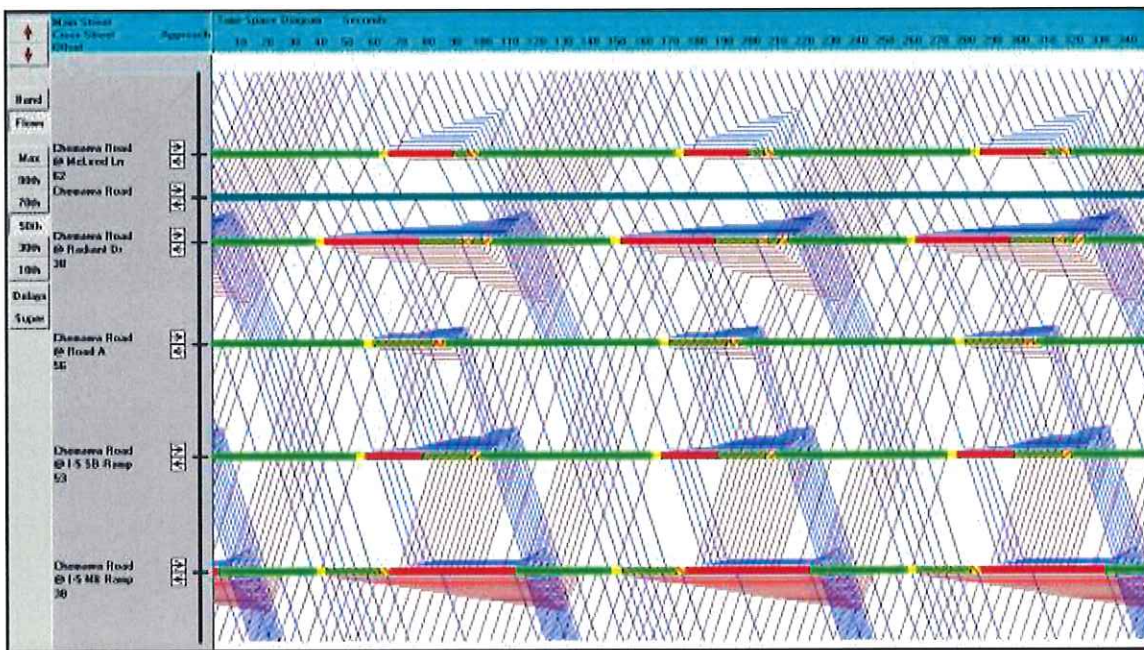
Weekday PM Peak Hour 50th Percentile Flows: 110-second cycle length (Scenario 1)



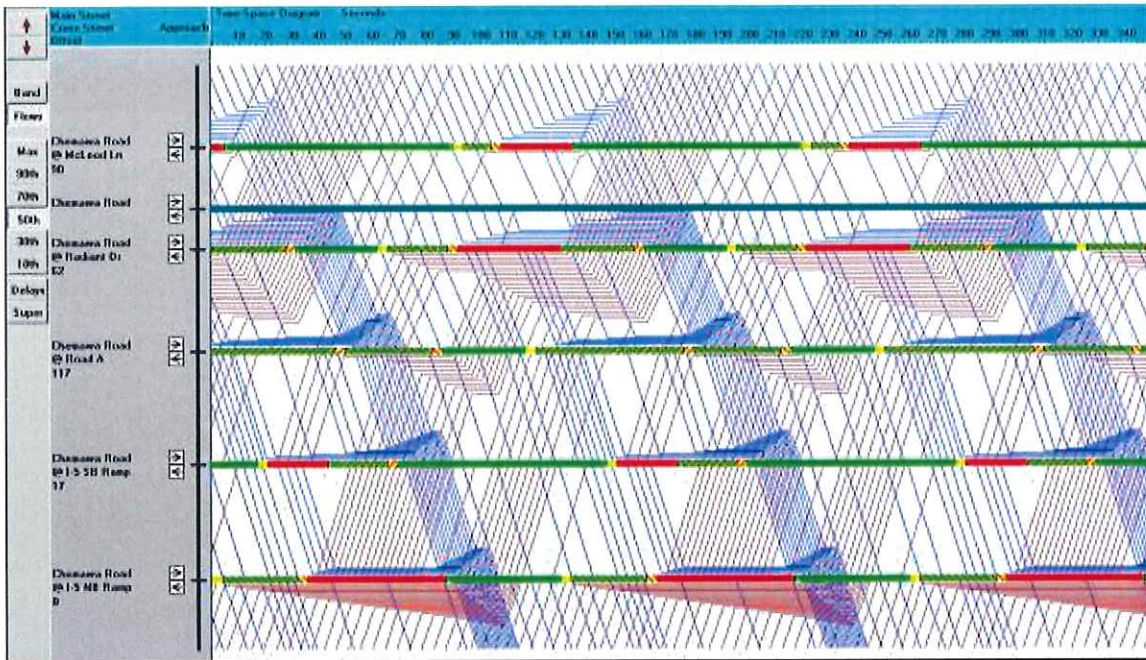
Weekday PM Peak Hour Max Band Width: 110-second cycle (Scenario 2)



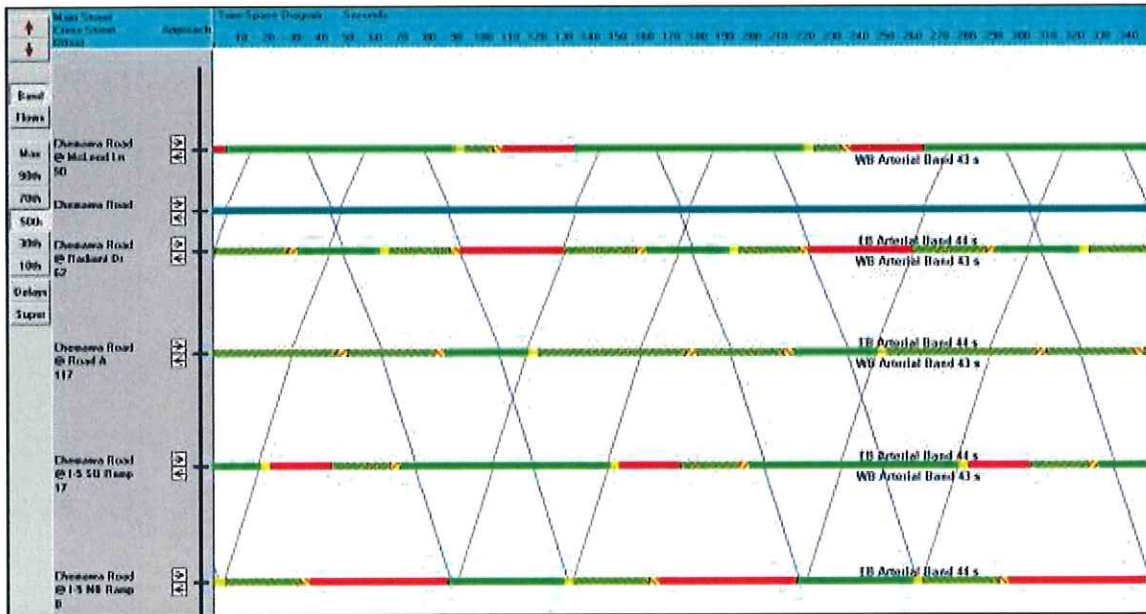
Weekday PM Peak Hour 50th Percentile Flows: 110-second cycle length (Scenario 2)



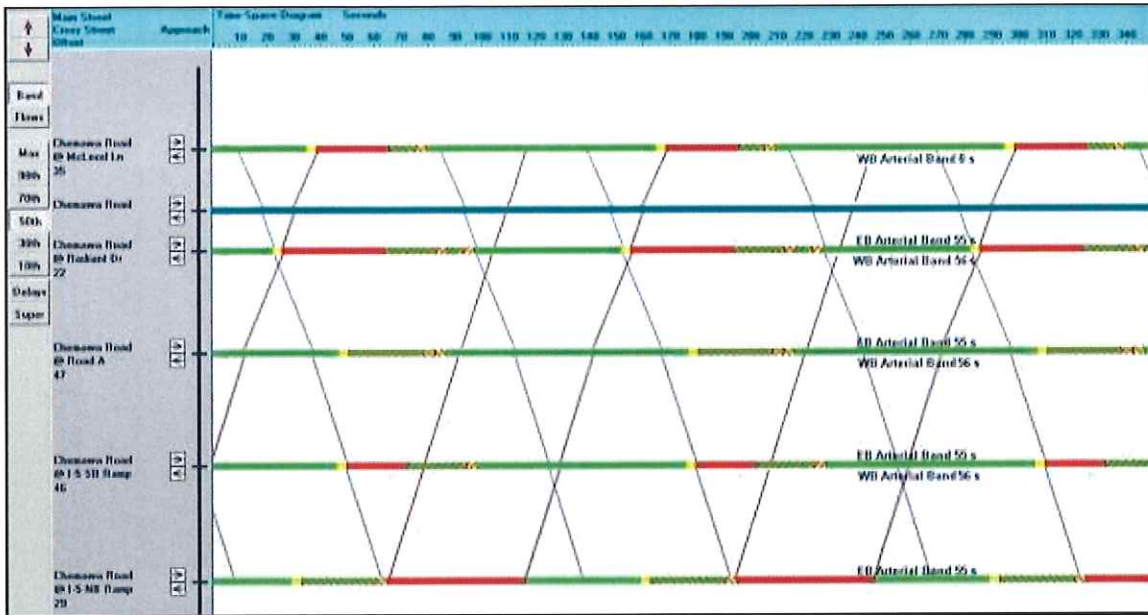
Weekday PM Peak Hour Max Band Width: 130-second cycle length (Scenario 1)



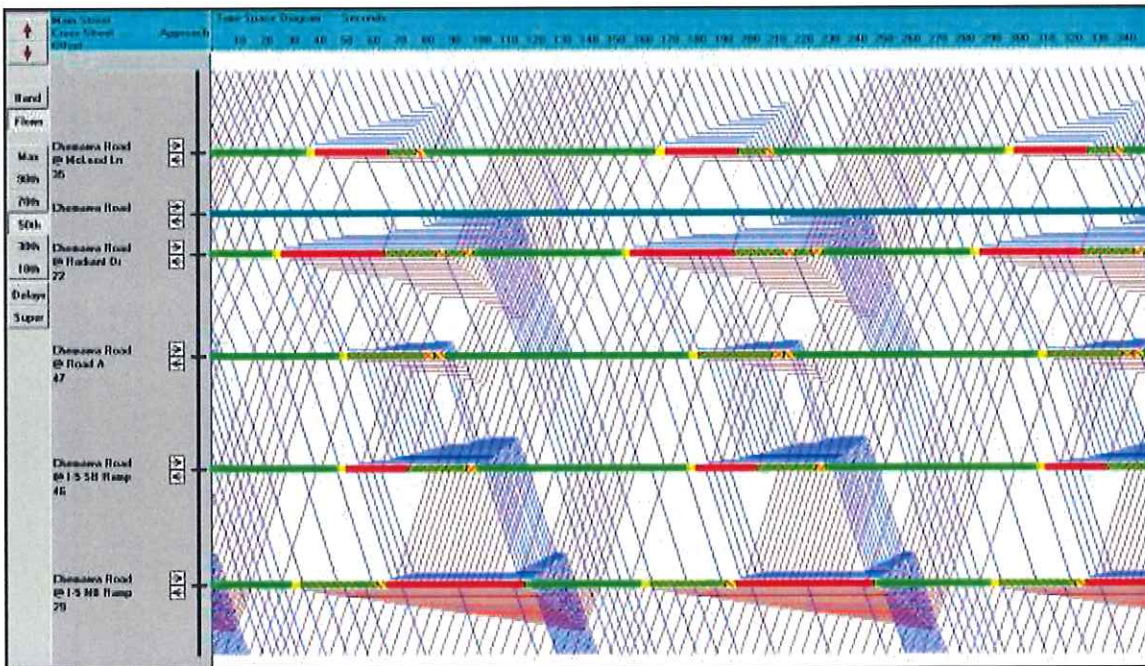
Weekday PM Peak Hour 50th Percentile Flows: 130-second cycle length (Scenario 1)



Weekday PM Peak Hour Max Band Width: 130-second cycle length (Scenario 2)



Weekday PM Peak Hour 50th Percentile Flows: 130-second cycle (Scenario 2)



Per OAR 734-020-0480 (1)(e), the through traffic on the state highway must have a bandwidth "...as large as that required, or as presently exists, for through traffic on the state highway at the most critical intersection within the roadway segment". The critical intersection is the one with the highest through volume; therefore the Chemawa Road/I-5 Southbound Ramp Terminal intersection is the critical intersection. In particular, the westbound through movement shows the largest volume (approximately 1,590). Table 2 illustrates the resulting progression bandwidth ratio along the Chemawa Road corridor for both scenarios focusing on the Chemawa Road/I-5 Southbound Ramp Terminal intersection. As shown in Table 2, *Scenario 2* results in adequate bandwidth at the critical intersection.

110-second cycle length scenario

Under *Scenario 1*, the Chemawa Road/Lockhaven Drive corridor is shown to have an eastbound bandwidth of 43 seconds and westbound bandwidth of 40 seconds during the weekday p.m. peak hour. *Scenario 2* results in an eastbound bandwidth of 31 seconds and westbound bandwidth of 46 seconds. This bandwidth under *Scenario 2* is also large enough to accommodate the highest through volumes in both directions (eastbound & westbound) along the Chemawa Road-Lockhaven Drive corridor.

130-second cycle length scenario

Under *Scenario 1*, the Chemawa Road/Lockhaven Drive corridor is shown to have an eastbound bandwidth of 44 seconds and westbound bandwidth of 43 seconds during the weekday p.m. peak hour. *Scenario 2* results in an eastbound bandwidth of 55 seconds and westbound bandwidth of 56 seconds. This bandwidth under Scenario 2 is also large enough to accommodate the highest through volumes in both directions (eastbound & westbound) along the Chemawa Road-Lockhaven Drive corridor.

**Table 2
 Chemawa Road Bandwidth Analysis of the Critical Through Volume (Westbound)**

Scenario	Critical Through Volume (p.m. peak hour)	Assumed Saturation Flow Rate	Assumed Cycle Length	Critical Through Volume Ratio	Progression Bandwidth Ratio	Adequate?
1	1,590 per 2 lanes	1,900	110	0.42	0.36	No
	1,590 per 2 lanes	1,900	130	0.42	0.33	No
2	1,590 per 2 lanes	1,900	110	0.42	0.42	Yes
	1,590 per 2 lanes	1,900	130	0.42	0.43	Yes

CONCLUSION

As shown in the analysis, a traffic signal at Chemawa Road/Lockhaven Drive and Chemawa Road/Road A/Road B (Right-In/Right-Out/Left-In Access) meets the technical and administrative requirements of OAR 734-020-0440 through 734-020-0480. In addition, the bandwidth analyses also proved that the addition of this intersection does not negatively impact the overall corridor-wide operations, and allows for adequate vehicle flow along the Chemawa Road-Lockhaven Drive corridor.

In particular, the analysis shows the following:

- There is an operational and safety need for a traffic signal at Chemawa Road/Road A/Road B (Right-In/Right-Out/Left-In Access) intersection.
- The estimated near-term intersection volumes are high enough to meet the MUTCD signal warrant requirements.
- A common cycle length can be provided at five intersections such that the resulting progression bandwidth is large enough to accommodate the critical through traffic along the Chemawa Road- Lockhaven Drive corridor.

Please contact us if you have any questions regarding this analysis.

Appendix A

Signal Warrant
Summary Worksheets



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

Project #: 4539
Project Name: Keizer Station Master Plan
Analyst: PML
Date: 9/24/2004
File: G:\projfile\4539\EXCEL\Sig-Warrants\Off-site\September04 Update\Weekday\ChemLock-SigWarrant.xls>Data Input
Intersection: Chemawa Road/Lockhaven Drive
Scenario: Year 2008 Weekday PM Peak Hour

Raw Traffic Volumes

Hour	Begin	End	Major Street		Minor Street	
			EB	WB	NB	SB
5:00 PM	5:00 PM	6:00 PM	901	1846	475	454
2nd	2nd	Highest Hour	865	1772	456	436
3rd	3rd	Highest Hour	847	1735	447	427
4th	4th	Highest Hour	721	1477	380	363
5th	5th	Highest Hour	685	1403	361	345
6th	6th	Highest Hour	613	1255	323	309
7th	7th	Highest Hour	568	1163	299	286
8th	8th	Highest Hour	541	1108	285	272
9th	9th	Highest Hour	432	886	228	218
10th	10th	Highest Hour	405	831	214	204
11th	11th	Highest Hour	405	831	214	204
12th	12th	Highest Hour	387	794	204	195
13th	13th	Highest Hour	351	720	185	177
14th	14th	Highest Hour	324	665	171	163
15th	15th	Highest Hour	324	665	171	163
16th	16th	Highest Hour	315	646	166	159
17th	17th	Highest Hour	180	369	95	91
18th	18th	Highest Hour	99	203	52	50
19th	19th	Highest Hour	90	185	48	45
20th	20th	Highest Hour	36	74	19	18
21st	21st	Highest Hour	27	55	14	14
22nd	22nd	Highest Hour	27	55	14	14
23rd	23rd	Highest Hour	18	37	10	9
24th	24th	Highest Hour	18	37	10	9

Warrant Summary

Warrant	Name	Analyzed?	Met?
#1	Eight-Hour Vehicular Volume	Yes	Yes
#2	Four-Hour Vehicular volume	Yes	Yes
#3	Peak Hour	Yes	Yes
#4	Pedestrian Volume	No	-
#5	School Crossing	No	-
#6	Coordinated Signal System	No	-
#7	Crash Experience	No	-
#8	Readway Network	No	-

Analysis Traffic Volumes

Hour	Begin	End	Major Street		Minor Street	
			EB	WB	NB	SB
5:00 PM	5:00 PM	6:00 PM	901	1846	475	454
2nd	2nd	Highest Hour	865	1772	456	436
3rd	3rd	Highest Hour	847	1735	447	427
4th	4th	Highest Hour	721	1477	380	363
5th	5th	Highest Hour	685	1403	361	345
6th	6th	Highest Hour	613	1255	323	309
7th	7th	Highest Hour	568	1163	299	286
8th	8th	Highest Hour	541	1108	285	272
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10th	10th	Highest Hour	405	831	214	204
11th	11th	Highest Hour	405	831	214	204
12th	12th	Highest Hour	387	794	204	195
13th	13th	Highest Hour	351	720	185	177
14th	14th	Highest Hour	324	665	171	163
15th	15th	Highest Hour	324	665	171	163
16th	16th	Highest Hour	315	646	166	159
17th	17th	Highest Hour	180	369	95	91
18th	18th	Highest Hour	99	203	52	50
19th	19th	Highest Hour	90	185	48	45
20th	20th	Highest Hour	36	74	19	18
21st	21st	Highest Hour	27	55	14	14
22nd	22nd	Highest Hour	27	55	14	14
23rd	23rd	Highest Hour	18	37	10	9
24th	24th	Highest Hour	18	37	10	9

Input Parameters

Volume Adjustment Factor =	1.0
North-South Approach =	Minor
East-West Approach =	Major
Major Street Thru Lanes =	2
Minor Street Thru Lanes =	1
Speed > 40 mph?	No
Population < 10,000?	No
Warrant Factor	100%
Peak Hour or Daily Count?	Peak Hour
Major Street: 4th-Highest Hour / Peak Hour	80%
Major Street: 8th-Highest Hour / Peak Hour	60%
Minor Street: 4th-Highest Hour / Peak Hour	80%
Minor Street: 8th-Highest Hour / Peak Hour	60%



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Project #: 4539
Project Name: Keizer Station Master Plan
Analyst: PML
Date: 9/24/2004
File: G:\projfile\4539\EXCEL\Sig-Warrants\Off-site\September04 Update\Weekday\[ChemRiRol-SigWarrant.xls]Data Input
Intersection: Chemawa Road/Right in-Right out/Left in
Scenario: Year 2008 Weekday PM Peak Hour

Raw Traffic Volumes

Hour	Begin	End	Major Street		Minor Street	
			EB	WB	NB	SB
5:00 PM	5:00 PM	6:00 PM	1159	1968	764	560
2nd	Highest Hour		1113	1889	733	538
3rd	Highest Hour		1089	1850	718	526
4th	Highest Hour		927	1574	611	448
5th	Highest Hour		881	1496	581	426
6th	Highest Hour		788	1338	520	381
7th	Highest Hour		730	1240	481	353
8th	Highest Hour		695	1181	458	336
9th	Highest Hour		556	945	367	269
10th	Highest Hour		522	886	344	252
11th	Highest Hour		522	886	344	252
12th	Highest Hour		498	846	329	241
13th	Highest Hour		452	768	298	218
14th	Highest Hour		417	708	275	202
15th	Highest Hour		417	708	275	202
16th	Highest Hour		406	689	267	196
17th	Highest Hour		232	394	153	112
18th	Highest Hour		127	216	84	62
19th	Highest Hour		116	197	76	56
20th	Highest Hour		46	79	31	22
21st	Highest Hour		35	59	23	17
22nd	Highest Hour		35	59	23	17
23rd	Highest Hour		23	39	15	11
24th	Highest Hour		23	39	15	11

Warrant Summary

Warrant	Name	Analyzed?	Met?
#1	Eight-Hour Vehicular Volume	Yes	Yes
#2	Four-Hour Vehicular volume	Yes	Yes
#3	Peak Hour	Yes	Yes
#4	Pedestrian Volume	No	-
#5	School Crossing	No	-
#6	Coordinated Signal System	No	-
#7	Crash Experience	No	-
#8	Roadway Network	No	-

Analysis Traffic Volumes

Hour	Begin	End	Major Street		Minor Street	
			EB	WB	NB	SB
5:00 PM	5:00 PM	6:00 PM	1159	1968	764	560
2nd	Highest Hour		1113	1889	733	538
3rd	Highest Hour		1089	1850	718	526
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15th	Highest Hour		417	708	275	202
16th	Highest Hour		406	689	267	196
17th	Highest Hour		232	394	153	112
18th	Highest Hour		127	216	84	62
19th	Highest Hour		116	197	76	56
20th	Highest Hour		46	79	31	22
21st	Highest Hour		35	59	23	17
22nd	Highest Hour		35	59	23	17
23rd	Highest Hour		23	39	15	11
24th	Highest Hour		23	39	15	11

Input Parameters

Volume Adjustment Factor =	1.0
North-South Approach =	Minor
East-West Approach =	Major
Major Street Thru Lanes =	2
Minor Street Thru Lanes =	2
Speed > 40 mph?	No
Population < 10,000?	No
Warrant Factor	100%
Peak Hour or Daily Count?	Peak Hour
Major Street: 4th-Highest Hour / Peak Hour	80%
Major Street: 8th-Highest Hour / Peak Hour	60%
Minor Street: 4th-Highest Hour / Peak Hour	80%
Minor Street: 8th-Highest Hour / Peak Hour	60%

Appendix B

Synchro Summary
Analysis Worksheets

Lanes, Volumes, Timings
2: Chemawa Road & McLeod Ln

110 Second Cycle length
Scenario 1



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↙	↑	↗	↙	↕	↕	↙	↗	↗	↙	↗	↙
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	225		0	175		0	125		0	175		0
Storage Lanes	1		0	1		0	1		0	1		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50	50	50		50	50		50	50	
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Satd. Flow (prot)	1770	1863	1583	1770	3440	0	1770	1803	0	1770	1723	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	1863	1583	1770	3440	0	1770	1803	0	1770	1723	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			12		33			11			21	
Link Speed (mph)		35			35			30			30	
Link Distance (ft)		621			454			335			523	
Travel Time (s)		12.1			8.8			7.6			11.9	
Volume (vph)	61	803	14	2	1115	252	8	40	11	87	21	21
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lane Group Flow (vph)	61	803	14	2	1367	0	8	51	0	87	42	0
Turn Type	Prot		Perm	Prot			Prot			Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases			2									
Total Split (s)	10.0	58.0	58.0	8.0	56.0	0.0	8.0	32.0	0.0	12.0	36.0	0.0
Act Effct Green (s)	6.0	78.3	78.3	4.0	71.9		4.0	10.3		7.8	20.5	
Actuated g/C Ratio	0.05	0.71	0.71	0.04	0.65		0.04	0.09		0.07	0.19	
v/c Ratio	0.63	0.61	0.01	0.03	0.60		0.12	0.28		0.69	0.12	
Uniform Delay, d1	52.1	11.6	0.9	54.5	12.9		54.4	36.2		46.9	18.4	
Delay	62.3	11.2	4.9	60.0	2.4		51.6	35.8		59.9	21.3	
LOS	E	B	A	E	A		D	D		E	C	
Approach Delay		14.7			2.4			37.9			47.3	
Approach LOS		B			A			D			D	

Intersection Summary

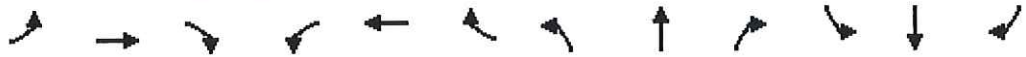
Area Type: Other
 Cycle Length: 110
 Actuated Cycle Length: 110
 Offset: 38 (35%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.69
 Intersection Signal Delay: 10.1 Intersection LOS: B
 Intersection Capacity Utilization 67.1% ICU Level of Service B

Splits and Phases: 2: Chemawa Road & McLeod Ln

↙ ø1	→ ø2	↙ ø3	↓ ø4
8 s	58 s	8 s	36 s
↙ ø5	← ø6	↑ ø8	↙ ø7
10 s	56 s	32 s	12 s

Lanes, Volumes, Timings
3: Chemawa Road & Radiant Dr

110 Second Cycle length
Scenario 1



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↕		↖↗	↕		↖	↕	↗	↖	↕	↗
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	250		0	450		0	175		250	275		300
Storage Lanes	1		0	2		0	1		1	1		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50		50	50	50	50	50	50
Trailing Detector (ft)	0	0		0	0		0	0	0	0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Satd. Flow (prot)	1770	3536	0	3433	3500	0	1770	1863	1583	1770	1863	1583
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	3536	0	3433	3500	0	1770	1863	1583	1770	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1			8				121			114
Link Speed (mph)		35			35			30				30
Link Distance (ft)		215			742			309				308
Travel Time (s)		4.2			14.5			7.0				7.0
Volume (vph)	201	694	6	576	1181	89	1	144	330	134	133	187
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lane Group Flow (vph)	201	700	0	576	1270	0	1	144	330	134	133	187
Turn Type	Prot			Prot			Prot		pm+ov	Prot		pm+ov
Protected Phases	5	2		1	6		3	8	1	7	4	5
Permitted Phases									8			4
Total Split (s)	20.0	38.0	0.0	30.0	48.0	0.0	8.0	23.0	30.0	19.0	34.0	20.0
Act Effct Green (s)	16.0	45.0		22.9	51.9		4.0	13.5	40.4	12.6	28.5	47.7
Actuated g/C Ratio	0.15	0.41		0.21	0.47		0.04	0.12	0.37	0.11	0.26	0.43
v/c Ratio	0.78	0.48		0.81	0.77		0.02	0.63	0.50	0.66	0.28	0.25
Uniform Delay, d1	45.3	26.3		41.4	26.6		54.0	42.9	14.8	46.6	32.5	6.1
Delay	48.7	20.4		34.5	35.5		51.0	45.1	15.4	46.4	31.8	6.5
LOS	D	C		C	D		D	D	B	D	C	A
Approach Delay		26.7			35.2			24.5			25.7	
Approach LOS		C			D			C			C	

Intersection Summary

Area Type: Other

Cycle Length: 110

Actuated Cycle Length: 110

Offset: 24 (22%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.81

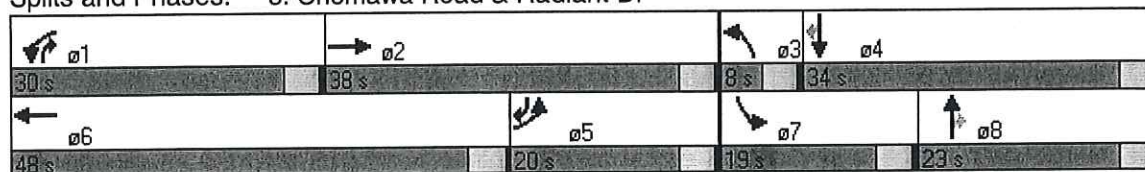
Intersection Signal Delay: 30.5

Intersection LOS: C

Intersection Capacity Utilization 75.0%

ICU Level of Service C

Splits and Phases: 3: Chemawa Road & Radiant Dr



Lanes, Volumes, Timings
4: Chemawa Road & Road A

110 Second Cycle length
Scenario 1



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↙	↑↑	↗	↙	↑↑	↗			↗↗			↗↗
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		200	350		375	0		0	0		0
Storage Lanes	1		1	1		1	0		0	0		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50	50	50	50			50			50
Trailing Detector (ft)	0	0	0	0	0	0			0			0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Satd. Flow (prot)	1770	3539	1583	1770	3539	1583	0	0	2787	0	0	2787
Flt Permitted	0.950			0.950								
Satd. Flow (perm)	1770	3539	1583	1770	3539	1583	0	0	2787	0	0	2787
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			318			473			376			95
Link Speed (mph)		35			45			30			30	
Link Distance (ft)		742			819			459			526	
Travel Time (s)		14.5			12.4			10.4			12.0	
Volume (vph)	93	748	318	210	1285	473	0	0	764	0	0	560
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lane Group Flow (vph)	93	748	318	210	1285	473	0	0	764	0	0	560
Turn Type	Prot		Perm	Prot		Perm			custom			custom
Protected Phases	5	2		1	6				1			5
Permitted Phases			2			6			1			5
Total Split (s)	43.0	70.0	70.0	40.0	67.0	67.0	0.0	0.0	40.0	0.0	0.0	43.0
Act Effct Green (s)	22.7	66.0	66.0	36.0	79.4	79.4			36.0			22.7
Actuated g/C Ratio	0.21	0.60	0.60	0.33	0.72	0.72			0.33			0.21
v/c Ratio	0.25	0.35	0.30	0.36	0.50	0.37			0.66			0.86
Uniform Delay, d1	36.5	11.1	0.0	28.2	6.7	0.0			15.0			34.8
Delay	37.7	6.9	0.5	23.6	2.4	0.4			15.5			34.1
LOS	D	A	A	C	A	A			B			C
Approach Delay		7.6			4.2			15.5			34.1	
Approach LOS		A			A			B			C	

Intersection Summary

Area Type: Other

Cycle Length: 110

Actuated Cycle Length: 110

Offset: 70 (64%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.86

Intersection Signal Delay: 10.8

Intersection LOS: B

Intersection Capacity Utilization 61.8%

ICU Level of Service B

Splits and Phases: 4: Chemawa Road & Road A

→ ø2 70 s	↗ ø1 40 s
↙ ø5 43 s	← ø6 57 s

Lanes, Volumes, Timings
5: Chemawa Road & I-5 SB Ramp

110 Second Cycle length
Scenario 1



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↗	↖	↑↑						↖	↗↗
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		350	275		0	0		0	0		325
Storage Lanes	0		1	1		0	0		0	0		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)		50	50	50	50					50	50	50
Trailing Detector (ft)		0	0	0	0					0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Satd. Flow (prot)	0	3539	1583	1770	3539	0	0	0	0	0	1777	2787
Flt Permitted				0.950							0.954	
Satd. Flow (perm)	0	3539	1583	1770	3539	0	0	0	0	0	1777	2787
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			741									63
Link Speed (mph)		45			45			30				30
Link Distance (ft)		819			838			475				557
Travel Time (s)		12.4			12.7			10.8				12.7
Volume (vph)	0	766	746	225	1588	0	0	0	0	169	5	380
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lane Group Flow (vph)	0	766	746	225	1588	0	0	0	0	0	174	380
Turn Type			Perm	Prot						Split		Perm
Protected Phases		2		1	6					4	4	
Permitted Phases			2									4
Total Split (s)	0.0	47.0	47.0	26.0	73.0	0.0	0.0	0.0	0.0	37.0	37.0	37.0
Act Effct Green (s)		58.4	58.4	22.0	84.5					17.6	17.6	17.6
Actuated g/C Ratio		0.53	0.53	0.20	0.77					0.16	0.16	0.16
v/c Ratio		0.41	0.63	0.64	0.58					0.61	0.76	0.76
Uniform Delay, d1		15.4	0.1	40.3	5.4					43.0	36.6	36.6
Delay		18.0	4.2	49.7	7.6					42.2	36.1	36.1
LOS		B	A	D	A					D	D	D
Approach Delay		11.2			12.8						38.0	
Approach LOS		B			B						D	

Intersection Summary

Area Type: Other

Cycle Length: 110

Actuated Cycle Length: 110

Offset: 83 (75%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.76

Intersection Signal Delay: 15.8

Intersection LOS: B

Intersection Capacity Utilization 78.3%

ICU Level of Service C

Splits and Phases: 5: Chemawa Road & I-5 SB Ramp

→ ø2 47 s	↖ ø1 26 s	↗ ø4 37 s
← ø6 73 s		

Lanes, Volumes, Timings
6: Chemawa Road & I-5 NB Ramp

110 Second Cycle length
Scenario 1



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗			↕		↖	↗	↕			
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		250	0		500	0		0
Storage Lanes	1		0	0		0	0		0	0		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50			50		50	50				
Trailing Detector (ft)	0	0			0		0	0				
Turning Speed (mph)	15		9	15		9	15		9	15		9
Satd. Flow (prot)	1770	3539	0	0	3490	0	3433	1585	0	0	0	0
Flt Permitted	0.950						0.950					
Satd. Flow (perm)	1770	3539	0	0	3490	0	3433	1585	0	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					10			172				
Link Speed (mph)		45			45			30			30	
Link Distance (ft)		838			542			658			555	
Travel Time (s)		12.7			8.2			15.0			12.6	
Volume (vph)	279	656	0	0	724	72	1089	1	172	0	0	0
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lane Group Flow (vph)	279	656	0	0	796	0	1089	173	0	0	0	0
Turn Type	Prot						Split					
Protected Phases	5	2			6		8	8				
Permitted Phases												
Total Split (s)	24.0	64.0	0.0	0.0	40.0	0.0	46.0	46.0	0.0	0.0	0.0	0.0
Act Effct Green (s)	20.0	62.6			38.6		39.4	39.4				
Actuated g/C Ratio	0.18	0.57			0.35		0.36	0.36				
v/c Ratio	0.87	0.33			0.65		0.89	0.26				
Uniform Delay, d1	43.7	12.5			29.5		33.2	0.1				
Delay	57.9	7.1			30.5		33.7	3.6				
LOS	E	A			C		C	A				
Approach Delay		22.2			30.5			29.5				
Approach LOS		C			C			C				

Intersection Summary

Area Type: Other

Cycle Length: 110

Actuated Cycle Length: 110

Offset: 80 (73%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.89

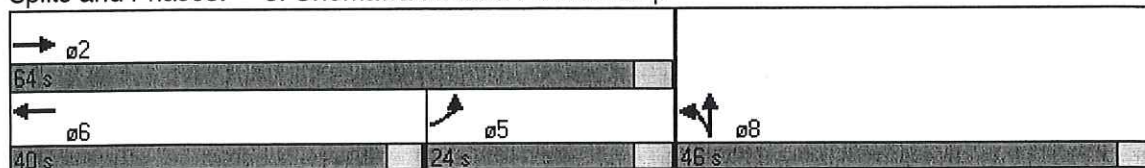
Intersection Signal Delay: 27.5

Intersection LOS: C

Intersection Capacity Utilization 78.8%

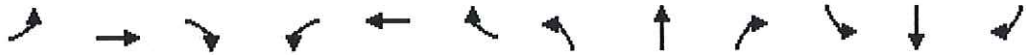
ICU Level of Service C

Splits and Phases: 6: Chemawa Road & I-5 NB Ramp



Lanes, Volumes, Timings
2: Chemawa Road & McLeod Ln

110 Second Cycle length
Scenario 2



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↙	↑	↗	↙	↑↓	↗	↙	↑	↗	↙	↑	↗
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	225		0	175		0	125		0	175		0
Storage Lanes	1		0	1		0	1		0	1		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50	50	50		50	50		50	50	
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Satd. Flow (prot)	1770	1863	1583	1770	3440	0	1770	1803	0	1770	1723	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	1863	1583	1770	3440	0	1770	1803	0	1770	1723	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			12		33			11			21	
Link Speed (mph)		35			35			30			30	
Link Distance (ft)		621			327			335			523	
Travel Time (s)		12.1			6.4			7.6			11.9	
Volume (vph)	61	803	14	2	1115	252	8	40	11	87	21	21
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lane Group Flow (vph)	61	803	14	2	1367	0	8	51	0	87	42	0
Turn Type	Prot		Perm	Prot			Prot			Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases			2									
Total Split (s)	10.0	58.0	58.0	8.0	56.0	0.0	8.0	32.0	0.0	12.0	36.0	0.0
Act Effct Green (s)	6.0	78.3	78.3	4.0	71.9		4.0	10.3		7.8	20.5	
Actuated g/C Ratio	0.05	0.71	0.71	0.04	0.65		0.04	0.09		0.07	0.19	
v/c Ratio	0.63	0.61	0.01	0.03	0.60		0.12	0.28		0.69	0.12	
Uniform Delay, d1	52.1	11.6	0.9	54.5	12.9		54.4	36.2		46.9	18.4	
Delay	62.3	11.2	4.9	68.5	2.4		51.6	35.8		59.9	21.3	
LOS	E	B	A	E	A		D	D		E	C	
Approach Delay		14.7			2.5			37.9			47.3	
Approach LOS		B			A			D			D	

Intersection Summary

Area Type: Other

Cycle Length: 110

Actuated Cycle Length: 110

Offset: 62 (56%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.69

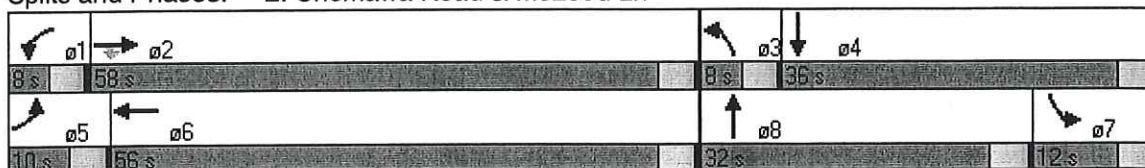
Intersection Signal Delay: 10.1

Intersection LOS: B

Intersection Capacity Utilization 67.1%

ICU Level of Service B

Splits and Phases: 2: Chemawa Road & McLeod Ln



Lanes, Volumes, Timings
3: Chemawa Road & Radiant Dr

110 Second Cycle length
Scenario 2



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↕		↖	↕		↖	↕	↗	↖	↕	↗
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	250		0	450		0	175		250	275		300
Storage Lanes	1		0	2		0	1		1	1		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50		50	50	50	50	50	50
Trailing Detector (ft)	0	0		0	0		0	0	0	0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Satd. Flow (prot)	1770	3536	0	3433	3500	0	1770	1863	1583	1770	1863	1583
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	3536	0	3433	3500	0	1770	1863	1583	1770	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1			8				115			114
Link Speed (mph)		35			35			30			30	
Link Distance (ft)		345			742			309			308	
Travel Time (s)		6.7			14.5			7.0			7.0	
Volume (vph)	201	694	6	576	1181	89	1	144	330	134	133	187
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lane Group Flow (vph)	201	700	0	576	1270	0	1	144	330	134	133	187
Turn Type	Prot			Prot			Prot		pm+ov	Prot		pm+ov
Protected Phases	5	2		1	6		3	8	1	7	4	5
Permitted Phases									8			4
Total Split (s)	20.0	38.0	0.0	30.0	48.0	0.0	8.0	23.0	30.0	19.0	34.0	20.0
Act Effct Green (s)	15.2	44.2		23.7	52.7		4.0	13.5	41.2	12.6	28.5	47.7
Actuated g/C Ratio	0.14	0.40		0.22	0.48		0.04	0.12	0.37	0.11	0.26	0.43
v/c Ratio	0.82	0.49		0.78	0.76		0.02	0.63	0.50	0.66	0.28	0.25
Uniform Delay, d1	46.1	26.9		40.6	25.9		54.0	42.9	14.9	46.6	32.5	7.2
Delay	62.4	23.9		45.8	24.3		51.0	45.1	15.7	46.4	31.8	7.3
LOS	E	C		D	C		D	D	B	D	C	A
Approach Delay		32.5			31.0			24.7			26.0	
Approach LOS		C			C			C			C	

Intersection Summary

Area Type: Other

Cycle Length: 110

Actuated Cycle Length: 110

Offset: 38 (35%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.82

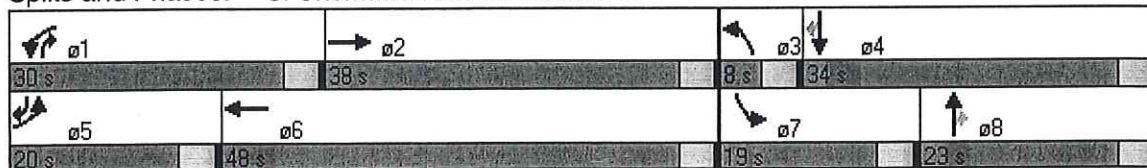
Intersection Signal Delay: 29.9

Intersection LOS: C

Intersection Capacity Utilization 75.0%

ICU Level of Service C

Splits and Phases: 3: Chemawa Road & Radiant Dr



Lanes, Volumes, Timings
4: Chemawa Road & Road A

110 Second Cycle length
Scenario 2



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↙	↕	↘	↙	↕	↘			↗			↗
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		200	350		375	0		0	0		0
Storage Lanes	1		1	1		1	0		0	0		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50	50	50	50			50			50
Trailing Detector (ft)	0	0	0	0	0	0			0			0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Satd. Flow (prot)	1770	3539	1583	1770	3539	1583	0	0	2787	0	0	2787
Flt Permitted	0.950			0.950								
Satd. Flow (perm)	1770	3539	1583	1770	3539	1583	0	0	2787	0	0	2787
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			318			473			376			95
Link Speed (mph)		35			45			30			30	
Link Distance (ft)		742			819			459			526	
Travel Time (s)		14.5			12.4			10.4			12.0	
Volume (vph)	93	748	318	210	1285	473	0	0	764	0	0	560
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lane Group Flow (vph)	93	748	318	210	1285	473	0	0	764	0	0	560
Turn Type	Prot		Perm	Prot		Perm			custom			custom
Protected Phases	5	2		1	6				1			5
Permitted Phases			2			6			1			5
Total Split (s)	43.0	70.0	70.0	40.0	67.0	67.0	0.0	0.0	40.0	0.0	0.0	43.0
Act Effct Green (s)	22.6	79.0	79.0	22.9	79.4	79.4			22.9			22.6
Actuated g/C Ratio	0.21	0.72	0.72	0.21	0.72	0.72			0.21			0.21
v/c Ratio	0.26	0.29	0.26	0.57	0.50	0.37			0.87			0.87
Uniform Delay, d1	36.6	5.5	0.0	39.1	6.7	0.0			20.9			34.8
Delay	32.0	5.8	0.7	43.0	3.6	0.4			20.1			34.3
LOS	C	A	A	D	A	A			C			C
Approach Delay		6.5			7.1			20.1			34.3	
Approach LOS		A			A			C			C	

Intersection Summary

Area Type: Other

Cycle Length: 110

Actuated Cycle Length: 110

Offset: 56 (51%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.87

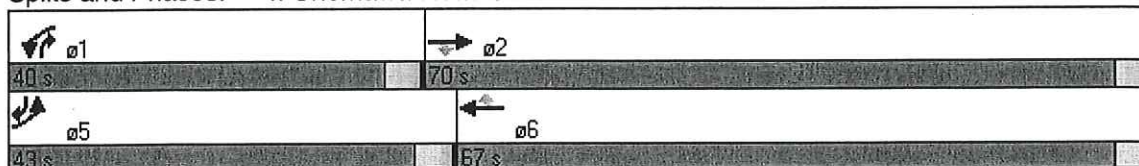
Intersection Signal Delay: 12.6

Intersection LOS: B

Intersection Capacity Utilization 61.8%

ICU Level of Service B

Splits and Phases: 4: Chemawa Road & Road A



Lanes, Volumes, Timings
5: Chemawa Road & I-5 SB Ramp

110 Second Cycle length
Scenario 2



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↑	↘	↑↑						↘	↑↑
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		350	275		0	0		0	0		325
Storage Lanes	0		1	1		0	0		0	0		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)		50	50	50	50					50	50	50
Trailing Detector (ft)		0	0	0	0					0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Satd. Flow (prot)	0	3539	1583	1770	3539	0	0	0	0	0	1777	2787
Flt Permitted				0.950							0.954	
Satd. Flow (perm)	0	3539	1583	1770	3539	0	0	0	0	0	1777	2787
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			741									63
Link Speed (mph)		45			45			30				30
Link Distance (ft)		819			838			475				557
Travel Time (s)		12.4			12.7			10.8				12.7
Volume (vph)	0	766	746	225	1588	0	0	0	0	169	5	380
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lane Group Flow (vph)	0	766	746	225	1588	0	0	0	0	169	174	380
Turn Type			Perm	Prot						Split		Perm
Protected Phases		2		1	6					4	4	
Permitted Phases			2									4
Total Split (s)	0.0	47.0	47.0	26.0	73.0	0.0	0.0	0.0	0.0	37.0	37.0	37.0
Act Effct Green (s)		63.3	63.3	17.2	84.5					17.6	17.6	17.6
Actuated g/C Ratio		0.58	0.58	0.16	0.77					0.16	0.16	0.16
v/c Ratio		0.38	0.61	0.82	0.58					0.61	0.76	0.76
Uniform Delay, d1		12.7	0.1	44.8	5.4					43.0	36.6	36.6
Delay		13.4	3.6	50.0	0.5					42.2	36.1	36.1
LOS		B	A	D	A					D	D	D
Approach Delay		8.5			6.7					38.0		38.0
Approach LOS		A			A					D		D

Intersection Summary:

Area Type: Other

Cycle Length: 110

Actuated Cycle Length: 110

Offset: 53 (48%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.82

Intersection Signal Delay: 11.9

Intersection LOS: B

Intersection Capacity Utilization 78.3%

ICU Level of Service C

Splits and Phases: 5: Chemawa Road & I-5 SB Ramp

↘ φ1 26 s	→ φ2 47 s	↘ φ4 37 s
← φ6 73 s		

Lanes, Volumes, Timings
6: Chemawa Road & I-5 NB Ramp

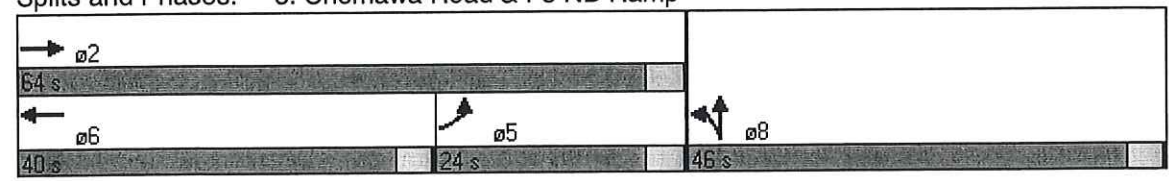
110 Second Cycle length
Scenario 2



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↙	↕			↕		↖	↕				
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		250	0		500	0		0
Storage Lanes	1		0	0		0	0		0	0		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50			50		50	50				
Trailing Detector (ft)	0	0			0		0	0				
Turning Speed (mph)	15		9	15		9	15		9	15		9
Satd. Flow (prot)	1770	3539	0	0	3490	0	3433	1585	0	0	0	0
Flt Permitted	0.950						0.950					
Satd. Flow (perm)	1770	3539	0	0	3490	0	3433	1585	0	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					10			172				
Link Speed (mph)		45			45			30				30
Link Distance (ft)		838			542			658				555
Travel Time (s)		12.7			8.2			15.0				12.6
Volume (vph)	279	656	0	0	724	72	1089	1	172	0	0	0
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lane Group Flow (vph)	279	656	0	0	796	0	1089	173	0	0	0	0
Turn Type	Prot						Split					
Protected Phases	5	2			6		8	8				
Permitted Phases												
Total Split (s)	24.0	64.0	0.0	0.0	40.0	0.0	46.0	46.0	0.0	0.0	0.0	0.0
Act Effct Green (s)	20.0	62.6			38.6		39.4	39.4				
Actuated g/C Ratio	0.18	0.57			0.35		0.36	0.36				
v/c Ratio	0.87	0.33			0.65		0.89	0.26				
Uniform Delay, d1	43.7	12.5			29.5		33.2	0.1				
Delay	53.0	8.3			30.5		33.7	3.6				
LOS	D	A			C		C	A				
Approach Delay		21.6			30.5			29.5				
Approach LOS		C			C			C				

Intersection Summary
 Area Type: Other
 Cycle Length: 110
 Actuated Cycle Length: 110
 Offset: 38 (35%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.89
 Intersection Signal Delay: 27.3 Intersection LOS: C
 Intersection Capacity Utilization 78.8% ICU Level of Service C

Splits and Phases: 6: Chemawa Road & I-5 NB Ramp



Lanes, Volumes, Timings
2: Chemawa Road & McLeod Ln

130 Second Cycle length
Scenario 1

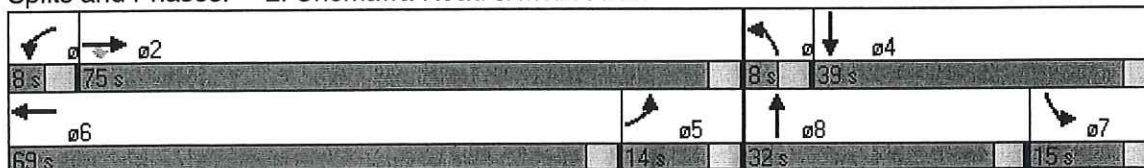


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↑	↗	↖	↑↓	↗	↖	↑	↗	↖	↑	↗
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	225		0	175		0	125		0	175		0
Storage Lanes	1		0	1		0	1		0	1		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50	50	50		50	50		50	50	
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Satd. Flow (prot)	1770	1863	1583	1770	3440	0	1770	1803	0	1770	1723	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	1863	1583	1770	3440	0	1770	1803	0	1770	1723	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			12		30			10			21	
Link Speed (mph)		35			35			30			30	
Link Distance (ft)		621			454			335			523	
Travel Time (s)		12.1			8.8			7.6			11.9	
Volume (vph)	61	803	14	2	1115	252	8	40	11	87	21	21
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lane Group Flow (vph)	61	803	14	2	1367	0	8	51	0	87	42	0
Turn Type	Prot		Perm	Prot			Prot			Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases			2									
Total Split (s)	14.0	75.0	75.0	8.0	69.0	0.0	8.0	32.0	0.0	15.0	39.0	0.0
Act Effct Green (s)	10.0	95.9	95.9	4.0	86.2		4.0	10.6		10.0	23.0	
Actuated g/C Ratio	0.08	0.74	0.74	0.03	0.66		0.03	0.08		0.08	0.18	
v/c Ratio	0.45	0.58	0.01	0.04	0.60		0.15	0.33		0.64	0.13	
Uniform Delay, d1	57.0	11.1	0.9	64.5	15.6		64.5	45.1		55.2	22.3	
Delay	58.1	10.4	4.5	85.0	2.5		61.8	44.3		58.4	25.4	
LOS	E	B	A	F	A		E	D		E	C	
Approach Delay		13.6			2.6			46.6			47.6	
Approach LOS		B			A			D			D	

Intersection Summary

Area Type: Other
 Cycle Length: 130
 Actuated Cycle Length: 130
 Offset: 90 (69%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.64
 Intersection Signal Delay: 10.0
 Intersection Capacity Utilization 67.1%
 Intersection LOS: B
 ICU Level of Service B

Splits and Phases: 2: Chemawa Road & McLeod Ln



Lanes, Volumes, Timings
3: Chemawa Road & Radiant Dr

130 Second Cycle length
Scenario 1



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	250		0	450		0	175		250	275		300
Storage Lanes	1		0	2		0	1		1	1		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50		50	50	50	50	50	50
Trailing Detector (ft)	0	0		0	0		0	0	0	0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Satd. Flow (prot)	1770	3536	0	3433	3500	0	1770	1863	1583	1770	1863	1583
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	3536	0	3433	3500	0	1770	1863	1583	1770	1863	1583
Right Turn on Red		Yes			Yes			Yes			Yes	
Satd. Flow (RTOR)		1			8			149				102
Link Speed (mph)		35			35			30			30	
Link Distance (ft)		215			742			309			308	
Travel Time (s)		4.2			14.5			7.0			7.0	
Volume (vph)	201	694	6	576	1181	89	1	144	330	134	133	187
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lane Group Flow (vph)	201	700	0	576	1270	0	1	144	330	134	133	187
Turn Type	Prot			Prot			Prot	pm+ov	Prot		pm+ov	
Protected Phases	5	2		1	6		3	8	1	7	4	5
Permitted Phases								8				4
Total Split (s)	26.0	56.0	0.0	34.0	64.0	0.0	8.0	20.0	34.0	20.0	32.0	26.0
Act Effct Green (s)	22.0	59.7		26.5	64.3		4.0	13.9	40.4	13.8	30.1	55.3
Actuated g/C Ratio	0.17	0.46		0.20	0.49		0.03	0.11	0.31	0.11	0.23	0.43
v/c Ratio	0.67	0.43		0.82	0.73		0.02	0.72	0.55	0.71	0.31	0.26
Uniform Delay, d1	50.6	25.8		49.5	28.4		64.0	56.2	11.6	53.1	41.3	9.0
Delay	45.9	20.3		38.9	34.8		61.0	56.0	11.6	56.0	41.2	9.4
LOS	D	C		D	C		E	E	B	E	D	A
Approach Delay		26.1			36.1			25.2			32.5	
Approach LOS		C			D			C			C	

Intersection Summary

Area Type: Other

Cycle Length: 130

Actuated Cycle Length: 130

Offset: 62 (48%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.82

Intersection Signal Delay: 31.8

Intersection LOS: C

Intersection Capacity Utilization 75.0%

ICU Level of Service C

Splits and Phases: 3: Chemawa Road & Radiant Dr

ø1 34 s	ø2 56 s	ø3 8 s	ø4 32 s
ø6 64 s	ø5 26 s	ø8 20 s	ø7 20 s

Lanes, Volumes, Timings
4: Chemawa Road & Road A

130 Second Cycle length
Scenario 1



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗	↘	↖	↗	↘	↖	↗	↘	↖	↗	↘
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		200	350		375	0		0	0		0
Storage Lanes	1		1	1		1	0		0	0		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50	50	50	50			50			50
Trailing Detector (ft)	0	0	0	0	0	0			0			0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Satd. Flow (prot)	1770	3539	1583	1770	3539	1583	0	0	2787	0	0	2787
Flt Permitted	0.950			0.950								
Satd. Flow (perm)	1770	3539	1583	1770	3539	1583	0	0	2787	0	0	2787
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			318			473			285			89
Link Speed (mph)		35			45			30			30	
Link Distance (ft)		742			819			459			526	
Travel Time (s)		14.5			12.4			10.4			12.0	
Volume (vph)	93	748	318	210	1285	473	0	0	764	0	0	560
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lane Group Flow (vph)	93	748	318	210	1285	473	0	0	764	0	0	560
Turn Type	Prot		Perm	Prot		Perm			custom			custom
Protected Phases	5	2		1	6				1			5
Permitted Phases			2			6			1			5
Total Split (s)	53.0	71.0	71.0	59.0	77.0	77.0	0.0	0.0	59.0	0.0	0.0	53.0
Act Effct Green (s)	31.4	67.0	67.0	55.0	90.6	90.6			55.0			31.4
Actuated g/C Ratio	0.24	0.52	0.52	0.42	0.70	0.70			0.42			0.24
v/c Ratio	0.22	0.41	0.33	0.28	0.52	0.38			0.57			0.76
Uniform Delay, d1	39.4	19.3	0.0	24.5	9.4	0.0			16.8			38.1
Delay	27.4	15.4	1.4	26.3	10.7	2.3			18.9			31.2
LOS	C	B	A	C	B	A			B			C
Approach Delay		12.5			10.4			18.9			31.2	
Approach LOS		B			B			B			C	

Intersection Summary

Area Type: Other

Cycle Length: 130

Actuated Cycle Length: 130

Offset: 117 (90%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.76

Intersection Signal Delay: 15.0

Intersection LOS: B

Intersection Capacity Utilization 61.8%

ICU Level of Service B

Splits and Phases: 4: Chemawa Road & Road A

→ ø2	↖ ø1
71 s	59 s
↘ ø5	← ø6
53 s	77 s

Lanes, Volumes, Timings
5: Chemawa Road & I-5 SB Ramp

130 Second Cycle length
Scenario 1



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↑	↖	↖	↑↑					↑	↑↑
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		350	275		0	0		0	0		325
Storage Lanes	0		1	1		0	0		0	0		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)		50	50	50	50					50	50	50
Trailing Detector (ft)		0	0	0	0					0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Satd. Flow (prot)	0	3539	1583	1770	3539	0	0	0	0	0	1777	2787
Flt Permitted				0.950							0.954	
Satd. Flow (perm)	0	3539	1583	1770	3539	0	0	0	0	0	1777	2787
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			722									76
Link Speed (mph)		45			45			30				30
Link Distance (ft)		819			838			475				557
Travel Time (s)		12.4			12.7			10.8				12.7
Volume (vph)	0	766	746	225	1588	0	0	0	0	169	5	380
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lane Group Flow (vph)	0	766	746	225	1588	0	0	0	0	174	5	380
Turn Type			Perm	Prot						Split		Perm
Protected Phases		2		1	6					4	4	
Permitted Phases			2									4
Total Split (s)	0.0	57.0	57.0	33.0	90.0	0.0	0.0	0.0	0.0	40.0	40.0	40.0
Act Effct Green (s)		78.0	78.0	20.8	102.8					19.2	19.2	19.2
Actuated g/C Ratio		0.60	0.60	0.16	0.79					0.15	0.15	0.15
v/c Ratio		0.36	0.60	0.80	0.57					0.66	0.80	0.80
Uniform Delay, d1		13.3	0.3	52.5	5.2					52.3	42.5	42.5
Delay		13.3	3.7	62.5	0.1					51.5	41.9	41.9
LOS		B	A	E	A					D	D	D
Approach Delay		8.6			7.8					44.9		44.9
Approach LOS		A			A					D		D

Intersection Summary

Area Type: Other

Cycle Length: 130

Actuated Cycle Length: 130

Offset: 17 (13%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.80

Intersection Signal Delay: 13.4

Intersection LOS: B

Intersection Capacity Utilization 78.3%

ICU Level of Service C

Splits and Phases: 5: Chemawa Road & I-5 SB Ramp

↖ ø1 33 s	→ ø2 57 s	↖ ø4 40 s
← ø6 90 s		

Lanes, Volumes, Timings
6: Chemawa Road & I-5 NB Ramp

130 Second Cycle length
Scenario 1

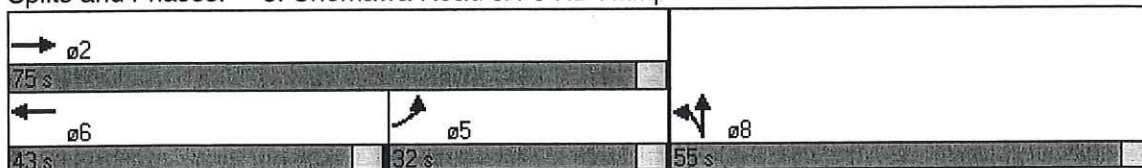


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗			↖	↗	↖	↗				
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		250	0		500	0		0
Storage Lanes	1		0	0		0	0		0	0		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50			50		50	50				
Trailing Detector (ft)	0	0			0		0	0				
Turning Speed (mph)	15		9	15		9	15		9	15		9
Satd. Flow (prot)	1770	3539	0	0	3490	0	3433	1585	0	0	0	0
Flt Permitted	0.950						0.950					
Satd. Flow (perm)	1770	3539	0	0	3490	0	3433	1585	0	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					8			172				
Link Speed (mph)		45			45			30				30
Link Distance (ft)		838			542			658				555
Travel Time (s)		12.7			8.2			15.0				12.6
Volume (vph)	279	656	0	0	724	72	1089	1	172	0	0	0
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lane Group Flow (vph)	279	656	0	0	796	0	1089	173	0	0	0	0
Turn Type	Prot						Split					
Protected Phases	5	2			6		8	8				
Permitted Phases												
Total Split (s)	32.0	75.0	0.0	0.0	43.0	0.0	55.0	55.0	0.0	0.0	0.0	0.0
Act Effct Green (s)	28.0	75.8			43.8		46.1	46.1				
Actuated g/C Ratio	0.22	0.58			0.34		0.35	0.35				
v/c Ratio	0.73	0.32			0.67		0.89	0.26				
Uniform Delay, d1	47.5	13.8			36.5		39.6	0.2				
Delay	48.2	11.3			37.8		39.3	3.8				
LOS	D	B			D		D	A				
Approach Delay		22.4			37.8			34.5				
Approach LOS		C			D			C				

Intersection Summary

Area Type:	Other
Cycle Length:	130
Actuated Cycle Length:	130
Offset:	0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow
Control Type:	Actuated-Coordinated
Maximum v/c Ratio:	0.89
Intersection Signal Delay:	31.6
Intersection Capacity Utilization:	78.8%
Intersection LOS:	C
ICU Level of Service:	C

Splits and Phases: 6: Chemawa Road & I-5 NB Ramp



Lanes, Volumes, Timings
2: Chemawa Road & McLeod Ln

130 Second Cycle length
Scenario 2



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	225		0	175		0	125		0	175		0
Storage Lanes	1		0	1		0	1		0	1		0
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50	50	50		50	50		50	50	
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	
Turning Speed (mph)	15		9	15		9	15		9	15		9
Satd. Flow (prot)	1770	1863	1583	1770	3440	0	1770	1803	0	1770	1723	0
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	1863	1583	1770	3440	0	1770	1803	0	1770	1723	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			12		30			10			21	
Link Speed (mph)		35			35			30			30	
Link Distance (ft)		621			454			335			523	
Travel Time (s)		12.1			8.8			7.6			11.9	
Volume (vph)	61	803	14	2	1115	252	8	40	11	87	21	21
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lane Group Flow (vph)	61	803	14	2	1367	0	8	51	0	87	42	0
Turn Type	Prot		Perm	Prot			Prot			Prot		
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases			2									
Total Split (s)	14.0	75.0	75.0	8.0	69.0	0.0	8.0	32.0	0.0	15.0	39.0	0.0
Act Effct Green (s)	8.8	95.9	95.9	4.0	86.6		4.0	10.6		10.0	23.0	
Actuated g/C Ratio	0.07	0.74	0.74	0.03	0.67		0.03	0.08		0.08	0.18	
v/c Ratio	0.51	0.58	0.01	0.04	0.59		0.15	0.33		0.64	0.13	
Uniform Delay, d1	59.6	11.1	0.9	64.5	13.9		64.5	45.1		55.2	22.3	
Delay	58.4	10.4	4.5	70.5	2.3		61.8	44.3		58.4	25.4	
LOS	E	B	A	E	A		E	D		E	C	
Approach Delay		13.6			2.4			46.6			47.6	
Approach LOS		B			A			D			D	

Intersection Summary

Area Type: Other

Cycle Length: 130

Actuated Cycle Length: 130

Offset: 35 (27%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.64

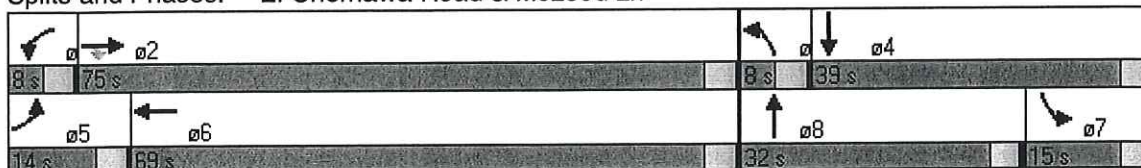
Intersection Signal Delay: 9.9

Intersection LOS: A

Intersection Capacity Utilization 67.1%

ICU Level of Service B

Splits and Phases: 2: Chemawa Road & McLeod Ln



Lanes, Volumes, Timings
3: Chemawa Road & Radiant Dr

130 Second Cycle length
Scenario 2



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗		↖	↗	↖	↗	↖	↗
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	250		0	450		0	175		250	275		300
Storage Lanes	1		0	2		0	1		1	1		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50		50	50		50	50	50	50	50	50
Trailing Detector (ft)	0	0		0	0		0	0	0	0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Satd. Flow (prot)	1770	3536	0	3433	3500	0	1770	1863	1583	1770	1863	1583
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	3536	0	3433	3500	0	1770	1863	1583	1770	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		1			8				139			102
Link Speed (mph)		35			35			30				30
Link Distance (ft)		215			742			309				308
Travel Time (s)		4.2			14.5			7.0				7.0
Volume (vph)	201	694	6	576	1181	89	1	144	330	134	133	187
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lane Group Flow (vph)	201	700	0	576	1270	0	1	144	330	134	133	187
Turn Type	Prot			Prot			Prot		pm+ov	Prot		pm+ov
Protected Phases	5	2		1	6		3	8	1	7	4	5
Permitted Phases									8			4
Total Split (s)	26.0	56.0	0.0	34.0	64.0	0.0	8.0	20.0	34.0	20.0	32.0	26.0
Act Effect Green (s)	18.4	58.4		27.9	67.8		4.0	13.9	45.8	13.8	30.1	52.6
Actuated g/C Ratio	0.14	0.45		0.21	0.52		0.03	0.11	0.35	0.11	0.23	0.40
v/c Ratio	0.80	0.44		0.78	0.69		0.02	0.72	0.51	0.71	0.31	0.27
Uniform Delay, d1	53.9	26.8		48.1	25.6		64.0	53.1	16.8	56.2	41.3	11.1
Delay	64.5	20.8		50.4	20.5		61.0	56.0	17.9	56.0	41.2	10.6
LOS	E	C		D	C		E	E	B	E	D	B
Approach Delay		30.6			29.8			29.5			32.9	
Approach LOS		C			C			C			C	

Intersection Summary

Area Type: Other

Cycle Length: 130

Actuated Cycle Length: 130

Offset: 22 (17%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.80

Intersection Signal Delay: 30.4

Intersection LOS: C

Intersection Capacity Utilization 75.0%

ICU Level of Service C

Splits and Phases: 3: Chemawa Road & Radiant Dr

↖ ø1 64 s	→ ø2 56 s	↖ ø3 8 s	↓ ø4 32 s
↗ ø5 26 s	← ø6 64 s	↗ ø7 20 s	↑ ø8 20 s

Lanes, Volumes, Timings
5: Chemawa Road & I-5 SB Ramp

130 Second Cycle length
Scenario 2



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑	↑	↖	↖	↑↑					↖	↖↖
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		350	275		0	0		0	0		325
Storage Lanes	0		1	1		0	0		0	0		1
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)		50	50	50	50					50	50	50
Trailing Detector (ft)		0	0	0	0					0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Satd. Flow (prot)	0	3539	1583	1770	3539	0	0	0	0	0	1777	2787
Flt Permitted				0.950							0.954	
Satd. Flow (perm)	0	3539	1583	1770	3539	0	0	0	0	0	1777	2787
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			722									76
Link Speed (mph)		45			45			30				30
Link Distance (ft)		819			838			475				557
Travel Time (s)		12.4			12.7			10.8				12.7
Volume (vph)	0	766	746	225	1588	0	0	0	0	169	5	380
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lane Group Flow (vph)	0	766	746	225	1588	0	0	0	0	0	174	380
Turn Type			Perm	Prot						Split		Perm
Protected Phases		2		1	6					4	4	
Permitted Phases			2									4
Total Split (s)	0.0	57.0	57.0	33.0	90.0	0.0	0.0	0.0	0.0	40.0	40.0	40.0
Act Effct Green (s)		78.0	78.0	20.8	102.8					19.2	19.2	
Actuated g/C Ratio		0.60	0.60	0.16	0.79					0.15	0.15	
v/c Ratio		0.36	0.60	0.80	0.57					0.66	0.80	
Uniform Delay, d1		13.3	0.3	52.5	5.2					52.3	42.5	
Delay		16.6	5.7	62.5	0.1					51.5	41.9	
LOS		B	A	E	A					D	D	
Approach Delay		11.2			7.8					44.9		
Approach LOS		B			A					D		

Intersection Summary

Area Type: Other
 Cycle Length: 130
 Actuated Cycle Length: 130
 Offset: 46 (35%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow
 Control Type: Actuated-Coordinated
 Maximum v/c Ratio: 0.80
 Intersection Signal Delay: 14.4
 Intersection LOS: B
 Intersection Capacity Utilization 78.3%
 ICU Level of Service C

Splits and Phases: 5: Chemawa Road & I-5 SB Ramp

↖ φ1 33 s	→ φ2 57 s	↖ φ4 40 s
← φ6 90 s		

