City of Oregon City

Molalla Avenue Boulevard and Bikeway Improvements Plan

January 2001

ADOPTED by Oregon City Commission,
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WE #1077A

WALLIS ENGINEERING

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Chapter 1 Introduction

BACKGROUND AND PURPOSE OF THE PLAN

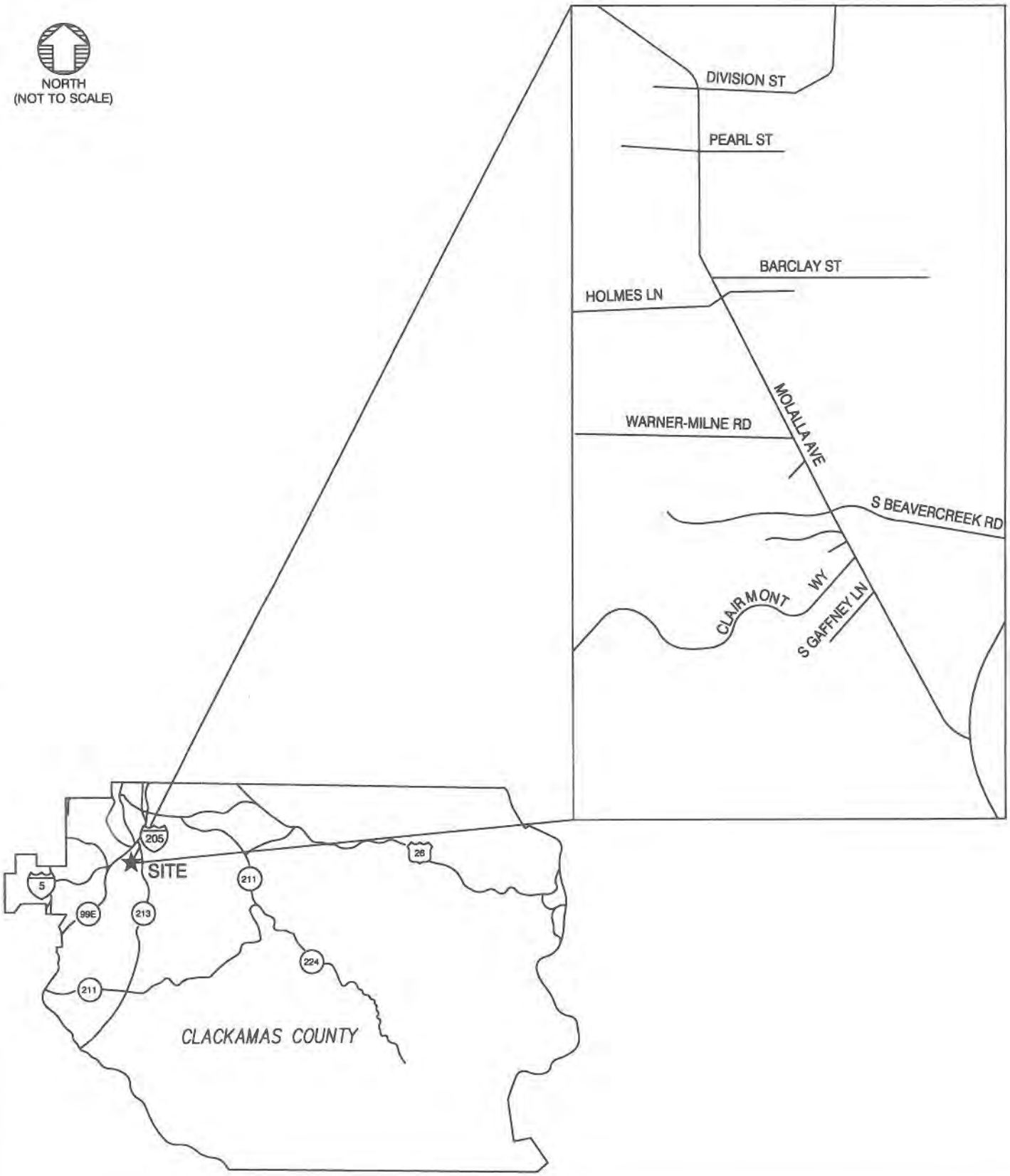
Recent growth has resulted in an increase in travel demand through Oregon City and heightened the need for a safe and efficient transportation system for all travel modes, as well as for efficient access strategies to properties and connecting local streets. These factors have combined to place significant demands on several of Oregon City's key transportation system links, resulting in congestion and unacceptable levels of service. They have made planning for the future travel demand along these corridors a priority for both the City and regional jurisdictions.

Molalla Avenue is a key arterial within the City. (See Figure 1 on the following page for a vicinity map of the area.) Combined with Singer Hill and 7th Street, Molalla Avenue creates the most important north-south arterial connection between I-205, Highway 99E, downtown Oregon City, and all regions of southern Oregon City to its terminus at Highway 213.

Historic development along the Molalla Avenue corridor has resulted in a mixture of adjacent land uses, geometric roadway configurations and streetscape characteristics. New development and the associated services needed to provide for the growth in population and employment throughout the Oregon City region have increased the demands placed on Molalla Avenue and heightened the need for improved roadway facilities, multi-modal enhancements, and associated streetscape improvements.

To address these transportation system needs, the Molalla Avenue Boulevard and Bikeway Improvements Plan project was initiated. The Plan identifies regional, local, and neighborhood needs and objectives for the corridor and serves to integrate and coordinate those needs into an overall vision. The objective of the study was to produce a set of corridor-specific strategies for roadway improvements, streetscape enhancement, multi-modal improvement, utility and pavement upgrade and rehabilitation, and access enhancement and efficiency projects. The plan includes specific recommendations for the provision and maintenance of safe and efficient facilities and services for public transportation, private automobile, and pedestrian and bicycle travel modes. The approach used to develop the final Molalla Avenue Boulevard and Bikeway Improvements Plan consisted of the following steps:

- Development of overall guiding principles and vision for the corridor
- Inventory and evaluation of existing conditions
- Identification of existing deficiencies and issues
- Projections of the twenty-year demands and needs of the corridor
- Development of preliminary corridor strategies and alternatives
- Formulation of the preferred strategies and alternatives into a systematic plan



Site Vicinity Map

Figure 1

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Molalla Avenue Boulevard and Bikeway Improvements Plan

Oregon City, Oregon

Study Goals, Objectives, and Guiding Principles

At the onset of this planning effort, study goals and objectives were developed by the consultant and City staff team. The goals and objectives evolved throughout the course of the project to reflect the understanding gained from information gathered and input from the public involvement process. The refined study goals and objectives that guided the development of the Molalla Avenue Boulevard and Bikeway Improvements Plan are summarized as follows:

1. Implement Metro Regional Street Design Standards throughout the corridor.
2. Maximize and/or improve roadway vehicular capacity, traffic operations, and safety along the Molalla Avenue corridor.
3. Enhance and encourage options for multi-modal travel along the corridor.
4. Develop a strategic pedestrian system improvement plan for the corridor to deal with existing deficiencies and comply with the Metro Transit/Mixed Use Main Street corridor designation.
5. Enhance the capacity, safety, and aesthetics of the bicycle facilities along corridor (by providing on-street striped bicycle lanes).
6. Develop an implementable streetscape improvement plan (including landscaping, median, street lighting, and other streetscape treatments) to enhance the aesthetic environment along the corridor.
7. Develop strategic access efficiency and enhancement goals and objectives for the corridor.
8. Develop a strategic plan to upgrade the existing pavement structure meet current and future needs.
9. Develop an improvement plan for the storm drainage system in conjunction with the roadway surfacing and landscaping improvement projects.
10. Develop a strategic plan for upgrading existing underground utilities and relocating overhead utilities underground.
11. Plan for traffic signal improvements (geometric, operational) to upgrade the existing signal system and accommodate the new roadway configuration.

Guiding Vision for the Molalla Avenue Corridor

Based on the previous planning work conducted for the Oregon City Transportation System Plan (TSP), numerous discussions with City Public Works and Planning staff, and through the public involvement process, an overall vision for the Molalla Avenue corridor was established to guide the development of the specific improvement projects recommended as part of this plan. The guiding vision for the corridor formed the foundation upon which improvement alternatives were judged and identified improvement projects were selected. The elements of the guiding vision for the corridor can be separated into six basic components: roadway capacity, streetscape environment, pedestrian and bicycle enhancements, access enhancements, drainage and utilities, and pavement.

Roadway Capacity

The vision for the roadway improvement element of the Molalla Avenue Boulevard and Bikeway Improvements Plan identified the objectives of providing and maintaining adequate capacity and mobility for all roadway users (vehicles, pedestrian, and cyclists). The physical and operational

characteristics of Molalla Avenue depended upon enhancing multi-modal travel and developing a livable Main Street environment with mixed-use, transit-oriented, and community business land uses. As such, the vision for the corridor recognizes that accepting a higher level of congestion for vehicular operations along the facility is a feasible policy decision that can be made by the community in order to achieve the overall transportation and land use goals for the corridor.

Streetscape Environment

Streetscape improvement recommendations were based upon the objective of improving the scenic and aesthetic quality of the corridor. The vision for the corridor included the provision of street furniture, median treatments, landscaping treatments, and other pedestrian and bicycle amenities to enhance the aesthetics of the corridor and foster a pedestrian- and bicycle-friendly environment. Landscaping treatments focused upon providing street trees which would create a "ribbon of greenery" along the corridor.

Pedestrian and Bicycle Enhancements

The key objective in the development of the recommended pedestrian and bicycle system improvement projects was to ensure a connected, efficient, pleasurable, and safe environment for pedestrians and cyclists. The guiding vision for the Molalla Avenue corridor includes the development of adjacent land uses that are non-auto mode-oriented and accessible, and the development of a corridor where walking and cycling are viable, efficient modes of travel. The vision for the corridor included the provision of improved crosswalks (both mid-block and at intersections), median treatments, on-street striped bicycle lanes, and street lighting to foster a pedestrian- and bicycle-friendly environment.

Access Enhancements

Access efficiency and enhancement improvements were developed based on the desire to balance the mobility and accessibility needs of through traffic, localized traffic, and pedestrians and bicyclists on the street network. The primary objectives of the access improvement recommendations were to prioritize safety for all roadway users, maximize the access efficiency to and from facilities and adjacent land uses, and maximize roadway capacity and traffic operations. In addition, the access efficiency and enhancement policies were developed to complement the livability and streetscape vision for the corridor, such as fostering a pedestrian and bicycle friendly environment and encourage the development of a pedestrian and transit-oriented Main Street atmosphere.

Drainage and Utilities

The guiding vision for the drainage and utilities aspect of the study is to provide direction for replacement or addition of drainage facilities that will provide both quantity and quality improvements over the existing system. While most of the corridor has existing facilities, continued development in and around the corridor will necessitate upgrades.

Pavement

As Molalla Avenue becomes a more important part of the City of Oregon City's transportation system, it is essential that the basic structural soundness of the pavement be maintained and improved. One of the goals of this study is to provide a plan to provide for the rehabilitation of the existing pavement to a 20-year structural life.

SUMMARY

The development of the Molalla Avenue Boulevard and Bikeway Improvements Plan was a collaborative process between the consultant team and City of Oregon City staff, with input from the public, undertaken with the goal of developing a systematic plan for implementing improvements along the Molalla Avenue corridor consistent with the goals outlined under the desired vision for the facility and surrounding community. The improvement plan will result in a facility that serves to meet the City's operational, safety, and functional transportation needs as well as the goals for aesthetics, mobility, accessibility, multi-modal enhancement, and land use development. The overall corridor plan was developed to reflect the community's character and the goals and objectives that were outlined at the beginning of this transportation planning process.

The plan covers Molalla Avenue from Harrison Street south to Highway 213. Occasionally within the text or figures, a shorter title – The Molalla Avenue Improvements Plan -- for the document is used. This shorter name is equivalent to this document, the Molalla Avenue Boulevard and Bikeway Improvements Plan.

Chapter 2 Existing Conditions Analysis

INTRODUCTION

This chapter defines the existing conditions of the corridor. These existing conditions include the character of the existing corridor and surrounding land uses, transportation facilities, traffic system conditions, corridor access, streetscape evaluation, existing pavement condition, drainage and other utilities. In addition, this chapter identifies existing opportunities and constraints available to the corridor. These existing conditions are the basis for developing improvement alternatives as outlined in Chapter 4.

CLASSIFICATIONS AND DESIGNATIONS

Roadway Classification

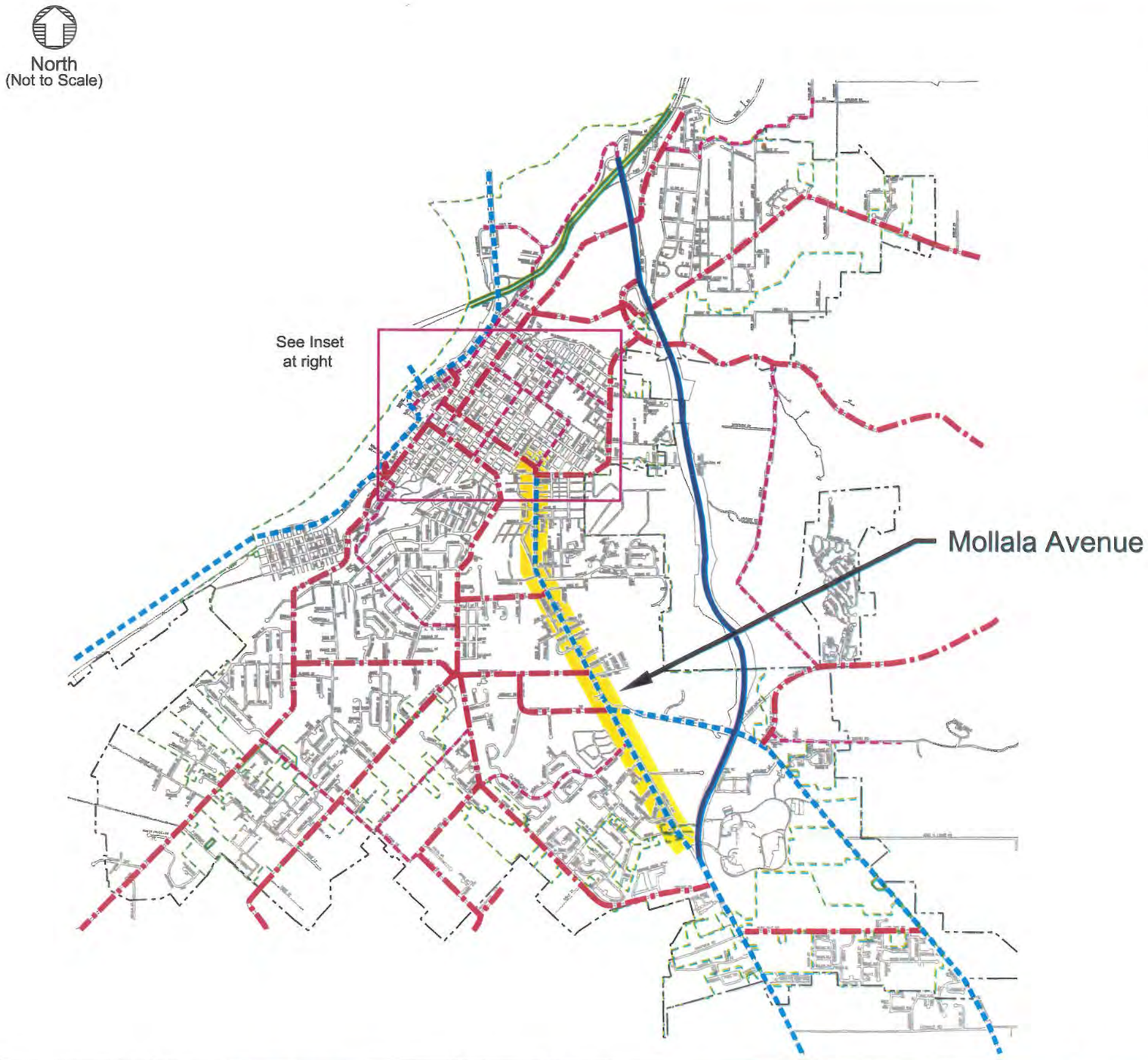
Roadway systems hierarchy and classification are based on two major roadway characteristics: access and mobility. Higher order facilities, such as freeways and highways, are intended to function as high speed and high volume (i.e., high mobility) roadways. As such, they typically offer very limited access to lower order facilities and adjacent local land uses (i.e., low accessibility). Conversely, the primary function of lower order facilities, such as collector and local streets, is to provide a high degree of accessibility, with less emphasis on mobility and capacity of operations. The existing functional classification system of the roadways within the City of Oregon City is illustrated in Figure 2, shown on the following page.

As can be seen in Figure 2, the City of Oregon City classifies Molalla Avenue as a *Major Arterial*. It traverses north-south through the center of Oregon City and provides the key connection from downtown and the 7th Street corridor to areas in southern Oregon City, finally terminating at Highway 213 and the Clackamas Community College. Metro has also designated Molalla Avenue as a *Major Arterial* and a *Regional Street* in its Regional Transportation Plan. In addition, Metro has identified the Molalla Avenue corridor as a *Regional Bus Route*, a *Community Connector*, and a *Transit/Mixed Use Corridor* in its Regional Public Transportation System, Bicycle System, and Pedestrian System plans, respectively (all included in Metro's Regional Transportation Plan, Reference 1 of Appendix H).

Bicycle Designation

Metro has designated the 7th Street-Molalla Avenue corridor as a *Community Connector* in the Regional Bicycle System Plan.

The City of Oregon City's 1994 Bicycle Plan identified Molalla Avenue as a primary corridor serving many destinations in all areas southeast in the City. The plan recommended the incorporation of five to six-foot bike lanes along all segments of Molalla Avenue (from 7th Street to Highway 213). It identified a planning-level cost estimate for this bicycle system improvement project of approximately $25,000 to $30,000 for signing and striping.



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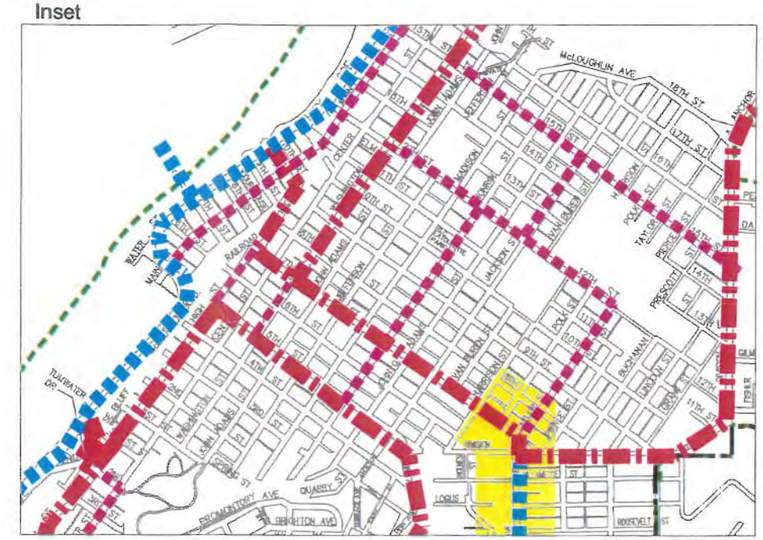

Downtown Oregon City

Legend

- Freeway
- Expressway
- Major Arterial
- Minor Arterial
- Collector
- Oregon City Limits
- Urban Growth Boundary
- Project Corridor

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Existing Corridor Character and Surrounding Land Uses

Molalla Avenue is a classic suburban commercial corridor that evolved in response to a rapidly suburbanizing metropolitan area. Although the corridor does vary significantly along its length, it is characterized by:

- Unsightly above ground utilities and street lights.
- Numerous large free-standing and portable signs.
- Few street trees or other landscape improvements.
- A proliferation of closely and unevenly spaced driveway access points.
- A streetscape dominated by large expanses of unscreened, or poorly screened parking areas, particularly in the central portion of the corridor.

For the purposes of this plan, the corridor was divided into three segments which vary substantially by character and surrounding land uses: 1) North Segment (Harrison Street to Warner-Milne Road), 2) Central Segment (Warner-Milne Road to Beavercreek Road), and 3) South Segment (Beavercreek road to Highway 213), described below (see Figure 3 for schematic map of Molalla Avenue).

North Segment – Harrison Street to Warner-Milne Road

The character of the North Segment of Molalla Avenue reflects the fact that it developed at a much earlier date than the remaining segments of the corridor. The parcels of property adjacent to Molalla Avenue are zoned commercial, and the existing development consists of a mix of small, older commercial buildings and single family residences. This area originally developed as a two-lane road within a 60-foot right-of-way. As Oregon City grew, the street was widened to four lanes to increase the vehicular capacity. In doing so, many of the buildings on either side of the street remained, as did the original 60-foot right-of-way. The end result is a corridor segment which primarily serves as a conduit for motor vehicles. There are sidewalks on both sides of the street through this segment, but they are relatively narrow and obstructed by utility poles. The restricted right-of-way has provided limited opportunities for street trees, multi-modal, or other aesthetic improvements.

Central Segment - Warner-Milne Road to Beavercreek Road

Large shopping malls and automobile dependent commercial establishments dominate the character of the Central Segment of the corridor. In light of the fact that the roadway accommodates traffic between Warner-Milne Road, Beavercreek Road, and the adjacent commercial centers, as well as Molalla Avenue through traffic, it is wider than the North and South Segments – maintaining a five-lane cross-section (two travel lanes in each direction plus a center left-turn lane). Also, it has a wider right-of-way. Narrow sidewalks are provided along both sides of the street through this segment.

South Segment - Beavercreek Road to Highway 213

The South Segment is the most recent to develop. In this segment, there are several large undeveloped parcels. Parcels are larger in this area. Although adjacent property is zoned commercial, its current use is a mix of commercial and residential. This is the least traveled segment. Sidewalks are absent in a few locations along its length.

EXISTING TRANSPORTATION FACILITIES

Roadway Facilities

At the north end of the corridor, as it transitions from 7th Street, Molalla Avenue maintains one travel lane in each direction. The roadway widens just to the south of Division Street to a four-lane cross-section (two travel lanes in each direction) and continues with this configuration until its intersection with Warner-Milne Road. At the Warner-Milne Road intersection the roadway widens to provide two travel lanes in each direction plus a two-way left-turn lane. This configuration continues south to Beavercreek Road. South of the Beavercreek Road intersection the southbound lanes taper down to one travel lane. By the Clairmont Way intersection, the northbound direction also tapers to one travel lane. The three-lane cross-section is maintained until Molalla Avenue's terminus at Highway 213/Clackamas Community College.

Key intersections and cross streets along the length of the Molalla Avenue study corridor include Division Street, Pearl Street, Barclay Hills Drive, Hilda Street-Holmes Lane, Warner-Milne Road, Hilltop Mall, Beavercreek Road, Clairmont Way-Fred Meyer Access, Gaffney Lane, and Highway 213. The local streets (Division Street, Pearl Street, Barclay Hills Drive, Hilda Street-Holmes Lane, Clairmont Way, and Gaffney Lane) provide connections to the residential Oregon City neighborhoods to the east and west of the corridor. Molalla Avenue also provides access to adjacent commercial and retail developments (Hilltop Mall, Fred Meyer). The intersections with other arterial streets (Holmes Lane, Warner-Milne Road, Beavercreek Road, and Highway 213) provide connectivity from the Molalla Avenue corridor to other regions of Oregon City and areas beyond.

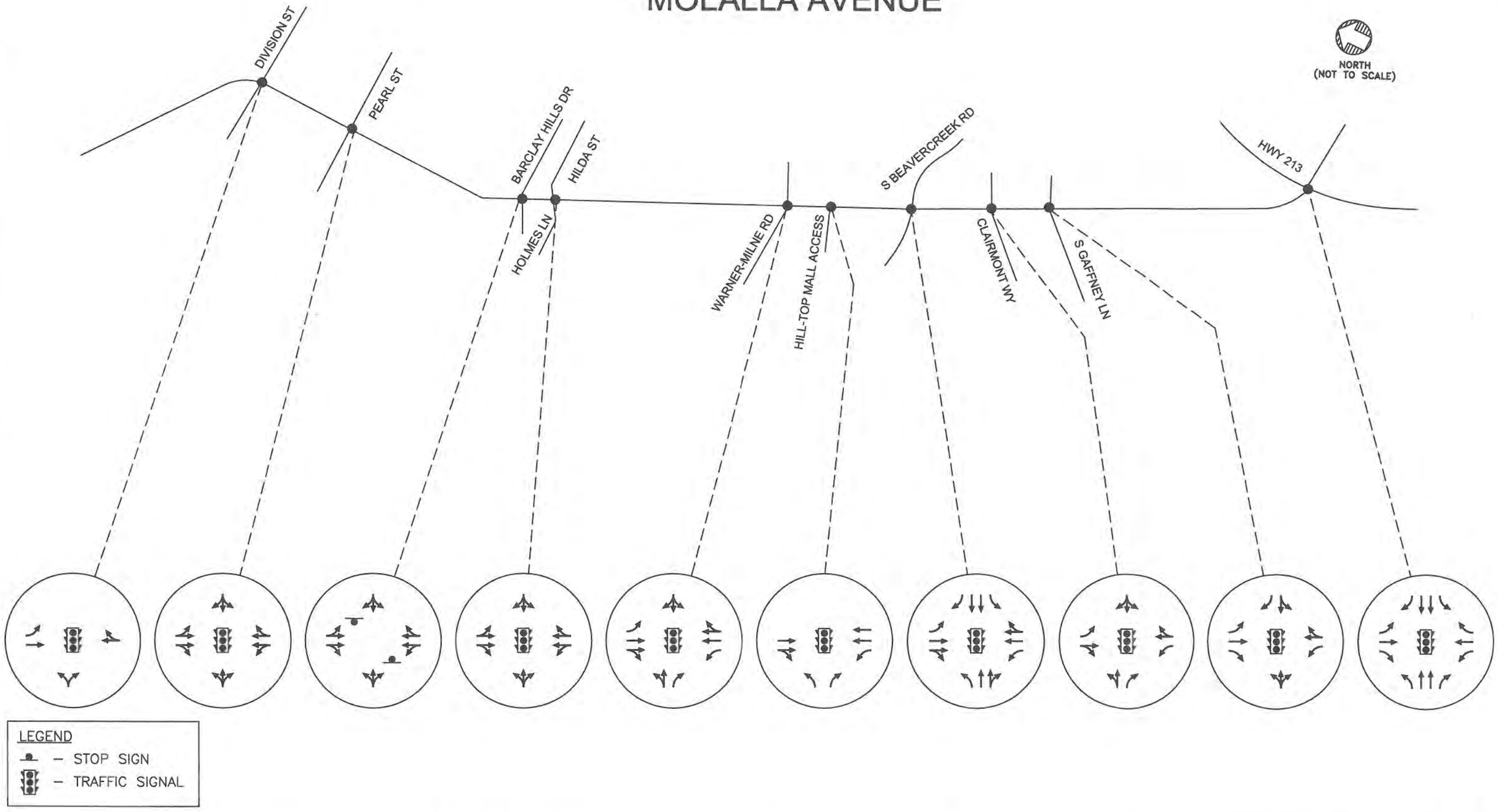
Along the Molalla Avenue corridor signalized intersections currently exist at Division Street, Pearl Street, Holmes Lane-Hilda Street, Warner-Milne Road, Hilltop Mall, Beavercreek Road, Clairmont Way-Fred Meyer Access, Gaffney Lane, and Highway 213. The remainder of the intersections and access points along Molalla Avenue are currently stop-controlled on the minor street approaches. Figure 3 illustrates the existing lane configurations and traffic control devices at the key intersections along the Molalla Avenue corridor chosen for inclusion in this study. Figure 4 presents an aerial photograph view of each of the study intersections.

Pedestrian Facilities

A detailed streetscape evaluation summarized in Appendix B shows that except for small gaps at the south end, sidewalks extend on both sides the full length of Molalla Avenue. However, the existing pedestrian environment suffers from non-standardized treatment and several gaps in pedestrian system connectivity. There are also many driveways and access points that create the possibility for pedestrian-vehicle conflict. Utility poles are positioned in the middle of the existing sidewalks, conflicting with pedestrian movements and distracting from the general aesthetic environment. Buffers between the pedestrian facilities and traffic flow on Molalla Avenue are generally non-existent. Sidewalks meet traditional minimum standards, but not current ADA standards. The surrounding street grid is considerably deficient in sidewalks. Molalla Avenue south of Warner-Milne has long stretches without intersecting streets, which limits opportunities for connectivity.

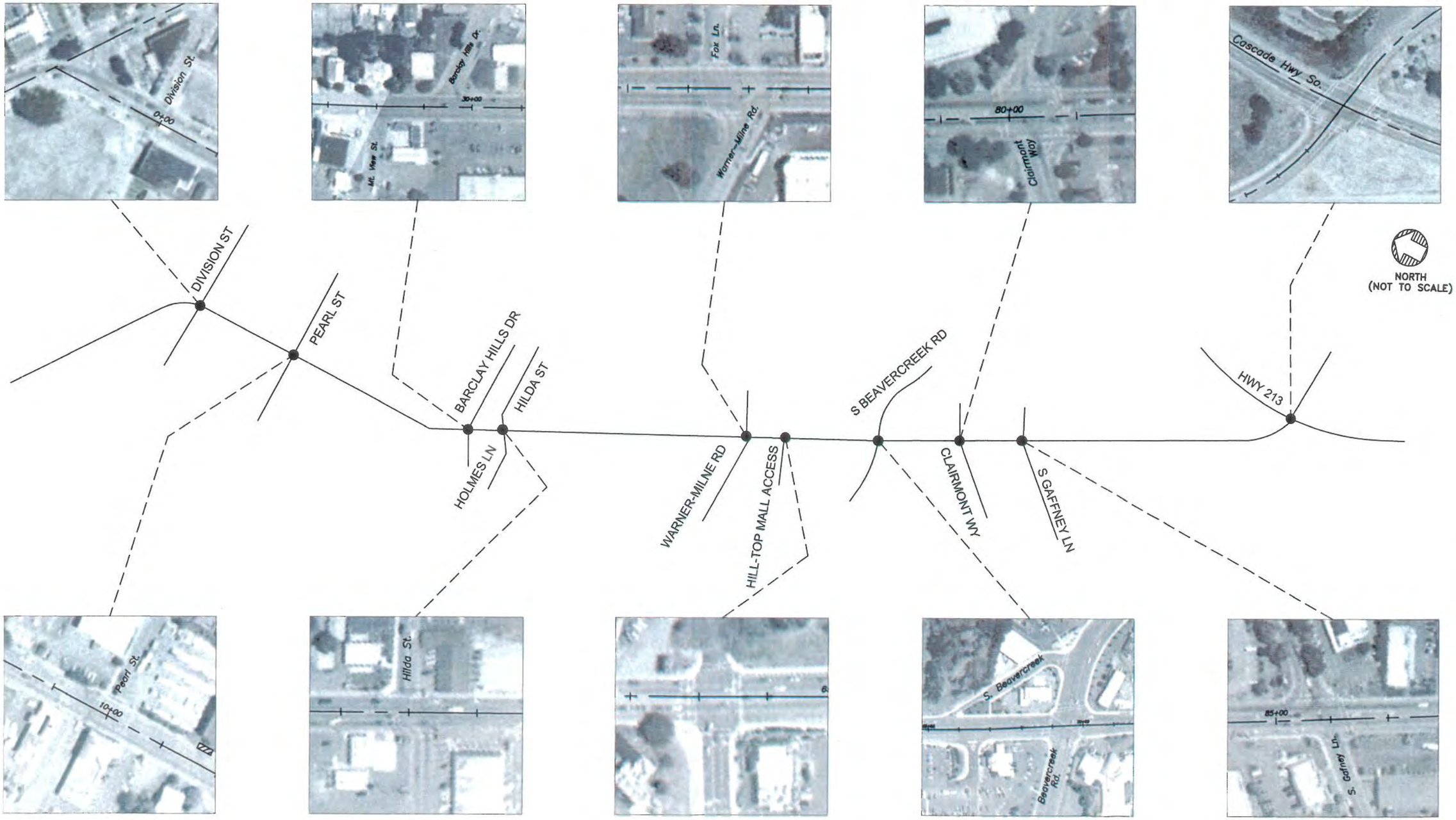
From limited field observations, it can be concluded that pedestrian activity on Molalla Avenue is quite limited, particularly south of Beavercreek Road.

MOLALLA AVENUE



January 2001 | Job 1077A	WALLIS ENGINEERING in association with GREENWORKS, Kittelson & Associates	Molalla Avenue Boulevard and Bikeway Improvements Plan Oregon City, Oregon	Existing Lane Configurations and Traffic Control Devices	Figure 3

MOLALLA AVENUE



January 2001 | Job 1077A	WALLIS ENGINEERING in association with GREENWORKS, Kittelson & Associates	Molalla Avenue Boulevard and Bikeway Improvements Plan Oregon City, Oregon	Existing Intersection Aerial Views	Figure 4

Bicycle Facilities

Currently no striped bike lanes exist anywhere in the corridor. Similar to the pedestrian activity observations, existing bicycle activity levels along the corridor appear to be extremely low. In addition to the non-existent bicycle facilities along the corridor itself, the surrounding street grid is not conducive to bicycle traffic. Due to topographic constraints and the existing street grid itself, bicycle movement from the southern area of the study to the northern 7th Street/Singer Hill area outside of Molalla Avenue is very difficult.

Public Transit Facilities

Along the Molalla Avenue corridor, public transit service is provided by Tri-Met, the primary transit provider for the entire Portland metropolitan area. Tri-Met operates inter-city bus routes to major Oregon City transit passenger generators and transit connections for the remainder of the metro area, via the Oregon City Transit Center. Tri-Met bus routes are highly visible throughout the greater Portland metropolitan area. Almost all routes are accessible to physically challenged and senior transit riders, with the only exceptions being some express routes. Those buses that are not accessible are currently being phased out of Tri-Met's fleet, and Tri-met will provide alternative transportation to any disabled or senior riders who need to use an inaccessible bus route. Tri-Met serves Oregon City with seven bus routes that converge at the Oregon City Transit Center to allow passengers to transfer between routes.

Along the Molalla Avenue study corridor, Tri-Met currently operates three bus routes:

Route 32: Oatfield — This route provides local service within Oregon City to Clackamas Community College and the Hilltop Mall area, as well as intercity service north to Gladstone, the Milwaukie Transit Center via Oatfield Road, and continues to downtown Portland via McLoughlin Boulevard during peak hours. Service is provided on weekdays and evenings, with the limited local service provided on Saturdays as well. Within Oregon City, the route serves the Oregon City Shopping Center, Oregon City Transit Center, downtown, 9th Street, Oregon City High School, Willamette Falls Community Hospital, and Molalla Avenue to Hilltop Mall. The route branches at Hilltop Mall, with some buses continuing to Clackamas Community College via Beavercreek Road, the Berry Hill Center, and Highway 213, and the others looping through the Hilltop area past the City Hall of Oregon City, Warner-Milne Road, Central Point Road, Partlow Road, South End Road, Telford Road, and Warner-Parrott Road. Service to the Hilltop Loop ("The Local") was added in September 1997 as a result of Tri-Met's Transit Choices for Livability Program. Some runs between the Oregon City Transit Center and the Hilltop Loop use minibuses rather than the usual 40-foot buses. Average travel times from the Oregon City Transit Center are: 18 minutes to Clackamas Community College, 25 minutes to the Milwaukie Transit Center, and 50 minutes to downtown Portland.

Route 33: McLoughlin — Route 33 is the trunk line for the east side of the Willamette River, connecting Clackamas Community College, downtown Oregon City, Milwaukie, and downtown Portland via McLoughlin Blvd. Service is provided weekdays, evenings, nights, and weekends. Within Oregon City, the route serves the Oregon City Shopping Center, downtown, 5th Avenue, Linn Avenue, the Hilltop Mall, Molalla Avenue south of Beavercreek Road, and Clackamas Community College. Average travel times from the Oregon City Transit Center are: 20 minutes to Clackamas Community College, 25 minutes to the Milwaukie Transit Center, and 45 minutes to downtown Portland.

Route 99X: McLoughlin Express — Route 99X provides peak hour, peak direction express service between Clackamas Community College, the Oregon City Transit Center, Milwaukie Transit Center,

and downtown Portland via McLoughlin Boulevard. Buses stop within Oregon City at Clackamas Community College, Molalla Avenue at Clairmont Way, and the Oregon City Transit Center. Average travel times from the Oregon City Transit Center are 12 minutes to Clackamas Community College and 35-40 minutes to downtown Portland.

Table 2-1 summarizes service frequencies for bus routes serving Molalla Avenue in Oregon City.

Table 2-1. Molalla Avenue Corridor Tri-Met Service Frequencies (minutes)

Route Number & Name	Peak	Midday	Evening	Night	Saturday	Sunday
32: Oatfield	15-20	30/60*	30**	30	15-60***	10-30***
33: McLoughlin	10-15	30	30	60	30	60
99X: McLoughlin Express	15-30	—	—	—	—	—

— No service
* 30-minute service between Oregon City TC and Molalla Avenue/Warner-Milne Road; 60-minute service from Clackamas Community College and Hilltop Loop
** 60-minute frequency on Hilltop Loop
*** 60-minute service from Clackamas Community College and Hilltop Loop
Peak: 6-9 a.m. and 3-6 p.m. Frequencies shown are for the peak direction.
Midday: 9 a.m. to 3 p.m.
Evening: 6-8 p.m.
Night: 8 p.m.-midnight

There is a Tri-Met Park-n-Ride facility located at the Clackamas Community College (40 spaces) at the southern end of the study corridor. Field observations revealed that the college park-and-ride lot is poorly signed and is approximately a 5-minute walk from the transit stop. Because the park-and-ride is a small portion of a larger, well-used lot, it is difficult to determine the park-and-ride usage at this location. Tri-Met has also recently obtained permission from the City of Oregon City to use a portion of a municipal lot downtown near the transit center as a park-and-ride. Users of this lot need to obtain a special windshield sticker in advance. This downtown lot provides 20 spaces and currently has about seven users.

Transit stop activity numbers for Molalla Avenue were obtained from a Tri-Met survey conducted in the spring of 2000. Average weekday boarding and alighting data for all bus stops along Molalla Avenue were provided and reviewed. The data indicates that, on an average weekday, the bus stops along Molalla Avenue serve a total of approximately 180 passenger movements (74 boardings and 107 alightings) for all Tri-Met routes traveling along the corridor. The transit stops with the most activity were located at Beavercreek Road (4 boardings and 24 alightings), Holmes Lane (5 boardings and 22 alightings), and Hilda Street (18 boardings and 8 alightings).

Preliminary discussions with Tri-Met staff identified no locations where either intersection operations or roadway design hampered transit operations. Tri-Met staff did identify that a lack of sidewalks serving many Oregon City bus stops was an obstacle to transit usage.

Transportation Facilities Summary

The City of Oregon City classifies Molalla Avenue as a *Major Arterial*. Through the study corridor the cross-section of the roadway varies between three and five lanes. There are nine signalized intersections along the study corridor occurring at Division Street, Pearl Street, Holmes Lane-Hilda Street, Warner-Milne Road, Hilltop Mall Access, Beavercreek Road, Clairmont Way, Gaffney Lane, and

Highway 213. Currently sidewalks are provided along both sides of the street for the majority of corridor. No on-street striped bicycle lanes are provided under existing conditions.

Table 2-2 presents a summary of the existing transportation facilities and amenities within the study corridor.

Table 2-2. Existing Transportation Facilities and Amenities

Street	Classification	Cross Section*	Posted Speed	Sidewalks	Bike Lanes	On-Street Parking	Tri-Met Service
Molalla Avenue	Major Arterial	4-5 lanes	35 mph	Yes	No	No	Yes
Division Street	Local Street	2 lanes	25 mph	Partial	No	Yes	Yes
Pearl Street	Local Street	2 lanes	25 mph	North Side	No	Yes	No
Barclay Hills Dr	Local Street	2 lanes	25 mph	Yes	No	Yes	No
Holmes Lane/ Hilda St	Minor Arterial/ Local Street	2 lanes	25 mph	North Side	No	No	No
Warner-Milne Rd	Minor Arterial	3 lanes	30 mph	Yes	No	No	Yes
Hilltop Mall	Local Access	N/A	15 mph	Yes	No	N/A	Yes
Beavercreek Rd	Major Arterial	5 lanes	35 mph	Partial	Partial	No	Yes
Clairmont Way	Collector	2 lanes	25 mph	Partial	Yes	Yes	No
Caffney Lane-Fred Meyer	Local Street	2 lanes	25 mph	Yes	No	No	No
Highway 213	Expressway/ Major Arterial	5 lanes	55 mph	No	Yes	No	Yes

*Indicates cross-section in the vicinity of Molalla Avenue.

EXISTING TRAFFIC OPERATIONS

Existing Traffic Volumes

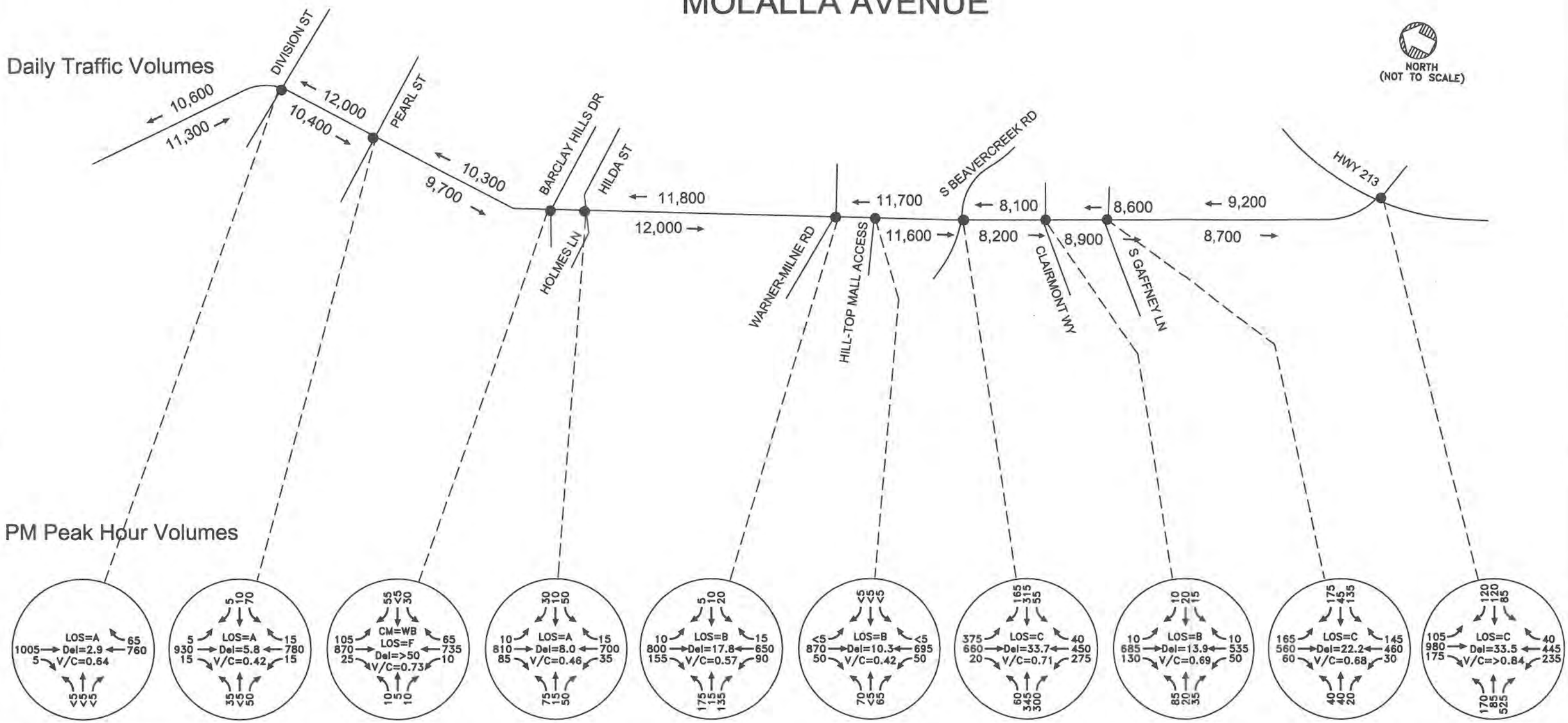
In order to develop a better understanding of the existing transportation system, both daily and weekday p.m. peak hour traffic counts along the study corridor were collected.

Existing Daily Traffic Volumes

The City of Oregon City conducted a series of daily traffic counts between March and May of 2000. The City placed tube counters at 14 locations along the Molalla Avenue corridor and provided the results of the data collection effort for use in this study process. A summary of the collected daily traffic volumes is provided in graphical form in Figure 5.

As shown in Figure 5, toward the north end of the study corridor (Harrison Street) Molalla Avenue is currently carrying approximately 11,300 vehicles in the southbound direction and 10,600 vehicles in the northbound direction on an average weekday (for a total of 21,900 vehicles per day). The most active portion of the corridor is between Holmes Lane and Beavercreek Road (in the vicinity of Warner-Milne Road and the Hilltop Mall). This segment carries between approximately 11,600 and 12,000 vehicles in the southbound direction and approximately 11,800 vehicles in the northbound direction on a daily basis (for a total of 23,800 vehicles per day). A 24-hour daily traffic volume profile for this section of Molalla Avenue on an average weekday is presented in Figure D-1 in Appendix D. By the southern terminus of the Molalla Avenue corridor, at its intersection with Highway 213, the average daily traffic volumes decrease to approximately 8,700 vehicles in the southbound direction and 9,200 vehicles in the northbound direction (for a total of 17,900 vehicles per day).

MOLALLA AVENUE



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

January 2001 | Job 1077A	WALLIS ENGINEERING in association with GREENWORKS, Kittelson & Associates	Molalla Avenue Boulevard and Bikeway Improvements Plan Oregon City, Oregon	Existing Weekday Daily Traffic Volumes and PM Peak Hour Traffic Conditions	Figure 5

Existing Weekday PM Peak Hour Traffic Volumes

Based on the daily traffic data information, discussions with City of Oregon City staff, and standard engineering practice, the average weekday p.m. peak hour period (which is also the daily peak hour period) was used to evaluate existing traffic operations along the study corridor. In addition to the weekday daily traffic volume data obtained from the City of Oregon City, average weekday manual turning movement counts were conducted at the study intersections on a typical weekday in June 2000. From these counts, the average weekday p.m. peak hour was determined to occur from approximately 4:30 p.m. to 5:30 p.m. Therefore, the traffic operational analysis described in this report focused on the average weekday p.m. peak hour of traffic flow on the transportation system. Figure 5 presents the average weekday p.m. peak hour traffic volumes at the study intersections along the Molalla Avenue corridor. Appendix D includes the peak period traffic volume data used for this analysis.

Existing Weekday PM Peak Hour Operational Levels of Service (LOS)

All level of service (LOS) analysis described in this report was performed in accordance with the procedures outlined in the *1997 Highway Capacity Manual* (Reference 2, Appendix H). A description of level of service and the criteria by which they are determined is presented in Appendix D. This description also indicates how level of service is measured and what is generally considered the acceptable range of level of service. Current City of Oregon City standards indicate that, typically, LOS "A" through "D" are acceptable for signalized intersection operations and LOS "A" through "E" are acceptable for unsignalized intersection operations. To ensure that the analysis was based on a reasonable worst-case scenario, the peak 15-minute flow rate during the study period was used in the evaluation of all intersection levels of service. For this reason, the analysis reflects conditions that are only likely to occur for 15 minutes out of each average weekday. Traffic operations during all other time periods will likely be better than those described in this report.

The existing weekday p.m. peak hour levels of service for the study intersections are also summarized in Figure 5. For signalized intersections the intersection volume-to-capacity ratio, average delay, and corresponding level of service are shown. For unsignalized intersections the critical approach, volume-to-capacity ratio of the critical approach, average delay for the critical approach, and corresponding level-of-service are shown.

As Figure 5 shows, all of the study intersections currently operate at acceptable levels of service during the average weekday p.m. peak hour, with the exception of the Molalla Avenue/Barclay Hills Drive intersection. The minor street approaches (i.e., Barclay Hills Drive) at this unsignalized intersection were found to operate with relatively long delays, resulting in level of service "F" during the peak 15 minute period. However, the analysis also showed that the existing p.m. peak volume-to-capacity ratio for the critical movement at this location is 0.73, indicating that the intersection operates under capacity during the peak period and that there are enough acceptable gaps in the mainline (Molalla Avenue) traffic flow to accommodate the minor street traffic demand. In addition, a specific signal warrant analysis revealed that Manual on Uniform Traffic Devices (MUTCD) (Reference 3, Appendix H) signal warrants are not met at this location under current conditions. Appendix D includes the level of service and signal warrant analysis worksheets.

It should be noted that although the operational analysis found the Molalla Avenue/Warner-Milne Road intersection to operate at an acceptable level of service, field observations revealed that the minor street approaches at this location (i.e., Warner-Milne Road and Fox Lane) are experiencing

relatively long delays and queues during the peak hour periods. This is due to the existing offset intersection alignment and split-phased traffic signal timing at this location.

Existing Traffic Safety Conditions

In addition to the traffic operational analysis, a safety evaluation for the study corridor was also conducted. The crash history of the study intersections and the Molalla Avenue corridor was examined in order to identify any existing safety issues and concerns. ODOT provided historical data that summarized all reported accidents along the corridor occurring in the three-year period between January 1, 1997 and December 31, 1999 in terms of both crash severity and type. This data was further reduced in order to isolate individual roadway segments and intersections within the study area.

Table 2-3 summarizes the crash history along Molalla Avenue with respect to both crash severity and type.

Table 2-3. Molalla Avenue Safety History – 1/1/1997 to 12/31/1999

	Crash Severity			Crash Type				
Intersection	PDO[1]	Injury	Fatal	Turning	Rear-End	Fixed Object	Other	Total
Division Street/Molalla Avenue	2	2	0	3	0	0	1	4
Pearl Street/Molalla Avenue	0	0	0	0	0	0	0	0
Barclay Hills Drive/Molalla Avenue	1	2	0	0	3	0	0	3
Holmes Lane-Hilda St/Molalla Ave	12	8	0	10	6	0	4	20
Warner-Milne Road/Molalla Avenue	8	13	0	6	14	0	1	21
Hilltop Mall/Molalla Avenue	1	1	0	2	0	0	0	2
Beavercreek Road/Molalla Avenue	15	14	0	10	12	0	7	29
Clairmont Way/Molalla Avenue	5	6	0	3	7	0	1	11
Gaffney Lane/Molalla Avenue	3	5	0	4	3	0	1	8
Highway 213/Molalla Avenue	2	5	0	6	1	0	0	7
Total	**49**	**56**	**0**	**44**	**46**	**0**	**15**	**105**

(1) PDO = Property Damage Only

As Table 2-3 indicates, during the 36-month period under review, a total of 105 crashes were reported along Molalla Avenue. While 56 of these crashes involved personal injury, there were no reported fatalities. Further evaluation of the reported crash locations revealed that the majority of the crashes occurring along Molalla Avenue could be attributed to conflicts in or around an intersection, with rear-end crashes being the most common type of crash occurring.

The crash history data was then used to examine individual crash rates for the study intersections along the Molalla Avenue corridor. Table 2-4 presents the crash rates for the study intersections. Intersection crash rates are expressed in terms of the number of *crashes per million entering vehicles (crashes/mev)*. Generally, a crash rate higher that 1.00 crashes per million entering vehicles indicates an existing safety problem that warrants the need for further evaluation.

Table 2-4. Molalla Avenue Corridor Crash Rates – 1/1/1997 to 12/31/1999

Intersection	Total Entering Volume[1]	Number of Crashes[2]	Crash Rate (crashes/mev)[3]
Division Street/Molalla Avenue	18,350	4	0.20
Pearl Street/Molalla Avenue	19,300	0	0.00
Barclay Hills Drive/Molalla Avenue	19,200	3	0.14
Holmes Lane-Hilda Street/Molalla Avenue	18,850	20	1.02
Warner-Milne Road/Molalla Avenue	20,800	21	0.92
Hilltop Mall/Molalla Avenue	18,000	2	0.10
Beavercreek Road/Molalla Avenue	30,600	29	0.87
Clairmont Way/Molalla Avenue	16,050	11	0.63
Gaffney Lane/Molalla Avenue	18,750	8	0.39
Highway 213/Molalla Avenue	30,850	7	0.21

(1) Average daily total entering volume (assumed to be 10 times the p.m. peak hour TEV)
(2) Number of crashes reported between 1/1/1997 and 12/31/1999
(3) Crashes/mev = crashes per million entering vehicles

As summarized in Table 2-4, the crash rates for all of the study intersections were below the threshold of 1.00 crashes per million entering vehicles, with the exception of the Holmes Lane-Hilda Street/Molalla Avenue intersection. The relatively high crash rate (1.02 crashes/mev) at this location can likely be attributed to the fact that the Holmes Lane-Hilda Street intersection with Molalla Avenue is significantly offset. This configuration results in poor decision-making sight distance for drivers entering the intersection, as well as awkward turning movement executions.

Regardless of the specific intersection crash rates identified, safety is a primary concern along the Molalla Avenue corridor. This study's recommendations and alternatives will focus on improving traffic, pedestrian, and bicyclist safety throughout the study area.

Corridor Access Configuration

Under existing conditions, the access configuration along the Molalla Avenue corridor consists of a proliferation of unevenly spaced driveway approaches. This is the result of piecemeal development patterns, caused by the absence of any corridor or overall access enhancement plan for the corridor. The large number of varying access approaches, in conjunction with growing traffic volumes along the corridor, impacts the overall mobility and operational safety of Molalla Avenue, making access to and from facilities and adjacent land uses difficult, reducing the potential roadway capacity, and impeding operations of traffic through the corridor. Consequently, motorists are faced with a high potential for encountering conflicting turning vehicles. The frequent, poorly delineated, and inconsistent access spacing along the corridor also provides increased opportunity for conflicts with pedestrians and bicyclists.

The Streetscape Evaluation, summarized in Appendix B, concluded that in certain instances there is relatively little delineation identifying approaches to Molalla Avenue. Organizing approaches in a more comprehensive manner and increasing access efficiency could allow for both increased capacity along the arterial corridor as well as for more effective land use and parking configurations for the abutting property owners.

Currently the City of Oregon City does not have an official access management or access spacing policy. However, the City is currently in the process of adopting a policy on Street Design Standards that includes provisions outlining Access Management Standards. Appendix E contains the proposed City of Oregon City Access Management Standards.

STREETSCAPE EVALUATION

A visual evaluation of Molalla Avenue through the corridor was completed and is summarized graphically in Appendix B. Within the project boundaries the curb, sidewalk and driveway conditions vary from the more recent developments in the southern portion that comply with the relevant jurisdictional requirements to the older northern segment that, in most cases, will require upgrades to the existing infrastructure to meet applicable codes. The results of that evaluation are summarized in the following paragraphs.

Curbs

Curbs throughout the project area appear to be in good condition overall. The only section exhibiting the need for immediate replacement is at the SE corner of Molalla Avenue and Division Street. Much of the area south of Gaffney Lane has yet to be developed and curb and sidewalk should be constructed at that time.

Sidewalks

While the sidewalks along the project corridor are predominately in good physical condition, the majority of them are too narrow to meet current code. Current standard sidewalk widths of six feet are met only in limited areas near the Hilltop Mall. Exacerbating this situation are the many obstructions within the sidewalk from power, light and turn signal poles. The majority of these occur north of Beavercreek Road and will need to be relocated to meet ADA requirements. Again, much of the area south of Gaffney Lane is not developed. As development occurs it will receive standard curb and sidewalk meeting current codes.

Driveways

Driveways along the project corridor are in good physical condition for the most part. Some driveways are either asphalt or gravel, and the majority of them north of Beavercreek Road have side slopes at the aprons that do not meet ADA requirements.

PAVEMENT EVALUATION

Appendix A includes the full pavement evaluation and a detailed description of the existing pavement condition. The general condition of the existing pavement is shown in Figures A-2 and A-3 of Appendix A. Between Harrison Street and approximately Holmes Lane, both the inner and outer lanes are in relatively good condition. The asphalt concrete in the outer lanes is thicker within this segment than elsewhere on the project, which probably explains the better condition of the pavement. Between Holmes Lane and Beavercreek Road the pavement in the outer lanes is in generally poor condition (with a significant amount of load associated cracking) and the inner lanes are generally in fair condition. The distress in the inner lanes is primarily wear (possibly caused by stripping of the AC) in the wheel paths and low severity joint reflective cracking and is not, in our opinion, the result of structural distress in the underlying PCC, such as corner breaks or poor load transfer.

Between Beavercreek Road and approximately Clairmont Way, the pavement within the travel lanes is in generally poor condition. Between Clairmont Way and approximately 500 feet north of Highway 213, the pavement is in fair condition, with the northbound lane in slightly worse condition than the southbound lane. The pavement within approximately 500 feet of Highway 213 is in good condition.

Drainage and Utilities

There are a number of deficiencies with the existing drainage system, most related to the condition of the existing storm drains (see Figures C-2 through C-6 of Appendix C). The City has a regular maintenance program and water quality monitoring for the drainage system. Most of the deficiencies noted on the figures are based on City television records. The latest TV inspection was completed about a year ago. The deficiencies detected consist of crushed or broken pipe sections, misaligned pipe, joints out of line, blocked sections, and bellies in pipe sections.

The existing water system within Molalla Avenue consists of pipelines varying in size from 4" to 16". Pipe materials include steel, cast iron and ductile iron. Many of the pipes are around 100 years old and require replacement. The City of Oregon City Water Master Plan provides detailed information regarding the water system. In Appendix C of this plan, potential water system upgrades are shown.

The existing sanitary sewer system within the Molalla Avenue corridor varies in age from as early as 1906 to the present. The northern segment consists of the older installation, while the central segment was constructed in the 1960's. The City of Oregon City has a Sanitary Sewer Master Plan that provides detailed information regarding the existing system, age and capacity. Figure C5 in Appendix C lists two sanitary projects for the Southern segment of Molalla Avenue.

There are numerous private utilities located along the Molalla Avenue corridor. Qwest, Northwest Natural Gas (NNG), AT&T, and PG&E are among companies that have utilities located within this corridor. Qwest and NNG have their major facilities located along Molalla Avenue.

In addition to the above listed utilities, there are former gas station sites along the corridor that may have contaminated soils.

Right-of-Way

Molalla Avenue was originally a two-lane rural state highway with a 60-foot right-of-way. The original 60-foot right-of-way has been increased in recent years as development has sprawled to the south. The end result is that most of the northern portions remain with a 60-foot right-of-way, and the southern portions have right-of-way widths varying between 60 feet and 90 feet. Right-of-way is shown in Figures C-2 through C-6 in Appendix C.

Chapter 3 Future Needs Assessment

INTRODUCTION

This chapter outlines the projected future conditions of the study corridor and identifies the forecast needs for the various transportation system components under the 20-year planning horizon assuming "No Build" transportation system conditions.

TRAFFIC NEEDS ASSESSMENT

The future forecast "No Build" scenario evaluates the traffic conditions likely to exist in the year 2020, assuming that there will be growth in travel demand, but that no roadway capacity improvements will be implemented within the study area beyond those projects already committed and acknowledged in the 20-year Metro regional model network. In the case of the Molalla Avenue corridor, the Metro regional model does not include any additional roadway capacity improvements to enhance the existing transportation system. This 2020 "No-Build" forecast scenario served as the basis for identifying the projected future transportation system deficiencies and needs along the study corridor. The results of this analysis, along with the results from the Existing Conditions Transportation System Assessment, were used to develop the future corridor plan alternative concepts designed to serve the identified needs and mitigate the forecast deficiencies.

2020 "No Build" Scenario Transportation System

The year 2020 "No-Build" analysis scenario serves to identify traffic conditions likely to exist in the year 2020 assuming no additional roadway capacity, pedestrian facility, bicycle facility, and/or public transit service improvements beyond those already committed and funded by either the City's or the Regional improvement plans. Within the study area for the Molalla Avenue Boulevard and Bikeway Improvements Plan project there are currently no such committed improvements. As such, the transportation system configuration used for the 2020 "No Build" analysis scenario was identical to the existing conditions transportation system (see Figures 3 and 4 in Chapter 2).

TRAFFIC FORECAST 2020 TRAVEL DEMAND AND PM PEAK HOUR VOLUMES

The following describes the forecast year 2020 "No-Build" Scenario daily and weekday p.m. peak hour travel demand volumes for the study corridor.

Forecast 2020 Travel Demand Volumes

To ensure consistency with the ongoing work for the Oregon City TSP, the forecast 2020 travel demand volumes for the Molalla Avenue Boulevard and Bikeway Improvements Plan were based on the same Metro regional 2015 travel demand model. The modeling methodology and assumptions used to generate and refine the year 2018 TSP forecast were examined and reviewed to determine their appropriateness for use in this corridor study. Modifications and adjustments were made where appropriate, and an additional three-percent per year growth factor (consistent with the TSP forecast) was applied to grow the volumes to a year 2020 forecast. This refined 20-year travel demand forecast was used to generate the projected link and intersection turning movement volumes for the study area. The resultant forecast year 2020 "No-Build" Scenario average weekday p.m. peak hour traffic volumes are presented in Figure 6, which also shows estimates for year 2020 average daily traffic volumes.

Comparing the forecast year 2020 volumes shown in Figure 6 to the existing year 2000 traffic volumes from Chapter 2, it can be seen that the weekday p.m. peak travel demand on all Molalla Avenue corridor segments is forecast to experience substantial growth over the next year 20-year period based on the Metro population and employment forecasts. In the north segment, traffic volumes are expected to increase an average of 70 percent by the year 2020. Through the segment of Molalla Avenue between Warner-Milne Road and Beavercreek Road the year 2020 travel demand forecast indicates approximately a 50 percent growth rate over the 20-year period. In the southern segment of the corridor (in the vicinity of Clairmont Way, Fred Meyer and Highway 213) peak period travel demand is forecast to increase by approximately 80 percent. This increase in travel demand along the Molalla Avenue corridor is consistent with the significant projected growth and development forecast for the greater Oregon City area, particularly in the southern portions of the city.

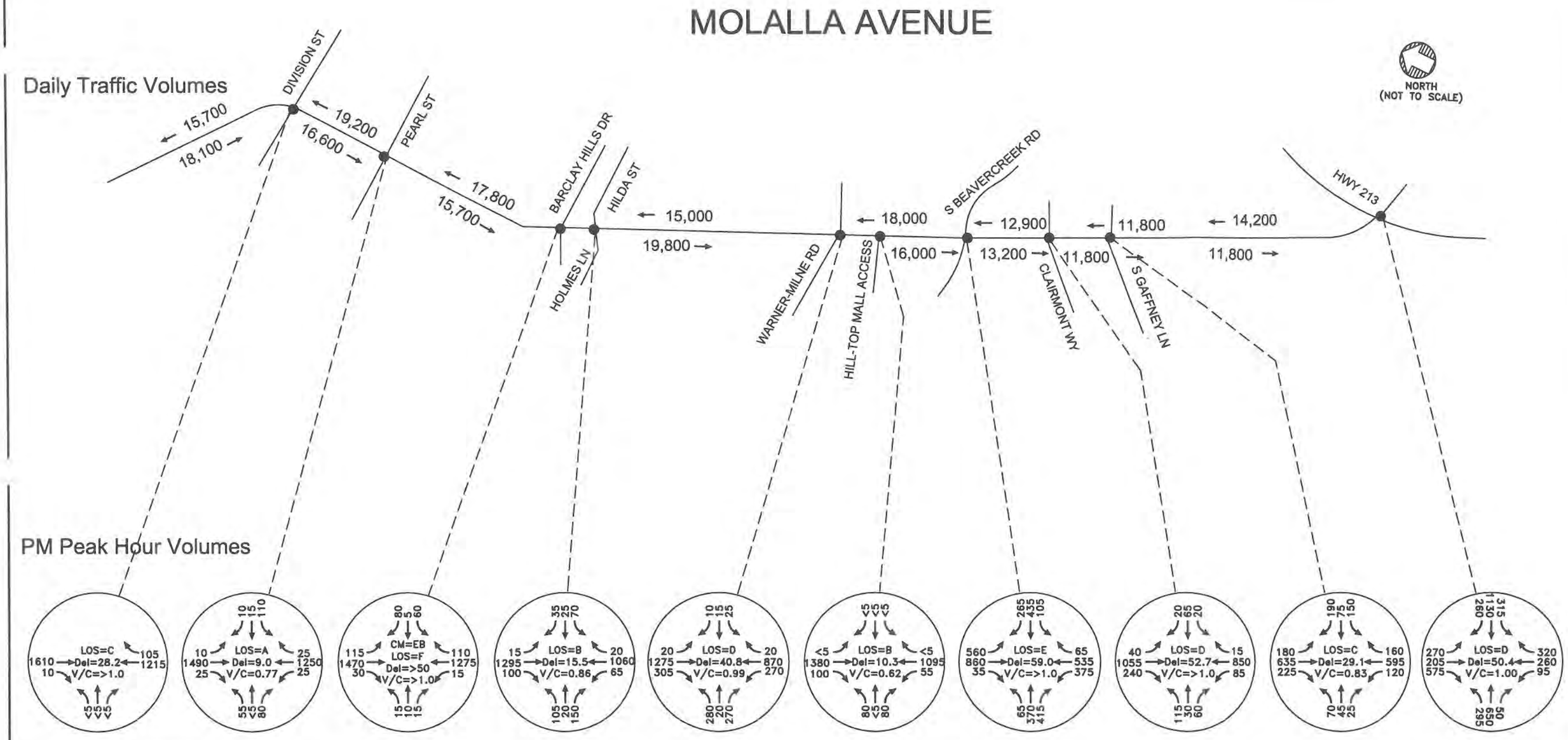
Traffic Forecast 2020 "No-Build" Scenario Operational Analysis

As under existing conditions, an operational level of service (LOS) analysis was conducted for the year 2020 "No-Build" Scenario to determine the future operational conditions at the study intersections. All level of service analysis described in this report were performed in accordance with the procedures outlined in the *1997 Highway Capacity Manual* (Reference 2, Appendix H). A description of level of service and the criteria by which they are determined is presented in Appendix D. This also indicates how level of service is measured and what is generally considered the acceptable range of level of service. To complete this analysis, the future forecast volumes shown in Figure 6 were used as the projected 20-year travel demand estimates.

2020 "No-Build" Scenario Intersection Operations

The results of the year 2020 "No-Build" Scenario intersection level of service operational analysis are also summarized in Figure 6. The current City of Oregon City standards indicate that LOS "A" through "D" are considered acceptable for signalized intersection operations, and LOS "E" and "F" are unacceptable. For unsignalized intersections, the City of Oregon City standards outline operational LOS "A" through "D" as acceptable, LOS "E" as marginally acceptable, and LOS "F" as unacceptable. It should be noted that the City is presently considering adopting Metro's *Title 6* regional performance measure standards that would allow for more relaxed mobility and operational performance requirements. Depending on if and how Metro's *Title 6* is incorporated into City of Oregon City policy, the operational standards along Molalla Avenue could be modified to level of service "F" in the peak hour, provided that in the second peak hour level of service "E" is maintained. City staff and decision makers are currently contemplating this policy revision.

MOLALLA AVENUE



LEGEND
CM = CRITICAL MOVEMENT (UNSIGNALIZED)
LOS = INTERSECTION LEVEL OF SERVICE (SIGNALIZED)/ CRITICAL MOVEMENT LEVEL OF SERVICE (UNSIGNALIZED)
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January 2001 | Job 1077A	WALLIS ENGINEERING in association with GREENWORKS, Kittelson & Associates	Molalla Avenue Boulevard and Bikeway Improvements Plan Oregon City, Oregon	2020 "No-Build" Scenario Daily Traffic Volumes and PM Peak Hour Traffic Conditions	Figure 6

As can be seen in Figure 6, there are several study intersections which are forecast to operate at an unacceptable level of service or over capacity during the average weekday p.m. peak hour under the forecast 2020 "No-Build" Scenario conditions. Table 3-1 summarizes these identified 2020 "No-Build" Scenario operational deficiencies.

Table 3-1. 2020 "No-Build" Operational Deficiencies

Intersection	2020 "No-Build" Scenario Operational Deficiency
Barclay Hills Drive/Molalla Avenue	• Operates over capacity (V/C > 1.00) and at LOS "F" • MUTCD (Reference 3, Appx F) Signal Warrants #2 (interruption of continuous flow) and #11 (peak hour volume) are met
Warner-Milne Road/Molalla Avenue	• Operates at capacity (V/C = 0.99)
Beavercreek Road/Molalla Avenue	• Operates over capacity (V/C > 1.00) and at LOS "E"
Clairmont Way/Molalla Avenue	• Operates over capacity (forecast to operate with a V/C > 1.00)
Highway 213/Molalla Avenue	• Operates at capacity (V/C = 1.00)

The above table shows that five of the ten study intersections are projected to experience significant capacity deficiencies under the 2020 "No-Build" Scenario forecast conditions. Due to the substantial increase in traffic volumes projected for the study area, the volume-to-capacity ratios and average delay for vehicles at these locations will reach levels correlating to unacceptable operational conditions by current standards. This is a substantial degradation in operations projected for the study area transportation system from existing conditions, where all intersections (with the exception of Barclay Hills Drive/Molalla Avenue) met the current City of Oregon City operational standards. It is interesting to note, however, that several of the identified deficiencies do still meet the Metro *Title 6* performance measure and mobility standards under the forecast 2020 "No-Build" Scenario conditions. Appendix D includes the level of service and signal warrant analysis worksheets.

In addition to the intersections identified above, two more intersections may also require improvements. Based on anticipated growth in traffic volumes and the opening of the Fir Street connection to Beavercreek Road, the Molalla Avenue/Fir Street intersection has also been identified as a location that will likely require signalization in the future. It is recommended that the City monitor this location to determine if and when signalization is warranted for either operational an/or safety reasons. In addition, this study also verified the need for both operational and safety improvements within the vicinity of the 7th Street-Molalla Avenue/Division Street-Taylor Street intersection. A variety of opportunities exist for this location, including the possibility for constructing a modern roundabout. However, due to the complex geometry and operational issues that currently exist, a definitive recommendation for improvements at this location was deemed beyond the scope of this planning-level effort. As such, it is recommended that the City undertake a detailed sub-area study for the 7th Street-Molalla Avenue/Division Street-Taylor intersection to develop and evaluate geometric, operational, and safety alternatives for the intersection.

Access Management Needs Assessment

Access management is needed to ensure both the safety and efficiency of traffic flow for vehicles traveling on the roadway system. Managing the access of roadways benefits the overall roadway system by increasing safety, increasing capacity, and reducing travel times. However, access management policy cannot be so restrictive as to prevent local businesses and homeowners from obtaining reasonable access to the public roadway system. Overall, access management must balance the

needs of through traffic, localized traffic, and pedestrians/bicyclists on a particular roadway. By the nature of the roadway functional classification system, arterials require the highest access management standards, while collectors and local streets require less restrictive access management standards. Appendix E contains the proposed City of Oregon City Access Management Standards. Access management will be reviewed by the City on a case-by-case basis.

Streetscape Needs Assessment

Curb and driveways appear to be in adequate condition for the most part; however, most do not meet the minimum requirements of the ADA. The vast majority of sidewalks through the corridor need to be replaced to provide ADA compliance. This will also involve driveway replacement, the installation of curb-ramps at intersections, utility pole and sign relocation, and street tree plantings in tree-wells.

Pavement Needs Assessment

Detailed recommendations for existing pavement rehabilitation and widening are given in Appendix A. They are shown graphically in Figures A-4 and A-5 of the same Appendix. Generally, inlays from 4 to 9 inches, and overlays from 3.5 to 5.5 inches are recommended for specific sections of the street. Due to budgetary constraints, rehabilitation work may need to be conducted in stages over more than one construction season. See Chapter 6 for the recommended Phasing Plan for improvements.

Drainage and Utilities Needs Assessment

Figures C-2 through C-6 of Appendix C show recommended upgrades to the storm drain system. In general, these consist of repairing damage and replacing pipe sections noted in the City's TV inspection. It is further recommended that a collection and conveyance system be installed in areas where new curb and sidewalk are constructed. The collection and conveyance system should be designed to include the onsite and offsite contributing areas. These locations are shown on the plan and are located on the southern end of the project in Caufield Sub Basins A and B.

It would be ideal to combine much of the storm drainage facilities. Presently, much of the system consists of drainage inlets and storm drains on both sides of the road. The cost to combine these into a single system, however, would be prohibitive. Our recommendation is to have new work consolidated into one storm drain system as much as possible.

As described under the existing conditions, the existing water system is comprised of old water pipe of varying materials. In some cases, the water piping is over one hundred years old. Much of these pipes needs to be replaced. In some cases, concrete telephone ducts cross the existing water line. The Water Master Plan, at the time of this writing, is being updated. This Master Plan should be reviewed and the recommendations within it should be incorporated into any development or construction projects within the Molalla Avenue corridor.

In addition, the Sanitary Sewer Master Plan is being updated. As with the Water Master Plan, the findings within the Sewer Master plan should be reviewed and incorporated into future development or municipal construction projects within the plan corridor.

There are a variety of private utilities along Molalla Avenue including Qwest, NW Natural, AT&T and PG&E. It is recommended that as construction projects are designed and completed, these pri-

vate utilities should be placed underground. This would happen through a coordination with the private utilities and the City of Oregon City.

As mentioned earlier in the document, there may be former gas station sites along corridor that have contaminated soils. These sites would have to be evaluated on a case by case basis.

Chapter 4 Alternatives Development and Selection

INTRODUCTION

This chapter serves to present the conceptual corridor design alternatives. These alternatives were developed and evaluated in order to address the transportation system needs identified in Chapters 2 and 3. The goal of this study was to provide for the implementation of a facility that will meet the City's operational, safety, and functional transportation needs as well as the City's desired goals for aesthetics, mobility, accessibility, multi-modal enhancement, and land use development. This summary of future transportation system improvement alternatives presents the projects that could be implemented in order to mitigate both existing and projected future transportation system deficiencies and to develop the Molalla Avenue corridor in such a manner as to achieve the City's long-term vision for the facility over time.

CONCEPTUAL ROADWAY CROSS-SECTION ALTERNATIVES

Alternatives Development

During the initial study efforts, it became apparent that corridor improvements necessary to meet the 20-year planning objectives would require extensive right-of-way acquisition. In light of the fact that the cost of obtaining this right-of-way is well beyond the City's financial means, a phased approach to improving the corridor was selected as follows:

- Phased Build-out Alternatives - Corridor improvements which could be implemented without extensive right-of-way acquisition.
- Full Build-out Alternatives - Corridor improvements which met the long-term transportation needs of and desires for the corridor.

The objective was to develop alternatives with the street cross-sections that would provide adequate level of service, bicycle facilities, and sidewalks meeting ADA requirements. For both the phased build-out and full build-out scenarios, several three-lane, four-lane, and five-lane cross-sections were developed based on the varying right-of-way availability and constraints along the corridor. The initial corridor cross-section concepts focused on a three-lane section for the northern (Harrison Street to north of Warner-Milne Road) and southern (south of Beavercreek Road to Highway 213) segments of Molalla Avenue.

After this first set of alternative concepts was presented to City Staff, internal discussions within the City Planning Division and Public Works departments were held in order to comment on and revise the options. City Staff then returned their recommended corridor cross-section alternatives based on City Planning Division understanding of the corridor and the desired long-range goals for the facility. Again, the Phased Build-out plan is achievable within the existing available right-of-way, while the Full Build-out goal requires the acquisition of additional right-of-way for the facility.

Overall there were nine different alternatives reviewed, divided between the two phases for corridor development. Within the north and south segment, three alternatives were discussed for the phased build-out plan and two alternatives were examined for the full build-out vision. For the central segment, there were two alternatives each for the phased and full build-out scenarios.

For the purposes of this evaluation, the Molalla Avenue corridor was divided into three segments based on the facility's existing characteristics:

- Northern Segment: Harrison to north of Warner-Milne Road (existing four lane cross-section),
- Central Segment: north of Warner-Milne Road to south of Beavercreek Road (existing five lane cross-section), and
- Southern Segment: south of Beavercreek Road to Highway 213 (varying existing two to three lane cross-section).

Phased Build-out Alternatives

North and South Segments

The three alternatives evaluated for the North and South (3-lane) segments are shown in Figure 7. They vary by lane and sidewalk widths. All can be constructed within the existing 60-feet of right-of-way.

Central Segment

Two alternatives for the Central (5-lane) segment were evaluated as shown in Figure 8. As right-of-way varies in this segment, so does the requirement for additional right-of-way to implement the improvements. These alternatives vary primarily by the fact that one has on-street parking, but does not have a center turn lane; the other has the turn lane but no parking.

Full Build-out Alternatives

North and South Segments

Two alternatives were developed for the full build-out condition in the northern and southern segments as shown in Figure 9. They vary by sidewalk width.

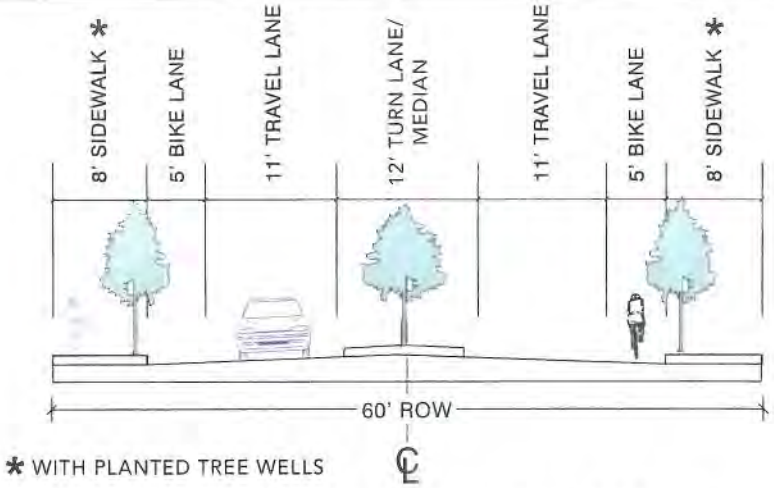
Central Segment

Two alternatives were considered for the Central Segment full build-out vision. These are shown in Figure 10.

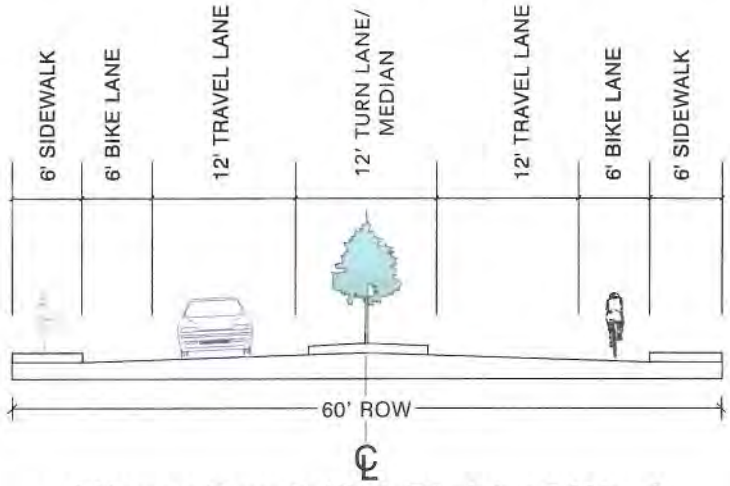
Preferred Alternative

The consultant team reviewed and refined City staff recommendations based on the results of operational analysis and the identified existing and future conditions transportation system needs. These revised recommended cross-sections were presented back to City staff and the public at a second workshop meeting where they were discussed and further refined. This resulted in an agreement between City staff and the consultant team on the preferred cross-section alternatives for the Molalla Avenue corridor.

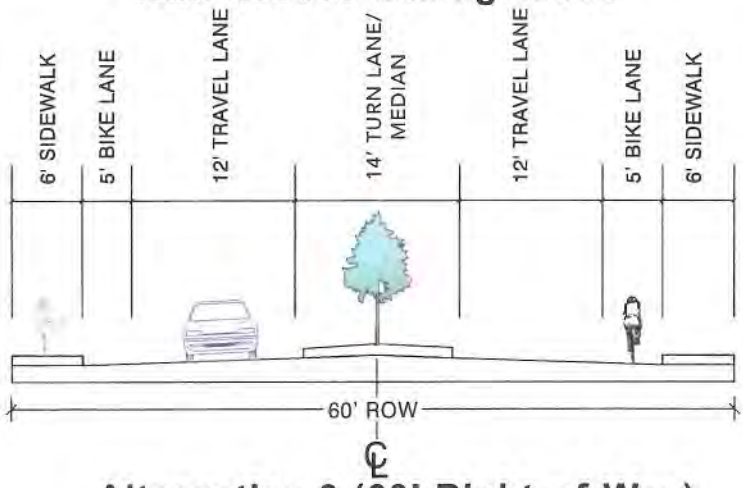
The preferred cross-section alternatives for Phased Build-out and Full Build-out, (and for each of the above Segments), are shown as the first alternative of each of the following Figures 7 through 10. They are also listed in Table 4-1 following the Figures. As can be seen from the figures, both Phased Build-out and Full Build-out cross-sections for the corridor were established with three-lane and five-lane cross-section options for specific segments of Molalla Avenue.



Alternative 1 (60' Right-of-Way) with access management



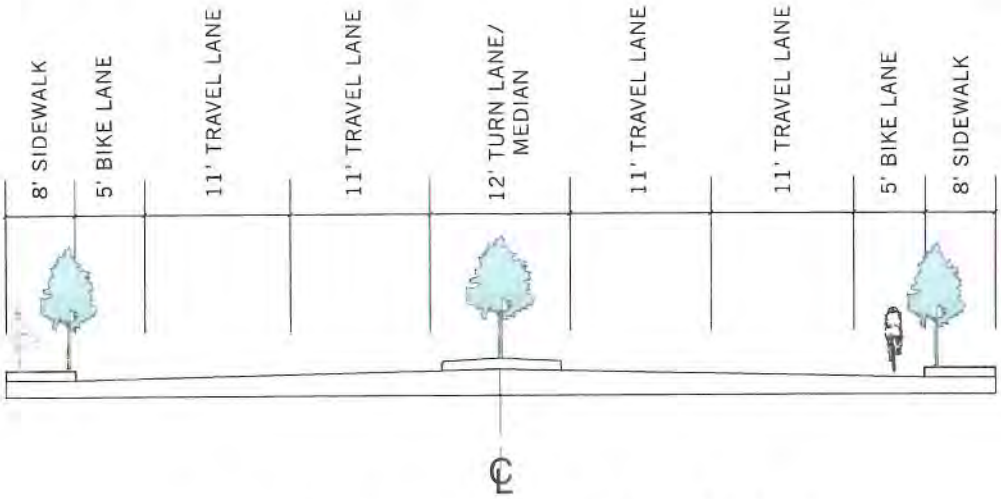
Alternative 2 (60' Right-of-Way) with access management



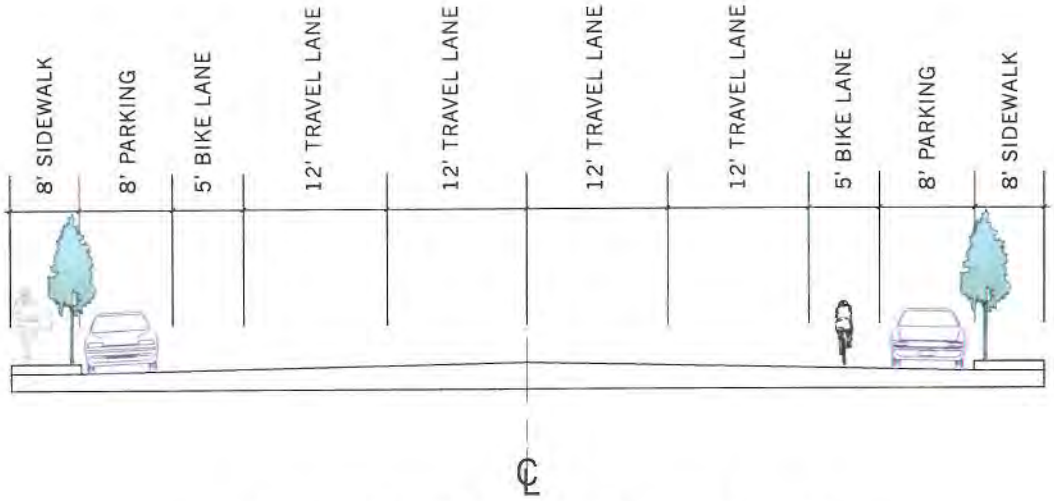
Alternative 3 (60' Right-of-Way) with access management

Phased Build-out Cross Sections North and South Segment Alternatives	Figure 7

January 2001 - Job 1077A	WALLIS ENGINEERING in association with GREEN WORKS Kittelson & Associates		Molalla Avenue Boulevard and Bikeway Improvements Plan Oregon City, Oregon

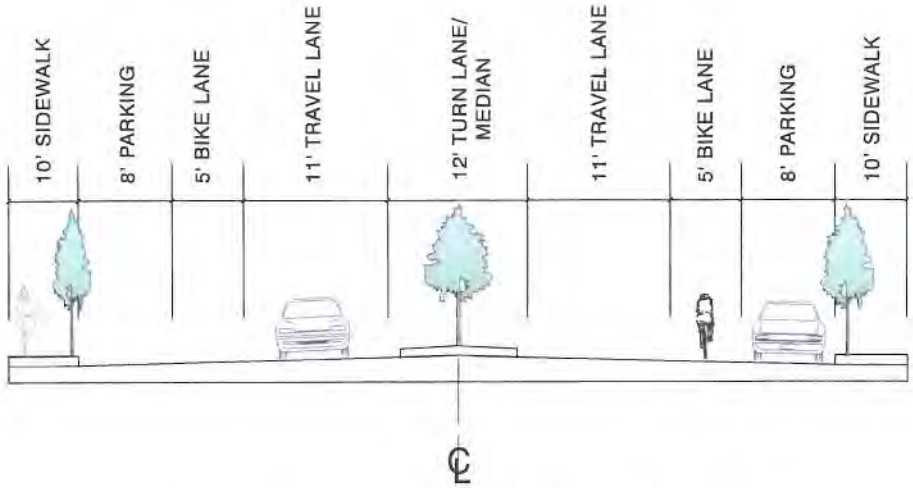


Alternative 1 (82' Right-of-Way) with access management

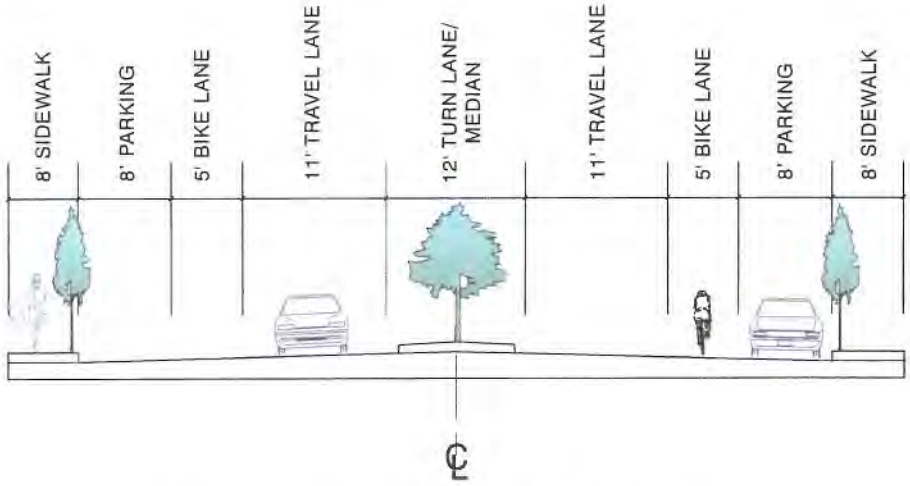


Alternative 2 (90' Right-of-Way) with access management

Phased Build-out Cross Sections Central Segment Alternatives			Figure 8
January 2001 - Job 1077A	WALLIS ENGINEERING in association with GREEN WORKS, Kittelson & Associates		Molalla Avenue Boulevard and Bikeway Improvements Plan Oregon City, Oregon

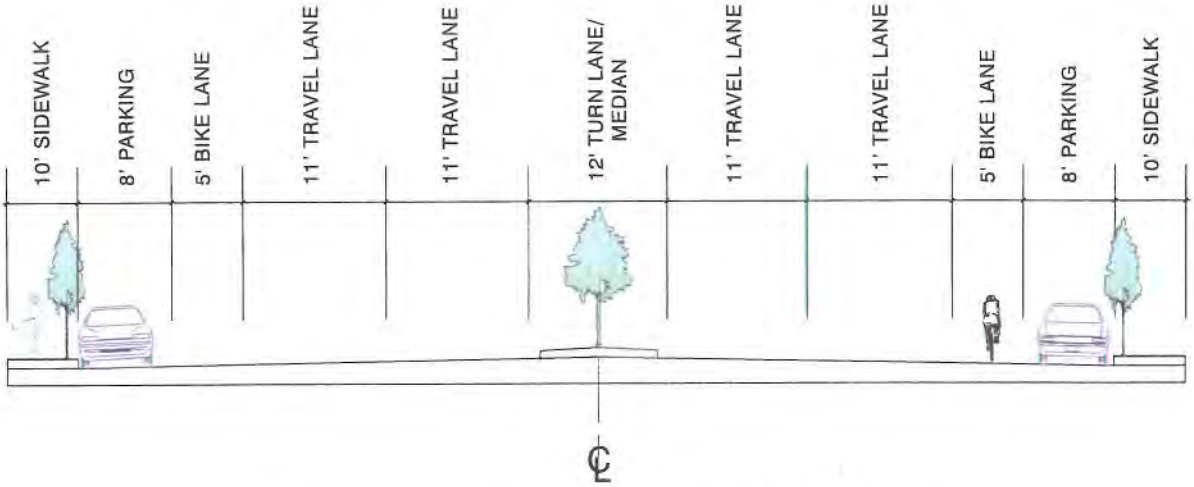


Alternative 1 (80' Right-of-Way) with access management

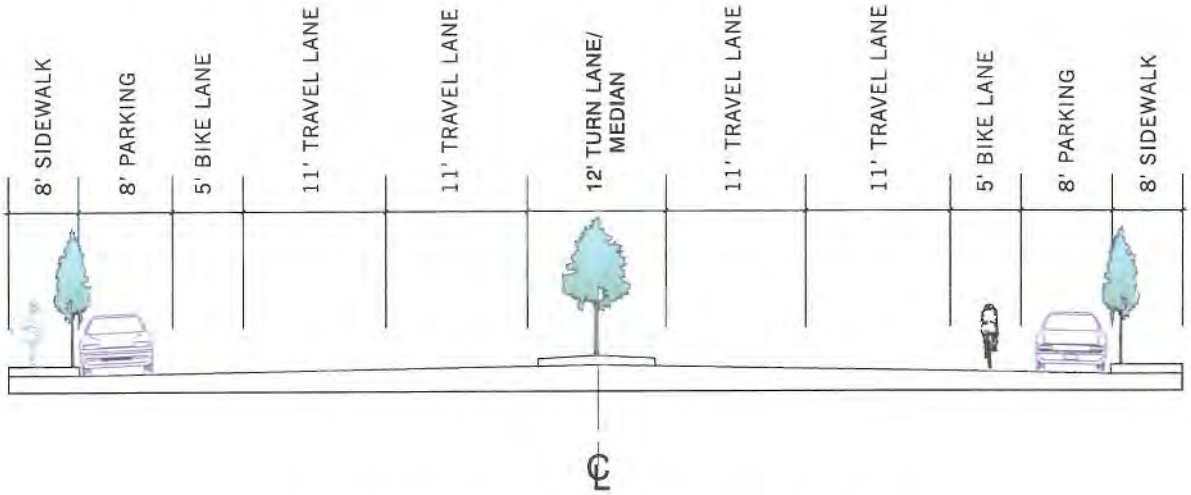


Alternative 2 (76' Right-of-Way) with access management

Full Build-out Cross Sections North and South Segment Alternatives			Figure 9
January 2001 - Job 1077A	WALLIS ENGINEERING in association with GREEN WORKS Kittelson & Associates		Molalla Avenue Boulevard and Bikeway Improvements Plan Oregon City, Oregon



Alternative 1 (102' Right-of-Way)\ with access management



Alternative 2 (98' Right-of-Way) with access management

Full Build-out Cross Sections Central Segment Alternatives			Figure 10
January 2001 - Job 1077A	WALLIS ENGINEERING in association with GREENWORKS Kittelson & Associates		Molalla Avenue Boulevard and Bikeway Improvements Plan Oregon City, Oregon

TABLE 4-1. SUMMARY OF PREFERRED ALTERNATIVE

	Phased Build-out		Full Build-out	
Roadway Segment	North and South (Alt. 1 of Figure 7)	Central (Alt. 1 of Figure 8)	North and South (Alt. 1 of Figure 9)	Central (Alt. 1 of Figure 10)
Right-of-Way Width	60'	82 '	80'	102'
Northbound Lanes (Number & Width)	1 / 11'	2 / 11'	1 / 11'	2 / 11'
Turning Lanes or Median	12' width	12' width	12' width	12' width
Southbound Lanes (Number & Width)	1 / 11'	2 / 11'	1 / 11'	2 / 11'
Sidewalk Width (Ea Side)	8'	8'	10'	10'
Bikeway Width (Ea Side)	5'	5'	5'	5'
8' Parking Lane	No	No	Yes	Yes

OPERATIONAL IMPACTS OF CORRIDOR PLAN IMPLEMENTATION

Implementation of the preferred phased build-out design concept for the Molalla Avenue corridor will significantly modify roadway geometry, lane configuration, traffic signal operations, and street amenities, particularly in the northern segment of the corridor. An evaluation of the projected impacts on traffic, traffic signal, and pedestrian operations was made, and these impacts are summarized in the following paragraphs.

Traffic Operations Analysis

The roadway geometry and intersection configuration of the preferred alternative was evaluated for operational performance under both existing conditions and the 20-year future forecast. All level of service (LOS) analysis described in this report was performed in accordance with the procedures outlined in the *1997 Highway Capacity Manual*. Current City of Oregon City standards indicate that, typically, LOS "A" through "D" are acceptable for signalized intersection operations and LOS "A" through "E" are acceptable for unsignalized intersection operations. To ensure that the analysis was based on a reasonable worst-case scenario, the peak 15-minute flow rate during the study period was used in the evaluation of all intersection levels of service. For this reason, the analysis reflects conditions that are only likely to occur for 15 minutes out of each average weekday. Traffic operations during all other time periods will likely be better than those described in this report.

The results of the intersection operational analysis for the preferred alternative are presented in Table 4-2 and the detailed analysis worksheets are provided in Appendix D. For each intersection the volume-to-capacity ratio, average delay, and corresponding level of service are shown.

Table 4-2. Preferred Alternative Weekday PM Peak Hour Operations

Intersection	Weekday PM Peak Hour Operations					
	Year 2000 Traffic Conditions			Year 2020 Traffic Conditions		
	V/C	Delay	LOS	V/C	Delay	LOS
Division Street/Molalla Avenue	0.64	2.9	A	0.97	15.1	B
Pearl Street/Molalla Avenue	0.79	13.3	B	1.10	51.1	D
Barclay Hills Drive/Molalla Avenue - *with signalization*	>1.20 *0.76*	>60.0 *9.2*	F *B*	1.05	42.4	E
Hilda St-Holmes Lane/Molalla Avenue	0.83	16.7	B	1.08	50.8	D
Warner-Milne Road/Molalla Avenue	0.57	17.8	B	0.95	36.0	D
Hilltop Mall/Molalla Avenue	0.42	10.3	B	0.62	10.3	B
Beavercreek Road/Molalla Avenue	0.72	33.7	C	0.81	35.2	D
Clairmont Way/Molalla Avenue - *with SB right-turn lane*	0.69	13.9	B	1.04 *0.86*	41.4 *20.0*	D C
Gaffney Lane/Molalla Avenue	0.68	22.2	C	0.83	29.1	C
Highway 213/Molalla Avenue	0.84	33.5	C	0.94	41.9	D

Table 4-2 shows the recommended roadway configuration of the preferred phased build-out roadway cross-section plan will provide acceptable operations at all of the study corridor intersections under the year 2000 existing traffic conditions, with the exception of the unsignalized Barclay Hills Drive/Molalla Avenue intersection.

Barclay Hills Drive, the minor street approach, was found to experience relatively long delays resulting in level of service "F" during the critical p.m. peak hour period. With signalization, the intersection will operate at an acceptable level of service "B" under existing traffic volume conditions. Given that the Barclay Hills Drive/ Molalla Avenue does not meet MUTCD signal warrants (see Alternatives Development Analysis Worksheets in Appendix D) and an alternative signalized access route for the minor street left-turning vehicles is available via Hilda Street, signalization is not recommended at this point in time. The intersection should be monitored to ensure that operational and/or safety problems do not arise and to determine if and/or when intersection improvements become necessary in the future.

By the year 2020, the forecast increase in weekday p.m. peak travel demand along the corridor is projected to result in a degradation of traffic operations. Table 4-2 shows that the majority of the intersections along the study corridor will still operate at an acceptable level of service, however, a number of the intersections in the northern segment will operate at or over capacity (namely Pearl Street, Barclay Hills Drive, Hilda Street-Holmes Lane) during the critical weekday p.m. peak hour period.

In order to meet the City's current operational standards given the forecast year 2020 traffic volume projection, an additional through lane of capacity (i.e. a five-lane cross-section) would be required in these locations to serve the projected weekday p.m. peak hour demand. However, there are three factors that are important to consider when determining the appropriateness of the forecast operations along the corridor; 1) limitations at north terminus of corridor, 2) travel demand model limitations, and 3) community goals. These are discussed in the following paragraphs.

When considering the Molalla Avenue corridor it is important to recognize the constraints that exist for the facility. The north end terminus of Molalla Avenue, 7th Street-Singer Hill, only maintains a two-lane cross-section. Due to topography and the adjacent development and land use pattern along 7th Street and Singer Hill, it is highly unlikely that the connection will ever be expanded to more than its existing two-lane cross-section. The same can be concluded for Washington Street that also feeds the north end of the study corridor. These constraints, therefore, will dictate and deter-

mine the amount of traffic that can actually travel to and from the Molalla Avenue corridor both today and in the future. As such, expanding the northern portion of Molalla Avenue to more than one travel lane in each direction will only serve to increase capacity and vehicle speeds in a short segment before a northbound bottle-neck is created prior to the transition at 7th Street. Maintaining the northern segment of Molalla Avenue as a three-lane cross-section will provide consistency with the connecting facilities and serve to meter traffic throughout the transportation system.

The second factor is the travel demand model limitations used to generate the forecast. The operational analysis is based on the unconstrained travel demand forecast generated by an EMME/2 model. In networks with only a limited number of travel routes, this model will continue to assign travel demand to roadway facilities in excess of their capacity until all of the specified travel demand is assigned. As such, the model does not recognize the practical fact that the actual travel demand that can be realistically achieved along Molalla Avenue is restricted by the capacity constraints of upstream and downstream roadway connections, such as Singer Hill and Washington Street. Therefore, it may be unlikely that traffic volumes exceeding the capacity of a three-lane cross-section will actually materialize on the facility.

Finally, the forecast levels of traffic operations on the facility must be evaluated and prioritized in conjunction with the community's vision and goals for the transportation corridor. The Oregon City community, City of Oregon City Staff, and the City decision and policy makers have all expressed a desire to maintain Molalla Avenue as a three-lane roadway in the northern segment with the focus of the facility to be directed to multi-modal travel enhancement, a livable Main Street environment, mixed-use/transit oriented land use, and community business development. As such, accepting a higher level of congestion for vehicular operations along the facility is a feasible policy decision that can be made by the community in order to achieve the overall transportation, land use and Metro goals for the corridor.

Impact of Pedestrian and Multi-Modal Improvements

The potential impacts of implementing the pedestrian improvements identified in the proposed preferred alternative plan were also reviewed as part of the plan development. Both the phased build-out and the full build-out corridor plans have provisions for improved and widened sidewalks, pedestrian crossings (both mid-block and at traffic signals), and the addition of other streetscape enhancements to foster a more pedestrian-friendly environment. Enhanced pedestrian crossing should be provided at all intersections along the corridor (a more detailed discussion of this issue is included in Chapter 5). In the central and southern segments of the Molalla Avenue corridor (i.e., south of Warner-Milne Road), these improvements can be achieved within the existing right-of-way or by acquiring limited amounts of additional right-of-way, without compromising the existing street cross-section configuration. However, as previously discussed, in the northern segment of the study corridor right-of-way constraints and adjacent land use development patterns present challenges to accommodating the desired pedestrian and bicycle system improvements and the development of the desired streetscape and land use/transportation system environment. The achievement of these goals will require limiting the street cross-section from the existing four-lane cross-section to three lanes. As described in previous sections, it is expected that this roadway reconfiguration and streetscape enhancement will slightly reduce the vehicle capacity along the corridor in the northern segment (from 7th Street to north of Warner-Milne Road). However, the compromises made to the vehicle carrying capacity of the corridor will serve to enhance and increase the multi-modal (pedestrian, bicycle, and transit) environment and capacity along Molalla Avenue. Given that City Staff, City decision makers, and the Oregon City community have all expressed their desire to develop Molalla Ave-

nue a transit and pedestrian oriented main street, combined with the operational issues described in the previous section, the proposed streetscape and pedestrian enhancement projects have been prioritized in the long-range full build-out corridor plan.

Traffic Signal Vehicular Detection Improvement Options

In addition to the operational evaluation performed for the preferred phased build-out street cross-section plan, options for traffic signal vehicular detection improvements were evaluated for the corridor. While the existing detection infrastructure utilizes inductive loops installed into the roadway pavement, implementation of newer video detection technology may be beneficial along the Molalla Avenue corridor. Throughout the corridor there exists the opportunity to implement video detection systems at all of the signalized intersections. Implementing a video detection system would allow for a long-term functional detection system regardless of future roadway changes and poor pavement conditions. The advantages of video traffic signal detection include the fact that trenching and cutting of the existing roadway pavement is not required and that the detection can easily be changed and modified to be compatible with future lane configuration and roadway geometry improvements.

If it is desired to maintain a pavement loop detection system, it is recommended that the loop detector junction boxes be placed at their ultimate locations determined from the typical cross-sections for the long-term full build-out plan for the corridor. By doing so, roadway maintenance, configuration changes, and pavement rehabilitation can occur with minimal need for replacing the signal detection system.

Sidewalk Surfacing Options

When considering sidewalk surfacing options, the alternatives are a function of the relative amount of cement concrete and brick. Cement concrete choice has been the traditional choice for surfacing sidewalks. In recent years, various brick surfacing materials have become common, particularly when used in conjunction with cement concrete in architecturally varied configurations. Following discussions with City staff and public input, the preferred option for sidewalks is to have them constructed entirely of cement concrete.

Street Tree Options

Street trees offer a number of advantages. They provide considerable scenic benefits, improve air quality, provide shade, and where located between sidewalk and drive lanes they offer a friendlier and safer pedestrian environment. Given the planning goals for the corridor, there is no question that street trees should be included with any options. The street tree options, however, involve details which need to be resolved. Some of these relate to engineering standards and some involve city-wide design policy – size and type of tree planted, size of tree-well and its surface treatment, and tree spacing.

Street Furniture Options

Street furniture are amenities that promote and assist in pedestrian activity along a street or corridor. There are many types of street furniture, including benches, waste containers, planters and kiosks. Like landscaping, street furniture is desired along the Molalla Avenue corridor. The most likely location for street furniture installation is at areas along the corridor where pedestrians gather. These locations include larger intersections and bus turnouts. Similar to the landscaping, the options

surrounding street furniture should be determined on the basis of engineering design and city-wide design policy.

MEDIAN OPTIONS

All of the alternatives, both phased and full build-out, have center turn-lanes that offer opportunities for medians in those locations without the need for turning at intersections and driveways. The feasibility of mid-block medians depends entirely upon the City's success at access control. With the current proliferation of driveways, there are no median opportunities. For any given alternative, an increase in traffic will have a negative impact. Medians will help mitigate that impact. Medians, therefore, are recommended wherever possible.

Assuming that opportunities will present themselves for medians, the options for medians relate basically to surface treatment and/or planting options. Basic median options include:

1. Landscaping for entire median.
2. Combination of hard surfacing and landscaping.

For either of these options, there are alternative surface treatments and alternative landscaping features. Considering the array of alternatives, and uncertainties regarding future maintenance budgets, discussion with City staff and public input through workshops and the Transportation Advisory Committee led to the selection of the second alternative – combination of hard surfacing and landscaping. Where median opportunities do present themselves, the preferred alternative is for landscaping to be limited to street trees.

ROADWAY LIGHTING OPTIONS

A key streetscape feature which was evaluated as part of the alternatives analysis were the various options available for improvements to the roadway lighting characteristics on Molalla Avenue. The extent and nature of the roadway lighting provided along a corridor plays an important role in defining the streetscape atmosphere, as well as in the facilitation of a safe and effective vehicular, pedestrian, and bicycle environment.

Three possible roadway lighting alternatives were identified for the Molalla Avenue corridor street illumination: traditional cobra-head streetlights, single-head ornamental streetlights, and double-head ornamental streetlights. An example of each of these roadway lighting fixtures is illustrated in Figure 11. A conceptual illumination plan (based on the required pole-spacing for the full build-out plan roadway cross-sections), planning-level cost estimates, and an outline of the advantages and disadvantages for each roadway lighting alternative were prepared in order to evaluate the options. This evaluation of the various roadway illumination alternatives is also summarized in Figure 11.

Traditional Cobra-Head Lighting Option

A traditional cobra-head lighting system typically utilizes 30 to 40-foot high illumination poles to project light down onto the roadway. The cobra-head fixture has good light distribution and good light "cut-off", such that light is only projected onto the roadway where it is directed. This unobtrusive feature is beneficial in residential areas.

As outlined in Figure 11, the traditional cobra-head lighting requires the least number of poles to meet illumination requirements along the corridor. As such, this lighting option would likely be the least expensive to maintain. However, because of the height of the lighting poles, maintenance of the illumination is more difficult which likely negates the cost benefits of a fewer number of poles.

The planning-level cost analysis determined this alternative to be the most expensive to implement given the assumed cost per illumination pole of $3,500 (material cost only). In addition, this alternative is typically considered the least aesthetically pleasing and conducive to fostering a pedestrian-friendly, livable Main Street roadway environment.

Single-Head Ornamental Lighting Option

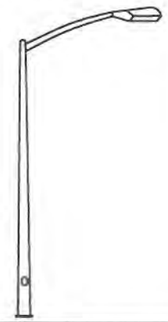
The second illumination option evaluated was a single-head ornamental streetlight. These light poles are lower to the ground and spread illumination throughout the roadway and roadside (i.e. sidewalk) areas. This type of illumination was found to require the most number of poles per mile in order to light the preferred roadway cross-sections to IES (Illuminating Engineer Society) standards (a staggered pole spacing of 100 feet was determined). Even so, with an estimated cost of $2,000 per light pole (material cost only), this was found to be the least expensive option to implement. This estimate represents a typical average cost for the single-head ornamental lighting, however, the price per pole could range higher depending on the illumination style selected. Ornamental lighting is generally considered very aesthetically pleasing and conducive to fostering a pedestrian-friendly, livable Main Street feel for a corridor. For example, flower baskets and banner treatments can be incorporated onto the lighting poles with this illumination option. The illumination pole is significantly lower than the traditional cobra-head light poles (typically only about 20 feet high) making maintenance of the lighting system easier. However, because a greater quantity of light poles are required, the system could be more expensive to maintain than the cobra-head alternative.

Double-Head Ornamental Lighting Option

Finally, the third roadway lighting option evaluated was double-head ornamental lighting. To meet IES illumination standards on the preferred alternative roadway cross-sections, a staggered light pole spacing of approximately 125-feet would be required for this type of lighting. Assuming a cost of $2,500 per pole (material cost only), this alternative would cost only slightly more to implement through the corridor than the single-head ornamental (the least expensive) option. The advantages of double-head ornamental lighting are similar to those of the single-head ornamental in terms of aesthetics, streetscape environment, and ease of maintenance.

Preferred Roadway Lighting Design Option

Evaluating the various costs, advantages, and disadvantages associated with each of the roadway lighting alternatives summarized in Figure 11, and based on discussions with City Staff and Oregon City residents about their desires for the overall character and streetscape for the facility, it is recommended that an ornamental lighting option be implemented along the Molalla Avenue corridor. For a relatively comparable implementing cost, either the single-head or double-head ornamental lighting can be used to enhance the desired streetscape character along the corridor. The corridor does not contain adjacent land uses that would be negatively impacted by upward lights or illumination spill over from the roadway. Maximizing the options available with the ornamental lighting alternatives for aesthetic improvements is strong recommended in order to generate the City's desired environment along the corridor. The ornamental lighting should be incorporated into the near-term phased build-out corridor plan and implemented in any future roadway projects along the facility.

OPTION	COST PER POLE	POLES PER MILE	TOTAL COST FOR CORRIDOR	ADVANTAGES	DISADVANTAGES
A: TRADITIONAL COBRA HEAD 	$3,500/POLE	41 POLES/MILE (130' SPACING)	$335,650	• FEWER POLES REQUIRED TO MEET ILLUMINATION STANDARDS • LESS EXPENSIVE TO MAINTAIN • MINIMAL LIGHT PROJECTION UPWARD OR INTO ROADSIDE DEVELOPMENTS	• NOT AS AESTHETICALLY PLEASING • LUMINAIRE IS HIGHER OFF THE GROUND SO MORE DIFFICULT TO MAINTAIN • MOST EXPENSIVE OPTION TO IMPLEMENT
B: SINGLE HEAD ORNAMENTAL	$2,000/POLE	53 POLES/MILE (100' STAGGERED SPACING)	$247,950	• AESTHETICALLY PLEASING • ENCOURAGES A PEDESTRIAN FRIENDLY ENVIRONMENT • LUMINAIRE IS CLOSER TO THE GROUND SO EASIER TO MAINTAIN • LEAST EXPENSIVE OPTION TO IMPLEMENT	• THE MOST POLES REQUIRED TO MEET ILLUMINATION STANDARDS • MORE EXPENSIVE TO MAINTAIN (MORE POLES)
C: DOUBLE HEAD ORNAMENTAL	$2,500/POLE	43 POLES/MILE (125' STAGGERED SPACING)	$251,450	• AESTHETICALLY PLEASING • ENCOURAGES PEDESTRIAN FRIENDLY ENVIRONMENT • LUMINAIRE IS CLOSER TO THE GROUND SO EASIER TO MAINTAIN • RELATIVELY LESS EXPENSIVE OPTION TO IMPLEMENT	• MORE POLES REQUIRED TO MEET ILLUMINATION STANDARDS • MORE EXPENSIVE TO MAINTAIN (MORE POLES)

NOTE:

PRICES SHOWN ARE FOR POLE MATERIALS ONLY. DESIGN, CONDUIT, AND INSTALLATION ARE NOT INCLUDED.

Chapter 5 Molalla Avenue Corridor Plan

INTRODUCTION

The following sections of the Molalla Avenue Boulevard and Bikeway Improvements Plan summarize the specific system-wide improvement projects recommended to address the community's existing and future needs, and to develop the Molalla Avenue corridor in such a manner as to achieve the City's long-term vision for the facility over time. The overall corridor plan was developed to reflect the community's character and the goals and objectives that were outlined at the beginning of this transportation planning process. The Molalla Avenue Boulevard and Bikeway Improvements Plan identifies a set of corridor-specific strategies for the following aspects:

- Roadway Improvement Plan
- Pedestrian System Improvements
- Corridor Streetscape Improvements
- Bicycle System Improvements
- Transit System Improvements
- Corridor Access Efficiency and Enhancement
- Drainage and Utility Improvements
- Pavement Improvements

ROADWAY IMPROVEMENT PLAN

The roadway element of the Molalla Avenue Boulevard and Bikeway Improvements Plan was developed based on the identified existing and the anticipated future conditions operational and circulation needs of the corridor. (Figures 16 through 20, included at the end of this chapter, show the Phased Build-out Corridor Plan in plan view for the entire corridor.) Traffic operations and safety on the facility were evaluated and prioritized in conjunction with the community's vision and goals for the transportation corridor. The Oregon City community, City of Oregon City Staff, and the city decision and policy makers have all expressed a desire to focus the physical and operational characteristics of Molalla Avenue on enhancing multi-modal travel and developing a livable Main Street environment with mixed-use, transit-oriented, and community business land uses. As such, accepting a higher level of congestion for vehicular operations along the facility is a feasible policy decision that can be made by the community in order to achieve the overall transportation and land use goals for the corridor.

The roadway improvement plan identifies the roadway typical sections, design standards, and intersection capacity improvements for implementation to meet both existing and future capacity, circulation, and safety needs. The street design standards and typical sections applied to the roadway facility serve to identify and preserve right-of-way needed for the transportation network. Because all travel modes use the public right-of-way that comprises the street network, all transportation modes were considered and incorporated into this portion of the planning process.

Roadway Typical Sections

Roadway design standards are based on the functional and operational characteristics of the street (such as travel demand, capacity, operating speed, adjacent land uses, composition of traffic,

travel mode split, and safety). The standards are also established to provide appropriate right-of-way widths and space for travel lanes, and pedestrian and bicycle facilities.

The typical sections for the Molalla Avenue corridor were developed through project workshops with City of Oregon City staff and public open houses. The street cross-sections developed for the corridor are illustrated in Figures 12 and 13. As can be seen from the figures, both a Phased Build-out and a Full Build-out typical section for the corridor were established with three-lane and five-lane cross-section options for specific segments of Molalla Avenue. The street cross-sections depict the recommended alternative developed in order to meet the outlined project goals for a plan to develop Molalla Avenue as a transit and pedestrian focused roadway that provides acceptable levels of both capacity and direct but efficient access and is an attractive, livable street providing a gateway to southern portions of the Oregon City community.

Corridor Intersection Improvements

In addition to the corridor typical section roadway improvements, several intersection geometry and alignment enhancement projects were identified to be implemented as part of the Molalla Avenue Boulevard and Bikeway Improvements Plan. Table 5-1 summarizes the proposed intersection improvements that are included in the corridor plan.

Table 5-1. Phased Build-out Corridor Plan Intersection Improvements

No.	Intersection	Proposed Improvements
I-1	Division Street/Molalla Avenue	Traffic signal modification to accommodate 3-lane cross-section, bicycle lanes, and sidewalk improvements on Molalla Avenue.
I-2	Pearl Street/Molalla Avenue	Realign offset intersection / acquire property for right-of-way as opportunity arises. Traffic signal modification to accommodate 3-lane cross-section, bicycle lanes, and sidewalk improvements on Molalla Avenue. Provision of a 50-foot southbound and a 50-foot northbound left-turn lane storage distance on the Molalla Avenue approaches at the intersection.
I-3	Barclay Hills Drive/Molalla Avenue	Monitor intersection to determine if and/or intersection geometry and control improvements are warranted. Provision of a 150-foot southbound and a 50-foot northbound left-turn lane storage distance on the Molalla Avenue approaches at the intersection.
I-4	Hilda St-Holmes Lane/Molalla Avenue	Realign offset intersection / acquire property for right-of-way as opportunity arises. Provision on exclusive left-turn lanes on the eastbound and westbound (Holmes Lane-Hilda Street) approaches. Traffic signal modification to accommodate 3-lane cross-section, bicycle lanes, and sidewalk improvements on Molalla Avenue. Provision of a 50-foot southbound and a 100-foot northbound left-turn lane storage distance on the Molalla Avenue approaches at the intersection.
I-5	Warner Milne Road/Molalla Avenue	Realign offset intersection / acquire property for right-of-way as opportunity arises. Provision on exclusive left-turn lanes on the eastbound and westbound (Warner Milne Road) approaches. Traffic signal modification to accommodate cross-section, bicycle lanes, and sidewalk improvements on Molalla Avenue. Provision of a 50-foot southbound and a 250-foot northbound left-turn lane storage distance on the Molalla Avenue approaches at the intersection.
I-6	Hilltop Mall/Molalla Avenue	Traffic signal modification to accommodate cross-section, bicycle lanes, and sidewalk improvements on Molalla Avenue. Provision of a 100-foot northbound left-turn lane storage distance on the Molalla Avenue approaches at the intersection**.
I-7	Beavercreek Road/Molalla Avenue	Traffic signal modification to accommodate cross-section, bicycle lanes, and sidewalk improvements on Molalla Avenue. Provision of a 325-foot southbound and a 275-foot northbound left-turn lane storage distance on the Molalla Avenue approaches at the intersection.

No.	Intersection	Proposed Improvements
I-8	Clairmont Way/Molalla Avenue	Traffic signal modification to accommodate cross-section, bicycle lanes, and sidewalk improvements on Molalla Avenue. Provision of a 75-foot southbound and a 125-foot northbound left-turn lane storage distance on the Molalla Avenue approaches at the intersection.
I-9	Gaffney Lane/Molalla Avenue	Traffic signal modification to accommodate cross-section, bicycle lanes, and sidewalk improvements on Molalla Avenue. Provision of a 175-foot southbound and a 150-foot northbound left-turn lane storage distance on the Molalla Avenue approaches at the intersection.
I-10	Highway 213/Molalla Avenue	Traffic signal modification to accommodate cross-section, bicycle lanes, and sidewalk improvements on Molalla Avenue. Provision of a 300-foot southbound and a 150-foot northbound left-turn lane storage distance on the Molalla Avenue approaches at the intersection.

Notes:
*A minimum storage distance of 50-feet should be provided for all intersection left-turn lanes.
**The required storage distance for the southbound left-turn movement at this intersection should be determined once the extension of the fourth leg of the intersection has been constructed.

As mentioned in Chapter 3, there are two more intersections not included in the above table which may need improvements. The Molalla Avenue/Fir Street intersection has also been identified as a location that will likely require signalization in the future (based on anticipated growth in traffic volumes and the opening of the Fir Street connection to Beavercreek Road). It is recommended that the City monitor this location to determine if and when signalization is warranted for either operational an/or safety reasons. In addition, there is a need for both operational and safety improvements within the vicinity of the 7th Street-Molalla Avenue/Division Street-Taylor Street intersection. Possibilities for improvements include constructing a modern roundabout. However, due to the complex geometry and operational issues that currently exist, a definitive recommendation for improvements at this location was deemed beyond the scope of this planning-level effort. As such, it is recommended that the City undertake a detailed sub-area study for the 7th Street-Molalla Avenue/Division Street-Taylor intersection to develop and evaluate geometric, operational, and safety alternatives for the intersection.

It is important to recognize that the recommended storage distances for the left-turn movements at each of the intersections along the study corridor are conservative best estimates based on a 20-year travel demand forecast and, therefore, at this time, they are only meant to serve for general corridor planning purposes. When roadway improvement projects are implemented, the actual intersection configuration design should be based on more refined analysis based on the design year travel demand and operational forecast. It is also important to note that these are storage lengths required for queue stacking at the intersection only. An associated transition taper length, in addition to the storage lengths show in the table, will have to be provided for each left-turn bay.

Traffic Signal and Signal Detection Improvements

As shown in Table 5-1, a major component of the implementation of the Molalla Avenue Boulevard and Bikeway Improvements Plan will be upgrading and modification of the corridor's traffic signals. The majority of the traffic signals along the corridor, particularly in the northern segment, are aging and in need of modernization. In addition, traffic signal modification will be required as the typical section street improvements, and their associated pedestrian, bicycle, and streetscape enhancement projects, are constructed.

It is anticipated that the traffic signals will be upgraded and replaced as the Phased Build-out Molalla Avenue Boulevard and Bikeway Improvements Plan is implemented. However, given the City's current traffic signal maintenance agreement with Clackamas County for the Molalla Avenue

facility, it is recommended that close coordination with the County and a revised traffic signal construction and maintenance agreement, agreeable to both parties, be developed between the two agencies.

The existing signal detection infrastructure utilizes inductive loops installed into the roadway pavement. It is recommended that newer video detection technology be implemented along the Molalla Avenue corridor. Throughout the corridor there exists the opportunity to implement video detection systems at all of the signalized intersections. Implementing a video detection system would allow for a long-term functional detection system regardless of future roadway changes and poor pavement conditions. The advantages of video traffic signal detection include the fact that trenching and cutting of the existing roadway pavement is not required and that the detection can easily be changed and modified to be compatible with future lane configuration and roadway geometry improvements.

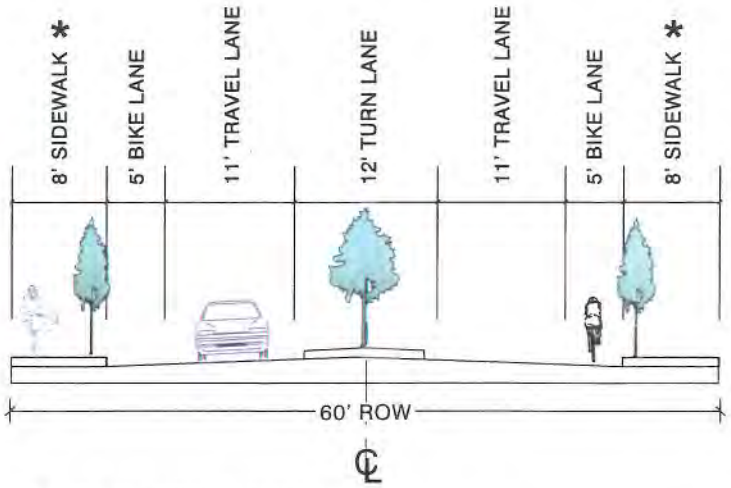
If the City desires to maintain a pavement loop detection system, it is recommended that the loop detector junction boxes be placed at their ultimate locations determined from the typical cross-sections for the long-term full build-out plan for the corridor. By doing so, roadway maintenance, configuration changes, and pavement rehabilitation can occur with minimal need for replacing the signal detection system.

Pedestrian System Improvements

The key objective in the development of the recommended pedestrian system improvement projects was to ensure a connected, efficient, pleasurable, and safe pedestrian environment along the extent of the Molalla Avenue corridor. The guiding vision for the Molalla Avenue corridor includes the development of adjacent land uses that are pedestrian-oriented and accessible. A primary goal of the plan was to achieve a pedestrian-friendly Main Street environment on the facility, where walking is a viable, efficient, enjoyable mode of travel. Maximizing the opportunities to increase pedestrian trips along the corridor was a key strategy in the development of this plan.

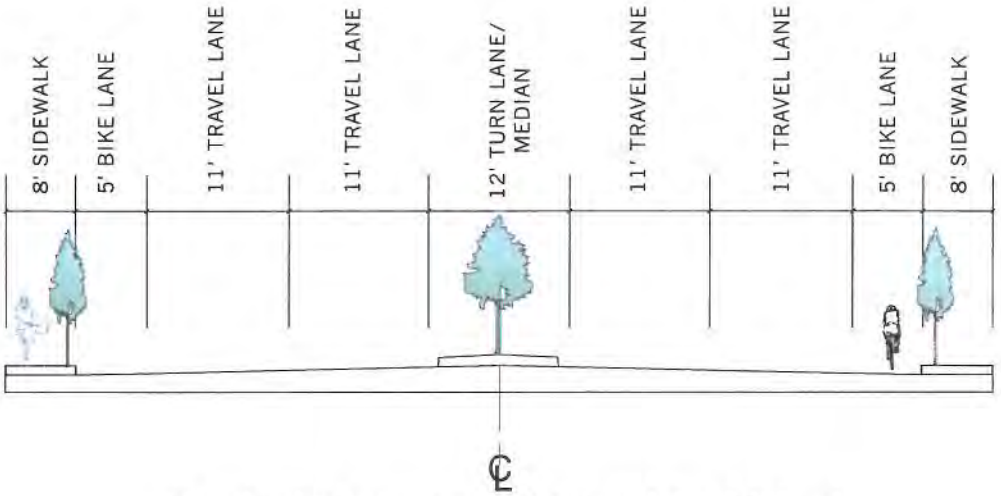
Sidewalk Improvement Projects

The preferred alternatives shown in Figures 12 and 13 ensure that enhanced pedestrian facilities are provided in conjunction with all roadway improvement and redevelopment projects initiated along the corridor. The Phased Build-out corridor plan maximizes the pedestrian facilities provided within the existing available right-of-way along the facility. Under the initial Phased Build-out portion of the plan, 8-foot pedestrian ways, separated from the vehicular travel way by bicycle lanes, are to be provided on both sides of Molalla Avenue for the extent of the corridor. The Full Build-out plan will serve to expand the public right-of-way, where necessary, to provide 10-foot sidewalks, buffered from vehicular flow by striped bicycle lanes and on-street parking, on both sides of the facility for the extent of the corridor.



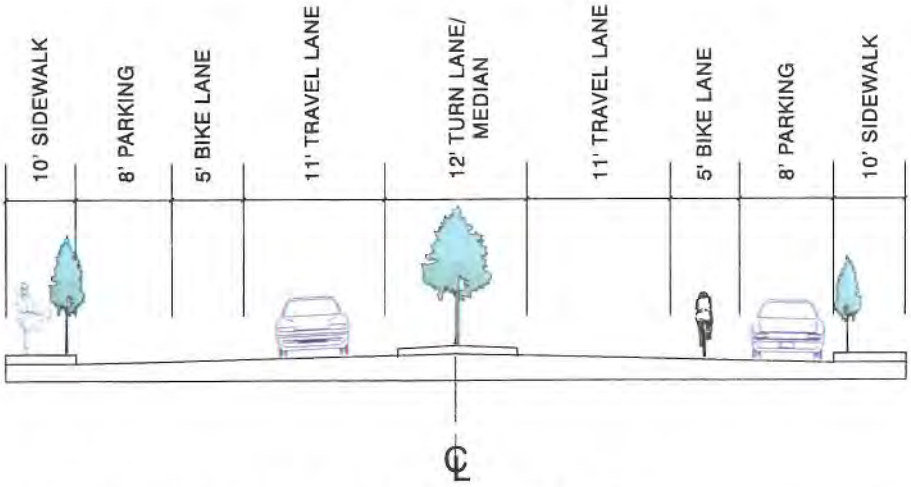
* WITH PLANTED TREE WELLS

North & South Segment (60' Right-of-Way) with access management

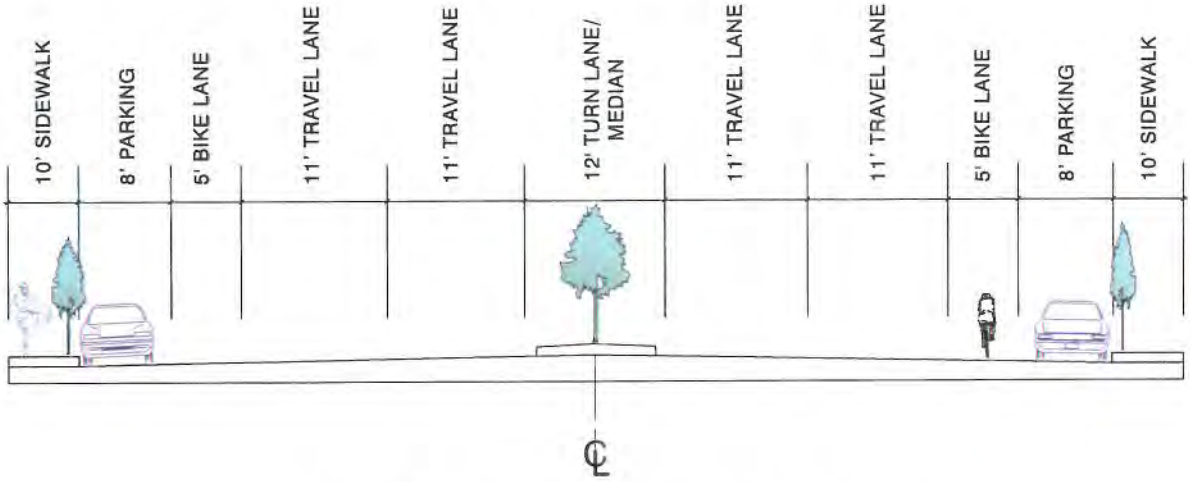


Central Segment (82' Right-of-Way) with access management

Typical Cross Sections Phased Build-out Plan			Figure 12
January 2001 - Job 1077A	WALLIS ENGINEERING in association with GREEN WORKS Kittelson & Associates		Molalla Avenue Boulevard and Bikeway Improvements Plan Oregon City, Oregon



North and South Segment (80' Right-of-Way) with access management



Central Segment (102' Right-of-Way) with access management

Typical Cross Sections Full Build-out Plan			Figure 13
January 2001 - Job 1077A	WALLIS ENGINEERING in association with GREENWORKS Kittelson & Associates		Molalla Avenue Boulevard and Bikeway Improvements Plan Oregon City, Oregon

Other Pedestrian Amenities

Pedestrian treatments located in Main Street, high density mixed use, and transit-oriented environments require additional consideration because of the desire to encourage pedestrian activity. Street furniture, improved crosswalks (both mid-block and at intersections), median treatments, landscaping treatments, and other pedestrian amenities all will enhance the aesthetics of the corridor and foster a pedestrian-friendly environment. It is also important to maintain the visibility of pedestrians, particularly in areas where they are in the proximity of vehicular and bicycle flow, to ensure the safety of all roadway users. Curb extensions and bulb-outs at intersections (to reduce the exposed crossing distance a pedestrian must walk), street planters, street lighting (to improve visibility at night), and on-street bicycle lanes and parking all act as pedestrian buffers and improve safety for pedestrians. Enhanced pedestrian crossing should be provided at all intersections along the corridor. Due to the short block spacing along the corridor, mid-block pedestrian crossings are not recommended except at locations that are deemed to be significant or high pedestrian generators or where a safety problem is perceived. When block spacing exceeds three hundred feet, a mid-block crossing should be considered. All pedestrian crossings should be constructed to meet ADA requirements with pedestrian refuges located where center medians exist. The pedestrian crossings should be constructed with materials consistent with the streetscape requirements outlined in this plan and with materials that highlight and signify the locations as pedestrian ways to all other roadway users. At signalized crossings, pedestrian push buttons should be provided on all intersection approaches. The specific Molalla Avenue Boulevard and Bikeway Improvements Plan recommendations for these streetscape and aesthetic enhancement projects are detailed in subsequent sections of this chapter.

Corridor Streetscape Improvements

Streetscape Improvements recommended for both Phased and Full Build-out scenarios are shown graphically on Figures 14 and 15. They are further described in the following paragraphs.

Landscaping and Trees

Recommended landscaping improvements are limited to street trees within the sidewalks and a combination of trees and shrubs within the medians. Tree planting intervals of 25 to 35 feet are recommended. It is also recommended that trees be restricted a distance of 30 feet from intersections to maintain sight distance. Tree height limitations should be based on the height of existing overhead wires. Replacing the overhead utilities underground would increase the possible options for street trees. The proposed street trees should be columnar in nature with tight, narrow branching. They should be narrow enough to avoid conflict with overhead utilities placed at the back of sidewalk along the right-of-way line. A Street Lighting and Tree Master Plan has been included with this document (Appendix F) to provide further guidance on placement of street trees.

Median Treatments

Medians are recommended for two purposes: 1) scenic value, and 2) pedestrian safety. For medians to provide pedestrian safety, they have to be located at pedestrian crossings, a situation that is only possible in mid-block pedestrian crossings and at tee intersections.

In the Central Segment, the roadway is particularly wide. The long distance between intersections in this Segment offers opportunities for mid-block pedestrian crossings. Medians in this area would be particularly beneficial. They would mitigate the negative impacts to pedestrian mobility caused by the wider roadway. The wider roadway acts as a barrier to pedestrians because of the

increased crossing distance and exposure to danger. Medians at pedestrian crossings would provide refuge for pedestrians in the center of the street, in essence breaking up the crossing distance into two halves. The reduced crossing distance of each half requires a smaller gap in the traffic flow, thus providing more opportunities for pedestrian crossings. Pedestrian safety is further improved because crossing each half of the roadway requires paying attention to only one direction of traffic flow instead of two.

Regardless of where medians are located, they will help improve scenic values. The narrowing visual effect of the median will also help improve land use cohesion between the two sides of the street.

Intersection Bulb-out Treatments

Intersection bulb-outs provide an excellent opportunity to increase both the scenic qualities and safety of a corridor. In the case of Molalla Avenue, this design concept can only be utilized in the Build-out Plan, where on-street parking is provided for. Intersection bulb-outs offer the opportunity for an increased landscaping footprint. They also serve to decrease the width of the pedestrian crossing, thus providing a safety feature similar to the median as discussed above.

Crosswalks

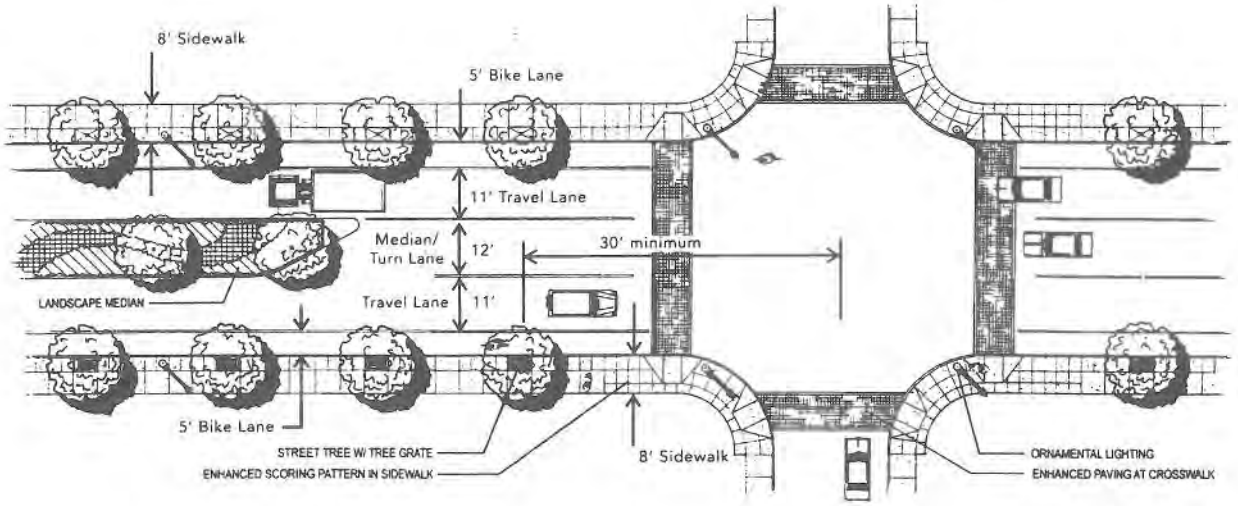
Along Molalla Avenue all signalized intersections should be marked clearly. Clear crosswalk delineation can be accomplished by paint or plastic striping in either ladder or zebra-style markings or with colored concrete and brick pavers. Crosswalks create more friendly pedestrian environments, make it easier for police to enforce street laws, and increase predictability of pedestrian crossing points, which result in safer interaction between cars and pedestrians. Crossings are particularly beneficial to children. Similar to street trees and furniture, there are many design issues involved with crosswalks that incorporate colored concrete or brick pavers. These options should be reviewed through engineering design and city-wide policy.

Street Furniture

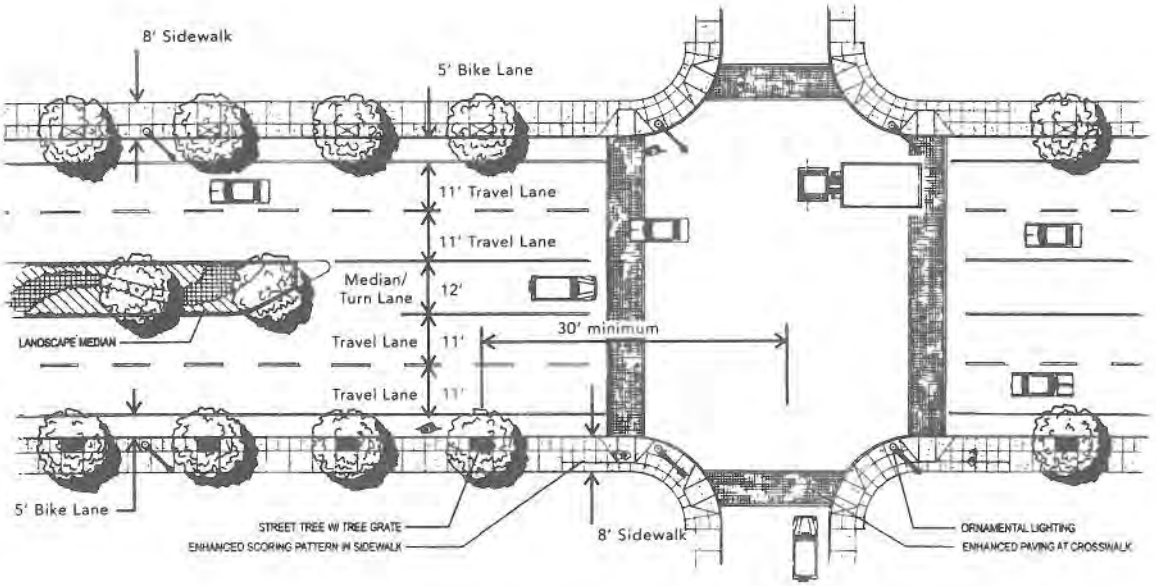
Street furniture such as benches, waste containers, flower and shrub planters, trees, bollards, lampposts, and kiosks encourage people to walk. With proper design, they also provide scenic benefits. Benches help seniors and disabled, who may need frequent rests. Street furniture, like landscaping improvements, comes at a price. In addition to initial costs, long-term maintenance and replacement expenditures are necessary. The City of Oregon City has a plan for the Main Street corridor that should be consulted regarding street furniture.

Roadway Illumination Enhancements

A key streetscape feature included as part of the corridor plan is the roadway lighting improvement recommendations for Molalla Avenue. The extent and character of the roadway lighting provided along a corridor plays an important role in defining the streetscape atmosphere, as well as in the facilitation of a safe and effective vehicular, pedestrian, and bicycle environment. See Appendix F for the Street Lighting and Tree Master Plan.

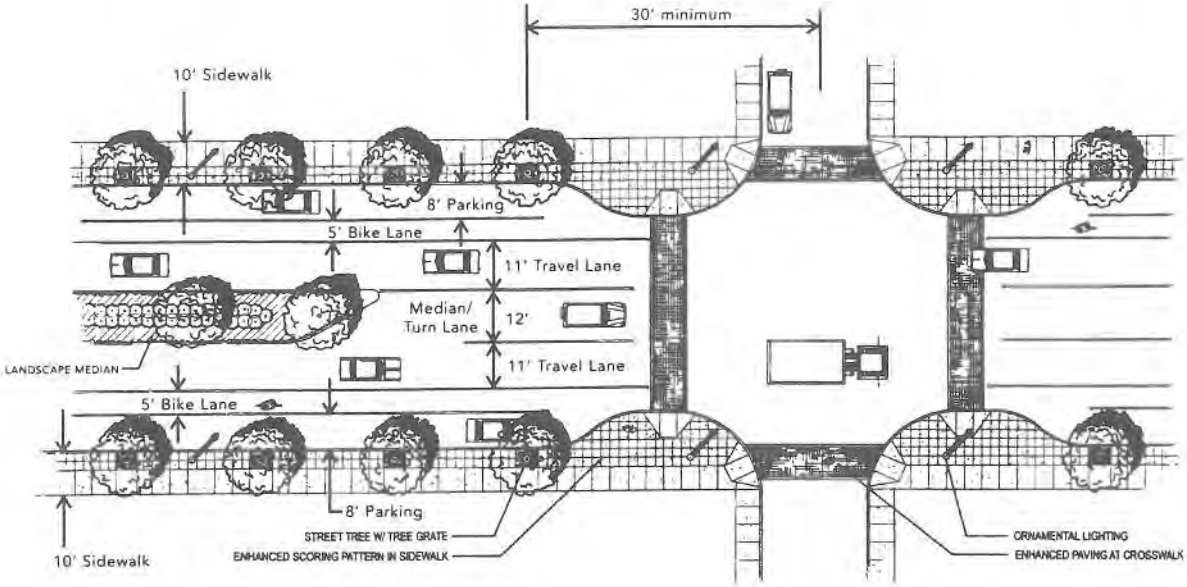


North and South Segment

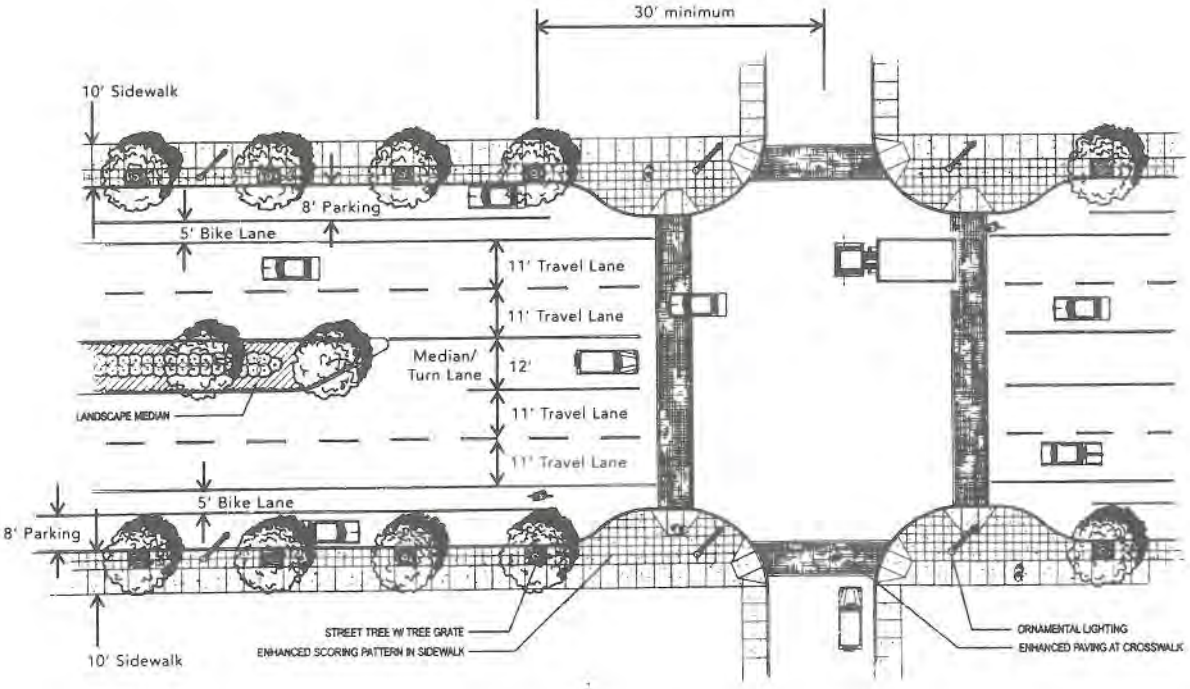


Central Segment

Typical Intersection Phased Build-out Plan			Figure 14
January 2001 – Job 1077A	WALLIS ENGINEERING in association with: GREEN WORKS, Kittelson & Associates		Molalla Avenue Boulevard and Bikeway Improvements Plan Oregon City, Oregon



North and South Segment



Central Segment

Typical Intersection Full Build-out Plan			Figure 15
January 2001 - Job 1077A	WALLIS Landscape in association with GREENWORKS Kittelson & Associates		Molalla Avenue Boulevard and Bikeway Improvements Plan Oregon City, Oregon

After evaluating the various costs, advantages, and disadvantages associated with several roadway lighting alternatives, and based on discussions with City Staff and Oregon City residents about their desires for the overall character and streetscape for the facility, the recommended illumination plan for the Molalla Avenue corridor includes the provision and maintenance of single-head ornamental street lighting along the facility. This lighting strategy provides light poles that are relative low to the ground, spread illumination throughout the roadway and roadside (i.e. sidewalk) areas, and that can be used to enhance the desired streetscape character and foster a pedestrian-friendly, Main Street focused environment along the corridor.

Based on the Full Build-out corridor plan typical section street width, the single-head ornamental illumination requires a staggered pole spacing of 100-feet in order to meet IES (Illuminating Engineer Society) standards. It is estimated that this roadway illumination plan will cost approximately $2,000 per light pole. This estimate represents a typical average cost for the single-head ornamental lighting, however, the price per pole could range higher depending on the illumination style selected. Ornamental lighting is generally considered very aesthetically pleasing and conducive to fostering a pedestrian-friendly, livable Main Street feel for a corridor. For example, flower baskets and banner treatments can be incorporated onto the lighting poles with this illumination option. Maximizing these (and other) options for aesthetic improvements available with ornamental lighting is strong recommended in order to generate the City's desired environment along the corridor. The illumination pole is significantly lower than the traditional cobra-head light poles (typically only about 20 feet high) making maintenance of the lighting system easier. However, because a greater number of light poles are required, will possible slightly more expensive to maintain than traditional alternatives.

A conceptual illumination plan (based on the required pole-spacing for the Full Build-out corridor plan roadway cross-sections), planning-level cost estimates, and an outline of the advantages and disadvantages of the roadway lighting strategy is summarized in Figure 11 (in Chapter 4). The ornamental street lighting should be incorporated into the near-term Phased Build-out corridor plan and implemented in any future roadway or redevelopment projects along the facility.

Bicycle System Improvements

Similar to the recommended pedestrian system improvement projects, the recommended bicycle system improvements were established to provide a connected, effective, and safe system for bicyclists along Molalla Avenue. As traffic volumes increase on streets, the on-street striped bike lanes should be provided to maintain safety and comfort for bicyclists within the system and to promote increased utilization of the bicycle travel mode.

Bicycle Improvement Projects

The typical street cross-sections, shown in Figures 12 and 13, ensure that on-street striped bicycle lanes are provided along the extent of the Molalla Avenue corridor in conjunction with all roadway improvement and redevelopment projects. Under both the Phased Build-out and Full Build-out plan, 5-foot striped on-street bike lanes are to be provided and maintained on both sides of the facility for the extent of the Molalla Avenue corridor.

Other Bicycle Amenities

Additional enhancements to the bicycle system focus on providing amenities for cyclists. It is recommended that, in addition to the pedestrian amenities provided, bicycle racks and parking spaces be provided along the corridor to encourage cycle use and provide opportunities for cyclists to secure their bicycles during trips. As with pedestrians, street furniture, improved crossings (both

mid-block and at intersections), median treatments, and landscaping treatments all enhance the aesthetics of the corridor and make cycling a more pleasurable and, therefore, viable mode of travel. Curb extensions and bulb-outs at intersections (to reduce the exposed crossing distance), street planters, and street lighting (to improve visibility at night) can all be implemented to enhance the streetscape environment for bicyclists. The specific Molalla Avenue Boulevard and Bikeway Improvements Plan recommendations for these types of streetscape and aesthetic enhancement projects are detailed in subsequent sections of this chapter.

Transit System Improvements

Public transit service provides mobility to community residents who do not have access to automobiles and provides an alternative choice of travel mode to those residents who do. Transit service should meet the needs both of travelers within the city and those of travelers making trips outside of the community. The provision of adequate public transit service is growing increasingly important in the Oregon City area due to the number of Oregon City residents for whom transit is the primary transportation mode. These residents include those who do not have access to automobiles, those who are prevented from driving by some physical condition, and those who prefer transit for environmental reasons or because they do not want to drive on congested roadways.

Metro has also designated Molalla Avenue as a Regional Bus Route, a Community Connector, and a Transit/Mixed Use Corridor in its Regional Transportation Plan. This, combined with the guiding vision for Molalla Avenue as a vibrant, high-density, mixed-use corridor, contributes to the need and desire for effective, convenient transit coverage along the facility. Improved transit service is also important because of the combination of increasingly congested roadway conditions during peak periods and the limitations in obtaining funding for roadway capacity improvements. These factors necessitate a diversion of automobile users to alternative modes of transportation.

The public transportation system along Molalla Avenue, and throughout the Oregon City community, was extensively studied through the on-going work for the City of Oregon City Transportation System Plan. Through the course of the TSP work, a series of specific improvement projects for the public transit service provided along Molalla Avenue were developed. These public transit service enhancements are summarized in Table 5-2.

Table 5-2. Recommended Public Transit System Improvements (Oregon City TSP)

No.	Transit Service	Recommended Improvement	Estimated Cost
T-9	Proposed "Commuter" Oregon City Trolley Route	Provide an additional trolley route along the Singer Hill-7th Street-Molalla Avenue corridor from the Oregon City Transit Center to the Hilltop Mall; route would serve to connect the various commercial and retail uses along 7th Street-Molalla Avenue to the downtown core; provide a park-n-ride facility at the Hilltop Mall for travelers from the southern areas of the city; provide reliable, consistent service at 30-minute headways; service of this route could eventually be extended to Clackamas Community College or increased in headway frequency.	$70,000/yr $1,000 for park-n-ride
T-12	Tri-Met *Route 32: Oatfield*	Increase service frequency from 60-minute to 30-minute headways; modify the existing Tri-met Route 32 service to continue straight through the Highway 213/Beavercreek Road intersection and along Beavercreek Road to access Clackamas Community College from the Beavercreek Road entrance as opposed to at Molalla Avenue as it does currently.	$50,000/yr
T-13	Tri-Met *Route 33: McLoughlin*	Increase the frequency of the existing Route 33 service (Clackamas Community College to Oregon City Transit Center) from 30-minute headways to 10 or 15-minute headways.	$50,000/yr

Overall, the City of Oregon City should continue to monitor the adequacy of the transit service provided along Molalla Avenue and work with Tri-Met to expand and/or modify service as necessary. In addition, both the City and Tri-Met should promote a greater public awareness of the available public transit services by providing additional information at City Hall and at the bus shelters. Greater awareness of the services provided will likely result in increased usage and ridership. Increased awareness of the park-n-ride locations and availability would also encourage ridership. The addition of distinct signage for the park-n-ride facilities would improve visibility.

Corridor Access Efficiency and Enhancement

Access efficiency and enhancement is needed to ensure both the safety and efficiency of the flow of vehicles, pedestrians, and bicyclists traveling on the roadway system. Managing the access of roadways benefits the overall transportation system by increasing safety, increasing capacity, and reducing travel times. However, access management policy cannot be so restrictive as to prevent local businesses and homeowners from obtaining deserved and reasonable access to the public roadway system. Overall, access efficiency and enhancement policy must balance the needs of through traffic, localized traffic, and pedestrians and bicyclists on the street network. By the nature of the roadway functional classification system and operational characteristics, arterials require the highest access efficiency standards, while collectors and local streets require less restrictive access management standards.

Existing Corridor Access Configuration

Under existing conditions, the access configuration along the Molalla Avenue corridor consists of a proliferation of unevenly spaced driveway approaches. This is the result of piecemeal development patterns, in the absence of any corridor or overall access enhancement and efficiency plan for the facility. The large number of varying access approaches, in conjunction with growing traffic volumes along the corridor, impacts the overall mobility and operational safety of Molalla Avenue, making access to and from facilities and adjacent land uses difficult, reducing the potential roadway capacity, and impeding operations of traffic through the corridor. Consequently, motorists are faced with a high potential for encountering conflicting turning vehicles. The frequent, poorly delineated, and inconsistent access spacing along the corridor also provides increased opportunity for conflicts with pedestrians and bicyclists.

In many locations, the existing access configuration along the corridor provides multiple access points and curb cuts for a single property. In certain instances there is relatively little delineation identifying approaches to Molalla Avenue from the adjacent land uses. Organizing approaches in a more comprehensive manner and increasing access efficiency could allow for both increased arterial capacity along the corridor, as well as for more effective land use and parking configurations for the abutting property owners.

The exiting configuration of accesses along Molalla Avenue does not adequately provide a safe and efficient environment in which mobility and accessibility are balanced. The proposed geometric and streetscape improvements identified in the Molalla Avenue Boulevard and Bikeway Improvements Plan will enhance the roadway, pedestrian space, streetscape environment, and adjacent properties by providing curbs, bicycle lanes, wider pedestrian ways, and landscaping treatments. However, from an operational and safety perspective, it is also necessary to properly manage the location and operation of both the public and private access approaches along the roadway in order to maximize the roadway capacity and minimize turning movement conflicts between adjacent and opposing points of access, and between vehicular, pedestrian, and bicycle movements.

General Corridor Access Efficiency and Enhancement Objectives

Access efficiency and enhancement concentrates on minimizing the number of direct access points to major surface streets, providing reasonable and effective indirect access to properties, effectively designing driveways, and enforcing safe and efficient spacing and location of driveways and public street connections. As Oregon City develops along with the greater Portland Metropolitan area, the community will rely more heavily upon a variety of travel modes as congestion increases. As such, it will become increasingly important to maximize access efficiency on both the existing and future roadway system as new development and redevelopment occurs. In the instance of Molalla Avenue, the access efficiency and enhancement policies implemented must complement the livability and streetscape vision for the corridor, such as fostering a pedestrian and bicycle friendly environment and encourage the development of a pedestrian and transit-oriented Main Street atmosphere.

Previous sections of this chapter have outlined the transportation system and streetscape improvements comprising the Molalla Avenue Boulevard and Bikeway Improvements Plan. However, another key component of the corridor plan will be the refinement of the corridor's access configuration to address safety, operational, mobility, and accessibility issues along the facility. Access efficiency and enhancements improvements should be aimed at balancing property accessibility, roadway safety, and roadway mobility; and should be designed to promote efficient on-site circulation patterns for the corridor land uses. Both public and private access locations should be placed appropriately to limit potential conflicting turning movements, weaving maneuvers over short distances, and congestion along roadway facilities. While the City Staff and consultant project team have determined that the identification of specific access efficiency and enhancement improvement projects is beyond the scope of this report, general corridor access efficiency plan goals and objectives are discussed below.

The key goals for access efficiency and enhancement along Molalla Avenue attempt to achieve a compromise between the issues of mobility for all roadway users (vehicles, pedestrians, and bicyclists) and accessibility to local property owners and the connecting transportation system. The key design, planning, and operational issues to be addressed as part of the development of the access efficiency and enhancement plan for the facility include:

- Reducing vehicular, pedestrian, and bicycle conflict points along Molalla Avenue and its intersecting access locations (both public and private).
- Prioritizing the safety of all roadway users.
- Developing an access efficiency and enhancement strategy plan to address property accessibility and roadway mobility (for all modes) throughout the corridor.
- Maximizing the vehicular, pedestrian, and bicycle capacity of the facility.
- Eliminating redundant and unused access points along the corridor.
- Developing improved, viable, and efficient on-site access and circulation patterns for adjacent properties consistent with and complementary to the proposed access efficiency and enhancement plan.
- Developing and fostering the desired aesthetic, land-use/transportation system vision for the corridor.
- Minimizing direct access to Molalla Avenue when alternative access to the street system is available.

It is recognized that these access improvement objectives will have to be achieved within the existing constraints and opportunities associated with the existing land uses and transportation system along the Molalla Avenue corridor. A best effort will have to be undertaken in developing a safe and efficient access enhancement plan that strives to achieve the community goals for Molalla Avenue while recognizing the existing constraints along the corridor.

A variety of techniques can be used in order to achieve access efficiency and enhancement including geometric design considerations (i.e., medians, islands, channelization) that prohibit certain movements, consolidation of access points (i.e., joint/shared driveways), and the provision of auxiliary lanes for turning movements. Such improvements when implemented correctly can provide significant benefit for smoother vehicle flow, reduced travel delay, and fewer crashes. These benefits lead in turn to advantages such as reduced road users travel time, fuel consumption, property damage, and personal injury. Driveways and local street access points should be placed appropriately to limit potential conflicting turning movements, weaving maneuvers over short distances, and to provide for safe and efficient on-site circulation.

The ability to manage access effectively is often dependent on how developed an area is when access enhancement action is taken and policies are implemented. If access efficiency is considered at the planning stages, before significant development has occurred, there exists the greatest potential and opportunity for results. In more established or built-out areas, such as Molalla Avenue, where little or no previous consideration has been given to planning access efficiency along the corridor, retrofitting is necessary. This process typically occurs by modifying the access to individual and joint properties as they change land use and/or redevelop or jointly with a major roadway reconstruction project. These approaches are often constrained, however, by limited site frontage and depth and lack of space for joint/shared access points. Access changes will be reviewed on a case-by-case basis.

Drainage and Utility Improvements

Detailed information regarding drainage and utility improvements is presented in Appendix C. Along Molalla Avenue a variety of underground utilities, including those owned by both the City and other utility purveyors, will require upgrading through the planning period. The timing for these upgrades will partly depend upon funding, which is a major factor in the timing of street improvements. Both the Water Master Plan and the Sanitary Sewer Master Plan are, at the time of this writing, being updated. Improvements included in these master plans should be reviewed and incorporated into any development or re-development projects along the Molalla corridor. It is recommended that as development or re-development projects are designed and completed, private utilities within the limits of these projects should be placed underground.

Pavement Improvements

Through the 20-year planning period, all of Molalla Avenue throughout the planning area will require pavement rehabilitation. Specific pavement requirements are discussed in detail in Appendix A.

Chapter 6 Molalla Avenue Implementation Plan

PROJECT COST ESTIMATES

The Phased Build-out project is estimated to cost just under $11 million (in year 2001 dollars). Detailed cost estimates are summarized in Appendix G. Cost estimates have not been prepared for the Full Build-out Plan due to uncertainties regarding right-of-way costs and issues regarding cost-sharing by developers in conjunction with the development of adjacent parcels of property.

IMPLEMENTATION

Timing of Project Phasing

During the initial phases of developing this plan, it became apparent that right-of-way constraints would prevent the City from immediately constructing those improvements that would meet the 20-year needs of the corridor. Two alternative plans were developed to provide for a phased approach; 1) Phased Build-out plan, and 2) Full Build-out plan.

It is the City's desire to move forward with the Phased Build-out plan as soon as funds and opportunities become available. Timing issues related to the Phased Build-out Plan are discussed later in this Section.

Timing of the Full Build-out plan will depend upon re-development of adjacent properties, which is largely outside of the City's control. For that reason, no attempt was made to establish timelines for the Full Build-out plan.

Technical Implications of Phasing

In light of the fact that the Phased Build-out Plan will be constructed over a number of years (see following section – Phased Build-out Sequencing), the Full Build-out Plan will serve as the basis of design for re-development of adjacent parcels. As a consequence, it is quite possible that for many years to come, Molalla Avenue will be a patchwork of cross-sections. One way to avoid this is to require new development to provide the right-of-way for the Full Build-out cross-section, but construct the Phased Build-out cross-section. The land area between Full Build-out and Phased Build-out right-of-way lines would have to be utilized in a manner which would not impact the site when that area becomes part of the Full Build-out cross-section.

Sequencing Phased Build-out Plan

The Phased Build-out plan has a construction cost estimate of just under $11 million. This estimate does not include professional services or contingency. The City's financial resources are far less than adequate to fund this project. Because of these financial constraints, no attempt was made to establish timelines for the implementation of the Phased Build-out plan. From discussions with City staff, it became apparent that the City may be able to implement the Phased Build-out plan incrementally by constructing a segment each year if that segment's cost was in the $500,000 to $1,000,000 range. As such, a project sequencing plan was developed for the Phased Build-out improvements, with individual segments in the aforementioned cost range.

The $500,000 to $1,000,000 cost range for project segments effectively limited each component of the project to a length of about 1,500 feet. To establish priorities, a hierarchy of deficiencies was first established. Molalla Avenue currently has a number of deficiencies which vary in magnitude

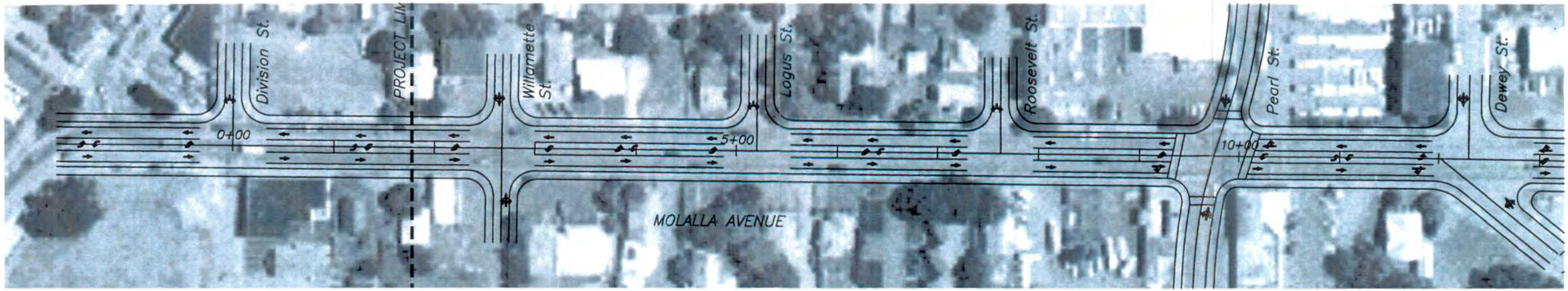
along its length. In establishing priorities, it was important to establish a relative priority by segment, but also by independent need. In other words, an individual segment could be deficient in sidewalks (pedestrian function) but adequate in pavement condition. Another segment might be the opposite. Where functional needs are consistent along the length of the corridor, that function did not need to enter into the evaluation of priorities. Those corridor needs (and deficiencies) that vary the most along the length of the corridor are:

1. User safety.
2. ADA improvements.
3. Pavement rehabilitation needs.
4. Utility replacement needs.
5. Aging signals.

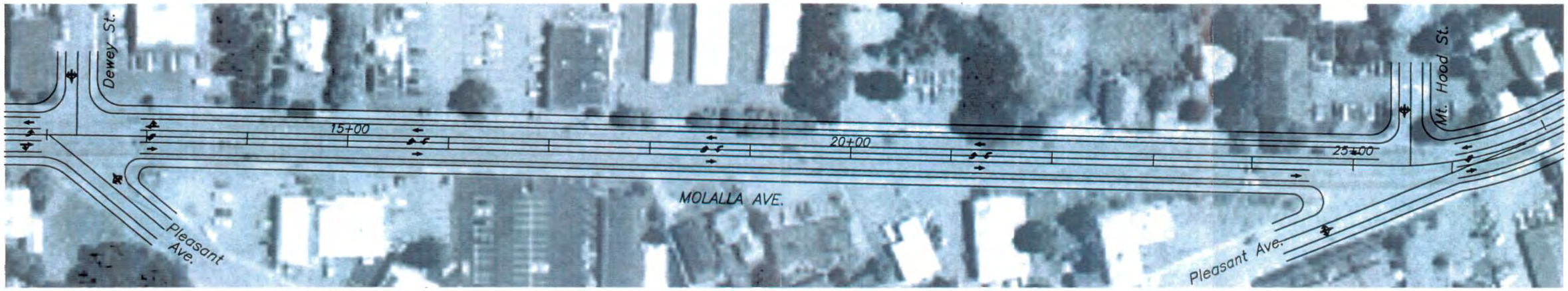
Of these five corridor needs, user safety was deemed the most important. Within that context, ADA improvements along the corridor will provide safer pedestrian facilities for all pedestrians. The first priority for Molalla Avenue, before any new cross section can be constructed to improve upon the above list, would be to change the striping along the northern section of Molalla Avenue to correspond with the Phased Build-out Plan. In order to change the striping to the Phased Build-out plan, two signals (at Molalla Avenue/Holmes Lane-Hilda Street and Molalla Avenue/Pearl Street) would have to be replaced. After that initial project were complete, the cross section of Molalla could be reconstructed to align with the Phased Build-out scenario and meet the above list of needs. Table 6-1 presents the proposed sequencing plan based upon priority.

Table 6-1. Molalla Avenue Phased Build-out Improvements Plan Summary

Improvement Project	Cost Estimate
Phase 1A: Division Street to Logus Street (Segment Length 528 feet)	
Division Street to Willamette Street (275 feet)	*$432,375*
Willamette Street to Logus Street (253 feet)	*$213,785*
Total Cost Phase 1A	**$646,160**
Phase 1B: Logus Street to Dewey Street (Segment Length 717 feet)	
Logus Street to Roosevelt Street (250 feet)	*$211,250*
Roosevelt Street to Pearl Street (226 feet)	*$390,970*
Pearl Street to Dewey Street (241 feet)	*$203,645*
Total Cost Phase 1B	**$805,865**
Phase 1C: Dewey Street to Mount Hood Street (Segment Length 1321 feet)	
Total Cost Phase 1C	**$1,090,645**
Phase 1D: Mount Hood Street to Hilda Street (Segment Length 798 feet)	
Mount Hood Street to Mountain View Street (290 feet)	*$211,550*
Mountain View Street to Barclay Hills Drive (142 feet)	*$105,790*
Barclay Hills Drive to Hilda Street-Holmes Lane (366 feet)	*$411,150*
Total Cost Phase 1D	**$728,490**
Phase 2A: Warner Milne Road to Beavercreek Road (Segment Length 1,190 feet)	
Total Cost Phase 2A	**$1,162,530**
Phase 2B: Beverly Drive (south) to Warner Milne Road (Segment Length 756 feet)	
Beverly Drive (south) to Gales Road (400 feet)	*$351,000*
Gales Road to Warner-Milne Road (356 feet)	*$507,940*
Total Cost Phase 2B	**$858,940**
Phase 2C: Harris Lane to Beverly Drive (south) (Segment Length 762 feet)	
Harris Lane to Warner Street (200 feet)	*$173,000*
Warner Street to Beverly Drive (south) (562 feet)	*$507,850*
Total Cost Phase 2C	**$680,850**
Phase 2D: Hilda Street to Harris Lane (Segment Length 960 feet)	
Hilda Street-Holmes Lane to May Street (610 feet)	*$527,650*
May Street to Harris Lane (350 feet)	*$302,750*
Total Cost Phase 2D	**$830,400**
Phase 3A: Beavercreek Road to Clairmont Way (Segment Length 1,121 feet)	
Total Cost Phase 3A	**$1,131,826**
Phase 3B: Clairmont Way to Fir Street (Segment Length 1,019 feet)	
Clairmont Way to Gaffney Lane (564 feet)	*$698,104*
Gaffney Lane to Fir Street (455 feet)	*$326,230*
Total Cost Phase 3B	**$1,024,334**
Phase 3C: Fir Street to Highway 213 (Segment Length 2,385 feet)	
Fir Street to Lazy Creek Lane (1800 feet)	*$1,463,580*
Lazy Creek Lane to Highway 213 (585 feet)	*$466,530*
Total Cost Phase 3C	**$1,930,110**
GRAND TOTAL ALL PHASES	**$10,890,150**



STA. PT. 0+00 TO 12+00



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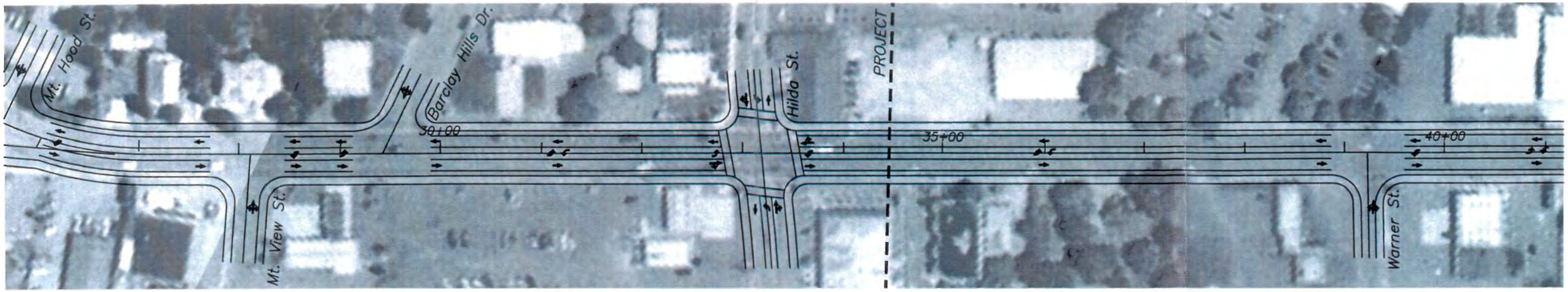
SCALE IN FEET

January 2001 | Job 1077A	WALLIS ENGINEERING in association with GREENWORKS Kittelson & Associates	Molalla Avenue Boulevard and Bikeway Improvements Plan Oregon City, Oregon	Phased Build-out Corridor Plan Sheet 1	Figure 16



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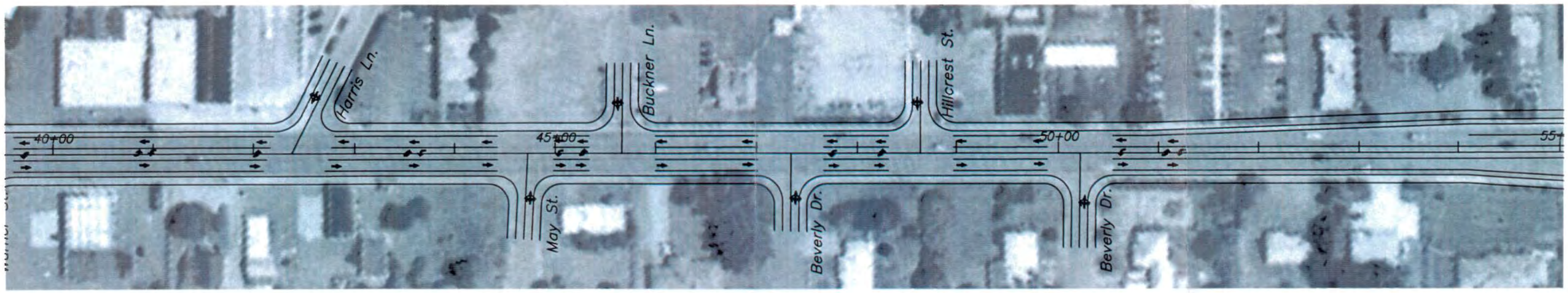

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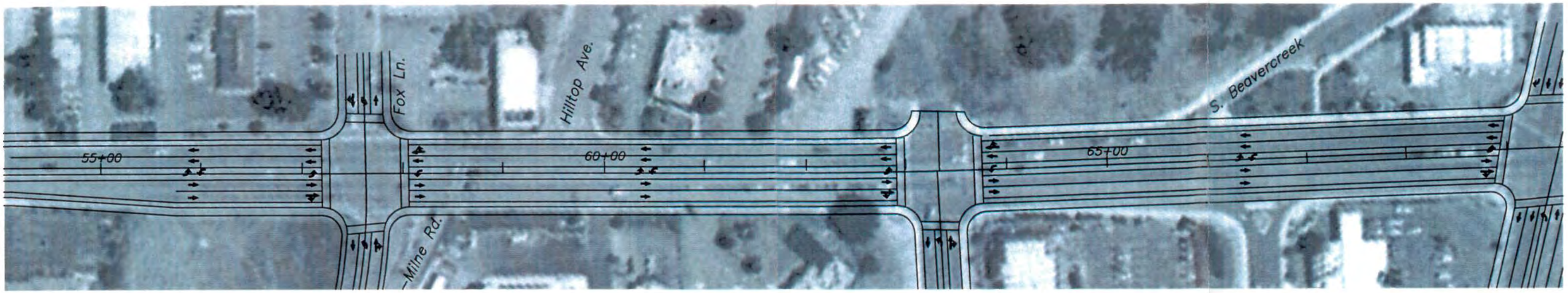

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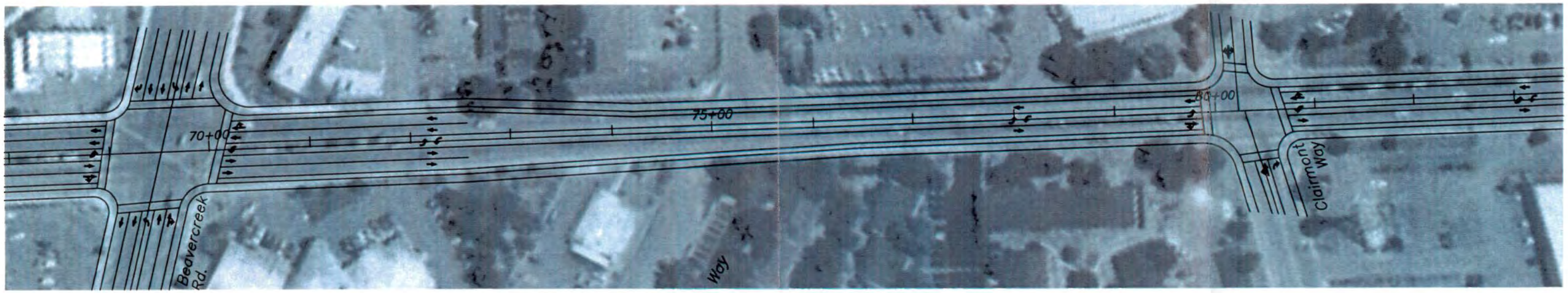

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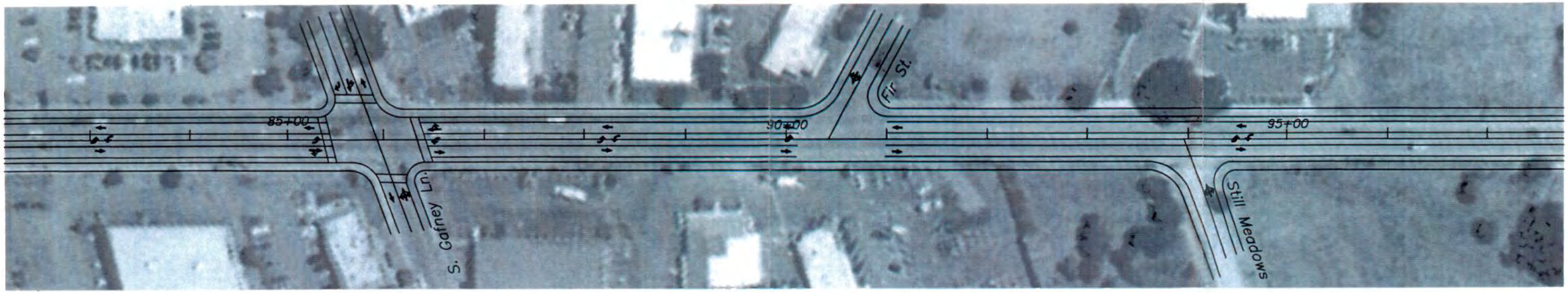

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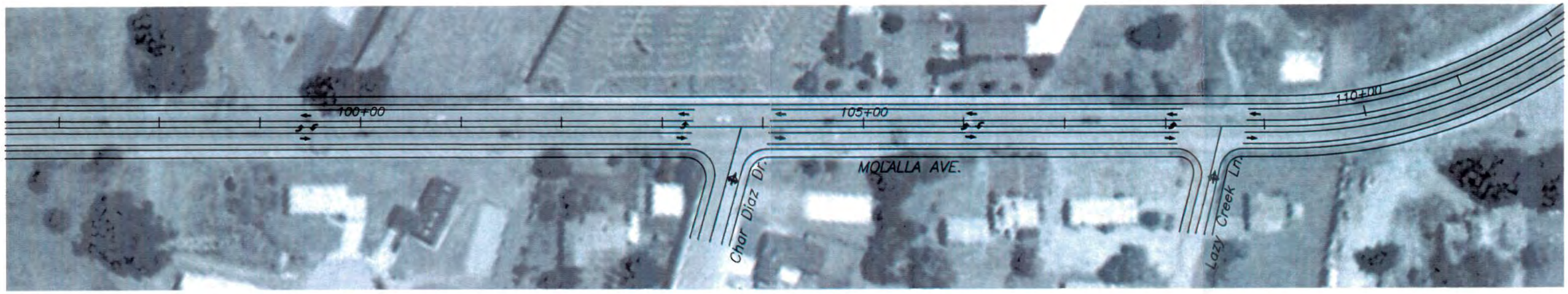

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SCALE IN FEET

January 2001 | Job 1077A	WALLIS ENGINEERING in association with GREENWORKS Kittelson & Associates	Molalla Avenue Boulevard and Bikeway Improvements Plan Oregon City, Oregon	Phased Build-out Corridor Plan Sheet 4	Figure 19

STA. PT. 110+00 TO 114+00

0 50 100
SCALE IN FEET

January 2001 | Job 1077A	WALLIS ENGINEERING in association with GREENWORKS Kittelson & Associates	Molalla Avenue Boulevard and Bikeway Improvements Plan Oregon City, Oregon	Phased Build-out Corridor Plan Sheet 5	Figure 20

MOLALLA AVENUE IMPROVEMENT PLAN
APPENDIX A - PAVEMENT EVALUATION REPORT
Oregon City, OR

June 2000

PAVEMENT SERVICES, INC

CONSULTING ENGINEERS FOR PAVEMENTS

541 N.E. 20TH AVENUE, SUITE 107
PORTLAND, OREGON 97232-2862
503-235-0377 • FAX 503-235-2885

240.00301

June 23, 2000

Mr. Bob Wallis, PE
Principal
Wallis Engineering
119 E. 8th Street
Vancouver, WA 98660-3206

Re: Appendix A - Molalla Avenue Pavement Evaluation Report

Dear Bob,

We have completed our pavement evaluation for the Molalla Avenue project. Our field test results and final pavement design recommendations for rehabilitation of the pavement are summarized in this report.

We have appreciated the opportunity to assist you in the evaluation of this project. We would be pleased to provide additional input, as necessary, during the design process. Please feel free to contact us for any questions that you may have regarding this report.

Sincerely,
PAVEMENT SERVICES, INC.

Arthur M. Furber, P.E.
Principal Engineer

Michael J. Maloney, P.E.
Pavement Engineer

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Appendix

1. FWD deflection test results and backcalculation results
2. Pavement core results
   - Map of pavement core locations
   - Core logs
3. Traffic analysis
4. Pavement design analysis
5. Construction recommendations

I INTRODUCTION

General

This report presents the results of our pavement evaluation and our design recommendations for the Molalla Avenue project in Oregon City, Oregon. The project as shown in Figure 1, extends between Division Street to Highway 213, a distance of approximately 2.2 miles. Between Division Street and South Beavercreek Road (a distance of approx. 1.3 miles), Molalla Avenue consists of a 4-lane section (2 lanes in each direction). South of Beavercreek Road, the roadway transitions from a 4-lane section down to a 3-lane section (one lane in each direction plus a center turn lane). The 3 lane section continues between approximately Clairmont Way (0.20 miles south of Beavercreek Road) and Highway 213.

Molalla Avenue is a major arterial within the city and is the primary connection between the downtown central business district and Highway 213 to the south. Molalla Avenue also serves numerous small businesses and two shopping centers that are located within the corridor between the project limits. Based on traffic data provided to us by the City, Molalla Avenue has a traffic volume of approximately 7,000 vehicles per day (1-way). The truck volume (1-way) north and south of Beavercreek Road is approximately 750 and 500 trucks per day, respectively.

The segment to the north of Beavercreek Road has concrete curbs with many driveways that access the road. Hence, rehabilitation by overlay is not practical within this segment, due to the grade constraints caused by the curbs and driveways that access the road. We understand that the City is evaluating two alternatives for the geometric design within this segment that include leaving the road as a 4-lane roadway or reducing it to a 3-lane section (2-lanes plus a center turn lane).

The segment to the south of Beavercreek Road has been widened in some areas. Generally, where the pavement has been widened a full lane width or more, there is concrete curbs, but much of the project has no curbs. We understand that the City is proposing to widen the road in order to provide a 5-lane section (2 lanes in each direction plus a center turn lane). Rehabilitation by overlay may be possible within this segment depending upon where the widening will occur.

Molalla Avenue was the old state highway (Hwy. 213) before it was re-aligned to bypass downtown Oregon City in approximately 1983. North of Beavercreek Road, the center portion of the pavement (i.e., the inner lanes) generally consists of asphalt concrete (AC) over portland cement concrete (PCC) pavement, though it has apparently been dugout and replaced with full depth AC in a few locations. The roadway was widened beyond the limits of the original PCC pavement with AC over aggregate base (AB).

The width of the underlying PCC and its position relative to the current alignment may vary along the project. At the very least, based on the core results, we know that the PCC does not extend the full width of the inner lanes at all locations, since at one location (Core No.'s C-4 and C-5) we encountered AC over AB in the outer wheel path of the inner lane and AC over PCC in the inner wheel path. Additional coring would be required to better define the boundaries of the underlying PCC pavement.

Based on core results, the pavement to the south of South Beavercreek Road consists of AC over (AB) except for the far south end of this segment, which also consists of AC over PCC.

Objective and Scope of Our Work

The project road was evaluated to determine the rehabilitation required to restore the existing pavement to a 20-year structural life. Our evaluation is based on well accepted engineering testing and analysis procedures and was conducted in accordance with the 1993 AASHTO Guide for Design of Pavement Structures, method. A brief summary of our primary work items are given below:

1. Falling Weight Deflectometer (FWD) deflection testing was conducted within each travel lane between the project limits. Along with core thickness information, the FWD results provide a measure of the structural capacity of the pavement and the strengthening that is required to meet the design traffic loading.

2. Pavement coring was accomplished at sixteen (16) locations along the project. The cores were selected based on a review of the FWD data and were taken at FWD test locations. The core thickness information was used in the structural analysis.

3. A visual walking survey of the pavement was conducted to identify areas of medium and high severity distress in order to determine areas that require specific rehabilitation work.

4. The FWD and pavement core results were analyzed to estimate the structural strengthening required to meet the design traffic loading, and along with the visual survey results, provided the basis for the rehabilitation recommendations.

II SUMMARY OF FINDINGS AND RECOMMENDATIONS

Present Pavement Condition

The general condition of the existing pavement is shown on Figures 2 and 3. Between Division Street and approximately Holmes Lane, both the inner and outer lanes are in relatively good condition. As discussed later herein, the asphalt concrete in the outer lanes is thicker within this segment than elsewhere on the project, which probably explains the better condition of the pavement. Between Holmes Lane and Beavercreek Road the pavement in the outer lanes is in generally poor condition (with a significant amount of load associated cracking) and the inner lanes are generally in fair condition. The distress in the inner lanes is primarily wear (possibly caused by stripping of the AC) in the wheel paths and low severity joint reflective cracking and is not, in our opinion, the result of structural distress in the underlying PCC, such as corner breaks or poor load transfer.

Between Beavercreek Road and approximately Clairmont Way, the pavement within the travel lanes is in generally poor condition. Between Clairmont Way and approximately 500 feet north of Highway 213, the pavement is in fair condition, with the northbound lane in slightly worse condition than the southbound lane. The pavement within approximately 500 feet of Hwy. 213 is in good condition.

Structural Analysis

The road carries a significant amount of heavy truck traffic. Adjusting for the various types of truck configurations and axle weights (including Tri-Met buses), the truck traffic loading (from a pavement evaluation standpoint) can be expressed in terms of the equivalent number of fully loaded 5-axle semi-trucks per day. The equivalent number of semi-trucks per day in each lane north and south of Beavercreek Road over the 20-year design period, is approximately 350 and 175 trucks, respectively.

Between Division Street and Beavercreek Road the pavement section in the inner lanes (based on the core results) generally consists of approximately 3 to 4.5 inches of AC over 6 to 7.5 inches of PCC. However, as discussed above, there are areas in the inner lane that have apparently been repaired with AC and the pavement consists of 5 to 6 inches of AC over AB. The pavement in the outer lanes north of Holmes Lane consists of approximately 7.5 inches of AC over 11 inches of AB. South of Holmes Lane, the pavement in the outer lanes consist of approximately 5 inches of AC over 14 inches of AB.

Between Beavercreek Road and approximately 500 feet north of Hwy. 213, the pavement consists of approximately 5 to 7 inches of AC over 11.5 to 19 inches of AB.

There are two primary types of pavement distress on Molalla Avenue. The first type is wear and/or stripping of the asphalt concrete within the wheel paths and it is found primarily in the inner lanes between Division Street and Beavercreek Road (above the underlying PCC pavement). The second type of pavement distress is load associated cracking (alligator cracking) and it is located in areas where the pavement consists of AC over AB. It is an indication that the AC layer has reached the end of its fatigue life. On Molalla Avenue, the severity and degree of load associated cracking is highest between approximately Holmes Lane and Clairmont Way.

These two types of defects and the methods for correcting them are discussed below.

> Wear and/or Stripping - This type of pavement distress is confined to the AC pavement layer and can generally be rehabilitated by inlay (i.e., removal and replacement of the AC). Where AC is located directly over PCC, it is usually desirable to mill the full thickness of the AC (to a practical limit of 6-inches or so) since it is generally preferred to remove all AC that may be susceptible to stripping prior to placing new AC. Also, the time until significant reflective cracking occurs is dependent upon the thickness of the new AC that is placed. Hence, for every inch of old AC that is replaced with new AC, additional time is gained until reflective cracking occurs. As presented below, since there is only 3 to 4 inches of AC (based on the core results) over the PCC, we recommend milling down to the surface of the PCC and replacing with the same thickness of new AC.
>
> Load Associated Cracking - In areas where load associated cracking occurs, the pavement requires structural strengthening. This could be provided by placement of overlay provided that the required overlay (from a structural standpoint) was of significant thickness to limit the potential of reflective cracking due to the underlying cracked pavement. North of Beavercreek Road, placement of any overlay is not feasible due to grade constraints. Hence, the practical alternative is to rehabilitate with

inlay. Inlay involves removing the existing pavement section to the required depth (to provide the required structural capacity) and replacing with new asphalt concrete resulting in no change in pavement grade. To provide the necessary structural capacity, the inlay on Molalla Avenue will generally require removal of the existing AC and a portion of the existing AB. The new AC is then placed on the remaining thickness of existing AB (essentially partial depth reconstruction). Fortunately, there is a relatively thick layer of existing AB on Molalla Avenue so that removal of a few inches of the AB will still likely provide a sufficient base layer to support construction traffic (assuming summertime construction and construction traffic on the exposed aggregate base layer is kept to a minimum).

South of Beavercreek Road, the required overlay (based on the FWD data) outside of areas of load associated cracking is much less than within areas of cracking. Hence, if areas of cracking are repaired (by partial depth reconstruction, or in other words inlay) prior to overlay, it may be feasible to rehabilitate the pavement with overlay.

General Rehabilitation Recommendations

Our recommendations for rehabilitation of the existing pavement and widening (for the section south of Beavercreek Rd.) are given below. Our FWD Station 0+00 is referenced to the south curb of Division Street. FWD Station 70+13 and Station 70+90 are referenced to the north and south curbs of S. Beavercreek Rd, respectively. Our recommendations are shown graphically on Figures 4 and 5.

Division St. to S. Beavercreek Rd.

Inner Lanes	FWD Station 0+00 to 65+00	4.0-in. Inlay
	FWD Station 65+00 to 70+13	9.0-in. Inlay
Outer Lanes	FWD Station 0+00 to 23+00	8.0-in. Inlay
	FWD Station 23+00 to 33+00	4.0-in. Inlay
	FWD Station 33+00 to 70+13	9.0-in. Inlay

Although the pavement in the outer lanes between FWD Station 0+00 to FWD Station 23+00 is generally in fair to good condition, the recommendation for rehabilitation is the same as the section between FWD Station 33+00 to FWD Station 70+13 where the pavement is generally in poor condition. This is because a 2-inch overlay is structurally required to meet the 20-year design traffic loading within this section (Sta. 0+00 to 23+00), but overlay is not feasible due to grade constraints. Hence, inlay is the only means to provide the necessary structural capacity. However, as discussed below under construction phasing, the City may wish to delay rehabilitation of this section to utilize the remaining life of the existing pavement prior to inlay.

S. Beavercreek Rd. to Hwy. 213

Pavement Rehabilitation

Both Lanes	FWD Station 70+90 to 110+00	3.5 in. overlay

Digout areas of medium or higher severity distress with a 5.5 in. inlay (i.e., prior to overlay, for a total asphalt concrete thickness after overlay of 9.0-in.).

If the northbound widened area is used as a travel lane, increase the overlay to 5.5 inches between FWD Station 88+00 and Station 98+00.

Areas requiring digout prior to overlay are given in Table 1. These areas should be field marked and surveyed to identify their exact location for the project plans.

If grade constraints are such that the roadway cannot accommodate a 3.5-inch overlay, then the existing roadway should be rehabilitated with a 9.0-inch inlay within the existing travel lanes and an 11.0-inch inlay within the existing widened areas (i.e., widened areas that are converted to travel lanes and thus are subject to the design traffic loading).

Molalla Avenue Digout Areas - Table 1
(Beavercreek Road to Hwy. 213)

Northbound				Southbound			
Station Limits				Station Limits			
From	To	Width, Ft.	Area, SY	From	To	Width, Ft.	Area, SY
73+23	72+63	3	20	71+24	72+00	12	101
76+28	73+23	12	407	74+59	75+60	3	33
76+76	76+25	3	17	77+32	77+96	4	28
77+38	73+51	4	172	77+32	77+77	3	15
79+43	79+10	3	11	78+14	78+65	12	68
79+59	79+45	3	5	78+95	79+29	12	45
80+16	80+11	6	3	78+99	79+17	4	8
80+81	80+70	8	10	79+29	80+15	5	48
80+82	80+67	2	3	79+36	79+63	3	9
80+94	80+87	4	3	79+68	80+01	12	44
82+09	81+71	3	13	80+11	80+52	3	14
82+19	82+11	3	3	80+55	80+62	5	4
82+78	82+70	6	5	81+56	81+90	24	91
87+52	87+36	4	7	81+89	82+41	12	69
89+74	89+57	5	9	81+89	82+41	12	69
95+09	94+96	3	4	82+41	82+89	4	21
96+28	96+15	3	4	101+94	102+02	12	11
96+85	96+79	3	2	109+33	109+59	4	12
97+62	97+38	3	8				
100+26	100+11	3	5				
100+46	100+34	3	4				
103+34	103+18	4	7				
105+55	105+48	4	3				
Total Area			726	Total Area			691

Widening

Widening should be accomplished with a pavement section consisting of 9.0-inches of asphalt concrete over 14-inches of aggregate base, placed over a compacted subgrade.

III. CONSTRUCTION PHASING

We understand that due to budgetary constraints, the rehabilitation work may need to be conducted in stages over more than one construction season. Our recommendations for construction phasing are shown on Figures 6 and 7.

In our opinion, the project area that should be assigned the highest construction priority, is the section between Beavercreek Road and Hwy. 213. This is because the amount of digout repair required prior to overlay, may increase (if the rehabilitation work is delayed) as areas of low severity cracking deteriorate into areas of medium severity cracking. Also, the structural capacity of the existing pavement will decrease at an accelerated rate if the overlay is delayed, which may mean that the required overlay (to provide a 20-year life) may be greater in a year or two than it is today. If the recommended overlay is not feasible from a grade standpoint, then this section does not necessarily have any higher priority than elsewhere on the project (from a cost standpoint).

In our opinion, the next priority should be given to rehabilitating the AC layer above the PCC (i.e., generally, the inner lanes north of Beavercreek Road).

Our recommendation for rehabilitation of the pavement in areas that require a deep inlay (generally, the outer lanes north of Beavercreek Road), will not change if the work is delayed by one or two years. Therefore, these areas can be given the lowest priority without increasing the construction cost for the project. However, there are a few areas requiring deep inlay where there is medium to high severity pavement cracking distress that could lead to total pavement failure (if the rehabilitation work is delayed). Hence, in these areas, we recommend that skin patching be done as a "stop-gap" measure until construction is completed, in order to reduce the potential for significant maintenance work. The limits for the skin patching are given in Table 2. When construction work is done in areas requiring deep inlay, the first priority (within these areas) should be in sections where the pavement condition is the worse, to reduce the potential for additional maintenance work (i.e., south of Holmes Lane).

Table 2 also includes areas south of Beavercreek Road that should be "skin patched" if the rehabilitation work (within this section) is delayed beyond this construction season.

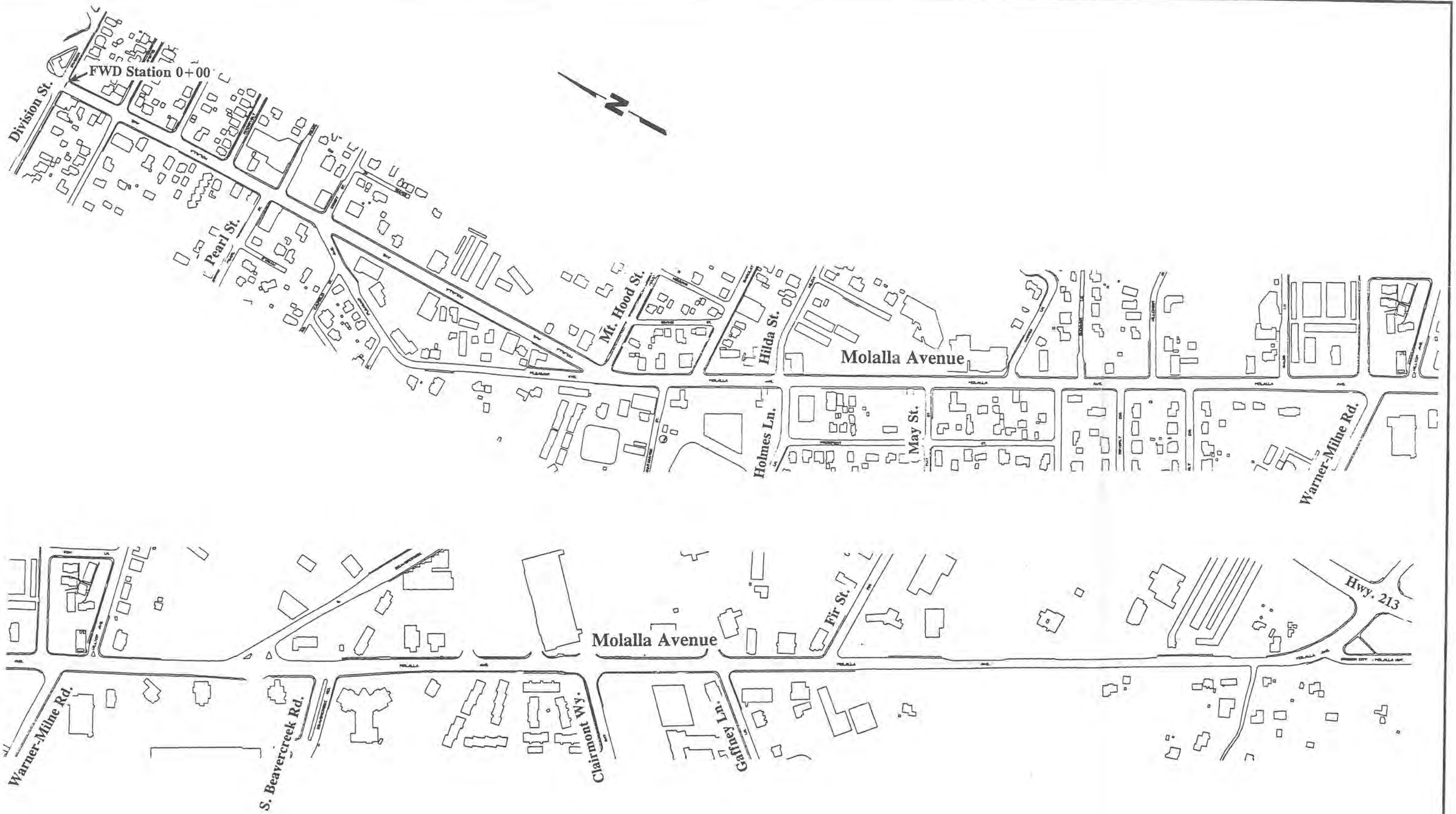
Areas of Skin Patching - Table 2
(Recommended if Construction Rehabilitation is Delayed Until Next Season)

FWD Station 0+00 = South curb of Division Street

FWD Station		Direction	Lane	Approx. Width, ft.	Area, SY
From	**To**				
Division St. to S. Beavercreek Rd.					
35+51	63+19	S	Outer	12	3,691
63+19	67+63	S	Both	24	1,184
66+19	68+16	N	Both	24	525
61+47	63+64	N	Outer	6	145
37+10	56+35	N	Outer	6	1,283
33+92	35+06	N	Outer	6	76
Isolated areas of high severity distress					
16+43	16+53	S	Outer	12	13
28+52	28+60	S	Inner	12	11
59+25	59+41	N	Outer	12	21
57+34	57+42	N	Outer	6	5
28+53	28+63	N	Inner	12	13
S. Beavercreek Rd. to Hwy. 213					
71+24	82+78	Both	All	48	6,155
95+09	100+46	N	Travel	6	358

Total	**13,480**

The above areas should be field marked to establish their exact project stationing since, they are based on distances obtained from a measuring wheel along the side of the road. We can assist you in field marking these areas, if necessary.



Approximate Scale: 1 inch = 400 feet

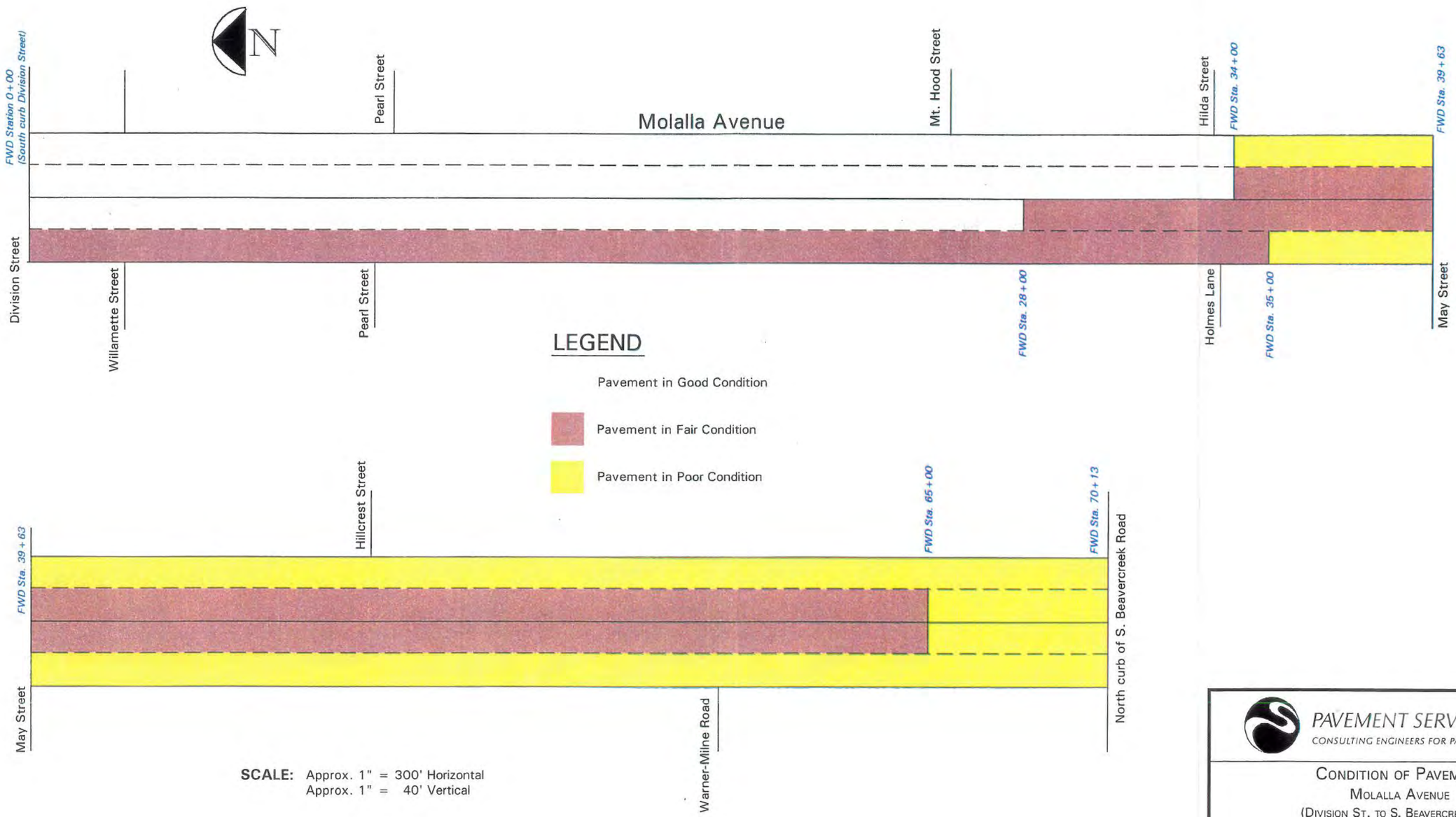
Base Map: Wallis Engineering, Inc.

PAVEMENT SERVICES, INC
CONSULTING ENGINEERS FOR PAVEMENTS

Molalla Avenue Site Map
Oregon City, OR

FIGURE
A-1

JOB NUMBER	DRAWN	APPROVED	DATE	REVISED	DATE
240.00301	MJM		6/20/00		

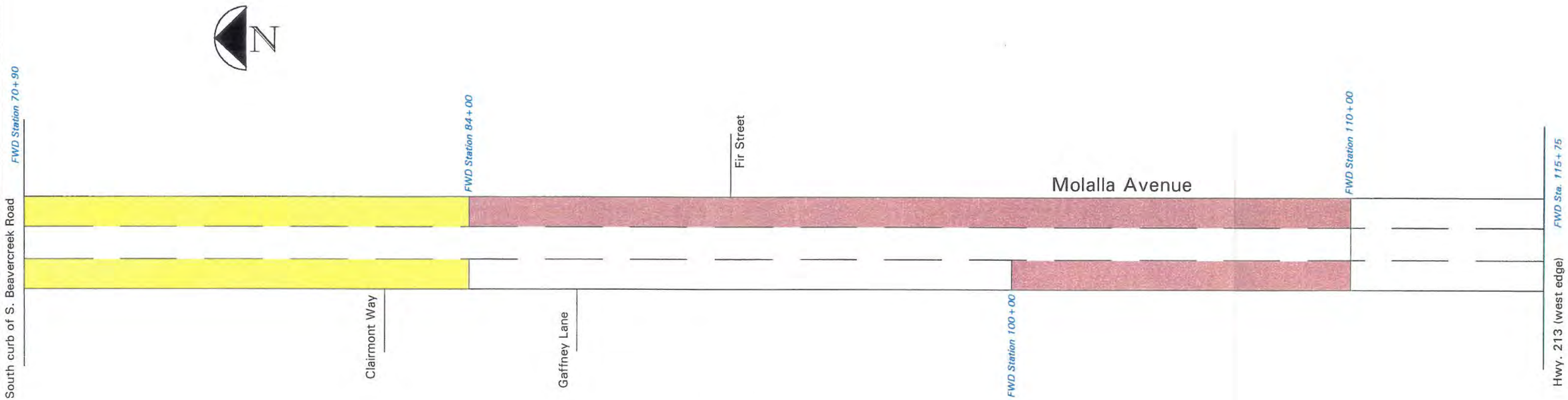


SCALE: Approx. 1" = 300' Horizontal
Approx. 1" = 40' Vertical

PAVEMENT SERVICES, INC
CONSULTING ENGINEERS FOR PAVEMENTS

CONDITION OF PAVEMENT
MOLALLA AVENUE
(DIVISION ST. TO S. BEAVERCREEK RD.)
OREGON CITY, OREGON

JOB NUMBER		FIGURE
240.00301		A-2
DRAWN	APPROVED	DATE
LGJ	MJM	6/20/2000



LEGEND

Pavement in Good Condition

Pavement in Fair Condition

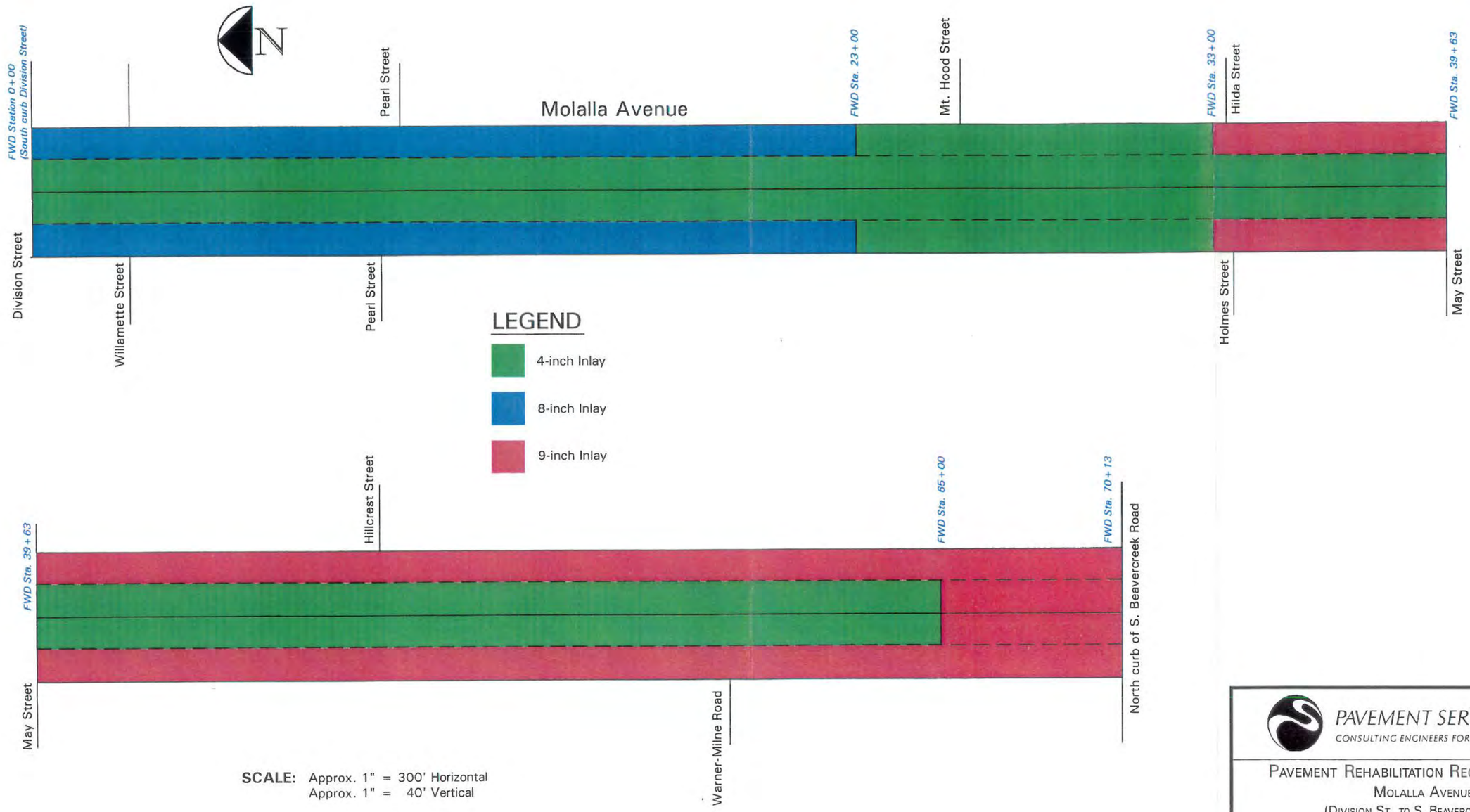
Pavement in Poor Condition

SCALE: Approx. 1" = 300' Horizontal
Approx. 1" = 40' Vertical

PAVEMENT SERVICES, INC
CONSULTING ENGINEERS FOR PAVEMENTS

CONDITION OF PAVEMENT
MOLALLA AVENUE
(S. BEAVERCREEK RD. TO HWY 213)
OREGON CITY, OREGON

JOB NUMBER		FIGURE
240.00301		A-3
DRAWN	APPROVED	DATE
LGJ	MJM	6/20/2000

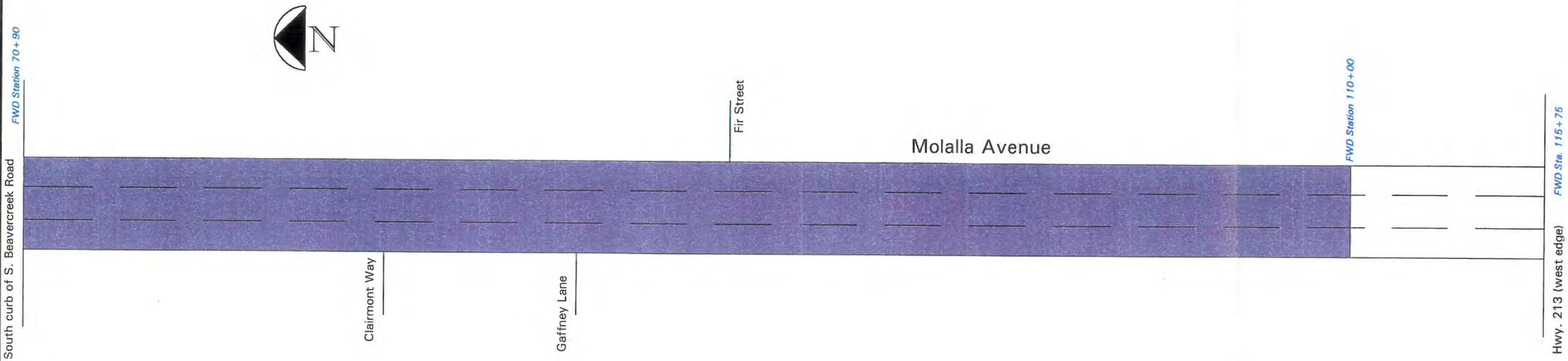


SCALE: Approx. 1" = 300' Horizontal
Approx. 1" = 40' Vertical

PAVEMENT SERVICES, INC
CONSULTING ENGINEERS FOR PAVEMENTS

PAVEMENT REHABILITATION RECOMMENDATIONS
MOLALLA AVENUE
(DIVISION ST. TO S. BEAVERCREEK RD.)
OREGON CITY, OREGON

JOB NUMBER		FIGURE
240.00301		A-4
DRAWN	APPROVED	DATE
LGJ	MJM	6/20/2000



SCALE: Approx. 1" = 300' Horizontal
Approx. 1" = 40' Vertical

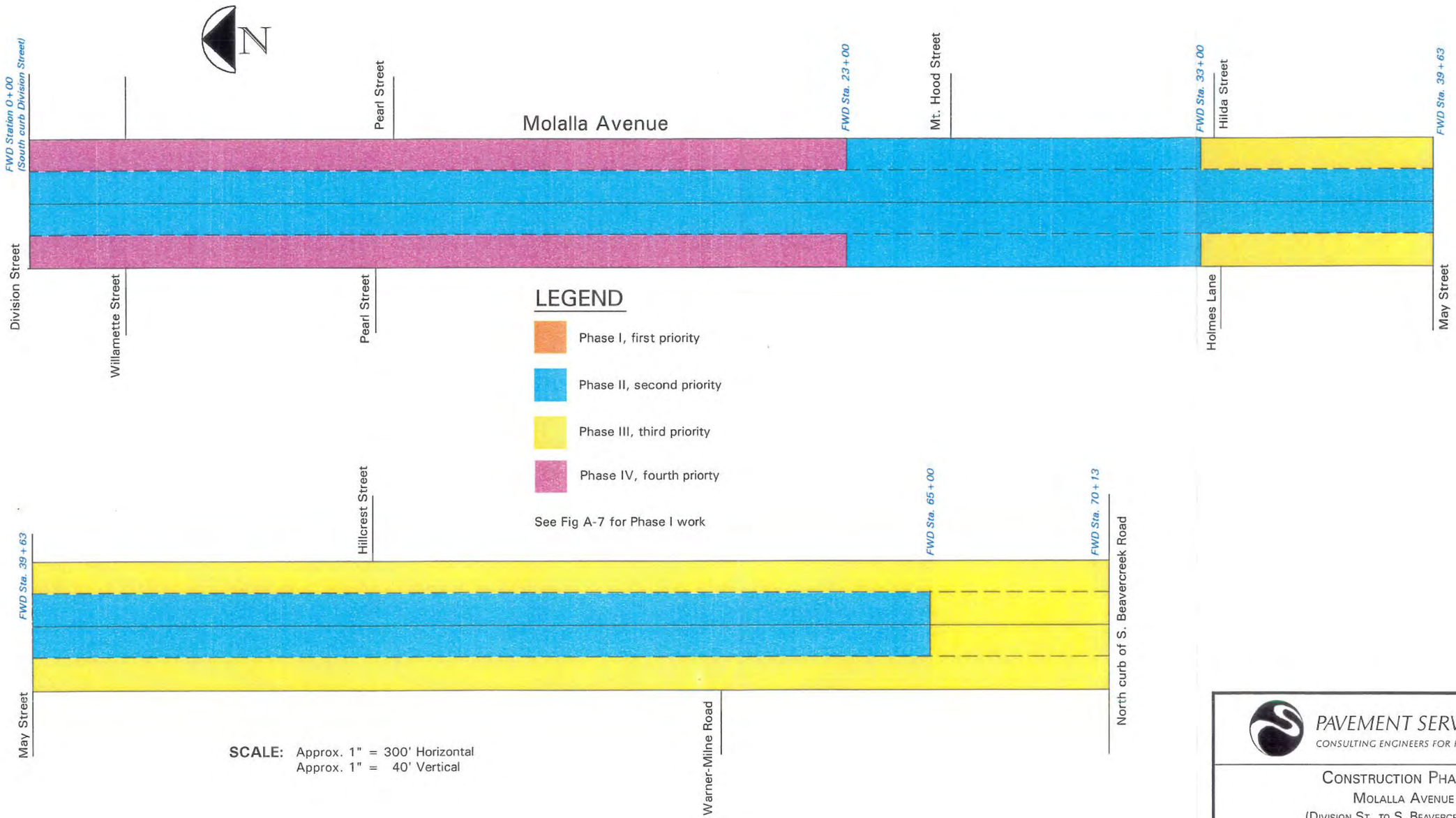
LEGEND

Digout areas of medium and high severity distress, place 3.5-inch overlay

PAVEMENT SERVICES, INC
CONSULTING ENGINEERS FOR PAVEMENTS

PAVEMENT REHABILITATION RECOMMENDATIONS
MOLALLA AVENUE
(S. BEAVERCREEK RD. TO HWY 213)
OREGON CITY, OREGON

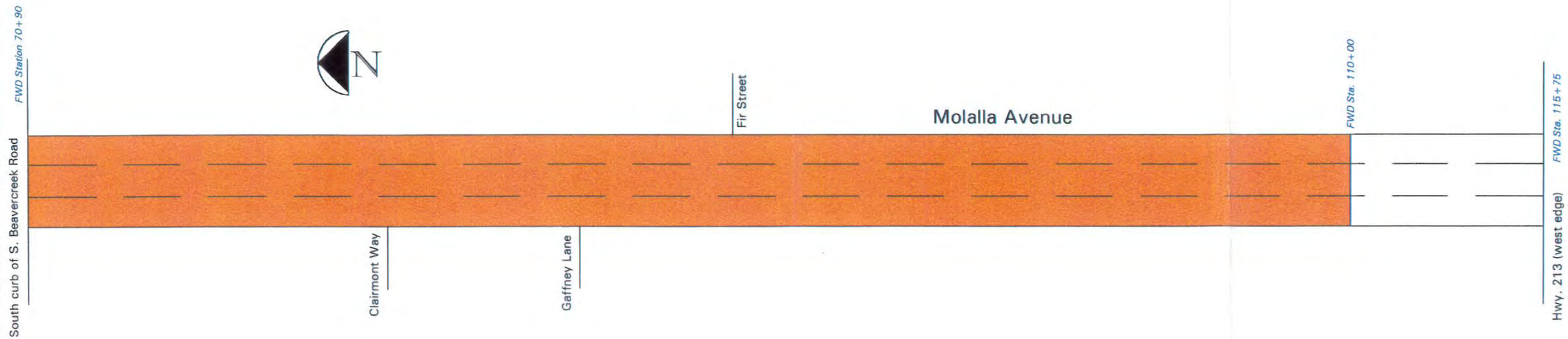
JOB NUMBER		FIGURE
240.00301		A-5
DRAWN	APPROVED	DATE
LGJ	MJM	6/20/2000



PAVEMENT SERVICES, INC
CONSULTING ENGINEERS FOR PAVEMENTS

CONSTRUCTION PHASING
MOLALLA AVENUE
(DIVISION ST. TO S. BEAVERCREEK RD.)
OREGON CITY, OREGON

JOB NUMBER		FIGURE
240.00301		A-6
DRAWN	APPROVED	DATE
LGJ	MJM	6/20/2000



LEGEND

- Phase I, first priority
- Phase II, second priority
- Phase III, third priority
- Phase IV, fourth priorty

See Fig A-6 for Phase II, III and IV work

SCALE: Approx. 1" = 300' Horizontal
Approx. 1" = 40' Vertical

PAVEMENT SERVICES, INC
CONSULTING ENGINEERS FOR PAVEMENTS

CONSTRUCTION PHASING
MOLALLA AVENUE
(S. BEAVERCREEK RD. TO HWY 213)
OREGON CITY, OREGON

JOB NUMBER		FIGURE
240.00301		A-7
DRAWN	APPROVED	DATE
LGJ	MJM	6/20/2000

APPENDIX 1 - FWD Deflection Test Data

Description of FWD Test Procedures - Deflection testing was accomplished on Molalla Avenue on May 8, 2000 and May 9, 2000. The deflection testing was conducted using our Falling Weight Deflectometer (FWD) device. The FWD device is a non-destructive testing device which measures the pavement deflection under an impact load that closely simulates actual truck traffic loading. Testing was performed between Division Street and Highway 213. The tests were conducted in the outer wheel path of the travel lanes at approximately 200-foot intervals in each direction. At each test location, a 12-inch diameter segmented load plate was used to apply the impact load to the pavement surface. Following an unrecorded conditioning load, two loads of approximately 9,000 lbs., and 12,500 lbs. were applied at each test point. Deflections were recorded at 0, 12, 18, 24, 36, 48 and 60 inches from the load center. The deflection test data are given in Table A-1-1.

Backcalculation Analysis Results - We analyzed the deflection test data to "backcalculate" the resilient modulus of the subgrade soil and to estimate the effective structural number of the pavement (for overlay analysis). The backcalculation results are tabulated with the FWD data in Table A-1-1.

Mollala Avenue - FWD Deflection Data - Table A-1-1

Test Date: 5/8/00
FWD Station 0+00: South curb of Division Street
Load Plate Radius, in 5.91
Sensor Distance, in. 0 12 18 24 36 48 60

Deflections Normalized To 9,000 lb. Load Basis

Test No.	Sta.	Direction	Lane	D0 mils	D1 mils	D2 mils	D3 mils	D4 mils	D5 mils	D6 mils	Surface Temp., oF	Comments	Subgrade Modulus, psi	AASHTO SNxeff
1	1+00	SB	right	7.01	5.98	5.28	4.69	3.48	2.62	1.88	57.0	start sb rl 9:42	10,386	5.09
2	2+02	SB	right	7.34	6.20	5.84	5.27	3.98	3.13	2.68	57.0		15,880	5.62
3	3+00	SB	right	9.88	7.96	6.93	6.05	4.36	3.12	2.47	58.0	270 - Willamette	12,479	4.16
4	4+00	SB	right	8.62	6.88	6.17	5.42	4.03	3.12	2.72	57.0		16,086	5.01
5	4+91	SB	right	12.22	9.44	8.44	7.36	5.40	3.99	3.18	57.0		11,435	3.91
6	6+07	SB	right	13.26	11.04	9.42	7.86	5.31	3.97	3.22	58.0		13,355	3.96
7	7+00	SB	right	10.18	7.74	6.55	5.50	3.88	2.72	2.50	56.0		17,865	4.30
8	8+01	SB	right	15.64	10.66	8.60	6.86	4.40	3.18	2.56	57.0		12,529	3.52
9	9+00	SB	right	10.59	7.96	6.75	5.75	3.96	3.12	2.33	57.0		17,318	4.24
10	10+05	SB	right	11.85	8.54	7.24	6.00	4.06	2.85	2.31	57.0	984 - Pearl	11,769	3.77
11	11+02	SB	right	6.06	4.55	4.01	3.68	2.76	2.01	1.47	58.0		13,828	5.35
12	11+99	SB	right	9.95	7.65	6.71	5.98	4.62	3.77	3.18	57.0		13,598	5.14
13	13+01	SB	right	9.30	7.34	6.32	5.67	4.28	3.51	2.93	57.0		14,708	5.08
14	14+03	SB	right	13.50	10.83	9.53	8.33	6.25	4.94	4.06	58.0		10,421	4.34
15	15+03	SB	right	8.55	6.89	6.04	5.33	3.93	3.20	2.73	58.0		16,016	5.09
16	16+00	SB	right	28.11	19.00	15.47	12.64	8.52	6.17	4.96	58.0		6,491	2.72
17	17+03	SB	right	13.83	11.02	9.39	8.22	6.12	4.72	3.80	58.0		10,969	4.17
18	18+01	SB	right	13.42	10.77	9.60	8.53	6.32	4.95	3.92	57.0		9,420	3.91
19	19+02	SB	right	10.24	8.15	7.14	6.38	4.80	3.78	3.03	58.0		13,698	4.79
20	20+07	SB	right	8.65	6.52	5.81	5.19	4.07	3.39	2.69	59.0		14,262	4.74
21	21+04	SB	right	7.87	5.29	4.27	3.49	2.19	1.66	1.28	58.0		24,368	4.02
22	22+06	SB	right	11.00	7.70	6.19	5.15	3.39	2.32	1.65	58.0		14,485	4.15
23	23+01	SB	right	10.50	7.67	6.57	5.68	3.89	2.71	2.12	58.0		11,881	4.03
24	24+02	SB	right	8.52	5.49	4.27	3.33	2.04	1.05	0.95	58.0		7,826	4.41
25	25+01	SB	right	6.77	5.31	4.60	3.90	2.58	1.82	1.27	59.0		11,328	4.88
26	26+00	SB	right	6.35	3.98	3.24	2.67	1.69	1.13	0.73	59.0		12,455	5.20
27	27+00	SB	right	9.55	6.41	4.95	3.93	2.34	1.47	0.75	59.0		11,979	4.29
28	28+01	SB	right	7.45	5.70	4.61	3.82	2.30	1.47	0.93	59.0		16,751	4.64
29	29+00	SB	right	5.24	4.13	3.43	2.94	2.03	1.36	0.90	59.0		11,683	5.49
30	30+00	SB	right	8.20	6.39	5.11	4.17	2.66	1.71	1.14	59.0		16,531	4.49
31	31+00	SB	right	5.11	3.90	3.30	2.75	1.79	1.22	0.80	59.0		12,395	5.45
32	32+00	SB	right	8.76	6.09	5.04	3.84	2.10	1.30	0.81	59.0	near utility cover	19,909	4.11
33	33+01	SB	right	8.32	6.19	4.86	3.80	2.13	0.95	0.89	59.0		5,138	4.07
34	34+10	SB	right	19.69	10.20	6.40	4.42	1.93	1.20	0.79	60.0	3375 - Holmes	12,706	2.87
35	35+01	SB	right	13.72	8.77	6.26	4.60	2.30	1.20	0.70	60.0	lac	15,705	3.36
36	36+03	SB	right	15.30	9.61	6.82	4.84	2.54	1.42	0.79	59.0		14,229	3.24
37	37+00	SB	right	11.64	7.25	5.45	3.96	2.22	1.35	1.04	58.0		18,276	3.63
38	38+00	SB	right	11.66	7.85	5.87	4.34	2.28	1.46	1.05	57.0		12,597	3.48
39	39+01	SB	right	12.14	8.19	6.51	4.82	2.70	1.69	0.97	58.0		13,624	3.73
40	40+08	SB	right	12.33	8.45	6.42	4.82	2.48	1.65	1.22	59.0		10,932	3.46
41	41+04	SB	right	19.44	12.72	9.29	6.51	3.62	2.16	1.61	58.0		13,143	2.96
42	42+00	SB	right	10.81	6.73	5.27	4.15	2.02	1.50	1.37	59.0		11,031	3.68
43	43+01	SB	right	12.90	9.20	7.32	5.75	3.16	1.87	1.06	59.0		9,941	3.76
44	44+01	SB	right	14.44	6.77	4.74	3.45	1.73	0.73	0.47	59.0		8,985	3.63
45	45+03	SB	right	15.19	9.94	6.93	4.81	2.00	0.78	0.23	58.0		5,662	3.18
46	46+01	SB	right	13.09	7.99	5.64	3.98	1.82	0.95	0.53	59.0		18,596	3.32
47	47+01	SB	right	13.87	9.48	7.38	5.59	3.04	2.12	1.27	58.0		10,843	3.33
48	48+08	SB	right	15.22	10.91	7.99	5.86	2.97	1.51	1.09	59.0	4797 - Beverly	10,196	3.34
49	49+00	SB	right	17.85	12.21	8.95	6.59	3.15	1.82	1.36	58.0		6,217	3.07
50	50+03	SB	right	14.10	10.44	8.28	6.29	3.49	2.16	1.36	59.0		13,507	3.51
51	51+02	SB	right	15.19	10.00	7.06	5.21	2.68	1.46	0.89	59.0	5102 - Beverly Dr south	15,623	3.22
52	52+00	SB	right	12.33	9.66	7.94	6.32	3.58	2.09	1.15	58.0		7,477	3.93
53	53+00	SB	right	11.02	7.82	5.98	4.54	2.40	1.16	0.60	58.0		10,413	3.84
54	54+03	SB	right	17.42	9.92	7.09	5.29	2.76	1.59	0.95	58.0	mac sealed	13,447	3.12
55	55+01	SB	right	10.53	7.61	6.33	4.91	3.11	2.14	1.31	58.0		12,509	4.20
56	56+00	SB	right	8.70	6.36	5.14	3.90	1.94	1.43	0.70	58.0		12,821	3.86
57	57+01	SB	right	12.76	9.64	7.81	6.22	3.75	2.41	1.33	59.0		7,526	3.97
58	58+01	SB	right	11.12	8.39	6.96	5.66	3.63	2.45	1.59	59.0		5,753	4.23
59	59+59	SB	right	9.40	7.30	5.92	4.68	2.71	1.76	0.98	60.0	5890 - Warner-Milne	11,946	4.25
60	60+07	SB	right	9.05	6.83	5.51	4.32	2.54	1.54	0.95	59.0		15,882	4.18
61	61+01	SB	right	10.34	8.11	6.74	5.31	2.77	1.60	1.18	60.0		12,531	4.04

Deflections Normalized To 9,000 lb. Load Basis

Test No.	Sta.	Direction	Lane	D0 mils	D1 mils	D2 mils	D3 mils	D4 mils	D5 mils	D6 mils	Surface Temp., eF	Comments	Subgrade Modulus, psi	AASHTO SNxeff
62	62+01	SB	right	7.85	5.70	4.58	3.36	1.87	1.15	1.04	60.0		24,331	4.18
63	63+12	SB	right	13.64	9.57	7.65	5.96	3.44	2.10	1.56	60.0		10,078	3.71
64	63+78	SB	right	9.39	7.43	6.24	4.99	3.28	2.37	1.53	61.0		13,479	4.44
65	65+01	SB	right	10.99	6.95	5.19	3.90	2.01	1.20	0.97	62.0		11,298	3.65
66	66+05	SB	right	10.24	6.91	5.14	3.88	2.15	1.37	1.04	62.0		21,915	3.81
67	67+03	SB	right	15.73	9.01	5.65	3.61	1.29	1.16	0.86	63.0		9,728	3.05
68	68+01	SB	right	12.74	8.10	5.94	4.52	2.04	1.25	0.95	65.0		8,947	3.48
69	69+04	SB	right	12.45	8.43	6.56	5.10	2.89	1.79	1.23	65.0		12,928	3.78
70	69+73	SB	right	11.60	8.12	6.19	4.92	2.38	1.37	0.81	66.0	end sb rl 7011-n curb Beaver Cr	16,643	3.71
71	69+40	NB	right	5.28	4.07	3.42	2.99	2.10	1.44	0.92	64.0	start nb rl	10,193	5.75
72	68+49	NB	right	7.56	5.81	4.87	4.09	2.66	1.71	1.12	70.0		13,246	4.96
73	67+50	NB	right	7.54	5.87	4.99	4.31	2.92	1.99	1.32	70.0		8,395	4.95
74	66+47	NB	right	6.68	5.23	4.50	3.93	2.55	1.89	1.10	68.0		24,602	4.57
75	65+44	NB	right	7.99	6.02	5.06	4.19	2.64	1.78	1.26	67.0		18,167	4.63
76	64+47	NB	right	7.38	5.83	4.87	4.14	2.97	1.94	1.27	69.0		7,963	5.03
77	63+44	NB	right	8.89	6.51	5.18	4.11	2.29	1.51	1.08	68.0		15,648	3.93
78	62+45	NB	right	6.54	5.15	4.39	3.77	2.44	1.73	1.24	68.0		19,990	5.16
79	61+49	NB	right	9.58	7.62	6.13	5.06	2.87	1.86	1.15	68.0		16,114	4.19
80	60+49	NB	right	8.96	7.11	6.05	5.16	3.26	2.09	1.36	69.0		10,826	4.68
81	59+48	NB	right	11.78	8.12	5.87	4.42	2.14	1.30	0.64	67.0		10,731	3.54
82	58+37	NB	right	9.05	6.85	5.69	4.59	2.66	1.77	1.16	65.0		18,037	4.25
83	57+50	NB	right	10.43	8.39	6.90	5.98	3.64	2.38	1.48	65.0		8,943	4.44
84	56+50	NB	right	8.85	7.37	6.11	5.16	3.39	2.31	1.51	65.0		6,686	4.62
85	55+49	NB	right	11.72	8.06	6.33	5.08	3.02	2.01	1.15	65.0		11,466	4.03
86	54+47	NB	right	12.82	7.99	5.82	4.76	2.96	2.16	1.34	64.0	5510-Gales Ln	23,371	3.53
87	53+47	NB	right	12.33	8.44	6.33	4.72	2.71	1.66	0.99	65.0		14,471	3.70
88	52+48	NB	right	12.36	8.88	6.98	5.62	3.29	2.13	1.11	66.0		8,219	4.02
89	51+43	NB	right	20.79	13.49	10.01	7.13	3.55	2.12	1.36	65.0		11,799	2.93
90	50+49	NB	right	14.59	9.97	7.36	5.63	3.41	2.22	1.46	66.0		14,072	3.50
91	49+49	NB	right	14.66	10.04	7.56	5.86	3.39	2.33	1.54	66.0	4946-Hillcrest	11,832	3.29
92	48+52	NB	right	14.86	10.21	7.71	5.92	3.26	2.12	1.49	68.0		10,491	3.30
93	47+48	NB	right	16.72	11.78	9.23	7.18	4.16	2.70	1.81	66.0		11,503	3.40
94	46+48	NB	right	22.67	12.76	7.95	6.22	3.64	2.12	1.36	68.0	4642-Buckner Ln	14,014	2.65
95	45+50	NB	right	14.56	9.50	7.29	5.32	2.63	1.23	0.85	72.0		5,041	3.50
96	44+50	NB	right	12.79	8.70	6.58	4.87	2.42	1.44	0.63	66.0		9,664	3.69
97	43+50	NB	right	9.05	7.12	5.83	4.80	2.94	1.83	1.04	65.0		9,041	4.53
98	42+47	NB	right	14.11	9.30	7.14	5.55	2.94	1.78	1.11	65.0		13,647	3.51
99	41+49	NB	right	12.77	8.96	7.01	5.33	2.77	1.70	0.89	63.0		11,446	3.70
100	40+49	NB	right	15.01	9.79	7.28	5.45	3.05	2.00	1.29	65.0		11,425	3.22
101	39+46	NB	right	14.11	9.64	7.57	5.93	3.33	2.16	1.28	63.0		11,131	3.63
102	38+50	NB	right	10.88	7.43	5.53	4.15	2.33	1.45	1.04	63.0		19,838	3.75
103	37+48	NB	right	11.82	7.66	5.69	4.07	2.09	1.14	0.52	62.0		12,289	3.70
104	36+49	NB	right	13.94	9.21	7.02	5.17	2.48	1.18	0.64	64.0		14,183	3.40
105	35+49	NB	right	16.19	10.82	7.96	5.86	3.00	1.58	0.85	63.0		10,682	3.28
106	34+58	NB	right	12.89	8.62	6.47	4.85	2.63	1.63	0.87	64.0		12,584	3.65
107	33+49	NB	right	8.74	5.02	4.20	3.57	2.26	1.51	1.00	63.0	3366-Hilda	16,989	5.05
108	32+50	NB	right	5.39	4.11	3.42	2.79	1.68	1.06	0.78	64.0		21,162	5.26
109	31+50	NB	right	5.79	4.34	3.50	2.91	1.86	1.17	0.74	63.0		18,539	5.23
110	30+45	NB	right	6.66	4.62	3.76	2.87	1.72	0.98	0.66	67.0		12,758	4.62
111	29+49	NB	right	5.75	4.45	3.66	3.13	2.02	1.32	0.82	65.0		9,157	5.40
112	28+49	NB	right	6.16	5.10	4.50	3.91	2.53	1.69	1.23	64.0		21,255	5.25
113	27+50	NB	right	8.53	6.34	5.08	4.12	2.44	1.47	0.86	65.0		12,841	4.46
114	26+68	NB	right	7.11	5.17	4.25	3.52	2.10	1.35	0.96	62.0		16,190	4.79
115	25+48	NB	right	6.42	4.68	3.89	3.24	2.00	1.48	1.17	67.0		25,953	4.47
116	24+50	NB	right	7.07	5.29	4.75	3.89	2.44	1.77	1.67	62.0		27,548	4.71
117	23+46	NB	right	8.30	6.14	5.36	4.59	3.15	2.46	2.15	66.0		20,566	4.79
118	22+50	NB	right	9.42	6.86	5.87	4.97	3.28	2.49	2.14	64.0		20,384	4.36
119	21+47	NB	right	7.01	4.95	3.98	3.30	2.16	1.85	1.90	64.0		27,774	4.98
120	20+50	NB	right	6.66	5.08	4.66	4.08	2.90	2.38	1.85	65.0		22,325	5.40
121	19+45	NB	right	8.37	6.56	5.59	4.92	3.50	2.71	2.47	61.0		18,355	4.91
122	18+43	NB	right	14.02	10.78	9.32	7.63	5.11	3.72	2.90	66.0		10,273	3.99
123	17+48	NB	right	9.86	7.80	6.80	6.00	4.35	3.37	2.88	65.0		15,023	4.72
124	16+50	NB	right	12.22	10.44	9.75	8.57	6.42	5.21	4.38	71.0		9,736	4.89
125	15+50	NB	right	13.64	11.23	10.16	9.17	6.78	5.23	4.53	70.0		9,506	4.54
126	14+49	NB	right	9.82	7.90	7.07	6.26	4.45	3.51	2.89	70.0		14,700	4.80
127	13+45	NB	right	9.43	7.35	6.47	5.73	4.12	3.27	2.94	71.0		15,328	4.96
128	12+41	NB	right	17.31	13.55	11.47	9.71	6.45	4.70	3.73	72.0		8,008	3.80
129	11+50	NB	right	8.57	7.55	6.92	6.24	4.82	3.85	3.21	73.0		13,096	5.58

Deflections Normalized To 9,000 lb. Load Basis

Test No.	Sta.	Direction	Lane	D0 mils	D1 mils	D2 mils	D3 mils	D4 mils	D5 mils	D6 mils	Surface Temp., oF	Comments	Subgrade Modulus, psi	AASHTO SNxeff
130	10+50	NB	right	7.93	6.35	5.47	4.83	3.39	2.56	1.97	75.0		14,965	4.67
131	9+50	NB	right	5.88	4.85	4.43	3.97	2.63	2.06	1.82	75.0		24,587	5.72
132	8+49	NB	right	8.85	7.69	6.92	6.37	4.54	3.57	3.15	72.0		13,944	5.27
133	7+43	NB	right	13.92	10.40	8.63	7.43	5.29	4.01	3.00	69.0		7,879	3.89
134	6+39	NB	right	8.72	6.45	5.88	5.07	3.32	2.43	2.04	70.0		20,904	4.63
135	5+41	NB	right	9.01	7.03	6.31	5.64	3.85	3.06	2.42	69.0		17,249	4.81
136	4+48	NB	right	10.64	8.28	7.31	6.12	4.20	3.05	2.29	72.0		12,421	4.57
137	3+49	NB	right	10.43	7.38	6.27	5.29	3.46	2.74	2.06	72.0		12,187	4.16
138	2+50	NB	right	8.95	6.47	5.33	4.57	2.89	2.04	1.38	72.0		14,997	4.62
139	1+50	NB	right	12.65	9.53	7.90	6.59	4.20	2.70	2.18	74.0		8,012	3.89
140	0+61	NB	right	11.41	9.27	7.94	6.78	4.62	3.07	1.93	73.0	24-cl Division end nb rl	4,389	4.52
141	1+00	SB	left	8.66	7.21	6.07	5.11	3.28	2.24	1.59	78.0	start sb ll	15,719	4.00
142	2+00	SB	left	7.80	6.52	5.82	5.06	3.74	2.90	2.08	77.0		9,043	4.95
143	3+01	SB	left	8.07	5.83	5.17	4.69	3.42	2.64	1.97	76.0		12,275	4.91
144	4+03	SB	left	5.53	3.95	3.77	3.55	2.98	2.34	2.14	72.0	lac/mac	21,025	7.07
145	4+98	SB	left	7.47	5.22	4.62	4.32	3.37	2.70	2.09	73.0	lac/mac	19,517	5.98
146	6+00	SB	left	6.40	5.10	4.85	4.24	3.25	2.64	2.11	68.0	lac/mac	19,786	5.85
147	7+00	SB	left	4.57	4.02	3.89	3.60	2.65	2.19	1.73	70.0		23,778	6.44
148	8+01	SB	left	12.09	9.00	7.85	6.93	4.81	3.78	2.60	66.0		15,014	4.43
149	9+02	SB	left	4.93	4.20	4.06	3.77	2.81	2.27	1.79	72.0		20,046	5.35
150	10+00	SB	left	6.47	5.50	5.09	4.79	3.69	2.97	1.74	70.0		4,517	6.50
151	11+04	SB	left	9.41	7.76	6.93	6.09	4.16	3.58	2.74	71.0		10,669	4.29
152	12+01	SB	left	6.31	5.34	5.01	4.79	3.99	3.35	2.65	71.0		13,645	5.83
153	13+00	SB	left	8.76	7.44	7.02	6.66	5.42	4.65	3.79	70.0		10,772	6.39
154	14+01	SB	left	9.87	7.78	7.01	6.39	4.79	3.90	3.01	70.0		13,693	4.93
155	15+00	SB	left	6.20	5.31	4.98	4.80	3.65	3.02	2.43	70.0		16,974	6.34
156	15+99	SB	left	8.12	7.38	6.91	6.58	5.36	4.55	3.65	71.0	lac	11,159	6.19
157	17+09	SB	left	8.33	7.76	7.06	6.87	5.47	4.50	3.55	71.0		9,946	4.81
158	18+00	SB	left	16.63	12.12	9.91	8.02	5.02	4.07	3.25	69.0		12,492	3.45
159	19+05	SB	left	7.29	6.19	5.76	5.33	4.37	3.58	2.83	70.0	lac	12,822	5.21
160	20+00	SB	left	5.69	4.39	4.20	4.12	3.32	2.93	2.37	69.0		17,914	7.15
161	21+00	SB	left	3.36	2.55	2.41	2.13	1.60	1.35	1.17	67.0	lac	38,639	7.28
162	22+03	SB	left	4.32	3.35	3.11	2.93	2.34	1.97	1.68	68.0		26,306	7.25
163	23+00	SB	left	4.95	3.74	3.46	3.20	2.61	2.11	1.67	70.0		22,489	6.02
164	24+04	SB	left	3.50	2.63	2.40	2.10	1.37	1.13	1.16	71.0		43,744	6.66
165	25+01	SB	left	4.87	3.91	3.64	3.38	2.68	2.27	1.80	70.0		20,676	6.07
166	26+01	SB	left	5.34	2.43	2.19	2.02	1.42	1.13	0.78	70.0		53,629	6.21
167	27+01	SB	left	4.26	3.08	2.70	2.49	1.67	1.06	0.77	70.0		44,477	4.84
168	28+05	SB	left	6.78	5.21	4.56	4.05	2.89	2.10	1.10	70.0		4,389	6.24
169	29+03	SB	left	4.52	3.55	3.25	3.11	2.35	1.98	1.24	70.0		29,985	6.10
170	30+03	SB	left	3.88	2.86	2.64	2.35	1.81	1.41	1.11	69.0		30,674	5.99
171	31+00	SB	left	4.16	3.47	3.12	2.92	2.11	1.63	1.08	69.0		11,230	6.68
172	32+10	SB	left	5.13	4.15	3.64	2.94	1.88	1.30	1.09	69.0		23,513	4.87
173	33+00	SB	left	3.69	3.18	2.98	2.67	2.04	1.21	1.20	70.0		13,745	6.12
174	34+07	SB	left	5.75	4.62	4.03	3.54	2.20	1.53	0.96	69.0	lac	15,805	5.25
175	35+01	SB	left	6.39	5.22	4.39	3.74	2.70	1.99	1.24	70.0	from Holmes south owp patched	7,248	5.75
176	35+99	SB	left	12.35	7.20	6.12	5.31	3.47	2.24	1.41	71.0		5,761	4.68
177	37+01	SB	left	5.14	4.17	3.66	3.45	2.29	1.70	1.07	72.0		12,178	6.34
178	38+02	SB	left	7.55	6.06	5.09	4.50	3.32	2.37	1.59	70.0		7,874	5.19
179	38+99	SB	left	7.01	5.71	5.05	4.42	2.99	2.09	1.31	72.0	sealed lc	6,627	5.28
180	40+06	SB	left	9.47	6.28	5.26	4.63	2.82	1.49	1.06	74.0		6,397	4.41
181	41+00	SB	left	4.91	3.93	3.57	3.31	2.54	1.90	1.24	74.0		9,584	6.55
182	42+00	SB	left	6.65	5.45	4.79	4.25	2.79	2.19	1.58	75.0		11,971	4.86
183	43+02	SB	left	3.36	6.14	5.01	4.40	2.45	1.14	0.62	75.0		67,607	6.21
184	44+03	SB	left	7.94	6.23	5.84	5.05	3.66	2.81	1.51	74.0		3,582	6.01
185	45+00	SB	left	4.84	3.85	3.42	3.24	2.18	1.67	0.93	76.0		35,848	4.64
186	46+00	SB	left	6.95	5.98	5.33	4.68	3.34	2.28	1.38	74.0		5,494	5.30
187	47+00	SB	left	6.71	5.55	5.16	4.68	3.55	2.81	1.91	73.0		7,765	5.76
188	48+10	SB	left	9.32	7.39	6.24	5.33	3.89	2.94	2.31	74.0		14,405	3.74
189	49+00	SB	left	6.69	5.42	4.65	4.31	2.75	2.10	1.63	74.0		24,000	4.49
190	50+00	SB	left	8.97	7.27	6.19	5.33	3.75	2.60	2.10	74.0		12,040	3.73
191	51+02	SB	left	6.65	5.47	4.96	4.66	3.31	2.49	1.60	72.0		6,723	5.71
192	52+00	SB	left	11.71	7.51	5.97	4.62	2.96	2.15	1.34	74.0		19,317	3.81
193	53+01	SB	left	11.28	6.42	4.75	3.97	2.82	2.20	1.43	72.0		25,947	4.11
194	54+01	SB	left	6.56	4.90	4.05	3.56	2.13	1.60	1.09	71.0	5366-pvmnt chng all 4 lanes	20,190	3.74
195	55+00	SB	left	6.92	4.71	3.79	3.09	1.89	1.33	0.89	71.0		24,081	3.41
196	56+04	SB	left	6.66	5.04	4.21	3.45	2.24	1.59	1.11	71.0		23,225	4.31
197	57+01	SB	left	7.02	5.59	4.66	4.00	2.65	1.91	1.37	71.0		20,321	4.37

Deflections Normalized To 9,000 lb. Load Basis

Test No.	Sta.	Direction	Lane	D0 mils	D1 mils	D2 mils	D3 mils	D4 mils	D5 mils	D6 mils	Surface Temp., oF	Comments	Subgrade Modulus, psi	AASHTO SNxeff
198	57+99	SB	left	5.57	4.22	3.55	3.05	2.02	1.59	0.92	70.0		7,241	6.47
199	59+15	SB	left	7.88	4.99	3.80	2.98	1.62	1.06	0.66	72.0		17,687	3.28
200	60+00	SB	left	6.74	4.21	3.04	2.18	1.23	0.89	0.52	70.0		34,818	3.35
201	61+08	SB	left	9.17	5.35	3.73	3.01	1.27	1.19	1.14	71.0		54,919	6.21
202	62+02	SB	left	10.86	5.80	4.12	3.17	1.58	1.36	0.95	72.0		38,960	3.75
203	63+00	SB	left	12.01	8.11	6.10	4.44	2.29	1.60	1.32	70.0		12,035	3.72
204	64+48	SB	left	10.62	7.18	5.37	4.19	2.27	1.35	0.91	70.0		15,355	4.16
205	65+00	SB	left	11.69	6.79	4.60	3.30	1.67	1.25	1.22	68.0	mac	14,509	3.67
206	65+89	SB	left	12.33	7.43	5.12	3.56	1.70	1.27	0.87	72.0		12,136	3.63
207	67+02	SB	left	13.44	8.19	5.82	4.25	1.97	1.29	1.05	75.0	this and above mac	10,157	3.61
208	67+57	SB	left	15.27	8.79	5.78	3.89	1.63	1.05	0.71	73.0	mac 6747 - pvmnt chng	8,438	3.38
209	69+04	SB	left	13.44	9.18	6.62	4.94	2.50	1.52	1.05	73.0		9,919	3.63
210	69+87	SB	left	12.52	7.99	5.97	4.46	2.45	1.44	0.95	72.0	6962 - FWD#70 end sb ll	18,053	3.82
211	69+40	NB	left	7.23	5.17	4.14	3.28	1.89	1.19	0.75	73.0	start nb ll	21,863	3.86
212	68+49	NB	left	6.48	4.79	3.76	2.99	1.89	1.22	0.82	74.0		25,733	4.00
213	67+49	NB	left	11.98	7.53	5.14	3.56	1.68	1.00	0.73	75.0		12,374	3.69
214	66+42	NB	left	4.01	3.14	2.82	2.59	2.05	1.49	1.02	75.0	utility patch 6628-6597	14,448	6.82
215	65+49	NB	left	9.78	6.90	5.37	4.28	2.47	1.55	1.20	73.0		17,016	3.42
216	64+40	NB	left	8.21	5.55	4.18	3.12	1.80	1.29	0.92	73.0		19,864	3.11
217	63+58	NB	left	7.05	5.77	5.06	4.54	3.44	2.59	1.78	75.0	mac	8,465	5.45
218	62+49	NB	left	6.84	4.32	3.34	2.73	1.83	1.35	1.04	75.0	6522-6348 utility	36,173	3.88
219	61+46	NB	left	4.49	3.41	2.69	2.12	1.38	0.97	0.70	74.0		40,209	4.50
220	60+46	NB	left	4.36	3.28	2.72	2.27	1.34	1.07	0.57	74.0		30,174	4.22
221	59+56	NB	left	9.30	5.24	3.72	2.80	1.55	0.93	0.59	73.0		27,463	3.02
222	58+45	NB	left	4.92	3.84	3.36	2.78	1.92	1.44	1.00	72.0		15,222	5.57
223	57+48	NB	left	5.96	4.70	4.10	3.60	2.32	1.70	1.25	71.0		24,334	3.94
224	56+47	NB	left	6.81	4.78	3.93	3.35	2.02	1.49	0.99	71.0		21,724	3.62
225	55+50	NB	left	6.11	4.41	3.62	3.06	2.03	1.39	0.91	71.0		10,941	5.40
226	54+50	NB	left	5.84	4.53	3.84	3.31	1.98	1.55	0.95	71.0		21,322	3.93
227	53+50	NB	left	7.96	6.43	5.68	4.95	3.38	2.14	1.55	72.0	5378 - full width pvmnt chng	9,575	4.19
228	52+48	NB	left	8.08	6.62	5.96	5.46	4.02	2.92	1.96	69.0		6,502	5.16
229	51+47	NB	left	8.22	6.22	5.11	4.52	3.22	2.34	1.48	71.0		24,057	3.71
230	50+49	NB	left	10.47	8.28	7.16	6.16	4.41	3.37	2.14	71.0		4,718	5.02
231	49+50	NB	left	11.67	8.07	6.79	5.90	4.36	3.12	2.24	70.0		7,914	4.51
232	48+47	NB	left	7.93	6.58	5.52	4.75	3.34	2.47	1.54	73.0		5,961	5.26
233	47+50	NB	left	8.32	6.25	5.09	4.32	2.93	2.25	1.73	73.0		23,652	3.75
234	46+50	NB	left	8.69	7.47	6.53	5.71	4.11	3.17	2.26	74.0		7,775	4.68
235	45+50	NB	left	6.61	5.08	4.76	3.96	2.51	1.72	1.12	75.0		15,091	5.03
236	44+47	NB	left	8.33	5.68	4.69	3.93	2.72	1.89	1.35	76.0		19,351	4.55
237	43+50	NB	left	8.93	6.84	6.18	5.76	4.23	3.29	2.14	78.0		5,489	5.48
238	42+42	NB	left	8.35	6.79	6.00	5.31	3.76	2.72	1.89	79.0		7,892	4.77
239	41+50	NB	left	6.18	4.78	4.08	3.63	2.79	2.21	1.66	78.0		15,297	5.49
240	40+47	NB	left	7.44	6.07	5.01	4.34	2.92	2.00	1.30	79.0		7,753	4.93
241	39+50	NB	left	10.21	6.50	5.39	4.39	2.78	1.93	1.00	79.0		8,350	4.93
242	38+50	NB	left	8.18	6.90	6.04	5.47	3.88	2.82	1.91	77.0		7,061	4.88
243	37+50	NB	left	7.88	5.18	3.98	3.13	2.00	1.53	0.94	76.0		27,792	3.05
244	36+48	NB	left	8.60	5.76	4.44	3.58	2.13	1.32	0.93	79.0		20,594	3.76
245	35+49	NB	left	12.30	7.72	6.31	5.29	3.90	2.85	1.79	78.0		5,230	5.10
246	34+48	NB	left	7.65	6.69	6.01	4.92	3.21	2.44	1.39	77.0		19,513	3.51
247	33+50	NB	left	5.63	4.49	3.87	3.37	2.40	1.63	0.80	76.0		5,224	5.42
248	32+47	NB	left	5.26	4.28	3.66	3.19	2.01	1.30	0.81	78.0		9,097	5.45
249	31+49	NB	left	4.69	3.65	3.34	2.99	1.89	1.36	0.70	76.0		27,548	4.47
250	30+49	NB	left	6.33	4.48	4.16	3.69	2.28	1.85	1.18	77.0		8,443	5.95
251	29+49	NB	left	3.29	2.88	2.36	2.03	1.41	1.22	1.16	75.0		42,684	6.57
252	28+49	NB	left	7.59	7.18	6.86	6.61	5.91	5.18	2.67	75.0		2,145	7.08
253	27+48	NB	left	4.54	3.97	3.65	3.61	2.61	2.17	1.41	76.0		26,400	6.00
254	26+50	NB	left	4.58	4.16	3.77	3.59	2.71	2.15	1.42	75.0		26,087	5.89
255	25+47	NB	left	4.02	2.86	2.45	2.26	1.63	1.43	1.41	77.0		35,359	7.18
256	24+39	NB	left	5.62	3.28	3.13	2.66	1.93	1.56	1.38	75.0		32,446	6.54
257	23+50	NB	left	6.32	4.36	4.07	3.57	2.61	2.09	1.79	75.0		24,426	5.97
258	22+49	NB	left	4.94	3.87	3.80	3.32	2.47	2.23	1.94	75.0		23,353	7.00
259	21+50	NB	left	3.83	3.20	2.99	2.71	1.96	1.89	1.50	74.0		30,168	7.24
260	20+48	NB	left	5.22	3.78	3.65	3.29	2.49	2.18	1.98	75.0		23,501	6.97
261	19+50	NB	left	7.21	5.13	4.89	4.66	3.69	3.10	2.70	74.0		16,335	6.65
262	18+50	NB	left	9.01	8.31	7.71	7.25	5.60	4.36	3.33	77.0		8,281	4.59
263	17+46	NB	left	6.87	5.94	5.63	5.47	4.12	3.43	2.97	77.0		14,384	6.46
264	16+47	NB	left	7.62	6.89	6.57	6.22	5.19	4.47	4.08	77.0		10,365	7.20
265	15+49	NB	left	7.80	6.97	6.69	6.54	5.10	4.66	4.04	76.0		10,326	7.08

Deflections Normalized To 9,000 lb. Load Basis

Test No.	Sta.	Direction	Lane	D0 mils	D1 mils	D2 mils	D3 mils	D4 mils	D5 mils	D6 mils	Surface Temp., oF	Comments	Subgrade Modulus, psi	AASHTO SNxeff
266	14+50	NB	left	7.31	6.06	5.54	5.17	4.00	3.29	2.71	76.0		15,569	6.04
267	13+50	NB	left	6.74	5.99	6.02	5.97	5.05	4.83	3.98	77.0		9,984	8.04
268	12+52	NB	left	9.23	7.00	6.44	5.74	4.08	3.39	2.80	78.0		15,424	5.05
269	11+49	NB	left	9.01	7.99	7.63	7.44	6.01	5.52	4.79	79.0		8,591	7.02
270	10+47	NB	left	6.05	5.25	4.85	4.53	3.40	3.02	2.49	80.0		17,101	6.67
271	9+40	NB	left	4.83	4.08	3.80	3.71	2.67	2.16	2.26	79.0		21,553	7.21
272	8+50	NB	left	7.20	5.95	5.62	5.14	3.86	3.30	2.87	78.0		15,291	6.26
273	7+48	NB	left	7.57	6.98	6.77	6.51	5.37	4.60	3.70	75.0		10,779	6.61
274	6+50	NB	left	4.61	4.00	3.91	3.66	2.88	2.71	2.26	78.0		19,032	7.86
275	5+50	NB	left	4.46	3.83	3.71	3.40	2.74	2.46	2.08	77.0		20,740	7.76
276	4+50	NB	left	5.46	4.57	4.21	3.79	2.94	2.57	1.98	78.0		20,894	6.60
277	3+48	NB	left	8.27	5.35	4.70	4.26	2.82	2.23	1.61	79.0	end nb ll	12,099	5.04
278	31+45	NB	Right curb	5.93	4.45	3.70	3.06	1.79	1.23	0.62	73.0	start nb next to curb	24,084	4.66
279	26+67	NB	Right curb	7.91	5.43	4.34	3.31	2.00	1.37	0.84	69.0		21,052	4.45
280	21+43	NB	Right curb	9.86	7.15	5.82	4.97	2.81	2.28	1.51	72.0		13,716	3.93
281	16+47	NB	Right curb	14.59	11.85	10.61	9.48	7.07	5.43	4.56	71.0		9,282	4.37
282	11+46	NB	Right curb	11.55	9.78	8.66	8.11	5.86	4.84	3.76	73.0		10,898	4.89
283	6+35	NB	Right curb	9.46	7.39	6.38	5.26	3.43	2.65	2.04	72.0		14,503	4.17
284	71+26	SB	travel lane	15.06	11.26	9.07	7.33	4.25	2.62	1.87	59.0		7,600	3.95
285	71+87	SB	travel lane	12.89	7.43	6.31	5.11	3.00	1.99	1.20	61.0		10,796	4.42
286	72+87	SB	travel lane	6.14	4.91	4.34	3.73	2.52	1.82	1.16	60.0		8,216	5.84
287	73+86	SB	travel lane	8.87	6.07	4.55	3.51	2.18	1.41	1.00	58.0		24,111	4.47
288	74+87	SB	travel lane	9.46	5.77	3.93	3.05	1.66	1.10	0.89	59.0		39,081	4.10
289	75+93	SB	travel lane	6.32	4.22	3.42	2.92	1.86	1.30	0.93	58.0		25,188	5.46
290	76+86	SB	travel lane	8.04	5.59	4.60	4.01	2.58	1.79	1.44	59.0		15,079	5.25
291	77+86	SB	travel lane	10.55	6.55	5.00	3.96	2.38	1.71	1.22	59.0		19,286	4.00
292	79+00	SB	travel lane	17.30	10.55	7.58	5.41	2.77	1.66	1.26	58.0		8,506	3.36
293	79+89	SB	travel lane	11.94	7.74	5.38	3.80	1.76	1.12	1.20	57.0		11,360	3.73
294	80+87	SB	travel lane	8.75	5.29	3.77	2.77	1.49	0.93	0.70	57.0		29,673	4.27
295	82+10	SB	travel lane	11.40	6.50	4.62	3.21	1.88	1.16	1.09	57.0	8146 Clairmont	26,277	3.89
296	82+86	SB	travel lane	5.98	3.77	3.35	2.49	1.44	1.45	0.84	58.0		36,279	5.29
297	83+86	SB	travel lane	6.92	5.08	4.10	3.51	2.17	1.51	1.20	58.0		24,355	4.76
298	84+86	SB	travel lane	9.57	6.27	4.84	3.95	2.29	1.50	0.92	58.0		16,413	4.54
299	85+87	SB	travel lane	6.20	4.40	3.67	3.28	2.16	1.71	1.35	58.0		30,627	5.51
300	87+34	SB	travel lane	6.32	4.22	3.44	2.80	1.63	1.56	0.84	58.0		6,776	6.68
301	87+86	SB	travel lane	4.94	3.49	2.83	2.16	1.32	0.95	0.86	58.0		38,903	5.16
302	88+88	SB	travel lane	5.75	3.81	3.20	2.69	1.66	1.32	0.74	58.0		29,864	5.08
303	89+86	SB	travel lane	6.73	4.81	3.82	3.06	1.83	1.17	0.85	58.0		20,279	5.15
304	90+90	SB	travel lane	6.21	4.36	3.49	2.77	1.54	1.00	0.75	58.0		24,094	4.82
305	91+86	SB	travel lane	8.13	5.39	4.13	3.15	1.77	1.08	0.98	57.0	9159 – Fir	20,994	4.61
306	92+88	SB	travel lane	8.52	5.54	4.22	3.25	2.02	1.42	0.92	58.0		23,589	4.62
307	93+86	SB	travel lane	10.98	7.18	5.30	4.03	2.35	1.54	1.04	58.0		21,183	4.08
308	94+86	SB	travel lane	8.44	5.66	4.40	3.44	2.04	1.36	1.02	56.0		22,687	4.60
309	95+87	SB	travel lane	10.75	7.15	5.56	4.32	2.54	1.58	1.15	58.0		14,557	4.31
310	96+89	SB	travel lane	14.31	9.64	7.23	5.70	3.05	1.86	1.24	57.0		15,490	3.71
311	97+87	SB	travel lane	14.05	9.96	7.71	6.07	3.56	2.22	1.53	58.0		13,830	3.84
312	98+85	SB	travel lane	8.14	5.33	3.93	3.08	1.68	0.95	0.71	58.0		17,613	4.65
313	99+86	SB	travel lane	8.65	6.12	5.02	4.08	2.81	1.86	1.48	58.0		13,852	4.61
314	100+87	SB	travel lane	7.02	4.52	3.30	2.42	1.31	0.73	0.45	57.0		31,110	4.65
315	101+97	SB	travel lane	12.47	7.86	5.60	3.89	1.81	1.00	0.77	58.0		9,402	3.75
316	102+84	SB	travel lane	14.00	9.33	7.02	5.23	2.80	1.85	1.15	59.0		11,333	3.60
317	103+92	SB	travel lane	10.05	6.85	4.87	3.90	2.36	1.57	1.11	59.0		22,361	4.29
318	104+86	SB	travel lane	8.68	5.92	4.54	3.76	2.29	1.54	1.06	58.0		20,145	4.68
319	105+86	SB	travel lane	13.77	8.75	6.15	4.42	2.14	1.19	0.61	59.0		15,832	3.66
320	106+90	SB	travel lane	10.76	6.67	4.71	3.45	1.79	1.00	0.87	59.0		20,113	4.03
321	107+87	SB	travel lane	10.80	6.96	5.16	3.89	1.97	1.27	0.75	59.0		13,642	3.93
322	108+81	SB	travel lane	9.14	6.01	4.44	3.31	1.91	0.83	0.89	59.0		5,883	4.30
323	109+88	SB	travel lane	9.64	6.67	5.06	3.79	2.02	1.32	0.92	59.0	10941 – pvmnt chng	15,577	4.08
324	110+86	SB	travel lane	3.78	2.67	2.22	1.80	1.12	0.89	0.70	59.0		48,626	5.78
325	111+82	SB	travel lane	1.70	1.16	1.16	1.15	0.77	0.71	0.64	60.0		67,447	11.85
326	112+86	SB	travel lane	2.49	2.11	1.91	1.89	1.56	1.26	0.99	61.0	11205 – Sebastian Way	33,905	8.40
327	113+86	SB	travel lane	2.62	2.12	1.93	1.78	1.40	1.02	0.72	62.0		23,851	7.98
328	114+82	SB	travel lane	3.28	2.54	2.45	2.11	1.59	1.39	1.01	62.0	11658 – west edge Hwy 213 end s	20,056	7.64
329	114+82	NB	travel lane	3.72	2.93	2.54	2.37	1.69	1.40	1.04	62.0	start nb	38,363	7.13
330	114+26	NB	travel lane	3.45	2.79	2.46	2.26	1.71	1.32	1.02	61.0		29,578	6.90
331	113+36	NB	travel lane	2.73	2.12	1.84	1.68	1.27	0.92	0.65	61.0		25,572	7.63
332	112+36	NB	travel lane	3.05	2.36	2.22	2.05	1.61	1.32	1.02	61.0		29,740	7.55
333	111+36	NB	travel lane	4.69	3.78	3.33	3.06	2.19	1.62	1.21	59.0		18,193	6.21

Deflections Normalized To 9,000 lb. Load Basis

Test No.	Sta.	Direction	Lane	D0 mils	D1 mils	D2 mils	D3 mils	D4 mils	D5 mils	D6 mils	Surface Temp., øF	Comments	Subgrade Modulus, psi	AASHTO SNxeff
334	110+37	NB	travel lane	7.42	5.08	4.05	3.09	1.90	1.27	0.65	60.0		13,447	5.11
335	109+36	NB	travel lane	10.09	6.71	5.05	3.86	2.16	1.48	1.10	61.0		17,364	4.03
336	108+36	NB	travel lane	7.27	4.82	3.71	2.93	1.79	1.24	0.82	61.0		26,463	4.91
337	107+36	NB	travel lane	9.58	5.87	4.17	3.09	1.82	1.27	0.81	59.0		23,389	4.02
338	106+36	NB	travel lane	12.93	8.54	6.36	4.80	2.73	1.67	0.97	60.0		13,050	3.97
339	105+26	NB	travel lane	8.67	5.99	4.59	3.72	2.36	1.62	1.11	60.0		20,066	4.72
340	104+36	NB	travel lane	10.72	7.12	5.28	4.00	2.28	1.60	1.00	60.0		17,189	3.93
341	103+35	NB	travel lane	14.86	10.16	7.57	5.76	3.33	2.10	1.31	60.0		12,721	3.76
342	102+36	NB	travel lane	11.17	7.39	5.46	4.15	2.20	1.34	0.89	60.0		22,400	3.97
343	101+35	NB	travel lane	7.91	4.72	3.41	2.49	1.28	0.85	0.49	56.0		21,047	4.31
344	100+36	NB	travel lane	9.91	6.69	5.45	4.62	3.06	2.08	1.47	58.0		14,326	4.79
345	99+35	NB	travel lane	9.08	7.09	5.97	5.02	3.50	2.44	1.77	58.0		12,874	5.04
346	98+36	NB	travel lane	19.05	13.81	10.46	7.71	3.87	1.94	1.16	59.0		9,943	3.32
347	97+36	NB	travel lane	23.43	17.35	13.44	10.51	6.19	3.90	2.60	57.0		8,039	3.24
348	96+35	NB	travel lane	16.25	12.60	10.29	8.42	5.29	3.38	2.17	55.0		6,966	3.93
349	95+36	NB	travel lane	19.61	14.59	11.84	9.55	5.99	3.86	2.29	53.0		2,626	3.77
350	94+36	NB	travel lane	17.95	14.43	11.82	9.67	6.25	4.33	3.18	53.0		9,851	3.69
351	93+35	NB	travel lane	13.81	10.90	9.08	7.70	5.18	3.54	2.40	53.0		5,316	4.14
352	92+36	NB	travel lane	11.60	9.36	7.87	6.72	4.49	3.12	2.03	54.0		5,062	4.53
353	91+23	NB	travel lane	10.80	8.22	6.73	5.63	3.54	2.40	1.64	55.0		12,055	4.52
354	90+34	NB	travel lane	9.96	7.97	6.82	5.77	3.83	2.59	1.65	55.0		5,460	4.79
355	89+31	NB	travel lane	17.11	12.33	9.49	7.52	4.14	2.37	1.49	56.0		10,187	3.57
356	88+45	NB	travel lane	8.19	6.79	5.76	4.97	3.26	2.11	1.06	56.0		10,953	5.01
357	86+54	NB	travel lane	12.67	8.96	6.86	5.20	2.80	1.61	1.02	55.0		18,548	3.84
358	85+35	NB	travel lane	16.51	10.67	7.61	5.58	3.12	1.97	1.32	55.0		16,658	3.43
359	84+36	NB	travel lane	11.82	9.29	7.96	6.31	3.57	2.29	1.29	56.0		8,795	4.28
360	83+35	NB	travel lane	5.16	4.10	3.61	3.19	2.33	1.83	1.29	55.0		14,034	6.12
361	82+37	NB	travel lane	11.26	7.81	5.81	4.53	2.57	1.61	1.02	56.0		16,835	4.11
362	81+31	NB	travel lane	13.07	7.19	4.76	3.36	1.63	0.84	0.50	55.0		23,944	3.61
363	80+37	NB	travel lane	9.57	6.36	4.47	3.38	1.63	1.11	0.83	55.0		14,680	4.05
364	79+35	NB	travel lane	19.85	12.49	9.48	7.28	4.11	2.32	1.81	56.0		6,828	3.50
365	78+42	NB	travel lane	8.70	6.60	5.31	4.53	2.87	2.02	1.44	56.0		17,191	4.83
366	77+36	NB	travel lane	9.76	6.83	5.31	4.44	2.60	1.68	1.68	56.0		14,292	4.56
367	76+36	NB	travel lane	25.81	15.72	10.63	6.76	3.18	2.01	1.56	58.0		10,235	2.86
368	75+35	NB	travel lane	13.04	8.92	7.13	5.65	2.93	1.59	1.05	57.0		5,183	3.97
369	74+36	NB	travel lane	12.24	8.32	6.33	4.89	2.77	1.73	1.12	56.0		16,110	3.99
370	73+52	NB	travel lane	13.86	9.09	6.77	5.22	2.78	1.56	1.25	57.0		10,481	3.87
371	72+36	NB	travel lane	10.30	7.62	5.95	4.86	3.02	1.98	1.46	58.0		11,961	4.23
372	71+52	NB	travel lane	11.56	9.37	8.29	7.23	5.21	3.75	2.70	58.0		7,007	4.55
373	111+36	NB	Widened	3.21	2.77	2.57	2.39	1.55	1.57	1.23	64.0	start nb widened	27,759	7.51
374	110+36	NB	Widened	8.83	7.20	5.90	4.94	3.09	1.96	1.25	65.0		11,539	4.94
375	109+36	NB	Widened	9.82	7.60	6.20	5.12	2.98	2.13	1.25	65.0		14,571	4.27
376	108+35	NB	Widened	12.66	9.24	6.97	5.33	2.83	1.49	0.80	65.0		10,920	3.99
377	107+36	NB	Widened	11.01	9.03	7.64	6.34	3.93	2.48	1.20	63.0		5,226	4.49
378	105+57	NB	Widened	12.84	9.41	7.28	5.49	2.83	1.41	0.63	63.0		3,860	3.84
379	104+29	NB	Widened	11.00	8.54	7.16	5.76	3.31	1.89	0.94	64.0		3,579	4.24
380	103+30	NB	Widened	16.64	12.23	9.82	7.39	4.06	2.48	1.50	65.0		10,364	3.66
381	100+31	NB	Widened	16.80	13.57	11.06	8.96	5.43	3.41	2.11	62.0		7,075	3.86
382	99+30	NB	Widened	14.01	10.30	8.55	6.96	4.46	2.86	1.43	62.0	9940 - start new pavement	2,774	4.08
383	98+35	NB	Widened	21.88	14.69	10.49	7.53	4.01	2.64	1.87	65.0		7,666	3.09
384	97+87	NB	Widened	19.86	13.29	9.46	7.08	3.92	2.48	1.62	65.0		12,852	3.30
385	97+06	NB	Widened	26.62	18.70	14.14	10.63	5.78	3.48	2.06	63.0	9686 - end newer pavement	7,010	3.07
386	94+25	NB	Widened	23.49	17.59	14.34	11.38	6.74	4.12	2.76	58.0		7,076	3.31
387	93+01	NB	Widened	32.09	21.41	15.53	10.94	5.26	2.94	2.09	62.0		3,491	2.77
388	92+50	NB	Widened	24.97	16.34	11.72	8.48	4.60	2.96	2.15	62.0		7,069	2.95
389	91+15	NB	Widened	24.33	16.35	11.71	8.68	4.68	2.76	1.56	58.0		7,979	3.11
390	90+29	NB	Widened	22.33	15.57	11.59	8.88	5.22	3.27	2.16	60.0	tests # 104-107 on trench	9,051	3.27
391	89+16	NB	Widened	16.77	11.88	8.75	6.44	3.09	1.67	1.04	60.0		5,530	3.50
392	88+14	NB	Widened	12.74	9.57	7.78	6.13	3.66	2.24	0.89	59.0		3,089	3.94
393	86+48	NB	Widened	12.95	9.46	7.21	5.46	2.90	1.55	0.94	60.0		14,625	3.85
394	85+36	NB	Widened	12.09	10.02	8.28	6.87	4.15	2.48	1.35	60.0		2,838	4.17
395	84+45	NB	Widened	15.44	10.88	8.29	6.26	3.28	1.74	0.88	64.0		7,583	3.75
396	83+31	NB	Widened	5.64	4.72	4.01	3.51	2.32	1.63	1.09	65.0		11,435	5.84
397	82+30	NB	Widened	7.67	5.82	4.59	3.67	2.09	1.34	0.87	64.0		23,735	4.80
398	81+19	NB	Widened	10.07	5.90	3.78	2.51	0.99	0.55	0.46	65.0		12,295	3.96
399	80+27	NB	Widened	7.10	5.43	4.50	3.79	2.07	1.31	0.85	69.0		23,492	5.04
400	79+08	NB	Widened	8.62	6.43	5.07	4.23	2.54	1.69	1.15	70.0		18,195	4.82
401	78+36	NB	Widened	8.80	6.96	5.77	4.94	3.30	2.25	1.58	73.0		12,357	5.18

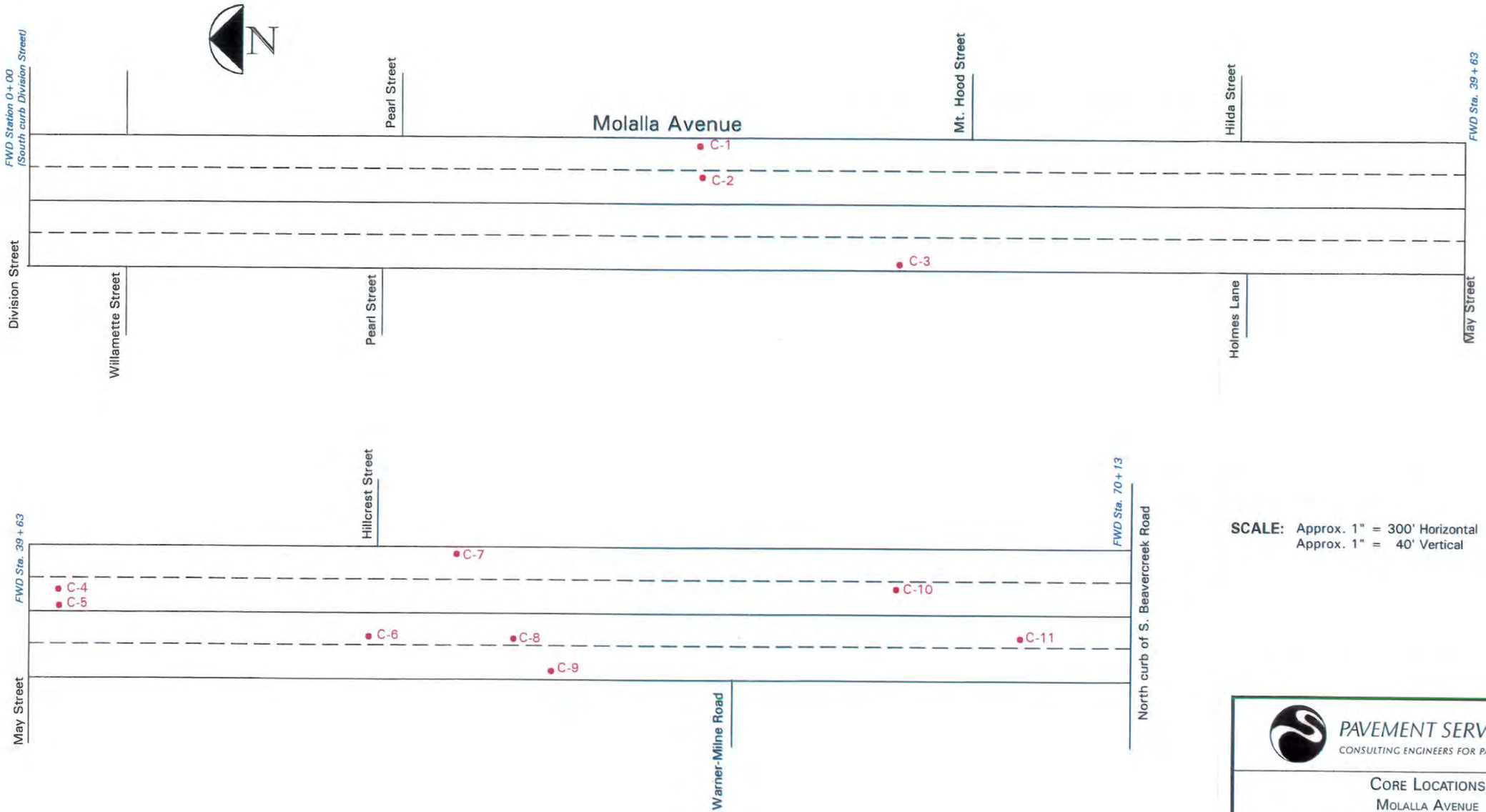
Deflections Normalized To 9,000 lb. Load Basis

Test No.	Sta.	Direction	Lane	D0 mils	D1 mils	D2 mils	D3 mils	D4 mils	D5 mils	D6 mils	Surface Temp., oF	Comments	Subgrade Modulus, psi	AASHTO SNxeff
402	77+32	NB	Widened	8.76	7.15	5.95	5.27	3.60	2.54	1.81	76.0		21,369	4.98
403	76+05	NB	Widened	10.14	7.11	5.24	4.08	2.32	1.46	0.98	71.0		21,779	4.28
404	75+15	NB	Widened	9.30	7.26	6.10	5.05	3.06	2.09	1.54	73.0		19,562	4.73
405	74+36	NB	Widened	9.54	6.78	5.39	4.39	2.37	1.48	1.11	70.0		15,098	4.58
406	73+48	NB	Widened	8.72	6.79	5.59	4.74	3.03	2.02	1.28	73.0		7,035	5.06
407	72+33	NB	Widened	11.20	9.38	8.40	7.44	5.10	3.83	2.36	71.0	7118-s curbline Beavercreek	15,242	4.58

APPENDIX 2 - Pavement Core Results

Pavement Core Explorations

Pavement core explorations were performed at sixteen (16) locations on the project. The approximate location of the pavement cores is shown on Figures A-2-1 and A-2-2. Five of the cores were surface core explorations only (i.e., coring of the AC and PCC layers only). The cores were selected to sample in representative locations based on review of the deflection data and were taken at a location coincident with a deflection test. At each core location, the pavement core was recovered for visual examination, the thickness of the pavement layers was determined and (for the full depth core explorations) jar samples of the subgrade were obtained for laboratory testing. The core logs are included herein.



SCALE: Approx. 1" = 300' Horizontal
Approx. 1" = 40' Vertical

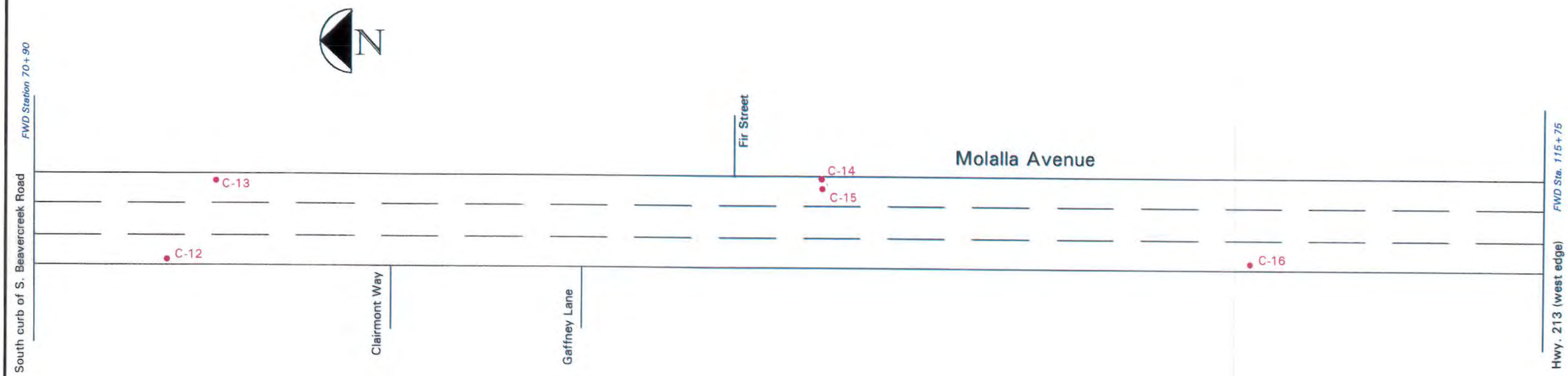
LEGEND

• C-1 Pavement Core Location

PAVEMENT SERVICES, INC
CONSULTING ENGINEERS FOR PAVEMENTS

CORE LOCATIONS
MOLALLA AVENUE
(DIVISION ST. TO S. BEAVERCREEK RD.)
OREGON CITY, OREGON

JOB NUMBER		FIGURE
240.00301		A-2-1
DRAWN	APPROVED	DATE
LGJ	MJM	6/20/2000



SCALE: Approx. 1" = 300' Horizontal
Approx. 1" = 40' Vertical

LEGEND

• C-1 Pavement Core Location

PAVEMENT SERVICES, INC
CONSULTING ENGINEERS FOR PAVEMENTS

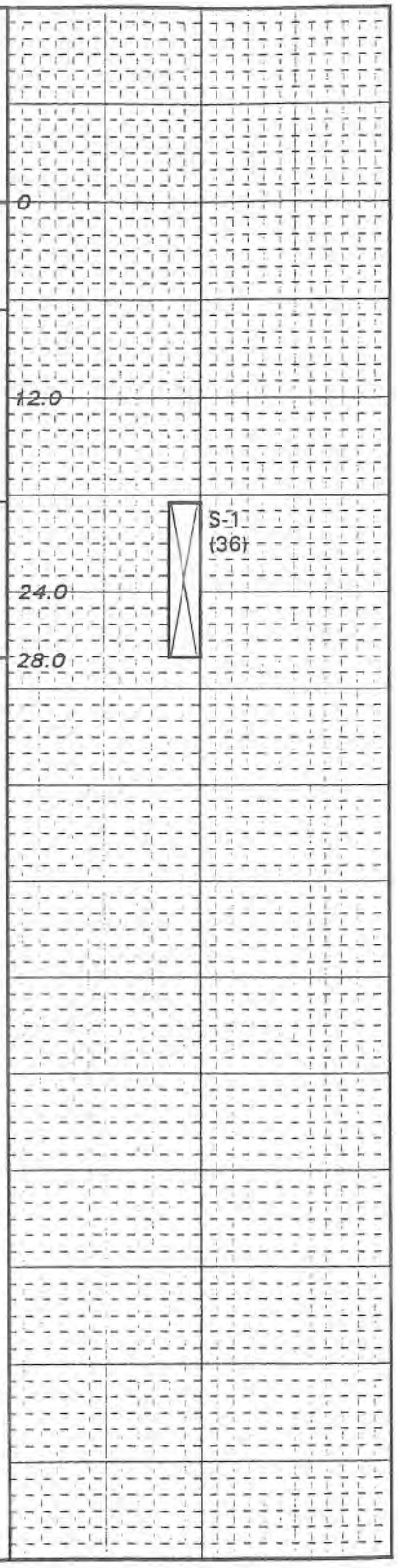
CORE LOCATIONS
MOLALLA AVENUE
(S. BEAVERCREEK RD. TO HWY 213)
OREGON CITY, OREGON

JOB NUMBER		FIGURE
240.00301		A-2-2
DRAWN	APPROVED	DATE
LGJ	MJM	6/15/2000

C-1 MOLALLA AVENUE
FWD 122, Station 18+43
Northbound, right lane

THICKNESS IN INCHES

0	
7.75"	ASPHALT CONCRETE
10.75"	Dense, gray, sandy GRAVEL with trace silt, moist. Gravel is angular to 2" diameter.
9.5"	Medium stiff, orange-brown, clayey SILT/silty CLAY with trace sand, moist.
	Bottom of Core @ 28" *Completed 5/23/2000* *NO FREE WATER OBSERVED*



LEGEND

☒ S- GRAB SAMPLE LOCATION AND NUMBER
( ) WATER CONTENT IN PERCENT

FIGURE

PAVEMENT SERVICES, INC
CONSULTING ENGINEERS FOR PAVEMENTS

LOG OF PAVEMENT CORE C-1

MOLALLA AVENUE
OREGON CITY, OREGON

JOB NUMBER	DRAWN	APPROVED	DATE
240.00301	LGJ	MJM	6/13/2000

C-2 MOLALLA AVENUE
FWD 262, Station 18+50
Northbound, left lane

THICKNESS IN INCHES		
0	ASPHALT CONCRETE	0
3.0"	PORTLAND CEMENT CONCRETE	
7.0"	Medium stiff, orange-brown, clayey SILT/silty CLAY with trace sand, moist.	12.0 — S-1 (27)
10.0"	*Bottom of Core @ 20"* *Completed 5/23/2000* *NO FREE WATER OBSERVED*	20.0

LEGEND

☒ S- GRAB SAMPLE LOCATION AND NUMBER
( ) WATER CONTENT IN PERCENT

FIGURE

PAVEMENT SERVICES, INC
CONSULTING ENGINEERS FOR PAVEMENTS

LOG OF PAVEMENT CORE C-2
MOLALLA AVENUE
OREGON CITY, OREGON

JOB NUMBER	DRAWN	APPROVED	DATE
240.00301	LGJ	MJM	6/13/2000

C-3 MOLALLA AVENUE
FWD 24, Station 24+02
Southbound, right lane

0	
7.5"	ASPHALT CONCRETE
	Bottom of Core @ 7.5" *Completed 5/24/2000* *NO FREE WATER OBSERVED*

THICKNESS IN INCHES

0

7.5

LEGEND

☒ S- GRAB SAMPLE LOCATION AND NUMBER
( ) WATER CONTENT IN PERCENT

FIGURE

PAVEMENT SERVICES, INC
CONSULTING ENGINEERS FOR PAVEMENTS

LOG OF PAVEMENT CORE C-3

MOLALLA AVENUE
OREGON CITY, OREGON

JOB NUMBER	DRAWN	APPROVED	DATE
240.00301	LGJ	MJM	6/13/2000

C-4 MOLALLA AVENUE
FWD 240, Station 40+47
Northbound, left lane, outer wheel path

0

5.0"

ASPHALT CONCRETE

Bottom of Core @ 5.0"
Completed 5/24/2000
NO FREE WATER OBSERVED

THICKNESS IN INCHES

0

5.0

LEGEND

☒ S- GRAB SAMPLE LOCATION AND NUMBER
( ) WATER CONTENT IN PERCENT

FIGURE

PAVEMENT SERVICES, INC
CONSULTING ENGINEERS FOR PAVEMENTS

LOG OF PAVEMENT CORE C-4

MOLALLA AVENUE
OREGON CITY, OREGON

JOB NUMBER	DRAWN	APPROVED	DATE
240.00301	LGJ	MJM	6/13/2000

C-5 MOLALLA AVENUE
FWD 240, Station 40+47
Northbound, left lane, inner wheel path

THICKNESS IN INCHES

0	
4.5"	ASPHALT CONCRETE
6.0"	PORTLAND CEMENT CONCRETE

Bottom of Core @ 10.5"
Completed 5/24/2000
NO FREE WATER OBSERVED

0

10.5

LEGEND

☒ S- GRAB SAMPLE LOCATION AND NUMBER
( ) WATER CONTENT IN PERCENT

PAVEMENT SERVICES, INC
CONSULTING ENGINEERS FOR PAVEMENTS

FIGURE

LOG OF PAVEMENT CORE C-5

MOLALLA AVENUE
OREGON CITY, OREGON

JOB NUMBER	DRAWN	APPROVED	DATE
240.00301	LGJ	MJM	6/13/2000

C-6 MOLALLA AVENUE
FWD 189, Station 49 + 00
Southbound, left lane

THICKNESS IN INCHES

0	
7.5"	ASPHALT CONCRETE
4.5"	PORTLAND CEMENT CONCRETE
	Bottom of Core @ 12.0" *Completed 5/24/2000* *NO FREE WATER OBSERVED*

0

12.0

LEGEND

☒ S- GRAB SAMPLE LOCATION AND NUMBER
( ) WATER CONTENT IN PERCENT

FIGURE

PAVEMENT SERVICES, INC
CONSULTING ENGINEERS FOR PAVEMENTS

LOG OF PAVEMENT CORE C-6

MOLALLA AVENUE
OREGON CITY, OREGON

JOB NUMBER	DRAWN	APPROVED	DATE
240.00301	LGJ	MJM	6/13/2000

C-7 MOLALLA AVENUE
FWD 89, Station 51 + 43
Northbound, right lane

THICKNESS IN INCHES

0		0
4.75"	ASPHALT CONCRETE	
13.25"	Dense, gray, sandy GRAVEL with trace silt, moist. Gravel is angular to 2" diameter.	12.0
22.0"	Medium dense, brown, medium to coarse SAND with some gravel. Grades to mixed with soft, brown, silty CLAY/clayey SILT, moist at 24".	24.0 S-1- [13] 36.0
	Bottom of Core @ 40" *Completed 5/23/2000* *NO FREE WATER OBSERVED*	40.0

LEGEND

☒ S- GRAB SAMPLE LOCATION AND NUMBER
( ) WATER CONTENT IN PERCENT

FIGURE

PAVEMENT SERVICES, INC
CONSULTING ENGINEERS FOR PAVEMENTS

LOG OF PAVEMENT CORE C-7

MOLALLA AVENUE
OREGON CITY, OREGON

JOB NUMBER	DRAWN	APPROVED	DATE
240.00301	LGJ	MJM	6/13/2000

C-8 MOLALLA AVENUE
FWD 193, Station 53+01
Southbound, left lane

THICKNESS IN INCHES

0		0
5.0"	ASPHALT CONCRETE	
15.0"	Dense, gray, sandy GRAVEL with trace silt, moist. Gravel is angular to 2" diameter.	12.0
12.0"	Medium stiff, orange-brown, clayey SILT/silty CLAY with trace sand, moist.	24.0 — S-1 (25)
	Bottom of Core @ 32" *Completed 5/23/2000* *NO FREE WATER OBSERVED*	32.0

LEGEND

☒ S- GRAB SAMPLE LOCATION AND NUMBER
( ) WATER CONTENT IN PERCENT

FIGURE

PAVEMENT SERVICES, INC
CONSULTING ENGINEERS FOR PAVEMENTS

LOG OF PAVEMENT CORE C-8

MOLALLA AVENUE
OREGON CITY, OREGON

JOB NUMBER	DRAWN	APPROVED	DATE
240.00301	LGJ	MJM	6/13/2000

C-9 MOLALLA AVENUE
FWD 54, Station 54+03
Southbound, right lane

THICKNESS IN INCHES

0		0
6.0"	ASPHALT CONCRETE	
16.5"	Dense, gray, sandy GRAVEL with trace silt, moist. Gravel is angular to 2" diameter.	12.0
10.5"	Medium stiff, orange-brown, clayey SILT/silty CLAY with trace sand, moist.	24.0 S-1 (23)
	Bottom of Core @ 33" *Completed 5/23/2000* *NO FREE WATER OBSERVED*	33.0

LEGEND

☒ S- GRAB SAMPLE LOCATION AND NUMBER
( ) WATER CONTENT IN PERCENT

FIGURE

PAVEMENT SERVICES, INC
CONSULTING ENGINEERS FOR PAVEMENTS

LOG OF PAVEMENT CORE C-9

MOLALLA AVENUE
OREGON CITY, OREGON

JOB NUMBER	DRAWN	APPROVED	DATE
240.00301	LGJ	MJM	6/13/2000

C-10 MOLALLA AVENUE
FWD 217, Station 63 + 58
Northbound, left lane

THICKNESS IN INCHES

0		0
4.0"	ASPHALT CONCRETE	
7.5"	PORTLAND CEMENT CONCRETE	
	Bottom of Core @ 11.5" *Completed 5/24/2000* *NO FREE WATER OBSERVED*	11.5

LEGEND

☒ S- GRAB SAMPLE LOCATION AND NUMBER
( ) WATER CONTENT IN PERCENT

FIGURE

PAVEMENT SERVICES, INC
CONSULTING ENGINEERS FOR PAVEMENTS

LOG OF PAVEMENT CORE C-10

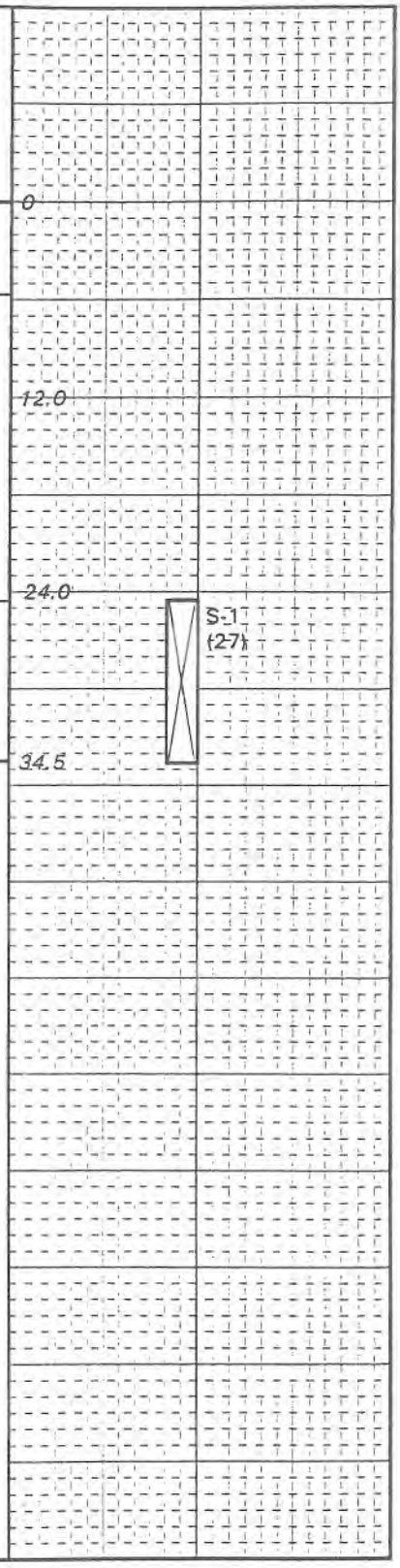
MOLALLA AVENUE
OREGON CITY, OREGON

JOB NUMBER	DRAWN	APPROVED	DATE
240.00301	LGJ	MJM	6/13/2000

C-11 MOLALLA AVENUE
FWD 207, Station 67+02
Southbound, left lane

THICKNESS IN INCHES

0	
5.75"	ASPHALT CONCRETE
18.75"	Dense, gray, sandy GRAVEL with trace silt, moist. Gravel is angular to 2" diameter.
10.0"	Medium stiff, orange-brown CLAY with some silt to silty, moist.
	Bottom of Core @ 34.5" *Completed 5/23/2000* *NO FREE WATER OBSERVED*



LEGEND

☒ S- GRAB SAMPLE LOCATION AND NUMBER
( ) WATER CONTENT IN PERCENT

FIGURE

PAVEMENT SERVICES, INC
CONSULTING ENGINEERS FOR PAVEMENTS

LOG OF PAVEMENT CORE C-11

MOLALLA AVENUE
OREGON CITY, OREGON

JOB NUMBER	DRAWN	APPROVED	DATE
240.00301	LGJ	MJM	6/13/2000

C-12 MOLALLA AVENUE
FWD 5, Station 74+87
Southbound, travel lane

THICKNESS IN INCHES

0		0
6.5"	ASPHALT CONCRETE	
16.5"	Dense, gray, sandy GRAVEL with trace silt, moist. Gravel is angular to 2" diameter.	12.0
10.5"	Medium stiff, orange-brown CLAY with some silt to silty, moist.	24.0 — S-1 (24)
	Bottom of Core @ 33.5" *Completed 5/23/2000* *NO FREE WATER OBSERVED*	33.5

LEGEND

☒ S- GRAB SAMPLE LOCATION AND NUMBER
( ) WATER CONTENT IN PERCENT

FIGURE

PAVEMENT SERVICES, INC
CONSULTING ENGINEERS FOR PAVEMENTS

LOG OF PAVEMENT CORE C-12

MOLALLA AVENUE
OREGON CITY, OREGON

JOB NUMBER	DRAWN	APPROVED	DATE
240.00301	LGJ	MJM	6/13/2000

C-13 MOLALLA AVENUE
FWD 84, Station 76+36
Northbound, travel lane

THICKNESS IN INCHES

0		0
7.0"	ASPHALT CONCRETE	
18.0"	Dense, gray, sandy GRAVEL with trace silt, moist. Gravel is angular to 1" diameter.	12.0
10.0"	Medium stiff, orange-brown CLAY with some silt to silty, moist.	25.0 S-1 [23]
	Bottom of Core @ 35" *Completed 5/23/2000* *NO FREE WATER OBSERVED*	35.0

LEGEND

☒ S- GRAB SAMPLE LOCATION AND NUMBER
( ) WATER CONTENT IN PERCENT

FIGURE

PAVEMENT SERVICES, INC
CONSULTING ENGINEERS FOR PAVEMENTS

LOG OF PAVEMENT CORE C-13

MOLALLA AVENUE
OREGON CITY, OREGON

JOB NUMBER	DRAWN	APPROVED	DATE
240.00301	LGJ	MJM	6/13/2000

C-14 MOLALLA AVENUE
FWD 103, Station 94 + 25
Northbound, widened lane

THICKNESS IN INCHES		
0	ASPHALT CONCRETE	0
4.5" 5.5"		
10.5"	Dense, red-brown, silty, sandy GRAVEL, moist. Gravel is angular to 2½" diameter.	12.0
	Medium stiff, orange-brown CLAY with some silt to silty, moist.	S-1 (25)
	Bottom of Core @ 24" *Completed 5/23/2000* *NO FREE WATER OBSERVED*	24.0
8.0"		

LEGEND

☒ S- GRAB SAMPLE LOCATION AND NUMBER
( ) WATER CONTENT IN PERCENT

FIGURE

PAVEMENT SERVICES, INC
CONSULTING ENGINEERS FOR PAVEMENTS

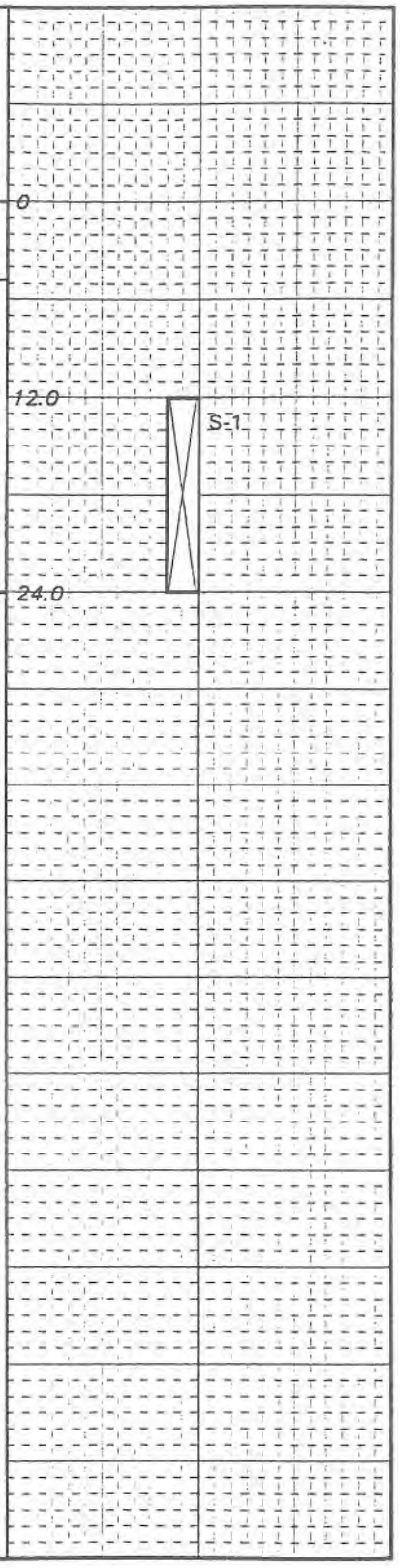
LOG OF PAVEMENT CORE C-14
MOLALLA AVENUE
OREGON CITY, OREGON

JOB NUMBER	DRAWN	APPROVED	DATE
240.00301	LGJ	MJM	6/13/2000

C-15 MOLALLA AVENUE
FWD 67, Station 94+36
Northbound, travel lane

0	
4.75"	ASPHALT CONCRETE
19.25"	Dense, brown, sandy GRAVEL with some silt, moist. Gravel is angular to ¾" diameter.
	Bottom of Core @ 24" *Completed 5/23/2000* *NO FREE WATER OBSERVED*

THICKNESS IN INCHES



LEGEND

☒ S- GRAB SAMPLE LOCATION AND NUMBER
( ) WATER CONTENT IN PERCENT

FIGURE

PAVEMENT SERVICES, INC
CONSULTING ENGINEERS FOR PAVEMENTS

LOG OF PAVEMENT CORE C-15
MOLALLA AVENUE
OREGON CITY, OREGON

JOB NUMBER	DRAWN	APPROVED	DATE
240.00301	LGJ	MJM	6/13/2000

C-16 MOLALLA AVENUE
FWD 37, Station 106+90
Southbound, travel lane

THICKNESS IN INCHES		
0	ASPHALT CONCRETE	0
5.75"	Dense, red-brown, silty, sandy GRAVEL, moist. Gravel is angular to 3" diameter.	12.0
14.25"	Medium stiff, orange-brown CLAY with some silt to silty, moist.	24.0
8.5"	*Bottom of Core @ 28.5"* *Completed 5/23/2000* *NO FREE WATER OBSERVED*	28.5

S-1 (19)

LEGEND

☒ S- GRAB SAMPLE LOCATION AND NUMBER
( ) WATER CONTENT IN PERCENT

FIGURE

PAVEMENT SERVICES, INC
CONSULTING ENGINEERS FOR PAVEMENTS

LOG OF PAVEMENT CORE C-16

MOLALLA AVENUE
OREGON CITY, OREGON

JOB NUMBER	DRAWN	APPROVED	DATE
240.00301	LGJ	MJM	6/13/2000

APPENDIX 3 - Traffic Analysis

The traffic loading estimate was based on traffic data that was provided to us by the City of Oregon City. The data consisted of classified traffic counts taken north and south of Beavercreek Road on May 8, 2000 and south of Beavercreek Road on April 12, 2000. The classified traffic count data provided to us that yielded the highest traffic loading north and south of Beavercreek Road is summarized in Table A-3-1.

Summary of Traffic Count Data - Table A-3-1
(24-hour count)

	Location			
	South of Beavercreek Road (near Fir Street)		North of Beavercreek Road (near May Street)	
Vehicle Class	**NB**	**SB**	**NB**	**SB**
Cars/light trucks	7,170	7,438	7,614	7,638
Buses	61	67	16	57
Class 5	316	348	54	267
Class 6	8	13	55	35
Class 7	1	0	128	50
Class 8	43	43	52	201
Class 9	19	22	14	5
Class 10	9	6	61	56
Class 11	1	1	0	3
Class 12	2	1	25	23
Class 13	2	3	22	23

The ODOT load equivalency factors (LEF's) were used to convert the truck volumes into 18-kip equivalent axle loads (EAL's. A zero percent growth rate was assumed for the truck and bus traffic. Based on this information, the 20-year traffic loading estimates for Molalla Avenue are summarized in Table A-3-2.

Molalla Avenue 20-Year Traffic Loading Estimates - Table A-3-2

Location	20-Year Design EAL's
North of Beavercreek Road	5,875,000
South of Beavercreek Road	2,700,000

APPENDIX 4 - Pavement Design Analysis

The overlay thicknesses were calculated for the individual FWD test locations (point-by-point analysis method) using the AASHTO overlay design equation (1993 AASHTO Guide for Design of Pavement Structures (*Guide*), Part III, Section 5.4.5):

$$D_{ol} = \frac{(SN - SN_{eff})}{a_{ol}} \qquad \text{.....1)}$$

Where

D_{ol} =	Thickness of overlay, inches
SN =	Structural number required for the design traffic loading
SN_{eff} =	Effective structural number of the existing pavement
a_{ol} =	Structural coefficient of the asphalt concrete (0.42)

The effective structural number of the existing pavement was estimated from the backcalculation results using the AASHTO procedures. For cases where milling was considered, the effective structural number of the existing pavement was reduced based on the depth of milling and the backcalculated resilient modulus of the asphalt concrete layer.

The structural number required for the design traffic, SN, was calculated by the AASHTO design equation (*Guide*, Part III, Section 3.1.1) using the following design parameters:

Overlay Design Parameters - Table A-4-1

Design period	20 years
Design traffic, W_{18}, EAL's	
North of Beavercreek Road	6,000,000 EAL's
South of Beavercreek Road	3,000,000 EAL's
Design reliability, R,% (calculated for individual test locations)	95%
(overall reliability)	90%
Design standard deviation, S_o	0.40
Initial serviceability	4.2
Terminal serviceability	2.5
Effective resilient modulus (M_r) of roadbed soil	Estimated from deflection data

Detailed explanation of these design parameters can be found in the *Guide* Part II, Chapters 2 and 3. The value of the design standard deviation, 0.40, is lower than the standard deviation value of 0.45 to 0.50, customarily used for overlay analysis where variation in both SN_{eff}, and M_r must be accounted for. This is because in the point-by-point analysis method, SN_{eff}, and M_r, are calculated from the deflection data at each test point and hence, variability in these parameters does not need to be included in the design standard deviation. The initial and terminal serviceability values are the values recommended for flexible pavement design in Part 2 of the *Guide*.

The design analysis for widening was also performed in accordance with the 1993 AASHTO *Guide* using the applicable design parameters given in Table A-4-1.

APPENDIX 5 – Construction Recommendations

General

Materials and construction methods should comply with the applicable specifications of the 1996 Oregon Department of Transportation (ODOT) Standard Specifications.

Widening

Widening should be accomplished by excavating to the necessary depth to remove all organic or unsuitable material and to a minimum depth of 6 inches below the existing surface. If fill material is required it should be non-organic, non-expansive, soil or granular material containing no particles greater than 3-inches in diameter and compacted at optimum moisture content. The fill should be placed in lifts not exceeding 9-inches (loose thickness). The entire depth of fill should be compacted to achieve a minimum density of 95% of the maximum density, as determined by AASHTO T-99 (standard Proctor). A subgrade geotextile should be placed above the compacted subgrade prior to placing the aggregate base material.

The subgrade should be prepared in accordance with Section 330 of the standard Specifications. Subgrade compaction should be conducted during warm, dry, summertime like conditions that are conducive to drying the subgrade soil, if necessary.

Wet Weather Construction

If subgrade preparation is undertaken during wet weather conditions, then the subgrade should be excavated to a depth necessary to accommodate a stable working platform consisting of crushed aggregate base. It has been our experience that approximately 24 inches of 2" - 0 crushed aggregate is required to provide a working platform for construction traffic, during wet weather construction in this area. The crushed aggregate should have not more than 6% (by dry weight of aggregate) passing the No. 200 sieve (wet sieve test). The subgrade should be excavated using hoe type equipment equipped with smooth cutting edges. After the subgrade is brought to grade, a subgrade geotextile fabric should immediately be placed followed by a 9-inches initial lift (loose thickness) of aggregate base. No traffic should be allowed on the unprotected subgrade. The initial lift of crushed aggregate should be compacted by at least 4 coverages of a static, smooth wheel roller weighing between 10 to 15 tons and having a contact pressure in the range of 300 to 500 pounds per lineal inch of roller. The remaining crushed aggregate base should be placed and compacted in maximum 6-inch lifts to achieve 95% of the maximum density, as determined by AASHTO T-99.

Aggregate Base

Aggregate base rock materials and construction should comply with Section 641 and Section 2630 in the Standard Specifications for 1" - 0 material except that not more than 6% by dry weight of material should pass the No. 200 sieve (wet sieve test). For wet weather construction the aggregate used to construct the working platform should be 2" - 0 material and should also have less than 6% passing the No. 200 sieve.

Geotextile Fabric

The geotextile fabric should meet the material requirements given in Sections 350 and 2320 of the Standard Specifications for subgrade geotextile. The geotextile, when tested in accordance with ASTM D 4491, should have a water permeability of at least 0.005 cm/sec.

Full Depth Inlay and Digout Repair

Full depth inlay or digout repair should be conducted by milling the full thickness of the existing asphalt concrete and excavating the necessary thickness of aggregate base in order to accommodate the required pavement section. The existing aggregate base should be compacted with a vibratory roller to produce a "tight" stable surface for placement of new asphalt concrete. The edges of the adjacent asphalt concrete should be cleaned and a tack coat should be applied to the edge of the existing pavement. The asphalt concrete should be placed in maximum 3-inch lifts and should be compacted as recommended herein.

Any areas that "pump" or are unstable under the action of the vibratory roller, should be overexcavated to accommodate a working platform of crushed 2"-0 aggregate base. The working platform should be at least 24-inches thick and may need to be thicker if very soft soils are encountered. A subgrade geotextile should be placed over the subgrade soil prior to placing the aggregate base.

Asphalt Concrete

Materials and construction for the asphalt concrete should comply with Section 00745, of the Standard Specifications. PBA-5 grade asphalt cement is recommended. A Level III ODOT mix with a maximum size aggregate of 19.0 mm is recommended for Molalla Avenue. If the Marshall procedure is used for the mix design, the mix design properties given in Table A-5-1 are recommended.

Marshall Method Mix Design Criteria - Table A-5-1

Marshall Property	Recommended Value
Number of blows, each end	75
Stability, minimum pounds	1,800
Flow (0.01 inches)	8 to 14
Percent Air Voids	3 to 5
Percent voids filled with asphalt (VFA)	65 to 75
Minimum percent voids in the mineral aggregate (VMA)	14

To reduce the potential for stripping in the asphalt concrete mix, the mix, when tested in accordance with ODOT TM 315, should have an Index of Retained Resilient Modulus (IRMr) of at least 70 percent.

The mix should be compacted to a minimum density of 91 percent of the theoretical maximum density, as determined by AASHTO T-209.

Appendix B
Streetscape Evaluation

General Description

The following Figures B-1 through B-5 delineate the existing conditions of the streetscape along Molalla Avenue. Within the project boundaries the curb, sidewalk and driveway conditions vary. From the more recent developments in the southern portion that comply with the relevant jurisdictional requirements to the older northern section that, in most cases, will require upgrades to the existing infrastructure to meet applicable codes. In some areas urban development has yet to occur, and are relatively unimproved.

Evaluation of the current streetscape conditions has been done by visual inspection along the project corridor. Curbs have been categorized from good to average to poor. Good curbs were those that exhibited no excessive wear, and would not need replacement in the near future (2-5 years). Average curbs were those that were cracking or showing excessive wear from traffic, and would need to be replaced in the near future. Curbs that appeared to need immediate replacement were labeled poor. Obstructions within the sidewalk were based on a standard 42" clear travel lane for wheelchair access. Obstructions noted on the following figures include power, light and turn signal poles. Traffic signage has not been shown due to the relative low cost of relocation. Compliance of ramps to the American Disabilities Act (ADA) have been based solely on visual inspection and would require a more detailed analysis to verify compliance.

Streetscape Evaluation

Curbs

Curbs throughout the project area appear to be in good condition overall. The only section exhibiting the need for immediate replacement is at the SE corner of Molalla Ave. and Division St.. The majority of the curbs met the requirements to be considered good. The majority of the average curbs were located in the area from Warner-Milne Rd. north to near Hilltop Lane. The only other average curb is at Pearl St. Much of the area south of Gaffney Lane has yet to be developed and will presumably receive curb and sidewalk at that time.

Sidewalks

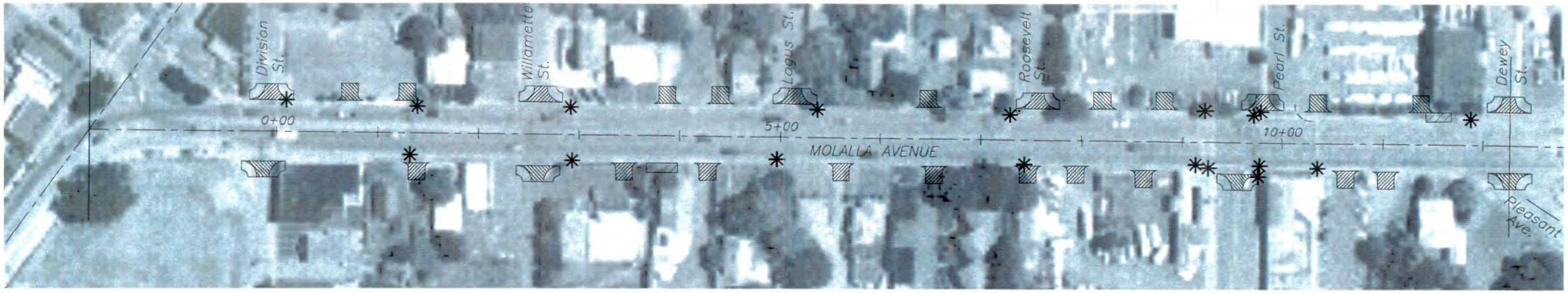
While the sidewalks along the project corridor are predominately in good physical condition, the majority of them are too narrow to meet current code. Current standard sidewalk widths of six feet are met only in limited areas near the Hilltop Mall. Exacerbating this situation are the many obstructions within the sidewalk from power, light and turn signal poles. The majority of these occur north of Beavercreek Rd. and will need to be relocated to meet ADA requirements. Again, much of the area south of Gaffney Lane is not developed, and will receive standard curb and sidewalk meeting current codes as development occurs.

Driveways

Driveways along the project corridor are in good physical condition for the most part. Some driveways are either asphalt or gravel, and the majority of them north of Beavercreek Rd. have side slopes at the aprons that do not meet ADA requirements.

Conclusions

In order to meet the needs of the public, Oregon City's desires and Current code, much of the existing sidewalk/curb will need to be replaced and/or repaired. The existing overhead utilities and other obstructions will need to be moved to the existing right-of-way line to allow for the maximum sidewalk widths and allow for compatibility with ADA requirements. This will also allow for upgrade of driveway aprons and curb ramps at intersections to current standards.



STA. PT. 0+00 TO 12+00

STA. PT. 12+00 TO 26+00

LEGEND

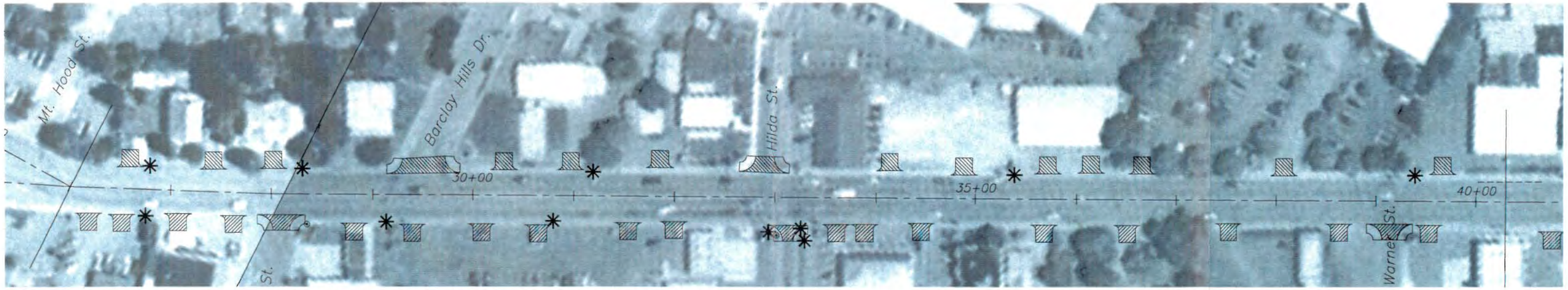
- BROKEN CURB
- SIDEWALK ADDITION OR REPLACEMENT
- STREET OR DRIVEWAY ACCESS POINT
- EXISTING POLE
- HYDRANT OBSTRUCTION
- NON-COMPLIANT ADA RAMP AT INTERSECTION

0 50 100
SCALE IN FEET

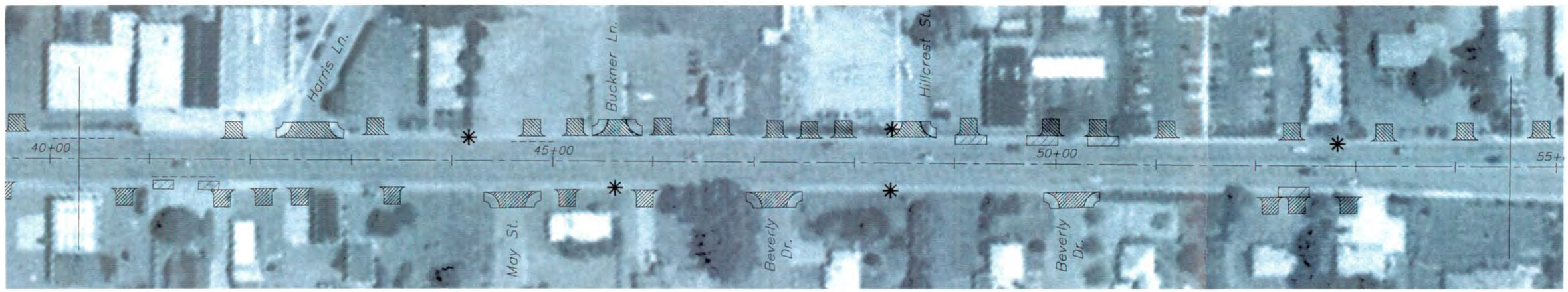
NOTES

1. ADA COMPLIANCE BASED ON ON-SITE VISUAL ANALYSIS ONLY.
2. PLAN ASSUMES SIDEWALK RAMPS TO BE ADA COMPLIANT UNLESS OTHERWISE NOTED.
3. POLE OBSTRUCTIONS AS SHOWN ON PLAN ARE LIMITED TO POWER, LIGHT AND TURN SIGNAL POLES. TRAFFIC SIGNAGE NOT SHOWN.
4. POLE OBSTRUCTIONS BASED ON MINIMUM 42 INCH CLEAR TRAVEL LANE ON SIDEWALK.
5. PLAN ASSUMES CURBS TO BE IN GOOD CONDITION UNLESS OTHERWISE NOTED ON PLAN.

January 2001 | Job 1077A	WALLIS ENGINEERING in association with GREENWORKS, Kittelson & Associates	Molalla Avenue Boulevard and Bikeway Improvements Plan Oregon City, Oregon	Streetscape Evaluation Sta 0+00 to Sta 26+00	Figure B-1



STA. PT. 26+00 TO 40+00



STA. PT. 40+00 TO 54+00

LEGEND

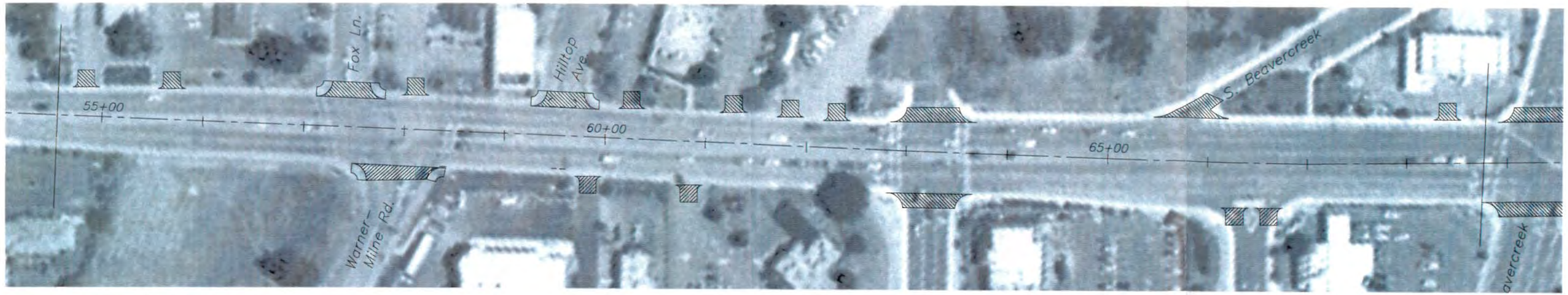
- BROKEN CURB
- SIDEWALK ADDITION OR REPLACEMENT
- STREET OR DRIVEWAY ACCESS POINT
- EXISTING POLE
- HYDRANT OBSTRUCTION
- NON-COMPLIANT ADA RAMP AT INTERSECTION

0 50 100
SCALE IN FEET

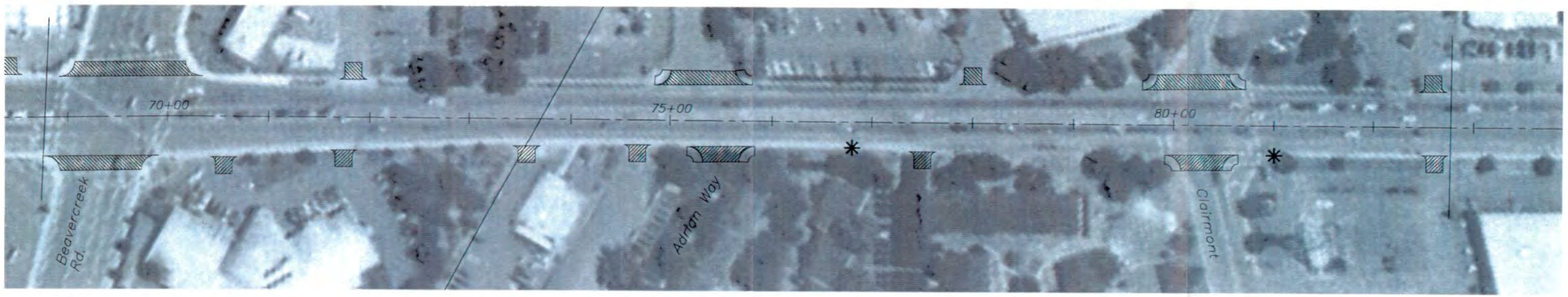
NOTES

1. ADA COMPLIANCE BASED ON ON-SITE VISUAL ANALYSIS ONLY.
2. PLAN ASSUMES SIDEWALK RAMPS TO BE ADA COMPLIANT UNLESS OTHERWISE NOTED.
3. POLE OBSTRUCTIONS AS SHOWN ON PLAN ARE LIMITED TO POWER, LIGHT AND TURN SIGNAL POLES. TRAFFIC SIGNAGE NOT SHOWN.
4. POLE OBSTRUCTIONS BASED ON MINIMUM 42 INCH CLEAR TRAVEL LANE ON SIDEWALK.
5. PLAN ASSUMES CURBS TO BE IN GOOD CONDITION UNLESS OTHERWISE NOTED ON PLAN.

January 2001 Job 1077A	WALLIS ENGINEERING in association with GREENWORKS Kittelson & Associates	Molalla Avenue Boulevard and Bikeway Improvements Plan Oregon City, Oregon	Streetscape Evaluation Sta 26+00 to Sta 54+00	Figure B-2



STA. PT. 54+00 TO 69+00



STA. PT. 69+00 TO 82+00

LEGEND

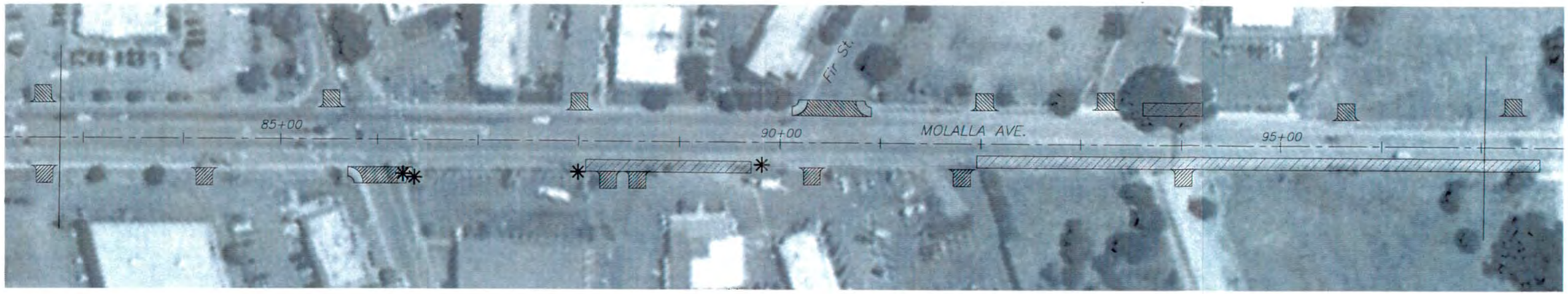
- BROKEN CURB
- SIDEWALK ADDITION OR REPLACEMENT
- STREET OR DRIVEWAY ACCESS POINT
- EXISTING POLE
- HYDRANT OBSTRUCTION
- NON-COMPLIANT ADA RAMP AT INTERSECTION

0 50 100
SCALE IN FEET

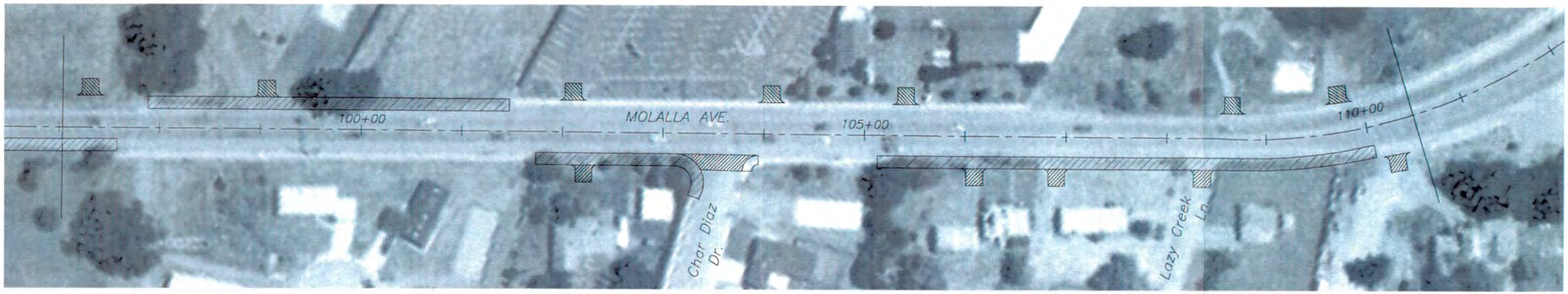
NOTES

1. ADA COMPLIANCE BASED ON ON-SITE VISUAL ANALYSIS ONLY.
2. PLAN ASSUMES SIDEWALK RAMPS TO BE ADA COMPLIANT UNLESS OTHERWISE NOTED.
3. POLE OBSTRUCTIONS AS SHOWN ON PLAN ARE LIMITED TO POWER, LIGHT AND TURN SIGNAL POLES. TRAFFIC SIGNAGE NOT SHOWN.
4. POLE OBSTRUCTIONS BASED ON MINIMUM 42 INCH CLEAR TRAVEL LANE ON SIDEWALK.
5. PLAN ASSUMES CURBS TO BE IN GOOD CONDITION UNLESS OTHERWISE NOTED ON PLAN.

January 2001	Job 1077A	WALLIS ENGINEERING in association with GREENWORKS, Kittelson & Associates	Molalla Avenue Boulevard and Bikeway Improvements Plan Oregon City, Oregon	Streetscape Evaluation Sta 54+00 to Sta 82+00	Figure B-3



STA. PT. 82+00 TO 97+00



STA. PT. 97+00 TO 110+00

LEGEND

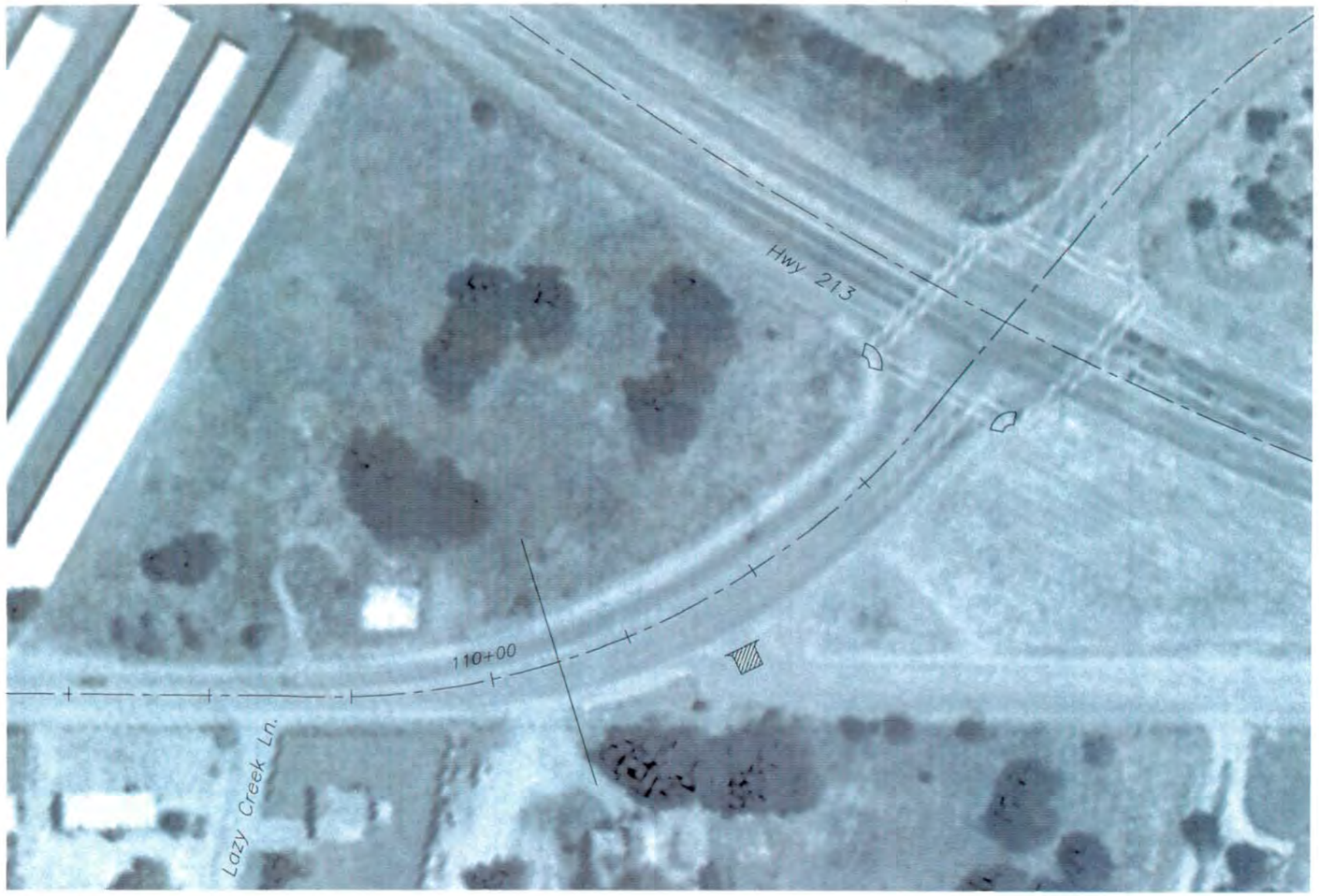
- BROKEN CURB
- SIDEWALK ADDITION OR REPLACEMENT
- STREET OR DRIVEWAY ACCESS POINT
- EXISTING POLE
- HYDRANT OBSTRUCTION
- NON-COMPLIANT ADA RAMP AT INTERSECTION

0 50 100
SCALE IN FEET

NOTES

1. ADA COMPLIANCE BASED ON ON-SITE VISUAL ANALYSIS ONLY.
2. PLAN ASSUMES SIDEWALK RAMPS TO BE ADA COMPLIANT UNLESS OTHERWISE NOTED.
3. POLE OBSTRUCTIONS AS SHOWN ON PLAN ARE LIMITED TO POWER, LIGHT AND TURN SIGNAL POLES. TRAFFIC SIGNAGE NOT SHOWN.
4. POLE OBSTRUCTIONS BASED ON MINIMUM 42 INCH CLEAR TRAVEL LANE ON SIDEWALK.
5. PLAN ASSUMES CURBS TO BE IN GOOD CONDITION UNLESS OTHERWISE NOTED ON PLAN.

January 2001	Job 1077A	WALLIS ENGINEERING in association with GREENWORKS, Kittelson & Associates	Molalla Avenue Boulevard and Bikeway Improvements Plan Oregon City, Oregon	Streetscape Elevation Sta 82+00 to Sta 110+00	Figure B-4



STA. PT. 110+00 TO 114+00

LEGEND

- BROKEN CURB
- SIDEWALK ADDITION OR REPLACEMENT
- STREET OR DRIVEWAY ACCESS POINT
- EXISTING POLE
- HYDRANT OBSTRUCTION
- NON-COMPLIANT ADA RAMP AT INTERSECTION

0 50 100
SCALE IN FEET

NOTES

1. ADA COMPLIANCE BASED ON ON-SITE VISUAL ANALYSIS ONLY.
2. PLAN ASSUMES SIDEWALK RAMPS TO BE ADA COMPLIANT UNLESS OTHERWISE NOTED.
3. POLE OBSTRUCTIONS AS SHOWN ON PLAN ARE LIMITED TO POWER, LIGHT AND TURN SIGNAL POLES. TRAFFIC SIGNAGE NOT SHOWN.
4. POLE OBSTRUCTIONS BASED ON MINIMUM 42 INCH CLEAR TRAVEL LANE ON SIDEWALK.
5. PLAN ASSUMES CURBS TO BE IN GOOD CONDITION UNLESS OTHERWISE NOTED ON PLAN.

January 2001 | Job 1077A	WALLIS ENGINEERING in association with GREENWORKS, Kittelson & Associates	Molalla Avenue Boulevard and Bikeway Improvements Plan Oregon City, Oregon	Streetscape Evaluation Sta 110+00 to Sta 114+00	Figure B-5

Appendix C
Drainage and Utility Evaluation

General Description

The project area consists of Molalla Avenue from its beginning at Harrison Street along 7th Street, to the project's end, at the intersection with Highway 213 across from Clackamas Community College. This is a distance of approximately 12,000 feet.

The route (from north to south) begins on a steep hill, climbs to the top and continues on to the Hilltop section of Oregon City. For most of the corridor (and particularly in the Hilltop section) the drainage courses tend to flow away from the road, with little offsite runoff that flows into the storm drainage system. Molalla Avenue varies in width. It is fully improved with curbs and inlets over most of its length. In areas that have not been improved, stormwater flows to roadside ditches or sheet flows directly onto adjacent parcels out of the right-of-way.

Although all of the Stormwater from Molalla Avenue eventually flows into the Willamette River, there are three separate drainage basins. These are delineated in the 1988 Oregon City Drainage Master Plan. They are described in more detail below (see Figure C1 for a map of the basin areas). The flow from the most southern basin flows to Singer Creek and then through town to the Willamette River. The next basin is Newell Creek which is divided into three subbasins (Newell Subbasins A, B and C). Stormwater from this basin flows to Newell Creek, then to Abernathy Creek and then to the Willamette River. The basin on the southern end of the project is the Caufield Basin. This has been divided into two subbasins (Caufield Subbasin A and B) which flow to Caufield Creek and then to Beaver Creek prior to reaching the Willamette River.

Basin Characteristics

Singer Subbasin

The Singer subbasin is located at the north end of the project. The existing land use is mixed between commercial, multifamily and single family residential. For the purposes of the hydraulic analysis, the land use was assumed to be commercial.

The section of Molalla Avenue included in this basin is from Division to about Dewey Street and Pleasant Avenue, a distance of approximately 1,250 feet. This section mostly includes runoff from the street area only. This along with the Newell Subbasin A is the steepest section of the project area, with street slopes up to 7%. The topography of this section has elevations ranging from 330 feet to 400 feet.

The drainage system in the basin consists of storm drain inlets generally located at the intersections. These are tied together with a 12" storm drainage pipe that generally runs between inlets. At the intersection with Division, the storm drain pipe continues to the west.

The soils in Basin A are classified as Jory Silty Clay Loam and Woodburn Silt Loam, according to the 1985 Soil Conservation Service Soil Survey of Clackamas County. The runoff from these soil types is described as slow and the hazard of water erosion is slight. As the terrain steepens, the runoff potential increases to medium, and the hazard of water erosion is moderate.

Newell Subbasin

Newell Subbasin A

Newell Subbasin A contains the area located from Dewey Street south to Barclay Hills Drive, a distance of approximately 1,900 feet. This subbasin includes the Pleasant Street area. Along with the Singer Creek subbasin, this includes the steepest section of the project area with street slopes up to 7%. The topography of the section has elevations ranging from 400 to 470. The existing land use is mixed between commercial, multifamily and single family residential. For the purposes of the hydraulic analysis, the land use was assumed to be commercial.

The drainage system in this subbasin consists of storm drain inlets generally located at the intersections. These are connected to manholes with a 12" storm drain that generally runs between manholes. At the intersection with Dewey, the storm drain continues to the east. From this location it runs across private property to Pearl Street, across more private property to Roosevelt and then down Roosevelt and is eventually conveyed to Newell Creek

Newell Subbasin B

Newell Subbasin B contains the area located from Barclay Hills Drive south to the northern intersection of Beverly and Molalla. This is a distance of approximately 1,700 feet. This section includes storm runoff from Molalla Avenue and about a half a block to the west of Molalla. This section is relatively flat, with elevations ranging from 460 to 470. Street longitudinal slopes are less than 2%. The soils in Basin B are classified as Jory Silty Clay loam.

The drainage system in this basin collects stormwater from both ends, and then continues on Harris Lane. The system consists of storm drain inlets located on both sides of Molalla Avenue and a 12" storm drain located on the west side of the street. The storm drain crosses Molalla Avenue at Harris Lane and continues to the east.

Newell Subbasin C

Basin C includes the area located along Molalla Avenue between Beverly and Clairmont, including the intersection with Beavercreek Road, a distance of approximately 3,350 feet. The area draining to this section is predominately Molalla Avenue and the immediate area adjoining it, as well as the Hilltop Mall Shopping Center. The land use in this area is primarily commercial, with pockets of residential, and a mobile home park just north of Clairmont. The topography in this area is flat, ranging in elevation from 430 to 460. Street slopes vary from 0.3% to 2.5%. The soils in this area are classified as Jory Silty Clay loam and Bornstedt silt loam. The runoff from these soil types is described as slow and the hazard of water erosion is slight.

The drainage system in this section is the most complex along the study route. This is due to runoff from the Hilltop Mall Shopping Center and the Beavercreek Road intersection. At this intersection, there are twin 36"storm drains from the Hilltop Shopping Center that cross from the west to the east. At the eastern side, these two 36" storm drains join with 12" and 15" storm drains. A 42" and 48" storm drain continue to the east on Beavercreek Road. The remainder of the drainage system on Molalla Avenue consists of storm drain inlets and 12" to 15" storm drains. The storm drains are located on both sides of the street along the length of this basin.

Caufield Basin

Caufield Subbasin A

Caufield Subbasin A is located from Clairmont to south of Fir Street. This basin includes approximately 2000 feet along Molalla Avenue. The terrain in this area is also flat, with elevations ranging from 410 to 440. The street slopes range from 1% to 2.5%. The soils in this basin are classified as Bornstedt silt loam. Runoff is described as slow and the hazard of water erosion is slight per the SCS soil survey.

This drainage area includes quite a bit of offsite area to the east. Much of this offsite portion is conveyed through a storm drain that had been installed with an LID about seven years ago along Fir Street. This area was included in this drainage analysis.

The drainage system in this section consists of storm drain inlets and storm drains. North of Fir Street, there is a 15" storm drain on the east side of Molalla Avenue and a 12" storm on the west side of the street. The 15" storm drain is connected to a 30" storm drain at the intersection with Fir. This 30" storm drain then continues south of Fir approximately 900 feet, is upsized to 36", crosses Molalla and discharges to an existing drainage channel on the west side. The 12" storm drain located on the west side appears to continue to the south and discharge to a roadside ditch. The roadside ditch then discharges to the same vicinity as the 36" storm drain.

Caufield Subbasin B

Caufield Subbasin B begins south of Fir Street and continues on to the south end of the project. It contains approximately 1,500 feet of Molalla Avenue. The terrain slopes to the south towards the end of the project. The street slopes range from 0.3% to 2.5%. The elevations in this basin range from 396 to 424. There is recent development along this section that is included in this basin.

The storm drain system in this basin begins with roadside ditches located in sections that do not have curb and sidewalk. The west side of the road generally drains away from the road. The east side of the road drains to the south to an existing 15" storm drain located at the Shurgard self storage facility. This 15" storm drain downsizes to a 12" storm drain and discharges back to a roadside ditch located to the south of the property. This ditch continues to a storm drain located at the curve from Molalla to 213. The storm drain then crosses Molalla Avenue to the south and discharges to an existing roadside ditch located along the old road.

CONVEYANCE ANALYSIS

The conveyance calculations have been analyzed using the Rational Formula, as required in the City's Stormwater and Grading Design Standards. This appendix contains the conveyance calculations. Pipe slopes have been obtained from design plans in some instances. For all other cases, the slope is assumed to be the same as the street slope for mains and to be 1 to 2% for inlet laterals. The street slope is measured from the aerial topography. Basin areas were measured from aerial topography; street areas were measured separately and assumed to be completely impervious. The offstreet contributing areas were assumed to be zoned city commercial, a conservative assumption made to reflect future development. A minimum time of concentration of 5 minutes was used, reflecting the fact that most of the basin is paved. Based on the Rational Formula analysis, there are several pipe sections that are over capacity. These pipes have been shaded on the conveyance calculations included with this appendix.

Conveyance design based on the Rational Formula is more conservative than many other models. The Rational Formula typically yields runoff estimates that can be three times as high as other hydrologic models such as the Santa Barbara Urban Hydrograph (SBUH). A comparison between the Rational Formula and the SBUH has been included within this appendix. This comparison is for the pipes that have been identified as over capacity per the Rational Formula analysis. The pipes that are over capacity per the Rational Formula are well under capacity using the SBUH.

DRAINAGE DEFICIENCIES

There are a number of deficiencies with the existing drainage system, most related to the condition of the existing storm drains (see Figures C1 through C5). The City has a regular maintenance program and water quality monitoring for the drainage system. Most of the deficiencies noted on the figures are based on City television records. The latest TV inspection was completed about a year ago. The deficiencies detected consist of crushed or broken pipe sections, misaligned pipe, joints out of line, blocked sections, and bellies in pipe sections.

The drainage calculations reveal several areas where the storm drain is at capacity or over capacity for the 10 year storm event. These locations are shaded on the calculations and are at the northern end of Basin A, the discharge from Molalla Avenue to Harris at Basin B, from MH 14 to MH 16 at Basin C, between CB 48 and 49 of Basin D and at CB E5 at Basin E. As noted in the discussion on conveyance, the Rational Formula is conservative. A comparison with the SBUH method indicates that the storm drains have adequate capacity. Prior to upgrading any storm drains based on these calculations, we recommend that field observation during significant rainfall events be performed to determine the extent of flooding. In addition, detailed surveying will be required to determine the actual slopes and invert elevations and to verify that offsite storm drains are sufficient. City maintenance personnel have indicated that they know of no areas with drainage capacity problems.

Other deficiencies include roadside ditches located south of Fir Street. These ditches will need to be filled and replaced with a storm drain system during construction of street improvements.

RECOMMENDED IMPROVEMENTS

Figures C2 through C5 show recommended upgrades to the storm drain system. In general, these consist of repairing damage and replacing pipe sections noted in the City's TV inspection. Another recommendation includes installing a collection and conveyance system in areas where new curb and sidewalk are constructed and ditches are replaced. The collection and conveyance system should be designed to include the onsite and offsite contributing areas. These locations are shown on the plan and are located on the southern end of the project in Caufield Subbasins A and B. A part of the street improvements may require relocation of existing inlets. Relocated inlets should be replaced with City Standard inlets.

It would be ideal to combine much of the storm drainage facilities. Presently, much of the system consists of drainage inlets and storm drains on both sides of the road. The cost to combine these into a single system, however, would be prohibitive. Our recommendation is to have new work consolidated into one storm drain system as much as possible.

WATER QUANTITY/QUALITY

Treatment of water quality has not been addressed in this memorandum. Due to limited available land area, if water quality is to be considered then we recommend treatment units be placed at areas with the highest potential for water quality problems. Control of the amount of runoff has not been considered. The increase in flows from existing conditions is negligible. We do recommend water quantity and quality management be implemented for new and redevelopment projects.

WATER SYSTEM IMPROVEMENTS

Noted on the plans are upgrades and replacements to the public water system. These are based on input from the Oregon City Public Works department. The upgrades are generally replacement of older lines, and replacement of cast iron mains with ductile iron.

SANITARY SEWER IMPROVEMENTS

The only sanitary sewer improvement planned by the Public Works Department is the extension of a sanitary sewer line in the area between Fir Street and Lazy Creek Drive. This extension would allow for the abandonment of an existing pump station at the Fir Street and Molalla Avenue intersection.

For construction in other areas, an evaluation should be made of the existing sanitary sewer lines to determine if any upgrades need to be performed. This evaluation should consist of a TV inspection at the time of design of street improvements.

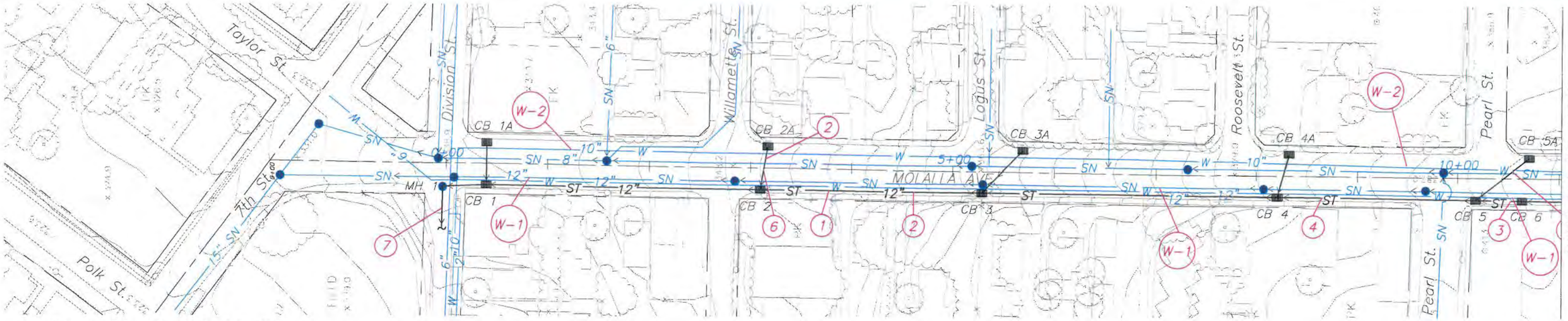
PRIVATE UTILITIES

There are numerous private utilities located along the Molalla Avenue corridor. Qwest, Northwest Natural Gas (NNG), AT&T, and PG&E are among companies that have utilities located within this corridor. Qwest and NNG have their major facilities located along Molalla Avenue. None of the companies contacted responded with planned improvements for the area. Their construction or upgrades would be in response to growth in the area.

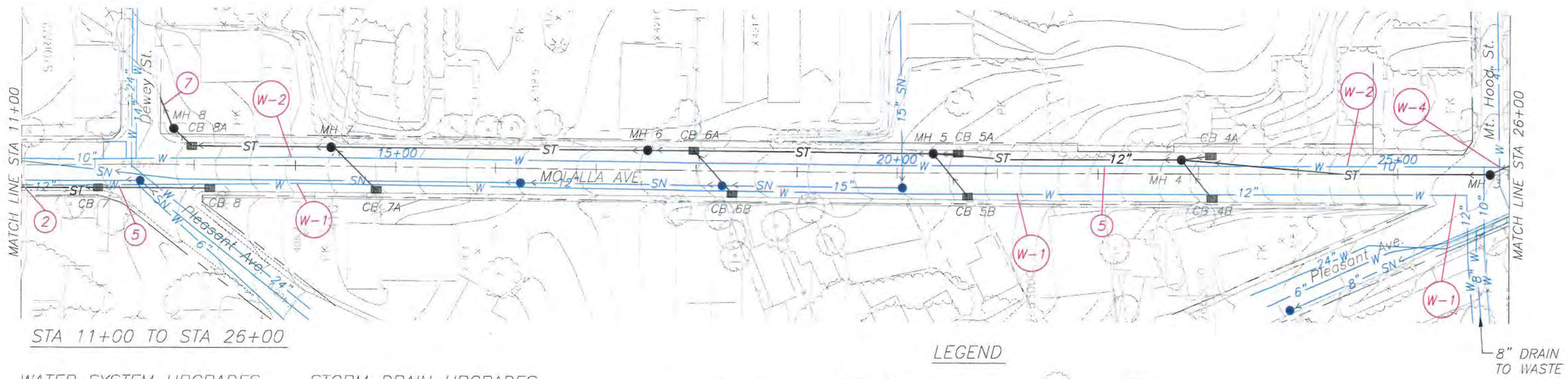
Figure C-1

Basin Areas

Molalla Avenue Improvement Project
November 2000



STA 0+00 TO STA 11+00



STA 11+00 TO STA 26+00

WATER SYSTEM UPGRADES

- (W-1) REPLACE EXISTING 12" MAIN W/16" D.I. INSTALL PRV.
- (W-2) INVESTIGATE OPTIONS TO ABANDON EXISTING WATER MAIN.
- (W-3) INSTALL FIRE HYDRANT. COORDINATE W/FIRE DEPT AND CITY PUBLIC WORKS DEPT.
- (W-4) INSTALL 8" D.I. INTERTIE.

STORM DRAIN UPGRADES

1. REPAIR EXISTING CRACK IN STORM DRAIN.
2. REPAIR BROKEN PIPE SECTION.
3. REPAIR/GROUT WHERE LATERAL ENTERS MAIN.
4. REMOVE STICK PROTRUDING INTO STORM MAIN FROM LATERAL.
5. REPAIR OFFSET JOINT.
6. REPAIR SEPARATED JOINT.
7. CHECK PIPE CAPACITY. REPLACE IF REQUIRED.

LEGEND

- RIGHT OF WAY
- 8" W — WATER LINE
- 12" ST — EXISTING STORM DRAIN
- 15" ST — PROPOSED STORM DRAIN
- 15" SN — EXISTING SANITARY SEWER
- CATCH BASIN
- MANHOLE
- PIPE FLOW DIRECTION
- TREE
- CONTOUR
- SPOT ELEVATION
- PARKING
- GRAVEL
- UTILITY POLE
- LIGHT STANDARD
- FENCE
- SHRUBBERY

0 50 100
SCALE IN FEET

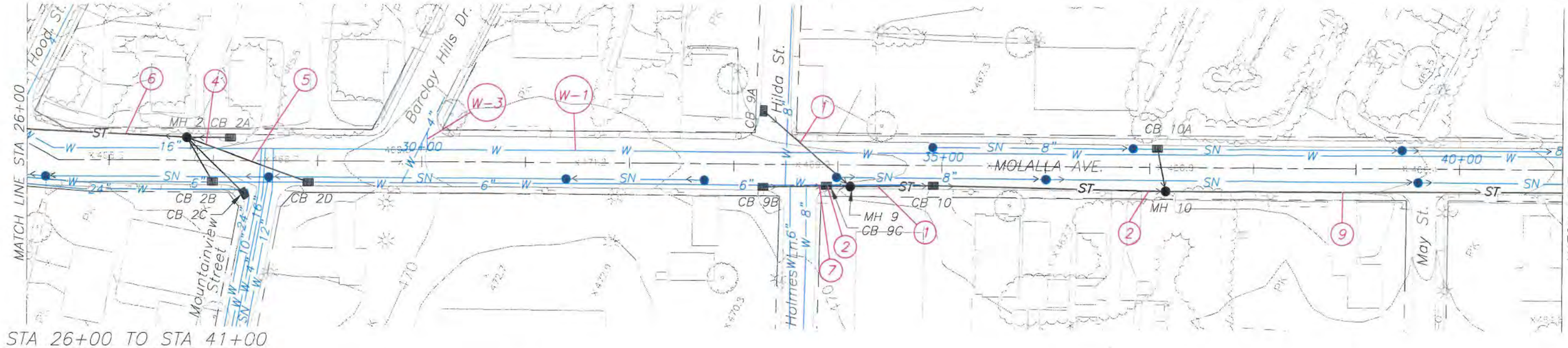
NOTE: TOPOGRAPHY BASED ON AERIAL SURVEY. DATUM IS NAD 83/91 WA-OR HIGH PRECISION GRID.

Figure C-2

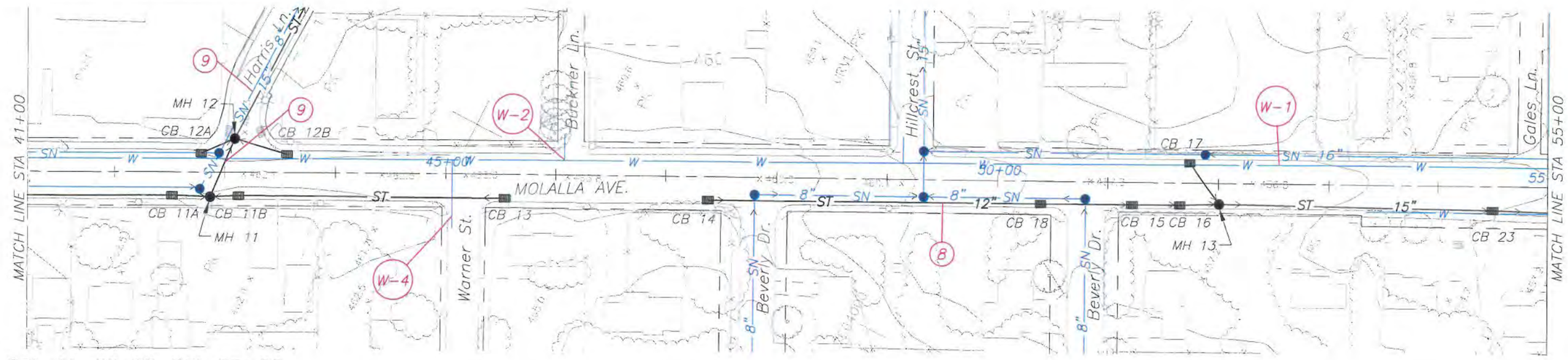
Existing Utilities and Drainage Improvements Sta 0+00 to Sta 26+00

Molalla Avenue Boulevard and Bikeway Improvements Plan

January 2001



STA 26+00 TO STA 41+00



STA 41+00 TO STA 55+00

WATER SYSTEM UPGRADES

- (W-1) REPLACE EXISTING 16" STEEL FROM RESERVOIR TO BEAVERCREEK ROAD W/16" D.I.
- (W-2) INSTALL 6" D.I. INTERTIE
- (W-3) INSTALL 8" D.I. INTERTIE
- (W-4) REPLACE EXISTING 4" STEEL PIPE WITH 8" D.I.

STORM DRAIN UPGRADES

1. REPLACE BROKEN PIPE SECTIONS.
2. REPAIR BROKEN AND OFFSET PIPE.
3. REPAIR FRACTURED AND OUT OF ROUND PIPE.
4. REPAIR OFFSET JOINT.
5. REPLACE BELLIES IN PIPE.
6. CLEAN PIPE SECTION.
7. REPAIR CRACK NEAR JOINT.
8. REPLACE DAMAGED PIPE SECTIONS FROM MH 13 TO CB 14.
9. CHECK PIPE CAPACITY. REPLACE IF REQUIRED.

LEGEND

- RIGHT OF WAY
- 8" W — WATER LINE
- 12" ST — EXISTING STORM DRAIN
- 15" ST — PROPOSED STORM DRAIN
- 15" SN — EXISTING SANITARY SEWER
- CATCH BASIN
- MANHOLE
- < PIPE FLOW DIRECTION
- TREE
- CONTOUR
- SPOT ELEVATION
- PARKING
- GRAVEL
- UTILITY POLE
- LIGHT STANDARD
- FENCE
- SHRUBBERY

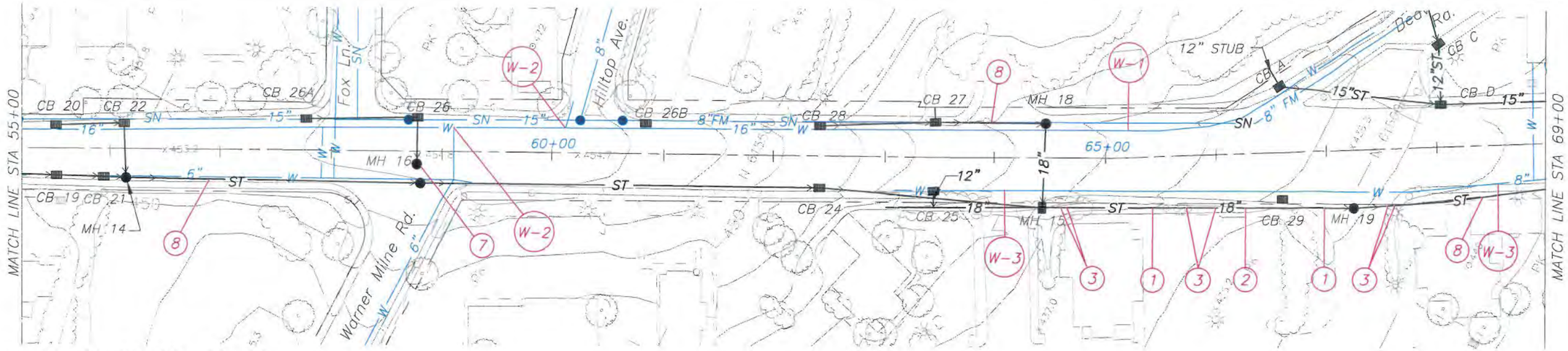
0 50 100
SCALE IN FEET

Figure C-3

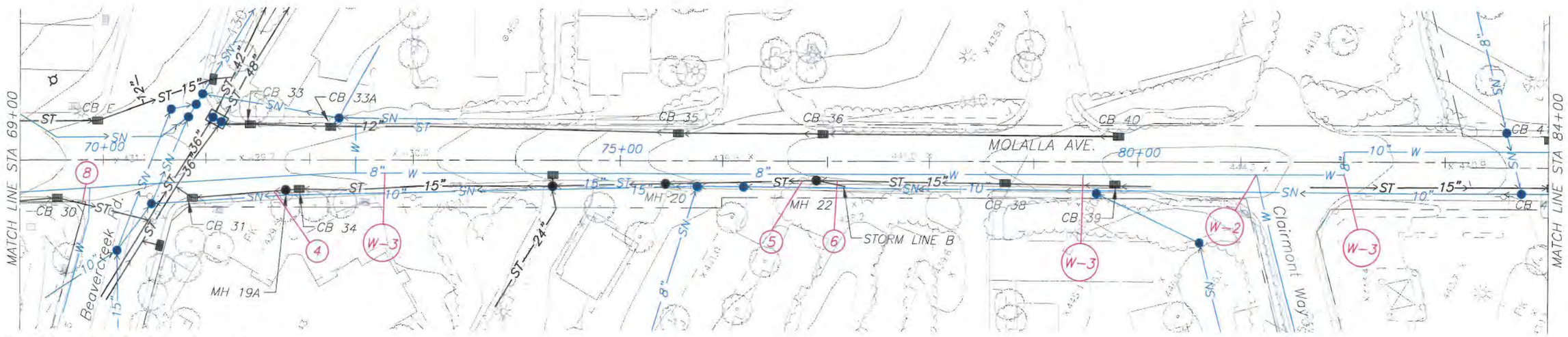
Existing Utilities and Drainage Improvements Sta 26+00 to Sta 55+00

Molalla Avenue Boulevard and Bikeway Improvements Plan

January 2001



STA 55+00 TO STA 69+00



STA 69+00 TO STA 84+00

LEGEND

- RIGHT OF WAY
- 8" W — WATER LINE
- 12" ST — EXISTING STORM DRAIN
- 15" ST — PROPOSED STORM DRAIN
- 15" SN — EXISTING SANITARY SEWER
- CATCH BASIN
- MANHOLE
- < PIPE FLOW DIRECTION
- TREE
- CONTOUR
- SPOT ELEVATION
- PARKING
- GRAVEL
- UTILITY POLE
- LIGHT STANDARD
- FENCE
- SHRUBBERY

0 50 100
SCALE IN FEET

STORM DRAIN UPGRADES

1. REPLACE PIPE SECTION(S) THAT HAS HOLE IN BOTTOM OF PIPE.
2. REPLACE DAMAGED PIPE SECTIONS. REALIGN EXISTING CONDUIT CROSSING.
3. REPAIR PIPE SECTION THAT HAS HOLE IN TOP OF PIPE.
4. REPLACE SECTION THAT HAS 1 1/2" OR 2" HOLE BORED IN PIPE.
5. REPLACE COLLAPSED PIPE SECTION.
6. CLEAN OUT BLOCKED PIPE SECTION ON STORMLINE B.
7. MANHOLE REPORTEDLY NOT CONNECTED TO DOWNSTREAM PIPE. INSTALL NEW PIPE SECTION.
8. CHECK PIPE CAPACITY

WATER SYSTEM UPGRADES

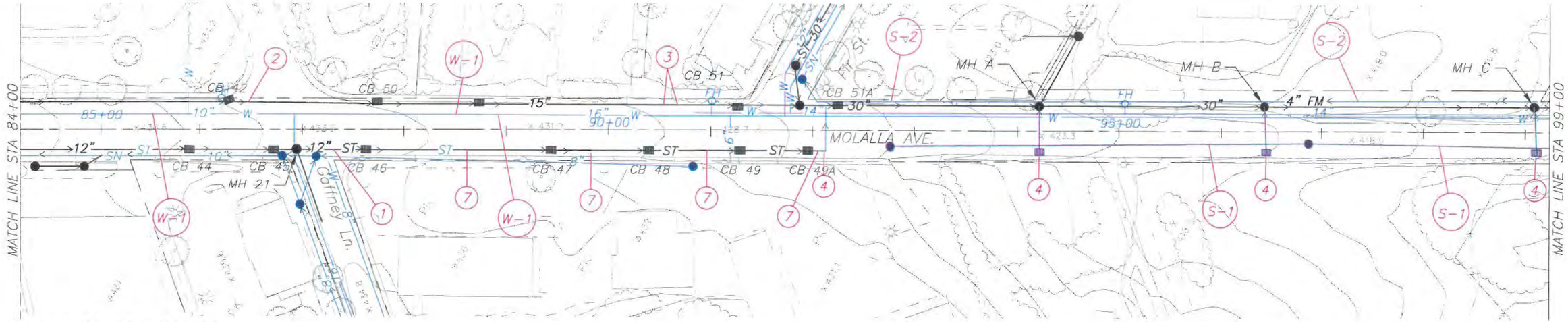
- W-1 REPLACE EXISTING 16" STEEL FROM RESERVOIR TO BEAVERCREEK ROAD W/16" D.I.
- W-2 INSTALL 8" D.I. INTERTIE W/ 16" D.I.
- W-3 REPLACE EXISTING C.I. WITH D.I.

Figure C-4

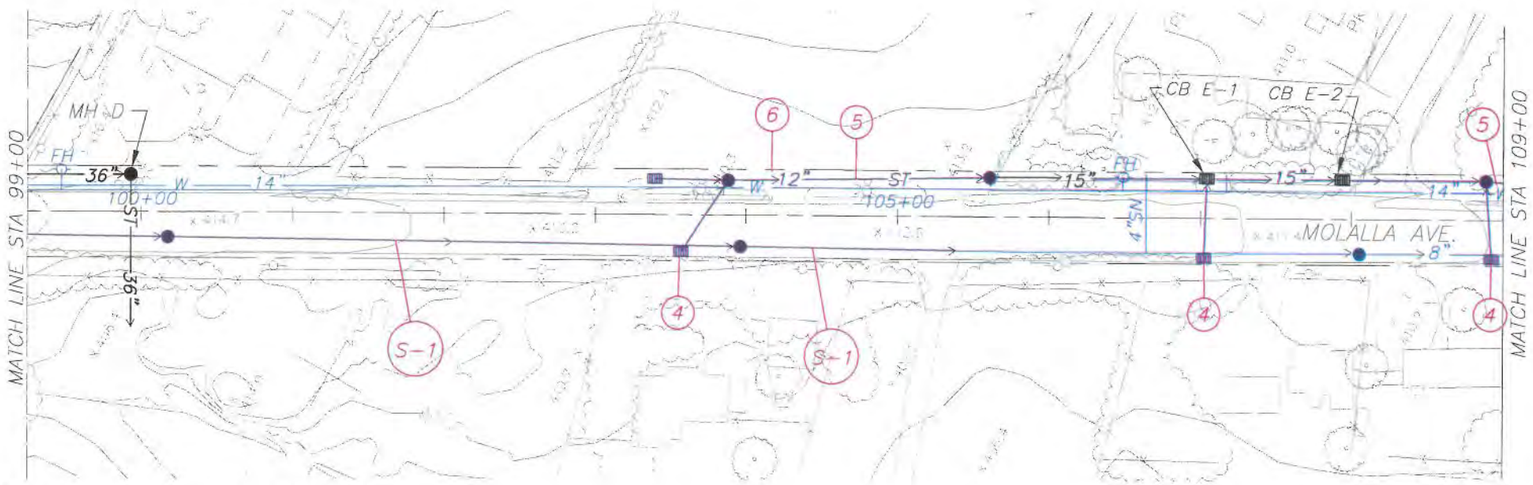
Existing Utilities and Drainage Improvements Sta 55+00 to Sta 84+00

Molalla Avenue Boulevard and Bikeway Improvements Plan

January 2001



STA 84+00 TO STA 99+00



STA 99+00 TO STA 109+00

LEGEND

- RIGHT OF WAY
- 8" W — WATER LINE
- 12" ST — EXISTING STORM DRAIN
- 15" ST — PROPOSED STORM DRAIN
- 15" SN — EXISTING SANITARY SEWER
- CATCH BASIN
- MANHOLE
- PIPE FLOW DIRECTION
- TREE
- CONTOUR
- SPOT ELEVATION
- PARKING
- GRAVEL
- UTILITY POLE
- LIGHT STANDARD
- FENCE
- SHRUBBERY

STORM DRAIN UPGRADES

1. SECTION OF CONCRETE STORM HAS BEEN WITH CAST IRON AND BAD JOINTS. REPAIR JOINTS OR REPLACE.
2. REMOVE PIECE OF BROKEN PIPE FROM PIPE.
3. SEAL SEPARATED JOINTS.
4. INSTALL NEW INLETS AND STORM LATERALS WITH CURB AND SIDEWALK.
5. INSTALL NEW STORM MAIN.
6. REGRADE EXISTING DITCH AS INTERIM UNTIL NEW STORM INSTALLED.
7. CHECK PIPE CAPACITY, REPLACE IF REQUIRED

SANITARY SEWER UPGRADES

S-1 INSTALL NEW SANITARY SEWER.

S-2 ABANDON EXISTING FORCE MAIN AND PUMP STATION.

WATER SYSTEM UPGRADES

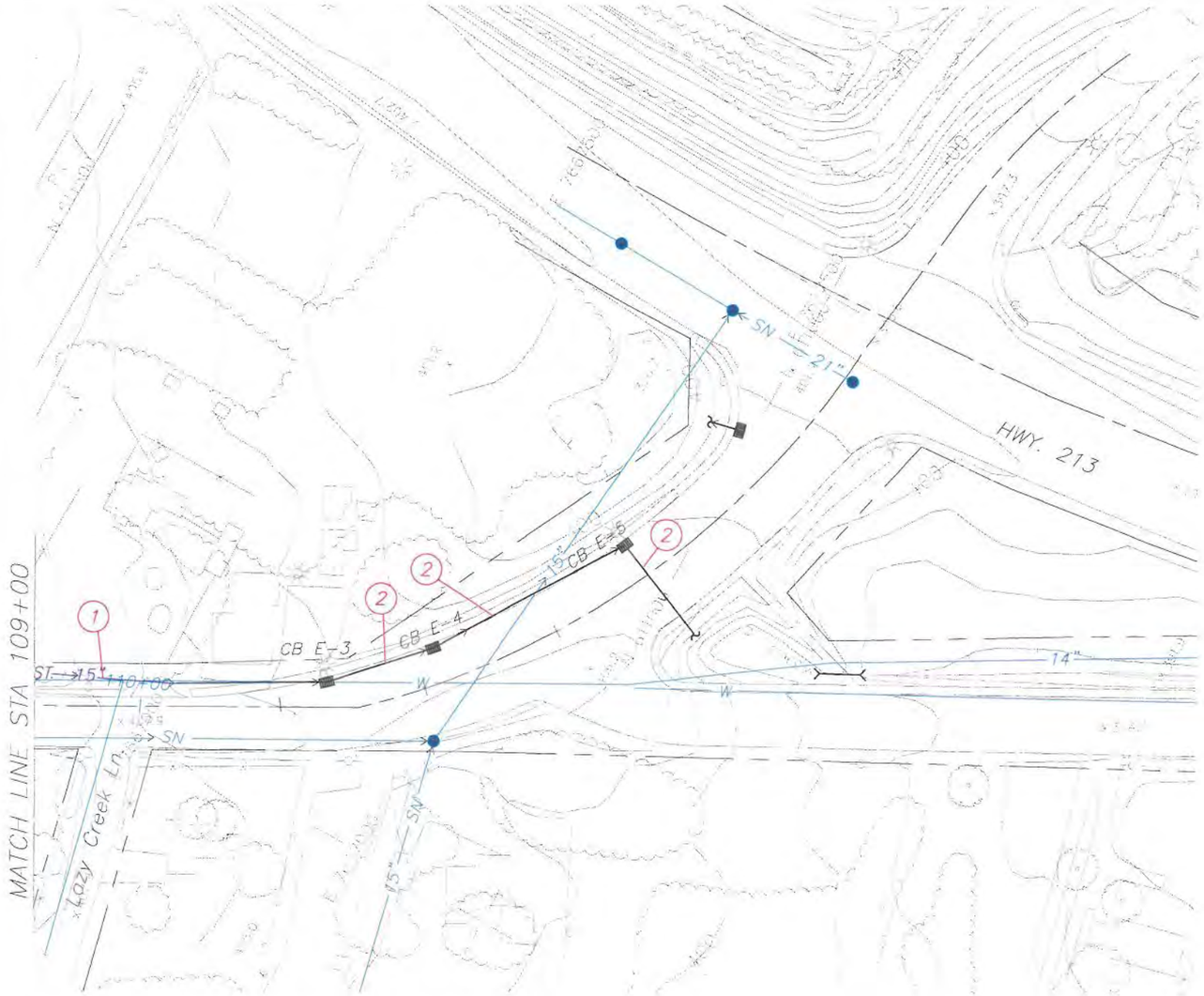
W-1 REPLACE EXISTING C.I. WITH D.I.

0 50 100
SCALE IN FEET

Figure C-5

Existing Utilities and Drainage Improvements
Sta 84+00 to Sta 109+00

Molalla Avenue Boulevard and Bikeway Improvements Plan
January 2001



STA 109+00 TO STA 114+00

STORM DRAIN UPGRADES

1. INSTALL NEW STORM DRAIN
2. CHECK PIPE CAPACITY, REPLACE IF REQUIRED

LEGEND

RIGHT OF WAY	TREE
8" W — WATER LINE	CONTOUR
12" ST — EXISTING STORM DRAIN	SPOT ELEVATION
15" ST — PROPOSED STORM DRAIN	PARKING
15" SN — EXISTING SANITARY SEWER	GRAVEL
CATCH BASIN	UTILITY POLE
MANHOLE	LIGHT STANDARD
< PIPE FLOW DIRECTION	FENCE
	SHRUBBERY

0 50 100
SCALE IN FEET

Figure C6

Existing Utilities and Drainage Improvements
Sta 109+00 to Sta 114+00

Molalla Avenue Boulevard and Bikeway Improvements Plan
January 2001

DRAINAGE AND UTILITY EVALUATION
APPENDIX C1 - CONVEYANCE CALCULATIONS

Rational Formula 10 year design-full buildout — Design by: CPA — Date September 27, 2000

Molalla Avenue Improvement Project

Project No. 1077A — Impervious C= 0.9 — Offsite (developed) C= 0.85

(1) Pipe	(2) Upstream Node	(3) Downstream Node	(4) Initial Subarea Tc (min)	(5) Total Tc (min)	(6) I in/hr	(7) A Imperv (acre)	(8) A Perv (acre)	(9) CxA incr (acre)	(10) Sum CxA (acre)	(11) Q CIA (cfs)	(12) Len (ft)	(13) Slope S %	(14) Dia d inches	(15) 'n'	(16) Capacity Q_{full} cfs	(17) V V_{max} fps	(18) Q/Q_{full}	(19) V/V_{full}	(20) Velocity actual fps	(21) Flow time (min)	(22) Tc at Downstream (min)
Singer Creek Subbasin																					
1	CB 8	CB7		5.0	2.8	0.3	0.0	0.2	0.2	0.7	100	5.5	12	0.012	9.0	11.5	0.08	0.3	3.5	0.5	5.5
2	CB 7	CB 6		5.5	2.7	0.2	0.0	0.2	0.5	1.2	160	5.0	12	0.012	8.6	11.0	0.14	0.4	4.4	0.6	6.1
3	CB 6	CB 5		6.1	2.6	0.1	0.7	0.7	1.1	3.0	30	6.7	12	0.012	10.0	12.7	0.30	0.7	9.4	0.1	6.1
4	CB 5A	CB 5	5.0	5.0	2.8	0.1	0.1	0.2	0.2	0.5	70	5.0	12	0.012	8.6	11.0	0.05	0.2	2.6	0.4	5.4
5	CB 5	CB 4		6.1	2.6	0.4	0.1	0.4	1.7	4.5	200	6.0	12	0.012	9.5	12.0	0.48	1.0	12.0	0.3	6.4
6	CB 4A	CB 4	5.0	5.0	2.8	0.1	0.1	0.2	0.2	0.5	40	2.0	12	0.012	5.5	6.9	0.09	0.7	4.5	0.1	5.1
7	CB 4	CB 3		6.4	2.5	0.3	0.2	0.4	2.3	5.8	300	6.0	12	0.012	9.5	12.0	0.61	1.1	13.0	0.4	6.8
8	CB 3A	CB 3	5.0	5.0	2.8	0.2	0.1	0.2	0.2	0.6	60	2.0	12	0.012	5.5	6.9	0.11	0.7	4.6	0.2	5.2
9	CB 3	CB 2		6.8	2.5	0.2	0.6	0.7	3.2	8.0	220	6.0	12	0.012	9.5	12.0	0.84	1.1	13.7	0.3	7.1
10	CB 2A	CB 2	5.0	5.0	2.8	0.2	0.0	0.1	0.1	0.4	40	2.0	12	0.012	5.5	6.9	0.07	0.6	4.2	0.2	5.2
11	CB 2	CB 1		7.1	2.4	0.2	0.4	0.5	3.8	9.2	280	6.0	12	0.012	9.5	12.0	0.97	1.0	12.3	0.4	7.5
12	CB 1A	CB 1	5.0	5.0	2.8	0.2	0.0	0.2	0.2	0.5	40	2.0	12	0.012	5.5	6.9	0.08	0.6	4.2	0.2	5.2
13	CB 1	**MH 1-Outfall**		7.5	2.4	0.2	0.0	0.2	4.1	9.9	40	6.0	12	0.012	9.5	12.0		–	12.6	0.1	7.5
Newell Subbasin A																					
14	CB 2A	MH 2	5.0	5.0	2.8	0.1	0.0	0.1	0.1	0.2	40	2.5	12	0.012	6.1	7.8	0.03	0.5	3.9	0.2	5.2
15	CB 2B	MH 2	5.0	5.0	2.8	0.0	0.0	0.0	0.0	0.1	40	2.5	12	0.012	6.1	7.8	0.02	0.5	3.9	0.2	5.2
16	CB 2C	MH 2	5.0	5.0	2.8	1.1	0.1	1.1	1.1	3.1	80	1.0	12	0.012	3.9	4.9	0.81	1.1	5.5	0.2	5.2
17	CB 2D	MH 2	5.0	5.0	2.8	0.6	0.0	0.5	0.5	1.5	100	2.5	12	0.012	6.1	7.8	0.24	0.8	6.4	0.3	5.3
18	MH 2	MH 3	N/A	7.1	2.4				1.7	4.2	200	2.0	12	0.012	5.5	6.9	0.77	1.1	7.6	0.4	7.5
19	MH 3	MH 4		7.5	2.4				1.7	4.2	300	5.3	12	0.012	8.9	11.3	0.47	1.0	10.8	0.5	8.0
20	CB 4A	MH 4	5.0	5.0	2.8	0.2	0.0	0.2	0.2	0.4	20	2.0	12	0.012	5.5	6.9	0.08	0.6	4.2	0.1	5.1
21	CB 4B	MH 4	5.0	5.0	2.8	0.2	0.0	0.2	0.2	0.5	40	2.0	12	0.012	5.5	6.9	0.09	0.6	4.4	0.2	5.2
22	MH 4	MH 5	N/A	8.0	2.3				2.1	4.8	300	5.3	12	0.012	8.9	11.3	0.54	1.0	11.6	0.4	8.4
23	CB 5A	MH 5	5.0	5.0	2.8	0.2	0.0	0.2	0.2	0.5	20	2.0	12	0.012	5.5	6.9	0.10	0.7	4.5	0.1	5.1
24	CB 5	MH 5	5.0	5.0	2.8	0.5	0.0	0.5	0.5	1.3	40	2.0	12	0.012	5.5	6.9	0.23	0.8	5.7	0.1	5.1
25	MH 5	MH 6		8.4	2.2				2.7	6.0	200	4.0	12	0.012	7.7	9.8	0.77	1.1	10.8	0.3	8.7
26	CB 6	MH 6	5.0	5.0	2.8	0.4	0.0	0.3	0.3	1.0	60	4.0	12	0.012	7.7	9.8	0.12	0.7	6.5	0.2	5.2
27	CB 6A	MH 6	5.0	5.0	2.8	0.2	0.0	0.1	0.1	0.4	20	4.0	12	0.012	7.7	9.8	0.05	0.2	2.4	0.1	5.1
28	MH 6	MH 7		8.7	2.2				3.2	7.0	350	3.4	12	0.012	7.1	9.1	0.99	1.1	10.3	0.6	9.3
29	CB7A	MH 7	5.0	5.0	2.8	0.8	0.0	0.7	0.7	2.0	60	2.0	12	0.012	5.5	6.9	0.37	0.9	6.4	0.2	5.2
30	MH 7	CB 8A		9.3	2.1				3.9	8.2	150	5.0	12	0.012	8.6	11.0	0.95	1.1	12.3	0.2	9.5
31	CB 8	CB 8A		5.0	2.8	0.3	0.2	0.5	0.5	1.4	50	5.0	12	0.012	8.6	11.0	0.16	0.5	4.9	0.2	5.2
32	CB 8A	**MH8 outfall**		9.5	2.1				4.4	9.3	150	5.0	12	0.012	8.6	11.0		–	11.8	0.2	9.7

DRAINAGE AND UTILITY EVALUATION
APPENDIX C1 - CONVEYANCE CALCULATIONS

Rational Formula 10 year design-full buildout — Design by: CPA — Date September 27, 2000

Molalla Avenue Improvement Project

Project No. 1077A — Impervious C= 0.9 — Offsite (developed) C= 0.85

(1) Pipe	(2) Upstream Node	(3) Downstream Node	(4) Initial Subarea Tc (min)	(5) Total Tc (min)	(6) I in/hr	(7) A Imperv (acre)	(8) A Perv (acre)	(9) CxA incr (acre)	(10) Sum CxA (acre)	(11) Q CIA (cfs)	(12) Len (ft)	(13) Slope S %	(14) Dia d inches	(15) 'n'	(16) Capacity Q_{full} cfs	(17) V V_{max} fps	(18) Q/Q_{full}	(19) V/V_{full}	(20) Velocity actual fps	(21) Flow time (min)	(22) Tc at Downstream (min)
Newell Subbasin B																					
33	CB 9A	M H 9	5.0	5.0	2.8	0.1	0.0	0.1	0.1	0.3	110	2.0	12	0.012	5.5	6.9	0.05	0.2	1.7	1.1	6.1
34	CB 9B	M H 9	5.0	5.0	2.8	0.8	0.1	0.8	0.8	2.3	80	2.0	12	0.012	5.5	6.9	0.41	0.9	6.5	0.2	5.2
35	CB 9C	M H 9	5.0	5.0	2.8	0.2	0.0	0.2	0.2	0.6	20	2.0	12	0.012	5.5	6.9	0.11	0.7	4.6	0.1	5.1
36	CB 10	MH 9	5.0	5.0	2.8	0.4	0.0	0.4	0.4	1.0	10	2.0	12	0.012	5.5	6.9	0.18	0.8	5.3	0.0	5.0
37	MH 9	MH 10		6.1	2.6				1.5	3.8	280	1.5	12	0.012	4.7	6.0	0.80	1.1	6.9	0.7	6.8
38	CB 10A	MH 10	5.0	5.0	2.8	0.3	0.0	0.3	0.3	0.7	40	2.0	12	0.012	5.5	6.9	0.13	0.7	4.6	0.1	5.1
39	MH 10	MH 11		6.8	2.5				1.7	4.3	650	1.0	12	0.012	3.9	4.9		–	5.5	2.0	8.7
40	CB 11A	MH 11	5.0	5.0	2.8	0.2	0.4	0.5	0.5	1.4	20	2.0	12	0.012	5.5	6.9	0.25	0.8	5.8	0.1	5.1
41	CB 11B	MH 11	5.0	5.0	2.8	0.3	0.8	0.9	0.9	2.5	20	2.0	12	0.012	5.5	6.9	0.46	1.0	6.8	0.0	5.0
42	CB 13	MH 11	5.0	5.0	2.8	0.2	0.5	0.6	0.6	1.6	270	1.0	12	0.012	3.9	4.9	0.42	0.9	4.6	1.0	6.0
43	MH 11	MH 12		8.7	2.2			2.0	3.7	8.1	60	2.0	12	0.012	5.5	6.9		–	10.3	0.1	8.8
44	CB 12A	MH 12	5.0	5.0	2.8	0.4	0.0	0.3	0.3	1.0	30	2.0	12	0.012	5.5	6.9	0.18	0.8	5.3	0.1	5.1
45	CB 12B	MH 12	5.0	5.0	2.8	0.2	0.0	0.2	0.2	0.5	50	2.0	12	0.012	5.5	6.9	0.10	0.7	4.6	0.2	5.2
46	MH 12	**Outfall**		8.8	2.2				4.2	9.3	50	2.0	12	0.012	5.5	6.9		–	11.8	0.1	8.9
Newell Subbasin C																					
47	CB 13	CB 14	5.0	5.0	2.8	0.2	0.5	0.6	0.6	1.6	180	1.0	12	0.012	3.9	4.9	0.42	0.9	4.6	0.6	5.6
48	CB 14	MH 13		5.6	2.7	0.2	0.5	0.6	1.1	3.1	450	2.0	12	0.012	5.5	6.9	0.57	1.1	7.8	1.0	6.6
49	CB 15	MH 13	5.0	5.0	2.8	0.2	0.1	0.3	0.3	0.7	80	2.0	12	0.012	5.5	6.9	0.13	0.7	5.0	0.3	5.3
50	CB 16	MH 13	5.0	5.0	2.8	0.2	0.1	0.3	0.3	0.7	30	2.0	12	0.012	5.5	6.9	0.13	0.7	5.0	0.1	5.1
51	CB 17	MH 13	5.0	5.0	2.8	0.2	0.0	0.1	0.1	0.4	50	2.0	12	0.012	5.5	6.9	0.07	0.6	4.0	0.2	5.2
52	MH 13	MH 14		6.6	2.5				1.8	4.5	430	0.5	15	0.012	4.9	4.0	0.91	1.1	4.6	1.6	8.2
53	CB 20	CB 22	5.0	5.0	2.8	0.2	0.3	0.4	0.4	1.2	60	1.0	12	0.012	3.9	4.9	0.32	0.9	4.3	0.2	5.2
54	CB 22	MH 14		5.2	2.8	0.2	0.5	0.6	1.0	2.8	50	1.0	12	0.012	3.9	4.9	0.74	1.1	5.4	0.2	5.4
55	CB 23	MH 14	5.0	5.0	2.8	0.2	0.9	0.9	0.9	2.6	170	1.0	12	0.012	3.9	4.9	0.67	1.1	5.3	0.5	5.5
56	CB 19	MH 14	5.0	5.0	2.8	0.1	0.2	0.2	0.2	0.6	70	1.0	12	0.012	3.9	4.9	0.16	0.7	3.6	0.3	5.3
57	CB 21	MH 14	5.0	5.0	2.8	0.2	0.0	0.2	0.2	0.6	20	1.0	12	0.012	3.9	4.9	0.16	0.7	3.6	0.1	5.1
58	MH 14	MH 16		8.2	2.2				4.2	9.2	270	1.0	15	0.012	7.0	5.7		–	7.5	0.6	8.8
59	CB 26A	CB 26	5.0	5.0	2.8	0.2	0.6	0.7	0.7	1.9	100	1.0	12	0.012	3.9	4.9	0.49	1.0	4.9	0.3	5.3
60	CB 26	MH 16		5.3	2.8	0.2	0.3	0.4	1.1	3.1	40	1.0	12	0.012	3.9	4.9	0.80	1.1	5.5	0.1	5.5
61	MH 16	MH 15		8.8	2.1				5.3	11.1	550	2.0	18	0.012	16.1	9.1	0.69	1.2	10.9	0.8	9.6
62	CB 24	MH 15	5.0	5.0	2.8	0.4	0.0	0.4	0.4	1.0	200	1.0	12	0.012	3.9	4.9	0.25	0.8	4.1	0.8	5.8
63	CB 25	MH 15	5.0	5.0	2.8	0.2	0.0	0.2	0.2	0.5	100	1.0	12	0.012	3.9	4.9	0.12	0.7	3.5	0.5	5.5

DRAINAGE AND UTILITY EVALUATION
APPENDIX C1 - CONVEYANCE CALCULATIONS

Rational Formula 10 year design-full buildout Design by: CPA Date September 27, 2000

Molalla Avenue Improvement Project

Project No. 1077A Impervious C= 0.9 Offsite (developed) C= 0.85

(1) Pipe	(2) Upstream Node	(3) Downstream Node	(4) Initial Subarea Tc (min)	(5) Total Tc (min)	(6) I in/hr	(7) A Imperv (acre)	(8) A Perv (acre)	(9) CxA incr (acre)	(10) Sum CxA (acre)	(11) Q CIA (cfs)	(12) Len (ft)	(13) Slope S %	(14) Dia d inches	(15) 'n'	(16) Capacity Q_{full} cfs	(17) V V_{max} fps	(18) Q/Q_{full}	(19) V/V_{full}	(20) Velocity actual fps	(21) Flow time (min)	(22) Tc at Downstream (min)
Newell Subbasin C - continued																					
64	CB 26B	CB 28	5.0	5.0	2.8	0.4	0.4	0.7	0.7	1.8	160	2.0	12	0.012	5.5	6.9	0.34	0.9	6.4	0.4	5.4
65	CB 28	CB 27		5.4	2.8	0.2	0.7	0.8	1.4	4.0	100	2.0	12	0.012	5.5	6.9	0.73	1.1	7.6	0.2	5.6
66	CB 27	MH 18		5.6	2.7	0.1	1.1	1.1	2.5	6.7	100	3.0	12	0.012	6.7	8.5		1.0	8.5	0.2	5.8
67	MH 18	MH 15		5.8	2.6				2.5	6.4	80	2.0	18	0.012	16.1	9.1	0.40	1.1	10.0	0.1	6.0
68	MH 15	MH 19		9.6	1.9				8.3	15.7	290	2.0	18	0.012	16.1	9.1	0.98	1.0	9.1	0.5	10.1
69	CB 29	MH 19	5.0	5.0	2.8	0.2	0.0	0.2	0.2	0.5	70	1.0	12	0.012	3.9	4.9	0.12	0.7	3.5	0.3	5.3
70	MH 19	**Outfall to 36" ST**		10.1	1.9				8.4	16.0	330	2.0	18	0.012	16.1	9.1		1.0	9.1	0.6	10.7
71	CB 30	36" ST	5.0	5.0	2.8	0.3	0.0	0.3	0.3	0.8	100	2.0	12	0.012	5.5	6.9	0.15	0.8	5.2	0.3	5.3
72	CB A	CB D	5.0	5.0	2.8	0.1	1.0	1.0	1.0	2.7	150	2.0	15	0.012	9.9	8.1	0.28	0.9	6.9	0.4	5.4
73	CB B	CB C	5.0	5.0	2.8	0.1	0.5	0.5	0.5	1.3	40	2.0	12	0.012	5.5	6.9	0.24	0.8	5.8	0.1	5.1
74	CB C	CB D		5.4	2.8	0.2	0.0	0.1	0.6	1.7	50	2.0	12	0.012	5.5	6.9	0.31	0.9	6.1	0.1	5.5
75	CB D	CB E		5.5	2.7	0.2	0.0	0.1	1.7	4.6	200	2.0	15	0.012	9.9	8.1	0.47	1.0	7.9	0.4	5.9
76	CB E	**Outfall to 48" ST**		5.9	2.6	0.3	0.0	0.2	2.0	5.1	150	2.0	15	0.012	9.9	8.1	0.51	1.0	8.1	0.3	6.2
77	CB 39	CB 38	5.0	5.0	2.8	0.1	0.2	0.3	0.3	0.7	110	2.0	12	0.012	5.5	6.9	0.14	0.7	5.0	0.4	5.4
78	CB 38	MH 22		5.4	2.8	0.1	0.4	0.4	0.7	1.9	200	1.0	15	0.012	7.0	5.7	0.27	0.9	4.8	0.7	6.1
79	MH 22	MH 20		6.1	2.6				0.9	2.5	150	1.0	15	0.012	7.0	5.7	0.35	0.9	5.2	0.5	6.5
80	MH 20	MH 19A		6.5	2.5				0.9	2.4	370	2.0	15	0.012	9.9	8.1	0.24	0.8	6.7	0.9	7.5
81	CB 34	MH 19A	5.0	5.0	2.8	0.4	0.6	0.8	0.8	2.4	20	2.0	15	0.012	9.9	8.1	0.24	0.8	6.7	0.0	5.0
82	MH 19A	**Outfall to 36" ST**		7.5	2.3				1.8	4.1	120	2.0	15	0.012	9.9	8.1	0.42	1.0	7.7	0.3	7.7
83	CB 31	**Outfall to 36" ST**	5.0	5.0	2.8	0.2	0.0	0.2	0.2	0.5	20	2.0	12	0.012	5.5	6.9	0.08	0.6	4.0	0.1	5.1
84	CB 40	CB 36	5.0	5.0	2.8	0.1	0.0	0.1	0.1	0.2	300	2.0	12	0.012	5.5	6.9	0.04	0.5	3.5	1.4	6.4
85	CB 36	CB 35		6.4	2.5	0.2	0.0	0.2	0.2	0.6	140	2.0	12	0.012	5.5	6.9	0.11	0.7	4.5	0.5	7.0
86	CB 35	CB 33A		7.0	2.4	0.2	0.0	0.2	0.4	1.0	360	2.0	12	0.012	5.5	6.9	0.17	0.8	5.2	1.2	8.1
87	CB 33A	CB 33		8.1	2.3	0.3	0.0	0.3	0.7	1.6	50	2.0	12	0.012	5.5	6.9	0.30	0.9	6.1	0.1	8.2
88	CB 33	MH		8.2	2.3	0.1	0.0	0.1	0.8	1.7	20	2.0	12	0.012	5.5	6.9	0.32	0.9	6.1	0.1	8.3

DRAINAGE AND UTILITY EVALUATION
APPENDIX C1 - CONVEYANCE CALCULATIONS

Rational Formula 10 year design-full buildout Design by: CPA Date September 27, 2000

Molalla Avenue Improvement Project

Project No. 1077A Impervious C= 0.9 Offsite (developed) C= 0.85

(1) Pipe	(2) Upstream Node	(3) Downstream Node	(4) Initial Subarea Tc (min)	(5) Total Tc (min)	(6) I in/hr	(7) A Imperv (acre)	(8) A Perv (acre)	(9) CxA incr (acre)	(10) Sum CxA (acre)	(11) Q CIA (cfs)	(12) Len (ft)	(13) Slope S %	(14) Dia d inches	(15) 'n'	(16) Capacity Q_{full} cfs	(17) V V_{max} fps	(18) Q/Q_{full}	(19) V/V_{full}	(20) Velocity actual fps	(21) Flow time (min)	(22) Tc at Downstream (min)
Caufield Subbasin A																					
90	CB 41	CB 42	5.0	5.0	2.8	0.4	0.0	0.4	0.4	1.0	230	2.0	15	0.012	9.9	8.1	0.10	0.7	5.2	0.7	5.7
91	CB 42	CB 50		5.7	2.7	0.1	0.0	0.1	0.4	1.2	150	2.0	15	0.012	9.9	8.1	0.12	0.7	5.3	0.5	6.2
92	CB 50	CB 51		6.2	2.6	0.3	0.0	0.2	0.7	1.8	350	1.0	15	0.012	7.0	5.7	0.25	0.8	4.7	1.2	7.4
93	CB 51	MH A		7.4	2.3	0.2	0.0	0.2	0.8	1.9	70	2.0	15	0.012	9.9	8.1	0.19	0.8	6.3	0.2	7.6
94	CB 51A	MH A	5.0	5.0	2.8	0.1	0.0	0.1	0.1	0.3	40	1.0	15	0.012	7.0	5.7	0.04	0.5	2.6	0.3	5.3
95	Fir Offsite		5.0	5.0	2.8	0.0	11.6	9.9	9.9	27.6	1200	0.7	30	0.012	38.0	7.7	0.73	1.1	8.4	2.4	7.4
96	MH A	MH B		7.4	2.5	0.1	0.1	0.1	10.9	27.3	225	0.7	30	0.012	38.0	7.7	0.72	1.1	8.2	0.5	7.8
97	MH B	MH C		7.8	2.5	0.1	0.1	0.1	11.0	27.6	225	0.7	30	0.012	38.0	7.7	0.73	1.1	8.5	0.4	8.3
98	MH C	MH D		8.3	2.5	0.1	0.1	0.1	11.2	27.9	270	0.3	36	0.012	39.6	5.6	0.71	1.1	5.0	0.9	9.2
99	MH D	**OUTFALL**		9.2	2.5	0.1	0.1	0.2	11.4	28.4	80	0.3	36	0.012	39.6	5.6	0.72	1.1	6.2	0.2	9.4
100	CB 43	CB 44	5.0	5.0	2.8	0.3	0.0	0.3	0.3	0.7	180	2.0	15	0.012	9.9	8.1	0.07	0.6	4.8	0.6	5.6
101	CB 44	CB 45		5.6	2.8	0.1	0.0	0.1	0.3	0.9	80	2.0	15	0.012	9.9	8.1	0.09	0.7	5.6	0.2	5.9
102	CB 45	CB 46		5.9	2.7	0.5	1.0	1.3	1.6	4.3	90	2.0	15	0.012	9.9	8.1	0.44	1.0	7.7	0.2	6.1
103	CB 46	CB 47		6.1	2.6	0.5	0.8	1.1	2.7	7.0	180	1.0	15	0.012	7.0	5.7		1.0	5.7	0.5	6.6
104	CB 47	CB 48		6.6	2.6	0.4	0.2	0.5	3.2	8.4	90	1.0	15	0.012	7.0	5.7		–	6.8	0.2	6.8
105	CB 48	CB 49		6.8	2.5	0.2	0.7	0.8	4.0	10.1	90	1.0	15	0.012	7.0	5.7		–	8.2	0.2	7.0
106	CB 49	CB 49A		7.0	2.5	0.2	0.0	0.2	4.2	10.5	70	2.0	15	0.012	9.9	8.1		–	8.6	0.1	7.1
107	CB 49A	DITCH		7.1	2.4	0.1	0.2	0.2	4.4	10.6	100	2.0	15	0.012	9.9	8.1		–	8.6	0.2	7.3
Caufield Subbasin B																					
108	Ditch	CB E1	5.0	5.0	2.8	0.5	1.0	1.3	1.3	3.6	600	0.5	ditch	0.012					2.0	5.0	10.0
109	CB E1	CB E2		10.0	2.0	0.2	0.0	0.1	1.4	2.9	230	0.3	15	0.012	3.8	3.1	0.75	1.1	3.6	1.1	11.1
110	CB E2	DITCH		11.1	1.9	0.2	0.0	0.2	1.6	3.0	70	1.4	12	0.012	4.6	5.9	0.65	1.1	6.2	0.2	11.3
111	DITCH	CB E3		11.3	1.9	0.2	0.0	0.2	1.8	3.4	100	1.0	12	0.012	3.9	4.9	0.87	1.1	5.6	0.3	11.6
112	CB E3	CB E4		11.6	1.9	0.3	0.0	0.3	2.1	3.9	60	1.0	12	0.012	3.9	4.9		–	4.9	0.2	11.8
113	CB E4	CB E5		11.8	1.9	0.3	0.0	0.3	2.4	4.5	120	1.0	12	0.012	3.9	4.9		–	5.7	0.4	12.1
114	CB E5	**OUTFALL**		12.1	1.8	0.3	0.0	0.3	2.7	4.8	100	1.0	12	0.012	3.9	4.9		–	6.1	0.3	12.4
115	CB E6	DITCH	5.0	5.0	2.8	0.3	0.0	0.2	0.2	0.6	100	1.0	12	0.012	3.9	4.9	0.16	0.8	3.7	0.5	5.5

DRAINAGE AND UTILITY EVALUATION
APPENDIX C1 - CONVEYANCE CALCULATIONS

Rational Formula 10 year design-full buildout Design by: CPA Date September 27, 2000

Molalla Avenue Improvement Project

Project No. 1077A Impervious C= 0.9 Street Offsite (developed) C= 0.85

(1) Pipe	(2) Upstream Node	(3) Downstream Node	(4) Initial Subarea Tc (min)	(5) Total Tc (min)	(6) I in/hr	(7) A Imperv (acre)	(8) A Perv (acre)	(9) CxA incr (acre)	(10) Sum CxA (acre)	(11) Q CIA (cfs)	(12) Len (ft)	(13) Slope S %	(14) Dia d inches	(15) 'n'	(16) Capacity Q_{full} cfs	(17) V V_{max} fps	(18) Q/Q_{full}	(19) V/V_{full}	(20) Velocity actual fps	(21) Flow time (min)	(22) Tc at Downstream (min)
Caufield Subbasin B - New Storm																					
108	NEW	CB E1	5.0	5.0	2.8	0.5	1.0	1.3	1.3	3.6	600	0.5	15	0.012	4.9	4.0	0.74	1.1	4.4	2.3	7.3
109	CB E1	CB E2		7.3	2.3	0.2	0.0	0.1	1.4	3.3	230	0.3	15	0.012	3.8	3.1	0.86	1.1	3.5	1.1	8.4
110	CB E2	NEW		8.4	2.2	0.2	0.0	0.2	1.6	3.5	70	1.4	15	0.012	8.4	6.8	0.42	1.0	6.5	0.2	8.5
111	NEW	CB E3		8.5	2.2	0.2	0.0	0.2	1.8	3.9	100	1.0	15	0.012	7.0	5.7	0.56	1.0	5.8	0.3	8.8
112	CB E3	CB E4		8.8	2.2	0.3	0.0	0.3	2.1	4.5	60	1.0	15	0.012	7.0	5.7	0.65	1.1	6.5	0.2	9.0
113	CB E4	CB E5		9.0	2.1	0.3	0.0	0.3	2.4	5.0	120	1.0	15	0.012	7.0	5.7	0.71	1.1	6.2	0.3	9.3
114	CB E5	**OUTFALL**		9.3	2.1	0.3	0.0	0.3	2.7	5.6	100	1.0	15	0.012	7.0	5.7	0.80	1.1	6.4	0.3	9.6
115	CB E6	DITCH	5.0	5.0	2.8	0.3	0.0	0.2	0.2	0.6	100	1.0	12	0.012	3.9	4.9	0.16	0.8	3.7	0.5	5.5

Project:	Molalla Avenue
Job No.:	1077A
Location:	Oregon City
By:	CPA
Date:	9-Jan-2001

8.10

Flow comparison - SBUH flows

Description	Drainage Area Imperv. (acres)	Drainage Area Pervious (acres)	Pervious CN	Time of Concentration Flow Path	Time of Concentration Tc (minutes)	Storm Freq. (years)	Rainfall Amount (inches)	Peak Flow (cfs)	Peak Time (hours)	Total Storm Volume (cf)
Singer Creek at Div. Pipe 13	2.70	2.30	80.00	--	6.00	10	3.4	3.13	7.67	44,129
Newell Subbasin A Pipe 32	4.60	0.30	80.00	--	6.00	10	3.4	4.03	7.67	54,670
Newell Subbasin B Pipe 39	1.80	0.10	80.00	--	6.00	10	3.4	1.57	7.67	21,294
Newell Subbasin B Pipe 43	2.50	1.80	80.00	--	6.00	10	3.4	2.78	7.67	38,992
Newell Subbasin B Pipe 46	3.10	1.80	80.00	--	6.00	10	3.4	3.29	7.67	45,901
Newell Subbasin C Pipe 58	1.90	3.10	80.00	--	6.00	10	3.4	2.73	7.67	39,452
Caufield Subbasin A pipe 104	1.80	2.00	80.00	--	6.00	10	3.4	2.25	7.67	32,065
Caufield Subbasin A pipe 105	2.00	2.70	80.00	--	6.00	10	3.4	2.67	7.67	38,336
Caufield Subbasin A pipe 106	2.20	2.70	80.00	--	6.00	10	3.4	2.84	7.67	40,639
Caufield Subbasin A pipe 107	2.30	2.90	80.00	--	6.00	10	3.4	3.00	7.67	42,925
Caufield Subbasin B Pipe 112	1.40	1.00	80.00	--	6.00	10	3.4	1.55	7.67	21,790
Caufield Subbasin B Pipe 113	1.70	1.00	80.00	--	6.00	10	3.4	1.81	7.67	25,245
Caufield Subbasin B Pipe 114	2.00	1.00	80.00	--	6.00	10	3.4	2.06	7.67	28,699

Note: Areas based on criteria used in Rational Formula Analysis, TC is conservatively set at 0.1 hr. (6 minutes)

Comparison of Flows

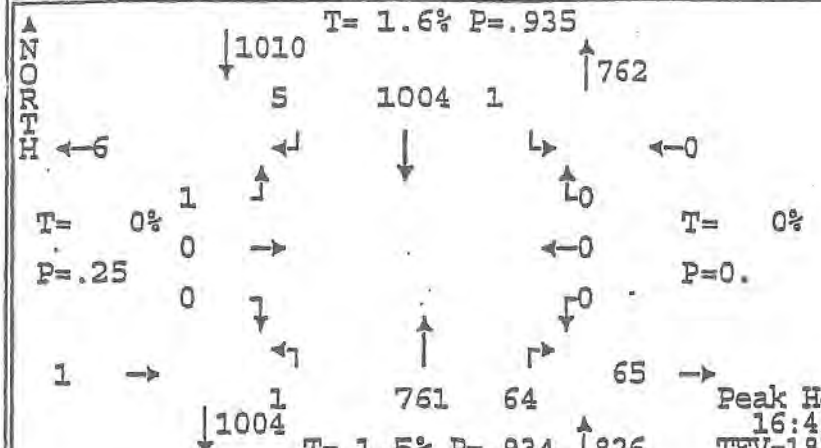
Pipe	Rational Flow(cfs)	SBUH Flow(cfs)
Singer Creek at Div. Pipe 13	9.9	3.13
Newell Subbasin A Pipe 32	9.3	4.03
Newell Subbasin B Pipe 39	4.3	1.57
Newell Subbasin B Pipe 43	8.1	2.78
Newell Subbasin B Pipe 46	9.3	3.29
Newell Subbasin C Pipe 58	9.2	2.73
Caufield Subbasin A pipe 104	7	2.25
Caufield Subbasin A pipe 105	8.4	2.67
Caufield Subbasin A pipe 106	10.1	2.84
Caufield Subbasin A pipe 107	10.5	3.00
Caufield Subbasin B Pipe 112	10.6	1.55
Caufield Subbasin B Pipe 113	4.5	1.81
Caufield Subbasin B Pipe 114	4.8	2.06

<print anchor>

Existing Conditions Traffic Count Data

INTERSECTION TURN MOVEMENT COUNT SUMMARY REPORT
DIVISION STREET AT MOLALLA AVENUE

24025



DATE OF COUNT: 06/22/00
DAY OF WEEK: Thu
TIME STARTED: 16:00
TIME ENDED: 18:00

TEV=TOTAL ENTRY VOLUME
T=%TRUCKS BY APPROACH
P=PHF BY APPROACH

chmk

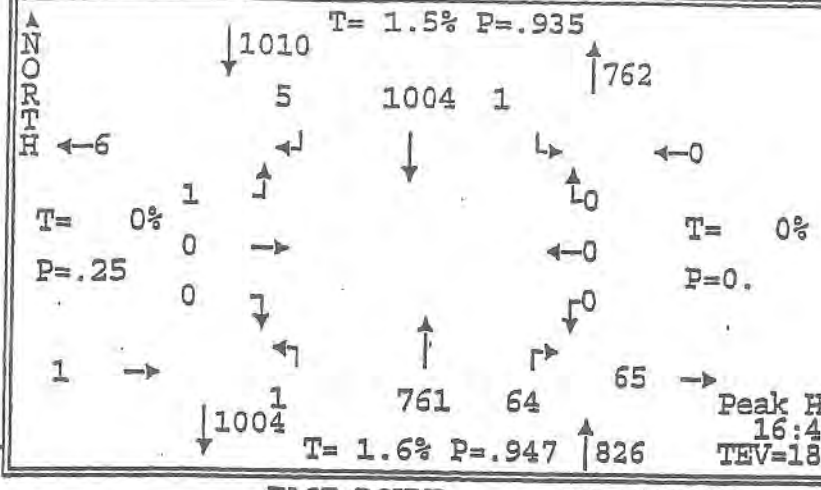
Peak Hour
16:45-17:45
TEV=1837

Traffic Smithy
(503) 641-6333

TIME PERIOD FROM - TO	EAST BOUND			SOUTH BOUND			NORTH BOUND			WEST BOUND			ALL
	↓	→	↑	↲	↓	↳	↰	↑	↱	↓	←	↑	
16:00-16:05	0	0	0	1	83	0	0	45	4	0	0	0	133
16:05-16:10	0	0	0	0	71	0	0	63	6	0	0	0	140
16:10-16:15	0	0	0	3	72	0	0	62	2	0	0	0	139
16:15-16:20	0	0	0	0	73	0	0	61	6	0	0	0	140
16:20-16:25	0	0	0	1	70	0	0	59	7	0	0	0	137
16:25-16:30	0	0	0	0	77	0	0	76	9	0	0	0	162
16:30-16:35	0	0	0	0	58	0	0	60	8	0	0	0	126
16:35-16:40	0	0	0	0	84	0	0	59	11	0	0	0	154
16:40-16:45	0	0	0	0	85	0	0	68	5	0	0	0	158
16:45-16:50	0	0	1	0	84	0	0	69	6	0	0	0	160
16:50-16:55	0	0	0	0	88	0	0	63	6	0	0	0	157
16:55-17:00	0	0	0	0	82	0	0	61	6	0	0	0	149
17:00-17:05	0	0	0	0	80	0	0	50	4	0	0	0	134
17:05-17:10	0	0	0	0	82	0	0	58	5	0	0	0	145
17:10-17:15	0	0	0	0	80	1	0	82	4	0	0	0	167
17:15-17:20	0	0	0	1	82	0	0	61	4	0	0	0	148
17:20-17:25	0	0	0	0	89	0	0	59	1	0	0	0	149
17:25-17:30	0	0	0	1	97	0	0	63	6	0	0	0	167
17:30-17:35	0	0	0	0	77	0	0	52	6	0	0	0	135
17:35-17:40	0	0	0	2	71	0	1	84	9	0	0	0	167
17:40-17:45	0	0	0	1	92	0	0	59	7	0	0	0	159
17:45-17:50	0	0	0	0	71	0	0	37	4	0	0	0	112
17:50-17:55	0	0	0	1	66	0	0	62	6	0	0	0	135
17:55-18:00	0	0	0	1	60	0	0	44	6	0	0	0	111
Total Survey	0	0	1	12	1874	1	1	1457	138	0	0	0	3484
PHF	0	0	.25	.42	.94	.25	.25	.94	.73	0	0	0	.979
% Trucks	0	0	0	0	1.7	0	0	1.3	3.6	0	0	0	1.6
Stopped Buses	0	0	0	0	0	0	0	0	0	0	0	0	
Peds	0	10	0	0	6	0	0	12	0	0	0	0	
Hourly Totals													
16:00-17:00	0	0	1	5	927	0	0	746	76	0	0	0	1755
16:15-17:15	0	0	1	1	943	1	0	766	77	0	0	0	1789
16:30-17:30	0	0	1	2	991	1	0	753	66	0	0	0	1814
16:45-17:45	0	0	1	5	1004	1	1	761	64	0	0	0	1837
17:00-18:00	0	0	0	7	947	1	1	711	62	0	0	0	1729

RECEIVED
JUL 6 2000

INTERSECTION TURN MOVEMENT COUNT PEAK HOUR REPORT
DIVISION STREET AT MOLALLA AVENUE



DATE OF COUNT: 06/22/00
DAY OF WEEK: Thu
TIME STARTED: 16:00
TIME ENDED: 18:00

TEV=TOTAL ENTRY VOLUME
T=%TRUCKS BY APPROACH
P=PHF BY APPROACH

Peak Hour
16:45-17:45
TEV=1837

chmk

Traffic Smithy
(503)641-6333

TIME PERIOD FROM - TO	EAST BOUND ↓	EAST BOUND →	EAST BOUND ↑	SOUTH BOUND ↲	SOUTH BOUND ↓	SOUTH BOUND ↳	NORTH BOUND ↰	NORTH BOUND ↑	NORTH BOUND ↱	WEST BOUND ↓	WEST BOUND ←	WEST BOUND ↑	ALL
ALL VEHICLES													
16:45-17:00	0	0	1	0	254	0	0	193	18	0	0	0	466
17:00-17:15	0	0	0	0	242	1	0	190	13	0	0	0	446
17:15-17:30	0	0	0	2	268	0	0	183	11	0	0	0	464
17:30-17:45	0	0	0	3	240	0	1	195	22	0	0	0	461
LIGHT TRUCKS (SINGLE UNIT 2 AXLES)													
16:45-17:00	0	0	0	0	4	0	0	2	1	0	0	0	7
17:00-17:15	0	0	0	0	3	0	0	2	0	0	0	0	5
17:15-17:30	0	0	0	0	6	0	0	0	1	0	0	0	7
17:30-17:45	0	0	0	0	1	0	0	3	0	0	0	0	4
MEDIUM TRUCKS (SINGLE UNIT > 2 AXLES)													
6:45-17:00	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00-17:15	0	0	0	0	0	0	0	1	0	0	0	0	1
17:15-17:30	0	0	0	0	0	0	0	0	0	0	0	0	0
17:30-17:45	0	0	0	0	1	0	0	0	0	0	0	0	1
HEAVY TRUCKS (SEMI-TRACTOR TRAILER)													
16:45-17:00	0	0	0	0	0	0	0	1	0	0	0	0	1
17:00-17:15	0	0	0	0	0	0	0	0	0	0	0	0	0
17:15-17:30	0	0	0	0	0	0	0	0	1	0	0	0	1
17:30-17:45	0	0	0	0	0	0	0	1	0	0	0	0	1
BICYCLES													
16:45-17:00	0	0	0	0	0	0	0	0	0	0	0	0	0
17:00-17:15	0	0	0	0	0	0	0	0	0	0	0	0	0
17:15-17:30	0	0	0	0	0	0	0	0	0	0	0	0	0
17:30-17:45	0	0	0	0	0	0	0	0	0	0	0	0	0

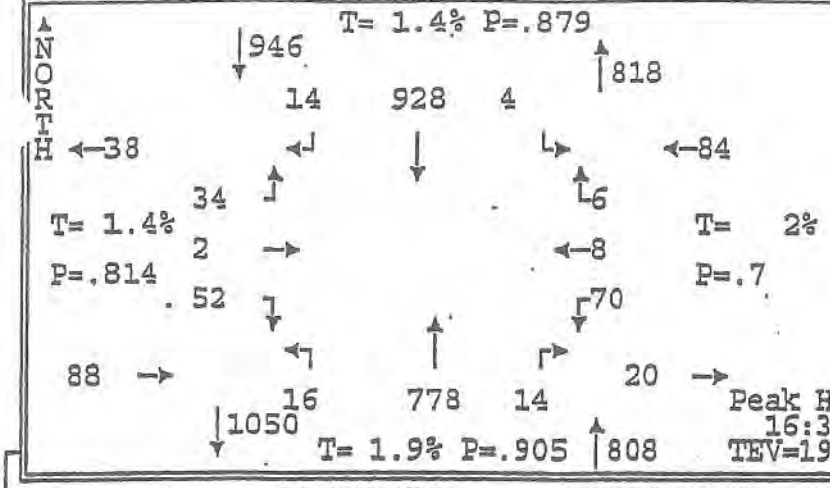
PEDESTRIANS	CROSSWALK USEAGE SOUTH	WEST	EAST	NORTH	ALL
16:45-17:00	0	0	0	0	0
17:00-17:15	0	1	2	0	3
17:15-17:30	2	1	0	0	3
17:30-17:45	4	2	6	0	12

Peak Hour by Movement	↓	→	↑	↲	↓	↳	↰	↑	↱	↓	←	↑	
PHF	0	0	.25	.42	.94	.25	.25	.98	.73	0	0	0	.985
% Trucks(all)	0	0	0	0	1.5	0	0	1.3	4.7	0	0	0	1.5
% Trucks(M+H)	0	0	0	0	.1	0	0	.4	1.6	0	0	0	.3
Stopped Buses	0	0	0	0	0	0	0	0	0	0	0	0	

Hourly Totals													
16:00-17:00	0	0	1	5	927	0	0	746	76	0	0	0	1755
16:15-17:15	0	0	1	1	943	1	0	766	77	0	0	0	1789
[illegible]:30-17:30	0	0	1	2	991	1	0	753	66	0	0	0	1814
[illegible]:45-17:45	0	0	1	5	1004	1	1	761	64	0	0	0	1837
17:00-18:00	0	0	0	7	947	1	1	711	62	0	0	0	1729

INTERSECTION TURN MOVEMENT COUNT SUMMARY REPORT
PEARL STREET AT MOLALLA AVENUE

24015



DATE OF COUNT: 06/21/00
DAY OF WEEK: Wed
TIME STARTED: 16:00
TIME ENDED: 18:00

TEV=TOTAL ENTRY VOLUME
T=%TRUCKS BY APPROACH
P=PHF BY APPROACH

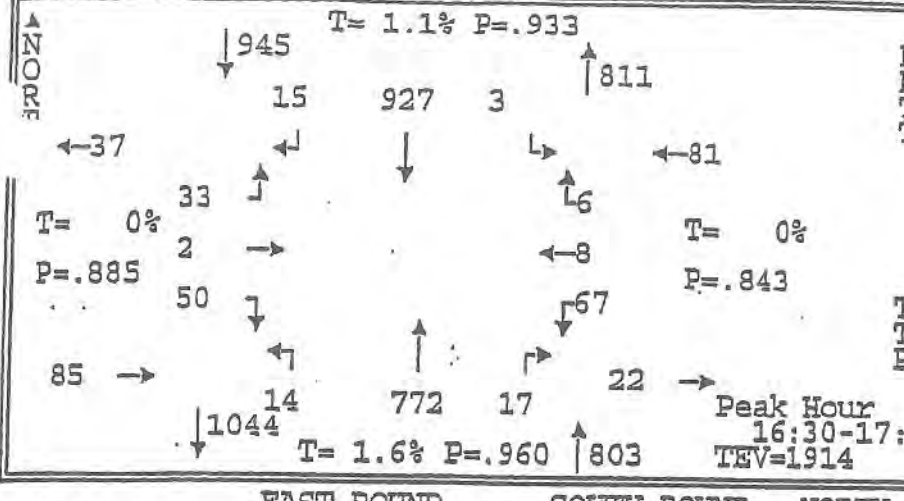
CHMJ

Peak Hour
16:35-17:35
TEV=1926

Traffic Smithy
(503) 641-6333

TIME PERIOD FROM - TO	EAST BOUND			SOUTH BOUND			NORTH BOUND			WEST BOUND			ALL
	↓	→	↑	↲	↓	↳	↰	↑	↱	↓	←	↑	
16:00-16:05	4	0	5	1	81	0	2	75	2	4	2	1	177
16:05-16:10	3	0	1	1	58	0	0	68	2	7	0	0	140
16:10-16:15	2	0	0	2	73	0	2	69	1	2	0	0	151
16:15-16:20	5	0	1	3	85	0	0	53	0	6	2	0	155
16:20-16:25	3	0	2	2	74	0	1	51	0	5	0	0	138
16:25-16:30	3	1	2	1	72	0	3	57	1	7	0	0	147
16:30-16:35	3	0	2	1	81	0	0	52	5	3	0	0	147
16:35-16:40	2	0	4	3	77	0	3	70	3	12	2	2	178
16:40-16:45	6	0	6	0	63	0	2	61	1	2	0	0	141
16:45-16:50	4	0	1	0	69	1	1	56	3	10	2	0	147
16:50-16:55	3	0	4	1	72	1	0	58	0	5	0	0	144
16:55-17:00	8	0	4	2	90	0	1	69	1	2	0	0	177
17:00-17:05	5	0	2	3	72	0	2	59	0	8	0	0	151
17:05-17:10	4	1	3	0	66	0	1	68	2	6	0	0	151
17:10-17:15	5	0	0	2	88	0	0	75	1	9	0	1	181
17:15-17:20	6	1	2	2	84	0	2	73	1	8	4	2	185
17:20-17:25	2	0	4	1	92	0	1	59	0	2	0	1	162
17:25-17:30	2	0	1	0	73	1	1	72	0	0	0	0	150
17:30-17:35	5	0	3	0	82	1	2	58	2	6	0	0	159
17:35-17:40	2	1	1	0	71	0	1	46	3	4	0	1	130
17:40-17:45	2	0	1	1	62	0	2	58	0	4	0	0	130
17:45-17:50	3	0	1	3	71	1	0	59	0	3	0	0	141
17:50-17:55	2	0	3	0	53	1	1	63	2	5	0	0	130
17:55-18:00	0	0	2	1	66	0	1	55	0	6	1	0	132
Total Survey	84	4	55	30	1775	6	29	1484	30	126	13	8	3644
PHF	.76	.25	.77	.58	.88	.5	.67	.9	.5	.73	.5	.38	.911
% Trucks	2.4	0	0	0	1.4	0	0	2	0	2.4	0	0	1.6
Stopped Buses	0	0	0	0	0	0	0	0	0	0	0	0	
Peds	0	1	0	0	22	0	0	8	0	0	1	0	
Hourly Totals													
16:00-17:00	46	1	32	17	895	2	15	739	19	65	8	3	1842
16:15-17:15	51	2	31	18	909	2	14	729	17	75	6	3	1857
16:30-17:30	50	2	33	15	927	3	14	772	17	67	8	6	1914
16:45-17:45	48	3	26	12	921	4	14	751	13	64	6	5	1867
17:00-18:00	38	3	23	13	880	4	14	745	11	61	5	5	1802

INTERSECTION TURN MOVEMENT COUNT PEAK HOUR REPORT
PEARL STREET AT MOLALLA AVENUE



DATE OF COUNT: 06/21/00
DAY OF WEEK: Wed
TIME STARTED: 16:00
TIME ENDED: 18:00

TEV=TOTAL ENTRY VOLUME
T=%TRUCKS BY APPROACH
P=PHF BY APPROACH

CHMJ

Peak Hour
16:30-17:30
TEV=1914

Traffic Smithy
(503)641-6333

TIME PERIOD FROM - TO	EAST BOUND ↓	EAST BOUND →	EAST BOUND ↑	SOUTH BOUND ↲	SOUTH BOUND ↓	SOUTH BOUND ↳	NORTH BOUND ↰	NORTH BOUND ↑	NORTH BOUND ↱	WEST BOUND ↓	WEST BOUND ←	WEST BOUND ↑	ALL
ALL VEHICLES													
16:30-16:45	11	0	12	4	221	0	5	183	9	17	2	2	466
16:45-17:00	15	0	9	3	231	2	2	183	4	17	2	0	468
17:00-17:15	14	1	5	5	226	0	3	202	3	23	0	1	483
17:15-17:30	10	1	7	3	249	1	4	204	1	10	4	3	497
LIGHT TRUCKS (SINGLE UNIT 2 AXLES)													
16:30-16:45	0	0	0	0	3	0	0	2	0	0	0	0	5
16:45-17:00	0	0	0	0	1	0	0	7	0	0	0	0	8
17:00-17:15	0	0	0	0	3	0	0	1	0	0	0	0	4
17:15-17:30	0	0	0	0	3	0	0	2	0	0	0	0	5
MEDIUM TRUCKS (SINGLE UNIT > 2 AXLES)													
16:30-16:45	0	0	0	0	0	0	0	0	0	0	0	0	0
16:45-17:00	0	0	0	0	0	0	0	0	0	0	0	0	0
17:00-17:15	0	0	0	0	0	0	0	0	0	0	0	0	0
17:15-17:30	0	0	0	0	0	0	0	0	0	0	0	0	0
HEAVY TRUCKS (SEMI-TRACTOR TRAILER)													
16:30-16:45	0	0	0	0	0	0	0	0	0	0	0	0	0
16:45-17:00	0	0	0	0	0	0	0	1	0	0	0	0	1
17:00-17:15	0	0	0	0	0	0	0	0	0	0	0	0	0
17:15-17:30	0	0	0	0	0	0	0	0	0	0	0	0	0
BICYCLES													
16:30-16:45	0	0	0	0	0	0	0	0	0	0	0	0	0
16:45-17:00	0	0	0	0	0	0	0	2	0	0	0	0	2
17:00-17:15	0	0	0	0	0	0	0	0	0	0	0	0	0
17:15-17:30	0	0	0	0	1	0	0	0	0	0	0	0	1

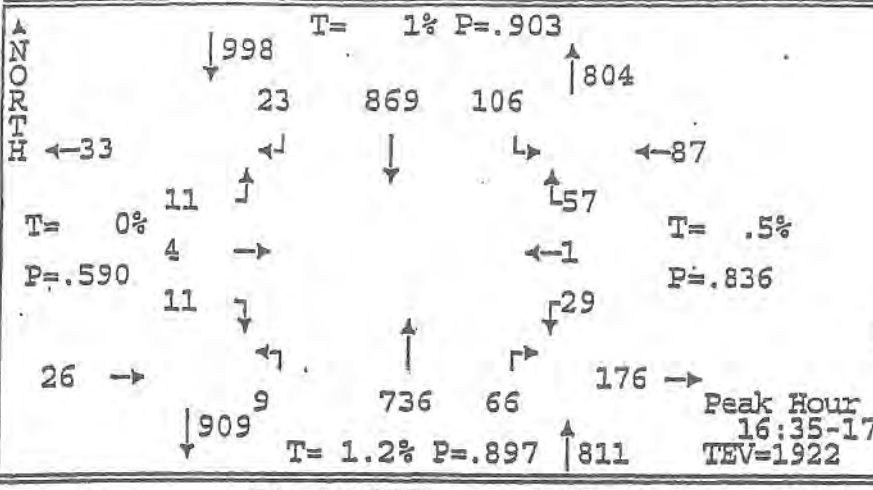
PEDESTRIANS	CROSSWALK USEAGE SOUTH	WEST	EAST	NORTH	ALL
16:30-16:45	0	2	0	0	2
16:45-17:00	0	0	1	0	1
17:00-17:15	0	3	6	0	9
17:15-17:30	0	2	1	0	3

Peak Hour by Movement	↓	→	↑	↲	↓	↳	↰	↑	↱	↓	←	↑	
PHF	.83	.5	.69	.75	.93	.38	.7	.95	.47	.73	.5	.5	.962
% Trucks (all)	0	0	0	0	1.1	0	0	1.7	0	0	0	0	1.2
% Trucks (M+H)	0	0	0	0	0	0	0	.1	0	0	0	0	.1
Stopped Buses	0	0	0	0	0	0	0	0	0	0	0	0	

Hourly Totals													
16:00-17:00	46	1	32	17	895	2	15	739	19	65	8	3	1842
16:15-17:15	51	2	31	18	909	2	14	729	17	75	6	3	1857
16:30-17:30	50	2	33	15	927	3	14	772	17	67	8	6	1914
16:45-17:45	48	3	26	12	921	4	14	751	13	64	6	5	1867
17:00-18:00	38	3	23	13	880	4	14	745	11	61	5	5	1802

INTERSECTION TURN MOVEMENT COUNT SUMMARY REPORT
BARCLAY STREET AT MOLALLA AVENUE

24053



DATE OF COUNT: 06/27/00
DAY OF WEEK: Tue
TIME STARTED: 16:05
TIME ENDED: 18:05

TEV=TOTAL ENTRY VOLUME
T=%TRUCKS BY APPROACH
P=PHF BY APPROACH

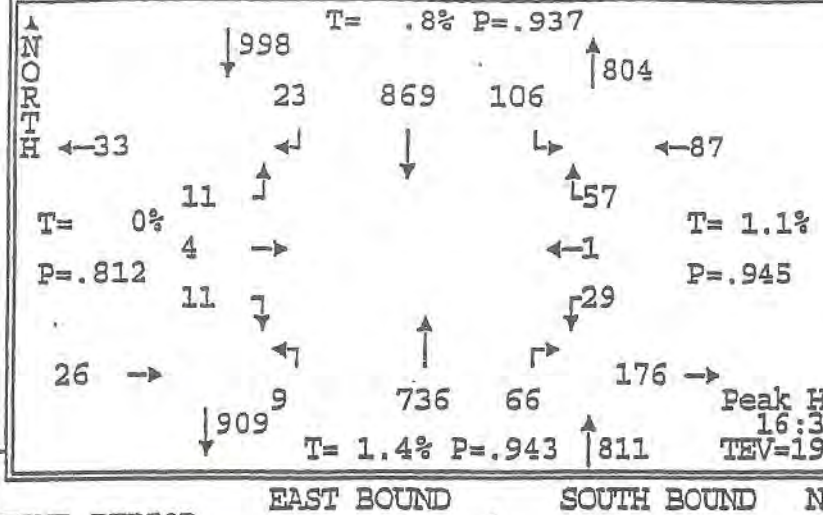
MM

Peak Hour
16:35-17:35
TEV=1922

Traffic Smithy
(503) 641-6333

TIME PERIOD FROM - TO	EAST BOUND ↓	EAST BOUND →	EAST BOUND ↑	SOUTH BOUND ↲	SOUTH BOUND ↓	SOUTH BOUND ↳	NORTH BOUND ↰	NORTH BOUND ↑	NORTH BOUND ↱	WEST BOUND ↓	WEST BOUND ←	WEST BOUND ↑	ALL
16:05-16:10	0	0	0	0	83	7	0	72	8	0	0	5	175
16:10-16:15	0	0	0	3	76	11	1	46	4	3	1	5	150
16:15-16:20	0	2	0	1	69	4	1	61	5	2	0	6	151
16:20-16:25	2	0	1	1	68	4	0	52	7	4	0	7	146
16:25-16:30	0	0	1	2	76	9	2	43	3	2	0	5	143
16:30-16:35	2	0	0	3	60	8	0	54	2	3	0	7	139
16:35-16:40	1	0	2	2	60	4	0	58	7	3	0	5	142
16:40-16:45	0	0	1	1	79	9	2	66	0	2	1	4	165
16:45-16:50	0	3	1	2	78	4	1	57	4	2	0	4	156
16:50-16:55	2	0	1	3	68	10	1	50	3	0	0	2	140
16:55-17:00	3	0	1	2	73	12	1	55	7	4	0	7	165
17:00-17:05	0	0	1	4	85	9	0	73	6	3	0	5	186
17:05-17:10	1	1	0	2	79	10	0	73	7	0	0	7	180
17:10-17:15	1	0	2	1	69	7	1	63	3	4	0	5	156
17:15-17:20	2	0	0	2	76	6	0	55	3	2	0	5	151
17:20-17:25	0	0	1	0	55	14	2	69	9	4	0	3	157
17:25-17:30	1	0	0	4	65	14	1	44	9	3	0	6	147
17:30-17:35	0	0	1	0	82	7	0	73	8	2	0	4	177
17:35-17:40	1	0	0	0	57	8	1	58	3	5	0	3	136
17:40-17:45	0	0	2	1	57	9	0	59	9	4	1	5	147
17:45-17:50	0	0	1	0	65	9	1	51	3	2	0	5	137
17:50-17:55	2	0	1	0	61	10	1	57	7	2	0	6	147
17:55-18:00	1	1	0	1	57	14	0	58	9	2	0	6	149
18:00-18:05	0	1	3	2	51	6	0	64	6	5	0	5	143
Total Survey	19	8	20	37	1649	205	16	1411	132	63	3	122	3685
PHF	.55	.33	.69	.64	.92	.76	.56	.88	.63	.73	.25	.75	.904
% Trucks	0	0	0	2.7	1.1	0	0	1.2	.8	0	0	.8	1
Stopped Buses	0	0	0	0	0	0	0	0	0	0	0	0	
Peds	0	2	0	0	4	0	0	2	0	0	5	0	
Hourly Totals													
16:05-17:05	10	5	9	24	875	91	9	687	56	28	2	62	1858
6:20-17:20	14	4	11	25	871	92	8	699	52	29	1	63	1869
6:35-17:35	11	4	11	23	869	106	9	736	66	29	1	57	1922
16:50-17:50	11	1	10	19	831	115	8	723	70	33	1	57	1879
17:05-18:05	9	3	11	13	774	114	7	724	76	35	1	60	1827

INTERSECTION TURN MOVEMENT COUNT PEAK HOUR REPORT
BARCLAY STREET AT MOLALLA AVENUE



DATE OF COUNT: 06/27/00
DAY OF WEEK: Tue
TIME STARTED: 16:05
TIME ENDED: 18:05

TEV=TOTAL ENTRY VOLUME
T=%TRUCKS BY APPROACH
P=PHF BY APPROACH

MM

Traffic Smithy
(503)641-6333

TIME PERIOD FROM - TO	EAST BOUND ↓	EAST BOUND →	EAST BOUND ↑	SOUTH BOUND ↲	SOUTH BOUND ↓	SOUTH BOUND ↳	NORTH BOUND ↰	NORTH BOUND ↑	NORTH BOUND ↱	WEST BOUND ↓	WEST BOUND ←	WEST BOUND ↑	ALL
ALL VEHICLES													
16:35-16:50	1	3	4	5	217	17	3	181	11	7	1	13	463
16:50-17:05	5	0	3	9	226	31	2	178	16	7	0	14	491
17:05-17:20	4	1	2	5	224	23	1	191	13	6	0	17	487
17:20-17:35	1	0	2	4	202	35	3	186	26	9	0	13	481
LIGHT TRUCKS (SINGLE UNIT 2 AXLES)													
16:35-16:50	0	0	0	0	1	0	0	4	0	0	0	0	5
16:50-17:05	0	0	0	0	1	0	0	2	1	0	0	0	4
17:05-17:20	0	0	0	0	2	0	0	1	0	0	0	0	3
17:20-17:35	0	0	0	0	1	0	0	1	0	0	0	0	2
MEDIUM TRUCKS (SINGLE UNIT > 2 AXLES)													
16:35-16:50	0	0	0	0	1	0	0	0	0	0	0	0	1
16:50-17:05	0	0	0	0	0	0	0	0	0	0	0	1	1
17:05-17:20	0	0	0	0	1	0	0	1	0	0	0	0	2
17:20-17:35	0	0	0	0	1	0	0	1	0	0	0	0	2
HEAVY TRUCKS (SEMI-TRACTOR TRAILER)													
16:35-16:50	0	0	0	0	0	0	0	0	0	0	0	0	0
16:50-17:05	0	0	0	0	0	0	0	0	0	0	0	0	0
17:05-17:20	0	0	0	0	0	0	0	0	0	0	0	0	0
17:20-17:35	0	0	0	0	0	0	0	0	0	0	0	0	0
BICYCLES													
16:35-16:50	0	0	0	0	0	0	0	3	0	0	0	0	3
16:50-17:05	0	0	0	0	0	0	0	0	0	0	0	0	0
17:05-17:20	0	0	0	0	0	0	0	1	0	0	0	0	1
17:20-17:35	0	0	0	0	0	0	0	0	0	0	0	0	0

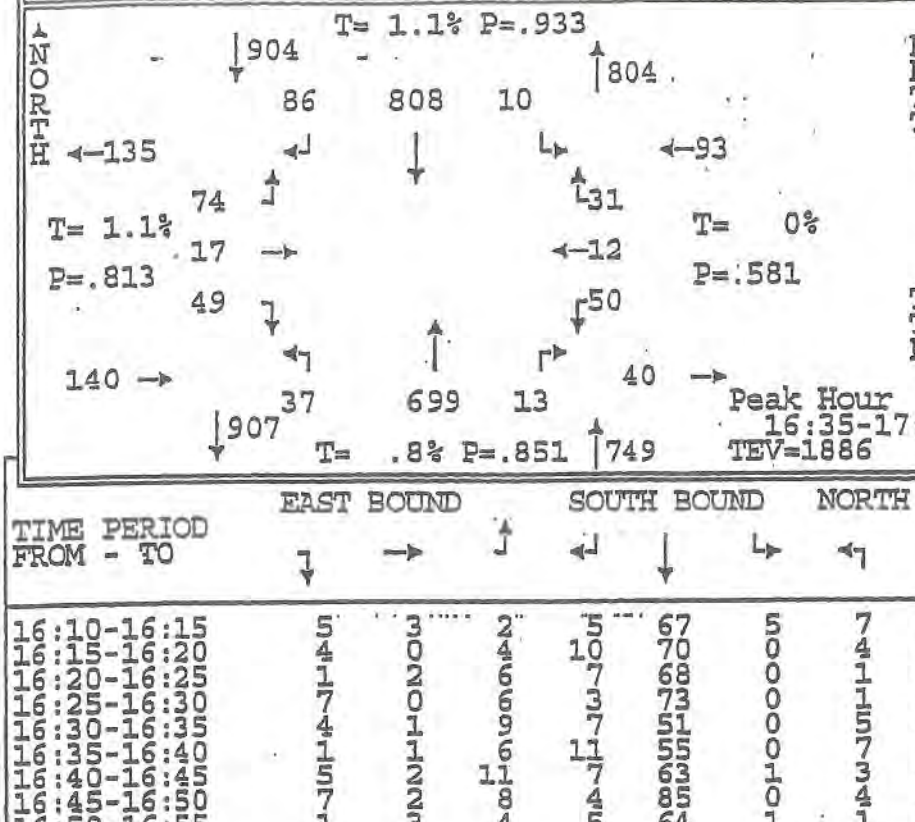
PEDESTRIANS	CROSSWALK USEAGE SOUTH	WEST	EAST	NORTH	ALL
16:35-16:50	2	3	0	0	5
16:50-17:05	0	0	1	0	1
17:05-17:20	0	0	0	1	1
17:20-17:35	0	0	0	0	0

Peak Hour by Movement													
PHF	.55	.33	.69	.64	.96	.76	.75	.96	.63	.81	.25	.84	.978
% Trucks(all)	0	0	0	0	.9	0	0	1.4	1.5	0	0	1.8	1
% Trucks(M+H)	0	0	0	0	.3	0	0	.3	0	0	0	1.8	.3
Stopped Buses	0	0	0	0	0	0	0	0	0	0	0	0	

Hourly Totals													
16:05-17:05	10	5	9	24	875	91	9	687	56	28	2	62	1858
16:20-17:20	14	4	11	25	871	92	8	699	52	29	1	63	1869
16:35-17:35	11	4	11	23	869	106	9	736	66	29	1	57	1922
16:50-17:50	11	1	10	19	831	115	8	723	70	33	1	57	1879
17:05-18:05	9	3	11	13	774	114	7	724	76	35	1	60	1827

INTERSECTION TURN MOVEMENT COUNT SUMMARY REPORT
HILDA/HOLMES LANE AT MOLALLA AVENUE

24054



DATE OF COUNT: 06/27/00
DAY OF WEEK: Tue
TIME STARTED: 16:10
TIME ENDED: 18:10

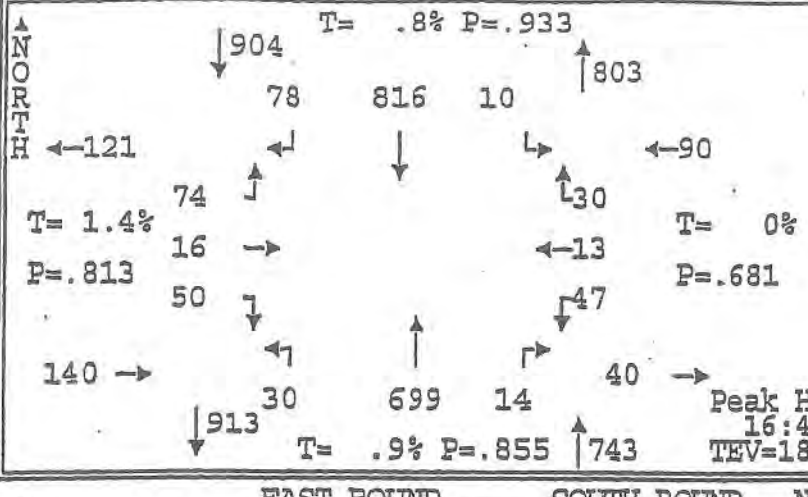
TEV=TOTAL ENTRY VOLUME
T=%TRUCKS BY APPROACH
P=PHF BY APPROACH

WJ

Traffic Smithy
(503) 641-6333

TIME PERIOD FROM - TO	EAST BOUND			SOUTH BOUND			NORTH BOUND			WEST BOUND			ALL
	↓	→	↑	↲	↓	↳	↰	↑	↱	↓	←	↑	
16:10-16:15	5	3	2	5	67	5	7	46	0	6	2	2	150
16:15-16:20	4	0	4	10	70	0	4	63	0	1	0	1	157
16:20-16:25	1	2	6	7	68	0	1	48	0	4	2	0	139
16:25-16:30	7	0	6	3	73	0	1	39	0	6	1	1	137
16:30-16:35	4	1	9	7	51	0	5	48	2	4	4	1	136
16:35-16:40	1	1	6	11	55	0	7	53	0	5	1	2	142
16:40-16:45	5	2	11	7	63	1	3	58	1	2	0	0	153
16:45-16:50	7	2	8	4	85	0	4	48	1	1	1	2	163
16:50-16:55	1	3	4	5	64	1	1	51	0	4	0	1	135
16:55-17:00	4	1	6	8	74	1	3	56	1	3	0	2	159
17:00-17:05	8	1	3	13	67	0	5	72	0	3	0	2	174
17:05-17:10	8	2	6	7	72	0	4	74	2	2	2	2	181
17:10-17:15	3	1	4	7	69	1	1	58	4	4	1	3	156
17:15-17:20	4	0	4	8	72	2	3	46	4	2	3	5	153
17:20-17:25	3	1	10	3	54	2	2	69	0	9	1	2	156
17:25-17:30	4	1	6	5	61	0	2	48	0	7	1	3	138
17:30-17:35	1	2	6	8	72	2	2	66	0	8	2	7	176
17:35-17:40	2	0	6	3	63	0	0	53	1	2	2	1	133
17:40-17:45	7	1	11	7	58	0	0	57	0	5	0	2	148
17:45-17:50	0	0	7	8	54	1	3	51	2	6	2	1	135
17:50-17:55	3	2	4	4	58	0	1	55	3	1	0	1	132
17:55-18:00	2	1	11	12	45	0	1	59	2	5	2	0	140
18:00-18:05	4	1	3	13	43	0	1	60	0	3	0	3	131
18:05-18:10	2	3	6	7	61	0	1	44	0	2	2	1	129
Total Survey	90	31	149	172	1519	16	62	1322	23	95	29	45	3553
PHF	.61	.61	.74	.77	.91	.5	.66	.86	.32	.52	.5	.65	.917
% Trucks	1.1	0	1.3	.6	1.1	0	0	.8	0	0	0	0	.9
Stopped Buses	0	0	0	0	0	0	0	0	0	0	0	0	
Peds	0	0	0	0	0	0	0	0	0	0	0	0	
Hourly Totals													
16:10-17:10	55	18	71	87	809	8	45	656	7	41	13	16	1826
16:25-17:25	55	15	77	83	799	8	39	672	15	45	14	23	1845
16:40-17:40	50	16	74	78	816	10	30	699	14	47	13	30	1877
16:55-17:55	47	12	73	81	774	9	26	705	17	52	14	31	1841
17:10-18:10	35	13	78	85	710	8	17	666	16	54	16	29	1727

INTERSECTION TURN MOVEMENT COUNT PEAK HOUR REPORT
HILDA/HOLMES LANE AT MOLALLA AVENUE



DATE OF COUNT: 06/27/00
DAY OF WEEK: Tue
TIME STARTED: 16:10
TIME ENDED: 18:10

TEV=TOTAL ENTRY VOLUME
T=%TRUCKS BY APPROACH
P=PHF BY APPROACH

WJ

Peak Hour
16:40-17:40
TEV=1877

Traffic Smithy
(503)641-6333

TIME PERIOD FROM - TO	EAST BOUND ↓	EAST BOUND →	EAST BOUND ↑	SOUTH BOUND ↲	SOUTH BOUND ↓	SOUTH BOUND ↳	NORTH BOUND ↰	NORTH BOUND ↑	NORTH BOUND ↱	WEST BOUND ↓	WEST BOUND ←	WEST BOUND ↑	ALL
ALL VEHICLES													
16:40-16:55	13	7	23	16	212	2	8	157	2	7	1	3	451
16:55-17:10	20	4	15	28	213	1	12	202	3	8	2	6	514
17:10-17:25	10	2	18	18	195	5	6	173	8	15	5	10	465
17:25-17:40	7	3	18	16	196	2	4	167	1	17	5	11	447
LIGHT TRUCKS (SINGLE UNIT 2 AXLES)													
16:40-16:55	1	0	0	0	2	0	0	4	0	0	0	0	7
16:55-17:10	0	0	0	0	0	0	0	1	0	0	0	0	1
17:10-17:25	0	0	1	0	3	0	0	2	0	0	0	0	6
17:25-17:40	0	0	0	0	1	0	0	0	0	0	0	0	1
MEDIUM TRUCKS (SINGLE UNIT > 2 AXLES)													
16:40-16:55	0	0	0	0	0	0	0	0	0	0	0	0	0
16:55-17:10	0	0	0	0	0	0	0	0	0	0	0	0	0
17:10-17:25	0	0	0	0	1	0	0	0	0	0	0	0	1
17:25-17:40	0	0	0	0	0	0	0	0	0	0	0	0	0
HEAVY TRUCKS (SEMI-TRACTOR TRAILER)													
16:40-16:55	0	0	0	0	0	0	0	0	0	0	0	0	0
16:55-17:10	0	0	0	0	0	0	0	0	0	0	0	0	0
17:10-17:25	0	0	0	0	0	0	0	0	0	0	0	0	0
17:25-17:40	0	0	0	0	0	0	0	0	0	0	0	0	0
BICYCLES													
16:40-16:55	0	0	0	0	0	0	0	0	0	0	0	0	0
16:55-17:10	0	0	0	0	0	0	0	0	0	0	0	0	0
17:10-17:25	0	0	0	0	0	0	0	0	0	0	0	0	0
17:25-17:40	0	0	0	0	0	0	0	0	0	0	0	0	0

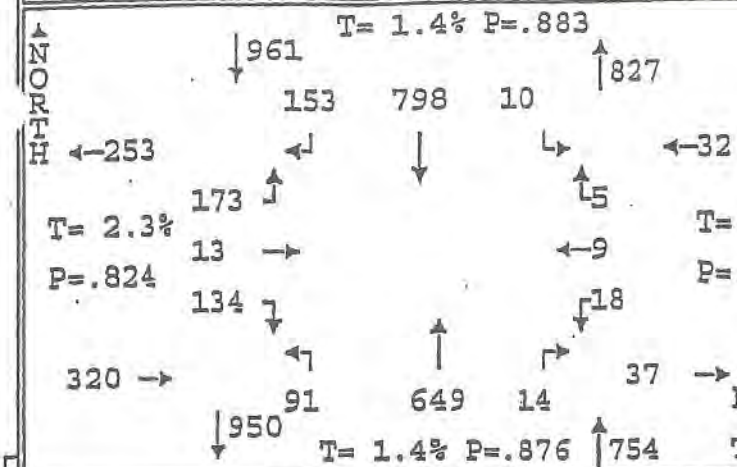
PEDESTRIANS	CROSSWALK USEAGE SOUTH	WEST	EAST	NORTH	ALL
16:40-16:55	0	0	0	0	0
16:55-17:10	0	0	0	0	0
17:10-17:25	0	0	0	0	0
17:25-17:40	0	0	0	0	0

Peak Hour by Movement													
PHF	.63	.57	.8	.7	.96	.5	.63	.87	.44	.69	.65	.68	.912
% Trucks (all)	2	0	1.4	0	.9	0	0	1	0	0	0	0	.9
% Trucks (M+H)	0	0	0	0	.1	0	0	0	0	0	0	0	.1
Stopped Buses	0	0	0	0	0	0	0	0	0	0	0	0	

Hourly Totals													
16:10-17:10	55	18	71	87	809	8	45	656	7	41	13	16	1826
16:25-17:25	55	15	77	83	799	8	39	672	15	45	14	23	1845
16:40-17:40	50	16	74	78	816	10	30	699	14	47	13	30	1877
16:55-17:55	47	12	73	81	774	9	26	705	17	52	14	31	1841
17:10-18:10	35	13	78	85	710	8	17	666	16	54	16	29	1727

INTERSECTION TURN MOVEMENT COUNT SUMMARY REPORT
MOLALLA AVENUE AT WARNER-MILNE ROAD

24055



DATE OF COUNT: 06/27/00
DAY OF WEEK: Tue
TIME STARTED: 16:00
TIME ENDED: 18:00

TEV=TOTAL ENTRY VOLUME
T=%TRUCKS BY APPROACH
P=PHF BY APPROACH

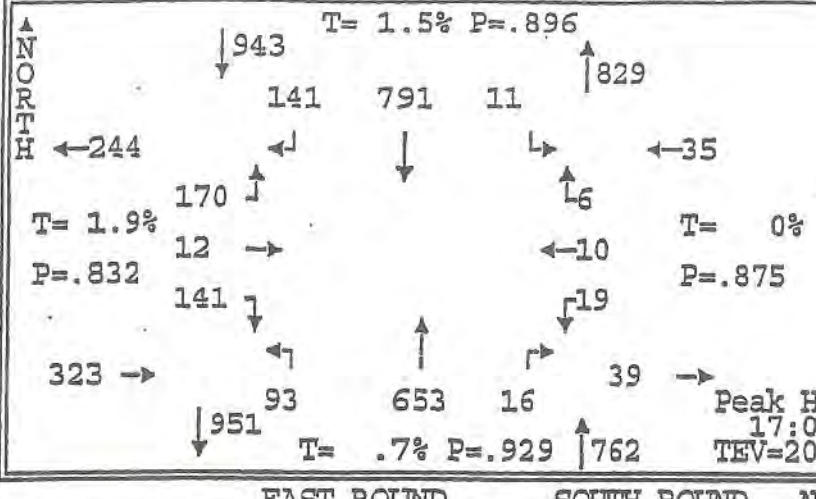
JWMB

Peak Hour
16:55-17:55
TEV=2067

Traffic Smithy
(503) 641-6333

TIME PERIOD FROM - TO	EAST BOUND ↓	EAST BOUND →	EAST BOUND ↑	SOUTH BOUND ↲	SOUTH BOUND ↓	SOUTH BOUND ↳	NORTH BOUND ↰	NORTH BOUND ↑	NORTH BOUND ↱	WEST BOUND ↓	WEST BOUND ←	WEST BOUND ↑	ALL
16:00-16:05	10	1	26	14	47	0	14	44	0	0	0	0	156
16:05-16:10	13	0	22	11	71	0	7	60	1	0	2	0	187
16:10-16:15	11	1	23	11	70	1	11	47	0	2	1	0	178
16:15-16:20	8	0	10	12	75	2	9	57	1	4	3	1	182
16:20-16:25	9	0	19	14	50	1	10	37	0	3	0	2	145
16:25-16:30	15	1	10	15	80	1	5	39	0	2	1	1	170
16:30-16:35	11	2	18	17	55	2	6	46	0	2	0	0	159
16:35-16:40	18	0	12	17	56	0	8	48	2	4	1	0	166
16:40-16:45	5	0	18	19	63	0	7	44	1	4	2	1	164
16:45-16:50	13	1	19	16	59	3	4	56	0	1	0	0	172
16:50-16:55	13	1	14	12	52	1	9	36	0	5	0	1	144
16:55-17:00	7	1	10	23	63	0	5	45	1	0	0	0	155
17:00-17:05	9	1	23	14	62	0	9	48	0	2	1	2	171
17:05-17:10	15	0	16	16	87	1	8	60	0	0	0	0	203
17:10-17:15	12	2	19	15	68	0	9	63	1	1	1	0	191
17:15-17:20	8	2	15	15	70	0	4	52	0	1	0	0	167
17:20-17:25	12	1	21	10	62	3	5	41	2	6	1	0	164
17:25-17:30	14	1	10	15	61	1	6	48	1	0	0	0	157
17:30-17:35	12	2	21	6	61	1	8	48	2	1	3	0	165
17:35-17:40	8	0	7	14	74	1	8	63	2	2	0	1	180
17:40-17:45	13	0	6	9	70	0	10	63	1	1	1	1	175
17:45-17:50	14	2	11	9	57	3	7	57	4	0	1	0	165
17:50-17:55	10	1	14	7	63	0	12	61	0	4	1	1	174
17:55-18:00	14	0	7	11	56	1	7	49	3	1	1	1	151
Total Survey	274	20	371	322	1532	22	188	1212	22	46	20	12	4041
PHF	.88	.65	.75	.72	.89	.5	.78	.89	.5	.56	.56	.63	.914
% Trucks	2.9	5	1.6	.9	1.5	0	1.1	1.5	0	0	0	0	1.5
Stopped Buses	0	0	0	0	0	0	0	0	0	0	0	0	
Peds	0	2	0	0	5	0	0	13	0	0	1	0	
Hourly Totals													
16:00-17:00	133	8	201	181	741	11	95	559	6	27	10	6	1978
16:15-17:15	135	9	188	190	770	11	89	579	6	28	9	8	2022
16:30-17:30	137	12	195	189	758	11	80	587	8	26	6	4	2013
16:45-17:45	136	12	181	165	789	11	85	623	10	20	7	5	2044
17:00-18:00	141	12	170	141	791	11	93	653	16	19	10	6	2063

INTERSECTION TURN MOVEMENT COUNT PEAK HOUR REPORT
MOLALLA AVENUE AT WARNER-MILNE ROAD



DATE OF COUNT: 06/27/00
DAY OF WEEK: Tue
TIME STARTED: 16:00
TIME ENDED: 18:00

TEV=TOTAL ENTRY VOLUME
T=%TRUCKS BY APPROACH
P=PHF BY APPROACH

JWMB

Peak Hour
17:00-18:00
TEV=2063

Traffic Smithy
(503)641-6333

TIME PERIOD FROM - TO	EAST BOUND ↓	EAST BOUND →	EAST BOUND ↑	SOUTH BOUND ↲	SOUTH BOUND ↓	SOUTH BOUND ↳	NORTH BOUND ↰	NORTH BOUND ↑	NORTH BOUND ↱	WEST BOUND ↓	WEST BOUND ←	WEST BOUND ↑	ALL
ALL VEHICLES													
17:00-17:15	36	3	58	45	217	1	26	171	1	3	2	2	565
17:15-17:30	34	4	46	40	193	4	15	141	3	7	1	0	488
17:30-17:45	33	2	34	29	205	2	26	174	5	4	4	2	520
17:45-18:00	38	3	32	27	176	4	26	167	7	5	3	2	490
LIGHT TRUCKS (SINGLE UNIT 2 AXLES)													
17:00-17:15	1	0	0	0	0	0	0	0	0	0	0	0	1
17:15-17:30	2	1	0	1	3	0	0	2	0	0	0	0	9
17:30-17:45	1	0	0	1	4	0	0	0	0	0	0	0	6
17:45-18:00	0	0	1	0	5	0	0	2	0	0	0	0	8
MEDIUM TRUCKS (SINGLE UNIT > 2 AXLES)													
17:00-17:15	0	0	0	0	0	0	0	1	0	0	0	0	1
17:15-17:30	0	0	0	0	0	0	0	0	0	0	0	0	0
17:30-17:45	0	0	0	0	0	0	0	0	0	0	0	0	0
17:45-18:00	0	0	0	0	0	0	0	0	0	0	0	0	0
HEAVY TRUCKS (SEMI-TRACTOR TRAILER)													
17:00-17:15	0	0	0	0	0	0	0	0	0	0	0	0	0
17:15-17:30	0	0	0	0	0	0	0	0	0	0	0	0	0
17:30-17:45	0	0	0	0	0	0	0	0	0	0	0	0	0
17:45-18:00	0	0	0	0	0	0	0	0	0	0	0	0	0
BICYCLES													
17:00-17:15	0	0	0	0	0	0	2	0	0	0	0	0	2
17:15-17:30	0	1	0	0	2	0	0	1	0	0	0	0	4
17:30-17:45	0	0	0	0	0	0	0	0	0	0	0	0	0
17:45-18:00	0	0	0	0	0	0	0	0	0	0	0	0	0

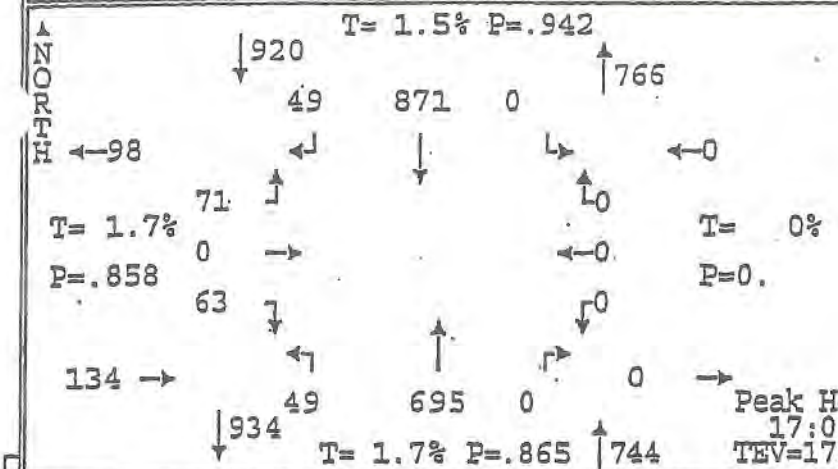
PEDESTRIANS	CROSSWALK USEAGE SOUTH	WEST	EAST	NORTH	ALL
17:00-17:15	0	0	1	0	1
17:15-17:30	0	1	2	0	3
17:30-17:45	0	0	0	0	0
17:45-18:00	0	0	1	0	1

Peak Hour by Movement	↓	→	↑	↲	↓	↳	↰	↑	↱	↓	←	↑	
PHF	.93	.75	.73	.78	.91	.69	.89	.94	.57	.68	.63	.75	.912
% Trucks(all)	2.8	8.3	.6	1.4	1.5	0	0	.8	0	0	0	0	1.2
% Trucks(M+H)	0	0	0	0	0	0	0	.2	0	0	0	0	0
Stopped Buses	0	0	0	0	0	0	0	0	0	0	0	0	-

Hourly Totals													
16:00-17:00	133	8	201	181	741	11	95	559	6	27	10	6	1978
16:15-17:15	135	9	188	190	770	11	89	579	6	28	9	8	2022
6:30-17:30	137	12	195	189	758	11	80	587	8	26	6	4	2013
.6:45-17:45	136	12	181	165	789	11	85	623	10	20	7	5	2044
17:00-18:00	141	12	170	141	791	11	93	653	16	19	10	6	2063

INTERSECTION TURN MOVEMENT COUNT SUMMARY REPORT
HILL TOP MALL SIGNAL AT MOLALLA AVENUE

24056



DATE OF COUNT: 06/27/00
DAY OF WEEK: Tue
TIME STARTED: 16:00
TIME ENDED: 18:00

TEV=TOTAL ENTRY VOLUME
T=%TRUCKS BY APPROACH
P=PHF BY APPROACH

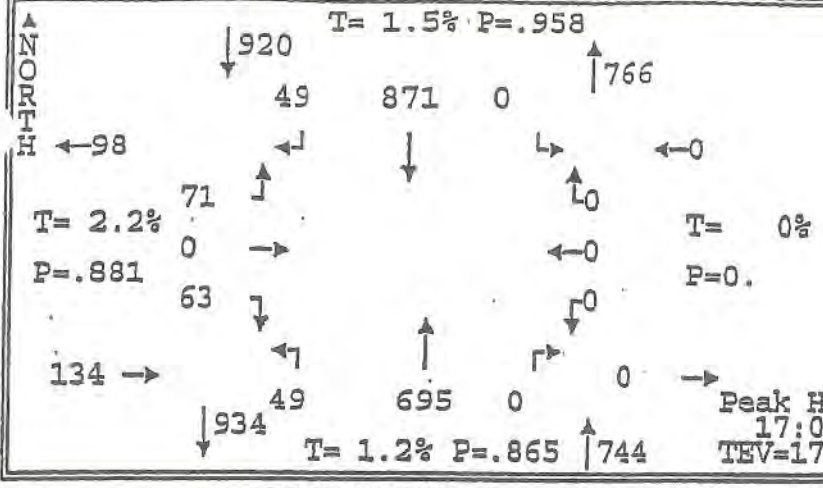
DJMV

Peak Hour
17:00-18:00
TEV=1798

Traffic Smithy
(503) 641-6333

TIME PERIOD FROM - TO	EAST BOUND ↓	EAST BOUND →	EAST BOUND ↑	SOUTH BOUND ↲	SOUTH BOUND ↓	SOUTH BOUND ↳	NORTH BOUND ↰	NORTH BOUND ↑	NORTH BOUND ↱	WEST BOUND ↓	WEST BOUND ←	WEST BOUND ↑	ALL
16:00-16:05	5	0	3	6	57	0	1	62	0	0	0	0	134
16:05-16:10	6	0	4	6	74	0	3	62	0	0	0	0	155
16:10-16:15	3	0	2	1	77	0	4	70	0	0	0	0	157
16:15-16:20	6	0	2	5	82	0	2	60	0	0	0	0	157
16:20-16:25	1	0	3	4	70	0	5	46	0	0	0	0	129
16:25-16:30	3	0	3	4	90	0	2	49	0	0	0	0	151
16:30-16:35	3	0	4	3	63	0	5	57	0	0	0	0	135
16:35-16:40	5	0	7	3	64	0	3	42	0	0	0	0	124
16:40-16:45	3	0	5	3	66	0	3	55	0	0	0	0	135
16:45-16:50	8	0	4	3	66	0	3	60	0	0	0	0	144
16:50-16:55	6	0	3	11	58	0	4	47	0	0	0	0	129
16:55-17:00	9	0	1	2	72	0	3	52	0	0	0	0	139
17:00-17:05	5	0	7	2	75	0	6	71	0	0	0	0	166
17:05-17:10	7	0	5	5	88	0	7	63	0	0	0	0	175
17:10-17:15	2	0	5	6	64	0	4	64	0	0	0	0	145
17:15-17:20	6	0	4	5	76	0	4	49	0	0	0	0	144
17:20-17:25	8	0	8	3	76	0	6	41	0	0	0	0	142
17:25-17:30	7	0	5	3	68	0	2	48	0	0	0	0	133
17:30-17:35	2	0	9	5	75	0	3	64	0	0	0	0	158
17:35-17:40	7	0	5	9	72	0	1	64	0	0	0	0	158
17:40-17:45	5	0	6	3	61	0	2	54	0	0	0	0	131
17:45-17:50	5	0	5	1	81	0	4	53	0	0	0	0	149
17:50-17:55	3	0	9	4	69	0	3	62	0	0	0	0	150
17:55-18:00	6	0	3	3	66	0	7	62	0	0	0	0	147
Total Survey	121	0	112	100	1710	0	87	1357	0	0	0	0	3487
PHF	.75	0	.81	.72	.96	0	.72	.88	0	0	0	0	.924
% Trucks	2.5	0	.9	1	1.5	0	3.4	1.5	0	0	0	0	1.6
Stopped Buses	0	0	0	0	1	0	0	0	0	0	0	0	
Peds	0	1	0	0	7	0	0	11	0	0	9	0	
Hourly Totals													
16:00-17:00	58	0	41	51	839	0	38	662	0	0	0	0	1689
16:15-17:15	58	0	49	51	858	0	47	666	0	0	0	0	1729
16:30-17:30	69	0	58	49	836	0	50	649	0	0	0	0	1711
16:45-17:45	72	0	62	57	851	0	45	677	0	0	0	0	1764
17:00-18:00	63	0	71	49	871	0	49	695	0	0	0	0	1798

INTERSECTION TURN MOVEMENT COUNT PEAK HOUR REPORT
HILL TOP MALL SIGNAL AT MOLALLA AVENUE



DATE OF COUNT: 06/27/00
DAY OF WEEK: Tue
TIME STARTED: 16:00
TIME ENDED: 18:00

TEV=TOTAL ENTRY VOLUME
T=%TRUCKS BY APPROACH
P=PHF BY APPROACH

DJMV

Traffic Smithy
(503)641-6333

TIME PERIOD FROM - TO	EAST BOUND ↓	EAST BOUND →	EAST BOUND ↑	SOUTH BOUND ↲	SOUTH BOUND ↓	SOUTH BOUND ↳	NORTH BOUND ↰	NORTH BOUND ↑	NORTH BOUND ↱	WEST BOUND ↓	WEST BOUND ←	WEST BOUND ↑	ALL
ALL VEHICLES													
17:00-17:15	14	0	17	13	227	0	17	198	0	0	0	0	486
17:15-17:30	21	0	17	11	220	0	12	138	0	0	0	0	419
17:30-17:45	14	0	20	17	208	0	6	182	0	0	0	0	447
17:45-18:00	14	0	17	8	216	0	14	177	0	0	0	0	446
LIGHT TRUCKS (SINGLE UNIT 2 AXLES)													
17:00-17:15	1	0	0	0	1	0	1	1	0	0	0	0	4
17:15-17:30	0	0	0	0	4	0	0	3	0	0	0	0	7
17:30-17:45	1	0	0	0	3	0	0	1	0	0	0	0	5
17:45-18:00	0	0	0	0	5	0	0	2	0	0	0	0	7
MEDIUM TRUCKS (SINGLE UNIT > 2 AXLES)													
17:00-17:15	0	0	1	0	0	0	0	0	0	0	0	0	1
17:15-17:30	0	0	0	0	1	0	0	0	0	0	0	0	1
17:30-17:45	0	0	0	0	0	0	0	0	0	0	0	0	0
17:45-18:00	0	0	0	0	0	0	0	0	0	0	0	0	0
HEAVY TRUCKS (SEMI-TRACTOR TRAILER)													
17:00-17:15	0	0	0	0	0	0	1	0	0	0	0	0	1
17:15-17:30	0	0	0	0	0	0	0	0	0	0	0	0	0
17:30-17:45	0	0	0	0	0	0	0	0	0	0	0	0	0
17:45-18:00	0	0	0	0	0	0	0	0	0	0	0	0	0
BICYCLES													
17:00-17:15	0	0	0	0	0	0	0	3	0	0	0	0	3
17:15-17:30	0	0	0	0	2	0	0	0	0	0	0	0	2
17:30-17:45	0	0	0	0	0	0	0	0	0	0	0	0	0
17:45-18:00	0	0	0	0	0	0	0	0	0	0	0	0	0

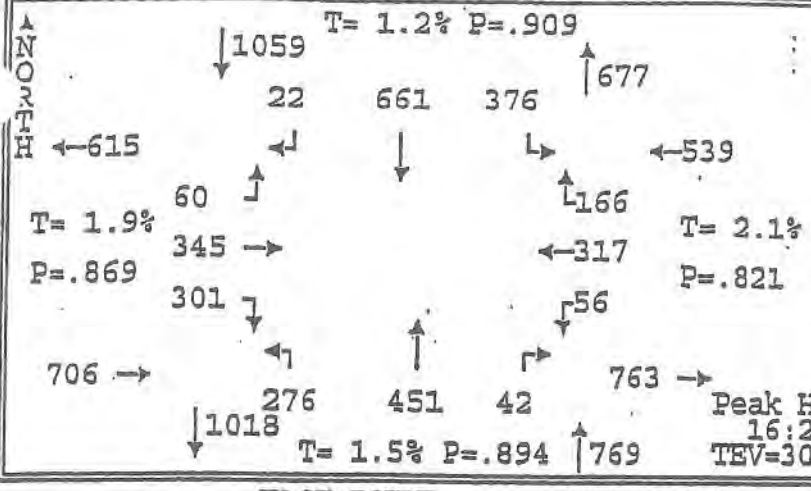
PEDESTRIANS	CROSSWALK USEAGE SOUTH	WEST	EAST	NORTH	ALL
17:00-17:15	0	0	0	3	3
17:15-17:30	0	0	2	3	5
17:30-17:45	0	0	0	2	2
17:45-18:00	0	1	0	0	1

Peak Hour by Movement	↓	→	↑	↲	↓	↳	↰	↑	↱	↓	←	↑	
PHF	.75	0	.89	.72	.96	0	.72	.88	0	0	0	0	.924
% Trucks (all)	3.2	0	1.4	0	1.6	0	4.1	1	0	0	0	0	1.4
% Trucks (M+H)	0	0	1.4	0	.1	0	2	0	0	0	0	0	.2
Stopped Buses	0	0	0	0	1	0	0	0	0	0	0	0	

Hourly Totals													
16:00-17:00	58	0	41	51	839	0	38	662	0	0	0	0	1689
16:15-17:15	58	0	49	51	858	0	47	666	0	0	0	0	1729
16:30-17:30	69	0	58	49	836	0	50	649	0	0	0	0	1711
16:45-17:45	72	0	62	57	851	0	45	677	0	0	0	0	1764
17:00-18:00	63	0	71	49	871	0	49	695	0	0	0	0	1798

INTERSECTION TURN MOVEMENT COUNT SUMMARY REPORT
BEAVERCREEK ROAD AT MOLALLA AVENUE

24058



DATE OF COUNT: 6/22/00
DAY OF WEEK: Thu
TIME STARTED: 16:00
TIME ENDED: 18:00

TEV=TOTAL ENTRY VOLUME
T=%TRUCKS BY APPROACH
P=PHF BY APPROACH

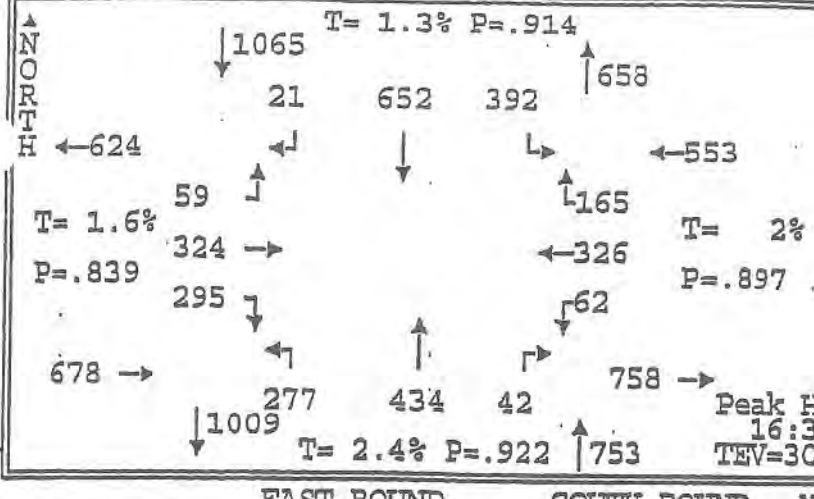
gtkf

Peak Hour
16:20-17:20
TEV=3073

Traffic Smithy
(503) 641-6333

TIME PERIOD FROM - TO	EAST BOUND			SOUTH BOUND			NORTH BOUND			WEST BOUND			ALL
	↓	→	↑	↲	↓	↳	↰	↑	↱	↓	←	↑	
16:00-16:05	23	19	0	4	58	19	14	46	1	5	22	14	225
16:05-16:10	21	31	16	0	32	38	19	37	1	6	34	17	252
16:10-16:15	28	32	3	3	62	26	22	37	4	5	16	16	254
16:15-16:20	28	22	4	3	52	23	16	32	3	7	19	14	223
16:20-16:25	17	27	1	1	52	38	17	42	2	7	22	19	245
16:25-16:30	29	25	5	2	53	27	23	30	6	2	22	11	235
16:30-16:35	21	23	4	3	50	31	30	28	3	4	29	14	240
16:35-16:40	31	41	7	0	46	19	25	30	2	4	25	11	241
16:40-16:45	30	27	4	4	53	38	18	35	6	3	22	12	252
16:45-16:50	29	28	6	1	62	41	25	33	3	3	21	15	267
16:50-16:55	23	25	5	4	58	28	20	37	2	6	40	19	267
:55-17:00	21	24	4	2	62	33	31	26	4	4	32	14	257
:00-17:05	21	36	2	1	56	22	29	46	1	8	29	12	263
17:05-17:10	24	30	10	3	58	34	16	37	7	8	28	13	268
17:10-17:15	35	35	9	0	50	32	17	49	2	3	27	14	273
17:15-17:20	20	24	3	1	61	33	25	58	4	4	20	12	265
17:20-17:25	18	11	1	1	58	39	13	27	3	7	31	14	223
17:25-17:30	22	20	4	1	38	42	28	28	5	8	22	15	233
17:30-17:35	15	32	0	0	67	32	19	31	1	4	31	11	243
17:35-17:40	21	24	4	4	71	20	24	46	4	1	27	12	258
17:40-17:45	17	35	4	1	32	28	21	32	3	4	24	14	215
17:45-17:50	22	18	5	0	53	26	28	47	4	6	11	13	233
17:50-17:55	21	18	3	0	54	28	21	34	0	2	20	17	218
17:55-18:00	20	18	1	2	63	25	13	36	4	5	19	15	221
Total Survey	557	625	105	41	1301	722	514	884	75	116	593	338	5871
PHF	.84	.85	.68	.61	.91	.88	.86	.78	.81	.7	.78	.86	.953
% Trucks	2.2	1.9	1	9.8	1.2	.8	1.2	1.4	5.3	1.7	2.5	1.5	1.6
Stopped Buses	0	1	0	0	0	0	0	0	0	0	0	0	
Peds	0	9	0	0	35	0	0	8	0	0	13	0	
Hourly Totals													
:00-17:00	301	324	59	27	640	361	260	413	37	56	304	176	2958
:15-17:15	309	343	61	24	652	366	267	425	41	59	316	168	3031
16:30-17:30	295	324	59	21	652	392	277	434	42	62	326	165	3049
16:45-17:45	266	324	52	19	673	384	268	450	39	60	332	165	3032
17:00-18:00	256	301	46	14	661	361	254	471	38	60	289	162	2913

INTERSECTION TURN MOVEMENT COUNT PEAK HOUR REPORT
BEAVERCREEK ROAD AT MOLALLA AVENUE



DATE OF COUNT: 6/22/00
DAY OF WEEK: Thu
TIME STARTED: 16:00
TIME ENDED: 18:00

TEV=TOTAL ENTRY VOLUME
T=%TRUCKS BY APPROACH
P=PHF BY APPROACH

Peak Hour
16:30-17:30
TEV=3049

gtkf

Traffic Smithy
(503)641-6333

TIME PERIOD FROM - TO	EAST BOUND ↓	EAST BOUND →	EAST BOUND ↑	SOUTH BOUND ↲	SOUTH BOUND ↓	SOUTH BOUND ↳	NORTH BOUND ↰	NORTH BOUND ↑	NORTH BOUND ↱	WEST BOUND ↓	WEST BOUND ←	WEST BOUND ↑	ALL
ALL VEHICLES													
16:30-16:45	82	91	15	7	149	88	73	93	11	11	76	37	733
16:45-17:00	73	77	15	7	182	102	76	96	9	13	93	48	791
17:00-17:15	80	101	21	4	164	88	62	132	10	19	84	39	804
17:15-17:30	60	55	8	3	157	114	66	113	12	19	73	41	721
LIGHT TRUCKS (SINGLE UNIT 2 AXLES)													
16:30-16:45	0	2	0	0	1	1	1	1	2	0	1	0	9
16:45-17:00	2	1	0	1	3	0	1	3	0	0	1	2	14
17:00-17:15	0	1	0	1	2	0	0	4	0	0	4	0	12
17:15-17:30	3	1	1	0	1	2	1	1	0	0	0	1	11
MEDIUM TRUCKS (SINGLE UNIT > 2 AXLES)													
:30-16:45	0	0	0	0	0	0	0	0	0	0	0	0	0
:45-17:00	0	0	0	0	0	0	0	0	0	0	0	0	0
17:00-17:15	0	0	0	0	0	0	0	0	0	0	0	0	0
17:15-17:30	0	0	0	0	0	1	0	0	0	0	1	0	2
HEAVY TRUCKS (SEMI-TRACTOR TRAILER)													
16:30-16:45	0	0	0	0	1	0	0	0	0	0	1	0	2
16:45-17:00	0	0	0	0	0	0	0	0	2	0	0	0	2
17:00-17:15	0	0	0	0	0	0	1	1	0	0	0	0	2
17:15-17:30	0	0	0	0	0	0	0	0	0	0	0	0	0
BICYCLES													
16:30-16:45	0	1	0	0	0	0	0	0	0	0	0	0	1
16:45-17:00	0	0	0	0	0	0	0	1	0	0	0	0	1
17:00-17:15	0	0	0	0	0	0	0	0	0	0	0	0	0
17:15-17:30	0	0	0	0	0	0	0	0	0	0	0	0	0

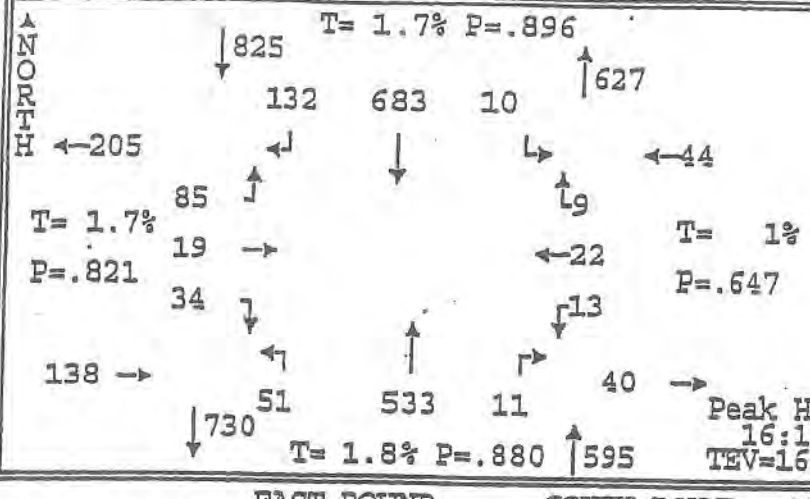
PEDESTRIANS	CROSSWALK USEAGE SOUTH	WEST	EAST	NORTH	ALL
16:30-16:45	1	1	1	2	5
16:45-17:00	1	6	3	6	16
17:00-17:15	0	9	0	3	12
17:15-17:30	0	5	1	0	6

Peak Hour by Movement	↓	→	↑	↲	↓	↳	↰	↑	↱	↓	←	↑	
PHF	.9	.8	.7	.75	.9	.86	.91	.82	.88	.82	.88	.86	.948
% Trucks(all)	1.7	1.5	1.7	9.5	1.2	1	1.4	2.3	9.5	0	2.5	1.8	1.8
% Trucks(M+H)	0	0	0	0	.2	.3	.4	.2	4.8	0	.6	0	.3
Stopped Buses	0	0	0	0	0	0	0	0	0	0	0	0	

Hourly Totals													
16:00-17:00	301	324	59	27	640	361	260	413	37	56	304	176	2958
16:15-17:15	309	343	61	24	652	366	267	425	41	59	316	168	3031
:30-17:30	295	324	59	21	652	392	277	434	42	62	326	165	3049
:45-17:45	266	324	52	19	673	384	268	450	39	60	332	165	3032
17:00-18:00	256	301	46	14	661	361	254	471	38	60	289	162	2913

INTERSECTION TURN MOVEMENT COUNT SUMMARY REPORT
CLAIRMONT WAY/FRED MEYER AT MOLALLA AVENUE

24057



DATE OF COUNT: 06/27/00
DAY OF WEEK: Tue
TIME STARTED: 16:00
TIME ENDED: 18:00

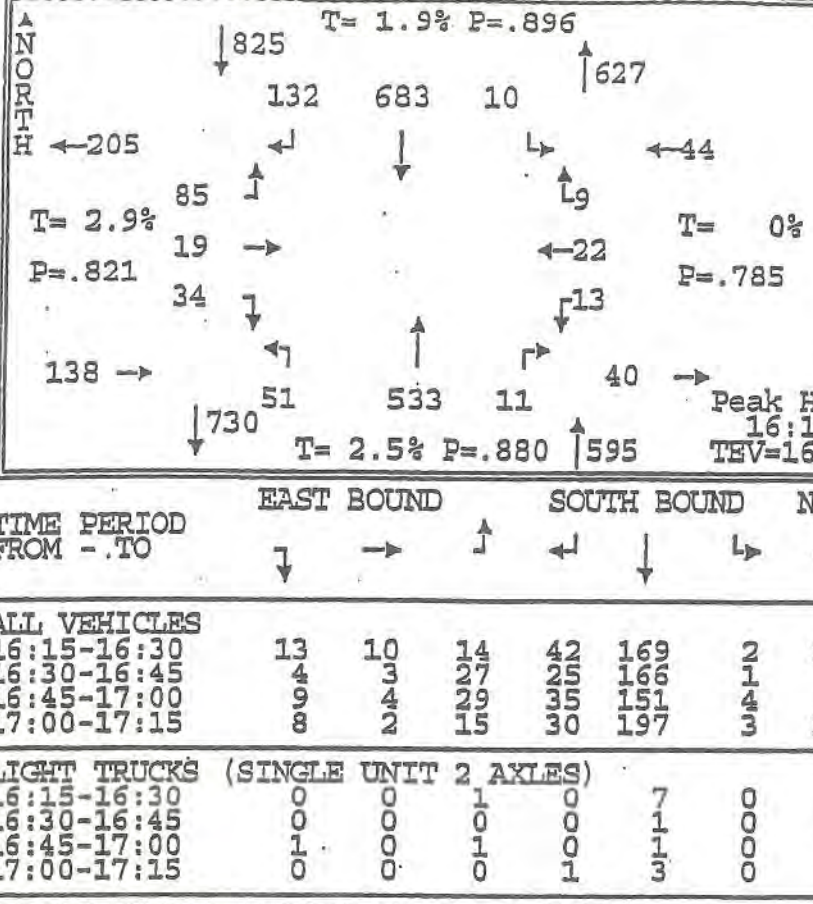
TEV=TOTAL ENTRY VOLUME
T=%TRUCKS BY APPROACH
P=PHF BY APPROACH

DGAK

Traffic Smithy
(503) 641-6333

TIME PERIOD FROM - TO	EAST BOUND			SOUTH BOUND			NORTH BOUND			WEST BOUND			ALL
	↓	→	↑	↲	↓	↳	↰	↑	↱	↓	←	↑	
16:00-16:05	3	0	5	10	51	1	8	45	2	1	4	1	131
16:05-16:10	2	2	6	9	64	2	5	45	0	1	7	0	143
16:10-16:15	0	2	5	11	57	1	4	39	1	0	2	3	125
16:15-16:20	3	3	4	17	50	0	5	41	3	3	2	0	131
16:20-16:25	5	5	4	17	56	2	7	43	1	0	2	1	143
16:25-16:30	5	2	6	8	63	0	4	46	2	3	2	1	142
16:30-16:35	1	2	10	10	57	0	2	47	0	1	2	1	133
16:35-16:40	3	1	8	6	57	0	4	37	0	0	6	1	123
16:40-16:45	0	0	9	9	52	1	3	44	0	1	0	1	120
16:45-16:50	6	0	8	9	43	0	5	40	1	1	1	0	114
16:50-16:55	3	3	7	17	65	4	3	40	0	1	2	0	145
16:55-17:00	0	1	14	9	43	0	1	46	1	0	1	1	117
17:00-17:05	4	1	7	9	61	0	6	49	0	2	2	2	143
17:05-17:10	1	1	4	12	78	1	3	46	1	1	1	1	150
17:10-17:15	3	0	4	9	58	2	8	54	2	0	1	0	141
17:15-17:20	1	3	3	13	46	0	4	34	1	1	0	1	107
17:20-17:25	3	1	10	17	61	0	0	30	0	3	4	2	131
17:25-17:30	1	1	8	8	47	2	4	36	2	0	3	0	112
17:30-17:35	8	1	11	12	62	2	4	38	7	0	3	1	149
17:35-17:40	1	1	13	11	51	0	2	40	0	2	0	0	121
17:40-17:45	1	0	8	14	51	1	7	49	1	3	1	1	137
17:45-17:50	11	1	7	9	50	2	0	44	5	0	3	1	133
17:50-17:55	2	1	11	9	46	1	2	44	0	0	4	1	121
17:55-18:00	5	3	11	11	47	1	4	35	0	3	3	2	125
Total Survey	72	35	183	266	1316	23	95	1012	30	27	56	22	3137
PHF	.65	.47	.73	.79	.87	.5	.75	.89	.46	.54	.55	.56	.922
% Trucks	2.8	2.9	1.1	.8	2	0	1.1	2	0	0	1.8	0	1.8
Stopped Buses	0	0	0	0	7	0	0	3	0	0	0	0	
Peds	0	5	0	0	7	0	0	12	0	0	32	0	
Hourly Totals													
16:00-17:00	31	21	86	132	658	11	51	513	11	12	31	10	1567
16:15-17:15	34	19	85	132	683	10	51	533	11	13	22	9	1602
16:30-17:30	26	14	92	128	668	10	43	503	8	11	23	10	1536
16:45-17:45	32	13	97	140	666	12	47	502	16	14	19	9	1567
17:00-18:00	41	14	97	134	658	12	44	499	19	15	25	12	1570

INTERSECTION TURN MOVEMENT COUNT PEAK HOUR REPORT
CLAIRMONT WAY/FRED MEYER AT MOLALLA AVENUE



DATE OF COUNT: 06/27/00
DAY OF WEEK: Tue
TIME STARTED: 16:00
TIME ENDED: 18:00

TEV=TOTAL ENTRY VOLUME
T=%TRUCKS BY APPROACH
P=PHF BY APPROACH

DGAK

Traffic Smithy
(503)641-6333

TIME PERIOD FROM - TO	EAST BOUND ↓	→	↑	SOUTH BOUND ↲	↓	↳	NORTH BOUND ↰	↑	↱	WEST BOUND ↓	←	↑	ALL
ALL VEHICLES													
16:15-16:30	13	10	14	42	169	2	16	130	6	6	6	2	416
16:30-16:45	4	3	27	25	166	1	9	128	0	2	8	3	376
16:45-17:00	9	4	29	35	151	4	9	126	2	2	4	1	376
17:00-17:15	8	2	15	30	197	3	17	149	3	3	4	3	434
LIGHT TRUCKS (SINGLE UNIT 2 AXLES)													
16:15-16:30	0	0	1	0	7	0	0	1	0	0	0	0	9
16:30-16:45	0	0	0	0	1	0	0	2	0	0	0	0	3
16:45-17:00	1	0	1	0	1	0	0	5	0	0	0	0	8
17:00-17:15	0	0	0	1	3	0	1	2	0	0	0	0	7
MEDIUM TRUCKS (SINGLE UNIT > 2 AXLES)													
16:15-16:30	0	0	0	0	0	0	0	0	0	0	0	0	0
16:30-16:45	0	0	0	0	0	0	0	0	0	0	0	0	0
16:45-17:00	0	0	0	0	0	0	0	0	0	0	0	0	0
17:00-17:15	0	0	0	0	0	0	0	0	0	0	0	0	0
HEAVY TRUCKS (SEMI-TRACTOR TRAILER)													
16:15-16:30	1	0	0	0	2	0	0	0	0	0	0	0	3
16:30-16:45	0	0	0	0	0	0	0	0	0	0	0	0	0
16:45-17:00	0	0	0	0	1	0	0	2	0	0	0	0	3
17:00-17:15	0	0	0	0	0	0	0	2	0	0	0	0	2
BICYCLES													
16:15-16:30	0	0	0	0	0	0	0	0	0	0	0	0	0
16:30-16:45	0	0	0	0	0	0	0	0	0	0	0	0	0
16:45-17:00	0	0	0	0	0	0	0	0	0	0	0	0	0
17:00-17:15	0	0	0	0	0	0	0	0	0	0	0	0	0

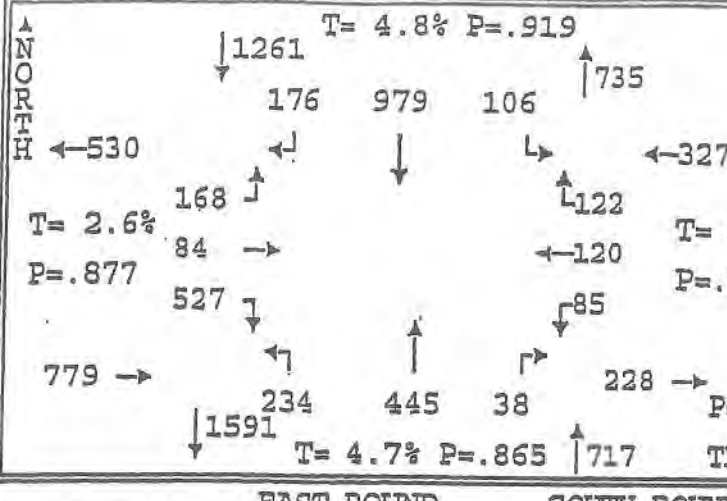
PEDESTRIANS	CROSSWALK USEAGE SOUTH	WEST	EAST	NORTH	ALL
16:15-16:30	1	1	0	4	6
16:30-16:45	0	3	3	7	13
16:45-17:00	0	1	2	5	8
17:00-17:15	2	0	2	6	10

Peak Hour by Movement	↓	→	↑	↲	↓	↳	↰	↑	↱	↓	←	↑	
PHF	.65	.47	.73	.79	.87	.63	.75	.89	.46	.54	.69	.75	.922
% Trucks(all)	5.9	0	2.4	.8	2.2	0	2	2.6	0	0	0	0	2.2
% Trucks(M+H)	2.9	0	0	0	.4	0	0	.8	0	0	0	0	.5
Stopped Buses	0	0	0	0	5	0	0	1	0	0	0	0	

Hourly Totals													
16:00-17:00	31	21	86	132	658	11	51	513	11	12	31	10	1567
16:15-17:15	34	19	85	132	683	10	51	533	11	13	22	9	1602
16:30-17:30	26	14	92	128	668	10	43	503	8	11	23	10	1536
16:45-17:45	32	13	97	140	666	12	47	502	16	14	19	9	1567
17:00-18:00	41	14	97	134	658	12	44	499	19	15	25	12	1570

INTERSECTION TURN MOVEMENT COUNT SUMMARY REPORT
MOLLALA AVENUE AT HIGHWAY 213

23018



DATE OF COUNT: 03/15/00
DAY OF WEEK: Wed
TIME STARTED: 16:00
TIME ENDED: 18:00

TEV=TOTAL ENTRY VOLUME
T=%TRUCKS BY APPROACH
P=PHF BY APPROACH

DMGO

Peak Hour
17:00-18:00
TEV=3084

Traffic Smithy
(503) 641-6333

TIME PERIOD FROM - TO	EAST BOUND			SOUTH BOUND			NORTH BOUND			WEST BOUND			ALL
	↓	→	↑	↲	↓	↳	↰	↑	↱	↓	←	↑	
16:00-16:05	36	6	18	16	68	5	15	40	1	10	6	5	226
16:05-16:10	29	4	13	26	77	6	20	46	2	6	10	12	251
16:10-16:15	34	7	15	13	85	4	19	29	1	7	9	9	232
16:15-16:20	35	6	18	15	53	3	31	47	4	4	4	9	229
16:20-16:25	39	6	16	6	63	8	11	52	3	6	5	2	217
16:25-16:30	46	10	21	19	56	6	18	19	5	7	10	9	226
16:30-16:35	39	5	12	10	83	5	12	58	2	6	5	7	244
16:35-16:40	38	9	13	12	59	6	21	38	2	4	11	5	218
16:40-16:45	32	1	12	17	102	5	29	37	5	10	8	7	265
16:45-16:50	29	4	20	19	105	8	19	29	6	9	4	6	258
16:50-16:55	54	7	11	15	63	6	28	31	3	2	7	3	230
16:55-17:00	40	5	12	8	76	4	33	50	4	7	10	8	257
17:00-17:05	49	5	11	19	90	4	14	44	3	2	11	9	261
17:05-17:10	44	3	15	11	81	4	23	42	1	13	7	15	259
17:10-17:15	59	14	22	19	62	3	21	36	4	12	22	17	291
17:15-17:20	38	2	10	18	67	10	24	21	0	9	9	7	215
17:20-17:25	43	7	15	16	91	9	14	45	3	6	11	5	265
17:25-17:30	33	12	15	16	83	11	16	32	0	3	18	10	249
17:30-17:35	48	5	16	14	83	7	19	35	4	2	7	13	253
17:35-17:40	49	6	13	18	69	9	18	33	6	8	6	11	246
17:40-17:45	46	9	6	11	86	21	25	39	1	0	8	7	259
17:45-17:50	37	3	11	10	98	7	20	41	4	11	9	6	257
17:50-17:55	38	5	15	13	89	8	22	47	8	10	4	11	270
17:55-18:00	43	13	19	11	80	13	18	30	4	9	8	11	259
Total Survey	978	154	349	352	1869	172	490	921	76	163	209	204	5937
PHF	.87	.88	.88	.83	.9	.72	.86	.88	.59	.63	.71	.74	.950
% Trucks	1.6	5.8	3.7	3.7	5.3	2.3	.4	6.8	6.6	1.2	2.4	3.9	4
Stopped Buses	0	0	0	0	0	0	0	0	0	0	0	0	
Peds	0	8	0	0	2	0	0	0	0	0	9	0	
Hourly Totals													
16:00-17:00	451	70	181	176	890	66	256	476	38	78	89	82	2853
16:15-17:15	504	75	183	170	893	62	260	483	42	82	104	97	2955
16:30-17:30	498	74	168	180	962	75	254	463	33	83	123	99	3012
16:45-17:45	532	79	166	184	956	96	254	437	35	73	120	111	3043
17:00-18:00	527	84	168	176	979	106	234	445	38	85	120	122	3084

Description of Level of Service Method and Criteria

Appendix D
Transportation Engineering Planning Data

Description of Level of Service Method and Criteria

Level of Service Concept

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

Signalized Intersections

The six level of service grades are described qualitatively for signalized intersections in Table D-1. Additionally, Table D-2 identifies the relationship between level of service and average control delay per vehicle. Control delay is defined to include initial deceleration delay, queue move-up time, stopped delay, and final acceleration delay. Using this definition, level of service D is generally considered to represent the minimum acceptable design standard.

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

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

1 Most of the material in this appendix is adapted from the Transportation Research Board, *Highway Capacity Manual*, Special Report 209 (1997).

Table D-2
Level of Service Criteria for Signalized Intersections

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

Unsignalized Intersections

Unsignalized intersections include two-way stop-controlled (TWSC) and all-way stop-controlled (AWSC) intersections. The *1997 Highway Capacity Manual* provides new models for estimating control delay at both TWSC and AWSC intersections. A qualitative description of the various service levels associated with an unsignalized intersection is presented in Table D-3. A quantitative definition of level of service for unsignalized intersections is presented in Table D-4. Using this definition, level of service "E" is generally considered to represent the minimum acceptable design standard.

Table D-3
Level of Service Criteria for Unsignalized Intersections

Level of Service	Average Delay per Vehicle to Minor Street
A	• Nearly all drivers find freedom of operation. • Very seldom is there more than one vehicle in queue.
B	• Some drivers begin to consider the delay an inconvenience. • Occasionally there is more than one vehicle in queue.
C	• Many times there is more than one vehicle in queue. • Most drivers feel restricted, but not objectionably so.
D	• Often there is more than one vehicle in queue. • Drivers feel quite restricted.
E	• Represents a condition in which the demand is near or equal to the probable maximum number of vehicles that can be accommodated by the movement. • There is almost always more than one vehicle in queue. • Drivers find the delays approaching intolerable levels.
F	• Forced flow. • Represents an intersection failure condition that is caused by geometric and/or operational constraints external to the intersection.

Table D-4
Level of Service Criteria for Unsignalized Intersections

Level of Service	Average Control Delay per Vehicle (Seconds)
A	≤10
B	>10 and ≤15
C	>15 and ≤25
D	>25 and ≤35
E	>35 and ≤50
F	>50

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

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

Existing Conditions Analysis Worksheets

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Scenario Report

Scenario:	Default Scenario
Command:	Default Command
Volume:	Default Volume
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

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Turning Movement Report

Volume	Northbound			Southbound			Eastbound			Westbound			Total
Type	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Volume
#1 Division Street/Molalla Avenue													
Base	0	760	65	0	1005	5	1	1	1	0	0	0	1838
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	760	65	0	1005	5	1	1	1	0	0	0	1838
#2 Pearl Street/Molalla Avenue													
Base	15	780	15	5	930	15	35	1	50	70	10	5	1931
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	15	780	15	5	930	15	35	1	50	70	10	5	1931
#3 Barclay Hills Drive/Molalla Avenue													
Base	10	735	65	105	870	25	10	5	10	30	1	55	1921
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	10	735	65	105	870	25	10	5	10	30	1	55	1921
#4 Hilda Street-Holmes Lane/Molalla Avenue													
Base	35	700	15	10	810	85	75	15	50	50	10	30	1885
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	35	700	15	10	810	85	75	15	50	50	10	30	1885
#5 Warner-Milne Avenue/Molalla Avenue													
Base	90	650	15	10	800	155	175	15	135	20	10	5	2080
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	90	650	15	10	800	155	175	15	135	20	10	5	2080
#6 Hill Top Mall Access/Molalla Avenue													
Base	50	695	1	1	870	50	70	1	65	1	1	1	1806
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	50	695	1	1	870	50	70	1	65	1	1	1	1806
#7 Beaver Creek Road/Molalla Avenue													
Base	275	450	40	375	660	20	60	345	300	55	315	165	3060
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	275	450	40	375	660	20	60	345	300	55	315	165	3060
#8 Clairmont Way-Fred Meyer/Molalla Avenue													
Base	50	535	10	10	685	130	85	20	35	15	20	10	1605
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	50	535	10	10	685	130	85	20	35	15	20	10	1605
#9 Gaffney Lane/Molalla Avenue													
Base	30	460	145	165	560	60	40	40	20	135	45	175	1875
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	30	460	145	165	560	60	40	40	20	135	45	175	1875

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Volume Type	Northbound Left	Northbound Thru	Northbound Right	Southbound Left	Southbound Thru	Southbound Right	Eastbound Left	Eastbound Thru	Eastbound Right	Westbound Left	Westbound Thru	Westbound Right	Total Volume
#10 Highway 213/Molalla Avenue													
Base	235	445	40	105	980	175	170	85	525	85	120	120	3085
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	235	445	40	105	980	175	170	85	525	85	120	120	3085
#99													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#100													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#101													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#102													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#103													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#104													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#105													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#106													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0

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Volume Type	Northbound Left	Northbound Thru	Northbound Right	Southbound Left	Southbound Thru	Southbound Right	Eastbound Left	Eastbound Thru	Eastbound Right	Westbound Left	Westbound Thru	Westbound Right	Total Volume
#107													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#108													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#109													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#110													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#111													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#112													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#113													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#114													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#115													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0

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Volume Type	Northbound Left	Thru	Right	Southbound Left	Thru	Right	Eastbound Left	Thru	Right	Westbound Left	Thru	Right	Total Volume
#116													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#117													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0

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Impact Analysis Report
Level Of Service

Intersection	Base LOS	Base Del/ Veh	Base V/ C	Future LOS	Future Del/ Veh	Future V/ C	Change in
# 1 Division Street/Molalla Avenue	A	2.9	0.643	A	2.9	0.643	+ 0.000 D/V
# 2 Pearl Street/Molalla Avenue	A	5.8	0.423	A	5.8	0.423	+ 0.000 D/V
# 3 Barclay Hills Drive/Molalla Av	F	84.4	0.000	F	84.4	0.000	+ 0.000 V/C
# 4 Hilda Street-Holmes Lane/Molal	A	8.0	0.463	A	8.0	0.463	+ 0.000 D/V
# 5 Warner-Milne Avenue/Molalla Av	B	17.8	0.574	B	17.8	0.574	+ 0.000 D/V
# 6 Hill Top Mall Access/Molalla A	B	10.3	0.422	B	10.3	0.422	+ 0.000 D/V
# 7 Beaver Creek Road/Molalla Aven	C	33.7	0.715	C	33.7	0.715	+ 0.000 D/V
# 8 Clairmont Way-Fred Meyer/Molal	B	13.9	0.691	B	13.9	0.691	+ 0.000 D/V
# 9 Gaffney Lane/Molalla Avenue	C	22.2	0.676	C	22.2	0.676	+ 0.000 D/V
# 10 Highway 213/Molalla Avenue	E	55.7	1.012	E	55.7	1.012	+ 0.000 D/V

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Level Of Service Computation Report
1997 HCM Operations Method (Base Volume Alternative)

Intersection #1 Division Street/Molalla Avenue

Cycle (sec): 90 Critical Vol./Cap. (X): 0.643
Loss Time (sec): 12 (Y+R = 4 sec) Average Delay (sec/veh): 2.9
Optimal Cycle: 51 Level Of Service: A

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	0 1	0	1 0	0 1	0	0 0	1! 0	0	0 0	0 0	0
Volume Module: 4:35-5:35												
Base Vol:	0	760	65	0	1005	5	1	1	1	0	0	0
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:	0	760	65	0	1005	5	1	1	1	0	0	0
User 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
PHF Adj:	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PHF Volume:	0	776	66	0	1027	5	1	1	1	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	776	66	0	1027	5	1	1	1	0	0	0
PCE 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
MLF 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
Final Vol.:	0	776	66	0	1027	5	1	1	1	0	0	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	0.87	0.87	1.00	0.98	0.98	0.73	0.73	0.73	1.00	1.00	1.00
Lanes:	0.00	0.92	0.08	1.00	0.99	0.01	0.34	0.33	0.33	0.00	0.00	0.00
Final Sat.:	0	1526	130	1900	1851	9	463	463	463	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.00	0.51	0.51	0.00	0.55	0.55	0.00	0.00	0.00	0.00	0.00	0.00
Crit Moves:					****			****				
Green/Cycle:	0.00	0.86	0.86	0.00	0.86	0.86	0.00	0.00	0.00	0.00	0.00	0.00
Volume/Cap:	0.00	0.59	0.59	0.00	0.64	0.64	0.64	0.64	0.64	0.00	0.00	0.00
Delay/Veh:	0.0	2.4	2.4	0.0	2.8	2.8	202.0	202	202.0	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	2.4	2.4	0.0	2.8	2.8	202.0	202	202.0	0.0	0.0	0.0
DesignQueue:	0	6	1	0	8	0	0	0	0	0	0	0

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Level Of Service Computation Report
1997 HCM Operations Method (Base Volume Alternative)

Intersection #2 Pearl Street/Molalla Avenue

Cycle (sec): 60 Critical Vol./Cap. (X): 0.423
Loss Time (sec): 8 (Y+R = 4 sec) Average Delay (sec/veh): 5.8
Optimal Cycle: 27 Level Of Service: A

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 1	0 1	0	0 1	0 1	0	0 0	1! 0	0	0 0	1! 0	0
Volume Module:												
Base Vol:	15	780	15	5	930	15	35	1	50	70	10	5
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:	15	780	15	5	930	15	35	1	50	70	10	5
User 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
PHF Adj:	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
PHF Volume:	16	856	16	5	1021	16	38	1	55	77	11	5
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	16	856	16	5	1021	16	38	1	55	77	11	5
PCE 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
MLF 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
Final Vol.:	16	856	16	5	1021	16	38	1	55	77	11	5
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.91	0.91	0.91	0.94	0.94	0.94	0.69	0.69	0.69	0.65	0.65	0.65
Lanes:	0.03	1.93	0.04	0.01	1.96	0.03	0.40	0.01	0.59	0.83	0.12	0.05
Final Sat.:	63	3346	63	17	3502	55	529	14	766	1028	147	67
Capacity Analysis Module:												
Vol/Sat:	0.26	0.26	0.26	0.29	0.29	0.29	0.07	0.07	0.07	0.07	0.07	0.07
Crit Moves:					****						****	
Green/Cycle:	0.69	0.69	0.69	0.69	0.69	0.69	0.18	0.18	0.18	0.18	0.18	0.18
Volume/Cap:	0.37	0.37	0.37	0.42	0.42	0.42	0.41	0.41	0.41	0.42	0.42	0.42
Delay/Veh:	4.0	4.0	4.0	4.2	4.2	4.2	23.0	23.0	23.0	23.3	23.3	23.3
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	4.0	4.0	4.0	4.2	4.2	4.2	23.0	23.0	23.0	23.3	23.3	23.3
DesignQueue:	0	9	0	0	11	0	1	0	2	2	0	0

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Kittelson & Associates, Inc.- Project #4054
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Level Of Service Computation Report
1997 HCM Unsignalized Method (Base Volume Alternative)

Intersection #3 Barclay Hills Drive/Molalla Avenue

Average Delay (sec/veh): 84.4 Worst Case Level Of Service: F

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			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	0 1	0 1	0	0 1	0 1	0	0 0	1! 0	0	0 0	1! 0	0
Volume Module:												
Base Vol:	10	735	65	105	870	25	10	5	10	30	1	55
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:	10	735	65	105	870	25	10	5	10	30	1	55
User 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
PHF Adj:	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
PHF Volume:	11	813	72	116	962	28	11	6	11	33	1	61
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	11	813	72	116	962	28	11	6	11	33	1	61
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx	7.5	6.5	6.9	7.5	6.5	6.9
FollowUpTim:	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx	3.5	4.0	3.3	3.5	4.0	3.3
Capacity Module:												
Cnflict Vol:	990	xxxx	xxxxx	885	xxxx	xxxxx	1638	2116	495	1587	2093	442
Potent Cap.:	700	xxxx	xxxxx	767	xxxx	xxxxx	68	51	525	73	52	566
Move Cap.:	700	xxxx	xxxxx	767	xxxx	xxxxx	51	42	525	56	43	566
Level Of Service Module:												
Stopped Del:	10.1	xxxx	xxxxx	9.7	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
LOS by Move:	B	*	*	A	*	*	*	*	*	*	*	*
Movement:	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT	LT -	LTR -	RT
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	75	xxxxx	xxxx	131	xxxxx
Shrd StpDel:	10.2	xxxx	xxxxx	10.5	xxxx	xxxxx	xxxxx	78.6	xxxxx	xxxxx	84.4	xxxxx
Shared LOS:	B	*	*	B	*	*	*	F	*	*	F	*
ApproachDel:	xxxxxx			xxxxxx			78.6			84.4		
ApproachLOS:	*			*			F			F		

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Level Of Service Computation Report
1997 HCM Operations Method (Base Volume Alternative)

Intersection #4 Hilda Street-Holmes Lane/Molalla Avenue

Cycle (sec): 60 Critical Vol./Cap. (X): 0.463
Loss Time (sec): 8 (Y+R = 4 sec) Average Delay (sec/veh): 8.0
Optimal Cycle: 29 Level Of Service: A

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 1	0 1	0	0 1	0 1	0	0 0	1! 0	0	0 0	1! 0	0
Volume Module:												
Base Vol:	35	700	15	10	810	85	75	15	50	50	10	30
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:	35	700	15	10	810	85	75	15	50	50	10	30
User 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
PHF Adj:	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
PHF Volume:	38	763	16	11	883	93	82	16	55	55	11	33
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	38	763	16	11	883	93	82	16	55	55	11	33
PCE 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
MLF 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
Final Vol.:	38	763	16	11	883	93	82	16	55	55	11	33
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.88	0.88	0.88	0.93	0.93	0.93	0.67	0.67	0.67	0.68	0.68	0.68
Lanes:	0.09	1.87	0.04	0.02	1.79	0.19	0.54	0.10	0.36	0.56	0.11	0.33
Final Sat.:	155	3114	65	39	3146	331	682	133	457	718	144	431
Capacity Analysis Module:												
Vol/Sat:	0.25	0.25	0.25	0.28	0.28	0.28	0.12	0.12	0.12	0.08	0.08	0.08
Crit Moves:					****			****				
Green/Cycle:	0.61	0.61	0.61	0.61	0.61	0.61	0.26	0.26	0.26	0.26	0.26	0.26
Volume/Cap:	0.40	0.40	0.40	0.46	0.46	0.46	0.46	0.46	0.46	0.29	0.29	0.29
Delay/Veh:	6.3	6.3	6.3	6.6	6.6	6.6	19.7	19.7	19.7	18.3	18.3	18.3
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	6.3	6.3	6.3	6.6	6.6	6.6	19.7	19.7	19.7	18.3	18.3	18.3
DesignQueue:	1	11	0	0	12	1	2	0	1	1	0	1

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Level Of Service Computation Report
1997 HCM Operations Method (Base Volume Alternative)

Intersection #5 Warner-Milne Avenue/Molalla Avenue

Cycle (sec): 90 — Critical Vol./Cap. (X): 0.574
Loss Time (sec): 12 (Y+R = 4 sec) — Average Delay (sec/veh): 17.8
Optimal Cycle: 45 — Level Of Service: B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Protected			Protected			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1	1 0	1 0	1	1 0	0 1	0	0 1	0 0	1!	0 0
Volume Module:												
Base Vol:	90	650	15	10	800	155	175	15	135	20	10	5
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:	90	650	15	10	800	155	175	15	135	20	10	5
User 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
PHF Adj:	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
PHF Volume:	98	711	16	11	875	170	191	16	148	22	11	5
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	98	711	16	11	875	170	191	16	148	22	11	5
PCE 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
MLF 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
Final Vol.:	98	711	16	11	875	170	191	16	148	22	11	5
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.94	0.99	0.99	0.94	0.97	0.97	0.69	0.69	0.83	0.73	0.73	0.73
Lanes:	1.00	1.96	0.04	1.00	1.67	0.33	0.92	0.08	1.00	0.58	0.29	0.13
Final Sat.:	1787	3668	83	1787	3074	597	1210	101	1583	798	399	181
Capacity Analysis Module:												
Vol/Sat:	0.05	0.19	0.19	0.01	0.28	0.28	0.16	0.16	0.09	0.03	0.03	0.03
Crit Moves:	****				****			****				
Green/Cycle:	0.10	0.57	0.57	0.02	0.50	0.50	0.28	0.28	0.28	0.28	0.28	0.28
Volume/Cap:	0.57	0.34	0.34	0.34	0.57	0.57	0.57	0.57	0.34	0.10	0.10	0.10
Delay/Veh:	43.6	10.3	10.3	49.7	16.4	16.4	30.3	30.3	26.5	24.4	24.4	24.4
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	43.6	10.3	10.3	49.7	16.4	16.4	30.3	30.3	26.5	24.4	24.4	24.4
DesignQueue:	4	16	0	1	24	5	7	1	5	1	0	0

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Level Of Service Computation Report
1997 HCM Operations Method (Base Volume Alternative)

Intersection #6 Hill Top Mall Access/Molalla Avenue

Cycle (sec): 120 — Critical Vol./Cap. (X): 0.422
Loss Time (sec): 16 (Y+R = 4 sec) — Average Delay (sec/veh): 10.3
Optimal Cycle: 43 — Level Of Service: B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Protected			Protected			Split Phase			Split Phase		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1	1 0	1 0	1	1 0	1 0	0	1 0	0 0	1!	0 0
Volume Module:												
Base Vol:	50	695	1	1	870	50	70	1	65	1	1	1
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:	50	695	1	1	870	50	70	1	65	1	1	1
User 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
PHF Adj:	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
PHF Volume:	54	752	1	1	942	54	76	1	70	1	1	1
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	54	752	1	1	942	54	76	1	70	1	1	1
PCE 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
MLF 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
Final Vol.:	54	752	1	1	942	54	76	1	70	1	1	1
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.93	0.98	0.98	0.93	0.97	0.97	0.93	0.83	0.83	0.84	0.84	0.84
Lanes:	1.00	1.99	0.01	1.00	1.89	0.11	1.00	0.01	0.99	0.34	0.33	0.33
Final Sat.:	1769	3719	5	1769	3494	200	1769	22	1564	533	533	533
Capacity Analysis Module:												
Vol/Sat:	0.03	0.20	0.20	0.00	0.27	0.27	0.04	0.04	0.04	0.00	0.00	0.00
Crit Moves:	****				****				****		****	
Green/Cycle:	0.07	0.71	0.71	0.00	0.64	0.64	0.11	0.11	0.11	0.00	0.00	0.00
Volume/Cap:	0.42	0.28	0.28	0.28	0.42	0.42	0.40	0.42	0.42	0.42	0.42	0.42
Delay/Veh:	42.2	4.8	4.8	84.8	8.1	8.1	39.0	39.3	39.3	80.4	80.4	80.4
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	42.2	4.8	4.8	84.8	8.1	8.1	39.0	39.3	39.3	80.4	80.4	80.4
DesignQueue:	3	12	0	0	18	1	3	0	3	0	0	0

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Level Of Service Computation Report
1997 HCM Operations Method (Base Volume Alternative)

Intersection #7 Beaver Creek Road/Molalla Avenue

Cycle (sec): 120 Critical Vol./Cap. (X): 0.715
Loss Time (sec): 16 (Y+R = 4 sec) Average Delay (sec/veh): 33.7
Optimal Cycle: 69 Level Of Service: C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Protected			Protected			Protected			Protected		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1	1 0	1 0	1	1 0	1 0	1	1 0	1 0	2	0 1
Volume Module:												
Base Vol:	275	450	40	375	660	20	60	345	300	55	315	165
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:	275	450	40	375	660	20	60	345	300	55	315	165
User 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
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	289	472	42	393	693	21	63	362	315	58	331	173
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	289	472	42	393	693	21	63	362	315	58	331	173
PCE 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
MLF 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
Final Vol.:	289	472	42	393	693	21	63	362	315	58	331	173
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.93	0.97	0.97	0.94	0.99	0.99	0.93	0.91	0.91	0.93	0.98	0.83
Lanes:	1.00	1.84	0.16	1.00	1.94	0.06	1.00	1.07	0.93	1.00	2.00	1.00
Final Sat.:	1769	3379	301	1787	3637	110	1769	1852	1611	1769	3724	1583
Capacity Analysis Module:												
Vol/Sat:	0.16	0.14	0.14	0.22	0.19	0.19	0.04	0.20	0.20	0.03	0.09	0.11
Crit Moves:		****		****				****		****		
Green/Cycle:	0.23	0.20	0.20	0.31	0.27	0.27	0.08	0.27	0.27	0.05	0.24	0.24
Volume/Cap:	0.70	0.72	0.72	0.72	0.70	0.70	0.45	0.72	0.72	0.72	0.37	0.45
Delay/Veh:	37.2	37.3	37.3	32.1	31.8	31.8	42.0	32.2	32.2	68.3	28.7	30.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	37.2	37.3	37.3	32.1	31.8	31.8	42.0	32.2	32.2	68.3	28.7	30.0
DesignQueue:	12	20	2	14	27	1	3	14	12	3	13	7

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Level Of Service Computation Report
1997 HCM Operations Method (Base Volume Alternative)

Intersection #8 Clairmont Way-Fred Meyer/Molalla Avenue

Cycle (sec): 120 Critical Vol./Cap. (X): 0.691
Loss Time (sec): 12 (Y+R = 4 sec) Average Delay (sec/veh): 13.9
Optimal Cycle: 57 Level Of Service: B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Protected			Protected			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	0	1 0	1 0	0	1 0	0 1	0	0 1	0 0	1	0 0
Volume Module:												
Base Vol:	50	535	10	10	685	130	85	20	35	15	20	10
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:	50	535	10	10	685	130	85	20	35	15	20	10
User 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
PHF Adj:	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
PHF Volume:	54	580	11	11	743	141	92	22	38	16	22	11
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	54	580	11	11	743	141	92	22	38	16	22	11
PCE 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
MLF 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
Final Vol.:	54	580	11	11	743	141	92	22	38	16	22	11
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.93	0.98	0.98	0.93	0.96	0.96	0.74	0.74	0.83	0.76	0.76	0.76
Lanes:	1.00	0.98	0.02	1.00	0.84	0.16	0.81	0.19	1.00	0.33	0.45	0.22
Final Sat.:	1769	1822	35	1769	1527	290	1127	270	1583	470	647	323
Capacity Analysis Module:												
Vol/Sat:	0.03	0.32	0.32	0.01	0.49	0.49	0.08	0.08	0.02	0.03	0.03	0.03
Crit Moves:	****				****			****				
Green/Cycle:	0.04	0.73	0.73	0.01	0.70	0.70	0.12	0.12	0.12	0.12	0.12	0.12
Volume/Cap:	0.69	0.43	0.43	0.43	0.69	0.69	0.69	0.69	0.20	0.29	0.29	0.29
Delay/Veh:	65.6	4.9	4.9	55.4	9.3	9.3	49.9	49.9	36.4	37.2	37.2	37.2
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	65.6	4.9	4.9	55.4	9.3	9.3	49.9	49.9	36.4	37.2	37.2	37.2
DesignQueue:	3	8	0	1	13	2	4	1	2	1	1	0

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Kittelson & Associates, Inc.- Project #4054
Molalla Avenue Corridor Study- Oregon City, Oregon
Year 2000 Existing Conditions Weekday PM

Level Of Service Computation Report
1997 HCM Operations Method (Base Volume Alternative)

Intersection #9 Gaffney Lane/Molalla Avenue

Cycle (sec): 90 Critical Vol./Cap. (X): 0.676
Loss Time (sec): 12 (Y+R = 4 sec) Average Delay (sec/veh): 22.2
Optimal Cycle: 55 Level Of Service: C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Protected			Protected			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	0 1	0	1 0	1 0	1	0 0	1! 0	0	0 1	0 0	1
Volume Module:												
Base Vol:	30	460	145	165	560	60	40	40	20	135	45	175
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:	30	460	145	165	560	60	40	40	20	135	45	175
User 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
PHF Adj:	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
PHF Volume:	31	479	151	172	583	63	42	42	21	141	47	182
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	31	479	151	172	583	63	42	42	21	141	47	182
PCE 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
MLF 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
Final Vol.:	31	479	151	172	583	63	42	42	21	141	47	182
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.94	0.95	0.95	0.93	0.98	0.83	0.69	0.69	0.69	0.70	0.70	0.85
Lanes:	1.00	0.76	0.24	1.00	1.00	1.00	0.40	0.40	0.20	0.75	0.25	1.00
Final Sat.:	1787	1379	435	1769	1862	1583	523	523	262	999	333	1615
Capacity Analysis Module:												
Vol/Sat:	0.02	0.35	0.35	0.10	0.31	0.04	0.08	0.08	0.08	0.14	0.14	0.11
Crit Moves:		****		****							****	
Green/Cycle:	0.03	0.51	0.51	0.14	0.62	0.62	0.21	0.21	0.21	0.21	0.21	0.21
Volume/Cap:	0.50	0.68	0.68	0.68	0.50	0.06	0.38	0.38	0.38	0.68	0.68	0.54
Delay/Veh:	49.1	18.3	18.3	43.6	9.6	6.7	31.5	31.5	31.5	39.3	39.3	33.5
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	49.1	18.3	18.3	43.6	9.6	6.7	31.5	31.5	31.5	39.3	39.3	33.5
DesignQueue:	2	13	4	8	12	1	2	2	1	6	2	7

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Kittelson & Associates, Inc.- Project #4054
Molalla Avenue Corridor Study- Oregon City, Oregon
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Level Of Service Computation Report
1997 HCM Operations Method (Base Volume Alternative)

Intersection #10 Highway 213/Molalla Avenue

Cycle (sec): 120 Critical Vol./Cap. (X): 1.012
Loss Time (sec): 16 (Y+R = 4 sec) Average Delay (sec/veh): 55.7
Optimal Cycle: 90 Level Of Service: E

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Protected			Protected			Protected			Protected		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	2 0	1	1 0	2 0	1	1 0	1 0	1	1 0	1 0	1
Volume Module:												
Base Vol:	235	445	40	105	980	175	170	85	525	85	120	120
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:	235	445	40	105	980	175	170	85	525	85	120	120
User 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
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	247	468	42	111	1032	184	179	89	553	89	126	126
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	247	468	42	111	1032	184	179	89	553	89	126	126
PCE 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
MLF 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
Final Vol.:	247	468	42	111	1032	184	179	89	553	89	126	126
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.90	0.95	0.81	0.90	0.95	0.81	0.92	0.97	0.83	0.92	0.97	0.83
Lanes:	1.00	2.00	1.00	1.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Sat.:	1718	3618	1537	1718	3618	1537	1753	1845	1568	1753	1845	1568
Capacity Analysis Module:												
Vol/Sat:	0.14	0.13	0.03	0.06	0.29	0.12	0.10	0.05	0.35	0.05	0.07	0.08
Crit Moves:	****				****				****	****		
Green/Cycle:	0.14	0.28	0.28	0.14	0.28	0.28	0.22	0.35	0.35	0.05	0.18	0.18
Volume/Cap:	1.01	0.46	0.10	0.46	1.01	0.42	0.46	0.14	1.01	1.01	0.39	0.46
Delay/Veh:	99.5	26.9	23.9	36.9	63.6	27.0	31.1	20.2	71.0	142.2	33.6	34.5
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	99.5	26.9	23.9	36.9	63.6	27.0	31.1	20.2	71.0	142.2	33.6	34.5
DesignQueue:	11	17	2	5	40	7	7	3	20	4	5	5

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MUTCD Signal Warrant Analysis

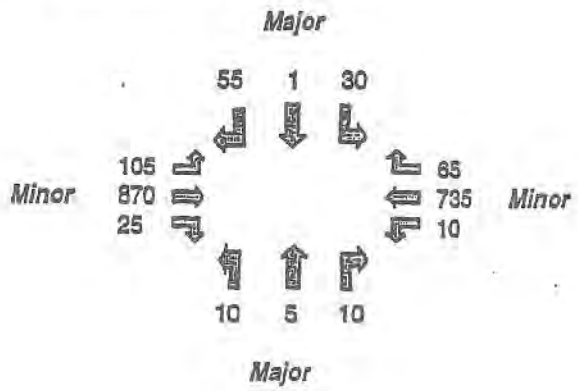
KITTELSON & ASSOCIATES, INC.
610 SW Alder, Suite 700
Portland, Oregon 97205
(503) 228-5230
Fax: (503) 273-8169

Project #: [redacted]
Project Name: [redacted]
Analyst: [redacted]
Intersection: [redacted]
Scenario: [redacted]
Date: 7/20/00
File: H:\projfile\4054\excel\[SIG WARRANT.XLS]Main

Input Data:

North-South Approach =	Major
East-West Approach =	Minor
Major Street Thru Lanes =	[redacted]
Minor Street Thru Lanes =	[redacted]
8th Highest/Peak Hour (Major) =	[redacted]
8th Highest/Peak Hour (Minor) =	[redacted]
Speed > 40 mph?	[redacted]
Population < 10,000?	[redacted]
Warrant Factor	100%

Turning Movement Volumes:



Signal Warrant Analysis Results

Warrant	Approach	Actual Volumes	Required Volumes	Met?
1 - Minimum Vehicular Volume	Major Street	78	800	No
	Minor Street	700	150	
2 - Interruption of Continuous Traffic	Major Street	78	900	No
	Minor Street	700	75	
11 - Peak Hour Volume	Major Street	111	111	#N/A
	Minor Street	1000	#N/A	

Future Conditions Analysis Worksheets

Kittelson & Associates, Inc.- Project #4054
Molalla Avenue Improvement Plan - Oregon City, Oregon
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Scenario Report

cenario:	Default Scenario
ommand:	Default Command
olume:	Default Volume
eometry:	Default Geometry
mpact Fee:	Default Impact Fee
rip Generation:	Default Trip Generation
rip Distribution:	Default Trip Distribution
aths:	Default Paths
outes:	Default Routes
onfiguration:	Default Configuration

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Turning Movement Report

Volume	Northbound			Southbound			Eastbound			Westbound			Total
Type	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Volume
#1 Division Street/Molalla Avenue													
Base	0	1215	105	0	1610	10	1	1	1	0	0	0	2943
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	1215	105	0	1610	10	1	1	1	0	0	0	2943
#2 Pearl Street/Molalla Avenue													
Base	25	1250	25	10	1490	25	55	1	80	110	15	10	3096
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	25	1250	25	10	1490	25	55	1	80	110	15	10	3096
#3 Barclay Hills Drive/Molalla Avenue													
Base	15	1275	110	115	1470	30	15	10	15	60	5	80	3200
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	15	1275	110	115	1470	30	15	10	15	60	5	80	3200
#4 Hilda Street-Holmes Lane/Molalla Avenue													
Base	65	1060	20	15	1295	100	105	20	150	70	25	35	2960
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	65	1060	20	15	1295	100	105	20	150	70	25	35	2960
#5 Warner-Milne Avenue/Molalla Avenue													
Base	270	870	20	20	1275	305	280	20	270	25	15	10	3380
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	270	870	20	20	1275	305	280	20	270	25	15	10	3380
#6 Hill Top Mall Access/Molalla Avenue													
Base	55	1095	1	1	1380	100	80	1	80	1	1	1	2796
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	55	1095	1	1	1380	100	80	1	80	1	1	1	2796
#7 Beaver Creek Road/Molalla Avenue													
Base	375	535	65	560	860	35	65	370	415	105	435	265	4085
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	375	535	65	560	860	35	65	370	415	105	435	265	4085
#8 Clairmont Way-Fred Meyer/Molalla Avenue													
Base	85	850	15	40	1055	240	115	30	60	20	65	20	2595
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	85	850	15	40	1055	240	115	30	60	20	65	20	2595
#9 Gaffney Lane/Molalla Avenue													
Base	120	595	160	180	635	225	70	45	25	150	75	190	2470
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	120	595	160	180	635	225	70	45	25	150	75	190	2470

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›lume /pe	Northbound Left	Thru	Right	Southbound Left	Thru	Right	Eastbound Left	Thru	Right	Westbound Left	Thru	Right	Total Volume
10 Highway 213/Molalla Avenue													
›se	295	652	50	315	1130	260	270	205	575	95	260	320	4427
lded	0	0	0	0	0	0	0	0	0	0	0	0	0
›tal	295	652	50	315	1130	260	270	205	575	95	260	320	4427
9													
›se	0	0	0	0	0	0	0	0	0	0	0	0	0
lded	0	0	0	0	0	0	0	0	0	0	0	0	0
›tal	0	0	0	0	0	0	0	0	0	0	0	0	0
100													
›se	0	0	0	0	0	0	0	0	0	0	0	0	0
lded	0	0	0	0	0	0	0	0	0	0	0	0	0
›tal	0	0	0	0	0	0	0	0	0	0	0	0	0
01													
›se	0	0	0	0	0	0	0	0	0	0	0	0	0
lded	0	0	0	0	0	0	0	0	0	0	0	0	0
›tal	0	0	0	0	0	0	0	0	0	0	0	0	0
02													
›se	0	0	0	0	0	0	0	0	0	0	0	0	0
lded	0	0	0	0	0	0	0	0	0	0	0	0	0
›tal	0	0	0	0	0	0	0	0	0	0	0	0	0
03													
se	0	0	0	0	0	0	0	0	0	0	0	0	0
lded	0	0	0	0	0	0	0	0	0	0	0	0	0
›tal	0	0	0	0	0	0	0	0	0	0	0	0	0
04													
›se	0	0	0	0	0	0	0	0	0	0	0	0	0
lded	0	0	0	0	0	0	0	0	0	0	0	0	0
tal	0	0	0	0	0	0	0	0	0	0	0	0	0
05													
se	0	0	0	0	0	0	0	0	0	0	0	0	0
lded	0	0	0	0	0	0	0	0	0	0	0	0	0
tal	0	0	0	0	0	0	0	0	0	0	0	0	0
06													
se	0	0	0	0	0	0	0	0	0	0	0	0	0
lded	0	0	0	0	0	0	0	0	0	0	0	0	0
tal	0	0	0	0	0	0	0	0	0	0	0	0	0

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Volume Type	Northbound Left	Thru	Right	Southbound Left	Thru	Right	Eastbound Left	Thru	Right	Westbound Left	Thru	Right	Total Volume
#107													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#108													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#109													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#110													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#111													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#112													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#113													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#114													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#115													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0

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Kittelson & Associates, Inc.- Project #4054
Molalla Avenue Improvement Plan - Oregon City, Oregon
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Level Of Service Computation Report
1997 HCM Unsignalized Method (Base Volume Alternative)

ntersection #3 Barclay Hills Drive/Molalla Avenue

verage Delay (sec/veh): OVERFLOW Worst Case Level Of Service: F

pproach:	North Bound			South Bound			East Bound			West Bound		
vement:	L	T	R	L	T	R	L	T	R	L	T	R
ntrol:	Uncontrolled			Uncontrolled			Stop Sign			Stop Sign		
ghts:	Include			Include			Include			Include		
nes:	0 1	0 1	0	0 1	0 1	0	0 0	1! 0	0	0 0	1! 0	0
lume Module:												
se Vol:	15	1275	110	115	1470	30	15	10	15	60	5	80
owth 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
itial Bse:	15	1275	110	115	1470	30	15	10	15	60	5	80
er 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
F Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
F Volume:	16	1342	116	121	1547	32	16	11	16	63	5	84
duct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
nal Vol.:	16	1342	116	121	1547	32	16	11	16	63	5	84
itical Gap Module:												
itical Gp:	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx	7.5	6.5	6.9	7.5	6.5	6.9
llowUpTim:	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx	3.5	4.0	3.3	3.5	4.0	3.3
pacity Module:												
flict Vol:	1579	xxxx	xxxxx	1458	xxxx	xxxxx	2511	3295	789	2453	3253	729
tent Cap.:	418	xxxx	xxxxx	465	xxxx	xxxxx	15	9	338	16	9	368
ve Cap.:	418	xxxx	xxxxx	465	xxxx	xxxxx	3	6	338	0	6	368
vel Of Service Module:												
opped Del:	13.6	xxxx	xxxxx	12.7	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
S by Move:	B	*	*	B	*	*	*	*	*	*	*	*
vement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
ared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	6	xxxxx	xxxx	0	xxxxx
rd StpDel:	14.0	xxxx	xxxxx	15.5	xxxx	xxxxx	xxxxx	4188	xxxxx	xxxxx	xxxx	xxxxx
ared LOS:	B	*	*	C	*	*	*	F	*	*	*	*
proachDel:	xxxxxx			xxxxxx			4187.6			xxxxxx		
proachLOS:	*			*			F			F		

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Kittelson & Associates, Inc.- Project #4054
Molalla Avenue Improvement Plan - Oregon City, Oregon
Year 2020 No Build Conditions Weekday PM

Level Of Service Computation Report
1997 HCM Operations Method (Base Volume Alternative)

Intersection #4 Hilda Street-Holmes Lane/Molalla Avenue

Cycle (sec): 60 Critical Vol./Cap. (X): 0.863
Loss Time (sec): 8 (Y+R = 4 sec) Average Delay (sec/veh): 15.5
Optimal Cycle: 68 Level Of Service: B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 1	0 1	0	0 1	0 1	0	0 0	1! 0	0	0 0	1! 0	0
Volume Module:												
Base Vol:	65	1060	20	15	1295	100	105	20	150	70	25	35
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:	65	1060	20	15	1295	100	105	20	150	70	25	35
User 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
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	68	1116	21	16	1363	105	111	21	158	74	26	37
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	68	1116	21	16	1363	105	111	21	158	74	26	37
PCE 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
MLF 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
Final Vol.:	68	1116	21	16	1363	105	111	21	158	74	26	37
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.12	0.99	0.99	0.74	0.74	0.74	0.69	0.69	0.69	0.61	0.61	0.61
Lanes:	0.65	1.33	0.02	0.02	1.84	0.14	0.38	0.07	0.55	0.54	0.19	0.27
Final Sat.:	152	2492	47	30	2594	200	498	94	709	622	219	311
Capacity Analysis Module:												
Vol/Sat:	0.45	0.45	0.45	0.53	0.53	0.53	0.22	0.22	0.22	0.12	0.12	0.12
Crit Moves:					****			****				
Green/Cycle:	0.61	0.61	0.61	0.61	0.61	0.61	0.26	0.26	0.26	0.26	0.26	0.26
Volume/Cap:	0.74	0.74	0.74	0.86	0.86	0.86	0.86	0.86	0.86	0.46	0.46	0.46
Delay/Veh:	10.1	10.1	10.1	14.5	14.5	14.5	41.2	41.2	41.2	19.9	19.9	19.9
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	10.1	10.1	10.1	14.5	14.5	14.5	41.2	41.2	41.2	19.9	19.9	19.9
DesignQueue:	1	16	0	0	20	2	3	1	4	2	1	1

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Kittelson & Associates, Inc.- Project #4054
Molalla Avenue Improvement Plan - Oregon City, Oregon
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Level Of Service Computation Report
1997 HCM Operations Method (Base Volume Alternative)

tersection #5 Warner-Milne Avenue/Molalla Avenue

cle (sec):	90	Critical Vol./Cap. (X):	0.989
ss Time (sec):	12 (Y+R = 4 sec)	Average Delay (sec/veh):	40.8
timal Cycle:	90	Level Of Service:	D

proach:	North Bound			South Bound			East Bound			West Bound		
vement:	L	T	R	L	T	R	L	T	R	L	T	R
ntrol:	Protected			Protected			Permitted			Permitted		
ghts:	Include			Include			Include			Include		
n. Green:	0	0	0	0	0	0	0	0	0	0	0	0
nes:	1 0	1 1	0	1 0	1 1	0	0 1	0 0	1	0 0	1 0	0
lume Module:												
se Vol:	270	870	20	20	1275	305	280	20	270	25	15	10
owth 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
itial Bse:	270	870	20	20	1275	305	280	20	270	25	15	10
er 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
F Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
F Volume:	284	916	21	21	1342	321	295	21	284	26	16	11
duct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
duced Vol:	284	916	21	21	1342	321	295	21	284	26	16	11
E 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
F 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
nal Vol.:	284	916	21	21	1342	321	295	21	284	26	16	11
turation Flow Module:												
t/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
justment:	0.94	0.99	0.99	0.94	0.96	0.96	0.69	0.69	0.83	0.61	0.61	0.61
nes:	1.00	1.96	0.04	1.00	1.61	0.39	0.93	0.07	1.00	0.49	0.30	0.21
nal Sat.:	1787	3667	84	1787	2948	705	1215	86	1583	569	350	241
pacity Analysis Module:												
l/Sat:	0.16	0.25	0.25	0.01	0.46	0.46	0.24	0.24	0.18	0.05	0.05	0.05
it Moves:	****				****			****				
een/Cycle:	0.16	0.59	0.59	0.03	0.46	0.46	0.25	0.25	0.25	0.25	0.25	0.25
lume/Cap:	0.99	0.42	0.42	0.42	0.99	0.99	0.99	0.99	0.73	0.19	0.19	0.19
lay/Veh:	87.6	10.1	10.1	48.7	43.3	43.3	81.0	81.0	38.2	27.2	27.2	27.2
er DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
jDel/Veh:	87.6	10.1	10.1	48.7	43.3	43.3	81.0	81.0	38.2	27.2	27.2	27.2
signQueue:	12	20	0	1	41	10	12	1	11	1	1	0

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Level Of Service Computation Report
1997 HCM Operations Method (Base Volume Alternative)

Intersection #6 Hill Top Mall Access/Molalla Avenue

Cycle (sec):	120	Critical Vol./Cap. (X):	0.621
Loss Time (sec):	16 (Y+R = 4 sec)	Average Delay (sec/veh):	10.3
Optimal Cycle:	58	Level Of Service:	B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Protected			Protected			Split Phase			Split Phase		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1 1	0	1 0	1 1	0	1 0	0 1	0	0 0	1! 0	0
Volume Module:												
Base Vol:	55	1095	1	1	1380	100	80	1	80	1	1	1
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:	55	1095	1	1	1380	100	80	1	80	1	1	1
User 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
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	58	1153	1	1	1453	105	84	1	84	1	1	1
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	58	1153	1	1	1453	105	84	1	84	1	1	1
PCE 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
MLF 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
Final Vol.:	58	1153	1	1	1453	105	84	1	84	1	1	1
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.93	0.98	0.98	0.93	0.97	0.97	0.93	0.83	0.83	0.84	0.84	0.84
Lanes:	1.00	1.99	0.01	1.00	1.87	0.13	1.00	0.01	0.99	0.34	0.33	0.33
Final Sat.:	1769	3721	3	1769	3438	248	1769	19	1568	533	533	533
Capacity Analysis Module:												
Vol/Sat:	0.03	0.31	0.31	0.00	0.42	0.42	0.05	0.05	0.05	0.00	0.00	0.00
Crit Moves:	****				****			****			****	
Green/Cycle:	0.05	0.73	0.73	0.00	0.68	0.68	0.09	0.09	0.09	0.00	0.00	0.00
Volume/Cap:	0.62	0.42	0.42	0.42	0.62	0.62	0.55	0.62	0.62	0.62	0.62	0.62
Delay/Veh:	54.0	4.8	4.8	136.1	8.5	8.5	43.7	48.2	48.2	184.1	184	184.1
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	54.0	4.8	4.8	136.1	8.5	8.5	43.7	48.2	48.2	184.1	184	184.1
DesignQueue:	3	17	0	0	26	2	4	0	4	0	0	0

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Level Of Service Computation Report
1997 HCM Operations Method (Base Volume Alternative)

Intersection #7 Beaver Creek Road/Molalla Avenue

cle (sec):	120	Critical Vol./Cap. (X):	1.019
ss Time (sec):	16 (Y+R = 4 sec)	Average Delay (sec/veh):	59.0
timal Cycle:	90	Level Of Service:	E

proach:	North Bound			South Bound			East Bound			West Bound		
vement:	L	T	R	L	T	R	L	T	R	L	T	R
ntrol:	Protected			Protected			Protected			Protected		
ghts:	Include			Include			Include			Include		
n. Green:	0	0	0	0	0	0	0	0	0	0	0	0
nes:	1 0	1	1 0	1 0	1	1 0	1 0	1	1 0	1 0	2	0 1
lume Module:												
se Vol:	375	535	65	560	860	35	65	370	415	105	435	265
owth 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
itial Bse:	375	535	65	560	860	35	65	370	415	105	435	265
er 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
F Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
F Volume:	393	561	68	588	902	37	68	388	435	110	456	278
duct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
duced Vol:	393	561	68	588	902	37	68	388	435	110	456	278
E 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
F 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
nal Vol.:	393	561	68	588	902	37	68	388	435	110	456	278
turation Flow Module:												
t/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
justment:	0.93	0.96	0.96	0.94	0.98	0.98	0.93	0.98	0.83	0.93	0.98	0.83
nes:	1.00	1.78	0.22	1.00	1.92	0.08	1.00	1.00	1.00	1.00	2.00	1.00
nal Sat.:	1769	3268	396	1787	3592	147	1769	1862	1583	1769	3724	1583
pacity Analysis Module:												
l/Sat:	0.22	0.17	0.17	0.33	0.25	0.25	0.04	0.21	0.27	0.06	0.12	0.18
it Moves:		****		****					****	****		
een/Cycle:	0.23	0.17	0.17	0.32	0.26	0.26	0.06	0.27	0.27	0.06	0.27	0.27
lume/Cap:	0.96	1.02	1.02	1.02	0.96	0.96	0.65	0.77	1.02	1.02	0.45	0.65
lay/Veh:	69.1	78.5	78.5	72.8	53.2	53.2	54.6	33.9	69.4	134.0	27.5	32.4
er DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
jDel/Veh:	69.1	78.5	78.5	72.8	53.2	53.2	54.6	33.9	69.4	134.0	27.5	32.4
signQueue:	16	24	3	22	36	1	3	15	17	5	17	11

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Level Of Service Computation Report
1997 HCM Operations Method (Base Volume Alternative)

Intersection #8 Clairmont Way-Fred Meyer/Molalla Avenue

Cycle (sec):	120	Critical Vol./Cap. (X):	1.085
Loss Time (sec):	12 (Y+R = 4 sec)	Average Delay (sec/veh):	52.7
Optimal Cycle:	90	Level Of Service:	D

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Protected			Protected			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	0	1 0	1 0	0	1 0	0 1	0	0 1	0 0	1	0 0
Volume Module:												
Base Vol:	85	850	15	40	1055	240	115	30	60	20	65	20
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:	85	850	15	40	1055	240	115	30	60	20	65	20
User 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
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	89	895	16	42	1111	253	121	32	63	21	68	21
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	89	895	16	42	1111	253	121	32	63	21	68	21
PCE 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
MLF 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
Final Vol.:	89	895	16	42	1111	253	121	32	63	21	68	21
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.93	0.98	0.98	0.93	0.95	0.95	0.59	0.59	0.83	0.73	0.73	0.73
Lanes:	1.00	0.98	0.02	1.00	0.81	0.19	0.79	0.21	1.00	0.19	0.62	0.19
Final Sat.:	1769	1824	33	1769	1474	336	889	235	1583	264	854	264
Capacity Analysis Module:												
Vol/Sat:	0.05	0.49	0.49	0.02	0.75	0.75	0.14	0.14	0.04	0.08	0.08	0.08
Crit Moves:	****				****			****				
Green/Cycle:	0.05	0.71	0.71	0.03	0.69	0.69	0.13	0.13	0.13	0.13	0.13	0.13
Volume/Cap:	1.08	0.69	0.69	0.69	1.08	1.08	1.08	1.08	0.32	0.64	0.64	0.64
Delay/Veh:	167.2	9.2	9.2	72.5	65.3	65.3	139.6	140	36.8	44.9	44.9	44.9
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	167.2	9.2	9.2	72.5	65.3	65.3	139.6	140	36.8	44.9	44.9	44.9
DesignQueue:	4	15	0	2	21	5	5	1	3	1	3	1

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Level Of Service Computation Report
1997 HCM Operations Method (Base Volume Alternative)

ntersection #9 Gaffney Lane/Molalla Avenue

/cle (sec):	90	Critical Vol./Cap. (X):	0.827
oss Time (sec):	12 (Y+R = 4 sec)	Average Delay (sec/veh):	29.1
ptimal Cycle:	80	Level Of Service:	C

pproach:	North Bound			South Bound			East Bound			West Bound		
ovement:	L	T	R	L	T	R	L	T	R	L	T	R
ontrol:	Protected Include			Protected Include			Permitted Include			Permitted Include		
ights:												
in. Green:	0	0	0	0	0	0	0	0	0	0	0	0
anes:	1 0	0 1	0	1 0	1 0	1	0 0	1 0	0	0 1	0 0	1
olume Module:												
ase Vol:	120	595	160	180	635	225	70	45	25	150	75	190
rowth 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
nitial Bse:	120	595	160	180	635	225	70	45	25	150	75	190
ser 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
HF Adj:	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
HF Volume:	125	620	167	188	661	234	73	47	26	156	78	198
educt Vol:	0	0	0	0	0	0	0	0	0	0	0	0
educed Vol:	125	620	167	188	661	234	73	47	26	156	78	198
CE 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
LF 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
nal Vol.:	125	620	167	188	661	234	73	47	26	156	78	198
turation Flow Module:												
t/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
djustment:	0.94	0.96	0.96	0.93	0.98	0.83	0.48	0.48	0.48	0.69	0.69	0.85
anes:	1.00	0.79	0.21	1.00	1.00	1.00	0.50	0.32	0.18	0.67	0.33	1.00
nal Sat.:	1787	1434	386	1769	1862	1583	454	292	162	877	438	1615
pacity Analysis Module:												
l/Sat:	0.07	0.43	0.43	0.11	0.35	0.15	0.16	0.16	0.16	0.18	0.18	0.12
it Moves:		****		****							****	
een/Cycle:	0.11	0.52	0.52	0.13	0.54	0.54	0.22	0.22	0.22	0.22	0.22	0.22
lume/Cap:	0.65	0.83	0.83	0.83	0.65	0.27	0.75	0.75	0.75	0.83	0.83	0.57
lay/Veh:	46.4	24.1	24.1	59.6	16.0	11.1	47.6	47.6	47.6	51.6	51.6	33.8
er DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
djDel/Veh:	46.4	24.1	24.1	59.6	16.0	11.1	47.6	47.6	47.6	51.6	51.6	33.8
signQueue:	6	17	4	8	17	6	3	2	1	6	3	8

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Level Of Service Computation Report
1997 HCM Operations Method (Base Volume Alternative)

Intersection #10 Highway 213/Molalla Avenue

Cycle (sec):	120	Critical Vol./Cap. (X):	0.998
Loss Time (sec):	16 (Y+R = 4 sec)	Average Delay (sec/veh):	50.4
Optimal Cycle:	90	Level Of Service:	D

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Protected Include			Protected Include			Protected Ovl			Protected Ovl		
Rights:												
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	2 0	1	1 0	2 0	1	1 0	1 0	1	1 0	1 0	1
Volume Module:												
Base Vol:	295	652	50	315	1130	260	270	205	575	95	260	320
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:	295	652	50	315	1130	260	270	205	575	95	260	320
User 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
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	311	686	53	332	1189	274	284	216	605	100	274	337
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	311	686	53	332	1189	274	284	216	605	100	274	337
PCE 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
MLF 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
Final Vol.:	311	686	53	332	1189	274	284	216	605	100	274	337
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.90	0.95	0.81	0.90	0.95	0.81	0.92	0.97	0.83	0.92	0.97	0.83
Lanes:	1.00	2.00	1.00	1.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Sat.:	1718	3618	1537	1718	3618	1537	1753	1845	1568	1753	1845	1568
Capacity Analysis Module:												
Vol/Sat:	0.18	0.19	0.03	0.19	0.33	0.18	0.16	0.12	0.39	0.06	0.15	0.21
Crit Moves:	****				****		****				****	
Green/Cycle:	0.18	0.25	0.25	0.26	0.33	0.33	0.16	0.24	0.42	0.07	0.15	0.41
Volume/Cap:	1.00	0.75	0.14	0.75	1.00	0.54	1.00	0.48	0.91	0.84	1.00	0.53
Delay/Veh:	87.1	34.5	26.2	37.7	55.6	25.8	90.3	30.0	40.5	80.2	91.9	21.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	87.1	34.5	26.2	37.7	55.6	25.8	90.3	30.0	40.5	80.2	91.9	21.0
DesignQueue:	13	27	2	13	43	10	12	8	19	5	12	10

MUTCD Signal Warrant Analysis

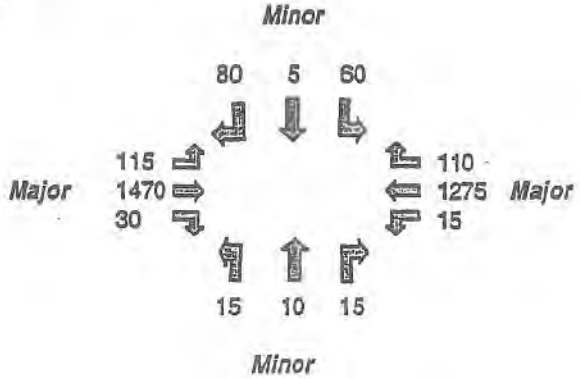
KITTELSON & ASSOCIATES, INC.
610 SW Alder, Suite 700
Portland, Oregon 97205
(503) 228-5230
Fax: (503) 273-8169

Project #:	[redacted]
Project Name:	[redacted]
Analyst:	[redacted]
Intersection:	[redacted]
Scenario:	[redacted]
Date:	7/21/00
File:	H:\projfile\4054\excel\[2020sigwar.XLS]Main

Input Data:

North-South Approach =	[redacted]
East-West Approach =	Major
Major Street Thru Lanes =	[redacted]
Minor Street Thru Lanes =	[redacted]
8th Highest/Peak Hour (Major) =	[redacted]
8th Highest/Peak Hour (Minor) =	[redacted]
Speed > 40 mph?	[redacted]
Population < 10,000?	[redacted]
Warrant Factor	100%

Turning Movement Volumes:



Signal Warrant Analysis Results

Warrant	Approach	Actual Volumes	Required Volumes	Met?
1 - Minimum Vehicular Volume	Major Street	2111	600	No
	Minor Street	102	150	
2 - Interruption of Continuous Traffic	Major Street	2111	900	Yes
	Minor Street	102	75	
11 - Peak Hour Volume	Major Street	3015	3015	Yes
	Minor Street	145	100	

Alternatives Development Analysis Worksheets

Kittelson & Associates, Inc.- Project #4054
Molalla Avenue Corridor Study- Oregon City, Oregon
Existing Conditions Preferred Alternative Weekday PM

Scenario Report

Scenario:	Default Scenario
Command:	Default Command
Volume:	Default Volume
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

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Kittelson & Associates, Inc.- Project #4054
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Existing Conditions Preferred Alternative Weekday PM

Turning Movement Report

Volume	Northbound			Southbound			Eastbound			Westbound			Total
Type	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Volume
#1 Division Street/Molalla Avenue													
Base	0	760	65	0	1005	5	1	1	1	0	0	0	1838
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	760	65	0	1005	5	1	1	1	0	0	0	1838
#2 Pearl Street/Molalla Avenue													
Base	15	780	15	5	930	15	35	1	50	70	10	5	1931
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	15	780	15	5	930	15	35	1	50	70	10	5	1931
#3 Barclay Hills Drive/Molalla Avenue													
Base	10	735	65	105	870	25	10	5	10	30	1	55	1921
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	10	735	65	105	870	25	10	5	10	30	1	55	1921
#4 Hilda Street-Holmes Lane/Molalla Avenue													
Base	35	700	15	10	810	85	75	15	50	50	10	30	1885
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	35	700	15	10	810	85	75	15	50	50	10	30	1885
#5 Warner-Milne Avenue/Molalla Avenue													
Base	90	650	15	10	800	155	175	15	135	20	10	5	2080
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	90	650	15	10	800	155	175	15	135	20	10	5	2080
#6 Hill Top Mall Access/Molalla Avenue													
Base	50	695	1	1	870	50	70	1	65	1	1	1	1806
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	50	695	1	1	870	50	70	1	65	1	1	1	1806
#7 Beaver Creek Road/Molalla Avenue													
Base	275	450	40	375	660	20	60	345	300	55	315	165	3060
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	275	450	40	375	660	20	60	345	300	55	315	165	3060
#8 Clairmont Way-Fred Meyer/Molalla Avenue													
Base	50	535	10	10	685	130	85	20	35	15	20	10	1605
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	50	535	10	10	685	130	85	20	35	15	20	10	1605
#9 Gaffney Lane/Molalla Avenue													
Base	30	460	145	165	560	60	40	40	20	135	45	175	1875
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	30	460	145	165	560	60	40	40	20	135	45	175	1875

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Kittelson & Associates, Inc.- Project #4054
Molalla Avenue Corridor Study- Oregon City, Oregon
Existing Conditions Preferred Alternative Weekday PM

Volume Type	Northbound Left	Northbound Thru	Northbound Right	Southbound Left	Southbound Thru	Southbound Right	Eastbound Left	Eastbound Thru	Eastbound Right	Westbound Left	Westbound Thru	Westbound Right	Total Volume
#10 Highway 213/Molalla Avenue													
Base	235	445	40	105	980	175	170	85	525	85	120	120	3085
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	235	445	40	105	980	175	170	85	525	85	120	120	3085
#99													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#100													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#101													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#102													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#103													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#104													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#105													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#106													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0

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Kittelson & Associates, Inc.- Project #4054
Molalla Avenue Corridor Study- Oregon City, Oregon
Existing Conditions Preferred Alternative Weekday PM

Volume Type	Northbound Left	Northbound Thru	Northbound Right	Southbound Left	Southbound Thru	Southbound Right	Eastbound Left	Eastbound Thru	Eastbound Right	Westbound Left	Westbound Thru	Westbound Right	Total Volume
#107													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#108													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#109													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#110													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#111													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#112													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#113													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#114													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#115													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0

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Kittelson & Associates, Inc.- Project #4054
Molalla Avenue Corridor Study- Oregon City, Oregon
Existing Conditions Preferred Alternative Weekday PM

Volume Type	Northbound Left	Northbound Thru	Northbound Right	Southbound Left	Southbound Thru	Southbound Right	Eastbound Left	Eastbound Thru	Eastbound Right	Westbound Left	Westbound Thru	Westbound Right	Total Volume
#116													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#117													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0

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Kittelson & Associates, Inc.- Project #4054
Molalla Avenue Corridor Study- Oregon City, Oregon
Existing Conditions Preferred Alternative Weekday PM

Impact Analysis Report
Level Of Service

Intersection	Base LOS	Base Del/ Veh	Base V/ C	Future LOS	Future Del/ Veh	Future V/ C	Change in
# 1 Division Street/Molalla Avenue	A	2.9	0.643	A	2.9	0.643	+ 0.000 D/V
# 2 Pearl Street/Molalla Avenue	B	13.3	0.790	B	13.3	0.790	+ 0.000 D/V
# 3 Barclay Hills Drive/Molalla Av	F	311.1	0.000	F	311.1	0.000	+ 0.000 V/C
# 4 Hilda Street-Holmes Lane/Molal	B	16.7	0.829	B	16.7	0.829	+ 0.000 D/V
# 5 Warner-Milne Avenue/Molalla Av	B	17.8	0.574	B	17.8	0.574	+ 0.000 D/V
# 6 Hill Top Mall Access/Molalla A	B	10.3	0.422	B	10.3	0.422	+ 0.000 D/V
# 7 Beaver Creek Road/Molalla Aven	C	33.7	0.715	C	33.7	0.715	+ 0.000 D/V
# 8 Clairmont Way-Fred Meyer/Molal	B	13.9	0.691	B	13.9	0.691	+ 0.000 D/V
# 9 Gaffney Lane/Molalla Avenue	C	22.2	0.676	C	22.2	0.676	+ 0.000 D/V
# 10 Highway 213/Molalla Avenue	C	33.5	0.838	C	33.5	0.838	+ 0.000 D/V

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Kittelson & Associates, Inc.- Project #4054
Molalla Avenue Corridor Study- Oregon City, Oregon
Existing Conditions Preferred Alternative Weekday PM

Level Of Service Computation Report
1997 HCM Operations Method (Base Volume Alternative)

Intersection #1 Division Street/Molalla Avenue

Cycle (sec): 90 Critical Vol./Cap. (X): 0.643
Loss Time (sec): 12 (Y+R = 4 sec) Average Delay (sec/veh): 2.9
Optimal Cycle: 51 Level Of Service: A

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	0 1	0	1 0	0 1	0	0 0	1! 0	0	0 0	0 0	0
Volume Module: 4:35-5:35												
Base Vol:	0	760	65	0	1005	5	1	1	1	0	0	0
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:	0	760	65	0	1005	5	1	1	1	0	0	0
User 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
PHF Adj:	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PHF Volume:	0	776	66	0	1027	5	1	1	1	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	776	66	0	1027	5	1	1	1	0	0	0
PCE 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
MLF 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
Final Vol.:	0	776	66	0	1027	5	1	1	1	0	0	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	0.87	0.87	1.00	0.98	0.98	0.73	0.73	0.73	1.00	1.00	1.00
Lanes:	0.00	0.92	0.08	1.00	0.99	0.01	0.34	0.33	0.33	0.00	0.00	0.00
Final Sat.:	0	1526	130	1900	1851	9	463	463	463	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.00	0.51	0.51	0.00	0.55	0.55	0.00	0.00	0.00	0.00	0.00	0.00
Crit Moves:					****			****				
Green/Cycle:	0.00	0.86	0.86	0.00	0.86	0.86	0.00	0.00	0.00	0.00	0.00	0.00
Volume/Cap:	0.00	0.59	0.59	0.00	0.64	0.64	0.64	0.64	0.64	0.00	0.00	0.00
Delay/Veh:	0.0	2.4	2.4	0.0	2.8	2.8	202.0	202	202.0	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	2.4	2.4	0.0	2.8	2.8	202.0	202	202.0	0.0	0.0	0.0
DesignQueue:	0	6	1	0	8	0	0	0	0	0	0	0

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Kittelson & Associates, Inc.- Project #4054
Molalla Avenue Corridor Study- Oregon City, Oregon
Existing Conditions Preferred Alternative Weekday PM

Level Of Service Computation Report
1997 HCM Operations Method (Base Volume Alternative)

Intersection #2 Pearl Street/Molalla Avenue

Cycle (sec): 60 Critical Vol./Cap. (X): 0.790
Loss Time (sec): 12 (Y+R = 4 sec) Average Delay (sec/veh): 13.3
Optimal Cycle: 62 Level Of Service: B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Protected			Protected			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	0 1	0	1 0	0 1	0	0 0	1! 0	0	0 0	1! 0	0
Volume Module:												
Base Vol:	15	780	15	5	930	15	35	1	50	70	10	5
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:	15	780	15	5	930	15	35	1	50	70	10	5
User 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
PHF Adj:	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
PHF Volume:	16	856	16	5	1021	16	38	1	55	77	11	5
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	16	856	16	5	1021	16	38	1	55	77	11	5
PCE 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
MLF 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
Final Vol.:	16	856	16	5	1021	16	38	1	55	77	11	5
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.93	0.98	0.98	0.94	0.99	0.99	0.72	0.72	0.72	0.70	0.70	0.70
Lanes:	1.00	0.98	0.02	1.00	0.98	0.02	0.40	0.01	0.59	0.83	0.12	0.05
Final Sat.:	1769	1822	34	1787	1848	29	556	15	804	1096	157	71
Capacity Analysis Module:												
Vol/Sat:	0.01	0.47	0.47	0.00	0.55	0.55	0.07	0.07	0.07	0.07	0.07	0.07
Crit Moves:	****				****						****	
Green/Cycle:	0.01	0.71	0.71	0.00	0.70	0.70	0.09	0.09	0.09	0.09	0.09	0.09
Volume/Cap:	0.79	0.66	0.66	0.66	0.79	0.79	0.77	0.77	0.77	0.79	0.79	0.79
Delay/Veh:	134.7	6.2	6.2	155.0	9.4	9.4	51.8	51.8	51.8	56.0	56.0	56.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	134.7	6.2	6.2	155.0	9.4	9.4	51.8	51.8	51.8	56.0	56.0	56.0
DesignQueue:	1	10	0	0	12	0	1	0	2	2	0	0

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Kittelson & Associates, Inc.- Project #4054
Molalla Avenue Corridor Study- Oregon City, Oregon
Existing Conditions Preferred Alternative Weekday PM

Level Of Service Computation Report
1997 HCM Unsignalized Method (Base Volume Alternative)

Intersection #3 Barclay Hills Drive/Molalla Avenue

Average Delay (sec/veh): 311.1 Worst Case Level Of Service: F

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			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	1 0	0 1	0	1 0	0 1	0	0 0	1! 0	0	0 0	1! 0	0
Volume Module:												
Base Vol:	10	735	65	105	870	25	10	5	10	30	1	55
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:	10	735	65	105	870	25	10	5	10	30	1	55
User 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
PHF Adj:	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
PHF Volume:	11	813	72	116	962	28	11	6	11	33	1	61
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	11	813	72	116	962	28	11	6	11	33	1	61
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx	7.1	6.5	6.2	7.1	6.5	6.2
FollowUpTim:	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx	3.5	4.0	3.3	3.5	4.0	3.3
Capacity Module:												
Cnflict Vol:	990	xxxx	xxxxx	885	xxxx	xxxxx	2111	2116	976	2088	2093	849
Potent Cap.:	702	xxxx	xxxxx	769	xxxx	xxxxx	38	51	307	39	53	362
Move Cap.:	702	xxxx	xxxxx	769	xxxx	xxxxx	27	43	307	30	44	362
Level Of Service Module:												
Stopped Del:	10.2	xxxx	xxxxx	10.5	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx
LOS by Move:	B	*	*	B	*	*	*	*	*	*	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	48	xxxxx	xxxx	72	xxxxx
Shrd StpDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	154	xxxxx	xxxxx	311	xxxxx
Shared LOS:	*	*	*	*	*	*	*	F	*	*	F	*
ApproachDel:	xxxxxx			xxxxxx			153.7			311.1		
ApproachLOS:	*			*			F			F		

Kittelson & Associates, Inc.- Project #4054
Molalla Avenue Corridor Study- Oregon City, Oregon
Existing Conditions Preferred Alternative Weekday PM

Level Of Service Computation Report
1997 HCM Operations Method (Base Volume Alternative)

Intersection #4 Hilda Street-Holmes Lane/Molalla Avenue

Cycle (sec): 60 Critical Vol./Cap. (X): 0.829
Loss Time (sec): 12 (Y+R = 4 sec) Average Delay (sec/veh): 16.7
Optimal Cycle: 68 Level Of Service: B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Protected			Protected			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	0 1	0	1 0	0 1	0	0 0	1! 0	0	0 0	1! 0	0
Volume Module:												
Base Vol:	35	700	15	10	810	85	75	15	50	50	10	30
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:	35	700	15	10	810	85	75	15	50	50	10	30
User 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
PHF Adj:	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
PHF Volume:	38	763	16	11	883	93	82	16	55	55	11	33
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	38	763	16	11	883	93	82	16	55	55	11	33
PCE 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
MLF 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
Final Vol.:	38	763	16	11	883	93	82	16	55	55	11	33
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.94	0.99	0.99	0.94	0.98	0.98	0.70	0.70	0.70	0.65	0.65	0.65
Lanes:	1.00	0.98	0.02	1.00	0.90	0.10	0.54	0.10	0.36	0.56	0.11	0.33
Final Sat.:	1787	1837	39	1787	1678	177	708	138	475	681	136	409
Capacity Analysis Module:												
Vol/Sat:	0.02	0.42	0.42	0.01	0.53	0.53	0.12	0.12	0.12	0.08	0.08	0.08
Crit Moves:	****				****			****				
Green/Cycle:	0.03	0.65	0.65	0.01	0.63	0.63	0.14	0.14	0.14	0.14	0.14	0.14
Volume/Cap:	0.83	0.64	0.64	0.64	0.83	0.83	0.83	0.83	0.83	0.58	0.58	0.58
Delay/Veh:	100.8	7.4	7.4	89.2	13.5	13.5	50.9	50.9	50.9	29.0	29.0	29.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	100.8	7.4	7.4	89.2	13.5	13.5	50.9	50.9	50.9	29.0	29.0	29.0
DesignQueue:	1	10	0	0	12	1	2	0	2	2	0	1

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Molalla Avenue Corridor Study- Oregon City, Oregon
Existing Conditions Preferred Alternative Weekday PM

Level Of Service Computation Report
1997 HCM Operations Method (Base Volume Alternative)

Intersection #5 Warner-Milne Avenue/Molalla Avenue

Cycle (sec): 90 Critical Vol./Cap. (X): 0.574
Loss Time (sec): 12 (Y+R = 4 sec) Average Delay (sec/veh): 17.8
Optimal Cycle: 45 Level Of Service: B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Protected			Protected			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1	1 0	1 0	1	1 0	0 1	0	0 1	0 0	1	0 0
Volume Module:												
Base Vol:	90	650	15	10	800	155	175	15	135	20	10	5
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:	90	650	15	10	800	155	175	15	135	20	10	5
User 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
PHF Adj:	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
PHF Volume:	98	711	16	11	875	170	191	16	148	22	11	5
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	98	711	16	11	875	170	191	16	148	22	11	5
PCE 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
MLF 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
Final Vol.:	98	711	16	11	875	170	191	16	148	22	11	5
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.94	0.99	0.99	0.94	0.97	0.97	0.69	0.69	0.83	0.73	0.73	0.73
Lanes:	1.00	1.96	0.04	1.00	1.67	0.33	0.92	0.08	1.00	0.58	0.29	0.13
Final Sat.:	1787	3668	83	1787	3074	597	1210	101	1583	798	399	181
Capacity Analysis Module:												
Vol/Sat:	0.05	0.19	0.19	0.01	0.28	0.28	0.16	0.16	0.09	0.03	0.03	0.03
Crit Moves:	****				****			****				
Green/Cycle:	0.10	0.57	0.57	0.02	0.50	0.50	0.28	0.28	0.28	0.28	0.28	0.28
Volume/Cap:	0.57	0.34	0.34	0.34	0.57	0.57	0.57	0.57	0.34	0.10	0.10	0.10
Delay/Veh:	43.6	10.3	10.3	49.7	16.4	16.4	30.3	30.3	26.5	24.4	24.4	24.4
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	43.6	10.3	10.3	49.7	16.4	16.4	30.3	30.3	26.5	24.4	24.4	24.4
DesignQueue:	4	16	0	1	24	5	7	1	5	1	0	0

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Level Of Service Computation Report
1997 HCM Operations Method (Base Volume Alternative)

Intersection #6 Hill Top Mall Access/Molalla Avenue

Cycle (sec): 120 Critical Vol./Cap. (X): 0.422
Loss Time (sec): 16 (Y+R = 4 sec) Average Delay (sec/veh): 10.3
Optimal Cycle: 43 Level Of Service: B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Protected			Protected			Split Phase			Split Phase		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1	1 0	1 0	1	1 0	1 0	0	1 0	0 0	1	0 0
Volume Module:												
Base Vol:	50	695	1	1	870	50	70	1	65	1	1	1
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:	50	695	1	1	870	50	70	1	65	1	1	1
User 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
PHF Adj:	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
PHF Volume:	54	752	1	1	942	54	76	1	70	1	1	1
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	54	752	1	1	942	54	76	1	70	1	1	1
PCE 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
MLF 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
Final Vol.:	54	752	1	1	942	54	76	1	70	1	1	1
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.93	0.98	0.98	0.93	0.97	0.97	0.93	0.83	0.83	0.84	0.84	0.84
Lanes:	1.00	1.99	0.01	1.00	1.89	0.11	1.00	0.01	0.99	0.34	0.33	0.33
Final Sat.:	1769	3719	5	1769	3494	200	1769	22	1564	533	533	533
Capacity Analysis Module:												
Vol/Sat:	0.03	0.20	0.20	0.00	0.27	0.27	0.04	0.04	0.04	0.00	0.00	0.00
Crit Moves:	****				****				****		****	
Green/Cycle:	0.07	0.71	0.71	0.00	0.64	0.64	0.11	0.11	0.11	0.00	0.00	0.00
Volume/Cap:	0.42	0.28	0.28	0.28	0.42	0.42	0.40	0.42	0.42	0.42	0.42	0.42
Delay/Veh:	42.2	4.8	4.8	84.8	8.1	8.1	39.0	39.3	39.3	80.4	80.4	80.4
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	42.2	4.8	4.8	84.8	8.1	8.1	39.0	39.3	39.3	80.4	80.4	80.4
DesignQueue:	3	12	0	0	18	1	3	0	3	0	0	0

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Level Of Service Computation Report
1997 HCM Operations Method (Base Volume Alternative)

Intersection #7 Beaver Creek Road/Molalla Avenue

Cycle (sec): 120 Critical Vol./Cap. (X): 0.715
Loss Time (sec): 16 (Y+R = 4 sec) Average Delay (sec/veh): 33.7
Optimal Cycle: 69 Level Of Service: C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Protected			Protected			Protected			Protected		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1	1 0	1 0	1	1 0	1 0	1	1 0	1 0	2	0 1
Volume Module:												
Base Vol:	275	450	40	375	660	20	60	345	300	55	315	165
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:	275	450	40	375	660	20	60	345	300	55	315	165
User 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
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	289	472	42	393	693	21	63	362	315	58	331	173
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	289	472	42	393	693	21	63	362	315	58	331	173
PCE 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
MLF 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
Final Vol.:	289	472	42	393	693	21	63	362	315	58	331	173
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.93	0.97	0.97	0.94	0.99	0.99	0.93	0.91	0.91	0.93	0.98	0.83
Lanes:	1.00	1.84	0.16	1.00	1.94	0.06	1.00	1.07	0.93	1.00	2.00	1.00
Final Sat.:	1769	3379	301	1787	3637	110	1769	1852	1611	1769	3724	1583
Capacity Analysis Module:												
Vol/Sat:	0.16	0.14	0.14	0.22	0.19	0.19	0.04	0.20	0.20	0.03	0.09	0.11
Crit Moves:		****		****				****		****		
Green/Cycle:	0.23	0.20	0.20	0.31	0.27	0.27	0.08	0.27	0.27	0.05	0.24	0.24
Volume/Cap:	0.70	0.72	0.72	0.72	0.70	0.70	0.45	0.72	0.72	0.72	0.37	0.45
Delay/Veh:	37.2	37.3	37.3	32.1	31.8	31.8	42.0	32.2	32.2	68.3	28.7	30.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	37.2	37.3	37.3	32.1	31.8	31.8	42.0	32.2	32.2	68.3	28.7	30.0
DesignQueue:	12	20	2	14	27	1	3	14	12	3	13	7

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Level Of Service Computation Report
1997 HCM Operations Method (Base Volume Alternative)

Intersection #8 Clairmont Way-Fred Meyer/Molalla Avenue

Cycle (sec): 120 Critical Vol./Cap. (X): 0.691
Loss Time (sec): 12 (Y+R = 4 sec) Average Delay (sec/veh): 13.9
Optimal Cycle: 57 Level Of Service: B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Protected			Protected			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	0	1 0	1 0	0	1 0	0 1	0	0 1	0 0	1!	0 0
Volume Module:												
Base Vol:	50	535	10	10	685	130	85	20	35	15	20	10
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:	50	535	10	10	685	130	85	20	35	15	20	10
User 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
PHF Adj:	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
PHF Volume:	54	580	11	11	743	141	92	22	38	16	22	11
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	54	580	11	11	743	141	92	22	38	16	22	11
PCE 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
MLF 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
Final Vol.:	54	580	11	11	743	141	92	22	38	16	22	11
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.93	0.98	0.98	0.93	0.96	0.96	0.74	0.74	0.83	0.76	0.76	0.76
Lanes:	1.00	0.98	0.02	1.00	0.84	0.16	0.81	0.19	1.00	0.33	0.45	0.22
Final Sat.:	1769	1822	35	1769	1527	290	1127	270	1583	470	647	323
Capacity Analysis Module:												
Vol/Sat:	0.03	0.32	0.32	0.01	0.49	0.49	0.08	0.08	0.02	0.03	0.03	0.03
Crit Moves:	****				****			****				
Green/Cycle:	0.04	0.73	0.73	0.01	0.70	0.70	0.12	0.12	0.12	0.12	0.12	0.12
Volume/Cap:	0.69	0.43	0.43	0.43	0.69	0.69	0.69	0.69	0.20	0.29	0.29	0.29
Delay/Veh:	65.6	4.9	4.9	55.4	9.3	9.3	49.9	49.9	36.4	37.2	37.2	37.2
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	65.6	4.9	4.9	55.4	9.3	9.3	49.9	49.9	36.4	37.2	37.2	37.2
DesignQueue:	3	8	0	1	13	2	4	1	2	1	1	0

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Level Of Service Computation Report
1997 HCM Operations Method (Base Volume Alternative)

Intersection #9 Gaffney Lane/Molalla Avenue

Cycle (sec):	90	Critical Vol./Cap. (X):	0.676
Loss Time (sec):	12 (Y+R = 4 sec)	Average Delay (sec/veh):	22.2
Optimal Cycle:	55	Level Of Service:	C

Approach:	North Bound						South Bound						East Bound						West Bound					
Movement:	L	-	T	-	R		L	-	T	-	R		L	-	T	-	R		L	-	T	-	R	
Control:	Protected						Protected						Permitted						Permitted					
Rights:	Include						Include						Include						Include					
Min. Green:	0	0			0		0	0			0		0	0			0		0	0			0	
Lanes:	1	0	0	1	0		1	0	1	0	1		0	0	1	0	0		0	1	0	0	1	
Volume Module:																								
Base Vol:	30	460		145			165	560		60			40	40		20			135	45		175		
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:	30	460		145			165	560		60			40	40		20			135	45		175		
User 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		
PHF Adj:	0.96	0.96		0.96			0.96	0.96		0.96			0.96	0.96		0.96			0.96	0.96		0.96		
PHF Volume:	31	479		151			172	583		63			42	42		21			141	47		182		
Reduct Vol:	0	0		0			0	0		0			0	0		0			0	0		0		
Reduced Vol:	31	479		151			172	583		63			42	42		21			141	47		182		
PCE 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		
MLF 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		
Final Vol.:	31	479		151			172	583		63			42	42		21			141	47		182		
Saturation Flow Module:																								
Sat/Lane:	1900	1900		1900			1900	1900		1900			1900	1900		1900			1900	1900		1900		
Adjustment:	0.94	0.95		0.95			0.93	0.98		0.83			0.69	0.69		0.69			0.70	0.70		0.85		
Lanes:	1.00	0.76		0.24			1.00	1.00		1.00			0.40	0.40		0.20			0.75	0.25		1.00		
Final Sat.:	1787	1379		435			1769	1862		1583			523	523		262			999	333		1615		
Capacity Analysis Module:																								
Vol/Sat:	0.02	0.35		0.35			0.10	0.31		0.04			0.08	0.08		0.08			0.14	0.14		0.11		
Crit Moves:		****					****													****				
Green/Cycle:	0.03	0.51		0.51			0.14	0.62		0.62			0.21	0.21		0.21			0.21	0.21		0.21		
Volume/Cap:	0.50	0.68		0.68			0.68	0.50		0.06			0.38	0.38		0.38			0.68	0.68		0.54		
Delay/Veh:	49.1	18.3		18.3			43.6	9.6		6.7			31.5	31.5		31.5			39.3	39.3		33.5		
User DelAdj:	1.00	1.00		1.00			1.00	1.00		1.00			1.00	1.00		1.00			1.00	1.00		1.00		
AdjDel/Veh:	49.1	18.3		18.3			43.6	9.6		6.7			31.5	31.5		31.5			39.3	39.3		33.5		
DesignQueue:	2	13		4			8	12		1			2	2		1			6	2		7		

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Kittelson & Associates, Inc.- Project #4054
Molalla Avenue Corridor Study- Oregon City, Oregon
Existing Conditions Preferred Alternative Weekday PM

Level Of Service Computation Report
1997 HCM Operations Method (Base Volume Alternative)

Intersection #10 Highway 213/Molalla Avenue

Cycle (sec):	120	Critical Vol./Cap. (X):	0.838
Loss Time (sec):	16 (Y+R = 4 sec)	Average Delay (sec/veh):	33.5
Optimal Cycle:	90	Level Of Service:	C

Approach:	North Bound						South Bound						East Bound						West Bound					
Movement:	L	-	T	-	R		L	-	T	-	R		L	-	T	-	R		L	-	T	-	R	
Control:	Protected						Protected						Protected						Protected					
Rights:	Include						Include						Ovl						Ovl					
Min. Green:	0	0			0		0	0			0		0	0			0		0	0			0	
Lanes:	1	0	2	0	1		1	0	2	0	1		1	0	1	0	1		1	0	1	0	1	
Volume Module:																								
Base Vol:	235	445		40			105	980		175			170	85		525			85	120		120		
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:	235	445		40			105	980		175			170	85		525			85	120		120		
User 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		
PHF Adj:	0.95	0.95		0.95			0.95	0.95		0.95			0.95	0.95		0.95			0.95	0.95		0.95		
PHF Volume:	247	468		42			111	1032		184			179	89		553			89	126		126		
Reduct Vol:	0	0		0			0	0		0			0	0		0			0	0		0		
Reduced Vol:	247	468		42			111	1032		184			179	89		553			89	126		126		
PCE 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		
MLF 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		
Final Vol.:	247	468		42			111	1032		184			179	89		553			89	126		126		
Saturation Flow Module:																								
Sat/Lane:	1900	1900		1900			1900	1900		1900			1900	1900		1900			1900	1900		1900		
Adjustment:	0.90	0.95		0.81			0.90	0.95		0.81			0.92	0.97		0.83			0.92	0.97		0.83		
Lanes:	1.00	2.00		1.00			1.00	2.00		1.00			1.00	1.00		1.00			1.00	1.00		1.00		
Final Sat.:	1718	3618		1537			1718	3618		1537			1753	1845		1568			1753	1845		1568		
Capacity Analysis Module:																								
Vol/Sat:	0.14	0.13		0.03			0.06	0.29		0.12			0.10	0.05		0.35			0.05	0.07		0.08		
Crit Moves:	****							****								****			****					
Green/Cycle:	0.17	0.34		0.34			0.17	0.34		0.34			0.19	0.25		0.42			0.06	0.12		0.29		
Volume/Cap:	0.84	0.38		0.08			0.38	0.84		0.35			0.55	0.19		0.84			0.84	0.55		0.27		
Delay/Veh:	54.6	22.6		20.1			33.9	32.6		22.6			35.2	26.8		32.5			83.1	39.9		24.7		
User DelAdj:	1.00	1.00		1.00			1.00	1.00		1.00			1.00	1.00		1.00			1.00	1.00		1.00		
AdjDel/Veh:	54.6	22.6		20.1			33.9	32.6		22.6			35.2	26.8		32.5			83.1	39.9		24.7		
DesignQueue:	11	16		1			5	37		6			7	3		17			4	6		5		

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Kittelson & Associates, Inc.- Project #4054
Molalla Avenue Corridor Study- Oregon City, Oregon
Existing Conditions Preferred Alternative Weekday PM

Level Of Service Computation Report
1997 HCM Unsignalized Method (Future Volume Alternative)

****

Intersection #3 Barclay Hills Drive/Molalla Avenue

****

Average Delay (sec/veh): 153.0 Worst Case Level Of Service: F

****

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			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Lanes:	1 0 0	1 0		1 0 0	1 0		1 0 0	1 0		1 0 0	1 0	
Volume Module:												
Base Vol:	10	735	65	105	870	25	10	5	10	30	1	55
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:	10	735	65	105	870	25	10	5	10	30	1	55
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:	10	735	65	105	870	25	10	5	10	30	1	55
User 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
PHF Adj:	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
PHF Volume:	11	813	72	116	962	28	11	6	11	33	1	61
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Final Vol.:	11	813	72	116	962	28	11	6	11	33	1	61
Critical Gap Module:												
Critical Gp:	4.1	xxxx	xxxxx	4.1	xxxx	xxxxx	7.1	6.5	6.2	7.1	6.5	6.2
FollowUpTim:	2.2	xxxx	xxxxx	2.2	xxxx	xxxxx	3.5	4.0	3.3	3.5	4.0	3.3
Capacity Module:												
Cnflict Vol:	990	xxxx	xxxxx	885	xxxx	xxxxx	2111	2116	976	2088	2093	849
Potent Cap.:	702	xxxx	xxxxx	769	xxxx	xxxxx	38	51	307	39	53	362
Move Cap.:	702	xxxx	xxxxx	769	xxxx	xxxxx	27	43	307	30	44	362
Level Of Service Module:												
Stopped Del:	10.2	xxxx	xxxxx	10.5	xxxx	xxxxx	212.1	xxxx	xxxxx	403.3	xxxx	xxxxx
LOS by Move:	B	*	*	B	*	*	F	*	*	F	*	*
Movement:	LT - LTR - RT			LT - LTR - RT			LT - LTR - RT			LT - LTR - RT		
Shared Cap.:	xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx	xxxx	xxxx	101	xxxx	xxxx	321
Shrd StpDel:	xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx	xxxxx	xxxx	47.8	xxxxx	xxxx	18.9
Shared LOS:	*	*	*	*	*	*	*	*	E	*	*	C
ApproachDel:	xxxxxx			xxxxxx			113.5			153.0		
ApproachLOS:	*			*			F			F		

Kittelson & Associates, Inc.- Project #4054
Molalla Avenue Corridor Study- Oregon City, Oregon
Existing Conditions Preferred Alternative Weekday PM

Level Of Service Detailed Computation Report
1997 HCM Unsignalized Method
Future Volume Alternative

****
Intersection #3 Barclay Hills Drive/Molalla Avenue
****

Approach:	North Bound	South Bound	East Bound	West Bound
Movement:	L - T - R	L - T - R	L - T - R	L - T - R
HevVeh:	1%	1%	0%	1%
Grade:	0%	0%	0%	0%
Peds/Hour:	0	0	0	0
LaneWidth:	12 feet	12 feet	12 feet	12 feet

Pedestrian Walk Speed: 4.00 feet/sec
Time Period: 0.25 hour

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MUTCD Signal Warrant Analysis

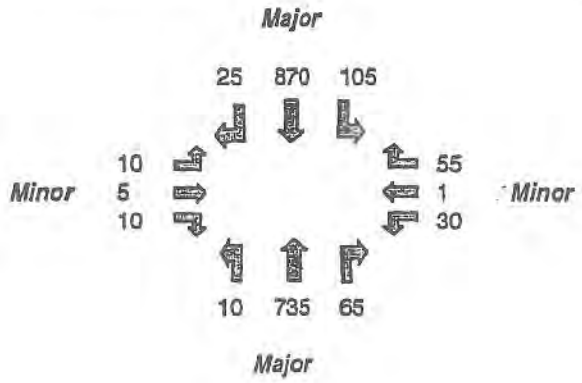
KITTELSON & ASSOCIATES, INC.
610 SW Alder, Suite 700
Portland, Oregon 97205
(503) 228-5230
Fax: (503) 273-8169

Project #: [redacted]
Project Name: [redacted]
Analyst: [redacted]
Intersection: [redacted]
Scenario: [redacted]
Date: 8/16/00
File: H:\projfile\4054\excel\sigwar\[bhexpref.XLS]Main

Input Data:

North-South Approach =	[redacted]
East-West Approach =	Minor
Major Street Thru Lanes =	[redacted]
Minor Street Thru Lanes =	[redacted]
8th Highest/Peak Hour (Major) =	[redacted]
8th Highest/Peak Hour (Minor) =	[redacted]
Speed > 40 mph?	[redacted]
Population < 10,000?	[redacted]
Warrant Factor	100%

Turning Movement Volumes:



Signal Warrant Analysis Results

Warrant	Approach	Actual Volumes	Required Volumes	Met?
1 - Minimum Vehicular Volume	Major Street	1267	500	No
	Minor Street	60	150	
2 - Interruption of Continuous Traffic	Major Street	1267	750	No
	Minor Street	60	75	
11 - Peak Hour Volume	Major Street	1810	1810	No
	Minor Street	86	100	

Kittelson & Associates, Inc.- Project #4054
Molalla Avenue Improvement Plan - Oregon City, Oregon
Year 2020 Preferred Alternative Weekday PM

Scenario Report

Scenario:	Default Scenario
Command:	Default Command
Volume:	Default Volume
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

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Kittelson & Associates, Inc.- Project #4054
Molalla Avenue Improvement Plan - Oregon City, Oregon
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Turning Movement Report

Volume	Northbound			Southbound			Eastbound			Westbound			Total
Type	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Volume
#1 Division Street/Molalla Avenue													
Base	0	1215	105	10	1610	0	1	1	1	0	0	0	2943
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	1215	105	10	1610	0	1	1	1	0	0	0	2943
#2 Pearl Street/Molalla Avenue													
Base	25	1250	25	10	1490	25	55	1	80	110	15	10	3096
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	25	1250	25	10	1490	25	55	1	80	110	15	10	3096
#3 Barclay Hills Drive/Molalla Avenue													
Base	15	1275	110	115	1470	30	15	10	15	60	5	80	3200
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	15	1275	110	115	1470	30	15	10	15	60	5	80	3200
#4 Hilda Street-Holmes Lane/Molalla Avenue													
Base	65	1060	20	15	1295	100	105	20	150	70	25	35	2960
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	65	1060	20	15	1295	100	105	20	150	70	25	35	2960
#5 Warner-Milne Avenue/Molalla Avenue													
Base	270	870	20	20	1275	305	280	20	270	25	15	10	3380
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	270	870	20	20	1275	305	280	20	270	25	15	10	3380
#6 Hill Top Mall Access/Molalla Avenue													
Base	55	1095	1	1	1380	100	80	1	80	1	1	1	2796
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	55	1095	1	1	1380	100	80	1	80	1	1	1	2796
#7 Beaver Creek Road/Molalla Avenue													
Base	375	535	65	560	860	35	65	370	415	105	435	265	4085
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	375	535	65	560	860	35	65	370	415	105	435	265	4085
#8 Clairmont Way-Fred Meyer/Molalla Avenue													
Base	85	850	15	40	1055	240	115	30	60	20	65	20	2595
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	85	850	15	40	1055	240	115	30	60	20	65	20	2595
#9 Gaffney Lane/Molalla Avenue													
Base	120	595	160	180	635	225	70	45	25	150	75	190	2470
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	120	595	160	180	635	225	70	45	25	150	75	190	2470

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Kittelson & Associates, Inc.- Project #4054
Molalla Avenue Improvement Plan - Oregon City, Oregon
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Volume Type	Northbound Left	Northbound Thru	Northbound Right	Southbound Left	Southbound Thru	Southbound Right	Eastbound Left	Eastbound Thru	Eastbound Right	Westbound Left	Westbound Thru	Westbound Right	Total Volume
#10 Highway 213/Molalla Avenue													
Base	295	652	50	315	1130	260	270	205	575	95	260	320	4427
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	295	652	50	315	1130	260	270	205	575	95	260	320	4427
#99													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#100													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#101													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#102													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#103													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#104													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#105													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#106													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0

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Kittelson & Associates, Inc.- Project #4054
Molalla Avenue Improvement Plan - Oregon City, Oregon
Year 2020 Preferred Alternative Weekday PM

Volume Type	Northbound Left	Northbound Thru	Northbound Right	Southbound Left	Southbound Thru	Southbound Right	Eastbound Left	Eastbound Thru	Eastbound Right	Westbound Left	Westbound Thru	Westbound Right	Total Volume
#107													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#108													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#109													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#110													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#111													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#112													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#113													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#114													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#115													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0

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Kittelson & Associates, Inc.- Project #4054
Molalla Avenue Improvement Plan - Oregon City, Oregon
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Volume Type	Northbound Left	Thru	Right	Southbound Left	Thru	Right	Eastbound Left	Thru	Right	Westbound Left	Thru	Right	Total Volume
#116													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0
#117													
Base	0	0	0	0	0	0	0	0	0	0	0	0	0
Added	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0	0	0

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Impact Analysis Report
Level Of Service

Intersection	Base LOS	Base Del/ Veh	Base V/ C	Future LOS	Future Del/ Veh	Future V/ C	Change in
# 1 Division Street/Molalla Avenue	B	15.1	0.972	B	15.1	0.972	+ 0.000 D/V
# 2 Pearl Street/Molalla Avenue	D	51.1	1.100	D	51.1	1.100	+ 0.000 D/V
# 3 Barclay Hills Drive/Molalla Av	E	42.4	1.045	E	42.4	1.045	+ 0.000 D/V
# 4 Hilda Street-Holmes Lane/Molal	D	50.8	1.081	D	50.8	1.081	+ 0.000 D/V
# 5 Warner-Milne Avenue/Molalla Av	D	36.0	0.954	D	36.0	0.954	+ 0.000 D/V
# 6 Hill Top Mall Access/Molalla A	B	10.3	0.621	B	10.3	0.621	+ 0.000 D/V
# 7 Beaver Creek Road/Molalla Aven	D	35.2	0.811	D	35.2	0.811	+ 0.000 D/V
# 8 Clairmont Way-Fred Meyer/Molal	D	41.4	1.038	D	41.4	1.038	+ 0.000 D/V
# 9 Gaffney Lane/Molalla Avenue	C	29.1	0.827	C	29.1	0.827	+ 0.000 D/V
# 10 Highway 213/Molalla Avenue	D	41.9	0.938	D	41.9	0.938	+ 0.000 D/V

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Level Of Service Computation Report
1997 HCM Operations Method (Base Volume Alternative)

Intersection #1 Division Street/Molalla Avenue

Cycle (sec): 90 Critical Vol./Cap. (X): 0.972
Loss Time (sec): 8 (Y+R = 4 sec) Average Delay (sec/veh): 15.1
Optimal Cycle: 90 Level Of Service: B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Permitted			Permitted			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	0 0	0 1	0	1 0	1 0	0	0 0	1! 0	0	0 0	0 0	0
Volume Module: 4:35-5:35												
Base Vol:	0	1215	105	10	1610	0	1	1	1	0	0	0
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:	0	1215	105	10	1610	0	1	1	1	0	0	0
User 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
PHF Adj:	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
PHF Volume:	0	1241	107	10	1645	0	1	1	1	0	0	0
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	0	1241	107	10	1645	0	1	1	1	0	0	0
PCE 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
MLF 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
Final Vol.:	0	1241	107	10	1645	0	1	1	1	0	0	0
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	1.00	0.87	0.87	0.73	0.98	1.00	0.73	0.73	0.73	1.00	1.00	1.00
Lanes:	0.00	0.92	0.08	1.00	1.00	0.00	0.34	0.33	0.33	0.00	0.00	0.00
Final Sat.:	0	1524	131	1383	1862	0	463	463	463	0	0	0
Capacity Analysis Module:												
Vol/Sat:	0.00	0.81	0.81	0.01	0.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Crit Moves:					****			****				
Green/Cycle:	0.00	0.91	0.91	0.91	0.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Volume/Cap:	0.00	0.90	0.90	0.01	0.97	0.00	0.97	0.97	0.97	0.00	0.00	0.00
Delay/Veh:	0.0	9.4	9.4	0.4	18.9	0.0	532.3	532	532.3	0.0	0.0	0.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	0.0	9.4	9.4	0.4	18.9	0.0	532.3	532	532.3	0.0	0.0	0.0
DesignQueue:	0	7	1	0	10	0	0	0	0	0	0	0

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Level Of Service Computation Report
1997 HCM Operations Method (Base Volume Alternative)

Intersection #2 Pearl Street/Molalla Avenue

Cycle (sec): 90 Critical Vol./Cap. (X): 1.100
Loss Time (sec): 12 (Y+R = 4 sec) Average Delay (sec/veh): 51.1
Optimal Cycle: 90 Level Of Service: D

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Protected			Protected			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	0 1	0	1 0	0 1	0	1 0	0 1	0	1 0	0 1	0
Volume Module:												
Base Vol:	25	1250	25	10	1490	25	55	1	80	110	15	10
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:	25	1250	25	10	1490	25	55	1	80	110	15	10
User 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
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	26	1316	26	11	1568	26	58	1	84	116	16	11
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	26	1316	26	11	1568	26	58	1	84	116	16	11
PCE 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
MLF 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
Final Vol.:	26	1316	26	11	1568	26	58	1	84	116	16	11
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.93	0.98	0.98	0.94	0.99	0.99	0.74	0.84	0.84	0.68	0.93	0.93
Lanes:	1.00	0.98	0.02	1.00	0.98	0.02	1.00	0.01	0.99	1.00	0.59	0.41
Final Sat.:	1769	1820	36	1787	1847	31	1403	19	1584	1300	1047	720
Capacity Analysis Module:												
Vol/Sat:	0.01	0.72	0.72	0.01	0.85	0.85	0.04	0.05	0.05	0.09	0.02	0.02
Crit Moves:	****				****					****		
Green/Cycle:	0.01	0.78	0.78	0.01	0.77	0.77	0.08	0.08	0.08	0.08	0.08	0.08
Volume/Cap:	1.10	0.93	0.93	0.93	1.10	1.10	0.51	0.65	0.65	1.10	0.19	0.19
Delay/Veh:	262.2	18.6	18.6	266.0	66.1	66.1	43.4	51.5	51.5	158.4	39.2	39.2
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	262.2	18.6	18.6	266.0	66.1	66.1	43.4	51.5	51.5	158.4	39.2	39.2
DesignQueue:	1	18	0	1	23	0	3	0	4	5	1	1

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Level Of Service Computation Report
1994 HCM Operations Method (Base Volume Alternative)

Intersection #3 Barclay Hills Drive/Molalla Avenue

Cycle (sec): 90 Critical Vol./Cap. (X): 1.045
Loss Time (sec): 12 (Y+R = 4 sec) Average Delay (sec/veh): 42.4
Optimal Cycle: 90 Level Of Service: E

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Protected			Protected			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	0 1	0	1 0	0 1	0	0 0	1! 0	0	1 0	0 1	0
Volume Module:												
Base Vol:	15	1275	110	115	1470	30	15	10	15	.60	5	80
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:	15	1275	110	115	1470	30	15	10	15	60	5	80
User 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
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	16	1342	116	121	1547	32	16	11	16	63	5	84
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	16	1342	116	121	1547	32	16	11	16	63	5	84
PCE 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
MLF 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
Final Vol.:	16	1342	116	121	1547	32	16	11	16	63	5	84
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.94	0.98	0.98	0.94	0.99	0.99	0.64	0.64	0.64	0.85	0.85	0.85
Lanes:	1.00	0.92	0.08	1.00	0.98	0.02	0.37	0.26	0.37	1.00	0.06	0.94
Final Sat.:	1787	1714	148	1787	1843	38	451	310	451	1618	91	1527
Capacity Analysis Module:												
Vol/Sat:	0.01	0.78	0.78	0.07	0.84	0.84	0.04	0.04	0.04	0.04	0.06	0.06
Crit Moves:		****		****							****	
Green/Cycle:	0.01	0.75	0.75	0.06	0.81	0.81	0.05	0.05	0.05	0.05	0.05	0.05
Volume/Cap:	1.04	1.04	1.04	1.04	1.04	1.04	0.67	0.67	0.67	0.74	1.04	1.04
Delay/Veh:	232.7	38.1	38.1	107.9	34.8	34.8	42.7	42.7	42.7	45.5	120	120.1
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	232.7	38.1	38.1	107.9	34.8	34.8	42.7	42.7	42.7	45.5	120	120.1
DesignQueue:	1	21	2	6	19	0	1	1	1	3	0	4

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Molalla Avenue Improvement Plan - Oregon City, Oregon
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Level Of Service Computation Report
1997 HCM Operations Method (Base Volume Alternative)

Intersection #4 Hilda Street-Holmes Lane/Molalla Avenue

Cycle (sec): 90 Critical Vol./Cap. (X): 1.081
Loss Time (sec): 12 (Y+R = 4 sec) Average Delay (sec/veh): 50.8
Optimal Cycle: 90 Level Of Service: D

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Protected			Protected			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	0 1	0	1 0	0 1	0	1 0	0 1	0	1 0	0 1	0
Volume Module:												
Base Vol:	65	1060	20	15	1295	100	105	20	150	70	25	35
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:	65	1060	20	15	1295	100	105	20	150	70	25	35
User 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
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	68	1116	21	16	1363	105	111	21	158	74	26	37
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	68	1116	21	16	1363	105	111	21	158	74	26	37
PCE 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
MLF 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
Final Vol.:	68	1116	21	16	1363	105	111	21	158	74	26	37
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.94	0.99	0.99	0.94	0.98	0.98	0.71	0.86	0.86	0.44	0.91	0.91
Lanes:	1.00	0.98	0.02	1.00	0.93	0.07	1.00	0.12	0.88	1.00	0.41	0.59
Final Sat.:	1787	1841	35	1787	1727	133	1349	192	1441	832	715	1018
Capacity Analysis Module:												
Vol/Sat:	0.04	0.61	0.61	0.01	0.79	0.79	0.08	0.11	0.11	0.09	0.04	0.04
Crit Moves:	****				****			****				
Green/Cycle:	0.04	0.75	0.75	0.01	0.73	0.73	0.10	0.10	0.10	0.10	0.10	0.10
Volume/Cap:	1.08	0.80	0.80	0.80	1.08	1.08	0.81	1.08	1.08	0.88	0.36	0.36
Delay/Veh:	181.0	10.4	10.4	156.5	61.6	61.6	69.0	134	133.6	98.9	39.0	39.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	181.0	10.4	10.4	156.5	61.6	61.6	69.0	134	133.6	98.9	39.0	39.0
DesignQueue:	3	16	0	1	23	2	5	1	7	3	1	2

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Level Of Service Computation Report
1997 HCM Operations Method (Base Volume Alternative)

Intersection #5 Warner-Milne Avenue/Molalla Avenue

Cycle (sec): 90 Critical Vol./Cap. (X): 0.954
Loss Time (sec): 12 (Y+R = 4 sec) Average Delay (sec/veh): 36.0
Optimal Cycle: 90 Level Of Service: D

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Protected			Protected			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1	1 0	1 0	1	1 0	1 0	0	1 0	1 0	0	1 0
Volume Module:												
Base Vol:	270	870	20	20	1275	305	280	20	270	25	15	10
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:	270	870	20	20	1275	305	280	20	270	25	15	10
User 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
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	284	916	21	21	1342	321	295	21	284	26	16	11
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	284	916	21	21	1342	321	295	21	284	26	16	11
PCE 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
MLF 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
Final Vol.:	284	916	21	21	1342	321	295	21	284	26	16	11
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.94	0.99	0.99	0.94	0.96	0.96	0.73	0.84	0.84	0.28	0.94	0.94
Lanes:	1.00	1.96	0.04	1.00	1.61	0.39	1.00	0.07	0.93	1.00	0.59	0.41
Final Sat.:	1787	3667	84	1787	2948	705	1389	110	1491	526	1057	727
Capacity Analysis Module:												
Vol/Sat:	0.16	0.25	0.25	0.01	0.46	0.46	0.21	0.19	0.19	0.05	0.02	0.02
Crit Moves:	****				****		****					
Green/Cycle:	0.17	0.62	0.62	0.03	0.48	0.48	0.22	0.22	0.22	0.22	0.22	0.22
Volume/Cap:	0.95	0.41	0.41	0.41	0.95	0.95	0.95	0.86	0.86	0.22	0.07	0.07
Delay/Veh:	76.9	9.0	9.0	48.1	34.9	34.9	73.3	51.6	51.6	29.6	27.7	27.7
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	76.9	9.0	9.0	48.1	34.9	34.9	73.3	51.6	51.6	29.6	27.7	27.7
DesignQueue:	12	19	0	1	40	9	12	1	12	1	1	0

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Molalla Avenue Improvement Plan - Oregon City, Oregon
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Level Of Service Computation Report
1997 HCM Operations Method (Base Volume Alternative)

Intersection #6 Hill Top Mall Access/Molalla Avenue

Cycle (sec): 120 Critical Vol./Cap. (X): 0.621
Loss Time (sec): 16 (Y+R = 4 sec) Average Delay (sec/veh): 10.3
Optimal Cycle: 58 Level Of Service: B

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L -	T -	R	L -	T -	R	L -	T -	R	L -	T -	R
Control:	Protected			Protected			Split Phase			Split Phase		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	1	1 0	1 0	1	1 0	1 0	0	1 0	0 0	1	0 0
Volume Module:												
Base Vol:	55	1095	1	1	1380	100	80	1	80	1	1	1
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:	55	1095	1	1	1380	100	80	1	80	1	1	1
User 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
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	58	1153	1	1	1453	105	84	1	84	1	1	1
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	58	1153	1	1	1453	105	84	1	84	1	1	1
PCE 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
MLF 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
Final Vol.:	58	1153	1	1	1453	105	84	1	84	1	1	1
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.93	0.98	0.98	0.93	0.97	0.97	0.93	0.83	0.83	0.84	0.84	0.84
Lanes:	1.00	1.99	0.01	1.00	1.87	0.13	1.00	0.01	0.99	0.34	0.33	0.33
Final Sat.:	1769	3721	3	1769	3438	248	1769	19	1568	533	533	533
Capacity Analysis Module:												
Vol/Sat:	0.03	0.31	0.31	0.00	0.42	0.42	0.05	0.05	0.05	0.00	0.00	0.00
Crit Moves:	****				****			****			****	
Green/Cycle:	0.05	0.73	0.73	0.00	0.68	0.68	0.09	0.09	0.09	0.00	0.00	0.00
Volume/Cap:	0.62	0.42	0.42	0.42	0.62	0.62	0.55	0.62	0.62	0.62	0.62	0.62
Delay/Veh:	54.0	4.8	4.8	136.1	8.5	8.5	43.7	48.2	48.2	184.1	184	184.1
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	54.0	4.8	4.8	136.1	8.5	8.5	43.7	48.2	48.2	184.1	184	184.1
DesignQueue:	3	17	0	0	26	2	4	0	4	0	0	0

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Kittelson & Associates, Inc.- Project #4054
Molalla Avenue Improvement Plan - Oregon City, Oregon
Year 2020 Preferred Alternative Weekday PM

Level Of Service Computation Report
1997 HCM Operations Method (Base Volume Alternative)

Intersection #9 Gaffney Lane/Molalla Avenue

Cycle (sec): 90 Critical Vol./Cap. (X): 0.827
Loss Time (sec): 12 (Y+R = 4 sec) Average Delay (sec/veh): 29.1
Optimal Cycle: 80 Level Of Service: C

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Protected			Protected			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1	0	0 1	0	1	0 1	0	0	1! 0	0	1	0 0 1
Volume Module:												
Base Vol:	120	595	160	180	635	225	70	45	25	150	75	190
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:	120	595	160	180	635	225	70	45	25	150	75	190
User 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
PHF Adj:	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
PHF Volume:	125	620	167	188	661	234	73	47	26	156	78	198
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	125	620	167	188	661	234	73	47	26	156	78	198
PCE 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
MLF 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
Final Vol.:	125	620	167	188	661	234	73	47	26	156	78	198
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.94	0.96	0.96	0.93	0.98	0.83	0.48	0.48	0.48	0.69	0.69	0.85
Lanes:	1.00	0.79	0.21	1.00	1.00	1.00	0.50	0.32	0.18	0.67	0.33	1.00
Final Sat.:	1787	1434	386	1769	1862	1583	454	292	162	877	438	1615
Capacity Analysis Module:												
Vol/Sat:	0.07	0.43	0.43	0.11	0.35	0.15	0.16	0.16	0.16	0.18	0.18	0.12
Crit Moves:		****		****							****	
Green/Cycle:	0.11	0.52	0.52	0.13	0.54	0.54	0.22	0.22	0.22	0.22	0.22	0.22
Volume/Cap:	0.65	0.83	0.83	0.83	0.65	0.27	0.75	0.75	0.75	0.83	0.83	0.57
Delay/Veh:	46.4	24.1	24.1	59.6	16.0	11.1	47.6	47.6	47.6	51.6	51.6	33.8
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	46.4	24.1	24.1	59.6	16.0	11.1	47.6	47.6	47.6	51.6	51.6	33.8
DesignQueue:	6	17	4	8	17	6	3	2	1	6	3	8

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Kittelson & Associates, Inc.- Project #4054
Molalla Avenue Improvement Plan - Oregon City, Oregon
Year 2020 Preferred Alternative Weekday PM

Level Of Service Computation Report
1997 HCM Operations Method (Base Volume Alternative)

Intersection #10 Highway 213/Molalla Avenue

Cycle (sec): 120 Critical Vol./Cap. (X): 0.938
Loss Time (sec): 16 (Y+R = 4 sec) Average Delay (sec/veh): 41.9
Optimal Cycle: 90 Level Of Service: D

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Protected			Protected			Protected			Protected		
Rights:	Include			Include			Ovl			Ovl		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	2	0	2 0 1	2	0	2 0 1	1	0	1 0 1	1	0	1 0 1
Volume Module:												
Base Vol:	295	652	50	315	1130	260	270	205	575	95	260	320
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:	295	652	50	315	1130	260	270	205	575	95	260	320
User 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
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	311	686	53	332	1189	274	284	216	605	100	274	337
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	311	686	53	332	1189	274	284	216	605	100	274	337
PCE 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
MLF 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
Final Vol.:	311	686	53	332	1189	274	284	216	605	100	274	337
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.90	0.95	0.81	0.90	0.95	0.81	0.92	0.97	0.83	0.92	0.97	0.83
Lanes:	2.00	2.00	1.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Final Sat.:	3437	3618	1537	3437	3618	1537	1753	1845	1568	1753	1845	1568
Capacity Analysis Module:												
Vol/Sat:	0.09	0.19	0.03	0.10	0.33	0.18	0.16	0.12	0.39	0.06	0.15	0.21
Crit Moves:	****				****				****	****		
Green/Cycle:	0.10	0.30	0.30	0.15	0.35	0.35	0.20	0.31	0.41	0.06	0.18	0.33
Volume/Cap:	0.94	0.64	0.12	0.64	0.94	0.51	0.83	0.37	0.94	0.94	0.83	0.65
Delay/Veh:	74.1	28.9	23.2	38.6	41.5	23.9	49.9	24.3	47.0	109.6	51.2	28.6
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	74.1	28.9	23.2	38.6	41.5	23.9	49.9	24.3	47.0	109.6	51.2	28.6
DesignQueue:	14	25	2	14	42	9	12	8	19	5	12	12

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Kittelson & Associates, Inc.- Project #4054
Molalla Avenue Improvement Plan - Oregon City, Oregon
Year 2020 Preferred Alternative Weekday PM

Level Of Service Computation Report
1997 HCM Operations Method (Future Volume Alternative)

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Intersection #8 Clairmont Way-Fred Meyer/Molalla Avenue

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Cycle (sec): 90 Critical Vol./Cap. (X): 0.85
Loss Time (sec): 12 (Y+R = 4 sec) Average Delay (sec/veh): 20.0
Optimal Cycle: 88 Level Of Service: C

****

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Protected			Protected			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0	0 1	0	1 0	[illegible]		1 0	0 1	0	1 0	0 1	0
Volume Module:												
Base Vol:	85	850	15	40	1055	240	115	30	60	20	65	20
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:	85	850	15	40	1055	240	115	30	60	20	65	20
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:	85	850	15	40	1055	240	115	30	60	20	65	20
User 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
PHF Adj:	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
PHF Volume:	89	895	16	42	1111	253	121	32	63	21	68	21
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	89	895	16	42	1111	253	121	32	63	21	68	21
PCE 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
MLF 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
Final Vol.:	89	895	16	42	1111	253	121	32	63	21	68	21
Saturation Flow Module:												
Sat/Lane:	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Adjustment:	0.93	0.98	0.98	0.93	0.98	0.83	0.67	0.88	0.88	0.65	0.96	0.96
Lanes:	1.00	0.98	0.02	1.00	1.00	1.00	1.00	0.34	0.66	1.00	0.76	0.24
Final Sat.:	1769	1824	33	1769	1862	1583	1277	565	1113	1243	1387	428
Capacity Analysis Module:												
Vol/Sat:	0.05	0.49	0.49	0.02	0.60	0.16	0.09	0.06	0.06	0.02	0.05	0.05
Crit Moves:	****				****		****					
Green/Cycle:	0.06	0.72	0.72	0.03	0.70	0.70	0.11	0.11	0.11	0.11	0.11	0.11
Volume/Cap:	0.86	0.68	0.68	0.68	0.86	0.23	0.86	0.51	0.51	0.15	0.44	0.44
Delay/Veh:	88.2	8.3	8.3	69.6	16.0	5.0	76.3	40.1	40.1	36.7	39.0	39.0
User DelAdj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	88.2	8.3	8.3	69.6	16.0	5.0	76.3	40.1	40.1	36.7	39.0	39.0
DesignQueue:	4	14	0	2	20	4	5	1	3	1	3	1

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Kittelson & Associates, Inc.- Project #4054
Molalla Avenue Improvement Plan - Oregon City, Oregon
Year 2020 Preferred Alternative Weekday PM

Level Of Service Detailed Computation Report
1997 HCM Operations Method
Future Volume Alternative

Intersection #8 Clairmont Way-Fred Meyer/Molalla Avenue

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
HCM Ops Adjusted Lane Utilization Module:												
Lanes:	1 0 0 1 0			1 0 1 0 1			1 0 0 1 0			1 0 0 1 0		
Lane Group:	L	RT	RT	L	T	R	L	RT	RT	L	RT	RT
#LnsInGrps:	1	1	1	1	1	1	1	1	1	1	1	1
HCM Ops Input Saturation Adj Module:												
Lane Width:	12	12	12	12	12	12	12	12	12	12	12	12
% Hev Veh:		2			2			2			1	
Grade:		0%			0%			0%			0%	
Parking/Hr:		No			No			No			No	
Bus Stp/Hr:		0			0			0			0	
Area Type:	< < < < < < < < < < < < < < Other > > > > > > > > > > > > > >											
Cnft Ped/Hr:		0			0			0			0	
ExclusiveRT:		Include			Include			Include			Include	
% RT Prtct:		0			0			0			0	
HCM Ops f(rt) and f(lt) Adj Case Module:												
f(rt) Case:	xxxx	5	5	xxxx	xxxx	2	xxxx	5	5	xxxx	5	5
f(lt) Case:	1	xxxx	xxxx	1	xxxx	xxxx	2	xxxx	xxxx	2	xxxx	xxxx
HCM Ops Saturation Adj Module:												
Ln Wid 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
Hev Veh Adj:	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.99	0.99	0.99
Grade 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
Parking Adj:	xxxx	1.00	1.00	xxxx	xxxx	1.00	xxxx	1.00	1.00	xxxx	1.00	1.00
Bus Stp Adj:	xxxx	1.00	1.00	xxxx	xxxx	1.00	xxxx	1.00	1.00	xxxx	1.00	1.00
Area 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
RT Adj:	xxxx	1.00	1.00	xxxx	xxxx	0.85	xxxx	0.90	0.90	xxxx	0.97	0.97
LT Adj:	0.95	xxxx	xxxxx	0.95	xxxx	xxxxx	0.69	xxxx	xxxxx	0.66	xxxx	xxxxx
HCM Sat Adj:	0.93	0.98	0.98	0.93	0.98	0.83	0.67	0.88	0.88	0.65	0.96	0.96
Usr Sat 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
MLF Sat 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
Fnl Sat Adj:	0.93	0.98	0.98	0.93	0.98	0.83	0.67	0.88	0.88	0.65	0.96	0.96
Delay Adjustment Factor Module:												
Coordinated:	< < < < < < < < < < < < < < < < No > > > > > > > > > > > > > > > >											
Signal Type:	< < < < < < < < < < < < < < Actuated > > > > > > > > > > > > > >											
DelAdjFctr:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

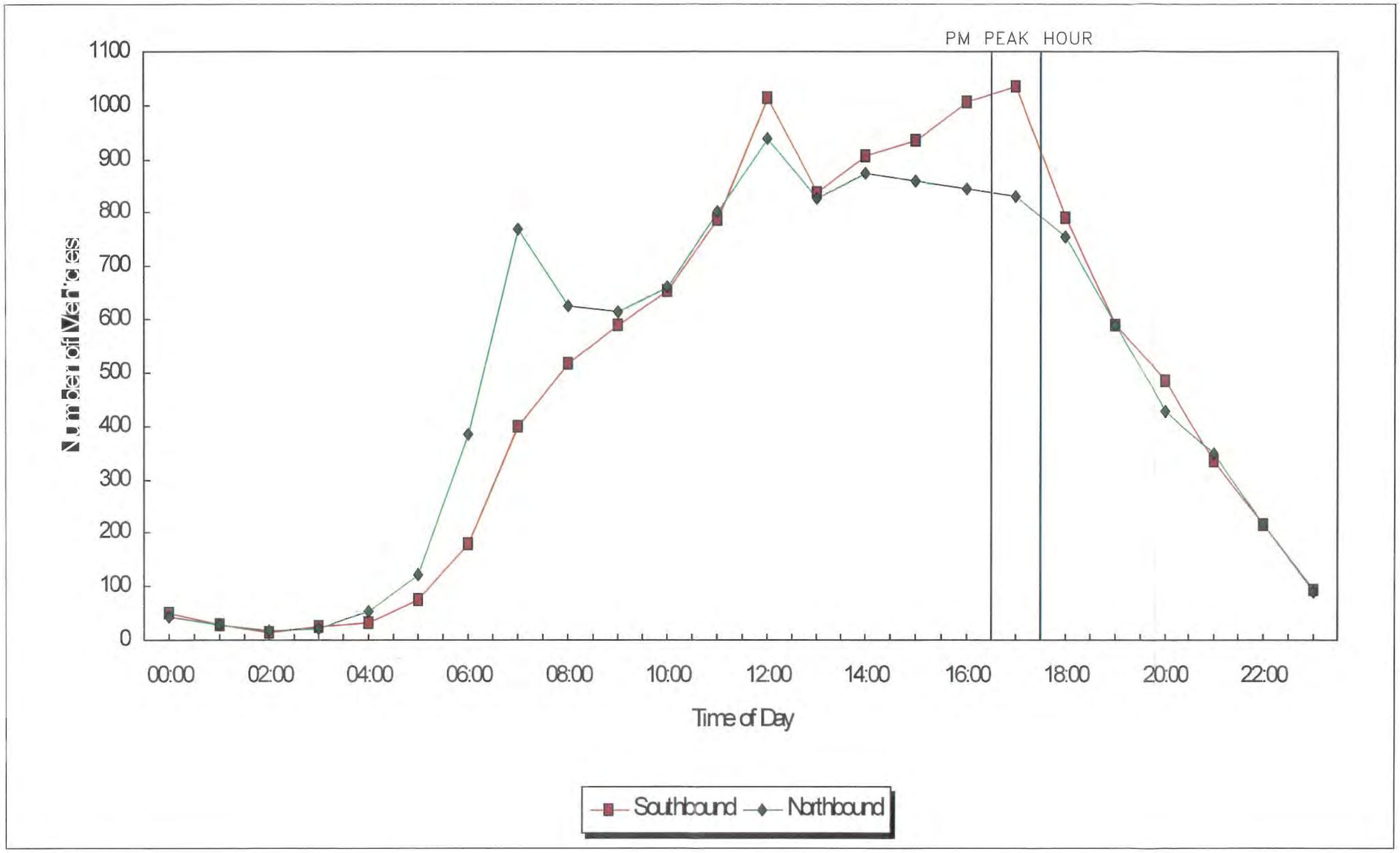
Kittelson & Associates, Inc.- Project #4054
Molalla Avenue Improvement Plan - Oregon City, Oregon
Year 2020 Preferred Alternative Weekday PM

Level Of Service Detailed Computation Report (Permitted Left Turn Sat Adj)
1997 HCM Operations Method
Future Volume Alternative

Intersection #8 Clairmont Way-Fred Meyer/Molalla Avenue

Approach:	North	South	East	West
Cycle Length, C:	xxxxxx	xxxxxx	90	90
Actual Green Time Per Lane Group, G:	xxxxxx	xxxxxx	9.96	9.96
Effective Green Time Per Lane Group, g:	xxxxxx	xxxxxx	9.96	9.96
Opposing Effective Green Time, go:	xxxxxx	xxxxxx	9.96	9.96
Number Of Opposing Lanes, No:	xxxxxx	xxxxxx	1	1
Number Of Lanes In Lane Group, N:	xxxxxx	xxxxxx	1	1
Adjusted Left-Turn Flow Rate, Vlt:	xxxxxx	xxxxxx	121	21
Proportion of Left Turns in Lane Group, Plt:	xxxxxx	xxxxxx	1.00	1.00
Proportion of Left Turns in Opp Flow, Plto:	xxxxxx	xxxxxx	xxxxxx	xxxxxx
Left Turns Per Cycle, LTC:	xxxxxx	xxxxxx	3.03	0.53
Adjusted Opposing Flow Rate, Vo:	xxxxxx	xxxxxx	89	95
Opposing Flow Per Lane Per Cycle, Volc:	xxxxxx	xxxxxx	2.23	2.38
Opposing Platoon Ratio, Rpo:	xxxxxx	xxxxxx	1.00	1.00
Lost Time Per Phase, tl:	xxxxxx	xxxxxx	4.00	4.00
Eff grn until arrival of left-turn car, gf:	xxxxxx	xxxxxx	0.00	0.00
Opposing Queue Ratio, qro:	xxxxxx	xxxxxx	0.89	0.89
Eff grn blocked by opposing queue, gq:	xxxxxx	xxxxxx	0.16	0.46
Eff grn while left turns filter thru, gu:	xxxxxx	xxxxxx	9.80	9.50
Max opposing cars arriving during gq-gf, n:	xxxxxx	xxxxxx	xxxxxx	xxxxxx
Proportion of Opposing Thru & RT cars, ptho:	xxxxxx	xxxxxx	xxxxxx	xxxxxx
Left-turn Saturation Factor, fs:	xxxxxx	xxxxxx	0.82	0.82
Proportion of Left Turns in Shared Lane, pl:	xxxxxx	xxxxxx	1.00	1.00
Through-car Equivalents, el1:	xxxxxx	xxxxxx	1.43	1.44
Single Lane Through-car Equivalents, el2:	xxxxxx	xxxxxx	xxxxxx	xxxxxx
Minimum Left Turn Adjustment Factor, fmin:	xxxxxx	xxxxxx	0.40	0.40
Single Lane Left Turn Adjustment Factor, fm:	xxxxxx	xxxxxx	0.69	0.66
Left Turn Adjustment Factor, flt:	xxxxxx	xxxxxx	0.69	0.66

25-Hour Volume Profile
Molalla Avenue North of Beavercreek Road



January 2001 Job 1077A	WALLIS ENGINEERING in association with GREENWORKS Kittelson & Associates	Molalla Avenue Boulevard and Bikeway Improvements Plan Oregon City, Oregon	25-Hour Volume Profile - Molalla Avenue North of Beavercreek Road	Figure D-1

Appendix E
Proposed City of Oregon City Access Management Standards

Minimum Traffic Signal Spacing

The minimum signal spacing standards on City of Oregon City roadways is shown in Table E-1.

Table E-1. Minimum Traffic Signal Spacing Standards

Roadway Functional Classification	Minimum Traffic Signal Spacing
Major Arterial	1/4 mile
Minor Arterial	1/4 mile
Collector	1/4 mile
Neighborhood Collector	¼ mile
Local Street	N/A

Note: N/A = Not Applicable.

Typically, local street intersections should not be controlled by a traffic signal; thus, the signal spacing standard is not applicable for these streets. Traffic signals closer than the minimums can be considered if the signal will not cause vehicle queues to back-up into the adjacent signal, and if vehicle progression will not be impacted. Also, signals closer than the minimums can be considered for the purpose of optimizing vehicle capacity and safety, as well as for providing pedestrian crossing opportunities in the Oregon City central business district, and other designated regional centers in the City.

Signals at private driveways, or access points, may be allowed with a variance but must adhere to the above signal spacing standards. One or more of the signal warrants described in the MUTCD should be met, or shown to be met upon full build-out of a development, before considering a traffic signal at a private access point. Alternatives to signals should be investigated, including restricting turning movements. The City of Oregon City Engineering Department shall make final decisions on a case-by-case basis.

Non-Traversable Median Openings

The minimum non-traversable median opening spacing standards on City of Oregon City roadways are shown in Table E-2.

Table E-2. Minimum Non-traversable Median Opening Spacing Standards

Functional Classification	Area (1)	Minimum Median Opening Spacing (1)
Major Arterial	Urban	600 feet
	Fully Developed	400 feet
Minor Arterial	Urban	300 feet
	Fully Developed	200 feet
Collector	All	N/A
Neighborhood Collector	All	N/A
Local Street	All	N/A

Notes:(1)-"Urban" refers to locations inside the urban growth boundary.
"Fully developed" refers to urban locations within the Oregon City central business district or another designated STA.
"All" refers to all areas within Oregon City.
N/A = Not Applicable, since non-traversable median should not be used under these conditions.

Table E-2 indirectly specifies the conditions which non-traversable medians should not be allowed, noted with a "NA". According to Table E-2, there are two different area types, which affect the median opening standards: urban, and fully developed. "Urban" refers to the area within the Urban Growth Boundary of Oregon City, and "fully developed" refers to urban locations within a central business district or regional centers. Non-traversable medians should not be allowed on collector or local streets, unless warranted under certain specified criteria.

Public Intersection Spacing

The minimum public intersection spacing standards on City of Oregon City roadways are shown in Table E-3.

Table E-3. Minimum Public Intersection Spacing Standards

Functional Classification	Major Arterial	Minor Arterial	Collector	Neighborhood Collector	Local Street
Major Arterial	2 mile	1 mile	1/4 mile	1,000 feet	500 feet
Minor Arterial	1 mile	1/2 mile	1,000 feet	800 feet	400 feet
Collector	1/4 mile	1,000 feet	800 feet	600 feet	300 feet
Neighborhood Collector	1,000 feet	800 feet	600 feet	500 feet	200 feet
Local Street	500 feet	400 feet	300 feet	200 feet	150 feet

As shown in Table E-3, the minimum spacing between a major arterial and neighborhood collector shall be 1,000 feet. The minimum spacing between a collector and minor arterial shall also be 1,000 feet. Intersection spacing closer than these standards may be granted through the variance process, and will be decided on a case-by-case basis by the City of Oregon City Engineering Department.

Private Access Driveway Requirements

Reducing the number of existing and proposed access points on arterials and major collectors and improving traffic flow and safety in accordance with the City of Oregon City Transportation System Plan will be the primary consideration when reviewing access proposals for approval. Variance to the access requirements of these rules for number, width, or location must be approved under the variance procedures of these rules. Restrictions may be imposed when approving a variance request. The restrictions could include limiting the turning movements, requiring a shared access, and/or closing one or more existing driveways. Existing lots of record, too small to meet the requirements, and minor modifications to existing active uses, may be given some flexibility when evaluating a variance request.

Single Family Residential Uses - Direct access onto arterials or major collectors will not be allowed if an approved alternate access is available. If no alternate is available, then direct access will only be allowed through the variance procedure of these rules. For access onto neighborhood collectors or local streets, the standard will be one driveway per frontage.

Multi-Family Residential, Commercial, Office, and Industrial Uses - All requests for access must include a site plan and a traffic report as required by the City of Oregon City. The scope of the development will determine the information required, and could include, but not limited to, any or all of the information listed in the variance requirements of these rules. The evaluation of the access request will consider the impacts that traffic generated or stacked by the proposed development will have on through traffic and traffic patterns and safety in the area. Approval will be based on the access requirements of this section. Shared driveways will be encouraged, or required where possible. Easements to accomplish shared access, either current or future, may be required as a condition of site design review or permit approval. Access may be denied if minimum requirements cannot be met and there is an approved alternate such as a shared access or access to an equal or lower classification street.

One driveway access per frontage will be the standard for approval. Double frontage lots will be limited to access from a single street, usually the lower classification street. Driveways, in addition to one, must be requested through the variance procedure.

Private Access Driveway Width
Private access driveways shall conform to the following width dimensions shown in Table E-4.

Table E-4. Private Access Driveway Width Standards

Land Use	Minimum	Maximum
Single Family Residential	12 feet	25 feet
Multi-Family Residential	20 feet	35 feet
Commercial	20 feet	40 feet
Industrial	20 feet	40 feet

In general, the minimum widths listed in Table E-4 should be used in designing the appropriate driveway width. However, larger widths may be used, up to the maximum widths listed in Table E-4, if there are high turning movements which require an additional traffic lane entering and/or exiting the driveway. Also, larger widths may be needed to accommodate a safe turning movement for buses or large trucks.

Private Access Driveway Spacing
Table E-5 shows the private access driveway, or access point, spacing standards on City of Oregon City roadways.

Table E-5. Minimum Private Access Driveway Spacing Standards

Functional Classification	Minimum Access Driveway Spacing ("D" in Figure D-1)	Minimum Setback from Intersecting Street ("S" in Figure D-1)
Major Arterial	400 feet	200 feet
Minor Arterial	300 feet	150 feet
Collector	150 feet	100 feet
Neighborhood Collector	100 feet	100 feet
Local Street	50 feet (1)	50 feet

Note: (1) - 50-foot spacing applies to all land uses except single family residential. There is no minimum spacing standard for single-family residential driveways on local streets.

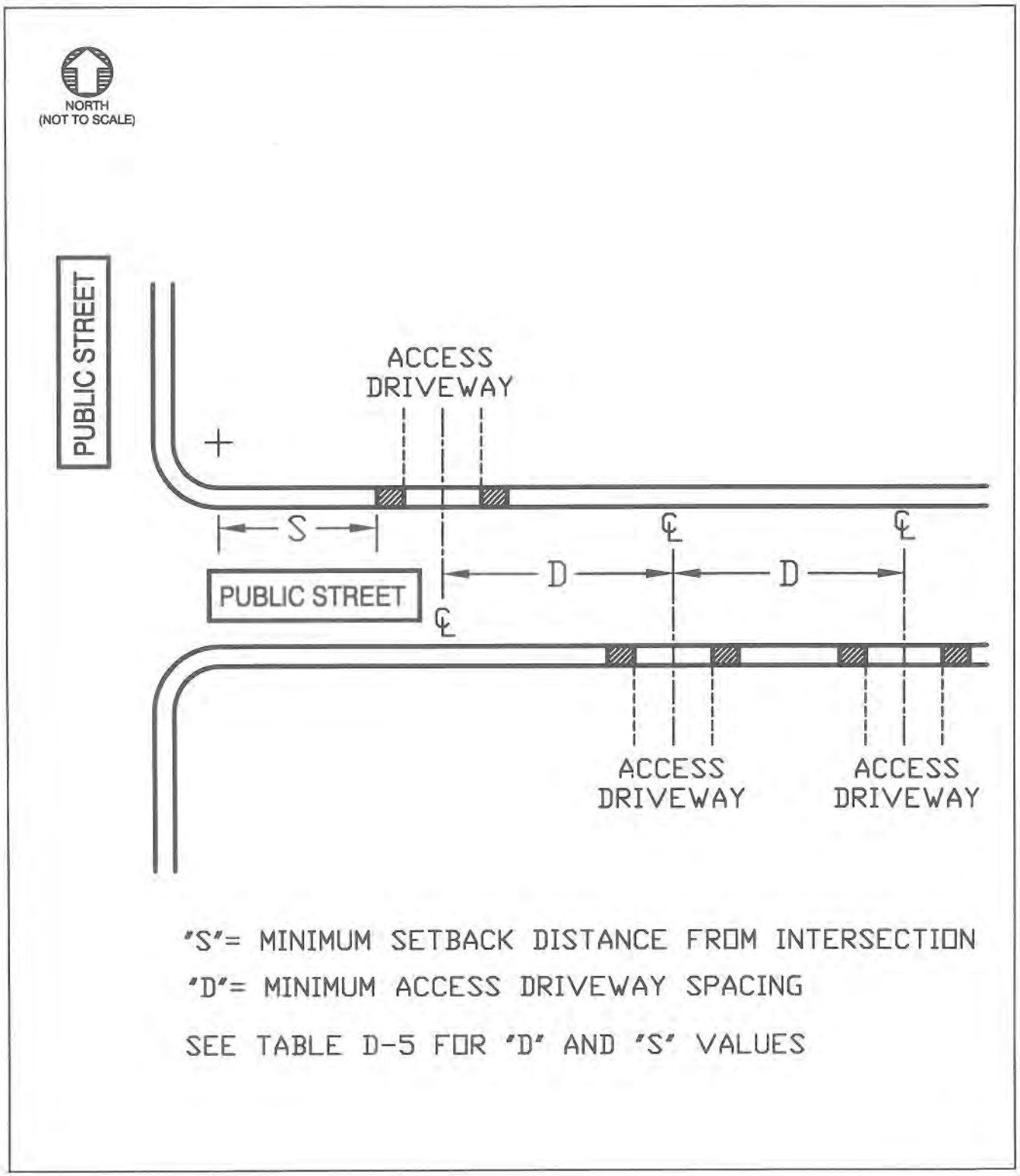
Figure D-1 illustrates the definition of "access driveway spacing" and "setback from intersecting street." As shown in Figure D-1, the access driveway spacing is defined as the distance between driveway centerlines. The minimums apply both to driveways on the same side of the street as well as driveways on opposite sides of the street. Access driveways on opposite sides of the street should be located directly opposite each other, whenever possible. If not possible, the minimum access driveway spacing shall conform to Table E-5. If these access driveway spacing standards preclude a frontage development from having an access driveway within their property, a driveway closer than the spacing standards with restricted turning movements can be considered

With the exception of shared driveways, no driveway may encroach on any neighboring frontage, and the top of the driveway ramp must start at least two feet from the property line. The intersection setback distance is defined as the distance between the intersection end of curb radius and the top of the driveway ramp. Access driveways near an intersection with a major collector or arterial shall be located beyond the average standing queue length at the intersection approach. If these intersection setback requirements prohibit access to the site, a driveway with restricted turning movements can be considered.

Pedestrian Crosswalk Spacing
Crosswalks shall be marked at all signalized intersections. Mid-block crosswalks may be considered in urbanized areas on major collector or arterial streets in the vicinity of a major pedestrian generator. For a mid-block crosswalk to be considered, the pedestrian generator must

be located at a point where it is inconvenient for pedestrians to walk to the nearest crosswalk to cross the street. The minimum distance between a mid-block crosswalk and an intersection crosswalk shall be 300 feet in fully developed urban areas (CBD or regional center) and 600 feet in other urban areas.

All designated mid-block pedestrian crosswalks shall have advance crossing warning signs per the MUTCD. Signalization of pedestrian crosswalks at locations where vehicular signal warrants are not met is appropriate where MUTCD pedestrian volume or crash experience warrants are met.



ACCESS SPACING

MOLALLA AVENUE IMROVEMENT PROJECT OREGON CITY, OREGON NOVEMBER 2000	FIGURE E-1

DWGS/TM/FI/4054FD_1

Appendix F
Street Lighting and Tree Master Plan

The Street Lighting and Tree Master Plan will be completed at a later date and included with this report at that time.

Appendix G
Cost Estimate

Assumptions:

1. All costs are in Year 2001 dollars and do not include engineering or contingency.
2. Cost estimates are for the proposed Phased Build-out Corridor Plan.
3. Sidewalk costs assume that existing sidewalks will be replaced. Sidewalk costs include associated sitework, driveway approaches, and treewells.
4. Pavement reconstruction design information is from PSI pavement evaluation.
5. Illumination costs assume single-head ornamental illuminators.
6. Utility costs assume all appurtenances such as manholes, valves, etc.
7. Curb costs include relocation or replacement of curb inlets.
8. Conduit costs assume that 4-inch PVC conduits will be installed under proposed sidewalks for future undergrounding of overhead utilities (one conduit each side of street).

Molalla Avenue Segment	Length (ft)	Item	Quantity	Unit Cost	Item Cost	Total Segment Cost
Division St - Willamette St	275	20' wide pvt - 4" inlay	5500 SF	$7	$38,500	$432,375
		20' wide pvt - 8" inlay	5500 SF	$12	$66,000	
		8' wide s/w both sides	275 LF	$75	$20,625	
		4" conduit both sides	275 LF	$20	$5,500	
		Division St. signal	1 LS	$200,000	$200,000	
		Illumination	275 LF	$100	$27,500	
		Landscaping (trees, benches, trash rec.)	275 LF	$150	$41,250	
		16" water	275 LF	$75	$20,625	
		Curb & 2' widening ea side	275 LF	$45	$12,375	
Willamette St - Logus St	253	20' wide pvt - 4" inlay	5060 SF	$7	$35,420	$213,785
		20' wide pvt - 8" inlay	5060 SF	$12	$60,720	
		8' wide s/w both sides	253 LF	$75	$18,975	
		4" conduit both sides	253 LF	$20	$5,060	
		Illumination	253 LF	$100	$25,300	
		Landscaping (trees, benches, trash rec.)	253 LF	$150	$37,950	
		16" water	253 LF	$75	$18,975	
		Curb & 2' widening ea side	253 LF	$45	$11,385	
Logus St - Roosevelt St	250	20' wide pvt - 4" inlay	5000 SF	$7	$35,000	$211,250
		20' wide pvt - 8" inlay	5000 SF	$12	$60,000	
		8' wide s/w both sides	250 LF	$75	$18,750	
		4" conduit both sides	250 LF	$20	$5,000	
		Illumination	250 LF	$100	$25,000	
		Landscaping (trees, benches, trash rec.)	250 LF	$150	$37,500	
		16" water	250 LF	$75	$18,750	
		Curb & 2' widening ea side	250 LF	$45	$11,250	
Roosevelt St - Pearl St	226	20' wide pvt - 4" inlay	4520 SF	$7	$31,640	$390,970
		20' wide pvt - 8" inlay	4520 SF	$12	$54,240	
		8' wide s/w both sides	226 LF	$75	$16,950	
		4" conduit both sides	226 LF	$20	$4,520	
		Illumination	226 LF	$100	$22,600	
		Landscaping (trees, benches, trash rec.)	226 LF	$150	$33,900	
		Pearl St. signal	1 LS	$200,000	$200,000	
		16" water	226 LF	$75	$16,950	
		Curb & 2' widening ea side	226 LF	$45	$10,170	
Pearl St - Dewey St	241	20' wide pvt - 4" inlay	4820 SF	$7	$33,740	$203,645
		20' wide pvt - 8" inlay	4820 SF	$12	$57,840	
		8' wide s/w both sides	241 LF	$75	$18,075	
		4" conduit both sides	241 LF	$20	$4,820	
		Illumination	241 LF	$100	$24,100	
		Landscaping (trees, benches, trash rec.)	241 LF	$150	$36,150	
		16" water	241 LF	$75	$18,075	
		Curb & 2' widening ea side	241 LF	$45	$10,845	

Molalla Avenue Segment	Length (ft)	Item	Quantity	Unit Cost	Item Cost	Total Segment Cost
Dewey St - Mt. Hood St.	1321	20' wide pvt - 4" inlay	31540 SF	$7	$220,780	$1,090,645
		20' wide pvt - 8" inlay	21300 SF	$12	$255,600	
		8' wide s/w both sides	1321 LF	$75	$99,075	
		4" conduit both sides	1321 LF	$20	$26,420	
		Illumination	1321 LF	$100	$132,100	
		Landscaping (trees, benches, trash rec.)	1321 LF	$150	$198,150	
		16" water	1321 LF	$75	$99,075	
		Curb & 2' widening ea side	1321 LF	$45	$59,445	
Mt. Hood St - Mountain View	290	40' wide pvt - 4" inlay	11600 SF	$7	$81,200	$211,550
		8' wide s/w both sides	290 LF	$75	$21,750	
		4" conduit both sides	290 LF	$20	$5,800	
		Illumination	290 LF	$100	$29,000	
		Landscaping (trees, benches, trash rec.)	290 LF	$150	$43,500	
		16" water	150 LF	$75	$11,250	
		12" storm	120 LF	$50	$6,000	
		Curb & 2' widening ea side	290 LF	$45	$13,050	
Mountain View - Barcley Hills	142	40' wide pvt - 4" inlay	5680 SF	$7	$39,760	$105,790
		8' wide s/w both sides	142 LF	$75	$10,650	
		4" conduit both sides	142 LF	$20	$2,840	
		Illumination	142 LF	$100	$14,200	
		Landscaping (trees, benches, trash rec.)	142 LF	$150	$21,300	
		16" water	142 LF	$75	$10,650	
		Curb & 2' widening ea side	142 LF	$45	$6,390	
Barcley Hills Dr - Hilda St / Holmes	366	40' wide pvt - 4" inlay	5680 SF	$7	$39,760	$411,150
		8' wide s/w both sides	366 LF	$75	$27,450	
		4" conduit both sides	366 LF	$20	$7,320	
		Illumination	366 LF	$100	$36,600	
		Landscaping (trees, benches, trash rec.)	366 LF	$150	$54,900	
		Hilda/Homes traffic signal	1 LS	$200,000	$200,000	
		8" water	30 LF	$40	$1,200	
		16" water	366 LF	$75	$27,450	
		Curb & 2' widening ea side	366 LF	$45	$16,470	
Hilda St / Holmes - May St	610	20' wide pvt - 4" inlay	12200 SF	$7	$85,400	$527,650
		20' wide pvt - 9" inlay	12200 SF	$13	$158,600	
		8' wide s/w both sides	610 LF	$75	$45,750	
		4" conduit both sides	610 LF	$20	$12,200	
		Illumination	610 LF	$100	$61,000	
		Landscaping (trees, benches, trash rec.)	610 LF	$150	$91,500	
		16" water	610 LF	$75	$45,750	
		Curb & 2' widening ea side	610 LF	$45	$27,450	
May St. - Harris Lane	350	20' wide pvt - 4" inlay	7000 SF	$7	$49,000	$302,750
		20' wide pvt - 9" inlay	7000 SF	$13	$91,000	
		8' wide s/w both sides	350 LF	$75	$26,250	
		4" conduit both sides	350 LF	$20	$7,000	
		Illumination	350 LF	$100	$35,000	
		Landscaping (trees, benches, trash rec.)	350 LF	$150	$52,500	
		16" water	350 LF	$75	$26,250	
		Curb & 2' widening ea side	350 LF	$45	$15,750	
Harris Lane - Warner	200	20' wide pvt - 4" inlay	4000 SF	$7	$28,000	$173,000
		20' wide pvt - 9" inlay	4000 SF	$13	$52,000	
		8' wide s/w both sides	200 LF	$75	$15,000	
		4" conduit both sides	200 LF	$20	$4,000	
		Illumination	200 LF	$100	$20,000	
		Landscaping (trees, benches, trash rec.)	200 LF	$150	$30,000	
		16" water	200 LF	$75	$15,000	
		Curb & 2' widening ea side	200 LF	$45	$9,000	

Molalla Avenue Segment	Length (ft)	Item	Quantity	Unit Cost	Item Cost	Total Segment Cost
Warner - Beverly (south)	562	20' wide pvt - 4" inlay	11240 SF	$7	$78,680	$507,850
		20' wide pvt - 9" inlay	11240 SF	$13	$146,120	
		8' wide s/w both sides	562 LF	$75	$42,150	
		4" conduit both sides	562 LF	$20	$11,240	
		Illumination	562 LF	$100	$56,200	
		Landscaping (trees, benches, trash rec.)	562 LF	$150	$84,300	
		12" storm	380 LF	$50	$19,000	
		6" water	20 LF	$36	$720	
		8" water	50 LF	$40	$2,000	
		16" water	562 LF	$75	$42,150	
		Curb & 2' widening ea side	562 LF	$45	$25,290	
Beverly (south) - Gales	400	20' wide pvt - 4" inlay	8000 SF	$7	$56,000	$351,000
		20' wide pvt - 9" inlay	8000 SF	$13	$104,000	
		8' wide s/w both sides	400 LF	$75	$30,000	
		4" conduit both sides	400 LF	$20	$8,000	
		Illumination	400 LF	$100	$40,000	
		Landscaping (trees, benches, trash rec.)	400 LF	$150	$60,000	
		12" storm	100 LF	$50	$5,000	
		16" water	400 LF	$75	$30,000	
		Curb & 2' widening ea side	400 LF	$45	$18,000	
Gales - Warner-Milne Rd	356	20' wide pvt - 4" inlay	7120 SF	$7	$49,840	$507,940
		20' wide pvt - 9" inlay	7120 SF	$13	$92,560	
		8' wide s/w both sides	356 LF	$75	$26,700	
		4" conduit both sides	356 LF	$20	$7,120	
		Illumination	356 LF	$100	$35,600	
		Landscaping (trees, benches, trash rec.)	356 LF	$150	$53,400	
		Warner-Milne Rd traffic signal	1 LS	$200,000	$200,000	
		16" water	356 LF	$75	$26,700	
		Curb & 2' widening ea side	356 LF	$45	$16,020	
Warner-Milne Rd - Beavercreek	1190	20' wide pvt - 4" inlay	22800 SF	$7	$159,600	$1,162,530
		20' wide pvt - 9" inlay	24800 SF	$13	$322,400	
		16' wide pvt - 4" inlay	19040 SF	$7	$133,280	
		8' wide s/w both sides	1190 LF	$75	$89,250	
		4" conduit both sides	1190 LF	$20	$23,800	
		Illumination	1190 LF	$100	$119,000	
		Landscaping (trees, benches, trash rec.)	1190 LF	$150	$178,500	
		12" storm	50 LF	$50	$2,500	
		18" storm	550 LF	$62	$34,100	
		8" water	1190 LF	$40	$47,600	
		16" water	700 LF	$75	$52,500	
Beavercreek - Clairmont	1121	44' wide pvt - 3.5" overlay	49324 SF	$9	$443,916	$1,131,826
		8' wide s/w both sides	1121 LF	$75	$84,075	
		4" conduit both sides	1121 LF	$20	$22,420	
		Illumination	1121 LF	$100	$112,100	
		Landscaping (trees, benches, trash rec.)	1121 LF	$150	$168,150	
		Clairmont traffic signal	1 LS	$200,000	$200,000	
		15" storm	120 LF	$56	$6,720	
		8" water	1100 LF	$40	$44,000	
		Curb & 2' widening ea side	1121 LF	$45	$50,445	
Clairmont - Gaffney	564	44' wide pvt - 3.5" overlay	24816 SF	$9	$223,344	$698,104
		8' wide s/w both sides	564 LF	$75	$42,300	
		4" conduit both sides	564 LF	$20	$11,280	
		Illumination	564 LF	$100	$56,400	
		Landscaping (trees, benches, trash rec.)	564 LF	$150	$84,600	
		Gaffney traffic signal	1 LS	$200,000	$200,000	
		12" storm	250 LF	$50	$12,500	
		16" water	564 LF	$75	$42,300	
		Curb & 2' widening ea side	564 LF	$45	$25,380	

Molalla Avenue Segment	Length (ft)	Item	Quantity	Unit Cost	Item Cost	Total Segment Cost
Caffney - Fir St	455	44' wide pvt - 3.5" overlay	20020 SF	$9	$180,180	$326,230
		8' wide s/w both sides	455 LF	$75	$34,125	
		4" conduit both sides	455 LF	$20	$9,100	
		Illumination	455 LF	$20	$9,100	
		Landscaping (trees, benches, trash rec.)	455 LF	$150	$68,250	
		12" storm	100 LF	$50	$5,000	
		Curb & 2' widening ea side	455 LF	$45	$20,475	
Fir St - Lazy Creek Ln	1800	44' wide pvt - 3.5" overlay	79200 SF	$9	$712,800	$1,463,580
		8' wide s/w both sides	1800 LF	$75	$135,000	
		4" conduit both sides	1800 LF	$20	$36,000	
		Illumination	1800 LF	$100	$180,000	
		Landscaping (trees, benches, trash rec.)	1800 LF	$150	$270,000	
		15" storm	380 LF	$56	$21,280	
		8" sanitary sewer	500 LF	$55	$27,500	
		Curb & 2' widening ea side	1800 LF	$45	$81,000	
Lazy Creek Ln - Hwy 213	585	44' wide pvt - 3.5" overlay	25740 SF	$9	$231,660	$466,530
		8' wide s/w both sides	585 LF	$75	$43,875	
		4" conduit both sides	585 LF	$20	$11,700	
		Illumination	585 LF	$100	$58,500	
		Landscaping (trees, benches, trash rec.)	585 LF	$150	$87,750	
		15" storm	120 LF	$56	$6,720	
		Curb & 2' widening ea side	585 LF	$45	$26,325	

GRAND TOTAL **$10,890,150**

Appendix H
Corridor Design Elements

This appendix will be added to the plan at a later date.

Appendix I
References

1. Metro. *1999 Regional Transportation Plan*. December 16, 1999.

2. Transportation Research Board. *Highway Capacity Manual, Special Report No. 209.* 1997.

3. United States Department of Transportation. *Manual on Uniform Traffic Control Devices (MUTCD)*. 1998.

4. Metro. *1997 Creating Livable Streets.* November 1997.