South North
Transit Corridor Study

South/North Corridor Project

Air Quality Impacts Results Report

(RR-10)

February 1998

METRO

Air Quality Impacts Results Report

South/North Transit Corridor Study
Draft Environmental Impact Statement

February 1998

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Prepared by: Metro
TW Environmental, Inc.

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S. EXECUTIVE SUMMARY

S.1 Introduction

This report documents regional and local air quality impacts of the South/North Project and compares the potential impacts of proposed light rail alternatives with existing conditions and the No-Build Alternative. Regional impacts are related to changes in vehicle miles traveled, traffic, and associated emissions throughout the Portland/Vancouver area which contribute to the formation of ozone. Localized air quality impacts are typically related to carbon monoxide (CO) pollution from increased traffic at park-and-ride facilities and modified traffic patterns at specific intersections.

S.2 Air Quality Regulations and Standards

The Federal government has established National Ambient Air Quality Standards (NAAQS) to protect the public from air pollution. In addition, the Oregon Department of Environmental Quality (DEQ) and the Washington Department of Ecology (DOE) have established State Ambient Air Quality Standards (SAAQS), which are at least as stringent as the NAAQS. (See Table 4.1-1 of this report for current ambient air quality standards in the Portland/Vancouver area). DEQ, DOE and the Southwest Washington Air Pollution Control Authority (SWAPCA) have delegation of air quality program implementation from the U.S. Environmental Protection Agency (EPA).

Geographic areas in which concentrations of a pollutant exceed the ambient air quality standards are classified as nonattainment areas. Areas previously designated as nonattainment that are now in compliance with air quality standards are classified as maintenance areas. Federal regulations require states to prepare State Implementation Plans (SIPs) that identify emission reduction strategies for nonattainment and maintenance areas. In the Oregon and Washington SIPs, DEQ and SWAPCA have identified measures to ensure compliance and maintain healthful air quality in the Portland/Vancouver area.

S.3 Existing Air Quality

Air quality has improved in the Portland/Vancouver area since the early 1980s. In April 1997, EPA redesignated the area from nonattainment to maintenance status for ground level ozone, which contributes to smog. In October 1997, EPA redesignated Vancouver and Portland as maintenance areas for CO. Ozone and CO maintenance plans are now in effect to ensure continued compliance with existing standards.

Ozone tends to be regional in nature because the chemical reactions that produce this pollutant occur over a period of time. High ozone levels typically occur downwind of Portland/Vancouver in Canby. The primary ozone precursors are nitrogen oxides (NO_x) and nonmethane hydrocarbons (NMHC), both of which react with sunlight to produce ozone. Vehicle emissions are the main source of NO_x and NMHC. Other sources include lawn mowers, other gas powered tools, and household products and paints, the use of which increases with population growth. The implementation of ozone maintenance plans is a coordinated effort between Oregon and Washington because of the regional nature of ozone formation and the expected population growth in the Portland/Vancouver area.

CO is a pollutant of local concern with highest concentrations usually measured near heavily congested intersections. Control strategies for CO have been developed separately for the Portland and Vancouver areas. The two plans are similar and focus on reducing emissions from vehicles, the primary source of CO in the Portland/Vancouver area. DEQ maintains monitoring stations for CO in two areas of Portland that typically experience maximum concentrations of CO – downtown Portland (within the South/North Corridor) and near the intersection of SE 82nd Avenue and SE Division Street (outside the corridor).

The Portland/Vancouver area is currently a designated attainment area for particulate matter. Particulate matter, including PM_{10} (particles less than 10 microns in diameter), is generated by wood stoves, open burning, industrial activities and motor vehicles.

S.4 Air Quality Impacts

S.4.1 Regional Impacts

Regional impacts to air quality are measured through forecast changes in emissions of NO_x, NMHC and CO. Compared to existing conditions, regional emissions would decrease significantly with all proposed South/North light rail alternatives (see Table 5.1-1). This reduction would be primarily due to lower emissions from the vehicle fleet as a result of future improvements in vehicle and engine technology, and more stringent vehicle inspection and maintenance programs. All of the light rail length alternatives would result in a slight improvement in air quality over the No-Build Alternative due primarily to reduced automobile usage. The Full-Length Alternative would result in the largest improvement over the No-Build Alternative, followed in order by MOS 1, MOS 5 and MOS 2. Regardless of the various alignment alternatives and the design options chosen, regional emissions for the length alternatives would not be expected to vary substantially.

S.4.2 Local Impacts

Local concentrations of CO near intersections would be affected by improvements or degradation in traffic congestion as a result of South/North alignment alternatives and design options. Localized effects would be expected where LRT operations would cause traffic delays, or where park-and-ride facilities would cause local increases in traffic volumes. Reductions in CO concentrations would be expected where grade separation or modifications to roadway configurations would improve local traffic conditions.

Twenty-two intersections were analyzed throughout the corridor to assess CO impacts. CO concentrations were forecast for up to 20 locations near each intersection (see Table 5.1-2). In most locations, future CO concentrations with the No-Build and all light rail alternatives would decrease compared to existing conditions. The LRT alternatives and options would have generally the same CO concentrations as the No-Build at most intersections. Even with minor increases at some intersections, compared to the No-Build Alternative, none of the LRT alternatives or options would result in an exceedance of the 8-hour CO standard (9 ppm).

S.4.3 Compliance with State Implementation Plans

As a result of the Clean Air Act Amendments of 1990, both Oregon and Washington developed regulations designed to ensure that transportation plans and regionally significant transportation projects are consistent (in conformance) with the State Implementation Plan (SIP). There are two parts to demonstrating conformity for transportation projects. The first requirement is that estimated pollutant emissions remain below the emissions budget for on-road mobile sources to ensure compliance with Federal ozone standards based on the projects included in the Regional Transportation Plan (RTP) for Oregon, the Metropolitan Transportation Plan (MTP) for Washington, and Transportation Improvement Plans (TIP). The second requirement for CO nonattainment or maintenance areas is that no individual project may cause an exceedance of the National Ambient Air Quality Standards (NAAQS) or an increase in the frequency or severity of an existing violation.

The South/North Light Rail Project is included in the Portland Area RTP (Metro, 1995), the 1996 Portland Area TIP (Metro, 1995), the projected 1998 Portland Area TIP (Metro, 1995), the 1996 Amendment to the Vancouver Area MTP (RTC, 1996), and the 1996 Vancouver Area TIP (RTC, 1996). These plans assume that the southern portion of the South/North LRT would be constructed by approximately 2005, and that the northern portion would be constructed by 2015. Metro and RTC have prepared regional emissions estimates and determined that the RTP, TIP and MTP are in conformance with the SIP. The conformity determinations for these plans have been reviewed and approved by the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA).

The hot spot analysis performed for the South/North DEIS analyzed localized impacts at 22 intersections potentially affected by the various South/North alignment alternatives and design options (and expected to be poorly performing). The results of the analysis showed that CO concentrations in the design year (2015) would stay below the NAAQS at all modeled locations. A full conformity analysis of the locally preferred strategy will be prepared and documented in the Final Environmental Impact Statement (FEIS). This will require additional detailed analysis for specific intersections and interim years.

S.4.4 Construction Impacts

Temporary air quality impacts could result from construction-related truck and equipment emissions, dust from excavation, dust from demolitions, and emissions from increased congestion. During construction, dust from excavation, grading, and road building would contribute to local concentrations of suspended particulates. Construction equipment, material hauling, and construction activities could affect traffic flow in the project area, contributing to idling time and, consequently, increasing emission levels in the project area.

S.5 Mitigation

All South/North light rail alternatives would result in a slight reduction of VMT and regional emissions compared with the No-Build Alternative. CO concentrations at most of the intersections modeled would decrease, and no intersections are expected to have CO concentrations in excess of

the NAAQS. Based on these findings, no negative long-term air quality impacts would occur and, therefore, no mitigation would be necessary.

Mitigation measures for short-term impacts resulting from construction activities include scheduling lane and road closures for off-peak traffic hours to the maximum extent possible. Construction contractors must comply with state regulations requiring that reasonable precautions be taken to avoid dust emissions. Mitigation measures for dust control include applying water or suppressants during dry weather and washing trucks and equipment to prevent the transport of construction dirt and dust onto nearby roads.

1. INTRODUCTION

1.1 Background

The South/North Corridor lies within the Portland/Vancouver metropolitan region (the Region) and encompasses portions of Clackamas and Multnomah Counties in Oregon and Clark County in Washington (Figure 1.1-1). The corridor is defined as a travel shed which extends north from the Oregon City area in Clackamas County, through downtown Portland and into Clark County north of Vancouver. The travel shed captures the trips that could benefit from the major transit investments being evaluated, either on light rail exclusively, or through a system of bus routes or park-and-ride lots which connect to light rail.

Light Rail Transit (LRT) connection points are defined by key activity centers within the South/North Corridor. These key activity centers include Oregon City, the Clackamas Town Center (CTC) area and the downtowns of Milwaukie, Portland and Vancouver. The corridor also includes other important centers such as the Central Eastside Industrial District, Oregon Museum of Science and Industry (OMSI), the North Macadam area, Portland State University (PSU), the Union Station/North River District area, the Rose Quarter, Portland Community College in north Portland, the Veterans Administration (VA) Medical Center and Clark College.

The South/North Corridor includes almost half of the Portland/Vancouver metropolitan region. It is characterized by high employment and residential growth with the potential for deteriorating travel conditions. In the next 20 years growth rates for population and employment in the Region are projected to be 37 percent and 47 percent, respectively. Growth in Clark and Clackamas Counties for the same period is expected to exceed these regional growth rates.

In April 1993, following the analysis of transportation, design, cost and environmental issues, the Region selected the South/North Corridor as the priority for defining and evaluating high capacity transit alternatives. The South/North Transit Corridor Study was initiated in October 1993 when the Federal Transit Administration (FTA) issued notice in the Federal Register of the intent to publish a Draft Environmental Impact Statement (DEIS) for the South/North Corridor. Because of the size of the South/North Corridor and the complexity of the issues involved, the study was divided into two tiers. In Tier I, completed in 1995, light rail was selected as the preferred high capacity transit mode and study termini. In addition, a small number of promising alignment alternatives (the locally preferred design concept and scope) were identified for further study in Tier II. The purpose of Tier II, initiated in January 1996, is to evaluate the alternatives defined in Tier I, to prepare and publish a DEIS and to select a Locally Preferred Strategy (LPS).

In response to the November 1996 failure of Ballot Measure 32, which would have secured State of Oregon funding for South/North light rail, the South/North Steering Committee and Metro Council requested that staff develop a range of options and design changes to significantly reduce project cost. This work was completed in May 1997 when the Metro Council adopted amendments to the range of alternatives to be studied in the DEIS to reflect the most promising cost-cutting measures.

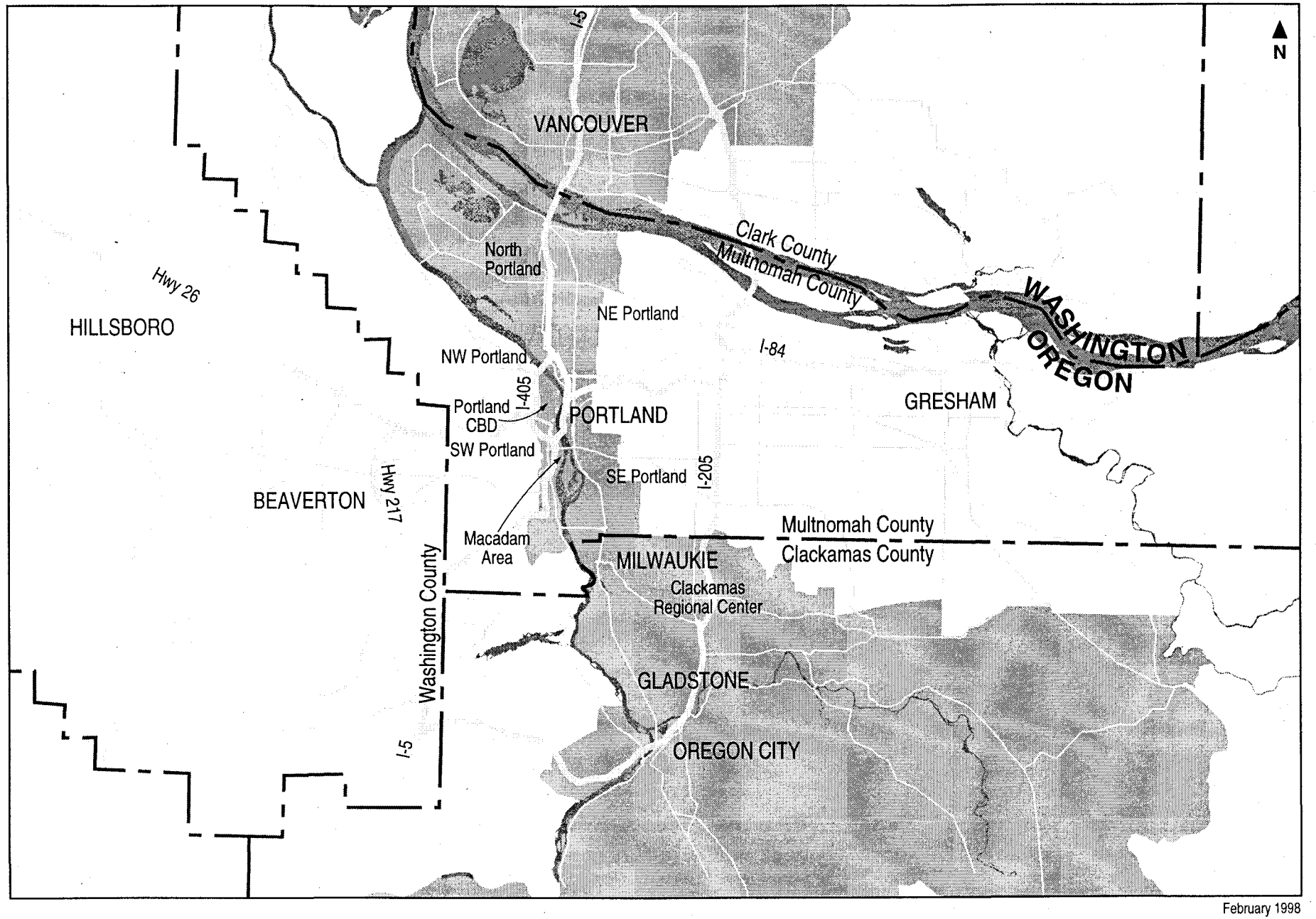

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Figure 1.1-1

South/North Corridor

Corridor

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Following is a list of documents summarizing the steps taken in the process of narrowing alternatives described above:

- **Scoping Process.** *Scoping Process Narrowing Report* (Metro: December 1993) and the *Tier I Description of Alternatives Report* (Metro: December 1993);

- **MIS Process.** *Tier I Final Report* (Metro: December 1994), the *Downtown Portland Tier I Final Report* (Metro: December 1996) and the *MIS Final Report* (Metro: November 1995);

- **Design Option Narrowing Process.** *Design Option Narrowing Final Report* (Metro: January 1996); and

- **Cost-Cutting Process.** *Cost-Cutting Measures Final Report* (Metro: May 1997).

This report contains findings and impacts which will be summarized in the DEIS and used in the selection of the LPS. The DEIS and supporting documents will provide a summary of the significant benefits, costs and environmental impacts associated with the alternatives and design options described below. Where choices are to be made between alternatives and design options, the DEIS will also summarize the trade-offs between those choices. Following publication of the DEIS and receipt of public comment, the Region will select the preferred alternatives and design options (termed the LPS) to advance into the Final Environmental Impact Statement, final design and construction. The process, criteria and measures to be used in the LPS selection process are described in the *Evaluation Methods Report* (Metro: May 1996).

1.2 Purpose and Need

The following range of problems and opportunities within the South/North Corridor and the Portland/Vancouver metropolitan region defines the purpose and need for the South/North Transit Corridor Study:

- **Growth.** Over the next 20 years, population growth for the Portland/Vancouver metropolitan region is forecast to exceed 600,000 new residents, an increase of almost 40 percent. Historical and current population and employment growth within the South/North Corridor is occurring at a faster rate than for the Region as a whole.

- **Traffic Problems.** Traffic in the South/North Corridor is exceeding the capacity of many roads and intersections within the highway system. For example, most of McLoughlin Boulevard is currently highly congested with a level-of-service of E or F. In the north, traffic across the Columbia River has almost doubled since the opening of the I-205 Bridge with projections for continued growth well into the future. This growth is causing demand to exceed capacity during peak commute periods.

- **Transit Problems.** As the highway network becomes congested, the bus system, which shares the road with cars and trucks, experiences longer travel times and high levels of unreliability. Deterioration in speed and reliability of buses increases operating costs, deters ridership and costs transit riders thousands of hours a day through longer bus trips.

- **Regional Plans.** For over 20 years, the Region has shaped its land use and transportation plans based upon the expectation that high capacity transit (HCT) would be provided within the South/North Corridor. Those plans have sized the road network, defined the comprehensive land use plans and implemented a bus network to enhance, and be served by, an HCT facility.

- **State Regulations.** Local jurisdictions in Oregon and Washington are implementing new state regulations which require the integration of transportation and land use planning. Oregon requires that the Region plan for a twenty percent reduction in the per capita vehicle miles traveled (VMT) and a ten percent reduction in the per capita number of parking spaces. In Washington, the Clark County area is required to adopt a commute trip reduction ordinance that would result in a thirty-five percent drop in trips to major employers by 1999.

- **Economic Health.** There is growing concern that reduced accessibility within the South/North corridor may reduce the Region's ability to attract and retain industrial and commercial development. In addition, requirements within Washington could limit new development if the transportation system is inadequate to handle the associated increase in demand.

- **Air Quality.** The Environmental Protection Agency (EPA) redesignated the Region as being in attainment of the federal ozone pollution standard in April 1997. EPA redesignation of the region as being in attainment of the carbon monoxide standard is anticipated in October 1997. Transit expansion is a key element of the Region's adopted Air Quality Maintenance Plans to ensure continued compliance with federal standards for these pollutants.

1.3 Definition of Alternatives

The DEIS evaluates the No-Build (All-Bus) Alternative and the proposed Light Rail Transit (LRT) Alternative for the South/North Corridor. The transit and roadway capital improvements and the transit operating improvements for the No-Build and light rail length alternatives are described in Sections 1.3.1 and 1.3.2, respectively. Characteristics about each alternative are described in more detail in the *Definition of Alternatives Compendium.*

The analysis for the DEIS is based upon the same transit fare policy, service frequency policy (policy headways), vehicle type and vehicle loading standards for all alternatives. Service policies for Tri-Met and C-TRAN are described briefly below. Consistent with adopted Tri-Met and C-TRAN policy, fares are projected to keep pace with inflation.

Tri-Met. Tri-Met currently has a three-zone fare system. In the South/North Corridor, Zone 1 extends from downtown Portland to N/NE Fremont Street in the north and SE Holgate Boulevard in the south. Zone 2 extends from N/NE Fremont Street to Jantzen Beach in the north and from SE Holgate Boulevard to SE Tacoma Street/Johnson Creek Boulevard in the south. Zone 3 extends from Jantzen Beach to Vancouver, Washington in the north and from SE Tacoma Street/Johnson Creek to Clackamas Community College in the south. Travel within one or two zones costs $1.05. The fare for travel within three zones is $1.35. Monthly passes cost $36 for one or two zones and

$46 for three zones. Fares are discounted for senior or handicapped citizens and school-aged riders. Tri-Met's policy has been to increase fares every other year, such that passenger revenue per vehicle grows at approximately an average annual rate of 4.5 percent. Transfers are free and may be used to transfer between buses and LRT. Transit trips within the downtown Portland "fareless square" zone are free. Fares for LRT and bus service are identical. There is no fee to park an automobile in a Tri-Met park-and-ride lot.

Tri-Met's weekday service policy calls for ten to 15 minutes between buses during the morning peak period (7:00 to 9:00 a.m.) and evening peak period (4:00 to 6:00 p.m.), with more frequent service if demand warrants, on most in-city bus lines and on regional radial trunk lines. Suburban local/feeder buses are to run every 30 minutes during peak periods. During midday periods, buses on most in-city bus lines run every 15 minutes, and buses on suburban bus lines run every 30 minutes. Most bus lines operate every 30 minutes or less frequently after 9:30 p.m.

Tri-Met operates standard 40-foot buses accommodating 44 seated and 20 standing passengers; 60-foot articulated buses accommodating 64 seated and 47 standing; and 88-foot light rail vehicles (LRVs) seating 76 with room for 90 standing passengers. LRVs are operated in either one-car or two-car train configurations, depending upon demand and vehicle availability.

C-TRAN. C-TRAN currently has a four-zone fare system. Zone 1 extends from downtown Portland to N/NE Fremont Street, Zone 2 extends from N/NE Fremont Street to Jantzen Beach, Zone 3 extends from Jantzen Beach to NE 134th Street and Zone 4 extends from NE 134th Street to Ridgefield and La Center. Zone fares are $0.60 for one zone, $0.85 for two zones, $1.10 for three zones and $1.35 for four zones. Monthly passes are set at $18 for one zone, $25 for two zones, $32 for three zones and $40 for four zones. Discounts are offered to seniors. C-TRAN's service policy calls for an average 15 minutes between buses on the heavily used urban routes and 30 minutes on all other routes. C-TRAN operates seventeen 25-foot buses each seating 16; twenty-five 30-foot buses each seating 30; twenty-two 35-foot buses each seating 37; and forty-seven 40-foot buses each seating 45. In addition, C-TRAN also operates a van-pool program that includes seven vehicles each seating 15.

Table 1.3-1 summarizes the transit and roadway capital improvements that would be included within the No-Build and light rail alternatives. Table 1.3-2 summarizes the transit vehicles and service characteristics of the No-Build and light rail alternatives. Table 1.3-3 summarizes the primary transit facilities that would be included with the No-Build and light rail alternatives.

1.3.1 No-Build (All-Bus or Transportation Systems Management) Alternative

The bus service network, related facilities and roadway improvements for the No-Build (All-Bus) Alternative would be consistent with the *1995 Interim Federal Regional Transportation Plan's* (Metro: July 1995) financially constrained transit and road network.

Through consultation with the FTA, it was determined that the financially constrained transit network used within the RTP and in the DEIS as the No-Build Alternative would serve in lieu of the

Transportation Systems Management (TSM) Alternative and as the baseline for calculating a Federal cost effectiveness index. This agreement was based upon the recognition that the financially

Table 1.3-1
Summary of Transit and Roadway Capital Improvements: No-Build and Light Rail Length Alternatives [1,2]

Alternative	Transit Improvements [3]		Road Improvements [4]
No-Build Alternative	**Tri-Met:** • Existing 1994 service • 1994 Annual Service Plan Improvements • 1995 service improvements • Westside MAX/Bus routes • Primary Transit Network Trunklines • Tri-Met service standards • Annual service level improvements.	**C-TRAN:** • Existing 1994 Service • 1994 Annual Service Plan • 1995 service improvements • Urban Transit Routes • Commuter Express Routes • Annual service level improvements. Annual service level improvements would increase the systemwide average weekly revenue vehicle hours from 28,600 in 1994 to 39,750 in 2015, a 39 percent increase.	Road improvements are limited to those in the RTP's financially constrained highway network.
Full-Length Alternative: Clackamas Regional Center to VA Medical Center/Clark College	Adjustment from No-Build bus network to: 1) eliminate or modify routes that would duplicate light rail service; and 2) modify routes to connect to light rail stations or modified transit centers. 20.6-mile, double-tracked new LRT alignment from the Clackamas Regional Center to Clark College (Vancouver, WA). A new LRT O&M facility would be sited at one of three locations. The Full-Length Alternative includes 37-42 LRT stations, depending on the specific alignment alternatives. Transit centers are located at Clackamas Town Center, downtown Milwaukie, downtown Portland transit mall, Rose Quarter and downtown Vancouver, (7th Street). The Full-Length Alternative includes park-and-ride facilities with capacity for 3,500 - 4,100 parking spaces in the southern portion of the corridor and 3,500 - 3,900 parking spaces in the northern portion of the corridor.		Road improvements include those in the RTP's financially constrained highway network and other changes specific to the alignment alternatives and design options under study.
MOS 1: Milwaukie Marketplace to VA Medical Center/Clark College	Adjustment from No-Build bus network to: 1) eliminate or modify routes that would duplicate light rail service; and 2) modify routes to connect to light rail stations or modified transit centers. 16.7-mile, double-tracked new LRT alignment from the Milwaukie Regional Center to Clark College (Vancouver). LRT stations, transit centers and park-and-ride facilities for this MOS are the same as for the corresponding segments of the LRT Full-Length Alternative. MOS 1 includes park-and-ride facilities with capacity for 1,300 parking spaces in the southern portion of the corridor and 3,500 - 3,900 parking spaces in the northern portion of the corridor. A new LRT O&M facility would be located at one of three locations.		Road improvements include those in the RTP's financially constrained highway network and other changes specific to the alignment alternatives and design options under study.
MOS 2: Clackamas Regional Center to Rose Quarter Transit Center	Adjustment from No-Build bus network to: 1) eliminate or modify routes that would duplicate light rail service; and 2) modify routes to connect to light rail stations or modified transit centers. 11.7-mile, double-tracked new LRT alignment from the Clackamas Regional Center to the Rose Quarter Transit Center.		Road improvements include those in the RTP's financially constrained highway network and other changes specific to the alignment alternatives and design options under study.

Alternative	Transit Improvements [3]	Road Improvements [4]
	LRT stations, transit centers and park-and-ride facilities for this MOS are the same as for the corresponding segments of the LRT Full-Length Alternative. MOS 2 includes park-and-ride facilities with capacity for 3,500 - 4,100 parking spaces in the southern portion of the corridor. No new facilities would be sited in the northern portion of the corridor. A new LRT O&M facility would be located at one of three locations.	
MOS 5: Clackamas Regional Center to N Lombard Street	Adjustment from No-Build bus network to: 1) eliminate or modify routes that would duplicate light rail service; and 2) modify routes to connect to light rail stations or modified transit centers. 15.3-mile, double-tracked new LRT alignment from the Clackamas Regional Center to N Lombard Street in north Portland. LRT stations, transit centers and park-and-ride facilities for this MOS are the same as for the corresponding segments of the LRT Full-Length Alternative. A new LRT O&M facility would be located at one of three locations.	Road improvements include those in the RTP's financially constrained highway network and other changes specific to the alignment alternatives and design options under study.

Source: *Definition of Alternatives Compendium* (Metro: February 1998).
Note: RTP=Regional Transportation Plan; VA=Veterans Administration; LRT=Light Rail Transit; O&M=Operating and Maintenance; and MOS=Minimum Operable Segment.

[1] MOS 3 and 4 were eliminated from further study during Cost-Cutting.

[2] Length Alternatives are based upon a common set of alignment alternatives and terminus and design options, see Section 1.3.2.1.1. Characteristics will vary depending upon which alignment alternatives and terminus and design options are selected as a part of the Locally Preferred Strategy.

[3] Refer to Sections 5 and 7 of the *Definition of Alternatives Compendium* for maps and descriptions of the transit routes included within each alternative.

[4] Refer to Section 15, Financially Constrained RTP Highway Atlas, of the *Definition of Alternatives Compendium* for a list of the highway improvements included in the alternatives.

constrained transit network included service increases and service improvement measures typically found in a TSM Alternative (see the *Major Investment Study Final Report*, pp. 42, 44; Metro: November 1995).

1.3.1.1 Capital Improvements

Transit Improvements. Under the No-Build Alternative, the Salmon Creek park-and-ride lot would be expanded to approximately 500 spaces, and a new park-and-ride lot would be constructed at Central County (approximately 500 spaces). Other capital improvements, such as additional shelters and buses, would be made to the existing transit system through Tri-Met's and C-TRAN's capital improvement programs, which are included within the transit districts' financial plans.

Roadway Improvements. The No-Build Alternative would include those highway improvements currently identified in the *1995 Interim Federal Regional Transportation Plan* and RTC's 1994 *Metropolitan Transportation Plan*. Following is a list of the significant roadway improvements that would occur within the South/North Corridor under the No-Build Alternative. Refer to the *Definition of Alternatives Compendium* for a more detailed list of the roadway improvements for the No-Build Alternative.

Table 1.3-2
Transit Vehicles [1] and Service Characteristics: No-Build and LRT Length Alternatives [2,3]

		No-Build	Full-Length	MOS 1 (Bi-State)	MOS 2 (Rose Quarter)	MOS 5 (Lombard)
Number of Transit Vehicles [1] – South/North Corridor						
BUSES						
Tri-Met	In Service	346	318	309	325	328
	In Service with Spares	433	398	386	406	410
C-TRAN	In Service	91	82	86	89	92
	In Service with Spares	114	103	108	111	115
LRV	In Service	0	50	42	30	34
	In Service with Spares	0	59	50	36	41
Number of Transit Vehicles – Systemwide						
BUSES						
Tri-Met	In Service	636	610	601	617	616
	In Service with Spares	795	763	751	771	770
C-TRAN	In Service	120	110	115	118	121
	In Service with Spares	150	138	144	148	151
LRV	In Service	68	118	110	98	102
	In Service with Spares	80	139	130	116	121
Transit VMT [4] (Weekday)						
South/North Corridor	Bus	50,300	49,100	49,300	49,800	49,600
	LRV	0	4,910	3,670	2,800	3,190
Non-Corridor	Bus	52,800	53,000	53,000	53,000	53,000
	LRV	7,500	7,500	7,500	7,500	7,500
Systemwide	Bus	103,100	102,100	102,300	102,800	102,600
	LRV	7,500	12,410	11,170	10,300	10,690
Place Miles [5] (Weekday)						
South/North Corridor	Bus	3,319,800	3,240,600	3,253,800	3,286,800	3,273,600
	LRV	0	1,630,120	1,218,440	929,600	1,059,080
Non-Corridor	Bus	3,484,800	3,498,000	3,498,000	3,498,000	3,498,000
	LRV	2,490,000	2,490,000	2,490,000	2,490,000	2,490,000
Systemwide	Bus	6,840,600	6,738,600	6,571,800	6,784,800	6,771,600
	LRV	2,490,000	4,120,120	3,708,440	3,419,600	3,549,080
Revenue Hours (Weekday)						
South/North Corridor	Bus	3,290	3,100	3,090	3,170	3,180
	LRV	0	298	238	176	198
Non-Corridor	Bus	3,300	3,300	3,300	3,300	3,300
	LRV	354	354	354	354	354
Systemwide	Bus	6,590	6,400	6,390	6,470	6,480
	LRV	354	652	592	530	552

Source: Metro, Tri-Met, 1997.

[1] LRV = Light rail vehicles.

[2] MOS 3 and 4 were eliminated from further study during Cost-Cutting.

[3] Length Alternatives are based upon a common set of alignment alternatives and terminus and design options, see Section 1.3.2.1.1. Characteristics will vary depending upon which alignment alternatives and terminus and design options are selected as a part of the LPS.

[4] VMT = Revenue Vehicle Miles Traveled.

[5] Place Miles = Transit Vehicle Capacity (seated and standing) multiplied by VMT.

Table 1.3-3
Primary Transit Facilities: No-Build and Light Rail Length Alternatives[1,2]

Length Alternatives	One-way South/North LRT Track Miles	South/North Stations[3]	South/North Park-and-Ride Lots	South/North Park-and-Ride Spaces	Maintenance Facility-Land (acres)/Bldg. (sq ft)[4]
No-Build	0	0	0	0	0/0
Full-Length	20.6	37	6	8,000	23.0/89,000
MOS 1 (Bi-State)	16.7	32	3	5,200	22.8/75,109
MOS 2 (Rose Quarter)	11.7	22	5	4,100	18.8/54,817
MOS 5 (Lombard)	15.3	28	5	4,100	20.9/65,000

Source: *Definition of Alternatives Compendium* (Metro: February 1998).

[1] MOS 3 and 4 were eliminated from further study as a result of the Cost-Cutting process.

[2] Length Alternatives are based upon a common set of alignment alternatives and terminus and design options, see Section 1.3.2.1.1. Characteristics will vary depending upon which alignment alternatives and terminus and design options are selected as a part of the LPS.

[3] Two additional stations are currently under study and are not reflected in these totals. One could be located in the south entry of downtown on SW Harrison Street and the other could be located in North Portland between the Expo Center and Portland International Raceway.

[4] Based upon a proposed maintenance facility at Brooklyn Yard; other sites are under study that could be larger or smaller than the Brooklyn Yard site.

- Greeley/North Banfield Phase II (excluding the NE First Avenue frontage road between NE Holladay and NE Weidler Streets);
- SW Harrison Street Connector between SW Front Avenue and SW Moody Avenue;
- SE Monterey Avenue overpass of I-205 with a new frontage road to SE Sunnyside Road;
- Reconstruction of SE Sunnybrook Street and SE Sunnyside Road intersections with I-205 into a split-diamond interchange;
- Extension of SE Sunnybrook Street between I-205 and SE Sunnyside Road; and
- Extension of SE Water Avenue from OMSI to SE Division Place.

1.3.1.2 Operating Characteristics

Bus Operations. The No-Build Alternative would provide peak-hour, trunkline bus service between the Portland CBD and the South/North Corridor, with buses operating on an average headway of four minutes and 3.5 minutes in the southern and northern portions of the corridor, respectively. Other buses would operate at the frequencies presented below. Current, peak-period-only bus lines would be upgraded to all-day operations. New routes, feeder buses and shuttle bus service would be added to meet trunkline buses at transit centers. Buses in the South/North Corridor would continue to operate in mixed traffic on increasingly congested streets and highways.

The No-Build bus system would provide approximately 39,750 of weekly revenue hours, 39 percent more than is currently provided. The No-Build Alternative is constrained by what would be funded through revenue sources by the year 2015 consistent with the *1995 Interim Federal RTP*. The service improvements associated with the No-Build Alternative include the following significant changes to the existing bus network:

Tri-Met

- All existing transit service that was new in 1995 and not included in the 1994 base network;
- All routes identified as Recommended New Routes in the *1994 Tri-Met Multimodal Annual Service Plan*;
- Recommended headway and route improvements suggested in the Tri-Met's annual service plan;
- All routes and headways proposed in the LRT Build Alternative in the *Hillsboro Corridor Final Definition of Alternatives Report* (Metro: October 1992) for the Hillsboro Corridor;
- All routes identified as "Trunkline Bus" in the Tri-Met Primary Transit Network (Tri-Met: September 1995), with minimum all-day headway of ten minutes are included in the No-Build network (These include: Routes 4 Division; 6 King/Lombard; 14 Hawthorne; 14 Sandy (12 Sandy); 15 Belmont; 15 NW 23rd Avenue; 33 McLoughlin; 35 Macadam; 54 Beaverton-Hillsdale; 66 Tualatin Valley Highway (57 Forest Grove); 72 Killingsworth/82nd Avenue);
- All Tri-Met fixed-routes (existing and future) would be at minimum policy headway as outlined in *Tri-Met Service Standards* (Tri-Met: May 1989) (These include: Urban Grid Routes, Regional/Urban Trunks (10 Peak; 15 Base), City Radials and Crosstown (15 Peak; 15 Base); and Suburban Timed Transfer, Regional Trunks (15 Peak; 30 Base), Suburban Radials/Feeders (30 Peak; 30 Base) and Peak-Only Radials/Feeders (30 Peak); and
- Light rail headway and routing would be as proposed in the Tri-Met FY 96 *Rail Operations Five Year Plan,* including a Gresham to Hillsboro line with a 10-minute base headway.

C-TRAN

- All existing transit service that was new in 1995 and not included in the 1994 base network;
- New routes, route improvements, service hour changes and headway adjustments recommended in the Service Plan of C-TRAN's *1996-2001 Transit Development Plan*;
- C-TRAN urban routes experiencing high ridership and increasing demand to provide service at 15-minute headways or less all day (These include: Routes 3 Rosemere/Brandt; 4 Fourth Plain; 6 Hazel Dell; 32 Evergreen; 37 Mill Plain; 38 MacArthur/Cascade Park; and 71 Highway 99); and
- C-TRAN's highly productive commuter express routes (existing and future) operating at 10-minute to 12-minute headways during the peak periods, and the addition or expansion of midday service.

Refer to Section 7 of the *Definition of Alternatives Compendium* for a complete listing of bus route changes for the No-Build Alternative.

LRT Operations. With the No-Build Alternative, LRT service would operate between Gresham, downtown Portland, Beaverton and Hillsboro with 6-minute peak and 10-minute daybase headways. One extra peak-hour run from Portland CBD to Gresham would be operated at a 60 minute headway

to accommodate demand. There would be no light rail service within the South/North Corridor under the No-Build Alternative.

1.3.2 Light Rail Alternatives

Light rail alternatives include a range of length alternatives, alignment alternatives, design options and terminus options. Following is a description of how these four terms are used to define the Light Rail Alternatives evaluated for the DEIS (see Figure 1.3-1):

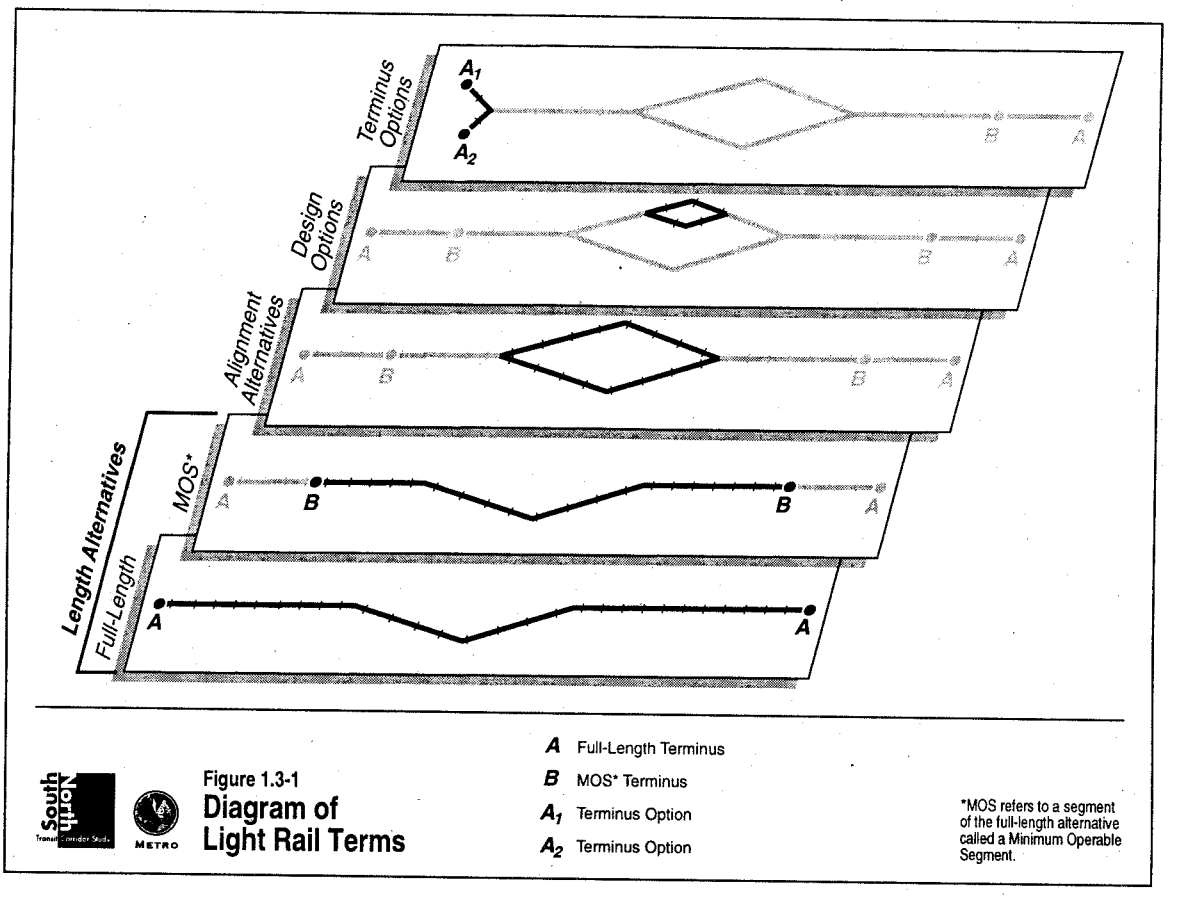


Figure 1.3-1
Diagram of Light Rail Terms

- **Length Alternatives.** Length alternatives specify alternatives that vary in the designation of south and north terminus points (and thus, the overall length of the project) for the proposed light rail line. Length alternatives other than the Full-Length Alternative are considered to be interim phases of the full South/North Project and are termed Minimum Operable Segments (MOSs);
- **Alignment Alternatives.** Alignment alternatives specify the general location of light rail alignment choices within a given segment of the South/North Corridor;
- **Design Options.** Design options specify detailed route choices within an alignment alternative; and
- **Terminus Options.** Terminus options are alternate sites or facility configurations for the northern or southern terminus location associated with a length alternative.

The discussions of light rail alternatives and options for the DEIS will generally follow this hierarchy, starting with the larger-scale length alternatives, moving to alignment alternatives and noting the more detailed and smaller-scale design and terminus options where appropriate.

Figure 1.3-2 provides a graphic illustration of the alternatives and options evaluated for the DEIS and how they interrelate. Figure 1.3-3 provides a key of the station names and locations used to describe the light rail alternatives and options. Following is a description of those length and alignment alternatives and design and terminus options. Capital improvements are discussed first (transit then roadway improvements) and transit operations improvements are discussed second. Within these two broad categories, length alternatives are discussed first followed by a segment-by-segment discussion of the alignment alternatives and design and terminus options.

1.3.2.1 Capital Improvements

Following is a description of the capital improvements that would be associated with the light rail length and alignment alternatives. Capital improvements include both transit and roadway facilities.

1.3.2.1.1 Length Alternatives

Following are the length alternatives evaluated for the DEIS:

- **Full-Length.** The Full-Length Alternative from the Clackamas Regional Center in Clackamas County to the Veterans Administration (VA) Medical Center/Clark College in Vancouver, Washington and three other alternatives (MOSs) that vary based on their northern and southern terminus points;

- **MOS 1 (Bi-State).** MOS 1 would extend from the Milwaukie Marketplace to VA Medical Center/Clark College;

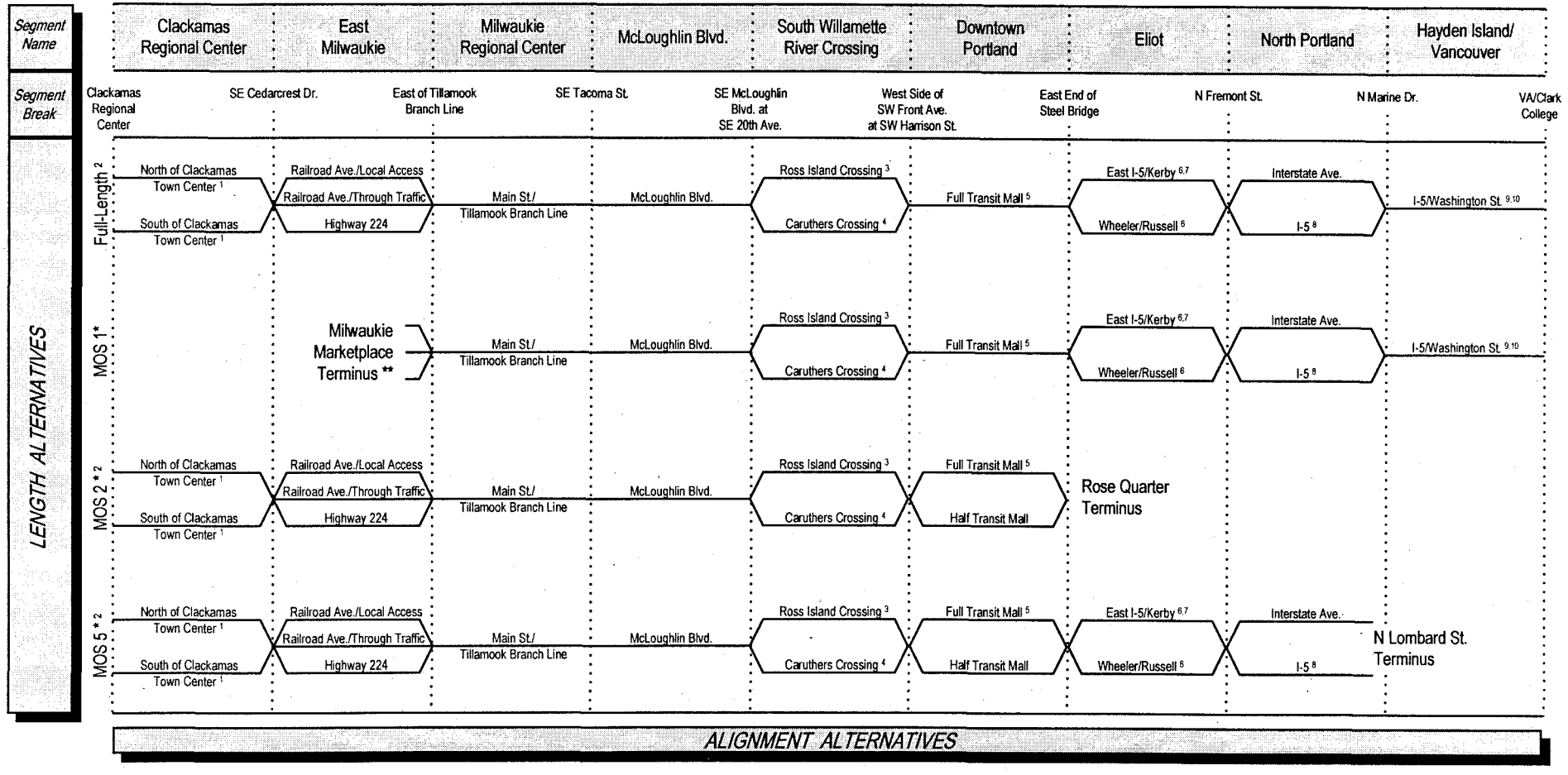
- **MOS 2 (Rose Quarter).** MOS 2 would extend from the Clackamas Regional Center to the Rose Quarter area in northeast Portland; and

- **MOS 5 (Lombard).** MOS 5 would extend from the Clackamas Regional Center to N Lombard Street in North Portland.

Note that the previously studied MOS 3, from the Clackamas Regional Center to the Edgar Kaiser Medical Center, and MOS 4, from the Clackamas Regional Center to the Expo Center, were replaced with MOS 5 as a result of the Cost-Cutting process.

The analysis of length alternatives contained in this DEIS is based upon a common set of alignment alternatives and terminus and design options, summarized in Table 1.3-4. The analysis of alignment alternatives and terminus and design options indicate how the results of the length alternatives analysis would change depending on which alternatives and options are selected as an element of the LPS.

Figure 1.3-2
South/North Light Rail Alternatives and Design Options



Design Options

1 South or North of CTC Alignment
- South of OIT/CCC Design Option
- North of OIT/CCC Design Option

2 Clackamas Regional Center Terminus Options
- North of CTC Transit Center Terminus Option
- South of CTC Transit Center Terminus Option
- 93rd Avenue Terminus Option
- 105th Avenue Terminus Option

3 Ross Island Crossing
- East of McLoughlin Blvd. Design Option
- West of McLoughlin Blvd. Design Option

4 Caruthers Crossing
- Moody Avenue Design Option
- South Marquam Design Option

5 North Entry Downtown Alignment
- Glisan St. Design Option
- Irving St. Design Option

6 Rose Quarter Transit Center
- At-Grade Rose Quarter Transit Center
- Multi-Level Rose Quarter Transit Center

7 East I-5-Broadway/Weidler
- At-Grade Design Option
- Grade-Separated Design Option

8 I-5 Alignment
- Modify Alberta Ramps Design Option
- Retain Alberta Ramps Design Option

9 Downtown Vancouver Alignment
- West side of Washington St. Design Option
- East side of Washington St. Design Option

10 North Terminus Park-and-Ride
- Surface VA Park-and-Ride Design Option
- Structured VA Park-and-Ride Design Option

Notes

* *MOS refers to a segment of the Full-Length alternative called a minimum operable segment.*

** *The configuration of Railroad Avenue/Local Access and Railroad Avenue/Through Traffic alternatives are identical between the Tillamook Branch Line and the Milwaukie Marketplace station.*

Schematic is not to scale.

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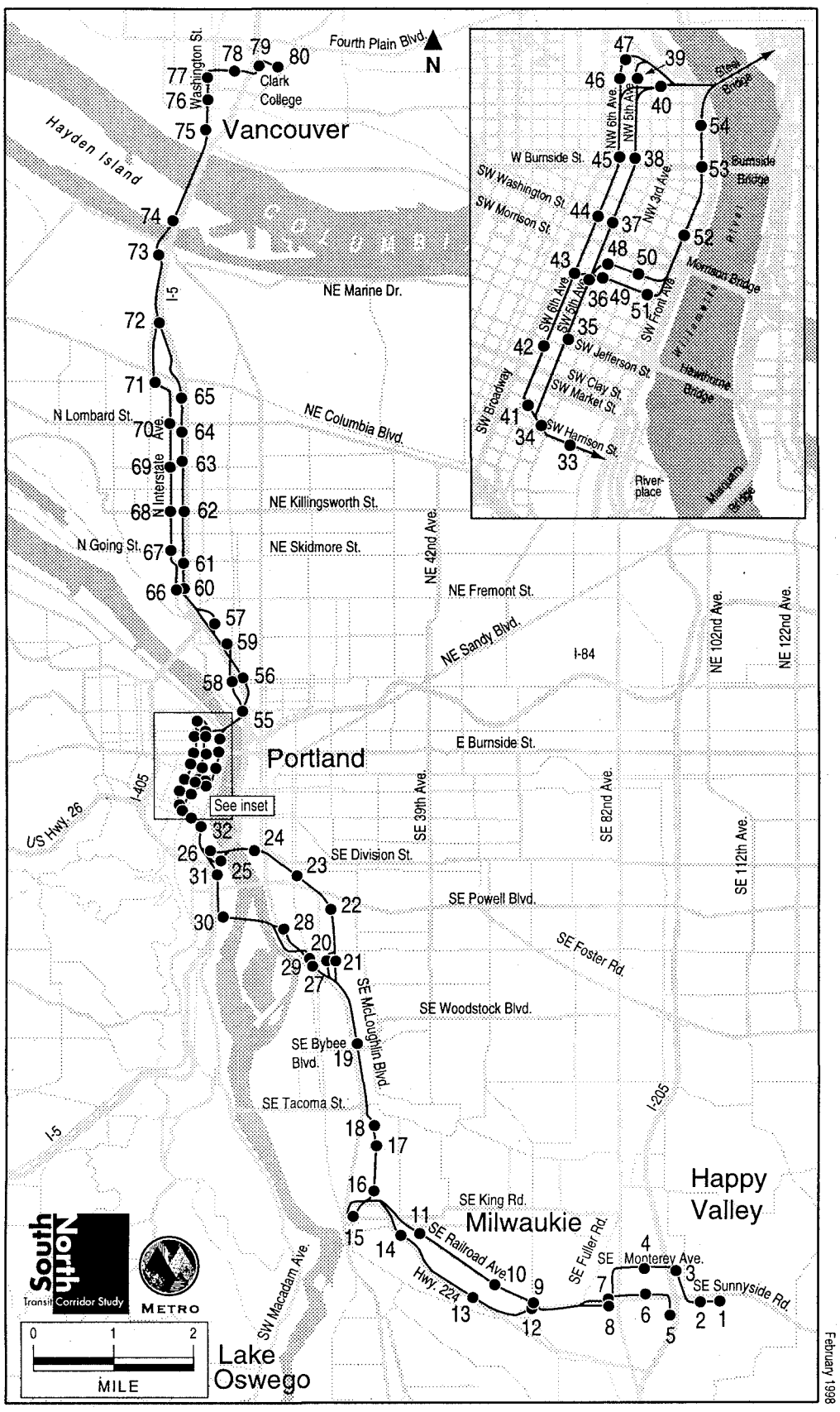


Figure 1.3-3

South/North Corridor Station Names

LRT Alignment Alternative

Station

Note: Alignment and station locations are currently under study and may change.

ID#	Station Names
80	Clark College Station
79	VA Station
78	Arnada Station
77	Uptown Station
76	Civic Center Station
75	Downtown Vancouver TC
74	Hayden Island Station
73	Expo Center Station
72	PIR Station (Under Study)
71	Kenton Station W
70	Lombard Station W
69	Portland Blvd. Station W
68	Killingsworth Station W
67	Going Station
66	Edgar Kaiser Station W
65	Kenton Station E
64	Lombard Station E
63	Portland Blvd. Station E
62	Killingsworth Station E
61	Skidmore Station
60	Edgar Kaiser Station E
59	Russell Station
58	Broadway Station W
57	Kerby Avenue Station
56	Broadway Station E
55	Rose Quarter TC
54	Old Town/Chinatown Station
53	Skidmore Fountain Station
52	Oak Street Station
51	Yamhill District Station
50	3rd Avenue Station
49	Pioneer Place - Morrison Station
48	Pioneer Place - Yamhill Station
47	Irving Station NB (North Option)
46	Irving Station NB (South Option)
45	Burnside Station NB
44	Washington Station NB
43	Taylor Station NB
42	Jefferson Station
41	PSU Station NB
40	Glisan Station (Option)
39	Irving Station SB (Option)
38	Burnside Station SB
37	Washington Station SB
36	Taylor Station SB
35	City Hall Station
34	PSU Station SB
33	Harrison Street Station (Under Study)
32	RiverPlace Station
31	Porter Street Station
30	Gaines Street Station
29	Schiller Street Station N (Option)
28	Center Street Station (Option)
27	Schiller Street Station S (Option)
26	North Marquam Station (Option)
25	South Marquam Station (Option)
24	OMSI Station
23	Clinton Street Station
22	Lafayette Street Station
21	Holgate w/o MF Station (Option)
20	Holgate w/ MF Station (Option)
19	Bybee Station
18	Tacoma Street Station (Option)
17	Ochoco Station (Option)
16	Hanna-Harvester Station (Option)
15	Milwaukie Transit Center
14	Milwaukie Marketplace Station W
13	Freeman Way Station
12	Linwood/Harmony Station S
11	Milwaukie Marketplace Station E
10	Wood Avenue Station (Option)
9	Linwood/Harmony Station N
8	OIT/Aquatic Center Station S (Option)
7	OIT/Aquatic Center Station N (Option)
6	South CTC Transit Center
5	93rd Avenue Station
4	North CTC Transit Center
3	New Hope Church Station
2	Kaiser Sunnyside Station
1	Sunnyside/105th Avenue Station

Table 1.3-4
Alignment Alternatives and Design Options Used for Length Alternative Analysis

Segment	Alignment Alternative	Design Option	Terminus Options
Clackamas Regional Center	South of CTC	South of OIT/CCC	SE 93rd Avenue
East Milwaukie [1]	Railroad Avenue/ Through Traffic	N/A	N/A
Milwaukie Regional Center [2]	Main Street/Tillamook Branch Line	N/A	N/A
McLoughlin Boulevard [3]	McLoughlin Boulevard	N/A	N/A
South Willamette River Crossing [4]	Ross Island	East of McLoughlin Blvd.	N/A
Downtown Portland	Full Transit Mall	Glisan Street	N/A
Eliot	East I-5/Kerby	Grade-Separated Broadway/Weidler and Multi-Level Rose Quarter TC [5]	N/A
North Portland	I-5	Retain Alberta Ramps	N/A
Hayden/Island Vancouver [6]	I-5/Washington Street	Eastside of Washington Street	Structured P&R Lot

Source: *South/North Definition of Alternatives Compendium* (Metro: February 1998).
[1] With Wood Avenue Station.
[2] With a Tacoma Street park-and-ride lot.
[3] With rebuilding of Bybee Overpass.
[4] Concrete segmental bridge type with a Brooklyn Yard maintenance facility.
[5] MOS 2 is based upon minimal improvements to the Rose Quarter Transit Center and at NE 11th Avenue and NE Holladay Street.
[6] Bow-string bridge type for Columbia River Crossing.

A. Transit Improvements

Full-Length Alternative – Clackamas Regional Center to VA Medical Center/Clark College

The Full-Length Alternative would consist of an approximately 21-mile, double-tracked LRT alignment from the Clackamas Regional Center to the VA Medical Center/Clark College in Vancouver, Washington. There are several terminus options for the Full-Length Alternative. The south terminus would be at one of four possible locations: 1) SE Sunnyside Road and SE 105th Avenue; 2) SE Sunnybrook Road and SE 93rd Avenue; 3) SE Monterey Avenue just north of the Clackamas Town Center; or 4) the north side of SE Sunnyside Road just south of the Clackamas Town Center (see Section 1.3.2.1.2 for more detail). The north terminus would be at a station near Clark College in Vancouver, Washington.

In the southern portion of the corridor, the Full-Length Alternative, with a terminus at either SE 93rd Avenue or SE 105th Avenue, would have park-and-ride capacity of approximately 4,100 spaces. With a terminus at a transit center just north or south of the Clackamas Town Center, park-and-ride capacity in the south would be approximately 3,500 spaces. In the northern portion of the corridor, two different park-and-ride lot configurations are possible with total capacity ranging from approximately 3,500 to 3,900 spaces (see Section 1.3.2.1.2 for more detail).

The Full-Length Alternative would include between 38 and 42 LRT stations (counting the six possible paired stations in downtown Portland as single stations) depending on the specific alignment alternatives and station locations under study. Transit centers would be located at the Clackamas Town Center (CTC) Mall, downtown Milwaukie, Portland State University, downtown Portland transit mall, Rose Quarter and downtown Vancouver (W 7th Street).

MOS 1 – Milwaukie Regional Center to VA Medical Center/Clark College

MOS 1 would be an approximately 17-mile, double-tracked LRT alignment from the Milwaukie Regional Center to VA Medical Center/Clark College in Vancouver, Washington. LRT stations, transit centers and park-and-ride facilities for this MOS would be the same as for the corresponding segments of the Full-Length Alternative. The south terminus would be the Milwaukie Marketplace station, instead of a Clackamas Regional Center southern terminus with the Full-Length Alternative (see Section 1.3.2.1.2 for more detail). The north terminus would be the same as with the Full-Length Alternative.

In the southern portion of the corridor, only a North Milwaukie park-and-ride lot (approximately 900 spaces) and the Milwaukie Marketplace park-and-ride lot (approximately 400 spaces) would be built under MOS 1. In the northern portion of the corridor, the park-and-ride lot would be the same as for the Full-Length Alternative. In the northern portion of the corridor, two different park-and-ride lot configurations are possible with total capacity ranging from approximately 3,500 to 3,900 spaces (see Section 1.3.2.1.2 for more detail).

MOS 2 – Clackamas Regional Center to Rose Quarter

MOS 2 would be an approximately 12-mile, double-tracked alignment from the Clackamas Regional Center to the Rose Quarter Transit Center continuing along the existing MAX line to a turn-around point in the vicinity of NE 11th Avenue and NE Multnomah Boulevard. LRT stations, transit centers and park-and-ride facilities for this MOS would be the same as for the corresponding segments of the Full-Length Alternative. The south terminus would be the same as for the Full-Length Alternative and the north terminus would be at the Rose Quarter (see Section 1.3.2.1.2 for more detail). Alternate north terminus locations could be in Kenton, either at the Kenton East Station or the Kenton West Station, or at the Expo Center.

The location and capacity of park-and-ride lots in the southern portion of the corridor would be identical to the Full-Length Alternative. A new park-and-ride lot would be developed in the northern portion of the corridor at Central County (approximately 500 spaces) and Salmon Creek park-and-ride lot would be expanded to approximately 500 spaces, identical to the No-Build (All-Bus) Alternative.

MOS 5 – Clackamas Regional Center to North Lombard Street

MOS 5 would be an approximately 16-mile, double-tracked alignment from the vicinity of the CTC to N Lombard Street in north Portland. The south terminus and LRT stations, transit centers and park-and-ride facilities for this MOS would be the same as for the corresponding segments of the Full-Length Alternative. The north terminus would be at the N Lombard Street station either at N Interstate Avenue or between I-5 and N Montana Avenue (see Section 1.3.2.1.2 for more detail). Alternate north terminus sites could be located at Kenton or the Expo Center.

The location and capacity of park-and-ride lots in the southern portion of the corridor would be identical to those for the Full-Length Alternative. A new park-and-ride lot would be developed in the northern portion of the corridor at Central County (approximately 500 spaces) and the Salmon Creek park-and-ride lot would be expanded to approximately 500 spaces.

B. Roadway Improvements

Roadway improvements with the Full-Length, MOS 1, MOS 2 and MOS 5 Alternatives would be consistent with the *1995 Interim Federal Regional Transportation Plan's* financially constrained highway network and the No-Build Alternative (see Section 1.3.1.1). Refer to Section 15 of the *Definition of Alternatives Compendium* for a detailed list of these roadway changes. Other roadway improvements and modifications that are specific to a particular alignment alternative or design option are noted in Section 1.3.2.1.2.

1.3.2.1.2 Alignment Alternatives

Following is a description of the alignment alternatives under consideration within each of the segments in the corridor. Table 1.3-5 summarizes the characteristics of alignment alternatives and design and terminus options for each segment of the South/North Corridor, including: 1) the segment's LRT track length; 2) the number of South/North LRT stations and park-and-ride lots and spaces within the segment; and 3) the number of corridor LRT vehicles.

A. Transit Improvements

Clackamas Regional Center Segment

The Clackamas Regional Center would be the location of the southern terminus of the Full-Length, MOS 2 and MOS 5 alternatives. The segment extends from the vicinity of SE 105th Avenue east of the Clackamas Town Center (CTC), to approximately SE Harmony Road and SE Cedarcrest Drive. Two alignment alternatives (each with two terminus options and two design options) are examined in this segment (see Figure 1.3-4).

- **South of CTC Alignment Alternative with 93rd Avenue Terminus Option.** This alignment would begin with a terminus station near SE 93rd Avenue and SE Sunnybrook Street co-located with a surface park-and-ride lot (approximately 600 spaces). From there, the alignment would run north to a grade-separated overcrossing of SE Sunnyside Road and would then turn west and run along the north side of SE Sunnyside Road to a new transit center south of CTC. This alignment would continue west along SE Sunnyside Road crossing over SE 82nd Avenue and would then turn south on SE 80th Avenue to connect to SE Harmony Road.

Proceeding west from SE 82nd Avenue there are two design options:

- ***South of Clackamas Community College (CCC)/Oregon Institute of Technology (OIT) Design Option.*** This southern design option would cross SE Harmony Road at grade and then enter a station and park-and-ride lot (approximately 900 spaces) south of SE Harmony Road and west of SE 80th Avenue. The park-and-ride lot would be divided into two facilities; a structured 600-space lot located just south of SE Harmony Road, east of SE 80th Avenue; and a 300-space surface lot located northwest of the intersection of SE Sunnybrook Street and SE 82nd Avenue. The LRT alignment would then proceed west, immediately south of the OIT and Clackamas Community

Table 1.3-5
Characteristics of South/North LRT Alternatives Summary: Alignment Alternatives and Design Options [1]

Segment	Alignment Alternatives and Options	One-Way LRT Track Miles [2,3]	S/N Stations [2]	S/N Park-and-Ride Lots [2]	S/N Park-and-Ride Spaces [2]	Corridor LRT Vehicles [4]
Clackamas Regional Center	South of CTC with South of OIT/CCC Design Option [5]	1.66	3	2	1,500	59
	South of CTC with North of OIT/CCC Design Option [5]	1.64	3	2	1,500	59
	North of CTC with South of OIT/CCC Design Option [6]	2.54	5	3	1,500 [7]	62
	North of CTC with North of OIT/CCC Design Option [6]	2.52	5	3	1,500 [7]	62
East Milwaukie	Railroad Ave [8]	2.19	3	2	1,750	59
	Highway 224	1.38	3	2	1,750	60
Milwaukie Regional Center	Main St./Tillamook Branch Line	2.05	2	1	900	59
McLoughlin Blvd.	McLoughlin Blvd.	0.97	1	0	N/A	59
South Willamette River Crossing	Ross Island Crossing with East of McLoughlin Design Option	3.03	5	0	N/A	59
	Ross Island Crossing with West of McLoughlin Design Option	3.04	4	0	N/A	59
	Caruthers Crossing with Caruthers/Moody Design Option	3.2	5	0	N/A	60
	Caruthers Crossing with Caruthers/South Marquam Design Option	3.33	5	0	N/A	60
Downtown Portland [9]	Full Transit Mall with Glisan Street Design Option	1.8	6	0	N/A	59
	Full Transit Mall with Irving Street Design Option	1.91	6	0	N/A	60
	Half Transit Mall	1.93 [10]	7 [11]	0	N/A	59
Eliot	East I-5/Kerby	1.76	3	0	N/A	59
	Wheeler/Russell	1.75	3	0	N/A	60
North Portland [12]	I-5	4.15	7	0	N/A	59
	Interstate Avenue	4.27	7	0	N/A	60
Hayden Island/ Vancouver [13]	I-5/Washington Street with Surface VA Park-and-Ride Design Option	3.03	7	2	2,500	59
	I-5/Washington Street with Structured VA Park-and-Ride Design Option	3.03	7	1	3,900	59

Source: *South/North Definition of Alternatives Compendium* (February 1998).

1 Additional design options are under consideration, however they would have no affect on the information in this table.

2 Data is presented by segment.

3 Based upon a proposed maintenance facility at Brooklyn Yard and a park-and-ride lot at SE Tacoma Street. Downtown Portland Segment length is an average of the LRT line on SW 5th and 6th Avenues.

4 The number of light rail vehicles includes spares and is based on the Full-Length Alignment Alternative (see Section 1.3.2.1.1). See the *Capital Cost Results Report* (Metro: February 1998) for information on how differences in LRT vehicle requirements for different alignment alternatives are reflected in capital cost estimates.

5 Based on 93rd Avenue Terminus Option. With a CTC Transit Center Terminus Option: LRT track miles would be reduced by .45 miles; there would be two LRT stations and one park-and-ride lot with 900 spaces; and it would require three fewer light rail vehicles.

6 Based on 105th Avenue Terminus Option. With a CTC Transit Center Terminus Option: LRT track miles would be reduced by 1.05 miles; there would be two LRT stations and one park-and-ride lot with 900 spaces at the 82nd Avenue park-and-ride lot; and it would require

three fewer light rail vehicles.

[7] Any combination of the 105th Avenue, New Hope Church and 82nd Avenue park-and-ride lots could be selected with varying capacities (combination would not exceed 1,500 spaces total).

[8] Same for Local Access and Through Traffic Alternatives.

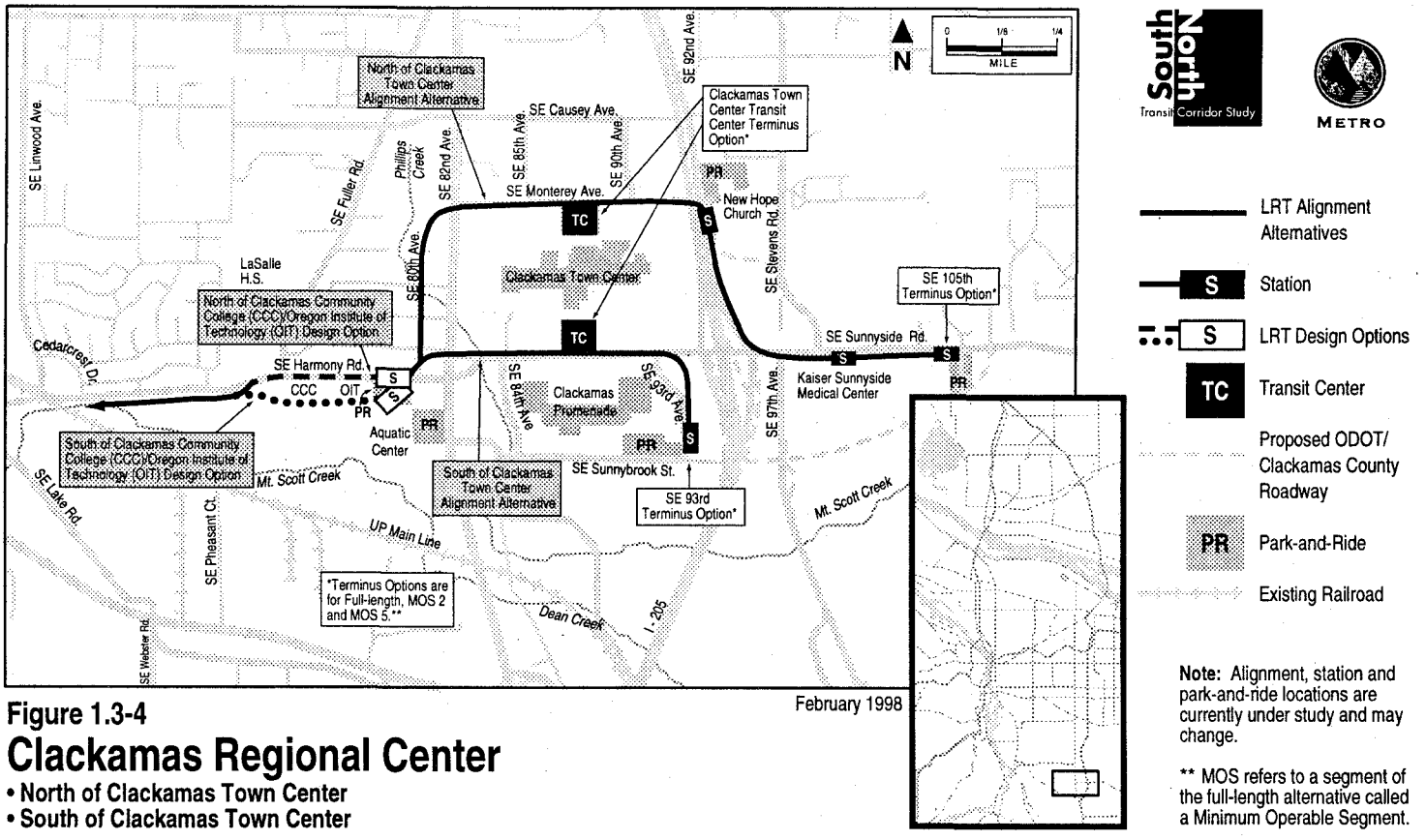
[9] An additional station in the vicinity of SW Harrison Street is currently under study and is not reflected in these totals.

[10] Includes 1.06 miles of existing Banfield MAX track.

[11] Number of stations includes five existing MAX stations.

[12] An additional station is currently under study in north Portland between Expo Center and Portland International Raceway.

[13] Includes 1,000 spaces at the VA site and 1,500 spaces in the vicinity of NE 88th Avenue and I-5.



Note: Alignment, station and park-and-ride locations are currently under study and may change.

** MOS refers to a segment of the full-length alternative called a Minimum Operable Segment.

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Figure 1.3-4

Clackamas Regional Center

- **North of Clackamas Town Center**
- **South of Clackamas Town Center**

College (CCC) buildings. From CCC, the alignment would proceed west, parallel to and south of SE Harmony Road, to the vicinity of SE Cedarcrest Drive.

– ***North of Clackamas Community College (CCC)/Oregon Institute of Technology (OIT) Design Option.*** This northern design option would cross SE Harmony Road at grade to a station and park-and-ride lot (approximately 900 spaces with the same configuration as described above for the South of CCC/OIT Design Option) located between Oregon Institute of Technology (OIT) and SE 80th Avenue. The alignment would then proceed west to SE Fuller Road in the existing right-of-way currently used by SE Harmony Road, relocating SE Harmony Road to the north of the LRT alignment. West of SE Fuller Road, the alignment would continue on the south side of the existing SE Harmony Road to SE Cedarcrest Drive.

- **South of CTC Alignment Alternative with South of CTC Transit Center Terminus Option.** This alternative, including design options, would be identical to the 93rd Avenue Terminus with the South of CTC Alignment Alternative, except it would begin at a transit center located south of CTC just north of Sunnyside Road, rather than at SE 93rd Avenue. This terminus option would result in a shorter length and one less park-and-ride lot.

- **North of CTC Alignment Alternative with 105th Avenue Terminus Option.** This alignment would begin with a terminus station at SE Sunnyside Road and SE 105th Street, which would be co-located with a structured park-and-ride lot (approximately 900 spaces). It would then proceed west on the south side of SE Sunnyside Road past the Edgar Kaiser Medical Facility. The alignment would turn north, crossing SE Sunnyside Road on a grade-separated overcrossing and would then run parallel to the east side of I-205 to a station and park-and-ride lot (approximately 600 spaces) at the New Hope Church. From the church, the alignment would turn west, crossing over I-205 on structure and would then follow the south side of SE Monterey Avenue to a reconfigured transit center on the north side of the CTC mall. The alignment would continue west crossing SE 82nd Avenue at grade and then turn south on SE 80th Avenue to connect to SE Harmony Road. At SE Harmony Road there are two design options that would be identical to the design options for the 93rd Avenue Terminus with the South of CTC Alignment Alternative.

  The analysis of the North of CTC Alignment Alternative with the 105th Avenue Terminus is based upon a capacity of 1,500 park-and-ride spaces in this segment. For the purposes of the DEIS analysis, the 105th Avenue Terminus Option would include a 600-space park-and-ride lot at the New Hope Church and a 900-space park-and-ride lot at SE 105th Avenue. If this alternative and terminus option were selected as part of the LPS, final determination of the park-and-ride lot location and capacity would be determined prior to completion of the FEIS. Any combination of the 105th Avenue, New Hope Church and 82nd Avenue park-and-ride lots (see Figure 1.3-4) could be selected, with a total capacity of 1,500 spaces.

- **North of CTC Alignment Alternative with North of CTC Transit Center Terminus Option.** This alternative, including design options, would be identical to the 105th Avenue Terminus with North of CTC Alignment Alternative, except it would begin at a terminus located at the reconfigured transit center north of CTC rather than at SE 105th Avenue. This terminus option would result in a shorter length and one opportunity for a park-and-ride lot located south of SE Harmony Road, just east of OIT.

East Milwaukie Segment

The East Milwaukie Segment extends from SE Cedarcrest Drive and SE Harmony Road to just east of the Tillamook Branch Line near Highway 224 and the southern portion of the North Milwaukie industrial area. The southern terminus for MOS 1 would be located at the Milwaukie Marketplace. Three alignment alternatives are examined in this segment (see Figure 1.3-5a) and are described in detail below.

- **Highway 224 Alignment Alternative.** From SE Cedarcrest Drive and SE Harmony Road, the Highway 224 alignment would continue along the south side of SE Harmony Road to a station and park-and-ride lot (approximately 1,300 spaces) located near SE Harmony Road and SE Linwood Avenue. Light rail would cross over the existing freight and intercity passenger rail line on a new structure southeast of the intersection of SE Harmony Road and SE Railroad Avenue. The alignment would proceed west on the south side of SE Harmony Road and would cross SE Harmony Road diagonally at grade at the intersection of SE Harmony Road, SE Lake Road and SE International Way. It would then continue on the north side of Highway 224, with a station at SE Freeman Way and a station and 400-space structured park-and-ride lot at SE Oak Street, closing access on the north side of Highway 224 between SE Oak and Harrison Streets. Northwest of SE Monroe Street, the alignment would cross under SE Harrison Street.

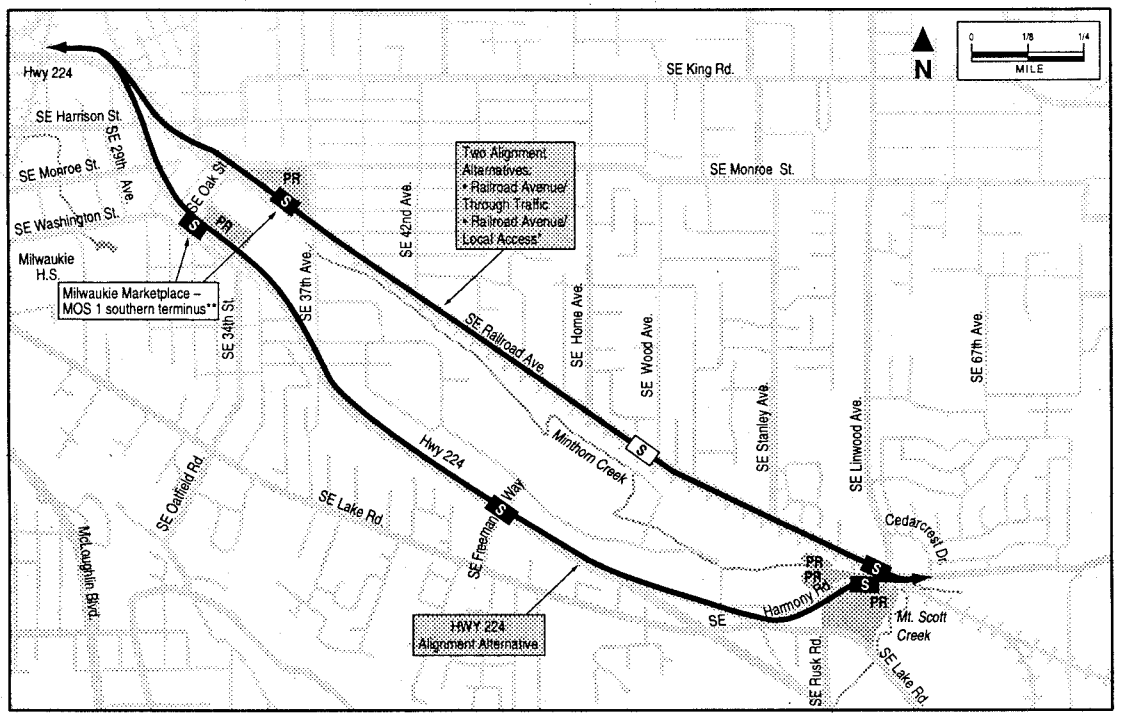
  With the Full-Length, MOS 2 and MOS 5 length alternatives, the Highway 224 would be as described above. With MOS 1, the Highway 224 alignment would terminate at the south side of the Milwaukie Marketplace with a three track island/side platform station near Highway 224 and SE Oak Street and a 400-space structured park-and-ride lot.

- **Railroad Avenue/Through Traffic Alignment Alternative.** From SE Cedarcrest Drive, the light rail alignment would continue along the south side of SE Harmony Road to a station and park-and-ride lot (approximately 1,300 spaces) located near SE Harmony Road and SE Linwood Avenue. The alignment would proceed west, adjacent to and on the north side of the Union Pacific (UP) Main Line in the area currently occupied by SE Railroad Avenue. SE Railroad Avenue would be reconstructed just north of and adjacent to the LRT alignment. This alignment could be built with or without a station near SE Wood Avenue. That station would include pedestrian access to the industrial area to the south. A Milwaukie Marketplace station and surface park-and-ride lot (approximately 400 spaces) would be located just west of SE 37th Avenue. The alignment would cross SE Oak Street at grade and would cross under the UP Main Line and SE Harrison Street.

  At the intersection of SE Linwood Avenue and SE Harmony Road, the existing road network would be raised to cross over the existing freight rail lines. Light rail would cross the raised SE Harmony Road at grade. Automobile lanes on SE Railroad Avenue with this alignment alternative would be narrowed from 12 feet to ten feet. New bicycle lanes would be five feet wide and a new sidewalk on the north side of the street would vary in width from four to six feet.

  With the Full-Length, MOS 2 and MOS 5 Length Alternatives, the Railroad Avenue/Through Traffic Alternative would be as described above. With MOS 1, the alignment would terminate at the Milwaukie Marketplace (SE 37th Avenue) with a three-track station and a 400-space surface park-and-ride lot.

- **Railroad Avenue/Local Access Alignment Alternative.** This alignment alternative would close sections of SE Railroad Avenue to through traffic by rebuilding only certain sections of the road. The proposed road design is illustrated in Figure 1.3-5b. Light rail would follow the same route as with the SE Railroad Avenue Through Traffic Alignment Alternative and could be built with or without a station near SE Wood Avenue. At the



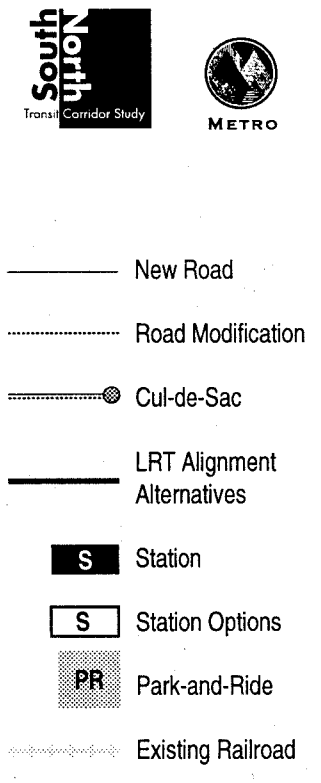


Figure 1.3-5a

East Milwaukie

- **Railroad Avenue/Through Traffic**
- **Railroad Avenue/Local Access***
- **Highway 224**

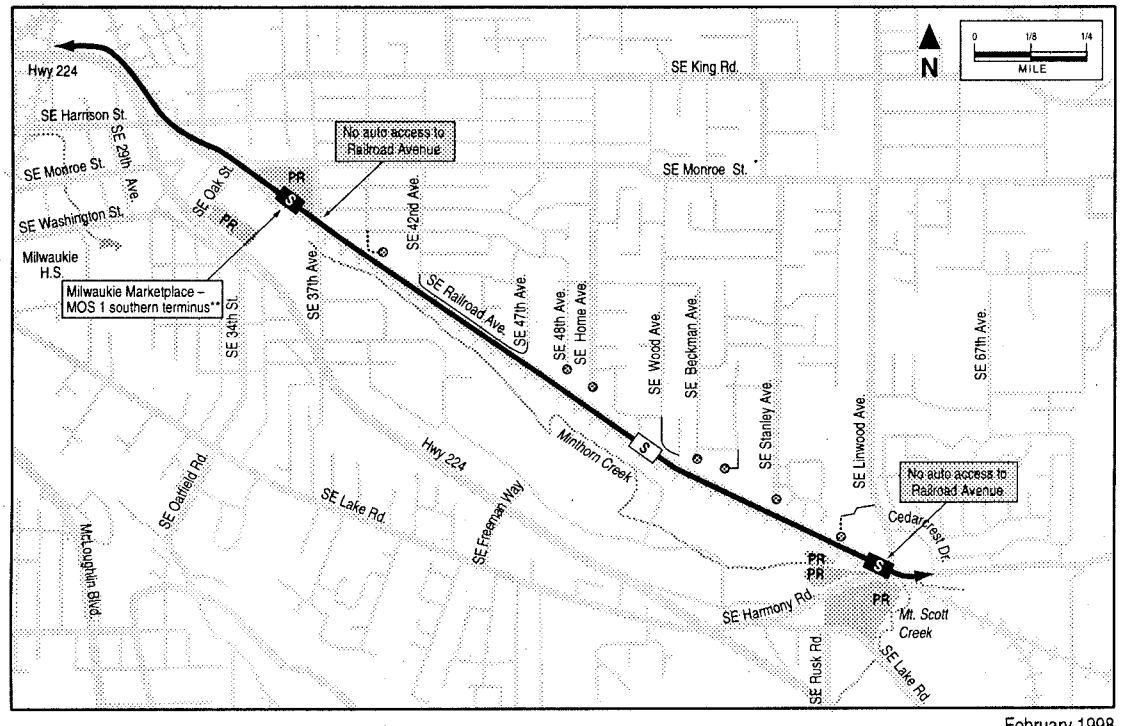


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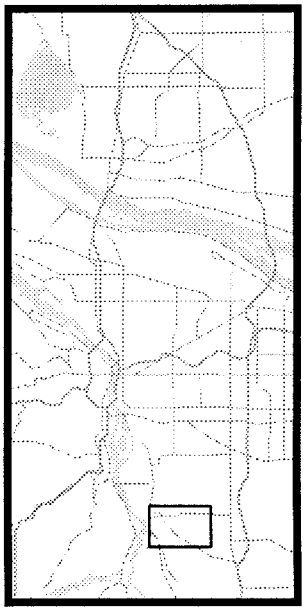
Figure 1.3-5b

Railroad Avenue/Local Access Alignment Alternative and Resulting Road Network Modification

Note: Alignment, station and park-and-ride locations are currently under study and may change.

* Refer to figure 2.3-4b for resulting road network modifications.

** MOS refers to a segment of the full-length alternative called a Minimum Operable Segment.



intersection of SE Linwood Avenue and SE Harmony Road, the existing road network would be raised to cross over the existing freight rail lines. Light rail would cross the raised SE Harmony Road at grade.

With the Full-Length, MOS 2 and MOS 5 Length Alternatives, the Railroad Avenue/Local Access alignment would be as described above. The alignment would be identical to the Railroad Avenue/ Through Traffic Alternative with MOS 1.

Milwaukie Regional Center Segment

The Milwaukie Regional Center Segment extends from north of Highway 224 just east of the Tillamook Branch Line near the north Milwaukie industrial area to SE Tacoma Street in the City of Portland. One alignment alternative is examined in this segment (see Figure 1.3-6).

Three possible sites for a North Milwaukie park-and-ride lot and two of the three possible sites for an operations and maintenance facility are located in this segment. These sites are shown in Figure 1.3-6. For a more detailed description of the North Milwaukie park-and-ride lot and operations and maintenance facility sites refer to the *Operations and Maintenance Facility and North Milwaukie Park-and-Ride Results Report* (Metro: February 1998).

- **Main Street/Tillamook Branch Line Alignment.** Starting from north of Highway 224 just east of the Tillamook Branch Line, the alignment would cross over the Tillamook Branch Line on a structure, would cross under the Highway 224 on/off ramps and would cross SE Main Street at grade. It would then extend south, parallel to and east of SE McLoughlin Boulevard, turning east just north of SE Scott Street to a station and transit center located in the vicinity of the currently vacant Safeway store. From the transit center, the alignment would curve north to the east of Kellogg Bowl. It would then curve northeast and cross under Highway 224 and the light rail alignment through a new underpass. North of Highway 224, the alignment would make a wide curve through the Heiberg Garbage transfer station east of the Hanna-Harvester site and then extend north, parallel to and west of the Tillamook Branch and UPRR Main Line. A new connection of freight spur tracks to the Tillamook Branch Line would be constructed just north of SE Mailwell Drive and would cross the light rail alignment at grade. The alignment would cross over Johnson Creek on a bridge and under an existing span of the SE Tacoma Street overpass.

McLoughlin Boulevard Segment

The McLoughlin Boulevard Segment extends from SE Tacoma Street to SE McLoughlin Boulevard at SE 20th Avenue. One alignment is being evaluated in this segment (see Figure 1.3-7).

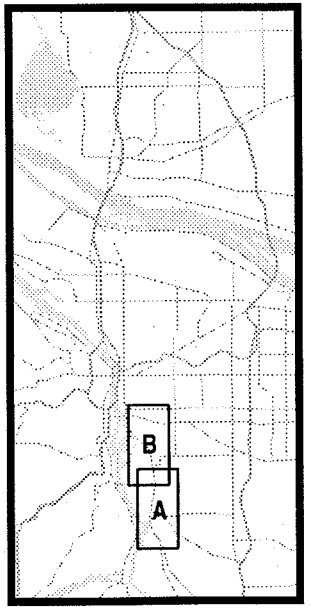
- **McLoughlin Boulevard Alignment.** From SE Tacoma Street, the alignment would proceed north along the east side of SE McLoughlin Boulevard (between the roadway and the UPRR railroad) past the Eastmoreland golf course. It would pass under SE Bybee Boulevard and would include an LRT station just north of SE Bybee Boulevard. The alignment would then proceed north to SE McLoughlin Boulevard and SE 20th Avenue in the vicinity of the Brooklyn Yard.

South North Transit Corridor Study

METRO

- LRT Alignment Alternative
- S — Station
- S — Station Options
- Existing Railroad
- TC — Transit Center
- MF — LRT Operations and Maintenance Facility
- PR — Park-and-Ride

Note: Alignment, station, LRT operations and maintenance facility and park-and-ride locations are currently under study and may change.



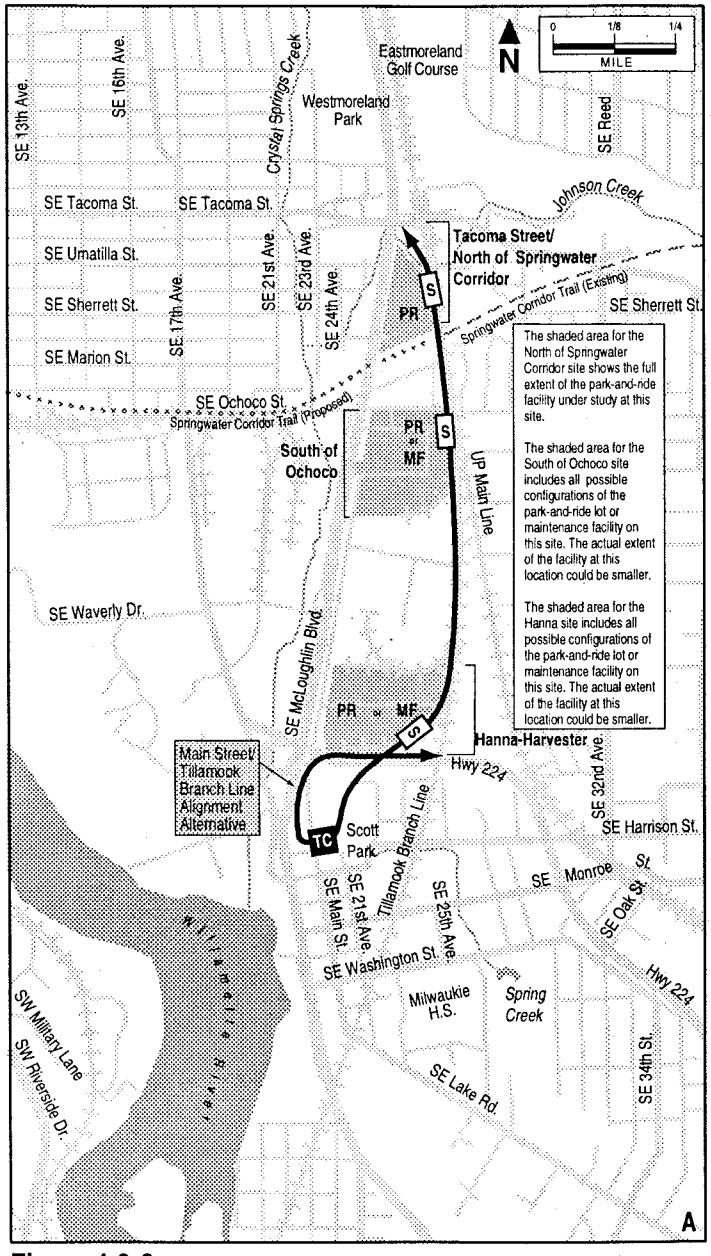


Figure 1.3-6

Milwaukie Regional Center

• Main Street/Tillamook Branch Line

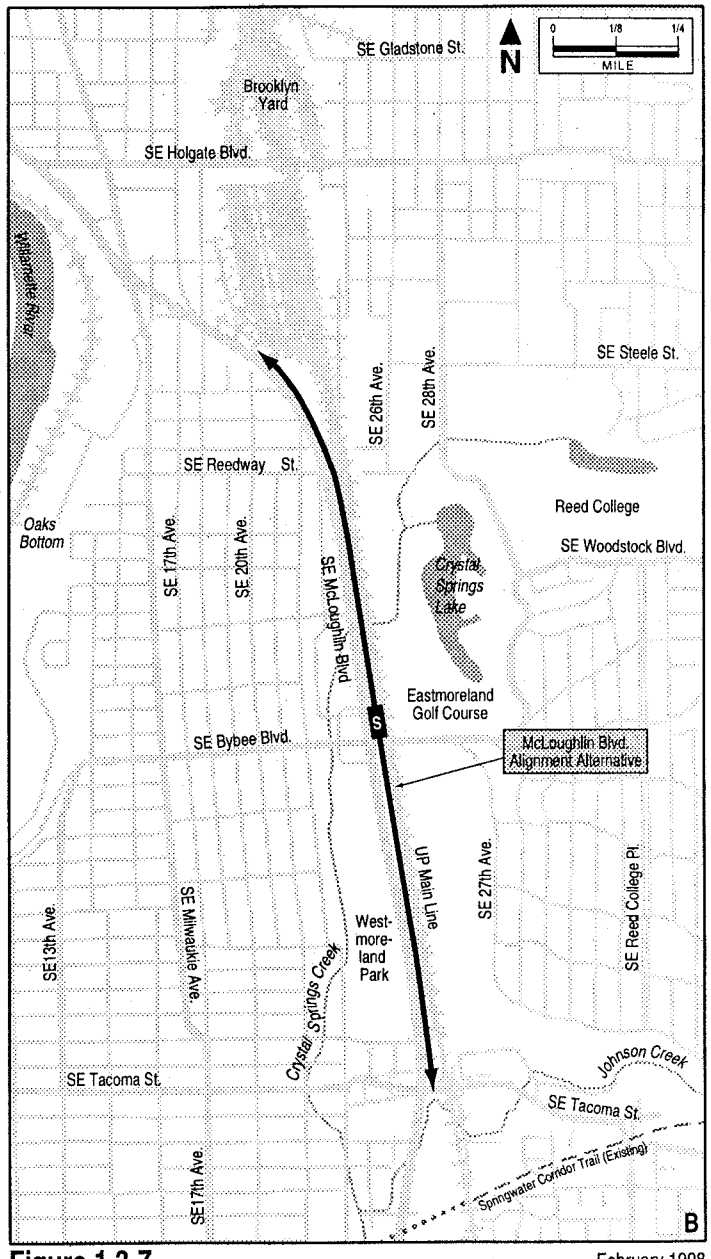


Figure 1.3-7

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McLoughlin Boulevard

A design consideration with this alignment is whether to retain or rebuild the existing SE Bybee Boulevard overpass. If the existing overpass is retained, a new pedestrian bridge would be built immediately north of the existing overpass to allow station access from both sides of SE McLoughlin Boulevard. If rebuilt, the approaches to the overpass would be regraded to facilitate station access and bus transfers.

South Willamette River Crossing Segment

The South Willamette River Crossing Segment extends from SE McLoughlin Boulevard at SE 20th Avenue to the east side of SW Front Avenue at SW Harrison Street. For costing purposes and for the visual and aesthetic analysis, a concrete segmental bridge type and one unique design variation was developed for both river crossings. The actual bridge type would be determined for the preferred crossing in the early stages of Preliminary Engineering, prior to completion of the FEIS.

One of the three possible sites for an operations and maintenance facility is located in this segment (see Figure 1.3-8). For a more detailed description of the North Milwaukie park-and-ride lot and operations and maintenance facility site, refer to the *Operations and Maintenance Facility and North Milwaukie Park-and-Ride Results Report* (Metro: February 1998).

- **Ross Island Crossing Alignment Alternative.** From the southwest side of Brooklyn Yard, this alignment would continue parallel to the east side of SE McLoughlin Boulevard to a station in the vicinity of SE Schiller Street. From this location west to the river crossing, there are two design options:

  - ***East of McLoughlin Design Option.*** The East of McLoughlin Design Option would follow the east side of SE McLoughlin Boulevard with a station near SE Center Street. From the Center Street station, the alignment would cross under SE McLoughlin Boulevard and would cross the Willamette River on a new bridge in the vicinity of the northern portion of Ross Island.

  - ***West of McLoughlin Design Option.*** From the Schiller Street station, the West of McLoughlin Design Option would continue north paralleling SE Milwaukie Avenue for a short distance and would then turn west crossing over SE McLoughlin Boulevard on a new grade-separated structure. The alignment would then proceed along the west side of SE McLoughlin Boulevard to the river crossing (identical in the two design options). There would be no Center Street Station with this design option.

    The new light rail bridge would span the Holgate Slough with a vertical clearance of 72 feet (CRD) and a horizontal clearance of 300 feet and would span the Willamette River with a vertical clearance of 99 feet (CRD) and a horizontal clearance of 250 feet (see Sections 3.2.7 and 4.4 for more information). The bridge would span a northern section of Ross Island and would land on the west side of the Willamette River near SW Moody Avenue with a station in the vicinity of SW Gaines Street. The alignment would then follow the west side of SW Moody Avenue to a SW Porter Street station and proceed north to the RiverPlace station over SW Harbor Drive.

- **Caruthers Crossing Alignment Alternative.** This alignment would separate from SE McLoughlin Boulevard and immediately turn north between SE McLoughlin Boulevard and SE Holgate Boulevard. There are two station options in this area. Station location depends on whether or not Brooklyn Yard is selected as the location of the South/North operations and maintenance facility. With a Brooklyn Yard operations and maintenance facility, light rail would proceed north on the east side of SE 17th Avenue to a station near SE Holgate Boulevard and SE 18th Avenue. Without the operations and maintenance facility, light rail would proceed north, east of SE 17th Avenue to a station near SE Holgate Boulevard and SE 18th Avenue.

  At SE Holgate Boulevard, the alignment would continue north, generally between parcels fronting on SE 17th Avenue and Brooklyn Yard. The alignment would continue to follow the west side of Brooklyn Yard to a station in the vicinity of SE Lafayette Street with pedestrian access across the UPRR main line to the East Brooklyn neighborhood.

  The alignment would continue north, crossing over SE Powell Boulevard on an elevated structure, paralleling the existing UPRR Main Line. From SE Powell Boulevard the alignment would extend north and would cross SE 11th and 12th Avenues at grade. A station would be located at approximately SE 12th Avenue and SE Clinton Street. Light rail would then cross under the existing McLoughlin Boulevard viaduct and would cross the Portland Traction Company freight rail line at grade with a station located just south of OMSI.

  From the OMSI station, light rail would cross the Willamette River on a fixed-span bridge with a vertical clearance of 72 feet (CRD) and a horizontal clearance of 300 feet. Note that if a Caruthers Crossing Alternative is selected within the *Locally Preferred Strategy Report*, the final determination of bridge height would be made through a permit process managed by the US Coast Guard. That process would conclude following completion of the Federal environmental process. The Caruthers bridge high-sensitivity analysis summarizes the significant changes to costs, benefits and impacts that would be associated with varying Caruthers bridge heights.

  On the west bank of the Willamette River there are two design options:

  - ***Moody Avenue Design Option.*** The Moody Avenue Design Option would extend from the Caruthers Bridge west, under the west end of the Marquam Bridge. The alignment would extend northwest, at grade, parallel to and north of SW Moody Avenue. It would then turn north, running east of and parallel to SW Harbor Drive. An at-grade North Marquam station could be located at SW Moody Avenue and SW River Parkway.

  - ***South Marquam Design Option***. The South Marquam Design Option would extend southwest from the Caruthers Bridge, generally south of, and parallel to, the Marquam Bridge approach ramps. A second-story light rail station could be integrated into a proposed development just south of the proposed light rail alignment. After crossing SW Moody Avenue at grade, the alignment would turn

north, running parallel to SW Harbor Drive. North of SW Moody Avenue, the alignment would head northwest to cross SW Harbor Drive on a new structure.

Downtown Portland Segment

The Downtown Portland Segment extends from SW Front Avenue at SW Harrison Street to the east end of the Steel Bridge. Two alignments are examined in this segment (see Figure 1.3-9).

- **Downtown Portland Full Transit Mall Alignment Alternative**

  South Entry: This portion of the downtown Portland alignment extends west from just east of SW Front Avenue. Crossing SW Front Avenue at grade, the alignment would continue west in the median of SW Harrison Street between SW 1st and 4th Avenues. From the corner of SW Harrison Street and SW 4th Avenue, the alignment would travel diagonally to connect to the SW 5th and 6th Avenue couplet. A station pair would be located in the area bordered by SW Harrison and Mill Streets and SW 4th and 6th Avenues serving PSU and the surrounding area. The RiverPlace area, the South Auditorium area and PSU are evaluated in the Portland CBD Station Access Study to determine which combination of stations should advance into the FEIS for further study.

  South Mall: This portion of the downtown Portland alignment extends north from SW Mill Street to SW Madison Street. Light rail would be placed in the left lane on SW 5th and 6th Avenues in the South Mall area with autos and buses sharing two general purpose lanes to the right of the LRT alignment. SW 5th and 6th Avenues would be reconstructed between SW Madison Street and the PSU Transit Center with improvements similar to those used on the Central Mall. Two pairs of auto-accessible stations would occur in this portion of the alignment. The first pair would be located at SW 5th and 6th Avenues on a diagonal alignment between SW Harrison and Mill Streets. The second pair would be located at SW Columbia Street and SW 6th Avenue and SW Jefferson Street and SW 5th Avenue.

  Central Mall: This portion of the downtown Portland alignment extends north from SW Madison Street to W Burnside Street. Light rail in this area would be located in the center lane of SW 5th and 6th Avenues. Two pairs of non auto-accessible stations would occur in this portion of the alignment. The first pair of stations would be located between SW Taylor and Yamhill Streets on SW 5th and 6th Avenues and the second pair would be located between SW Washington and Stark Streets on SW 5th and 6th Avenues.

  North Mall: This portion of the downtown Portland alignment extends north of W Burnside Street to just south of NW Glisan Street. A station would be located between W Burnside and NW Couch Streets on NW 5th and 6th Avenues. Light rail would be located in the left lane on NW 5th and 6th Avenues in the North Mall with buses and autos sharing the right lane.

  North Entry: This portion of the downtown Portland alignment extends from NW Glisan Street to the east end of the Steel Bridge in Northeast Portland. There are two design options for the north entry connection to the Steel Bridge from NW 5th and 6th Avenues. This area is evaluated in greater detail in the Portland CBD Station Access Studies.

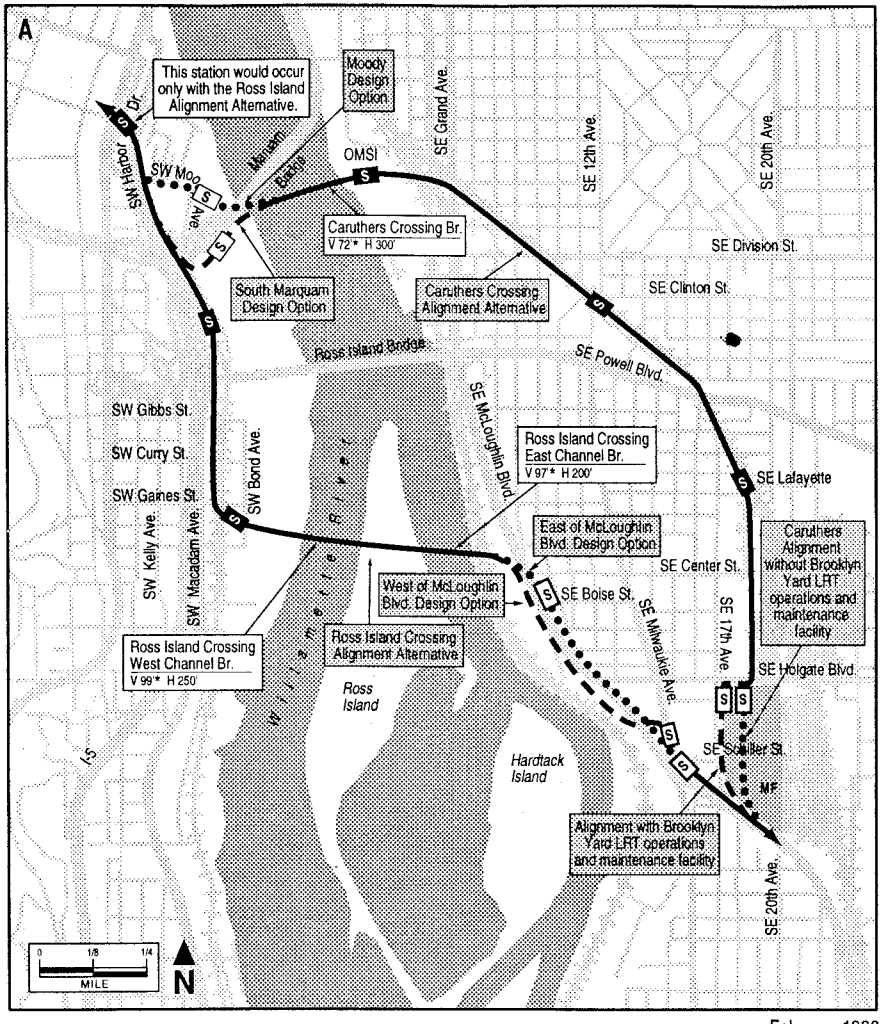

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Figure 1.3-8

South Willamette River Crossing

- Caruthers Crossing
- Ross Island Crossing

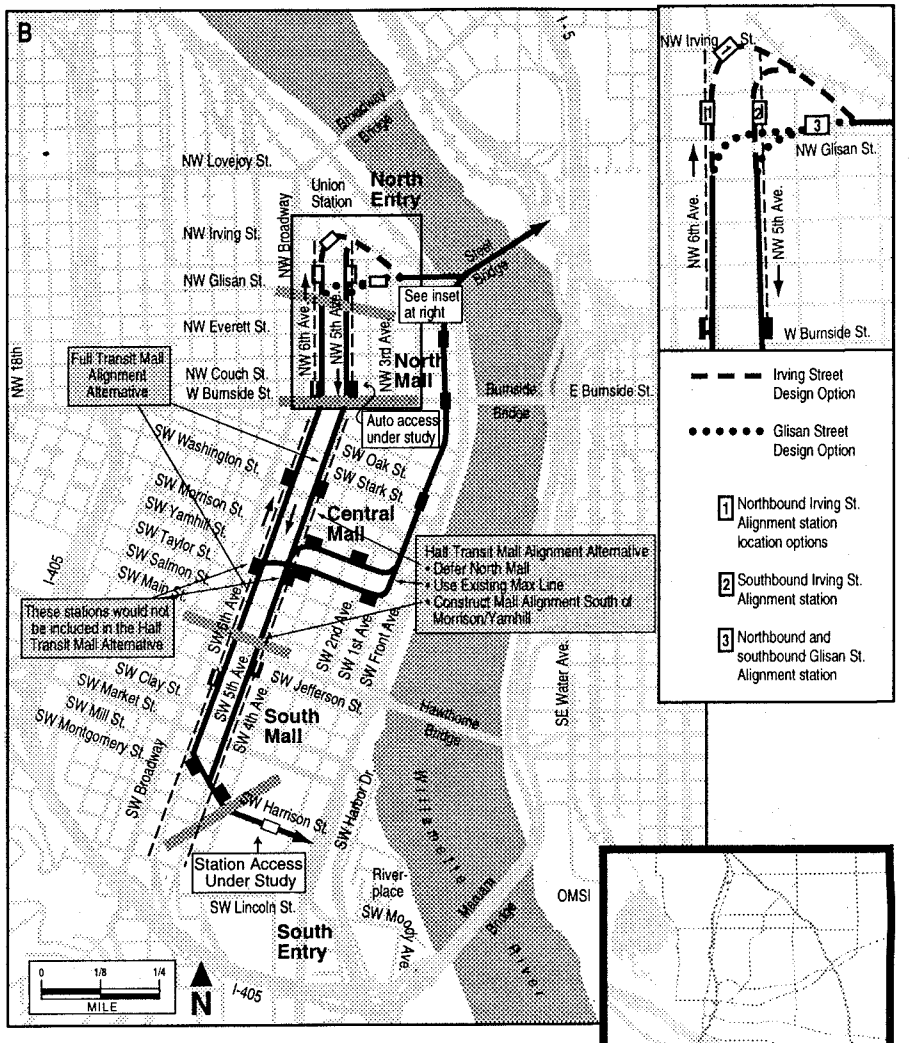


Figure 1.3-9

Downtown Portland

- Full Transit Mall
- Half Transit Mall

METRO

South North Transit Corridor Study

LRT Alignment Alternative

LRT Design Options

S Station

Existing Railroad

Mall Auto Access

Station with auto access on Mall

Station with no auto access on Mall

MAX

Westside LRT

MF LRT Operations and Maintenance Facility

Note: Alignment, station and LRT operations and maintenance facility locations are currently under study and may change.

*Proposed maximum vertical clearances are Columbia River Datum - see section 3.2.7.

- ***Glisan Street Design Option.*** The alignment for the Glisan Street Design Option would turn from NW 5th and 6th Avenues onto NW Glisan Street with a proposed station on NW Glisan Street between NW 3rd and 4th Avenues (serving both northbound and southbound). From the station, the alignment would continue east connecting to the existing MAX tracks across the Steel Bridge.

- ***Irving Street Design Option***. The alignment for the Irving Street Design Option would continue two blocks farther north than the Glisan Street Design Option with a southbound station on NW 5th Avenue between NW Glisan and Hoyt Streets and a northbound station on NW 6th Avenue between NW Glisan and Hoyt Streets or adjacent to NW Irving Street at NW 6th Avenue. From the NW Irving Street area, the alignment would curve and travel diagonally to NW Glisan Street and would then continue east connecting to the existing MAX tracks across the Steel Bridge.

On the Steel Bridge, the alignment would continue east using the existing MAX tracks. Motor vehicles would be excluded from the center lanes of the Steel Bridge. Improvements to the bridge's expansion joints and bushings would be made to increase LRT operating speeds across the bridge.

- **Downtown Portland Half Transit Mall Alignment Alternative.** The Downtown Portland Half Transit Mall Alignment Alternative would be identical to the Full Transit Mall alignment from the South Entry through PSU and the South Mall. In the Central Mall, this alignment alternative would connect the northbound track on SW 6th Avenue with the existing eastbound MAX track on SW Yamhill Street and the southbound track on SW 5th Avenue with the existing westbound MAX track on SW Morrison Street. No new track would be installed in the area generally north of SW Morrison Street. The South/North mall improvements north of SW Yamhill and Morrison Streets would be deferred to a later phase of project development when warranted by demand and/or funding availability.

  Because of projected ridership and capacity constraints (of approximately three-minute headways in each direction) on the shared-track section of the existing MAX tracks, the Half Transit Mall Alternative would not be feasible with the Full-Length or the MOS 1 Length Alternatives. Current travel demand and operations analysis indicate that the Half Transit Mall Alternative would be feasible with MOS 2 and MOS 5 through the forecast year of 2015. Increasing demand on the east/west and south/north lines, either over time or due to extensions of the LRT lines, would require the construction of the remaining Full Transit Mall Alternative due to headway limitations on the shared-track segment of the existing MAX tracks.

Eliot Segment

The Eliot Segment extends from the east end of the Steel Bridge to the Edgar Kaiser Medical Facility. For the Full-Length, MOS 1 and MOS 5 Length Alternatives, this segment includes two alignment alternatives: East I-5/Kerby and Wheeler/Russell (see Figure 1.3-10). Each of these alignment alternatives includes two common design options for the Rose Quarter Transit Center: the Multi-Level Transit Center and the At-Grade Transit Center Design Options. The East I-5/Kerby

Alignment Alternative also includes two additional design options for crossing the N/NE Broadway/Weidler Street couplet: the At-Grade and the Grade-Separated Design Options.

Alignment Alternatives

- **East I-5/Kerby Alignment Alternative.** The East I-5/Kerby Alignment Alternative would proceed east from the Rose Quarter Transit Center (see design options below) and turn north along the eastern edge of I-5. The alignment would continue north between I-5 and the Harriet Tubman Middle School, crossing over N Russell Street on structure, to a station on N Kerby Avenue between N Graham and Stanton Streets, west of Emanuel Hospital. The alignment would curve west, passing over I-5 on structure to a location just west of the freeway, near the Edgar Kaiser Medical Facility.

- **Wheeler/Russell Alignment Alternative.** The Wheeler/Russell Alignment Alternative would proceed north from the Rose Quarter Transit Center (see design options below) and would pass along the eastern edge of the Rose Garden Arena parallel to N Wheeler Avenue, with a station north of the arena, between N Broadway and N Weidler Street. The alignment would cross N Weidler Street and N Broadway at grade. After crossing over I-5 on a new structure the alignment would proceed north along the east side of N Flint Avenue. The alignment would turn west at N Russell Street with a station on N Russell Street at the south end of the Emanuel Hospital campus. The alignment would then be elevated on a structure and would pass over N Kerby Avenue, Stanton Yard and N Mississippi Avenue. The alignment would then curve to the west, passing over I-5 on structure to a location just west of the freeway, near the Edgar Kaiser Medical Facility.

Rose Quarter Transit Center Design Options

As noted above, the East I-5/Kerby and Wheeler/Russell Alignment Alternatives share the following common design options at Rose Quarter Transit Center:

- ***Multi-Level Rose Quarter Transit Center.*** The Multi-Level Rose Quarter Design Option would include a multi-level Rose Quarter Transit Center with the light rail crossing over N Interstate Avenue. With the multi-level design option, the transit center functions (i.e., bus-to-bus transfers, bus-to-rail transfers, pedestrian-to-bus access and pedestrian-to-rail access) would all occur above the N Interstate Avenue street grade with auto traffic below. This design option would also include a grade-separated pedestrian connection between the Rose Quarter Transit Center and the Rose Garden Arena.

- ***At-Grade Rose Quarter Transit Center.*** This design option would include an at-grade crossing of N Interstate Avenue west of the Rose Quarter Transit Center. With this design option, the transit center functions (i.e. bus-to-bus transfers, bus-to-rail transfers, pedestrian-to-bus access and pedestrian-to-rail access) would all occur at the existing street level.

East I-5/Kerby Design Options at N Broadway and Weidler Streets

In addition to the Rose Quarter Transit Center design options described above, the I-5/Kerby Alignment Alternative has the following two additional design options for crossing the NE Broadway/Weidler Street couplet:

- ***Grade-Separated Design Option.*** With the Grade-Separated Design Option, the light rail alignment would cross over NE Weidler Street and NE Broadway on a new structure. The Broadway Station would be elevated between NE Broadway and NE Weidler Street, with access via stairs and an elevator.

- ***At-Grade Design Option.*** With the At-Grade Design Option, the light rail alignment would cross NE Broadway and NE Weidler Street at grade (at the current street level). The Broadway Station would also be at grade between NE Broadway and NE Weidler Street.

With MOS 2, the light rail alignment would terminate at the Rose Quarter Transit Center. A light rail turnback area would be located near NE 11th Avenue and NE Holladay Street in the vicinity of the Lloyd Center.

North Portland Segment

The North Portland Segment extends from the Edgar Kaiser Medical Facility to N Marine Drive. Two alignment alternatives are examined in this segment (see Figure 1.3-11). N Lombard Street in this segment represents the northern terminus for MOS 5 with alternate terminus sites at Kenton and the Expo Center. Alignment alternatives in this segment are described in detail below.

- **I-5 Alignment Alternative.** From the station at the Edgar Kaiser Medical Facility, the light rail alignment would proceed north along the top of the western bank of I-5 to a station south of N Skidmore Street. The alignment would then continue north, passing beneath N Going Street in a box structure, then run adjacent to I-5 at the same general elevation as N Minnesota Avenue (west of the freeway ramps) from N Going Street to a station at N Killingsworth Street. The alignment would then proceed along the top of the freeway bank and then curve west along the freeway ramps to a N Portland Boulevard street-level station and continue north along the west bank of the freeway to a station on the south side of N Lombard Street. This station would serve as the northern terminus for MOS 5. The alignment would proceed over N Lombard Street on a structure staying on the west side of I-5 with a station in the Kenton area. It would then cross over N Columbia Boulevard and it would cross the Columbia Slough over a new bridge with a vertical clearance of 44 feet (CRD) and a horizontal clearance of 94 feet. The alignment would continue north between N Expo Road and I-5 to a station located on retained fill, 17 feet above the Expo Center parking lot.

  With the Full-Length and MOS 1 Length Alternatives, the I-5 alignment alternative would be as described above. With MOS 5, the alignment would terminate with a station at N Lombard Street between I-5 and N Montana Avenue as shown in Figure I-29. This alignment alternative is not included in MOS 2, which terminates at the Rose Quarter Transit Center.

There are two design options for the I-5 Alignment Alternative:

- ***Modify Alberta Street Ramps Design Option.*** Light rail would be located within the right-of-way vacated by the closure of the Alberta Street southbound I-5 on and off ramps.

- ***Retain Alberta Street Ramps Design Option.*** This design option would retain the Alberta Street I-5 ramps as they are today.

- **Interstate Avenue Alignment Alternative.** From a street-level station located diagonally across from the Edgar Kaiser Medical Facility near the existing Town Hall building, the alignment would turn onto N Interstate Avenue near N Overlook Boulevard and proceed north in the center of N Interstate Avenue. A single traffic lane would be provided on either side of the LRT tracks, except at the approaches to N Going Street and N Lombard Street where two lanes of traffic in each direction would be provided. Major intersections would be signalized, at-grade crossings, appropriately widened to accommodate turn lanes. Stations would be located at N Going Street, N Killingsworth Street, N Portland Boulevard, N Lombard Street and N Denver Avenue in the Kenton commercial district.

  From the Kenton station, the alignment would parallel the east side of the N Denver Avenue viaduct. It would proceed on an elevated structure over N Columbia Boulevard and would cross the Columbia Slough over a new bridge with a vertical clearance of 34 feet (CRD) and a horizontal clearance of 66 feet. Near West Delta Park, the track would climb for approximately ½ mile and cross over Highway 99 adjacent to N Expo Road. The alignment would be located between N Expo Road and I-5 and would proceed to a station located on retained fill, 17 feet above the Expo Center parking lot.

  With the Full-Length and MOS 1 Length Alternatives, the Interstate Avenue Alignment Alternative would be as described above. With MOS 5, the alignment would terminate with a station located south of N Lombard Street on N Interstate Avenue. This alignment alternative is not included in MOS 2, which would terminate at the Rose Quarter Transit Center.

- **Crossover Options.** A crossover option between the Overlook Neighborhood and the Kenton Neighborhood may be the outcome of detailed technical studies. The *LPS Report* will specify whether or not an examination of specific crossover options will be evaluated during the FEIS phase of the project.

Hayden Island/Vancouver Segment

The Hayden Island/Vancouver Segment extends from N Marine Drive north of the Expo Center, across the Columbia River to the vicinity of Clark College in Vancouver, Washington. The VA Medical Center/Clark College area in Vancouver represents the northern terminus for the Full-Length Alternative and MOS 1. One alignment is being evaluated in this segment (see Figure 1.3-12).

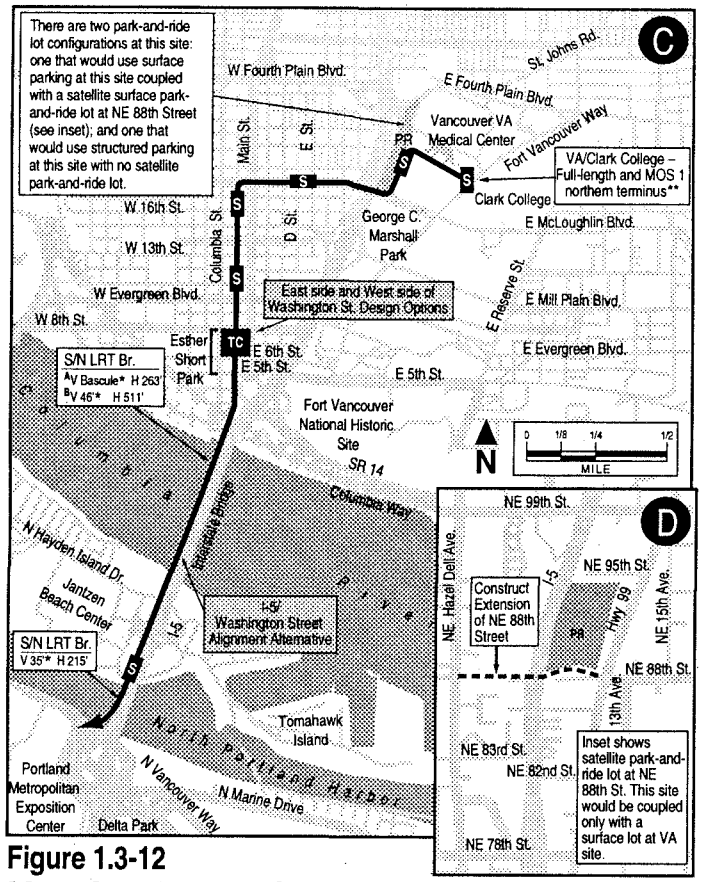


Figure 1.3-12

Hayden Island/Vancouver

- I-5/Washington Street

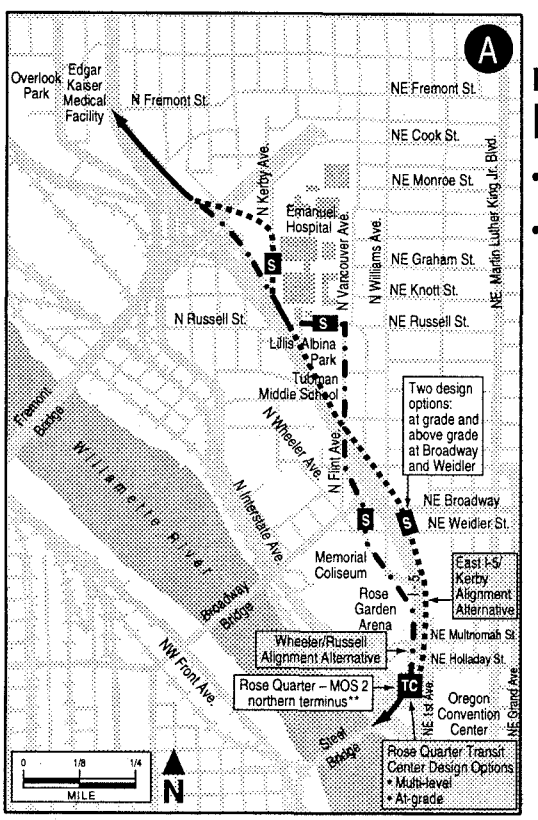
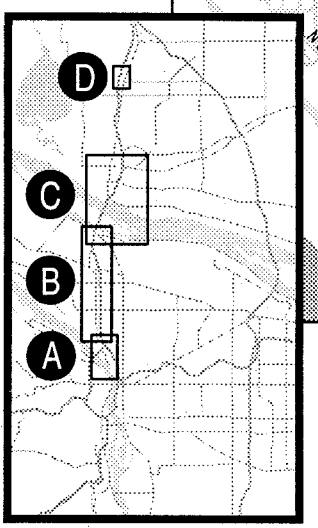


Figure 1.3-10

Eliot

- Wheeler/ Russell
- East I-5/ Kerby



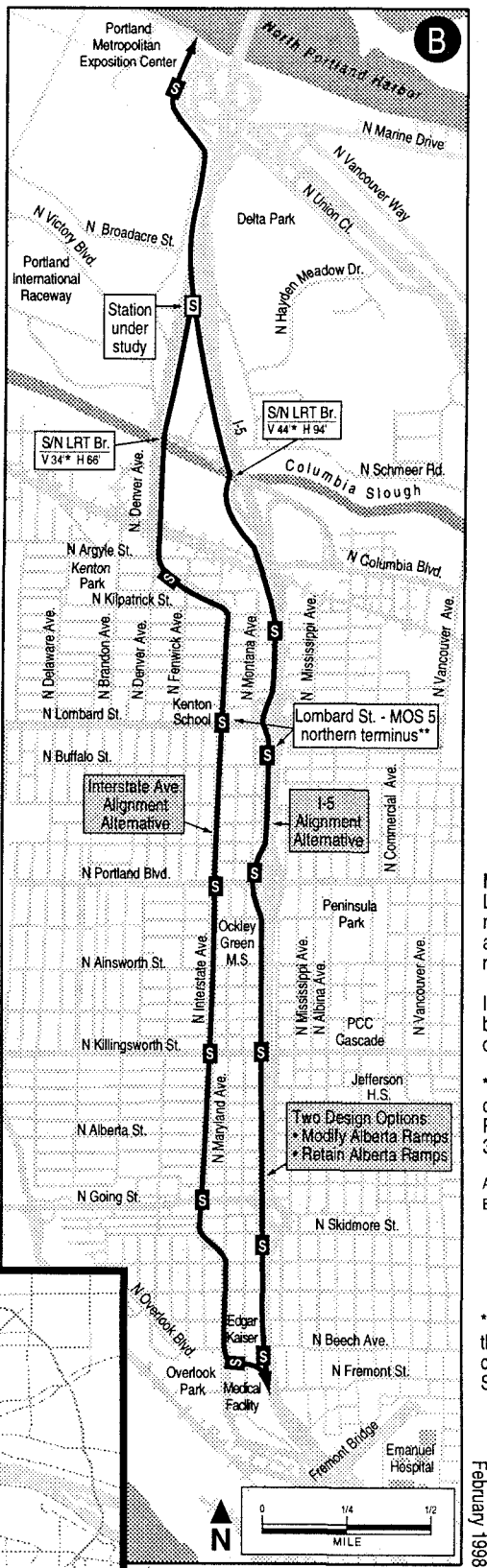


Figure 1.3-11

North Portland

- Interstate Avenue
- I-5

South North Transit Corridor Study

METRO

Wheeler/ Russell LRT Alignment Alternative

East I-5/ Kerby LRT Alignment Alternative

Common LRT Alignments

S Station

Existing Railroad

TC Transit Center

PR Park-and-Ride

Note: Alignment, station and LRT operations and maintenance facility locations are currently under study and may change.

In their open position bascule bridges would have no vertical clearance limitiation.

*Proposed maximum vertical clearances are Columbia River Datum - see section 3.2.7.

A Main Channel
B Alternate barge channel

**MOS refers to a segment of the full-length alternative called a Minimum Operable Segment.

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- **I-5/Washington Street Alignment Alternative.** Traveling north from the Expo Center on the west side of I-5, the alignment would cross over N Marine Drive, the North Portland Harbor and N Jantzen Street on a bridge structure. Over North Portland Harbor the LRT span would have a vertical clearance of 35 feet (CRD) and a horizontal clearance of 215 feet. A station would be located near N Jantzen Street. The alignment would pass under the I-5 ramps, then continue north along the west side of the freeway to a new lift-span bridge crossing the Columbia River. The light rail bridge would parallel the west side of the existing I-5 southbound bridge and would be approximately the same height above the river. The LRT bridge would have a lift span directly adjacent to the existing lift spans and would provide a vertical clearance of 178 feet (CRD) in the full open position, with a horizontal clearance of 263 feet. An alternate barge channel to the south would have a vertical clearance of 46 feet (CRD) and a horizontal clearance of 511 feet. The alignment would pass over Columbia Way in Vancouver and then would cross under the Burlington Northern railroad berm before connecting with the southern end of Washington Street.

  From the southern end of Washington Street, the light rail alignment would proceed north to stations at W 7th Street (transit center), between W 11th and 12th Streets and between W 16th and 17th Streets. At McLoughlin Boulevard, the alignment would turn east, proceeding in the center of E McLoughlin Boulevard to the east side of I-5. A station would be located on E McLoughlin Boulevard between "D" and "E" Streets.

  There are two design options on Washington Street in downtown Vancouver between W 5th and 8th Streets:

  - ***West side of Washington Street.*** With this design option, light rail would operate on the west side of Washington Street. A transit center would be located in the vicinity of W 7th Street near the Esther Short redevelopment parcel bordered by W 5th and 7th Streets and Main and Columbia Streets.

  - ***East side of Washington Street.*** With this design option, light rail would operate on the east side of Washington Street. A transit center would be located in the vicinity of W 7th Street near the C-TRAN transit center.

  From the station on E McLoughlin Boulevard, the alignment would cross under I-5, turn north and proceed along the east side of I-5 to a park-and-ride lot east of I-5 between E McLoughlin Boulevard and E Fourth Plain Boulevard. From the VA Medical Center park-and-ride lot and station, the alignment would turn east, proceeding to the terminus station west of Fort Vancouver Way and across the street from Clark College.

  There are two design options for providing park-and-ride capacity for the north terminus in Clark County.

  - ***Surface VA Park-and-Ride Design Option.*** This design option would include a surface park-and-ride lot (approximately 1,000 spaces) in the vicinity of the VA Medical Center. With the surface park-and-ride lot design option, an additional

satellite park-and-ride lot (approximately 1,500 spaces) would be developed at NE 88th Street, linked to the light rail line by shuttle bus service.

- ***Structured VA Park-and-Ride Design Option.*** This design option includes a station and structured park-and-ride lot (approximately 3,900 spaces) in the vicinity of the VA Medical Center.

B. Highway Improvements

Highway improvements would be consistent with those included in the *1995 Interim Federal Regional Transportation Plan's* financially constrained highway network. For a complete listing of those improvements refer to the *South/North Definition of Alternatives Compendium* (Section 15, RTP Financially Constrained Highway Project Atlas). Following is a summary by corridor segment of the additional roadway improvements that would be associated with the proposed light rail alignment alternatives and design options.

Clackamas Regional Center Segment. Highway improvements associated with the South of Clackamas Town Center Alignment Alternative would include: a new signalized crossing of SE Harmony Road in the vicinity of SE 80th Avenue; and traffic signal modifications at the entrances to Clackamas Town Center. Roadway improvements associated with the North of Clackamas Town Center Alignment Alternative would include: a new signalized crossing of SE Harmony Road near SE 80th Avenue; a half-street improvement of SE 80th Avenue between SE McBride and SE Sunnyside Drive; the modification of signals at SE 82nd Avenue and SE Monterey; the reconstruction of portions of the south side of SE Monterey; the reconstruction of the entrance to Clackamas Town Center mall to align with newly signaled SE 85th and SE 90th Avenues; and the construction of gated crossings on the south side of SE Sunnyside Road between I-205 and SE 105th Avenue.

East Milwaukie Segment. Highway improvements related to the Railroad Avenue/Through Traffic and the Railroad Avenue/Local Access Alternatives would include: the reconstruction of the SE Linwood Avenue and SE Harmony Road intersection as a grade-separated crossing over the UPRR; and the closure of SE Railroad Avenue between SE Oak and SE Harrison Streets. Roadway improvements associated with the Railroad Avenue/Through Traffic Alternative would also include: the reconstruction of SE Railroad Avenue between SE Linwood Avenue and SE 37th Avenue; and the realignment of the intersection of SE Railroad and SE Linwood Avenues to a newly signalized intersection with SE Cedarcrest Drive. Highway improvements related to the Railroad Avenue/Local Traffic Alternative would also include: the closure of the existing SE Railroad Avenue at various points; the reconstruction of several segments of SE Railroad Avenue to provide local property access; and the construction of a multi-use path along the entire length of SE Railroad Avenue (see Figure 1.3-5b). Highway improvements associated with the Highway 224 Alternative would include: the reconstruction, realignment and signal modifications of intersections along Highway 224; and the closure of the east leg of the intersection of SE Monroe Street at Highway 224.

McLoughlin Boulevard Segment. Under one option, the SE Bybee Boulevard overpass of SE McLoughlin Boulevard would be reconstructed with wider travel lanes, bike lanes, sidewalks and bus pullouts; the other option would retain the existing roadway structure for vehicular traffic and would add a separate pedestrian bridge just north and parallel to the existing structure to provide

improved pedestrian access to the light rail station. Highway improvements would include the reconstruction of the SE McLoughlin Boulevard northbound on-ramp to SE Tacoma Street.

South Willamette River Crossing Segment. Highway improvements associated with the Ross Island Crossing would include the reconstruction of SW Gibbs Street between SW Macadam Avenue and SW Bond Avenue. SW Curry Street, SE Long Street and SE 18th Avenue would be closed with the Ross Island Alternative. SE 9th Avenue, SE Mall Street and SE Reynolds Street would be modified with the Ross Island Alternative. Roadway modifications associated with the Caruthers Crossing would include: the closure of SE Clinton Street between SE 11th and 12th Avenues and the reconstruction of the SE 17th Avenue overpass of SE Powell Boulevard; the closure of portions of SE Clinton Street, SE 18th Avenue, SE Haig Street and SE Rhine Street; and the relocation of adjacent bike lanes.

Downtown Portland Segment. Highway improvements for both the Full Transit Mall Alternative and the Half Transit Mall Alternative would include the extension of the downtown Portland transit mall from SW Madison Street to SW Harrison Street; the reconstruction of portions of SW Harrison Street, SW 5th Avenue and SW 6th Avenue; and the modification of traffic signals at several intersections. Roadway modifications associated with the Glisan Street Design Option would include: the reconstruction of portions of NW Glisan Street; and the widening of the west approach to the Steel Bridge. Roadway modifications for the Irving Street Design Option would include: the reconstruction of the north portion of the downtown Portland transit mall; the closure of a portion of NW Hoyt Street; the reconstruction of and/or relocation of NW Irving Street; and the widening of the west approach to the Steel Bridge.

Eliot Segment. Highway improvements that would be common to both light rail alignment alternatives within this segment would include: the closure of the middle two lanes on the Steel Bridge to auto, truck and bus traffic; and the reconstructing portions of NE Interstate Avenue and NE Williams Avenue. Highway improvements associated with the East I-5/Kerby Alternative would include: the reconstruction of portions of N Kerby Avenue and NE Multnomah Street; the closure of portions of N Monroe Street and NE Hancock Street; the construction of a local access road; and the modification of signals at various intersections. Highway improvements associated with the East I-5/Kerby Alternative with the at-grade design option would include the reconstruction of the northbound I-5 exit ramp to NE Weidler Street and NE Broadway. Roadway modifications of the Wheeler/Russell Alternative would include: the modification of NE Multnomah Street to provide a bus-only turnaround with the at-grade Rose Quarter Transit Center Design Option; the removal of one southbound travel lane along N Wheeler Street; the conversion of portions of N Flint Avenue to one-way southbound operations, the relocation of the southbound I-5 to N Broadway Street ramp; the relocation of N Mississippi Street near the I-405 ramps; the closure of N Page Street at N Flint Avenue; and the closure of N Center Court and reconstruction of N Winning Way to maintain access to the Rose Garden parking garage structures.

North Portland Segment. Highway improvements associated with the I-5 Alternative would include: the closure of portions of N Prescott Street, N Minnesota Avenue, N Humboldt Street and one-block of N Montana Avenue; the reconstruction of portions of N Humboldt Street, N Holman Street, N Liberty Street, N Webster Street, N Kilpatrick and one block of N Baldwin Street as cul-de-sacs; and the reconfiguration of two segments of N Minnesota Avenue. Highway improvements associated with the Interstate Avenue Alternative would include the reconstruction of

portions of N Interstate Avenue generally from a four-lane section to a two-lane section. Reconstruction of the roadway would include new sidewalks, curbs and gutters, auto and bicycle lanes, turn and/or auxiliary lanes at intersections and parking lanes at mid-block locations. Additional roadway improvements would include: the construction of a new segment of N Overlook Boulevard, the realignment of N Farragut Street; the reconfiguration of the street network in the Kenton area; the modification and addition of traffic signals and additional left-hand turn restrictions.

Hayden Island/Vancouver Segment. Highway improvements with the I-5/Washington Street Alternative would include: the elimination W 3rd Street access to Washington Street; vacating W 4th Street between Washington and Columbia Streets; the restriction of eastbound and westbound left turn movements along portions of E McLoughlin Boulevard; and the reduction of Washington Street's three southbound travel lanes to two southbound lanes. In addition, one northbound lane would be provided along Washington Street between W 7th and W 11th Streets and between W 12th and W 16th Streets. LRT vehicles would operate with full traffic signal preemption within this segment and all intersections with cross-traffic movements would be signalized. With the East Side of Washington Street Design Option, the northbound lane on Washington Street would begin at W 7th Street. With the West Side of Washington Street Design Option, the northbound lane would begin at W 8th Street. With a Surface VA Park-and-Ride Lot at the northern terminus, a NE 88th Street extension between Highway 99 and NE Hazel Dell Avenue would be constructed.

1.3.2.2. Transit Operations

The light rail alternatives would affect both light rail and bus operations within the corridor, as described below.

1.3.2.2.1 LRT Operations

LRT operations in the South/North Corridor would vary by length alternative and by alignment alternative, as described below.

A. Length Alternatives

Table 1.3-6 summarizes LRT operating characteristics for the light rail length alternatives. Light rail travel times have been developed through simulations that account for grades, curvature, speed and vehicle characteristics. Light rail travel times between stations for each length and alignment alternative are included in Section 9 of the *Definition of Alternatives Compendium*.

The South/North line would operate in conjunction with the present Eastside MAX route and future Westside line. There would be no through routing from South/North to the east or west line, but schedules would be coordinated to optimize connections. Operation would be from approximately 5:00 a.m. to 1:30 a.m. on weekdays, with later starting hours on Saturdays and Sundays.

Under all length alternatives, trains would be limited to two cars with a total length under 200 feet because blocks in downtown Portland are generally 200 feet long. All trains would be operated with a one-person crew, and all fares would be prepaid. Random inspection for proof-of-payment would be conducted.

Table 1.3-6
South/North LRT Operating Characteristics: Length Alternatives [1,2]

Operating Characteristics	Full-Length	MOS 1 (Bi-State)	MOS 2 (Rose Quarter)	MOS 5 (Lombard)
One-way LRT track miles	20.6	16.7	11.7	15.3
One-way running time (average through trip in minutes:seconds)	65:23	56:58	41:40	47:32
Layovers, average (minutes:seconds)	14	13	14	15
Weekday headways [3]				
Peak periods (within daybase) (7:00 p.m.-8:00 a.m.; 4:30 p.m.-5:30 p.m.)	6[4]	6[4]	7.5	7.5
Daybase (excluding peak periods) (6:00 a.m.-7:00 p.m.)	10	10	10	10
Night (7:00 p.m.-12:00 a.m.)	15	15	15	15
Train (platform) hours, weekday	356	290	229	248
Train miles, weekday	4,910	3,670	2,800	3,190
Car miles, weekday	9,030	6,750	5,150	5,870
Vehicles scheduled in peak periods	50	42	30	34
Vehicles in fleet, including spares	59	50	36	41

Source: Tri-Met, 1997.
[1] MOS 3 and 4 were eliminated from further study as a result of the Cost-Cutting process.
[2] Length alternatives are based upon a common set of alignment alternatives and terminus and design options, see Section 1.3.2.1.1. Characteristics would vary depending upon which alignment alternatives and terminus and design options are selected as a part of the LPS.
[3] Headways are the average number of minutes between trains in a given hour.
[4] Headway times are north of RiverPlace. South of RiverPlace, headways would be 7.5 minutes.

Under all length alternatives, the safety and security of the LRT system would be enhanced through an operations plan that includes a transit security force to patrol both stations and trains, an on-board force of fare inspectors to monitor public adherence to Tri-Met's self-service fare collection system and system-wide CCTV camera surveillance of some LRT facilities. While the exact security staffing and operations plan for the proposed system have not yet been developed. The plan would be coordinated and consistent with Tri-Met's overall security efforts. For example, camera surveillance would monitor pedestrian activity and fare equipment at major stations. Breaches of security or safety would be

reported directly to transit security force personnel or to the local police force. The Central Control facility would be connected to all local fire and police departments and would serve as the transit system's communications center for all security and emergency situations.

Full-Length Alternative. With the Full-Length Alternative, light rail trains would operate from the Clackamas Regional Center to the VA/Clark College terminus at 7.5-minute headways during the peak travel period and 10-minute headways during the off-peak. Additional light rail trains would operate from the RiverPlace Station to the VA/Clark College terminus at 30-minute headways during the peak travel period, resulting in a combined LRT headway of six minutes between RiverPlace and the VA/Clark College area. The one-way travel time from the Clackamas Regional Center to the

VA/Clark College terminus would be approximately 65 minutes, depending upon the alignment options and right-of-way conditions.

MOS 1 Alternative. With MOS 1, light rail from the Milwaukie Regional Center to the VA/Clark College terminus would operate at 7.5-minute headways during the peak travel period and 10-minute headways during the off-peak. Additional light rail trains would operate from the RiverPlace Station to the VA/Clark College terminus at 30-minute headways during the peak travel period, resulting in a combined LRT headway of six minutes between RiverPlace and the VA/Clark College terminus. The one-way travel time from the Milwaukie Transit Center to the VA/Clark College terminus would be approximately 57 minutes, depending upon the alignment options and right-of-way conditions.

MOS 2 Alternative. With MOS 2, light rail from the Clackamas Regional Center to the Rose Quarter Transit Center would operate at 7.5-minute headways during the peak travel period and 10-minute headways during the off-peak. The one-way travel time from the Clackamas Regional Center to the Rose Quarter Transit Center would be approximately 42 minutes, depending upon the alignment options and right-of-way conditions.

MOS 5 Alternative. With MOS 5, light rail from the Clackamas Regional Center to the Lombard Transit Center would operate at 7.5-minute headways during the peak travel period and 10-minute headways during the off-peak. The one-way travel time from the Clackamas Regional Center to the Lombard Transit Center would be approximately 48 minutes, depending upon the alignment options and right-of-way conditions.

B. Alignment Alternatives

Differences in light rail running times between alignment alternatives would affect light rail operating characteristics by increasing or decreasing the LRT platform hours and miles and the peak light rail vehicle requirements. Table 1.3-7 summarizes the differences in LRT operating characteristics between the alignment alternatives.

1.3.2.2.2 Bus Operations

A. Length Alternatives

Bus operations would vary depending upon the LRT length alternatives. Section 5 of the *Definition of Alternatives Compendium* includes maps illustrating the bus routing variations. Section 7 of the *Compendium* provides a detailed listing of bus route configurations for each length alternative. Table 1.3-2 summarizes the bus operating characteristic differences between the length alternatives.

B. Alignment Alternatives

Bus operations and levels of service would be substantially similar throughout the corridor independent of the alignment alternatives or design options. Minor variations in bus routing would occur where different alignment alternatives within a segment would change the location of a transit center or bus/light rail transfer location or where light rail service would replace bus service on an adjacent parallel street. Following are the segments where different alignment alternatives would

result in minor bus routing variations. Section 5 of the *Definition of Alternatives Compendium* includes maps illustrating these bus routing variations.

Table 1.3-7
South/North LRT Operating Characteristics: Alignment Alternatives and Design Options

Segment	Alignment Alternatives	Running Time, Average Through Trip [1] (min:sec)	Train Platform Hours [2]	Train Miles [2] (weekday)	Car Miles [2] (weekday)
Clackamas Regional Center	South of CTC with South of OIT/CCC Design Option [3]	5:18	356	4,910	9,030
	South of CTC with North of OIT/CCC Design Option [3]	4:41	354	4,900	9,020
	North of CTC with South of OIT/CCC Design Option [4]	8:43	372	5,120	9,410
	North of CTC with North of OIT/CCC Design Option [4]	8:06	369	5,110	9,400
East Milwaukie	Railroad Ave. [5]	3:14	356	4,910	9,030
	Highway 224	4:31	362	4,950	9,110
Milwaukie Regional Center	Main St./Tillamook Branch Line	5:14	356	4,910	9,030
McLoughlin Blvd.	McLoughlin Blvd.	4:04	356	4,910	9,030
South Willamette River Crossing	Ross Island Crossing with East of McLoughlin Design Option	5:48	356	4,910	9,030
	Ross Island Crossing with West of McLoughlin Design Option	5:32	355	4,910	9,030
	Caruthers Crossing with Moody Avenue Design Option	6:31	360	4,950	9,100
	Caruthers Crossing with South Marquam Design Option	6:47	361	4,980	9,160
Downtown Portland	Full Transit Mall with Glisan Street Design Option	15:01	356	4,910	9,030
	Full Transit Mall with Irving Street Design Option	15:54	360	4,930	9,080
	Half Transit Mall	14:53	356	4,940	9,080
Eliot	East I-5/Kerby	5:27	356	4,910	9,030
	Wheeler/Russell	6:11	360	4,900	9,020
North Portland	I-5	9:24	356	4,910	9,030
	Interstate Avenue	11:07	364	4,940	9,080
Hayden Island/ Vancouver	I-5/Washington Street with Surface VA Park-and-Ride Design Option	12:00	356	4,910	9,030
	I-5/Washington Street with Structured VA Park-and-Ride Design Option	12:00	356	4,910	9,030

Source: Tri-Met, 1997.

[1] Segment running time.

[2] Based on Full-Length Alternative.

[3] Based on 93rd Avenue Terminus Option. With a CTC Transit Center Terminus Option: LRT track miles would be reduced by 0.45 miles; there would be two LRT stations and one park-and-ride lot with 900 spaces; and it would require three fewer light rail vehicles.

[4] Based on 105th Avenue Terminus Option. With a CTC Transit Center Terminus Option: LRT track miles would be reduced by 1.05 miles; there would be two LRT stations and one park-and-ride lot with 900 spaces; and it would require three fewer light rail vehicles.

[5] Same for Local Access and Through Traffic Alternatives. Not building a Wood Avenue Station would reduce travel times by 45 seconds.

- **Clackamas Regional Center Segment.** The North of CTC Alignment Alternative would locate the CTC Transit Center south of SE Monterey Avenue, near its current location. The South of CTC Alignment Alternative would locate the CTC Transit Center north of SE Sunnyside Road and the routing of buses serving the CTC Transit Center would be slightly different.

- **East Milwaukie Segment.** Service on SE Monroe Street, SE Home Avenue and SE Railroad Avenue would vary depending upon the alignment alternative and the corresponding local street network.

- **North Portland Segment.** The I-5 Alignment Alternative would retain the number 5 bus route on N Interstate Avenue. Bus transfers from routes operating on N Lombard Street would be shifted east from N Interstate Avenue to N Minnesota Avenue. The Interstate Avenue Alignment Alternative would shift number 5 bus service west from N Interstate Avenue to N Denver Avenue between Kenton and N Killingsworth Street.

2. METHODOLOGY

2.1 Introduction

The South/North Corridor encompasses a large geographical area and has the potential to impact air quality on both a regional scale and a local scale. Air quality impacts are closely related to traffic impacts. Regional air quality impacts could occur as a result of the transfer of trips between transportation modes, or the selection of alternatives that either increase or decrease general levels of traffic and congestion and associated air pollution levels. On a local scale, impacts could occur as a result of increased automobile traffic at park-and-ride facilities and as a result of modified traffic patterns at some intersections.

The purpose of the air quality analysis is to compare the impacts of existing conditions, the No-Build Alternative and South/North light rail alternatives and options. The analysis of regional impacts was based primarily on average weekday regional vehicle miles traveled (VMT) and average weekday regional speeds. The analysis of local impacts relied on the results of the South/North project's traffic analysis to identify intersections with potentially high carbon monoxide (CO) concentrations.

2.2 Related Federal, State, and Local Regulations

The Federal government has established National Ambient Air Quality Standards (NAAQS) to protect the public from air pollution. In addition, the Oregon Department of Environmental Quality (DEQ) and Washington Department of Ecology (DOE) have established State Ambient Air Quality Standards (SAAQS) which must be at least as stringent as the National Ambient Air Quality Standards (NAAQS). DEQ, DOE and the Southwest Washington Air Pollution Control Authority (SWAPCA) have delegation of air quality program implementation from the U.S. Environmental Protection Agency (EPA).

The following regulations were referenced as part of this air quality analysis:

- Oregon Administrative Regulations (OAR), Chapter 340, Division 20, which regulates indirect sources and establishes criteria and procedures for determining conformity to state or federal implementation plans of transportation plans, programs, and projects funded or approved under Title 23 of the Federal Transit Act

- OAR, Chapter 340, Division 31, which establishes ambient air quality standards

- Washington Administrative Code (WAC), Chapter 173-420, which outlines requirements for conformity of transportation to air quality implementation plans

- WAC, Chapter 173-475, "Ambient Air Quality Standards for Carbon Monoxide, Ozone, and Nitrogen Dioxide"

2.3 Methods

2.3.1 Existing Air Quality

Existing air quality conditions were documented using existing ambient monitoring data available from DEQ and SWAPCA. The entire South/North Corridor is within an area that was recently redesignated from nonattainment to maintenance area status for carbon monoxide and ozone (see Section 4.1.2 for a more detailed discussion of nonattainment and maintenance area designations). Pollutants of concern for this analysis are CO, non-methane hydrocarbons (NMHC), and nitrogen oxides (NO_x). NMHC and NO_x contribute to ozone formation through photochemical processes. No other pollutants were analyzed in detail.

2.3.2 Impact Assessment

Regional impacts were assessed using 1996 base year (existing conditions) and 2015 design year (future conditions) traffic volumes. Emission factors developed by Metro for the ozone and CO maintenance plans were used to predict regional emissions. 2010 emission factors were used to estimate 2015 since vehicle emissions are not expected to change significantly between 2010 and 2015. Maximum ozone formation occurs during high temperature periods, consequently regional NMHC, NO_x, and CO emissions were calculated based on summer weather conditions. Localized CO impacts were calculated based on winter weather conditions. Maximum CO concentrations usually occur during colder months when temperature inversions trap vehicle emissions near the ground.

The assessment of air quality impacts entailed a regional burden analysis and a localized hot spot analysis. The burden analysis compared the regional emissions associated with the No-Build Alternative and length alternatives which contribute to ozone formation. The hot spot analysis addressed potential localized impacts of the alignment alternatives and design options on CO levels. The hot spot analysis modeled CO concentrations for intersections located in all of the general geographic areas where alignment alternatives and design options could potentially impact air quality. An air quality impact was considered to occur when intersection modeling for the hot spot analysis showed an exceedance of the NAAQS for CO.

To demonstrate conformity, a project must be included in a conforming Regional Transportation Plan (RTP) and a hot spot analysis must be performed on the three intersections with the worst level-of-service and the three intersections with the highest traffic volumes. The proposed South/North light rail project is included in a conforming RTP (Metro: 1995). A hot spot analysis was performed for 22 intersections potentially affected by the project's alignment alternatives and design options. In order to assess air quality impacts throughout the South/North Corridor, the intersection selection process for this analysis did not follow the conformity guidance. However, a full conformity analysis of the Locally Preferred Strategy will be conducted for the Final Environmental Impact Statement (FEIS).

2.3.3 Emission Factors

Emission factors as a function of speed were supplied by Metro for the regional emissions analysis. This ensured that the emission factors used in this analysis were consistent with the emission factors

used in the maintenance planning process. RTC supplied emission factors for the local CO impacts analysis in the Vancouver area. Emission factors used in the analysis of localized CO impacts in Oregon were developed using MOBILE5a_H with consultation from DEQ on appropriate model input assumptions.

2.3.4 Regional Impacts (Burden) Analysis

The regional impacts analysis used average weekday regional vehicle miles traveled (VMT) and average weekday regional speeds. The analysis region included all of Clark, Washington, Multnomah, and Clackamas Counties. The emission estimation technique developed by Metro for the conformity and air quality maintenance plan analyses uses a complicated methodology that requires multiple runs of MOBILE5a_H to develop composite emission factors. These emission factors account for the relative mix of vehicles from the two state's inspection and maintenance (I/M) areas and non-inspected areas during three different periods of the day on a link-by-link basis. The method also accounts for hot and cold starts, and hot soak and diurnal emissions separately by zone.

The South/North air quality analysis used a simplified method for comparing the regional emissions associated with the No-Build and South/North Length Alternatives. Metro supplied regional VMT and start data for all alternatives. Metro also supplied the percentage of vehicles from the various vehicle I/M areas for existing and future conditions. Hot stabilized emission factor function curves (emissions as a function of speed) developed by Metro (using MOBILE5a_H) for each of the I/M and non-I/M programs were then used to calculate daily regional emissions of NMHC, NO_x, and CO. Daily regional emissions from hot and cold starts, hot-soak, and diurnal sources were calculated based on the number of trips and emission factors for each of the I/M and non-I/M programs for existing conditions, the No-Build Alternative and the four length alternatives.

2.3.5 Local Impacts (Hot Spots) Analysis

A comparative analysis of the local air quality impacts of the alignment alternatives and design options was performed at discrete locations. Twenty-two intersections were analyzed for local CO impacts. The selection of these intersections was based on traffic analysis data and generally followed the guidance in the EPA document *Guideline for Modeling Carbon Monoxide from Roadway Intersections* (November 1992). This guidance recommends ranking intersections based on level of service and traffic volume to select the intersections where CO impacts would most likely to occur. The EPA CAL3QHC dispersion model was used to estimate CO concentrations near the selected intersections. The model input assumptions used in the CAL3QHC model are shown in Table 2.3-1.

2.3.6 Construction Impacts

Construction impacts are addressed qualitatively in Chapter 5 of this report (Environmental Consequences). Potential construction impacts are expected from clearing, excavation, grading, blasting, and demolition. Short-term impacts may also result from additional traffic congestion during construction.

Table 2.3-1
CAL3QHC Model Input Assumptions

Meteorological Variables	Model Assumptions
Averaging time	60 minutes
Surface roughness	Between S terminus & SE 82nd Avenue--272.50 (apartment/office mix)
	SE 82nd Avenue north to Scott Park area--108.00 (single-family residential)
	Scott Park area north to PDX CBD--175.00 (office)
	PDX Central Business District--321.00 (CBD)
	North end of PDX CBD north to north terminus--175.00 (office)
Wind speed	1 meter/second
Wind angle	0 to 360 degrees in 10 degree increments
Stability class	4 (D)
Mixing height	1,000 meters
Persistence factor (1 hour to 8 hour)	Washington - 0.70 Oregon - 0.76
Ambient background concentration	Washington - 3 parts per million Oregon - 2 parts per million
Site Variables	**Model Assumptions**
Receptor coordinates	At least 3 meters from each traveled roadway on both sides of the street, at distances of 3 meters, 25 meters, 50 meters, and midblock from the cross street
	Height 1.8 meters.

Source: TW Environmental, Inc. (November 1997)

2.3.7 Mitigation Measures

Mitigation measures are discussed in Chapter 6 of this report (Mitigation). Additional mitigation may be developed during the FEIS analysis for full conformity.

3. Agency Coordination and Involvement

The *South/North Air Quality Results Report* was prepared to meet state and federal air quality analysis standards. To ensure the acceptability of the methodology prior to analysis, the methodology report was submitted to both the regional and state air quality authorities in Oregon and Washington. The methodology report was also submitted to agencies in affected jurisdictions for review and input. Meetings were held with Howard Harris of DEQ (October 14, 1996) and Steve Kelley of the Regional Transportation Council (April 23, 1996) to discuss the methodology.

The agencies that reviewed the methodology report are listed in Table 3.1-1.

Table 3.1-1
Methodology Review Agencies

Agency	Contact and Address	Phone/Fax
Oregon Department of Transportation	Vince Carrow/ ODOT Environmental Services 1158 Chemeketa NE, Salem, OR 97310	(503) 986-3485 FAX (503) 986-3524
Southwest Washington Air Pollution Control Authority	Jennifer Brown /SWAPCA 1308 NE 134th St., Vancouver, WA 98685-0925	(360) 574-3058 FAX (360) 576-0925
Regional Transportation Council	Steve Kelley, SW Washington RTC 1351 Officers Row, Vancouver, WA 98661	(360) 737-6067 FAX (360) 696-1847
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4. AFFECTED ENVIRONMENT

The area which would be affected by the South/North Project extends from Clackamas County, Oregon to Vancouver, Washington. Air quality issues can be regional or localized in nature, depending on the source and type of the pollutant. Air pollutant emissions from vehicles are the single largest contributor to air pollution in the Portland/Vancouver area. Projected increases in population, associated increases in motor vehicle use and emissions from other population-related sources (such as lawn mowers, car painting, house paints, and consumer products) will make future reductions in pollution levels more difficult to accomplish. Reductions in emissions from motor vehicles will be a critical issue in improving and maintaining air quality in the area.

4.1 Regulations

4.1.1 Ambient Air Quality Standards

Ambient air quality standards have been established by the federal (U. S. Environmental Protection Agency (EPA)) and state governments (Oregon Department of Environmental Quality (DEQ) and Washington Department of Ecology) to protect public health and welfare. The Southwest Washington Air Pollution Control Authority (SWAPCA) implements the Washington State standards in the project area. The ambient air quality standards are listed in Table 4.1-1. Areas with air pollutant concentrations exceeding ambient air quality standards are designated as nonattainment areas for that pollutant.

The air pollutants of concern in evaluating the impacts of transportation projects are carbon monoxide (CO), ozone, particulate and lead. Nonmethane hydrocarbons (NMHC) and nitrogen oxides (NO_x) are also important pollutants to be evaluated since they contribute to the formation of ozone through photochemical reactions in the atmosphere.

4.1.2 Nonattainment Classification

Until recently, the Portland/Vancouver area was classified by EPA as a nonattainment area for ground level ozone and carbon monoxide. Nonattainment status means that the area has historically violated EPA standards for CO (9 ppm during any given 8-hour period) and ozone (0.12 ppm in a 1-hour period). CO and ozone levels are considered to be in compliance with the standard if they do not exceed the standard more than once per year on average. During the 1970s, the Portland/ Vancouver area exceeded the standards for CO on one day out of every three, and ozone levels were often as high as 50 percent over the federal standard. Programs and regulations implemented to control air pollutant emissions have been effective and air quality in the area has improved. EPA redesignated the Portland/Vancouver area from nonattainment to maintenance status for ozone and CO in 1997.

In order for EPA to redesignate the nonattainment areas as maintenance areas, DEQ and SWAPCA developed ozone and CO maintenance plans containing strategies to be implemented over the next ten years to control air pollution and maintain compliance with the standards. The maintenance plans are approved as amendments to the Federal Clean Air Act State Implementation Plans (SIPs),

the statewide air quality implementation plans. Redesignation to maintenance status has removed some Clean Air Act restrictions on industrial growth and federal transportation funding.

Table 4.1-1
Ambient Air Quality Standards

Pollutant	Averaging Time	Federal	Oregon	Washington
Carbon Monoxide	8-hour	9 ppm	9 ppm	9 ppm
	1-hour	35 ppm	35 ppm	35 ppm
Lead	Calendar Quarter	1.5$\mu g/m^3$	1.5$\mu g/m^3$	1.5$\mu g/m^3$
Ozone	1-hour	0.12 ppm	0.12 ppm	0.12 ppm
Nitrogen Dioxide	Annual Arithmetic Mean	0.053 ppm	0.053 ppm	0.053 ppm
Sulfur Dioxide	Annual Arithmetic Mean	0.03 ppm	0.02 ppm	0.02 ppm
	24-hour	0.14 ppm	0.10 ppm	0.10 ppm
	3-hour	0.5 ppm	0.5 ppm	0.5 ppm
Total Suspended Particulate	Annual Geometric Mean	---	60 $\mu g/m^3$	60 $\mu g/m^3$
	24-hour Average	---	150 $\mu g/m^3$	150 $\mu g/m^3$
PM_{10}	Annual Arithmetic Mean	50 $\mu g/m^3$	50 $\mu g/m^3$	50 $\mu g/m^3$
	24-hour Average	150 $\mu g/m^3$	150 $\mu g/m^3$	150 $\mu g/m^3$

Sources: Oregon Department of Environmental Quality and Southwest Air Pollution Control Authority

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
PM_{10} = particulate with an aerodynamic diameter of $\leq$ 10 micrometers

Ozone is formed in the atmosphere through a complex chemical reaction involving NMHC, NO_x, and sunlight. In the Portland/Vancouver area high ozone levels typically occur quite a distance downwind of the source of the pollutants. In order to address sources in the entire Portland/ Vancouver area, DEQ and SWAPCA worked together to coordinate the development and implementation of the Portland and Vancouver ozone maintenance plans.

In contrast to the regional nature of ozone formation, CO pollution is more localized and strongly influenced by emissions from nearby vehicles in both Portland and Vancouver. Control strategies for CO were developed separately for the Portland and Vancouver CO maintenance plans. However, both plans focus on lowering emissions from vehicles, reducing vehicle miles traveled (VMT) and reducing traffic congestion.

The ozone and CO maintenance plans have identified several measures to ensure continued compliance and maintain healthful air quality in the face of continuing population growth and increasing motor vehicle travel. The majority of DEQ's control strategies related to motor vehicle emissions (SWAPCA has similar strategies) apply to controlling both CO and ozone, and include:

- Expanding the Motor Vehicle Inspection Program

- Reducing motor vehicle trips using such measures as employee commute options and a voluntary parking ratio program (ozone control strategy only)

- Adopting the Central City Transportation Management Plan and associated parking policies (CO control strategy only)

- Implementing Metro's Region 2040 Growth Concept for land use and transportation planning

- Specific commitments for increases in transit service, bicycle and pedestrian facilities as included in the Regional Transportation Plan (RTP). Public transportation is particularly effective in reducing vehicle emissions not only because it reduces overall vehicle miles traveled, but because it often eliminates motor vehicle cold starts, a significant source of vehicle emissions

One key element of the ozone and CO maintenance plans is coordinating land use and transportation to reduce vehicle use and encourage development in areas already served by alternative transportation. Metro's Region 2040 Growth Concept is designed to significantly improve the balance between motor vehicles and other less-polluting forms of transportation. Specific emissions reduction measures included in the Regional Transportation Plan have been incorporated into DEQ's maintenance plans and must receive priority funding, or be replaced by measures achieving an equal emissions reduction. Completion of the Westside LRT and the South/North LRT have been included as transportation control measures in the maintenance plans.

4.1.3 Conformity

Both Oregon and Washington have regulations designed to ensure that transportation plans and regionally significant transportation projects are consistent (in conformance) with the SIP. The regulations require metropolitan planning organizations to prepare transportation plans identifying transportation projects that are likely to be funded and built. Emissions from all of the included projects cannot exceed emission budgets contained in the SIPs, and cannot cause or contribute to a violation of the national ambient air quality standards (NAAQS), or delay attainment in a nonattainment area. Individual projects can increase emissions, as long as overall emissions decrease. A conformity analysis is performed each time the transportation plan is updated. To demonstrate conformity, a project must be included in a conforming transportation plan. For CO nonattainment areas, an analysis of localized impacts (hot spots) is also required.

4.1.4 Indirect Source Construction Permits

As part of the environmental review process for new or improved roadways or facilities that will generate additional traffic, Oregon requires an indirect source construction permit under OAR Chapter 340, Part 20. A permit must be obtained if increases in traffic volumes or the number of parking spaces exceed specific limits. Within the City of Portland, a permit must be obtained for parking lots with more than 150 spaces. Higher thresholds apply outside the city limits. All South/North park-and-ride facilities proposed in Oregon would require an indirect source permit.

4.2 Pollutants of Concern

4.2.1 Carbon Monoxide

Carbon monoxide is a colorless, odorless, poisonous gas that decreases the oxygen-carrying capacity of blood. High concentrations of CO can severely affect brain, heart, and muscle function, and can aggravate heart disease and circulatory disorders. The primary source of CO in the Portland/Vancouver area is vehicle emissions. Wood heating is another significant source.

DEQ maintains monitoring stations for CO in the central business district (CBD) and on SE 82nd Avenue. These areas have been identified by DEQ as the sites of maximum concentrations of CO. The proposed South/North LRT alignments would pass through the CBD. Table 4.2-1 shows the highest and the second highest 8-hour average concentrations measured from 1990 through 1996 at two locations in the Portland CBD.

SWAPCA has maintained a CO monitoring station at Fourth Plain and Fort Vancouver Way for a number of years. A second monitoring station was added at Highway 99 and 78th in Hazeldell in 1995. The highest recorded data are at the original monitoring station. CO levels measured at the Fourth Plain and Fort Vancouver Way station from 1990 through 1996 are shown in Table 4.2-1.

Table 4.2-1
Portland [1] and Vancouver [2] Ambient Carbon Monoxide Concentrations

Year	Highest 8-hour		Second Highest 8-hour (ppm)		No. Days > 9 ppm	
	Portland	Vancouver	Portland	Vancouver	Portland	Vancouver
1990	8.5	12.6	7.1	10.8	0	2
1991	10.6	12.6	9.2	9.1	1	2
1992	7.2	8.1	6.3	7.0	0	0
1993	6.6	7.9	5.8	6.8	0	0
1994	7.4	9.5	6.3	7.7	0	1
1995	7.1	6.8	6.6	6.2	0	0
1996	6.4	6.8	5.7	6.2	0	0

Source: Oregon Department of Environmental Quality and Southwest Air Pollution Control Authority, 1997.

ppm = parts per million.
[1] Data includes highest concentrations measured at monitoring stations in downtown Portland.
[2] Data is from monitoring station at the intersection of Fourth Plain Boulevard and Fort Vancouver Way in Vancouver, Washington.

4.2.2 Ozone

Ozone is a pungent, highly reactive form of oxygen formed in the atmosphere by a chemical reaction of volatile organic compounds (VOCs) and nitrogen oxides (NO_x). Ground level ozone is commonly

referred to as smog, the reddish-brown haze visible in urban areas on hot summer days. Ozone can aggravate respiratory illness, impair athletic performance, and cause permanent respiratory system damage. It can be especially harmful to children and older people, and can damage crops and other materials. VOCs and NO_x from automotive emissions are primary sources of ozone, as well as household products, lawn mowers and other gas powered tools, and paints.

Ozone is not emitted directly by motor vehicles. It is produced in the atmosphere by chemical reactions involving NMHC, NO_x, and sunlight; therefore, increased emissions of NMHC and NO_x can contribute to ozone formation. Several monitoring stations are maintained to monitor ozone in the Portland/Vancouver area. The highest measured levels have been recorded at the station in Canby, Oregon. Ozone data collected at the monitor in Canby during 1990 through 1996 are summarized in Table 4.2-2. Expected population growth in the Portland/Vancouver area may cause future violations of the ozone standard even with the maintenance plan measures.

Table 4.2-2
Ambient Ozone Monitoring Data

Year	Summer Average (ppm)	Highest 1-hour (ppm)	Second highest 1-hour (ppm)	No. of Days >0.12 ppm
1990	0.029	0.165	0.146	4
1991	0.030	0.129	0.111	1
1992	0.030	0.126	0.108	1
1993	0.023	0.092	0.083	0
1994	0.029	0.117	0.106	0
1995	0.027	0.099	0.092	0
1996	0.029	0.149	0.124	1

Source: Oregon Department of Environmental Quality

4.2.3 Particulates

Total suspended particulate (TSP) is the total amount of particulate matter suspended in the air and usually consists of particles up to about 75 micrometers in diameter. Until 1987, there were federal and state regulations limiting allowable TSP concentrations. In 1987, the federal TSP standards were replaced with standards based on fine particulate matter (PM_{10}). Fine particulate matter can be inhaled deep into the lungs and has been found to have a more significant effect on human health. Both Oregon and Washington adopted the PM_{10} standard and have retained a TSP standard since 1987, although monitoring has focused on PM_{10}.

PM_{10} is primarily generated by wood stoves, open burning, industrial activities and motor vehicles. PM_{10} concentrations are monitored at seven locations in the Portland/Vancouver area. The entire area is designated as a PM_{10} attainment area. None of the South/North project alternatives (including the No-Build) is expected to have a significant effect on PM_{10} concentrations in the corridor.

4.2.4 Lead

Since the phase-out of leaded gasoline, lead concentrations have decreased substantially nationwide. The last exceedance of the lead standard in the Portland/Vancouver area occurred near I-5 in Portland in 1984. Lead is no longer a pollutant of concern for transportation-related projects.

5. Environmental Consequences

5.1 Long-Term Impacts

Long-term impacts associated with the South/North Project could result from an overall increase or decrease in regional pollutant emissions, or from localized impacts at intersections due to improved or degraded traffic congestion.

5.1.1 Regional Impacts

Regional air quality impacts are measured through forecasting changes in emissions of ozone precursors (NMHC and NO_X) and CO. Estimated regional average weekday emissions of NMHC, NO_X and CO are shown in Table 5.1-1. Regional emissions are expected to decrease significantly for all future conditions relative to existing conditions. This reduction is primarily due to reduced emissions from the vehicle fleet resulting from improvements in technology and more stringent vehicle inspection and maintenance programs in the future. All of the light rail length alternatives would result in a slight improvement in air quality over the No-Build Alternative due primarily to reduced automobile usage. The Full-Length Alternative would result in the largest improvement over the No-Build Alternative followed in order by MOS 1, MOS 5 and MOS 2. Specific alignment alternatives and design options are not expected to significantly affect regional emissions.

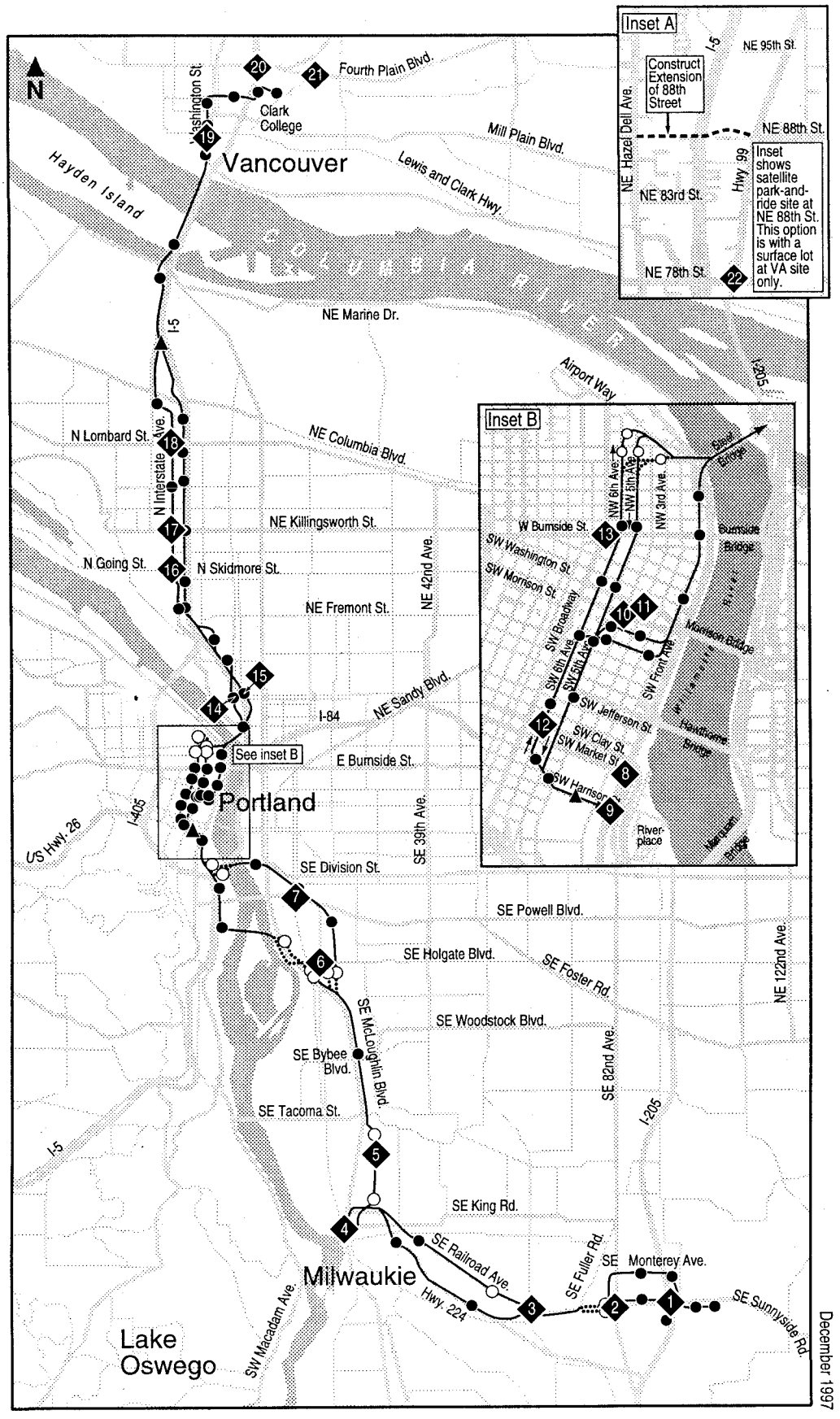
Table 5.1-1
Estimated Average Weekday Regional Pollutant Emissions
(tons/day)

Length Alternative	Daily VMT	NMHC	CO	NO_X
Existing Conditions	20,971,100	77.5	499.8	71.0
No-Build	33,022,500	50.7	403.3	61.1
Full-Length	32,808,800	50.4	401.1	60.7
MOS 1	32,861,500	50.5	401.7	60.8
MOS 2	32,971,600	50.6	402.8	61.0
MOS 5	32,909,000	50.6	402.3	60.9

Source: TW Environmental, Inc. (November 1997)

5.1.2 Local Impacts (Hot Spots)

Local concentrations of CO near intersections would be affected by improvements or degradation in traffic congestion as a result of the South/North Project. Localized effects would likely occur where LRT operations cause traffic delays or where park-and-ride facilities cause local increases in traffic volumes. Reductions in CO concentrations would be expected where grade separation or modifications to roadway configurations would improve local traffic conditions. Twenty-two intersections were analyzed throughout the corridor as shown in Figure 5.1-1. CO concentrations



December 1997

Note: Alignment, station and LRT facility locations are currently under study and may change.

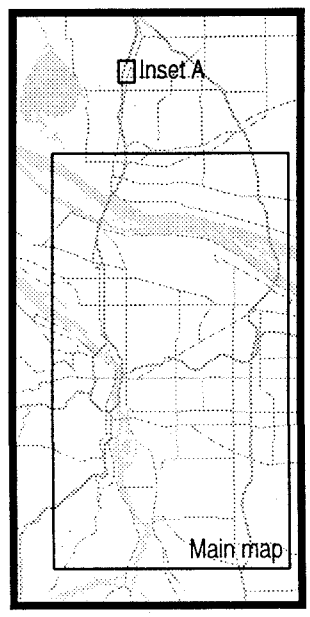
South North Transit Corridor Study

METRO

Figure 5.1-1
Carbon Monoxide Hot Spot Analysis Intersections

- Carbon Monoxide Hot Spot
- LRT Alignment Alternatives
- LRT Design Options
- Station
- Station Options
- Station Access Under Study

0 1 2 MILE



were predicted at up to 20 locations near each intersection. Table 5.1-2 includes the highest CO concentration modeled at each intersection. Both 1-hour and 8-hour CO concentrations were forecast, however, only the 8-hour concentrations are shown since they are typically of greater concern.

As shown in Table 5.1-2, future (2015) CO concentrations are not expected to increase for the No-Build or any light rail alternative alignment relative to existing conditions. In most locations, future CO concentrations would decrease relative to existing conditions. Forecasts show that all future CO concentrations would be below the 8-hour CO standard of 9 ppm and would not cause an exceedance of ambient air quality standards. Patterns of CO reductions between existing and future conditions, and relative concentrations between No-Build and light rail alignment alternatives would be similar for all South/North Corridor segments.

5.2 Short-Term (Construction) Impacts

The primary impacts of construction would be the generation of dust from site clearing, excavation, and grading, and impacts to traffic flow in the project area. Traffic congestion would increase idling times and reduce travel speeds resulting in increased vehicle emission levels. Construction of concrete structures could have associated dust emitting sources, such as concrete mixing operations. Stationary sources such as concrete mix plants would generally be required to obtain air contaminant discharge permits from the DEQ and to comply with regulations to control dust and other pollutant emissions.

Construction impacts would vary in extent and location, depending on the alternative selected and on weather conditions (rain suppresses dust). Construction impacts would be lowest with the No-Build Alternative and slightly higher for alternatives involving structural elements such as elevated crossings.

5.3 Compliance with State Implementation Plans

As a result of the Clean Air Act Amendments of 1990, both Oregon and Washington developed regulations designed to ensure that transportation plans and regionally significant transportation projects are consistent (in conformance) with the SIP. There are two parts to demonstrating conformity for transportation projects. The first requirement is that estimated pollutant emissions remain below the emissions budget for on-road mobile sources to ensure compliance with ambient air quality standards for ozone based on the projects included in the Regional Transportation Plan (RTP) for Oregon and the Metropolitan Transportation Plan (MTP) for Washington, and Transportation Improvement Plans (TIP). The second requirement for CO nonattainment or maintenance areas is that no individual project may cause an exceedance of the NAAQS, or an increase in the frequency or severity of an existing violation.

The South/North Light Rail Project is included in the Portland Area RTP (Metro, 1995), the 1996 Portland Area TIP (Metro, 1995), the projected 1998 Portland Area TIP (Metro, 1995), the 1996 Amendment to the Vancouver Area MTP (RTC, 1996), and the 1996 Vancouver Area TIP (RTC 1996). These plans assume that the southern portion of the LRT would be constructed by 2005, and that the northern portion would be constructed by 2015. Metro and RTC have prepared regional

Table 5.1-2
Projected 8-Hour [1] Carbon Monoxide Concentrations [2] Near Potentially Impacted Intersections

Segment/ Intersection	Existing 1996	No-Build 2015	Alternatives/Options 2015		
Clackamas Regional Center Segment			**South of CTC**	**North of CTC**	
SE Sunnyside Rd./I-205 SB Ramps	10	6	6	6	
SE Sunnyside Rd./SE Harmony Rd. at SE 82nd Ave.	8	6	6	6	
East Milwaukie Segment			**RR Ave./Through**	**MOS 1/MOS 5**	
SE Harmony/Railroad/Linwood [3]	6	5	–	–	
SE Harmony Rd. at SE Railroad Ave.	–	–	6	6	
SE Railroad Ave. at SE Linwood Ave.	–	–	4	4	
Milwaukie Regional Center Segment			**Main St./ Tillamook**	**MOS 1**	
SE McLoughlin Blvd./Harrison Ave.	9	6	6	6	
SE McLoughlin Blvd./Ochoco Ave.	7	6	6	–	
South Willamette River Crossing Segment			**Ross Island**	**Caruthers**	
SE Holgate/SE 17th Ave.	5	4	4	3	
SE Powell/SE Milwaukie Ave.	9	7	7	7	
Downtown Portland Segment			**Full Transit Mall**	**Half Transit Mall**	
SW Front Ave./Market St.	11	8	7	–	
SW Harrison Ave./SW Front Ave.	7	5	6	–	
SW 4th Ave./SW Alder St.	6	4	4	–	
SW 3rd Ave./SW Washington St.	5	4	4	–	
SW 6th Ave./SW Clay St.	5	4	4	–	
Eliot Segment			**East I-5/Kerby**	**Wheeler/ Russell**	
W Burnside St./NW Broadway St.	6	5	5	6	
N Vancouver Ave./N Weidler St.	8	6	7	6	
NE Broadway St./ N Williams St.	8	5	6	–	
North Portland Segment			**I-5**	**Interstate Ave.**	**MOS 5**
N Interstate Ave./N Going St.	7	6	6-7 [4]	6	6
N Interstate Ave./N Lombard St.	8	6	–	–	5
N Interstate Ave./N Alberta St.	4	4	4 [5]	4	4
Hayden Island/Vancouver Segment			**I-5/Washington St. w/Structured P&R**	**Surface P&R**	
6th Ave./Washington St.	6	4	4	–	
E Forth Plain at I-5 NB Ramps	7	5	5	5	
E Fourth Plain at Ft. Vancouver Way	9	5	5	5	
Highway 99 at NE 78th Ave.	11	6	6	–	

Source: TW Environmental, Inc. (December 1997)

Note: SB = southbound; CTC = Clackamas Town Center; RR Ave./Through = Railroad Avenue/Through Traffic Alignment Alternative; MOS = minimum operable segment; P&R = park-and-ride lot.

[1] 8-hour average concentration.
[2] Concentrations are expressed in parts per million (ppm).
[3] The road system and light rail line at this location would be grade separated from the existing freight rail line.
[4] Concentration would be 6 ppm for Retain Alberta Ramps Option and 7 ppm with Modify Alberta Ramps Option.
[5] Concentration would be the same with both the Retain and Modify Alberta Ramps Options.

emissions estimates and determined that the RTP, MTP, and TIP are in conformance with the SIP. The conformity determinations for these plans have been reviewed and approved by FHWA and FTA.

The hot spot analysis performed for the DEIS analyzed localized impacts at 22 intersections potentially affected by the various South/North alignment alternatives and design options. The results of the analysis showed that none of the South/North alternatives and options would cause an exceedance of the NAAQS in the design year (2015). The analysis included a geographically representative sample of intersections throughout the South/North Corridor expected to perform poorly based on traffic analysis findings. A full conformity analysis of the locally preferred strategy will be prepared and documented in the FEIS. This will require additional detailed analysis for specific intersections and interim years.

5.4 Cumulative Impacts

The impacts described throughout this chapter represent cumulative air quality impacts. The forecast traffic volumes used in this analysis included traffic from all sources. In addition, background concentrations, representing the cumulative impact of all other air pollution sources in the area, were added to the local CO concentrations predicted for the intersections analyzed.

6. MITIGATION

6.1 Long-Term Impacts Mitigation

All of the South/North light rail length alternatives would reduce VMT when compared with the No-Build Alternative, and would result in a slight reduction in regional air pollution emissions. CO concentrations at most intersections analyzed would decrease and modeling results indicate that none of these intersections would experience CO concentrations higher than the NAAQS. Based on these findings, no negative long-term air quality impacts are expected as a result of any of the South/North alternatives and options. Therefore, no additional mitigation measures would be necessary.

6.2 Short-Term Impacts (Construction) Mitigation

Construction contractors are required to comply with state regulations (OAR 340-21-060(2)) requiring that reasonable precautions be taken to avoid dust emissions. Mitigation measures normally used to control dust include applying water or suppressants during dry weather, and washing trucks and equipment to prevent construction area dirt and dust from being transported to nearby roads. To reduce the effect of construction delays on traffic flow and resultant air pollutant emissions, road or lane closures should be restricted to off-peak periods when possible.

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