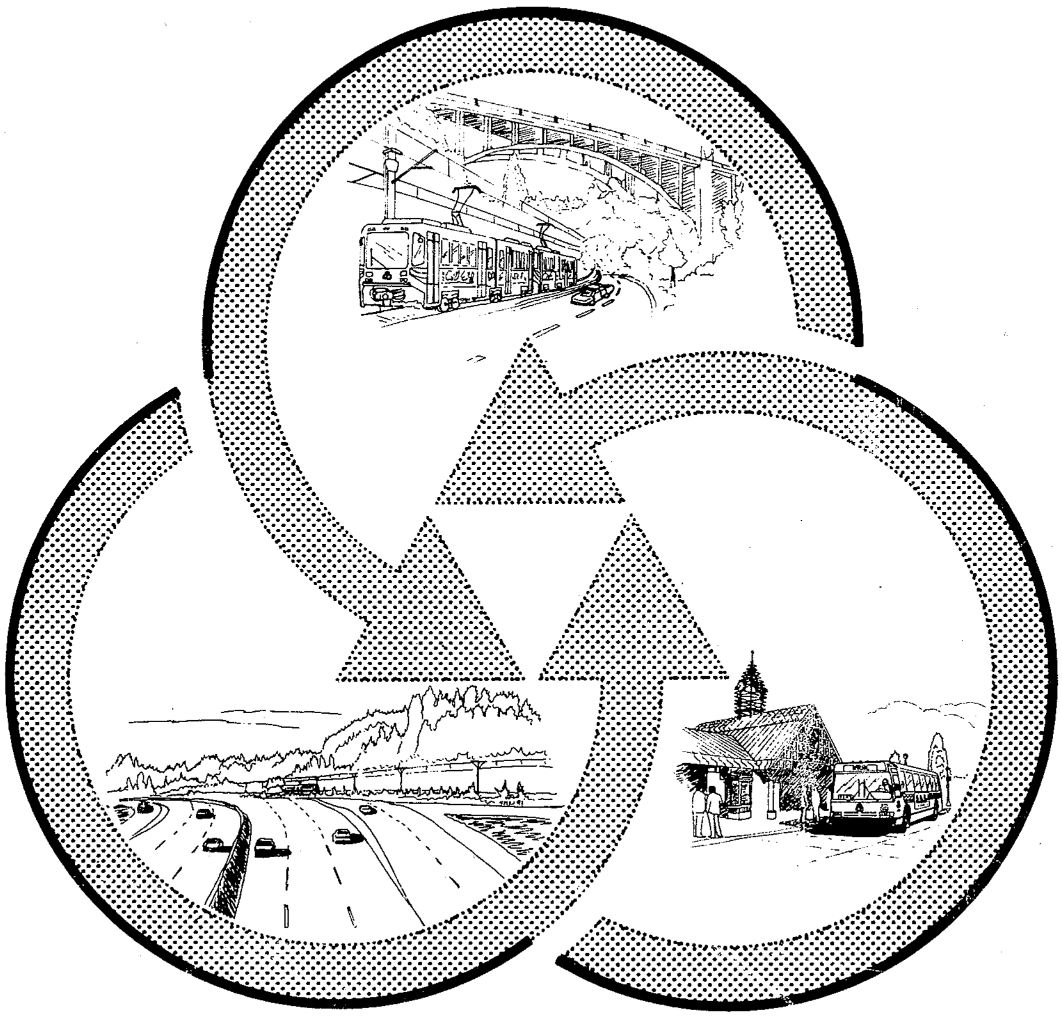
SUPPLEMENTAL DRAFT ENVIRONMENTAL IMPACT STATEMENT



WESTSIDE CORRIDOR PROJECT

PORTLAND, OREGON

JANUARY 1991

U.S. Department of Transportation
Urban Mass Transportation Administration

Tri-County Metropolitan Transportation
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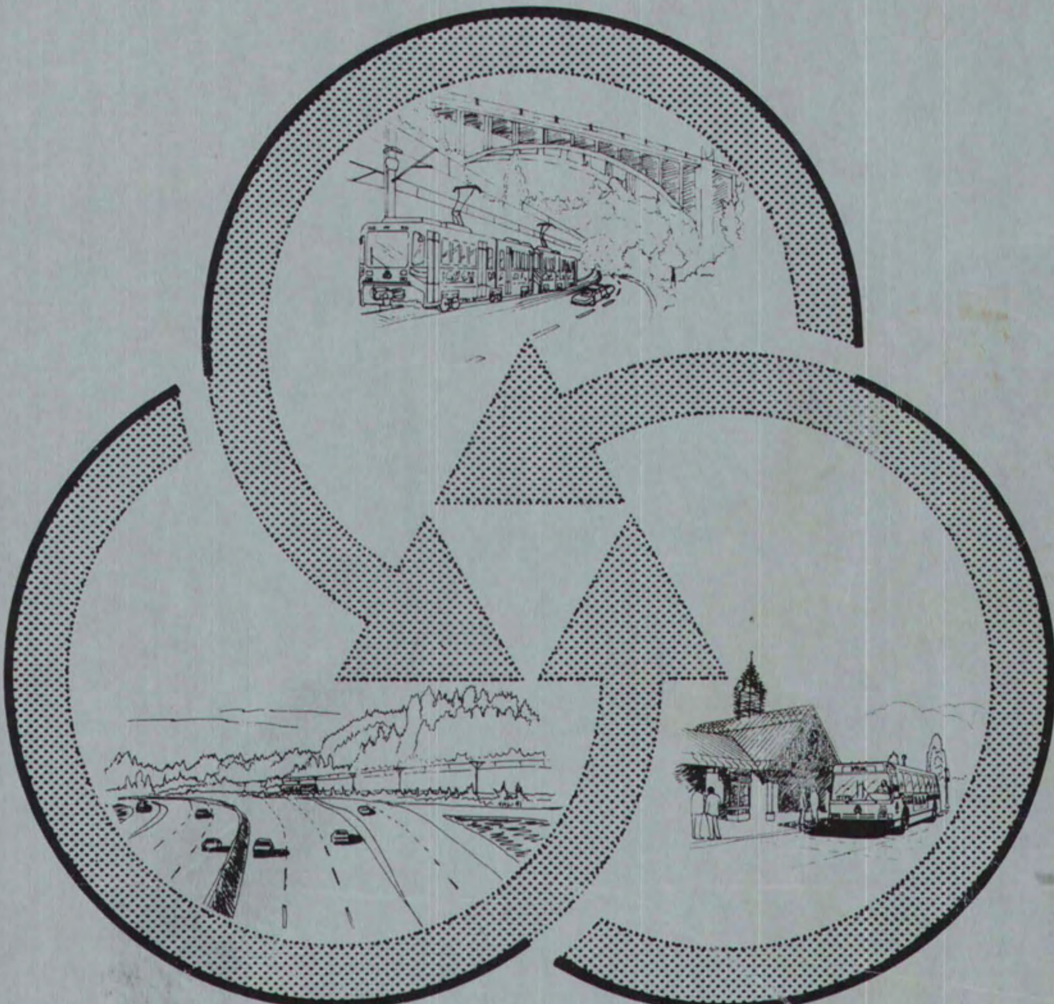

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The
Oregon
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of Transportation

WESTSIDE CORRIDOR PROJECT
PORTLAND, OREGON

SUPPLEMENTAL DRAFT ENVIRONMENTAL IMPACT STATEMENT

Submitted Pursuant to the National Environmental Policy Act
42 U.S.C. 4322(2)(c)

by the

U.S. DEPARTMENT OF TRANSPORTATION
URBAN MASS TRANSPORTATION ADMINISTRATION

and

TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT OF OREGON

In Cooperation with

FEDERAL HIGHWAY ADMINISTRATION
OREGON DEPARTMENT OF TRANSPORTATION

JAN 25 1991
Date of Approval

Western Area Director — Louis F. Mraz, Jr
For Urban Mass Transportation Administration

Jan. 25, 1991
Date of Approval

General Manager — James E. Cowen
For Tri-County Metropolitan Transportation District of Oregon

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Abstract

The proposed action is an improvement to the existing urban transportation system in the Portland metropolitan region. Alternatives considered include the No Build Alternative, a Transportation Systems Management (TSM) Alternative, and a light rail transit (LRT) Alternative. The LRT Alternative includes four alignment options in the Canyon segment, four alignment options in Beaverton, and three terminus options. Both the TSM and LRT Alternatives include improvements to Sunset Highway and Highway 217. The analysis and impact assessment considered potential effects on transit service, ridership, accessibility, highway congestion, land use, neighborhoods, ecosystems, air quality, noise and vibration, energy, hazardous materials, parklands, and historic and cultural resources. The analysis also considered the financial feasibility and cost effectiveness of the alternatives. The information resulting from these studies will be used to select a preferred alternative for the corridor.

Comments

Comments on this document may be submitted in writing or may be made orally at a public hearing. Written comments should be submitted to Mr. Alonzo Wertz at the above address. Information on the public hearing also can be obtained from Mr. Alonzo Wertz.

Comments are due by March 25, 1991.

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LIST OF ACRONYMS

ABS	-	Automatic Block Signal
ACHP	-	Advisory Council on Historic Preservation
ADT	-	Average Daily Traffic
AGR	-	Annual Growth Rate
APTA	-	American Public Transportation Association
AQMA	-	Air Quality Maintenance Area
ASCP	-	Arterial Street Classification Policy
AWD	-	Average Weekday
BMP	-	Best Management Practice
BPA	-	Bonneville Power Administration
BN	-	Burlington Northern
Btu	-	British Thermal Unit
CAC	-	Citizens Advisory Committee
CBD	-	Central Business District
CFR	-	Code of Federal Regulations
Corps	-	U.S. Army Corps of Engineers
CPO	-	Community Planning Organization
dB	-	Decibel
dBA	-	Average decibel
DFW	-	Oregon Department of Fish and Wildlife
DOE	-	U.S. Department of Energy
DEIS	-	Draft Environmental Impact Statement
DEQ	-	Oregon Department of Environmental Quality
DOT	-	Oregon Department of Transportation
DSL	-	Oregon Division of State Lands
EIS	-	Environmental Impact Statement
EPA	-	Environmental Protection Agency
EQC	-	Oregon Environmental Quality Commission
FEIS	-	Final Environmental Impact Statement
FHWA	-	Federal Highway Administration
FIRE	-	Finance, Insurance, and Real Estate
HOV	-	High Occupancy Vehicle
IOOF	-	International Order of Odd Fellows
Ldn	-	24-hour, time averaged, A-weighted sound level from midnight to midnight
Leq	-	Equivalent continuous sound levels
Lmax	-	Maximum passby noise levels
LCDC	-	Oregon Land Conservation and Development Commission
LOS	-	Level-of-Service
LRT	-	Light Rail Transit
LRV	-	Light Rail Vehicle
MAX	-	Existing Eastside LRT System
Metro	-	Metropolitan Service District
MOA	-	Memorandum of Agreement
NAAQS	-	National Ambient Air Quality Standards
NAC	-	Noise Abatement Criteria
NAC	-	Neighborhood Association Committees in Beaverton
NEPA	-	National Environmental Policy Act
NHDB	-	Oregon Natural Heritage Database
O&M	-	Operating and Maintenance
OAR	-	Oregon Administrative Rule
OMSI	-	Oregon Museum of Science and Industry
ORS	-	Oregon Revised Statutes

LIST OF ACRONYMS (Continued)

PMSA	-	Primary Metropolitan Statistical Area
RTP	-	Regional Transportation Plan
SDEIS	-	Supplemental Draft Environmental Impact Statement
SHPO	-	State Historic Preservation Officer (or Office)
SIP	-	State Implementation Plan
SP&S	-	Spokane, Portland and Seattle Railroad
TAC	-	Technical Advisory Committee
TCOD	-	Transit Corridor Overlay District
TCPU	-	Transportation, Communications and Public Utilities
TES	-	Traction Electrification System
THPRD	-	Tualatin Hills Park and Recreation District
TSM	-	Transportation Systems Management
TWC	-	Train to Wayside Communication System
UGB	-	Urban Growth Boundary
UMTA	-	Urban Mass Transportation Administration
USA	-	Unified Sewer Agency (Washington County)
USFWS	-	U.S. Fish and Wildlife Service
V/C	-	Volume to Capacity Ratio
VHT	-	Vehicle Hours Traveled
VMT	-	Vehicle Miles Traveled

PROJECT NOMENCLATURE

The LRT Alternative discussed throughout this SDEIS includes several alignments and terminus options. Because the number of all possible combinations of these options is quite large (i.e., 36), it is not practical to display or discuss every option for each point of interest. Therefore, representative options have been used to illustrate the key points for each analysis. Also, to enhance readability of this document, several abbreviated names are used, as follows:

Build Alternatives	Refers to both the TSM and LRT Alternatives
Southside Option	Southside Surface Option (Canyon Segment)
Northside Option	Northside/Short Tunnel Option (Canyon Segment)
Surface Options	Refers to both the Southside and Northside Options (Canyon Segment)
Long Tunnel Options	Refers to both the Long Tunnel with Zoo station and Long Tunnel without Zoo station Options (Canyon Segment)
Tunnel Option	Same as Long Tunnel (Canyon Segment)
North Option	Refers to the North alignment option in East Beaverton
South Option	Refers to the South alignment option in East Beaverton
Short Terminus Options	Refers to S.W. Murray Boulevard and Sunset Transit Center Terminus Options

PREFACE

This Supplemental Draft Environmental Impact Statement (SDEIS) is prepared in compliance with the National Environmental Policy Act. Two federal agencies have provided partial funding for this project, the Urban Mass Transportation Administration (UMTA) and the Federal Highway Administration (FHWA).

UMTA is the lead federal agency for this project, and the Tri-County Metropolitan Transportation District of Oregon (Tri-Met) is the lead local agency. The FHWA, Oregon Department of Transportation (ODOT), and the U.S. Army Corps of Engineers (Corps) are cooperating agencies. The SDEIS has been prepared in accordance with UMTA guidelines, Procedures and Technical Methods for Transit Project Planning" (September 1986, revised July 1989); UMTA/FHWA regulations, "Environmental Impact and Related Procedures" (August, 1987); and Council on Environmental Quality's "Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act" (July 1986).

P.1 PROJECT HISTORY

In 1983, the Metro Council and local jurisdictions in the Portland metropolitan area chose light rail transit (LRT) as the major component of transportation system improvements needed to accommodate travel demand in the Westside Corridor. This decision was made following several years of studies that examined more than 15 alternatives including a busway, an expanded bus system, and various LRT alignments. A preferred alignment (route) for LRT also was adopted, and certain improvements to the segments of Sunset Highway (U.S. 26) and Highway 217 adjacent to the alignment were planned by the ODOT. An Alternatives Analysis (AA) and Draft Environmental Impact Statement (DEIS) for the transit improvements was approved by UMTA. UMTA authorized funds in 1983 to begin preliminary engineering of the preferred LRT Alternative. The program was subsequently delayed until January 1988 when UMTA approved continuation and expansion of the preliminary engineering effort.

As the preliminary engineering program was reactivated in 1988, it became increasingly apparent that proposed highway improvements along Sunset Highway and Highway 217 and adjacent LRT alignments should be analyzed concurrently. Although responsibility and funding for these transit and highway projects are separated both at the local level between Tri-Met and ODOT, and at the federal level between UMTA and FHWA, the proximity of the projects suggested that preliminary design work be integrated and that the environmental analysis be combined.

Accordingly, a SDEIS is being prepared to:

- update the transportation and environmental analyses for the Westside (formerly Sunset) transit alternatives to reflect current conditions and forecasts of future population, employment, and development conditions;
- update the definition of highway improvements proposed for Sunset Highway and Highway 217 between downtown Portland and central Beaverton;
- define the cumulative environmental impacts and mitigation measures for the proposed transit and highway improvements;
- respond to citizen and agency concerns about the previously "adopted" LRT alignment;
- analyze alignment and terminus options to the adopted LRT alignment, as a result of the scoping process and UMTA directives;
- update the definition of the No Build Alternative to provide a basis for contemporary comparison of environmental impacts for the proposed transit alternatives and highway improvements; and

- compare and evaluate the proposed Westside alternatives in terms of their effectiveness, cost-effectiveness, and financial feasibility.

The fundamental purpose of this SDEIS is to evaluate changed conditions relative to the previously adopted LRT Alternative and to analyze additional LRT alignment and terminus options, and an expanded set of highway improvements. The No Build Alternative and TSM Alternative and associated highway improvements, have also been updated to provide a basis of comparison for the required environmental, cost-effectiveness, and financial analyses and to provide information on how effective an expansion of the bus system would be in serving transit demand in the corridor.

P.2 ROLE OF FEDERAL, STATE AND LOCAL AGENCIES

There are eight state and local jurisdictions participating in the Westside Corridor Project: Tri-Met, ODOT, Metro, the cities of Portland, Beaverton, and Hillsboro, and Multnomah and Washington Counties. Their coordinated effort is taking place within a process UMTA and FHWA prescribe for evaluating environmental impacts, cost-effectiveness, and financing of the proposed project.

UMTA, as lead federal agency, and Tri-Met, as lead local agency, are responsible for issuing the EIS. Tri-Met and its consultants performed the technical analyses supporting this document. UMTA furnished technical and procedural guidance to Tri-Met, participated in the preparation of the SDEIS, and independently evaluated the SDEIS prior to its approval and adoption. The next steps in the process include: a public comment period (including a public hearing), development and adoption of the locally preferred alternative recommendation, preparation of the Final EIS (FEIS) on the locally preferred alternative, and UMTA approval of the FEIS. Concurrently, the jurisdictions are developing a plan to pay for implementation of the preferred alternative. This plan will be determined following public hearings held by Tri-Met and local jurisdictions.

P.3 ORGANIZATION OF THE SDEIS

The SDEIS has seven chapters plus an Executive Summary. The Executive Summary presents the major findings of the document in a summary form. This Summary is intended to provide a reader with a basic understanding of the transportation problems on the Westside, the alternatives evaluated to solve these problems, and the significant impacts associated with each alternative. In addition, summary information is provided on costs, cost-effectiveness, and financing of each alternative.

Chapter One, Purpose and Need, describes the Westside Corridor study area and existing transportation facilities. A discussion of regional and local transportation goals is presented. Specific transportation problems, on both the highway and street system, and the transit system, are then discussed. Finally, other factors pertinent in selection of an alternative, such as land use development and environmental criteria, are identified.

Chapter Two, Alternatives Considered, provides an overview of the screening and selection process, a definition and description of the alternatives analyzed in the SDEIS, and the capital, operating and maintenance costs involved in each alternative.

Chapter Three, Affected Environment, describes the existing social and natural environmental conditions in the Westside Corridor. The discussion provides an understanding of the environment in which the project would take place, and identifies significant sensitive resources in the study area.

Chapter Four, Transportation Impacts, presents both transit and highway impacts as a result of each of the alternatives. Transit impacts are presented in terms of changes in travel time and ridership levels between the Westside and the Portland Central Business District (CBD).

Highway and street impacts include changes in congestion levels on surface streets and at key intersections for each alternative. For the TSM and LRT Alternatives, the impacts of pedestrian and vehicular activity around transit stations and park-and-ride lots are discussed. Parking impacts are described for all alternatives.

Chapter Five, Environmental Consequences, discusses the potential impacts of the Westside Corridor Project on the built and natural environments. Construction-related as well as long-term impacts are included. Specific elements analyzed in this chapter include:

- Land Use and Economic Development
- Displacement and Relocation
- Neighborhoods
- Visual and Aesthetic Resources
- Air Quality
- Noise and Vibration
- Ecosystems
- Water Quality and Hydrology
- Energy
- Geology
- Construction Impacts

Mitigation measures are discussed for each element, as appropriate.

Chapter Six, Historic, Archaeological, and Parkland Resources, presents a summary of applicable federal laws governing historic, cultural, and parkland resources. The process for determining impacts to these resources and appropriate mitigation is explained. Historic, archaeological, and parkland resources in the Corridor are described. Potential impacts and mitigation measures are discussed.

Chapter Seven, Financial Analysis and Evaluation of Alternatives presents the financial analysis for the Westside Corridor Project, and compares the alternatives in terms of costs, cost-effectiveness, and financial feasibility. Each alternative also is evaluated in terms of how effectively and equitably it meets the projects goals and objectives. Significant trade-offs between alternatives also are discussed.

P.4 SUPPORTING DOCUMENTS

The in-depth technical analysis that supports this document is presented in Technical Memoranda prepared for the elements of both the built and natural environment. The Technical Memoranda, listed below, are available for review at Tri-Met 's Engineering Offices located at 115 N.W. First Avenue, Suite 500, in Portland.:

Westside Corridor Project, Land Use and Economic Development Technical Memorandum 20a
Westside Corridor Project, Displacement and Relocation Technical Memorandum 20b
Westside Corridor Project, Neighborhoods Technical Memorandum 20c
Westside Corridor Project, Visual Quality and Aesthetics Technical Memorandum 20d
Westside Corridor Project, Air Quality Technical Memorandum 20e
Westside Corridor Project, Noise and Vibration Technical Memorandum 20f
Westside Corridor Project, Ecosystems Technical Memorandum 20g
Westside Corridor Project, Hydrology and Water Quality Technical Memorandum 20h
Westside Corridor Project, Energy Technical Memorandum 20i
Westside Corridor Project, Section 106 Documentation Technical Memorandum 20j
Westside Corridor Project, Section 4(f) Documentation Technical Memorandum 20k
Westside Corridor Project, Hazardous Waste Technical Memorandum 20l
Westside Corridor Project, Local Traffic Impacts Technical Memorandum 20m
Westside Corridor Project, SDEIS Capital Cost Estimates Technical Memorandum 20n
Westside Corridor Project, Operating and Maintenance Cost Technical Memorandum 20o
Westside Corridor Project, Travel Demand and Transit Patronage Forecast Technical Memorandum 20p
Westside Corridor Project, Financial Feasibility Technical Memorandum 20q

P.5 PUBLIC INVOLVEMENT PROGRAM

An extensive public involvement program has been implemented throughout the Westside Corridor SDEIS process.

Two advisory committees have been formed. The Technical Advisory Committee (TAC) consists of representatives of all eight affected jurisdictions. The TAC meets on a regular basis to identify outstanding issues and provide technical expertise for the analysis. The 24-member Citizens Advisory Committee (CAC) consists of local residents and business people from the Westside Corridor, appointed by Tri-Met and the various jurisdictions. The CAC meets monthly with Tri-Met staff to receive project updates and provide public input on the project.

Since 1988, project Community Relations staff have held more than 100 community meetings. These include public meetings to provide information and obtain public input, neighborhood meetings to address the concerns of specific neighborhood groups, and meetings with community leaders to keep them apprised of the effects of light rail in their community and of project progress.

Several newsletters have been distributed to citizens in the project area. This information has been distributed using ZIP code mailings, local area newspaper inserts, and the Westside Corridor Project mailing list. All publications have included addresses and telephone numbers so interested citizens could request additional information.

The project has compiled a mailing list with more than 2,500 names and addresses of citizens interested in the project. Citizens on this list receive monthly notification of the CAC meetings and activities, as well as any other communication distributed to citizens in the project area.

P.6 DECISION AT HAND/ROLE OF THE SDEIS IN PROJECT DECISION MAKING

The SDEIS is being circulated to federal, state, regional, and local agencies and officials, and will be made available to interested people and groups. During a 45-day circulation period, the public, agencies, and jurisdictions will have the opportunity to provide comments on this SDEIS to Tri-Met, ODOT, UMTA, and FHWA, in writing or at public hearings. The locally preferred alternative will be selected by all eight affected jurisdictions after the public-comment period closes. A FEIS will then be developed, focusing on the locally preferred alternative, its impacts, and measures to mitigate adverse impacts. Federal funds cannot be committed to any of the alternatives until the EIS process has been completed.

EXECUTIVE SUMMARY

S. EXECUTIVE SUMMARY

INTRODUCTION

In 1983, jurisdictions in the Portland metropolitan area chose Light Rail Transit (LRT) as the major transit component of the transportation system improvements needed to accommodate travel demand in the Westside Corridor. A surface alignment was adopted through the Sunset Canyon, continuing through Beaverton along the Burlington Northern (BN) Railroad to a terminus at approximately S.W. 185th Avenue. Subsequently, a series of lane and interchange improvements to Sunset Highway (Highway 26) between the Vista Ridge Tunnels and the interchange with Highway 217 were adopted.

The LRT project was reintroduced in 1988, and the decision was made to evaluate LRT alignment options through the corridor jointly with the planned highway improvements between downtown Portland and central Beaverton along Sunset Highway and Highway 217. The evaluation of these options is presented in this supplement to the previously approved Draft Environmental Impact Statement (DEIS). The No Build and Transportation Systems Management (TSM) Alternatives have been updated to provide a contemporary basis for evaluating the proposed transit and highway improvements.

The Supplemental DEIS (SDEIS) informs government agencies and interested citizens about the proposed transportation alternatives. The SDEIS assesses probable adverse environmental impacts and measures to mitigate or eliminate these impacts. It also presents the latest estimates of capital and operating costs, assesses the effects of the alternatives on highway and transit service levels, and evaluates the alternatives in terms of their effectiveness, cost-effectiveness, financial feasibility and other factors.

The SDEIS is designed to address National Environmental Policy Act (NEPA) requirements and other federal regulations and guidelines of the Urban Mass Transportation Administration (UMTA). The document is based on an extensive series of supporting technical reports which are available for review at the following locations: Tri-Met Library, Tri-Met Engineering Office, local public libraries, city planning departments, and the Oregon Department of Transportation (ODOT) Metro Region Office.

During the formal review period, interested citizens and government agencies are invited to comment on the contents of the SDEIS and on the selection of a preferred alternative. A public hearing will be held to receive comments. The Final EIS (FEIS) will respond to these comments and the SDEIS findings.

The Local Decision and The Process

The eight jurisdictions participating in the Westside Corridor Project (Tri-Met; ODOT; Metropolitan Service District (Metro); the cities of Portland, Beaverton, and Hillsboro; and Multnomah and Washington Counties) are working cooperatively on the development and analysis of the alternatives and will ultimately make a decision on the locally preferred alternative. Their coordinated effort is taking place within the process UMTA prescribes for developing a federally funded mass transit project. That process includes the following steps:

- preparation of the draft SDEIS
- UMTA approval of the SDEIS for public review
- a public comment period, including a public hearing
- jurisdiction hearings and actions recommending the locally preferred alternative
- Tri-Met adoption of the locally preferred alternative
- preparation of the Final EIS (FEIS) on the locally preferred alternative
- UMTA approval of the FEIS

Concurrently, the jurisdictions are developing a plan to pay for building and operating whichever alternative is chosen as the preferred alternative, while funding the rest of an expanding transit and highway system.

S.1 PURPOSE AND NEED

Between 1970 and 1980, the Westside accounted for 47% of all Portland metropolitan area population growth and 40% of all employment growth, more than twice the percentage of regional growth experienced by any other major subarea of the Portland metropolitan area. Between 1980 and 1987, the Westside accounted for 68% of regional population growth, and 96% of regional employment growth. Regional forecasts show continued population growth in Washington County, from 263,000 people in 1985 to 411,000 by 2005. Employment is projected to increase significantly from 121,000 in 1985 to 227,000 in 2005. The number of person trips within the Washington County portion of the corridor is expected to increase from 561,000 to 913,000 per day, or 63%.

Downtown Portland is the region's principal transit destination due to its concentration of jobs; retail, financial, and governmental services; and cultural entertainment, and recreational facilities. Downtown Portland employment grew from 59,000 in 1970 to 89,200 in 1987. By 2005, downtown employment is expected to reach 108,500. As a consequence, the overall travel demand between the Westside Corridor and Portland is projected to grow from 176,000 to 198,000 per day, or 13%.

The existing highway system on the Westside is inadequate to accommodate current traffic volumes. Vehicular volumes on many of the roadways in the area exceed design capacity, especially during the peak hours. Substantial segments of Sunset Highway, Highway 217, Canyon Road, and Tualatin Valley (T.V.) Highway are presently operating at or near their design capacity. If additional transportation improvements are not provided, these conditions will become worse, causing increased congestion for longer periods of time. For example, vehicle hours of delay on the highway and arterial system are projected to increase by nearly 60% and miles of congested highways and arterials would increase by 57% and 68%, respectively, by the year 2005.

Similarly, the lack of transportation improvements would significantly affect the future performance of the transit system. As a result of the increased congestion, the ability to provide fast, efficient transit service would decrease, with bus travel times degrading by nearly 50% between central Beaverton and downtown Portland, and bus operating costs increasing accordingly. Transit service also would become less reliable as more highway breakdowns and accidents occur. Without a significant increase in transit service and coverage to developing areas in Washington County, there would be a decrease in the percentage of the Corridor's population and employment that would have access to the system. The net effect of not improving the transportation system -- increased congestion, longer bus travel times, and decreased transit accessibility -- would result in a transit share of Corridor trips to downtown Portland that would not increase over today and an inability to achieve desired regional transportation, land use, and environmental objectives.

Long range planning for Portland's regional transportation needs is performed by the Metropolitan Service District (Metro) and documented in the Regional Transportation Plan (RTP). The RTP calls for a combination of highway improvements and a major expansion of the transit system capacity in the Westside Corridor by 2005 as the region's number one transportation priority. The transportation improvements are needed to make Sunset Highway and Highway 217 operate more efficiently and safely between downtown Portland and central Beaverton. While highway improvements are proposed to help improve travel flows, highway vehicular capacity will continue to be limited east of the Zoo Interchange by the existing capacities of the Vista Ridge Tunnels and S.W. Jefferson Street. The West Hills, which separate downtown Portland from the Westside, preclude, from a practical standpoint, the ability to construct new highways and severely limit the ability to expand existing highways. Therefore, regional policy calls for a major transit system expansion to accommodate the forecast growth in travel between downtown Portland and the Westside Corridor.

Transportation Goals and Objectives

The overall goal which has been established for the Westside Corridor Project is: "To build a transit and highway project designed to optimize the transportation system, be environmentally sensitive reflecting community values, while remaining fiscally responsive".

The criteria which will be used to evaluate how effective each alternative is in meeting the goal are as follows:

- Provide transit service that is a reasonable alternative to the automobile.
- Implement a transit system which meets demands of growth.
- Maintain a balanced road system.
- Provide transportation facilities needed to support planned development within the Urban Growth Boundary (UGB).
- Provide an environmentally sensitive transportation system.

The alternatives are also evaluated in terms of their financial feasibility, cost-effectiveness, and equity in distributing costs and benefits. The results of this evaluation are summarized in Section S.5 and presented in more detail in Chapter 7 of this SDEIS.

S.2 ALTERNATIVES CONSIDERED

Three general transportation alternatives are reviewed in this SDEIS: No Build, Transportation Systems Management (TSM), and Light Rail Transit (LRT). The LRT Alternative includes several options, including four alignment options through the Sunset Canyon, two alignment options from S.W. Cabot Street to S.W. Watson Avenue in Beaverton, two alignment options from S.W. Watson Avenue to S.W. Murray Boulevard in Beaverton, and two short terminus options (Sunset Transit Center and S.W. Murray Boulevard) in addition to the option to S.W. 185th Avenue. These alternatives and the alignment and terminus options are described below and summarized in Table S.2-1. In addition, the TSM and LRT Alternatives include a number of highway and bicycle improvements that are common to both alternatives. The highway and bicycle improvements are listed in Section S.2.3. A more complete description of all the alternatives and options is found in Chapter 2 of this document.

S.2.1 Screening and Selection Process

In the late 1970's, regional policy makers in the Portland area identified the Westside Corridor as the second priority corridor for a major transit investment (after the Eastside), and a full spectrum of mode and route alternatives were developed and examined by Metro. This initial work culminated in a 1982 Draft Environmental Impact Statement (DEIS) and Alternatives Analysis which analyzed five alternatives, including No Build, Bus Expansion, Sunset Busway, Sunset LRT, and Multnomah LRT. In 1983 Westside Corridor jurisdictions chose Sunset LRT to S.W. 185th Avenue as the locally preferred alternative, and UMTA authorized the initiation of the preliminary engineering phase.

For several reasons, the preliminary engineering studies were placed on hold until after completion of the Eastside (Banfield) LRT line. Reintroduction of the project in 1988 revealed the need to analyze changed conditions since the 1982 DEIS and the desire by various groups to investigate LRT alignment options throughout the corridor. Several alternative routings in Washington County were compared, and Tri-Met conducted feasibility studies of surface and tunnel alignments in the Sunset Highway (Canyon) segment. After extensive public review, four alignment options in the Canyon segment and four alignment options in Beaverton were chosen by the Westside Corridor jurisdictions for formal inclusion in this SDEIS. Also, at UMTA request, two short terminus options have been included.

S.2.2 No Build Alternative

The No Build Alternative would include current transit service levels plus customary service increases that could be funded with existing revenue sources through 2005. No new bus routes would be added. The existing Transit Mall would be extended north to N.W. Irving Street. A system wide bus fleet of 689 vehicles and a corridor bus fleet of 174 vehicles are proposed. An additional bus maintenance

TABLE S.2-1
DESCRIPTION OF ALTERNATIVES SUMMARY

	Alternative 1	Alternative 2	Alternative 3		
	NO BUILD	TSM	LRT TO 185TH	LRT TO MURRAY	LRT TO SUNSET TC
LRT Alignment Options					
Sunset Highway (Canyon)	N/A	N/A	1-Southside Surface 2-Northside Short Tunnel 3-Long Tunnel with Zoo 4-Long Tunnel no Zoo	Same as 185th terminus	Same as 185th terminus
East Beaverton	N/A	N/A	1-South entry 2-North entry	Same as 185th terminus	None
West Central Beaverton	N/A	N/A	1-BN 2-Henry St.	Same as 185th terminus	None
Length of new LRT Line (miles)	N/A	N/A	11.4 to 12.0	9.2 to 9.8	5.4 to 5.8
Number of new LRT Stations	N/A	N/A	11 to 13	8 to 10	4 to 6
Number of new Park-and-Ride Lots	1	6	5 to 6	2 to 3	1 to 2
Number of new Park-and-Ride Spaces	600	3,060	3,050 to 3,350	1,600 to 1,900	600 to 900
Bus service	Expansion of existing service level but no new routes.	Expansion of service levels with new trunk and feeder routes.	Expansion of service levels with new feeder routes.	Same as 185th terminus	Same as 185th terminus
Downtown Portland Bus Improvements	North Mall Extension	Same as No Build plus South Mall extension and reserved lanes.	Same as No Build	Same as No Build	Same as No Build
Highway Improvements along Sunset Highway and Hwy 217	None	Interchange, lane and bikeway improvements	Same as TSM	Same as TSM	Same as TSM

	Bus	LRV	Bus	LRV	Bus	LRV	Bus	LRV	Bus	LRV
Total Number of Transit Vehicles in Corridor	174	N/A	273	N/A	174	29	180	24	193	10
Transit VMT Weekday in Corridor	20,000	N/A	29,000	N/A	19,000	5,130	20,000	4,430	21,000	2,030
Place-Miles Weekday in Corridor	1,493,000	N/A	2,112,000	N/A	1,403,000	851,580	1,459,000	735,380	1,559,000	336,980
Platform Hours Weekday in Corridor	1,470	N/A	2,200	N/A	1,420	260	1,460	220	1,570	100

	NO BUILD	TSM	LRT TO 185TH	LRT TO MURRAY	LRT TO SUNSET TC
Project Capital Cost ($1990, millions)					
Transit only	N/A	$72.2	$439.5 to $501.6	$388.9 to $451.0	$254.5 to $302.5
Highway	N/A	$87.7	$87.7	$87.7	$87.7
Annual O&M Cost for Year 2005 ($1990, millions)	$21.5	$27.1	$23.4 to $23.8	$24.1	$22.9

Source: Tri-Met Engineering Services, 1991.

facility would be built to support fleet expansion. A 600-space park-and-ride facility would be constructed at the Sunset Transit Center.

Existing Eastside MAX service would continue much as it currently does, with some minor improvements and increased service levels. Improvements would include adding a second track between Ruby Junction and the east end of the line and improved signalization.

There would be no major highway improvements along Sunset Highway or Highway 217.

S.2.3 TSM Alternative With Highway Improvements

The TSM Alternative would include a major expansion of bus service, with an emphasis on trunk lines served by feeder lines for more efficient service and on new routes providing increased transit coverage throughout the corridor (see Figure S.2-1). Some associated street and highway improvements, such as reserved bus lanes, bypass lanes, and bus turnouts, would be included to allow for improved operations on the Westside. The Westside TSM bus fleet would consist of 273 vehicles. Transit hours and miles of service would increase by almost 50% compared to the No Build. Eight new park-and-ride lots would be built and one expanded to provide a total of 3,060 park-and-ride spaces.

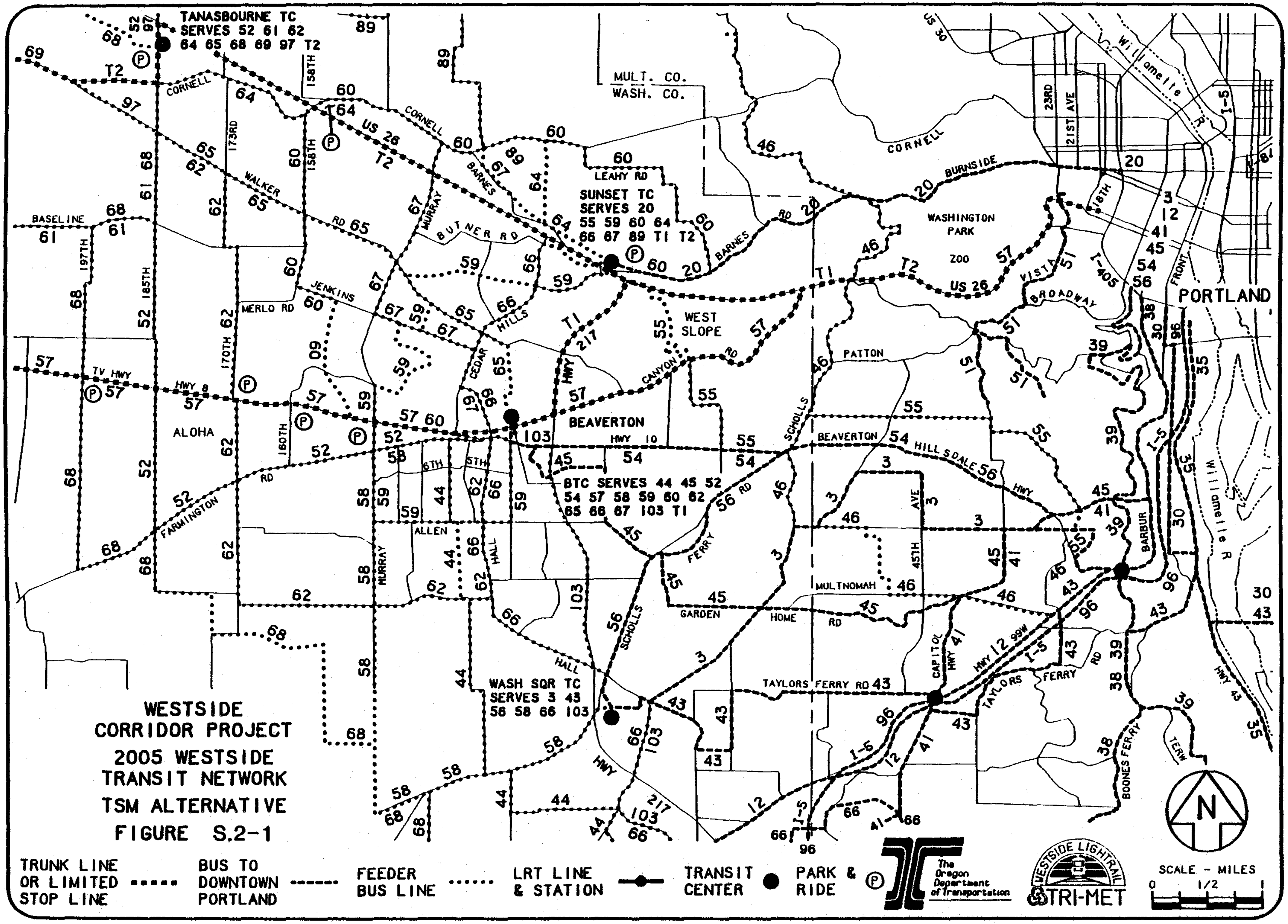
The following improvements would be made to Sunset Highway and Highway 217 between downtown Portland and central Beaverton (see Figure S.2-2):

- A westbound entrance ramp to Sunset Highway would be built at the Zoo Interchange.
- The westbound climbing lane would be extended from the Zoo Interchange to the west side of the Sylvan Interchange. A fifth, auxiliary lane would be added between the westbound Zoo entrance ramp and the westbound exit ramp at the Sylvan Interchange.
- The Sylvan, Canyon Road, and Camelot Court Interchanges would be rebuilt with collector-distributor roads both eastbound and westbound.
- The Sunset Highway would be widened to three lanes in each direction from Sylvan to S.W. 185th Avenue.
- The westbound exit ramps to S.W. Barnes Road and Highway 217 would be rebuilt, and the entrance ramp connecting S.W. Barnes Road and northbound Highway 217 to the westbound Sunset Highway would be widened from one to two lanes.
- Highway 217 would be widened to three lanes in each direction between the Sunset Highway Interchange and the Canyon Road/Beaverton-Hillsdale Highway Interchange. In each direction an auxiliary lane would be added to accommodate weaving activity between the Walker Road and the Canyon Road Interchanges.
- Modifications would be made to the Wilshire entrance ramp, Sunset Highway exit ramp, the Walker Road Interchange and Canyon Road/Beaverton-Hillsdale Highway Interchange.
- A bicycle path would be constructed from S.W. 18th Avenue along S.W. Jefferson Street and adjacent to the Sunset Highway to the interchange with Highway 217.

S.2.4 LRT Alternative With Highway Improvements

Four LRT alignment options crossing the West Hills, four alignment combinations through central Beaverton, and three terminus options have been carried into the SDEIS analysis and preliminary engineering designs (see Figure S.2-3). The highway improvements along the Sunset Highway and Highway 217 associated with the TSM Alternative in Section S.2.3 would be identical for the LRT Alternative.

[PROJ.WS.ALIGN]SDEISFIG.FGB TSMALT



WESTSIDE CORRIDOR PROJECT
2005 WESTSIDE TRANSIT NETWORK
TSM ALTERNATIVE
FIGURE S.2-1

S.2.4.1 S.W. 185th Avenue Terminus Option

The locally preferred alternative from the 1982 DEIS was an LRT line from downtown Portland along Sunset Highway and Highway 217 to Beaverton, then generally along the BN Railroad to a terminus in the vicinity of S.W. 185th Avenue. The screening process in 1988 and 1989 produced options to this previously adopted alignment in certain areas along the route. In other areas the LRT alignment is essentially the same as that selected in 1983 including: downtown Portland from the existing S.W. 11th Avenue LRT terminus to the Goose Hollow station at S.W. 20th Avenue and S.W. Jefferson Street; between Sunset Highway at S.W. 76th Avenue and Highway 217 at S.W. Center Street (Beaverton); and west of S.W. Murray Boulevard to S.W. 185th Avenue.

Depending on the alignment option, the LRT line to S.W. 185th Avenue would be from 11.4 to 12.0 miles long and would have 11 to 13 stations, five or six park-and-ride lots, and 3,050 to 3,350 park-and-ride spaces. Approximately 29 light rail vehicles would be required for operation. The technology and design concepts employed on the Eastside line would generally be used for the Westside line, and the two lines would be through-routed to the maximum extent possible. Nearly all of the right-of-way would either be physically separated from other traffic or reserved for transit use only with intersections protected by gates or a traffic signal pre-emption system. In the high speed sections, the operation would be protected by a train signal system, permitting an overall average speed of about 24 mph, including dwell times at stations.

Beginning at S.W. 11th Avenue, the proposed project would extend the existing trackway, auto lane, and sidewalk configurations of S.W. Morrison and S.W. Yamhill Streets west to S.W. 18th Avenue. At S.W. 17th Avenue, the S.W. Morrison Street track would turn southwest through a city block to join the S.W. Yamhill Street track at S.W. 18th Avenue. The two tracks would turn south in the median of S.W. 18th Avenue, flanked by an auto travel lane, parking lane and sidewalk in each direction. At S.W. Jefferson Street, the tracks would turn west into the median of S.W. Jefferson Street. The LRT alignment in this segment would be entirely at grade. All intersections crossed by the LRT along S.W. Morrison and S.W. Yamhill Streets would be signalized. Along S.W. 18th Avenue, intersections at S.W. Morrison, S.W. Yamhill, S.W. Salmon, and S.W. Jefferson would be signalized. Only emergency vehicles would be permitted to cross the tracks on S.W. 18th Avenue at S.W. Taylor, S.W. Main and S.W. Madison Streets. Stations would be located on S.W. Morrison and S.W. Yamhill Streets between S.W. 13th and 14th Avenues; on the block bounded by S.W. Morrison Street, S.W. 17th Avenue, S.W. Yamhill Street, and S.W. 18th Avenue; and between S.W. 18th and 20th Avenues on S.W. Jefferson Street. No park-and-ride facilities would be provided at these stations.

From S.W. 20th Avenue/S.W. Jefferson Street to the Sunset Transit Center at the intersection of Sunset Highway and Highway 217, there are four alignment options, which are discussed in Section S.2.4.2.

The Sunset Transit Center would be a major station with off-street bus transfer facilities and a park-and-ride facility and would be located at the northwest quadrant of the Sunset Highway/Highway 217 Interchange. The tracks would leave the Sunset Transit Center and pass under Sunset Highway to parallel the ramp from eastbound Sunset Highway to southbound Highway 217. The alignment then continues south along the west side of Highway 217 to approximately S.W. Center Street. The tracks would pass under S.W. Parkway, S.W. Wilshire Street, and S.W. Walker Road, and the existing S.W. Cabot Street structure would be removed.

At approximately S.W. Center Street, the tracks leave the Highway 217 corridor to enter Beaverton. There are four alignment combinations in Beaverton from Highway 217 to S.W. Murray Boulevard. These are discussed in Section S.2.4.3.

The LRT transitway would then cross under S.W. Murray Boulevard at the existing overpass and either occupy a portion of the existing BN Railroad right-of-way or run parallel to, and immediately north of, the BN right-of-way. Between S.W. 170th Avenue and S.W. 185th Avenue, the BN tracks would be shifted to the south. The line would terminate just west of S.W. 185th Avenue. All intersections west of S.W. Murray Boulevard would be crossed at grade with gated protection. Stations would be located at S.W. Murray Boulevard, S.W. Merlo Road, S.W. 170th Avenue, and S.W. 185th Avenue and would all have park-and-ride facilities and bus transfer connections. A Westside maintenance and storage facility would be located just east of S.W. 170th Avenue.

S.2.4.2 Canyon Segment Alignment Options

There are four alignment options under consideration in this segment.

Southside Surface (adopted)

This was the adopted alignment in 1983. From S.W. 20th Avenue and S.W. Jefferson Street westward, the LRT tracks would rise gradually above the median of S.W. Jefferson Street/Canyon Road to cross over Sunset Highway just west of the Vista Ridge Tunnel portals. The tracks would follow the south side of the highway west to approximately midway between the Zoo and Sylvan Interchanges. At this point, the alignment would cross back over Sunset Highway to the north side just east of Sylvan. The alignment would then cross under S.W. Skyline Boulevard and continue on the north side to the Highway 217 Interchange, where it would cross over Highway 217 on structure and under the westbound Sunset Highway-to-southbound Highway 217 ramp. There would be a station on the south side of the Zoo overpass and on the northeast corner of the Sylvan Interchange, near the highway level. A park-and-ride lot accommodating approximately 300 cars would be located at the north side of the Sylvan station, east of Skyline Boulevard.

Northside/Short Tunnel

West from S.W. 20th Avenue and S.W. Jefferson Street, the tracks would occupy the median of S.W. Jefferson Street but would be entirely at-grade. Just west of the Vista Bridge, the alignment would cross the westbound lanes of S.W. Canyon Road at-grade and enter a tunnel portal near S.W. Murray Lane and S.W. Canyon Road. The tunnel would be approximately 2,500 feet long with a west portal on the north side of Sunset Highway, approximately one-half mile east of the Zoo Interchange. The tunnel would be a twin-tube structure. The alignment would follow the north side of Sunset Highway, passing over the Zoo Interchange on the north side. The alignment would continue west along the north side of Sunset Highway to the interchange with Highway 217. From just east of the Sylvan Interchange, the Southside and Northside options follow the same alignment. With the Northside option, the Zoo station would be located above the north end of the Zoo overpass structure at about the same elevation as the Zoo entrance. The station at Sylvan would be the same as for the Southside option.

Long Tunnel with Zoo Station

The Long Tunnel option would have the same alignment on S.W. Jefferson Street and the same east portal location as the Northside option, but would continue under the West Hills for three miles to the vicinity of S.W. 76th Avenue, on the north side of Sunset Highway. From this point, the alignment to the Sunset Transit Center would be the same as for the Southside and Northside options. The Long Tunnel alignment option does not include a station at Sylvan, although one could be readily accommodated within the existing design guidelines. The Zoo station would be located beneath the existing parking lot adjacent to the OMSI and Zoo entrances and would be accessed by elevator.

Long Tunnel without Zoo Station

This alignment option would be similar to that of the Long Tunnel with Zoo Station. The portal locations would be identical but the alignment would be slightly shorter and straighter through the hills. After surfacing, the alignment would be the same on the north side of Sunset Highway as for the other alignment options. With this option, there would be no stations in this segment.

S.2.4.3 Beaverton Alignment Options

Two sets of alignment options are proposed through Central Beaverton: the North and South alignment options running from S.W. Cabot Street to S.W. Watson Avenue, and the Burlington Northern (BN) and Henry Street alignment options running from S.W. Watson Avenue to S.W. Murray Boulevard.

South Option (adopted)/S.W. Cabot Street to S.W. Watson Avenue

This alignment option would turn west from Highway 217 near S.W. Cabot Street, cross S.W. 114th Avenue at grade and run southwesterly along Hall Creek to an at-grade crossing of S.W. 117th Avenue. The alignment then would pass through the Canyon Place Shopping Center to the south side of the Beaverton Transit Center. From here, the alignment would cross S.W. Lombard Avenue at grade. Between S.W. Lombard Avenue and S.W. Watson Avenue, the LRT would occupy the S.W. Beaverdam Road right-of-way. The South option would include stations at the Beaverton Transit Center and at S.W. Watson Avenue. There would be no park-and-ride facilities at either of these stations. The Beaverton Transit Center would be the major bus interface point for the Westside LRT line.

North Option/S.W. Cabot Street to S.W. Watson Avenue

The North option would follow an alignment similar to the South option between S.W. Cabot Street and S.W. 114th Avenue. From S.W. 114th Avenue the alignment would run west along the north edge of the Canyon Place Shopping Center and along the north side of the Beaverton Transit Center. The alignment would then cross S.W. Lombard Avenue, approximately 600 feet north of S.W. Canyon Road, and continue west across S.W. Hall Boulevard and S.W. Watson Avenue. As with the South option, the crossings of S.W. 114th Avenue, S.W. 117th Avenue, S.W. Lombard Avenue, S.W. Hall Boulevard and S.W. Watson Avenue would all be at grade. The North option would also include stations at Beaverton Transit Center and at S.W. Watson Avenue, with no park-and-ride facilities.

Burlington Northern (BN) Option (adopted)/S.W.Watson Avenue to S.W. Murray Boulevard

From just west of S.W. Watson Avenue to S.W. Murray Boulevard, the LRT would follow the existing BN Railroad right-of-way, crossing under the existing S.W. Murray Boulevard overpass. S.W. Cedar Hills Boulevard, S.W. Hocken Avenue, and S.W. 141st Avenue would be crossed at grade. An LRT station would be built on the east side of S.W. Hocken Avenue. No bus transfer or park-and-ride facilities would be provided at this location.

Henry Street Option/S.W. Watson Avenue to S.W. Murray Boulevard

The alignment would run west from S.W. Watson Avenue on new right-of-way and enter the S.W. Henry Street right-of-way at S.W. Cedar Hills Boulevard. At S.W. Hocken Avenue, the alignment would leave S.W. Henry Street and proceed northwest on new right-of-way, passing through the intersection of S.W. 141st Avenue and S.W. Whitney Street to S.W. Murray Boulevard. At S.W. Murray Boulevard, the alignment would turn north, paralleling the east side of S.W. Murray Boulevard to the existing BN Railroad right-of-way. The LRT would turn west from there, crossing under the existing S.W. Murray Boulevard overpass. S.W. Cedar Hills Boulevard, S.W. Hocken Avenue, S.W. 141st Avenue/S.W. 144th Avenue, and S.W. Milikan Street would be crossed at grade. The S.W. Henry Street alignment option would include a station at S.W. 141st Avenue. No park-and-ride facilities would be provided at this location, but a bus transfer facility would be built pending appropriate redevelopment in the vicinity.

S.2.4.4 Short Terminus Options

Two options that would terminate the Westside LRT east of S.W. 185th Avenue also are evaluated in this SDEIS. These options are the S.W. Murray Boulevard terminus and Sunset Transit Center terminus. The S.W. Murray Boulevard terminus option would shorten the LRT line to S.W. Murray Boulevard and provide a light rail vehicle (LRV) maintenance facility just west of the terminus. The line would be 9.2 to 9.8 miles in length, or about two miles shorter than the line to S.W. 185th Avenue. All Canyon and Central Beaverton alignment options described above would apply to this terminus option. Stations and park-and-ride lots for this option would be the same as for the alignment extending all the way to S.W. 185th Avenue, with two exceptions:

- no stations or park-and-ride lots west of S.W. Murray Boulevard, and
- a 1,000-space park-and-ride lot at the S.W. Murray Boulevard terminus.

The Sunset Transit Center terminus option would end the LRT line at the interchange of Sunset Highway with Highway 217. There would be no Westside LRV maintenance facility with this option, and only the Canyon segment alignment options would be relevant. There would be no LRT stations or park-and-ride lots west of Sunset Transit Center. This line would be 5.4 to 5.8 miles in length, or about six miles shorter than the line to S.W. 185th Avenue.

S.2.5 Capital and Operating Costs

Table S.2-1 provides a summary of the estimated Project Capital cost for construction of both the transit facilities and the highway improvements and the annual Operating and Maintenance (O&M) cost for the transit component of the alternatives. Both Project Capital costs and O&M costs are presented in 1990 dollars. Project Capital costs are defined as all costs over and above the No Build Alternative and include all engineering, administration, construction, and equipment purchase costs for all aspects of the alternatives plus an appropriate contingency allowance. The O&M costs represent Tri-Met's total annual costs for operating, maintaining, and administering the Westside Corridor transit networks at year 2005 service levels, including both LRT and bus components.

Table S.2-1 shows that the Project Capital cost of the TSM Alternative is $72.2 million. For the LRT Alternative, Table S.2-1 provides a range of Project Capital costs, from the least expensive alignment option to the most expensive alignment option, for each terminus option. Further detail for specific options is found in Table S.5-1 in this Summary, Sections 2.3 and 7.1 of the SDEIS, and as follows:

Southside to 185th Via South/BN	Northside to 185th Via South/BN	Long Tunnel with Zoo to 185th Via South/BN	Long Tunnel w/o Zoo to 185th Via South/BN	Northside to 185th Via North/BN	Northside to 185th Via South/Henry	Northside to 185th Via North/Henry	Northside to Murray Via South/BN	Northside to Sunset TC
$445.8	$441.1	$491.2	$466.3	$439.5	$451.5	$448.9	$390.6	$254.5

Note: Costs are in millions of 1990 dollars.

Source: Tri-Met, 1990.

From this information, the following general observations can be made:

- For the S.W. 185th Avenue and S.W. Murray Boulevard terminus options, the range in costs of alignment options is about $60 million.
- The Long Tunnel with Zoo Station is about $25 million more expensive than the Long Tunnel without Zoo Station, $45 million more than the Southside, and $50 million more than the Northside.
- The Henry Street option is about $10 to $12 million more expensive than the BN option.
- The S.W. 185th Avenue terminus option is about $50 million more expensive than the S.W. Murray Boulevard terminus option and $185 million more than the Sunset Transit Center terminus option.

Table S.2-1 also shows that the annual O&M costs for the TSM Alternative is $5.6 million more than the No Build Alternative. Annual O&M costs for the LRT Alternative are $1.4 million to $2.3 million more than that of the No Build and about $3.3 million to $4.2 million less than that of the TSM Alternative.

The Project Capital cost of the highway improvements is $87.7 million for both the TSM and LRT Alternatives.

S.3 TRANSPORTATION IMPACTS

This section summarizes the impacts of each alternative on transit, traffic, and freight movement in the study area. A more complete description is provided in Chapter 4 of this document.

S.3.1 Transit Impacts

This section analyzes the transit service and ridership impacts of the alternatives.

S.3.1.1 Service Characteristics

The No Build Alternative would retain the current bus route network and geographic coverage. Bus service would increase approximately 40% over existing levels but would not meet demand.

The TSM and LRT Alternatives (the build alternatives) are designed to accommodate peak period rider demand in 2005. For the TSM Alternative, a new, all-day trunk bus line would operate between Hillsboro and downtown Portland. A second, new bus trunk line would operate between the Beaverton Transit Center and downtown Portland via the Sunset Transit Center during peak hours. New local feeder bus service would be added in Hillsboro, Beaverton and in east Cedar Hills.

The local feeder bus service for the LRT Alternative would be virtually the same as for the TSM Alternative. However, with the LRT Alternative, light rail rather than buses would provide the trunk line connection between downtown Portland and Beaverton. Two-car trains would operate approximately every six minutes east of, and every 12 minutes west of, the Beaverton Transit Center during peak hours. Westside light rail service would provide a through route with MAX service on the Eastside. The S.W. Murray Boulevard and Sunset Transit Center terminus options would shorten the LRT alignment and require the extension of several feeder bus lines to reach either of these terminus locations.

The increased amount of service incorporated in the build alternatives is reflected by an increase in corridor passenger carrying capacity. Place miles is an indicator of the seated and standing capacity of each alternative. Table S.3-1 shows that with the TSM Alternative, Westside Corridor place miles would increase by 619,000 daily, a 41% increase over the No Build Alternative. With the LRT Alternative to S.W. 185th Avenue, Westside Corridor place miles would be 143,000 place miles (7%) more than the TSM Alternative and almost 50% more than the No Build. The S.W. Murray Boulevard terminus option would have slightly fewer place miles than the S.W. 185th Avenue option while the Sunset Transit Center terminus option would have 15% fewer.

The greater feeder bus network associated with the build alternatives is reflected by an increase in transit service coverage. Table S.3-1 shows the percentage of population and employment in the Westside Corridor within a quarter-mile of a transit stop for each alternative. The LRT Alternative to S.W. 185th Avenue would provide a quarter mile walk access to light rail or to feeder bus service to 63% of Westside residents and 83% of Westside jobs. These numbers are similar for the TSM Alternative and shorter terminus LRT options. In comparison, the No Build network provides a quarter-mile walk access to 43% of Westside residents and 46% of Westside jobs.

The build alternatives require more transfers for transit users. From Table S.3-1, it is seen that the No Build Alternative has the lowest transfer rate because it provides less service coverage and has fewer feeder routes than the build alternatives. The LRT Alternative would increase transferring within the corridor by about 25% over the No Build Alternative, while the rate for the TSM Alternative is about 10% higher than the No Build. The TSM Alternative has a lower transfer rate than the LRT Alternative because it provides direct transit service to downtown Portland from more locations.

The increased transfer requirements of the LRT Alternative are generally countered by increased reliability and faster travel speeds. The number of miles that transit operates on a reserved or separated ROW for the TSM Alternative and various LRT options is shown in Table S.3-1. The only reserved ROW for the bus alternatives is the Transit Mall in downtown Portland, and its length is only a fraction

Table S.3-1

SUMMARY OF TRANSIT IMPACTS

	No Build	TSM	Surface to 185th	Tunnel to 185th	Surface to Murray	Surface to Sunset TC
Corridor Place Miles (1)	1,493,000	2,112,000	2,254,600	2,238,400	2,194,400	1,896,000
Access to Transit						
Percent Population within 1/4 miles	43%	60%	63%	63%	63%	60%
Percent Employment within 1/4 mile	46%	82%	83%	83%	83%	82%
Percent of Transit Trips Requiring Transfer (1)	37%	48%	65%	60%	67%	60%
Total Weighted Transit Travel Time (minutes)(2)						
From Pioneer Sq. to Beaverton TC	60	51	33	32	34	46
From Pioneer Sq. to 185th/ Baseline	69	67	48	47	58	57
From Pioneer Sq. to 185th/ TV Highway	70	77	51	52	57	65
From Pioneer Sq. to Hillsboro	93	88	70	71	76	73
Miles of Reserved ROW	0.7	0.8	11.8	11.5	9.5	5.7
Percent of Intersections Protected	0%	0%	73%	70%	69%	52%
Bus Volumes on Transit Mall - S.W. Fifth Avenue (2)	140	191	167	175	167	167
Total Corridor Transit Trips (1)	28,000	33,400	38,000	38,000	35,100	31,800
Total Corridor Transit Trips to Portland CBD (1)	11,900	17,000	19,400	19,800	17,300	14,800
Percent Transit Trips to Portland CBD (1)	17%	24%	27%	28%	24%	21%
Total Corridor LRT Trips (1)	0	0	27,100	25,200	22,900	16,900

Notes: (1) Average Weekday.
(2) P.M. Peak Hour.

Source: Metro, 1990 and Tri-Met, 1990.

of the reserved ROW of the LRT options. The LRT options to S.W. 185th Avenue provide about 11.6 miles of reserved or separated "transit-only" ROW, 20% more than the S.W. Murray Boulevard option and over twice that offered by the Sunset Transit Center option. Table S.3-1 also shows that 50% to 70% of all the intersections through which the light rail operates have traffic signals preempted by light rail, have gated crossings for light rail, or actually have the light rail separated from the other traffic. The LRT options to S.W. 185th Avenue have a higher percentage of protected intersections than do the shorter terminus options. The No Build and TSM Alternatives have no protected intersections. Such priority measures improve the reliability and travel speed of light rail service, compared with buses operating in mixed traffic.

Service reliability and speeds on the Portland Transit Mall are also considerations. With the TSM Alternative, the estimated downtown Portland bus volumes approach the theoretical capacity of approximately 180 to 200 buses per hour per Mall street. As a result, the estimated operating time would increase by approximately three minutes (30%) compared to today's times. By reducing Westside bus volumes downtown, the LRT Alternative improves the Mall bus travel times and reliability compared to the TSM.

The transit priority measures and highway improvements associated with the build alternatives generally produce faster transit travel times than the No Build. Table S.3-1 shows the P.M. peak hour, total weighted transit travel times between downtown Portland and some representative locations in the corridor for each of the alternatives. Total weighted transit travel times include extra (penalty) factors applied to the walk times and transfer times. Such trips in the P.M. peak hour are generally fastest with the LRT options to S.W. 185th Avenue, slower with the TSM Alternative, and slowest with the No Build Alternative. There are, however, a few other locations in the corridor where the TSM or No Build is the fastest.

S.3.1.2 Transit Ridership

The impacts of the build alternatives on transit service is reflected in ridership gains. Table S.3-1 shows total Westside corridor transit ridership (rail and bus) for each alternative. The No Build Alternative would generate approximately 28,000 daily riders. The TSM Alternative would generate approximately 33,400 transit riders. The LRT options to S.W. 185th Avenue would generate corridor ridership of approximately 38,000 riders (bus and light rail) per average weekday, which is almost double current ridership. The longer LRT options, therefore, are projected to have approximately 10,000 more average weekday trips compared to the No Build Alternative (an increase of 36%) while the TSM Alternative would carry 5,300 more riders (a 19% increase). The S.W. Murray Boulevard and Sunset Transit Center terminus options would generate approximately 7,100 and 3,800 more daily transit riders, respectively, than would the No Build Alternative or 2,900 and 6,200 fewer transit riders, respectively, than the S.W. 185th Avenue terminus option.

Transit ridership to the Portland CBD is an important indicator of effectiveness of the alternatives. Table S.3-1 shows there would be approximately 11,900 daily transit trips to the CBD with the No Build Alternative, 17,000 trips with the TSM Alternative, and 19,400 trips with the LRT option to S.W. 185th Avenue. The LRT options to S.W. 185th Avenue result in a 44% transit mode share to the CBD for work trips, compared to 38% for the TSM Alternative and 26% for the No Build Alternative. The LRT options to S. W. 185th Avenue also have the highest transit mode share for all trips (work and non-work) destined to the CBD, with a mode share of approximately 27%. The TSM Alternative has a mode share of 24%, while the No Build Alternative has a mode share of 17%.

Table S.3-1 also shows projected 2005 ridership on light rail for each LRT option. The Surface options to S.W. 185th Avenue are projected to serve 27,100 passengers on light rail per average weekday, which is approximately 1,900 more daily trips than the Long Tunnel option with a station at the Washington Park Zoo. While the Long Tunnel option would be slightly faster, LRT ridership is forecasted to be somewhat lower with the Long Tunnel option because this option does not include a station at Sylvan and has competing parallel bus service on Sunset Highway. It is reasonable to assume that the addition of a Sylvan station to the Tunnel option would result in slightly higher ridership than the Surface options as a result of marginally faster travel times. The Tunnel option which does not include a station at the

Zoo is estimated to serve 900 fewer daily riders than the Tunnel Option with a Zoo Station. Light rail ridership on the S.W. Murray Boulevard and Sunset Transit Center terminus options is projected to be 15% and 38% less, respectively, than the surface options to S.W. 185th Avenue.

S.3.2 Highway and Street Impacts

This section summarizes the analysis of the impacts of the proposed alternatives on highway congestion and parking in the corridor.

S.3.2.1 Congestion

Traffic has been growing historically in the Portland metropolitan area at a rate of approximately 2.5% annually. As the population and employment base continue to grow, trip making will also increase, resulting in increased traffic on the street and highway system. One of the objectives of expanding the transit system is to help reduce this growth in auto travel in order to help relieve congestion and improve environmental quality.

Under existing afternoon rush hour (P.M. peak hour) conditions (1987), Sunset Highway operates at level-of-service (LOS) E, or near capacity, from the Vista Tunnels to the Zoo. From the Zoo to Sylvan, where the westbound climbing lane stops, and west of Sylvan, where the highway narrows to two lanes per direction, the existing condition is LOS F, representing congested, stop-and-go traffic.

The No Build Alternative would not include any improvements to Sunset Highway. Traffic congestion on all segments is expected to worsen, with the roadway operating at a LOS F in all locations except just east of the Zoo, where traffic demands would approach the capacity of the facility (see Table S.3-2). Increased P.M. peak hour congestion and poorer levels-of-service would result in drivers seeking alternative routes and a lengthening of the duration of peak period congestion.

Traffic projections indicate that Sunset Highway traffic operations would be similar for the TSM and LRT Alternatives, which include the same highway improvements. Highway capacity improvements west of the Zoo would make the highway more attractive, and demand between the S.W. Jefferson Street on-ramp and the Zoo would increase, compared to the No Build Alternative, resulting in a slightly worse level of service in this segment. Between the Zoo and Sylvan intersection, the highway congestion would improve slightly to LOS E, as a result of extension of the climbing lane and addition of an auxiliary lane. Under both alternatives, conditions on the highway segments west of Sylvan would be somewhat improved as compared to the No Build Alternative or the existing condition.

Table S.3-2 also provides estimates of traffic demand on streets parallel to Sunset Highway for the P.M. peak hour, outbound direction at a location near Sylvan. For the No Build Alternative, traffic demand increases on all parallel streets by approximately 50% over existing conditions. For the TSM and LRT Alternatives, estimated traffic demand on these streets is reduced by approximately 23% and 27%, respectively, compared to the No Build Alternative.

Table S.3-2 also provides an estimate of overall (Sunset Highway and parallel streets) corridor traffic demand for the P.M. peak hour in the outbound direction. In general, the corridor is close to capacity today, would significantly exceed capacity with the No Build Alternative, and would accommodate year 2005 demand levels but approach capacity of the corridor with the TSM or LRT Alternatives. With either the TSM or LRT Alternatives, an additional 1,000 to 1,200 vehicles will be attracted to the Sunset Highway as compared to the No Build Alternative, thereby reducing infiltration on parallel streets.

Table S.3-2 also shows P.M. peak hour outbound (southbound) traffic characteristics on Highway 217 from the Sunset Highway Interchange to S.W. Canyon Road. Currently the facility operates at LOS E, and traffic is projected to worsen with the No Build Alternative. Significant improvements to peak hour operation of the facility would result with the build alternatives. Highway 217 is projected to operate at LOS C north of S.W. Walker Road and LOS D south of S.W. Walker Road, an acceptable level-of-service, with either of these alternatives. These improvements are the result of the widening of Highway 217 and the additional transit service.

Table S.3-2

SUMMARY OF HIGHWAY IMPACTS

	No Build	TSM	Surface to 185th	Tunnel to 185th	Surface to Murray	Surface to Sunset TC
Vehicle Hours of Delay(1)						
Highway	2,300	1,800	1,700	1,700	1,700	1,800
Arterial	2,000	1,500	1,500	1,500	1,500	1,500
Miles of Congested Streets and Highways						
Highway	18	11	11	11	11	11
Arterial	76	57	54	54	54	57
Sunset Highway Level-of-Service(2)						
Jefferson on Ramp to Zoo	E	F	F	F	F	F
Zoo to Sylvan	F	E	E	E	E	E
Sylvan to Canyon	F	E	E	E	E	E
Canyon to 217	F	E	E	E	E	E
Sunset Highway Corridor Traffic Volumes(2)						
On Parallel Streets	4,800	3,700	3,500	3,500	3,500	3,700
On Sunset Highway	7,300	8,500	8,500	8,500	8,500	8,500
Total Sunset Highway Corridor Demand(2)	12,100	12,200	12,000	12,000	12,000	12,200
Total Sunset Highway Corridor Capacity(2)	10,900	12,900	12,900	12,900	12,900	12,900
Highway 217 Level-of-Service(2)						
Sunset to Walker	F	C/D	C/D	C/D	C/D	C/D
Walker to Canyon	F	D	D	D	D	D
Total Auto Person Trips to Portland CBD(1)	60,100	55,000	52,600	52,200	54,700	57,200
Parking Spaces						
Total Removed by Project	135	210	785 to 1,405	735 to 1,355	785 to 1,405	690
Reduction in Needed CBD Spaces	N/A	1,500	2,300	2,400	1,600	600

Note: (1) Average Weekday.
(2) P.M Peak Hour.

Source: Metro, 1990 and Tri-Met, 1990.

Under the No Build Alternative, most intersections in Beaverton would experience traffic demands near or slightly below their capacities, resulting in LOS D to F. This represents an increase in traffic demand and a worsening of traffic operations compared to existing conditions. Traffic projections indicate that the TSM and LRT Alternatives would result in similar traffic volumes within this portion of the project area, and traffic demands with either would be somewhat lower compared to the No Build Alternative.

The LRT options would have certain localized traffic and access impacts that would require mitigation. These are discussed in Chapter 4.

Table S.3-2 also shows the total mileage on the corridor's highway and arterial system with traffic volumes approaching or exceeding capacity during the P.M. peak hour. Both the TSM and LRT Alternatives would reduce the miles of highway congestion by approximately 39% compared with the No Build Alternative. The number of congested miles with these alternatives would be similar to what is experienced today. On the arterial system, the TSM Alternative would reduce congested miles of roadway by more than 22% compared with the No Build Alternative, while the LRT Alternative would reduce congested miles by 28%.

S.3.2.2 Parking Supply and Demand

Table S.3-2 presents the total number of existing parking spaces that would be lost with each alternative. The No Build Alternative would eliminate 135 on-street parking spaces in downtown Portland because of the north extension of the Transit Mall. The TSM Alternative would eliminate a total of 210 parking spaces throughout the corridor, and the LRT Alternative would eliminate 690 to 1400 spaces total. The parking loss for the TSM and LRT Alternatives includes the 135 spaces lost under the No Build Alternative. The total number of spaces lost for the LRT Alternative would depend upon the alignment option. In East Beaverton, parking losses with the North option would occur primarily on private lots while the South option would have greater impacts, primarily in the Canyon Town Shopping Center. In West Central Beaverton, the BN alignment option would cause minimal parking impacts, while the Henry Street alignment option would result in the loss of significant amounts of parking.

Auto person trips to the CBD are forecast to increase with all alternatives compared to existing conditions. The increase in auto person trips is greatest for the No Build Alternative because transit ridership is lowest. Conversely, the increase in auto person trips is lowest for the LRT options to S.W. 185th Avenue because they have the highest transit ridership. Considering average auto occupancy and parking turnover factors, the LRT option to S.W. 185th Avenue would reduce the demand for downtown parking by approximately 2,300 spaces compared to the No Build Alternative and 800 to 900 spaces compared to the TSM Alternative.

S.3.3 <u>Freight Movements</u>

Rail freight service exists only in the portion of the corridor from Beaverton westward. The LRT Alternative would impact one shipper who would be displaced and would need to relocate elsewhere on the BN. During the short term, Tri-Met would have to coordinate light rail construction activities with the BN Railroad to minimize impacts.

Freight deliveries via trucks are affected in two areas of the LRT alignment, downtown Portland and Beaverton. In downtown Portland, three truck loading zones are proposed for removal by the LRT Alternative. All impacts can be mitigated. In Beaverton, impacts on truck access and circulation will be confined to five locations and mitigation measures are proposed as part of the project.

S.4 ENVIRONMENTAL CONSEQUENCES

This section summarizes the key environmental effects of building and operating the alternatives in the Westside Corridor. A more detailed description of these effects is found in Chapter 5 of this SDEIS.

S.4.1 Land Use and Economic Development

The Portland Region has experienced a period of economic growth since the early 1980's. This growth is the result of a variety of factors including availability of land, proximity to the Pacific Rim, and overall quality of life. The overall quality of the transportation system has also been a factor to firms considering locating in the Portland region, and specifically in the Westside Corridor. However, rapid growth in traffic and degradation of level-of-service on Sunset Highway in the past decade has raised concerns by local officials that this will not be true in the future. The highway and transit elements of both the TSM and LRT Alternatives would help assure that land use and development objectives on the Westside are realized.

None of the alternatives is expected to affect the rate of regional growth or the share of that growth occurring in the corridor. The TSM Alternative is also not expected to encourage any change or development patterns in the corridor. The primary impact of the LRT Alternative could be to focus development around transit station areas where improved transit accessibility would lead to higher land values. If these impacts do occur, they would be expected to be concentrated in the CBD and in station areas along the corridor currently undergoing development or redevelopment.

Land use plans and policies have been adopted by Washington County, Beaverton, and the City of Portland to encourage the concentration of future corridor development in LRT station areas. Increased densities on existing urban land would help limit the need for future expansion of Urban Growth Boundary, which defines the limit of urban growth in the Portland Metropolitan area.

Both the TSM and LRT Alternatives would assist in meeting land use objectives for increased densities in downtown Portland. Both alternatives would improve transit accessibility between corridor residents and employment, cultural, and shopping opportunities in downtown Portland. As a result of this increased accessibility, higher densities in downtown would be possible. The LRT Alternative would be somewhat more supportive of development objectives in the downtown than the TSM as reflected by the higher LRT ridership.

A more comprehensive analysis of station area impacts is found in Section 5.1 of this SDEIS.

Construction of the TSM Alternative is estimated to create 4,790 job-years in Oregon and have an economic impact of $465 million compared to 22,850 job-years and up to $1.91 billion for the LRT Alternative (Public Financial Management, Inc., 1990). The TSM Alternative also would result in approximately 550 Westside transit operations and maintenance jobs with a direct annual economic impact of $27.1 million. This compares to approximately 470 jobs and $22.9 million to $24.1 million of direct annual economic impact with the LRT Alternative (Tri-Met, 1990).

S.4.2 Displacements And Relocation

Improvements proposed by the TSM and LRT Alternatives are mostly located within existing public right-of-way (ROW). Where improvements are not within existing ROW, they would generally affect under-developed property. Table S.4-1 provides a summary of the residential units and businesses displaced by the TSM and LRT Alternatives. The TSM Alternative would displace a total of 16 residential units and businesses. The LRT Alternative to a S.W. 185th Avenue terminus would cause from 90 to 127 displacements. The S.W. Murray Boulevard terminus option would cause from 73 to 110 displacements, and the Sunset Transit Center terminus option, 26 to 43 displacements. Federal and State procedures will be applied in all instances of displacement, and every effort would be made to accomplish satisfactory relocation within the community or to providc adequate compensation.

S.4.3 Neighborhoods

Each of the alternatives would provide transit service to most neighborhoods in the corridor. The TSM Alternative's impact on neighborhoods would be most apparent in downtown Portland on the Transit Mall, along S.W. Jefferson and S.W. Columbia Streets in the Goose Hollow neighborhood, and in central Beaverton due to increased numbers of diesel buses and some increase in noise levels. The

Table S.4-1

SUMMARY OF ENVIRONMENTAL IMPACTS

	Impact by Complete Alternative					Impact by Geographical Segment								
			LRT Adopted Alignment			LRT Alignment Options								
						Canyon Segment				East Beaverton		Beaverton		
	No Build	TSM	185th Terminus	Murray Terminus	Sunset Terminus	Southside Adopted	Northside	Long Tunnel w/ Zoo Station	Long Tunnel w/o Zoo Station	South Adopted	North	BN Adopted	Henry	Common to all Options to 185th
Displacements:														
Single Family	0	6	19	13	5	5	5	5	5	4	4	0	5	10
Multi Family	0	8	58	58	18	18	18	16	16	40	41	0	6	0
Business	0	2	30	26	20	17	17	2	2	6	1	0	9	7
Retaining Wall Exposure (SF)	48,700	222,900	446,220	446,220	446,220	446,220	384,440	241,940	241,940	0	0	0	0	0
Air Quality														
Locations Violating 8-Hr. "CO" Standard (PPM)	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Adversely Affected Noise Receptors														
Hwy and LRT with Recommended Mitigation	133	125	114	114	115	79	79	79	79	0	0	0	5	35
Acres of Tree Removal	0	14.1	32.5	32.5	32.5	32.5	23.1	16.3	16.3	0	0	0	0	0
Acres of Affected Wetland	0	0.8	4.7	2.5	0.8	0.8	0.4	0.2	0.2	0.8	1.0	0	0.6	3.05
Daily Eneregy Consumption														
Direct, Regional (Btu x 10**9)	239	239	239	239	239	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hazardous Waste Sites Affected	1	6	37	48	21	12	12	12	12	12	11	4	20	20
Resources Adversely Affected														
Historic	0	0	1	1	1	1	1	1	1	0	0	0	1	0
Archaeological	0	0	2	2	2	2	2	2	2	0	0	0	0	0
Parks Affected														
Number	0	0	4	3	1	1	1	1	1	0	0	0	0	3
Acres	0	0	0.86	0.85	0.5	0.5	2.3	1.5	1.3	0	0	0	0	0.36

N/A - Not Applicable.

Source: Shapiro and Associates, Inc., 1990 and Tri-Met, 1990.

cumulative affect of the TSM Alternative on these neighborhoods, however, would not be significant because these impacts would occur along busy arterial streets already carrying bus traffic. Neither the increased number of buses nor highway projects would create any long-term barrier to social interaction.

The LRT Alternative would also not create any new long-term barriers to social interaction in neighborhoods in the corridor. In the Goose Hollow neighborhood, the LRT facilities would reinforce the existing division of the neighborhood caused by S.W. 18th Avenue and S.W. Jefferson Street. Conversely, the LRT would benefit Goose Hollow by eliminating non-neighborhood through traffic and creating a more pedestrian-friendly environment. No significant impacts on neighborhood cohesiveness and character are anticipated in the Beaverton and Washington County segments of the LRT alignment.

S.4.4 Visual and Aesthetic Resources

The major visual impact of the build alternatives would occur in the Canyon segment (from S.W. Jefferson Street to Highway 217). With no aesthetic mitigation, both the TSM Alternative and LRT Alternative (depending on alignment option) would significantly reduce the visual quality of the Sunset Canyon segment. Construction of the transit and highway facilities would increase retaining walls and bridges, and necessitate the removal of trees and vegetation. For example, the TSM would remove 14.1 acres of trees and add 174,200 square feet (360% increase) of retaining wall exposure in the Canyon segment compared to the existing condition or the No Build Alternative. The LRT Southside option would remove 32.5 acres of the trees and add 397,520 square feet (820% increase) of retaining wall exposure; the Northside, 23.1 acres and 335,740 square feet (690% increase), respectively; and the Long Tunnel, 16.3 acres and 193,240 square feet (400% increase), respectively. Thus, for the LRT Alternative, the Long Tunnel options would have approximately half the impact of the Southside and two-thirds the impact of the Northside.

With aesthetic mitigation (e.g., architecturally treated retaining walls and bridge structures, visual screening, buffering, and landscaping), the visual impact of construction and facilities associated with the TSM and LRT Alternatives could be alleviated to some degree. The current cost estimates presented in this Summary and SDEIS do include a high degree of mitigation in the Canyon segment.

Through Beaverton and west of Beaverton, the TSM and LRT Alternatives would have little negative impact on visual quality. With proper design treatment, the LRT facilities may improve the visual quality of some areas. A detailed visual quality and aesthetic impact mitigation plan will be developed for the locally preferred alternative and presented in the FEIS.

S.4.5 Air Quality

On a regional basis, the TSM and LRT Alternatives would result in approximately a one percent reduction in regional vehicle miles travelled and total air pollutant emissions compared to the No Build Alternative. In the Westside Corridor, the No Build Alternative would result in one air quality measurement receptor (at the Zoo) with CO concentrations above the eight-hour standard (National Ambient Air Quality Standards). With the TSM and LRT Alternatives, CO concentrations would not exceed either the one-hour or eight-hour concentration standards. The Westside Corridor Project conforms with the State Implementation Plan.

S.4.6 Noise and Vibration

General highway traffic would continue to be the primary source of noise in the Westside Corridor and especially for the segments of the Sunset Highway and Highway 217 between downtown Portland and central Beaverton. With the No Build Alternative, 133 receptors would be impacted according to Federal Highway Administration Noise Abatement Criteria. The TSM and LRT Alternatives, without mitigation, would impact approximately 200 more receptors than the No Build. However, noise mitigation is proposed for the TSM and LRT Alternatives in some locations throughout the corridor.

Noise barriers can reduce noise to acceptable levels at nearly all adversely affected noise-sensitive locations (i.e., residences, schools, churches, businesses, and parks) for all alternatives. However, when cost-effectiveness criteria for noise abatement are applied and visual impacts of the barriers are considered, not all potential mitigation barriers may be practical. Based on the current mitigation plan, the resulting number of adversely affected, noise-sensitive locations for the TSM Alternative and each LRT option would be as shown in Table S.4-1. The TSM Alternative with cost-effective barriers would affect 125 receptors, virtually all in the Canyon and Highway 217 segments, while the LRT options with cost-effective barriers would affect about 114, nearly all in the Canyon and Highway 217 segments. West of Highway 217, with the LRT options and proposed cost-effective noise barriers, there are no receptors that would be adversely impacted except for five receptors with the Henry Street option. Included among the LRT impacts are those due to ancillary facilities such as the LRV storage yard and maintenance shop, traction power substations, and tunnel ventilation shafts.

Neither the TSM or LRT Alternatives would create significant adverse impacts to existing uses due to ground-borne vibration. At locations in downtown Portland, along Highway 217, and in central Beaverton where vibration due to LRT operation could be a potential concern, the addition of ballast mats to the trackway subgrade or other techniques would mitigate potential problems.

A detailed noise and vibration mitigation plan will be prepared for the locally preferred alternative and presented in the FEIS.

S.4.7 Ecosystems

Neither the TSM nor LRT Alternatives would adversely affect any wildlife or plant species listed as sensitive, threatened, or endangered on either the National Fish and Wildlife Service's Natural Heritage Data Base (1989), or the Oregon Natural Heritage Data Base. As shown in Table S.4-1, the TSM Alternative with highway improvements would remove approximately 14.1 acres of forested land (in Sunset Canyon) and fill about 0.8 acres of wetland. These impacts compare to a range of 16.3 to 32.5 acres of forest removed and from 0.8 to 5.5 acres of filled wetlands with the LRT options. Acres of forest removed are the same for all LRT terminus options. However, the S.W. Murray Boulevard terminus option would reduce LRT Alternative wetland impacts by 2.2 acres and the Sunset Transit Center terminus option would reduce wetland impacts by an additional 1.65 acres.

Detailed mitigation plans for forest land and wetland impacts will be prepared for the locally preferred alternative and presented in the FEIS.

S.4.8 Water Quality and Hydrology

Both the TSM and LRT Alternatives would increase the area of impervious surface in the Westside Corridor due to construction of new transit centers, park-and-ride lots, and an LRV storage yard and maintenance shop. These new surfaces would increase future amounts of storm water runoff within the Tualatin River Basin. However, because the project is located in a largely developed area, the additional impervious area and storm water runoff would be minor compared to the basin's existing impervious surface area and volume of storm water runoff. Furthermore, in response to the need for control of non-point source pollution in the Tualatin River Basin, all facilities built as part of the Westside Corridor Project would include storm water runoff and phosphorus contaminant controls required by DEQ.

All LRT alignment options through central Beaverton would be partially below the 100-year flood level if built on existing grades. However, except for the South alignment option near S.W. 117th Avenue, they could all be relatively easily elevated to at least one foot above the 100-year flood level with additional ballast under the LRT tracks. Floodplain impact of the South alignment option cannot be mitigated without raising the level of S.W. 117th, damming the floodway associated with Hall Creek and implementing a major floodway capacity improvement. With no mitigation, periodic flooding of the tracks may occasionally halt LRT service and increase LRT operating and maintenance costs. West of central Beaverton, resulting unavoidable floodplain encroachments can be mitigated by removal of the Windolph rail spur and fill near S.W. Merlo Road and S.W. 158th Avenue.

S.4.9 Energy

Compared to the No Build Alternative, neither the TSM nor LRT Alternative would significantly reduce overall Portland metropolitan area consumption of energy for transportation. On a regionwide basis, automobile travel will continue to be the primary mode choice for trips not oriented to the central city and consequently the overwhelming determinant of regional transportation energy consumption. Nevertheless, the TSM Alternative would save approximately 2.3 million gallons of gasoline annually, and the LRT Alternative would save about 2.9 million gallons, compared to the No Build. Considering transit energy consumption only, the LRT Alternative would consume approximately 3% less energy than the TSM Alternative for daily operations.

S.4.10 Geology

Geologic impacts for the TSM and LRT Alternatives would be concentrated in the Canyon segment. Highway improvements included in the TSM Alternative would result in changes in topography, potential impacts on slope stability, and minor erosion. In addition, cuts into steep slopes associated with the Southside alignment option and the surface portion of the Northside alignment option could exacerbate localized slope instability, with potential adverse impacts on residences located near the crests of slopes. Proposed retaining walls, are of the tie-back type, which are designed to improve slope stability both during and after construction.

Impacts associated with tunnel construction include possible vibrations from drill and blast excavation, ground water intrusion, the removal of excavated materials, and potential destablization of steep unstable slopes at tunnel portal sites. Faulting is not considered a major issue in the project vicinity.

Additional geotechnical investigation (i.e., soil and rock drilling) and design study will be conducted for the locally preferred alternative to more specifically address potential slope instability, erosion, and fault hazards.

S.4.11 Historic, Archaeological, and Parklands

There are 47 historic resources, 2 potential archaeological sites, and 7 public parklands within the Westside Corridor. Chapter 6 of this SDEIS provides further detail on these resources. Neither the No Build nor TSM Alternative would adversely affect any of the historic or archaeological resources or require use of any of the public parklands.

The adverse effects of the LRT Alternative on historic or archaeological sites and parklands would vary depending on the alignment option. Adverse effects on historic resources include an adverse visual impact on the Vista Bridge with the Southside option in the Canyon, and an adverse effect on the J. Henry House with the S.W. Henry Street option in central Beaverton. There is the potential for an adverse effect on the two potential archaeological sites with all alignment options.

Some use of four public parklands is required with all LRT options. The impact on Washington Park varies depending on the alignment option (Southside option - 0.5 acres, Northside - 2.3 acres, Long Tunnel with Zoo station - 1.2 acres, and Long Tunnel without a Zoo station - 1.3 acres). Use is also required of 3 other small neighborhood parks (Roxbury Park - 0.1 acres, C.E. Mason Wetlands Park - 0.25 acres, and Salix Park - 0.01 acres).

S.4.12 Construction Impacts

Within the Sunset Canyon area and along Highway 217, construction of highway improvements associated with the TSM or LRT Alternatives would result in traffic impacts for four or more years due to: temporary lane adjustments and closures; the addition of construction-related traffic to normal traffic; local access disruption; and noise, dust, vibration, and potential disruption of utilities and services. Construction impacts associated with the TSM Alternative would primarily be restricted to locations west of the Zoo Interchange, while the LRT options would also have impacts east of the Zoo Interchange in varying degrees. With little excess capacity on arterials paralleling Sunset Highway through the West

Hills to absorb diverted traffic or heavier bus service, delays to all vehicles could be 20 to 30 minutes in both directions, with long queues most of the day.

Outside the Canyon and Highway 217 segments, the greatest construction impacts of the LRT line would be in downtown Portland and the Goose Hollow neighborhood, in east Beaverton through an apartment complex and shopping center east of the Beaverton Transit Center, and along S.W. Beaverdam Road and S. W. Henry Street west of the Transit Center, depending on the alignment options considered. Impacts to these areas would typically include increased congestion, temporary disruption of access, temporary street closures, noise, dust, and temporary use of private property (through easements) for construction purposes. Construction at any of these locations could continue for one to two years.

Measures to at least partially mitigate these adverse construction impacts include coordination of highway and LRT construction to minimize the length of time required; employment of traffic management measures to reduce the volume of traffic particularly during peak hours including, rideshare/carpooling programs, transit use incentives, additional park-and-ride transit service, and staggering of work hours where possible; and traffic control measures to maintain safety and keep the street and highway system operating.

S.5 EVALUATION OF ALTERNATIVES

The SDEIS evaluates each of the project alternatives from five different perspectives: (a) financial feasibility, (b) effectiveness, which evaluates how well project objectives are met, (c) cost-effectiveness, (d) equity considerations, and (e) major trade-offs between alternatives. Chapter 7 of this SDEIS provides a more detailed discussion of these evaluations.

S.5.1 Financial Analysis

This section evaluates two aspects of the feasibility of the financing scenarios for the project alternatives:

Project Capital Cost Feasibility Analysis: focuses on whether there are adequate Project Capital resources to implement the preferred alternative and, if not, how the Project Capital shortfall will be resolved. Project Capital costs in this analysis relate only to the implementation of the Westside Corridor Project.

System Fiscal Feasibility Analysis: focuses on whether there are adequate resources to operate and maintain the entire transit System, including the operation of the preferred alternative and, if not, how the System shortfall will be resolved. System costs also include all transit capital expenditures to the year 2005 other than costs for the Westside Corridor Project Capital cost.

S.5.1.1 Costs

Table S.5-1 shows that transit Project Capital costs in Year of Expenditure dollars range from about $110 million for the TSM Alternative up to $703 million for the Long Tunnel with Zoo station option to S.W. 185th Avenue. Surface LRT options to S.W. 185th Avenue would cost $632 to $638 million. The shorter terminus Surface LRT options are projected to cost in the $364 to $559 million range. In addition, the highway projects associated with each of the transit options add another $125 million, in Year of Expenditure dollars, to the capital costs of the alternatives.

System costs include all capital and operating and maintenance expenditures by Tri-Met between FY 1989 and FY 2005 (in Year of Expenditure Dollars) except for the Westside Corridor Project Capital cost. System costs include the cost of: (a) a 1% per year "customary" increase in transit service hours, (b) the added operation and maintenance costs that result from the Westside Corridor Project, (c) a regular schedule of vehicle replacement purchases and (d) the cost of already committed capital projects and purchases. Table S.5-1 shows that the total System cost for the TSM Alternative is $3.068 billion, about $40 to $71 million more than that exhibited by the LRT options.

Table S.5-1

SUMMARY OF FISCAL FEASIBILITY ANALYSIS
($ Millions)

	TSM	Surface to 185th	Tunnel w Zoo to 185th	Tunnel w/o Zoo to 185th	Surface to Murray	Surface to Sunset TC
Transit Project Capital cost (YOE dollars) (8)	$109.9	$638.1	$703.2	$667.6	$559.1	$364.4
Existing Regional Capital Funds	0.0	87.0	87.0	87.0	87.0	87.0
Existing Transit Capital Shortfall	109.9	551.1	616.2	580.6	472.1	277.4
Proposed Federal Funds	54.9	478.6	527.4	500.7	419.3	273.3
Proposed Regional Funds (1)	0.0	19.2	19.7	19.5	18.2	18.0
Proposed State Funds (2)	56.6	79.6	87.9	83.4	69.9	45.6
Resulting Capital Reserve Account (3)	1.6	26.4	18.8	23.0	26.2	26.1
Highway Project Capital Costs (YOE dollars)	$125.2	$125.2	$125.2	$125.2	$125.2	$125.2
Existing State Funds (4)	41.5	41.5	41.5	41.5	41.5	41.5
Proposed Additional State Funds (4)	83.7	83.7	83.7	83.7	83.7	83.7
Total Transit System Cost (5)	3,068.4	3,026.9	3,028.3	3,026.1	3,021.8	2,996.9
Existing System Revenues (5)	3,040.6	3,051.3	3,051.5	3,050.7	3,048.5	3,037.9
Low-Year Working Capital (existing Revenues) (6)	0.4	2.1	2.0	2.1	2.2	2.8
Low-Year Working Capital (new Revenues) (6) (7)	4.2	6.0	6.0	6.0	6.1	6.8

Notes:
(1) Includes interest earnings.
(2) Tri-Met issued certificates of participation backed by State Funds. Includes interest earnings.
(3) Unused regional revenues reserved for contingencies.
(4) Combination of State Highway Funds and Federal and Primary Funds.
(5) Cumulative total between FY 1989 and FY 2005.
(6) Measured in months of operating expenses.
(7) Assumes a new $3.5 million ($1990) per year revenue is implemented in 1993.
(8) YOE means Year of Expenditure dollars.

Source: Tri-Met, 1990.

S.5.1.2 Existing Revenues

While no capital revenue is currently available for the TSM Alternative, $87 million in transit Project Capital revenues are currently available for a light rail project including:

$80 Million From Light Rail Construction General Obligation Bonds: On November 6, 1990, the voters of the Tri-Met District approved a $125 million General Obligation Bond to expand the regional light rail system subject to a preferred alternative decision. The Regional Compact approved by Metro's Joint Policy Advisory Committee on Transportation prescribes a plan for the use of the bond proceeds. The Regional Compact provides that up to $80 million of the bond proceeds may be used by the Westside Corridor Project to cover one-eighth of the Project Capital costs of the LRT options plus the Capital Reserve Account (CAPRA) for contingencies.

$7 Million in Local Government Contributions: The Regional Compact also requires governments representing areas directly served by the Westside Corridor Project to provide additional Project Capital funding. This includes: (a) $7 million from the City of Portland, (b) $5 million from Washington County, (c) $2 million from Metro; and (d) $7 million from Tri-Met. The Tri-Met Board of Directors has approved their financial participation. The remaining governmental approvals are currently being scheduled.

The Oregon Department of Transportation (ODOT) has programmed a portion of the funds needed for the highway projects, which are common to all transit alternatives, in the 1991-1996 Six Year Highway Improvement Program. This consists of approximately $41.2 million of Federal Aid Primary and State Highway Funds.

Transit System revenues are derived from a series of on-going sources. In total, between FY 1989 and FY 2005 these revenue sources are expected to provide between $3.038 and $3.052 billion depending on the alternative. Due to greater passenger revenues caused by higher ridership, the LRT options to S.W. 185th Avenue generate about $10 million more in System revenue than the TSM Alternative, and as much as $14 million more than the shorter terminus LRT options.

S.5.1.3 Existing Revenue Shortfalls

In this study, an option is fiscally feasible if it meets the following two conditions:

(a) There must be sufficient capital revenues to meet the estimated Project Capital cost of the option plus, for the LRT options, a capital reserve account (CAPRA) equal to at least $15 million.

(b) There must be sufficient on-going revenues to meet the estimated total System costs plus sufficient beginning year working capital (for System contingencies) to meet two months of operating costs.

If these conditions are not met, a revenue shortfall exists. As Table S.5-1 illustrates, existing Project Capital shortfalls occur for all transit alternatives ranging from $110 million for the TSM Alternative to $616 million for the Long Tunnel with Zoo station LRT option. In addition, the $15 million capital reserve account requirement is not met. An additional Project Capital shortfall of $83.7 million occurs for the highway improvements associated with all of the transit alternatives.

Table S.5-1 also demonstrates that for the LRT options, available System revenues: (a) meet the System capital and operating costs, and (b) meet the beginning working capital requirements. Accordingly, there is not a System revenue shortfall for the LRT options. The TSM Alternative does not meet these tests, and consequently, would require additional revenue sources or management controls to compensate for the System revenue shortfall.

S.5.1.4 Proposed Additional Revenues

The following have been identified as potential sources of additional revenues to meet transit Project Capital shortfalls:

UMTA Section 3 Grants: The baseline funding scenario assumes that an UMTA Section 3 Grant would provide 50% of the capital cost of the TSM Alternative. The grant, viewed in Year of Expenditure dollars, would be approximately $55 million. The baseline funding scenarios assume that an UMTA

Section 3 "New Start Grant" would provide 75% of the cost of the LRT Alternative. The grant, viewed in Year of Expenditure dollars, would be approximately $472 to $527 million for the LRT options to S.W. 185th Avenue. The assumed federal grant for the shorter LRT options would be in the $273 to $419 million range.

Battery and Tire Fee: This revenue option is identified to fund the local share of the Project Capital cost of the TSM Alternative. Under this scenario, a Battery and Tire Fee, or an equivalent source, would be proposed to the legislature in either 1991 or 1993. In total, between 1993 and 2005, the fee or its equivalent would produce $56 million for Tri-Met, sufficient revenue to meet the 50% local matching ratio for the TSM Alternative.

State Light Rail Construction Fund: This revenue source is anticipated to pay for one-eighth of light rail Project Capital costs. The Fund was established by the legislature in 1989, although revenue was not appropriated to it. The Governor has submitted a bill to the 1991 Legislative Assembly that appropriates $10 million per year of State Cigarette Tax proceeds to the Fund for use by the Westside Corridor Project. The baseline financing scenario assumes that the proceeds in the State Fund would pay debt service on Tri-Met issued Certificates of Participation.

Local Government Contributions: An additional $14 million in formal commitments is anticipated under the Regional Compact provision regarding Project Capital funding to be provided by local governments.

All of the alternatives require additional highway Project Capital revenues. ODOT intends to program the needed additional $83.7 million in Federal Formula Grants or State Highway Funds in its 1993-1998 program update. The programming of the additional funds will require Oregon Transportation Commission approval.

The System revenue shortfall projected for the TSM Alternative is of a magnitude that might be met by standard management techniques, such as adjusting fares or the rate of service increase. However, additional revenues may be required. If required, it is likely that a new revenue stream of, at least, $3.5 million ($1990) would be sought. The source of this revenue has yet to be identified. Additional System revenues are not required for the LRT Alternative.

S.5.1.5 Financial Feasibility Conclusions and Uncertainties

Assuming the baseline funding scenarios described above, Tri-Met is capable of providing sufficient capital revenues to meet the Project Capital cost and CAPRA requirements of all project options. Tri-Met is capable of meeting the System costs and beginning working capital requirements for the LRT Alternaitve without a new revenue source. A new source of operating revenue may be required for the TSM Alternative to meet the System fiscal feasibility standard.

The fundamental risk associated with the Project Capital funding concepts is the possibility that the new revenue sources are not approved at the levels assumed. Even if federal funds are authorized at assumed levels, their timing may be uncertain. Thus, there may be insufficient federal revenues to meet Project Capital costs in certain years. A second Project Capital uncertainty is the possibility that the capital costs or capital cost inflation is underestimated. To guard against these risks, capital reserves and other contingencies have been built into the Project Capital financing plan which can accommodate a significant range of underestimated costs or overestimated revenues.

There are also uncertainties inherent in the System analysis. One such uncertainty is the possibility of weak regional growth and concurrent high inflation in transit labor costs. Long-term conditions of this nature are not very likely. Short-term System deficits caused by such economic conditions could be managed through standard management measures or, if necessary, the enactment of an additional revenue source.

S.5.2 Effectiveness Evaluation

"Effectiveness" is measured on the basis of an alternative's ability to meet the objectives for the Westside Corridor Project defined in Section S.1.

S.5.2.1 Maintain A Balanced Road System

The relative effectiveness of the alternatives in providing a balanced highway system was measured in terms of highway/arterial congestion and the specific impacts of the project alternatives on the performance of Sunset Highway. The TSM and LRT Alternatives are equally effective in meeting this objective.

As shown in Table S.5-2, the TSM Alternative and LRT options to S.W. 185th Avenue both reduce the amount of peak period congestion on highways by seven miles (39%) in comparison to the No Build Alternative. Miles of arterial congestion exhibit almost a 22-mile (29%) reduction for the LRT options and a 19-mile (25%) reduction for the TSM Alternative.

Sunset Highway and Highway 217 traffic operations would be similar for the TSM and LRT Alternatives. Highway capacity improvements west of the Zoo will make Sunset Highway more attractive under both alternatives, except between the S.W. Jefferson Street on-ramp and the Zoo. Demand increases in this area will result in a somewhat worse level-of-service (LOS) compared to the No Build Alternative. Under both build alternatives, Sunset Highway congestion will improve slightly to LOS E between the Zoo and Highway 217, as compared to a LOS F for the No Build Alternative. Both build alternatives would improve the level-of-service on Highway 217 to LOS C-D, compared to LOS F for the No Build Alternative.

S.5.2.2 Provide Transit Service That is A Reasonable Alternative To The Automobile

The ability of the alternatives to provide high-quality attractive transit service that is a reasonable alternative to the automobile is evaluated on the basis of service factors and ridership. Overall, the LRT Alternative is more effective in meeting this objective than the TSM Alternative.

As shown in Table S.5-2, both the LRT and TSM Alternatives exhibit significantly better service coverage than the No Build Alternative. About 40% more corridor population and 80% more corridor employment is within one-quarter mile of a transit stop with the LRT and TSM Alternatives, as compared to the No Build.

The LRT Alternative is expected to provide more reliable service than the TSM Alternative. The LRT options to S.W. 185th Avenue provide about 12 miles of reserved ROW. The only reserved ROW for the TSM Alternative is the Transit Mall in downtown Portland and its length is only a fraction of the reserved ROW of the LRT options. As a result, the LRT options to S.W. 185th Avenue provide reserved ROW for about two-thirds of the corridor's passenger miles, as compared to 2% for the TSM and No Build Alternatives. Table S.5-2 also shows that 50% to 70% of all the intersections through which the light rail operates have priority treatment for transit. The No Build and TSM Alternatives have no such priority treatment.

The LRT options would be expected to operate more reliably in downtown Portland than the TSM Alternative. Projected downtown Portland bus volumes indicate that TSM bus volumes would equal or exceed the Mall capacity. In comparison, the LRT Alternative exhibits bus volumes that are below the Mall capacity.

Due to their common highway improvements, the TSM and LRT Alternatives result in slightly faster (two to four minutes) auto travel time between downtown Portland and the Westside Corridor than the No Build Alternative. Total weighted transit travel times from downtown Portland to major corridor destinations are generally projected to be two to nine minutes faster for the TSM Alternative, and 19 to 27 minutes faster for the LRT options to S.W. 185th Avenue than the No Build Alternative. As a result, the TSM would attract 5,400 (20%) more daily riders in 2005 compared to the No Build Alternative.

TABLE S.5-2
SUMMARY OF EFFECTIVENESS MEASURES

	No Build	TSM	Surface LRT to SW 185th	Tunnel LRT with Zoo to SW 185th	Tunnel LRT without Zoo to SW 185th	Surface LRT to Murray	Surface LRT to Sunset TC
Miles of Congested Roads – Highway	18	11	11	11	11	11	11
Miles of Congested Roads – Arterial	76	57	54	54	54	54	57
Sunset Highway Level of Service – PM Peak Hour							
Jefferson On-Ramp to Zoo	E	F	F	F	F	F	F
Zoo to Sylvan	F	E	E	E	E	E	E
Sylvan to Canyon	F	E	E	E	E	E	E
Canyon to 217	F	E	E	E	E	E	E
Highway 217 Level of Service – PM Peak Hour							
Sunset to Walker	F	C/D	C/D	C/D	C/D	C/D	C/D
Walker to Canyon	F	D	D	D	D	D	D
Access to Transit							
Percent of Population within 1/4 mile	43%	60%	63%	63%	63%	63%	60%
Percent of Employment within 1/4 mile	46%	82%	83%	83%	83%	83%	82%
Miles of Reserved or Separated ROW.	0.7	0.8	11.8	11.5	11.4	9.5	5.7
Percent of Corridor Passenger Miles on Reserved ROW	2%	2%	65%	66%	65%	56%	39%
Percent of Intersections Pre-empted, Gated or Separated	0%	0%	71%	70%	70%	67% – 69%	48% – 52%
Total Weighted Travel Time – PM Peak Hour (minutes) from Pioneer Square to:							
Beaverton TC by Transit	60	51	33	32	32	34	46
Beaverton TC by Auto	30	28	28	28	28	28	28
185th/Baseline by Transit	69	67	48	47	47	58	57
185th/Baseline by Auto	37	33	33	33	33	33	33
185th/TV Hwy by Transit	70	77	51	52	52	57	65
185th/TV Hwy by Auto	39	36	36	36	36	36	36
Hillsboro by Transit	93	88	70	71	71	76	73
Hillsboro by Auto	49	46	46	46	46	46	46
Year 2005 Total Corridor Transit Trips – Avg. Weekday	28,000	33,400	38,000	38,000	38,000	35,100	31,800
Percent of All New Corridor Trips on Transit	2%	3%	4%	4%	4%	4%	3%
Percent of New Corridor Trips to CBD on Transit	19%	59%	77%	80%	80%	62%	42%
Peak Cutline Ridership	2,945	4,060	4,548	4,413	4,315	4,180	3,372
Corridor Population within:							
30 minutes of CBD by Transit	7,100	9,500	18,200	(1)	(1)	(1)	(1)
30 minutes of CBD by Highway	78,500	105,600	117,300	(1)	(1)	(1)	(1)
45 minutes of CBD by Transit	20,200	52,600	124,500	(1)	(1)	(1)	(1)
45 minutes of CBD by Highway	282,200	282,200	282,200	(1)	(1)	(1)	(1)
Total Transit Trips to CBD – Avg. Weekday	11,900	17,000	19,400	19,800	19,400	17,300	14,800
Total Reduced Downtown Parking Demand (Relative to No Build)	N/A	1,500	2,300	2,400	2,300	1,600	500
Residential Units Displaced	0	14	77	75	75	71	23
Businesses Displaced	0	2	30	15	15	26	20
Acres of Tree Removal	0	14.1	23.1 to 32.5	16.3	16.3	23.1 to 32.5	23.1 to 32.5
Retaining Wall Exposure (SF)	48,700	222,900	384,440 to 446,220	241,940	241,940	384,440 to 446,220	384,440 to 446,220

Note (1) Not specifically calculated.

The LRT options to S.W. 185th Avenue would attract 10,000 (36%) more daily riders than the No Build, and 4,600 (14%) more than the TSM Alternative. The shorter terminus options would attract about 8% to 18% less ridership than the longer LRT option.

S.5.2.3 Meet Demands Of Regional Growth With Transit

The relative effectiveness of the alternatives in meeting the demands of projected population and employment growth with transit is measured in terms of (a) the amount of service provided, (b) the percent of new trips handled by transit, and (c) transit ridership. Overall, the LRT options to S.W. 185th Avenue are more effective in meeting this objective than the TSM Alternative.

With the TSM and LRT Alternatives, transit would accommodate 3% to 4% of all new (the difference between year 2005 and existing levels) trips in the Westside Corridor. However, as shown in Table S.5-2, with the LRT options to S.W. 185th Avenue, transit would accommodate approximately 77% to 80% of all new Westside Corridor trips to the CBD. With the TSM Alternative and the LRT option to S.W. Murray Boulevard, transit would accommodate about 25% fewer new corridor trips to the CBD than the LRT options to S.W. 185th Avenue. The LRT option to Sunset Transit Center ranks the lowest on this measure.

Another measure of effectiveness is Peak Cutline transit ridership. Peak Cutline is defined as the total P.M. peak-hour, peak-direction transit riders in the corridor at a cutline just east of the Zoo Interchange. The TSM Alternative would attract 1,115 (38%) more Peak Cutline riders than the No Build Alternative. Peak Cutline ridership for the S.W. 185th Avenue terminus option is 1,368 to 1,603 (46% to 54%) greater than the No Build Alternative, and 225 to 488 (6% to 12%) greater than the TSM Alternative.

S.5.2.4 Provide Transportation Needed To Support Planned Development

The ability of the build alternatives to provide the transportation system necessary to support planned development is evaluated in the context of four geographic areas: downtown Portland, Central Beaverton, Sunset Corridor and the Urban Growth Boundary. Available empirical evidence does not suggest that transportation has any effect on the amount of net regional growth. Accessibility historically has not been a limiting factor to development in the Westside Corridor. However, recent experience has found the overall quality of the transportation system to be a factor to firms considering locating in the Portland region. The assumption underlying this SDEIS is that the alternatives will have no effect on the amount of development within the region and the corridor, but could have an effect on the distribution of development within the corridor.

The TSM Alternative provides transportation access levels that are supportive of downtown Portland development goals. Improved transportation facilities associated with the TSM Alternative would result in 30-minute access to the Downtown for 2,400 more corridor residents by transit and 27,100 by highway, as compared to the No Build Alternative. The LRT options to S.W. 185th Avenue would provide similar highway access to downtown Portland as the TSM Alternative, and 30-minute transit service to downtown Portland to 8,700 (92%) more corridor residents than the TSM Alternative (Table S.5-2). The differences are even greater for a 45-minute travel time.

The greater access to downtown Portland would result in 5,100 more daily trips on transit to downtown Portland with the TSM Alternative than the No Build Alternative. The LRT options to S.W. 185th Avenue would result in 7,500 to 7,900 more daily transit trips to downtown Portland than the No Build Alternative, and 3,400 to 3,800 more than the TSM Alternative. These ridership differences are reflected in a reduced need for additional parking spaces in downtown Portland. The TSM Alternative would reduce year 2005 downtown parking demand by 1,500 spaces compared to the No Build Alternative. The LRT options to S.W. 185th Avenue would eliminate the need for 2,300 to 2,400 more parking spaces than the No Build, and 800 to 900 more parking spaces than the TSM Alternative. As a result of these advantages, the LRT options are more supportive of downtown development than the TSM Alternative.

The TSM and LRT Alternatives are consistent with the transit and highway access levels needed to support Beaverton's development concept. The LRT options (except for the Sunset Transit Center terminus option) are integrated into the retail/commercial esplanade extending from the Civic Center to the Beaverton Transit Center, as proposed in the Downtown Beaverton Development Plan.

The TSM and LRT Alternatives would improve the highway and transit connection between the Sunset Corridor and its potential eastside labor pool and, therefore, are supportive of Sunset Corridor development objectives.

Studies of the long-term land use effects of transportation improvements have concluded that such projects often continue the trend towards decentralization of households and some businesses by extending the reasonable commuting distance to the CBD. Without effective land use controls, these improvements could encourage urban sprawl. In the Westside Corridor, the Urban Growth Boundary, and city and county comprehensive plans support urban containment and increased densities in the urban area. If these local land use policies prove to be effective over time, the highway and transit improvements covered in this SDEIS are unlikely to contribute to the dispersion of households and jobs that might otherwise occur.

S.5.2.5 Provide An Environmentally Sensitive Transportation System

The ability of the alternatives to provide an environmentally sensitive transportation system is evaluated as shown in Table S.5-2. Both the TSM and LRT Alternatives are generally supportive of the region's long-term environmental goals. The most notable differences are observed in terms of displacement and visual/aesthetic impacts. The LRT options to S.W. 185th Avenue would displace 75 to 89 residential units and 10 to 39 businesses. In comparison, the TSM Alternative would displace 14 residential units and two businesses. The LRT options would remove from 16 to 33 acres of trees in the Canyon segment, the TSM about 14 acres. The LRT options also would require up to twice the amount of retaining wall exposure compared to the TSM Alternative.

S.5:3 Cost-Effectiveness

This section presents a cost-effectiveness evaluation of project alternatives. It employs the UMTA index and a series of locally defined operating cost-effectiveness measures.

S.5.3.1 UMTA Cost Per Added Rider Index

Cost-effectiveness analysis provides a means of comparing the benefits of each alternative with its costs. The cost-effectiveness analysis has become an important part of the UMTA procedures for review of major transit projects. UMTA has established the cost-effectiveness index as one measure for evaluating the relative merits of fixed guideway alternatives within a corridor. Specifically, the UMTA index is computed as follows:

$$\text{UMTA New Rider Index} = \frac{\Delta\$CAP + \Delta\$OandM - \Delta\$TT}{\Delta\ Riders}$$

Where the Δ s represent changes in cost and benefits compared to the TSM Alternative, and

Δ $CAP = change in equivalent annual capital cost;
Δ $OandM = change in annual operating and maintenance costs;
Δ $TT = change in value of travel time savings for existing riders; and
Δ Riders = change in annual transit ridership, measured in "linked" trips.

"Existing" riders are defined in this equation as the minimum number of transit patrons carried with either alternative. Values necessary to convert travel time into its monetary equivalent have been determined by UMTA to equal $4.00 per hour for work trips and $2.00 for non-work trips.

The output of the formula is an alternative's cost per new rider as compared to the TSM Alternative. The TSM Alternative is used as the baseline since it is designed to represent the most effective solution to transportation problems in the corridor, short of constructing major new facilities. Thus, the TSM Alternative provides a baseline, against which it is possible to isolate the added costs and added benefits resulting from a proposed major investment.

UMTA developed this index because the achievement of many goals and objectives of public transportation investments, such as the reduction of energy consumption and air pollutant emissions, and the promotion of economic development, are closely related to a project's ability to improve the level of transit service for existing transit riders, and to attract new riders. Thus, projects that provide substantial travel time savings and ridership increases are likely to not only satisfy the basic mobility objective, but may also meet transit's other objectives as well.

For the LRT Alternative, those options terminating at S.W. 185th Avenue cost the least per new transit rider and, therefore, are more cost-effective than the shorter terminus options (see Table S.5-3). The LRT options to S.W. 185th Avenue cost between $14.91 and $15.51 per new rider. In comparison, the S.W. Murray Boulevard terminus option is estimated to cost $23.76 per new rider. Because it attracts less ridership than the TSM Alternative, the UMTA cost-effectiveness index can not be calculated for the Sunset Transit Center terminus option. More detailed cost-effectiveness analysis provided in Section 7.2.3 shows the results for the major alignment options. In the Canyon segment, the Northside option costs slightly less per new rider ($15.00) than the Southside option ($15.23). The Long Tunnel with a Zoo station option ($17.81) is less cost-effective than the Northside or Southside options but more cost-effective than the Long Tunnel without a Zoo station option ($18.25). In Beaverton, the North option is slightly more cost-effective than the South option, and the BN option is slightly more cost-effective than the Henry Street option.

Table S.5-3

SUMMARY OF COST-EFFECTIVENESS MEASURES

Total Corridor	No Build	TSM	Surface to 185th	Tunnel w Zoo to 185th	Surface to Murray	Surface to Sunset TC
UMTA Total Cost per Added Rider Index	N/A	N/A	$15.00 to $15.23	$17.81	$23.76	N/A
UMTA Total Cost per Added Rider Index - Modified	N/A	N/A	$13.02 to $13.23	$15.57	$19.20	$69.39
O&M Cost per Rider ($1990)	$2.65	$2.80	$2.02	$2.01	$2.22	$2.36
O&M Cost per 1000 Place Miles ($1990)	$49.72	$44.40	$35.40	$35.46	$36.83	$41.16
Percent Farebox Recovery	21%	20%	31%	31%	28%	26%

Source: Tri-Met, 1990.

S.5.3.2 Operating Cost Efficiency Indices

The ability of the alternatives to provide a fiscally efficient operation is evaluated in this section. The LRT options to S.W. 185th Avenue operate more cost-effectively, as measured in Table S.5-3 on a per rider, per unit of capacity and cost-recovery basis, than the TSM Alternative. These measures do not take capital costs into account.

The TSM Alternative costs $0.25 (10%) more per rider to operate and maintain than the No Build Alternaitve. In comparison, the corridor O&M cost per rider for the LRT options is $0.29 to $0.64 less than the No Build, and $0.54 to $0.89 less than the TSM Alternative. The LRT options to S.W. 185th Avenue cost $0.18 to $0.35 less per rider to operate and maintain than the shorter terminus options.

The operating cost per 1,000 place miles for the TSM Alternative is $5.28 less than the No Build Alternative. In comparison, the operation and maintenance of 1,000 place miles for the LRT options to S.W. 185th Avenue costs about $14.00 less than the No Build, and about $9.00 less than the TSM Alternative.

Farebox recovery ratios for the LRT options to S.W. 185th Avenue are approximately 30% including all bus and rail operations in the corridor. In comparison, the farebox recovery ratios for the No Build and TSM Alternatives are approximately 20%.

S.5.4 Equity Considerations

The Westside Corridor has only a small percentage of the region's low income residents. Overall, the project options do not disrupt any identifiable low income neighborhoods or any concentration of low income residences or jobs. While the Westside Corridor Project alternatives are not physically located in a low-income area, they do provide an improved transportation connection between the low-income areas on the eastside of Portland and the growing Westside employment market.

S.5.5 Significant Trade-Offs Between Alternatives

This section draws upon the preceding sections to define the major trade-offs between modal and alignment options.

S.5.5.1 Build Versus No Build

The No Build Alternative includes certain system wide transit and street improvements, but no major construction or expansion of transportation capacity. The TSM and LRT Alternatives are defined as "build" alternatives because they implement major increases in transportation capacity. With the build alternatives, daily transit ridership in the corridor is projected to increase by approximately 5,400 to 10,000 more riders in 2005 over the No Build Alternative; year 2005 daily transit ridership to/from the CBD is projected to increase by 5,100 to 7,500 riders; highway and intersection levels-of-service would improve in most locations; and parking demand would be reduced in downtown Portland by 1,500 to 2,400 spaces. These benefits are achieved at a substantial cost, both financial and otherwise. Specifically, the build alternatives (including highway and transit components) would cost roughly $160 million to $590 million ($1990) more to construct than the No Build Alternative, would displace 16 to 127 families and businesses, and would require tree removal and increased retaining wall exposure in the Canyon segment.

In summary, the high capital and increased operating costs and environmental impacts associated with the build alternatives, and the resulting improvement in transportation access and mobility, must be considered in comparison to the lower capital cost, negligible construction impact, but increasingly congested transportation system associated with the No Build Alternative.

S.5.5.2 LRT Versus TSM Alternative

The information previously presented shows that all LRT options would have a higher capital cost and greater environmental impact than the TSM Alternative. These costs and impacts must be viewed in light of the resulting improvement in transit service, higher transit ridership, lower operating costs, improved operating efficiency, reduced parking demand in downtown Portland, and greater support for development in the downtown and in the immediate vicinity of transit stations. Specifically the LRT options would cost from approximately $180 million to $420 million ($1990) more than the TSM Alternative, but result in annual operating cost savings of $3 to $4 million ($1990) compared to the TSM Alternative. The LRT options to S.W. 185th Avenue would attract about 4,600 more daily transit riders in 2005 than the TSM Alternative and have a cost-effectiveness index of $14.91 to $15.51 per additional rider, compared to the TSM Alternative.

Construction of a light rail line creates a new transportation facility in the region with capacity to meet demand beyond a 2005 time frame. The TSM Alternative provides the capacity for 2005, but on an increasingly congested highway system with little opportunity for expansion beyond this time-frame.

S.5.5.3 LRT Alignment Options in Canyon Segment

There are three major trade-offs to be considered among the alignment options in this segment. First, the higher capital costs of the Long Tunnel options must be weighed against the greater tree removal and retaining wall impacts of the Surface (Southside or Northside) options. Depending on whether or not a Zoo Station is included, the Long Tunnel options are estimated to cost approximately $25 million to $50 million more than the Surface options. However, the Long Tunnel options result in about half the tree removal and retaining wall exposure of the Southside option and about two-thirds of those of the Northside option. The Surface options are projected to cost $2.30 to $3.34 less per new rider (compared to the TSM Alternative) than the Long Tunnel options.

Second, for the Long Tunnel options, the capital cost of the Zoo station must be weighed against the importance of the station as a regional attraction and ridership generator. The underground Zoo station for the Long Tunnel option is estimated to cost approximately $20 million and carry at least 250,000 more riders a year than would be served by buses with the Long Tunnel without Zoo station option. Accordingly, the cost per new rider is lower ($0.44) with the Zoo station. LRT options which include a Zoo station also would reduce the need to provide additional parking capacity at the Zoo.

Third, the additional LRT ridership, broader development potential, and consistency with planning goals associated with a Sylvan station must be weighed against the absence of a station with the Long Tunnel options.

S.5.5.4 LRT Alignment Options in Beaverton

In East Central Beaverton, the South option was the previously adopted alignment and is consistent with the existing Comprehensive Plan. This must be weighed against the lower costs (about $2 to $4 million in Year of Expenditure dollars), lower business disruption, reduced flood plain concerns, and fewer traffic impacts of the North option. In West Central Beaverton, the lower cost (about $13 to $15 million in Year of Expenditure dollars), smaller displacement impact, lower traffic impact, and lower risk of delay and cost overruns of the BN option must be weighed against the somewhat greater redevelopment potential around the S.W. 141st Avenue station with the Henry Street option.

S.5.5.5 LRT Terminus Options

Three LRT terminus options were examined: S.W. 185th Avenue, S.W. Murray Boulevard and the Sunset Transit Center. The higher capital costs associated with the S.W. 185th Avenue terminus option must be weighed against the improved operating efficiency, higher ridership, increased travel time savings, and generally improved transit service levels. The S.W. 185th Avenue terminus option would cost approximately $50 million ($1990) more than the S.W. Murray Boulevard terminus option and approximately $200 million ($1990) more than the Sunset Transit Center terminus option. However, the longer terminus option would capture 2,900 to 6,200 more daily transit trips and reduce the O&M cost per rider by 10% and 20%, respectively, compared to the short terminus options Additionally, the S.W. 185th Avenue terminus option would capture 80% of all new trips to the CBD versus only 62% and 42% for the shorter terminus options. The lower capital costs of the shorter terminus options must be weighted against maintenance site difficulties, lower levels of cost-effectiveness and reduced effectiveness in meeting the objectives of the project.

S.6 ISSUES TO BE RESOLVED

The analysis and preparation of this SDEIS represent only one phase, albeit an important one, in the course of the Westside Corridor Project. There are numerous issues still to be resolved, and this section addresses some of the more important and immediate landmarks ahead.

S.6.1 Selection Of The Locally Preferred Alternative

The SDEIS, related technical documents, and comments received during the public review period and at the public hearing provide a basis for local jurisdictions to recommend and adopt a Locally Preferred Alternative (LPA). There are many points of view and differing value systems that must be brought to bear on this important decision. The choice at hand is not an easy one, and the alternatives and options presented in this SDEIS offer a wide range of possibilities.

The recommendation for the LPA will be made by the Metro Council, Portland City Council, Beaverton City Council, Hillsboro City Council, Multnomah County Commission, Washington County Commission, and the Oregon Transportation Commission after each of these bodies holds its own deliberations. Final adoption of the LPA will be made by the Tri-Met Board of Directors.

An LPA report will be prepared which documents the selection, and this report will be forwarded to UMTA to complete this step in the process.

S.6.2 Implementation Of The Financing Plan

The financial analyses in this SDEIS and supporting technical reports show that both the TSM and LRT Alternatives will require, in varying degrees, significant revenue that is currently not available. The financial analysis also identifies required new levels and proposed sources of revenue.

To construct the transit portion of the TSM Alternative, both State and federal transit funds must be secured. State funds would be proposed to come from a new revenue source enacted by the state Legislature, while federal funds would be provided through a normal UMTA grant process.

To construct the transit portion of the LRT Alternative, it is proposed that new local, State and federal funds be secured. The new local funds have been identified as coming from Metro, the City of Portland, and Washington County. A Regional Compact has been agreed to by all participating jurisdictions which, among other things, allocates fiscal contributions and confirms intent to participate at the local level. To implement the overall financial plan, these three jurisdictions must pass resolutions through their normal budgeting process to commit the required funds.

The proposed financing plan also includes approximately a one-eighth share of the total transit Project Capital cost by the State of Oregon. The legislature has previously created a Light Rail Construction Fund account and must now specify and commit, by legislative action, to the funding of the state share.

Finally, implementation of the financial plan includes completing all federal NEPA and UMTA requirements and execution of a Full Funding Agreement with UMTA. The proposed financial plan assumes that the federal share will be 75% of total Project Cost, the maximum percentage allowable under current federal legislation. Definition of all items that are considered eligible for federal funding must be resolved in the Full Funding Agreement.

To construct the highway improvements associated with the TSM and LRT Alternatives, ODOT will need additional revenues not currently committed to in its existing Six Year Program. These additional funds must be committed by the State during the periodic updating of the Six Year Program.

S.6.3 Completion of the Proposed Mitigation Plan

Design, determination of impact, and estimates of costs for any major project such as the Westside Corridor Project proceed from conceptual to preliminary to final as the project advances to construction. At this SDEIS stage of the process, numerous impacts have been identified, and many mitigation measures have already been incorporated into the preliminary design and cost estimates or committed to by Tri-Met. Examples of these include:

- preliminary landscaping and architectural design treatment of retaining walls in the Canyon segment for the transit portions of the Southside and Northside options;
- conformance with ODOT and applicable federal policy concerning relocation assistance;
- initial coordination with the SHPO and other affected parties to ensure compatible design of LRT facilities with historic structures;
- one-to-one wetland replacement;
- one-to-one replacement of (100-year) floodplain encroachment; and
- adherence to State requirements for phosphorous removal.

In addition, Tri-Met has committed to further study of ways to mitigate or finalize the mitigation of certain impacts. Examples of areas or considerations requiring further study and commitment include:

- final decisions regarding landscaping and architectural design treatment of retaining walls in the Canyon segment for both the transit and highway portions of the TSM or LRT Alternatives;
- traffic capacity problems at the intersection of S.W. 18th Avenue and S.W. Jefferson Street for all LRT options;
- grade separation of the westbound lane of S.W. Jefferson Street with the Northside and Long Tunnel options;
- traffic connections between S.W. 114th Avenue and S.W. 117th Avenue in East Beaverton for both the North and South options;
- final definition (e.g. location, height, extent, type) of noise and vibration mitigation measures for all LRT options;
- final wetland replacement plan;
- a Memorandum of Agreement negotiated with the SHPO and concurred in by the Advisory Council on Historic Preservation;
- demonstration of compliance with all federal requirements concerning parklands and historic properties; and
- development of a traffic management plan for the construction phase.

Depending on input during the public comment period and on selection of the LPA, Tri-Met will develop a more detailed mitigation plan for inclusion in the FEIS.

REQUIRED PERMITS AND APPROVALS

Dependent on the Preferred Alternative selection, the following permits and approvals may be required:

FEDERAL

U.S. Army Corps of Engineers Permit for Activities in Waterways
U.S. Army Corps of Engineers Section 404 Permit

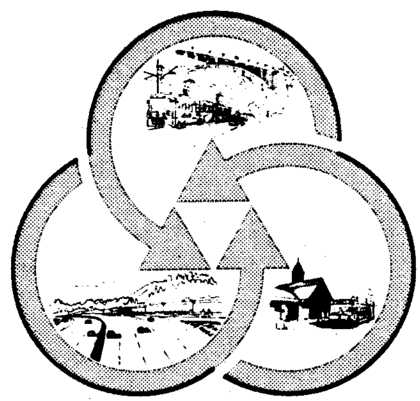
STATE

Department of Environmental Quality Indirect Source Construction Permit(s)
Division of State Lands Fill and Removal Permit

LOCAL

Access Permits
Right-of-Way Permits
Design Review Approvals
Local Comprehensive Plan Compliance
Utility Connection Permits
Plumbing Permits
Wetlands Fill/Removal Permits
Surface Water Management Permits
Erosion Control Plan Approval
Demolition Permit
Conditional Use Permits
Variance Approvals
Landmarks Commission Approvals
Land Partition Approval

All other permits or approvals that would be required would be obtained.



CHAPTER 1

PURPOSE AND NEED

1.0 PURPOSE AND NEED

This chapter describes the Westside Corridor study area and existing transportation facilities. A discussion of regional and local transportation goals is included. Specific transportation problems, including both surface streets and transit system, are discussed. Finally, other factors pertinent in selection of an alternative, such as land use, and development and environmental criteria, are identified.

1.1 DESCRIPTION OF THE STUDY AREA

The Westside Corridor is part of the expanding Portland, Oregon metropolitan area. It originates in downtown Portland and generally encompasses developed and developing urban areas west of the Willamette River and north of Clackamas County (see Figure 1.1-1). Portions of both Multnomah and Washington Counties are included, as well as the Cities of Portland (southwest and downtown), Beaverton, and Hillsboro. Unincorporated areas such as Sylvan, Raleigh Hills, Garden Home, Cedar Hills, and Aloha are included. The study area is entirely within the regional Urban Growth Boundary (UGB) established for the Portland metropolitan area. This area contains major residential, commercial, and industrial developments, as well as large tracts of land destined for future urban development.

While the study area is relatively flat, the West Hills create a formidable barrier that separates the Westside from downtown Portland and easterly parts of the metropolitan area. The West Hills constrict traffic into a few routes such as Sunset Highway and Beaverton-Hillsdale Highway. As the Westside has grown, the capacity of its roadway system has remained relatively constant and congestion has increased.

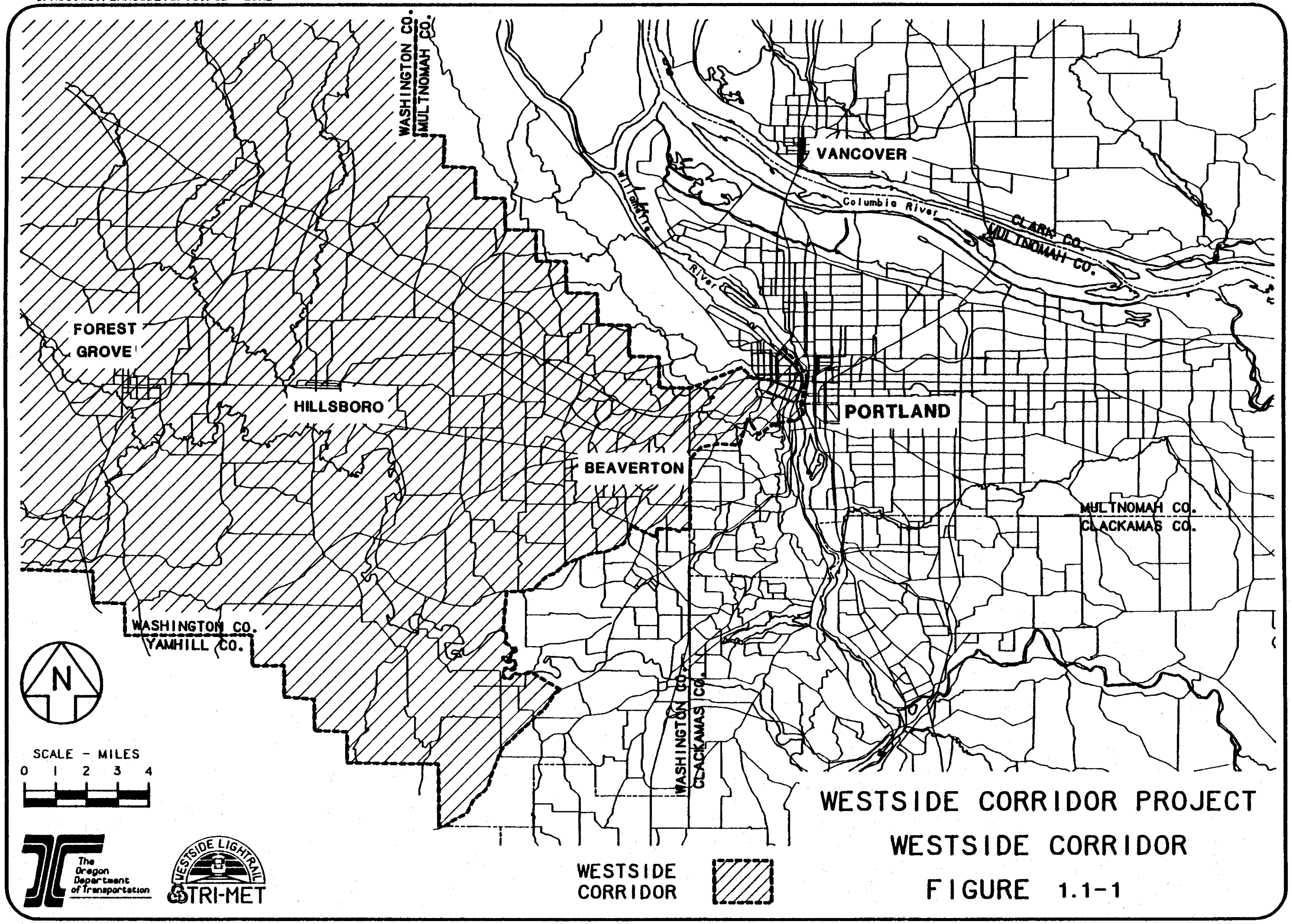
The highest concentrations of population and employment growth in the Portland metropolitan region over the past 17 years have occurred on the Westside. Between 1970 and 1980, the Westside captured 47% of the metropolitan area's population growth and 40% of its employment growth. Between 1980 and 1987, the percentages increased to 68% and 96% respectively, with Washington County accounting for more than two-thirds of the population growth in the State of Oregon. The Westside is expected to continue to capture between 40% and 50% of the area's growth over the next 20 years. Population is expected to increase from approximately 263,000 in 1985 to 411,000 by 2005, while employment is expected to increase from 121,000 in 1985 to approximately 227,000 in 2005. This growth will significantly increase traffic volume on Sunset Highway, Highway 217, and local arterials.

A vital component of both the Westside and regional economies is the Portland Central Business District (CBD), which has maintained a significant and relatively steady share of the regional office growth. Portland's downtown is a fully diversified economic environment. Its position as the economic center of the region is strengthened by geographic features (Willamette River on the east, the West Hills on the west), which have prevented the sprawl of commercial development from the core.

Over the past two decades, downtown Portland has seen a steady growth in employment. In 1970, approximately 59,000 people were employed downtown. In 1987, approximately 89,160 people were employed downtown, an increase of 7,000 from the 1980 employment level of 82,140. The number of people working downtown is expected to increase 0.9% annually to approximately 108,470 by 2005. Based on a summary of planned or proposed developments for downtown, it is anticipated that nearly six million square feet of new space will become available by the year 2000, which will create added pressure on the transportation system between the central city and the suburbs.

Beaverton is the largest city west of Portland, and has experienced substantial development in the past decade. The demand for commercial development is strong, and the city anticipates significant growth in office employment. Hillsboro, the Washington County seat, has the highest annual growth rate of all communities on the Westside, and is the Westside hub for high-technology development.

In 1988, there were approximately 176,000 daily trips traveling in a radial direction from the Westside Corridor to the City of Portland and Multnomah County. These 176,000 trips represented about 21% of all auto and transit trips that began in the corridor. About 68%, or 561,000, of the trips that began in



WESTSIDE CORRIDOR PROJECT

WESTSIDE CORRIDOR

FIGURE 1.1-1

Washington County had destinations within the county (see Figure 1.1-2). Looking specifically at work trips that began in the corridor in 1988, approximately 13% were destined to Portland's CBD, 52% had Washington County destinations and 35% were destined elsewhere, including locations in Portland outside the CBD (Metro, 1990).

By 2005, the proportion of Westside Corridor trips destined to the City of Portland is projected to drop from today's 21% to 16%. The share of trips that begin and end within Washington County is expected to rise from today's 68% to 75%. Despite the decline in the percentage of trips destined to Portland, projected traffic increases will result in an increase in the absolute number of trips to the city. Between 1988 and 2005, the number of trips will increase by 13% or 22,000 trips per day.

Similarly, the number of work trips from the Westside Corridor to downtown Portland is expected to increase by about 25% by 2005, putting further strain on an already congested road system. In addition, reverse travel flow, from Portland into Washington County, is expected to increase from 87,000 trips per day in 1988 to 100,000 trips in 2005.

As development continues to expand westward, the existing highway and transit systems will become inadequate, unless they are expanded to provide service to new areas of population and employment concentration.

1.2 REGIONAL TRANSPORTATION FACILITIES

The Westside Corridor is served by federal and state highways, local arterial roads, and bus service provided by Tri-Met.

The highway system on the Westside (see Figure 1.2-1) consists of the Sunset Highway (U.S. 26), a major east-west link between Portland and the communities to the west; Highway 217, a north-south link between Sunset Highway and the cities of Beaverton, Tigard, and Lake Oswego; and S.W. Canyon Road/Tualatin Valley (T.V.) Highway (Highway 8), which provides an east-west link serving the West Hills of Portland and communities to the west, including Beaverton, Hillsboro, and Forest Grove. Arterial roads in Washington County include S.W. Canyon Road and Highway 217, as mentioned above; S.W. Murray Boulevard, a north-south link between Sunset Highway and Beaverton; S.W. 185th Avenue, a north-south link between northern Washington County and Beaverton; and several roads that serve as east-west connectors, including Baseline Road, Walker Road, and Cornell Road.

The Tri-Met system is multidestinational by design, with downtown Portland as the primary destination. Timed-transfer centers in suburban areas and high-frequency grid service in the city help make transit travel between non-downtown locations more practical.

Transit service for the Westside is provided through 11 bus lines including eight radial/trunk lines (see Figure 1.2-2). Four of these provide all-day operation, four provide peak-hour-only operation, and three are local feeder lines. There are transit centers with timed-transfers at Beaverton, Cedar Hills, and Hillsboro. Several park-and-ride lots for transit riders are located in west Beaverton and Hillsboro. The service focal point is the Beaverton Transit Center, located near Highway 217 and S.W. Canyon Road, which provides timed-transfer bus connections. Service is concentrated east of S.W. Murray Boulevard and along S.W. 185th Avenue. Line 57, along T.V. Highway/S.W. Canyon Road, is the principal radial trunk connection between the Westside Corridor and downtown Portland. Most corridor bus lines operate each half-hour, with 20-minute peak-hour service. Line 57 operates every six minutes on average during peak hours.

1.3 STATE AND LOCAL PLANS

The Westside Corridor Project is designated in applicable state, regional, and local plans to help meet transportation and land use objectives established by the Oregon Legislature and local jurisdictions. A brief discussion of these plans follows.

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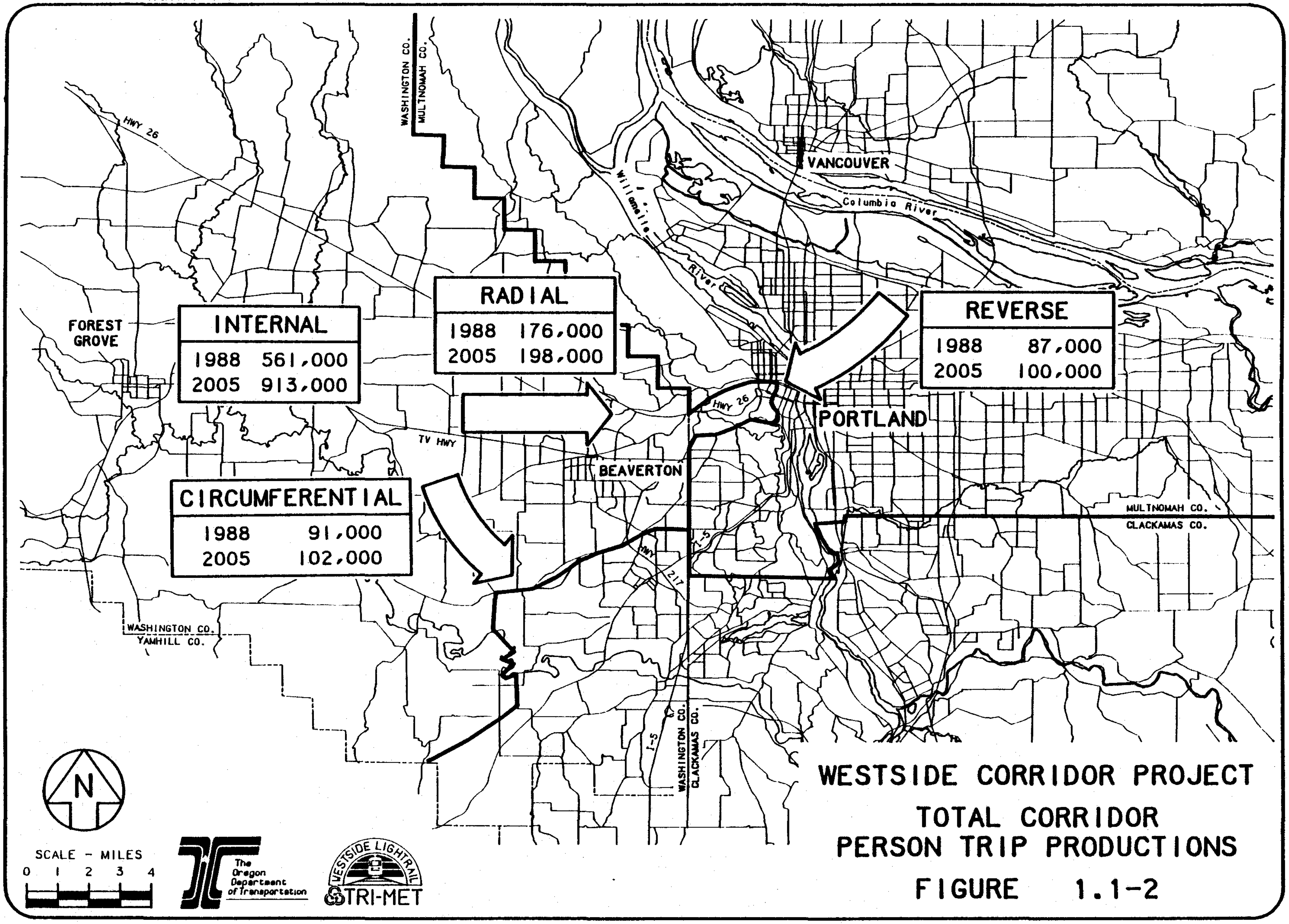
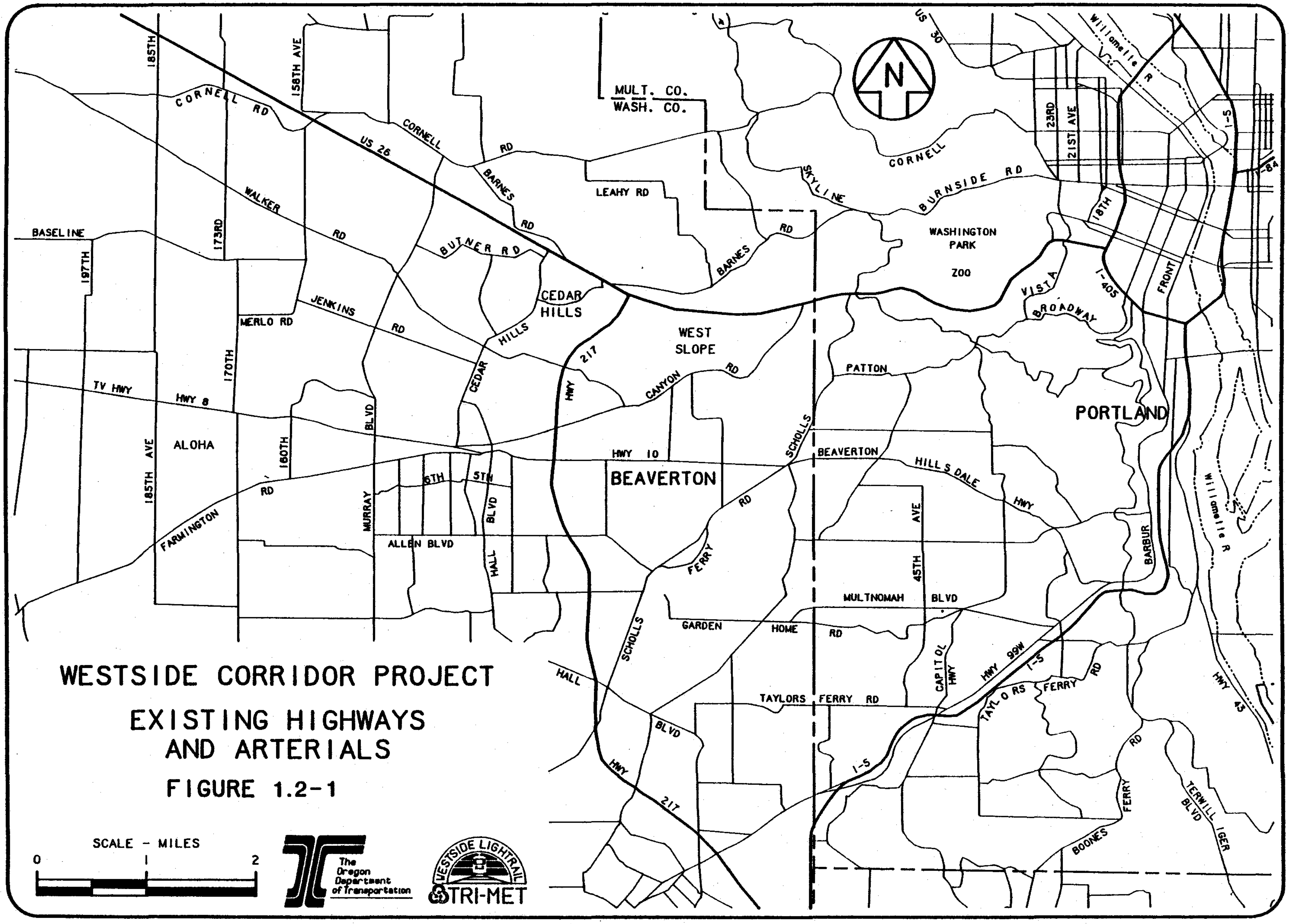


WESTSIDE CORRIDOR PROJECT

TOTAL CORRIDOR
PERSON TRIP PRODUCTIONS

FIGURE 1.1-2

[PROJ.WS.ALIGN]SDEISFIG.FGB EXSTHWY

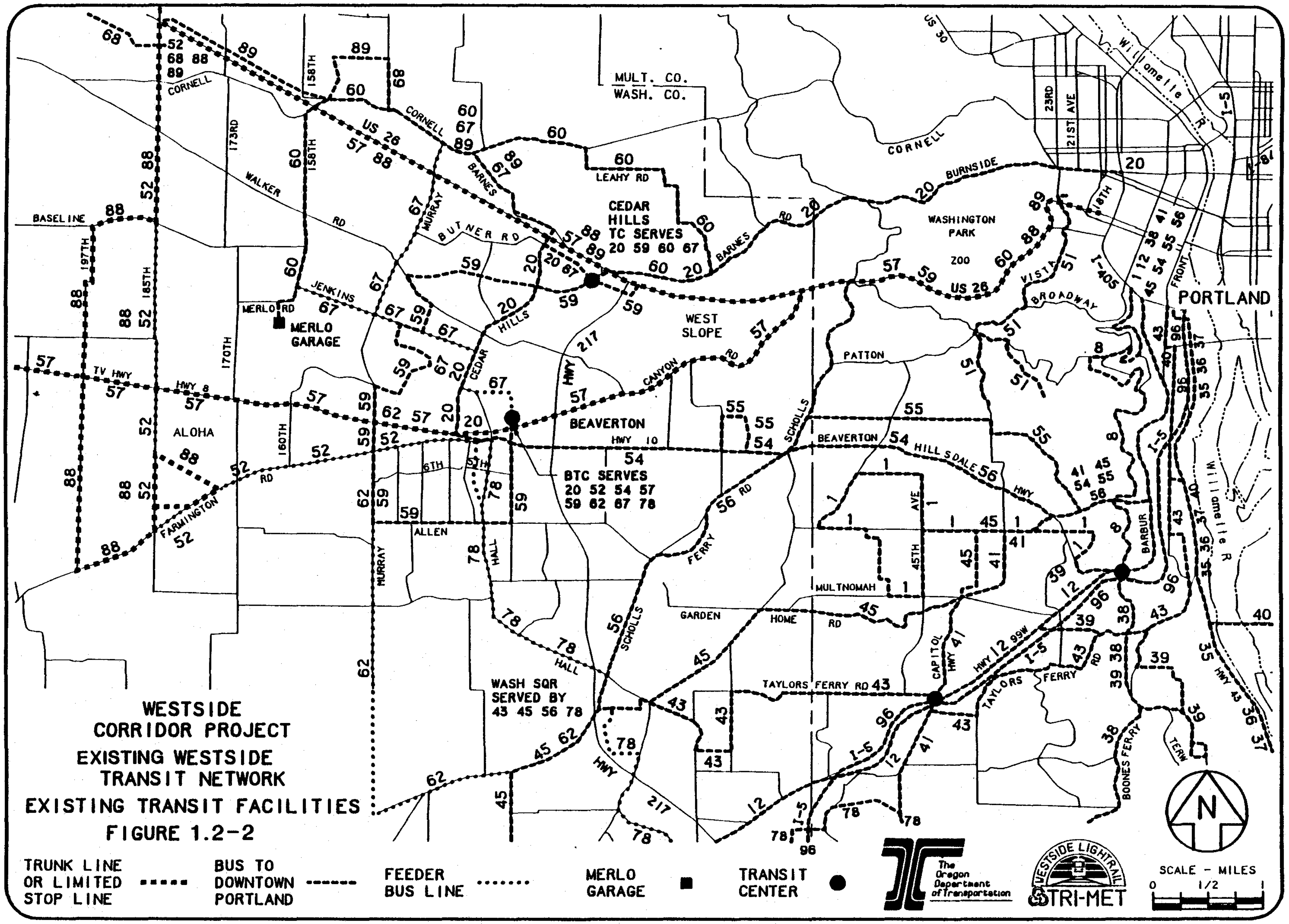


WESTSIDE CORRIDOR PROJECT

EXISTING HIGHWAYS AND ARTERIALS

FIGURE 1.2-1

[PROJ.WS.ALIGN]SDEISFIG.FGB EXFAC



WESTSIDE CORRIDOR PROJECT

EXISTING WESTSIDE TRANSIT NETWORK

EXISTING TRANSIT FACILITIES

FIGURE 1.2-2

1.3.1 LCDC Goals

The State of Oregon Land Conservation and Development Commission (LCDC) has adopted statewide planning goals that must be implemented through a comprehensive plan adopted by each city and county in the state. State law requires the Metropolitan Service District (Metro), as the regional transportation planning authority, to adopt a functional plan for transportation and to review the comprehensive plans of those jurisdictions within the Metropolitan Service District for conformance. The driving force behind the adoption of the statewide planning goals was to accommodate growth in defined urban areas through the establishment of Urban Growth Boundaries while protecting valuable natural resources. Other objectives include reducing sprawl and efficiently providing public services and utilities. As a result, land use and infrastructure planning are highly interrelated in local planning. This discussion of goals and objectives at the regional, county, and city levels is addressed further in Chapter 5.

1.3.2 Regional Transportation Plan

The Regional Transportation Plan (RTP) was adopted by Metro in 1982 and updated in 1983 and 1989. The RTP addresses transportation needs in the Portland area, and identifies rapid growth as the cause of many of the area's problems. The RTP states that without major transportation improvements, the travel demands associated with growth will overload a system that is already at or over capacity in some areas. As a result of travel demand, intensified development, and increased intra-area trips, developing areas need an entirely new highway and transit system. Already-urbanized areas require improvements that maximize the efficiency of the sizable transportation investments that already have been made.

The RTP identifies population growth and increased automobile travel as potential problems for air-quality. Uncertainties in the price and supply of fuel have contributed to the need for alternative modes of travel. The RTP identifies the primary constraint to meeting the region's transportation needs over the next two decades as the cost of both construction and maintenance of needed infrastructure.

The RTP identifies regional transitways, such as light rail and exclusive busways, as an attractive way to provide trunk service on heavily traveled routes. Transitways use an exclusive right-of-way and larger vehicles than city buses. Consequently, they provide greater capacity and faster service at a lower operating cost than normal bus operations in mixed traffic. The RTP identifies the Westside LRT as the preferred alternative in the Westside Corridor and the region's top-priority transportation improvement.

Transitways are identified as the long-range method to provide regional trunk-route service in radial travel corridors. Local jurisdictions are required to identify these transitways (fixed routes) in their comprehensive plans. Due to the high construction cost, the full RTP transit system will be implemented in increments, as growth in transit ridership warrants and as funding is available.

The RTP calls for significant highway improvements and a major transit system capacity increase in the Westside Corridor by the year 2005. Highway system improvements that are specified in the RTP on Sunset Highway include extending the climbing lane to the Sylvan Interchange, widening Sunset Highway to six lanes from the Sylvan Interchange to the S.W. Cornell Road Interchange, and adding ramp metering from the S.W. Jefferson Street on-ramp to the Cornelius Pass Interchange. Designated improvements on Highway 217 include constructing an auxiliary lane and widening the highway to six lanes from the Sunset Highway Interchange to the S.W. Hall Boulevard overpass. Ramp metering also is specified from the Sunset Interchange to Scholls Ferry Road.

Transit system improvements must accommodate the forecast growth in travel between downtown Portland and the Westside Corridor because planned highway improvements, to increase safety and efficiency on Sunset Highway, will not significantly increase highway capacity into downtown Portland. According to the RTP, the travel demand that has been forecast for the corridor, particularly along Sunset Highway and Highway 217, cannot be met simply by lane additions and operational improvements. Significant transit expansion is necessary to carry an increasing share of Westside Corridor trips. With minimal transit expansion, the highway system, even with the proposed highway improvements, would not function at an acceptable level-of-service.

1.3.3 Local Jurisdictions Comprehensive Plans

The City of Portland Comprehensive Plan, adopted in 1980, contains several goals linking land use and transportation. The Arterial Streets Classification Plan (ASCP), which designates specific transportation policies for areas within the City, is incorporated into the Comprehensive Plan. The ASCP emphasizes the importance of providing expanded public transportation service to the northwest and southwest portions of the city, and reducing through traffic on local streets in these areas. The transportation element of the Public Facilities Plan (1988), which is designed to support the goals of the Comprehensive Plan, specifies expanding the downtown LRT system to serve the Westside.

Portland has established policies to encourage increased use of public transportation and to preserve air quality in the metropolitan area. The Downtown Parking and Circulation Policy, adopted in 1975, supports economic development, air quality, traffic flow management, and transit use. The parking component limits the total number of parking spaces, establishes maximum parking space ratios based on land use, discourages surface lots, encourages short-term parking, provides for new parking only in new developments or major rehabilitations with conditional use approvals, and allows new buildings with no parking. The policies have reduced the growth of auto travel to the downtown and increased transit ridership since the 1970s. The parking policy is a major factor in achieving the objective in Portland's Downtown Plan that calls for 75% of trips to the Central Business District to be on transit.

The 1988 Central City Plan was developed to promote the goals of the Comprehensive Plan in the central part of the city. The plan supports a system of expanded bus service and extended LRT lines from downtown. Limits on the construction of new parking facilities encourage transit ridership through the metropolitan area.

One goal of the Beaverton Comprehensive Plan, adopted in 1988, is to maximize the efficiency of traffic circulation by providing transit services throughout Beaverton and the surrounding vicinity. The Plan identifies a framework for implementing the LRT within the city, and adopts the Central Beaverton South and the Burlington Northern (BN) alignment options as LRT routes through the city.

The Transportation Plan for Washington County, which is part of the County Comprehensive Plan, promotes development of an enhanced mass transit system supported by land use planning. The County's Transportation Plan adopts the Sunset LRT alignment analyzed in the 1982 DEIS through unincorporated portions of the County.

A fundamental transportation goal of the Hillsboro Comprehensive Plan, adopted in 1977, is to increase transportation system capacity between Hillsboro and Beaverton. General policies promote the use of mass transit. This plan currently is being revised.

1.4 SPECIFIC TRANSPORTATION PROBLEMS IN THE CORRIDOR

This section discusses existing transportation problems with both the highway and transit systems in the Westside Corridor. The impacts of not improving the systems beyond projects which are currently committed to also are briefly discussed. Further analysis of transportation problems and impacts is found in Chapter 4.

1.4.1 Highway Problems and Constraints

As a result of the projected population and employment growth, traffic in the Portland area, measured in vehicle miles travelled (VMT), is forecast to increase approximately 35% by 2005 in the No Build Alternative. This will cause significant increases in congestion unless transportation improvements are made. For example, vehicle hours of travel on the freeway and arterial system during the afternoon (P.M.) peak hour are forecast to increase 27%, while vehicle hours of delay would increase 59%. Miles of congested (i.e., volume/capacity >0.9) freeways and arterials are forecast to increase by 57% and 68%, respectively. Within the Westside Corridor during the P.M. peak hour, Sunset Highway, Highway 217, and S.W. Canyon Road in Beaverton are forecast to be heavily congested.

The Westside is separated from downtown Portland by a major topographic feature known as the West Hills, which has limited construction of radial transportation routes other than Sunset Highway/S.W. Canyon Road and the Beaverton/Hillsdale Highway. The Westside LRT and highway improvements are key components of the area's transportation system plan to provide increased capacity in this corridor.

Level-of-service (LOS) is used to describe the quality of traffic operations on roadways. It is a measure of operational conditions and motorists' perceptions of these conditions. LOS ratings range from A to F; LOS A represents the best operation or free-flow traffic and LOS F the poorest operation, with forced or breakdown flow. The following paragraphs present current LOS conditions in the study area.

In general, Sunset Highway operates below the regional standard of LOS D during peak hours. During morning and evening peak hours, eastbound traffic demands exceed the capacity of the existing highway between the Highway 217 and Sylvan Interchanges, and traffic volumes are constrained. Between the Sylvan Interchange and Vista Tunnels, morning peak-hour traffic volumes exceed 2,000 passenger cars per lane per hour, the generally-accepted capacity of a single freeway lane. During this period, average travel speeds range between 30 and 40 miles per hour, creating traffic densities equivalent to LOS E.

Forecasts for 2005 indicate morning peak hour conditions on Sunset Highway between Sylvan and the Vista Tunnels would be similar to those that occur today, except that the duration of peak period congestion would lengthen. Increases in eastbound traffic volumes during the evening peak hour would result in a deterioration in traffic operations between Sylvan and the Vista Tunnels from LOS D to LOS E (see Table 1.1-1).

In the westbound direction, Sunset Highway currently operates at or near capacity during the evening peak hour between the Zoo and Highway 217 Interchanges (Table 1.1-1). The westbound capacity of Sunset Highway between the Zoo and Sylvan Interchanges is lower than the eastbound capacity, which shifts a portion of outbound, evening peak hour traffic to other, non-freeway routes in the Westside Corridor.

Forecasts indicate that evening peak-hour traffic at the Vista Tunnels will deteriorate to LOS F by the year 2005. Increasing the capacity of the tunnels would require adding more lanes to the freeway loop around downtown Portland. Regional policy has rejected this approach, calling instead for a major transit expansion in the Westside Corridor.

Rapid growth has caused significant congestion on Highway 217 during peak hours. This highway operates at LOS D - F, depending on the segment, during both morning and afternoon peak hours. Traffic conditions are projected to degrade on all sections of Highway 217 from the Sunset Highway Interchange to the Canyon Road Interchange without additional transit or highway improvements.

West Beaverton and Washington County are served by Sunset Highway and T.V. Highway, west of Highway 217. High peak hour through-traffic volumes on T.V. Highway cause high volume-to-capacity ratios at many intersections, specifically at S.W. Murray Boulevard, S.W. 160th Avenue, and S.W. 170th Avenue. Traffic demands on T.V. Highway will increase significantly by 2005, resulting in traffic operations below regional standards west of Hocken Avenue. The highest traffic demands would occur at the intersection of S.W. Murray Boulevard and T.V. Highway, where the intersection would operate well over its capacity, in the LOS F range. Traffic demands at the intersection of S.W. 170th Avenue and T.V. Highway would exceed the capacity of the intersection.

In general, the Sunset Highway west of Highway 217 operates at an acceptable level-of-service today. Exceptions include the interchange ramps at Murray Boulevard and Cornell Road, which often create congestion on the freeway itself. Improvements that will help to relieve this situation are planned at these interchanges, although the improvements at Murray Boulevard will not entirely alleviate all problems as traffic grows through 2005.

Table 1.1-1

LEVEL OF SERVICE ANALYSIS
SUNSET HIGHWAY
Evening Peak Hour

Segment	LOS 1987	2005*
Eastbound		
West of Highway 217	E	E
Highway 217 Interchange	F	F
Highway 217 to Canyon Road	F	F
Canyon Road to Sylvan	E	F
Sylvan to Zoo	D	E
Zoo to Columbia Exit	D	E
Vista Tunnel	D	E
Westbound		
Vista Tunnel	E	F
Jefferson Entrance to Zoo	E	E
Zoo to Sylvan	F	F
Sylvan to Canyon Road	F	F
Canyon Road to Highway 217	F	F
Highway 217 Interchange	F	F
West of Highway 217	F	F

*Represents forecasts for the No Build Alternative

Source: HNTB, 1990.

1.4.2 Transit Service Problems and Constraints

The No Build Alternative assumes a future transit service based on service level increases of approximately 1% per year through 2005. At the same time, Portland area population and employment are forecast to increase by 37% and 46%, respectively, by 2005. Within the Westside Corridor, population is forecast to increase 36% and the number of jobs 56% during this same period. As a result of the increased congestion on the highway and street system, Tri-Met's ability to provide fast, reliable transit service with buses operating in mixed traffic will decrease over time.

Because of traffic congestion on Sunset Highway and along S.W. Canyon Road through central Beaverton, Line 57, the Westside Corridor's transit trunkline, currently demonstrates substandard on-time arrival performance at the Beaverton Transit Center. On a daily basis, many Line 57 bus trips do not arrive on time. The Beaverton Transit Center exhibits the lowest overall on-time performance (71% on-time arrival rate) of all transit centers in the Tri-Met system. Other transit centers' on-time performance ranges from 72% to 83%.

Without major transit or highway improvements, transit schedule reliability at the Beaverton Transit Center will worsen by 2005. Increased traffic congestion and longer bus travel times are of particular concern for the future effectiveness of timed-transfers between trunk and feeder buses at this key transfer point. Once a rider connects with a bus bound for downtown Portland, travel time will be about 50%

longer than it is presently. Transit schedules will also become less reliable as more freeway breakdowns and accidents occur.

In addition, substantial development in the Westside Corridor is occurring, and will continue to occur, at locations not served or poorly served by transit (e.g., Northwest Hills, south Beaverton, and east Hillsboro). Without expansion of transit coverage, the accessibility of transit in the Westside Corridor will decline by 2005. The proportion of homes within a quarter mile of a transit line, an indicator of transit accessibility, would drop from the current level of 45% to 43%. Accessibility to jobs would drop from 55% to 46%. Without service improvements, transit accessibility in the Westside Corridor would compare poorly to the remainder of the region, which is projected to have accessibility to 57% of the population and 82% of the employment in 2005.

Taking all these factors together, increased traffic congestion, longer bus travel time, potentially less reliable transfers at the Beaverton Transit Center, and decreasing transit accessibility, the transit share of corridor trips to downtown Portland will not increase in 2005 from the current 26% of work trips and 16% of all weekday trips. This suggests that without improvement of transit service in the Westside Corridor, transit will not contribute to achievement of transportation goals identified previously.

1.5 GOALS AND OBJECTIVES FOR THE WESTSIDE CORRIDOR PROJECT

The SDEIS compares the social, economic, and environmental impacts of the combined highway and transit alternatives, including LRT alignments and terminus options that are being considered in the Westside Corridor. The decision regarding the locally preferred alternative will be made by determining which alternative best meets the overall goal of the project. The goal for the project, as stated by the Westside Corridor Project Management Group, a committee composed of transportation officials representing each jurisdiction in the study, is as follows:

> "To build a transit and highway project designed to optimize the transportation system, be environmentally sensitive reflecting community values, while remaining fiscally responsive."

Based on this goal, the following objectives and measures of effectiveness will be used to evaluate the alternatives:

- Maintain a balanced road system. This will be measured by examining indicators of highway congestion, including miles of congested highways and arterials, vehicle hours of delay, volume to capacity ratios, and level-of-service on Sunset Highway.

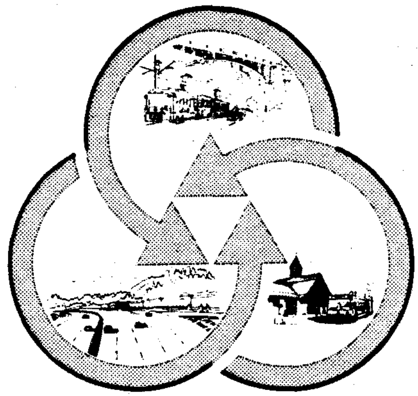
- Provide transit service that is a reasonable alternative to the automobile. This will be measured by examining corridor transit ridership, service coverage, reliability, and travel times.

- Meet demands of growth with transit. This will be measured by analyzing transit capacity, transit ridership, transit mode share to the CBD, and percent of new trips on transit.

- Provide transportation needed to support planned development within the Urban Growth Boundary. This will be measured by examining impacts on the UGB, and potential development impacts in downtown Portland, central Beaverton, and the Sunset Corridor.

- Provide an environmentally sensitive transportation system. This will be measured by examining impacts on noise, displacements, aesthetics, wetlands, parks, and historic and cultural resources.

The alternatives also will be evaluated in terms of their financial feasibility, cost-effectiveness, and equity in distributing costs and benefits (see Chapter 7).



CHAPTER 2

ALTERNATIVES CONSIDERED

2.0 ALTERNATIVES CONSIDERED

Chapter 2 presents the transit/highway improvement alternatives under consideration for the Westside Corridor. The alternatives encompass a range of proposed improvements from no improvements other than those currently committed, to a major investment in a LRT transit system along with major highway improvements.

Section 2.1 provides background on the Westside Corridor Project and the screening process that produced the alternatives being considered in this SDEIS.

Section 2.2 defines the alternatives under consideration:

- No Build,
- Transportation Systems Management (TSM) with highway improvements,
- LRT Alternative with alignment options, terminus options and highway improvements.

Proposed transit facilities, vehicle fleets, service networks, and levels of service are presented for each alternative, along with projected improvements to highways, interchanges, and the local street system.

Section 2.3 presents capital costs and Section 2.4, operating and maintenance costs for the alternatives in the year 2005.

A more detailed description of the alternatives can be found in the Westside Corridor Project Description of Alternatives Report (Tri-Met, 1990). Plan and profile drawings of the LRT Alternative alignment options can be found under separate cover.

2.1 SCREENING AND SELECTION PROCESS

Regional transportation planning, which began locally in 1959, has shifted dramatically from an emphasis on accommodating automobiles to a broader approach aimed at maximizing the efficient use of land and the transportation system. A major shift occurred in 1976, when the U.S. Department of Transportation formally withdrew plans for the Mount Hood Freeway, freeing up money for alternate urban transportation projects. Later that year, the State of Oregon prioritized transit projects in the Portland metropolitan area. The Westside (then called Sunset) Corridor was given third priority, behind Banfield (Eastern) and Oregon City (Southern). The State allocated $26 million to the Westside Corridor Project.

Priorities were re-evaluated in 1978. The Regional Transportation System Planning Program recommended that the Westside Corridor be the second priority corridor for a major transit investment. The following year, Metro adopted the Regional Transportation Corridor Improvement Strategy, which gave priority to the Westside Corridor. This determination shifted approximately $30 million from the southern corridor project to the Westside Corridor Project.

A full spectrum of mode and route alternatives was developed and examined in 1979. Natural constraints presented by the West Hills limited consideration to three practical routes between downtown Portland and Beaverton:

- Sunset Highway/S.W. Canyon Road
- Beaverton/Hillsdale Highway
- Multnomah Boulevard

A range of practical service options for each of the route alternatives was evaluated for performance, costs, and potential impacts. Of the 16 options examined, the following were retained for further consideration:

- Sunset Bus Lane
- Sunset Busway
- Sunset LRT to Tigard and Hillsboro
- Sunset LRT to Tigard
- Sunset LRT to Hillsboro
- Sunset LRT to Beaverton

Scoping for the Westside Corridor Alternatives Analysis resulted in five options, which were evaluated in the March 1982 Westside Corridor Project Draft Environmental Impact Statement (DEIS) Alternatives Analysis:

- Alternative 1: No Build. This alternative described the consequences in 1995 of not making any additional transit improvements beyond those committed in 1980.

- Alternative 2: Bus Service Expansion. This alternative proposed an increase in capacity, coverage, and frequency of bus service to the Westside. It envisioned timed-transfer stations, park-and-ride lots, and highway traffic management improvements; no major new construction was proposed.

- Alternative 3: Sunset Busway. This alternative proposed a more capital-intensive approach to improving Westside transit service, including a separated, bus-only roadway between Downtown Portland and Beaverton in addition to the improvements proposed in Alternative 2.

- Alternative 4: Sunset Light Rail Transit. This alternative followed the same alignment as Alternative 3, except the separated facility would be a two-track light rail system rather than a roadway between Downtown Portland and Beaverton. LRT extended west of Beaverton to approximately S.W. 185th Avenue.

- Alternative 5: Multnomah Light Rail Transit. This alternative differed from Alternative 4 in its alignment between Downtown Portland and Beaverton (following S.W. Multnomah Boulevard).

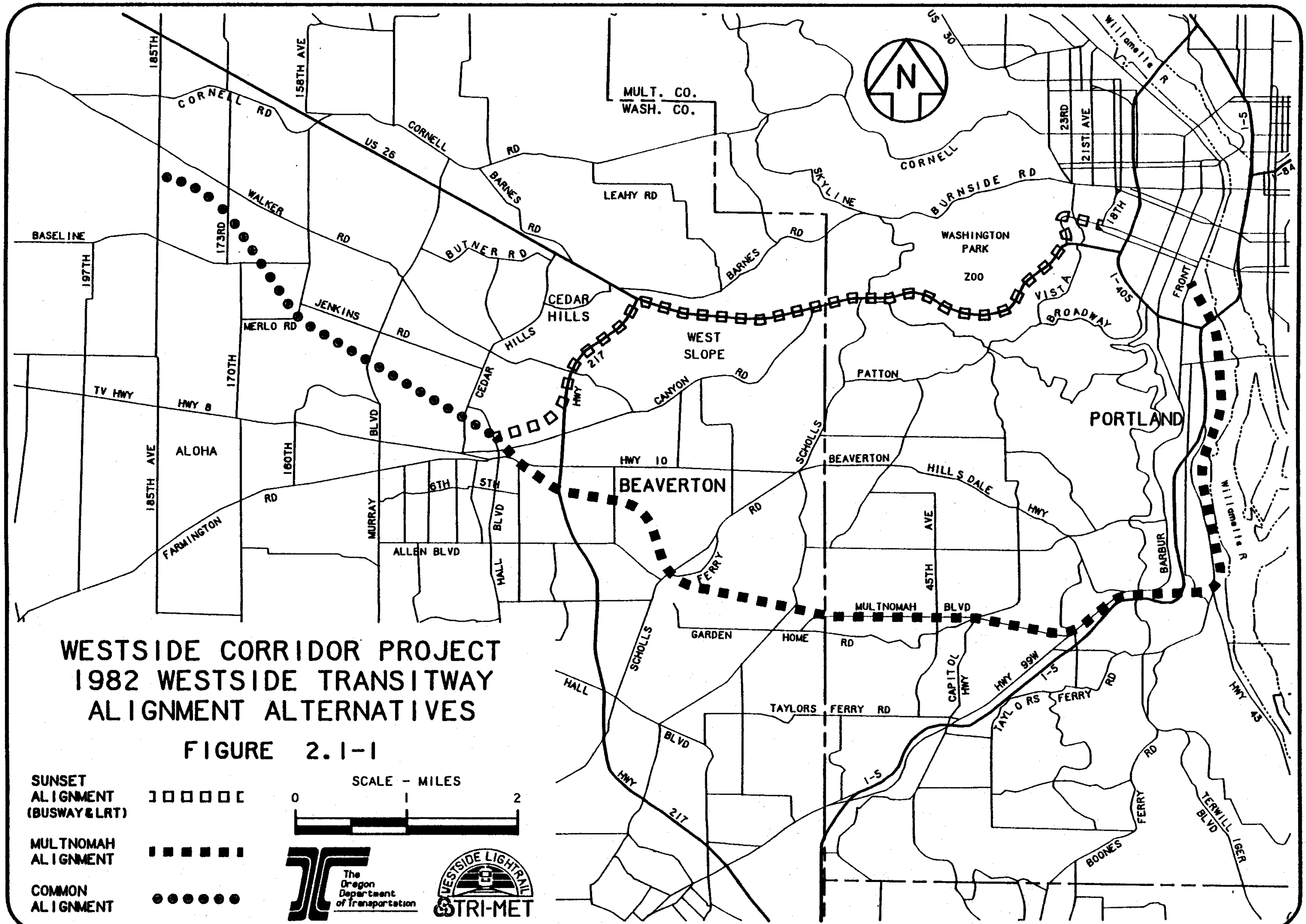
Figure 2.1-1 shows the transitway alignment options considered in the 1982 DEIS.

In 1983, Portland area jurisdictions adopted LRT as the mode for the major transit service improvement needed to accommodate year 2005 travel demand in the Westside Corridor. Also, a surface alignment was adopted through the canyon and continuing through Beaverton along the BN Railroad to S.W. 158th Avenue, and then in a northerly arc to a terminus just south of S.W. 185th Avenue and S.W. Walker Road. At that time, the Portland City Council requested study of alternative alignments through the canyon. However, the economic recession of the 1980's delayed further study of the alternatives for about four years. Reintroduction of the Westside Corridor Project in 1988 resulted in public decisions to evaluate alternative LRT alignments through the corridor.

Alignment options in Washington County were studied in 1988 and 1989. These included LRT routes continuing west from the Sunset Transit Center along Sunset Highway, and west from the Beaverton Transit Center along the T.V. Highway or along the BN Railroad. In August of 1989, after reviewing the alignment for Westside LRT west of S.W. 158th Avenue, Westside Corridor jurisdictions reached a consensus to shift the west end of the alignment to follow the BN Railroad to a S.W. 185th Avenue terminus. Further public review identified LRT alignment options through central Beaverton.

Also during 1988 and 1989, Tri-Met undertook feasibility studies of tunneling through the West Hills. These studies included an investigation of various tunnel alignments and five east portal locations (Tunnel Feasibility Study, Cornforth Consultants, 1988 and Initial Findings of the Technical Advisory Committee - Light Rail Line Sections 4c and 5, Tri-Met, 1989). As a result of these studies and much public discussion, Westside Corridor jurisdictions in August of 1989 recommended one short tunnel and two long tunnel alignments, all with a common east portal location, for further study. The east portal location was selected because the resulting Long Tunnel alignment had the shortest length of tunnel (of

[PROJ.WS.ALIGN]SDEISFIG.FGB TWCORR



WESTSIDE CORRIDOR PROJECT
1982 WESTSIDE TRANSITWAY
ALIGNMENT ALTERNATIVES

FIGURE 2.1-1

those options with a Zoo station), the lowest overall costs, the least disruption to nearby residences, and the best geologic conditions for portal construction.

Because these various options represented significant changes in impact and cost as well as design, the corridor jurisdictions and UMTA concurred in the need to supplement the previously approved DEIS.

2.2 DEFINITION OF ALTERNATIVES

The discussion below presents characteristics of each transit alternative, plus a detailed description of the highway improvements common to the TSM and LRT Alternatives. Table 2.1-1a and 1b provides a summary of each alternative. Various descriptors of the transit networks, LRT alignment options, transit supply and service characteristics, and associated highway improvements are summarized in this table to allow easy comparison. In some cases, both systemwide and Westside Corridor parameters are shown to provide context. Physical descriptors include the number of transit vehicles, LRT stations, park-and-ride lots and spaces, maintenance facilities, and length of LRT line. Transit service characteristics include the number of vehicle miles travelled (VMT), place miles of service, and hours of service. Sections 2.2.1 through 2.2.4 provide further discussion and detail relative to the definition of the alternatives.

Each of the alternatives shares the same transit fare policy, bus-service frequency policy, vehicle types and vehicle loading standards.

Tri-Met's current, three-zone fare system and fare rates are assumed for each alternative. In the Westside Corridor, zone 1 extends from downtown Portland to a line roughly north and south from the Highlands (Zoo) Interchange on Sunset Highway. Zone 2 extends farther west to roughly 90th Avenue. Travel within one or two zones costs $.90. For three zones the fare is $1.20. Monthly passes cost $29.00 for one or two zones and $39.00 for three zones. Fares are discounted for senior and handicapped citizens and school-aged riders. Tri-Met's policy has been to increase fares every other year, such that passenger revenue per vehicle hour grows about 4.5% on average annually. Transfers are free, as are rides wholly within the downtown Portland "fareless square" zone. Fares are the same for LRT rides as for bus rides. There is no fee to park in a Tri-Met park-and-ride lot.

Tri-Met weekday service policy calls for 10 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, such as Line 57 on the Westside. Suburban local/feeder buses 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, every 30 minutes. Most bus lines operate half-hourly 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 passengers; and 88-foot light rail vehicles (LRVs) seating 76 with room for 90 standees.

2.2.1 <u>No Build Alternative</u>

This alternative proposes only those transit improvements currently committed for implementation in Tri-Met's Transit Development Program. No major improvements are proposed to the highway system between downtown Portland and central Beaverton in this alternative.

2.2.1.1 Basic Characteristics

<u>Transit Improvements</u>

The No Build bus system (Figure 2.2-1) would provide approximately 1,470 total service hours, or 20% more than currently provided. The No Build Alternative is constrained by what can be funded through existing revenue sources by the year 2005. Those service improvements include additional peak-hour service on the Forest Grove trunk lines and heavily used radial bus lines. No entirely new routes are

TABLE 2.2-1a
DESCRIPTION OF ALTERNATIVES SUMMARY

	Alternative 1	Alternative 2	Alternative 3		
	NO BUILD	TSM	LRT TO 185TH	LRT TO MURRAY	LRT TO SUNSET TC
LRT Alignment Options					
Sunset Highway (Canyon Segment)	N/A	N/A	1–Southside Surface 2–Northside Short Tunnel 3–Long Tunnel with Zoo 4–Long Tunnel no Zoo	Same as 185th terminus.	Same as 185th terminus.
East Beaverton Segment	N/A	N/A	1–South entry 2–North entry	Same as 185th terminus.	None
West Central Beaverton Segment	N/A	N/A	1–BN 2–Henry St.	Same as 185th terminus.	None
Length of LRT Line (miles)					
Westside Corridor	N/A	N/A	11.4 to 12.0	9.2 to 9.8	5.4 to 5.8
Eastside (Banfield)	15.1	15.1	15.1	15.1	15.1
Total	15.1	15.1	26.5 to 27.1	24.3 to 24.9	20.5 to 20.9
Number of new LRT Stations.	N/A	N/A	11 to 13	8 to 10	4 to 6
Number of new Park-and-Ride Lots.	1	6	5 to 6	2 to 3	1 to 2
Number of new Park-and-Ride Spaces.	600	3,060	3,050 to 3,350	1,600 to 1,900	600 to 900
Westside Maintenance Facilities.	One, one hundred bus facility.	One hundred bus expansion to No Build facility.	Same as No Build plus LRV facility at SW 170th.	Same as No Build plus LRV facility at SW Murray.	Same as No Build plus expansion of existing Ruby Junction facility.
Bus service.	Expansion of existing service level but no new routes.	Expansion of service levels with new trunk and feeder routes.	Expansion of service levels with new feeder routes.	Same as 185th Terminus but with routings to Murray Boulevard.	Same as 185th Terminus but with routings to Sunset TC.
Downtown Portland Improvements.	North Mall Extension.	Same as No Build plus South Mall extension and reserved lanes.	Same as No Build.	Same as No Build.	Same as No Build.
Highway Improvements along Sunset Highway and Hwy 217.	None	Interchange, lane and bikeway improvements Extend climbing lane to Sylvan. Widen Sunset Highway to six lanes. Add collector distributer system west of Sylvan. Widen Highway 217 to six lanes plus auxiliary lanes. Add bikeway from downtown to Highway 217.	Same as TSM.	Same as TSM	Same as TSM

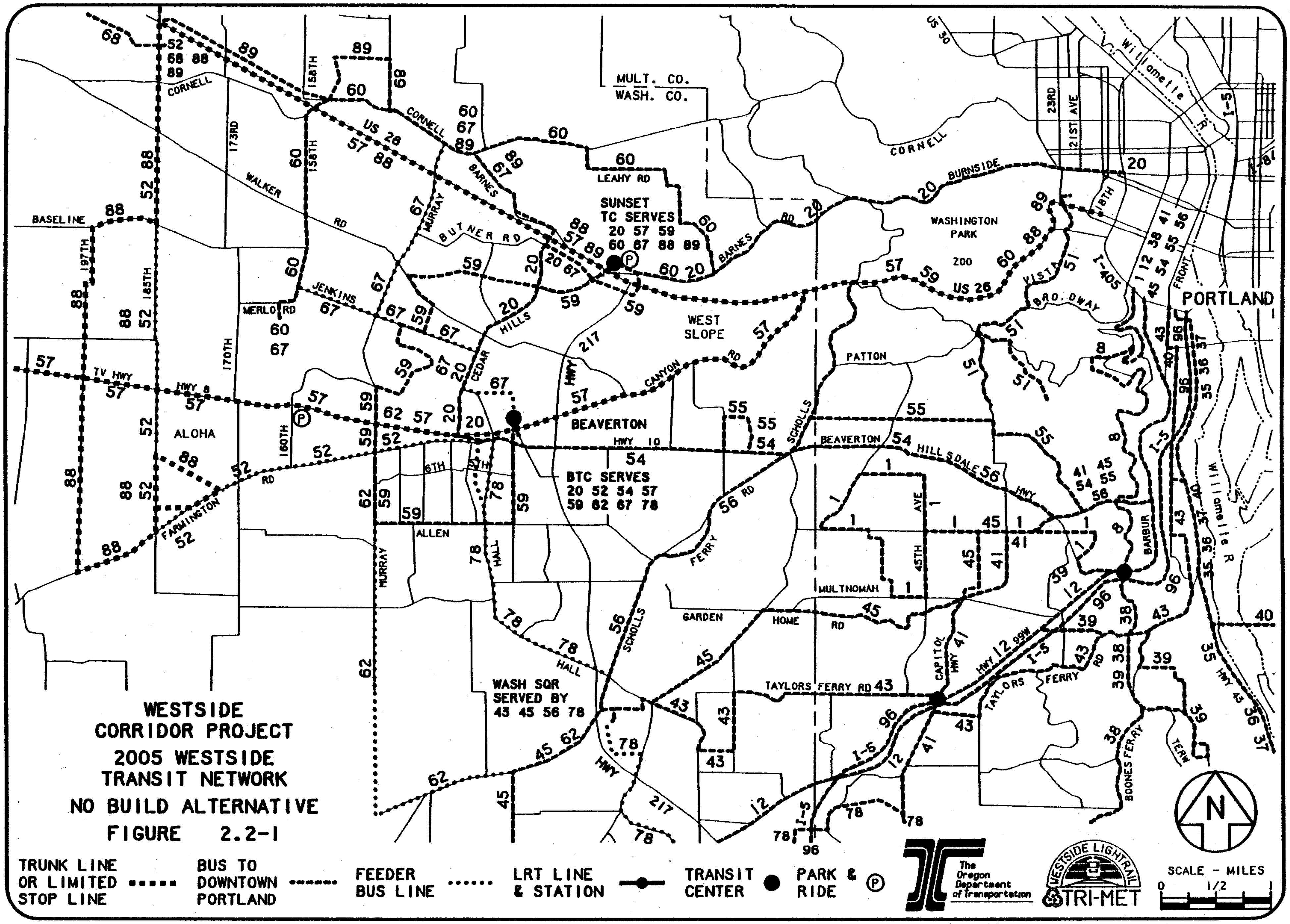
Source: Tri-Met Engineering Services, 11/90.

TABLE 2.2-1b
DESCRIPTION OF ALTERNATIVES SUMMARY

	EXISTING		Alternative 1 NO BUILD		Alternative 2 TSM		Alternative 3 LRT TO 185TH		Alternative 3 LRT TO MURRAY		Alternative 3 LRT TO SUNSET TC	
	BUS	LRV	BUS	LRV	BUS	LRV	BUS	LRV	BUS	LRV	BUS	LRV
NUMBER OF TRANSIT VEHICLES												
WESTSIDE CORRIDOR												
STANDARD BUSES	86	N/A	122	N/A	188	N/A	174	N/A	180	N/A	193	N/A
ARTICULATED BUSES	34	N/A	52	N/A	85	N/A	0	N/A	0	N/A	0	N/A
TOTAL VEHICLES	120	N/A	174	N/A	273	N/A	174	29	180	24	193	10
PEAK VEHICLES	89	N/A	145	N/A	228	N/A	145	24	150	20	161	8
SYSTEMWIDE												
STANDARD BUSES	503	N/A	505	N/A	802	N/A	787	N/A	792	N/A	804	N/A
ARTICULATED BUSES	87	N/A	184	N/A	302	N/A	218	N/A	217	N/A	217	N/A
TOTAL VEHICLES	590	26	689	41	1,104	48	1,005	77	1,009	72	1,021	58
PEAK VEHICLES	439	22	574	34	920	40	838	64	841	60	851	48
TRANSIT VMT WEEKDAY												
WESTSIDE CORRIDOR	14,000	N/A	20,000	N/A	29,000	N/A	19,000	5,130	20,000	4,430	21,000	2,030
NON-CORRIDOR	57,000	3,900	61,000	6,050	88,000	6,750	92,000	6,750	92,000	6,750	92,000	6,750
SYSTEMWIDE	71,000	3,900	81,000	6,050	117,000	6,750	111,000	11,880	112,000	11,180	113,000	8,780
PLACE-MILES WEEKDAY (1)												
WESTSIDE CORRIDOR	1,022,000	N/A	1,493,000	N/A	2,112,000	N/A	1,403,000	851,580	1,459,000	735,380	1,559,000	336,980
NON-CORRIDOR	4,188,000	647,400	4,447,000	1,004,300	6,438,000	1,120,500	6,677,000	1,120,500	6,721,000	1,120,500	6,701,000	1,120,500
SYSTEMWIDE	5,210,000	647,400	5,940,000	1,004,300	8,550,000	1,120,500	8,080,000	1,972,080	8,180,000	1,855,880	8,260,000	1,457,480
PLATFORM HOURS WEEKDAY (2)												
WESTSIDE CORRIDOR	1,030	N/A	1,470	N/A	2,200	N/A	1,420	260	1,460	220	1,570	100
NON-CORRIDOR	4,020	280	4,310	380	6,700	440	6,760	440	6,740	440	6,730	440
SYSTEMWIDE	5,050	280	5,780	380	8,900	440	8,180	700	8,200	660	8,300	540

Source: Tri-Met Engineering Services, 11/90.
Notes: (1) Place miles are a multiplication of transit vehicle capacity (seats and standees) and VMT.
(2) Platform hours are all transit service hours, including layovers and dead-heading.

[PROJ.WS.ALIGN]SDEISFIG.FGB NOBUILD



WESTSIDE CORRIDOR PROJECT
2005 WESTSIDE TRANSIT NETWORK
NO BUILD ALTERNATIVE
FIGURE 2.2-1

included in the No Build Alternative. To support the fleet expansion, construction of a new bus maintenance facility would be required. Table 2.2-2 lists associated facilities that Tri-Met is currently committed to build that would support the No Build Alternative. A total bus fleet of 689 is proposed; the Westside Corridor bus fleet would be about 120 buses. In addition, a park-and-ride lot would be constructed at the Sunset Transit Center, where 600 parking spaces would be provided (see Figure 2.2-2). In downtown Portland, the Transit Mall would be extended north of West Burnside Street to N.W. Irving Street, with a terminal facility for buses.

Table 2.2-2

NO BUILD ALTERNATIVE
TRANSIT IMPROVEMENTS

Sunset Transit Center and Park-and-Ride Lot	600 spaces
One 100 to 150-bus maintenance facility	
Transit Mall extension north of Burnside to Irving	
North Mall terminus facility	
Double tracking MAX line from Ruby Junction to Gresham Terminal plus associated improvements.	

Source: Tri-Met, 1989.

The No Build Alternative would retain the existing Eastside (MAX) LRT line, which would operate much as it does today with some minor improvements and increased service levels. There is a possibility that another station would be added to serve a new Gresham shopping mall. A second track would have been installed in the present single-track section between Ruby Junction and the east end of the line, and a Train-to-Wayside Communication (TWC) system completed for improved signal preemption.

Highway and Arterial Improvements

Table 2.2-3 lists the committed highway and arterial improvements throughout the corridor that complete the definition of the No Build Alternative. Along Sunset Highway and Highway 217, no improvements are assumed for the No Build Alternative.

2.2.1.2 Bus Operations

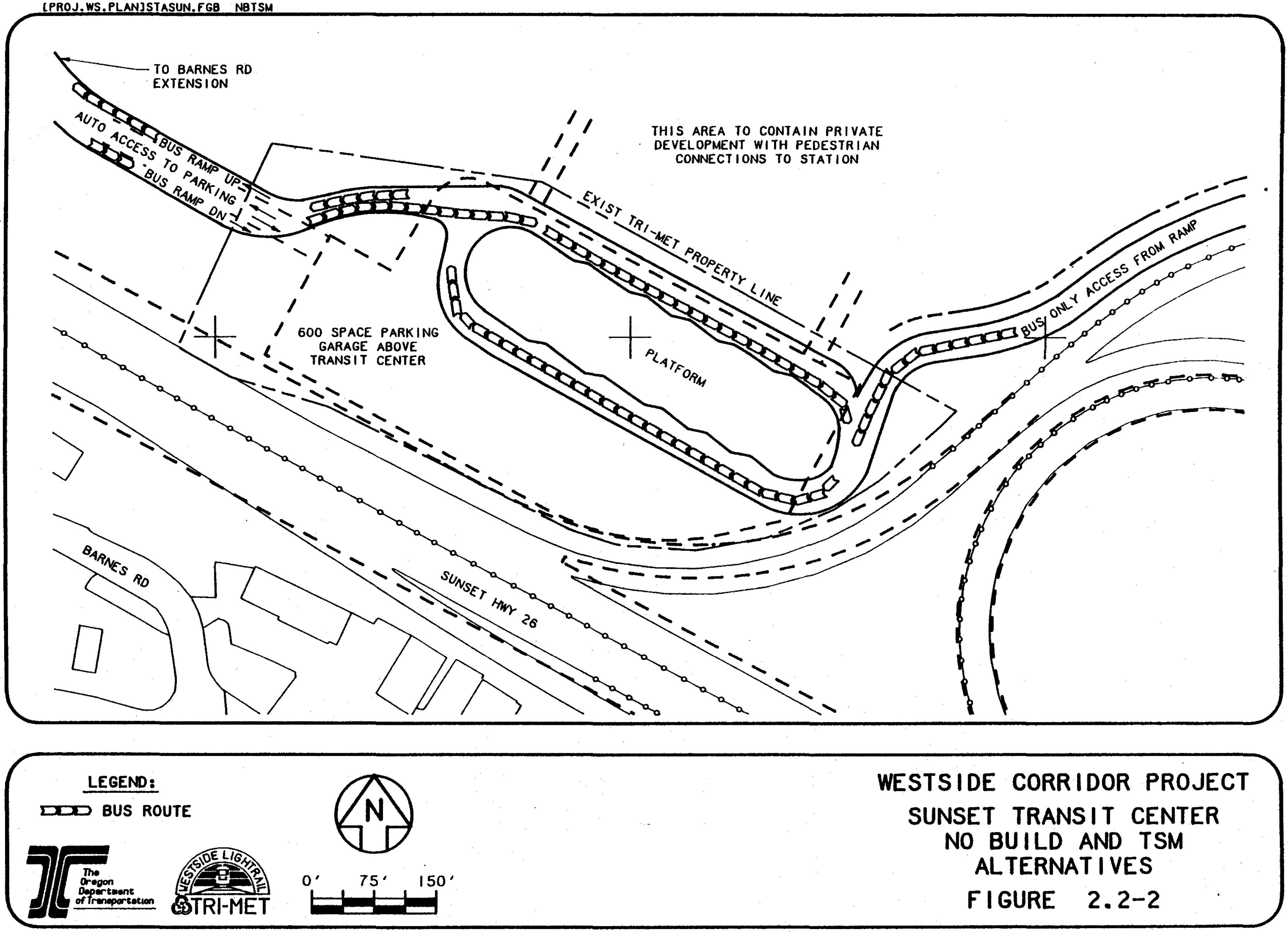
Operating Characteristics

The No Build Alternative would provide peak hour, trunkline bus service between the Portland Mall and the rest of the Westside Corridor, with articulated buses operating on an average headway (time between buses at a given stop) of six minutes. Other bus lines would operate at the service headways presented above.

Current, peak-period-only bus lines (lines 60, 88 and 89) would be upgraded to all-day operation via the Sunset Transit Center at the interchange between Sunset Highway and Highway 217. Local/feeder bus lines, operating as they do today, would continue to meet trunkline buses at transit centers.

Buses in the Westside Corridor would continue to operate in mixed traffic on increasingly congested streets and highways (see Section 4.2.1).

[PROJ.WS.PLAN]STASUN.FGB NBTSM



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WESTSIDE LIGHTRAIL TRI-MET

WESTSIDE CORRIDOR PROJECT

SUNSET TRANSIT CENTER NO BUILD AND TSM ALTERNATIVES

FIGURE 2.2-2

Table 2.2-3

NO BUILD ALTERNATIVE
HIGHWAY AND ARTERIAL IMPROVEMENTS

Highway 217/Highway 99 West Interchange improvements
Farmington Road widening - S.W. Murray Boulevard to S.W. 209th Avenue
S.W. Murray Boulevard improvements - Sunset Highway to S.W. Scholls Ferry
Cornell Road widening - S.W. 185th Avenue to Cornelius Pass Road
216th/219th Avenue widening - Five lanes Sunset Highway to Cornell Road and three lanes Cornell Road to T.V Highway

Source: Metro, 1989.

LRT Operations

LRT service would continue to be provided between the eastern terminus at Cleveland Avenue in Gresham and the western terminus in downtown Portland at S.W. 11th Avenue and S.W. Morrison Street. The service day would continue to be approximately 5:00 a.m. to 1:00 a.m. Some peak-period short turns would be made at Gateway Transit Center. Operating data for year 2005 are:

Length of route, one way (miles)	15.1
Running time, through trip (average minutes)	45
Layovers, average (minutes)	12
Headways, weekday (minutes)	
Peaks (7:00 - 8:00 a.m.; 4:30 - 5:30 p.m.)	6
Midday and Evening (8:00 a.m. - 4:30 p.m.; 5:30 - 10:30 p.m.)	15
Late night (10:30 p.m. - 12:30 a.m.)	30
Train (platform) hours, weekday	200
Train miles, weekday	3,145
Car miles, weekday	6,050
Vehicles scheduled in peaks	34
Vehicles in fleet, including spares	41

It is assumed that the light rail vehicle (LRV) fleet would increase between now and 2005 by approximately 15 cars, from its current level of 26, to satisfy increasing peak-hour use and to respond to projected downtown employment growth.

2.2.2 TSM Alternative with Highway Improvements

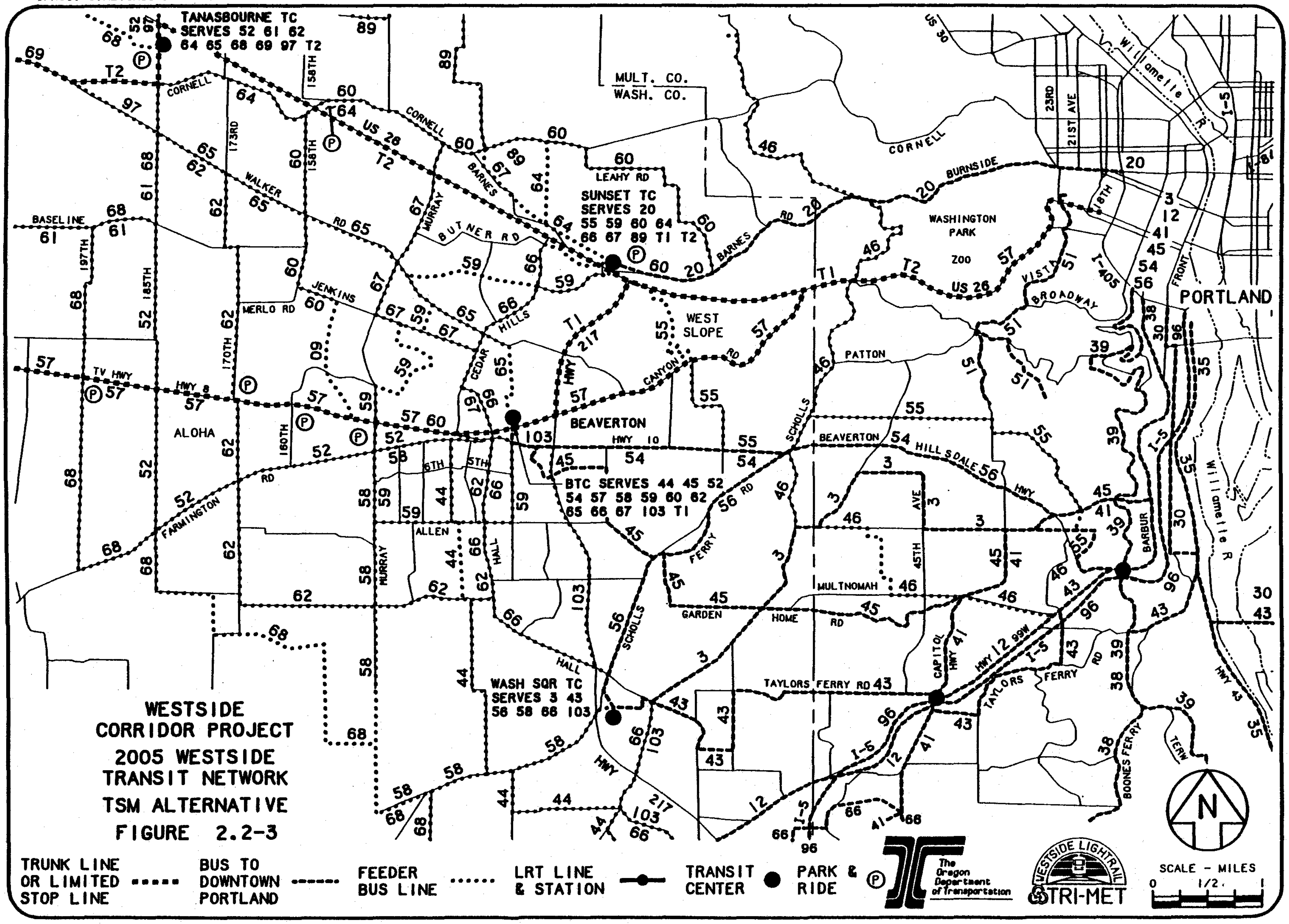
The TSM Alternative represents the best that can be done to meet the transit needs in the Westside Corridor without constructing a new guideway facility (i.e., LRT trackway). Bus service is increased substantially, park-and-ride lots are added, and comparatively small physical improvements are made to the local street system and freeway interchanges to achieve improved bus operation at key locations. The TSM Alternative is assumed to include all No Build improvements.

2.2.2.1 Basic Characteristics

Transit Improvements

The bus network assumed for the TSM analysis (Figure 2.2-3) is consistent with the Regional Transportation Plan (RTP) and has coverage and service levels that are virtually identical to those in the Westside LRT Alternative. Unlike the No Build Alternative, new revenues for both capital and operational improvements would be required for the TSM Alternative. The major Westside bus service

[PROJ.WS.ALIGN]SDEISFIG.FGB TSMALT



WESTSIDE CORRIDOR PROJECT
2005 WESTSIDE TRANSIT NETWORK
TSM ALTERNATIVE
FIGURE 2.2-3

improvements for the TSM network include trunk-level bus service between downtown Portland and Beaverton Transit Center; trunk-level bus service along the Sunset Highway to the Hillsboro Transit Center via the Sunset Transit Center, Tanasbourne Evergreen Parkway, and Cornell Road; a major shortening of trunk headways; an increase in suburban crosstown service; and suburban feeder service to new growth centers in south Beaverton, west Beaverton, and east Hillsboro.

The systemwide bus fleet would consist of 1,104 vehicles, including 302 articulated buses, with 920 buses in service during peak hours. The Westside Corridor bus fleet would total 273 buses. Expansion of the No Build bus maintenance facility would be needed to meet Westside Corridor bus maintenance and storage requirements by the year 2005.

Transit centers not included in the No Build Alternative would be added at Washington Square and Tanasbourne Mall. Construction of several park-and-ride lots has been proposed to provide a total of 3,060 parking spaces. The location (see Figures 2.2-4a through 4b) and number of spaces at each of the proposed park-and-ride lots is as follows:

Tanasbourne Park-and-Ride	600 spaces
Cornell/158th Park-and-Ride	200 spaces
S.W. Murray Boulevard /T.V. Highway Park-and-Ride	360 spaces
S.W. 160th Avenue/T.V. Highway Park-and-Ride (150 space expansion)	400 spaces (total)
S.W. 170th Avenue/T.V. Highway Park-and-Ride	400 spaces
S.W. 198th Avenue/T.V. Highway Park-and-Ride	500 spaces
Sunset Transit Center and Park-and-Ride	600 spaces

Additional TSM improvements would be included from the Beaverton Transit Center east to Highway 217 and west along T.V. Highway. These improvements would include bypass lanes at selected intersections and traffic signal modifications to enhance bus movements. In downtown Portland, the Transit Mall would be extended south two blocks to S.W. Columbia Street. Projected bus volumes indicate that exclusive peak-hour bus lanes would be required on S.W. Fifth and S.W. Sixth Avenues south to S.W. Montgomery Street. During peak hours, parking would be prohibited along the right-hand curbs of these streets.

Highway Improvements

Sunset Highway Improvements

Figures 2.2-5a and 2.2-5b illustrate the series of improvements proposed for Sunset Highway and Highway 217 between downtown Portland and Central Beaverton. Numbers on the figure identify where groupings of related improvements would be located. The numbers are keyed to the more detailed listing of improvements that follows.

1. Highlands (Zoo) Interchange Improvements

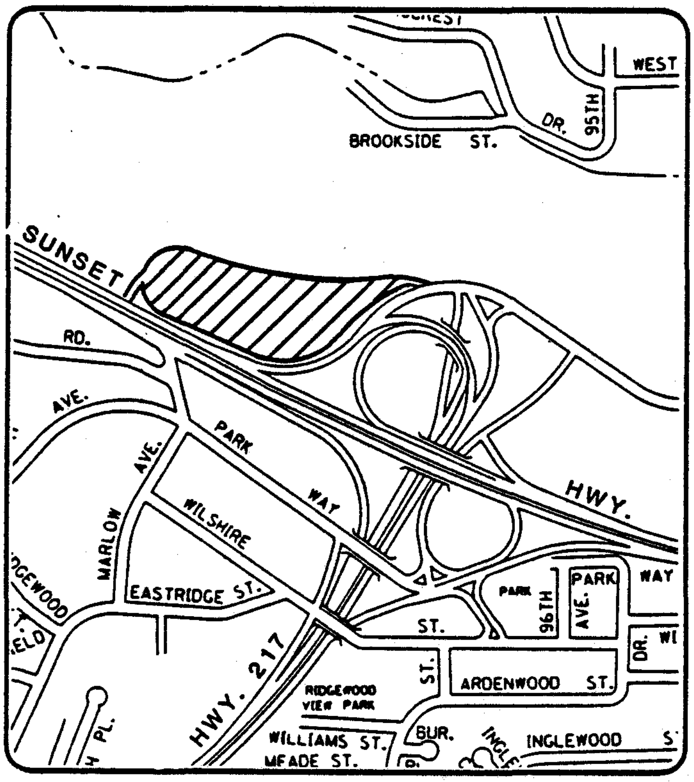
   - Build new westbound on-ramp.

   - Shift Sunset Highway centerline south between the Highlands and Sylvan Interchanges to accommodate the westbound on-ramp and extended westbound truck climbing lane.

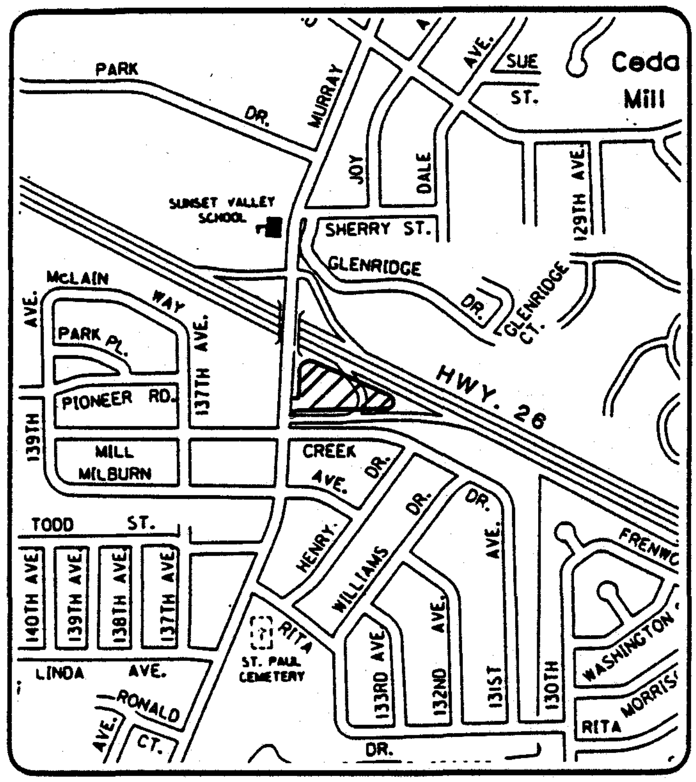
   - Rebuild eastbound Highland Interchange ramps to accommodate highway centerline shift.

2. Extended westbound truck climbing lane from Highlands Interchange to Sylvan Interchange (fourth lane uphill).

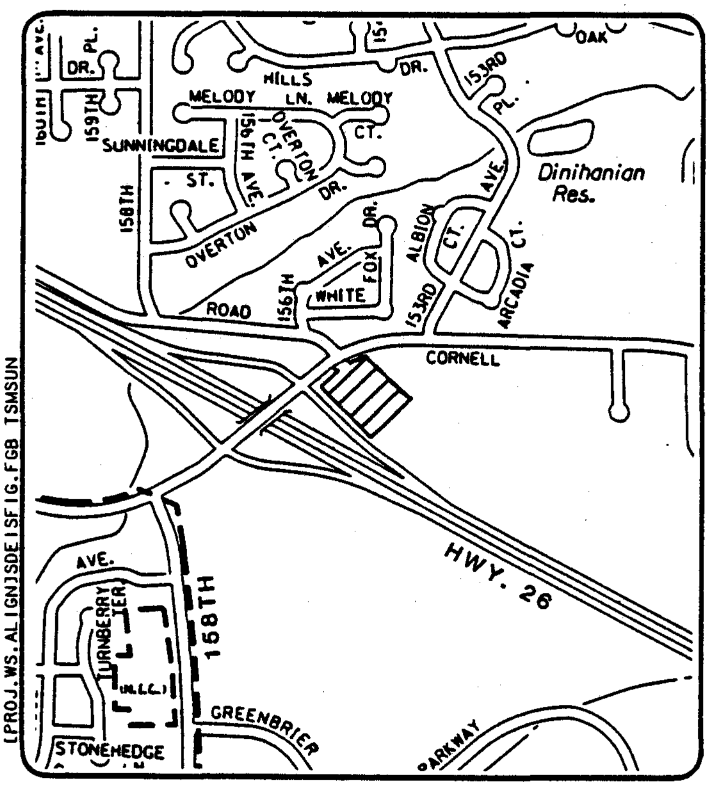
3. Sylvan Interchange Improvements.



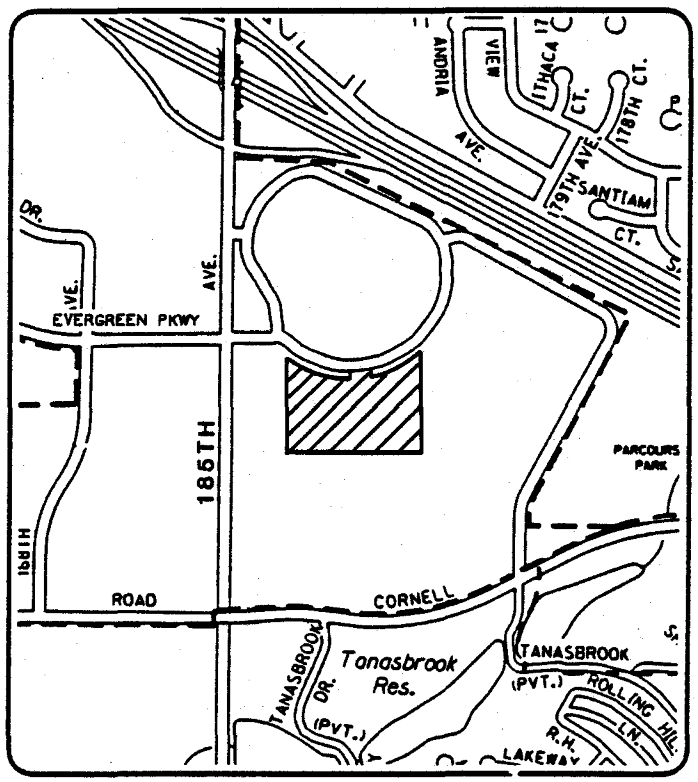
SUNSET



MURRAY



CORNELL



TANASBOURNE

[PROJ.WS.ALIGN]SDEISFIG.FGB TSMSUN

PARK AND RIDE LOT

The Oregon Department of Transportation

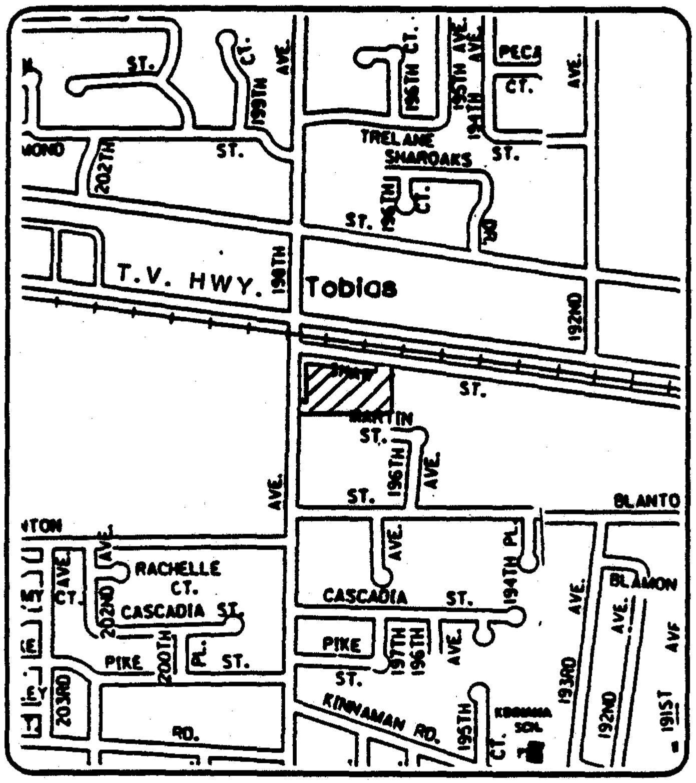
WESTSIDE LIGHTRAIL TRI-MET

0′ 500′ 1000′

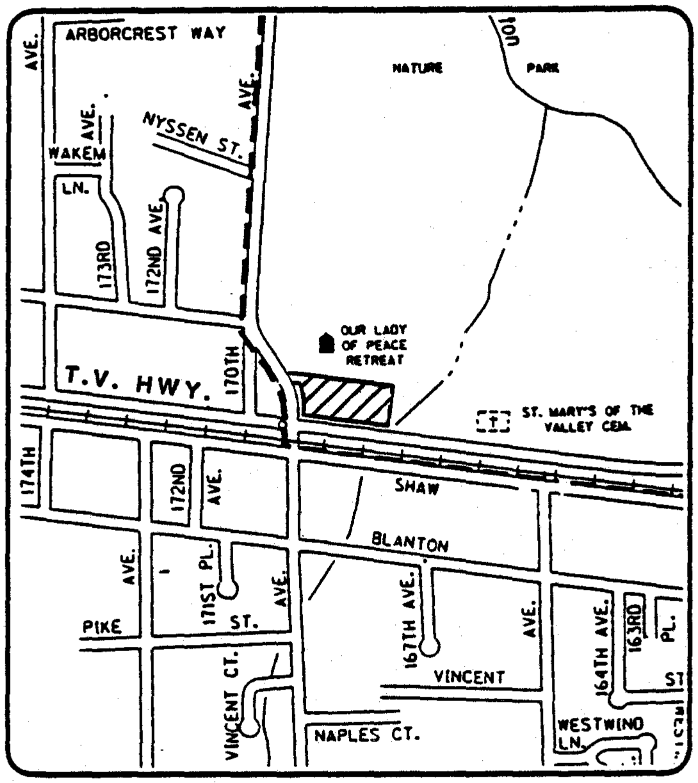
WESTSIDE CORRIDOR PROJECT

TSM PARK AND RIDE LOTS ON SUNSET HIGHWAY

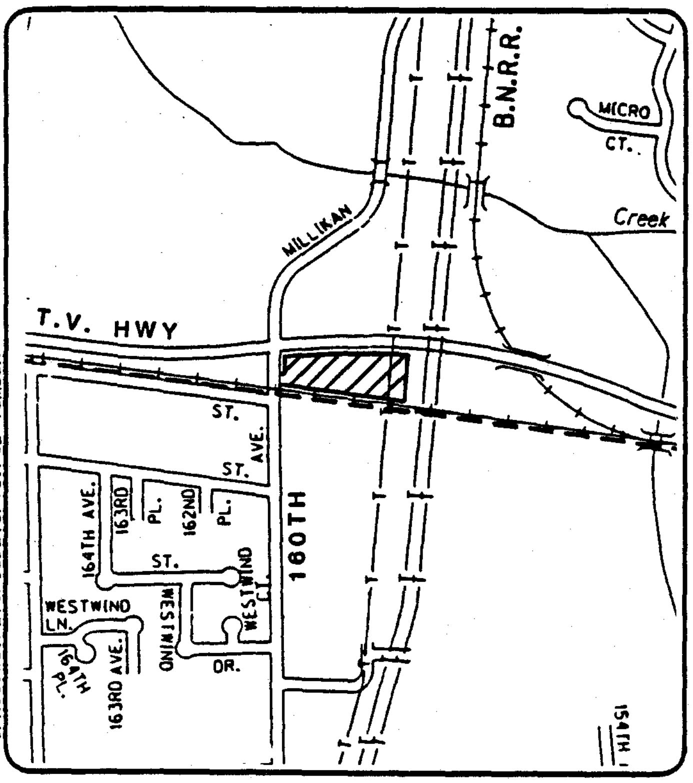
FIGURE 2.2-4a



198TH AVE



170TH AVE



160TH AVE

[PROJ.WS.ALIGN]SDEISFIG.FGB TSMSUN

PARK AND RIDE LOT

The Oregon Department of Transportation

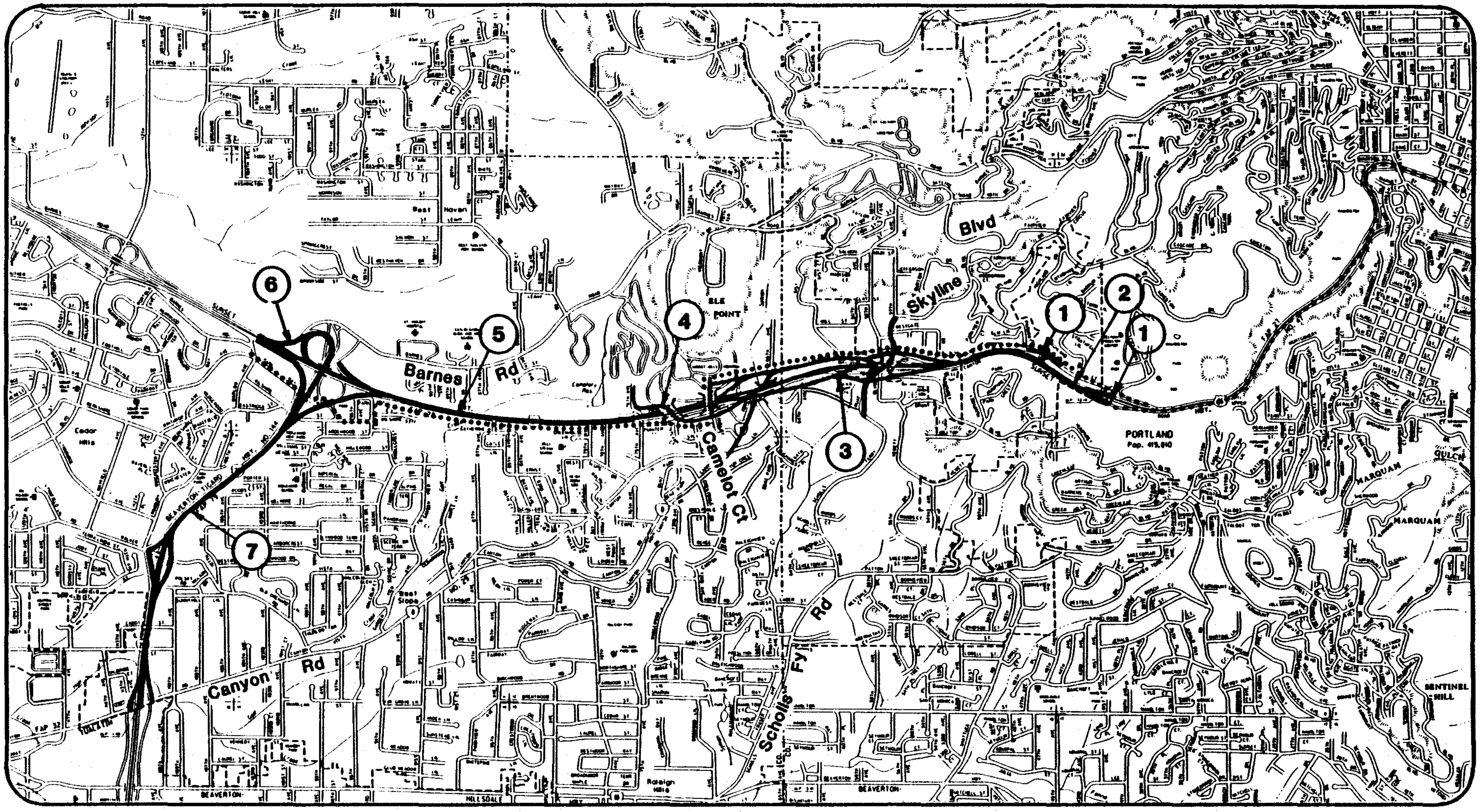
WESTSIDE LIGHT RAIL
TRI-MET

0′ 500′ 1000′

WESTSIDE CORRIDOR PROJECT

TSM PARK AND RIDE LOTS
ON T.V. HIGHWAY

FIGURE 2.2-4b



LEGEND

- HIGHWAY IMPROVEMENT
- ① HIGHLANDS (ZOO) INTERCHANGE IMPROVEMENTS
- ② EXTEND WESTBOUND CLIMBING LANE
- ③ SYLVAN INTERCHANGE IMPROVEMENTS
- ④ 76TH AVENUE OVERPASS
- ⑤ WIDEN SUNSET HIGHWAY TO 6 LANES
- ⑥ SUNSET/217 INTERCHANGE IMPROVEMENTS
- ⑦ WIDEN HIGHWAY 217 TO 8 LANES
- •••• BIKEWAY OR BIKE LANES

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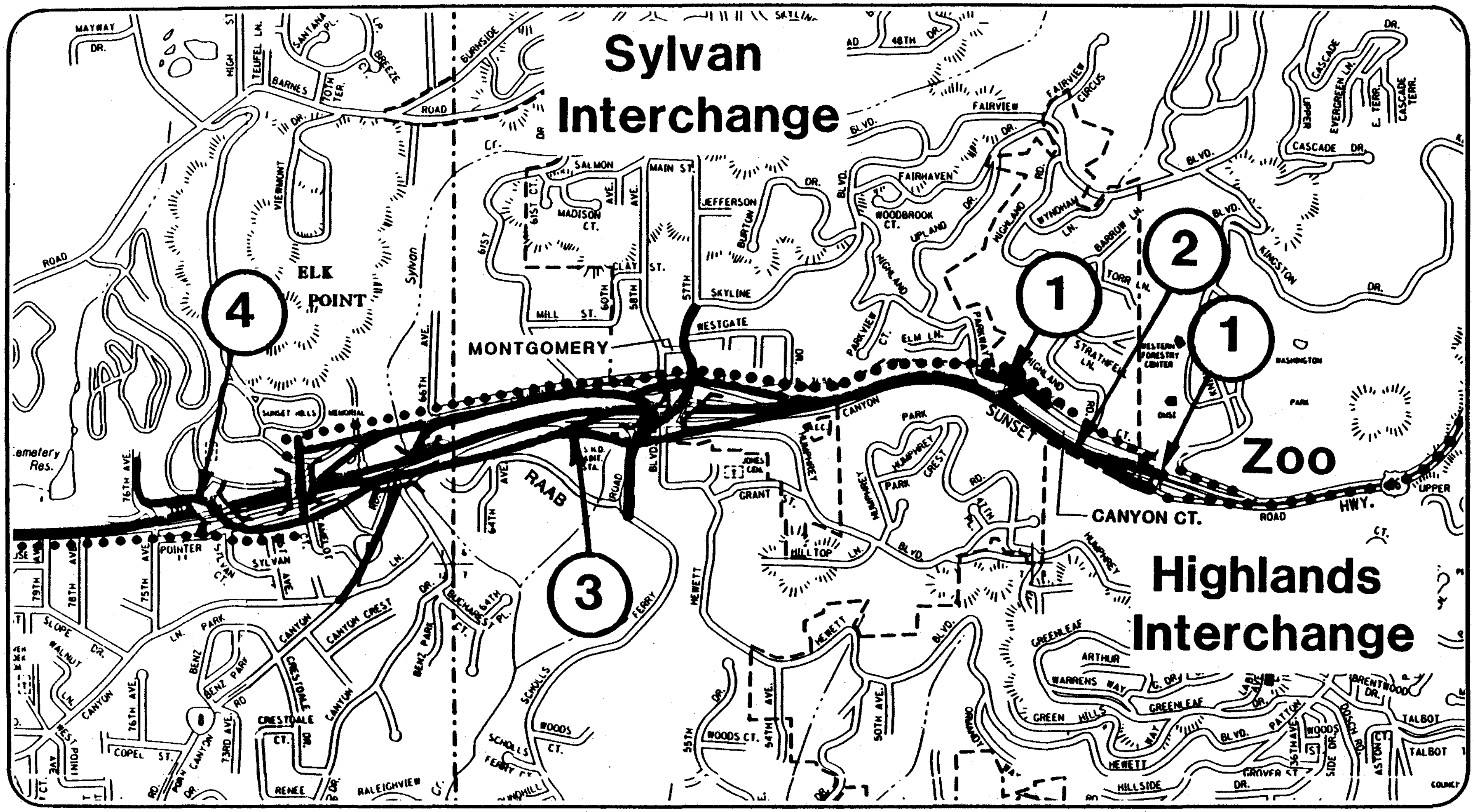
WESTSIDE LIGHTRAIL TRI-MET

WESTSIDE CORRIDOR PROJECT IMPROVEMENTS TO SUNSET HIGHWAY AND HIGHWAY 217

FIGURE 2.2-5a



LEGEND:

— HIGHWAY IMPROVEMENTS

1. HIGHLANDS (ZOO) INTERCHANGE IMPROVEMENTS
2. EXTEND WESTBOUND CLIMBING LANE
3. SYLVAN INTERCHANGE IMPROVEMENTS
4. 76TH AVENUE OVERPASS

• • • • BIKE PATH

The Oregon Department of Transportation

WESTSIDE LIGHTRAIL TRI-MET

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WESTSIDE CORRIDOR PROJECT

SUNSET HIGHWAY IMPROVEMENTS
HIGHLANDS INTERCHANGE TO
CAMELOT COURT INTERCHANGE

FIGURE 2.2-5b

- Replace existing structure over Sunset Highway to accommodate highway widening.

- Relocate westbound ramps to accommodate highway widening and provide additional storage space on S.W. Skyline Boulevard for turning vehicles.

- Build eastbound and westbound collector-distributor (C-D) road systems between Sylvan Interchange and Camelot Court Interchange.

- Shift Sunset Highway centerline south between the Sylvan and Camelot Court Interchanges to accommodate highway widening and the C-D road systems.

4. New S.W. 76th Avenue overpass to connect S.W. 76th Avenue and the Golf Creek Development on the north side of Sunset Highway with S.W. Pointer Road on the southside.

5. Widen Sunset Highway to six lanes.

   - Replace existing Sunset Highway structure over S.W. Canyon Road with a wider structure.

   - Replace existing Camelot Court structure over Sunset Highway to accommodate highway widening.

   - Add a third lane in each direction between the S.W. Canyon Road structure and the Sunset/217 Interchange.

6. Sunset/217 Interchange Improvements.

   - Widen Sunset Highway structure over Highway 217.

   - Widen to two lanes and realign major ramp connections between Sunset Highway and Highway 217.

7. Widen Highway 217 to six lanes.

   - Widen to four lanes in each direction from Sunset Highway ramps to S.W. Canyon Road ramps, including an auxiliary lane; and taper back to two lanes in each direction at S.W. Beaverton-Hillsdale Highway.

   - Rebuild ramps at S.W. Wilshire Street, S.W. Walker Road, and S.W. Canyon Road to accommodate highway widening.

   - Shift Highway 217 centerline slightly east and lower at S.W. Walker Road to accommodate highway widening.

ADDITIONAL IMPROVEMENTS:

- Build a two-way bikeway roughly paralleling Sunset Highway from the Vista Ridge Tunnels to Cedar Hills.

- Install congestion management ramp metering facilities on the following ramps:

			Lanes to be Metered
Eastbound:	Cedar Hills		1
	Highway 217		2
	Parkway		1
	Canyon Road		2
	T.V. Highway		1
	Sylvan		2
	Walker Road		1
Westbound:	Sylvan		2
	Cedar Hills		1
	Jefferson Street		2

- Close S.W. Canyon Court between S.W. Highland Parkway and S.W. Skyline Boulevard.
- Connect S.W. Canyon Court west of S.W. Skyline Boulevard to S.W. Skyline Boulevard via S.W. 58th Avenue and S.W. Montgomery Street.
- Relocate S.W. Raab Road further south with a new connection to S.W. Scholls Ferry Road.
- Improve traffic signals and channelization along S.W. Skyline Boulevard near the Sylvan Interchange.
- Reestablish access to Big Red's and Carrows Restaurants from S.W. Skyline Boulevard to the north.
- Close local accesses to Sunset Highway at:

  a. S.W. 75th Avenue - south side
  b. S.W. 78th Avenue - south side
  c. S.W. 79th Avenue - south side
  d. S.W. Katherine Lane - south side
  e. S.W. 76th Avenue - north side

- Remove S.W. Cabot Street structure crossing over Highway 217.

2.2.2.2 Operating Characteristics

<u>Bus Operations</u>

The TSM Alternative would increase bus service hours in the Westside Corridor by 50% over the No Build Alternative, to 2,200 weekday hours. Buses in the Westside Corridor would travel 29,000 miles daily, 45% more than with the No Build Alternative as a result of increased service levels and increased coverage.

The Hillsboro trunk line (T2) would operate all day and would provide trunk-level service along the corridor. Stops would be at the Zoo, Sylvan, Sunset Transit Center, Cedar Hills Boulevard, S.W. Murray Boulevard and S.W. 158th Avenue/Cornell Road. During peak hours, limited stop bus service would operate at 12- to 15-minute headways with a stop only at Sunset Transit Center between downtown Portland and Tanasbourne (S.W. 185th Avenue and Sunset Highway). Comparable service in the No Build Alternative would operate every 30 minutes during peak periods. A second new trunk line (T1) would operate during peak and base hours between Beaverton Transit Center and downtown Portland via Highway 217, Sunset Transit Center and Sunset Highway. There is no comparable service in the No Build Alternative.

These trunk lines would be in addition to the existing T.V. Highway/S.W. Canyon Road trunk line (Line 57), which would be retained. High-capacity buses would be operated at six-minute intervals on these lines during peak hours and at 15-minute intervals during midday. Compared to the No Build Alternative, which proposes four local feeder bus lines, the TSM Alternative proposes 17. Figure 2.2-2 shows the concentration of these lines in south and west Beaverton, and east Hillsboro. Local feeder bus lines would generally operate every 30 minutes to transit centers to meet the trunk lines. A detailed description of individual bus line characteristics is provided in the Description of Alternatives Report (Tri-Met, 1990).

LRT Operations

The TSM Alternative retains the No Build (MAX) LRT line, which would operate much as it does today with a 16% increase in service hours over the No Build Alternative to 440 car platform hours or 242 train platform hours daily. Car service levels are different from train service levels because Tri-Met operates both one and two car trains. The line would continue to operate from about 5:00 a.m. to 1:00 a.m. on weekdays, with a slightly later starting time on Saturdays and Sundays. Headways in the peak hours would be approximately five minutes, with all trains operating between Cleveland Terminal (or Ruby Junction) in Gresham and the S.W. 11th Avenue terminus in downtown Portland. During the base period, trains would operate every 15 minutes between the Cleveland and the S.W. 11th Avenue termini and also every 15 minutes between Gateway Transit Center and the S.W. 11th Avenue terminus. The combined weekday base headway between Gateway Transit Center and the S.W. 11th Avenue terminus would therefore be 7.5 minutes. Evening and weekend service would operate every 15 minutes between the Cleveland and S.W. 11th Avenue terminus.

Operating data for year 2005 operation of the line are:

Length of route, one way (miles)	15.1
Running time, through trip (average minutes)	45
Layovers, average (minutes)	12
Headways, weekday (minutes)	
Peaks (7:00 - 8:00 a.m.; 4:30 - 5:30 p.m.)	5
Midday (8:00 a.m. - 4:30 p.m.)	7.5/15
Evening (5:30 - 10:30 p.m.)	15
Late night (10:30 - 12:30 a.m.)	30
Train (platform) hours, weekday	242
Train miles, weekday	3,700
Car miles, weekday	6,750
Vehicles scheduled in peaks	40
Vehicles in fleet, including spares	48

Since the TSM Alternative involves an expanded bus operation, the safety and security measures and procedures currently in use by Tri-Met would continue to apply to this alternative.

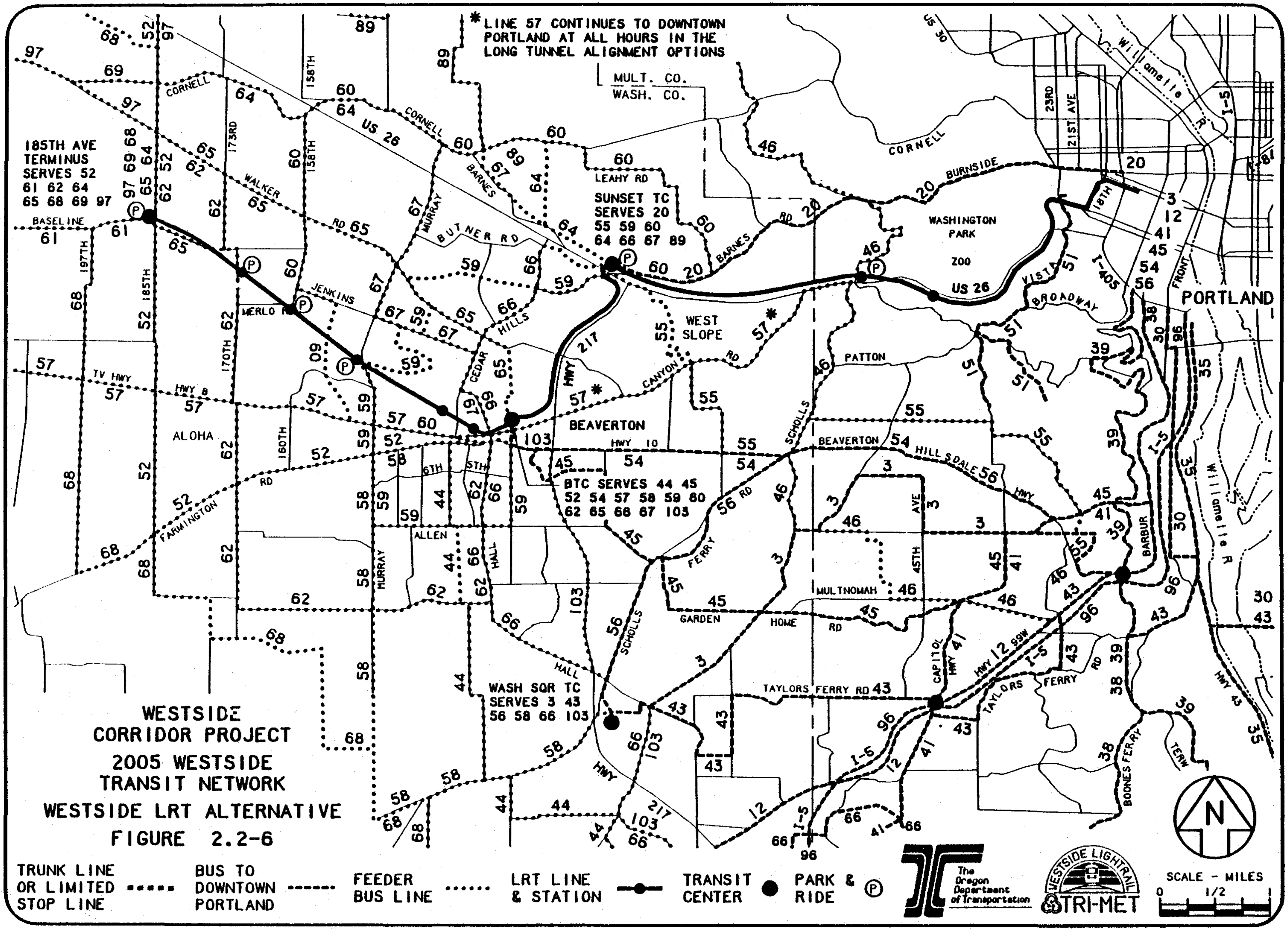
2.2.3 LRT Alternative to S.W. 185th Avenue with Highway Improvements

2.2.3.1 Basic Characteristics

The Westside LRT Alternative is the locally preferred alternative selected as a result of the 1980-83 Alternatives Analysis/DEIS. This alternative would provide high-capacity rail transit service generally separated from traffic congestion, along with a feeder-bus network (Figure 2.2-6) virtually identical to the TSM network. The Westside LRT line would connect with the Banfield LRT line in downtown Portland, providing light rail train service between the Westside and Eastside of the metropolitan area.

Highway improvements along Sunset Highway and Highway 217 generally would be the same as those proposed for the TSM Alternative. Since LRT provides trunk line service in this alternative, capital improvements to facilitate bus movements along T.V. Highway, Sunset Highway, and in downtown

[PROJ.WS.ALIGN]SDEISFIG.FGB LRTALT



WESTSIDE CORRIDOR PROJECT

2005 WESTSIDE TRANSIT NETWORK

WESTSIDE LRT ALTERNATIVE

FIGURE 2.2-6

Portland would not be needed. As with the TSM Alternative, however, the LRT Alternative assumes the No Build improvements, such as extending the downtown Transit Mall north of Burnside Street. Major transit centers, not included in the No Build Alternative, would be located at the S.W. 185th Avenue LRT terminus and at Washington Square (for buses only).

Transit Improvements

A systemwide bus fleet of 1,005 is proposed, including 218 articulated buses. Of the total, 838 buses would be in service during peak hours. The Westside Corridor bus fleet would total 174 buses.

The current Ruby Junction yard and building would be the primary maintenance and storage facility for the combined lines. Heavy repair and body work would be done at Ruby Junction. Another LRV storage yard and maintenance facility for inspection and running repairs would be built on the Westside, north of BN Railroad and east of S.W. 170th Avenue (see Figure 2.2-10a).

The Westside line would be entirely double-tracked, and would be approximately 12 miles long, from S.W. 11th to S.W. 185th Avenues (see Figure 2.2-7). The line would be signalized, with an Automatic Block Signal (ABS) system similar to that on portions of the MAX line, except in downtown Portland and portions of central Beaverton. Along Sunset Highway and Highway 217, all crossings would be grade-separated. In other areas, the at-grade intersections would be controlled by a signal preemption system or protected by crossing gates. An expanded communications system and central control would be incorporated as part of the combined system. Approximately 13 mainline traction power substations would be required for the line to S.W. 185th Avenue. There would be approximately 13 passenger stations west of the existing Galleria station, including three major transit centers. Six of these stations would have park-and-ride lots, with a total of approximately 3,050 to 3,350 spaces.

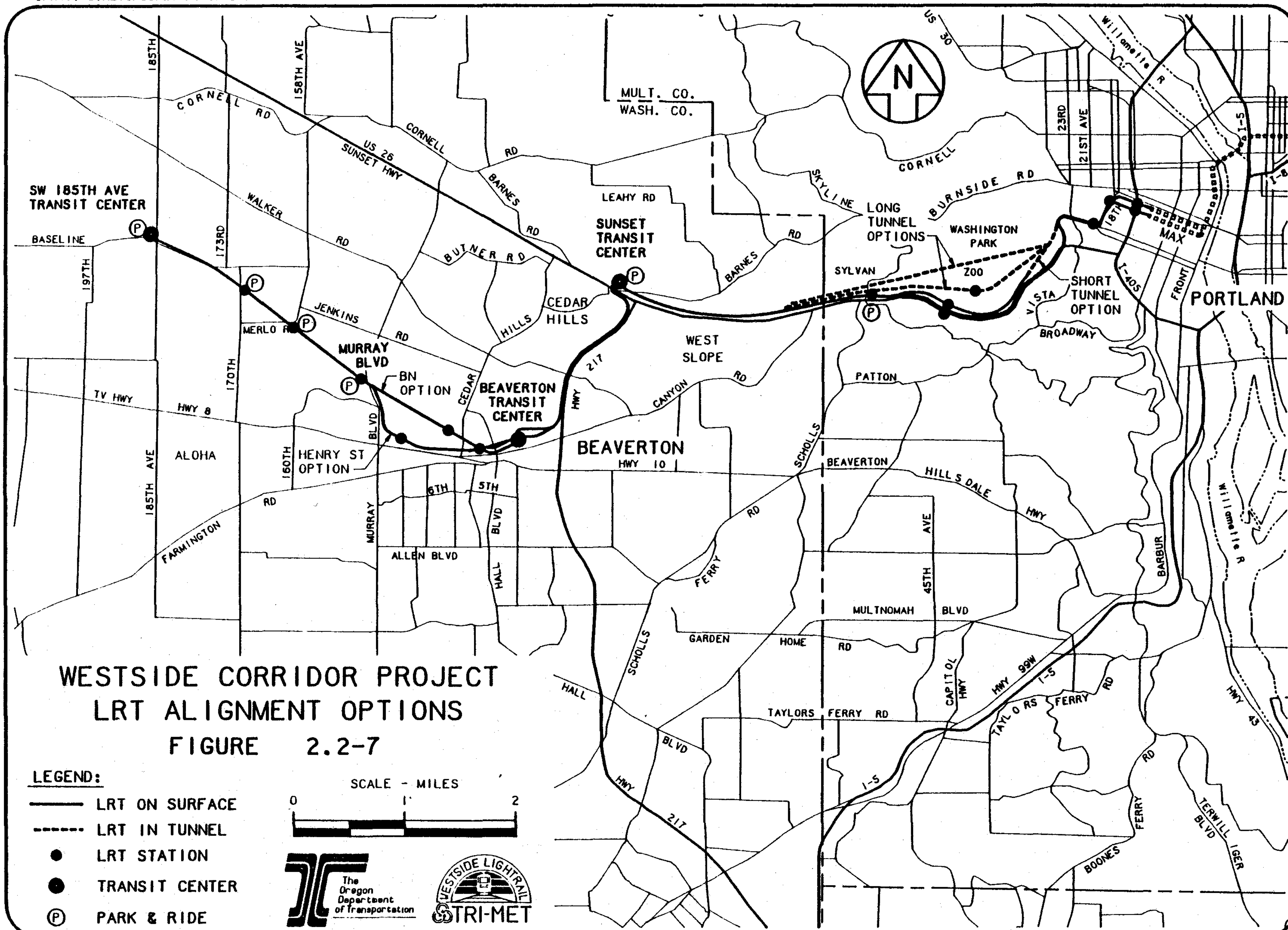
Three distinct station configurations would be developed for the proposed LRT alignment option: a basic station, a transit center station, and a station with a park-and-ride. All station types would have pedestrian connections, signage, and appropriate landscaping. The basic station site would generally consist of a single center platform or two side platforms with a partially enclosed shelter. The following sites would be constructed as basic stations (see Figure 2.2-8 for conceptual layout):

S.W. 13th/14th Avenue Station
S.W. 18th Avenue/Jefferson Street Station
Zoo Station
S.W. Watson Avenue Station
S.W. 141st Avenue Station
S.W. Hocken Avenue Station

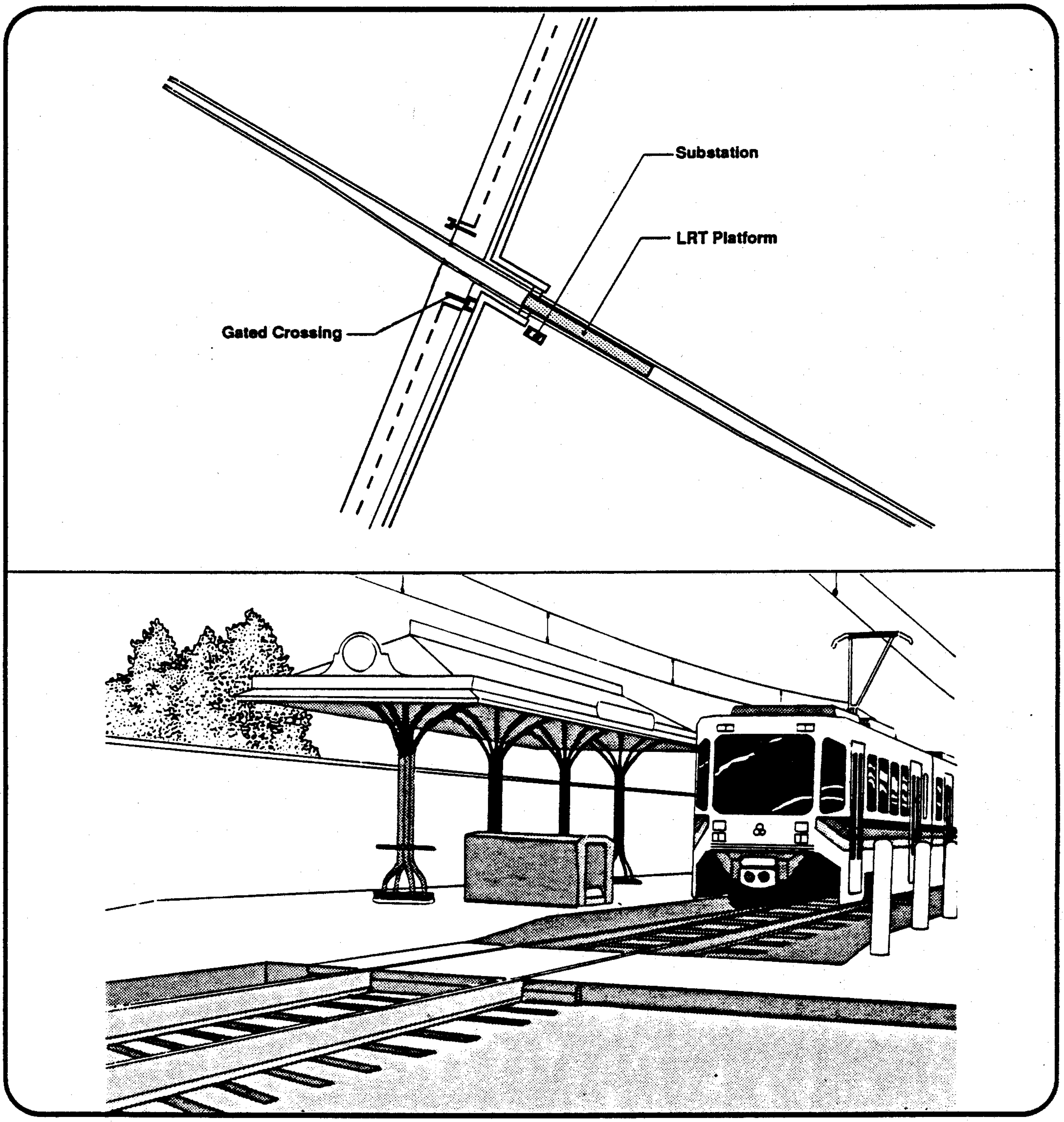
The transit center station is a major focal point for feeder bus connections. It would generally consist of both LRT platforms and several adjacent bus platforms. A passenger drop-off area, sometimes called a kiss-and-ride, would be provided at some of the transit centers (see Figures 2.2-9a and 9b). Transit centers generally accommodate more activity than a basic station, and are usually located in high-density commercial areas. The following would be constructed as transit centers (see Figures 2.2-9a and 9b):

Sunset Transit Center and Park-and-Ride	600 spaces
Beaverton Transit Center	
S.W. 185th Avenue Transit Center and Park-and-Ride	1,000 spaces

[PROJ.WS.ALIGN]SDEISFIG.FGB MAPWALGN



WESTSIDE CORRIDOR PROJECT
LRT ALIGNMENT OPTIONS
FIGURE 2.2-7



Westside Corridor Project

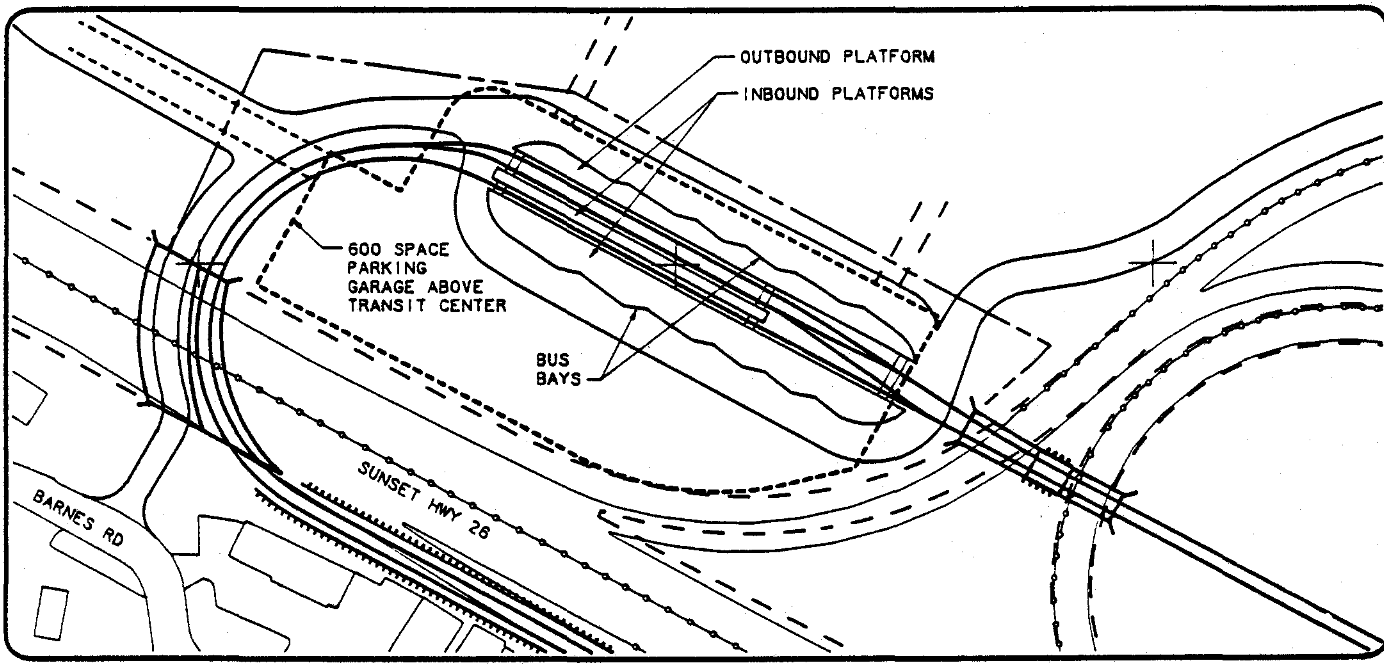
Basic Transit Station

The Oregon Department of Transportation

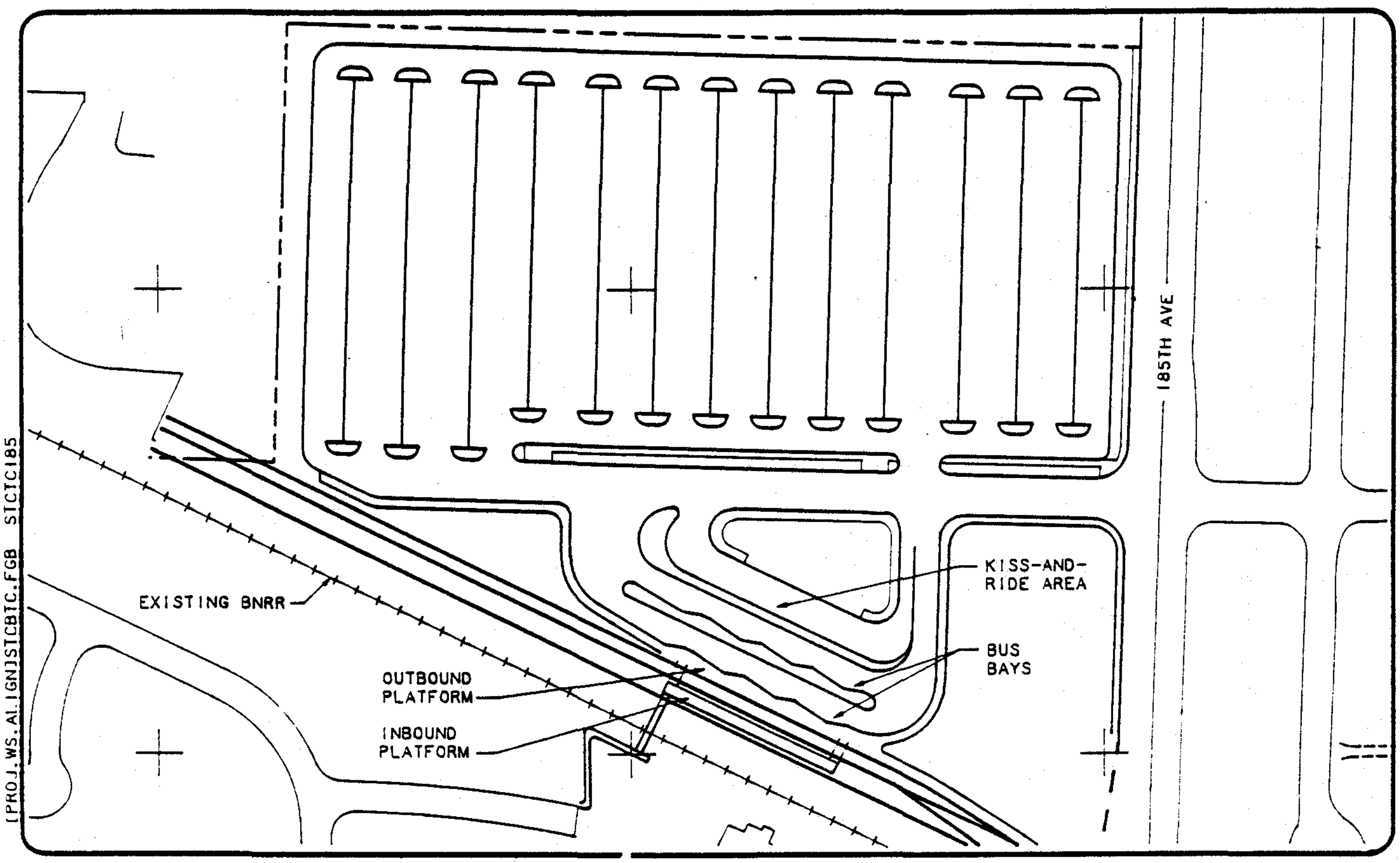
WESTSIDE LIGHT RAIL

TRI-MET

Figure 2.2-8



SUNSET TRANSIT CENTER & PARK & RIDE



185TH AVE TRANSIT CENTER & PARK & RIDE

[PROJ.WS.ALIGN]STCBTC.FGB STCTC185

The Oregon Department of Transportation

WESTSIDE LIGHTRAIL TRI-MET

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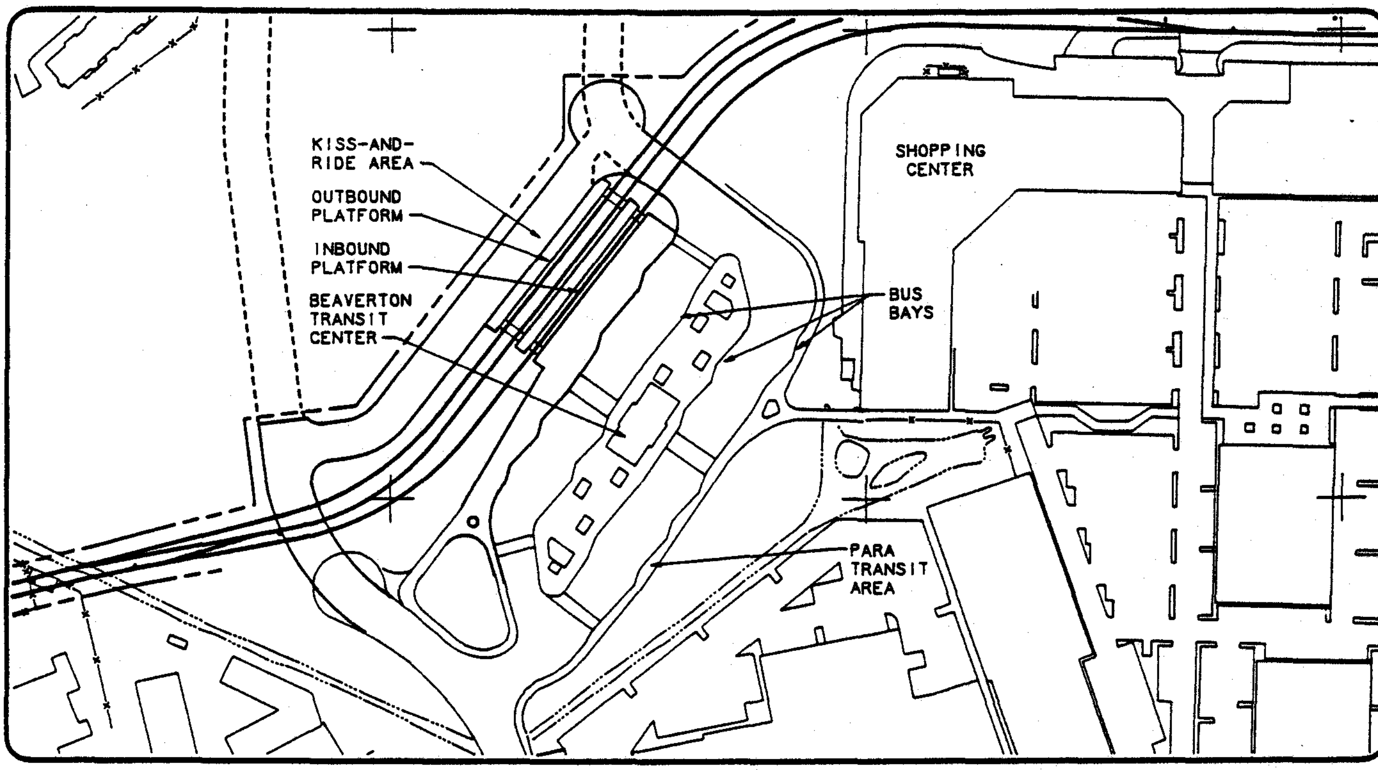
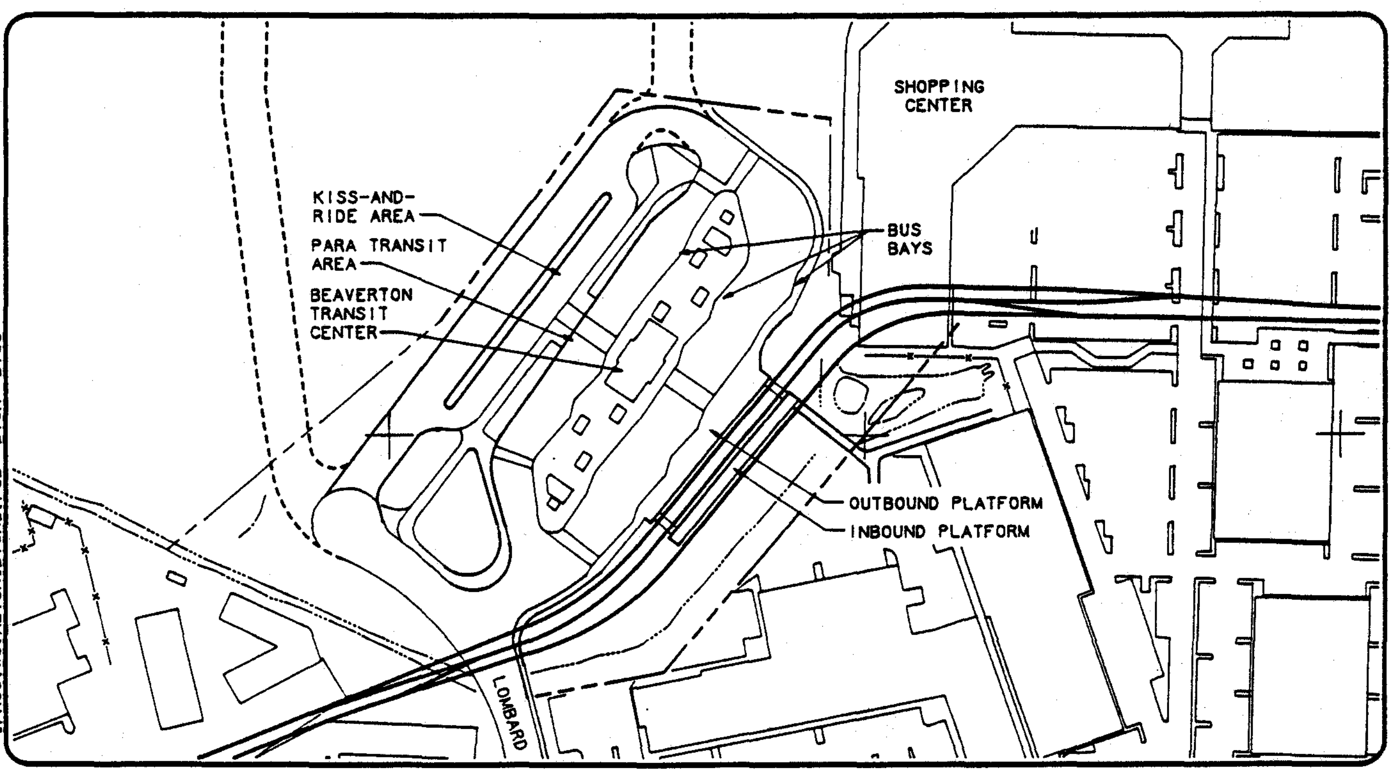
WESTSIDE CORRIDOR PROJECT

SUNSET AND 185TH AVE
TRANSIT CENTER/PARK & RIDES

FIGURE 2.2-9a



BEAVERTON TRANSIT CENTER NORTH SIDE OPTION



BEAVERTON TRANSIT CENTER SOUTH SIDE OPTION

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The Oregon Department of Transportation

WESTSIDE LIGHTRAIL TRI-MET

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WESTSIDE CORRIDOR PROJECT

BEAVERTON TRANSIT CENTER
NORTH & SOUTH OPTIONS

FIGURE 2.2-9b

The stations with a park-and-ride lot would consist of a platform, a park-and-ride lot, and a kiss-and-ride area. The following proposed stations would be constructed as park-and-ride stations (see Figures 2.2-10a and 10b):

Sylvan Station and Park-and-Ride	300 spaces
S.W. Murray Boulevard Station and Park-and-Ride	800 spaces
S.W. Merlo Road Station and Park-and-Ride	250 spaces
S.W. 170th Avenue Station and Park-and-Ride	400 spaces

Additionally, the Civic Stadium Station, due to its geometry and location, offers a plaza setting with high pedestrian activity at event times and a turnback track for operational considerations.

Operating Characteristics

Bus Operations. Compared to the TSM Alternative, the LRT Alternative proposes 35% fewer bus hours in the Westside Corridor (1,420 daily hours total) and 34% fewer daily bus miles (19,000 total).

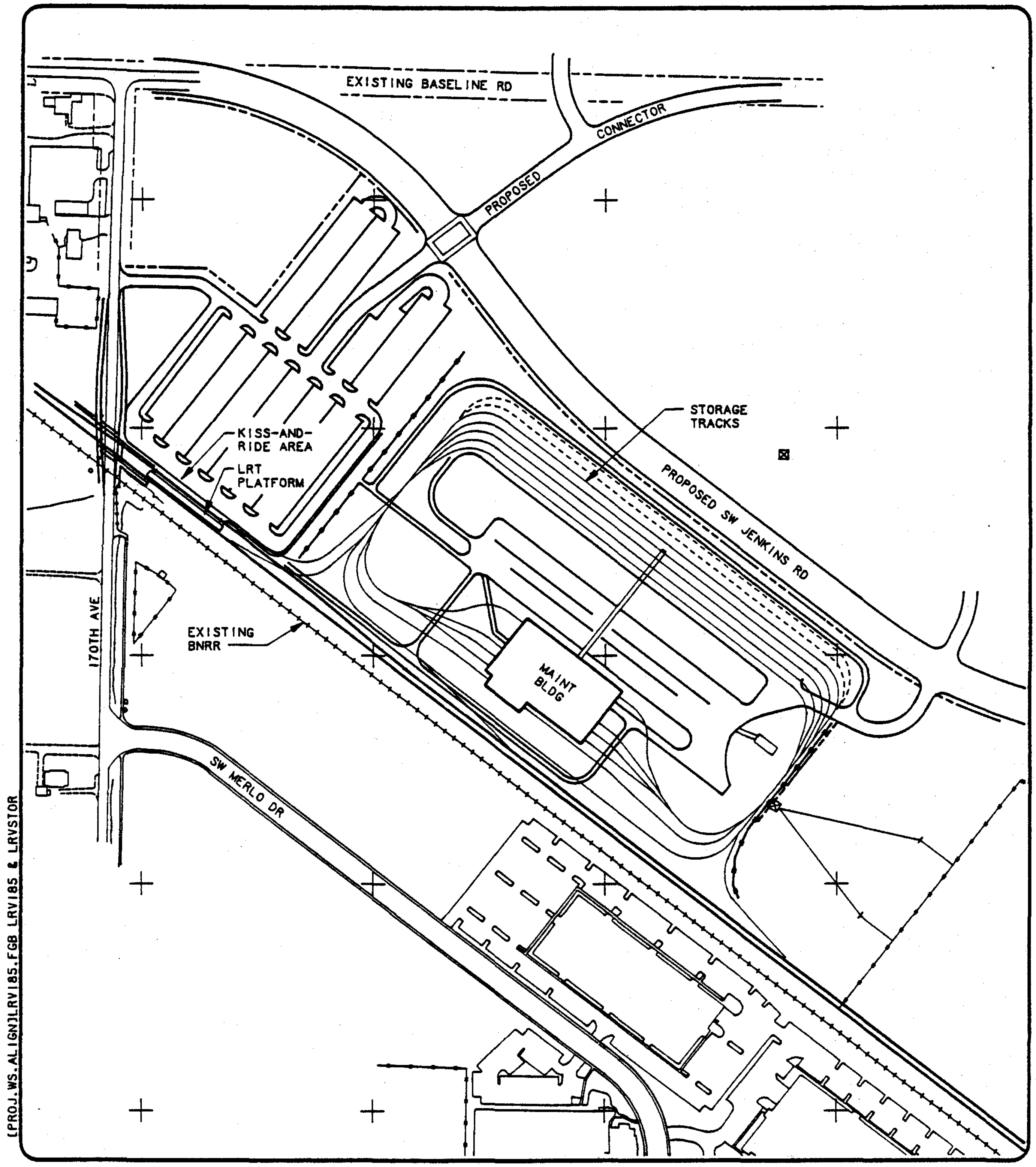
Bus system changes are proposed to provide good connections to the rail system. The major differences from the TSM bus network in the Westside Corridor include: replacement of bus trunk service via Sunset Highway to Beaverton with LRT service to Beaverton; relocating the transit center at S.W. 185th Avenue from Tanasbourne Mall to the terminus at S.W. 185th Avenue; and operation of Line 57, which serves S.W. Canyon Road and T.V. Highway, between Sylvan and Hillsboro. Feeder bus service would remain virtually the same with the Westside LRT Alternative as with the TSM Alternative.

If the LRT line is in a tunnel and the Zoo station is eliminated, Line 57 would operate to downtown Portland during off-peak hours by diverting into the Zoo from its Sunset Highway route. This would provide service to the Zoo every 30 minutes from Washington County and downtown Portland. Line 63 would continue to provide hourly service to the Zoo from downtown Portland until early evening. A detailed description of individual bus line characteristics is provided in the Description of Alternatives Report (Tri-Met, 1990).

LRT Operations. The Westside line would be operated in conjunction with the present Eastside MAX route, upgraded per the No Build description (see Section 2.2.1), as a through-line between Cleveland Avenue in Gresham and the Beaverton Transit Center or S.W. 185th Avenue in Hillsboro. Initial analysis indicates that alignment options, including a tunnel or minor modifications to the surface routing, would not significantly affect the operating characteristics, although grades and alignments may vary considerably.

Operation would be from about 5:00 a.m. to 1:30 a.m. on weekdays, with later starting hours on Saturdays and Sundays. Metro's preliminary ridership forecasts for 2005 have been used in determining peak service. During the heaviest peak-hour, headways on the Eastside would average five minutes; on the westside headways would average six minutes east of Beaverton Transit Center and 12 minutes west of Beaverton Transit Center. All peak-hour trains would operate to and from Cleveland Terminal (or Ruby Junction) on the Eastside. Depending on exact schedules and balancing of loadings, a few Eastside trains will turn back in downtown Portland. On the Westside, approximately half the through-routed trains would terminate at Beaverton Transit Center and the balance at the S.W. 185th Avenue terminus. During the off-peak hours, trains would operate every 15 minutes between the Gateway and Beaverton Transit Centers and also every 15 minutes between the Cleveland and S.W. 185th Avenue termini. The combined weekday base headway between the Gateway and Beaverton Transit Centers would be 7.5 minutes. Evening and weekend service would operate every 15 minutes between the Cleveland and S.W. 185th Avenue termini.

Trains would continue to be limited to two cars, since the block length in downtown Portland makes longer trains impractical. All trains would be operated with a one-person crew, and all fares would be prepaid. Random inspections for proof-of-payment would be conducted.



170TH AVE PARK & RIDE AND LRV MAINTENANCE SITE

The Oregon Department of Transportation

WESTSIDE LIGHTRAIL TRI-MET

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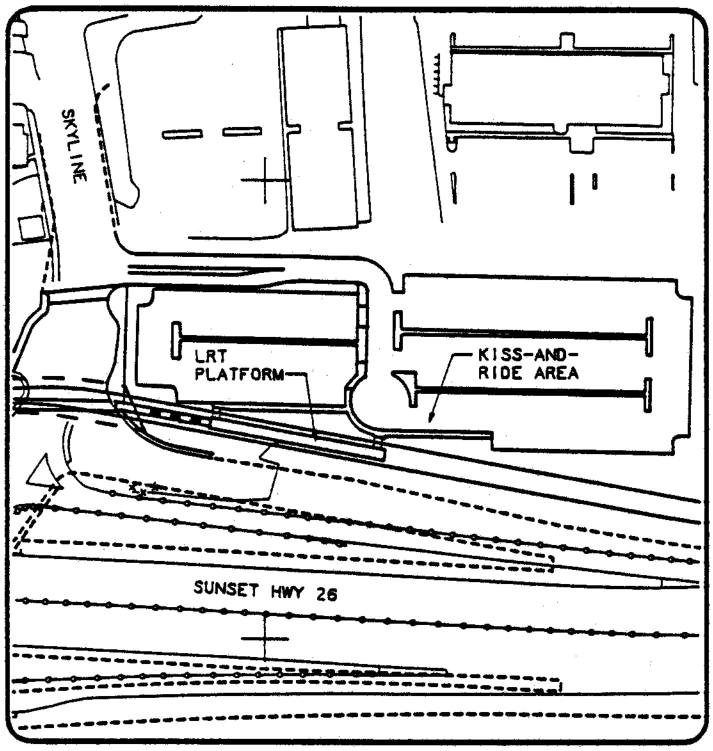
0' 150' 300'

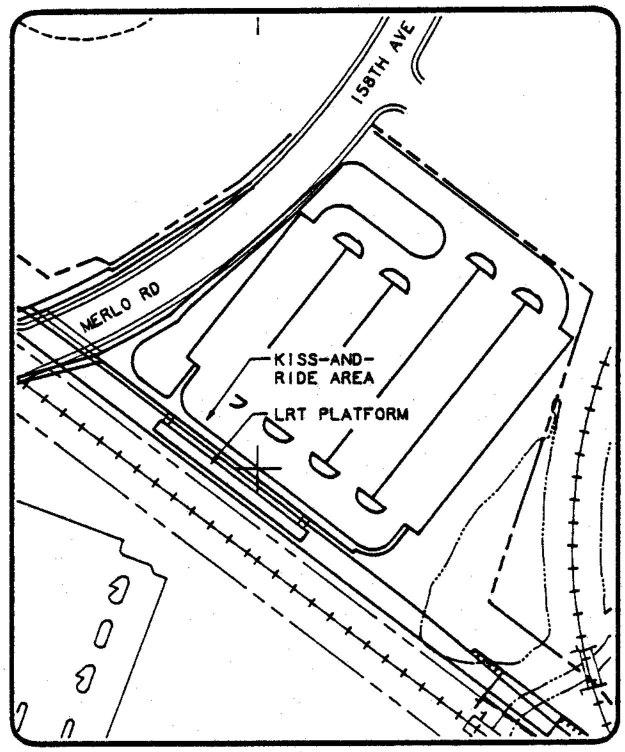
WESTSIDE CORRIDOR PROJECT

170TH AVE PARK & RIDE AND LRV MAINTENANCE SITE

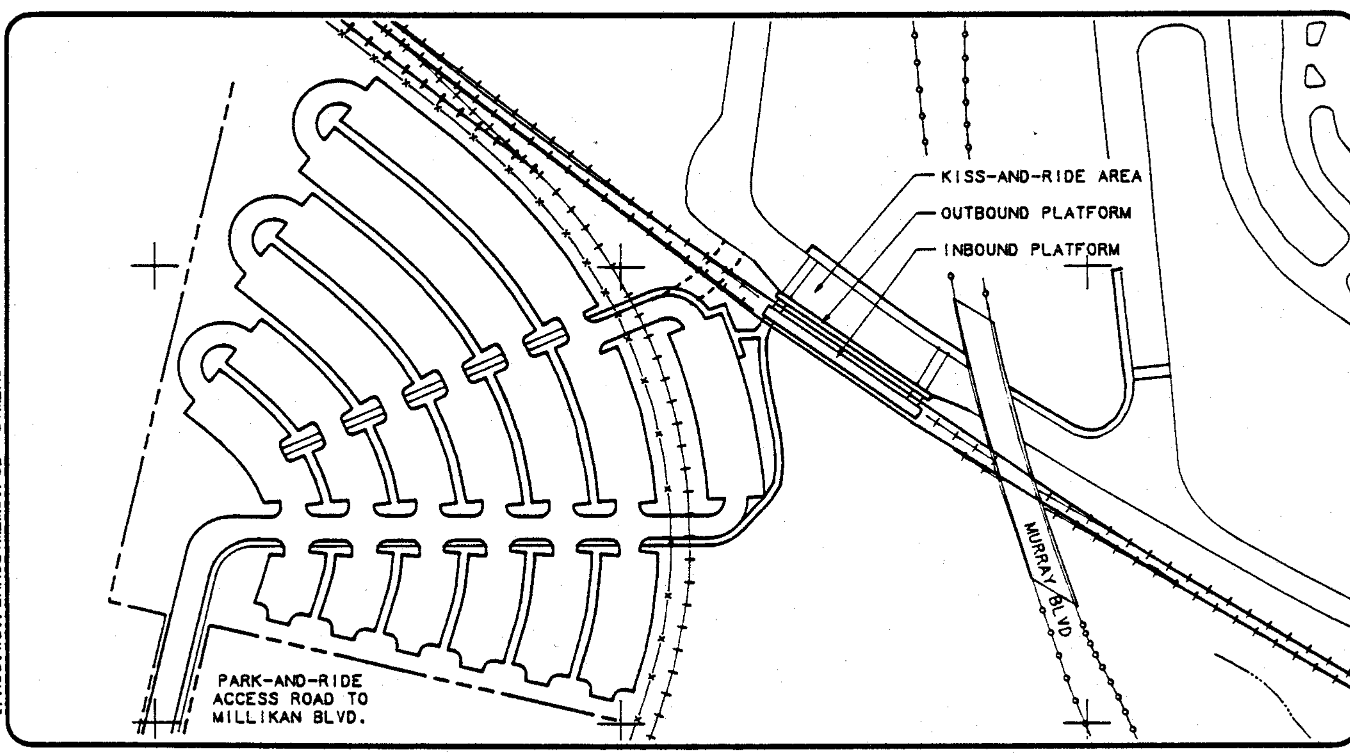
FIGURE 2.2-10a



SYLVAN PARK & RIDE



MERLO PARK & RIDE



MURRAY BOULEVARD PARK & RIDE

The Oregon Department of Transportation

WESTSIDE LIGHTRAIL TRI-MET

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0' 100' 200'

WESTSIDE CORRIDOR PROJECT

LRT PARK & RIDES AT SYLVAN MERLO ROAD & MURRAY BLVD

FIGURE 2.2-10b

[PROJ.WS.PLAN]SYMEMU.FGB SYMEMU

Running times have been developed through simulation, with consideration of grades, curvature, speed, and vehicle characteristics. The one-way running time from the existing Galleria Station (S.W. 10th Avenue) to the S.W. 185th Avenue terminus would be between 26 and 29 minutes, depending upon the alignment options and right-of-way conditions. Two minutes is added to this range to account for traffic congestion, wheelchair boarding, and other potential delays.

Operating data for year 2005 for the combined east-west line would be:

Length of route, one way (miles)	26.5 to 27.1
Running time, through trip (average minutes)	77
Layovers, average (minutes)	14
Headways, weekday (minutes)	
Peaks Eastside (7:00 - 8:00 a.m.; 4:30 - 5:30 p.m.)	5
Peaks Westside (7:00 - 8:00 a.m.; 4:30 - 5:30 p.m.)	6
Midday (8:00 a.m. - 4:30 p.m.)	7.5/15
Evening (5:30 - 10:30 p.m.)	15
Late night (10:30 p.m. - 12:30 a.m.)	30
Train (platform) hours, weekday	388
Train miles, weekday	6,570
Car miles, weekday	11,880
Vehicles scheduled in peaks	64
Vehicles in fleet, including spares	77

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 Central Control function with the LRT options would be significantly expanded and operated on a 24-hour basis. 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.

2.2.3.2 S.W. 11th Avenue to S.W. 18th Avenue/S.W. Jefferson Street Segment

Adopted Alignment

This segment would begin at S.W. 11th Avenue where the existing LRT alignment ends (see Figure 2.2-11). The LRT extension would match the sections of S.W. Morrison and S.W. Yamhill Streets, consisting of one LRT lane on the south side of S.W. Morrison Street and on the north side of S.W. Yamhill Street, and a single traffic lane on the right side. At the west end of S.W. Morrison Street, between S.W. 17th and S.W. 18th Avenues, the westbound LRT tracks would turn diagonally through the block bounded by S.W. 18th Avenue, S.W. 17th Avenue, S.W. Morrison Street and S.W. Yamhill Street to join the eastbound LRT tracks at S.W. Yamhill Street, and S.W. 18th Avenue.

The eastbound and westbound LRT tracks would occupy the center of S.W. 18th Avenue. One traffic lane and a curb parking lane would be provided on either side of the LRT tracks. At S.W. Jefferson Street, both LRT lines would proceed west past Collins Circle.

Stations/Park-and-Ride Lots

There are three stations proposed for this segment of the LRT alignment: S.W. 13th/S.W. 14th Avenues, the Portland Civic Stadium, and S.W. 18th Avenue/S.W. Jefferson Street. The S.W. 13th/S.W. 14th Avenues Station would span Interstate 405 (I-405) between S.W. 13th and S.W. 14th Avenues, with the westbound platform on S.W. Morrison Street and the eastbound platform on S.W. Yamhill Street.

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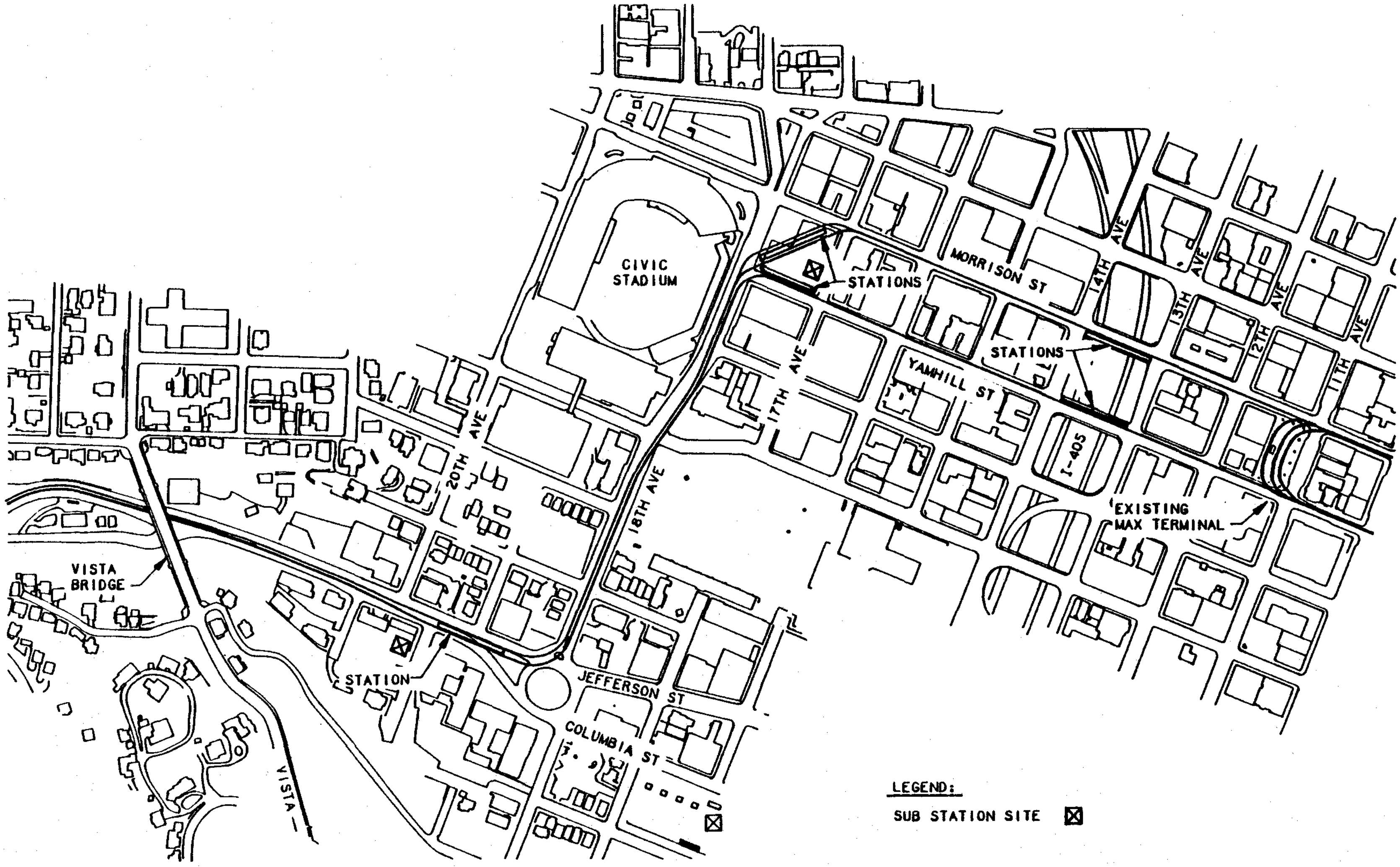

The Oregon Department of Transportation

WESTSIDE LIGHTRAIL TRI-MET

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WESTSIDE CORRIDOR PROJECT

DOWNTOWN PORTLAND ALIGNMENT

FIGURE 2.2-11

The Portland Civic Stadium Station would be located between S.W. 17th and S.W. 18th Avenues. The westbound (outbound) platform would be located diagonally through the block bounded by S.W. 17th Avenue, S.W. 18th Avenue, S.W. Morrison Street and S.W. Yamhill Street. This platform would be provided with two tracks to accommodate increased LRT service for events held in the Portland Civic Stadium. The eastbound (inbound) platform would be located on S.W. Yamhill Street, extending through S.W. 17th Avenue, requiring the closure of S.W. 17th Avenue between S.W. Yamhill and S.W. Morrison Streets.

The S.W. 18th Avenue/S.W. Jefferson Street Station, serving the Goose Hollow neighborhood, would be located within S.W. Jefferson Street, between Collins Circle and S.W. 20th Avenue.

Local Street System

Westbound traffic on S.W. Jefferson Street would be restricted to one through-lane at Collins Circle and west of the station platforms.

The existing unsignalized intersections of S.W. Morrison and S.W. Yamhill Streets with S.W. 15th, S.W. 16th, and S.W. 17th Avenues would be signalized. A signal would be installed at S.W. Yamhill Street and S.W. 18th Avenue.

The intersection of S.W. 18th Avenue and S.W. Salmon Street would be widened to provide turning lanes for traffic approaching on S.W. 18th Avenue. Left turns onto and off of S.W. 18th Avenue will be prohibited at Main, Madison and Taylor Streets.

Highway Improvements

No highway improvements are proposed for this segment.

2.2.3.3 S.W. 18th Avenue/S.W. Jefferson Street to Sunset Transit Center Segment

There are four LRT alignment options (see Figures 2.2-12a and 12b) proposed for Sunset Highway: the Southside (adopted) surface alignment, the Northside surface alignment with a short tunnel, and the Long Tunnel alignment with and without an LRT station at the Zoo. The LRT alignment would run west from Collins Circle within the median of S.W. Jefferson Street. At Vista Bridge, the Southside option diverges from the other three LRT alignment options.

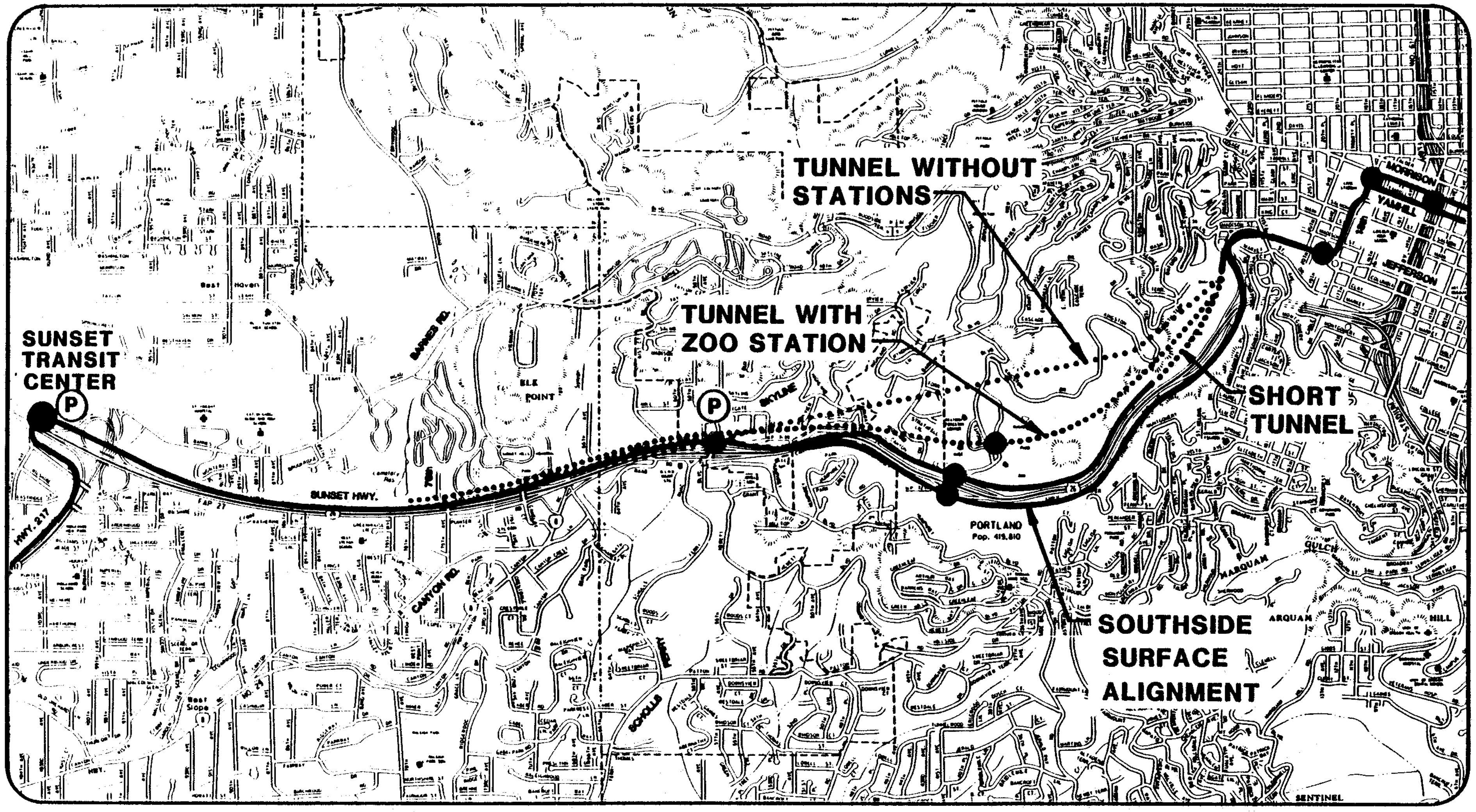
Southside Option

Adopted Alignment. The LRT tracks would occupy the median of the rebuilt S.W. Jefferson Street. Between S.W. 20th Avenue and the Vista Bridge, the transitway would begin to rise on an embankment supported by retaining walls away from the grade of S.W. Jefferson Street to cross above the Sunset Highway west of the Vista Bridge. One traffic lane, a bicycle lane, and a sidewalk would be provided on either side of the transitway.

West of the Vista Bridge, the LRT tracks would be elevated on a bridge structure occupying the median of S.W. Canyon Road. The alignment proceeds south and crosses over Sunset Highway just west of the Vista Ridge Tunnels. It then generally parallels the highway's south side through the canyon.

The alignment would pass to the south of the eastbound highway ramps at the Zoo Interchange. Just east of the Sylvan Interchange, the alignment would cross back over Sunset Highway on a bridge structure to the northside. The proposed alignment would cross under Skyline Boulevard in a box structure north of the highway ramps and would continue traveling west along the northside of the highway. The LRT would cross under S.W. Camelot Court and under a proposed S.W. 76th Avenue overpass.

At the Highway 217 Interchange, the LRT alignment would cross over the surface street connection between Barnes Road and Park Way, the Highway 217 mainline, and the Barnes Road entrance ramp to



LEGEND:

- LRT ON SURFACE
- LRT IN TUNNEL
- LRT STATION
- TRANSIT CENTER
- (P) PARK & RIDE

The Oregon Department of Transportation

WESTSIDE LIGHTRAIL TRI-MET

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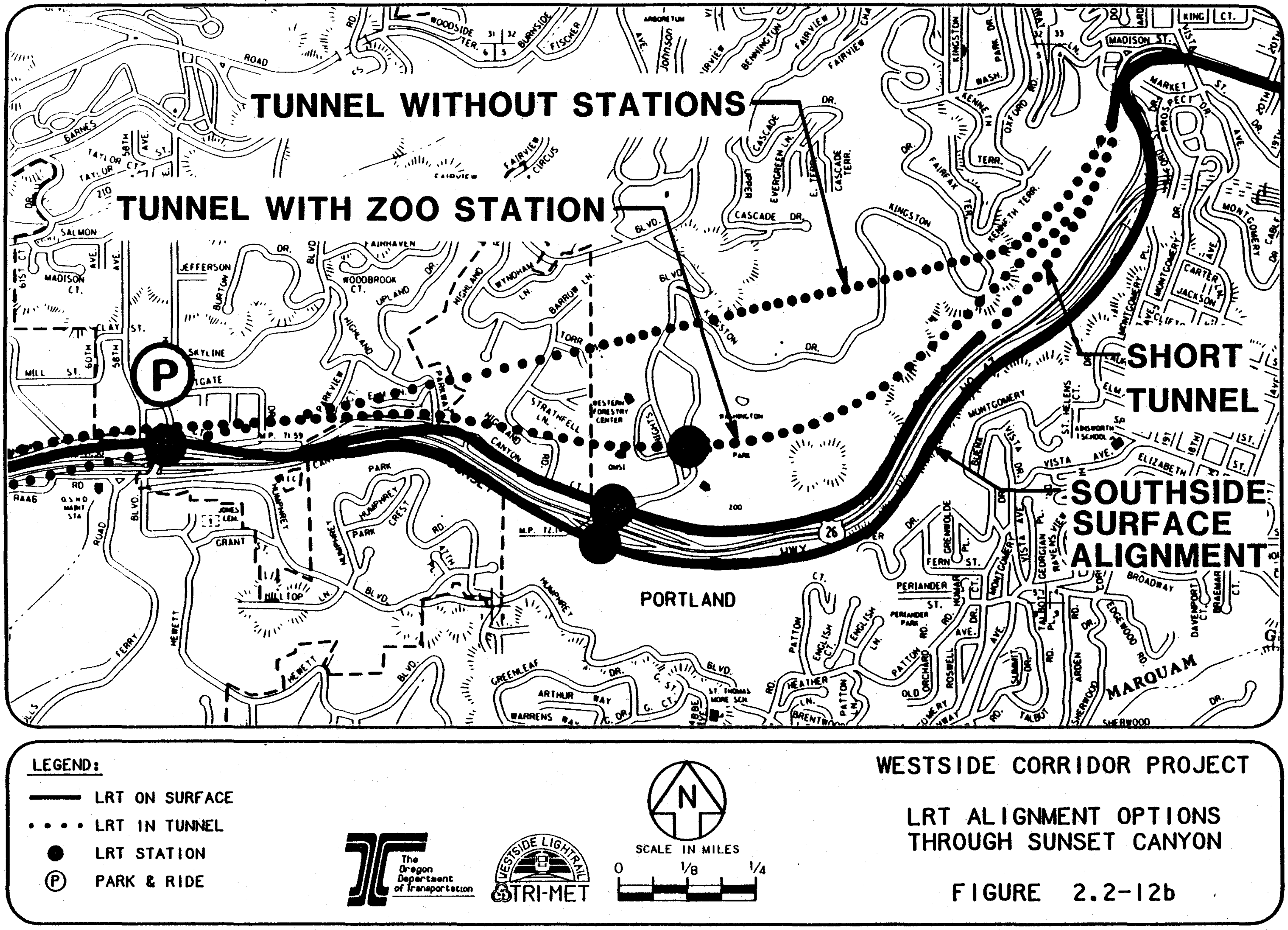
WESTSIDE CORRIDOR PROJECT

LRT ALIGNMENT EAST OF SUNSET TRANSIT CENTER

FIGURE 2.2-12a

[PROJ.WS.ALIGN]SDEISFIG.FGB TWCORR



WESTSIDE CORRIDOR PROJECT

LRT ALIGNMENT OPTIONS THROUGH SUNSET CANYON

FIGURE 2.2-12b

southbound Highway 217. The LRT alignment would cross under the westbound Sunset Highway to the southbound Highway 217 loop ramp and the Barnes Road-to-westbound-Sunset Highway entrance ramp.

Stations/Park-and-Ride Lots. The LRT station at the Zoo would be located east of the existing overpass. The station would consist of a center platform accessed by a bus turnaround at the south end of the overpass. Pedestrians would be provided with a route across the overpass and along the south side of the Zoo entrance road. Shuttle buses could provide service between the station and the Zoo.

The Sylvan Station (see Figure 2.2-10b), which would serve a 300-car Sylvan park-and-ride lot and surrounding neighborhoods, would be located east of Skyline Boulevard.

The Sunset Transit Center (see Figure 2.2-9) would be located north and west of the westbound Sunset Highway entrance ramp. Buses would access the station from the westbound entrance ramp, and from the Barnes Road Extension to the north and Barnes Road to the south. The transit center would incorporate ten bus bays outside the LRT platforms, and a 600-car parking garage above the platforms and bus bays.

Local Street System. S.W. Jefferson Street would be changed from two through-lanes and one right-hand turn lane approaching Collins Circle to one left-turn lane, one through-lane, and one right-turn lane. West of Collins Circle, one through-lane in each direction would be provided. The north approach on S.W. 18th Avenue would be reduced from two through lanes to one. Eastbound, the three lanes approaching Collins Circle from the west would be reduced to two lanes. Left turns onto and off of S.W. Jefferson Street would be prohibited and 20th and 21st Streets.

Additional modifications to the local street system near the Zoo and Sylvan Interchanges, including the closure of Canyon Court west of Highland Parkway, would be the same as described under the TSM Alternative.

Highway Improvements. Highway improvements in this segment would be the same as under the TSM Alternative.

<u>Northside Surface/Short Tunnel Option</u>

Alignment. This LRT option is currently configured to cross the westbound lanes of S.W. Canyon Road at grade, west of the Vista Bridge at the intersection of S.W. Canyon Road and Murray Street. The LRT would enter a short tunnel (2,500 feet long) west of the proposed crossing. At the west portal of the tunnel, approximately one-half mile east of the westbound Zoo exit ramp, the LRT would surface and parallel the north side of the Sunset Highway. The LRT would then pass to the north of the westbound exit ramp at the Zoo Interchange, crossing over the exit ramp and the existing overpass structure on a bridge. West of the Zoo Interchange, the LRT would generally follow the existing alignment of S.W. Canyon Court. East of Highland Parkway, Canyon Court would be reconstructed to preserve local access to Highland Road and Highland Parkway. From just east of the Sylvan Station, the LRT would continue along the same route as the Southside alignment option on the north side of the Sunset Highway.

Stations/Park-and-Ride Lots. The Zoo station is the only station located in this segment of the project that would have a location different from those discussed in the Southside option. The Zoo station would be located on the LRT bridge on the north side of the highway east of the existing overpass. Pedestrian access would be by stairs down to the highway overpass to the west or by elevated walkway toward the Zoo to the north.

The station at Sylvan would be the same for the Northside option as for the Southside option.

Local Street System. Canyon Court would be rebuilt north of its existing alignment to provide room for the LRT, which would generally occupy the right-of-way currently used by Canyon Court. Other local street system changes would be the same as described for the Southside (adopted) alignment option.

Highway Improvements. Highway improvements in this segment would be the same as under the TSM Alternative.

Long Tunnel with Zoo Station Option

Alignment. A tunnel through this segment would begin at the same east portal as the Northside option, but would continue beneath the surface north of the short tunnel alignment. The three-mile twin-tube tunnel would cross under the West Hills and bypass the Sunset Canyon. The tunnels would run between the Vista Ridge area and a point just west of Finley Ridge. The west portal would be located in the vicinity of S.W. 76th Avenue, on the north side of the Sunset Highway. West of this location the Long Tunnel alignment option would continue along the same alignment on the north side of Sunset Highway as the other alignment options.

Station. The Long Tunnel alignment option does not include a station at Sylvan. However, the surface characteristics (e.g., park-and-ride lot size and location, bus connection, etc.) for an underground Sylvan station would be similar to those of the Southside or Northside Sylvan station. The Zoo station would have considerations different from those discussed in the Northside and Southside alignment options. The proposed location for the Zoo station, under this alignment option, is beneath the existing Zoo parking lot adjacent to the OMSI and Zoo entrances, to be accessed by elevator.

Local Street System. Changes to the local street system would be the same as described for the Southside alignment option.

Highway Improvements. Highway improvements in this segment would be the same as under the TSM Alternative.

Long Tunnel without Zoo Station Option

Alignment. This alignment would be similar to that of the Long Tunnel with Zoo station. The portal locations would be identical but the alignment would be shorter and straighter through the hills. After surfacing, the alignment would be the same, on the north side of Sunset Highway, as for the other alignment options.

Station. With this option, there would not be any stations between S.W. 20th Avenue/S.W. Jefferson Street and the Sunset Transit Center.

Local Street System. Changes to the local street system would be the same as described for the Southside alignment option.

Highway Improvements. The highway improvements associated with this alignment option would be the same as the TSM Alternative.

2.2.3.4 Sunset Transit Center to S.W. Cabot Street/Highway 217 Segment

Adopted Alignment

This segment (see Figure 2.2-13a) would begin at the Sunset Transit Center, cross underneath the Sunset Highway in a box structure, briefly travel east along the existing southbound on-ramp to Highway 217 and continue south along the west side of Highway 217. Just beyond S.W. Cabot Street, the alignment would turn west, leaving the Highway 217 corridor.

Transit Stations/Park-and-Ride Lots

There would not be any transit stations between the Sunset Transit Center and the Beaverton Transit Center.

Local Street System

The existing S.W. Cabot Street overpass at Highway 217 would be removed.

Highway Improvements

Highway improvements in this segment would be the same as under the TSM Alternative.

2.2.3.5 East Beaverton/Cabot Street to Beaverton Transit Center Segment

Within this segment of the Westside Corridor Project there are two alignment options: the North option and the South option (see Figures 2.2-13a and 13b). The North option would extend directly west from Highway 217, passing through the north side of the Beaverton Transit Center. The South option would extend in a southwesterly direction from Highway 217, passing through the south side of the Beaverton Transit Center.

The City of Beaverton is planning to construct a new street known as the East/West Arterial. This street is in the vicinity of the LRT alignments in the Beaverton segments described in Sections 2.2.3.5, 2.2.3.6, and 2.2.3.7. The proposed East-West Arterial is not included in the Westside Corridor Project, nor are its impacts evaluated in this SDEIS. However, the LRT route design has been developed to respect the proposed East/West Arterial locations, and no major conflicts between these projects have been identified.

North Option

Alignment. The LRT alignment would diverge from Highway 217 and extend west approximately 500 feet south of and parallel to Center Street. The alignment would skirt the north side of the Canyon Place Shopping Center and proceed southwest into the Beaverton Transit Center. Three LRT tracks would pass through the northern side of the transit center before continuing west across Beaverton Creek to the S.W. Watson Avenue Station.

Transit Stations/Park-and-Ride Lots. The Beaverton Transit Center, a recently opened 15-bay timed-transfer center, would be a major station within this section of the LRT alignment. A kiss-and-ride area would be provided to the north of the LRT platforms. Both LRT platforms kiss-and-ride areas would be located north of the bus platforms. Figure 2.2-9b shows the North option configuration. No park-and-ride facilities would be provided.

Local Street System. Some changes to the local street system would occur to accommodate this option:

- S.W. 114th Avenue at McBride Court would be closed, dead ending on both sides of this LRT alignment.
- There would be two at-grade crossings of the LRT alignment in this segment: S.W. 117th Avenue and the Beaverton Transit Center north bus roadway.
- The LRT would displace a segment of S.W. Beaverdam Road north of Canyon Place.

Highway Improvements. No highway improvements are proposed for this segment.

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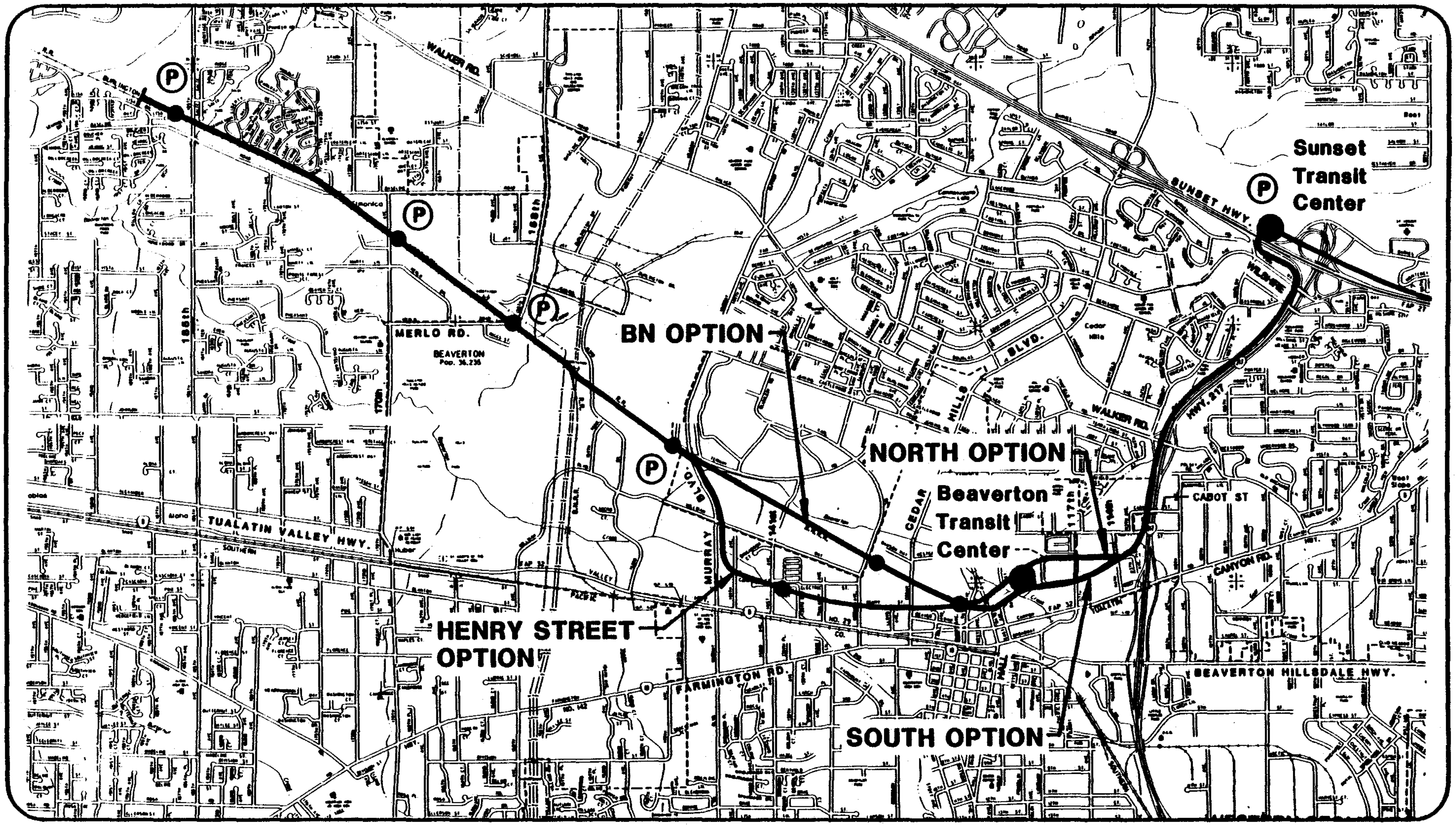

The Oregon Department of Transportation

WESTSIDE LIGHT RAIL TRI-MET

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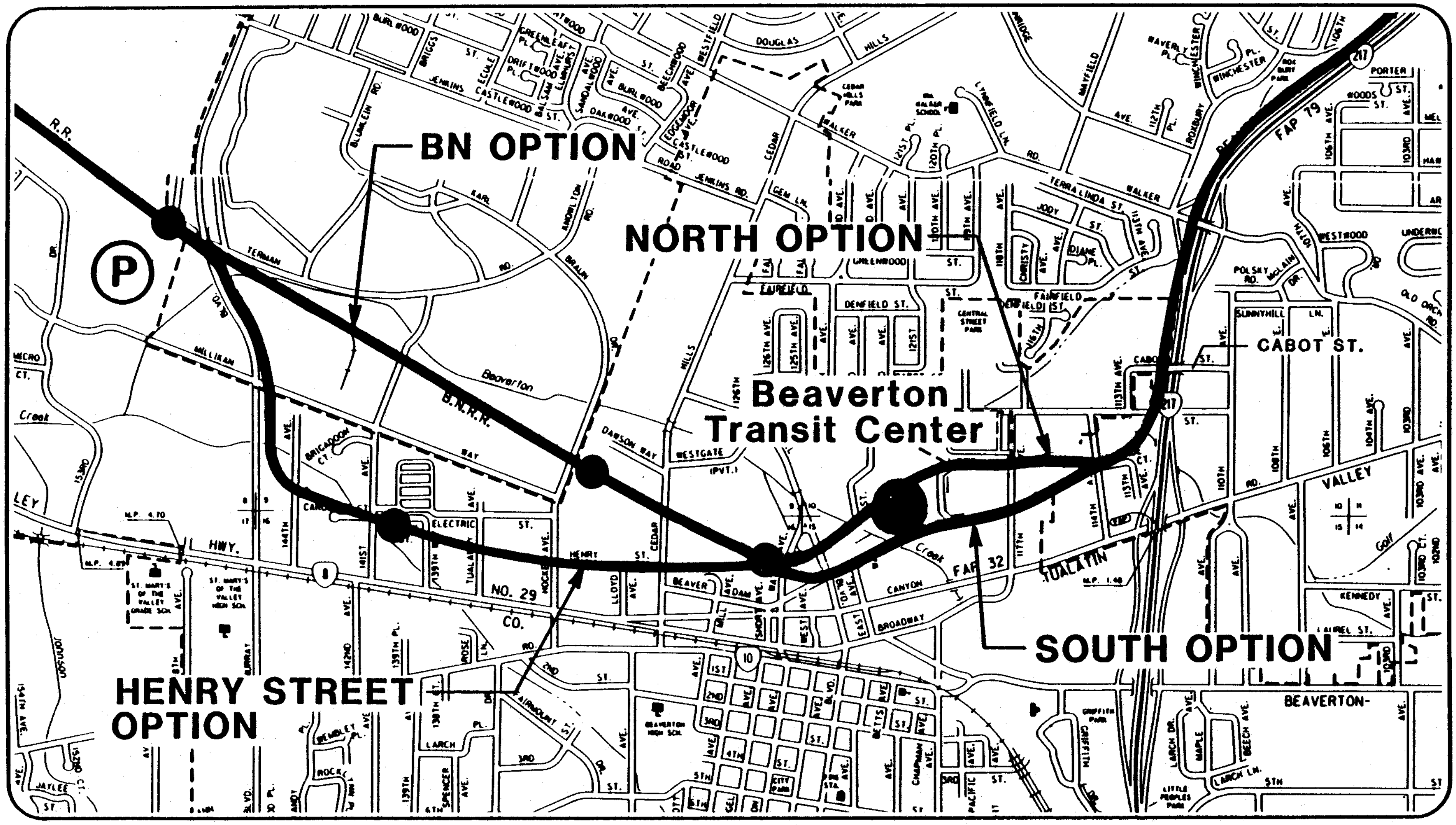
WESTSIDE CORRIDOR PROJECT
LRT ALIGNMENT WEST OF SUNSET TRANSIT CENTER
FIGURE 2.2-13a



The Oregon Department of Transportation

WESTSIDE LIGHT RAIL TRI-MET

WESTSIDE CORRIDOR PROJECT
BEAVERTON ALIGNMENT OPTIONS

FIGURE 2.2-13b

South Option

Adopted Alignment. The South option would be similar to the North option between Cabot Street and S.W. 114th Avenue. The South option then would run in a southwesterly direction along Hall Creek from S.W. 114th Avenue to S.W. 117th Avenue. There, the South option would turn west, passing through the Canyon Place Shopping Center to the south side of the Beaverton Transit Center. Three tracks would be provided on the south side of the existing bus platforms.

Transit Stations/Park-and-Ride Lots. The Beaverton Transit Center (see Figure 2.2-9) would be the only station within this section of the LRT alignment. A kiss-and-ride area would be located north of the bus platforms and LRT platforms to the south. No park-and-ride facilities would be provided.

Local Street Improvements. The following changes to the local street system would occur to accommodate this option:

- As in the North option, S.W. 114th Avenue would be closed at the limits of the LRT right-of-way.
- Grade crossings would occur at S.W. 117th Avenue and within the Canyon Place Shopping Center.

Highway Improvements. No highway improvements are proposed for this segment.

2.2.3.6 East Beaverton/Beaverton Transit Center to S.W. Watson Avenue Segment

Between the Beaverton Transit Center and S.W. Watson Avenue the LRT would follow one of two proposed alignments: a North option and a South option (see Figures 2.2-13a and 13b). The North option would exit the north side of the Beaverton Transit Center and proceed west toward S.W. Hall Boulevard and S.W. Watson Avenue on new right-of-way. The South option would exit the south side of the transit center, then follow the existing S.W. Beaverdam Road right-of-way to S.W. Hall Boulevard and S.W. Watson Avenue.

North Option

Alignment. The North option would exit the Beaverton Transit Center, cross S.W. Lombard Avenue at grade and turn in a westerly direction. The LRT transitway would cross S.W. Hall Boulevard and S.W. Watson Avenue at grade, approximately 600 feet north of Canyon Road.

Transit Stations/Park-and-Ride Lots. A transit station would be provided immediately west of S.W. Watson Avenue. No bus transfer or park-and-ride facilities would be provided at this location.

Local Street System. Some minor changes to the local street system would occur to accommodate the LRT, including at-grade crossings of S.W. Lombard Avenue, S.W. Hall Boulevard and S.W. Watson Avenue.

Highway Improvements. No highway improvements are proposed for this segment.

South Option

Adopted Alignment . The South option would exit the transit center and cross S.W. Lombard Avenue at grade. Between S.W. Lombard Avenue and S.W. Watson Avenue, the LRT would in part occupy the S.W. Beaverdam Road right-of-way. Between S.W. Hall Boulevard and S.W. Watson Avenue, the LRT alignment would turn northwest and enter right-of-way formerly occupied by the BN Railroad, or turn west towards the S.W. Henry Street right-of-way.

Transit Stations/Park-and-Ride Lots. A transit station would be provided immediately west of S.W. Watson Avenue. No bus transfer, park-and-ride, or kiss-and-ride facilities would be provided at this location.

Local Street System. Some minor changes to the local street system would occur to accommodate LRT, including at-grade crossings of S.W. Lombard Avenue, S.W. Hall Boulevard, and S.W. Watson Avenue. In addition, the LRT transitway would occupy the right-of-way of S.W. Beaverdam Road, which would be closed to all other traffic.

Highway Improvements. No highway improvements are proposed for this segment.

2.2.3.7 Beaverton/S.W. Watson Avenue to S.W. Murray Boulevard Segment

Two LRT alignment options are under consideration for the western portion of central Beaverton, between S.W. Watson Avenue and S.W. Murray Boulevard (see Figures 2.2-13a and 13b). A northern alignment option, the BN option, would occupy the existing BN Railroad right-of-way between these points. The second alignment option, the S.W. Henry Street option, would follow a route south of the BN Railroad right-of-way, occupying S.W. Henry Street between Cedar Hills Boulevard and S.W. Hocken Avenue.

BN Option

Adopted Alignment. From S.W. Watson Avenue west to S.W. Murray Boulevard, the LRT would occupy the existing BN Railroad right-of-way. The LRT tracks would be constructed in place of the existing railroad tracks and would cross under the existing S.W. Murray Boulevard overpass, see Section 4.3.1, Freight Railroads.

Transit Stations/Park-and-Ride Lots. An LRT station would be built at S.W. Hocken Avenue on the east side of S.W. Karl Braun Drive. No bus transfer or park-and-ride facilities would be provided at this location.

Local Street System. Some minor changes to the local street system would occur to accommodate the LRT, including a new at-grade crossing at S.W. Cedar Hills Boulevard and improvements to existing at-grade crossings at S.W. Karl Braun Drive, S.W. Shannon Road, and S.W. Schottky Road.

Highway Improvements. No highway improvements are proposed for this segment.

Henry Street Option

Alignment. The LRT would run west from S.W. Watson Avenue on new right-of-way to connect with S.W. Henry Street at S.W. Cedar Hills Boulevard. At S.W. Hocken Avenue, the LRT transitway would leave S.W. Henry Street and proceed northwest on new right-of-way, passing through the intersection of S.W. 141st Avenue and Whitney Street, to S.W. Murray Boulevard. At S.W. Murray Boulevard, the LRT transitway would turn north, paralleling the east side of S.W. Murray Boulevard on new right-of-way to the existing BN Railroad right-of-way. There, the LRT would turn west, crossing under the existing S.W. Murray Boulevard overpass. The existing BN railroad tracks east of S.W. Murray Boulevard would be removed.

Transit Stations/Park-and-Ride Lots. The Henry Street alignment option would include a station at S.W. 141st Avenue. No bus transfer or park-and-ride facilities would be provided at this location.

Local Street System. Some minor changes to the local street system would occur to accommodate this option. These include:

- At-grade crossings would occur at Cedar Hills Boulevard, S.W. Hocken Avenue, S.W. Tualaway Avenue, S.W. 139th Avenue, S.W. 141st Avenue (and Whitney Street), S.W. 144th Avenue, and Millikan Way at S.W. Murray Boulevard.

- S.W. Henry Street would be reconstructed from a two-way street (one lane per direction) to a single, eastbound lane.

- S.W. Lloyd Street would be closed at S.W. Henry Street.

- The Tektronix internal roadway serving Building #78 would require relocation.

Highway Improvements. No highway improvements are proposed for this segment.

2.2.3.8 Beaverton/S.W. Murray Boulevard to S.W. 185th Avenue Segment

Alignment

The LRT transitway would cross under S.W. Murray Boulevard at the existing overpass (see Figures 2.2-13a and 13b). Between S.W. Murray Boulevard and S.W. 153rd Avenue, the LRT would parallel the existing BN Railroad industrial spur track, which would be relocated to the southside of the existing BN right-of-way. Between S.W. 153rd Avenue and S.W. Baseline Road, the LRT would occupy a new right-of-way north of the existing BN Railroad mainline tracks. From S.W. Baseline Road to the existing Willow Creek trestle, the LRT would occupy the existing BN Railroad right-of-way, with the BN tracks reconstructed on new right-of-way to the south. From the trestle to the end of the line just west of S.W. 185th Avenue, the LRT would parallel the existing BN track on new right-of-way to the north.

Transit Stations/Park-and-Ride Lots

The S.W. Murray Boulevard station (see Figure 2.2-10b) would include an 800-space park-and-ride lot, a kiss-and-ride area, and bus transfer platforms. The park-and-ride facilities would be located south of the LRT tracks. The BN spur track would continue to operate on the existing alignment through the park-and-ride site.

The S.W. Merlo Road station (see Figure 2.2-10b) would include a 250 space park-and-ride lot, a kiss-and-ride area, and bus transfer platforms. The park-and-ride lot would be located north of the LRT tracks, fronting on the east side of S.W. Merlo Road.

The LRT station at S.W. 170th Avenue (see Figure 2.2-10a) would include a 400-space park-and-ride lot, a kiss-and-ride area, and bus transfer platforms. The park-and-ride lot would be located north of the LRT transitway on the east side of S.W. 170th Avenue, immediately west of the proposed Westside maintenance facility site. The proposed Westside maintenance facility will be located approximately 500 to 1,000 feet east of S.W. 170th Avenue and north of the BN ROW (see Figure 2.2-10a).

The S.W. 185th Avenue station (see Figure 2.2-10a) would include a 1,000-space park-and-ride lot, a major bus transfer facility, and a kiss-and-ride area. Current plans call for a station location approximately 900 feet west of S.W. 185th Avenue.

Local Street System

At-grade crossings would occur at the following locations: S.W. 153rd Avenue, S.W. Merlo Road, S.W. 170th Avenue, Baseline Road, and S.W. 185th Avenue.

Highway Improvements

No highway improvements are proposed for this segment.

2.2.4 Short Terminus Options

Two short terminus options are being considered: the S.W. Murray Boulevard terminus and the Sunset Transit Center terminus. While the LRT Alternative previously described extends about 12 miles from S.W. 11th Avenue to S.W. 185th Avenue, the S.W. Murray Boulevard terminus is approximately two miles shorter (ten miles total extension), and the Sunset Transit Center terminus is six miles shorter (six miles total extension). In general, shortening the LRT line to either terminus affects the light rail operating plan and operating results, as well as the local feeder bus network, operations of specific bus lines, and associated improvements.

The Sunset Transit Center terminus option would not fulfill a basic planning objective of the Westside Corridor Project, which is to connect downtown Portland to downtown Beaverton. This option is being developed to acknowledge possible federal funding limitations. It is seen only as an initial increment for future extension.

The short terminus options differ in varying degrees from the S.W. 185th Avenue terminus option. First, only the S.W. Murray Boulevard terminus option extends far enough west to reach a suitable LRV maintenance and storage facility site. Physical constraints and comprehensive plan and zoning designations preclude siting such a facility adjacent to the LRT line anywhere east of S.W. Murray Boulevard. Therefore, the Sunset Transit Center option assumes all Westside train operations and LRV maintenance would occur from the Ruby Junction facility in Gresham.

Improvements would be needed at Ruby Junction to accommodate the Westside LRV fleet for the Sunset Transit Center terminus option. The S.W. Murray Boulevard terminus option would likely use a maintenance facility site on the southwest quadrant of the intersection of S.W. Murray Boulevard and the BN Railroad. In the S.W. 185th Avenue terminus option, this facility would be sited just east of S.W. 170th Avenue.

Both short terminus options would limit or reduce direct park-and-ride access to the light rail line, compared with the S.W. 185th Avenue terminus option. S.W. Murray Boulevard is the first practical site west of Sunset Transit Center for a park-and-ride lot adjacent to a light rail station. The park-and-ride demand for the corridor is forecast to be about 3,200 to 3,400 spaces in 2005. Each terminus option would assume approximately 300 spaces at Sylvan. In the S.W. Murray Boulevard terminus option, as many parking spaces as possible would be placed at S.W. Murray Boulevard. Approximately 1,000 spaces could be provided there. The Sunset Transit Center is assumed to have approximately 600 spaces. The S.W. Murray Boulevard terminus option would accommodate approximately 1,900 park-and-ride spaces. The Sunset Transit Center terminus option would provide about 900. With both terminus options, all potential park-and-ride lot sites adjacent to proposed LRT stations would be utilized for park-and-ride access to LRT.

2.2.4.1 S.W. Murray Boulevard Terminus Option

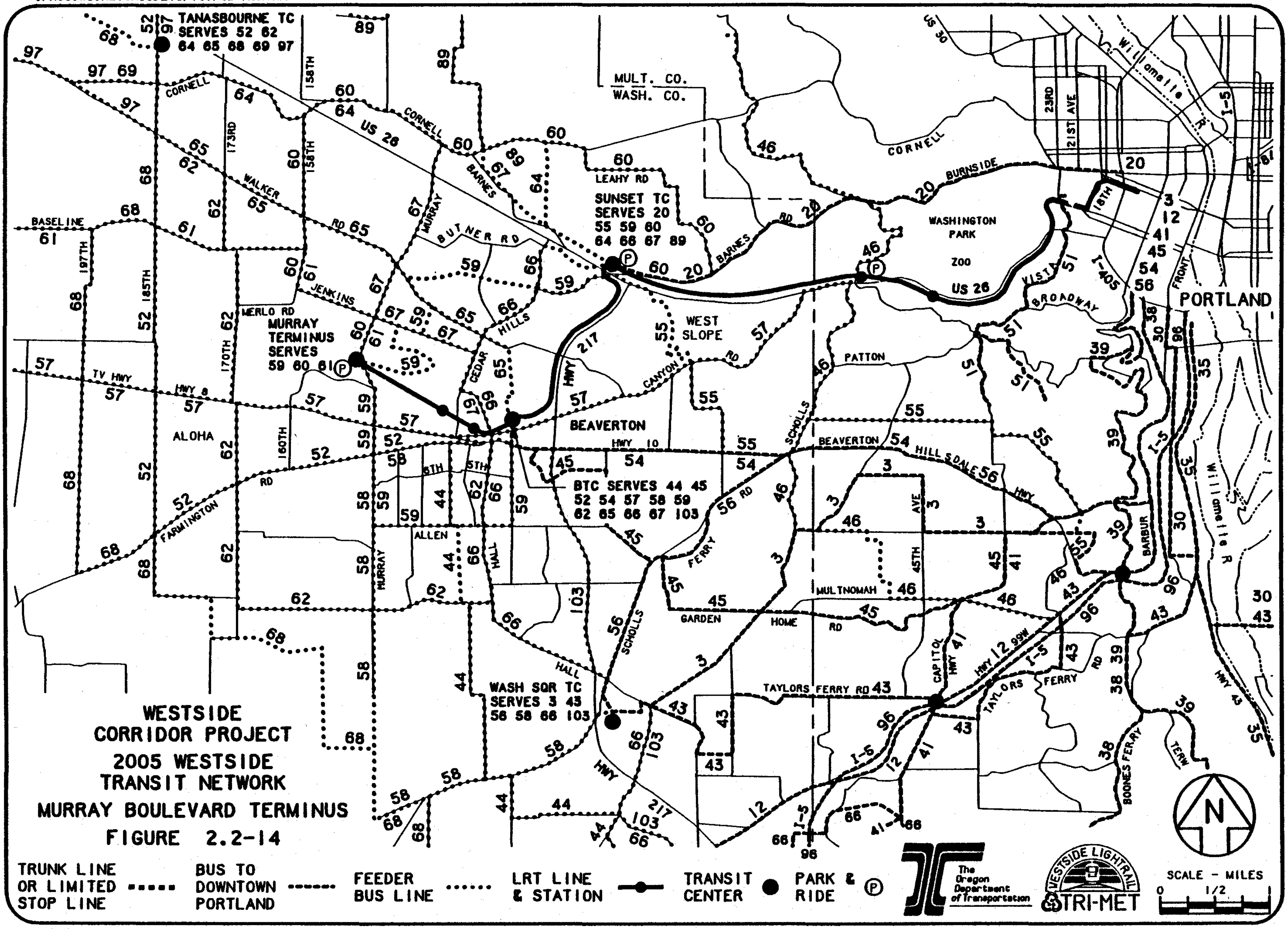
Basic Characteristics

The LRT alignment is the same as described for the S.W. 185th Avenue terminus option, except that it ends two miles further east at S.W. Murray Boulevard. Alignment options through the West Hills and through central Beaverton are the same as described for the S.W. 185th Avenue terminus option.

The bus network for the S.W. Murray Boulevard terminus option does not differ significantly from that of the S.W. 185th Avenue terminus option. Bus routes that previously connected to the S.W. 185th Avenue Transit Center would connect to the S.W. Murray Boulevard station or Beaverton Transit Center instead. Figure 2.2-14 illustrates the transit service network associated with the S.W. Murray Boulevard terminus option in 2005.

A systemwide bus fleet of 1,009 is proposed, including 217 articulated buses, with 841 buses in service during peak hours. The Westside Corridor bus fleet would total 180 buses.

[PROJ.WS.ALIGN]SDEISFIG.FGB MURTRM



WESTSIDE CORRIDOR PROJECT
2005 WESTSIDE TRANSIT NETWORK
MURRAY BOULEVARD TERMINUS
FIGURE 2.2-14

An LRV maintenance and storage yard for the Westside line would be developed on a new site at the southwest quadrant of the intersection of S.W. Murray Boulevard and the BN Railroad, adjacent to the park-and-ride lot (see Figure 2.2-15). There are, however, physical limitations associated with this site that constrain the layout of yard trackwork and result in a less-than-optimal configuration. Also, construction of a facility at this site will require relocation of the existing BN Railroad spur track (see Section 4.3.1).

Approximately 1,450 fewer park-and-ride spaces directly connected to the LRT line would be available in the S.W. Murray Boulevard terminus option, compaıed with the S.W. 185th Avenue terminus option, and 1,210 fewer spaces than with the TSM Alternative.

The entire Westside line to S.W. Murray Boulevard would be double-tracked. Its length from S.W. 11th Avenue to S.W. Murray Boulevard would be approximately ten miles, with eight to ten stations, depending on the alignment option through the West Hills. The line would, for the most part, be signalized and operated similarly to the S.W. 185th Avenue terminus option. An expanded communications system and central control would be incorporated as part of the combined LRT system.

Operating Characteristics

Bus Operations. Compared to LRT with a S.W. 185th Avenue terminus, the S.W. Murray Boulevard terminus option proposes 3% more daily bus hours in the Westside Corridor (1,460 daily hours total), and 5% more daily bus miles (20,000 bus miles total).

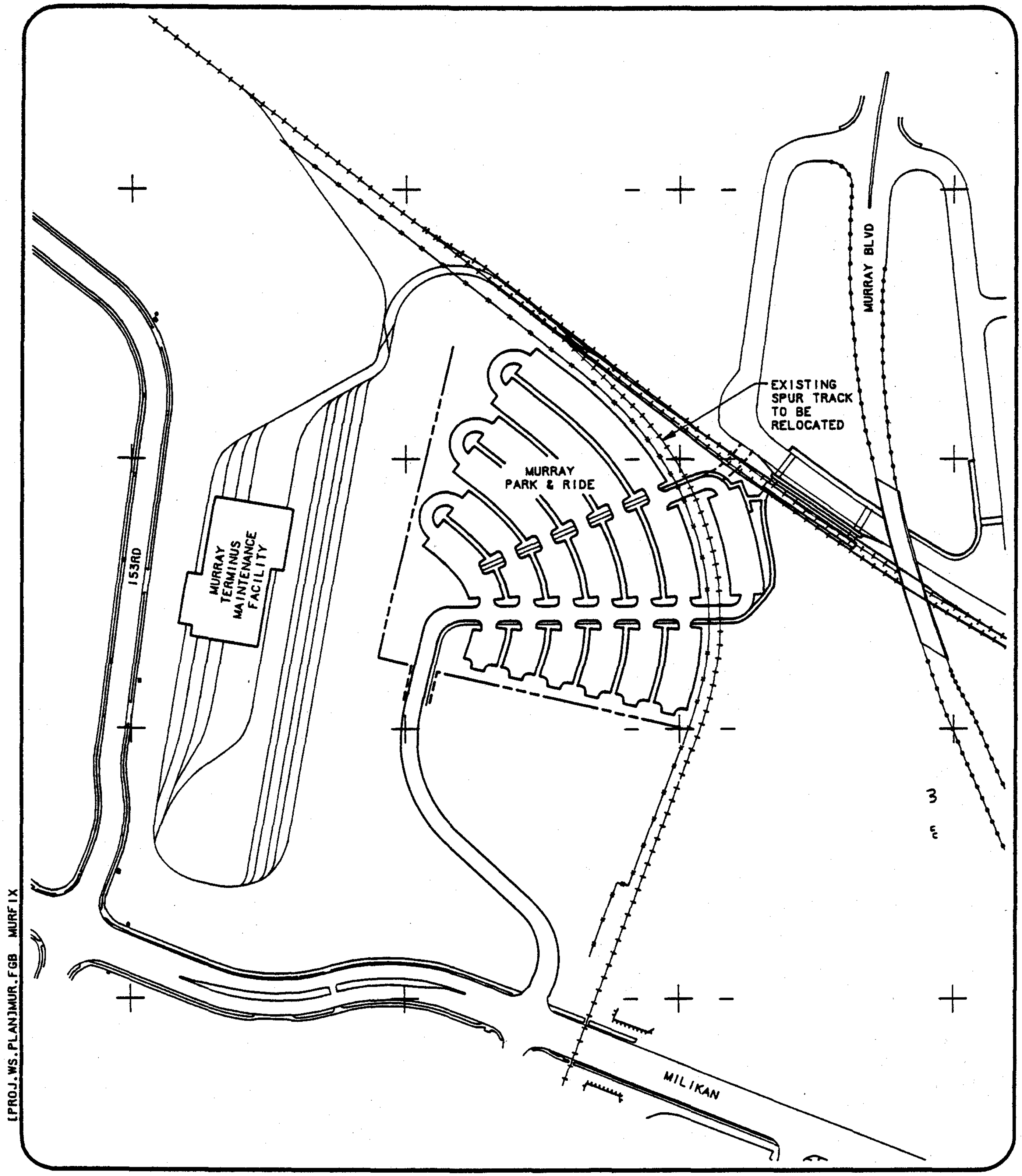
LRT Operations. The shortened Westside line would be operated in conjunction with the existing MAX line. Trains would be through-routed between Cleveland Avenue in Gresham and S.W. Murray Boulevard to the extent possible. Peak-hour service would be a combination of Gresham to S.W. Murray Boulevard and Gresham to Beaverton Transit Center, similar to the S.W. 185th Avenue terminus option. Base period service would be Gresham to S.W. Murray Boulevard and Gateway Transit Center to Beaverton Transit Center.

Metro's preliminary ridership forecast for 2005 suggests an average peak-hour headway of six minutes on the Westside line and four minutes on the Eastside line.

One way running time from the existing Galleria Station (S.W. Tenth Avenue) to S.W. Murray Boulevard would be between 21 and 24 minutes, depending on the alignment option. Again, two minutes would be added to account for anomalous conditions. For the combined east-west line (Cleveland Avenue to S.W. Murray Boulevard), operating data for 2005 are as follows:

Length of route, one way (miles)	24.3 to 24.9
Running time, through trip (average minutes)	71
Layover, (average minutes)	13
Headways, weekdays (minutes)	
Peaks Eastside (7:00 - 8:00 a.m.; 4:30 - 5:30 p.m.)	5
Peaks Westside (7:00 - 8:00 a.m.; 4:30 - 5:30 p.m.)	7
Midday (8:00 a.m. - 4:30 p.m.)	7.5-15*
Evening (5:30 - 10:30 p.m.)	15
Late night (10:30 p.m. - 12:30 a.m.)	30
Train (platform) hours, weekday	373
Train miles, weekday	6,290
Car miles, weekday	11,180
Vehicles scheduled in peaks	60
Vehicles in fleet, including spares	72

*See Text.



WESTSIDE CORRIDOR PROJECT

MURRAY TERMINUS
MAINTENANCE FACILITY

FIGURE 2.2-15

2.2.4.2 Sunset Transit Center Terminus Option

Basic Characteristics

Terminating the LRT line at Sunset Transit Center is different from the S.W. 185th Avenue terminus option in a fundamental way: Sunset Transit Center becomes the primary transit focal point for the Westside Corridor, with Beaverton Transit Center providing a secondary focal point for buses only. Most Westside feeder bus lines would have no other opportunity to connect with the LRT line. All time-coordinated meetings with the LRT line would occur at Sunset Transit Center or in a few instances at Sylvan. Line 57 would operate to Sylvan via the Beaverton Transit Center. Line 61 would connect the Forest Grove/Hillsboro area directly to Sunset Transit Center. Lines 44, 45, 58, 62, 65 and 103 would operate from Beaverton Transit Center to Sunset Transit Center via Highway 217 to connect with the LRT.

The Westside line would be fully double-tracked. Its length from S.W. 11th Avenue to Sunset Transit Center would be approximately six miles, with four to six stations, depending on the alignment option. Except for downtown Portland, the line would be signalized with an ABS system. All Sunset Highway crossings in the Sunset Highway segment would be grade-separated. In downtown Portland, at-grade intersections would be controlled by a signal preemption system. An expanded communications system and central control would be incorporated as part of the combined LRT system.

Figure 2.2-16 illustrates the local feeder bus network associated with the Sunset Transit Center Terminus option in 2005.

For this terminus option, the alignment options through the West Hills also are the same as described for the S.W. 185th Avenue terminus option (i.e., Southside, Northside, and Long Tunnel). Park-and-ride opportunities are limited to Sylvan and Sunset Transit Center. Because Sunset Transit Center is considered only as an interim terminus, only 600 parking spaces are assumed at the Sunset Transit Center site, the same as in the other terminus options. It is likely that park-and-ride demand would outstrip supply until the line is extended further west.

A systemwide bus fleet of 1,021 is proposed, including 217 articulated buses, with 851 buses in service during peak hours. The Westside Corridor bus fleet would total 193 buses.

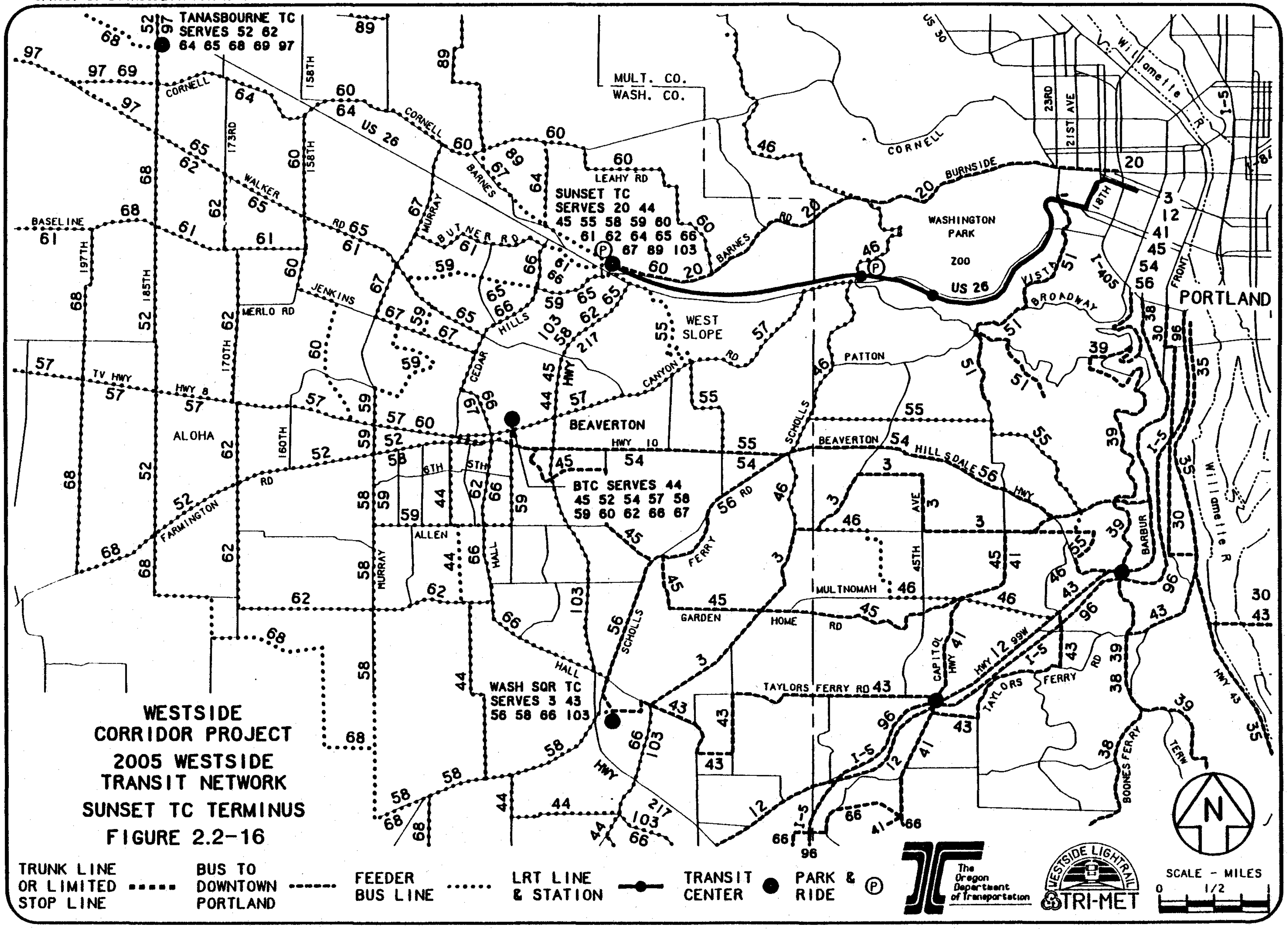
Operating Characteristics

Bus Operations. Compared to LRT with a S.W. 185th Avenue terminus, the Sunset Transit Center terminus option proposes 11% more daily bus hours in the Westside Corridor (1,570 daily hours total), and 11% more daily bus miles (21,000 bus miles total).

LRT Operations. The shortened Westside line would be operated in conjunction with the present MAX line. Trains would be through-routed between Cleveland Avenue in Gresham and Sunset Transit Center, to the extent possible. With patronage substantially lower than with the S.W. 185th Avenue terminus option, the imbalance in peak-hour headways would increase, and more Eastside trains would loop downtown instead of being through-routed. Metro's preliminary ridership forecasts for 2005 suggest an average peak-hour headway of 7.5 minutes on the Westside line and four minutes on the Eastside line. All Westside trains (peak, base, evening, and night) would operate to the Sunset Transit Center with no shorter turnbacks practical. Eastside trains would have shorter turnbacks as in the TSM Alternative and other terminus option.

All LRV maintenance and storage for the combined lines would take place at the existing Ruby Junction shop and yard. There is no practical site for a Westside facility with a Sunset Transit Center Terminus option. Storage tracks would be added within the existing Ruby Junction site to accommodate the total LRV fleet. Lack of a Westside storage and maintenance facility and headway imbalances would create operational difficulties and expense until the initial increment could be extended at least as far as S.W. Murray Boulevard.

[PROJ.WS.ALIGN]SDEISFIG.FGB SUNTRM



WESTSIDE CORRIDOR PROJECT
2005 WESTSIDE TRANSIT NETWORK
SUNSET TC TERMINUS
FIGURE 2.2-16

One-way running time from the existing Galleria Station to Sunset Transit Center Terminus would be from 12 to 15 minutes, depending on the alignment. One minute is included to account for unusual conditions. For the combined east-west line (Cleveland Avenue to Sunset Transit Center), operating data for 2005 are as follows:

Length of route, one way (miles)	20.5 to 20.9
Running time, through trip (average minutes)	61
Layovers (average minutes)	13
Headways, weekday (minutes)	
Peaks Eastside (7:00 - 8:00 a.m.; 4:30 - 5:30 p.m.)	5
Peaks Westside (7:00 - 8:00 a.m.; 4:30 - 5:30 p.m.)	9
Midday (8:00 a.m. - 4:30 p.m.)	7.5-15*
Evening (5:30 - 10:30 p.m.)	15
Late night (10:30 p.m. - 12:30 a.m.)	30
Train (platform) hours, weekday	296
Train miles, weekday	4,810
Car miles, weekday	8,780
Vehicles scheduled in peaks	48
Vehicles in fleet, including spares	58

*See Text.

2.3 CAPITAL COSTS

This section presents capital cost estimates for each Westside Corridor Project alternative. Capital cost estimates were developed for all possible combinations of LRT alignment and terminus options. Since the total number of combinations is quite large (36), only representative examples are summarized here. These examples show differences that exist among the main options - differing alignments in the Sunset Canyon and Beaverton sections, and the various terminus options.

2.3.1 Methodology

A full description of the estimating methodology is found in the "Capital Cost Estimation Methodology Report" by Tri-Met, dated February 1989.

For cost estimating purposes, the LRT options were divided into 13 functional elements and six geographic segments (where applicable). Functional elements were estimated for a particular segment and others were considered as "systemwide" elements.

Functional elements include utilities, track materials and installation, civil construction, stations, park-and-ride lots, fare collections, elderly and handicapped accessibility, and right-of-way. Right-of-way estimates were prepared for Tri-Met by ODOT. Right-of-way needs were identified on a parcel basis.

Systemwide elements include LRVs, an operations facility, traction electrification system (TES), and signals and communication. TES, signals and communications are equipment-based elements and emphasis was placed on determining overall quantities and descriptions rather than distributing these needs on a geographic basis.

Early estimates relied heavily on unit rates developed from the data base for Portland's Banfield Corridor project. A similar methodology has been applied for the SDEIS estimates for some of the major functional elements. Historical data base rates were used for most utilities, track, civil construction outside the Canyon section, stations, park-and-ride lots, fare collection, and elderly and handicapped accessibility.

The tunnel estimates were produced by a consulting engineering firm for Tri-Met, and cost estimates for construction in the canyon are based on specific design features (walls, excavation, structures and landscaping). Route design and construction cost estimates in the canyon and along Highway 217 were coordinated with ODOT. Right-of-way estimates were produced by ODOT and include administrative, legal, and risk considerations.

Engineering, administration, construction management, design, testing, operational start-up, claims review, litigation (excluding settlement costs), and project-wide insurance are all included in the budget's engineering line item. The approach assumed these costs as a 30% add-on to all construction-cost-estimates, with the exception of right-of-way acquisition.

Tri-Met applied a project-wide contingency factor equal to 20% of all construction costs, except for right-of-way acquisition. An additional geotechnical contingency of 12.5% has been applied to approximately 80% of the line-item cost estimate for heavy underground construction associated with tunnels.

Costs for the No Build and TSM Alternatives have been estimated with a consistent methodology, except that engineering and contingencies have been reduced for bus purchases to reflect Tri-Met's experience.

2.3.2 Capital Cost Estimates

All capital cost estimates in this section are presented in base year (January 1990) dollars without consideration of future inflation or project staging and scheduling. Chapter 7 also presents capital cost estimates in year of expenditure dollars, based on these 1990 estimates, an assumed construction schedule, and an assumed inflation rate. All cost estimates are based on a November 1989 design definition of the LRT options and are intended to be comprehensive. ODOT cost estimates for highway improvements along Sunset Highway and Highway 217 are shown separately. A full description of all cost estimates is found in the "SDEIS Capital Cost Estimates" Technical Memorandum 20n, dated February 1990 and updated in December 1990.

Table 2.3-1 provides a summary of cost estimates for nine LRT alignment and terminus options. The range of cost estimates for the canyon options is from $441.1 million to $491.2 million for the line from S.W. 11th Avenue to the S.W. 185th Avenue terminus, assuming the adopted alignment in Beaverton (South/BN). The range of cost estimates for the Beaverton options to S.W. 185th Avenue is from $439.5 million to $451.5 million, assuming the Northside option in the canyon. The cost estimates for the terminus options range from $254.5 million for a Sunset Transit Center terminus, $390.6 million for a S.W. Murray Boulevard terminus, and $441.1 million for a S.W. 185th Avenue terminus. These estimates assume a Northside in the canyon and the South/BN alignment in Beaverton.

The cost per route foot is estimated at $7,145 for the Southside and Northside alignment options (to S.W. 185th Avenue via South/BN). The Long Tunnel alignment option with a Zoo Station (to S.W. 185th Avenue via South/BN) is $8,110 per route foot.

Relative to the terminus options, the total cost per route foot increases as the line is shortened from about $7,200 for a S.W. 185th Avenue terminus to about $7,800 for a S.W. Murray Boulevard terminus and approximately $8,500 for a Sunset Transit Center terminus. Again, the estimates assume the alignment on the Northside in the canyon and the South/BN alignment in Beaverton. The estimates illustrate the increased costs due to urban design standards in downtown Portland, the more difficult construction in the canyon, and the relative ease (hence, decreased cost) of construction along the BN Railroad right-of-way and a suburban setting.

As discussed above, cost estimates for all 36 possible LRT options, bus costs, and highway costs are provided in the Capital Cost Estimates Technical Memorandum (Tri-Met Engineering Services, 1990).

Table 2.3-2 provides a summary of cost estimates for the related bus elements of the nine LRT options shown in Table 2.3-1 and for the No Build and TSM Alternatives. All TSM, Westside LRT and bus element estimates are presented as incremental costs relative to the No Build Alternative. Table 2.3-3 shows that the systemwide No Build cost is $105.4 million and is assumed to be the same for all

TABLE 2.3-1
LRT CAPITAL COST ESTIMATE SUMMARY
(1990 dollars)

DESCRIPTION	SOUTHSIDE SURFACE to 185th via South BN	NORTHSIDE SHORT TUNNEL to 185th via South BN	LONG TUNNEL WITH ZOO to 185th via South BN	LONG TUNNEL NO ZOO to 185th via South BN	NORTHSIDE SHORT TUNNEL to 185th via North BN	NORTHSIDE SHORT TUNNEL to 185th via South Henry	NORTHSIDE SHORT TUNNEL to 185th via North Henry	NORTHSIDE SHORT TUNNEL to Murray via South BN	NORTHSIDE SHORT TUNNEL to Sunset TC
UTILITY RELOCATION	$12,997,968	$11,291,813	$7,902,000	$7,902,000	$10,929,999	$11,665,581	$11,312,424	$10,239,843	$7,610,639
TRACK INSTALLATION	$8,028,854	$8,894,172	$10,485,583	$10,404,583	$8,459,997	$8,721,830	$8,492,551	$7,787,130	$5,530,910
TRACK MATERIALS	$8,339,350	$8,432,768	$9,527,173	$9,446,173	$8,385,983	$8,516,041	$8,488,922	$6,894,543	$4,234,402
CIVIL CONSTRUCTION	$126,520,187	$102,147,729	$61,713,089	$61,713,089	$102,351,907	$104,260,704	$104,477,761	$97,209,040	$71,408,421
STATIONS	$7,475,004	$7,664,721	$6,330,621	$6,330,621	$7,664,721	$7,664,721	$7,664,721	$5,975,007	$4,453,367
PARK AND RIDE LOTS	$8,886,780	$8,886,780	$8,306,200	$8,306,200	$8,886,780	$8,886,780	$8,886,780	$5,183,080	$3,281,180
FARE COLLECTION	$2,860,637	$2,860,637	$2,706,008	$2,551,379	$2,860,637	$2,860,637	$2,860,637	$2,396,750	$1,623,605
E & H ACCESSABILITY	$903,584	$903,584	$903,584	$790,636	$903,584	$903,584	$903,584	$734,162	$451,792
TUNNELS	$0	$20,480,428	$92,893,118	$80,891,985	$20,480,428	$20,480,428	$20,480,428	$20,480,428	$20,480,428
LIGHT RAIL VEHICLES	$49,300,000	$49,300,000	$49,300,000	$45,900,000	$49,300,000	$49,300,000	$49,300,000	$40,800,000	$20,000,000
MAINTENANCE FACILITY	$14,716,938	$14,716,938	$14,716,938	$14,716,938	$14,716,938	$14,716,938	$14,716,938	$16,236,938	$3,000,000
TRACTION ELECTRIFICATION	$13,320,945	$13,242,185	$14,343,010	$14,322,440	$13,242,185	$13,349,985	$13,349,985	$11,295,185	$6,067,215
SIGNALS	$12,130,140	$11,953,740	$13,885,180	$13,885,180	$11,953,740	$12,659,340	$12,659,340	$10,058,140	$4,527,080
COMMUNICATIONS	$6,378,944	$6,378,944	$6,378,944	$6,378,944	$6,378,944	$6,378,944	$6,378,944	$5,826,392	$4,074,880
RIGHT OF WAY (MARGINS INCLUDED)	$37,962,193	$38,378,095	$32,609,283	$32,587,063	$37,667,160	$43,954,876	$41,855,015	$26,855,671	$17,374,606
ADMIN. INSPTN. & PROF. SVCS.	$81,557,799	$80,146,332	$89,817,434	$85,062,050	$79,954,753	$81,109,654	$80,991,904	$72,334,991	$47,023,176
CONTINGENCY	$54,371,866	$55,468,822	$69,383,728	$65,145,678	$55,341,103	$56,111,037	$56,032,537	$50,261,262	$33,386,718
TOTAL	$445,751,189	$441,147,688	$491,201,893	$466,334,959	$439,478,859	$451,541,080	$448,852,471	$390,568,562	$254,528,419
Length in route feet	62,377	61,740	60,570	60,210	61,593	62,665	62,613	50,194	30,039
Cost per foot	$7,146	$7,145	$8,110	$7,745	$7,135	$7,206	$7,169	$7,781	$8,473

Source: Tri-Met Engineering Services, 11/90.

TABLE 2.3-2
BUS CAPITAL COST ESTIMATE SUMMARY
(1990 dollars)

DESCRIPTION	TSM	SOUTHSIDE SURFACE to 185th via South BN	NORTHSIDE SHORT TUNNEL to 185th via South BN	LONG TUNNEL WITH ZOO to 185th via South BN	LONG TUNNEL NO ZOO to 185th via South BN	NORTHSIDE SHORT TUNNEL to 185th via North BN	NORTHSIDE SHORT TUNNEL to 185th via South Henry	NORTHSIDE SHORT TUNNEL to 185th via North Henry	NORTHSIDE SHORT TUNNEL to Murray via South BN	NORTHSIDE SHORT TUNNEL to Sunset TC
STANDARD BUSES										
Corridor Increment to No Build										
Number	66	52	52	49	49	52	52	52	58	71
Estimated Cost	$11,470,800	$9,037,600	$9,037,600	$8,516,200	$8,516,200	$9,037,600	$9,037,600	$9,037,600	$10,080,400	$12,339,800
ARTICULATED BUSES										
Corridor Increment to No Build										
Number	33	(52)	(52)	(52)	(52)	(52)	(52)	(52)	(52)	(52)
Estimated Cost	$9,982,500	($15,730,000)	($15,730,000)	($15,730,000)	($15,730,000)	($15,730,000)	($15,730,000)	($15,730,000)	($15,730,000)	($15,730,000)
BUS MAINTENANCE FACILITY										
Corridor Increment to No Build										
Estimated Cost	$7,500,000									
ASSOCIATED IMPROVEMENTS										
Corridor Increment to No Build										
Estimated Cost	$43,247,319									
TOTAL BUS (Non LRT)										
Corridor Increment to No Build										
Estimated Cost	$72,200,619	($6,692,400)	($6,692,400)	($7,213,800)	($7,213,800)	($6,692,400)	($6,692,400)	($6,692,400)	($5,649,600)	($3,390,200)

Note: All costs include engineering and contingency

	No Build	TSM									
Year 2005 SYSTEMWIDE FLEET (Sept 1990)											
STANDARD BUS	505	802	787	787	790	790	787	787	787	792	804
ARTICULATED BUS	184	302	218	218	216	216	218	218	218	217	217
TOTAL BUS	689	1104	1005	1005	1006	1006	1005	1005	1005	1009	1021
Year 2005 CORRIDOR ONLY FLEET (Sept 1990)											
STANDARD BUS	122	188	174	174	171	171	174	174	174	180	193
ARTICULATED BUS	52	85	0	0	0	0	0	0	0	0	0
TOTAL BUS	174	273	174	174	171	171	174	174	174	180	193

Source: Tri-Met Engineering Services, 11/90.

Table 2.3-3
WESTSIDE CORRIDOR CAPITAL COST SUMMARY
Including No Build
(1990 dollars)

DESCRIPTION	No Build	TSM	SOUTHSIDE SURFACE to 185th via South BN	NORTHSIDE SHORT TUNNEL to 185th via South BN	LONG TUNNEL WITH ZOO to 185th via South BN	LONG TUNNEL NO ZOO to 185th via South BN	NORTHSIDE SHORT TUNNEL to 185th via North BN	NORTHSIDE SHORT TUNNEL to 185th via South Henry	NORTHSIDE SHORT TUNNEL to 185th via North Henry	NORTHSIDE SHORT TUNNEL to Murray via South BN	NORTHSIDE SHORT TUNNEL to Sunset TC
Westside LRT Improvements	N/A	N/A	445,751,189	441,147,688	491,201,893	466,334,959	439,478,859	451,541,080	448,852,471	390,568,562	254,528,419
Bus/Related Improvements											
Systemwide No Build	$105,391,583	$105,391,583	105,391,583	105,391,583	105,391,583	105,391,583	105,391,583	105,391,583	105,391,583	105,391,583	105,391,583
Westside Bus Increment to No Build		$72,200,619	(6,692,400)	(6,692,400)	(7,213,800)	(7,213,800)	(6,692,400)	(6,692,400)	(6,692,400)	(5,649,600)	(3,390,200)
ODOT Highway Improvements	N/A	$87,718,000	$87,718,000	$87,718,000	$87,718,000	$87,718,000	$87,718,000	$87,718,000	$87,718,000	$87,718,000	$87,718,000

NOTE: "NO BUILD" IS SYSTEMWIDE AND NOT SPECIFIC TO JUST THE WESTSIDE.

Source: Tri-Met Engineering Services 11/90 and ODOT 11/90.

alternatives. For the various LRT alignment options, however, the supporting Westside bus fleet varies slightly in size and mix of standard and articulated buses and is estimated to cost somewhat less than the No Build Westside bus fleet. This difference in bus cost is shown as a savings compared to the No Build, and is accounted for in the financial considerations in Chapter 7.

The LRT, related bus (compared to No Build), and ODOT highway costs are summarized in Table 2.3-3. These highway estimates are assumed to be constant for all TSM and LRT Alternatives.

2.4 OPERATING AND MAINTENANCE COSTS

This section summarizes transit operating and maintenance costs for each of the Westside Corridor Project alternatives.

2.4.1 Methodology

Operating and maintenance costs (O&M) were estimated using a model in which labor and material costs are calculated as a function of service levels. In this model, vehicle miles, vehicle hours, the number of vehicles, and other operating statistics for a particular transit alternative are converted to resources such as employees, materials, and services that would be required to operate and maintain the alternative. Full documentation of the methodology is found in the "Operations and Maintenance Cost Methodology Report" by Tri-Met, dated August 1988.

In accordance with the Methodology Report, the following assumptions were applied to estimate operating and maintenance costs for the Westside Corridor Project alternatives:

- over the next 15 years, worker benefits costs will increase at a rate of 2% annually above inflation;
- wages will increase with inflation;
- workers' compensation costs will increase with inflation;
- non-operator productivity will not increase appreciably, leaving overtime at current percentages; and
- diesel fuel will increase with inflation.

Cost inflation assumptions were based on historical trends. The productivity factors used in the estimates of operating and maintenance costs were based on fiscal year 1987/88 Tri-Met statistics and the current labor contract.

2.4.2 Operating and Maintenance Cost Estimates

Operation and maintenance (O&M) costs have been estimated for the transit portion of the major alternatives in the "Operating and Maintenance Cost Results" report, Technical Memorandum 20o by Tri-Met, dated September 1990, with addenda in December 1990. Only the network operating characteristics (bus and rail vehicle miles, vehicle hours, peak vehicles, facilities, stations, and route miles) differ among alternatives. As discussed above, unit costs and productivity factors are based on Tri-Met's current bus and rail costs, as well as on new information gathered during the preliminary engineering on the Westside LRT energy requirements and tunnel staffing levels.

Table 2.4-1 summarizes estimated annual O&M costs for each of the Westside Corridor Project alternatives. The cost estimates are presented in fiscal year 1989 dollars and are for the Westside Corridor alone. These costs are divided into bus transportation and maintenance, rail transportation and maintenance, and administrative categories. The "transportation" category refers primarily to bus or rail operators and supporting personnel who provide the transit service. The "maintenance" category, of

TABLE 2.4-1
WESTSIDE CORRIDOR ANNUAL TRANSIT OPERATING AND MAINTENANCE COST SUMMARY
(FY89 dollars)
YEAR 2005 SERVICE LEVELS

	NO BUILD	TSM	Surface to 185th	Tunnel with Zoo Station to 185th	Tunnel without Zoo Station to 185th	Surface to Murray Blvd	Surface to Sunset TC
Bus Transportation	$12,870,828	$16,383,514	$10,809,694	$10,851,549	$10,851,549	$11,193,912	$12,020,671
Bus Maintenance	$7,078,955	$9,188,060	$5,733,757	$5,790,567	$5,790,567	$6,065,606	$6,340,330
Rail Transportation	$0	$0	$2,013,597	$1,999,589	$1,848,074	$1,896,486	$945,624
Rail Maintenance	$0	$0	$3,734,624	$3,512,034	$3,410,303	$3,404,447	$2,181,595
General & Administrative	$1,501,597	$1,550,790	$1,555,810	$1,549,319	$1,547,155	$1,506,406	$1,428,155
Totals	$21,451,380	$27,122,364	$23,847,482	$23,703,058	$23,447,648	$24,066,857	$22,916,375

Source: Tri-Met Financial Planning, 1990 course, refers primarily to the vehicle and facilities maintenance function and maintenance of the right-of-way, e.g., the track, stations, and signals. Energy costs are included in the maintenance categories. The "administrative" category is a pro-ration of Tri-Met's general costs of administering and managing the transit system.

Overall, estimated annual O&M costs are greatest for the TSM Alternative at $27.1 million, which is $5.7 million or 26% more than the No Build. O&M costs for the LRT options to S.W. 185th Avenue are $3.3 to $3.7 million, or about 13%, less than the TSM and about $2.0 million, or 9%, more than the No Build. As presented earlier in this chapter and evaluated in Chapters 4 and 7, the TSM and LRT Alternatives represent significant increases in transit service levels for the Westside Corridor.

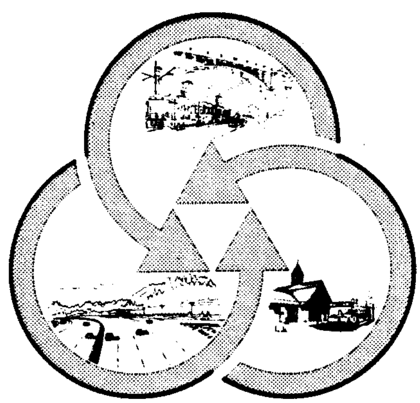
Among the LRT options, the annual O&M costs vary from $22.9 million for the Sunset Transit Center terminus option, to $24.1 million for the S.W. Murray Boulevard terminus option, for a spread of about 4%. The difference in annual O&M costs for the LRT options to S.W. 185th Avenue is only about $400,000, or less than 2%, with the Tunnel without Zoo station the lowest, and the Southside the highest. These relatively minor cost differences are the result of slightly different service levels or differing compositions of bus and rail service.

It is important to note that the bus transportation and maintenance costs (plus associated administrative costs) amount to approximately 75% of the total annual O&M costs for the LRT options. Rail transportation and maintenance costs (plus associated administrative costs) amount to only about $5.6 to $6.0 million, or roughly 25% of the total corridor annual O&M costs for the LRT options to S.W. 185th Avenue or S.W. Murray Boulevard. The bus percentage is higher for the LRT option to the Sunset Transit Center because the rail line is significantly shorter and the bus service proportionally greater.

According to Technical Memorandum 20o, on the average, labor costs amount to 75% to 80% of the annual O&M costs for all alternatives. Typically, the labor percentage for buses, whether an all-bus alternative such as the TSM or just the bus portion of the LRT Alternative, is somewhat higher than that of light rail, about 80% labor for buses and 70% labor for light rail. Conversely, material costs tend to be proportionally higher for light rail.

Further analysis of the O&M costs shows another distinct difference between bus and light rail O&M costs. Bus transportation accounts for almost two-thirds of the bus O&M costs, and maintenance only about one-third. For rail, the split is reversed with slightly more than one-third of the O&M costs attributable to transportation and nearly two-thirds to maintenance. Thus, the increased rail transportation productivity, resulting from larger vehicles and the ability to combine (couple) vehicles into a train with only one driver, is offset by the increased maintenance requirements, both for the more complex LRVs and for the extensive rail infrastructure. This relationship is generally typical in the transit industry.

The capital and O&M cost estimates in this chapter, along with the service and ridership impacts in Chapter 4, are further evaluated in Chapter 7.



CHAPTER 3

AFFECTED ENVIRONMENT

3.0 AFFECTED ENVIRONMENT

This chapter describes the existing social and natural environment in the Westside Corridor. The discussion provides an understanding of the environment in which the project would take place and identifies significant sensitive resources in the study area.

3.1 LAND USE AND ECONOMIC ACTIVITY

3.1.1 The Regional Environment

The following sections summarize the existing land use and economic conditions in the study area. Additional detail can be found in Technical Memorandum 20a.

Metropolitan Portland, with downtown Portland as its urban center, is located in northwestern Oregon, along the banks of the Willamette River. The Portland region, as defined by the U.S. Bureau of the Census, comprises the Portland Primary Metropolitan Statistical Area (PMSA). It includes Washington, Multnomah, Clackamas, and Yamhill counties in Oregon, and the Vancouver PMSA, which encompasses Clark County in Washington. The region, which includes the suburban communities of Vancouver, Gresham, Beaverton, and Hillsboro, is experiencing considerable growth in population, housing, and employment.

Population and housing growth in the Portland region is directly related to both regional and national economies. The 1960s and 1970s were a period of economic growth, the early 1980s a period of recession, and the mid to late 1980s a period of economic recovery (see Table 3.1-1).

Total employment in the Portland region increased approximately 3.8% annually during the 1960s and 1970s, while population increased by approximately 2.2% annually. These growth rates slowed during the 1980s, with population increasing at an average annual rate of 0.9% between 1983 and 1987 and employment increasing by 2.0% annually during that same period. In 1987, regional population was approximately 1,303,400 persons, with 522,000 households. There were approximately 635,600 jobs.

In the Portland region, population and housing are projected to continue to increase (Metro, 1989). By 2010, total population is projected to be 1,789,400, reflecting an average annual increase of 1.2%. Concurrently, the number of households is expected to reach approximately 762,300, representing an average annual increase of 1.5%. However, average household size will continue to decrease to 2.3 persons by 2010. The regional housing market will continue to be composed primarily of single-family houses, with the percentage of single-family units decreasing from 69.5% (in 1987) to 68.2% (2010). The number of housing units is estimated to increase to 803,350 by 2010, reflecting an average annual increase of 0.9%.

The 2010 projections account for substantial increases in the self-employment, service, and trade sectors (increases of 91%, 59%, and 58%, of total employment, respectively). Those same projections point towards a 33% decrease in the agricultural sector.

Substantial development opportunities exist for the Portland region. Pacific Rim growth is expected to shape the development of Portland in the future (Metro, 1989). Technological advancements will continue to increase the region's productivity, particularly in the manufacturing sector. It is anticipated that many new high-technology businesses will follow a historical pattern, evolving as spin-offs of established firms. Portland has large parcels of land available in proximity to such major facilities as the airport and the port ,which would be able to accommodate this anticipated growth. In addition, the region has some less-expensive parcels that can be considered good locations for development projects (Metro, 1989).

Table 3.1-1

REGIONAL POPULATION, HOUSING, AND EMPLOYMENT

	1960	1970	1980	1983	1987	2010
Population	821,900	1,009,130	1,241,900	1,258,500	1,303,430	1,789,430
Households	269,190	341,510	477,460	482,550	522,000	762,280
Household Size	2.99	2.89	2.56	2.57	2.46	2.30
Total Housing	279,510	356,640	504,100	528,490	553,720	803,350
Single-family	230,280	274,840	353,780	370,350	385,070	547,640
% of Total	82.4%	77.1%	70.2%	70.1%	69.5%	68.2%
Multifamily	49,230	81,800	150,320	158,130	168,650	255,710
% of Total	17.6%	22.9%	29.8%	29.9%	30.5%	31.8%
Total Employment	314,000	433,600	618,820	584,900	635,580	929,390
TCPU*	27,500	30,200	36,200	34,200	33,520	38,270
Trade	66,800	92,600	140,020	137,400	151,570	239,800
FIRE**	14,900	24,700	45,900	43,300	42,490	63,510
Service	37,800	67,700	111,100	112,200	133,030	211,490
Government***	39,900	62,400	77,900	80,400	85,670	117,070
Construction	14,800	17,300	24,800	16,400	20,190	23,640
Manufacturing	64,400	85,700	112,800	94,600	100,380	112,200
Agriculture	17,000	10,400	9,200	8,900	6,210	4,170
Self-employed	30,900	42,600	60,900	57,500	62,510	119,240

* TCPU - Transportation, communications and public utilities.
** FIRE - Finance, insurance and real estate.
***Government - All federal, state and local employees regardless of SIC category.

Source: Metro Regional Forecasts, June 1989.

The Portland region comprises five economic submarkets: Westside, downtown Portland, east Multnomah County, east Clackamas County, and Clark County (Metro, 1989). Population, housing, and employment characteristics and trends for these economic submarkets are presented in Table 3.1-2. The Westside has been the high-growth submarket of the Portland region since 1970. Between 1980 and 1987, the Westside captured 68.3% of the region's population growth, 47.6% of the single-family housing unit growth, 52.7% of the multifamily housing unit growth, and 96.1% of the regional employment growth. This trend is expected to continue, with the Westside capturing an estimated 45.4% of the regional population growth, 42.1% of the single-family housing unit growth, 47.9% of multifamily housing unit growth, and 44% of the employment growth between 1987 and 2010.

3.1.2 Community Profiles

3.1.2.1 Downtown Portland

Downtown Portland is located along the western bank of the Willamette River and serves as the financial center for the region (see Figure 3.1-1). Population and housing downtown have increased

Table 3.1-2

POPULATION, HOUSING, EMPLOYMENT BY COMMUNITY

Characteristic/Community	1980	1987	2005	AGR* 80-87	AGR* 87-05
Population					
Downtown Portland	8,193	8,992	10,585	1.4%	0.8%
West Hills/West Portland	79,216	80,890	89,648	0.3%	0.5%
Beaverton Area	72,875	78,879	88,313	1.2%	0.5%
Washington County	245,583	278,307	377,412	1.9%	1.5%
Hillsboro Area	30,950	33,914	51,269	1.4%	2.2%
Households					
Downtown Portland	6,178	6,804	8,315	1.4%	1.0%
West Hills/West Portland	36,885	38,758	44,076	0.7%	0.6%
Beaverton Area	29,426	33,230	39,305	1.8%	0.8%
Washington County	90,920	107,466	154,695	2.6%	1.9%
Hillsboro Area	10,728	12,201	19,806	2.0%	2.7%
Average Household Size					
Downtown Portland	1.25	1.25	1.19	NA	NA
West Hills/West Portland	2.09	2.03	1.99	NA	NA
Beaverton Area	2.46	2.35	2.29	NA	NA
Washington County	2.67	2.56	2.51	NA	NA
Hillsboro Area	2.84	2.73	2.67	NA	NA
Total Housing Units					
Downtown Portland	7,099	7,869	9,661	1.5%	1.0%
West Hills/West Portland	39,102	41,377	46,800	0.8%	0.6%
Beaverton Area	31,442	35,434	41,810	1.8%	0.8%
Washington County	96,537	113,748	162,979	2.5%	1.9%
Hillsboro Area	11,290	12,780	20,588	1.9%	2.7%
Single-Family Units					
Downtown Portland	199	190	180	-0.6%	0.2%
West Hills/West Portland	19,793	21,192	24,646	1.0%	0.7%
Beaverton Area	17,674	19,111	21,716	1.2%	0.6%
Washington County	65,093	75,467	104,234	2.3%	1.7%
Hillsboro Area	8,464	9,604	14,914	1.9%	2.4%
Multifamily Units					
Downtown Portland	6,900	7,679	9,481	1.6%	1.0%
West Hills/West Portland	19,309	20,185	22,155	0.6%	0.4%
Beaverton Area	13,768	16,323	20,094	2.7%	1.0%
Washington County	31,444	38,281	58,744	3.1%	2.3%
Hillsboro Area	2,826	3,176	5,674	1.8%	3.4%
Total Employment					
Downtown Portland	82,140	89,160	108,471	1.2%	0.9%
West Hills/West Portland	70,160	62,059	66,183	-1.6%	0.3%
Beaverton Area	48,330	53,452	65,448	1.5%	1.0%
Washington County	107,460	124,685	190,277	2.3%	2.3%
Hillsboro Area	11,790	16,047	29,122	5.2%	3.5%
Retail Employment					
Downtown Portland	9,120	8,714	10,892	-0.6%	1.1%
West Hills/West Portland	8,090	7,244	9,285	-1.5%	1.2%
Beaverton Area	9,730	9,751	13,853	0.0%	1.8%
Washington County	22,200	23,252	38,250	0.7%	2.8%
Hillsboro Area	1,980	2,659	5,647	4.9%	4.9%
Non-Retail Employment					
Downtown Portland	73,020	80,446	97,579	1.5%	0.9%
West Hills/West Portland	62,070	54,815	56,897	-1.7%	0.2%
Beaverton Area	38,600	43,701	51,595	1.9%	0.8%
Washington County	85,260	101,433	152,027	2.7%	2.2%
Hillsboro Area	9,810	13,388	23,475	5.2%	3.3%

* AGR - Annual growth rate calculated as simple average annual growth rate.
NA - Not Applicable
See Figure 3.1-1 for geographic areas.

Source: Metro, Regional Forecast, June 1989.

steadily at an annual rate of 1.4% in the past decade (see Table 3.1-2). By 1987, downtown had approximately 9,000 residents in 6,800 households, averaging 1.25 persons per household. Housing in downtown Portland has been dominated by multifamily units. By 1987, there were approximately 7,900 housing units in the downtown area, nearly 98% of which were multifamily units.

By 2005, the population in downtown Portland is expected to increase to approximately 10,600 residents, representing an average annual increase of 0.8% (Metro, 1989). During this same period, the number of households is expected to increase by approximately 1.0% annually. This means a decrease in household size to 1.19 persons per household. The trend to multifamily residential uses in downtown Portland is expected to continue, with nearly 98.1% of the projected 9,661 total housing units classified as multifamily units.

Downtown Portland has experienced a steady growth in employment over the past decade (see Table 3.1- 2). In 1987, approximately 89,200 persons were employed downtown, an increase of 7,000 jobs from 1980. The increase in downtown employment has occurred in non-retail sectors such as Transportation, Communication, Public Utilities (TCPU); Finance, Insurance, Real Estate (FIRE); and Government. Retail-sector employment in downtown Portland decreased during the 1980s, from approximately 9,100 employees in 1980 to approximately 8,700 in 1987. In 1987, retail-sector employees constituted 9.8% of the total employment base. The trend of increasing employment opportunities in downtown Portland, particularly in the service sector and government, is estimated to continue through 2005. The total number of employed persons working in the downtown area is expected to be approximately 108,471 by 2005, an annual increase of 0.9%. The retail sector will constitute an almost constant share of total employment through 2005, accounting for approximately 10,892 employees, or 10% of the total employment base.

Increases in employment in downtown Portland are interrelated with its status as the region's major business and financial center. Figures for net leasable space for the first quarter 1990 in downtown Portland reveal 13,584,700 square feet of office space, 924,400 square feet of retail space, and 249,000 square feet of industrial space. Table 3.1-3 presents an historical overview of absorption and vacancy rates for industrial, office, and retail space in Portland. Generally, vacancy rates for these spaces have declined since 1987. With the exception of retail space, projected vacancy rates for 1990 followed this trend. For the first quarter of 1990, vacancy rates were 18.9% for industrial, 17.8% for office, and 10.7% for retail space in downtown Portland. Based on a summary of planned or proposed developments downtown, it is anticipated that nearly six million square feet of office space will be added between 1986 and 2000. Specifically, 1.7 million square feet of office space was made available for lease between 1986 and 1990, three million square feet will be made available between 1991 and 1995, and 970,700 square feet will be made available between 1996 and 2000 (Economic Development Services, 1989).

Retail development trends in downtown Portland differ from those in the office sector. Although downtown's share of retail sales has declined, it remains a viable, growing retail market. The amount of leasable retail space is projected to increase by more than one million square feet through 2000. Specifically, 589,900 square feet was added between 1986 and 1989, 361,300 square feet will be added between 1991 and 1995, and 55,700 square feet will be added between 1996 and 2000 (Economic Development Services, 1989).

3.1.2.2 West Hills/West Portland

Downtown Portland is surrounded by the West Hills, including the neighborhoods of Arlington Heights, Goose Hollow, Upper Highlands, and Southwest Hills (see Figure 3.1-1). The Civic Stadium, located in the Goose Hollow neighborhood near S.W. 18th Avenue, S.W. Morrison Street, and S.W. Yamhill Street, is the major outdoor athletic facility in Portland. The stadium is bounded by a mix of office, retail, and industrial land uses to the east and south, and by residential uses to the west and north. Washington Park, a large open space located north of Sunset Highway, and west of the Goose Hollow and Upper Highlands neighborhoods, is the dominant feature of this area. Several attractions are located within the park, including the Washington Park Zoo, the Oregon Museum of Science and Industry

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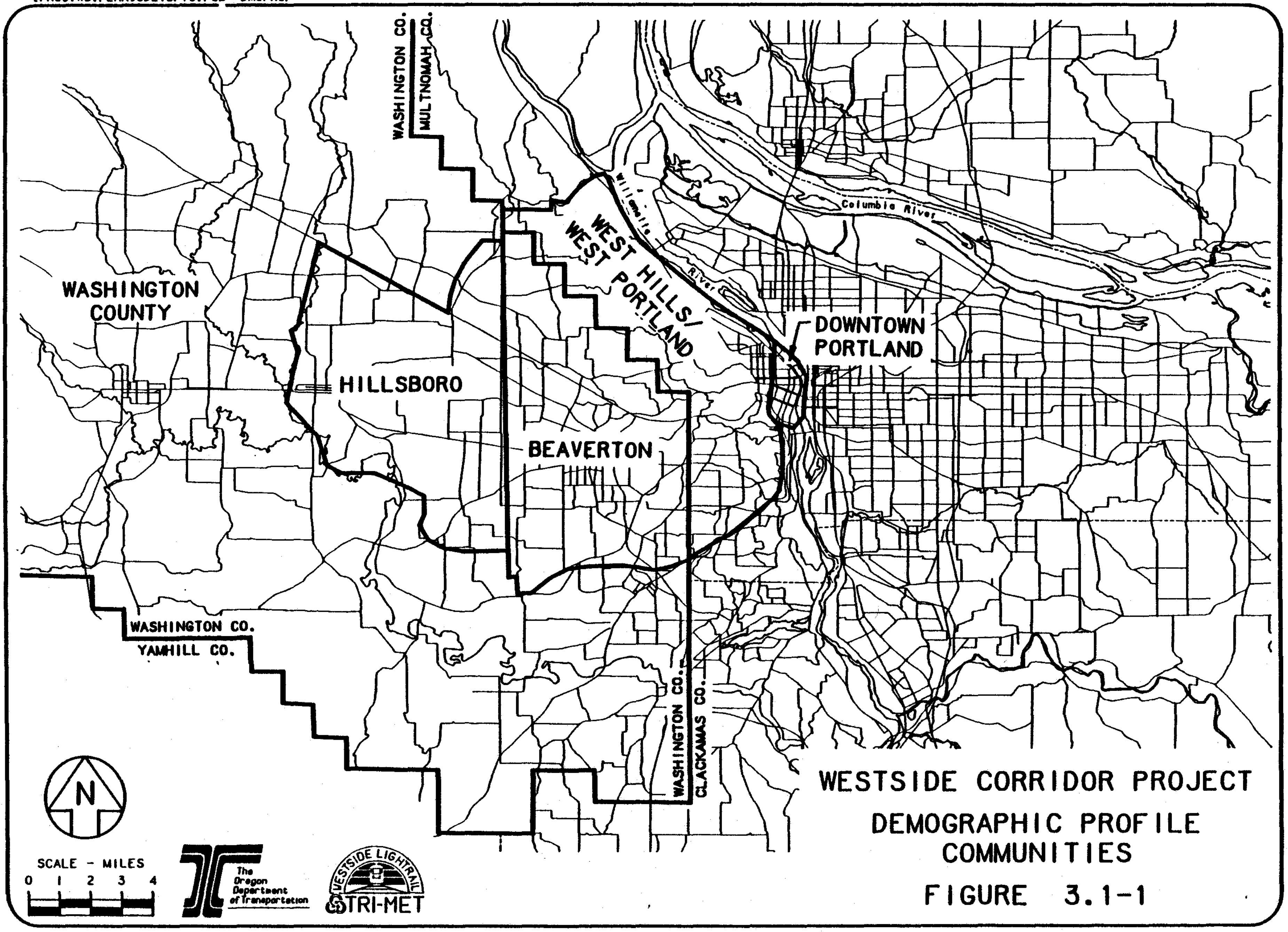


WESTSIDE CORRIDOR PROJECT
DEMOGRAPHIC PROFILE
COMMUNITIES
FIGURE 3.1-1

Table 3.1-3

REAL ESTATE STATISTICS
PORTLAND REGION

Historic Real Estate Statistics

Year	Industrial Vacancy Rate	Industrial Absorption (1,000 sq. ft.) Net	Industrial Absorption (1,000 sq. ft.) Gross	Office Vacancy Rate	Office Absorption (1,000 sq. ft.) Net	Office Absorption (1,000 sq. ft.) Gross	Retail Vacancy Rate	Retail Absorption (1,000 sq. ft.) Net	Retail Absorption (1,000 sq. ft.) Gross
1987	24%	1,159	3,495	22%	1,091	2,377	7.5%	1,220	1,636
1988	19%	2,076	5,568	18%	4,412	2,745	6.1%	1,712	3,362
1989	17%	2,318	3,938	17%	919	2,435	6.5%	1,069	1,823
1990*	14%			15%			7.8%		

First Quarter 1990 Real Estate Statistics

Area	Industrial Vacancy Rate	Industrial Absorption (1,000 sq. ft.) Net	Industrial Absorption (1,000 sq. ft.) Gross	Office Vacancy Rate	Office Absorption (1,000 sq. ft.) Net	Office Absorption (1,000 sq. ft.) Gross	Retail Vacancy Rate	Retail Absorption (1,000 sq. ft.) Net	Retail Absorption (1,000 sq. ft.) Gross
Downtown	18.9%	(7)	20	17.8%	(10)	230	10.7%	140	140
NW/SW Ptlnd.	22.4%	(330)	42	12.4%	(4)	24	2.0%	0	0
Beaverton	19.4%	173	297	13.0%	31	51	7.4%	35	3
Wash. Co Corr.	13.6%	12	46	18.9%	0	0	9.8%	3	3

*First Quarter, 1990.

Source: Grubb and Ellis, Portland Office, 1990.

(OMSI), the World Forestry Center, and the International Rose Test Gardens. The Sylvan area is developing as a commercial center.

This area has not experienced significant growth in the past seven years. During the 1980s, population increased at an average rate of 0.3% annually. By 1987, 80,890 persons resided in this area, primarily in the Goose Hollow, Southwest Hills, Arlington Heights, Forest Heights, Upper Highlands, Sylvan, Northwest, Hillside and Forest Park neighborhoods. There were approximately 38,800 households with an average of 2.03 persons per household. The area's housing stock is a mix of single-family and multifamily units. During the 1980s, the number of housing units increased annually at an average rate of less than 1%. By 1987, 51% of the 41,400 housing units were single-family units. Most of these units were located in the Southwest Hills, Arlington Heights, and West Highlands neighborhoods. In contrast, the Goose Hollow and Northwest neighborhoods have many older single-family units, and are characterized by multifamily housing.

By 2005, total population in the area is expected to be 89,600 residents. Single-family residential units will continue to represent 53% of the housing stock in 2005. The total number of housing units is projected to increase 0.6% annually to 46,800 units. The number of households is expected to reach approximately 44,000 and average household size is expected to continue to decrease to 1.9 persons per household by 2005.

Employment in the area between downtown Portland and Beaverton decreased over the past several years. In 1987, approximately 62,050 persons were employed in this area, representing an annual decrease of approximately 1.6% from the 1980 employment level of 70,160 persons. Much of this decline occurred outside the retail sector. Retail sector employment decreased slightly over this period, from approximately 8,100 employees in 1980 to approximately 7,250 employees in 1987. The trend of decreasing employment opportunities in the West Hills/West Portland area is expected to shift, with increases estimated through the year 2005. The total number of employed persons working in this area is expected to be approximately 66,200 persons by 2005, representing an increase of 0.3% annually.

The steepness of the West Hills and the large amount of designated open space limit development opportunities. Development is expected to occur primarily in the Sylvan area. Several office developments, totaling 177,630 square feet, have recently been built in this area (BOMA, 1989). These include the Highlands at Sylvan, the Sylvan Westgate, Westridge Park Gardens, and the 1730 Sylvan Skyline Building. Vacancy rates for the first quarter 1990 are 22.4% for industrial, 12.4% for office, and 2% for retail space (see Table 3.1-3).

3.1.2.3 Beaverton Area

Beaverton is the largest city west of Portland and the third largest of the 27 cities in the Portland PMSA (see Figure 3.1-1). Population in the Beaverton area increased from approximately 72,900 persons in 1980 to 78,900 persons in 1987 (see Table 3.1-2). This trend is expected to continue at an average annual growth rate of 0.5% through 2005, with the population reaching 88,300 persons.

Although this area has experienced substantial development in the past several years, growth has occurred at a slower rate here than in eastern Washington County. In 1980, there were about 31,400 housing units; in 1987 there were 35,400 units. The number of housing units is estimated to increase to 41,800 by 2005. Single-family units constitute a slight majority, (51%) of housing in the Beaverton area, (Metro, 1989).

The current demand for commercial development in Beaverton is strong (Robert J. Harmon and Associates, 1989). A variety of factors have fueled the growth of the office market, and several development trends have become evident. In general, Beaverton has emerged as an attractive office location because of its proximity to labor, lower land prices, and greater land availability as compared with Portland. In addition, the business campuses of Nike and Tektronix have helped to create a desirable identity for campus-style developments.

Because of the favorable retail location and trade area characteristics of Beaverton's downtown area, it is anticipated that the downtown can continue to capture new retail development. The city is studying the feasibility of different types of retail development (i.e., pedestrian-oriented versus auto-oriented) for the downtown, which could alter the character and composition of the project area's retail market. Currently, vacancy rates in Beaverton are 19.4% for industrial, 12.9% for office, and 7.4% for retail space (see Table 3.1-3).

Total employment in Beaverton increased 1.5% annually between 1980 (48,300 persons) and 1987 (53,500 persons). This trend is expected to continue through 2005, with a projected total employment of 66,400 persons.

Office space accounts for a relatively small percentage of total employment, but this sector is growing faster than the average of total employment. Office-based employment is anticipated to increase by 1,800 employees per year in the period between 1987 to 2000 (Robert J. Harmon and Associates, 1989).

3.1.2.4 Washington County

Washington County is located west of Portland, between Multnomah and Tillamook Counties, and is characterized by rapidly growing residential and employment areas (see Figure 3.1-1). The major incorporated areas are Beaverton, Hillsboro, Forest Grove, Tigard, and Tualatin. All types of economic activity have increased in the county over the past several years. Numerous residential, commercial, and industrial developments are under construction or planned for the immediate future.

Population growth has attracted employers seeking a large, well-trained labor force, while the growth in population has created the demand for many supporting business activities. Population and employment in Washington County are expected to increase steadily (Economic Development Task Force, 1989).

In 1980, Washington County's population was approximately 245,600 (see Table 3.1-2). Population increased to 278,300 persons in 1987, representing an annual increase of 1.9%. Population is projected to increase by 1.5% annually between 1987 and 2005 (Metro, 1989). The urban communities of eastern Washington County (including Beaverton and Hillsboro) are expected to experience a substantially greater share of this population growth than western Washington County.

The total number of housing units increased from 96,500 units in 1980 to 113,700 in 1987. By 2005, the number of housing units is expected to reach 163,000. Single-family housing units constituted 67% of the total housing stock in 1980. This single-family majority is expected to decrease to 63% by 2005.

Washington County's economic growth has exceeded that of the greater Portland area, of the State of Oregon, and of the nation in recent years (Economic Development Task Force, 1989). Washington County accounted for more than one-third of the jobs added to Portland's economy between 1970 and 1986. County employers accounted for approximately 97% of all net regional job growth between 1980 and 1986. Washington County is expected to account for as much as three-fourths of net regional job growth between 1989 and 2010 (Economic Development Task Force, 1989).

Washington County reflects the general economic growth in the region. Employment increased from approximately 107,500 people in 1980 to 124,700 in 1987. This trend is expected to continue through the year 2005, with total employment reaching 190,300 people (see Table 3.1-2). Employment increases in eastern Washington County are expected to be slightly greater than those in the County overall, as a result of higher development densities within the Urban Growth Boundary.

Future employment growth is expected to be greatest in the services, finance, insurance, real estate, transportation, and communications sectors (Economic Development Task Force, 1989). Employment growth in the retail and wholesale trades should occur at a slower rate. The county is likely to capture a greater share of regional employment growth than of regional population growth in the future; however, the difference is not great. It is likely that the county's share of total regional employment and population will continue to be balanced.

Vacancy figures for office, retail, and industrial space in Washington County for the first quarter of 1990 are 13.6% for industrial, 18.9% for office, and 9.8% for retail space (Grubb and Ellis, 1990).

3.1.2.5 Hillsboro Area

The Hillsboro area is experiencing substantial high-technology development (see Figure 3.1-1). The major growth areas include the Primate Center and the Oregon Graduate Center. The approved Oregon Graduate Center Master Plan would provide for 3.2 million square feet of institutional, high-technology, and research space.

The population of Hillsboro increased from about 31,000 people to 33,900 between 1980 and 1987, as a result of a modest rate of residential development and annexations (see Table 3.1-2). Residential development is expected to occur at a much higher rate through 2005, reaching approximately 51,300 people. About 75% of the housing consisted of single-family units in 1987. This figure is expected to decrease to 72% by 2005.

Total employment increased from 11,800 to 16,100 between 1980 and 1987. Hillsboro's employment base is expected to more than double between 1987 and 2005, exceeding the growth rate for Washington County as a whole.

3.1.3 Corridor Inventory

A detailed corridor inventory of current and planned land uses, population, and employment was prepared for the area adjacent to the proposed highway and transit facilities. The corridor boundaries encompass the facilities proposed as part of the TSM and LRT Alternatives. From downtown Portland (S.W. 11th Avenue between S.W. Morrison and S.W. Yamhill Streets) to the Zoo, the corridor is defined as 500 feet from the proposed LRT centerline in each direction, for a total width of 1,000 feet. West of the Zoo, the corridor is defined as 0.25 miles from the proposed LRT centerline in each direction, for a total width of 0.50 mile. The Corridor also includes a 0.25-mile radius around proposed TSM park-and-ride lots.

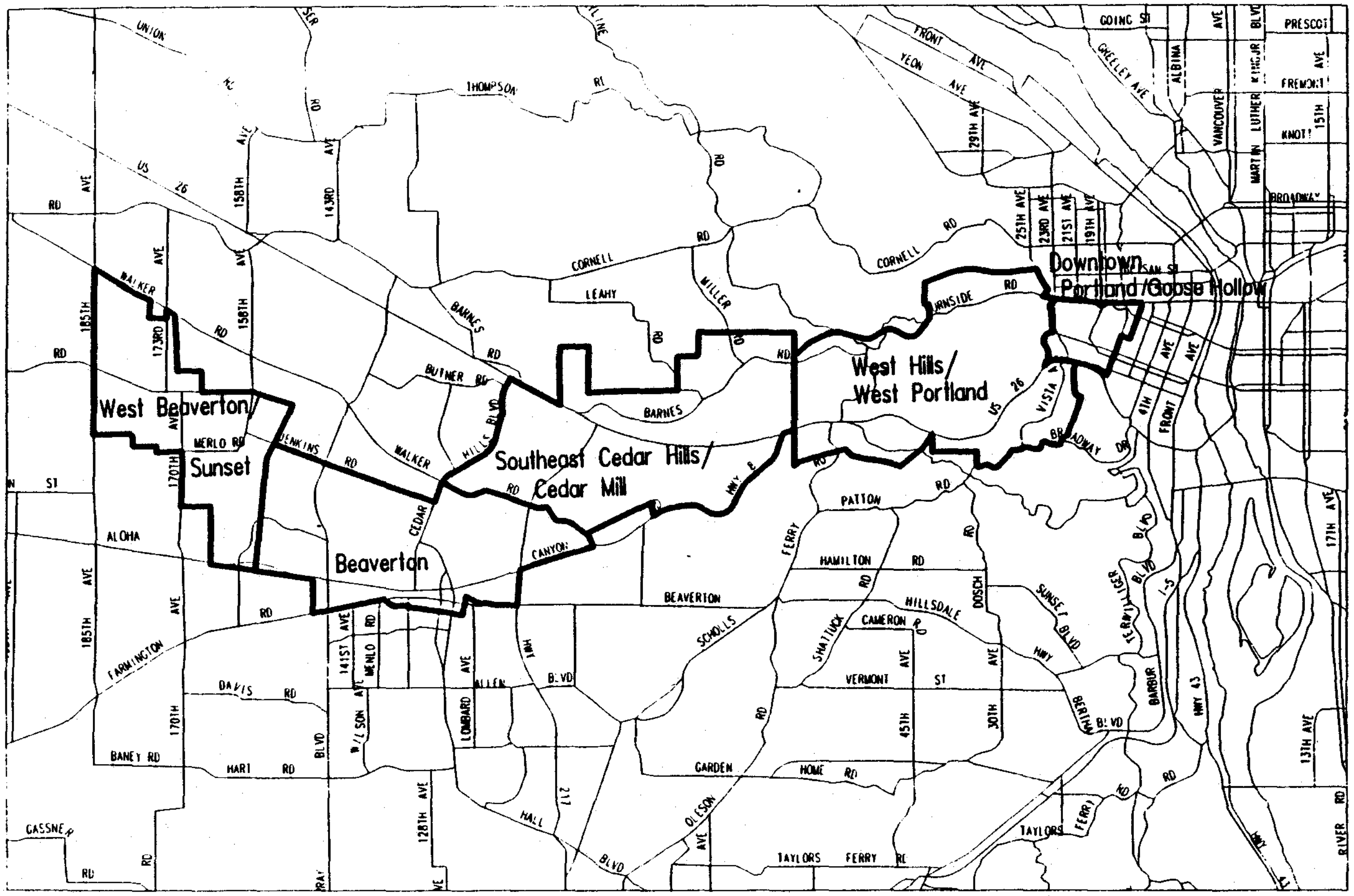
3.1.3.1 Downtown Portland (S.W. 11th Avenue to Vista Bridge)

The downtown Portland segment of the corridor extends from downtown Portland to the southeastern portion of Washington Park (see Figure 3.1-2). Notable attractions include the Civic Stadium and the Goose Hollow neighborhood. In the eastern portion of the corridor, Interstate 405 (I-405) bisects an area of mixed land uses, predominantly commercial. Other uses include high-density residential and industrial, such as the Oregonian newspaper distribution center, and some vacant parcels (see Figures 3.1-3a and 3b). Large areas of public use include the Civic Stadium and Lincoln High School, various churches, and the Multnomah Athletic Club (MAC). The area west of S.W. 20th Avenue to Washington Park consists primarily of residential use, with some commercial uses intermixed.

The area immediately east of I-405 is zoned for multifamily residential (RX) and is generally referred to as the RX area (see Figure 3.1-4a and 4b). West of I-405, the area is zoned commercial and high-density residential, with the Civic Stadium site designated as open space. The Goose Hollow neighborhood is zoned primarily multifamily residential, with some areas designated for single-family residential and commercial uses. In 1987, the Goose Hollow neighborhood and the RX area of downtown (see Table 3.1-3) consisted of 3,300 households, averaging 1.32 people per household. Of the 3,600 total housing units, 95% were multifamily housing units.

By 2005, an estimated 4,500 people are projected to be living in 3,600 households, for an average household size of 1.24 people. It is estimated that the number of housing units will increase from 3,600 in 1987 to 3,900 in 2005. The proportion of single-family units is expected to decrease 70%, yielding a housing stock that is 99% multifamily.

Over the next 15 years, employment in this segment of the corridor is expected to increase faster than population. In 1987, 4,800 persons were employed in this area, approximately 20% of whom worked in



Note: This graphic represents the Corridor as defined for the purpose of generating population and employment estimates using Metro Underlying Zones.

SCALE - MILES
0 1 2

Source: Shapiro & Associates, Inc., 1990

Westside Corridor Project

LAND USE INVENTORY AREAS

The Oregon Department of Transportation

WESTSIDE LIGHT RAIL
TRI-MET

Figure 3.1-2

LEGEND:

S Single family Residential
M Multifamily Residential
O Office
C Commercial
I Industrial
P Park and Open Space
P/SP Public/Semi-Public
PK Parking
V Vacant
A Agriculture

Study Area Boundary

Source: Shapiro & Associates, Inc., 1990

N

SCALE-FEET

0 500 1000

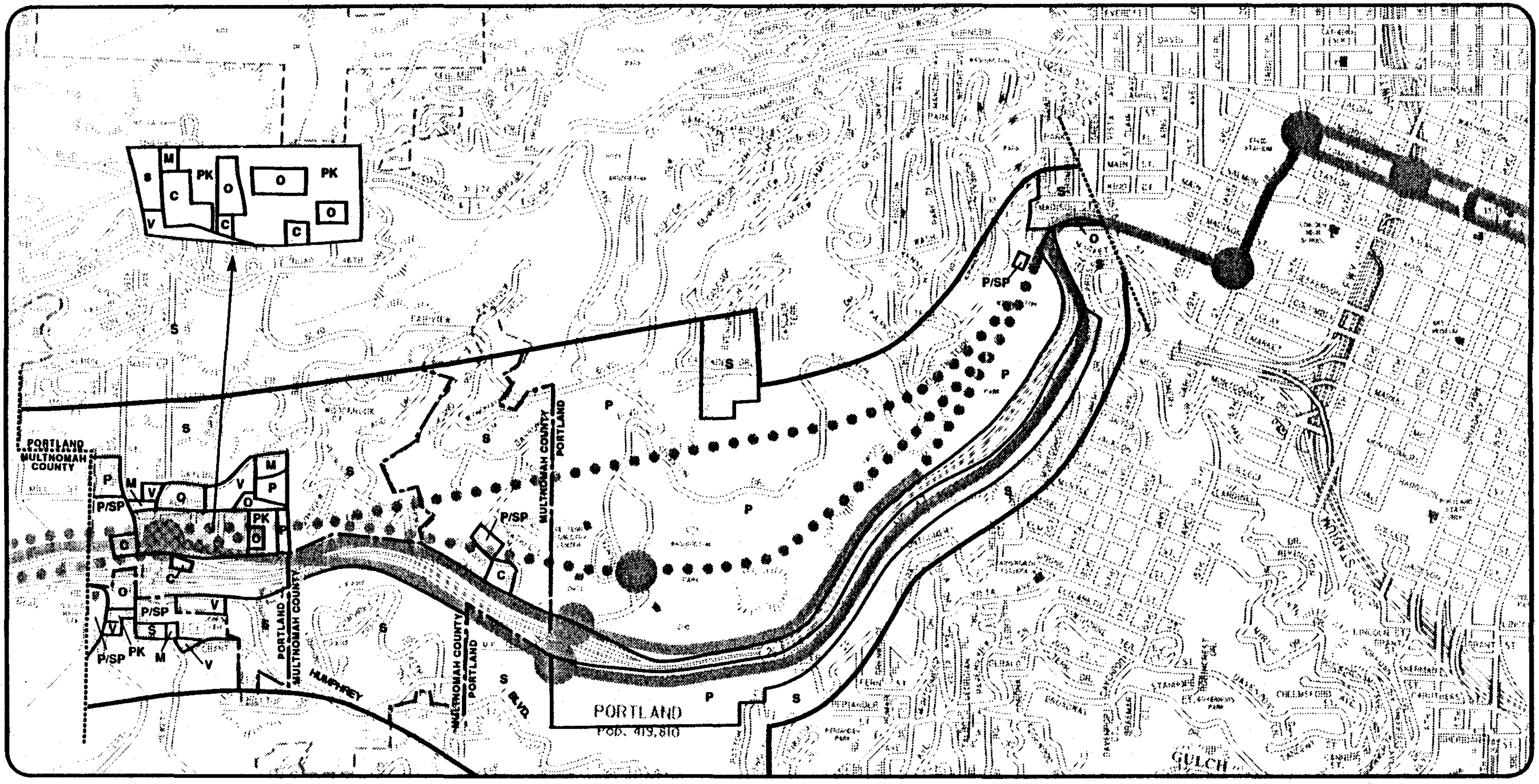
Westside Corridor Project

Existing Land Use Along Proposed LRT Alignments

The Oregon Department of Transportation

WESTSIDE LIGHT RAIL TRI-MET

Figure 3.1-3a
1 of 5



LEGEND:

S	Single-family Residential
M	Multifamily Residential
O	Office
C	Commercial
I	Industrial
P	Park and Open Space
P/SP	Public/Semi-Public
PK	Parking
V	Vacant
A	Agriculture

Study Area Boundary

Source: Shapiro & Associates, Inc., 1990

N

SCALE-FEET

0 1000 2000

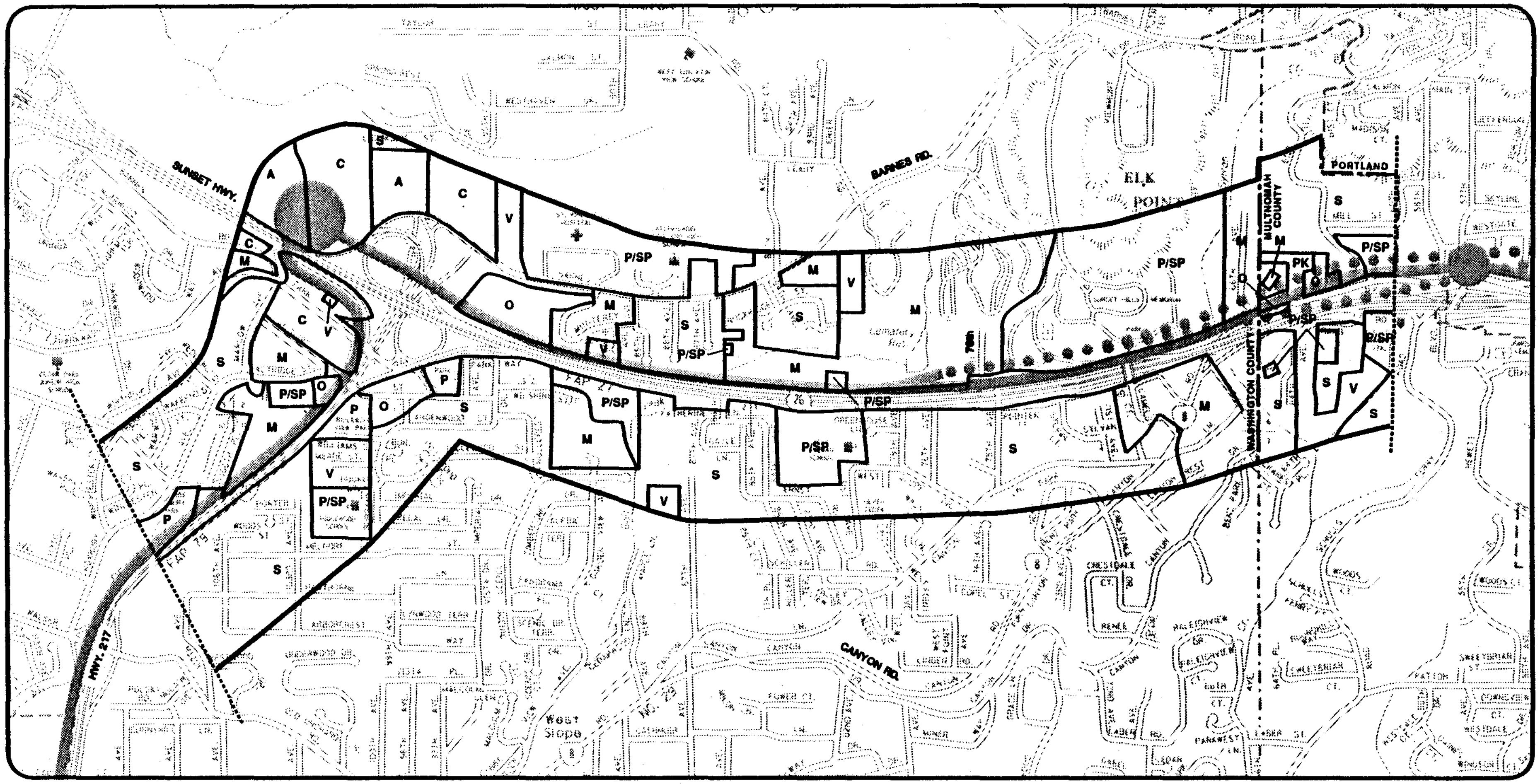
Westside Corridor Project

Existing Land Use
Along Proposed LRT Alignments

The Oregon Department of Transportation

Westside Light Rail TRI-MET

Figure 3.1-3b
2 of 5



LEGEND:

S	Single-family Residential
M	Multifamily Residential
O	Office
C	Commercial
I	Industrial
P	Park and Open Space
P/SP	Public/Semi-Public
PK	Parking
V	Vacant
A	Agriculture

Study Area Boundary

Source: Shapiro & Associates, Inc., 1990

N

SCALE-FEET

0 1000 2000

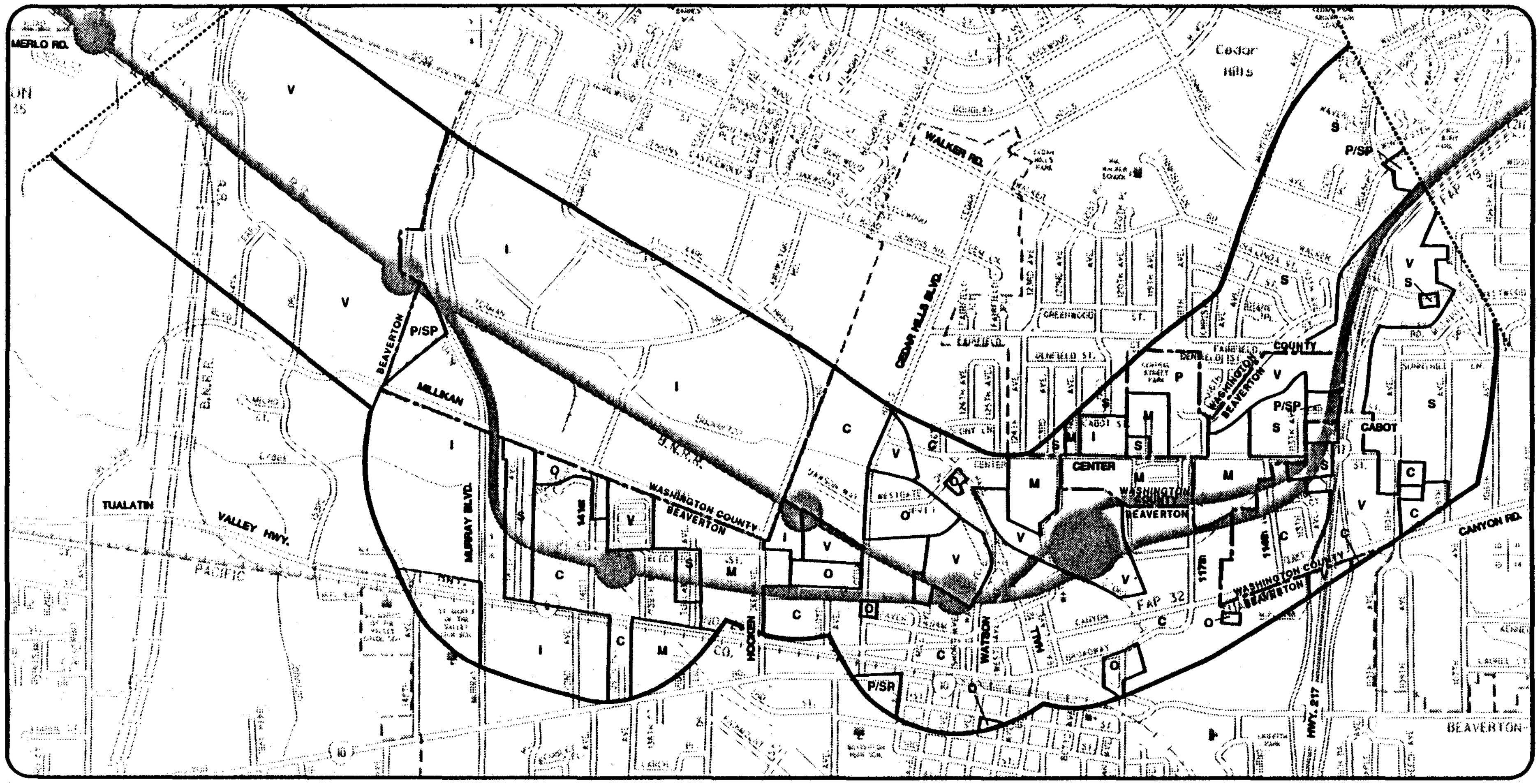
Westside Corridor Project

Existing Land Use
Along Proposed LRT Alignments

The Oregon Department of Transportation

WESTSIDE LIGHT RAIL TRI-MET

Figure3.1-3c
3of5



LEGEND:

- S Single-family Residential
- M Multifamily Residential
- O Office
- C Commercial
- I Industrial
- P Park and Open Space
- P/SP Public/Semi Public
- PK Parking
- V Vacant
- A Agriculture

Study Area Boundary

SCALE-FEET

0 1000 2000

Source: Shapiro & Associates, Inc., 1990

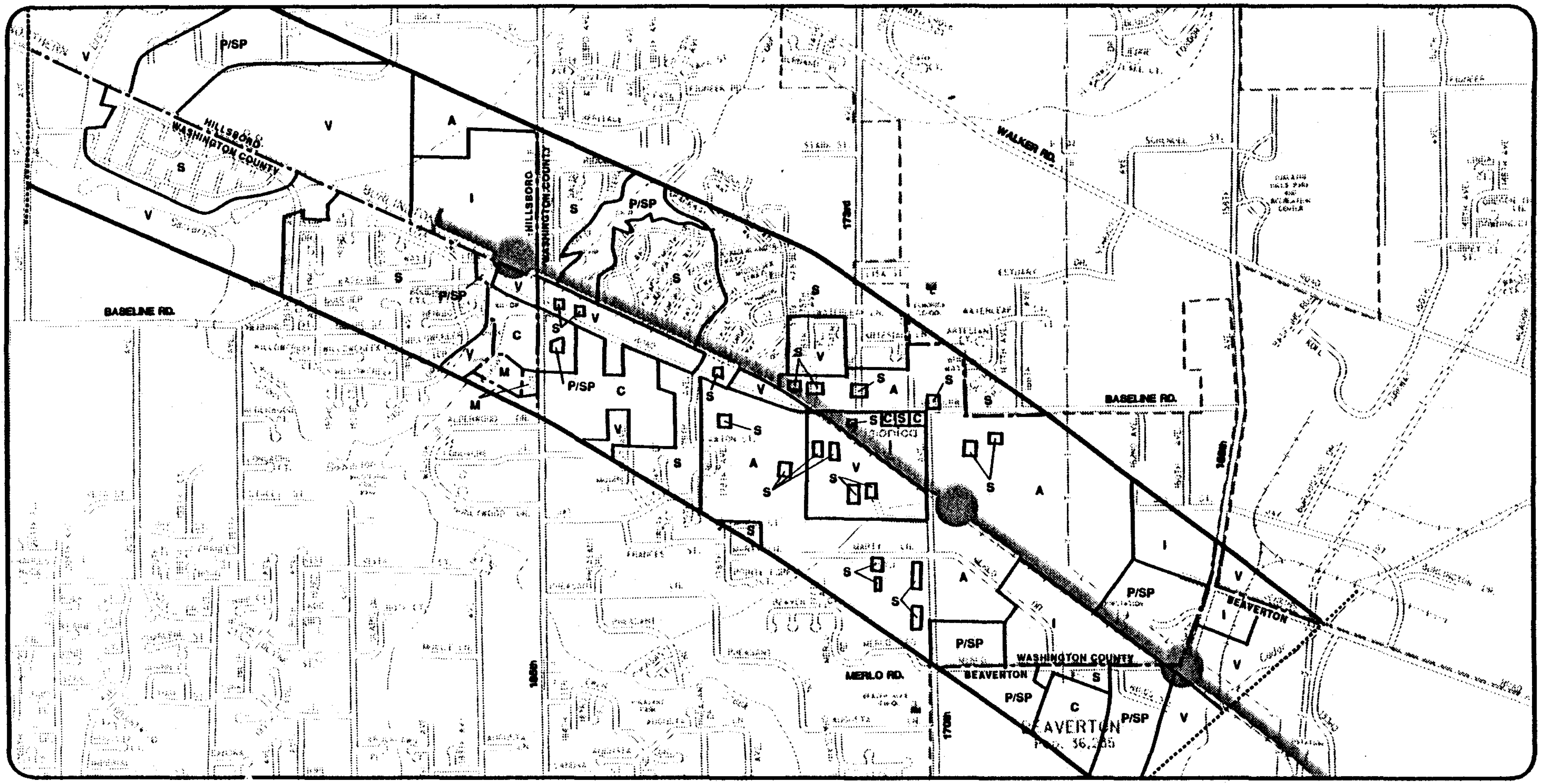
Westside Corridor Project

Existing Land Use Along Proposed LRT Alignments

The Oregon Department of Transportation

TRI-MET

Figure3.1-3d
4of5



LEGEND:

S Single family Residential
M Multifamily Residential
O Office
C Commercial
I Industrial
P Park and Open Space
P/SP Public/Semi Public
PK Parking
V Vacant
A Agriculture

Study Area Boundary

Source: Shapiro & Associates, Inc., 1990

N

SCALE-FEET

0 1000 2000

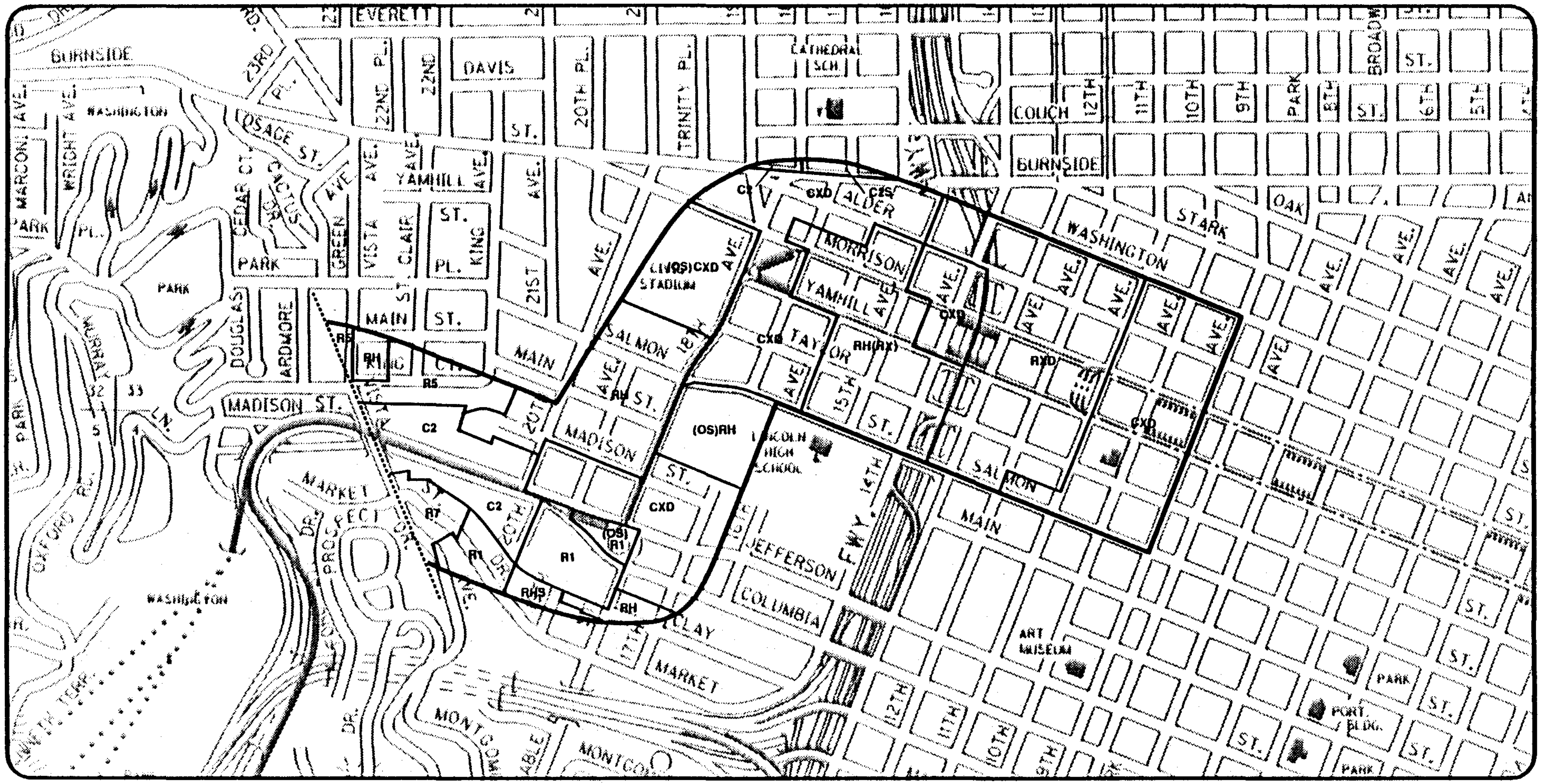
Westside Corridor Project

Existing Land Use Along Proposed LRT Alignments

The Oregon Department of Transportation

TRI-MET

Figure 3.1-3e
5of5



LEGEND:

Portland

- R7 One Family Residential - 6 DU/Ac.
- R5 One Family Residential - 8 DU/Ac.
- R1 Medium Density Multifamily
- RH High Density Multifamily
- (RX) Central Multifamily Residential Zone
- CX Central Commercial Zone
- C2 General Commercial
- S Sign Control Overlay
- D Design Control Overlay
- (OS) Open Space

Study Area Boundary

Source: Shapiro & Associates, Inc., 1990

N

SCALE-FEET

0 500 1000

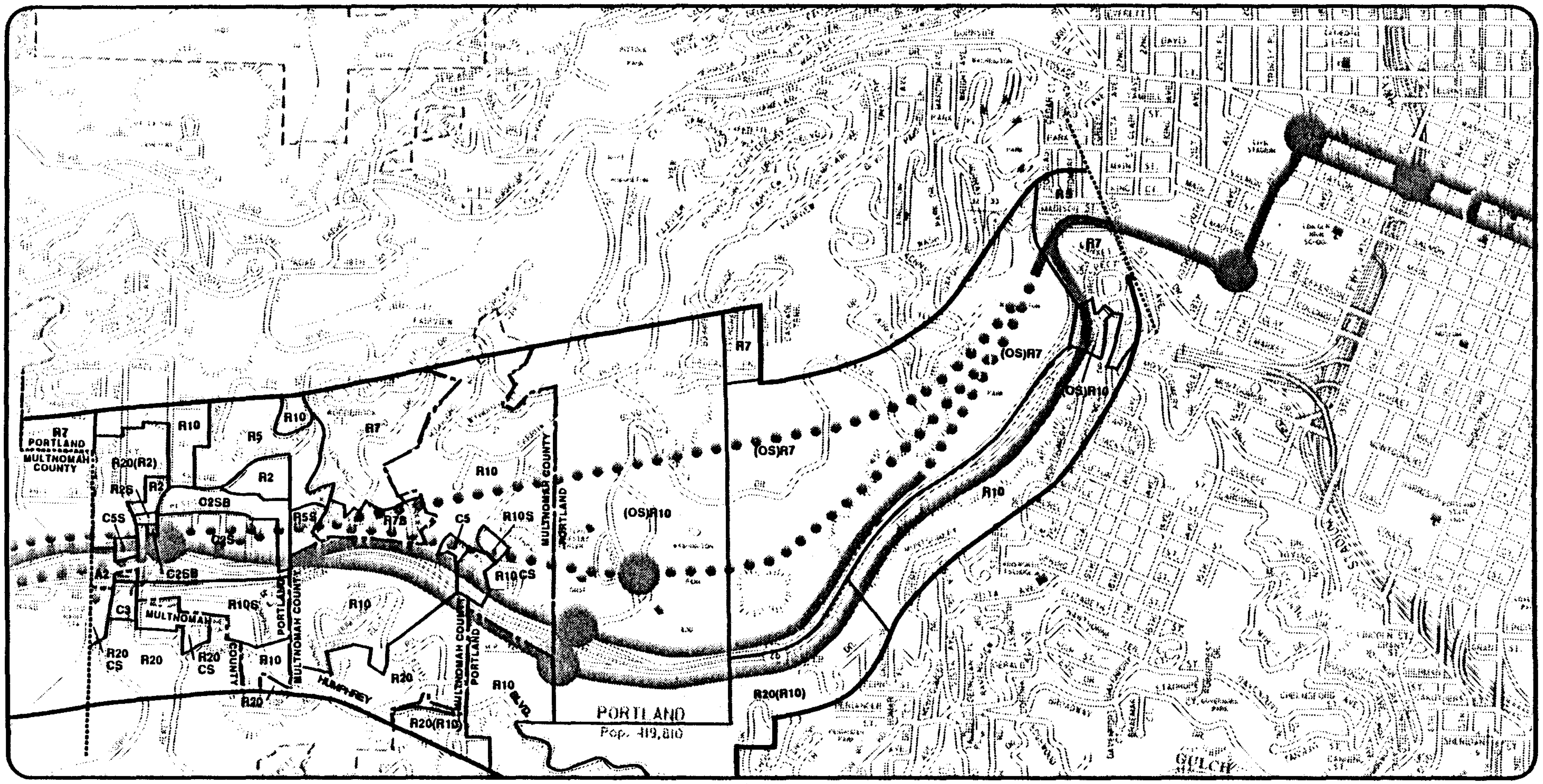
Westside Corridor Project

Zoning/Comprehensive Plan Designation Along Proposed LRT Alignments

The Oregon Department of Transportation

WESTSIDE LIGHT RAIL TRI-MET

Figure 3.1-4a
1 of 5



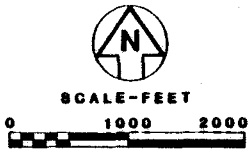
LEGEND:

Multnomah County
R20 Single Family Residential - 2 DU/Ac.
R10 Single Family Residential - 4 DU/Ac.
A2 Apartment - Residential
CS Community Service

Portland
R20 One Family Residential - 2 DU/Ac.
R10 One Family Residential - 4 DU/Ac.
R7 One Family Residential - 6 DU/Ac.
R5 One Family Residential - 8 DU/Ac.
R2 Multifamily Residential
C5 Limited Commercial
C2 General Commercial
S Sign Control Overlay
B Buffer Zone
(OS) Open Space

Study Area Boundary

Source: Shapiro & Associates, Inc., 1990



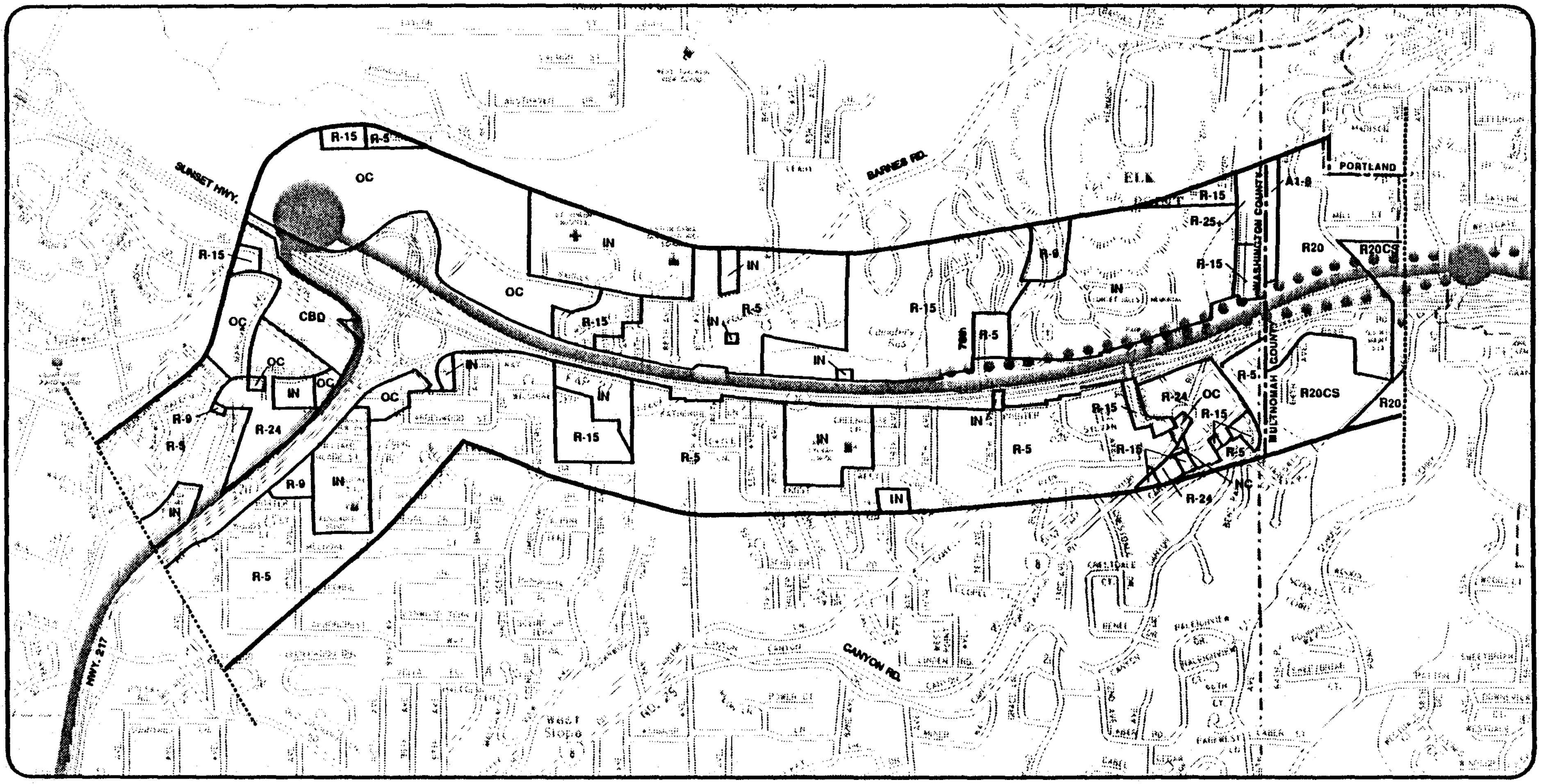
Westside Corridor Project

Zoning/Comprehensive Plan Designation Along Proposed LRT Alignments

The Oregon Department of Transportation

TRI-MET

Figure 3.1-4b
2 of 5



LEGEND:

Washington County
R 5 Residential - 5 DU/Ac.
R 9 Residential - 9 DU/Ac.
R 15 Residential - 15 DU/Ac.
R 24 Residential - 24 DU/Ac
R 25+ Residential - 25+ DU/Ac.
OC Office Commercial
NC Neighborhood Commercial
CBD Community Business District
IN Institutional

Multnomah County
R20 Single Family Residential - 2 DU/Ac
A1-8 Apartment Residential Business Office
CS Community Service

Study Area Boundary

Source: Shapiro & Associates, Inc., 1990

SCALE-FEET
0 1000 2000

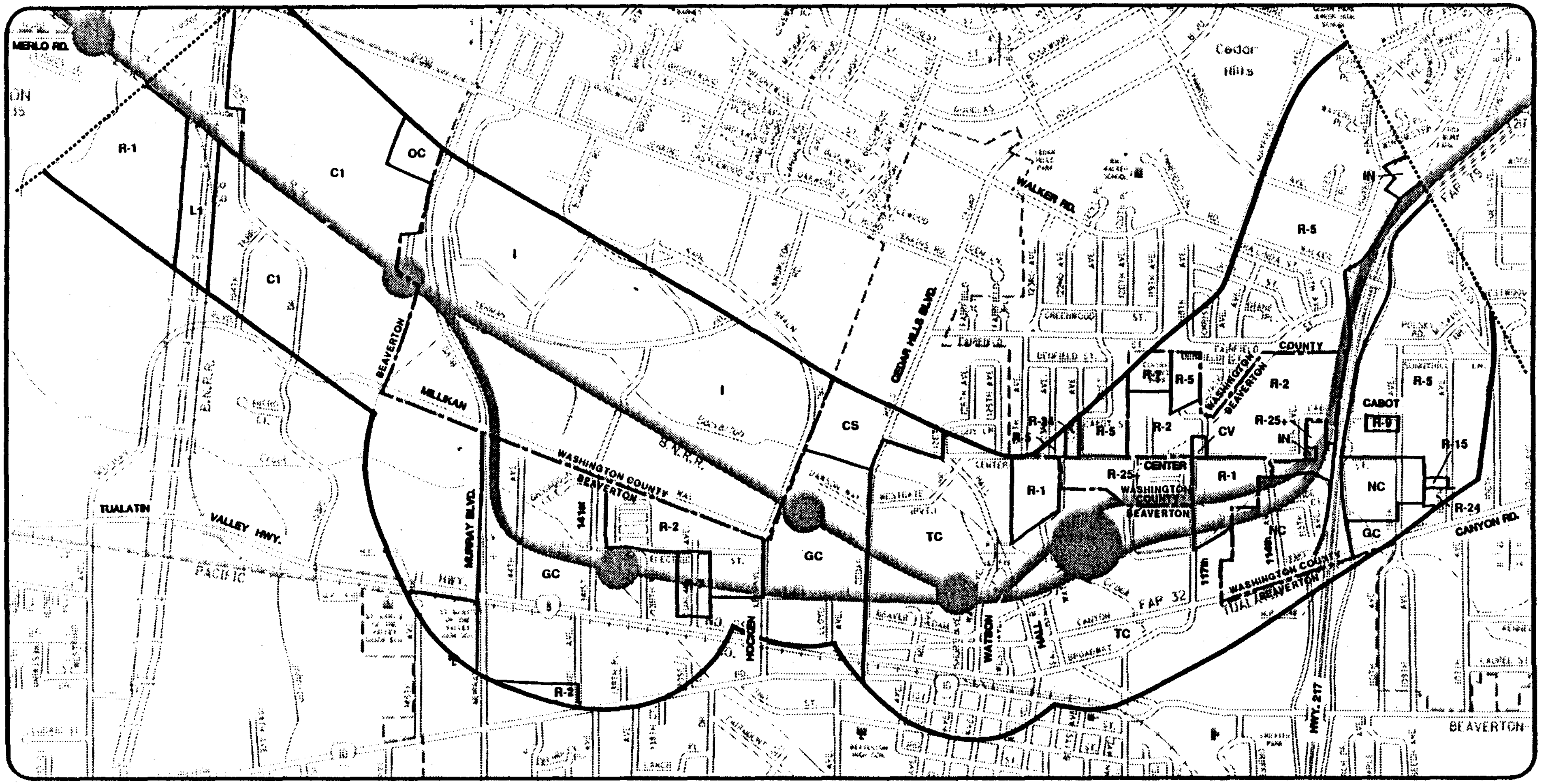
Westside Corridor Project

Zoning/Comprehensive Plan Designation Along Proposed LRT Alignments

The Oregon Department of Transportation

TRI-MET

Figure 3.1-4c
3 of 5



LEGEND:

Washington County
R 5 Residential · 5 DU/Ac.
R 9 Residential · 9 DU/Ac.
R 15 Residential · 15 DU/Ac.
R 24 Residential · 24 DU/Ac.
R 25+ Residential · 25+ DU/Ac.
NC Neighborhood Commercial
GC General Commercial
I Industrial
IN Institutional

Beaverton
R-7 Single Family (Standard) · 6 DU/Ac.
R-5 Single Family (Standard) · 8 DU/Ac.
R-2 Multifamily (Medium) · 22 DU/Ac.
R-1 Multifamily (High) · 44 DU/Ac.
OC Office
TC Town Center
CS Community Service
GC General Commercial
CI Campus Industrial
LI Light Industrial
CV Convenience

Study Area Boundary

N

SCALE-FEET
0 1000 2000

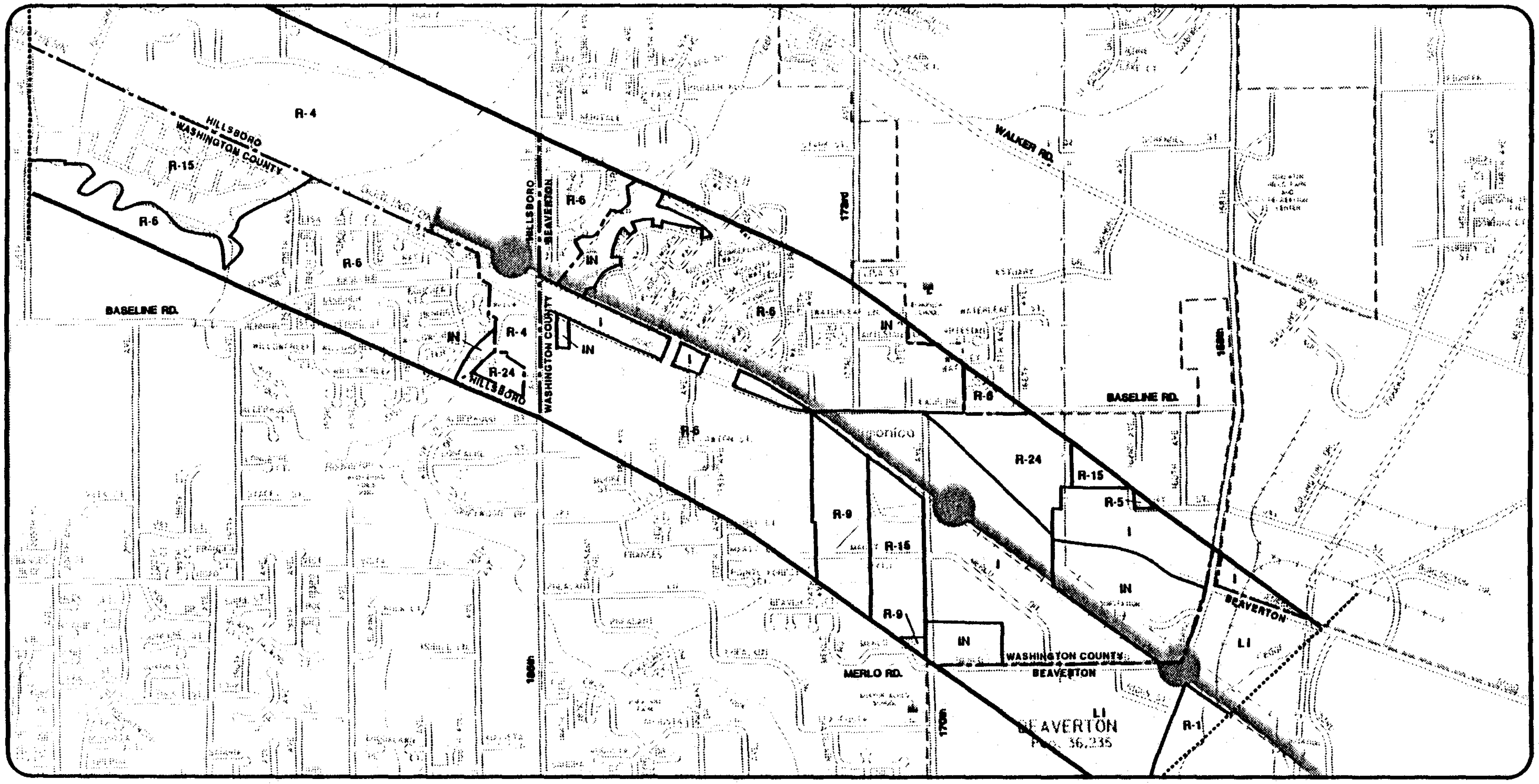
Westside Corridor Project

Zoning/Comprehensive Plan Designation Along Proposed LRT Alignments

The Oregon Department of Transportation

TRI-MET

Figure 3.1-4d
4 of 5



LEGEND:

Washington County
R-5 Residential - 5 DU/Ac.
R-6 Residential - 6 DU/Ac.
R-9 Residential - 9 DU/Ac.
R-15 Residential - 15 DU/Ac.
R-24 Residential - 24 DU/Ac.
I Industrial
IN Institutional

Beaverton
LI Multifamily (High) - 44 DU/Ac.
R-1 Light Industrial

Hillsboro
R-4 Multifamily Residential

Study Area Boundary

Source: Shapiro & Associates, Inc., 1990

N

SCALE-FEET
0 1000 2000

Westside Corridor Project

Zoning/Comprehensive Plan Designation Along Proposed LRT Alignments

The Oregon Department of Transportation

TRI-MET

Figure 3.1-4e 5of5

the retail sector (see Table 3.1-4). By 2005, it is estimated that 5,600 persons will be employed in this area, with 24% in the retail sector.

3.1.3.2 West Hills/West Portland (Vista Bridge to Sylvan Interchange)

The West Hills/West Portland segment of the corridor includes the area from the Vista Bridge to the Multnomah/Washington County line (see Figure 3.1-2). The major land use is Washington Park (see Figure 3.1-3b), with a limited number of single-family residences at the northern and southern extremes of the corridor. In the West Hills portion of the corridor, extending west from the Washington Park Zoo to Sylvan, the primary land use is single-family residential. In the Sylvan Interchange area, commercial uses predominate, with some large tracts of open space and vacant land.

The Washington Park Zoo is designated as open space. The areas south of Sunset Highway and west of Washington Park to the Multnomah/Washington County line are zoned single-family residential (see Figure 3.1-3b). In the Sylvan area, there is a large tract zoned commercial, as well as small areas zoned multifamily residential.

The West Hills/West Portland segment of the corridor is not expected to experience much growth in either population or housing in the next 15 years. In 1987, 5,300 people lived in this segment of the corridor (see Table 3.1-4) comprising 2,300 households with an average of 2.26 people per household. Approximately 76% of the housing stock consisted of single-family dwelling units. By 2005, this area is projected to have 5,200 residents in 2,400 households. Average household size is expected to decrease from 2.26 to 2.13 by 2005. The housing stock in this area is expected to increase from 2,400 to 2,500 units by 2005, with approximately 73% projected to be single-family units.

Although little change is anticipated in the residential population, employment is expected to increase by approximately 19% over the next 15 years. In 1987, approximately 2,400 people were employed in this area, 13% of them in the retail sector. By 2005, the number of employed people is estimated to increase to 2,900 with 14% in the retail sector.

A 35-unit subdivision is planned near S.W. Humphrey Boulevard, south of Sunset Highway between the Washington Park Zoo and Sylvan.

3.1.3.3 Southeast Cedar Hills-Cedar Mill (Sylvan Interchange to S.W. Cabot Street/Highway 217)

The Cedar Hills-Cedar Mill area extends west from the Multnomah-Washington County line to the Beaverton city limits (see Figure 3.1-2), and lies in incorporated Washington County.

Existing land use in the Cedar Hills-Cedar Mill area is characterized by residential uses (see Figure 3.1-3c). Multifamily development is concentrated on the north side of Sunset Highway, east of S.W. Barnes Road, and at the southwest quadrant of the Sunset Highway/Highway 217 Interchange. Generally, single-family uses are located south of Sunset Highway.

Commercial uses are located near the proposed Sunset Transit Center (see Figure 3.1-3c). This location includes a 250-acre site known as the Peterkort Property. A plan has been prepared to develop 134 acres of the site as a mixed-use facility with approximately one million square feet of office space. The proposed Sunset Transit Center would be integrated into this project. The land currently is used as a nursery.

The Golf Creek Apartments were recently constructed north of Sunset Highway and west of the Finley Cemetery reservoir. In addition, a 63-unit apartment complex has been built east of the Finley Cemetery reservoir. The development of Shilo Inn, to be located northeast of the Sunset Highway/Highway 217 Interchange, has been proposed to county officials.

Land uses in this segment of the corridor are defined by the Cedar Hills-Cedar Mill Community Plan (see Figure 3.1-4c). This area is dominated by residential uses ranging from 5 to 24 units per acre.

Table 3.1-4

POPULATION, HOUSING, AND EMPLOYMENT WITHIN LRT CORRIDOR

Characteristic/Corridor Link	1987	2005
Population		
Downtown Portland/Goose Hollow	4,331	4,485
West Hills/West Portland	5,279	5,197
Southeast Cedar Hills - Cedar Mill	9,717	9,751
Beaverton	7,835	9,523
West Beaverton/Sunset	5,671	12,722
Households		
Downtown Portland/Goose Hollow	3,293	3,607
West Hills/West Portland	2,337	2,439
Southeast Cedar Hills - Cedar Mill	4,117	4,593
Beaverton	4,963	6,196
West Beaverton/Sunset	3,451	6,670
Average Household Size		
Downtown Portland/Goose Hollow	1.32	1.24
West Hills/West Portland	2.26	2.13
Southeast Cedar Hills - Cedar Mill	2.36	2.12
Beaverton	1.58	1.54
West Beaverton/Sunset	1.64	1.91
Total Housing Units		
Downtown Portland/Goose Hollow	3,558	3,888
West Hills/West Portland	2,437	2,527
Southeast Cedar Hills - Cedar Mill	4,681	5,014
Beaverton	3,150	4,468
West Beaverton/Sunset	3,412	6,951
Single-Family Units		
Downtown Portland/Goose Hollow	182	54
West Hills/West Portland	1,861	1,846
Southeast Cedar Hills - Cedar Mill	1,965	2,123
Beaverton	942	1,143
West Beaverton/Sunset	2,896	5,332
Multifamily Units		
Downtown Portland/Goose Hollow	3,376	3,834
West Hills/West Portland	576	684
Southeast Cedar Hills - Cedar Mill	2,716	2,891
Beaverton	2,234	3,325
West Beaverton/Sunset	2,503	3,624
Total Employment		
Downtown Portland/Goose Hollow	4,776	5,548
West Hills/West Portland	2,435	2,887
Southeast Cedar Hills - Cedar Mill	9,505	12,798
Beaverton	25,202	32,039
West Beaverton/Sunset	1,034	3,460
Retail Employment		
Downtown Portland/Goose Hollow	952	1,321
West Hills/West Portland	321	412
Southeast Cedar Hills - Cedar Mill	896	1,906
Beaverton	6,397	9,415
West Beaverton/Sunset	7	262
Non-Retail Employment		
Downtown Portland/Goose Hollow	3,824	4,227
West Hills/West Portland	2,114	2,475
Southeast Cedar Hills - Cedar Mill	8,609	10,892
Beaverton	20,792	24,629
West Beaverton/Sunset	1,027	3,198

See Figure 3.1-2 for geographic areas.

Source: Metro Regional Forecasts, June 1989.

Commercial uses are divided into two districts: Office Commercial and Community Business. The Office Commercial District permits office buildings of various sizes and limited accessory commercial uses. The Community Business District permits a mix of retail, office, service, and business uses intended to serve the larger community. Several parcels within this segment are zoned institutional (i.e., schools, parks, churches, hospitals, and water reservoirs).

The 1987 population of 9,800 is expected to remain stable through 2005 (see Table 3.1-4). The number of housing units is expected to grow by 0.4% a year, indicating a decrease in average household size. The annual growth rate of single-family housing units is expected to outpace that of multifamily units. Employment is expected to increase from 9,500 in 1987 to 12,800 by 2005, with most of the growth in retail employment (see Table 3.1-4).

3.1.3.4 Beaverton (S.W. Cabot Street/Highway 217 to S.W. Merlo Road)

The Beaverton area includes land south and west of S.W. Walker Road to S.W. Merlo Road (see Figure 3.1-2). Existing land uses in this area of the corridor generally consist of commercial developments (see Figure 3.1-3d). However, areas of residential, industrial, and public or semi-public uses are located within the corridor. The larger industrial and public or semi-public uses are located on both sides of the Beaverton city limits at S.W. Merlo Road. These include the Tri-Met bus maintenance facility, and PGE substation. The Tektronix campus, located between S.W. Cedar Hill Boulevard and S.W. Murray Boulevard in unincorporated Washington County is designated industrial. The corridor west of S.W. Murray Boulevard includes a large area of vacant land.

The corridor traverses the Beaverton area, skirting the southeastern edge of medium- to high-density multifamily residential districts located near the S.W. Center Street Park (see Figure 3.1-4d). The corridor then extends through the commercially zoned Town Center District. The Town Center District is intended to allow the CBD to develop into a mixed-use, regional employment and service center. The other commercial zones provide areas for more generalized commercial uses. The Campus Industrial and Light Industrial Districts extend west beyond S.W. Murray Boulevard. The Campus Industrial District is intended to provide areas for combining light manufacturing, office, and limited retail use in an "employment activity center" concept. The 54-acre Beaverton Creek Business Park is being developed northeast of the S.W. Millikan Way and S.W. Terrace Drive intersection.

The 1987 population in this area was 7,800 (see Table 3.1-4). This figure is expected to increase to 9,500 by 2005, representing an annual growth rate of 2.1%. This increase in population is expected to be accompanied by a 2.3% annual increase in housing units. The annual growth rate of multifamily housing units (2.7%) is expected to outpace that of single-family units (1.2%).

Employment in Beaverton is expected to increase at an average annual rate of 1.51%, from 25,200 in 1987 to 32,000 in 2005. The City of Beaverton constitutes a large employment base that is expected to increase its retail share in the future.

3.1.3.5 West Beaverton/Sunset (S.W. Merlo Road to S.W. 185th Avenue)

Most of the West Beaverton/Sunset segment between Beaverton and Hillsboro is located within the Sunset West Community Planning area (see Figure 3.1-2). The corridor beyond the proposed S.W. Merlo Road Station is developed primarily with single-family residences and industrial land uses (see Figure 3.1-3e). Some commercial uses are located near the S.W. 170th Avenue and S.W. 185th Avenue Stations. Between S.W. Merlo Road and S.W. 173rd Avenue, the corridor is dominated by agricultural land.

This segment of the corridor extends through areas zoned for industrial, institutional, and residential uses (see Figure 3.1-4e). The predominant uses are industrial and institutional in the area north of S.W. Merlo Road and west of S.W. 158th Avenue. Limited commercial uses are allowed. North of this industrial district (from S.W. 162nd Avenue to S.W. 170th Avenue) the majority of land is zoned residential with a maximum density of 24 units per acre. The corridor west of S.W. 170th Avenue extends through residential areas that allow densities of 6 to 15 units per acre. The area east of S.W. 185th Avenue, between Baseline Road and the BN Railroad tracks, is zoned industrial.

The proposed S.W. 185th Avenue station would be located within the Hillsboro city limits. The City of Hillsboro has zoned this area multifamily residential (see Figure 3.1-4e). The land uses surrounding the proposed station vary from residential to industrial and commercial. The predominant use is residential.

Plans to develop a golf driving range and an auto repair shop have been discussed with Washington County officials, although no formal land use application has been made. The driving range would be south of Baseline Road near S.W. 162nd Avenue. The auto repair shop would be at the intersection of S.W. 179th Avenue and the BN alignment.

The greatest increase in population and housing is projected to occur within the West Beaverton/Sunset link of the corridor, which includes several vacant sites. The 1987 population in this area was about 5,700 (see Table 3.1-4). This figure is expected to increase to 12,700 by 2005, representing an annual growth rate of 6.9%. This increase in population is expected to be accompanied by a 5.8% annual increase in housing units. The increase in single-family housing units (average growth rate of 4.7%) is expected to outpace that of multifamily units (average growth rate of 2.5%).

The employment projections within this segment of the corridor reflect Washington County's overall economic growth (see Table 3.1-4). Based on physical conditions and land use patterns, land within the West Beaverton/Sunset segment of the corridor appears most suited for lower density light industrial development. Total employment in 1987 was 1,000. This figure is projected to increase to 3,500, an annual growth rate of 13%, through 2005.

3.1.3.6 Future TSM Park-and-Ride Lot Locations

The TSM Alternative would provide several additional park-and-ride lots throughout the Westside, most of them along T.V. Highway (see Figures 3.1-5a and 5b). Existing land use and zoning within one-quarter mile of the proposed park-and-ride lots is discussed in this section.

The intersection of S.W. Murray Boulevard and T.V. Highway is located in a largely single-family residential area. Some commercial uses and a school are located immediately adjacent to the intersection. The area north of the intersection of N.W. Cornell Road and T.V. Highway is developed with single-family residences. The area south of the intersection currently is vacant, except for some limited commercial development. This area is zoned for a mix of multifamily, office, commercial, and industrial uses.

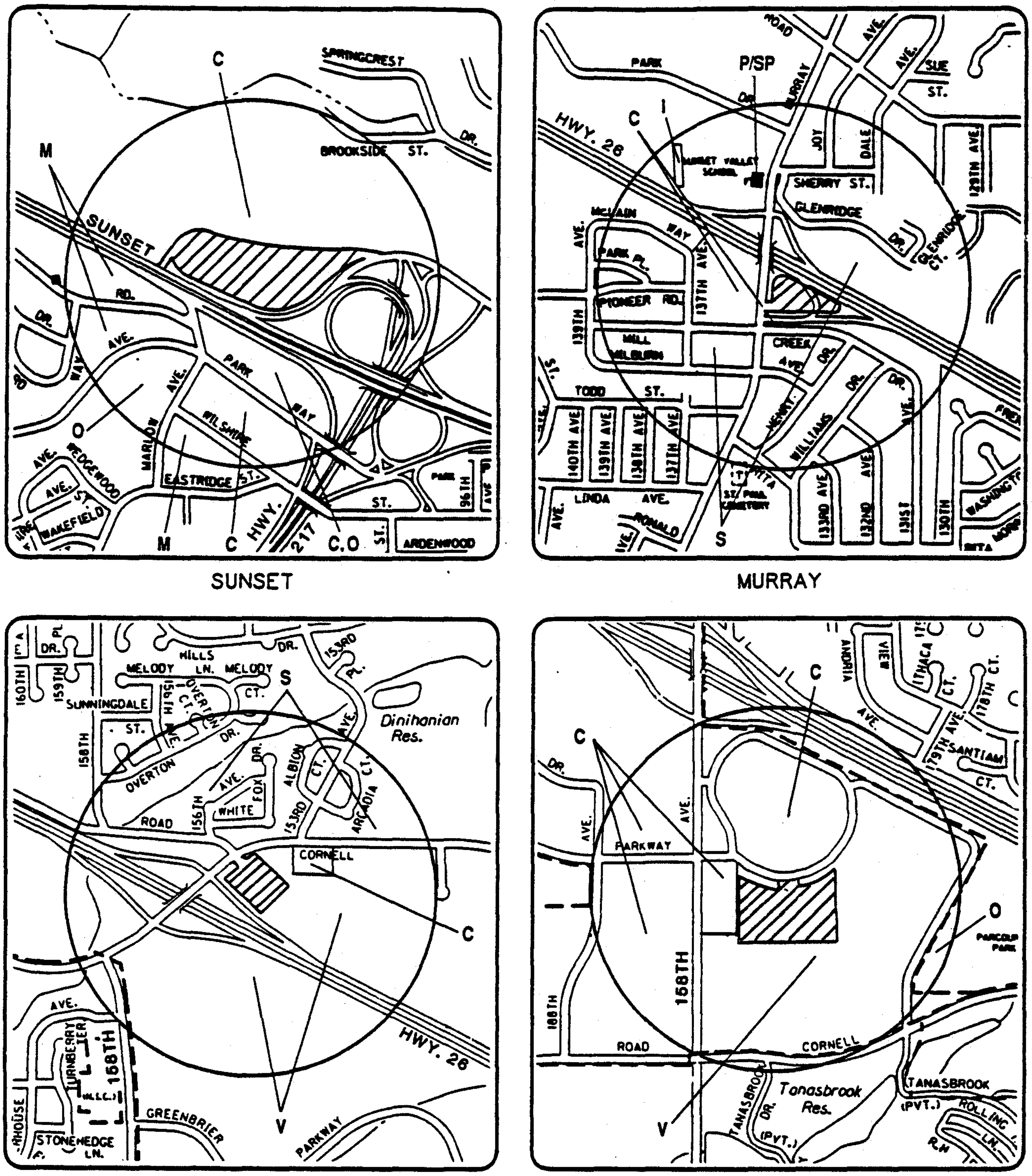
The Tanasbourne Mall area is developed with commercial uses, and the remaining vacant land in this area is zoned campus industrial. The intersection of S.W. 160th Avenue and T.V. Highway is largely undeveloped, except for some residential and limited commercial development south of the Northern Pacific railroad tracks. The areas south of T.V. Highway are zoned for high-density multifamily, while the areas north of the highway are zoned industrial.

The S.W. 170th Avenue/T.V. Highway intersection is developed primarily with residential uses south of T.V. Highway. North of the highway is the St. Mary's Home for Boys, and some office development. The intersection of S.W. 198th Avenue and T.V. Highway also is located in a developed area, consisting primarily of industrial and office uses (see Figures 3.1-6a and 6b).

3.2 TRANSPORTATION

The following section describes the existing transit, highway, and arterial facilities in the Westside Corridor. It provides background for describing and evaluating the transportation impacts of the project alternatives and LRT alignment and terminus options.

Section 3.2.1 describes current transit and highway travel behavior within the Westside Corridor. Section 3.2.2 describes the existing transit network and facilities in the corridor and within the entire Tri-



PARK AND RIDE LOT

LEGEND

S	SINGLE FAMILY	I	INDUSTRIAL
M	MULTIFAMILY	P/SP	PUBLIC/SEMI-PUBLIC
C	COMMERCIAL	V	VACANT
O	OFFICE		

The Oregon Department of Transportation

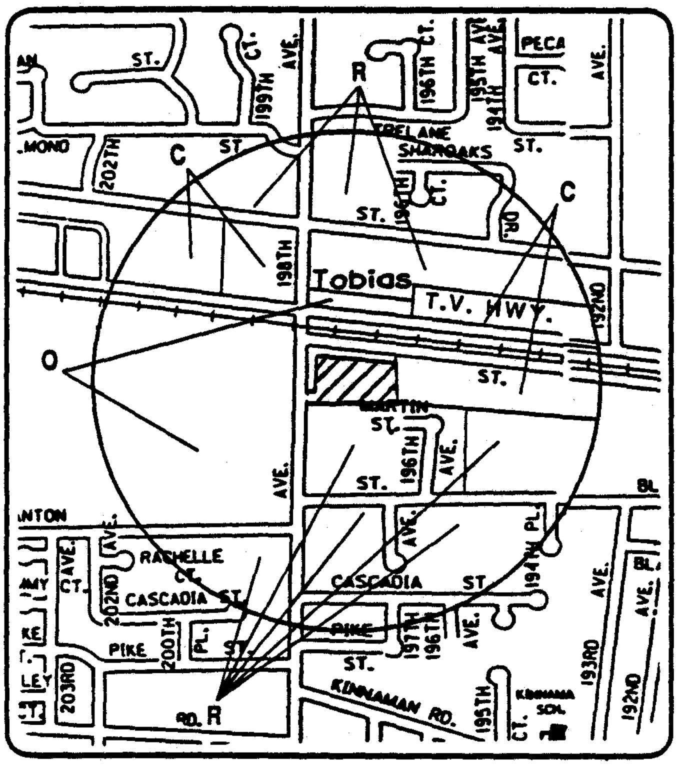
WESTSIDE LIGHTRAIL TRI-MET

0' 500' 1000

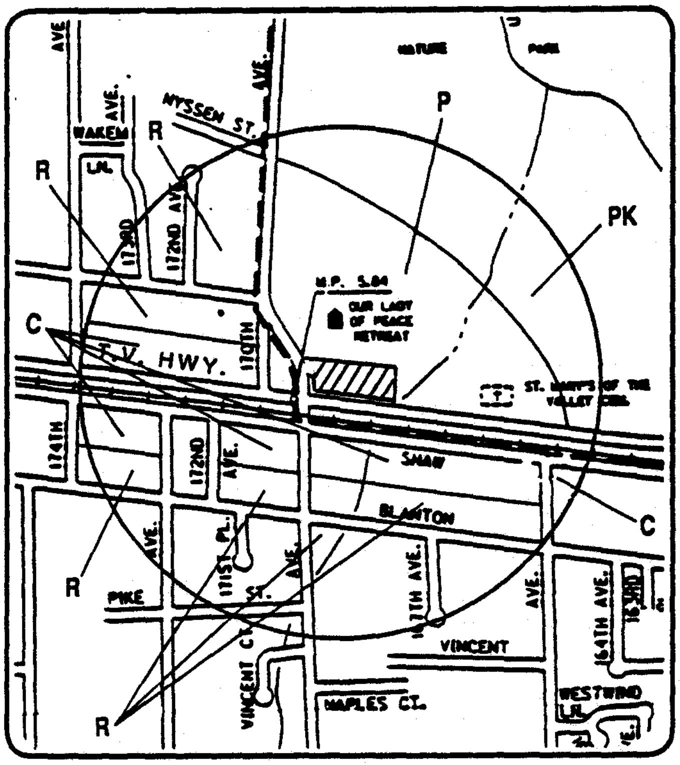
WESTSIDE CORRIDOR PROJECT

TSM PARK AND RIDE LOTS ON SUNSET HWY. - EXISTING LAND USE

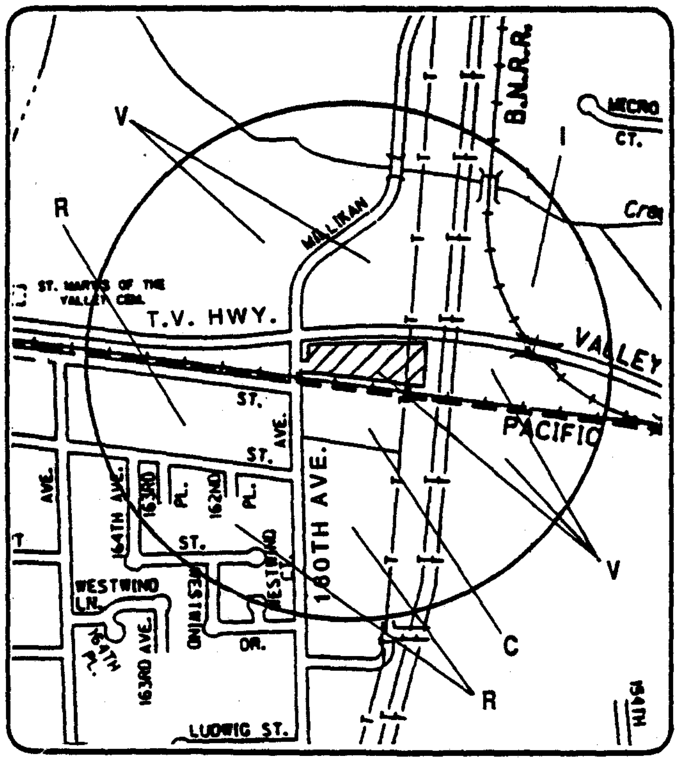
FIGURE 3.1-5a



198TH AVE



170TH AVE



160TH AVE

PARK AND RIDE LOT

LEGEND

R	RESIDENTIAL	I	INDUSTRIAL
C	COMMERCIAL	P/SP	PUBLIC/SEMI-PUBLIC
O	OFFICE	P	PARK & OPEN SPACE
		V	VACANT

The Oregon Department of Transportation

WESTSIDE LIGHTRAIL TRI-MET

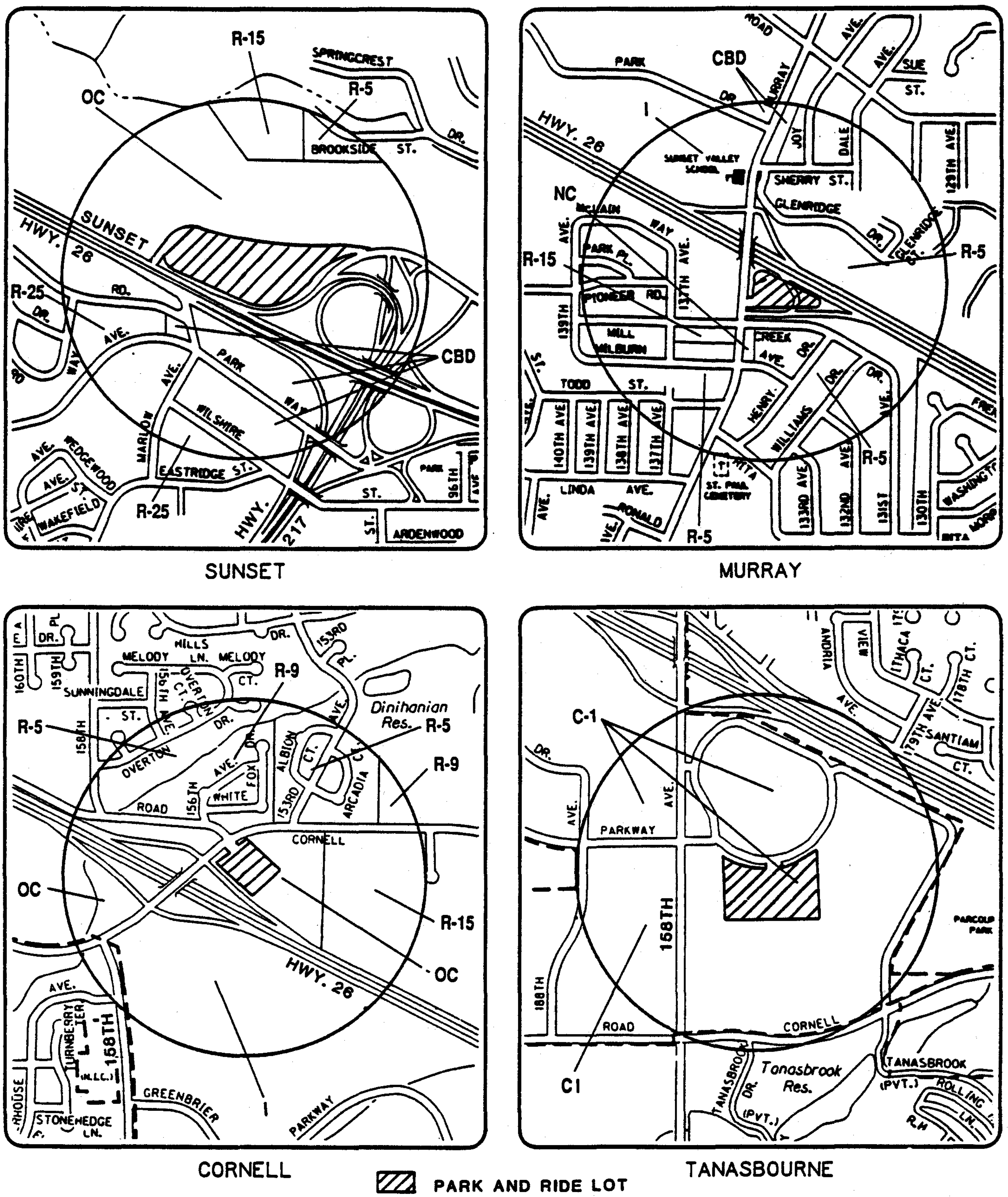
N

0' 500' 1000'

WESTSIDE CORRIDOR PROJECT

TSM PARK AND RIDE LOTS ON T.V. HWY. EXISTING LAND USE

FIGURE 3.1-5b



LEGEND

R-5	RESIDENTIAL - 8 DU/AC.	OC	OFFICE COMMERCIAL
R-9	RESIDENTIAL - 9 DU/AC.	NC	NEIGHBORHOOD COMMERCIAL
R-15	RESIDENTIAL - 15 DU/AC..	I	INDUSTRIAL
R-25	RESIDENTIAL - 40 DU/AC.	CI	CAMPUS INDUSTRIAL
		C-1	GENERAL COMMERCIAL

The Oregon Department of Transportation

WESTSIDE LIGHTRAIL TRI-MET

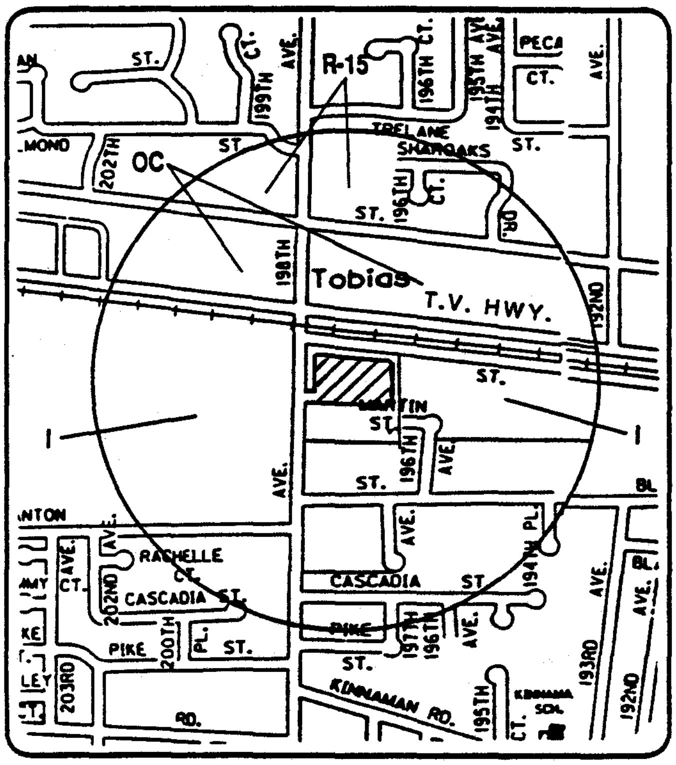
N

0' 500' 1000'

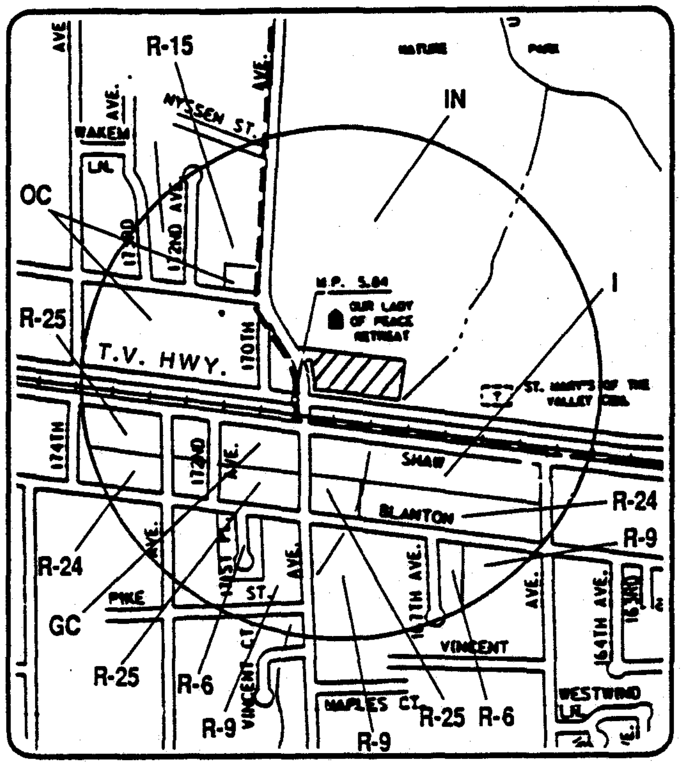
WESTSIDE CORRIDOR PROJECT

TSM PARK AND RIDE LOTS ON SUNSET HWY. - COMPREHENSIVE PLAN DESIGNATIONS

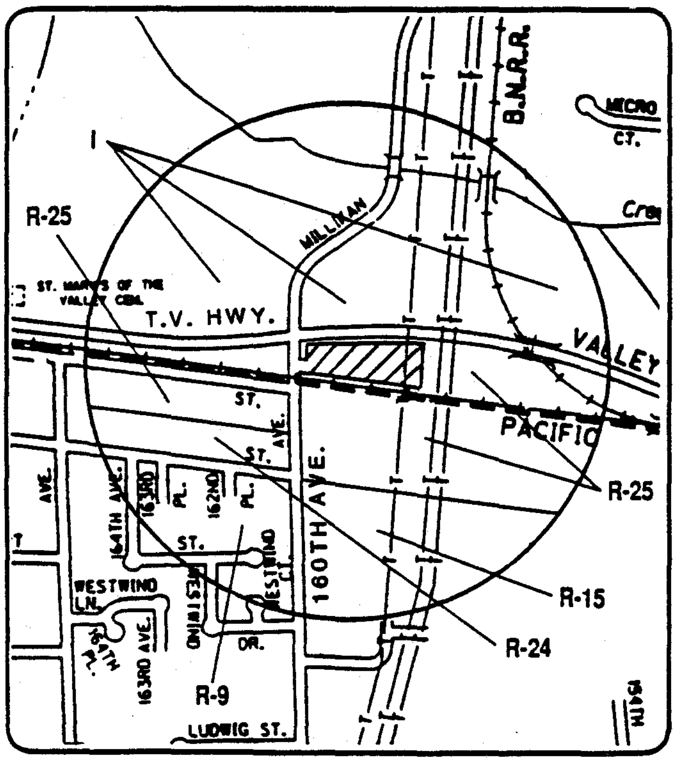
FIGURE 3.1-6a



198TH AVE



170TH AVE



160TH AVE

PARK AND RIDE LOT

LEGEND

R-6	RESIDENTIAL - 7 DU/AC.	R-25	RESIDENTIAL - 40 DU/AC.
R-9	RESIDENTIAL - 9 DU/AC.	GC	GENERAL
R-15	RESIDENTIAL - 15 DU/AC.	OC	OFFICE
R-24	RESIDENTIAL - 24 DU/AC.	I	INDUSTRIAL
		IN	INSTITUTIONAL
		C-2	GENERAL COMMERCIAL

The Oregon Department of Transportation

WESTSIDE LIGHTRAIL TRI-MET

N

0' 500' 1000'

WESTSIDE CORRIDOR PROJECT

TSM PARK AND RIDE LOTS ON T.V. HWY. - COMPREHENSIVE PLAN DESIGNATIONS

FIGURE 3.1-6b

Met transit system. Section 3.2.2 also presents existing availability of transit within the corridor, and transit operations revenue and cost information for the corridor and total Tri-Met system. Section 3.2.3 identifies the key highway and arterial facilities, and presents information describing traffic congestion problems within the corridor. Section 3.2.4 describes the existing parking supply and local parking policies. Section 3.2.5 describes facilities and key local plans providing for bicycle and pedestrian travel within the corridor.

3.2.1 Travel Behavior

The transportation facilities in the Westside Corridor accommodate a total of 976,500 person-trips on an average weekday. Of these, approximately 19,400 are on the transit system. The Westside Corridor accounts for approximately 18% of all daily person-trips and 13% of all daily transit trips in the Portland metropolitan area. About 59,000 daily person-trips are made between downtown Portland and the rest of the Westside Corridor, accounting for approximately 6% of all corridor trips. Daily work trips in the corridor total 226,000. Eleven percent of all corridor work trips are to and from downtown Portland. Between 1983 and 1988, total travel demand in the corridor increased 26%.

Like most areas in the country, people traveling to, from, or within the Westside Corridor typically travel via automobile (Table 3.2-1). However, transit is a significant mode for trips to downtown Portland. More than 25% of work trips to downtown Portland are made via the transit system.

Downtown Portland is the principal destination of Westside Corridor transit users, with 60% of all home-based transit trips to or from downtown. Central Beaverton is the second most likely transit destination, with 5% of corridor home-based transit trips. The cities of Hillsboro and Tigard are third, with about 4.4% each. The orientation of trunkline bus service (discussed in Section 3.2.2) is consistent with the predominance of downtown Portland as a transit trip destination.

3.2.2 Public Transportation

A restructuring of Westside bus service occurred in June 1979, when Tri-Met introduced a timed-transfer system to the area. This system involved four elements: (1) constructing two transit centers where buses in the area would meet at regular intervals; (2) restructuring lines into feeders and trunk lines; (3) establishing a "pulse" scheduling system; and (4) expanding transit lines into previously unserved areas. The transit centers, one in central Beaverton and the other at the Cedar Hills Shopping Center southwest of the Sunset Highway/Highway 217 Interchange, are the focus of the system (see Figure 1.2-2).

Table 3.2-1

EXISTING WESTSIDE CORRIDOR TRAVEL MODE CHOICE SUMMARY
(Percent)

Mode	All Trips	Trips To Downtown Portland	Work Trips	Work Trips to Downtown Portland
Drive	95	83	83	53
Carpool	*	*	11	20
Transit	2	16	4	26
Walk or Bicycle	3	1	2	1

*Carpool use data available only for work trips.

Source: Metro, 1990.

The route structure was realigned so most bus lines in the area operate to one (or both) of these transit centers. Certain bus lines operate only or substantially within the Westside. These are designated as local feeders. Other bus lines, the trunk lines, operate to downtown Portland or to other major destinations beyond the Westside. Bus trunk lines operate on Sunset Highway, Canyon Road, and T.V. Highway in the Westside; and on S.W. Jefferson and S.W. Columbia Streets and the Portland Mall in downtown Portland. With few exceptions, feeder bus lines are concentrated east of S.W. 185th Avenue, between Cornell Road on the north and Farmington Road on the south.

The timed-transfer service plan led to strong growth in both radial and intra-Westside Corridor transit travel, with most transit ridership concentrated on the trunk lines. The existing Westside Corridor transit network places transit service within a quarter mile of 45% of corridor residents and 55% of corridor jobs. This is poorer service than the balance of Tri-Met's service area where transit service is within a quarter mile of 62% of residents and 85% of jobs.

3.2.2.1 Transit Lines and Operations

Tri-Met currently operates a fleet of 590 buses and 26 light rail vehicles (LRV). During peak hours, 439 buses and 22 LRVs are in service. The buses travel a total of 71,346 miles each weekday, with LRVs traveling an additional 3,894 miles. Total daily platform hours are 5,050 for the buses and 258 for the light rail line. Platform hours are the total number of hours a transit vehicle is in service per day. Systemwide average speed is 14.1 mph for buses and 20.0 mph for the light rail line. City grid bus lines and the MAX light rail line generally operate every 15 minutes, with shorter headways during peak hours if rider demand warrants. Suburban trunk lines operate every 30 minutes during midday hours and every 15 minutes or less during peak hours. Buses on feeder lines run every 30 minutes and every 20 minutes during peak hours.

Twenty-two buses depart downtown Portland for the Westside Corridor during the P.M. Peak hour. These are distributed among five routes and each route has between three and ten P.M. peak hour trips.

During midday hours, Lines 57 and 59 provide from four to six trips per hour each direction between downtown Portland and the Westside Corridor. In 1982, Tri-Met's third bus garage was opened in the corridor near S.W. 158th Avenue and S.W. Merlo Road.

The Beaverton Transit Center, which is served by seven Tri-Met bus lines, is the primary focus of Westside Corridor transit service. All but one line (57) terminate here. Each of the seven bus lines has between 34 to 58 scheduled departures daily.

3.2.2.2 Passenger Facilities

Tri-Met offers riders 8,000 bus stops, more than 700 bus shelters, park-and-ride lots, special services for the elderly and handicapped, a Customer Assistance office, volunteer sales and assistance outlets, ticket machines at LRT stations, a concession at the Gateway Transit Center, and Fareless Square (a free-ride zone in downtown Portland).

The Beaverton Transit Center, opened in 1988, is located off S.W. Lombard Avenue, north of S.W. Canyon Road. The site is on the proposed Westside LRT line. Also in 1988, a transit center/park-and-ride facility opened in Hillsboro to provide transit access from western Washington County. It is the focal point for future transit service expansion in Hillsboro. The West Beaverton park-and-ride lot opened in 1989 on T.V. Highway at S.W. 160th Avenue.

Among Tri-Met's 14 existing transit centers, Beaverton Transit Center exhibits the lowest overall on-time performance (71% on-time arrival rate). Other transit centers' on-time performance (no more than two minutes early or nine minutes late) ranges from 72% to 83%. Line 57, the Westside trunk bus line and key bus line operating through Beaverton Transit Center currently arrives on-time 65% of the time.

On Portland's eastside, Gateway Transit Center has physical and operational characteristics very similar to Beaverton Transit Center, and provides a good performance comparison between a transit center served by a bus trunk line and one served by a LRT trunk line. MAX, the Eastside LRT trunk line, is the principal feature distinguishing Gateway Transit Center from Beaverton Transit Center. Gateway's overall on-time performance is 79%, due largely to the LRT line's 90% on-time performance.

3.2.2.3 Management

Tri-Met is the mass-transit operating agency for the Portland metropolitan area. It is the largest transit district in Oregon and the fifth-largest transit agency on the West Coast. Under Oregon law (ORS 267), Tri-Met is a nonprofit, municipal corporation operating in the urbanized portions of three Oregon counties: Multnomah, Washington, and Clackamas. Its operating area covers approximately 1,000 square miles and it serves a total population of about 1.1 million.

3.2.2.4 Current Ridership, Operating Revenue, and Operating Expenses

Average daily originating ridership on Tri-Met's fixed-route bus and LRT services declined from 130,600 in 1981 to 115,600 in 1986. By FY 1990, average daily ridership had recovered to a new high of 136,200. Westside Corridor transit ridership accounts for approximately 13% of the system total.

Compared with riders for the Tri-Met system as a whole, Westside Corridor transit riders are more likely to be male within a common age group, have slightly higher incomes, and use transit slightly more for work trips and slightly less for shopping and school trips. The average Westside Corridor resident uses transit three times each month, compared with five times per month for all residents of the Tri-Met service area. As with all Tri-Met system riders, approximately 58% of Westside riders have a car, but choose to use transit.

Tri-Met fares for adults are $.90 ($1.20 for more than two zones), with monthly passes costing $29 for two-zone use and $39 for use in all zones. Discounted ticket prices are available to senior citizens, the handicapped, and school-aged children.

For the full Tri-Met system during the period FY 1986 to FY 1990, fare revenue increased from $18.38 million to $22.35 million. Cost for transit operation and maintenance during this period increased from $55.93 million to $69.20 million. Fare revenue as a percentage of cost for operation and maintenance declined slightly from 33% to 32%, and operations costs per originating ride increased from $1.66 to $1.75.

For the Westside Corridor only, from FY 1986 to FY 1990, the cost for transit operation and maintenance increased from approximately $8.01 million to $9.91 million, while operations cost per originating ride increased from $1.78 to $1.87.

3.2.2.5 Accessible Service

Of Tri-Met's 590 standard and articulated buses, 306 are lift-equipped. Forty-seven of 74 bus lines provide accessible service. By March 1991, 63 bus lines will be accessible, including eight Westside Corridor bus lines. LRT service on the existing eastside MAX line is accessible.

Tri-Met works with local jurisdictions in providing access to the transportation system. Tri-Met coordinates with cities and counties to provide bus stops, curb cuts, and other sidewalk amenities needed for access to and from bus stops, park-and-ride lots, and transit stations. Tri-Met's goal is full accessibility of its fixed-route services. All vehicle and facilities improvements proposed for the Westside Corridor will be consistent with this agency goal.

The LIFT is a special transportation program providing more than 400,000 door-to-door trips annually to individuals who cannot use regular Tri-Met buses because of a physical or mental disability. Tri-Met's intention has been to make LIFT service available to the most severely disabled residents in the Tri-Met service area by providing service in situations not appropriate for regular Tri-Met fixed-route service. LIFT service also provides a reliable, reasonable-cost resource for agencies wishing to purchase pre-scheduled door-to-door service for their clients.

LIFT service is provided weekdays, from 6:30 a.m. to 6:00 p.m.

3.2.3 Highway Network

A major part of the transportation system serving the Westside Corridor is a network of state highways, arterials, and local streets (see Figure 1.2-1). On many of these roadways, traffic demand exceeds the design capacity, especially during peak periods. Many of the roads, especially those in Washington County, were designed as farm-to-market roads. Subsequent upgrading of these roads has not kept pace with growth and land use changes. The ability to meet the increased demand also is constrained by topography.

The quality of traffic operations on roadways is described in terms of level of service, a measure of operational conditions and their perception by motorists. Level-of-service (LOS) ratings range from A to F; LOS A represents the best operation and LOS F the poorest operation. Within the Portland metropolitan region, the goal for peak-hour traffic flow is LOS D. Under local policy, where LOS drops below D, that road or intersection is deemed deficient. The policy makes allowances for accepting a lower level of service on a road or intersection if policy, impact, or cost constraints dictate.

Attainment of the regional level-of-service goal would result in moderate peak-hour congestion levels without significant breakdowns in flow. Table 3.2-1a contains level of service criteria for freeways with a 60 mile-per-hour (mph) design speed, such as Sunset Highway or Highway 217. Descriptions of traffic conditions for each level of service, LOS A through LOS F, is as follows:

- Level-of-Service A represents free flow. Individual users are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to maneuver within the traffic stream is extremely high.

- Level-of-Service B is in the range of stable flow, but the presence of other users in the traffic stream begins to be noticeable. Freedom to select desired speeds is relatively unaffected, but there is a slight decline in the freedom to maneuver within the traffic stream from LOS A.

- Level-of-Service C is in the range of stable flow, but marks the beginning of the range of flow in which the operation of individual users becomes significantly affected by interactions with others in the traffic stream. The selection of speed is now affected by the presence of others, and maneuvering within the traffic stream requires substantial vigilance on the part of the user.

- Level-of-Service D represents high-density but stable flow. Speed and freedom to maneuver are severely restricted, and the driver experiences a generally poor level of comfort and convenience.

- Level of Service E represents operating conditions at or near the capacity level. All speeds are reduced to a low, but relatively uniform value. Freedom to maneuver within the traffic stream is extremely difficult, and is generally accomplished by forcing a vehicle to "give way" to accommodate such maneuvers. Comfort and convenience are extremely poor, and driver frustration is generally high.

- Level-of-Service F is used to define forced or breakdown flow. This condition exists wherever the amount of traffic approaching a point exceeds the amount that can traverse the point. Queues form behind such locations. Operations within the queue are characterized by stop-and-go waves, and are extremely unstable.

Table 3.2-2 contains intersection level-of-service criteria. Signalized intersection criteria are based on the intersection volume to capacity ratio. The values in Table 3.2-2 reflect acceptable values in an urban area with a populaiton greater than 500,000. Unsignalized interection level of service is based on reserve capacity, a measure of the unused capacity for traffic movements that must stop or yield at an intersection.

Table 3.2-1a

LEVEL-OF-SERVICE CRITERIA, FREEWAY MAINLINE
(60 mph Design Speed)

V/C[1]	Density[2]	Level of Service
N.A.[3]	≤12	A
≤0.49	≤20	B
≤0.69	≤30	C
≤0.84	≤42	D
≤1.00	≤67	E
N.A[4]	>67	F

[1] V/C - volume-to-capacity ratio.
[2] Density - passenger cars per mile per lane.
[3] LOS A not attainable due to design speed restrictions.
[4] Highly variable, observed volumes unstable at LOS F.

Source: Highway Capacity Manual, 1985.

Table 3.2-2

INTERSECTION LEVEL OF SERVICE

V/C[1] (signalized)	Reserve Density[2] (unsignalized)	Level of Service
0.00 - 0.55	>400	A
0.56 - 0.66	300-399	B
0.67 - 0.76	200-299	C
0.80 - 0.90	100-199	D
0.91 - 1.00	0-99	E
1.01 +	none	F

[1] V/C = volume-to-capacity ratio.
[2] Density = passenger cars per hour.

Sources: SIGCAP User's Guide, 1987 (signalized intersections).
1985 HCM, Table 10-3 (unsignalized intersections).

3.2.3.1 Downtown Portland/Goose Hollow

Downtown Portland is served by a regional highway network arranged in a radial pattern converging on the CBD. The Inner-Loop Freeway, consisting of the Fremont Bridge to the north, Interstate 5 (I-5) on the east bank of the Willamette River, the Marquam Bridge to the south, and I-405 (Stadium Freeway) to the west of the CBD, serves as the hub of the regional highway network. Radial highways connecting to the Inner-Loop Freeway include I-5 from the north and southwest, Interstate 84 (I-84 or Banfield Freeway) from the east, and U.S. Highway 26 (Sunset Highway) from the west. Major non-freeway routes within the Westside Corridor that connect downtown Portland to Washington County include N.W. Cornell Road, West Burnside Road, and Beaverton-Hillsdale Highway.

Sunset Highway connects directly to the Inner Loop Freeway and the CBD street system via tunnels through Vista Ridge. Additional access to the CBD from Sunset Highway is provided via the Canyon Road ramps, which connect to the paired one-way street couplet of S.W. Jefferson and S.W. Columbia Streets.

N.W. Cornell Road is another route into northwest and downtown Portland from Washington County. The city's current policy towards the function of N.W. Cornell Road is that traffic volumes should be stabilized or reduced as transit service is improved. West Burnside Street is a significant source of Westside Corridor traffic. The city's current policy is to discourage capacity improvements on West Burnside Street that would increase automobile capacity.

Beaverton-Hillsdale Highway, a state route, runs south of the West Hills, providing access to downtown Portland from the Westside via S.W. Barbur Boulevard. Because it runs through a relatively mature suburban area, traffic operations on Beaverton-Hillsdale Highway are subject to delays from numerous driveways intersections. Beaverton-Hillsdale Highway is not within the primary study area for the Westside Corridor Project.
The following descriptions of existing local traffic conditions start in downtown Portland at the transit mall and progress west along the proposed LRT line to the Goose Hollow neighborhood. Capacity analyses have been provided at key intersections that would be significantly affected by the proposed project. These analyses are summarized in Table 3.2-3.

Within the CBD, a transit mall is provided on the S.W. Fifth Avenue/S.W. Sixth Avenue one-way couplet. Consisting of one general-traffic lane, a curbside bus-stop lane, and a bus-passing lane, the transit mall extends from Madison Street north to West Burnside Street. The transit mall currently is served by 41 transit lines, providing bus service between the CBD and outlying areas served by Tri-Met. The transit mall was designed to accommodate approximately 200 standard buses per hour on each street. Currently, the mall carries 120 southbound buses on S.W. Fifth Avenue and 77 northbound buses on S.W. Sixth Avenue during the P.M. Peak hour.

S.W. Morrison and S.W. Yamhill Streets are two-lane, one-way streets that operate as a paired couplet from S.W. 18th Avenue on the west to Front Avenue on the east. The existing Banfield LRT system operates on this couplet between S.W. First Avenue and S.W. 11th Avenue. Between S.W. 11th Avenue and S.W. 18th Avenue, S.W. Morrison and S.W. Yamhill Streets provide two general traffic lanes. Access to properties along S..W. Morrison and S.W. Yamhill Streets is provided by driveways and is unrestricted on the portions of these streets west of the existing LRT line.

S.W. 18th Avenue is a four-lane, two-way neighborhood collector street that connects the S.W. Morrison/S.W. Yamhill and S.W. Jefferson/S.W. Columbia couplets on the west side of the CBD. The only major intersection between these two couplets is with S.W. Salmon Street.

S.W. 18th Avenue intersects S.W. Jefferson and S.W. Columbia Streets at Collins Circle, which is classified as a city entrance and major focal point. Traffic movements through the circle are controlled by three signalized intersections at S.W. Jefferson Street, S.W. 18th Avenue, and S.W. Columbia Street.

West of Collins Circle, between S.W. 19th Avenue and the Vista Bridge, S.W. Jefferson Street is a four-lane, two-way street. Between Collins Circle and S.W. 21st Avenue, a third eastbound lane is added and these three lanes diverge to the south of Collins Circle to form S.W. Columbia Street. West of S.W. 20th Avenue, access to S.W. Jefferson Street is right-on and right-off only, resulting in free-flow traffic conditions. The level-of-service on this section is controlled by the signalized intersections at Collins Circle (Table 3.2-3).

West of the Vista Bridge, the four-lane through-route to Sunset Highway is known as S.W. Canyon Road. S.W. Canyon Road is a four-lane, two-way street that originally extended through Sunset Canyon from S.W. Jefferson Street at the Vista Bridge, through Sylvan, and down the West Slope into

Beaverton. Most of that alignment became what is now Sunset Highway. The level-of-service on S.W. Canyon Road between the Vista Bridge and Sunset Highway freeway ramps is controlled by the capacity of the freeway ramps to and from Sunset Highway, and by traffic conditions on the Sunset Highway mainline. When freeway incidents close the Vista Tunnels, S.W. Canyon Road provides an emergency access route to and from Sunset Highway, providing eastbound freeway traffic with a route off of the freeway.

3.2.3.2 Sunset Highway Corridor

Sunset Highway is a primary state highway and a major link between the Portland metropolitan area and coastal areas to the west. Sunset Highway is the only limited-access facility in the Westside Corridor that provides a direct connection between downtown Portland and Washington County. For much of its length within the project area, Sunset Highway is designed to freeway standards. However, because it evolved from earlier, non-freeway facilities, portions of the highway do not meet current design standards.

From downtown Portland through the Vista tunnels, Sunset Highway is a six-lane divided freeway with full access control. A fourth, westbound, truck climbing lane is provided between the S.W. Canyon Road entrance ramp and the Zoo Interchange. West of the S.W. Canyon Road on/off ramp, the highway narrows to two lanes in each direction. Between the S.W. Camelot Court overpass and the Highway 217 Interchange, partial-access control is provided, resulting in a number of local street "T" intersections on the Sunset Highway.

Table 3.2-3

INTERSECTION LEVEL-OF-SERVICE ANALYSIS
DOWNTOWN PORTLAND/GOOSE HOLLOW
1987 P.M. Peak Hour

Intersection	V/C[1]	Reserve[2] Capacity	LOS
S.W. 18th Avenue and S.W. Morrison Street	0.49		A
S.W. 18th Avenue and S.W. Yamhill Street		125	D
S.W. 18th Avenue and S.W. Salmon Street	0.64		B
S.W. 18th Avenue and S.W. Jefferson Street	0.55		A
S.W. 18th Avenue and S.W. Columbia Street (west)	0.33		A
S.W. 18th Avenue and S.W. Columbia Street (east)		622	A

[1] V/C - volume to capacity ratio (signalized intersections).
[2] Reserve Capacity - Unsignalized intersections only.

Source: HNTB, 1990.

Table 3.2-4 summarizes existing traffic conditions during the A.M. Peak hour in the peak direction, eastbound, between the Highway 217 Interchange and the Vista Tunnels. Table 3.2-5 summarizes existing traffic conditions in both directions during the P.M. Peak hour. The traffic volumes used in the analyses are based on actual traffic counts made by ODOT's Highway Division during 1987. Table 3.2-6 summarizes P.M. Peak hour conditions at surface street intersections within the corridor.

During the A.M. Peak hour, traffic demands west of the Sylvan Interchange exceed the capacity of the existing highway, resulting in LOS F traffic operations. The bottlenecks that exist in this portion of the corridor limit the amount of eastbound traffic that can be delivered to Sunset Highway east of the Sylvan Interchange. Consequently, traffic operations between the Sylvan Interchange and the Vista Tunnels are generally free-flowing, with traffic volumes that exceed 2,000 passenger cars per hour per lane, the generally-accepted capacity of a single freeway travel lane, during peak periods. These high lane volumes, combined with travel speeds of 30 to 40 mph, result in densities of approximately 50 passenger cars per mile per lane, equivalent to LOS E.

P.M. Peak hour level-of-service analyses, summarized in Table 3.2-5, indicate that Sunset Highway operates at LOS F in the westbound direction during peak hour periods. Eastbound P.M. Peak hour traffic operations are generally better than AM conditions, because of lighter traffic demands, although LOS F operations do occur between the Sylvan and Highway 217 Interchanges.

Table 3.2-4

FREEWAY LEVEL-OF-SERVICE ANALYSIS
SUNSET HIGHWAY
1987 A.M. Peak Hour

Intersection	V/C[1]	Density	LOS
Eastbound A.M. Peak Hour			
Highway 217 to Canyon Road	---	83	F
Canyon Road to Sylvan	---	NA [2]	F
Sylvan to S.W. Columbia Street	---	52	E
Vista Tunnel	---	52	E

[1] Volume to capacity ratios not available for AM conditions
[2] Density - passenger cars per lane mile.
NA[2] - Density not applicable, LOS influenced by weave section.

Source: ODOT, 1988.

The alignment and grade of the Sunset Highway between the Vista Tunnels and the S.W. Canyon Road on/off ramps are constrained by steep canyon walls and existing development. Westbound vehicles encounter a 2.1-mile-long grade that ranges between 4% and 6%, warranting a climbing lane. The climbing lane is dropped west of the Zoo Interchange, midway up the grade, at a point where heavy trucks are still at speeds below 30 mph, creating a bottleneck during peak periods and safety concerns during off-peak periods. Because of these bottlenecks, which create a capacity imbalance on the Sunset Highway, many commuters use the Sunset Highway for their inbound trips in the morning but use alternative routes, such as Beaverton-Hillsdale Highway, West Burnside Street, or N.W. Cornell Road, for their outbound trips in the evening.

No westbound entrance ramp is provided at the Zoo Interchange. Instead, westbound traffic must use S.W. Canyon Court to reach the Sylvan Interchange, where it may then access Sunset Highway.

The Sylvan Interchange provides access to and from Sunset Highway from S.W. Skyline Boulevard, S.W. Scholls Ferry Road, and several local streets that converge in the vicinity of the interchange. Four major intersections, three signalized and one unsignalized, control traffic operations on the surface-street portion of the interchange. The proximity of the signalized intersections is a major contributor to traffic congestion and delay at the Sylvan Interchange. In addition, the freeway ramps, local streets, and adjacent commercial developments generate a high percentage of turning movements. Many vehicles are forced to weave or cross lanes in the short distances between intersections in order to access turning lanes. During peak periods, congestion at downstream intersections in the system affects groups of vehicles leaving upstream intersections.

The analysis indicates that the critical intersection in the system is S.W. Skyline Boulevard and the westbound Sunset Highway ramps (Table 3.2-6). This intersection is operating at LOS F. Because the intersections of S.W. Skyline Boulevard, and the eastbound ramps, westbound ramps, and S.W. Canyon Court are closely spaced and operate in an interconnected system, LOS F conditions at one intersection cause a breakdown in traffic operations at the other two intersections.

Table 3.2-5

FREEWAY LEVEL-OF-SERVICE ANALYSIS SUNSET HIGHWAY
1987 P.M. PEAK HOUR

Segment	V/C[1]	Density[2]	LOS
Eastbound			
West of Highway 217	0.96	57	E
Highway 217 Interchange	NA[3]	NA[3]	F
Highway 217 to S.W. Canyon Road	1.06	NA[4]	F
S.W. Canyon Road to Sylvan	NA[3]	NA[3]	E
Sylvan to Zoo	0.76	34	D
Zoo to S.W. Columbia Street	0.82	39	D
Vista Tunnel	0.73	32	D
Westbound			
Vista Tunnel	1.00	66	E
S.W. Jefferson Street Entrance to Zoo	0.86	43	E
Zoo to Sylvan	1.06	NA[4]	F
Sylvan to S.W. Canyon Road	NA[3]	NA[3]	F
S.W. Canyon Road to Highway 217	1.09	NA[4]	F
Highway 217 Interchange	NA[3]	NA[3]	F
West of Highway 217	1.30	NA[4]	F

[1] V/C - volume to capacity ratio (capacity = 2,000 vph).
[2] Density - passenger cars per lane mile.
[3] Density not applicable, LOS influenced by ramps or weave section.
[4] Density is highly variable for LOS F.
NA - Not Applicable.

Source: HNTB, 1990.

The Sylvan and Canyon Road Interchanges are separated by approximately 1,000 feet in the westbound direction and 750 feet in the eastbound direction. Heavy weaving volumes between these interchanges, combined with a reduction in the number of through lanes from three to two, result in a high degree of congestion in this area.

From S.W. Canyon Road to the Highway 217 Interchange, Sunset Highway traffic flow is disrupted by access from local streets at several "T" intersections. These intersections, which allow right-in, right-out access to local streets, do not meet current design standards for acceleration or deceleration distances.

Primarily because of its partial access control, this section of Sunset Highway does not meet freeway design criteria and suffers from degraded traffic operations.

The overall accident rate on Sunset Highway between the Vista Tunnels and the S.W. Canyon Road Interchange is 0.90 accidents per million vehicle miles, slightly below the statewide average accident rate of 0.99 for urban freeways. Analysis to determine possible high-accident locations indicated that the only definitive location was in the westbound lanes near the S.W. Canyon Road exit, where a total of 14 accidents occurred during the five-year analysis period. The remainder of the accidents occurred randomly throughout the corridor. An analysis of accident types indicates that the predominant accident type is rear-end collision, particularly during A.M. and P.M. peak hour periods. The predominance of rear-end accidents is an indication of congestion during peak hour periods.

Table 3.2-6

INTERSECTION LEVEL-OF-SERVICE ANALYSIS
SUNSET HIGHWAY CORRIDOR
1987 P.M. Peak Hour

Intersection	V/C[1]	Reserve[2] Capacity	LOS
Zoo Interchange			
WB[4] Exit Ramp and Zoo Entrance Road		570	A
S.W. Canyon Court and Zoo Entrance Road		595	A
EB[4] Exit Ramp and Zoo Entrance Road		564	A
Sylvan Interchange			
Skyline Boulevard and Scholls Ferry Road/EB[4] Ramps	0.95		E
Skyline Boulevard and WB[4] Ramps	1.11		F
Skyline Boulevard and Canyon Court	0.76		C[3]
Skyline Boulevard and Westgate Drive		88	E

[1] V/C - volume to capacity ratio (signalized intersections).
[2] Reserve Capacity - unsignalized intersections only.
[3] Actual LOS controlled by Skyline Boulevard and WB[4] Ramps intersection.
[4] EB - Eastbound; WB - Westbound.

Source: HNTB, 1990.

The partial cloverleaf interchange at Sunset Highway and Highway 217 provides diagonal and loop-ramp connections between the two highways. Additional connections are provided between S.W. Barnes Road, Sunset Highway, and Highway 217. This interchange is currently operating at LOS F (Table 3.2.5). In addition to suffering from capacity constraints, traffic operations within the interchange suffer from design deficiencies and from the mixing of freeway and local traffic.

Highway 217 currently ends at Barnes Road with an unsignalized, modified "T" intersection. This intersection operates at LOS F for northbound Highway 217 traffic turning left onto the westbound Sunset Highway entrance ramp. Because this traffic also is provided with a freeway ramp connection, the demand for this left turn is minimal, consisting primarily of motorists who missed the westbound Sunset Highway exit.

3.2.3.3 Highway 217 Corridor

Highway 217 is a four-lane freeway connecting Sunset Highway and I-5. The freeway runs south and east through Washington County, passing through the cities of Beaverton and Tigard. At its southern terminus, Highway 217 provides access to the city of Lake Oswego via Kruse Way. Access to Highway 217 is fully controlled, with freeway ramps provided at all interchanges. A number of auxiliary lanes are provided between interchanges; within the project area these lanes can be found northbound between the S.W. Canyon Road, the S.W. Walker Road, and Sunset Highway Interchanges and southbound between the S.W. Walker Road and S.W. Canyon Road Interchanges.

Rapid growth in the Westside Corridor has caused significant localized traffic congestion on Highway 217 during peak hour periods (see Table 3.2-7). The existing highway configuration, which consists of a series of diamond interchanges, is susceptible to operational problems resulting from heavy weaving of traffic entering and exiting the highway between the closely spaced interchanges.

S.W. Walker Road is a two-lane collector street. At the Highway 217 Interchange it widens, crossing Highway 217 on a four-lane structure. The interchange itself is a simple diamond configuration with signalized intersections at the ramp termini. A significant portion of the traffic passing through the interchange during the peak hour is destined to or comes from the Tektronix campus.

S.W. Canyon Road connects to Highway 217 at the northern end of a spread diamond interchange. Frontage roads, parallel to Highway 217, extend between S.W. Canyon Road and the Beaverton-Hillsdale Highway. At Highway 217, S.W. Canyon Road consists of two through lanes and a left-turn lane in each direction, for a total of six lanes at the signalized ramp intersections. Traffic demands exceed the capacity of the intersections of S.W. Canyon Road and Beaverton-Hillsdale Highway with the southbound Highway 217 frontage road. Operations are at LOS F during peak periods. The poor peak hour operation at these intersections is caused by heavy traffic volumes on S.W. Canyon Road that conflict with high peak exit volumes on southbound Highway 217 (see Table 3.2-8).

Table 3.2-7

FREEWAY LEVEL-OF-SERVICE ANALYSIS, HIGHWAY 217
1987 P.M. Peak Hour

Segment	V/C[1]	Density[2]	LOS
Southbound P.M. Peak Hour			
Sunset Highway to S.W. Park Way	NA[3]	NA[3]	F
S.W. Park Way to S.W. Walker Road	1.04	NA[4]	F
S.W. Walker Road to S.W. Canyon Road	NA[3]	NA[3]	D
S.W. Canyon Road to Beaverton-Hillsdale Highway	0.84	33	D
Northbound P.M. Peak Hour			
Beaverton-Hillsdale Highway to S.W. Canyon Road	0.79	30	D
S.W. Canyon Road to S.W. Walker Road	NA[3]	NA[3]	D
S.W. Walker Road to Sunset Highway	0.69	25	C

[1] V/C - volume to capacity ratio (capacity = 2,000 vph).
[2] Density - passenger cars per lane mile.
[3] Density not applicable, LOS influenced by ramps or weave section.
[4] Density is highly variable for LOS F.
NA - Not Applicable.

Source: HNTB, 1990.

Table 3.2-8

INTERSECTION LEVEL-OF-SERVICE ANALYSIS
HIGHWAY 217 CORRIDOR
1987 P.M. Peak Hour

Intersection	V/C[1]	LOS
Along Highway 217		
S.W. Walker Road, northbound ramps	0.98	E
S.W. Walker Road, southbound ramps	0.73	C
S.W. Canyon Road, northbound ramps	0.82	D
S.W. Canyon Road, southbound ramps	1.09	F
Beaverton-Hillsdale Highway, northbound ramps	0.88	D
Beaverton-Hillsdale Highway, southbound ramps	1.02	F

[1]V/C - volume to capacity ratio (signalized intersections).

Source: HNTB, 1990.

The Beaverton-Hillsdale Highway is at the southern end of the spread diamond interchange. The Beaverton-Hillsdale Highway is a five-lane major arterial with signalized ramp intersections. Traffic demands at the southbound ramp intersection exceed the capacity of the intersection, resulting in LOS F during peak periods (Table 3.2-8).

3.2.3.4 East and Central Beaverton

Much of Central Beaverton north of Canyon Road does not have public local streets. Most local traffic circulation takes place within large private developments, such as Fred Meyer, the Beaverton Mall, and the Tektronix campus, which have a limited number of access points on adjacent major streets. Local traffic is forced to use the public arterial and collector streets for short trips between the large private development areas. Short, local trips are mixed with the through traffic on major streets.

S.W. Canyon Road and T.V. Highway combined form a continuous arterial route through east and central Beaverton. Between Highway 217 and S.W. Cedar Hills Boulevard, most of S.W. Canyon Road is a five-lane street with a center two-way left-turn lane, although some limited sections of road without the left-turn lane exist, most notably at S.W. Cedar Hills Boulevard. The traffic signals on S.W. Canyon Road/T.V. Highway are interconnected between S.W. 110th Avenue, near Highway 217, and S.W. Murray Boulevard. East of S.W. Murray Boulevard, T.V. Highway is generally a five-lane street, with two through lanes in each direction and a continuous center two-way left-turn lane.

The capacity analyses summarized in Table 3.2-9 indicate that most of the intersections in the S.W. Canyon Road/T.V. Highway corridor are experiencing P.M. Peak hour traffic demands below their capacities, in the LOS D range. The level of service on an arterial such as S.W. Canyon Road/T.V. Highway is defined in terms of average travel speed. The overall level of service on an arterial can be severely degraded by a single intersection that is overloaded; furthermore, the long signal cycles used on S.W. Canyon Road result in significant delays to side streets. Streets in the east and central Beaverton areas affected by delays at S.W. Canyon Road/T.V. Highway include S.W. 117th Avenue, S.W. Hall Boulevard, S.W. Watson Avenue, S.W. Cedar Hills Boulevard, and S.W. Hocken Avenue. These side street delays have significant impacts on traffic circulation within east and central Beaverton.

S.W. Millikan Way is a private street, owned and maintained by Tektronix. Although the streets on the Tektronix campus are privately-maintained, they are open to the public. The City of Beaverton is studying alternatives to improve traffic circulation in central Beaverton by using the private portion of S.W. Millikan Way as part of a new east-west arterial route between Highway 217 and S.W. Murray Boulevard.

A BN Railroad spur runs through the southern portion of the Tektronix Campus. This spur, currently used for switching and railroad car storage, was formerly the BN mainline through Beaverton. A railroad relocation project completed in the early 1980s moved the BN mainline west of S.W. Murray Boulevard, eliminating a number of grade crossings within downtown Beaverton.

Table 3.2-9

INTERSECTION LEVEL-OF-SERVICE ANALYSIS
EAST AND CENTRAL BEAVERTON
EXISTING CONDITIONS
1987 P.M. Peak Hour

Intersection	V/C[1]	Reserve[2] Capacity	LOS
Along S.W. Canyon Road/T.V. Highway			
S.W. 114th Avenue		190	D
S.W. 117th Avenue	0.84		D
S.W. Lombard Avenue	0.63		B
S.W. Hall Boulevard	0.74		C
S.W. Watson Avenue	0.82		D
S.W. Cedar Hills Boulevard	0.82		D
S.W. Hocken Avenue	0.85		D
Beaverton-Hillsdale Highway and S.W. Lombard Avenue	0.71		C
S.W. Farmington Road and S.W. Lombard Avenue	0.69		C
S.W. Beaverdam Road and S.W. Hall Boulevard		120	D
S.W. Cedar Hills Boulevard and S.W. Henry Street	0.63		B
S.W. Hocken Avenue and S.W. Henry Street		182	D
S.W. 141st Avenue and Whitney Street		730	A

[1] V/C - volume to capacity ratio (signalized intersections).
[2] Reserve Capacity - Unsignalized intersections only.

Source: HNTB, 1990.

3.2.3.5 West Beaverton/Washington County

Existing north-south streets serving the west Beaverton area include S.W. Murray Boulevard, which runs from N.W. Cornell Road north of Sunset Highway to S.W. Scholls Ferry Road; S.W. 158th Avenue/S.W. 170th Avenue, which runs from N.W. Cornell Road to S.W. Road south of S.W.

Farmington Road; and S.W. 185th Avenue, which runs from Germantown Road north of Sunset Highway to Gassner Road south of S.W. Farmington Road. These routes serve as feeders to major east-west roads, such as T.V. Highway and Sunset Highway. Table 3.2-10 summarizes existing conditions at key intersections in the West Beaverton/Washington County portion of the Westside Corridor study area.

T.V. Highway, from S.W. Murray Boulevard to S.W. 198th Avenue, is a five-lane arterial with an additional (third) through lane in each direction at S.W. Murray Boulevard. Traffic operations on this portion of T.V. Highway are constrained by the signalized intersections with arterial and collector streets. High peak hour through-traffic volumes on the T.V. Highway are the main cause of high volume-to- capacity ratios at these intersections. The intersection of T.V. Highway and S.W. 130th Avenue is the only key intersection that does not meet the regional standard of LOS D.

Baseline Road is a two-lane minor arterial that provides east-west access west of S.W. 158th Avenue to the area between Sunset Highway and T.V. Highway. The intersections at S.W. 170th Avenue and S.W. 185th Avenue are unsignalized. Analyses indicate that the intersections at S.W. 170th Avenue and S.W. 185th Avenue currently operate at LOS E and F, respectively (Table 3.2-10). Major improvements to S.W. 185th Avenue between T.V. Highway and Sunset Highway are currently under construction. These improvements include the installation of traffic signals at the Baseline Road intersection and widening of S.W. 185th Avenue to a minimum of five lanes. The analysis of existing conditions at this intersection assumed pre-construction conditions.

West of the Highway 217 Interchange, Sunset Highway serves an area of Washington County that is experiencing rapid economic growth, accompanied by a transition from rural to suburban land uses. Three of the four interchanges between Highway 217 and S.W. 185th Avenue may be impacted by proposed park-and-ride lots that are part of the TSM Alternative. Existing traffic demands exceed the capacity of the N.W. Murray Boulevard and N.W. Cornell Road Interchanges. Improvements to provide more capacity are currently in the design phase and are expected to be built prior to construction of the highway or transit elements associated with the Westside Corridor Project.

The N.W. 185th Avenue/Sunset Highway Interchange is a simple diamond configuration. Unlike the interchanges at N.W. Murray Boulevard and N.W. Cornell Road, the cross-street, in this case N.W. 185th Avenue, has been improved to five lanes across the entire width of the interchange. Two other key intersections are adjacent to this interchange. The intersection of Evergreen Parkway and N.W. 185th Avenue also serves the entrance to the Tanasbourne Town Center and a park-and-ride lot. This intersection is currently experiencing P.M. Peak hour traffic demands in the LOS C range (Table 3.2-10). The intersection of N.W. Cornell Road and N.W. 185th Avenue is immediately south of the Tanasbourne Town Center area. This intersection is currently experiencing P.M. Peak hour traffic demands higher than the capacity of the intersection, resulting in LOS F operation, and improvements are currently under construction.

3.2.4 Parking

Parking supplies and governing policies vary throughout the corridor. In general, parking supplies are most constrained in downtown Portland and become more plentiful in the western portions of the corridor.

The City of Portland has placed an upper limit of 43,914 spaces on the parking supply within the downtown area in order to improve air quality and reduce traffic congestion (1985 Downtown Parking and and Circulation Policy, Ordinance No. 158354). A 1988 study of parking supplies in the downtown area indicated that the supply then was more than 42,000 spaces, or 96% of the policy limit. The 1988 parking supply consisted of garage spaces (56%), surface lots (31%), and on-street parking (13%). On-street parking competes with other uses for street space, particularly with transit and pedestrian circulation. The City's parking and circulation policy recognizes that efficient transit and pedestrian circulation can have a higher priority than on-street parking.

Table 3.2-10

INTERSECTION LEVEL-OF-SERVICE ANALYSIS
WEST BEAVERTON/WASHINGTON COUNTY
1987 P.M. Peak Hour

Intersection	V/C[1]	Reserve[2] Capacity	LOS
Murray Boulevard and Millikan Way	0.71		C
Along T.V. Highway			
S.W. Murray Boulevard and T.V. Highway	0.84		D
S.W. 160th Avenue and T.V. Highway	0.82		D
S.W. 170th Avenue and T.V. Highway	0.93		E
S.W. 198th Avenue and T.V. Highway	0.77		C
Along Sunset Highway			
N.W. Murray Boulevard Westbound Ramps	0.80		D
N.W. Murray Boulevard Eastbound Ramps		-214	F
N.W. Cornell Road Westbound Ramps	0.96		E
N.W. Cornell Road Eastbound Ramps		-44	F
N.W. 185th Avenue Westbound Ramps	0.73		C
N.W. 185th Avenue Eastbound Ramps	0.68		C
N.W. 185th Avenue and Cornell Road	0.77		C
N.W. 185th Avenue and Evergreen Parkway	0.66		B
N.W. 170th Avenue and Baseline Road		24	F
N.W. 185th Avenue and Baseline Road		-611	F

[1] V/C - volume to capacity ratio (signalized intersections).
[2] Reserve Capacity - unsignalized intersections only.

Source: HNTB, 1990.

The portions of S.W. Morrison, S.W. Yamhill, S.W. Jefferson, and S.W. Columbia Streets, south of S.W. 18th Avenue, that would be affected by the Westside Corridor Project are considered to be within downtown Portland. Approximately 55 loading zone spaces, 235 long-term (greater than 90 minutes) spaces, and 50 short-term spaces are provided on these streets. A number of surface lots, primarily associated with businesses, also are found in the downtown portion of the study area.

Parking supplies in Goose Hollow consist primarily of private, off-street surface parking with a limited amount of on-street parking. On-street parking is allowed on S.W. 18th Avenue, and on the north side of S.W. Jefferson Street between S.W. 18th Avenue and S.W. 21st Avenue.

In the vicinity of the Zoo, parking is constrained by topography. Public parking is provided in two large and several smaller lots with a total of approximately 1,150 spaces. On peak days, overflow parking is provided in private lots in the Sylvan area. Shuttle buses operate between the overflow parking lots and the Zoo.

The Sylvan area has two predominant sources of parking, private surface lots and public, on-street parking. The latter is limited in supply. Field surveys indicate that on weekdays, 60-70 vehicles park along area streets in unmarked, often unpaved, parking spaces. This may represent park-and-ride demand for downtown transit service. This weekday use is most common along S.W. Canyon Court in the vicinity of S.W. Skyline Boulevard, and on S.W. Humphrey Boulevard immediately east of S.W.

Hewett Boulevard. Space in private surface lots is generally adequate for existing demand. The Sylvan area represents a boundary between constrained parking supplies, resulting from physical constraints or governmental policies, and unconstrained parking supplies. West of Sylvan, governmental policies generally set minimum parking supply requirements.

The predominant parking supply in the Sunset Highway corridor west of Sylvan, and the Highway 217 corridor, consists of driveway and on-street parking in residential areas and private surface lots associated with businesses. No significant parking shortages appear to exist in these areas.

Parking supplies within Beaverton vary according to location. In the eastern and central portions of the city, on-street parking predominates in older neighborhoods and in the downtown historic district, while large, privately-owned surface lots predominate in the newer retail and business districts. Demand for on-street parking supplies appears to be high in the former areas, particularly adjacent to retail businesses and multifamily housing units north of S.W. Canyon Road and T.V. Highway. Specific examples would include S.W. Beaverdam Road east of S.W. Watson Avenue, S.W. Henry Street, and the S.W. 141st Avenue/S.W. Whitney Street neighborhood. In the western portion of Beaverton, suburban residential, business park, and retail developments with adequate off-street parking supplies predominate. Similar developments and associated parking supplies exist in Washington County. In these areas, policies generally set minimum off-street parking requirements. This, along with commercial market requirements for adequate parking supplies, results in generally high supplies of off-street parking and low demand for on-street parking spaces.

3.2.5 Bicycle Travel and Pedestrian Facilities

In downtown Portland, S.W. Morrison, S.W. Yamhill, S.W. Salmon, S.W. Jefferson, and S.W. Columbia Streets, as well as S.W. Canyon Road, are classified as bicycle routes in the City's ASCP. S.W. Morrison and S.W. Salmon Streets are designated pedestrian paths with crossings. Although signs are in place, these routes have not been improved.

West of downtown, Sunset Highway, Zoo Entrance Road, S.W. Canyon Court, S.W. Skyline Boulevard, S.W. Scholls Ferry Road, S.W. Hewitt Boulevard and S.W. Raab Road are classified as bicycle routes in the ASCP. Zoo Entrance Road also is a designated pedestrian path. Except for Sunset Highway, which has wider shoulders for bicycle use between the S.W. Jefferson/S.W. Columbia ramps and the Zoo, the only improvements on these routes are the placement of directional signage.

3.3 NEIGHBORHOODS

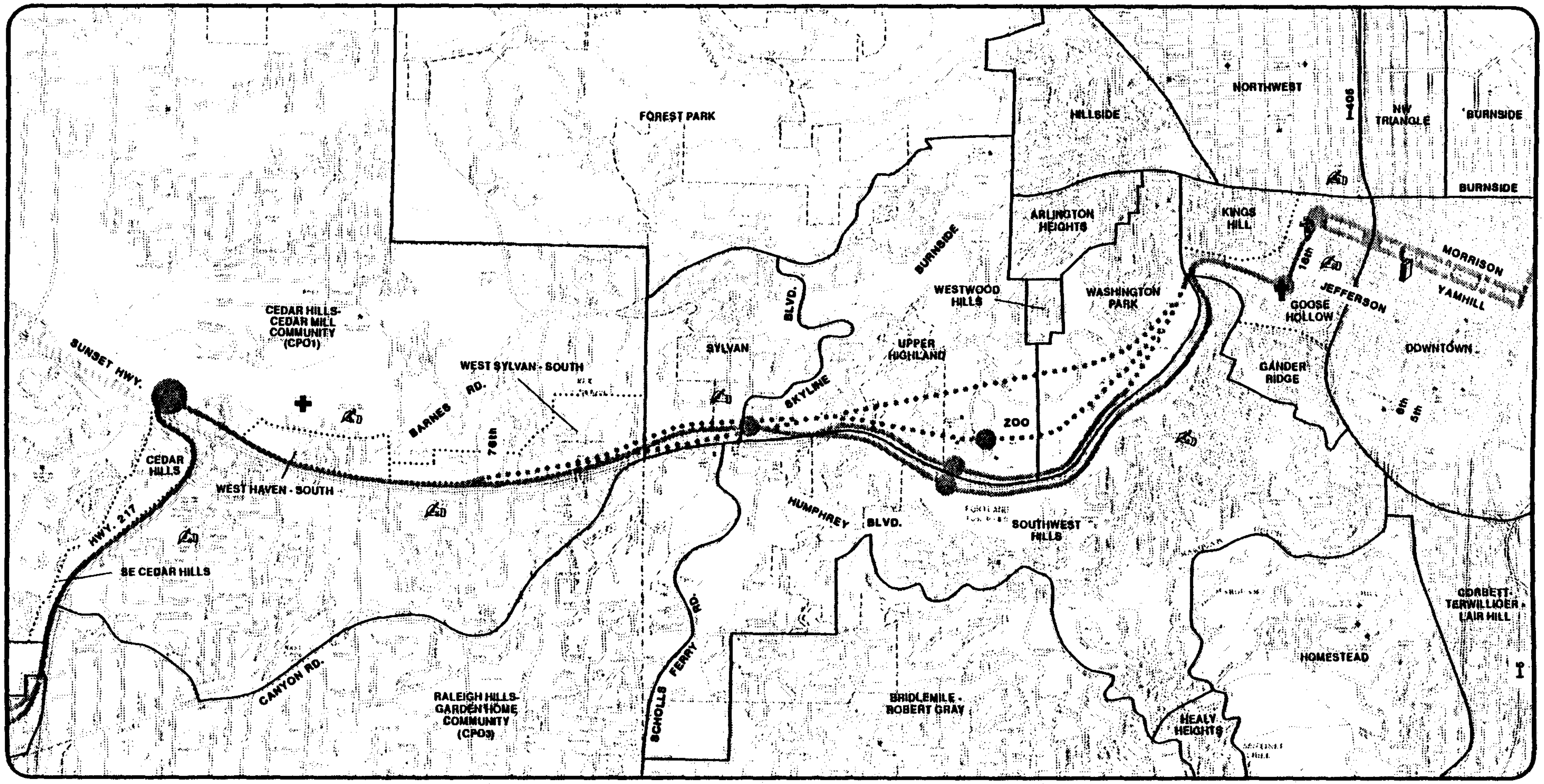
Several neighborhoods and communities are located within the Westside Corridor study area. Figures 3.3-1a and 3.3-1b illustrate the adopted boundaries of the neighborhood associations in Portland, the Citizen Participation Organizations (CPOs) in Washington County, and the Neighborhood Association Committees (NACs) in Beaverton. These figures also identify neighborhood subareas, which are smaller units that are particularly cohesive. Additional information on neighborhoods is contained in Technical Memorandum 20c.

3.3.1 Demographic Description

Data gathered from the 1980 U.S. Census of Population and Housing (the most current available) was used to define the demographic description for the neighborhoods within the study area. The demographic data are compiled by census tract. The census tract boundaries do not, however, correspond to the Figure neighborhood boundaries, and therefore direct application of census data is not necessarily representative of the overall neighborhood environment.

3.3.1.1 Neighborhood Descriptions and Population Characteristics

While the Westside Corridor contains more than 25% of the Portland metropolitan area's population, it has disproportionately small percentages of the region's low-income (12%), elderly (14%), and minority (15%) populations. Within the corridor, the low-income and elderly population is concentrated in urban



LEGEND:

——— Adopted Neighborhood Road Boundaries

······ Neighborhood Sub-areas

School

House of Worship

Library

Hospital

Note: Community facilities are within a .25 mile radius of the corridor.

Source: Shapiro & Associates, Inc., 1990

SCALE-FEET

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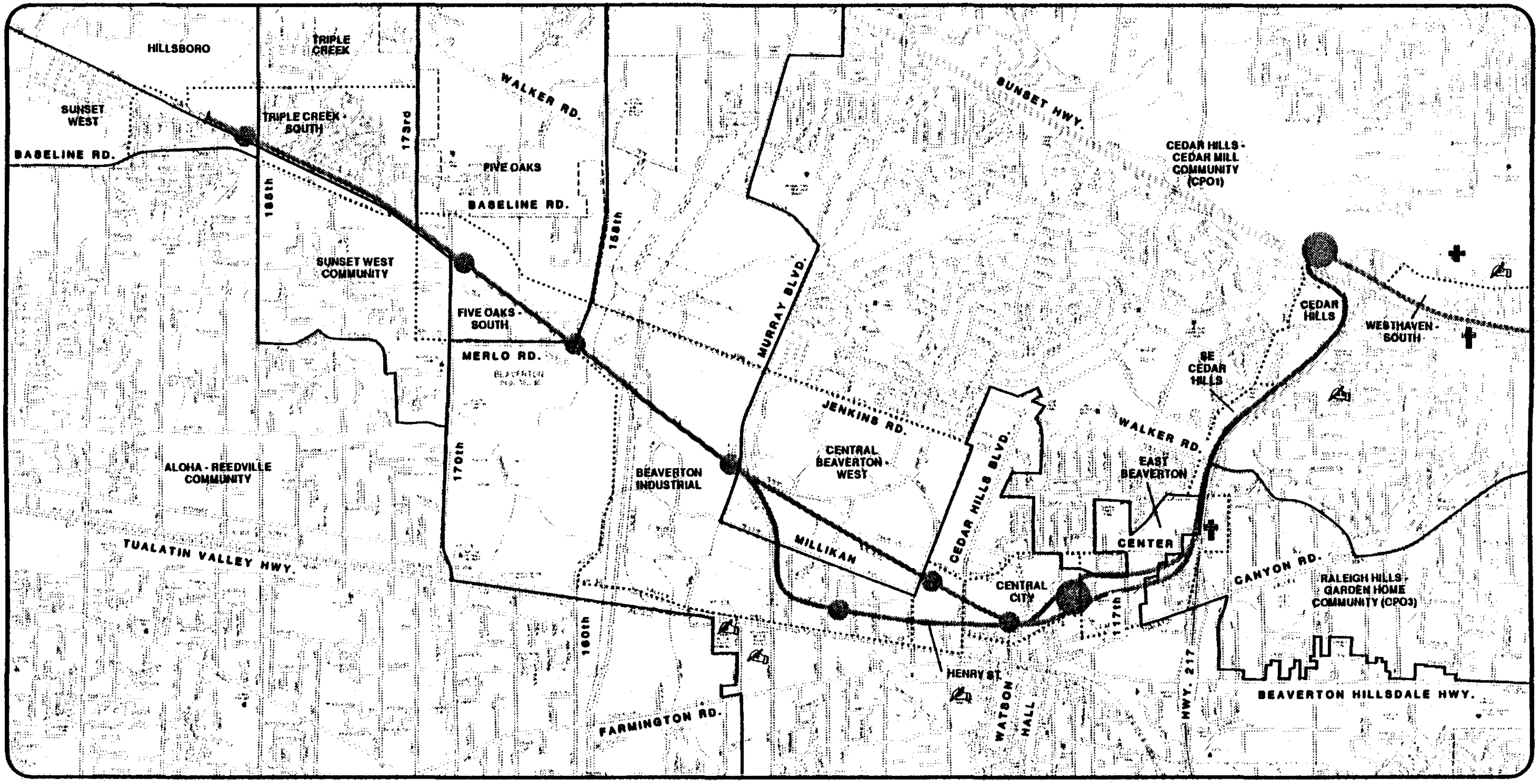
Westside Corridor Project

Neighborhood Boundaries and Community Facilities

The Oregon Department of Transportation

WESTSIDE LIGHT RAIL TRI-MET

Figure 3.3-1a
1 of 2



LEGEND:

——— Adopted Neighborhood Road Boundaries

...... Neighborhood Sub-areas

School

House of Worship

Library

Hospital

Note: Community facilities are within a .25 mile radius of the corridor.

Source: Shapiro & Associates, Inc., 1990

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Westside Corridor Project

Neighborhood Boundaries and Community Facilities

The Oregon Department of Transportation

WESTSIDE LIGHT RAIL TRI-MET

Figure 3.3-1b
2 of 2

areas. Specifically, minority populations of 20% or more are found in the neighborhoods of Burnside and West Beaverton. Elderly populations of 20% or more are found in the Portland and Goose Hollow. Concentrations of low-income populations are found in several Portland neighborhoods such as Northwest Portland, Goose Hollow, Multnomah, and Maplewood, as well as Beaverton and Hillsboro (DEIS, 1982).

Neighborhoods affected by the project are identified and described from east to west, or from downtown Portland to the Triple Creek neighborhood west of Beaverton (See Figures 3.3-1a and 1b). The Downtown Portland neighborhood, which includes the Central Business District, is the major commercial and business center for the metropolitan area. The neighborhood also accommodates a broad range of housing.

The Goose Hollow neighborhood lies west of downtown. It is bounded by I-405 to the east, West Burnside Street to the north, Washington Park to the west, and the Southwest Hills to the south. Within the Goose Hollow neighborhood are three identifiable subareas: Kings Hill (the predominantly residential area between S.W. 18th Avenue and Washington Park), Gander Ridge (the area between I-405 and the Southwest Hills neighborhood), and Goose Hollow (S.W. 18th Avenue/S.W. Jefferson Street corridors). Each of these subareas has an identifiable character. Portions of the Goose Hollow neighborhood have low-income populations of more than 20% of the total population.

Washington Park is identified by the city as a neighborhood, and is defined as the area west of Goose Hollow to the Zoo. The neighborhood does not have a residential population.

The Southwest Hills neighborhood lies south of Sunset Highway, generally south of Goose Hollow and east of S.W. Scholls Ferry Road. Most of the neighborhood is located within the Portland city limits, with the westernmost portion located in unincorporated Multnomah County. Single-family houses are the predominant land use, along with a few neighborhood-oriented facilities, such as schools and neighborhood commercial uses. An estimated 10-20% of the population is elderly, residing mostly in the eastern portion of the neighborhood.

The Upper Highland neighborhood is located north of Sunset Highway, between the Zoo and S.W. Skyline Boulevard at Sylvan. It extends northward to S.W. Barnes Road and Forest Park, and lies mostly within the Portland city limits. The remainder is located within unincorporated Multnomah County. The neighborhood consists of low-density residential uses, and Washington Park facilities including the Zoo, OMSI, and the World Forestry Center. Some office and retail development is located at the Sylvan Interchange. Low-income, elderly, or minority populations represent less than 10% of the neighborhood population.

The Sylvan neighborhood is bounded by Sunset Highway to the south, S.W. Skyline Boulevard to the east, S.W. Barnes Road to the north, and the Washington/Multnomah County line to the west. This neighborhood also lies primarily within the City of Portland. Predominant land uses are low-density residential, with office and commercial uses located near the Sylvan Interchange. Elderly, low-income, or minority groups comprise less than 10% of the population in this neighborhood.

Cedar Hills - Cedar Mill is a large unincorporated suburban community bounded by the Washington County line to the east, the Beaverton city limits to the south, and by the Sunset West Community Planning Area to the north and west. The area is mostly residential, with nodes of retail or office use located along arterials. The Cedar Hills area contains several subareas that would be affected by the proposed transportation system improvements. These subareas, located along Sunset Highway and Highway 217, include West Sylvan-South, Westhaven-South, Cedar Hills Shopping Center, and Southeast Cedar Hills. Less than 10% of the neighborhood population consists of minority, elderly, or low-income residents.

The Central Beaverton neighborhood consists of several subareas, including East Beaverton, Central City, Henry Street, Central Beaverton-West, and the Beaverton Industrial Area. The Central Beaverton neighborhood is bounded by Highway 217 on the east, St. Mary's Woods on the west, the Cedar Hill - Cedar Mill area on the north, and S.W. Allen Boulevard/S.W. Fifth Avenue on the south. This neighborhood is the major retail, office, and government center in Beaverton. This neighborhood has more than a 20% low-income population, and less than 10% minority and elderly population.

Four neighborhoods are located within the study area west of Central Beaverton: Five Oaks, Sunset West, Triple Creek, and Hillsboro. The area includes portions of Beaverton, Hillsboro, and unincorporated Washington County. The area is characterized by scattered development interspersed with undeveloped land. Development includes industrial and residential uses. Population in this area is 10 to 20% low income, and less than 10% minority or elderly residents.

3.3.1.2 Economic Characteristics

The Portland region is located on the Pacific Rim. This location is an economic asset as businesses expand and locate in the Portland area to participate in Pacific Rim and global trade. Land is available to accommodate future growth and development activities in accordance with the comprehensive land use plans of the respective jurisdictions.

The Portland region is comprised of five economic submarkets: the Westside, downtown Portland, east Multnomah County, east Clackamas County; and Clark County (Metro, 1989). The Westside has been the fastest growing submarket in the region. The Westside captured 68.3% of the region's population growth, 47.6% of the growth in single-family housing, 52.7% of the growth in multifamily housing, and 96.1% of the regional employment growth between 1980 and 1987. The Westside is expected to experience a high percentage of regional growth through 2010.

3.3.1.3 Housing Characteristics

The housing supply varies in age and quality among neighborhoods. Central city neighborhoods generally are characterized by older housing, while suburban areas on the west end of the corridor tend to contain newer housing stock. The region has been characterized by smaller families living in single-family dwelling units. Single-family housing units dominate the market by a ratio of nearly two-to-one; however, multifamily units are slowly gaining an increasing market share.

3.3.2 Community Facilities and Services

Community facilities and services include libraries, shopping centers, churches and other places of worship, police stations, fire stations, neighborhood recreation centers, schools, and hospitals and clinics. These facilities are predominantly located in the Portland CBD, though some are in central Beaverton and Hillsboro (see Figures 3.3-1a and 1b). Neighborhood facilities such as shopping, churches, and schools are dispersed throughout the corridor (see Land Use discussion, Section 3.1, for additional information).

3.4 VISUAL AND AESTHETIC CONDITIONS

This section summarizes existing visual and aesthetic conditions in the study area. Additional details can be found in Technical Memorandum 20d.

Visual resources include both natural and human-produced features of the landscape, including parks and recreation areas, views and vistas, and buildings of architectural or historic significance. The Westside Corridor has an array of visual elements, including mountains, urban landscapes, open space, industrial areas, and both high- and low-density residential areas.

For purposes of analysis, the study area was divided into landscape districts and units. These areas have similar physical and cultural landscapes, and possess a distinct and recognizable sense of place. Information on these units was gathered from maps, field surveys, and aerial photographs.

Visual assets in the Westside Corridor represent a wide range of urban and natural elements. For example, downtown Portland offers a diverse urban landscape, including high-density development, street furniture, and historic structures. The view from the Vista Bridge gateway toward downtown

Portland is noteworthy. The Sunset Canyon is characterized by natural elements that include steep slopes and heavily vegetated areas contiguous to the highway. A small meadow on the north side of Sunset Highway offers an open space in an otherwise confined area. The vegetated canyon walls are visible from the residential areas overlooking and surrounding the canyon and to users of Sunset Highway.

The area extending from the Zoo to Sylvan reflects a mix of visual elements. Sunset Highway dominates most views of the area. A mix of buildings, overhead utility lines, and road signs are prominent in the landscape. Sunset Hills Memorial Park, with its park-like setting, provides some visual rest. The Golf Creek area, which extends from the cemetery to the Sunset Highway/Highway 217 Interchange, offers an open view of the Tualatin Mountains. Apartment complexes of varying densities are located in this area. The interchange area, located south of St. Vincent Hospital and north of Wilshire Boulevard, is characterized by the freeway interchange, commercial buildings, and the St. Vincent Hospital tower.

The Highway 217 corridor begins south of Sunset Highway, and includes the east and west side of Highway 217. The corridor is dominated by the highway, but provides views of the distant Tualatin Valley and Cooper Mountain. Central Beaverton is defined as that area west of Highway 217, north of Canyon Road, south of Jenkins Road and Center Street, and east of S.W. Murray Boulevard. This area is a mixture of commercial, campus, industrial, residential structures, and wetlands.

The St. Mary's area, located south of Jenkins Road, north of Tualatin Nature Park, east of S.W. 170th Avenue and west of S.W. Murray Boulevard, consists of agricultural fields and natural areas, industrial buildings, and utility facilities. Several large transmission-line towers dominate views of the area. The area west of S.W. 170th Avenue, north of Jay Street, east of S.W. 185th Avenue, and south of Liberty Drive includes views of pastureland interspersed with mixed development. A railway trestle and Willow Creek are important visual elements in this landscape.

3.5 AIR QUALITY

The following section summarizes the existing air quality in the study area. Additional details on air quality can be found in Technical Memorandum 20e.

The federal government has established National Ambient Air Quality Standards (NAAQS) designed to protect health and welfare of the public from air pollution. Primary standards define the level of air quality that protects public health. Secondary air quality standards define levels necessary to protect public welfare (plants, animals, visibility, property, economic values, man-made materials, and personal comfort). Standards have been established for particulates, carbon monoxide (CO), ozone, sulfur dioxide, nitrogen dioxide, and lead. Oregon's pollution control strategy is designed to meet the more stringent secondary standards.

Geographic areas in which concentrations of a particular pollutant exceed the NAAQS are classified as nonattainment areas. Nonattainment areas within the Portland-Vancouver Air Quality Maintenance Area (AQMA) include the Portland CBD for CO and the entire Portland-Vancouver AQMA for ozone. Oregon adopted a CO control strategy and both Oregon and Washington adopted ozone control strategies for the Portland-Vancouver AQMA as part of the State Implementation Plans (SIPs) in 1982.

CO concentrations in the CBD and ozone concentrations in the AQMA generally improved as projected in the SIP and were in compliance with the NAAQS during 1987-89. However, recent air pollution monitoring indicates that the area has continuing CO and ozone problems: (1) CO violations were recorded outside of the CBD at Fourth Plain/Fort Vancouver Way in Vancouver during 1988-90, and two exceedances were recorded at S.E. 82nd Avenue/S.E. Division Street in Portland during 1989; and (2) ozone exceedances were measured downwind of the AQMA during 1990.

Because of these recent CO and ozone exceedances, the 1990 Clean Air Act requires that the Oregon and Washington SIPs be revised by November 1992 to include new CO and ozone attainment strategies for the Portland-Vancouver AQMA. In preparation for revised SIPs, the Oregon Department of

Environmental Quality (ODEQ) and the Washington Department Ecology (WDOE) prepared updated emission inventories during 1989 and 1990 for ozone precursors and fall/winter CO.

Facilities with the potential for causing or contributing to vehicle emissions of a pollutant are required to obtain an Indirect Source Construction Permit from DEQ. A permit must be obtained for any facility with more than 500 parking spaces in metropolitan Portland, more than 250 spaces within five miles of the boundary of Portland, or 150 spaces within the City of Portland. New highway facilities within metropolitan Portland with an average daily traffic (ADT) of 20,000 vehicles, or highway improvements increasing the ADT by 10,000 or more vehicles within ten years of completion, must obtain a permit (OAR 340-20-115).

Analysis of existing air quality was based on data collected from monitoring sites located in the project area and throughout metropolitan Portland. CO concentrations declined in the Portland area between 1979 and 1988 (DEQ, 1989). Between 1985 and 1988, five days exceeded the eight-hour standard at the five DEQ monitoring stations in Portland. During that period, the number of exceedances at any station was either zero or one per year, which complied with the standard (the NAAQS allow one exceedance per year). Prior to 1984, violations of the standard have been recorded.

Ozone concentrations have fluctuated along a relatively steady value from 1979 to 1988 in Portland. Ozone concentrations reached record or near record highs at most sites in 1988, although the Portland area experienced only two days of ozone levels that exceeded the standards (DEQ, 1989).

Particulate emissions from industrial sources have fluctuated in the Portland-Vancouver Air Quality Maintenance Area (AQMA) during recent years. The overall trend suggests that emissions from point sources are decreasing, probably as a result of improved pollution-control equipment. These reductions, however, appear to have been offset by increased emissions from area sources, the most important of which are wood stoves. Overall, Portland has experienced little change in regional particulate emissions over the past few years (DEQ, 1989). No exceedances of the PM10 standard have been recorded near the project site.

No site in Oregon exceeded the lead standard in 1988 (DEQ, 1989). The last exceedance of the lead standard was reported in Portland in 1984 near the I-5 freeway. In addition, no exceedances of the sulfur dioxide and nitrogen dioxide standards have been recorded in Oregon.

Air quality in the Portland area is affected by seasonal weather conditions. During late fall and winter, the area is often blanketed by stable air masses. This stable air, which receives little vertical mixing, combined with increased emissions of carbon monoxide and particulate emissions from vehicles and wood stoves, causes the highest CO and particulate concentrations to occur during the winter. During late spring and summer, warm temperatures, strong sunlight, and poor ventilation result in greater ambient concentrations of ozone. For 100 days between 1974 and 1988, the National Weather Service had issued Air Stagnation Advisories when poor atmospheric dispersion characteristics existed and were forecast to persist for 24 hours or longer (DEQ, 1989).

3.6 NOISE AND VIBRATION

Noise is a form of vibration that causes pressure variations in elastic media such as air and water. These pressure differences are most commonly measured in decibels (dB). The "A" weighting scale is widely used in environmental analysis because it closely resembles the human response to these pressure variations. The A-weighted equivalent sound level (L_{eq}), represents the average energy level for the time period being considered. All modeled highway noise levels referred to in this impact assessment are in dBA L_{eq} averaged over one hour.

Community response to projected LRT noise was evaluated using the 24-hour equivalent continuous sound level, L_{eq}; the day-night average sound level, L_{dn}; and the maximum passby sound level, L_{max}. L_{dn} is the 24-hour, time averaged, A-weighted sound level from midnight to midnight with 10 dB added to sound levels from 10:00 p.m. to 7:00 a.m. L_{max} is the maximum sound level averaged over the duration of one train passage. Wheel squeal is a high-pitched squeal or screech caused by LRT wheel surfaces rubbing or sliding on curved rails. Because of the intermittent nature of the wheel squeal noise, the level exceeded 2% of the time was interpreted as the L_{max}.

Ground-borne vibration is described in terms of vibration velocity levels in dB relative to 1 micro-inch per second (dB re 10^{-6} inches/second). For comparison, 60 to 70 dB re 10^{-6} inches/second is at the threshold of human perception. The 0.01 to 0.1 inches/second peak particle velocity range is roughly equivalent to the vibrations felt in a house located about one city block from a fast freight railroad.

The following sections summarize existing noise and vibration in the study area. Additional details can be found in Technical Memorandum 20f.

3.6.1 Related Laws and Regulations

3.6.1.1 Highway Noise

The analysis of the future noise levels within the Sunset Highway/Highway 217 corridor was based upon the Code of Federal Regulations governing the FHWA, Title 23, Part 772. The Noise Abatement Criteria (NAC) sited in Title 23, Part 772 for various land uses are presented in Table 3.6-1.

3.6.1.2 LRT Noise and Vibration

The American Public Transit Association (APTA) and UMTA both have criteria or general guidelines for noise and vibration resulting from light rail and transit operations. APTA categorizes communities along transit corridors into five areas, as follows:

I **Low Density** urban residential, open space park, suburban residential, or quiet recreational area. No nearby highways or boulevards.

II **Average** urban residential, quiet apartments and hotels, open space, suburban residential, or occupied outdoor areas near busy streets.

III **High Density** urban residential, average semi-residential/commercial areas, parks, museum, and non-commercial public building areas.

IV **Commercial** areas with office buildings, retail stores, etc., primarily daytime occupancy. Central Business Districts.

V **Industrial** areas or **Freeway** and **Highway Corridors**.

The APTA guidelines for maximum passby sound levels, typical ambient day-night sound levels, and maximum noise level of ancillary facilities for each of these communities are presented in Tables 3.6-2 through 3.6-4.

UMTA's criteria for evaluating noise impacts of transit facilities are presented in Table 3.6-5.

The APTA criteria for evaluating vibration impacts of transit facilities are presented in Table 3.6-6.

Table 3.6-1

FHWA NOISE ABATEMENT CRITERIA
HOURLY A-WEIGHTED SOUND LEVEL
Decibels (dBA)[1]

Activity Category	L_{eq}	Description of Activity Category
A	57 dBA (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need, and where the preservation of those qualities is essential if the lands are to continue to serve their intended purpose.
B	67 dBA (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, hotels, schools, churches, libraries, and hospitals.
C	72 dBA (Exterior)	Developed lands, properties, or activities not included in Categories A or B above.
D	---	Undeveloped lands.
E	52 dBA (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

Source: Code of Federal Regulations, Title 23, Part 772, Procedures for Abatement of Highway Traffic Noise and Construction Noise (Revised July 1982).

Table 3.6-2

MAXIMUM PASSBY SOUND LEVELS (L_{max})

	Community Area	Single-Family Dwellings	Multifamily Dwellings	Commercial Buildings
I	Low Density Residential	70 dBA	75 dBA	80 dBA
II	Average Residential	75 dBA	75 dBA	80 dBA
III	High Density Residential	75 dBA	80 dBA	85 dBA
IV	Commercial	80 dBA	80 dBA	85 dBA
V	Industrial/Highway	80 dBA	85 dBA	85 dBA

Source: APTA, Guidelines for Design of Rapid Transit Facilities, Section 2-7.6 (no date).

Table 3.6-3

TYPICAL AMBIENT DAY-NIGHT SOUND LEVELS (L_{dn})

Community Area		Exposure Level
I	Low Density Residential	< 55 dBA
II	Average Residential	60 dBA
III	High Density Residential	65 dBA
IV	Commercial	> 60 dBA
V	Industrial/Highway	> 65 dBA

Source: APTA, Guidelines for Design of Rapid Transit Facilities, Section 2-7.6.

Table 3.6-4

MAXIMUM NOISE LEVEL FROM TRANSIT SYSTEM ANCILLARY FACILITIES (L_{max})

Community Area		Transient Noises	Continuous[1] Noises
I	Low Density Residential	50 dBA	40 dBA
II	Average Residential	55 dBA	45 dBA
III	High Density Residential	60 dBA	50 dBA
IV	Commercial	65 dBA	55 dBA
V	Industrial/Highway	75 dBA	65 dBA

Note 1: L_{max} for transformer noise or hum should be 5 dBA less.

Source: APTA, Guidelines for Design of Rapid Transit Facilities, Section 2-7.6.

Table 3.6-5

UMTA NOISE IMPACT EVALUATION

Degree of Impact	Increase in L_{eq}
Generally No Impact	≤ 3 dBA
Possible Impact	≤ 5 dBA
Generally an Impact	6-10 dBA

Source: UMTA C5620.1, Guidelines for Preparing Environmental Assessments, 1979.

Table 3.6-6

MAXIMUM SINGLE EVENT GROUND-BORNE VIBRATION VELOCITY LEVELS
(dB re 10^{-6} inches/second)

Community Area	Single-Family Dwellings	Multifamily Dwellings	Hotel/Motel Buildings
I Low Density Residential	70	70	70
II Average Residential	70	70	75
III High Density Residential	70	75	75
IV Commercial	70	75	75
V Industrial/Highway	75	75	75

Special Function Buildings	Maximum Vibration Level
Concert Hall/TV Studios	65
Auditoriums/Music Rooms	70
Churches and Theaters	70
Hospital Sleeping Rooms	70
Courtrooms	75
Schools and Libraries	75
University Buildings	75
Offices	75
Commercial/Industrial Buildings	75
Vibration Sensitive Industrial or Research Laboratory	60

Note: Criteria apply to vertical floor surface vibration.

Source: Wilson and Ihrig and Associates, Inc., 1990.

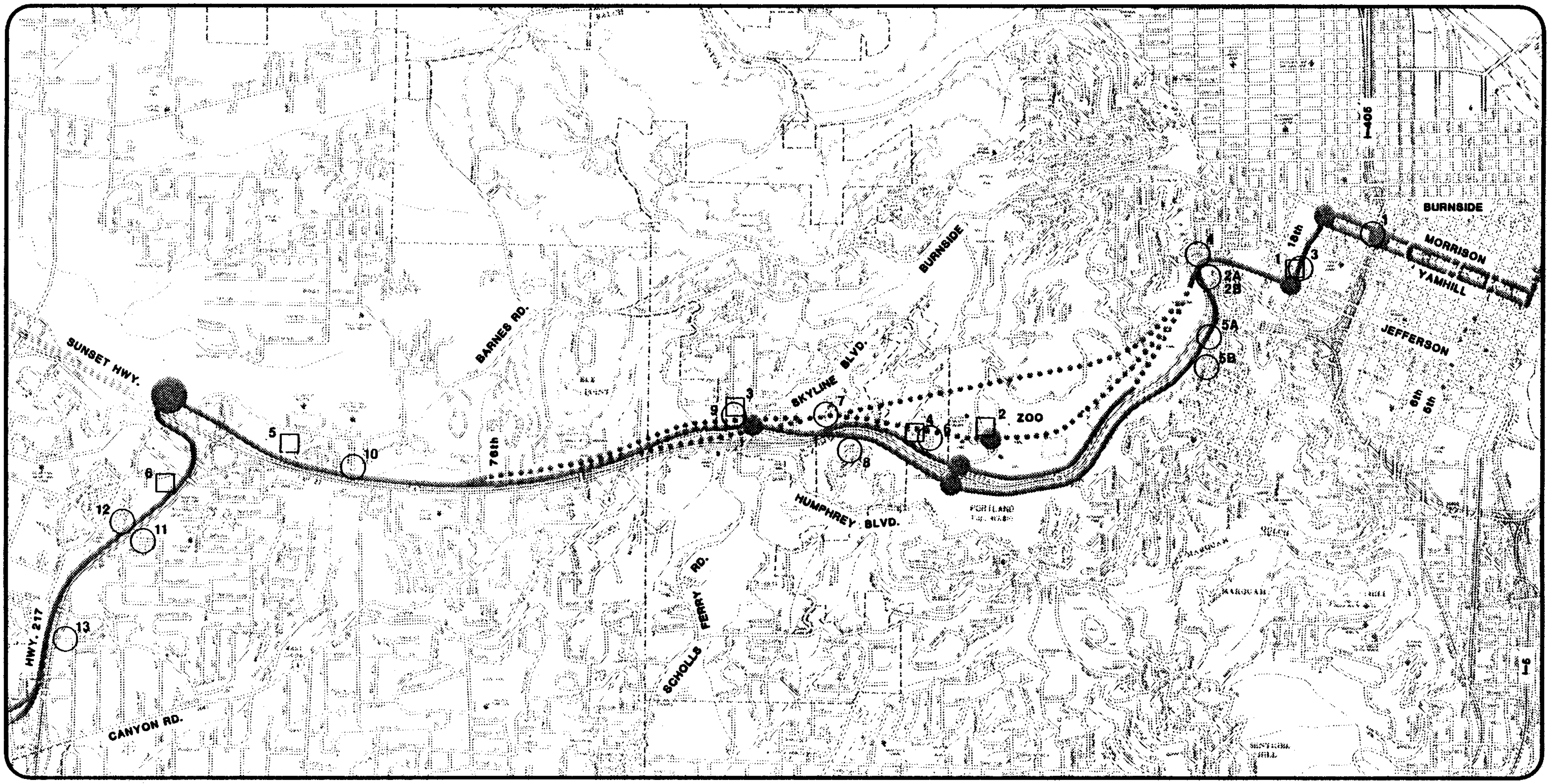
3.6.2 Existing Noise Levels

Existing noise levels were measured along the proposed LRT transitway alignments at 18 representative sites (see Figures 3.6-1a and 1b). The results of the highway noise monitoring are presented in Table 3.6-7.

3.6.2.1 Existing Noise Levels - Banfield LRT

Passby noise levels were measured at ballast-and-tie and embedded track sections of the existing Banfield LRT. The results indicate that passby noise levels for the LRT on ballast-and-tie tangent track at a train speed of 45 mph are 80, 77-78, and 72 dBA at 35, 50, and 100 feet, respectively. Noise levels at different speeds can be determined by applying a correction of 6 dB per doubling of train speed.

Maximum passby noise levels at embedded track sections in downtown Portland at an estimated train speed of 15 to 20 mph were approximately 76 and 73 dBA at 35 and 50 feet, respectively. These levels would be about 82 and 79 dBA, respectively, at 30 to 40 mph assuming a 6 dB increase per doubling of train speed. Noise levels are lower for ballast-and-tie track relative to embedded track, due to the sound absorption provided by the ballast.



LEGEND:

2 Vibration Measurement Locations

1 Noise Monitoring Sites

SCALE-FEET

0 2000 4000

Source: Howard Needles Tammen & Bergendorf, 1990

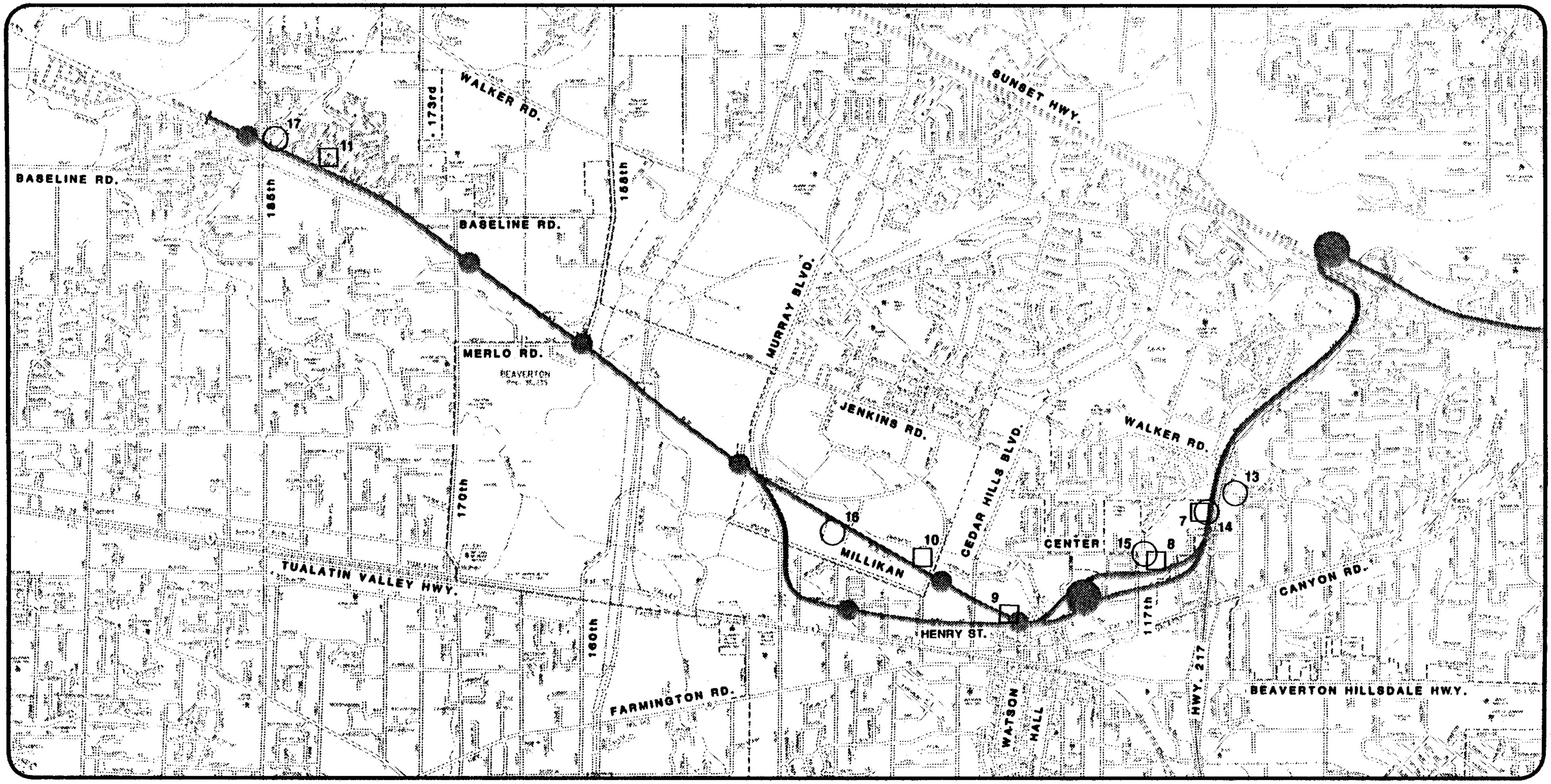
Westside Corridor Project

Noise Monitoring Sites and Vibration Measurement Locations

The Oregon Department of Transportation

TRI-MET

Figure 3.6-1a



LEGEND:

2 Vibration Measurement Locations

1 Noise Monitoring Sites

SCALE-FEET

0 2000 4000

Westside Corridor Project

Noise Monitoring Sites and Vibration Measurement Locations

The Oregon Department of Transportation

TRI-MET

Figure 3.6-1b

Source: Howard Needles Tammen & Bergendorf, 1990

Table 3.6-7

HIGHWAY NOISE MONITORING
EXISTING CONDITIONS

	Site/Location	FHWA Activity Category*	Noise Level L_{eq}	Noise Level L_{dn}
1	S.W. 14th Street	C	80	82
2a	S.W. Market Street and Vista Avenue	B	53	56
2b	2353 S.W. Market Street (freeway side)	B	66	66
3	S.W. Madison Street	B	64	63
4	S.W. Murray Lane	B	65	66
5a	S.W. Montgomery Place	B	59	56
5b	1943 S.W. Montgomery Place	B	68	71
6	Highland Road	B	61	63
7	Parkview Court cul-de-sac	B	65	67
8	Humphrey Park Road	B	53	56
9	S.W. 58th Avenue	B	60	63
10	S.W. 88th Avenue	B	71	74
11	Porter Street cul-de-sac	B	68	70
12	Berkshire Street and S.W. 106th Place	B	68	70
13	Polsky Road cul-de-sac	B	64	67
14	R-O-W	B	73	75
15	S.W. 117th Street	B	63	63
16	Tektronix Campus Area	C	49	57
17	Salix Place cul-de-sac	B	49	52

*Refer to Table 3.6-1 for explanation of Activity Categories.

Source: HNTB, 1989.

Wheel squeal noise measurements were performed at selected curved track sections along the existing Banfield LRT. The wheel squeal noise levels varied significantly from one curve to the next. At 50 feet from the curves, maximum sound levels during curve negotiation, represented by the sound level exceeded 2% of the time (L_{max}), were 86 and 80 dBA for 100-and 200-foot radius curves, respectively. Train speeds during the measurements were about 15 mph, though they varied with track curvature. The measurements from the Banfield LRT indicate that the attenuation rates for L_{max} noise levels during curve negotiation, as a function of distance from the track centerline, should be 5.5 dB per doubling of distance for ballast-and-tie curved track with a radius of between 160 to 200 feet. For wheel squeal levels from embedded curved rack with a radius of of 82 to 91 feet, the attentuation rates for L_{max} noise levels are 4.5 dB per doubling of distance. Based on these measurements, the projected L_{max} noise levels should be reduced by 5.5 dB and 4.5 dB per doubling of distance from ballast-and-tie and embedded curved track, respectively.

3.6.3 Existing Vibration Levels

Ambient vibration measurements were made at 11 locations along the proposed LRT transitway alignment (see Figure 3.6-1a and 1b). The daytime vibration levels measured in the project corridor are summarized in Table 3.6-8. The threshold of human reaction to vibration is about 65 to 75 dB re 1 micro-inch per second. The measured energy equivalent (L_{eq}) vibration levels range from 37 to 67 dB re 1 micro-inch per second, averaged over the sample duration of about ten minutes.

Table 3.6-8

ENVIRONMENTAL DAYTIME VIBRATION LEVELS
EXISTING CONDITIONS

Location Number	Type of Location	APTA Community Area	Description	Overall Vibration Velocity Level L_{eq} (dB re 10^{-6} in/second)
1	Commercial/ Residential	III	N.W. corner of S.W. 18th Avenue and S.W. Madison, at setback line of houses facing S.W. 18th Avenue.	67
2	Park/Museum	III	Merlo Hall, on concrete terrace at entrance, facing parking lot over LRT tunnel alignment.	37
3	School	III	French/American School, west of S.W. 58th Street, in school parking lot.	43
4	Park/ Recreational	III	Racquet Club grounds, at east edge of tennis court lawn, 100 feet north of tunnel alignment.	42
5	Residential/ Commercial	III	Parking lot near Monterey Place, north side of Sunset Highway, at setback line of residences along Sunset Highway.	45
6	Multifamily/ Residential	III	Between apartment buildings over-ooking Hwy 217, west of LRT alignment, at setback line of buildings.	39
7	Church	III	Rear parking lot of St. Bartholemew at setback, west side of Hwy 217.	45
8	Multifamily/ Residential	III	In apartment building complex, on lawn between 3780 and 3820 S.W. 117th Street, over LRT alignment.	43
9	Commercial/ Theater	IV	Parking lot at S.W. rear corner of Westgate Cinema, approximately 50 feet north of LRT alignment.	47
10	Industrial	V	Tektronix Site, 200 feet west of S.W. Karl Braun Drive, 30 feet north of LRT alignment.	48
11	Residential	III	Between 717 and 716 Concord Way, at setback line of residences, 70 feet nort of LRT alignment.	44

Source: Wilson Ihrig and Associates, Inc., 1990.

3.7 ECOSYSTEMS

The following sections summarize existing ecosystems in the study area. Additional details can be found in Technical Memorandum 20g.

3.7.1 Fish and Wildlife

Several creeks are located within the study area, including Sylvan, Golf, the north tributary of Hall (Wessenger Creek), Hall, Beaverton, Cedar-Mill, and Willow. All of the creeks except Sylvan are within the upstream portion of Beaverton Creek Drainage. Sylvan Creek is in the Fanno Creek Drainage. Both the Beaverton and Fanno Creek Drainages are within the Tualatin River Drainage.

The Beaverton Creek Drainage is characterized by poor water quality and minimal stretches of natural stream channels and floodplains (Tri-Met, 1982). In general, fish resources do not exist this far upstream within the Beaverton watershed due to poor fish habitat. Existing conditions of the Beaverton Creek Drainage present several factors that may limit fish production. These include lack of suitable spawning gravels, high flow fluctuation, high temperature peaks in summer, lack of overhanging vegetation, lack of instream cover, and poor water quality. Although game fish are not present this far upstream, quality habitat for trout, salmon and steelhead exists downstream in the Tualatin River (DFW, 1989).

Game fish do not occur in the Fanno Creek Drainage within the project area; however, game fish populations have increased downstream in recent years. This increase may be attributed to improvements in water quality (DFW, 1989).

Important wildlife habitat areas within the study area include Sunset Canyon, Tualatin Hills Regional Nature Park (St. Mary's Woods), and TEK Woods. Sunset Canyon is composed primarily of coniferous and mixed forest. It provides valuable wildlife habitat because it contains large wooded areas connected to other undeveloped areas. However, the Canyon is not an area of pristine habitat. It is bisected by the Sunset Highway, bordered by residential development and park facilities, overgrown with ivy, and without a riparian area.

Tualatin Hills Regional Nature Park, an approximately 180-acre park located south of the BN Railroad tracks near S.W. 158th Avenue, includes upland mixed, deciduous, and coniferous forests, as well as forested and scrub-shrub swamp, and emergent marsh habitats. This variety of habitat supports an abundant and diverse wildlife population. In addition, two open-water ponds surrounded by emergent and forested wetlands occur along Cedar Mill Creek north of the railroad tracks. Wildlife frequent these wetland habitats and the upland forest on the south side of the railroad.

TEK Woods, consisting of approximately 100 acres, is located west of S.W. Murray Boulevard and north of the BN railroad tracks. Mixed forest composed of oak and ponderosa pine is dominant, with pockets of forested, seasonal wetland occurring in slight depressions throughout. This area provides valuable habitat because of its proximity to Beaverton Creek and the mixture of neighboring vegetative communities, including grassland and oak/ponderosa pine forest.

No sensitive, threatened, or endangered wildlife species are known to occur within the immediate project area (USFWS, 1989; Oregon Natural Heritage Database (NHDB), 1989). Species listed in the Oregon Natural Heritage Database, as well as those observed near the proposed Sunset Transit Center, include painted turtle (Chrysamys picta), a threatened species listed in the NHDB, observed in ponds north of the transit center; red-legged frog (Rana aurora) and piliated woodpecker (Dryocopus pileatus), listed on NHDB Review List; and northern pygmy-owl (Glaucidium gnoma), northern saw-whet owl (Acgolius acadiucus), and bufflehead (Bucephala albeola), listed on the NHDB Sensitive List (Corkran, 1989).

3.7.2 Vegetation

The project area is characterized by an incised canyon, Sunset Canyon, and the relatively flat topography of the Willamette Plateau. Logging, agriculture, and urban development have significantly altered the original coniferous forest, oak/ponderosa pine woodlands, and grasslands in the region. Although large expanses of the region are occupied by residential and commercial development, significant natural areas still remain.

Thirteen major habitat types have been identified within the project area. Nine are upland habitats and four are wetland habitats. Upland habitats include agriculture, grassland, mixed forest-maple/Douglas fir, mixed forest-oak/ponderosa pine, coniferous forest, deciduous forest, parkland, residential development, and urban development. Wetland habitats include open water, scrub-shrub swamp, forested swamp, and emergent marsh. Much of the proposed corridor is in urban or developed areas. Residential development within and adjacent to Sunset Canyon is wooded, thus providing a different habitat than the urban classification. Particularly within the Sunset Canyon area, many large deciduous and coniferous trees remain in the residential areas.

No sensitive, threatened, or endangered plant species are known to occur within the project area (USFWS, 1989; NHDB, 1989). No sensitive, threatened, or endangered plant species were observed during site visits, nor are they expected to occur since the habitat types found are common and do not typically support unusual species.

3.7.3 Wetland and Riparian Areas

Wetlands are recognized as an important and valuable natural resource and their protection has been determined to be a matter of public interest. The following definition of wetlands is used by the U.S. Army Corps of Engineers (Corps) for administering the permit program for Section 404 of the Clean Water Act (Federal Register, 1980, 1982) as well as by other federal and state agencies:

> "Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."

Wildlife and fisheries habitat are recognized as areas of particular concern by federal, state, and local agencies, as well as the general public. Numerous federal, state, and local regulations, including Executive Order 11990, Section 404 of the Clean Water Act; Oregon's Removal-Fill Permit Program; and Oregon's Senate Bill 3 have been established to reflect those concerns.

Sixteen wetland areas have been identified in the project area. They consist of four wetland habitat types: open water, forested swamp, scrub-shrub swamp and emergent marsh. Most of the wetlands are associated with permanent or intermittent creeks within the Beaverton Creek Drainage. Many of the wetland areas occur within or near the City of Beaverton, and have been channelized, diverted, culverted, and surrounded by development. The location and characteristics of wetlands, and riparian and intermittent drainages that occur within the project area, are discussed in more detail below (see Table 3.7-1).

3.7.3.1 Sunset Canyon

One wetland area and several intermittent drainages occur within Sunset Canyon (see Figures 3.7-1a and 3.7-1b). Wetland Area 1 is an emergent wetland located within Sunset Canyon, west of the Vista Ridge tunnel in a depressed area between the south side of the highway off-ramp and the hillslope. An intermittent drainage occurs near the proposed west tunnel portal for the Northside Surface/Short Tunnel alignment option, and two occur on the south side of Sunset Highway near the Zoo overpass. All are characterized by riparian vegetation in a defined corridor.

3.7.3.2 Sylvan Creek

Sylvan Creek is a defined riparian corridor on the north side of the highway. It passes under both the highway and S.W. Canyon Place Road in a culvert to the south side, where it continues in a fairly steep and incised ravine. One wetland area and an intermittent creek are associated with Sylvan Creek.

Table 3.7-1

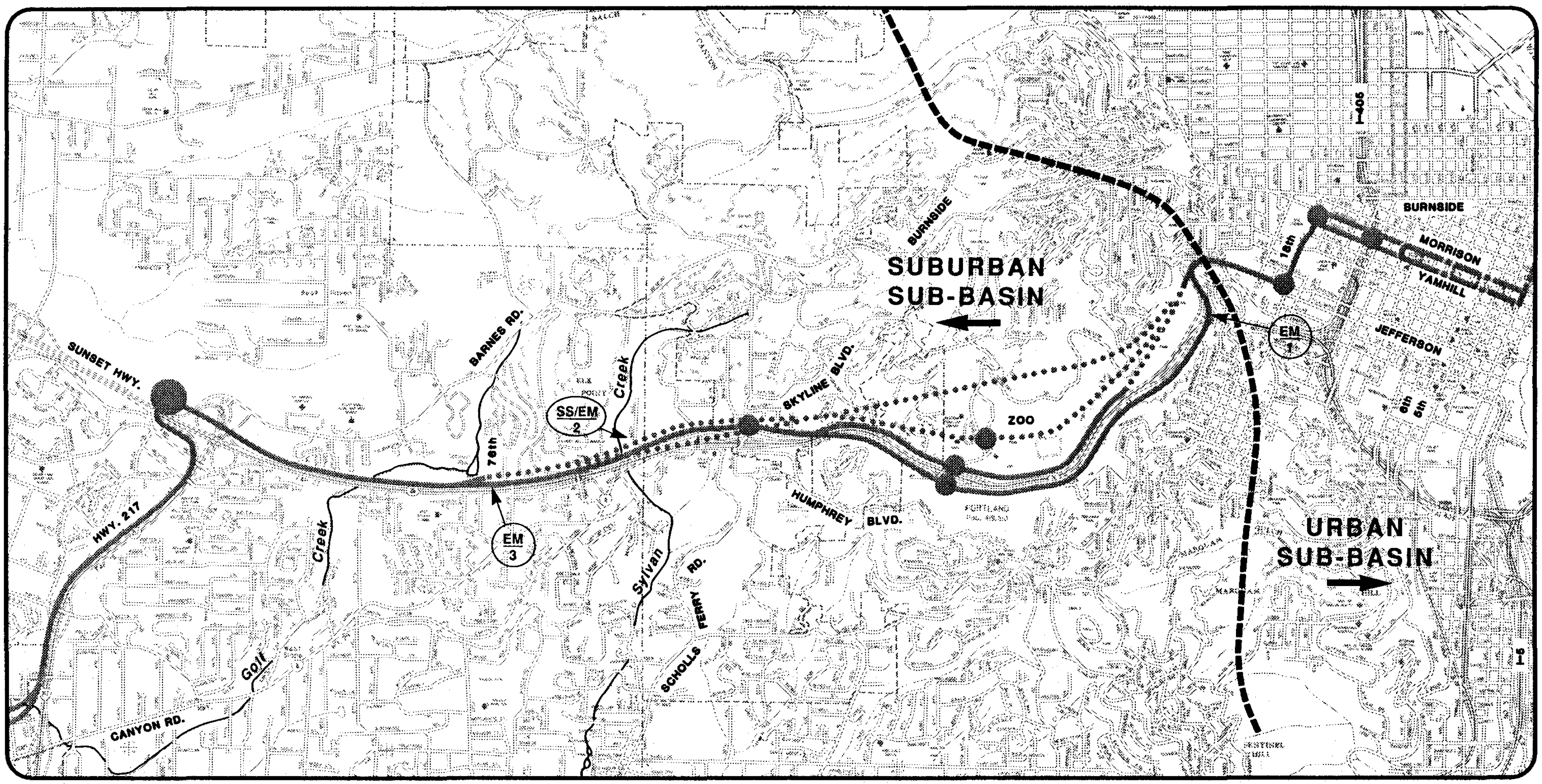
COMPARISON OF WETLAND VALUES

Wetland Area	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Wetland Information																
Approximate wetland size in acres	0.4 acre	0.8 acre	0.2 acre	0.3 acre	>5 acres'	0.4 acre	1.4 acres	2.8 acres	0.6 acre	1.2 acres	1.2 acres	0.4 acres	1.1 acres	>10 acres	1.5 acres	1.3 acres
Wetland adjacent to a creek or seasonal drainage	no	no	no	no	yes	no	yes	yes	yes	yes	yes	no	no	yes	yes	yes
Isolated Wetland	yes	yes	yes	yes	no	yes	no	no	no	no	no	yes	yes	no	no	no
Wetland Type	E	S-S	E	E/F	S-S/E	OW/E	E/F	E/F	OW	E	F	E	E	OW/E/F	E	E/F
1. HYDROLOGIC SUPPORT	**Mod.**	**Mod.**	**Mod.**	**Mod.**	**High**	**High**	**High**	**High**	**High**	**Mod.**	**Mod.**	**Low**	**Mod.**	**High**	**Mod.**	**High**
2. SHORELINE PROTECTION	**n/a**	**Mod.**	**n/a**	**n/a**	**High**	**Mod.**	**M-High**	**M-High**	**Mod.**	**M-Low**	**Mod.**	**n/a**	**n/a**	**M-High**	**M-Low**	**M-High**
A. Type of Vegetation	-	High	-	-	High	Mod.	M-High	Mod.	M-Low	Mod.	High	-	-	Mod.	Mod.	M-High
B. Wetland Width (along shore)	-	Low	-	-	High	Mod.	High	High	High	Low	Low	-	-	High	Low	High
3. STORAGE OF STORM AND FLOODWATER	**Low**	**Mod.**	**Low**	**Low**	**High**	**M-Low**	**M-High**	**Mod.**	**M-Low**	**Low**	**Mod.**	**Low**	**Low**	**M-High**	**Low**	**High**
A. Flood Storage	Low	Low	Low	Low	High	Mod.	Mod.	Mod.	Mod.	Low	Low	Low	Low	High	Low	High
B. Flood Retardation (Vegetative Cover)	Low	High	Low	Low	High	Low	High	Mod.	Low	Low	High	Low	Low	Mod.	Low	High
4. NATURAL GROUNDWATER RECHARGE	**Low**	**Low**	**Low**	**Low**	**High**	**Low**	**Mod.**	**Mod.**	**M-High**	**Low**	**Low**	**Low**	**Low**	**High**	**Low**	**High**
5. WATER QUALITY	**M-Low**	**M-Low**	**M-Low**	**M-Low**	**M-High**	**M-Low**	**M-High**	**Mod.**	**M-Low**	**M-Low**	**M-Low**	**M-Low**	**Mod.**	**M-High**	**M-Low**	**M-High**
A. Wetland Size/Water Coverage	Low	Low	Low	Low	Mod.	Low	Mod.	Low	M-Low	Low	Low	Low	Low	High	Low	M-High
B. Vegetation Density/Hydroperiod	Mod.	Mod.	Mod.	Mod.	High	Mod.	High	High	Mod.	Mod.	Mod.	Mod.	M-Low	M-High	Mod.	Mod.
C. Proximity to Pollution Source	Mod.	Mod.	Mod.	Mod.	Mod.	Mod.	Mod.	Mod.	Low	Mod.	Low	Low	Mod.	Mod.	Low	Mod.
6. NATURAL BIOLOGICAL FUNCTION	**M-Low**	**M-Low**	**M-Low**	**M-Low**	**M-High**	**M-Low**	**Mod.**	**Mod.**	**M-Low**	**M-Low**	**Mod.**	**Low**	**M-Low**	**High**	**M-Low**	**M-High**
A. General Habitat	Low	Mod.	Low	Low	High	Mod.	M-High	Mod.	Low	Low	Mod.	Low	Low	High	Low	Mod.
B. Food Chain Production	Mod.	Mod.	Mod.	Mod.	High	Mod.	M-High	M-High	M-Low	Mod.	Mod.	Low	Mod.	High	M-Low	M-High
C. Potential for Study Area, Sanctuary, or Refuge	Low	Low	Low	Low	Mod.	Low	Low	Low	Low	Low	Mod.	Low	Low	High	Low	Mod.

Note: Mod. = Moderate
M-High = Moderate-High
M-Low = Moderate-Low

E - Emergent
S-S - Shrub-Scrub
F - Forested
OW - Open Water

Source: Shapiro and Associates, Inc, 1990.



Source: Wilsey & Ham Pacific, 1990.

LEGEND:

EM / 13 — Wetland Label No. / Habitat Types

- OW = Open Water
- FO = Forested Swamp
- SS = Scrub-Shrub Swamp
- EM = Emergent Marsh

N

SCALE-MILES

0 .25 .50

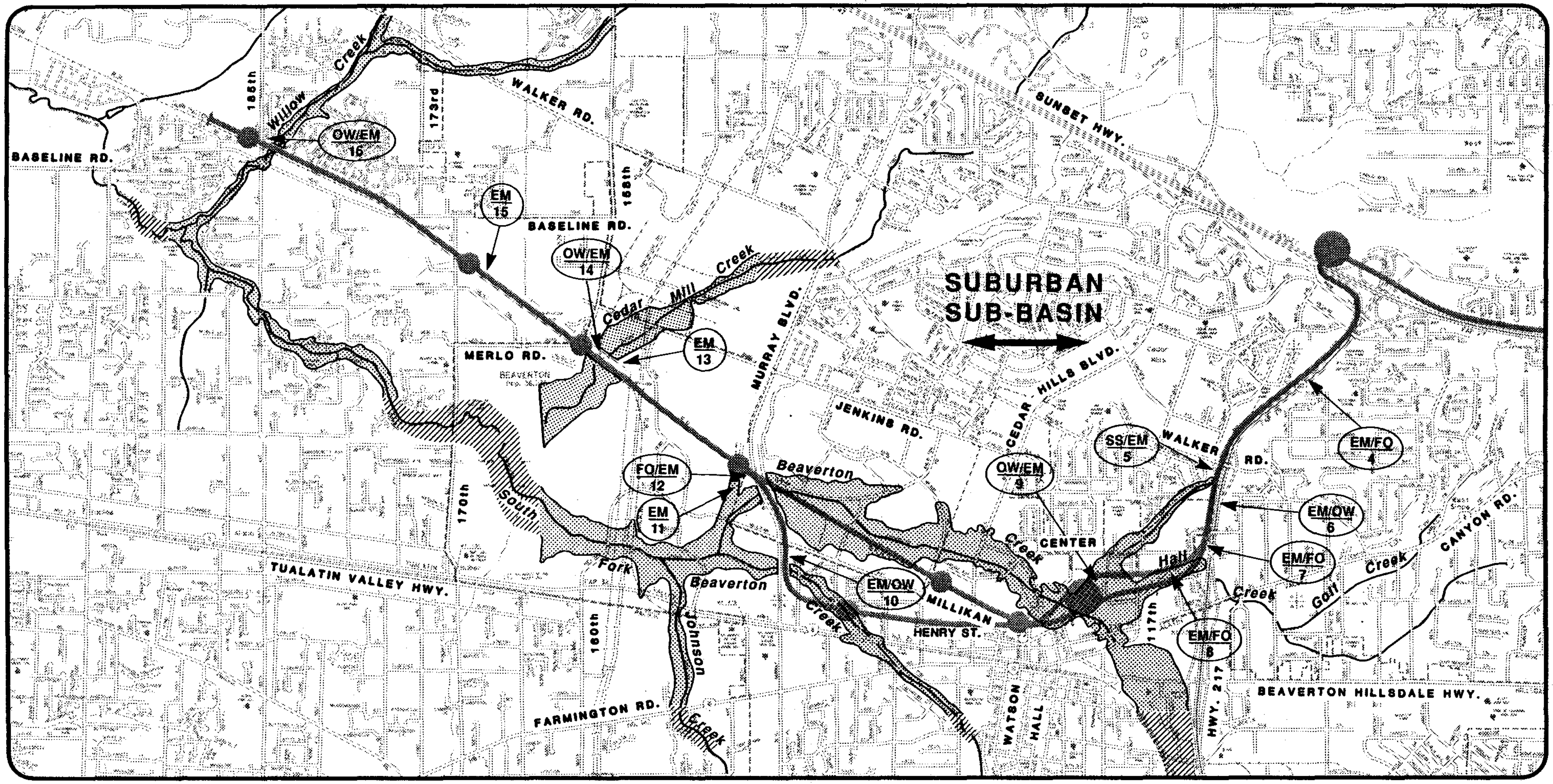
Westside Corridor Project

Hydrologic Features and Wetlands

The Oregon Department of Transportation

TRI-MET

Figure 3.7-1a



Source: Wilsey & Ham Pacific, 1990.

LEGEND:

100 year flood plain

Floodplains not mapped

EM / 13 — Wetland Label No.

Habitat Types
- OW = Open Water
- FO = Forested Swamp
- SS = Scrub-Shrub Swamp
- EM = Emergent Marsh

N

SCALE-MILES
0 .25 .50

Westside Corridor Project

Hydrologic Features and Wetlands

The Oregon Department of Transportation

WESTSIDE LIGHT RAIL TRI-MET

Figure 3.7-1b

Wetland Area 2 is a small scrub-shrub wetland located north of Sunset Highway. The intermittent creek occurs in a defined riparian corridor east of Sylvan Creek, on the south side of Sunset Highway.

3.7.3.3 Golf Creek

Golf Creek is located north of Sunset Highway and flows between apartment complexes west of S.W. 76th Avenue. North of S.W. 76th Avenue, two constructed ponds are located along Golf Creek. The smaller pond is east of the creek and the larger pond, known as Cemetery Reservoir, is fed directly by Golf Creek. Golf Creek flows west from the larger pond, parallel to Sunset Highway, in a defined riparian corridor, passing through a culvert under Sunset Highway west of the apartment complexes. It continues as a steep-sided riparian corridor on the south side of the highway. Wetland Area 3 is a small, isolated, emergent wetland located on the south side of Sunset Highway, east of Golf Creek and south of the S.W. 76th Avenue exit.

3.7.3.4 East Side of Highway 217

One wetland area and an intermittent drainage are located in this area. Wetland Area 4 is an emergent and forested wetland system located north of the S.W. Walker Road overpass. The intermittent drainage flows between the S.W. Wilshire Street overpass and S.W. Walker Road on the east side of Highway 217, from Ridgewood View Park south to the wetland system.

3.7.3.5 Hall Creek and its North Tributary

On the east side of Highway 217, Hall Creek has been rerouted and ditched. The property surrounding the creek is currently under construction. Hall Creek crosses under Highway 217 and the proposed LRT alignment north of the Highway 8 exit. It is culverted under S.W. 114th Avenue, continues westward to S.W. 117th Avenue, and is culverted under the Canyon Place Shopping Center west of S.W. 117th Avenue. It meets the north tributary of Hall Creek near the Beaverton Transit Center.

Two wetland areas are associated with the north tributary of Hall Creek. Wetland Area 5 is a fairly expansive scrub-shrub/emergent wetland system supported by the north tributary of Hall Creek. The wetland is located just south of S.W. Walker Road and west of Highway 217. This wetland system extends for approximately a half mile southwest of Highway 217, until it reaches an area at S.W. 116th Avenue where the tributary is channelized. It joins Hall Creek northeast of the Beaverton Transit Center. The wetland system is bordered by residential development to the north, and by undeveloped mixed and coniferous forest to the south. Wetland Area 6 is a wetland system composed mainly of open water and emergent vegetation in a depressed area on the east side of Highway 217, south of the S.W. Walker Road overpass and off-ramp.

Three wetland areas are associated with Hall Creek. Wetland Area 7 is an emergent and forested wetland located between Highway 217 and S.W. 114th Avenue. Wetland Area 8 is composed of a mixture of emergent and forested wetland habitat types abutting the Lynmarie Manor Apartments parking lot on the north, and the edge of fill on the south. It extends from S.W. 114th Avenue to S.W. 117th Avenue, where Hall Creek is channelized and the wetland is restricted to a narrow corridor.

East of the Beaverton Transit Center, Hall Creek flows through a culvert under the Canyon Place Shopping Center. Wetland Area 9 is a newly created pond at the confluence of Hall Creek and its north tributary. This portion of Hall Creek has experienced considerable disturbance in the past, and much of the newly planted vegetation in the mitigated wetland has died. Hall Creek flows into Beaverton Creek east of the Beaverton Transit Center.

3.7.3.6 Beaverton Creek and its Tributary

Beaverton Creek is channelized and banked by blackberries and upland vegetation from the Beaverton Transit Center through the Tektronix campus, where scattered patches of vegetation associated with the creek occur between the parking lots and landscaping. The creek is channelized under S.W. Murray Boulevard, then flows southwest under S.W. Millikan Way. The tributary to Beaverton Creek is channelized east of S.W. 144th Avenue, through a neighborhood park and Wetland Area 10 (discussed below), and under S.W. Murray Boulevard.

Two wetland areas are associated with Beaverton Creek and its tributary. Wetland Area 10 is an emergent wetland associated with a tributary to Beaverton Creek, located east of S.W. Murray Boulevard and west of S.W. 144th Avenue. This wetland is bordered by Nike office buildings and parking lots to the north and south, and by S.W. 144th Avenue to the east. East of S.W. 144th Avenue, the creek is channelized through a neighborhood park, emergent wetland, and under S.W. Murray Boulevard.

Wetland Area 11 is a thin band of forested wetland associated with a drainage swale. It extends from the BN railroad tracks west of S.W. Murray Boulevard to the emergent wetland associated with Beaverton Creek, between S.W. Murray Boulevard and S.W. Millikan Way. This wetland may function as an overflow area for Beaverton Creek.

3.7.3.7 Isolated Wetland

Wetland Area 12 is an isolated, emergent wetland located west of the BN railroad tracks and the S.W. Murray Boulevard overpass on the eastern end of an agricultural field, and west of a railroad spur and Beaverton Creek.

3.7.3.8 Cedar Mill Creek

Cedar Mill Creek is crossed by the BN Railroad tracks and the proposed LRT corridor. The creek is also crossed by a railroad spur east of S.W. 158th Avenue, and then continues south under the main railroad bridge through Tualatin Hills Regional Nature Park on the south side of the study area. A small, isolated, emergent wetland, Wetland Area 13, is located in a slight depression east of Cedar Mill Creek and north of the BN railroad tracks. Wetlands associated with Cedar Mill Creek (Wetland Area 14) consist of two ponds composed of open water, emergent, and forested wetlands on either side of a railroad spur that crosses Cedar Mill Creek before joining the main railroad line in the vicinity of S.W. 158th Street. This wetland area is connected with the diverse upland and wetland habitats within Tualatin Hills Regional Nature Park.

3.7.3.9 S.W. 170th Avenue

The drainage pattern in this area has been bisected by the BN railroad tracks and S.W. 170th Avenue, and the drainage rerouted and culverted. An emergent wetland, Wetland Area 15, occurs along a broad drainage swale north of the BN railroad tracks east of S.W. 170th Avenue. The drainage flows under the railroad tracks and S.W. 170th Avenue, and emergent wetland continues through a horse pasture south of the tracks and west of S.W. 170th Avenue.

3.7.3.10 Willow Creek

Wetland Area 16 is associated with Willow Creek. Both the wetland and creek are bordered by S.W. 185th Avenue to the west and Baseline Road to the south. Forested and emergent wetland is located north of the railroad trestle, with a pond surrounded by newly planted emergent and scrub-shrub vegetation located south of the trestle. Stormwater empties into the wetland via a culvert from S.W. 185th Avenue just north of the railroad tracks.

3.7.3.11 Specific Wetland Values

Wetlands in urban environments provide habitat for urban wildlife, education, and recreation areas, and aesthetically pleasing greenbelts in addition to the values addressed in the wetland value assessment presented in Table 3.7-1.

Since many drainages in the area have been channeled, and the amount of impervious surface is increasing, remaining wetlands within the project area provide substantial shoreline protection, storm and flood water storage, and natural groundwater exchange.

In general, wetlands in the project area that are isolated or associated with channelized creeks (Wetland Areas 1, 2, 3, 4, 6, 9, 10, 11, 12, 13, and 15) have moderate to low values for shoreline protection and stormwater and flood water storage functions. Wetlands with moderate to high values for these functions (Wetland Areas 7, 8, 14, and 16) are hydrologically altered to varying degrees. The highest value for these functions occurs in Wetland Area 5, which is one of the least hydrologically disturbed areas.
Water quality is an issue in the Tualatin River Drainage. Any wetlands that improve water quality are valuable. Wetland areas 5, 7, 14, and 16 have the highest value for water quality improvement, moderate-high. Wetland areas 1, 2, 3, 4, 6, 9, 10, 11, 12, 15, and 16 have a moderate-low value.

Wetland areas that are connected to portions of intact creeks and include a diversity of habitat types provide some of the best wildlife habitat (Wetland Areas 5, 7, 8, 11, 14, and 16). Wetland Areas 5 and 14 are characterized by a diversity of habitat types, large size, and surrounding natural vegetation buffer. Many of the wetland areas do not provide moderate or high wildlife habitat values (Wetland Areas 1, 2, 3, 4, 6, 9, 10, 12, 13, and 15).

3.8 WATER QUALITY AND HYDROLOGY

The following sections summarize existing water quality and hydrology in the study area. Additional details can be found in Technical Memorandum 20h.

3.8.1 Surface Water

The Westside Corridor Project lies within the Willamette River drainage basin. The Willamette River joins the Columbia River north of Portland. About 110 river miles downstream from this junction, the Columbia River enters the Pacific Ocean. There are no navigable waterways within the project area.

The project area can be divided into two primary subbasins: an urban basin and a suburban basin (see Figures 3.7-1a and 1b.) There are no stream-flow or water-quality monitoring stations within either basin.

3.8.1.1 The Urban Basin

Approximately one-quarter of the project area drains directly into the Willamette River via the stormwater system maintained by the City of Portland. The proposed alignment does not traverse any major watercourses within the urban basin.

Water quality in the urban basin of the proposed project area is typical of that found in most urban areas in the United States. Oil, grease, nitrates, phosphates, sediment, and heavy metals have been detected in urban stormwater runoff.

3.8.1.2 The Suburban Basin

The suburban basin, which drains the remaining three-quarters of the project area, is located west of the divide created by the Tualatin Mountains (known locally as Portland's West Hills). Through five small streams, this basin drains into the Tualatin River, which enters the Willamette River just south of Portland.

Water quality concerns here are similar to those in the urban basin, with additional focus on the persistent problem of algae growth in the Tualatin River. This problem has been traced to high levels of phosphorus in the river. The algal bloom problem, which is at its worst in warm weather, creates aesthetic and odor problems throughout the Tualatin River basin and in Lake Oswego, which receives water from the river. These algal blooms adversely affect water-contact sports, depress dissolved oxygen levels below minimums required to maintain fish populations, and generate noxious odors detectable in neighboring areas.

Approximately 80% of the excess phosphorus enters the river from a publicly owned treatment works, operated by the Unified Sewer Agency of Washington County (USA). The remaining 20% is from nonpoint source pollution within the Tualatin River basin. The Oregon Environmental Quality Commission (EQC) has established a goal of a 65% reduction in phosphorus levels for the Tualatin River and has designated USA as the lead agency for meeting the target. To this end, USA is adopting rules proposed by the Oregon Environmental Quality Commission; these rules require the development of stormwater control facilities designed to achieve targeted levels of phosphorus reduction.

Extensive floodplain areas exist in the Beaverton area, particularly in the vicinity of the Beaverton Transit Center and Canyon Place Shopping Center (see Figure 3.7-1a and 1b).

Filling within designated flood hazard areas in either the City of Beaverton or adjacent Washington County areas would require a permit from the appropriate local jurisdiction. Requirements for flood hazards would have to be met before track construction or highway improvements in designated areas could be permitted. Executive Order 11988 establishes the federal policy of avoiding actions that have negative impacts on flood areas. In addition, regulating agencies require that all fill operations in designated flood hazard areas preserve net flood-water storage volume.

Figures 3.7-1a and 1b show the designated 100-year floodplains and flood hazard areas within and adjacent to the rights-of-way of the proposed transit alignment options.

Floodplains are valuable natural resources and provide fish and wildlife habitat, flood control, stormwater storage, water quality enhancement, sediment and erosion control, and educational, recreational, research, and aesthetic uses. Floodplains can play an important role in slowing and storing floodwaters, thus reducing the threat of flood damage downstream. The storage capacity of some floodplains allows water to be added to groundwater that recharges domestic and municipal water supplies. Since many drainages in the area have been channelized, and the amount of impervious surface is increasing, remaining floodplains within the project area provide substantial shoreline protection, storm and floodwater storage, and natural groundwater recharge.

3.9 GEOLOGY

The Westside Corridor study area traverses three distinct but related geologic areas: the Willamette River floodplain (within the Portland basin), the Tualatin Mountains, and the Tualatin Valley.

The following sections summarize existing geology in the study area. Additional details can be found in Westside Corridor Project Phase 2, Geotechnical Investigations and Preliminary Tunnel Design Report (Parsons, Brinkerhoff, Quade and Douglas, Inc., 1989).

3.9.1 Portland Basin

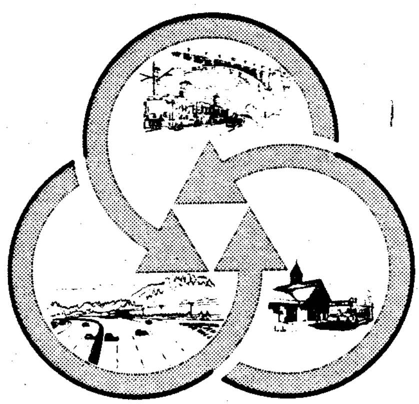
The Portland Basin includes the existing LRT turnaround at S.W. 11th Avenue, between S.W. Morrison and S.W. Yamhill Streets, and extends to the western end of S.W. Jefferson Street. Evidence suggests the existence of a probable trace of the Portland Hills Fault in this section of the project area. This fault, if it exists, is not considered active and is therefore of limited significance with respect to design constraints.

3.9.2 Tualatin Mountains

Detailed knowledge of the geology of the Tualatin Mountains, commonly referred to as the Portland West Hills, is limited by the lack of subsurface explorations, and of suitable soil and bedrock exposure. It is generally accepted that large displacement faults (i.e., the Portland Hills Fault) exist, along with ancient landslide areas. The slopes within ancient landslide terrain are considered marginally stable. This means that changes in the slope from construction activities, rainfall, or groundwater fluctuations could trigger slope failure. Slides have occurred at the Zoo and in the area of Washington Park near the rose garden. Both areas are considered to be located in ancient landslide terrain (Cornforth, 1989; Squier Associates, 1989). The Highlands District is another landslide area, where a slide was caused by previous highway construction. Horizontal drains appear to have stabilized the slope, and the area is presently considered to be marginally stable.

3.9.3 Tualatin Valley

West of the Tualatin Mountains, the Westside LRT alignment lies within the Tualatin Valley geologic area. The wide shallow drainage channels formed by erosion are poorly drained.



CHAPTER 4

TRANSPORTATION IMPACTS

4.0 TRANSPORTATION IMPACTS

This chapter presents the impacts that each of the alternatives would have on the transit system, traffic, and freight movement in the study area. Transit impacts are defined by various measures of service level and ridership. Traffic impacts are defined by various measures of demand; congestion of streets, freeways, and intersections; and parking loss and parking-demand reduction. Finally, a brief discussion of the impacts to freight railroads and truck delivery is provided.

4.1 TRANSIT IMPACTS

This section's discussion of transit impacts is limited to service and ridership considerations. Cost and other financial considerations are discussed in Chapters 2 and 7.

4.1.1 Service Characteristics

Transit-service considerations in this section include amount and coverage of transit service, travel time, transferring, reliability, Transit Mall operations, and comfort.

4.1.1.1 Amount and Coverage of Service

Table 4.1-1 summarizes major service characteristics of the transit alternatives under consideration. The table shows the Westside Corridor's daily vehicle hours of service, daily vehicle miles of travel (VMT), and daily place-miles of service. As discussed in Chapter 2, place-miles of service refers to the total carrying capacity of transit vehicles and is calculated by multiplying the capacity of each train or bus by the number of miles that vehicle travels each day. Daily vehicle hours and vehicle miles are simply the cumulative time that the transit vehicles are in service and the distance they travel.

The No Build Alternative would retain the current bus route network and geographic coverage. Bus lines that currently operate only during peak hours would be upgraded to all-day service. Approximately 1,470 service hours would be provided, an increase of approximately 40% over existing levels.

The TSM Alternative is designed to accommodate peak-period rider demand in 2005. A new, all-day trunk bus line would operate between Hillsboro and downtown Portland via Cornell Road and Sunset Highway. A second new trunk line would operate between the Beaverton Transit Center and downtown Portland via Sunset Transit Center during peak hours. New local feeder bus service would be added in Hillsboro, Beaverton, and east Cedar Hills. The number of daily service hours in the TSM Alternative would increase to approximately 2,200 (bus only), an increase of 50% over the No Build Alternative.

With the LRT Alternative, the LRT would provide the trunk line connection between downtown Portland and Beaverton. Two-car trains would operate every five minutes east of the Beaverton Transit Center and every ten minutes west of the center during peak hours. Westside LRT service would provide a through route connecting with MAX service on the Eastside. The geographic area and coverage of local feeder bus service would be virtually the same for the TSM and LRT Alternatives. Most local feeder bus lines would meet the Westside LRT at either the S.W. 185th Avenue terminus, Beaverton Transit Center, or Sunset Transit Center. The T.V. Highway/S.W. Canyon Road bus (line 57) would terminate at the Sylvan station or continue into Portland, depending on the alignment option. A new bus line between the northwest industrial area and the south end of downtown Portland via N.W. 18th and N.W. 19th Avenues, and S.W. Jefferson and S.W. Columbia Streets would provide a direct transfer connection between Portland State University and the Westside LRT Line. The number of daily service hours in the LRT Alternative would be approximately 1,420 for buses and 260 for LRT, an increase of about 15% over the No Build Alternative.

The S.W. Murray Boulevard and Sunset Transit Center terminus options would shorten the LRT alignment and require the extension of several feeder bus lines. In addition, with the Sunset Transit Center terminus option, bus routes would be extended through Beaverton via Highway 217 to the Sunset

Table 4.1-1

SUMMARY TABLE FOR TRANSIT SERVICE CHARACTERISTICS
WESTSIDE CORRIDOR ONLY
Year 2005

	Existing		No Build		TSM		LRT to 185th		LRT to Murray		LRT to Sunset TC	
TRANSIT CHARACTERISTIC	Bus	LRT	Bus	LRT	Bus	LRT	Bus	LRT	Bus	LRT	Bus	LRT
Vehicle Hours Weekday	1,030	0	1,470	0	2,200	0	1,420	260	1,460	220	1,570	100
VMT Weekday	14,000	0	20,000	0	29,000	0	19,000	5,130	20,000	4,430	21,000	2,030
Place-Miles Weekday	1,022,000	0	1,493,000	0	2,112,000	0	1,403,000	851,580	1,459,000	735,380	1,559,000	336,980

Source: Tri-Met, 1990.

Transit Center rather than terminating at the Beaverton Transit Center. Overall service hours would be about the same for all LRT terminus options.

Place-miles is an indicator of the seated and standing capacity associated with each alternative, and is a better quantitative measure of service than hours or VMT. Table 4.1-1 shows that with the TSM Alternative, Westside Corridor bus place-miles would increase by 619,000 daily, a 41% increase over the No Build Alternative. With the LRT Alternative, S.W. 185th Avenue terminus option, Westside Corridor bus place-miles would decrease by 709,000 compared with the TSM Alternative. However, LRT place-miles would increase by 852,000 miles, resulting in a net increase of 143,000 place-miles for the LRT Alternative over the TSM Alternative. This represents approximately a 7% increase in transit capacity with the LRT Alternative, compared with the TSM Alternative. The S.W. Murray Boulevard terminus option would have 4% more bus place-miles and 13% fewer LRT place-miles than the S.W. 185th Avenue terminus option. The Sunset Transit Center terminus option would have 10% more bus place-miles, and a 60% reduction in LRT place-miles.

Access to transit, or transit coverage, is another measure that can be used to indicate how well population and employment are served by alternative transit systems. Table 4.1-2 shows the percentage of population and employment in the Westside Corridor and other parts of the region that would live and work within one-quarter mile of a transit station or stop under each of the alternatives. One-quarter mile is a common standard for the maximum distance people will walk to or from a transit stop. The LRT Alternative, S.W. 185th Avenue terminus option would provide transit service within a one-quarter mile walk of 63% of Westside residents and 83% of Westside jobs. These numbers are similar for the TSM Alternative (60% and 82%, respectively), as both transit networks have been designed to optimize transit service in the corridor. Both networks provide a significant increase in transit coverage as compared to the No Build network, which provides one-quarter mile access to 43% of Westside residents and 46% of Westside jobs. The lower transit access under the No Build Alternative results from the lack of new transit lines to serve growth areas in the corridor. The short terminus LRT options have similar access characteristics to the S.W. 185th Avenue terminus option.

Table 4.1-2

ACCESS TO TRANSIT
(by % within 1/4 mile of transit stop)

	Existing	No Build	TSM	LRT
WESTSIDE CORRIDOR				
% Population	45%	43%	60%	63%
% Employment	55%	46%	82%	83%
REMAINDER OF REGION				
% Population	62%	57%	64%	64%
% Employment	85%	82%	86%	86%
TOTAL				
% Population	59%	54%	63%	63%
% Employment	80%	76%	85%	86%

Source: Metro, 1990.

4.1.1.2 Travel Time

Tables 4.1-3, 4.1-4 and 4.1-5 compare travel times among all the alternatives. Table 4.1-3 shows actual in-vehicle transit travel times, while Table 4.1-5 shows door-to-door weighted total travel times. The latter includes the time walking to transit, the time waiting for transit, the in-vehicle time, and the time walking from the transit vehicle to the destination. "Weighted" time is intended to simulate travelers' perceptions of travel time. As such, it is considered a better indicator of the difference in attractiveness of transit alternatives than in-vehicle time or door-to-door times, which are not weighted. Weighted travel time is determined by adding in-vehicle time to 2.1 times the out-of-vehicle time during the peak period, and 2.7 times the out-of-vehicle time during the off-peak period. Out-of-vehicle time is factored because it is considered more onerous than in-vehicle time.

Peak hour, in-vehicle travel times between Pioneer Square in downtown Portland and the Beaverton Transit Center would be 16-18 minutes faster with the LRT Alternative (except the Sunset Transit Center terminus option) than the TSM Alternative (see Table 4.1-3). Travel times for such a trip in the P.M. peak hour would be approximately 18 minutes with the LRT Long Tunnel options, 20 minutes with LRT Surface options, 36 minutes with the TSM Alternative, and 43 minutes with the No Build Alternative. A similar trip from Pioneer Square to Hillsboro would take approximately 50-52 minutes with the LRT Long Tunnel and Surface options, 61 minutes with the TSM Alternative, and 78 minutes with the No Build Alternative. Table 4.1-4 provides a summary comparison of the percent change in travel times of the TSM and LRT Alternatives, compared with existing conditions and the No Build Alternative.

Compared with the S.W. 185th Avenue terminus option, the S.W. Murray Boulevard terminus option would generally increase transit travel times slightly for trips in the corridor west of S.W. Murray Boulevard, because more rides would involve transfers, and buses would travel more slowly than the light rail. The Sunset Transit Center terminus option would increase transit travel times significantly to many Westside Corridor destinations, because of increased transfers and slower bus travel speeds, as feeder buses from the south and west travel through central Beaverton on a congested highway network to the Sunset Transit Center to reach the LRT system.

LRT operation and running times on the steep grades in the Canyon segment have been the subject of much investigation by Tri-Met (Report on Rail Operation on Steep Gradients, Tri-Met, 1990) and review by UMTA. This analysis has included the effects of right-of-way (ROW) conditions, alignment design, wheel-rail adhesion, and traction and braking equipment performance on operation in both uphill and downhill directions. LRT running times could increase approximately one minute over those presented in this chapter, depending on the alignment option, as a result of reduction of allowable downhill speed limits and other factors. The operational considerations associated with the Canyon segment grades will be studied further during the preliminary and final engineering phases.

Tables 4.1-3 and 4.1-5 also provide a comparison of transit and auto travel times. General findings can be summarized as follows:

1) For the LRT options, in-vehicle transit times are less than in-vehicle auto times for P.M. peak hour trips to certain locations on the LRT line. To locations off the LRT line, in-vehicle auto times are always less than in-vehicle transit times.

2) In-vehicle auto times are always less than in-vehicle transit times, for off-peak trips.

3) Total weighted auto times are always less than total weighted transit times.

Figures 4.1-1 through 4.1-4 display geographically a comparison of weighted transit travel times to the Portland CBD. As discussed above, weighted transit travel times include in-vehicle and out-of-vehicle times, and factors that reflect the common perception that out-of-vehicle time is more onerous than in-vehicle time. These figures show the areas in the Westside Corridor that have a difference in weighted transit time of more than five minutes when comparing transit alternatives. In analyzing these maps, it is important to keep in mind that the weighting factor causes small differences in out-of-vehicle times to

TABLE 4.1-3
IN VEHICLE TRAVEL TIME COMPARISON TO SELECTED LOCATIONS
Year 2005
(in minutes)

		EXISTING (1988)		NO BUILD		TSM		LRT SURFACE TO 185TH		LRT TUNNEL TO 185TH		LRT SURFACE TO MURRAY		LRT SURFACE TO SUNSET	
From Pioneer Square		in vehicle		in vehicle		in vehicle		in vehicle		in vehicle		in vehicle		in vehicle	
to the following:		auto	transit	auto	transit	auto	transit	auto	transit	auto	transit	auto	transit	auto	transit
Sunset and Hwy 217															
	PM peak	15	21	20	31	18	23	18	15	18	13	18	15	18	15
	Off peak	11	23	12	17	12	14	12	15	12	13	12	15	12	15
Beaverton															
	PM peak	20	30	25	43	23	36	23	20	23	18	23	20	23	28
	Off peak	15	25	15	31	15	25	15	20	15	18	15	20	15	25
185th/Baseline															
	PM peak	26	34	32	50	28	45	28	29	28	27	28	39	28	38
	Off peak	19	43	20	27	20	29	20	29	20	27	20	35	20	34
185th & TV Hwy															
	PM peak	27	42	34	55	31	51	31	34	31	32	31	34	31	42
	Off peak	20	40	21	34	21	35	21	33	21	32	21	33	21	38
Hillsboro															
	PM peak	36	60	44	78	41	61	41	52	41	50	41	54	41	51
	Off peak	27	53	29	57	29	43	29	47	29	45	29	48	29	48
South Beaverton															
	PM peak	22	39	27	49	25	42	25	26	25	25	25	26	25	34
	Off peak	14	35	16	36	16	28	16	24	16	23	16	24	16	30
Rock Creek															
	PM peak	26	39	32	54	28	45	28	44	28	43	28	43	28	43
	Off peak	20	-	21	35	20	30	20	39	20	38	20	37	20	37

Source: Metro 1990.
Note: Assumes access to LRT by walk or feeder bus.

Table 4.1-4

IN-VEHICLE TRAVEL TIME COMPARISON TO SELECTED LOCATIONS
SUMMARY AND % CHANGE FROM NO BUILD
P.M. Peak Hour Outbound, Year 2005

	No Build		TSM		Surface to 185th		Tunnel to 185th		Surface to Murray		Surface to Sunset TC	
From Pioneer Square to the following:	time	% change	time	% change	time	% change	time	% change	time	% change	time	% change
Sunset and Highway 217	31	0%	23	-26%	15	-52%	13	-58%	15	-52%	15	-52%
Beaverton	43	0%	36	-16%	20	-53%	18	-58%	20	-53%	28	-35%
185th/Baseline	50	0%	45	-10%	29	-42%	27	-46%	39	-22%	38	-24%
185th/T.V. Highway	55	0%	51	-7%	34	-38%	32	-42%	34	-38%	42	-24%
Hillsboro	78	0%	61	-22%	52	-33%	50	-36%	54	-31%	51	-35%
South Beaverton	49	0%	42	-14%	26	-47%	25	-49%	26	-47%	34	-31%
Rock Creek	54	0%	45	-17%	44	-19%	43	-20%	43	-20%	43	-20%

Note: LRT times assume access to LRT by walk or bus.
Surface denotes either Southside or Northside alignment option.

Source: Metro, 1990.

TABLE 4.1-5
TOTAL WEIGHTED TRAVEL TIME COMPARISON TO SELECTED LOCATIONS
Year 2005
(in minutes)

From Pioneer Square to the following:		EXISTING (1988) total weighted		NO BUILD total weighted		TSM total weighted		LRT SURFACE TO 185TH total weighted		LRT TUNNEL TO 185TH total weighted		LRT SURFACE TO MURRAY total weighted		LRT SURFACE TO SUNSET total weighted	
		auto	transit	auto	transit	auto	transit	auto	transit	auto	transit	auto	transit	auto	transit
Sunset and Hwy 217	PM peak	20	44	25	48	23	38	23	29	23	28	23	30	23	32
	Off peak	16	44	17	66	17	31	17	32	17	37	17	32	17	28
Beaverton	PM peak	25	54	30	60	28	51	28	33	28	32	28	34	28	46
	Off peak	20	49	20	49	20	45	20	33	20	34	20	33	20	43
185th/Baseline	PM peak	31	66	37	69	33	67	33	48	33	47	33	58	33	57
	Off peak	24	79	25	52	25	65	25	45	25	44	25	60	25	51
185th & TV Hwy	PM peak	32	70	39	70	36	77	36	51	36	52	36	57	36	65
	Off peak	25	63	26	70	26	69	26	61	26	61	26	67	26	70
Hillsboro	PM peak	41	84	49	93	46	88	46	70	46	71	46	76	46	73
	Off peak	32	85	34	112	34	77	34	72	34	72	34	73	34	75
South Beaverton	PM peak	27	60	32	71	30	61	30	42	30	41	30	42	30	53
	Off peak	19	55	21	67	21	62	21	52	21	53	21	52	21	64
Rock Creek	PM peak	31	74	37	85	33	84	33	69	33	66	33	82	33	68
	Off peak	25	-	26	89	25	105	25	96	25	95	25	135	25	132

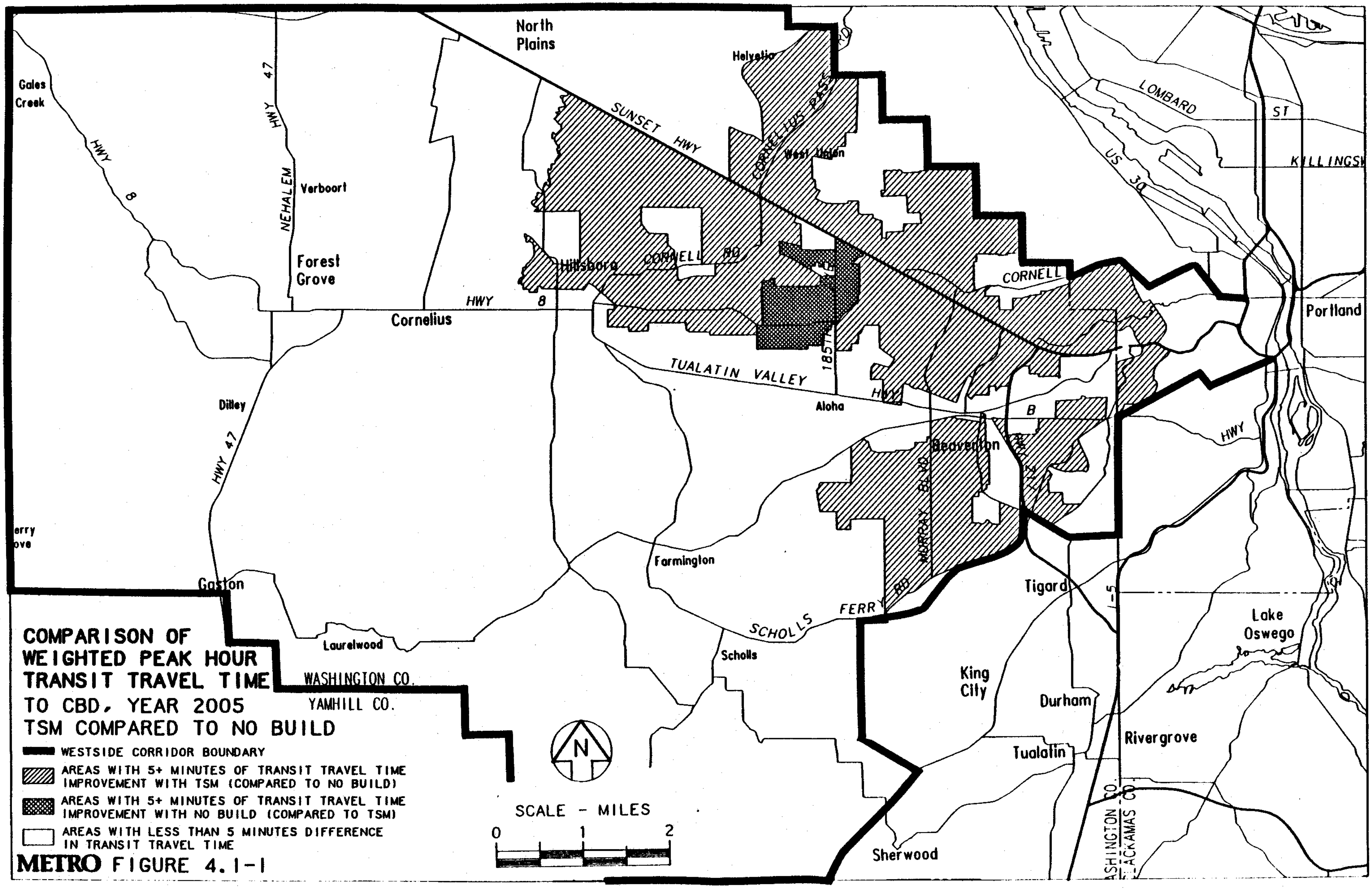
Note: Total weighted travel time equals weight factor times out-of-vehicle time plus in-vehicle time.

Peak weight factor = 2.1

Off peak weight factor = 2.7

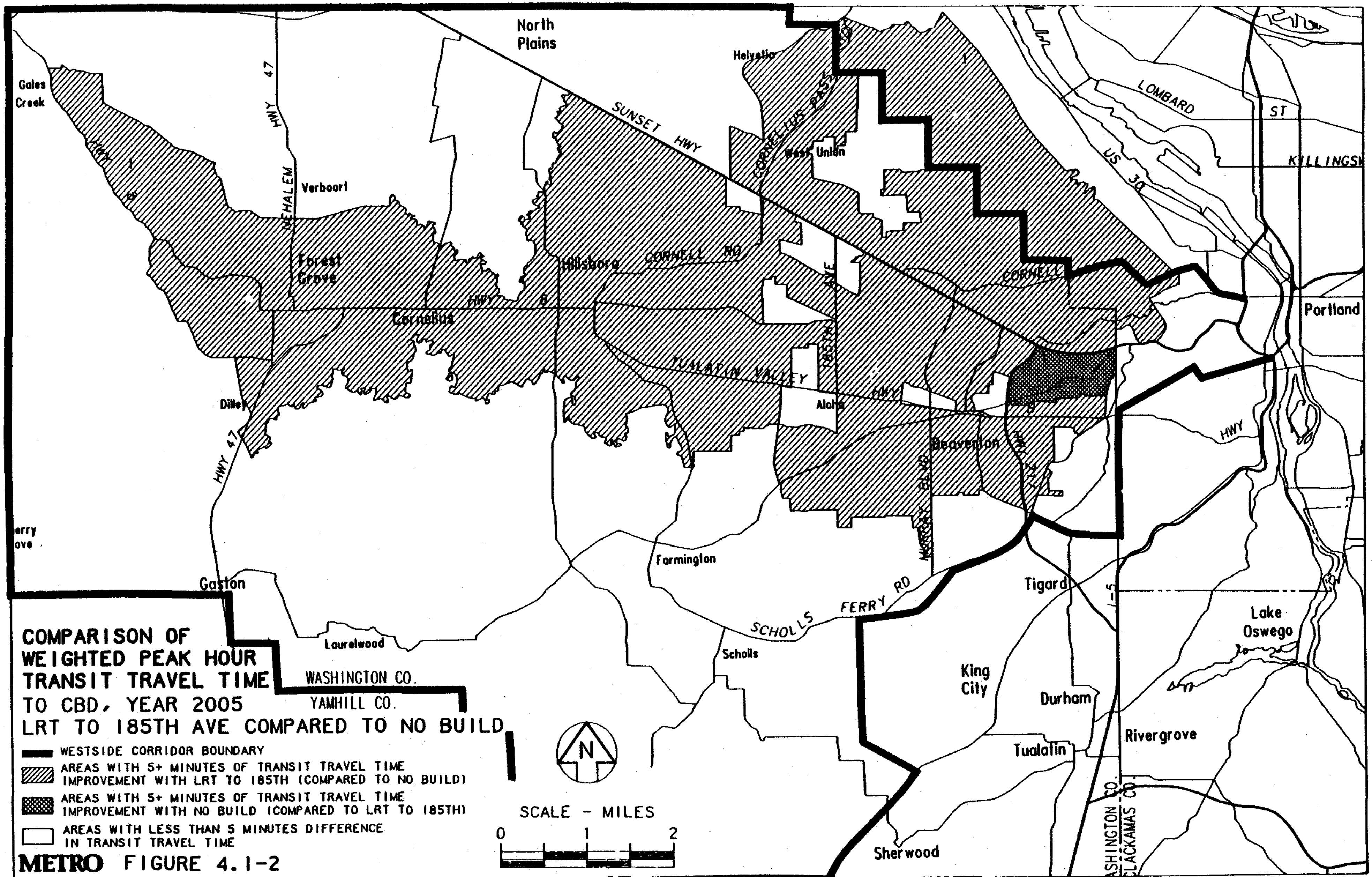
Assumes access to LRT by walk or feeder bus.

Source: Metro 1990.



COMPARISON OF WEIGHTED PEAK HOUR TRANSIT TRAVEL TIME TO CBD, YEAR 2005
TSM COMPARED TO NO BUILD

METRO FIGURE 4.1-1



COMPARISON OF WEIGHTED PEAK HOUR TRANSIT TRAVEL TIME TO CBD, YEAR 2005
LRT TO 185TH AVE COMPARED TO NO BUILD

FIGURE 4.1-2

Note: Assumes access to LRT by walk or feeder bus.

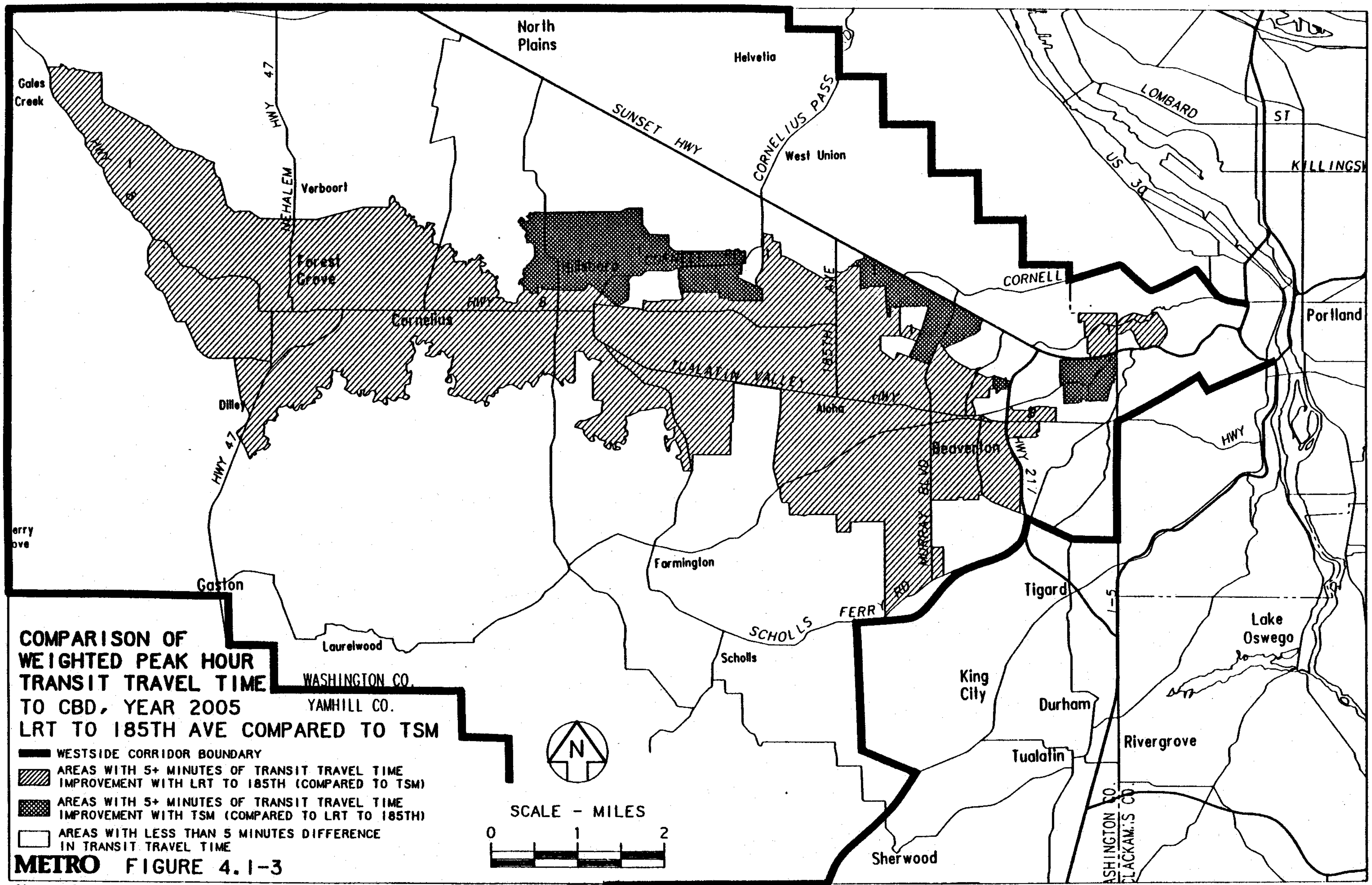
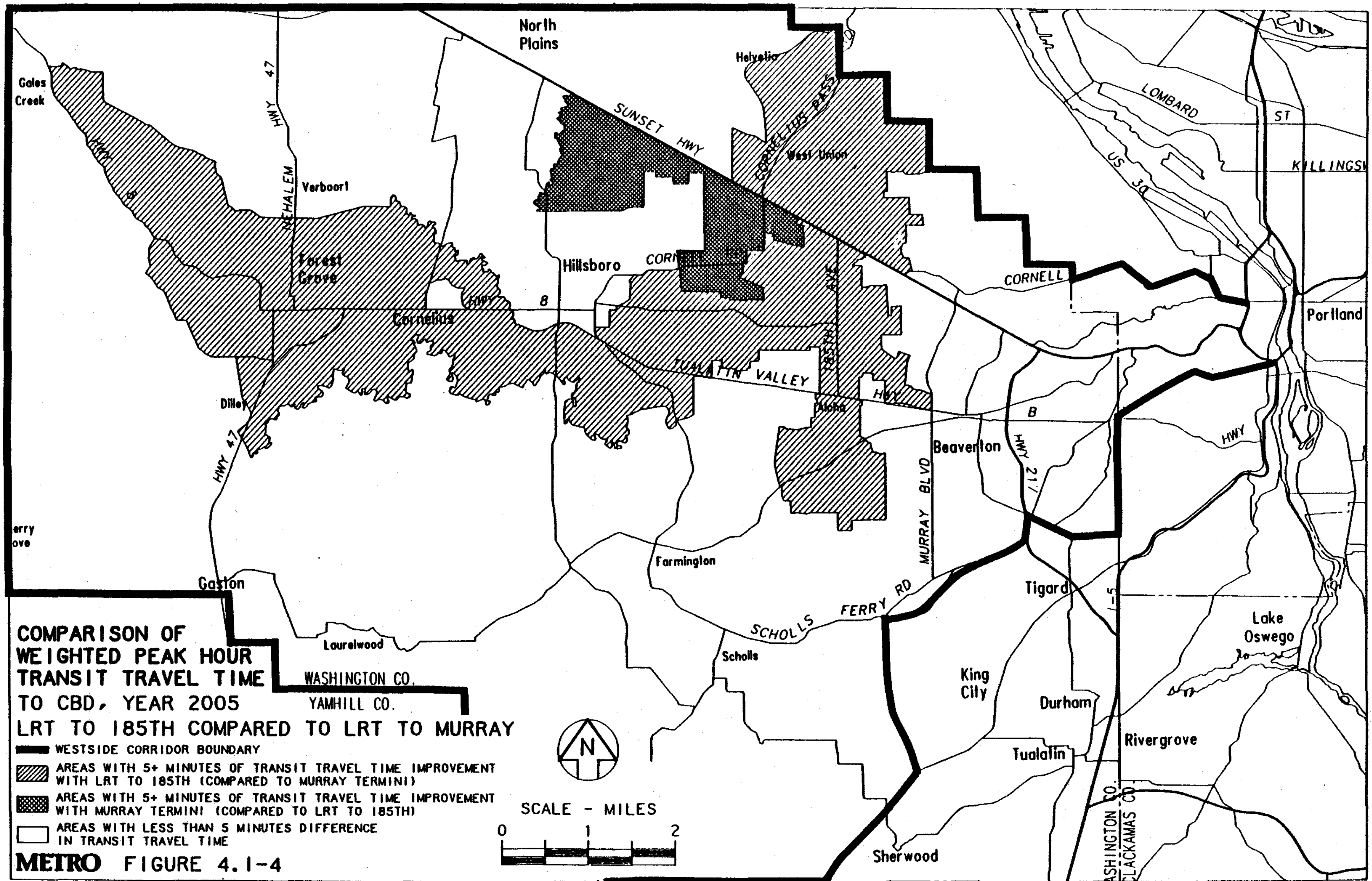


FIGURE 4.1-3

Note: Assumes access to LRT by walk or feeder bus.



COMPARISON OF WEIGHTED PEAK HOUR TRANSIT TRAVEL TIME TO CBD, YEAR 2005

LRT TO 185TH COMPARED TO LRT TO MURRAY

- WESTSIDE CORRIDOR BOUNDARY
- AREAS WITH 5+ MINUTES OF TRANSIT TRAVEL TIME IMPROVEMENT WITH LRT TO 185TH (COMPARED TO MURRAY TERMINI)
- AREAS WITH 5+ MINUTES OF TRANSIT TRAVEL TIME IMPROVEMENT WITH MURRAY TERMINI (COMPARED TO LRT TO 185TH)
- AREAS WITH LESS THAN 5 MINUTES DIFFERENCE IN TRANSIT TRAVEL TIME

METRO FIGURE 4.1-4

Note: Assumes access to LRT by walk or feeder bus.

have significant impacts on the perceived travel times. Out-of-vehicle time differences can result from changes in assumed headways, or changes in transfer routings and requirements between the alternative transit networks.

A comparison of the No Build and TSM transit networks shows that a broad area of the Westside Corridor, including south Beaverton, Cedar Hills, Rock Creek, and east Hillsboro, has at least five minutes of weighted transit time savings with the TSM network (see Figure 4.1-1). The No Build transit network provides transit travel time savings to the Tanasbourne area, because no transfer is required.

Figures 4.1-2 and 4.1-3 compare transit times for the LRT Alternative, S.W. 185th Avenue terminus option with those for the No Build and TSM Alternatives. The LRT network provides a transit travel time improvement of at least five minutes to almost the entire Westside Corridor, when compared with the No Build network. The only exception is along S.W. Canyon Road between Highway 217 and Sunset Highway at Sylvan. With the LRT network, S.W. Canyon Road riders must transfer at Sylvan to reach the Portland CBD. This area is served by through buses under both the TSM and No Build Alternatives. Compared with the TSM network, the LRT provides at least a five-minute transit travel time advantage for most trips from south Beaverton, Aloha, central Hillsboro, Cornelius, and Forest Grove to the CBD. The TSM Alternative provides a transit time advantage for trips from the S.W. Canyon Road area, the Sunset Highway/S.W. Cornell Road Interchange area, and north Hillsboro.

Figure 4.1-4 compares the LRT Alternative, S.W. 185th Avenue and S.W. Murray Boulevard terminus options. As indicated, weighted travel times east of S.W. Murray Boulevard are identical. West of S.W. Murray Boulevard, improved access to the longer LRT line terminating at the timed transfer center at S.W. 185th Avenue results in weighted travel time savings for most areas.

4.1.1.3 Transferring

The expansion of transit service and creation of transit networks more oriented toward trunk lines served by feeder buses, would result in more transferring, both from bus to bus and from bus to LRT. Table 4.1-6 provides two measures of projected transferring between modes.

Table 4.1-6

WESTSIDE CORRIDOR TRANSIT TRANSFER CHARACTERISTICS
Year 2005

	Existing (1988)	No Build	TSM	Surface to 185th	Tunnel to 185th	Surface to Murray	Surface to Sunset TC
Bus Access to LRT	N/A	N/A	N/A	61%	62%	67%	77%
Corridor Transfer Rate	1.36	1.37	1.48	1.65	1.60	1.67	1.60

Note: Corridor Transfer Rate equals total boardings divided by total originating trips.
Surface denotes either Southside or Northside alignment options.

Source: Metro, 1990.

The first measure is the percent of transit riders arriving at the LRT by bus. It is estimated that approximately 60% of the riders on the LRT Alternative, S.W. 185th Avenue terminus option will reach the LRT by bus. This percentage increases as the line gets shorter, because the shorter terminus options have fewer park-and-ride lots.

The second measure in Table 4.1-6 is the corridor transfer rate. In technical terms, this is defined as the number of "boarding" trips in the corridor divided by the number of "originating" or "linked" trips in the corridor. Simply stated, a boarding trip occurs every time a person gets on a transit vehicle, while an originating trip reflects a person's complete journey from origin to destination. Thus, a trip from home to workplace that involves a bus ride and a transfer to LRT would have two boardings and a transfer rate of 2.00. From Table 4.1-6, it is evident that the LRT Alternative would increase the transfer rate for the corridor from 23% to 30%, compared with the No Build Alternative. The TSM Alternative would increase the transfer rate about 11% over the No Build Alternative. The No Build has the lowest transfer rate, in large part because it provides less extensive service coverage and has fewer feeder routes than the TSM and LRT Alternatives. The TSM Alternative has a lower transfer rate than the LRT Alternative because the TSM network provides direct bus service to the CBD from some areas that would have feeder bus service under the LRT Alternative.

The LRT options all have similar transfer rates, ranging from 1.60 (Long Tunnel alignment and Sunset Transit Center terminus options) to 1.67 (S.W. Murray Boulevard terminus option). The Long Tunnel alignment options have a slightly lower rate than the Surface options, because the Long Tunnel options do not include a station at Sylvan, eliminating the transfer possibility with the line 57 bus east of Beaverton.

4.1.1.4 Reliability

Reserved or separated ROW for transit vehicles is a major contributing factor toward making transit service more reliable, because transit vehicles operating in mixed traffic are subject to delays caused by accidents, breakdowns, and congestion. As discussed in Chapters 1 and 3, Tri-Met has found that the existing Eastside LRT, which uses reserved or separated ROW, has historically exhibited a higher percentage of on-time arrivals (no more than two minutes early or three minutes late) than buses in mixed traffic. For example, LRT has a 90% on-time arrival at Gateway Transit Center, while the buses have a 79% on-time arrival at Gateway and a 65% on-time arrival at the Beaverton Transit Center.

Table 4.1-7 shows the number of miles that transit operates on a reserved or separated ROW for the TSM and LRT Alternatives. Virtually all of the Westside LRT right-of-way is reserved or separated for transit only use. The LRT Alternative, S.W. 185th Avenue terminus option provides 20% more length of transit-only ROW than the S.W. Murray Boulevard terminus option, and more than twice that offered by the Sunset Transit Center terminus option. The only reserved ROW for the No Build and TSM Alternatives is the Transit Mall in downtown Portland, the length of which is a fraction of the reserved ROW of the LRT Alternative. Table 4.1-7 also shows the passenger miles on reserved or separated ROW and the percentage of total corridor passenger miles that occur on reserved or separated ROW. Each mile that one passenger travels is one passenger mile. For the LRT Alternative, S.W. 185th Avenue terminus option, about two-thirds of all corridor passenger miles (bus and rail) occur on reserved or separated ROW, while for the No Build and TSM Alternatives, only a small fraction (2%) are on reserved or separated ROW.

Another indicator of the relative service reliability among the alternatives is characterized by the priority given to the transit trunk lines at intersections. As indicated in Table 4.1-7, 50% to 70% of all the intersections through which the LRT operates have traffic signals preempted by LRT, have gated crossings for LRT, or actually have the LRT separated from other traffic. The S.W. 185th Avenue terminus option has a higher percentage of protected intersections than do the shorter terminus options. The No Build and TSM Alternatives have no protected intersections. These protective measures significantly improve the reliability of LRT service, compared with buses operating in mixed traffic on surface streets. Consequently, LRT is less likely to experience delays at intersections.

Table 4.1-7

WESTSIDE TRANSIT RELIABILITY MEASURES

Reliability Measure	No Build	TSM	SOUTHSIDE SURFACE to 185th via South BN	NORTHSIDE SHORT TUNNEL to 185th via South BN	LONG TUNNEL WITH ZOO to 185th via South BN	LONG TUNNEL W/O ZOO to 185th via South BN	NORTHSIDE SHORT TUNNEL to 185th via North BN	NORTHSIDE SHORT TUNNEL to 185th via South Henry	NORTHSIDE SHORT TUNNEL to 185th via North Henry	NORTHSIDE SHORT TUNNEL to Murray via South BN	NORTHSIDE SHORT TUNNEL to Sunset TC
Miles of Reserved or Separated ROW	0.7	0.8	11.8	11.7	11.5	11.4	11.7	11.9	11.9	9.5	5.7
Percent of ROW Reserved or Separated	0.02	0.02	100%	100%	100%	100%	100%	100%	100%	100%	100%
Passenger Miles	4000	5700	204100	202300	193800	85300	202300	205800	205800	146400	89200
Percent of Corridor Passenger Miles	2%	2%	65%	65%	66%	65%	65%	65%	65%	56%	39%
Protected Intersections											
Preempted Signals	0	0	3	3	3	3	3	3	3	3	3
Gated Crossings	0	0	15	16	16	16	15	18	17	11	1
Grade Separations *	0	0	11	11	7	7	11	11	11	11	8
Total Protected	0	0	29	30	26	26	29	32	31	25	12
Total Intersections	large	large	41	41	37	37	40	43	42	36	23
% of Intersections Protected	0%	0%	71%	73%	70%	70%	73%	74%	74%	69%	52%

* These grade separations all require new bridges or underpasses to be constructed as part of the Westside Project.
When a single bridge or underpass crosses multiple streets or ramps it is considered to be one grade separation.
Existing grade separations (i.e. the Vista Bridge) are not counted.

Source: Tri-Met Engineering Services, 1990.

4.1.1.5 Transit Mall Operations

The Portland Transit Mall was constructed to increase downtown service reliability and speeds. Since completion in 1978, the Portland Transit Mall has proven to be a successful means of separating, concentrating, and improving bus operations through the downtown core. However, 2005 systemwide bus fleet volumes for the TSM and LRT Alternatives represent a 70% to 80% increase over current volumes, and will result in P.M. peak hour bus demand on S.W. Fifth and Sixth Avenues that approach or exceed the theoretical capacities of the Mall streets. Achievable bus speeds on the Mall are influenced by the volume of buses on the streets and several other factors, such as traffic signal characteristics, dwell times, and the percentage of longer articulated buses. Boarding of elderly and handicapped passengers is expected to lengthen dwell times in 2005, when the bus fleet is fully accessible to the elderly and handicapped. This will affect the mall's transit capacity. As described in Chapter 2, bus volumes for the LRT and TSM Alternatives assume a major expansion outside the LRT (Eastside and Westside) corridors.

Table 4.1-8 provides a comparison of the estimated Mall bus speeds for the various alternatives. The speeds are slowest for the TSM Alternative because of its larger volume of buses and higher percentage of articulated buses. With the TSM Alternative, the estimated bus volumes approach the theoretical capacity of approximately 180 to 190 buses per hour per Mall street, and the estimated operating speeds decrease by approximately 50% from today's speeds. By reducing Westside bus volumes downtown, the LRT Alternative would improve the Mall bus speeds by approximately 0.4 mph over the TSM Alternative. This speed difference translates to approximately a one minute time savings for all buses on the existing Mall for the LRT Alternative.

Table 4.1-8

TRANSIT MALL BUS OPERATIONS
PM Peak Hour

	Existing (1989)	No Build (2005)	TSM (2005)	LRT (2005)
Fifth Avenue (Southbound)				
Standard Buses	96	116	107	107
Articulated Buses	24	24	84	60
Total Buses	120	140	191	167
Average Speed (mph)	4.4	4.2	3.3	3.7
Travel Time (minutes)				
Burnside to Jefferson	8.1	8.4	10.7	9.6
Sixth Avenue (Northbound)				
Standard Buses	62	82	72	72
Articulated Buses	15	15	76	52
Total Buses	77	97	148	124
Average Speed (mph)	4.7	4.6	3.6	4
Travel Time (minutes)				
Columbia to Burnside	8.2	8.3	10.7	9.6

Note: Burnside is at the north end of the existing Mall.
Columbia and Jefferson are a one-way couplet at the south end of the existing Mall.

Source: Tri-Met, 1990; Metro, 1990.

Bus operations on the Mall with the LRT Alternative would be more reliable than with the TSM Alternative if these large bus volumes are realized. Buses could be moved from the Mall to parallel streets, but these streets also are slow and congested during the peak hours. Diversion of buses to other streets could affect traffic on those streets.

4.1.1.6 Comfort

Passenger comfort involves a number of factors, such as ride quality, spaciousness, absence of unpleasant odors, and likelihood of getting a seat. LRT offers several advantages in terms of passenger comfort, compared with the bus service.
Light Rail Vehicles (LRV's) generally make fewer stops per mile because of longer station spacing (on the order of 0.8 miles for the Westside Corridor), make extensive use of reserved or separate ROW (virtually all of the Westside Corridor), and make extensive use of either traffic signal pre-emption or railroad gates at intersections. LRT tracks on curves are banked (superelevated) to limit lateral accelerations to approximately one-fifth of those typically experienced by a bus passenger. Vertical accelerations are minimized by the absence of potholes, bumps, ruts, and other street problems that buses in mixed traffic must face. Tri-Met's LRT tracks are inspected weekly and promptly repaired, if needed.

All modern LRV's use complex control systems to limit the vehicles' acceleration, brake, and jerk rates to fairly low and comfortable levels. Typically these levels are about one-third of those experienced by a bus passenger. Modern LRV's are typically up to a foot wider than buses, and six to 12 inches taller. LRV's do not burn hydrocarbon fuels and typically do not generate any odors.

During peak hours, the likelihood of obtaining a seat on an LRV is less than that on a bus, because the ratio of seats to total vehicle capacity is lower. For example, in Tri-Met's fleet, seats are 46% of total capacity for an LRV, 58% for an articulated bus, and 69% for a standard bus.

4.1.2 Transit Ridership

This section provides an analysis of transit ridership in the corridor, usage of stations, and ridership considerations for the Zoo Station.

4.1.2.1 Corridor Ridership

Table 4.1-9 shows total Westside Corridor transit ridership (rail and bus) for all trips produced in, or attracted to, the corridor including intra-corridor trips, CBD trips, and Eastside trips. Trips totally contained within downtown Portland are not included in these numbers. The table shows that the LRT Surface and Long Tunnel alignment options to S.W. 185th Avenue would generate corridor ridership of approximately 38,000 riders per average weekday, almost double current ridership. The TSM Alternative would generate approximately 33,400 transit riders, and the No Build Alternative approximately 28,000 daily riders. LRT ridership is, therefore, projected to have approximately 4,600 more average weekday trips than the TSM Alternative, an increase of 14%, and 10,000 more daily trips than the No Build Alternative, an increase of 36%.

There are several key reasons for these differences in ridership. The higher ridership associated with the TSM Alternative, as compared with the No Build, reflects increased transit service with new feeder lines and more frequent service to other locations. The No Build capacity would not meet demand and passengers could be left waiting at stops as full buses pass by. With the LRT Alternative, ridership would increase primarily because of significantly faster travel between the Westside Corridor and most of the CBD. The S.W. Murray Boulevard and Sunset Transit Center terminus options would generate approximately 2,900 and 6,200 fewer transit riders, respectively, than the S.W. 185th Avenue terminus option. The lower ridership of these shorter terminus options results from slower travel, more transfers from bus to LRT, and fewer park-and-ride spaces available.

Table 4.1-9

TOTAL WESTSIDE TRANSIT TRIPS COMPARISON
Average Weekday, Year 2005

	Existing (1988)	No Build	TSM	Surface to 185th	Tunnel to 185th	Surface to Murray	Surface to Sunset TC
Total transit trips	19,400	28,000	33,400	38,000	38,000	35,100	31,800
% change from Existing	0%	+44.3%	+72.2%	+95.9%	+95.9%	+80.9%	+62.4%
% change from No Build	NA	0%	+18.9%	+35.7%	+35.7%	+25.4%	+13.6%

Note: Surface denotes either Southside or Northside alignment option.
Total transit trips include all LRT and Bus, intra-corridor, CBD, and Eastside trips produced in or attracted to the Westside Corridor. Internal CBD trips are not included.
Total transit trips are one-way trips. A commuter traveling from home to work and back again counts as two trips.

Source: Metro, 1990.

The previously described differences in level-of-service, access, travel time, and other factors influence transit ridership to the CBD. Table 4.1-10 shows corridor transit trips and the transit mode share for trips produced in the corridor destined to Portland's CBD for work and non-work purposes. The table shows approximately 19,400 daily transit trips to the CBD with the LRT Surface alignment options to S.W. 185th Avenue, 17,000 trips with the TSM Alternative, and 11,900 trips with the No Build Alternative. The table indicates that the LRT options to S.W. 185th Avenue would result in a 44% transit mode share to the CBD for work trips, as compared with 38% for the TSM Alternative, and 26% for the No Build Alternative. The LRT options to S. W. 185th Avenue also have the highest transit mode share (approximately 27%) for all trips (work and non-work) destined to the CBD. The impact of transit ridership on downtown auto trips and parking demand is discussed in section 4.2.3.2.

Table 4.1-11 shows projected 2005 LRT ridership for each alternative. The table shows the LRT Surface alignment options to S.W. 185th Avenue would serve 27,100 passengers per average weekday, approximately 1,900 more daily trips than the Long Tunnel with Zoo station alignment option. While the Long Tunnel alignment option would reduce travel time between the Beaverton/ Hillsboro area and downtown Portland by approximately 1.5 minutes, daily LRT ridership volumes are forecast to be lower with this option because it does not include a station and park-and-ride lot at Sylvan, and has competing parallel bus service on Sunset Highway. It is reasonable to assume that the addition of a Sylvan station and park-and-ride lot to the Long Tunnel alignment option would result in slightly higher average weekday (AWD) ridership than the Surface alignment options as a result of marginally faster travel times. The Long Tunnel without Zoo station alignment option is estimated to serve 900 fewer AWD riders than the Long Tunnel with Zoo station alignment option.

LRT ridership associated with the S.W. Murray Boulevard and Sunset Transit Center terminus options is projected to be 15.5% and 37.6% less, respectively, than the Surface alignment options to S.W. 185th Avenue. This results primarily from significantly fewer park-and-ride and walk-on opportunities. Ridership forecasts project an unmet parking demand at either the S.W. Murray Boulevard or Sunset Transit Center park-and-ride lots with those terminus options. Additional parking spaces at those locations are not practical because of space restrictions, excessive costs for structured parking, local traffic congestion, wetland impacts, and the potentially interim nature of these termini, particularly the Sunset Transit Center terminus.

4.1.2.2 Station Usage

Tables 4.1-12 and 4.1-13 and Figure 4.1-5 describe characteristics of station access, station use, and trip levels on LRT between stations for the alignment and terminus options. In all options, the greatest number of riders would reach the LRT by bus, ranging from 61% with the Surface options to S.W. 185th Avenue, to 77% with the Sunset Transit Center terminus option. Park-and-ride trips accessing the system would range from 27% with the Surface options to S.W. 185th Avenue, to 15% with the Surface options to Sunset Transit Center. The lower park-and-ride access and higher bus access for the Sunset Transit Center terminus option is a result of significantly fewer available park-and-ride spaces. Walk access accounts for 8% to 12% of all trips under any of the options.

Table 4.1-10

WESTSIDE TRIPS AND TRANSIT MODE SHARE TO/FROM THE CBD
Average Weekday, Year 2005

	Existing (year 1988)	No Build	TSM	Surface to 185th	Tunnel to 185th	Surface to Murray	Surface to Sunset TC
Home-Based-work							
transit	6,400	8,500	11,600	13,300	13,400	11,600	9,300
persons	24,300	30,500	30,500	30,500	30,500	30,500	30,500
modesplit	26.3%	27.9%	38.0%	43.6%	43.9%	38.0%	30.5%
Non-Work							
transit	3,000	3,400	5,400	6,100	6,400	5,700	5,500
persons	34,600	41,500	41,500	41,500	41,500	41,500	41,500
modesplit	8.7%	8.2%	13.0%	14.7%	15.4%	13.7%	13.3%
Total							
transit	9,400	11,900	17,000	19,400	19,800	17,300	14,800
persons	58,900	72,000	72,000	72,000	72,000	72,000	72,000
modesplit	16.0%	16.5%	23.6%	26.9%	27.5%	24.0%	20.6%

Note: Surface denotes either Southside or Northside alignment option.

Source: Metro, 1990.

The most frequently used LRT stations outside the CBD would be the Beaverton Transit Center, S.W. 185th Avenue, and Sunset Transit Center stations with the S.W. 185th Avenue terminus option (see Table 4.1-13). These three stations would account for more than 60% of station activity occurring outside the CBD. The two major park-and-ride lots at the S.W. 185th Avenue terminus and the Sunset Transit Center are projected to attract more than 50% of the corridor's park-and-ride demand.

Figure 4.1-5 shows the number of outbound riders on LRT between each station during the P.M. peak hour. Ridership is greatest near downtown, and gradually decreases as the line extends. The figure shows that the peak load point for LRT is between the station at S.W. 18th Avenue/S.W. Jefferson Street and the Zoo, under any option. The peak load point is approximately 3,375 riders per hour for the Surface alignment options, 3,200 for the Long Tunnel alignment options, 2,950 with the S.W. Murray Boulevard terminus option, and 2,075 with the Sunset Transit Center terminus option.

Table 4.1-11

LRT RIDERSHIP
Year 2005

	Existing (1990)	No Build	TSM	LRT: Southside to 185th	LRT: Northside to 185th	LRT: Tunnel w/ Zoo to 185th	LRT: Tunnel w/o Zoo to 185th	LRT: Northside to Murray	LRT: Northside to Sunset TC
Average Weekday Ridership									
•Westside	0	0	0	27,100	27,100	25,200	24,300	22,900	16,900
•Eastside	21,000	25,100	28,000	28,300	28,300	28,300	27,900	28,100	27,600
Westside PM Peak Hour Ridership									
•Outbound	0	0	0	3,750	3,750	3,550	3,550	3,200	2,200
•Inbound	0	0	0	700	700	650	650	600	500
•Total	0	0	0	4,450	4,450	4,200	4,200	3,800	2,650
PM Peak Hour, Peak Direction, Peak Load Point									
•Westside	0	0	0	3,375	3,375	3,200	3,200	2,950	2,075
•Eastside	2,000	3,700	4,200	4,300	4,300	4,300	4,300	4,275	4,200

Source: Metro, 1990.

FIGURE 4.1-5

WESTSIDE LRT RIDERSHIP
PM PEAK HOUR DIRECTION

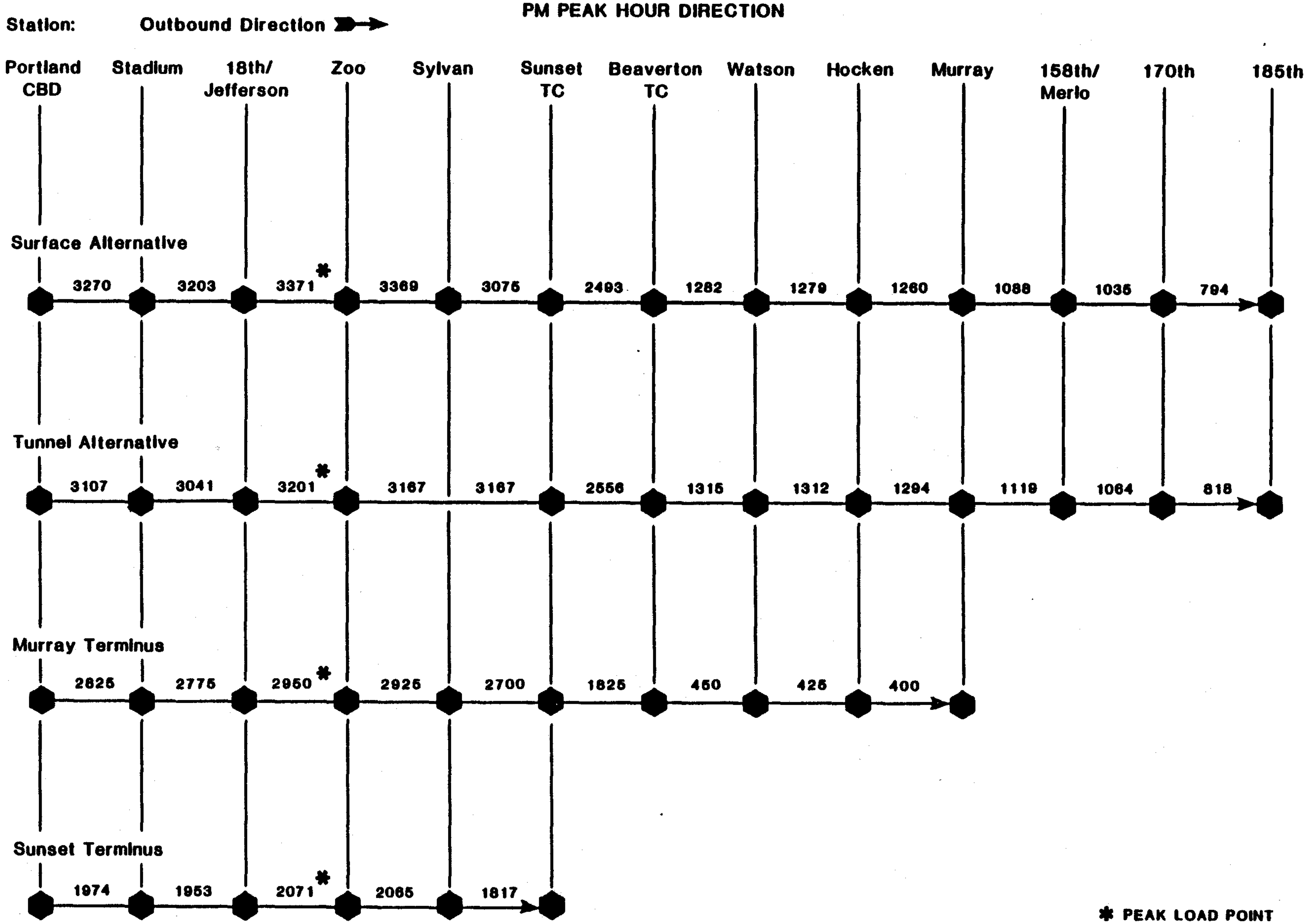


Table 4.1-12

WESTSIDE LRT MODE OF ACCESS SUMMARY
Average Weekday, Year 2005

	Surface to 185th	Tunnel w/Zoo Station to 185th	Surface to Murray	Surface to Sunset TC
Walk	12%	11%	11%	8%
Bus-Transfer	61%	62%	67%	77%
Park and Ride	27%	27%	22%	15%

Note: Surface denotes either Southside or Northside alignment option.

Source: Metro, 1990.

Table 4.1-13

LRT STATION USAGE (On's and Off's)
Average Weekday, Year 2005

Station	Surface to 185th	%	Tunnel w/Zoo Station to 185th	%	Surface to Murray	%	Surface to Sunset TC	%
CBD	17,850	33%	16,350	33%	15,500	34%	11,550	34%
Stadium	2,400	4%	2,200	4%	2,300	5%	1,900	6%
18th and Jefferson	3,100	6%	3,300	7%	3,000	7%	2,500	7%
Zoo	900	2%	900	2%	800	2%	600	2%
Sylvan	2,500	5%	0	0%	2,200	5%	2,300	7%
Sunset Transit Center	5,100	9%	5,300	11%	6,500	14%	13,000	38%
Beaverton Transit Center	8,700	16%	8,700	17%	9,800	21%		
Watson	300	1%	300	1%	200	0%		
Hocken	500	1%	500	1%	500	1%		
Murray	1,700	3%	1,700	3%	2,700	6%		
158th (Merlo)	500	1%	500	1%				
170th	1,800	3%	1,800	4%				
185th	6,400	12%	6,400	13%				
TOTAL	51,750	95%	47,950	95%	43,500	95%	31,850	94%
Non-corridor	2,450	5%	2,300	5%	2,200	5%	1,950	6%
Total Westside Ons and Offs	54,200	100%	50,250	100%	45,700	100%	33,800	100%
Total Westside Ridership	27,100		25,150		22,850		16,900	

Note: Total Ridership, i.e. number of trips, is half of total On's and Off's. Numbers are rounded.
Surface denotes either Southside or Northside alignment option.

Source: Metro, 1990.

4.1.2.3 Zoo Ridership

Table 4.1-14 delineates ridership to the Washington Park Zoo area by weekly and seasonal fluctuation. This information reflects the unique characteristics of attendance to the attractions in this area. Attendance at the Zoo/OMSI/World Forestry Center site is higher on an average weekend than on an average weekday, and is also significantly higher on summer and special-event weekends than during winter weekends. Therefore, to calculate annual attendance to this complex, it was necessary to estimate ridership under each of these scenarios.

Table 4.1-14

ANNUAL ZOO RIDERSHIP
Year 2005

to TC	TSM*	Surface to 185th	Long Tunnel w/Zoo Station to 185th	Long Tunnel w/o Zoo Station to 185th *	Surface to Murray	Surface Sunset
Average Weekday Ridership	450	900	900	350	800	600
Number of days	255	255	255	255	255	255
Annual Subtotal	114,750	229,500	229,500	89,250	204,000	153,000
Average Non-Peak Weekend Ridership	570	1,140	1,140	450	1,000	800
Number of Days	55	55	55	55	55	55
Annual Subtotal	31,350	62,700	62,700	24,750	55,000	44,000
Average Peak Weekend Ridership	890	1,780	1,780	700	1,600	1,200
Number of Days	55	55	55	55	55	55
Annual Subtotal	48,950	97,900	97,900	38,500	88,000	66,000
Total Annual Ridership by LRT	0	390,100	390,100	0	347,000	263,000
Total Annual Ridership by Bus	195,050	0	0	152,500	0	0

*Bus service only.

Note: Surface denotes either Southside or Northside alignment option.

Source: Metro, 1990.

For purposes of this analysis, it was assumed that LRT options with a Zoo Station would attract approximately 10% of all trips destined to the Zoo area. The existing mode share is about 3%. This 10% assumption was made after examining: 1) rail transit ridership to zoos and other special attractions across North America, and; 2) parking and attendance characteristics of the Washington Park Zoo. This examination found transit mode shares range from less than 1% (Miami) to more than 40% (Washington D.C.). The city most analogous to Portland is Calgary, Alberta, which has a light rail station at its Zoo and an 18% LRT mode share on summer weekdays. This analysis shows that with the 10% mode share, the LRT alignment options with Zoo station that extend to S.W. 185th Avenue would serve approximately 390,100 trips annually. (An 18% mode share would serve approximately 700,000 trips annually.) Comparative LRT ridership to the Zoo area would be approximately 347,000 with the S.W. Murray Boulevard terminus option, and 263,000 with the Sunset Transit Center terminus option. These lower numbers result because fewer people have access to LRT with these options. The Long Tunnel without Zoo station alignment option obviously would have no Zoo ridership on LRT. It is assumed that buses would carry approximately 4% of Zoo area attendees with this option. The TSM Alternative would carry more riders annually to the Zoo than the Long Tunnel without a Zoo Station alignment option, because of a higher level of bus service on Sunset Highway.

4.1.2.4 Other Non-CBD Ridership

Previous sections have discussed ridership destined to the CBD or the Zoo area. This section briefly discusses ridership destined to other locations in the corridor. On an average day, approximately 12,600 transit trips would be attracted to Westside Corridor locations west of the Zoo under either the Surface or Long Tunnel options. This number includes the return trips from the origins either inside or outside the corridor. With the S.W. Murray Boulevard terminus option, approximately 12,100 trips would be attracted to the corridor, and with either the Sunset Transit Center terminus option or the TSM Alternative, approximately 11,800 trips would be attracted to the corridor. Of these trips, the major destinations are Central Beaverton and a high-growth area commonly referred to as the Sunset Corridor. In brief, approximately 4,650 trips would be attracted to the Sunset Corridor with the longer LRT options, and approximately 4,310 with the TSM Alternative. Approximately 3,670 trips would be attracted to Central Beaverton with the longer LRT options, and 3,180 trips with the TSM Alternative.

4.2 HIGHWAY AND STREET IMPACTS

The Westside Corridor Project would have varying effects on the highway and street system within the corridor. System wide impacts within the corridor are addressed in this section, so overall differences in highway and street travel between alternatives can be discerned. Specific changes in level-of-service on key highway segments and at key intersections are addressed on a section-by-section basis, starting in downtown Portland and proceeding west to S.W. 185th Avenue. The effects of transit stations on adjacent roads, the impact of the "build" alternatives on parking supplies, and mitigation measures for local traffic impacts comprise the remainder of this section.

4.2.1 Congestion

In this section, congestion is analyzed first for the entire corridor, then on a segment-by-segment basis to highlight local concerns.

Traffic volumes from the 2005 EMME/2 Regional Travel Model were used as the basis for local traffic analysis for the Westside Corridor. The same land use assumptions were used to project travel volumes for the No Build, TSM, and LRT Alternatives. In addition, the same street and highway network was assumed for both the TSM and LRT Alternatives.

Traffic has been growing in the Portland metropolitan area at a rate of approximately 2.5% annually. As the population and employment base continue to grow, so will traffic on the street and highway system. One of the objectives of transit system expansion is to help reduce this growth in auto travel, which will help relieve congestion and improve environmental quality.

Table 4.2-1 shows the forecast growth in travel for the Portland region by 2005. Auto, truck, and motorcycle vehicle miles of travel (VMT) were estimated at approximately 18.8 million miles per day in 1987. Under the No Build Alternative, traffic growth is forecast to increase approximately 35%, to 25.5 million miles daily. With the TSM Alternative, the growth in traffic would be reduced by approximately

Table 4.2-1

VEHICLE MILES TRAVELED
Regionwide, Average Daily, Year 2005

	Existing (1987)	No Build	TSM	LRT: Southside to 185th	LRT: Northside to 185th	LRT: Tunnel w/ Zoo to 185th	LRT: Tunnel w/o Zoo to 185th	LRT: Northside to Murray	LRT: Northside to Sunset TC
Autos, Trucks and Motorcycles	18,807,000	25,491,000	25,345,000	25,297,000	25,297,000	25,308,000	25,308,000	25,324,000	25,342,000
Buses, Systemwide	71,000	81,000	117,000	111,000	111,000	111,000	111,000	112,000	113,000
Total Highway-related	18,878,000	25,572,000	25,462,000	25,408,000	25,408,000	25,419,000	25,419,000	25,436,000	25,455,000
Total LRT	3,894	6,050	6,750	11,880	11,880	11,730	11,580	11,180	8,780

Source: Metro, 1990.

146,000 miles per day (0.6% on a regional basis or roughly 3% on a corridor basis) as compared with the No Build Alternative. Construction of the LRT Surface alignment options to S.W. 185th Avenue would reduce regional travel by an additional 47,000 miles per day (0.2% on a regional basis or roughly 1% on a corridor basis). The table shows that the Long Tunnel alignment options would increase regional VMT slightly, compared with the Surface options, and the short terminus options would increase regional VMT even further. The Sunset Transit Center terminus option would have approximately the same impact on VMT as the TSM Alternative. Miles of bus and LRT travel are shown on Table 4.2-1 for the entire system. Total highway-related vehicle miles of travel are lowest for the Surface options to S.W. 185th Avenue.

Table 4.2-2 shows three measures of highway system performance during the P.M. peak hour for the highway system in the Westside Corridor. Vehicle hours of travel (VHT) is the total number of hours of vehicular travel on the freeway and arterial system. The table shows that VHT on the freeway system with the TSM Alternative would be increased by approximately 200 hours compared with the No Build Alternative; VHT with the LRT Alternative would be reduced by approximately 200 hours as compared with the TSM Alternative, to about the same level as the No Build Alternative. The LRT and No Build Alternatives are similar because freeway improvements that are part of the LRT Alternative would add vehicle capacity, allow more through trips to occur with less freeway congestion, and reduce travel on the arterial system. Vehicular hours of travel on the arterial system would be reduced by approximately 300 hours during the peak hour with TSM Alternative, compared with the No Build Alternative, and by approximately 400 hours during the peak hour with the LRT Alternative, as compared with the No Build Alternative.

Table 4.2-2

COMPARATIVE MEASURES OF FREEWAY AND ARTERIAL SYSTEM
Year 2005
P.M. Peak Hour

	Existing (1988)	No Build	TSM	LRT to 185th
Vehicle Hours of Travel				
Freeways	6,400	7,300	7,500	7,300
Arterials	13,600	18,100	17,800	17,700
Totals	20,000	25,400	25,300	25,000
Vehicle Hours of Delay				
Freeways	1,500	2,300	1,800	1,700
Arterials	1,200	2,000	1,500	1,500
Totals	2,700	4,300	3,300	3,200
Miles with V/C Ratio >0.9				
Freeways	11.5	18.0	11.0	11.0
Arterials	45.2	75.9	57.3	54.3
Totals	56.7	93.9	68.3	65.3

Source: Metro, 1990.

Each alternative's effect on the street and highway system is demonstrated more clearly by examining vehicle hours of delay, a measure of travel time beyond optimal travel conditions. Vehicle hours of delay on the freeway system would be reduced by more than 25% (600 hours) with the LRT Alternative, and about 22% with the TSM Alternative, as compared with the No Build Alternative. This is a direct result of the highway and transit improvements. Similarly, vehicle hours of delay on the arterial system would be reduced by approximately 25% with either the TSM or LRT Alternatives.

The last measure shown on Table 4.2-2 shows miles on the freeway and arterial system that experience traffic volumes approaching the roadway's capacity during the P.M. peak hour. Both the TSM and LRT Alternatives would reduce projected congested miles on the freeway system by approximately 39%, as compared with the No Build Alternative. The number of congested miles with these alternatives is similar to what is experienced today. On the arterial system, the LRT Alternative would reduce congested miles of roadway by more than 28%, as compared with the No Build Alternative. This is a slightly greater reduction than would be experienced with the TSM Alternative.
The following sections discuss the effect of each alternative at specific locations in the Westside Corridor. The measure used to describe congestion is level-of-service. Definitions of level-of-service for uninterrupted flow facilities, such as freeways, and interrupted flow facilities, such as streets with traffic signals, are contained in Chapter 3.

4.2.1.1 Downtown Portland/Goose Hollow

In downtown Portland, the No Build Alternative includes extending the Transit Mall north to N.W. Irving Street, which would remove through auto lanes and parking on N.W. Fifth and Sixth Avenues. However, overall effects to the local street system in downtown Portland would be insignificant. A more complete discussion of these impacts can be found in the Environmental Assessment for the Portland Transit Mall Extension Project (Tri-Met, 1989).

The TSM Alternative also extends the Transit Mall south to S.W. Columbia Street, similarly removing through auto lanes and parking, and further extends an exclusive, peak-hour bus lane in the right lane of S.W. Fifth and S.W. Sixth Avenues to S.W. Harrison and S.W. Hall, respectively. By removing on-street parking only during peak traffic hours, the removal of one travel lane for use by buses would not significantly affect general traffic operations on these streets.

The extension of LRT along S.W. Morrison and S.W. Yamhill Streets to S.W. 18th Avenue would remove parking and one auto lane on each street, but would not significantly affect downtown traffic operations.

Table 4.2-3 provides level-of-service estimates for several intersections in the Goose Hollow area for the various alternatives. In the No Build Alternative, travel forecasts indicate that P.M. peak hour traffic would increase from present levels, in the northbound direction on S.W. 18th Avenue and in the westbound direction on West Burnside Street, because of existing capacity constraints on Sunset Highway. This change in travel pattern partially explains the slight decrease in automobile levels-of-service projected at three of six intersections along S.W. 18th Avenue.

The highway improvements associated with the TSM and LRT Alternatives would make Sunset Highway more attractive. As a result, traffic volumes through Goose Hollow on S.W. Jefferson and S.W. Columbia Streets would increase, in comparison with existing conditions or the No Build Alternative. With the TSM Alternative, adequate capacity at key intersections would accommodate this traffic at a good level-of-service (Table 4.2-3).

With the LRT Alternative, the number of through auto lanes on S.W. 18th Avenue would be reduced from four to two. In addition, left turns to and from S.W. 18th Avenue would be prohibited at Main, Madison and Taylor Streets, in order to improve transit and traffic flow along S.W. 18th Avenue. Because of the limited right-of-way width on S.W. Jefferson Street and the desire to accommodate bicycle lanes and an LRT station, the number of through lanes would be reduced from four to two. Left turns to and from S.W. Jefferson Street would be prohibited at S.W. 20th and S.W. 21st Avenues to facilitate transit and traffic flow along S.W. Jefferson Street.

For the LRT Alternative, level-of-service would decrease at two intersections and improve at one, as compared with the No Build Alternative. The most significant local traffic impact would occur at the intersection of S.W. 18th Avenue and S.W. Jefferson Street. A significant portion of the traffic passing through this intersection would be destined for Sunset Highway via the S.W. Jefferson Street entrance ramp. Increased traffic volumes, combined with reduced auto lanes, would result in P.M. peak hour traffic demands that would exceed the capacity of this intersection.

Mitigation measures are being considered for this location. One possible solution to the projected capacity problem would be to restore the four lanes through the intersection, which would require additional ROW and displacement. Another possible solution would be a traffic management strategy that would encourage freeway-bound traffic to enter S.W. Clay Street instead of S.W. Jefferson Street. A third possible solution would be a minor shift of the LRT alignment, so it would cross diagonally through the block on the northwest quadrant of the intersection instead of through the intersection. This solution would have ROW and displacement impacts. Tri-Met is committed to further study of these considerations in order to arrive at acceptable mitigation of impacts at this intersection.

Table 4.2-3

INTERSECTION LEVEL-OF-SERVICE ANALYSIS
GOOSE HOLLOW
P.M. Peak Hour

Intersection	Existing Condition (1987)	No Build	TSM	LRT
S.W. 18th Avenue and S.W. Morrison Street	A	B	B	B
S.W. 18th Avenue and S.W. Yamhill Street	D (1)	E (1)	A (2)	B (2)
S.W. 18th Avenue and S.W. Salmon Street	B	B	B	D
S.W. 18th Avenue and S.W. Jefferson Street	A	C	B	F
S.W. 18th and S.W. Columbia Street (West)	A	A	A	A
S.W. 18th and S.W. Columbia Street (East)	A	A	B	A

1 - Unsignalized Intersection
2 - Signalized Intersection

Source: HNTB, 1990.

The Northside and Long Tunnel alignment options raise traffic and safety concerns associated with the LRT grade crossing of the westbound lane at the western end of S.W. Jefferson Street in Goose Hollow. These concerns could be alleviated by a grade separation of this crossing, and Tri-Met is committed to studying grade separation as a mitigation measure.

4.2.1.2 Sunset Highway Corridor

Various traffic characteristics for outbound Sunset Highway in the P.M. peak hour are presented in Table 4.2-4. In this table, Sunset Highway is divided into five geographic segments that reflect different conditions and types of improvements from the Vista Tunnel to the intersection with Highway 217. The highway improvements are reflected in Table 4.2-4 as increases in capacity where appropriate. As discussed in Chapter 2, the improvements to Sunset Highway are the same for the TSM and LRT Alternatives.

The forecasted demand, volume-to-capacity (V/C) ratio, and level-of-service (LOS) for the freeway are provided in Table 4.2-4. For this analysis, demand volumes are in Passenger Car Equivalents, and have been adjusted to account for trucks, grades, and peaking conditions, while capacities are unadjusted theoretical capacities assumed to be 2,000 cars per hour per freeway lane. With different capacity assumptions, e.g. 2,200 cars per hour per lane to account for higher speeds and shorter following distances between individual vehicles, the V/C results in Table 4.2-4 would be slightly different, but differences in the resulting level-of-service, as measured by density, are not considered significant.

Under existing (1987) P.M. peak hour conditions, Sunset Highway operates at level-of-service (LOS) E from the Vista Tunnels to the Zoo. From the Zoo to Sylvan, where the westbound climbing lane stops, and west of Sylvan, where the freeway narrows to two lanes in each direction, the highway operates at LOS F, representing congested, stop-and-go traffic.

Table 4.2-4

SUNSET HIGHWAY TRAFFIC CHARACTERISTICS
P.M. Peak Hour Outbound, Year 2005

Section of Sunset Highway	Characteristic	Existing (1987)	No Build	TSM		LRT	
Vista Tunnels	Capacity	6,000	6,000		6,000		6,000
	Demand	6,000	6,800		6,300		6,300
	V/C	1.00	1.13		1.05		1.05
	L.O.S.	E/F	F		F		F
Jefferson on Ramp to Zoo	Capacity	8,000	8,000		8,000		8,000
	Demand	6,900	7,800		8,300		8,300
	V/C	0.86	0.98		1.04		1.04
	L.O.S.	E	E		F		F
Zoo to Sylvan	Capacity	6,000	6,000		9,000		9,000
	Demand	6,400	7,300		8,500		8,500
	V/C	1.06	1.22		0.95		0.95
	L.O.S.	F	F		E		E
Sylvan to Canyon	Capacity	6,000	6,000	6,000	[<4,000]	6,000	[<4,000]
	Demand	>6,000	>6,000	5,200	[2,800]	5,200	[2,800]
Freeway [C-D Lanes]	V/C	>1.0	>1.0	0.87	[N/A]	0.87	[N/A]
Lanes	L.O.S.	F	F	E	[E]	E	[E]
Canyon to 217	Capacity	4,000	4,000		6,000		6,000
	Demand	4,300	4,400		6,000		6,000
	V/C	1.09	1.11		1.00		1.00
	L.O.S.	F	F		E		E

Note: Demand volumes are in Passenger Car Equivalents and are adjusted for trucks, grade and peaking. Capacities are based on 2,000 cars per hour per lane unadjusted except for auxiliary lane.

Abbreviations: ">" means greater than; "< means less than; "L.O.S" means Level of Service; "V/C" means Ratio of Volume to Capacity.

Source: HNTB, 1990.

The No Build Alternative would not include any highway or interchange improvements on Sunset Highway. Traffic congestion on all segments is expected to worsen, with the roadway operating at a LOS F in all locations except just east of the Zoo, where traffic demands would approach capacity. Increased P.M. peak hour traffic demands and V/C ratios would force drivers to seek alternative routes and spread or lengthen peak period congestion.

Traffic projections indicate that Sunset Highway traffic operations would be similar for the TSM and LRT Alternatives, which include the same highway improvements. Highway capacity improvements west of the Zoo would make the freeway more attractive, and demand between the S.W. Jefferson Street on-ramp and the Zoo would increase, compared with the No Build Alternative, resulting in a somewhat worse level of service. Between the Zoo and Sylvan Interchange, freeway congestion would improve slightly to LOS E, as a result of extending the climbing lane and adding an auxiliary lane. Under both alternatives, conditions on the freeway segments west of Sylvan would be somewhat improved, as compared with the No Build Alternative, and existing conditions, as a result of the widening of the freeway and addition of the C-D system.

In summary, during the P.M. peak hour, the greatest existing freeway congestion occurs west of the Zoo and particularly west of Sylvan. All conditions would degrade with the No Build Alternative. For the TSM and LRT Alternatives, the LOS would be virtually identical, and somewhat better than the No Build Alternative. The congestion points would move east of the Zoo, with some improvement to freeway operation west of Sylvan. Experience in this corridor shows that the actual carrying capacity of Sunset Highway is slightly higher than the theoretical value based on 2,000 cars per lane per hour at operating speeds of about 40 mph. Using this actual speed-volume relationship, along with freeway management practices now being implemented in the Portland area, the planned highway and transit improvements are expected to result in a relatively smooth flow during the P.M. peak hour.

Table 4.2-5 provides estimates of traffic demand on streets parallel to Sunset Highway for the P.M. peak hour, outbound direction at a location just east of S.W. Scholls Ferry Road, near Sylvan. For the No Build Alternative, traffic demand would increase on all parallel streets by approximately 50%. For the TSM and LRT Alternatives, estimated traffic demand on these streets would be reduced by approximately 23% and 27%, respectively, compared with the No Build Alternative. Thus, the LRT Alternative would reduce traffic demand on these streets slightly more than the TSM Alternative.

Table 4.2-5

TRAFFIC DEMAND ON PARALLEL STREETS
Cutline east of Scholls Ferry/Skyline
P.M. Peak Hour Outbound, Year 2005

Parallel Street	Existing (1987)	No Build	TSM	LRT
Cornell Road	500	1,000	800	800
West Burnside	1,600	2,000	1,600	1,500
Patton	200	400	200	200
BH Highway	1,000	1,400	1,100	1,000
Total Parallel Streets	3,300	4,800	3,700	3,500

Source: HNTB, 1990.

Table 4.2-6 summarizes the previous two tables and provides an estimate of overall corridor traffic demand for the P.M. peak hour in the outbound direction. This table shows that, in general, the major streets and freeway system in the corridor are near capacity today, would significantly exceed capacity with the No Build Alternative, and would accommodate 2005 demand levels, but approach capacity of the corridor with the TSM or LRT improvements. With either the TSM or LRT Alternative, an additional 1,000 to 1,200 vehicles would be attracted to Sunset Highway, thereby reducing infiltration on parallel streets.

Table 4.2-6

TRAFFIC DEMAND IN SUNSET CORRIDOR
Cutline east of Scholls Ferry/Skyline
PM. Peak Hour Outbound, Year 2005

	Existing (1987)	No Build	TSM	LRT
Parallel Streets	3,300	4,800	3,700	3,500
Sunset Highway	6,400	7,300	8,500	8,500
Total Demand	9,700	12,100	12,200	12,000
Total Link Capacity	10,900	10,900	12,900	12,900
Overall Corridor Demand as a % of Overall Corridor Capacity	89%	111%	95%	93%

Source: HNTB, 1990.

In addition to analysis of traffic on freeway and arterial links, traffic characteristics at key intersections throughout the corridor have been analyzed. Table 4.2-7 provides the results of this LOS analysis for intersections along Sunset Highway. This table also provides a comparison of the intersection impacts of the Northside and Southside LRT alignment options in the Sunset segment. P.M. peak hour conditions at the Zoo interchange would be well below capacity in all cases. Table 4.2-7 also shows the differences between the Northside and Southside alignment options at the Zoo would be relatively minor.

At Sylvan, the LOS for the intersections with freeway exit and entrance ramps would degrade for the No Build Alternative and would improve for the TSM and LRT Alternatives, reflecting interchange improvements. The closure of S.W. Canyon Court at S.W. Skyline Boulevard would divert traffic to the unsignalized intersection of S.W. Montgomery Drive and S.W. Skyline Boulevard. The intersections of S.W. Westgate and S.W. Montgomery Drives at S.W. Skyline Boulevard would operate at LOS F with the TSM and LRT Alternatives. Signals at these intersections would mitigate the LOS impacts and partially mitigate the impacts of the proposed S.W. Canyon Court closure. Tri-Met and ODOT would study these intersections further as the project progresses.

The intersection of S.W. Barnes Road and Highway 217 near the Sunset Highway/Highway 217 Interchange would experience increased traffic demand as adjacent land is developed. Proposed intersection improvements are planned with the extension of S.W. Barnes Road. However, traffic demands projected with any of the alternatives would approach the capacity of the proposed intersections.

For either the TSM or LRT Alternative, the ramp meters currently being installed at entrance ramps from Highway 217 and S.W. Park Way to eastbound Sunset Highway could be modified to operate during the P.M. peak hour, reducing merging problems at this location on Sunset Highway. On Highway 217, the proposed southbound interchange configuration at the Sunset Highway Interchange would operate at LOS F during P.M. peak hour conditions. The proposed lane configuration, which would consist of entrance ramps merging onto the mainline pavement, could be modified by restriping to add a through lane at each entrance ramp. This modification to the proposed design would not require any significant increases in pavement area, and would equalize lane volumes.

Table 4.2-7

INTERSECTION LEVEL-OF-SERVICE
SUNSET HIGHWAY CORRIDOR
P.M. Peak Hour

Intersection	Existing Conditions (1987)	No Build	TSM	LRT Southside	LRT Northside
WB Exit Ramp and Zoo Entrance Road	A	B	B	A	A
S.W. Canyon Court and Zoo Entrance Rd.	A	A	B	B	C
EB Exit Ramp and Zoo Entrance Rd.	A	A	B	A	A
S.W. Canyon Court and WB Entrance Ramp	--	--	A	C	--
Zoo Entrance Rd. and WB Entrance Ramp	--	--	--	--	B
Sylvan Interchange					
S.W. Scholls Ferry and EB Exit Ramps	E*	F	A	B	B
S.W. Skyline Blvd. and EB Entrance Ramps	E	F**	B	B	B
S.W. Skyline Blvd. and S.W. Canyon Ct.	C*	F	--	--	--
S.W. Skyline Blvd. and Westgate Dr.	E	F	F	F	F
S.W. Skyline Blvd. and Montgomery Dr.	*	D	F	F	F
Highway 217 Interchange					
S.W. Barnes Rd. and Highway 217	F	E	D/E	D/E	D/E

* Not Analyzed.
** Actual LOS controlled by S.W. Skyline Boulevard and Westbound Ramps Intersection.

Source: HNTB, 1990.

4.2.1.3 Highway 217

Table 4.2-8 provides estimated P.M. peak hour outbound (southbound) traffic characteristics on Highway 217 from the Sunset Highway Interchange (south of S.W. Park Way) through the S.W. Walker Road Interchange to S.W. Canyon Road. Currently the road operates at LOS E, and traffic operations are projected to worsen with the No Build Alternative. Significant improvements to peak hour operation of the facility would result with the TSM or LRT Alternative. Highway 217 is projected to operate at LOS C north of S.W. Walker Road and LOS D south of S.W. Walker Road with either of these alternatives. These improvements result from widening Highway 217 and adding transit service.

Table 4.2-8

HIGHWAY 217 TRAFFIC CHARACTERISTICS
P.M. Peak Hour Outbound, Year 2005

Section of Sunset Highway	Characteristic	Existing (1987)	No Build	TSM	LRT
Sunset to Walker	Capacity	4,000	4,000	7,200	7,200
	Demand	3,800	5,100	4,900	5,000
	V/C	0.95	1.27	0.68	0.69
	LOS	E	F	C/D	C/D
Walker to Canyon (Freeway only)	Capacity	4,000	4,000	6,000	6,000
	Demand	3,900	5,200	5,000	5,100
	V/C	0.98	1.3	0.83	0.85
	LOS	E	F	D	D

Note: Demand volumes are in Passenger Car Equivalents and are adjusted for trucks, grade and peaking. Capacities are based on 2,000 cars per hour per freeway lane unadjusted except for auxiliary lane.

Abbreviations: "LOS" means Level of Service;
"V/C" means Ratio of Volume to Capacity.

Source: HNTB, 1990.

Table 4.2-9 provides the results of an LOS analysis for key intersections in the Highway 217 corridor. The projected increase in P.M. peak hour traffic demands would push several key intersections in the corridor toward capacity under all alternatives. Intersection operations that would result from the TSM or LRT Alternatives would generally be improved in comparison with the No Build Alternative.

Table 4.2-9

INTERSECTION LEVEL-OF-SERVICE ANALYSIS
HIGHWAY 217 CORRIDOR
P.M. Peak Hour

Intersection	Existing (1987)	No Build	TSM	LRT
S.W. Walker Road and Northbound Ramp	D	F	E	E
S.W. Walker Road and Southbound Ramp	C	D	C	C
S.W. Canyon Road and Northbound Ramp	D	D	C	C
S.W. Canyon Road and Southbound Ramp	D	E	E	E
B.H. Highway and Northbound Ramp	D	D	E	E
B.H. Highway and Southbound Ramp	F	F	F	F

Source: HNTB, 1990.

In addition to these freeway and intersection impacts, removal of the S.W. Cabot Street overpass on Highway 217 would affect neighborhood circulation. No mitigation is proposed at this location because the proposed East-West arterial would restore this link.

4.2.1.4 East and Central Beaverton

Table 4.2-10 summarizes the peak hour LOS analysis for key intersections in the S.W. Canyon Road/T.V. Highway Corridor in East and Central Beaverton, a section extending from Highway 217 to S.W. Watson Avenue.

Table 4.2-10

INTERSECTION LEVEL-OF-SERVICE ANALYSIS
EAST AND CENTRAL BEAVERTON
P.M. Peak Hour

Intersection	Existing (1987)	No Build	TSM	LRT North Option	LRT South Option
Along S.W. Canyon Road/T.V. Highway					
S.W. 114th Avenue	D	F	*	F	F
S.W. 117th Avenue	D	E	*	D	D
S.W. Lombard Avenue	B	D	D	C	C
S.W. Hall Boulevard	C	E	*	D	D
S.W. Watson Avenue	D	E	*	D	D

* Not analyzed.

Source: HNTB, 1990.

Under the No Build Alternative, most of the intersections would experience traffic demands near or slightly below their capacities, resulting in LOS D to F. This represents an increase in traffic demand and a worsening of traffic operations compared with existing conditions.

The TSM Alternative does not include any significant street improvements in East or Central Beaverton; however, transit-priority measures would be implemented at a limited number of locations. Traffic projections indicate the TSM and LRT Alternatives would result in similar traffic volumes within this portion of the project area. The intersection of S.W. Canyon Road and S.W. Lombard Avenue, the primary access point to the Beaverton Transit Center, would operate at a diminished level-of-service with the TSM Alternative as compared with the LRT Alternative, because of the impact of bus priority and bus volumes.

Two LRT alignment options are under consideration in East and Central Beaverton, the North and South options (see Chapter 2). With either option, traffic demands at these same intersections would be somewhat lower than the No Build Alternative. Both LRT alignment options would have similar effects on local traffic circulation in East Beaverton. Under both LRT alignment options, S.W. 114th Avenue would be closed at its intersection with the LRT alignment, and access to S.W. 114th Avenue would be limited to the existing, unsignalized intersection at S.W. Canyon Road, which is forecast to operate at LOS F. The South alignment option also would close S.W. Beaverdam Road, which would restrict circulation east of S.W. Hall Boulevard and increase traffic entering S.W. Canyon Road at the unsignalized East Street intersection. Closure of S.W. 114th Avenue at the LRT crossing would require mitigation measures, such as restricting access to right-in or right-out at S.W. Canyon Road, or constructing a link between S.W. 114th and S.W. 117th Avenues. Further study of potential mitigation measures at this crossing is recommended.

Within Central Beaverton, the LRT grade crossings at S.W. Hall Boulevard and S.W. Watson Avenue would be more likely to affect surface street circulation with the South than with the North alignment option, because the South alignment option would provide less vehicle storage space between LRT grade crossings and S.W. Canyon Road. The LRT grade crossing at S.W. Hall Boulevard may cause traffic backups across S.W. Canyon Road. At S.W. Watson Avenue, traffic could back up onto the LRT crossing. A potential mitigation measure would be to interconnect the S.W. Canyon Road traffic signal system with the LRT grade crossing protection system to provide clearance intervals for traffic on S.W. Hall Boulevard and S.W. Watson Avenue. A northward realignment of the South alignment option in the vicinity of S.W. Hall and S.W. Watson also would alleviate this problem. Local circulation and access between S.W. Hall Boulevard and S.W. Lombard Avenue could be improved by connecting S.W. East Street to S.W. Lombard Avenue on the south side of the LRT. This connection also would relieve the unsignalized intersection of S.W. East Street and S.W. Canyon Road. Further study of these mitigation measures is recommended.

The LRT alignment would accommodate the location of the proposed East-West Arterial, which is not part of this project. In general, neither the South nor North alignment options in East Beaverton would have a significant impact on traffic operations on the proposed arterial.

4.2.1.5 West Central Beaverton

Table 4.2-11 provides the results of intersection LOS analyses for key intersections in West Central Beaverton, a section of the corridor extending from S.W. Watson Avenue to S.W. Murray Boulevard.

Table 4.2-11

INTERSECTION LEVEL-OF-SERVICE ANALYSIS
WEST CENTRAL BEAVERTON
P.M. Peak Hour

Intersection	Existing (1987)	No Build	TSM	LRT BN Option	LRT Henry Option
Along S.W. Canyon Road/T.V. Highway					
S.W. Cedar Hills Boulevard	D	D	D	D	D
S.W. Hocken Avenue	D	E	E	E	F
T.V. Highway and S.W. Lombard Avenue	C	**	**	**	**
S.W. Farmington Road and S.W. Lombard Avenue	C	*	D	*	*
S.W. Cedar Hills Boulevard and S.W. Henry Street	B	C	*	*	B
S.W. Hocken Avenue and S.W. Henry Street	D	F	*	F	E
S.W. 141st Avenue and S.W. Whitney Street	A	A	*	*	A
S.W. Murray Boulevard and S.W. Millikan Way	C	D	*	D	D

* Not analyzed.
**T.V. Highway and Lombard Avenue will be rebuilt by 2005. Traffic would use S.W. Farmington Road and S.W. Lombard Avenue.

Source: HNTB, 1990.

Under all of the alternatives, traffic demands would increase on S.W. Canyon Road/T.V. Highway to the point where the intersection of T.V. Highway and S.W. Hocken would approach its capacity. With the No Build Alternative, traffic demands on S.W. Hocken Avenue would increase to the point where traffic turning out of S.W. Henry Street would operate at LOS F.

The TSM Alternative would provide bus-priority measures at three intersections within West Central Beaverton; P.M. peak hour traffic operations at these intersections would not differ significantly from the No Build or LRT Alternatives.

Two LRT alignment options are under consideration in West Central Beaverton, the BN and the Henry Street options. Of the two, the Henry Street alignment option would have the greater impact on traffic operations on S.W. Canyon Road and T.V. Highway. With the proposed one-way westbound operation of S.W. Henry Street, eastbound traffic from S.W. Henry Street would be detoured onto T.V. Highway, resulting in LOS F P.M. peak hour conditions at the S.W. Hocken Avenue/T.V. Highway intersection (see Table 4.2-11).

Mitigation could consist of operating S.W. Henry Street one-way eastbound instead of one-way westbound. Increased westbound traffic flows on T.V. Highway, which would occur with this mitigation, could be better accommodated if curb returns at the intersections of T.V. Highway/S.W. Hocken Avenue and S.W. Canyon Road/S.W. Cedar Hills Boulevard were increased in radius, and right-turn lanes were provided.

A second impact associated with the Henry Street option would be potential conflicts between LRT vehicles and auto traffic backed up across LRT grade crossings at S.W. Cedar Hills Boulevard and S.W. Hocken Avenue. These potential conflicts would occur because of the proximity of the proposed LRT alignment to intersections on S.W. Canyon Road and T.V. Highway. These conflicts could be mitigated by connecting the LRT grade crossings with the traffic-signal system on S.W. Canyon Road and T.V. Highway, to provide a clearance interval for auto traffic on S.W. Cedar Hills Boulevard and S.W. Hocken Avenue.

The East-West Arterial proposed by the City of Beaverton would be affected by both LRT alignment options. The primary area of concern with the BN alignment option is at the intersection of the proposed arterial and S.W. Cedar Hills Boulevard, where the LRT would cross diagonally through the intersection at grade. The S.W. Henry Street alignment would cross S.W. Millikan Way at grade, adjacent to the intersection of S.W. Millikan Way and S.W. Murray Boulevard. S.W. Millikan Way is assumed to be the location of the East-West Arterial in this part of Beaverton. Preliminary analysis of 2005 traffic demands and available capacity at these intersections indicates that both would operate at LOS D. At both locations, growth in traffic beyond 2005 or decreases in LRT headways could reduce intersection operations to LOS F.

4.2.1.6 West Beaverton/Washington County

Table 4.2-12 provides the results of intersection LOS analysis for key intersections in West Beaverton and Washington County. Traffic demands on T.V. Highway would increase significantly over existing conditions. Traffic operations below regional standards would occur west of S.W. Murray Boulevard under the No Build and TSM Alternatives. The highest traffic demand would occur at the intersection of T.V. Highway and S.W. Murray Boulevard, which would experience traffic demands well above its capacity. Since these intersections are remote from, or not adjacent to, the LRT alignments, they were not analyzed for the LRT Alternative.

With both the No Build and TSM Alternatives, the level-of-service at intersections along Sunset Highway, from S.W. Murray Boulevard west to S.W. 185th Avenue, would change slightly, with some improving a little and others degrading a little.

For all alternatives, traffic operations at the intersections at S.W. 170th and S.W. 185th Avenues with S.W. Baseline Road (near the end of the LRT line for the S.W. 185th Avenue terminus option) generally would improve from LOS F to LOS D. These improvements are primarily a result of roadway improvements recently completed at these intersections. At S.W. 185th Avenue and S.W. Baseline Road, the proximity of the proposed LRT grade crossing to the intersection may occasionally result in impacts to the operation of the intersection, as LRT operations preempt traffic movements through the intersection. Measures to address these problems could include coordination of rail operations with traffic signalization, and increased capacity for right and left turn movements from S.W. 185th Avenue. Also, when the area north of the S.W. 185th Avenue Transit Center develops, the City of Hillsboro plans to build a new street to provide an alternative exit from the park-and-ride lot. Further study of these mitigation measures is recommended.

Table 4.2-12

INTERSECTION LEVEL-OF-SERVICE ANALYSIS
WEST BEAVERTON/WASHINGTON COUNTY
P.M. Peak Hour

Intersection	Existing Conditions (1987)	No Build	TSM	LRT
S.W. Murray Boulevard and T.V. Highway	D	F	F	*
S.W. 160th Avenue and T.V. Highway	D	E	E	*
S.W. 170th Avenue and T.V. Highway	E	F	F	*
S.W. 198th Avenue and T.V. Highway	C	D	E	*
Along Sunset Highway				
S.W. Murray Boulevard Westbound Ramps	D	E	E	*
S.W. Murray Boulevard Eastbound Ramps	F	D	C	*
N.W. Cornell Road Westbound Ramps	E	B	B	*
N.W. Cornell Road Eastbound Ramps	F	B	B	*
S.W. 185th Avenue Eastbound Ramps	C	D	D	*
S.W. 185th Avenue Westbound Ramps	C	D	D	*
S.W. 185th Avenue and N.W. Cornell Road	C	F	F	*
S.W. 185th Avenue and Evergreen Pkwy.	B	F	F	*
S.W. 170th Avenue and Baseline Road	F	C	D	D
S.W. 185th Avenue and Baseline Road	F	D	D	D

*Intersection not analyzed.

Source: HNTB, 1990.

4.2.2 Access to Stations

Pedestrian and vehicular traffic generated by transit stations could have an impact on the operation of local streets. Outside downtown Portland, no access problems would be created by pedestrian traffic with any of the alternatives. Within downtown, some impact would result from pedestrian traffic generated by transit riders transferring between buses and the LRT. Potential impacts from this mode of access would be significant in the Goose Hollow area, where pedestrian traffic at the Stadium or S.W. 18th Avenue/S.W. Jefferson Street LRT stations could reduce the capacity of some traffic movements. These impacts are not expected to be significant during P.M. peak hours.

Station and park-and-ride facilities associated with the TSM Alternative would not significantly affect local traffic circulation. Analysis of driveway intersections for this alternative indicates that all locations would operate at or above the regional standard of LOS D during the P.M. peak hour.

Under the LRT Alternative, the most significant vehicular traffic generated by stations and park-and-ride lots would occur at Sylvan, Sunset Transit Center, Beaverton Transit Center, S.W. Murray Boulevard, and S.W. 185th Avenue. Table 4.2-13 provides a summary of access by mode to these major LRT stations, as well as the Stadium and S.W. 18th Avenue/S.W. Jefferson Street stations. In some cases, the additional traffic generated by these transit facilities would result in increased levels of congestion in areas already functioning at or near capacity.

Traffic exiting the proposed park-and-ride lot at Sylvan, which would be built as a part of the LRT Surface alignment options, would experience LOS E conditions during the P.M. peak hour. Without a traffic signal, traffic exiting the park-and-ride lot would experience long delays, and a safety problem could be created on S.W. Skyline Boulevard as turning vehicles disrupt through traffic. P.M. peak hour traffic volumes on S.W. Skyline Boulevard would increase by approximately 10% as a result of the proposed park-and-ride lot.

The general traffic entrance to the Sunset Transit Center would operate at LOS F without a traffic signal, resulting in long delays for vehicles leaving the park-and-ride lot. Transit buses, which would have separate driveways, would not be affected by delays at the exit driveway. Traffic volumes generated by the transit center and accompanying park-and-ride lot would be relatively insignificant in comparison to traffic generated by adjacent developments.

The signalized intersection at the proposed S.W. 185th Avenue park-and-ride lot would experience traffic demands near its capacity, and would operate at LOS E during the P.M. peak hour. Traffic entering and leaving the park-and-ride lot would conflict with heavy southbound traffic on S.W. 185th Avenue. Without mitigation for this condition, southbound traffic on S.W. 185th Avenue could experience significant delays as a result of the proposed park-and-ride lot. Section 4.2.1.6 addressed this issue. Driveways and adjacent intersections at all other stations or park-and-ride lots would meet the regional standard of LOS D operations during the P.M. peak hour.

4.2.3 Parking Supply and Demand

This section addresses the loss of parking supply attributable to the alternatives, and the impacts on parking demand in downtown Portland.

4.2.3.1 Parking Loss

Table 4.2-14 presents the total number of existing parking spaces that would be lost with each of the project alternatives. The Southside alignment option in the Canyon segment was assumed for the LRT Alternative, and a comparison of the North/BN and South/Henry Street alignment options in Beaverton is given for the S.W. 185th Avenue terminus option. Private parking facilities that would be removed by the proposed LRT and highway facilities have been inventoried and included in these totals.

The No Build Alternative would result in a loss of 135 parking spaces in downtown Portland because of the removal of on-street parking spaces for the extension of the Transit Mall. Additionally, some loss would result from new bus stops, but this would be insignificant and was not specifically addressed in this analysis. The parking loss numbers in this table for the TSM and LRT Alternatives include the 135 spaces removed by the Transit Mall extension. The highway improvements associated with the TSM Alternative would result in some minor parking space losses throughout the Westside Corridor. Most of these spaces are public, on-street parking adjacent to the Sylvan Interchange on Sunset Highway. Additionally, about 100 spaces would be lost during the peak hours to accommodate the exclusive bus lanes in downtown Portland.

Table 4.2-13

PEAK HOUR VEHICLE ACTIVITY AT KEY LRT STATIONS
Year 2005

	185th Terminus (Surface and Tunnel)			Murray Terminus			Sunset T.C. Terminus		
Stations	P&R[1] Vehicle trips	K& R[2] Vehicle trips	Bus Vehicle trips	P&R[1] Vehicle trips	K&R[2] Vehicle trips	Bus Vehicle trips	P&R[1] Vehicle trips	K&R[2] Vehicle trips	Bus Vehicle trips
Stadium	-	30	28	-	25	28	-	30	28
18th and Jefferson	-	55	8	-	55	8	-	55	8
Sylvan	80	15	16	80	15	16	80	15	16
Sunset	260	50	48	290	55	48	290	55	92
Beaverton TC	-	150	78	-	170	78	N/A	N/A	N/A
Murray	195	40	8	275	55	16	N/A	N/A	N/A
185th Avenue	375	70	38	N/A	N/A	N/A	N/A	N/A	N/A

1. Assumes a 21% peaking factor for park and ride trips and 1.1 vehicle occupancy
2. Kiss-and-ride trips estimated at 15% of total park-and-ride trips.

Source: Metro, 1990.

Table 4.2-14

TOTAL PARKING LOSSES
LRT Terminus Options

	No Build	TSM	Southside to S.W. 185th Via North/BN	Southside to S.W. 185th Via South/Henry	Southside to Murray Via South/BN	Southside to Sunset Transit Center
Space Lost	135	210*	860	1,480	1,000	690

* Does not include spaces lost only during peak-hour.

Source: HNTB, 1990.

The greatest loss of parking spaces would result from the LRT Alternative. The number of spaces lost would vary depending upon the alignment option. Table 4.2-15 provides further detail and presents the number of public and private parking spaces potentially lost with the LRT Alternative in each segment of the corridor. Public spaces or facilities are primarily on-street parking, whereas private spaces are primarily limited to off-street parking.

Within downtown Portland, the primary impact to parking would be the loss of public on-street parking. In the Sunset Highway Corridor, parking impacts would occur at the Zoo, and Sylvan and Sunset Highway/Highway 217 Interchanges. These impacts would vary depending on the LRT alignment option. Some parking losses would occur as a result of the highway improvements near the Sylvan Interchange. No parking losses would occur in the Highway 217 Corridor between Sunset Highway and S.W. Canyon Road.

The location and magnitude of parking losses in East Beaverton would depend on the LRT alignment option between S.W. Cabot Street/Highway 217 and the Beaverton Transit Center. Parking losses with the North alignment option would occur primarily in private lots associated with the Glen Terrace and Lynmarie Manor Apartments. The South alignment option would have a greater parking impact on private property, primarily in the Canyon Town Shopping Center.

In Central Beaverton, parking losses would be similar in magnitude, but distributed differently between the two alignment options. The North alignment option would displace more private spaces used by Damerow Ford for auto sales and storage. The South alignment option would have less impact on private parking, but would displace a significant number of public, on-street parking spaces along S.W. Beaverdam Road.

In West Central Beaverton, between S.W. Watson Avenue and S.W. Murray Boulevard, the BN alignment option would occupy an existing freight railroad right-of-way, so parking impacts would be minimal. A proposed LRT substation at Hinds Supply on S.W. Karl Braun Drive would displace existing parking on the northwest corner of the Hinds Supply yard.

The Henry Street alignment option would result in the loss of significant amounts of parking. All parking on S.W. Henry Street would be displaced by the proposed LRT transitway, which would occupy the south side of the street right-of-way. On-street parking would be prohibited near the LRT grade crossings at S.W. Cedar Hills Boulevard, S.W. Hocken Avenue, S.W. Tualaway, S.W. 139th Avenue, S.W. 141st Avenue, and S.W. Whitney Street. Approximately 12 businesses would lose off-street parking as a result of the LRT construction. The most significant losses would occur at the Herzog Meier GMC dealership on S.W. 139th Avenue and at the Nike buildings on S.W. Murray Boulevard.

West of S.W. Murray Boulevard in the West Beaverton/Washington County area, no on-street or private parking losses would occur.

Table 4.2-15

PARKING LOSSES - LRT ALTERNATIVE

Location/Option	Public Spaces*	Private Spaces*	Total
Downtown Portland	350	50	400
Zoo Interchange Area			
Southside & Northside Options	NA	NA	
Long Tunnel w/ Zoo Option	15	0	15
Long Tunnel w/o Zoo Option	10	0	10
Sylvan Interchange			
TSM/LRT Long Tunnel Option	70	5	75
LRT Southside and Northside Options			
Long Tunnel Options	0	140	140
Highway 217 Interchange	0	75	75
East Beaverton			
LRT North Option	25	60	85
LRT South Option	10	235	245
Central Beaverton			
LRT North Option	5	75	80
LRT South Option	40	20	60
West Central Beaverton			
LRT BN Option	0	5	5
LRT Henry St. Option	120	365	485

* All parking losses rounded to nearest five spaces.

Source: HNTB, 1990.

4.2.3.2 Downtown Portland Parking Demand Considerations

Relative to parking demand, Table 4.1-10 in section 4.1.2.1 shows that the LRT Alternative, S.W. 185th Avenue terminus option would carry approximately 7,500 more daily transit trips to and from the Portland CBD than the No Build Alternative, and 2,500 more than the TSM Alternative. Roughly two-thirds of these additional trips are work trips, and one-third nonwork trips. Higher transit ridership translates to lower auto usage and thus reduced demand for downtown parking.

From Table 4.2-16, it is seen that auto person trips to the CBD will increase with all alternatives, compared with existing conditions. The increase in auto person trips is greatest for the No Build Alternative because transit ridership is lowest, and the lowest for the LRT Alternative, S.W. 185th Avenue terminus option, because it has the highest transit ridership. Considering average auto occupancy and parking turnover, the LRT options to S.W. 185th Avenue would reduce the demand for downtown parking by approximately 2,300 spaces compared with the No Build Alternative, and 800 to

Table 4.2-16

WESTSIDE TRIPS TO/FROM THE CBD AND PARKING DEMAND IMPACTS
Average Weekday, Year 2005

	Existing (Year 1988)	No Build	TSM	Surface to 185th	Tunnel to 185th	Surface to Murray	Surface to Sunset TC
Home-Based Work							
transit person trips	6,400	8,500	11,600	13,300	13,400	11,600	9,300
auto person trips	17,900	22,000	18,900	17,200	17,100	18,900	21,200
parking spaces reduced vs No Build	N/A	N/A	(1,300)	(2,000)	(2,000)	(1,300)	(300)
parking spaces reduced vs TSM	N/A	N/A	N/A	(700)	(700)	0	1,000
Non-Work							
transit person trips	3,000	3,400	5,400	6,100	6,400	5,700	5,500
auto person trips	31,600	38,100	36,100	35,400	35,100	35,800	36,000
parking spaces reduced vs No Build	N/A	N/A	(200)	(300)	(400)	(300)	(200)
parking spaces reduced vs TSM	N/A	N/A	N/A	(100)	(100)	0	0
Total							
transit person trips	9,400	11,900	17,000	19,400	19,800	17,300	14,800
auto person trips	49,500	60,100	55,000	52,600	52,200	54,700	57,200
parking spaces reduced vs No Build	N/A	N/A	(1,500)	(2,300)	(2,400)	(1,600)	(600)
parking spaces reduced vs TSM	N/A	N/A	N/A	(800)	(900)	0	900

Note: Surface denotes either Southside or Northside alignment option.
For work, calculations assume average auto alignment option occupancy of 1.1 and parking turnover of 1.1.
For non-work, calculations assume average auto occupancy of 1.4 and parking turnover of 3.0.

Source: Metro, 1990 and HNTB, 1990.

900 spaces compared with the TSM Alternative. At roughly 100 parking spaces per downtown city block or per one floor of structured parking, these reductions in parking demand translate to a savings of 23 floors of structured parking compared with the No Build Alternative, and eight to nine floors compared with the TSM Alternative.

Of the alternatives under consideration, the LRT Alternative would be most consistent with the city's parking policy, because it would result in the smallest increase in auto trips to the CBD. If parking supplies were increased to meet the projected increase in demand with the LRT Alternative, the total supply likely would be under the policy cap of 43,914 spaces (see Chapter 3.3.4 for an explanation of the policy and existing parking supplies). If parking supplies were increased to meet the potential demands that would result from the No Build Alternative, the total parking supply would likely exceed the city policy limit.

4.3 FREIGHT MOVEMENTS

This section analyzes the impacts of the alternatives on freight railroads and truck deliveries in the corridor.

4.3.1 Freight Railroads

Rail freight service exists only in the portion of the corridor from Beaverton westward. Both the Southern Pacific (SP) and Burlington Northern (BN) Railroads serve the area. The SP line runs along the south side of Tualatin Valley Highway and is not affected by any of the alternatives. The LRT Alternative (except for the Sunset Transit Center terminus option) runs immediately parallel to the BN line from Beaverton to S.W. 185th Avenue, and will have some impact on that line.

The BN line through Beaverton is part of BN's route from Portland to Eugene. There are usually two large freight train movements and two local switching train movements each day over this portion of the line. The LRT design uses surplus BN right-of-way, where available, and is intended to avoid interference with active BN spurs or mainline operations. There will be no at-grade crossings between freight and LRT movements for any of the alignment options.

The eastern portion of the original BN route through Central Beaverton was abandoned in the 1970s and a new connection made west of S.W. Murray Boulevard to the SP line to the south. Tracks remain on the original alignment from approximately S.W. Cedar Hills Boulevard west through the Tektronix campus. From the east, the LRT alignment for the BN option will occupy the largely unused BN right-of-way between S.W. Cedar Hills Boulevard and S.W. Murray Boulevard, displacing the existing tracks. The railroad occasionally uses a portion of these tracks, just east of S.W. Murray Boulevard, for rail car storage, an activity that would need relocation as part of the ROW purchase. It is anticipated that the storage tracks would be relocated to just west of S.W. Murray Boulevard.

From S.W. Murray Boulevard to St. Mary's Junction, the BN track serves as a spur track to an active shipper. This track would be relocated to the south edge of the existing ROW, to enable the LRT to occupy the remainder. Freight service would be maintained. For the S.W. Murray Boulevard terminus option, the spur track would be relocated to new ROW to eliminate an at-grade crossing with the yard lead track from the LRT maintenance facility, which would be located on the southside of the BN right-of-way.

From St. Mary's Junction to Baseline Road, the LRT would occupy a new, 50-foot right-of-way to be acquired immediately on the north side of the BN. The unused Windolph Spur would be removed. There would be no impact on railroad operations in this segment.

From Baseline to Willow Creek, the north side of the BN tracks is fully developed. To avoid displacing 40 housing units the BN track would be relocated southward, and the LRT would occupy the BN right-of-way.

From Willow Creek to S.W. 185th Avenue, the LRT would occupy a new 50 foot ROW on the immediate north side of the BN right-of-way. At S.W. 185th Avenue, the park-and-ride lot would displace an existing rail shipper. This is the only impact on existing rail service in the corridor.

Shared use of track was considered and discarded for safety, clearance, and economic reasons. The plan as now proposed has no long-term impact on rail freight operations, except on one shipper that would be displaced and intends to relocate elsewhere on the BN line. During the short term, for the S.W. 185th Avenue and S.W. Murray Boulevard terminus options, Tri-Met would coordinate construction activities with the BN Railroad to minimize impacts during relocation of the BN spur line and affected portion of the mainline.

4.3.2 Truck Deliveries

Extension of the westbound climbing lane on Sunset Highway, and other highway improvements associated with the TSM and LRT Alternatives, would improve access for trucks in the Westside Corridor and, from a statewide perspective, to regions west of Portland served by Sunset Highway. Geometric improvements, such as widening and straightening, would generally improve the safety of these facilities for heavy truck operations. With the No Build Alternative, increased congestion would increase truck operating costs and the potential for accidents involving trucks.

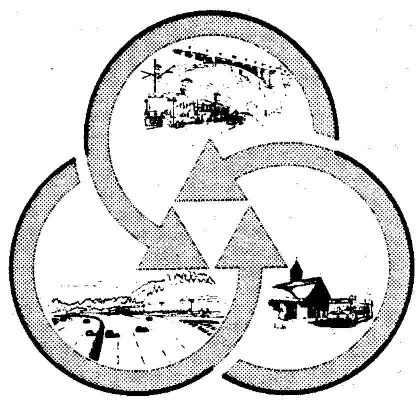
Freight deliveries via trucks are affected in two areas of the LRT alignment, downtown Portland and Beaverton. In addition to travel pattern changes common to all vehicles, caused by such things as turn prohibitions, the following impacts would occur.

In downtown Portland, between the existing MAX turnaround at S.W. 11th Avenue and Sunset Highway, seven truck loading zones are proposed for removal by the LRT Alternative. Of these seven, four serve parcels that would be acquired for the project, two serve parcels with at least one other loading zone on side streets in the same block, and one serves a parcel that has two hotel zones within the same block on the side streets. All truck loading zones proposed for removal are on either S.W. Morrison Street, S.W. Yamhill Street, or S.W. 18th Avenue. Some off-street loading docks have access from streets where LRT would be built, but no direct or significant impacts would result.

In Beaverton, impacts on truck access and circulation would be confined to a few locations as follows:

- Canyon Place Shopping Center - The North alignment option would close S.W. Beaverdam Road at S.W. 117th Avenue. An alternative access to the shopping center shipping and receiving area is available through the shopping center.
- Canyon Town Center - The South alignment option would cut off access to loading docks. Compensation would be paid to allow the owner to develop an alternative loading access.
- Beaverton Transmission - The South alignment option would cut off access to this auto shop. The project would provide an access easement across from the Damerow Ford property.
- Henry Street - The Henry Street alignment option would cut off all southside driveways between S.W. Cedar Hills Boulevard and S.W. Hocken Avenue. Alternative access is available from S.W. Canyon Road.
- 3700 S.W. Murray Boulevard (North Nike Building) - The Henry Street alignment option would cut off access to this building. The owner would be compensated, and is expected to develop alternative access via S.W. Millikan Way (a private street), or S.W. 144th Avenue.

At other locations in Beaverton, truck access to buildings may need to be modified, but no major impacts have been identified.



CHAPTER 5

ENVIRONMENTAL CONSEQUENCES

5.0 ENVIRONMENTAL CONSEQUENCES

This chapter discusses the potential impacts of the Westside Corridor Project on the built and natural environments. Construction related as well as long-term impacts are included.

5.1 LAND USE AND ECONOMIC DEVELOPMENT

This section summarizes land use and economic development impacts that could be expected to occur at the regional, corridor, and station-specific levels as a result of the project alternatives. This discussion is summarized from the analysis presented in Technical Memorandum 20a.

5.1.1 Regional Impacts

The Portland region has experienced a period of economic growth since the early 1980s. The economic base of the area has diversified from a logging and agriculture based economy to include high technology and research and development industries. This diversification has resulted largely because of the availability of land, proximity to the Pacific Rim, and overall quality of life. Available empirical evidence does not suggest that transit has any effect on the amount of net regional growth. However, recent experience has found the overall quality of the transportation system to be a factor to firms considering locating in the Portland region (Portland Development Commission, 1990). Because transit does contribute to the overall level of service on the transportation system, its role in maintaining the operation of the system is expected to become more important in the future as significant highway expansion is not feasible. The highway and transit elements of both the TSM and LRT Alternatives would contribute toward achieving the desired level of service for the system and would therefore help to maintain the economic growth of the region. Nevertheless, the assumption underlying this SDEIS is that the alternatives would have no net effect on the amount of development within the Portland region.

5.1.2 Corridor Level Impacts

5.1.2.1 Land Use and Development Impacts

Accessibility historically has not been a limiting factor to development in the Westside Corridor. However, rapid growth in traffic and degradation of level of service on the Sunset Highway in the past decade has raised concern by local officials that this will not be true in the future. The corridor has historically had a higher rate of growth than other areas in the Portland metropolitan region and is expected to have a very high share of growth in the future, with total employment expected to increase by 87% by 2005.

The adequacy of the transportation system in the Sunset Corridor will help assure that land use objectives are realized. The following analysis has not assumed that any of the alternatives would affect the rate or share of regional growth expected to occur in the corridor. It does recognize, however, that a primary effect of improved transportation facilities could be to influence the site location of specific types of uses that desire to take advantage of improved transit accessibility.

The TSM Alternative would not encourage any change in the existing development patterns on the Westside as a result of increased bus service or numerous park-and-ride lots throughout the Westside. With the LRT Alternative, impacts would tend to be more focused around transit stations where improved transit accessibility would lead to higher land values and higher density residential and some retail uses. Empirical evidence on the extent of these land use impacts is not readily available (ECO, 1990). Some limited research to date indicates that a healthy CBD is critical to the success of LRT, that transit-oriented households tend to bid up rents in the LRT corridor, and that development impacts are greatest in the CBD. Developers in the Portland region that have been involved with projects along the existing Eastside line indicate that their projects enjoy a higher occupancy rate and faster leasing rates than projects not on the line (ECO, 1990).

Based on available information, it is not possible to predict with any certainty the land use impacts of the LRT Alternative within the Westside Corridor. If impacts do occur, they would be expected to be concentrated in the CBD and in station areas currently undergoing development or redevelopment. In the Westside Corridor, these areas include downtown Portland/West Hills, the Sunset/217 Interchange area, the Beaverton Transit Center, the S.W. Watson Avenue area, and the S.W. Murray Boulevard area. As discussed below, land use plans and policies are in place to encourage the concentration of future corridor development in LRT station areas.

5.1.2.2 Compatibility with Land Use Plans and Policies

At the corridor level, the proposed TSM and LRT Alternatives are supportive of stated objectives contained in Oregon's Statewide Planning Goals; the Regional Transportation Plan; and with the Comprehensive Plans of the Cities of Portland, Beaverton, and Hillsboro, and Multnomah and Washington Counties. Both transit alternatives would improve transit accessibility, consistent with the adopted goals and plans related to an integrated transportation system, that would support the existing and planned growth for the Westside. The LRT Alternative would support those policies of the RTP and local comprehensive plans that specifically identify the LRT as a priority in the Westside.

Some jurisdictions adopted specific alignments in their comprehensive plans based on the 1983 selection of the preferred alternative. Depending on the alignment decisions made subsequent to the hearings on this SDEIS, some plan maps may have to be amended. In addition, certain local policies or code requirements may necessitate mitigation measures or coordination agreements. Findings that determine final consistency with the local plans will be developed by the jurisdictions prior to the adoption of the locally preferred alternative. Mitigation measures or coordination agreements necessitated by these findings will be addressed in the Final EIS.

Since 1973, when statewide planning requirements were adopted, state, regional, and local agencies have implemented a land use policy framework that emphasizes urban containment, limitation of sprawl, protection of rural resource lands from development, and increased densities. This emphasis is clearly evident in the statewide planning goals that are mandatory for state, regional, and local plans and therefore has the force of state law. The UGB, the Metro RTP, and local city and county comprehensive plans support this emphasis and provide the planned land use framework for the Westside Corridor Project's analysis and decision-making. In addition, the Portland region is currently developing policies that emphasize increased development densities. The draft Regional Urban Growth Goals and Objectives (Metro, 1990) emphasize a land use concept moving toward high density, mixed use economic activity centers at key locations on the regional light rail system. This is intended to increase densities in key locations that can effectively be served by transit thereby reinforcing the intent of the UGB to limit urban expansion into rural lands. Because an expansion to the UGB must, by statute, be based on the demonstrated "need" for more urban land, the region's ability to increase densities on existing urban land will help limit future expansion of the boundary.

The transit overlay zones adopted by local jurisdictions clearly indicate local plans for higher density development in areas with good transit accessibility. These zones include the Transit Corridor Overlay District (TCOD) and LRT Overlay in Washington County, and the LRT Overlay in Beaverton. These zones would permit development of higher density residential, commercial, and office development in areas along the LRT alignment and in transit station areas. Development under these zones would be transit supportive. Compatibility of impacts with specific plan and policy documents is discussed in the Station Area Impacts section of this document, as appropriate.

Both the TSM and the LRT Alternatives would assist in meeting land use objectives as they relate to increased densities in downtown Portland, as defined in the Central City Plan (Portland, 1988). Both alternatives would improve transit accessibility between residents on the Westside, and jobs, shopping, and cultural opportunities in downtown Portland. As a result of this increased accessibility to downtown Portland, higher downtown densities would be possible. The LRT Alternative would be somewhat more supportive of the development objectives in downtown than the TSM, as reflected by the higher LRT ridership level to the CBD for both work and nonwork trips. The LRT also would be somewhat more supportive of development objectives in the Portland CBD by helping to reduce downtown traffic and parking needs, thereby enhancing the pedestrian environment (see Chapter 4).

5.1.2.3 Compatibility with Existing and Proposed Development

Under the TSM Alternative, the expansion of the existing transit centers at Tanasbourne Mall and Washington Square Shopping Center would be compatible with the existing use of the area. In addition, park-and-ride lots would be located at the following locations throughout the Westside: north of Sunset Highway, south of N.W. Cornell Road, and east of N.W. 158th Street (200 spaces); intersection of S.W. Murray Boulevard/T.V. Highway (360 spaces); intersection of S.W. 160th Avenue/T.V. Highway (expand from 250 to 400 spaces); northeast quadrant of the S.W. 170th Avenue/T.V. Highway intersection (400 spaces); and southeast quadrant of the S.W. 198th Avenue/T.V. Highway intersection (500 spaces). These park-and-rides would be located to provide transit accessibility to existing and future suburban residential neighborhoods and have been sited to be compatible with existing land uses and zoning.

The LRT Alternative would be developed in existing roadway or railroad right-of-way along much of the alignment. In the downtown Portland/West Hills area, adjacent land uses consist primarily of a mix of commercial, office, and residential development. The commercial and high density residential zoning in this area would be compatible with transit-supportive development near the LRT.

The Central Beaverton Plan, currently being updated by the city of Beaverton, incorporates land use scenarios for all LRT alignment options being evaluated through the city (see Figures 5.1-1 and 5.1-2). The draft plan designates transit supportive residential and commercial/office uses for the LRT corridors. Much of these areas currently are developed with a variety of commercial, retail and residential densities, most of which are auto-oriented. Existing uses that would be negatively affected by LRT construction include several small single-family neighborhoods located in transitional areas, and two large multifamily apartment complexes that would be directly affected through displacement. The LRT would be compatible with redevelopment of these areas in accordance with market trends.

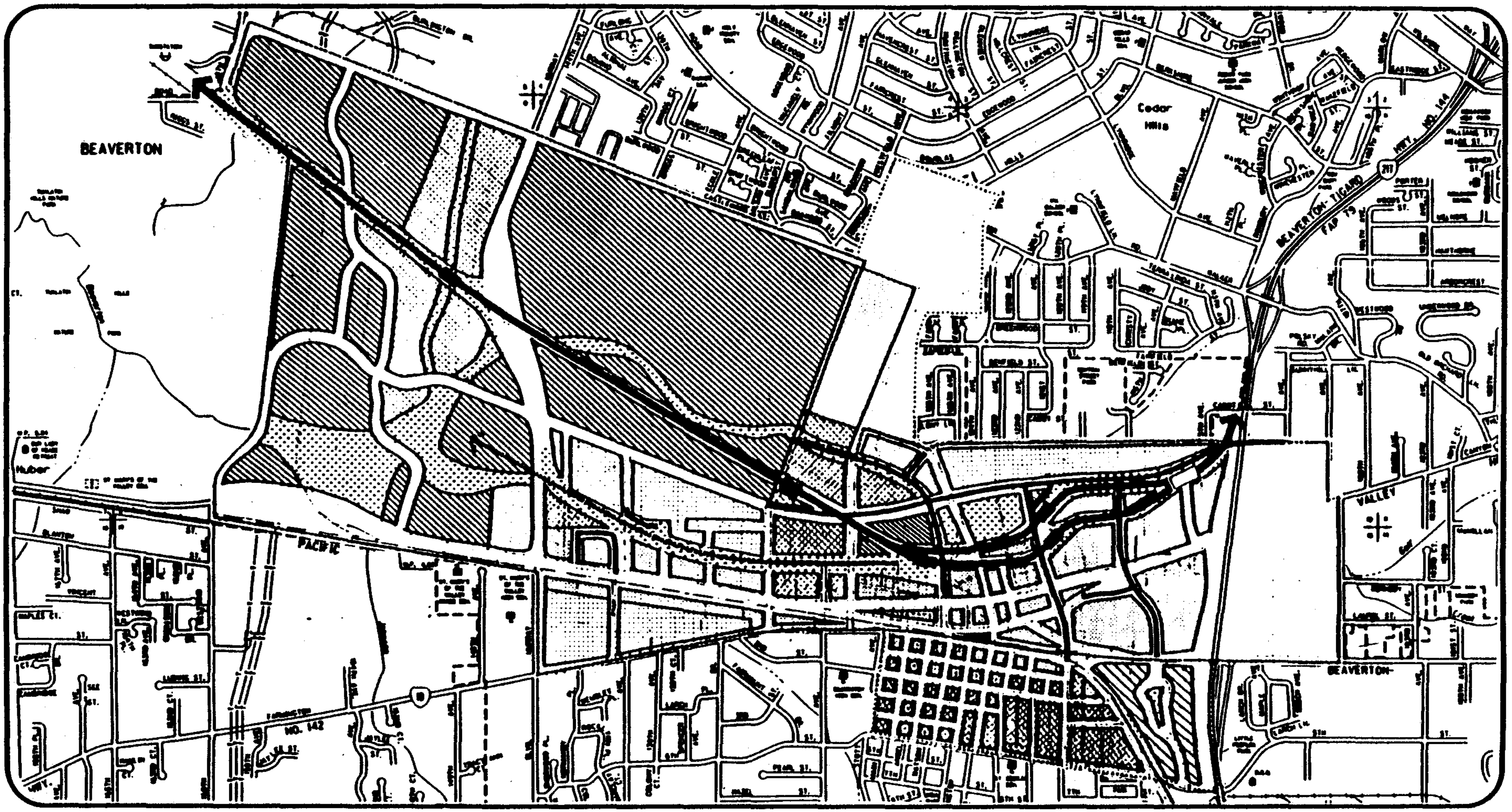
Through unincorporated Washington County, the LRT would be located in or adjacent to existing railroad right-of-way and would pass through some campus industrial areas, undeveloped agricultural lands, and residential areas. The LRT would be compatible with existing zoning for industrial park and residential development, and would be supportive of implementation of the TCOD and LRT Overlay as market conditions allow.

The proposed transit alternatives reinforce a number of proposed development projects on the Westside. At the Sylvan Interchange and the Sunset Transit Center, land use and zoning currently are in place to encourage intensification of development. At the Sunset Transit Center, a specific proposal for a master-planned development to include office, hotel, and retail space, has been submitted. Development of all alternatives is consistent with this proposal. In central Beaverton, the goal is to develop projects that promote pedestrian orientation and support transit usage. Both the TSM and LRT Alternatives would be consistent with such development projects. Development of the S.W. Merlo Boulevard LRT station would be compatible with development of the proposed Tualatin Hills Nature Park.

5.1.2.4 Impacts on Existing Business Community

Construction impacts on businesses and displacement and relocation of specific businesses are discussed in Sections 5.11 and 5.2, respectively.

Roadway improvements associated with the TSM and LRT Alternatives would impact local businesses at the Sylvan Interchange. The closing of S.W. Canyon Court west of Highland Parkway and east of S.W. 58th Avenue would require modifications in existing travel patterns. Access to businesses in this area from the south would be limited to the Sylvan Interchange. Traffic traveling eastbound on S.W. Canyon Court would be routed north on S.W. Montgomery Street, and across S.W. Skyline Boulevard to S.W. Westgate Drive to access business east of S.W. Skyline Boulevard. All business establishments would continue to have access; turning movements to and from side streets would be maintained. Current congestion and conflicting turn movements in the area would be improved or eliminated.



Legend

- Office
- Retail/Commercial
- Civic Center
- Mixed Commercial/Residential
- Park/Open Space
- Campus Industrial
- Multi-Family Residential
- LRT Alignment Alternative
- LRT Station
- LRT Future Station Opportunity
- Shuttle Corridor

N

SCALE-FEET

0 500 1000 2000

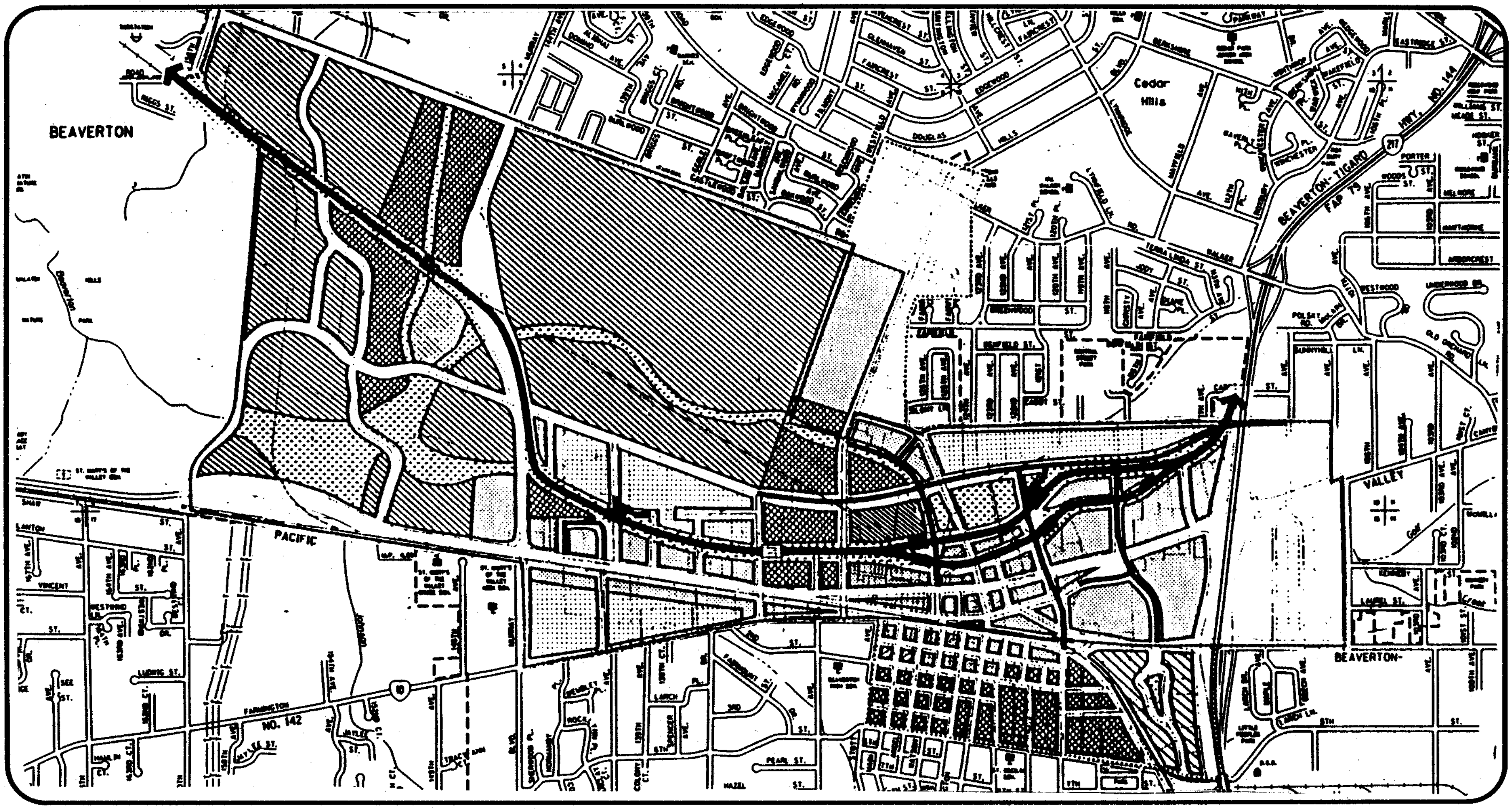
Westside Corridor Project

Central Beaverton Concept Plan, BN LRT Option

The Oregon Department of Transportation

WESTSIDE LIGHT RAIL TRI-MET

Figure 5.1-1



Legend

- Office
- Retail/Commercial
- Civic Center
- Mixed Commercial/Residential
- Park/Open Space
- Campus Industrial
- Multi-Family Residential
- LRT Alignment Alternative
- LRT Station
- LRT Future Station Opportunity

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SCALE-FEET

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Westside Corridor Project

Central Beaverton Concept Plan, Henry Street LRT Option

The Oregon Department of Transportation

WESTSIDE LIGHT RAIL

TRI-MET

FIGURE 5.1-2

The TSM Alternative also would displace parking on the right hand side of S.W. Sixth Avenue, from S.W. Montgomery Street to S.W. Madison Street during the weekday morning peak period (7:00 a.m. to 9:00 a.m.), and on the right hand side of S.W. Fifth Avenue from S.W. Jefferson Street to S.W. Harrison Street during the weekday evening peak period (4:00 p.m. to 6:00 p.m.). Access to metered parking from businesses, offices, a high-rise apartment building, and a high school would be partially disrupted on this twice-daily basis.

The LRT Alternative would have additional impacts on local businesses in several segments of the alignment. These are discussed below.

S.W. 11th Avenue to S.W. 18th Avenue/S.W. Jefferson Street Station

On-street parking on both S.W. Morrison and S.W. Yamhill Streets would be reduced and driveway access to two properties on the south side of S.W. Morrison Street and the north side of S.W. Yamhill Street would be eliminated. Street access to properties in this area would be limited to cross streets. Vehicular access to the site of a currently vacant office building on S.W. 17th Avenue would be reduced to access on S.W. 17th Avenue, which is not a through street. These areas would receive increased direct transit access to the CBD, to areas to the east via MAX and to areas to the west, with a transit station located at S.W. 18th Avenue/S.W. Morrison and S.W. Yamhill Streets. The loss of vehicular access to businesses along these roadways could be offset by increased visibility and pedestrian activity, especially near transit stations. Access to small commercial businesses along S.W. 18th Avenue would be limited to right-in/ right-out access, except at the intersections of S.W. Salmon and S.W. Jefferson Streets.

S.W. 18th Avenue/S.W. Jefferson Street to Sunset Transit Center

Access to small commercial businesses along S.W. Jefferson Street would continue to be limited to right-in/right-out turn movements, except at the intersections of S.W. 18th Avenue/S.W. Jefferson Street and S.W. Jefferson and S.W. Murray Lane. Restrictions on left-turn movements between S.W. 18th Avenue and S.W. 20th Avenue could affect some retail establishments in that area.

Between S.W. 90th Avenue and the Sunset Highway/Highway 217 Interchange, the parking areas of two office buildings and a restaurant would be affected, and one of the office buildings would require modification as a result of right-of-way acquisition. Continued use of these buildings would be viable.

Sunset Transit Center to S.W. Cabot Street/Highway 217

Adjacent to the LRT facilities, a pedestrian underpass would be constructed connecting the Sunset Transit Center with the Cedar Hills Shopping Center on the south side of Sunset Highway. This would provide direct pedestrian access to LRT and other uses on the north side of the highway, including a hospital and schools, possibly benefitting businesses located at the shopping center.

East Beaverton to S.W. Cabot Street to Beaverton Transit Center

Under the North Option, S.W. 114th Avenue would provide local access at the LRT crossing only, affecting access from the north to several businesses located south of the LRT. Alternative access is available from S.W. Canyon Road via S.W. 117th Avenue. Access to S.W. 114th Avenue from S.W. Canyon Road would be limited to right-in/right-out turn movements, which could result in hardships for businesses located south of the LRT.

Under the South Option, the LRT would pass through the parking lot of a large shopping center, affecting parking and circulation. Crossing of the LRT tracks would be prohibited except at designated locations. An adjacent shopping center would be affected by loss of a loading dock and some parking spaces. Pedestrian safety would have to be maintained. Both centers would have access to LRT service at the adjacent Beaverton Transit Center.

Beaverton Transit Center to S.W. Watson Avenue

Under the South Option, a business area between S.W. Lombard Street and S.W. Watson Avenue would be affected because S.W. Beaverdam Road would be closed to vehicular traffic. Access to several businesses would be less convenient via S.W. East Avenue and S.W. Canyon Road. A grade crossing would be provided for local traffic at S.W. East Avenue.

Beaverton to S.W. Watson Avenue to S.W. Murray Boulevard

The BN alignment option would improve access to commercial and industrial areas, including the Tektronix facility. There is concern that vibration caused by the LRT could affect some operations at Tektronix. Mitigation would be coordinated closely with the property owner to prevent disturbance, if possible.

The Henry Street alignment option would change Henry Street from a two-way access to a one-way street, and driveways on the south side of the street would be closed. Driveways on the north side would have only right-in/right-out access. Current on-street parking also would be removed. Commercial uses on Henry Street could experience some hardship from these access changes. The Nike office building would lose its current access to S.W. Murray Boulevard, which would result in the need to relocate its access.

5.1.3 Station Area Impacts

Potential development opportunities would most likely occur in areas around LRT stations where local jurisdictions permit multifamily development, office, and retail uses because these uses would benefit from improved transit access and increases in pedestrian activity. Such increases could lead to changes in land value, which would tend to support specific types of development to serve the transit-oriented segments of the population. Stations do not create a new market for development, but could tend to focus certain types of development, such as multifamily development, near the station.

Impacts depend both on market forces that result in developer decisions to build higher intensity uses in station areas and on public policies that permit and/or encourage transit-supportive types and densities of development. The assessment of station area development impacts in the following sections resulted from an evaluation of historic development patterns, vacancy and absorption rates, developer perceptions, land availability, projected ridership levels, and local land use regulations and other policies that are instrumental in guiding development in the Portland region.

Stations generally fall into two groups: (1) intensification of uses, and (2) support for existing development trends (see Table 5.1-1). In the first group, elements are present that could lead to an intensification of uses. Such elements include a strong demand for higher density development, historical development that includes higher density development or redevelopment, and high levels of projected walk-on ridership. In the second group, development of the LRT station is expected to support existing development, but not to intensify existing uses.

The analysis presented in the following section recognizes that total passenger activity in station areas is only one indicator of development or redevelopment potential. Walk-on riders may be more likely to utilize commercial activities in station areas than those passengers who are transferring from bus to rail. Accordingly, both indicators are provided.

5.1.3.1 Downtown Area Stations

Downtown Portland has experienced steady growth in employment over the past ten years (see Chapter 3). This steady increase in employment is directly related to Portland's role as a major business and financial center in the region. Vacancy rates in the Portland area have declined steadily since 1987 and projected vacancy rates for office and industrial space follow this trend. Vacancy rates in the first quarter of 1990 were 17.8% for office space, 18.9% for industrial space, and 10.7% for retail space. By 2000, nearly six million square feet of new office space is expected to come on-line (Economic

Development Services, 1989). The retail sector has experienced some decline in regional share; however, it is still considered a viable, growing, retail market. The amount of leasable retail space is projected to increase by more than one million square feet through 2000.

Table 5.1-1

STATION DEVELOPMENT IMPACT SUMMARY

Intensification of Uses	Supports Existing Development Trends
Civic Stadium	S.W. 13th/S.W. 14th Avenue
S.W. 18th Avenue/S.W. Jefferson Street	Zoo
Sylvan	Sunset Transit Center
Beaverton Transit Center*	S.W. Watson Avenue
S.W. 170th Avenue*	S.W. Hocken Avenue
	S.W. 141st Avenue
	S.W. Murray Boulevard
	S.W. Merlo Boulevard
	S.W. 185th Avenue

*Development impacts assumes appropriate zoning change/public policy support.

Source: Shapiro and Associates, Inc., 1990.

The city of Portland has adopted a Light Rail Transit Station overlay zone (LRT zone) that can be applied to areas near transit stations if the city elects to do so. The LRT zone sets forth development standards that encourage pedestrian-oriented design compatible with promoting use of transit facilities.

One indicator of how the alternatives could impact activity in downtown station areas is the accessibility of the population to the CBD (see Table 5.1-2). With the No Build Alternative, approximately 7,100 persons would be within 30 minutes of the CBD by transit, including both in-vehicle and out-of-vehicle travel time, and 78,500 persons would be within 30 minutes of the CBD by automobile. Under the TSM Alternative, approximately 9,500 persons would be within 30 minutes by transit and 105,600 by auto; and with the Surface LRT options to S.W. 185th Avenue, approximately 18,200 persons would be within 30 minutes of the CBD by transit and 117,300 by auto. The differences for the transit options are more pronounced at 45 and 60 minutes.

S.W. 13th/S.W. 14th Avenue Stations

These stations would be located on S.W. Morrison Street (westbound) and S.W. Yamhill Street (eastbound) at the I-405 overpass. This area is known as the RX (high-density residential zone) district of downtown Portland and borders the Goose Hollow neighborhood to the west. The transit station impact zone is bisected by I-405. East of the highway, land use is predominantly commercial, office, and surface parking lots, while west of the highway multifamily development is more prevalent (see Figure 5.1-3). Convenient access to the central employment and retail core and to the Civic Stadium make this area attractive for high-density residential development. The City has been promoting redevelopment of multifamily residential units through mechanisms such as high-density residential zoning and tax incentives.

Table 5.1-2

CORRIDOR POPULATION WITHIN 30, 45 AND 60 MINUTES
TRAVEL TIME OF THE CBD
(In-Vehicle plus Out-of-Vehicle Time)

	Population w/in 30 min.		Population w/in 45 min.		Population w/in 60 min.	
	Transit	Auto	Transit	Auto*	Transit	Auto*
No Build	7,100	78,500	20,300	282,200	88,700	282,200
TSM	9,500	105,600	52,600	282,200	120,100	282,200
LRT, Surface	18,200	117,300	124,500	282,200	185,100	282,200

*Entire corridor population is served by auto within 45 minutes

Source: Metro, 1990.

The Central City has been experiencing an increase in multifamily development as a result of the City's aggressive multifamily housing policies. This trend is expected to continue through 2005. One provision of the RX zone permits a mix of up to 50% commercial uses with multifamily development in transit station areas. The continued success of commercial and residential growth downtown, combined with restrictions on parking, would support this type of mixed use development in transit station areas.

Civic Stadium Station

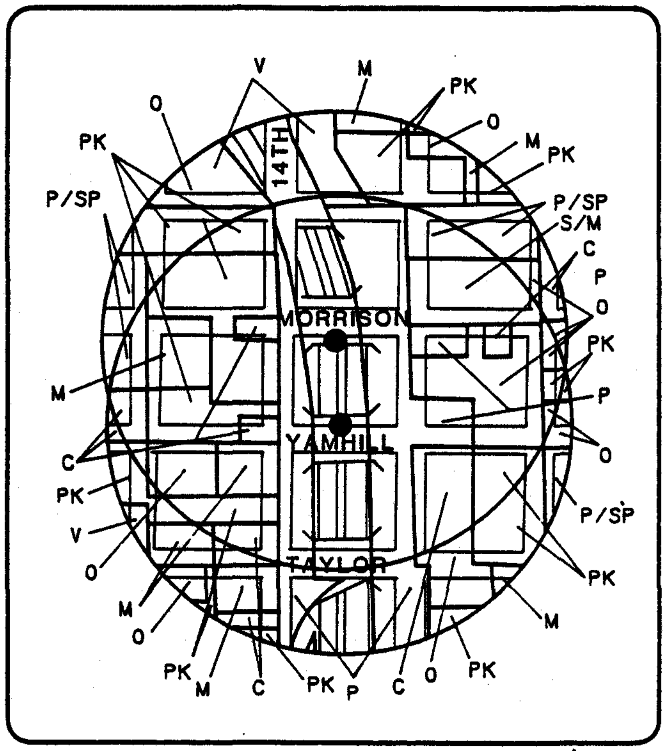
The Civic Stadium Station would be located on the block bounded by S.W. Morrison and S.W. Yamhill Streets and S.W. 17th and S.W. 18th Avenues, currently the site of the Rasmussen BMW car dealership (see Figure 5.1-3). Tri-Met has identified the Civic Stadium Station as a potential joint development site, although no specific proposal has yet been prepared. The station would be located across the street from the Civic Stadium, a major regional recreational facility in Portland.

The area currently is underdeveloped when compared to uses permitted by existing zoning. Most of the station area is zoned Central Commercial, with high density multifamily zoning generally east of S.W. 17th Avenue. Many of the underutilized individual parcels are adjacent to other small, individual parcels and could be assembled into larger, developable parcels.

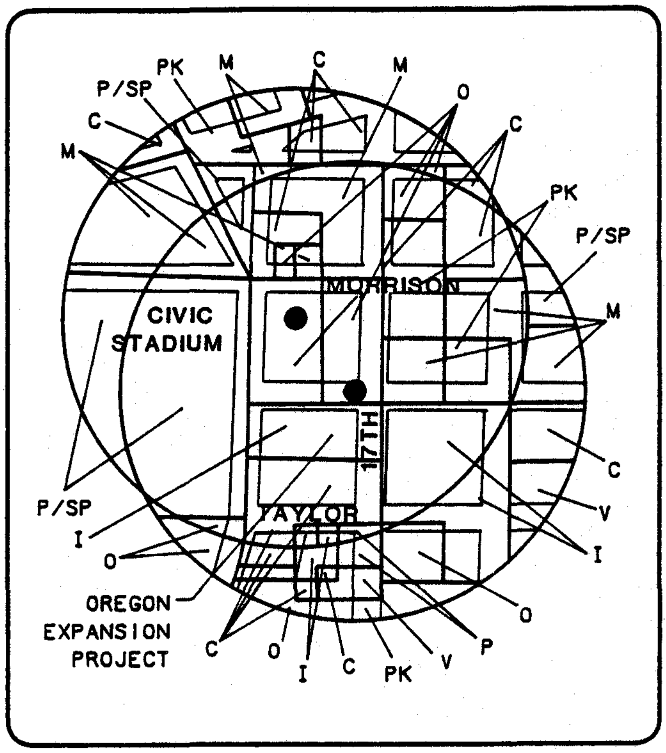
Total passenger activity expected at this station would range from 2,200 persons per day under the Long Tunnel/S.W. 185th terminus option to 2,400 persons per day with the Surface/S.W. 185th Avenue terminus option (Metro, 1990). More than 1/3 of the riders accessing the LRT at this station are expected to be walk-on passengers. Higher levels of pedestrian activity in the area surrounding the station would support retail and commercial redevelopment. The potential for joint public-private development would be enhanced by market conditions and existing land use regulations in the station area.

S.W. 18th Avenue/S.W. Jefferson Street Station

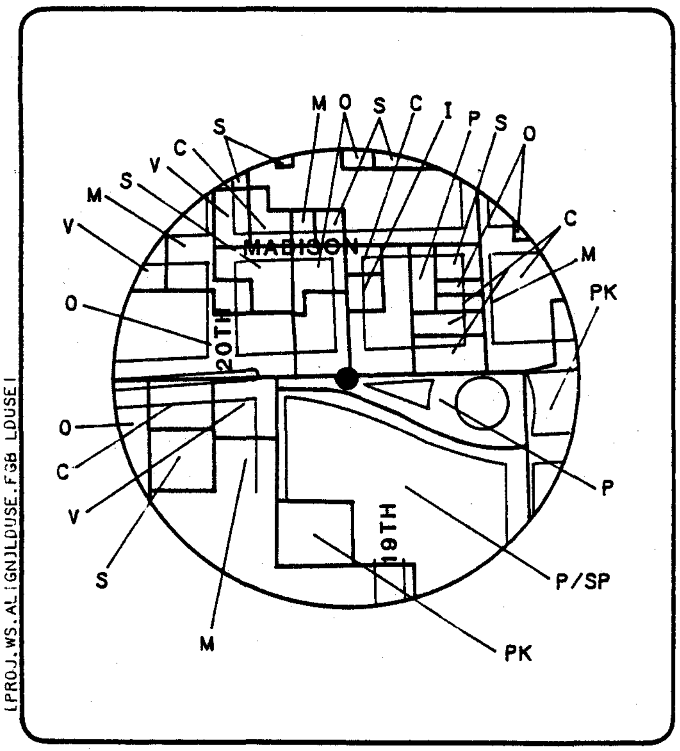
The area under consideration is located between S.W. Jefferson and S.W. Main Streets and S.W. 18th and S.W. 19th Avenues. Much of this area currently is developed with low intensity commercial uses that do not maximize the use of the property as permitted under the existing zoning, Central Commercial (Figure 5.1-3). The LRT would result in a significant level of transit activity in the station area, with



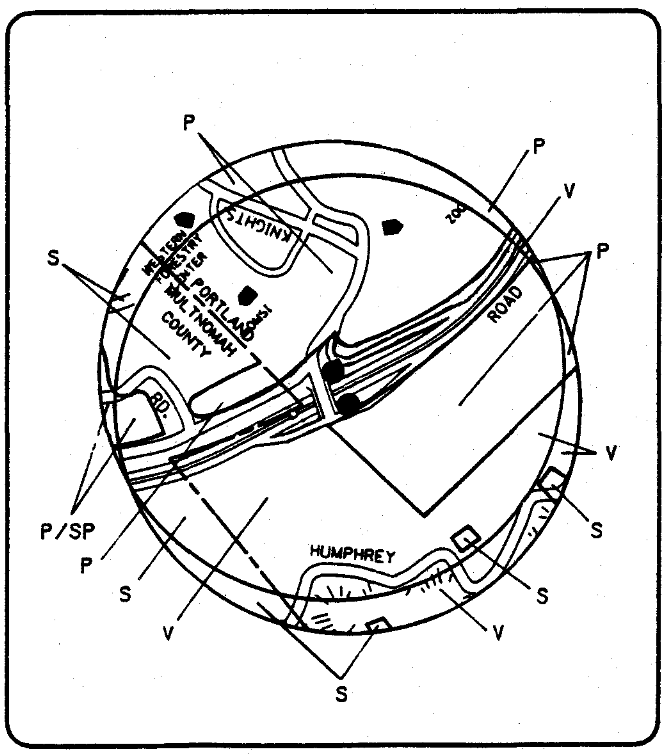
S.W. 13TH/S.W. 14TH



CIVIC STADIUM



S.W. 18TH AVE/S.W. JEFFERSON ST.



ZOO STATION
(NORTHSIDE & SOUTHSIDE OPTIONS)

LEGEND

S - SINGLE FAMILY
M - MULTIFAMILY
C - COMMERCIAL
O - OFFICE
I - INDUSTRIAL
A - AGRICULTURE
PK - PARKING
P/SP - PUBLIC/SEMI-PUBLIC
P - PARK & OPEN SPACE
V - VACANT
● - LRT STATION LOCATION

The Oregon Department of Transportation

WESTSIDE LIGHTRAIL
TRI-MET

WESTSIDE CORRIDOR PROJECT

STATION AREAS EXISTING LAND USE

FIGURE 5.1-3

[PROJ.WS.ALIGN]LDUSE.FGB LDUSE]

approximately 3,100 persons boarding or de-boarding at this station, 200 of whom would be walk-ons (Metro, 1990). Existing businesses along S.W. Jefferson Street, especially convenience and service establishments, may benefit from increased pedestrian activity and visibility. Over the long term, the neighborhood and city goals encourage more housing in the area. The improved transit access to the CBD also may encourage redevelopment to more intensive commercial and multifamily development, which is permitted north of the Central Commercial zone.

Zoo/OMSI/World Forestry Center Station

The Washington Park Zoo, World Forestry Center, Oregon Museum of Science and Industry (OMSI), and Viet Nam Veterans Memorial occupy the southern portion of Washington Park, just north of the Sunset Highway. In accordance with the Washington Park Master Plan, this area is intended as a location for major public attractions with an intended market area of the region or larger (Portland, 1981).

Consistent with the Washington Park Master Plan, the Washington Park Zoo Master Plan (Metro, 1987) calls for continued improvement of the facility and expansion of its function and attendance. It is now the largest paid public attraction in the state of Oregon and is expected to continue to increase its attendance. According to the 1987 Master Plan, annual attendance in 1996 was forecast to be 990,000. As of 1990, these forecasts have been exceeded with attendance surpassing 1,080,000.

A major constraint to realizing the growth potential of the Zoo/OMSI/WFC complex is the limited parking. Demand often exceeds the existing supply of 1,113 spaces, which, according to Zoo officials, results in many visitors cancelling their trips. Construction of any of the LRT Alternative options except the Long Tunnel without Zoo station would alleviate the parking pressure on the Zoo/OMSI/WFC area and allow greater growth in attendance than the TSM Alternative. Peak attendance days at the Zoo are on weekends in the spring, summer and fall and on special event weekdays during the summer. On these days, the LRT options that include a Zoo station could reduce the need for parking by as many as 200 spaces, as compared to the TSM Alternative.

The LRT Alternative would not only provide improved residential access to the area from both the Eastside and Westside MAX routes, but would also provide improved park-and-ride access to a broader regional market than the TSM Alternative. This would result from improved transit travel times from the Eastside to the Zoo area, and the elimination of the transfer from rail to bus required under the TSM Alternative. In addition, direct transit service between the Zoo/WFC/OMSI complex, downtown hotels, and the Oregon Convention Center would enhance access for out-of-town visitors, particularly as increased marketing for the new Convention Center increases the number of convention visitors. Travel time between the Zoo area and the Convention Center would be nine to ten minutes faster during both peak and off-peak hours with the LRT Alternative as compared to the TSM Alternative (Metro, 1990).

Sylvan Station and Park-and-Ride

This station would be constructed under both Surface LRT options and could be added to the Long Tunnel options. The station would be located northeast of the interchange of Sunset Highway and Skyline Boulevard (see Figure 5.1-4). The station impact area is bisected by Sunset Highway. Total passenger activity would range from 2,200 to 2,500 ons-and-offs, depending on the LRT alignment chosen, with approximately 400 walk-on passengers forecast. Construction of the LRT is expected to have minimal impact on the area south of Sunset Highway, which is part of the Southwest Hills Neighborhood. North of Sunset Highway, construction of the LRT would disrupt the existing neighborhood/highway commercial center. Development impacts associated with the LRT transit station would be limited to this area.

Access to this area, as defined by changes in impedance values, would improve with the provision of an LRT station at the Sylvan interchange (Metro, 1990). The improved accessibility, combined with development opportunities created by construction of the transit station, would support redevelopment of this area.

Sunset Transit Center and Park-and-Ride

The station site, located west of the Sunset Highway/Highway 217 Interchange, has been purchased by Tri-Met and is incorporated into a proposed private development on a 250-acre holding known as the Peterkort Property (see Figure 5.1-4). The development master plan for the property currently includes a significant mixed use development, including hotel, retail, and office facilities, on approximately 134 acres. The transit station would be physically integrated with the development. The zoning to permit such an intensive land use was changed as part of the initial Westside Alternatives Analysis/DEIS process to take advantage of the recommended LRT alignment at that time. In general, development of this parcel would proceed with or without LRT due to its excellent highway access. However, the LRT Alternative is most consistent with the original intent of the upzoning.

Construction of the LRT is not expected to impact development patterns in the remainder of the Sunset Transit Center area. The LRT project is consistent with the proposed Peterkort development under all options. Access to the site would improve as a result of improved travel times and activity levels would increase significantly, as revealed by the 5,100 ons-and-offs projected for this station under the S.W. 185th Avenue terminus option and the 13,000 ons-and-offs projected under the Sunset Transit Center terminus option. Park-and-ride activity at this station is projected to account for approximately 30% of this total, walk-on activity is projected to account for approximately 22% with the remainder being bus transfers under the S.W. 185th Avenue terminus option.

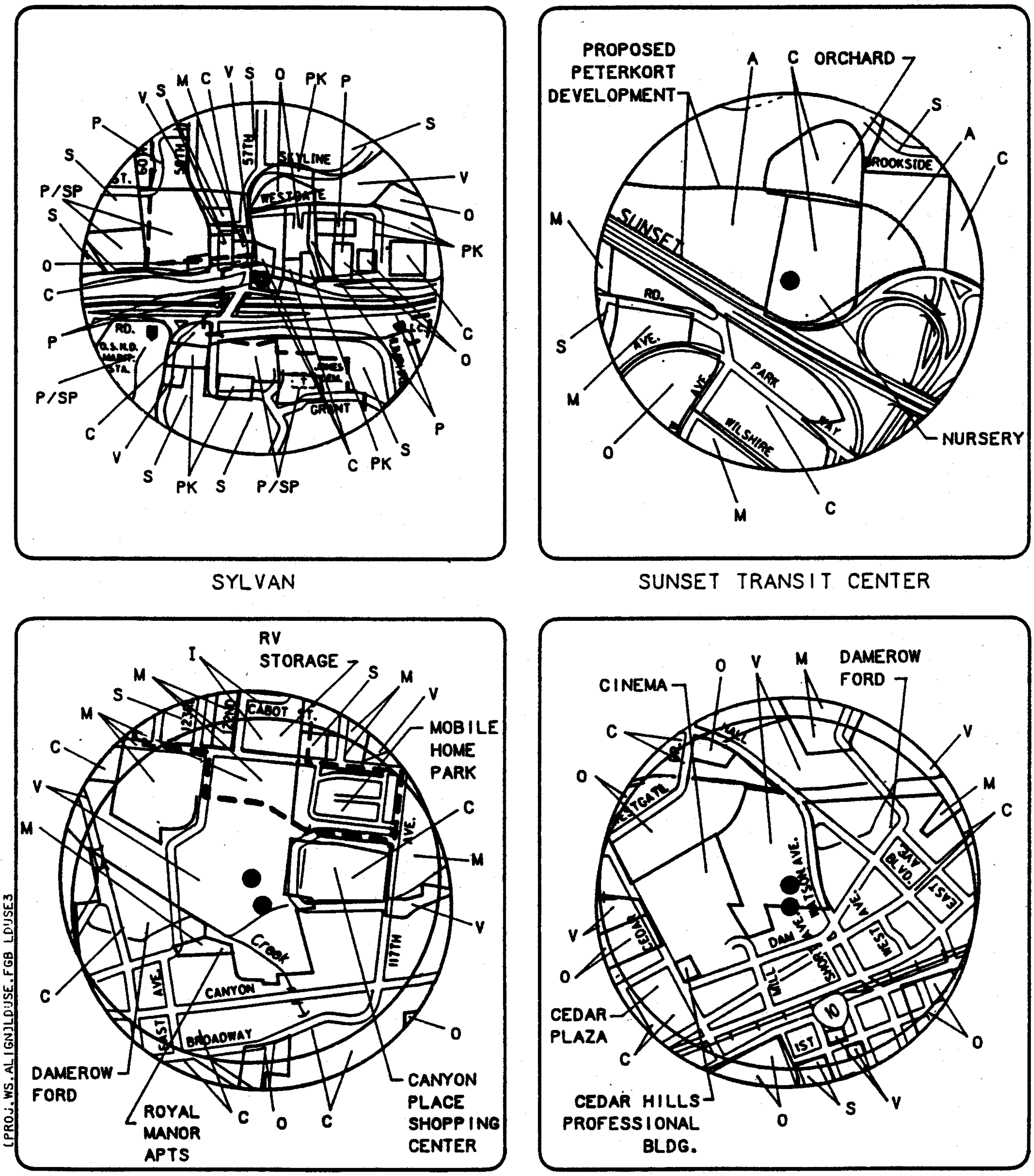
Under the Sunset Transit Center terminus option, the pressure for redevelopment of areas south of Sunset Highway that are currently underdeveloped in terms of zoning potential, such as the Cedar Hill Shopping Center, could increase because perceived LRT benefits would end at this point. Under the S.W. Murray Boulevard or S.W. 185th Avenue terminus options, development impacts on this area would be less, as the real and perceived benefits of LRT would be extended through a larger geographic area.

5.1.3.2 Beaverton Area Stations

Beaverton is the largest city west of Portland. The current demand for commercial development in Beaverton is strong (Robert J. Harmon and Associates, 1989). Beaverton has emerged as an attractive business location because of its proximity to labor, lower land prices, and availability of land as compared to Portland. Current vacancy rates in Beaverton are 19.4% for industrial space, 12.9% for office space, and 7.4% for retail space. Beaverton's trade area characteristics have made it a favorable retail location. According to the Downtown Beaverton LRT Alignment Analysis prepared for the City of Beaverton by Robert C. Lesser and Company (1990), the development and operation of the LRT, coupled with development policies, could alter the distribution of economic activity which might have taken place in its absence. The study presents an aggressive growth scenario with a significant impact on local development patterns. The analysis points out that city policies and programs would need to be instituted to bring about this aggressive growth.

Currently, the Comprehensive Plan for the City of Beaverton contains some land use development policies for the Beaverton CBD that would enable the City to benefit from the proposed LRT. In addition, these policies are designed to develop an identity and sense of place for the CBD. Specifically, these policies include: the reduction of parking in the CBD in order to attract land-intensive developments; development of the uptown area of the CBD to attract office employment and other developments that support the regional focus of the CBD; encouragement of additional office and retail developments in the CBD to assure its role as a regional employment and retail center; and reduction of the CBD's auto dependency to achieve more efficient land use, more jobs, reduced air pollution, improved traffic circulation and fewer parking problems.

In addition, the Draft Downtown Development Plan for the City of Beaverton has recommended several policies in order to keep Beaverton regionally competitive. These policies are: to develop a long-term strategy to promote downtown Beaverton as a transit and pedestrian-oriented district; to promote a greater mixing of land uses in order to provide increased vitality, more efficient use of land, and decreased use of the automobile; and to align the new light rail line and locate stations to ensure the



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BEAVERTON TRANSIT CENTER
(NORTH AND SOUTH OPTIONS)

S.W. WATSON AVENUE
(NORTHSIDE, SOUTHSIDE, & HENRY OPTIONS)

LEGEND

S - SINGLE FAMILY
M - MULTIFAMILY
C - COMMERCIAL
O - OFFICE
I - INDUSTRIAL
A - AGRICULTURE
PK - PARKING
P/SP - PUBLIC/SEMI-PUBLIC
P - PARK & OPEN SPACE
V - VACANT
● - LRT STATION LOCATION

The Oregon Department of Transportation

WESTSIDE LIGHTRAIL
TRI-MET

0' 500' 1000'

WESTSIDE CORRIDOR PROJECT

STATION AREAS
EXISTING LAND USE

FIGURE 5.1-4

development of a compact, pedestrian-oriented commercial core. The city has prepared two zoning concept plans for areas along the LRT alignment options that would further support these goals (see Figures 5.1-1 and 5.1-2).

The LRT would not trigger development on its own, but serves to reinforce the policy intent of these redevelopment plans. There are currently 195 acres of redevelopable land within 1,500 feet of planned LRT stations in Beaverton, with another 42 to 74 acres (depending on alignment options) deemed redevelopable by 2005 (Lesser, 1990).

Beaverton Transit Center

The Beaverton Transit Center is an existing facility north of downtown Beaverton. Current zoning within the Transit Center area is for high density multifamily uses to the north and for Town Center (TC) commercial development to the south (see Figure 5.1-4). The City of Beaverton currently is updating the Central Beaverton Plan, which includes the area through which the LRT would be located.

Walk-on ridership may give some indication of retail activity that could be generated by a transit station. In this regard, activity levels at the Beaverton Transit Center would more than double over the No Build Alternative under the TSM Alternative and either the S.W. Murray Boulevard or S.W. 185th Avenue terminus options of the LRT Alternative (Metro, 1990). The pedestrian activity ranges from 700 to 800 walk-ons, depending upon the LRT alignment option chosen. Much of the commercial area southwest of the Beaverton Transit Center currently is underdeveloped as compared with existing zoning, providing opportunities for redevelopment. The prevalence of small, single lot ownership in this area could limit the attractiveness for redevelopment without sufficient levels of public intervention and support. Specifically, redevelopment would require assembling these parcels into larger parcels under single ownership. Some of this area is classified as wetlands and would be subject to appropriate regulations (see Ecosystems Technical Memorandum [SHAPIRO, 1990]).

S.W. Watson Avenue Station

Existing land uses in the vicinity of the proposed S.W. Watson Avenue Station consist largely of auto-oriented commercial uses, with some office uses to the northwest and multifamily uses to the northeast (see Figure 5.1-4). Existing zoning in the station area is almost exclusively Town Center, which permits high-density office and commercial development.

The Downtown Alignment Analysis prepared for the city concluded that development impacts would be more significant under the Henry Street alignment option than under the BN alignment option because the station would be located closer to existing commercial developments and would support the east-west configuration of existing streets (Lesser, 1990). With the BN option, the proximity of the S. W. Hocken Avenue Station would moderate the potential impact of the S.W. Watson Avenue Station. Walk-on activity at the S.W. Watson Avenue Station is projected at approximately 200 to 300 ons-and-offs with both the S.W. Murray Boulevard and the S.W. 185th Avenue terminus options (Metro, 1990). This level of activity could encourage some minor density increases in the immediate vicinity of the transit station, but is unlikely to have the significant impact on local development patterns described in the Alignment Analysis unless substantial public support is provided for redevelopment.

S.W. Hocken Avenue Station

The S.W. Hocken Avenue Station would be constructed under the BN alignment option with the S.W. Murray Boulevard and S.W. 185th Avenue terminus options. The station would be located along the BN right-of-way, just east of the Tektronix property. Surrounding land uses include the Kuni Cadillac dealership and Beaverton Mall to the north, multifamily uses to the southwest, mixed commercial uses to the south, and Tektronix to the west (see Figure 5.1-5). Existing zoning for the area immediately adjacent to the station is General, which permits auto-oriented commercial development and low-intensity uses. The draft Central Beaverton Plan designates mixed commercial/residential uses in this area, which would promote more transit-supportive development than the existing zoning. This station falls within the same subareas as the S.W. Watson Avenue Station for the purposes of the Downtown

Alignment Analysis prepared for the City of Beaverton; consequently, the conclusions are the same as discussed above (Lesser, 1990).

S.W. 141st Avenue Station

This station would be constructed under the Henry Street alignment option, and would be located at the southeast quadrant of the S.W. 141st Avenue/S.W. Whitney Street intersection. Land use in the area includes a mix of low-intensity commercial, industrial, and residential uses (see Figure 5.1-5). The area currently is zoned General, which is consistent with existing development. For the purposes of this discussion, activity levels are assumed to be similar to those projected for the S.W. Hocken Avenue Station. Given existing zoning, construction of an LRT station at this site could result in intensification of uses on the site of the existing trailer court and the industrial area, both of which are north of the station. The Alignment Analysis, which assumes adoption of zoning as recommended in the Central Beaverton Plan, concludes that land values would be significantly affected and that the area would support commercial and employment uses (Lesser, 1990).

S.W. Murray Boulevard Station and Park-and-Ride

This station would be located west of the BN right-of-way/S.W. Murray Boulevard intersection, and would be constructed under both the BN and Henry Street alignment options. The area immediately adjacent to the station and park-and-ride is vacant land within the boundaries of the Beaverton Business Park (see Figure 5.1-5). The Tektronix campus is located east of S.W. Murray Boulevard. The transit station area is zoned for Campus Industrial, consistent with the surrounding pattern of development. The draft Central Beaverton Plan, however, designates mixed commercial/residential uses for the area immediately north and south of the transit station and park-and-ride.

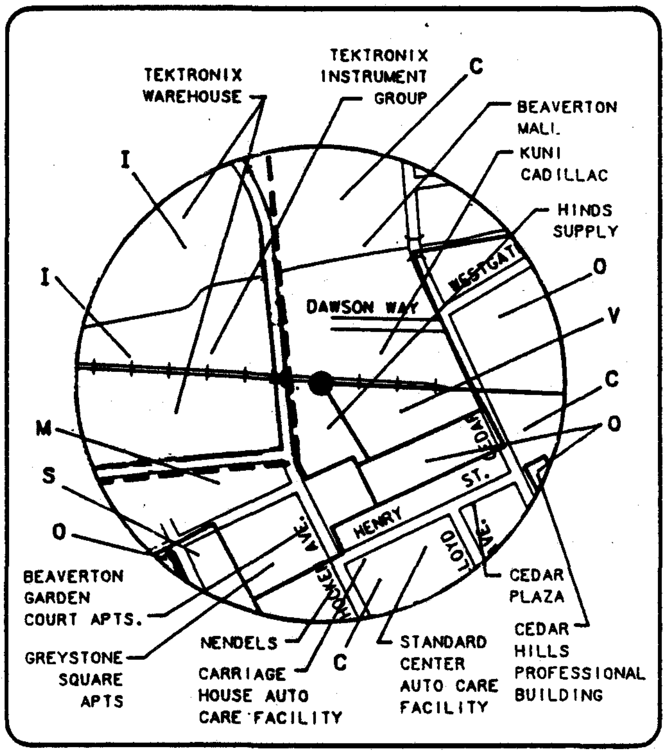
Activity levels at the S.W. Murray Boulevard Station would be high under both the S.W. Murray Boulevard and the S.W. 185th Avenue terminus options, with approximately 2,700 and 1,700 ons-and-offs, respectively. The largest segment of riders would be attributed to park-and-ride access, with approximately 400 ons-and-offs being walk-on riders (Metro, 1990). The provision of park-and-ride lots in suburban areas generally results in less pressure for increased density development around station areas.

This would support the conclusion of the Alignment Analysis, which states that development of an LRT station at this site would have a minimal impact on land values and development patterns (Lesser, 1990). The area in which the station would be located has been experiencing substantial industrial park development in recent years, and that trend is expected to continue. Consequently, it is expected that development patterns would remain stable, but that development could occur at a slightly accelerated pace than would occur without construction of the station.

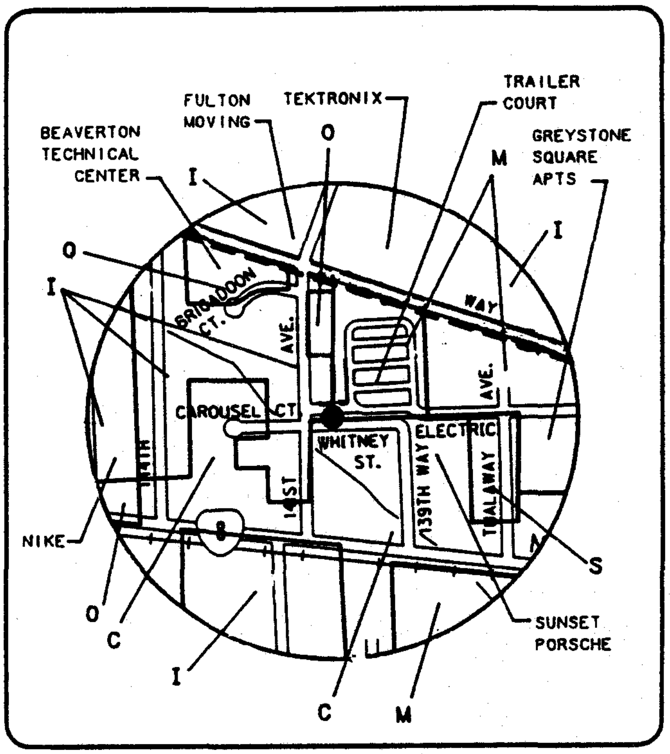
5.1.3.3 Washington County Stations

Economic expansion in Washington County is part of the rapid population growth that has characterized the county over the past several years. Population growth has attracted employers seeking a large, well trained labor force. Numerous residential, commercial, and industrial developments are under construction or planned for the immediate future. Vacancy rates for office, retail, and industrial space in Washington County for the first quarter of 1990 were 18.9%, 9.8% and 13.6%, respectively.

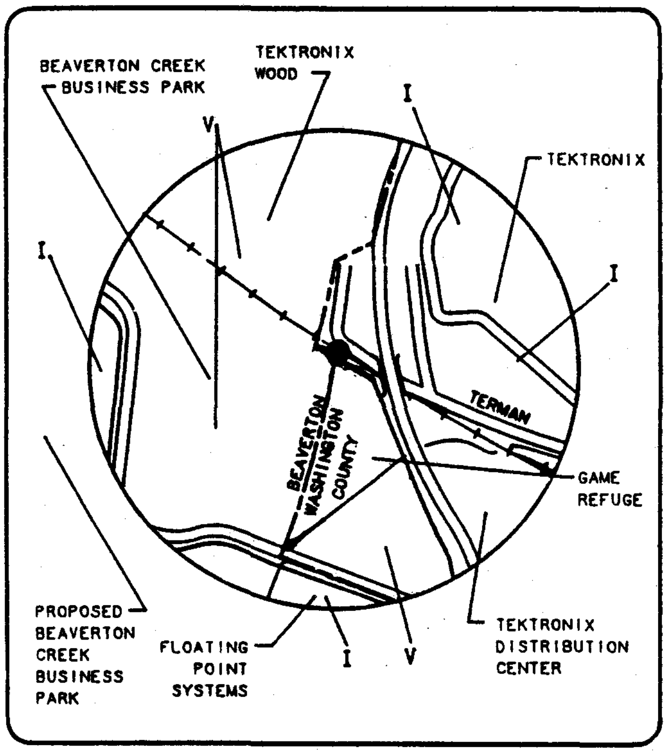
In the area between S.W. 158th and S.W. 185th Avenues, the Washington County Comprehensive Plan provides for two types of LRT overlay districts: the Transit Corridor Overlay District (TCOD) and the LRT Land Use Overlay. The intent of the TCOD, is to preserve the option for future intensification of development in potential transit corridors, while at the same time allowing a certain level of development based on current plans prior to the time the actual transit improvements are made. The purpose is to permit development within the corridor without exceeding the maximum number of units that can be accommodated by the existing transportation system, and to preserve the option for future intensification of development when transit improvements are made.



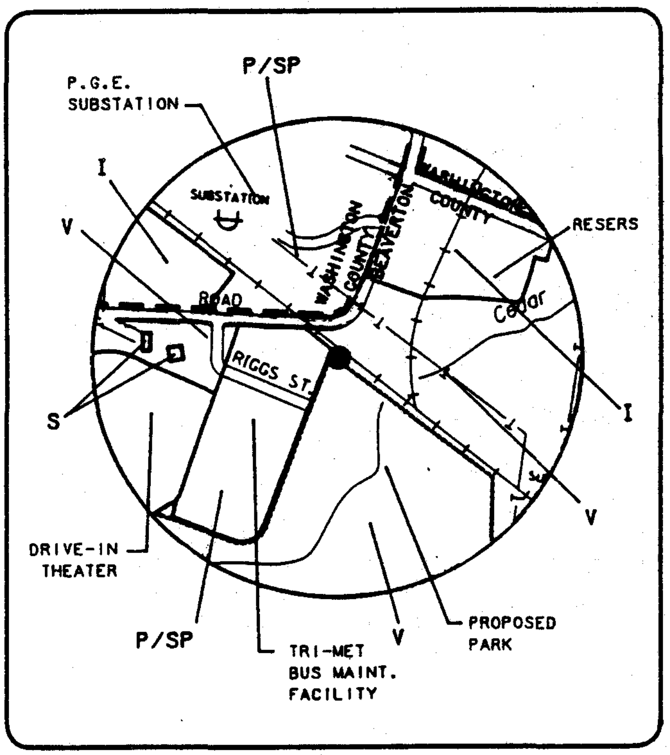
S.W. HOCKEN AVENUE



S.W. 141ST AVENUE (HENRY OPTION)



S.W. MURRAY BLVD



S.W. MERLO ROAD

LEGEND

S - SINGLE FAMILY
M - MULTIFAMILY
C - COMMERCIAL
O - OFFICE
I - INDUSTRIAL
A - AGRICULTURE
PK - PARKING
P/SP - PUBLIC/SEMI-PUBLIC
P - PARK & OPEN SPACE
V - VACANT
● - LRT STATION LOCATION

The Oregon Department of Transportation

WESTSIDE LIGHTRAIL TRI-MET

0' 500' 1000'

WESTSIDE CORRIDOR PROJECT

STATION AREAS EXISTING LAND USE

FIGURE 5.1-5

The LRT Land Use Overlay zone changes the basic land use designations in station areas and along the corridor. The LRT Land Use Overlay is a conceptual plan for these areas that could make major changes in the intensity and density of development with LRT. The Board of County Commissioners has expressed its intent to implement the overlay zone following a build decision. However, formal Board action is required to approve a plan amendment to effect these changes.

S.W. Merlo Road Station and Park-and-Ride

The S.W. Merlo Road Station would be constructed under the S.W. 185th Avenue terminus option, and would be located southeast of the S.W. Merlo Road/S.W. 158th Avenue intersection. The station would provide access to the proposed Tualatin Hills Nature Park located to the southeast of the station. Other surrounding uses include the Tri-Met Bus Maintenance Facility, a drive-in theater, the Oregon Primate Center, and a P.G.E. substation (see Figure 5.1-5). The area is zoned for industrial and institutional uses, except for the proposed park, which is zoned high-density multifamily. Activity levels at this station are expected to average approximately 500 daily ons-and-offs, two-thirds of which will be due to park-and-ride access, with approximately 100 walk-on riders forecast (Metro, 1990). Development impacts are not expected to result from construction of this station.

S.W. 170th Avenue Station and Park-and Ride

The S.W. 170th Avenue Station would be located on the BN right-of-way east of S.W. 170th Avenue. The area is characterized by agricultural land and scattered single-family residences, with some minor commercial and industrial activity concentrated at the intersection of S.W. Baseline Road and S.W. 170th Avenue. Zoning in the station area consists of industrial uses and medium density multifamily residential uses (see Figure 5.1-6). Projections indicate that this area will experience substantial growth by 2005.

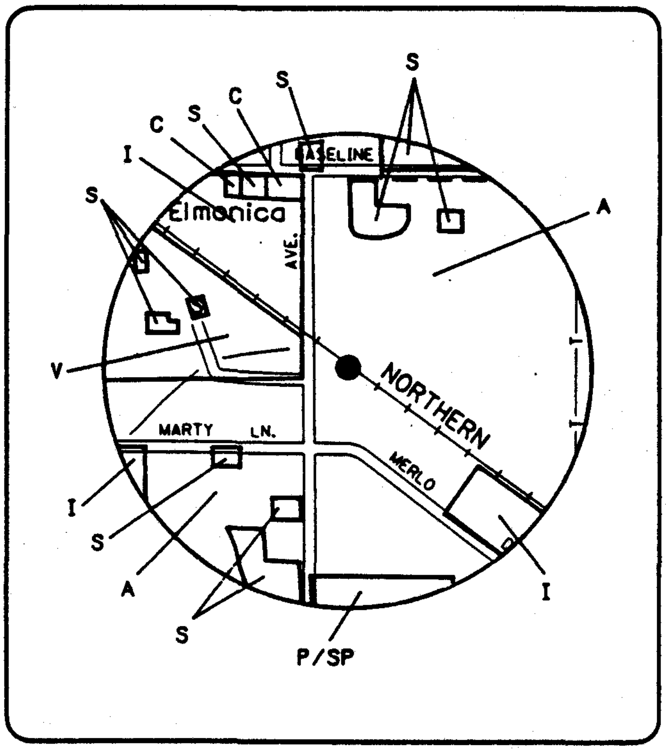
Ridership activity is expected to average 1,800 persons per day, approximately 1,000 of whom would use park-and-ride access, and 600 that would be walk-on riders (Metro, 1990). Construction of the LRT station would not be expected to significantly affect land values or development patterns, unless Washington County adopted the LRT Land Use Overlay in this area.

The LRT Land Use Overlay, as previously described (see Corridor Level discussion) would permit higher intensity uses in the vicinity of the transit station. This could include high-density multifamily uses, and higher intensity office, commercial, and industrial uses. Also included in the LRT Land Use Overlay was a regional mall site which, if adopted at this station area, could provide an opportunity for joint public-private development. The extent to which such development would occur would also depend on the level of public investment in roads and other infrastructure in the area.

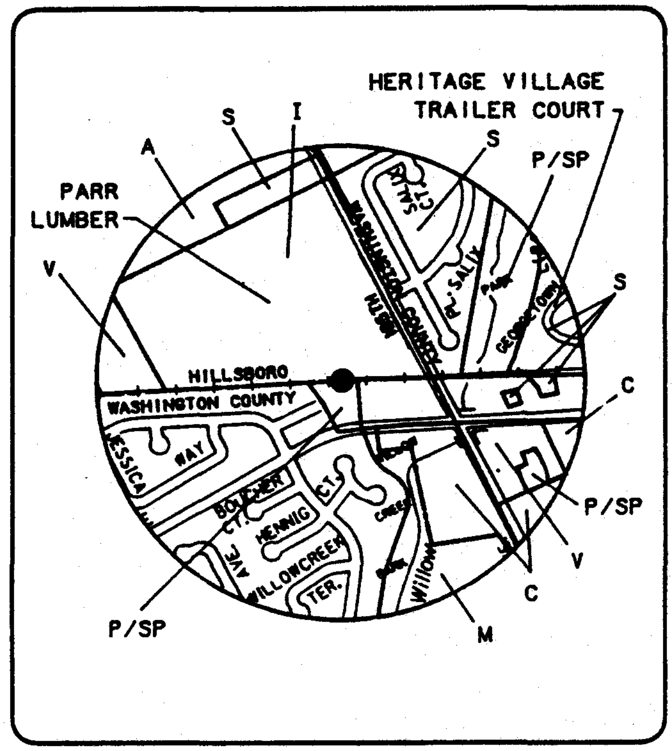
S.W. 185th Avenue Station and Park-and-Ride

This station is located just within the Hillsboro city limits, and represents the westernmost terminus option for the Westside Corridor LRT. The station would be located west of S.W. 185th Avenue north of the BN right-of-way. The station area consists of single-family residential uses to the south, west, and east (see Figure 5.1-6), and commercial use (i.e., the Parr Lumber yard), north of the station. The southeast quadrant of the station area is a mix of commercial, multifamily residential uses and vacant land. Existing land use configurations meet the existing zoning requirements.

Activity levels would be approximately 6,400 ons-and-offs per day, with over half attributed to bus transfers from outlying areas and most of the remainder, to park-and-ride access. Consequently, development of the station is not expected to affect land use in the station area. The City of Hillsboro, however, currently is revising their Comprehensive Plan for the portion of the station area within its jurisdiction, and will be evaluating land uses in light of promoting transit supportive development. The remainder of the area, located in unincorporated Washington County, could be subject to the LRT Land Use Overlay zone, which could promote redevelopment in the southeast quadrant of the station area. The existing single-family neighborhoods would not be affected by construction of the LRT station.



S.W. 170TH AVENUE



S.W. 185TH

LPROJ.WS.ALIGN]LDUSE.FGB LDUSE4

LEGEND

S - SINGLE FAMILY
M - MULTIFAMILY
C - COMMERCIAL
O - OFFICE
I - INDUSTRIAL
A - AGRICULTURE
PK - PARKING
P/SP - PUBLIC/SEMI-PUBLIC
P - PARK & OPEN SPACE
V - VACANT
● - LRT STATION LOCATION

The Oregon Department of Transportation

WESTSIDE LIGHTRAIL TRI-MET

0' 500' 1000'

WESTSIDE CORRIDOR PROJECT

STATION AREAS
EXISTING LAND USE

FIGURE 5.1-6

5.1.4 Impacts on Services and Tax Base

The Westside Corridor study area is located within the Urban Growth Boundary (UGB) of the Portland metropolitan area. In accordance with statewide land use planning goals, all areas within the UGB are appropriate for urban development, and will be provided with urban-level services. The transportation improvements would not affect the overall rate of development in the corridor and, consequently, development impacts resulting from the transportation alternatives would not require the provision of infrastructure in addition to that already anticipated. However, development impacts associated with transit facilities could affect the location of where infrastructure investments are needed. Impacts to the tax base resulting from the provision of infrastructure to service development near transit stations and highway interchanges would not be significant. In those cases where infrastructure was not in place, development would be tied to the provision of necessary services and utilities.

5.1.5 Economic and Employment Impacts

Economic and employment impacts, as a result of the construction and operations phases of the project, would be experienced throughout the Portland region. Project expenditures would filter through the local economy triggering additional and secondary economic activity; specifically, more consumer and business spending.

The following sections summarize the construction-related and operational impacts associated with each of the project alternatives. Direct, indirect, and induced employment impacts are discussed as they relate to both the construction and operational phases of the project.

5.1.5.1 Construction Phase

Employment impacts during the construction phase generally consist of short-term, temporary increases in construction jobs and the subsequent economic activity generated by those jobs (see Table 5.1-3). Economic activity generated by the construction phase is dependent upon the alternative selected, the duration of the construction phase, the size of the local labor pool, and the availability of materials and services in the area.

Table 5.1-3

ECONOMIC AND EMPLOYMENT IMPACTS

	TSM*	LRT* (S.W. 185th Avenue Terminus)
Economic Impact in Oregon (million $)		
Direct	$186	$766
Indirect	$279	$1,147
Total	$465	$1,913
Job-years Created by Project in Oregon		
Direct	1,910	9,140
Indirect	2,880	13,710
Total	4,790	22,850

*Includes Highway Improvements.

Source: Public Financial Management, Inc., 1990.

The estimated expenditures for the TSM Alternative would create approximately $465 million in economic activity in Oregon, over a period similar to the construction period assumed for the LRT Alternative. This level of activity is estimated to create 1,910 direct person-years of employment and 4,790 total person-years of employment, including secondary effects.

Construction of the Long Tunnel LRT options to S.W. 185th Avenue, the most costly options, are estimated to create $766 million of direct expenditures and $1.1 billion of indirect expenditures, for a total economic impact in Oregon of $1.9 billion (year of construction $) through 2000 (Public Financial Management, Inc., 1990). These numbers assume that each dollar of direct expenditure creates $2.50 of indirect expenditures, which is based on an analysis of studies that have been prepared for the Westside Corridor Project, the Oregon Convention Center, the Oregon Department of Transportation, and the Oregon Department of Economic Development. These numbers also assume that approximately 27% of the project's materials and equipment expenditures and 10% of labor expenditures are outside the State of Oregon, which is based on the Banfield LRT construction experience.

An analysis of the LRT Alternatives expenditures for labor during the construction period has concluded that approximately 9,140 person-years of employment would be generated in Oregon directly as a result of construction activities. The total number of job-years generated, including the secondary jobs (as a result of the multiplier effect), would be approximately 22,850 (Public Financial Management, Inc., 1990).

The decreased expenditures associated with the Northside option would create approximately 10% less employment and economic activity as compared to the Long Tunnel options. Lower construction costs associated with the S.W. Murray Boulevard and Sunset Transit Center terminus options would result in approximately 20% and 48% less employment and economic activity, respectively, than the Long Tunnel options to S.W. 185th Avenue.

5.1.5.2 Operations Phase

Long-term impacts include changes in employment as a direct result of the operation and maintenance of the facilities associated with each alternative.

The minimal expansion of bus service under the No Build Alternative would result in a nominal expansion of Tri-Met's workforce for both the maintenance and operation of the bus and rail system within the Westside Corridor (see Table 5.1-4). The TSM Alternative would result in approximately 196 more jobs in operation and maintenance of transit facilities at Tri-Met than the No Build Alternative by 2005. These jobs would consist mostly of bus operator and service mechanic positions. Average annual salaries (full-time) for these types of jobs range from $27,000 to $31,000 (Tri-Met, 1990).

The LRT Alternative would result in approximately 107 to 120 more total jobs in operations and maintenance facilities at Tri-Met than the No Build Alternative. Most of these jobs would be associated with the expanded feeder bus system, and would include operations and maintenance positions. The increase in employment and income under all LRT options would be less than under the TSM Alternative. Among the LRT options, the greatest increase in employment and income would result from the Long Tunnel options to S.W. 185th Avenue.

5.2 DISPLACEMENTS AND RELOCATION

5.2.1 Displacements

Displacement and relocation impacts are summarized in Table 5.2-1. A more detailed discussion of displacements and relocation is presented in Technical Memorandum 20b. Discussions concerning minority or low-income displacements are based on data obtained in a late-1989 survey of affected businesses and residences.

Table 5.1-4

TRI-MET EMPLOYMENT IMPACTS
WITHIN THE WESTSIDE CORRIDOR
Year 2005

	No Build	TSM	Surface to 185th	Tunnel to 185th	Surface to Murray	Surface to Sunset TC
TOTAL TRANSIT EMPLOYEES	351	547	460	471	467	458
Total Direct Economic Impact* (millions, 1990 dollars)	$21.5	$27.1	$23.8	$23.7	$24.1	$22.9

*Estimated operations and maintenance costs associated with each alternative.

Source: Tri-Met Financial Planning, 1990.

No businesses or residences would be displaced under the No Build Alternative. Displacement under the TSM Alternative would result primarily from highway-related improvements. Specifically, the highway- related improvements at the Sylvan Interchange would displace two service stations at the northeast quadrant of the Interchange. At the S.W. Canyon Road Interchange, two single-family homes would be displaced. In addition, eight units of an apartment complex just south of Sunset Highway would be displaced. One single-family home would be displaced on the west side of Sunset Highway at the S.W. Cabot Street overpass. A proposed park-and-ride lot at S.W. 198th Avenue and T.V. Highway would displace three single-family homes.

Displacement under the LRT Alternative ranges between 21 and 89 residential units and 5 to 39 businesses (see Table 5.2-1). In the canyon segment, two fewer residential units and 15 fewer businesses would be displaced with the Long Tunnel alignment options than with either Surface alignment option. Differences in displacement between the North and South alignment options within the East Beaverton segment are minor. They include one additional multifamily unit and three fewer businesses with the North alignment option. Within the Beaverton segment, the Henry Street alignment option displaces 11 residential units and nine businesses, as compared with the BN alignment option, which would cause no displacements. Assuming the previously adopted LRT alignment options were built, displacements would range from 23 residences and 20 businesses, for the Sunset Transit Center terminus option, to 77 residences and 30 businesses, for the S.W. 185th Avenue terminus option.

In downtown Portland, four business along S.W. 18th Avenue would be displaced.

In the canyon segment, displacement impacts would be the same for both the Southside and Northside alignment options, with the majority of impacts occurring at the Sylvan Interchange (Table 5.2-1). In the northeast quadrant of the interchange, four businesses and approximately 117 jobs would be affected. The highway improvements affect a residential area on the south side of the highway at the S.W. Canyon Road on/off ramp. The impacts would be the same as under the TSM Alternative. For both the Southside and Northside options, a total of 23 residential units, 69 residents, 17 businesses, and 173 employees would be displaced. The displacement impacts would be the same for both Long Tunnel alignment options, and would include a single-family home on S.W. Jefferson Street. The Long Tunnel options have the same displacement impacts as those outlined under the TSM Alternative described

Table 5.2-1
DISPLACEMENT AND RELOCATION

ALTERNATIVE	Single-Family Residential Units Displaced	Multifamily Residential Units Displaced	Number of Residents Displaced	Number of Businesses Relocated	Number of Employees Relocated	Number of Acres of Business Land Acquired [1]
No Build	0	0	0	0	0	0
TSM	6	8	42	2	12	0.65
LRT Adopted Alignment:						
Sunset Transit Center Terminus	5	18	69	20	237	4.17
S.W. Murray Boulevard Terminus	13	58	213	26	285	5.07
S.W. 185th Avenue Terminus	19	58	231	30	374	32.28
LRT ALIGNMENT OPTIONS [2]						
Canyon Segment:						
Southside (adopted)	5	18	69	17	173	3.07
Long Tunnel						
With station	5	16	63	2	12	0.65
Without station	5	16	63	2	12	0.65
Northside	5	18	69	17	173	3.07
East Beaverton:						
South (adopted)	4	40	132	6	48	0.91
North	4	41	135	1	8	0.75
Beaverton						
BN (adopted)	0	0	0	0	0	0
Henry Street	5	6	33	9	46	1.65
Segments Common to All Alignment Options[3]	10	0	30	7	153	

[1] Includes only land area where business are displaced
[2] Includes only data for the specific segment of the alignment
[3] To S.W. 185th Avenue Terminus

Source: Tri-Met, 1990.

above. For both tunnel options, a total of 21 residential units, 63 residents, two businesses, and 12 employees would be displaced.

From the Sunset Transit Center to S.W. Cabot Street, the transit alignment lies along the west side of Highway 217. In this segment, two single family homes would be displaced north of S.W. Walker Road.

In East Beaverton, from S.W. Cabot Street to S.W. Watson Avenue, two alignment options are under consideration: the North option and the South, or previously adopted, option. With the North option, displacement between S.W. Cabot Street and S.W. 117th Avenue is primarily residential, consisting of four single-family homes and 16 apartments. Two businesses also would be displaced. Between S.W. 114th and S.W. 117th Avenues, 25 apartments in the Lynmarie Manor Apartments would be displaced, as the alignment bisects the complex. One business would be displaced on S.W. Hall Road. In total, 45 residential units, 135 residents, one business, and eight employees would be displaced.

Displacements under the South alignment option would be the same as the North alignment between S.W. Cabot Street and S.W. 114th Avenue. In addition, the entire Royal Manor Apartments complex on S.W. Beaverdam Road would be displaced. Four retail spaces would be displaced at the Canyon Place Shopping Center, and one business would be displaced on S.W. Beaverdam Road at S.W. Watson Avenue. In total, 44 residential units, 132 residents, six businesses, and 48 employees would be displaced.

In central Beaverton, from S.W. Watson Avenue to S.W. Murray Boulevard, two alignment options are being considered: the BN right-of-way and Henry Street. There are no displacements with the BN alignment option. The Henry Street option would displace a single-family home and a business on S.W. Beaverdam Road and a business on Cedar Hills Boulevard. Several residential units would be displaced on S.W. Hocken Street and S.W. Tualaway. One business on S.W. 141st Street would be displaced. In total, the Henry Street option would displace 11 residential units, 33 residents, nine businesses, and 46 employees.

Displacements on the alignment segment from S.W. Murray Boulevard to S.W. 185th Avenue would occur west of S.W. 170th Avenue. In total, six residential units, four businesses, and approximately 107 employees would be displaced.

5.2.2 Mitigation

A relocation assistance program would assist displaced businesses and residents. This program would be designed according to the guidelines of the ODOT's Relocation Assistance Program and the Uniform Relocation Assistance and Real Property Acquisition Regulations for Federal and Federally Assisted Programs (March 2, 1989). Under these federal and state guidelines, relocation experts would explain all relocation programs to the affected people, who also would receive assistance in preparing and filing reimbursement claims, and in completing forms required by lending institutions, the Small Business Administration, and others associated with the lease or purchase of new properties. All properties required for the highway and transit improvements would be acquired by Tri-Met and/or ODOT at fair market value.

Every effort would be made to help displaced residents and businesses relocate within their community. Tri-Met's preliminary relocation survey indicated that more-than-adequate housing is available in a wide price range in the project area. Choices are available for most of the businesses that would be displaced under the LRT Alternative. The exceptions would be the two service stations displaced under the TSM and LRT Alternatives, and the two restaurants displaced under the Northside and Southside alignment options of the LRT Alternative. If these businesses are unable to relocate, a fixed payment will be made in lieu of other relocation benefits.

5.3 NEIGHBORHOODS

Each of the alternatives would provide service to most of the neighborhoods in the corridor, identified in Section 3.3.1.1 and Figures 3.3.1a and 3.3.1b. However, the level of service would vary depending on the alternative and, for the LRT Alternative, on the alignment option.

Many factors that could affect neighborhood cohesion or quality of life have been evaluated, and their impacts are described, in other sections of this document. These include: displacements, Section 5.2; noise and vibration, Section 5.6; visual quality and aesthetics, Section 5.4; local traffic and parking, Chapter 4.0; access to community facilities, Section 5.1; parklands, Chapter 6.0; historic resources, Chapter 6.0; wetlands, Section 5.7; hazardous wastes, Section 5.11; and, natural hazards, Sections 5.10 and 5.11. These sections evaluate the project alternatives with respect to their impacts on individual properties, residents, businesses, and other resources. This discussion considers the larger neighborhood areas with respect to cumulative or neighborhood-wide impacts.

Through the ongoing citizen involvement process, individual neighborhoods have identified issues of concern within their local areas. These areas of concern include: the location of the east portal, if a tunnel option is chosen; visual impacts of a surface LRT option in the Sunset Highway canyon; and, local traffic circulation in the area of the proposed S.W. 76th Avenue overpass.

These issues have been evaluated and, where possible, the design of the project has been revised or mitigation has been included to address the issues. The impacts have been identified in the respective analyses, and will be taken into account or modified through either the preferred alternative decision or the Final EIS.

5.3.1 Barriers to Social Interaction

The No Build Alternative would not impose additional physical barriers to social interaction or neighborhood cohesion. However, increased traffic congestion in the corridor would result in increased through-traffic in some neighborhoods, as commuters attempting to avoid highway and arterial congestion seek alternative routes using local streets.

The TSM Alternative would result in an increased number of articulated buses on streets projected to be congested. The increased number of buses would not create barriers to social interaction. Proposed highway improvements are along existing highways and would not create any new long-term physical barriers to social interaction.

The LRT Alternative would not result in long-term barriers to social interaction in most neighborhoods along the alignment options. In general, the LRT facilities would be located within existing right-of-way and along highways, and would not divide neighborhoods. In the Goose Hollow neighborhood, some people feel the LRT facilities would reinforce the existing division of the neighborhood caused by S.W. 18th Avenue and S.W. Jefferson Street. Conversely, others feel that the LRT would benefit the neighborhood by eliminating non-neighborhood through traffic, and creating a more pedestrian-friendly environment. Proposed highway improvements are along existing highways and would not create any new long-term physical barriers to social interaction.

In Beaverton, social barrier impacts differ depending on the alignment option. Both the North and South options in East Beaverton would displace portions of existing apartment complexes. This would not jeopardize the viability of the remaining units. In addition, the South option would bisect the Canyon Place Shopping Center. However, LRT was anticipated within the center's original design. Along the Henry Street option in Central Beaverton, construction of LRT would limit access to businesses and residences from S.W. Henry Street. On the Tektronix campus (Howard Vollum Park), the presence of the LRT facilities along the BN option would reinforce the existing campus division caused by the BN Railroad right-of-way and tracks.

5.3.2 Pedestrian and Bicycle Travel

The RTP provides for an integrated network of separated and shoulder bike lanes connecting major destinations in the region. Funding for construction of bicycle lanes is provided by Oregon law, which allocated 1% of gas tax revenues for that purpose. Therefore, under all alternatives bicycle travel would be enhanced as new bike paths are constructed in the region.

Under the TSM and LRT Alternatives, a bike path would be constructed between the Zoo Interchange and the Highway 217 Interchange. This would provide a bicycle connection between the Central City and Westside neighborhoods. With the No Build Alternative, this bike path would not constructed.

The No Build Alternative would affect pedestrians and bicyclists in neighborhoods, as increased traffic volumes on through streets and congestion at intersections exacerbate the potential for conflict between motorized vehicles and pedestrians and bicyclists. The TSM Alternative would have a minor impact on pedestrian and bicycle travel, resulting from increased bus volumes.

The proposed LRT improvements would enhance the pedestrian environment within some neighborhoods, such as downtown Portland, Goose Hollow, and Central Beaverton, because of the addition of sidewalks and landscape treatments.

5.3.3 Access to Community Facilities

The No Build Alternative would impair access to community facilities through increased traffic congestion and increased travel time. The TSM Alternative would result in some improvements in travel time and reduced congestion. Because many community facilities are located in downtown Portland, both the No Build and the TSM Alternatives would lead to increased automobile or bus traffic, in the downtown area.

Compared with the No Build Alternative, the TSM and LRT Alternatives would increase access between most neighborhoods in the Westside Corridor and regional facilities, including local, state, and federal offices, in downtown Portland; the Civic Stadium; the Oregon Convention Center; Memorial Coliseum; the Portland Center for the Performing Arts; and numerous retail centers throughout the metropolitan area. The LRT Alternative would provide for faster travel time to these facilities than the TSM Alternative, and would make them more accessible to a larger population (see Chapter 4).

Access to Washington Park facilities, including the Washington Park Zoo would be improved under all LRT alignment options except the Long Tunnel without Zoo station. The partial closure of S.W. Canyon Court would result in decreased auto access to the Zoo's overflow parking lot; however, with all but the Long Tunnel without Zoo station alignment option, this loss of access to overflow parking is expected to be offset by improved transit service and access to 3,500 park-and-ride spaces in the corridor.

Disabled people would find their access to community facilities increased with both the TSM and LRT Alternatives, as the bus fleet would be expanded with accessible vehicles. All LRT stations would be equipped with lift equipment for physically disadvantaged riders.

5.3.4 Safety and Security

Safety or security in existing neighborhoods would not be affected by any of the alternatives. Reports from police officials in jurisdictions served by the existing MAX LRT line show no causal connection between LRT stations and criminal activity in surrounding neighborhoods (Vicars, 1991).

Safety and security measures currently in place within the neighborhoods and on the transit system would be continued. These include the Portland Police Bureau Transit Police Unit, which patrols transit vehicles and is available to investigate complaints and answer emergency calls. Tri-Met is considering installing surveillance equipment on platforms, at park-and-ride lots, and on transit vehicles.

The TSM and LRT Alternatives would incorporate design features as necessary to ensure safe operation of the transit system. With the LRT Alternative, along most of the right-of-way outside downtown Portland, the LRT alignment would be physically separated, fenced, or equipped with safety devices such as signals and gated crossings, to ensure safe operation of the system.

Additional safety and security measures that would be built into the LRT design include security lighting at platforms and park-and-ride lots; telephones on all LRT platforms; and site design to minimize security risks throughout the LRT system (i.e., no dense shrubs or bushes near platforms or waiting areas).

5.4 VISUAL AND AESTHETIC RESOURCES

5.4.1 Summary

Each of the alternatives would have an impact on the visual resources of the study area. Under the TSM and LRT Alternatives, the visual quality of the study area would be modified by construction of new stations and park-and-ride lots, road cuts, overpass structures, railbeds and track, retaining walls, and landscaping. Substations, overhead catenary systems, new stations, and park-and-ride lots would be similar in appearance to those on the existing Eastside line (see Figure 2.2-8). Other physical elements of the system would include sound walls, safety rails, barriers, and fences.

The study corridor was divided into 27 units for assessing visual quality (see Figures 5.4-1a and 1b). Assessment was based on three criteria: vividness/memorability, intactness/visual integrity, and unity/compositional harmony . Each of these criteria was rated on a weighted scale for a given landscape unit. The overall visual rating is based on a composite of the three criteria. All three elements must rate high for the landscape to be considered high in visual quality.

Visual impact was calculated from three factors: extent of visual resource displacement, extent to which the proposed project would change existing visual resources, and viewer response to the changes in the visual resource. The extent of the unmitigated visual impact (amount of visual change) was compared with existing visual quality to determine the resulting unmitigated visual quality rating depicted in Table 5.4-1.

The No Build Alternative would have minimal effect on the visual quality of the Westside Corridor. Impacts to visual features resulting from the TSM and LRT Alternatives are discussed in Sections 5.4.2 and 5.4.3. Table 5.4-2 summarizes retaining wall exposure under the LRT Alternative.

5.4.2 TSM Alternative - Visual Impacts

This discussion includes only those segments that would be affected by the highway improvements proposed as part of the TSM Alternative.

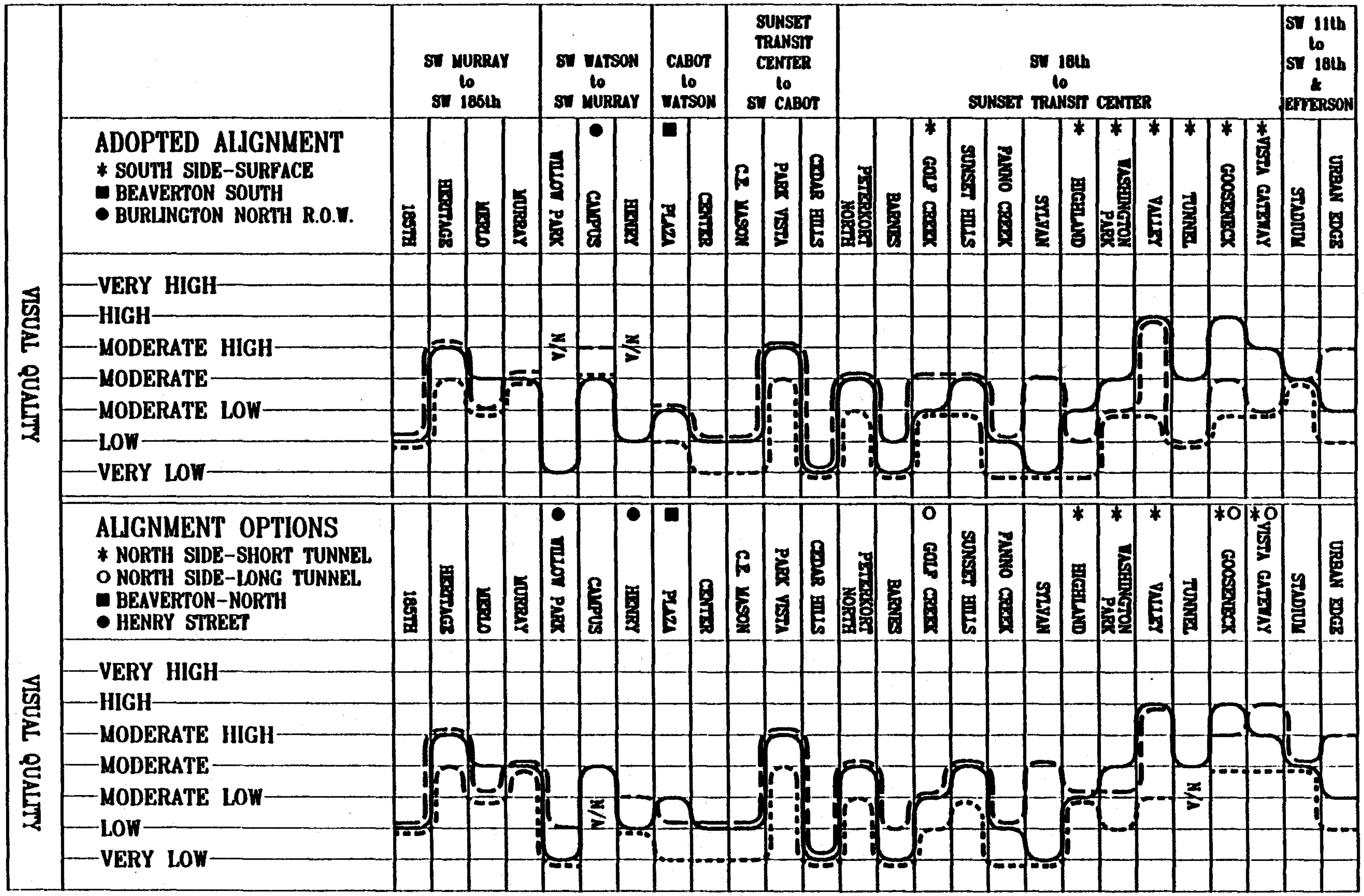
5.4.2.1 S.W. 18th Avenue/S.W. Jefferson Street to Sunset Transit Center

The existing visual quality rating of this segment ranges from "high" to "very low", and averages "moderate". For the eight landscape units directly affected by the proposed improvements the existing visual quality ranges from “moderate” to “very low”, averaging “moderate”. This segment contains eight landscape units that would be affected by TSM improvements (see Figure 5.4-1a). Large areas of existing mature vegetation would be removed in the eastern portion of this segment. Highway improvements would include overpass structures, road cuts, retaining walls, additional lanes, a bicycle path, and landscaping. Other physical elements that would be introduced include safety rails, barriers, and fences.

The TSM Alternative would result in a greater dominance of highway-related structures within this segment. The resulting visual quality of this segment is projected to range from "moderate" to "very low", averaging "moderately low".

Table 5.4 - 1

VISUAL ANALYSIS SUMMARY CHART



EXISTING

UNMITIGATED VISUAL QUALITY

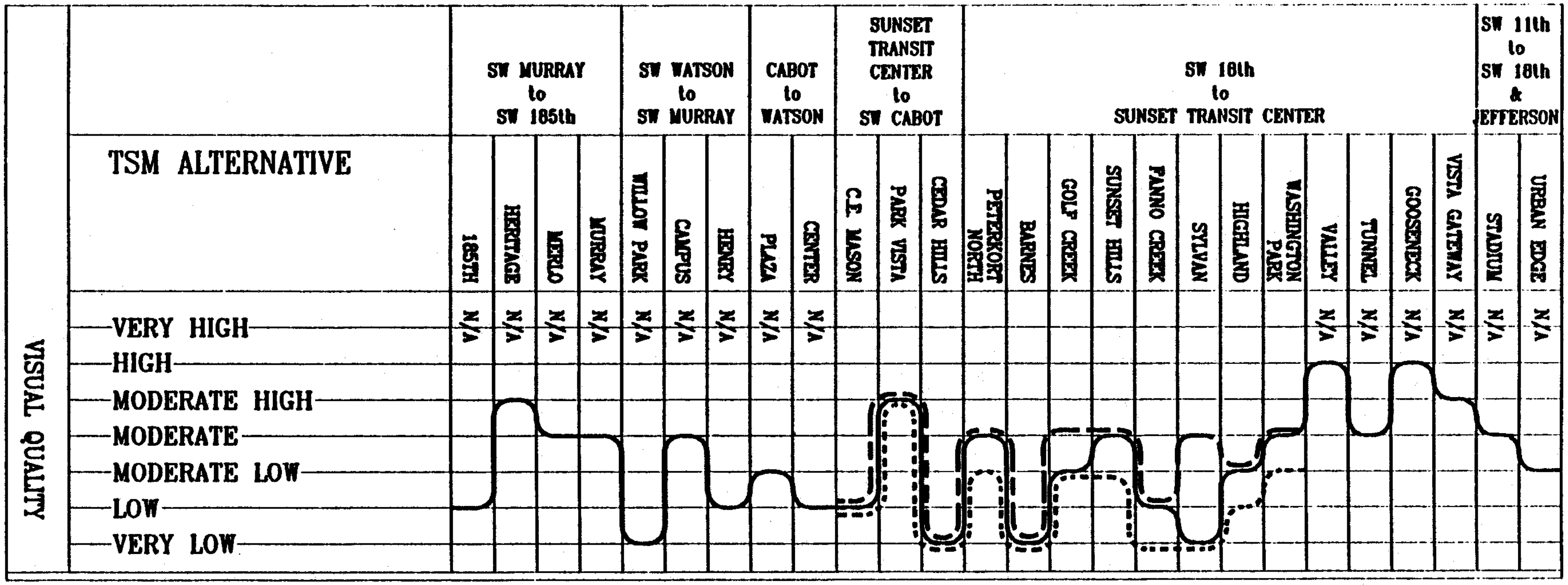
MITIGATED VISUAL QUALITY

SOURCE: WILSEY & HAM PACIFIC
ZIMMER GUNSUL FRASCA

VISUAL ANALYSIS SUMMARY CHART: The mitigated and unmitigated alignments are compared to the existing visual quality for the different alignment options. Units not designated as an option are common to all alignments.

Table 5.4 - 1 (continued)

VISUAL ANALYSIS SUMMARY CHART



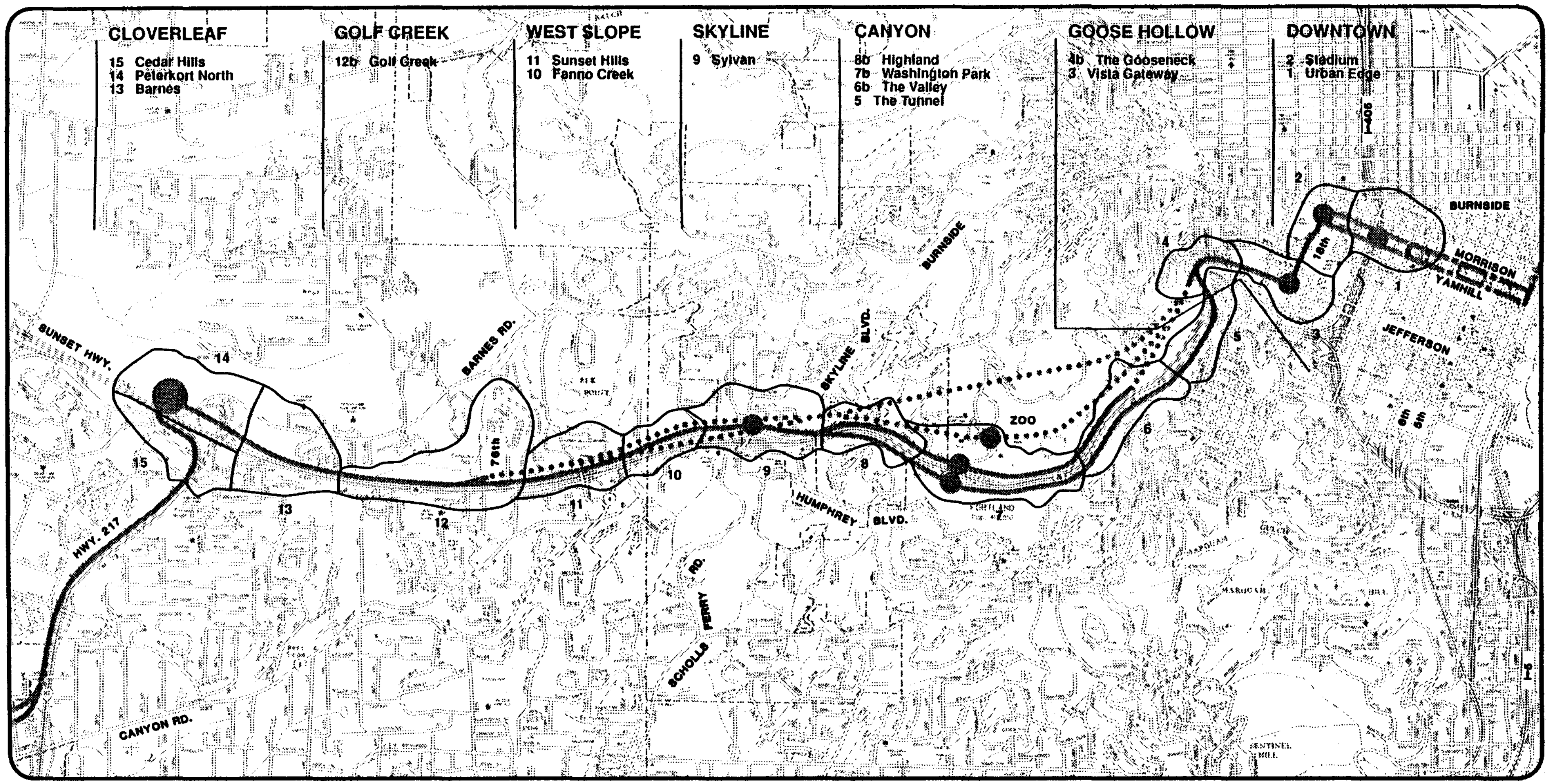
EXISTING

UNMITIGATED VISUAL QUALITY

MITIGATED VISUAL QUALITY

SOURCE: WILSEY & HAM PACIFIC
ZIMMMER GUNSUL FRASCA

VISUAL ANALYSIS SUMMARY CHART: The mitigated and unmitigated alignments are compared to the existing visual quality for the different alignment options. Units not designated as an option are common to all alignments.



Source: Wilsey & Ham Pacific, 1990

SCALE-FEET
0 2000 4000

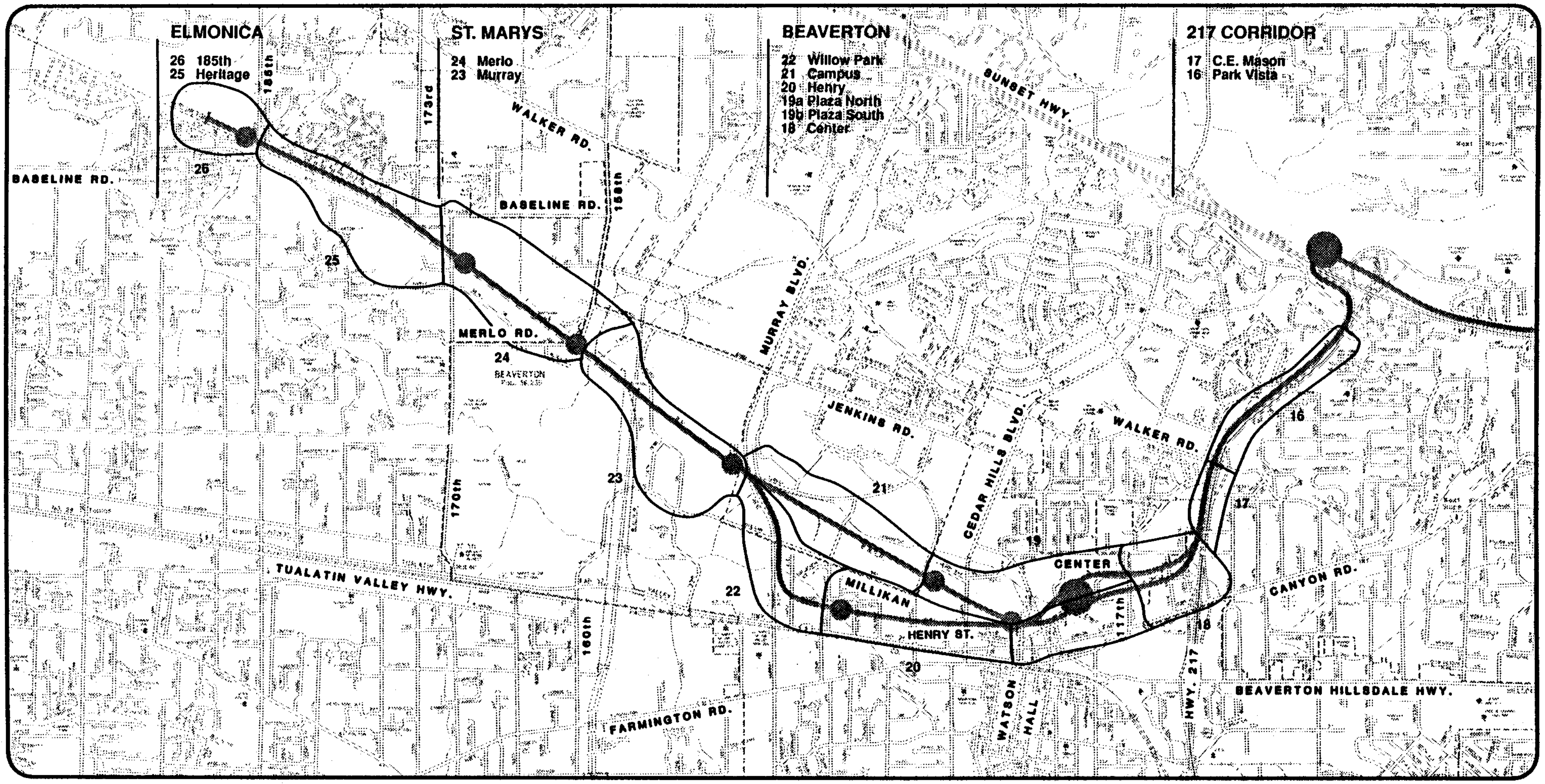
Westside Corridor Project

Visual Landscape Units

The Oregon Department of Transportation

Westside Light Rail TRI-MET

Figure 5.4-1a
1 of 2



Source: Wilsey & Ham Pacific, 1990

Westside Corridor Project

Visual Landscape Units

The Oregon Department of Transportation

WESTSIDE LIGHT RAIL TRI-MET

Figure 5.4-1b
2 of 2

5.4.2.2 Sunset Transit Center to S.W. Cabot Street

This segment contains three landscape units. Existing visual quality ranges from "high" to "very low", averaging "moderately low". The highway improvements in this segment include on-ramp expansions, lane widening, retaining walls, the elimination of an overpass structure, loss of vegetation, and areas of cut-and-fill. The proposed improvements would cause relatively little visual change in an area currently characterized by views of highway facilities and other structures. Resulting visual quality would be the same as existing visual quality.

5.4.3 <u>LRT Alternative - Visual Impacts</u>

5.4.3.1 S.W. 11th Avenue to S.W. 18th Avenue/S.W. Jefferson Street

The existing visual quality rating of this segment ranges from "moderate" to "moderately low". This segment contains two landscape units. The LRT alignment is similar with all options and includes LRT facilities mixed with the urban environment, generally at grade and within existing right-of-way. The proposed improvements would introduce a major change in the visual environment of the area from S.W. 11th Avenue to S.W. 18th Avenue, because of view obstruction, the extent of street reconstruction required and the sensitivity of surrounding viewers. Without mitigation, the visual quality of this area would decrease to "low".

5.4.3.2 S.W. 18th Avenue/S.W. Jefferson Street to Sunset Transit Center

The existing visual quality rating of this segment ranges from "high" to "very low", and averages "moderate". This segment contains 11 landscape units. The LRT and highway improvements vary greatly through this segment and include two Long Tunnel options (with and without a Zoo station), a short tunnel/surface option (Northside) and an all-surface option (Southside). The most visually sensitive area in this segment is in the heavily vegetated lower canyon area.

The Southside alignment option would bring about the most dramatic visual change because of extensive loss of vegetation and introduction of significant structures. The Northside alignment option would also cause substantial visual change as a result of vegetation removal and addition of retaining walls and structures along the highway in the Tunnel, Valley and Washington Park landscape units. These options would result in the visual quality of these units decreasing from "high" to "moderately low" or "low". Highway improvements in landscape units from Washington Park to Peterkort North would have the visual affects described in Section 5.4.2.1 for the TSM Alternative. Additionally, LRT-related improvements for the Southside alignment option would further reduce the visual quality of the Highlands unit from "low" to "very low". Adding the Northside LRT improvements to the highway improvements would further reduce the Washington Park Unit's visual quality from "moderately low" to "low" and reduce the Golf Creek unit's visual quality from "moderately low" to "low". The two Long Tunnel alignment options would cause the least visual change because the alignment would be below the surface for most of the segment.

5.4.3.3 Sunset Transit Center to S.W. Cabot Street

The existing visual quality rating of this segment ranges from "high" to "very low" and averages "moderately low". This segment contains three landscape units. The LRT alignment and highway improvements are similar with all options, and include LRT facilities along the west side of Highway 217 and highway widening. The proposed improvements would introduce moderate visual change to an

area currently characterized by highway-related structures and other built improvements. The visual quality of this segment would be unaffected by the proposed highway and LRT improvements.

5.4.3.4 S.W. Cabot Street to S.W. Watson Avenue

The existing visual quality rating of this segment ranges from "moderately low" to "low", and averages "moderately low". Two landscape units are in this segment. There are two LRT alignment options through this segment, the North and the South options. Both options require displacement of apartment units and some wetland vegetation. Both alignment options would cause major visual change, although the North alignment option would result in a greater change in the visual quality rating (from "moderately low" to "very low" in one unit) because the views affect residential, rather than commercial, uses.

5.4.3.5 S.W. Watson Avenue to S.W. Murray Boulevard

The existing visual quality rating of this segment ranges from "moderate" to "very low". There are three landscape units within this segment. Two LRT alignment options are proposed in this segment, the BN and Henry Street options. The BN option is contained within the old BN Railroad right-of-way, and the Henry Street option traverses a developed commercial area. Both options result in minimal visual displacement that has limited exposure and sensitivity to viewers. Overall visual quality would not change as a result of either alignment option.

5.4.3.6 S.W. Murray Boulevard to S.W. 185th Avenue

The existing visual quality rating of this segment ranges from "moderate/moderate high" near S.W. Murray Boulevard, to "low" at S.W. 185th Avenue. There are four landscape units in this segment. One alignment option is proposed along the BN Railroad right-of-way. The greatest visual change would occur near Cedar Mill Creek and near S.W. 170th Avenue, where existing riparian vegetation and pasture areas would be replaced with built structures. Visual quality in these areas would change from "moderate" to "moderately low". In addition, the removal of vegetation and construction of the LRT improvements near the Heritage Village Mobile Home Park would result in a change in visual quality from "moderately high" to "moderate", because of the sensitivity of residential viewers in Heritage Village. Visual quality in the remainder of this segment would be unchanged.

5.4.4 Analysis of Retaining Wall Exposure

The introduction of retaining walls in the canyon would result in a visual impact. To determine the extent of this impact, the square footage of retaining wall that would be exposed, or visible, was analyzed for the following segments within the Sunset Highway corridor:

- The Jefferson Street segment, from S.W. 20th Avenue/S.W. Jefferson Street to the Vista Ridge Tunnels.
- The canyon segment, which includes the lower Sunset Canyon from the Vista Ridge Tunnels south and west to the proposed LRT station at the Sylvan Interchange. The segment is divided into two sub-segments: the Vista Ridge Tunnels to the Zoo, and the Zoo to the Sylvan Interchange.
- The Sylvan water tank segment, which includes the portion of the corridor between the Sylvan Interchange and the water tank at S.W. 76th Avenue.

Retaining walls would be constructed as a result of both highway and transit improvements. Within the entire Sunset Highway corridor, construction of highway improvements would require an additional 184,400 square feet of retaining wall between the Zoo and the Sylvan water tank (see Table 5.4-2). The transit improvements under the LRT Alternative would require between 19,000 square feet and 260,000 square feet of additional retaining wall, beyond that required for highway improvements (see Table 5.4-2).

No highway widening would occur in the segment between the Vista Ridge Tunnels and the Zoo under the TSM Alternative. Under the LRT Alternative, a substantial increase in wall exposure would occur with the Southside or Northside option (see Table 5.4-3). The Southside option would require an aerial structure at the east end of the canyon, to cross over Sunset Highway, and a nearly continuous band of walls and bridges along the south canyon slope throughout the length of the segment. This construction would represent an additional 99,200 square feet in retaining wall exposure over that which currently exists (see Table 5.4-3). The Northside option would result in an additional 51,800 square feet, because of a continuous band of wall along the north canyon slope from the west tunnel portal to the Zoo and an aerial structure at the Zoo Interchange. In contrast, the Long Tunnel options would require only an additional 2,320 square feet of retaining wall exposure, related to construction of the wing walls at the tunnel portal.

Between the Zoo and Sylvan Interchanges, highway improvements under the TSM Alternative would result in 42,500 square feet of additional wall exposure. Additional improvements under the LRT Alternative would result in an additional 50,000 square feet of retaining wall exposure for the Southside option and about 36,000 additional square feet for the Northside option (see Table 5.4-3). The Long Tunnel options would not result in any additional retaining wall exposure in this segment, because the LRT would be below ground.

Table 5.4-2

ESTIMATED CANYON SEGMENT RETAINING WALL EXPOSURE,
VISTA TUNNEL TO WATER TANK
(in square feet)

	Existing Wall Area	Unaffected Existing Wall Area	New Wall Area for Highway	New Wall Area for LRT	Total Future Wall Area
No Build	48,700	NA	NA	NA	48,700
TSM with Highway Improvements	48,700	38,500	184,400	NA	222,900
LRT with Highway Improvements					
Southside	48,700	1,900	184,400	259,920	446,220
Northside	48,700	36,600	184,400	163,440	384,440
Long Tunnel	48,700	38,500	184,400	19,040	241,940

Source: Tri-Met, 1990.

Between the Sylvan and S.W. Canyon Road Interchanges, the TSM Alternative would result in substantial visual impacts from highway improvements. These impacts would occur under all LRT options as well. The Surface LRT options, as compared with the TSM Alternative or Long Tunnel LRT options, would increase the amount of retaining wall required north of the highway centerline. Becuase of proposed highway improvements, the character of the area between Sunset Hills and the water tank would change, regardless of the LRT option chosen; however, the degree of visual impact would be greater with the Surface options than with the Long Tunnel options. Cuts into the north slope, for the Surface options, would be extensive and probably would require at least partial support by retaining walls. Construction of the Long Tunnel options would contribute only minor additional retaining wall exposure over the TSM Alternative.

Table 5.4-3

ESTIMATED RETAINING WALL EXPOSURE BY CANYON SUB-SEGMENT
(in square feet)

	Vista Tunnel to Zoo	Zoo to Sylvan	Sylvan to Water Tank	Total
No Build	38,500	10,200	0	48,700
TSM	38,500	52,700	131,700	222,900
LRT				
Southside	137,700	102,830	205,690	446,220
Northside	90,300	88,450	205,690	384,440
Long Tunnel	40,820	52,700	148,420	241,940

Source: Tri-Met, 1990.

For the entire Sunset Highway corridor, the Southside option with highway improvements would require 204,800 square feet more of additional retaining wall exposure than the Long Tunnel options (see Table 5.4-3). The Northside option with highway improvements would require 142,500 square feet of additional retaining wall exposure compared with the Long Tunnel options with highway improvements. To illustrate the quantity of retaining wall that would be required, the 446,220 square feet of retaining wall exposure for the Southside option would be equivalent to 4.2 miles of 20-foot-high walls. Similarly, the 384,440 square feet of retaining wall exposure under the Northside Surface option would be equivalent to 3.6 miles, and the 222,900 square feet for the TSM Alternative would be equivalent to 2.1 miles of 20-foot-high walls. The comparison illustrates that the proposed highway improvements under the TSM Alternative with highway improvements, which would occur regardless of any LRT option chosen, would result in significant aesthetic and visual impacts in the corridor.

5.4.5 Mitigation Measures

The purpose of visual impact mitigation would be to eliminate or reduce an adverse change in visual quality caused by improvements associated with the TSM or LRT Alternative. Mitigation could help prevent unnecessary loss of visual resources, provide a basis for better integration of the project with existing visual resources, and visually buffer any negative views of the proposed project. Mitigation measures could include screening and buffering, landscaping and berming, and structural design concepts for visual enhancement of areas. Potential mitigation measures specific to each landscape unit identified in Sections 5.4.2 and 5.4.3 are discussed in detail in Technical Memorandum 20d.

In addition, a variety of measures could be used to lessen the visibility and soften the impact of proposed retaining walls. Measures could include use of recessed or stepped retaining walls, landscape buffers, architectural treatment of bridge structures, and minor alignment shifts. These treatments have been assumed in the design and cost estimates for the Southside and Northside options, and are assumed possible for the highway improvements under the TSM Alternative. Special treatment of the tunnel portal exposures also is assumed, including the possibility of using basalt stone facia treatments.

The rating for mitigated visual quality displayed in Table 5.4-1 represents achievable visual quality if potential mitigation measures are implemented. Commitments for implementation of mitigation measures have not yet been made. After a preferred alternative is selected, a detailed mitigation plan with associated capital costs will be developed.

In some instances, most notably the Urban Edge, Sylvan and Golf Creek units, visual quality after mitigation would be higher than existing visual quality (Table 5.4-1). In these instances, construction of the proposed alternatives would create an opportunity to improve the visual quality of an area through the removal of negative visual features, and the introduction of landscaping and pedestrian-oriented amenities.

5.5 AIR QUALITY

The air quality analysis was conducted in cooperation with appropriate agencies and jurisdictions, including Oregon Department of Environmental Quality (DEQ), ODOT, Environmental Protection Agency (EPA) Region 10, and Metro.

The analysis methodology was discussed with representatives of ODOT and DEQ at the initial stages of the project. The Air Quality Division of DEQ was contacted by telephone on several subsequent occasions to confirm model assumptions, input parameters, existing background data, nonattainment areas, and status of the State Implementation Plan. DEQ also provided an input data set for the MOBILE4 analysis, which included data on vehicle mixes and the inspection and maintenance program specific to the Portland area. Recommended computer models were discussed with EPA. DEQ has been provided with the copy of the entire Air Quality Technical Memorandum for review, and has not yet commented on the document.

5.5.1 Regional Emissions

Projected daily Vehicle Miles Traveled (VMT)for 2005 were provided by Metro for the four-county area Portland airshed. Regional air pollutant emissions for the No Build, TSM, and LRT Alternatives were predicted and compared to 1987 conditions (see Table 5.5-1).

Under the No Build Alternative, the Portland airshed would experience a 35% increase in daily VMT by 2005 compared with existing conditions. The TSM and LRT Alternatives would result in less than a 1% reduction in daily VMT, compared with the No Build Alternative.

Regional emissions of carbon monoxide (CO), nitrous oxides, and non-methane hydrocarbons would decrease under all alternatives, when compared with existing conditions. This would probably be accompanied by a reduction in ozone concentrations as the pollutants that contribute to the production of ozone decrease. The reduction in pollutants from mobile sources would be due primarily to the federal Motor Vehicle Emission Control Program, and to the vehicle inspection and maintenance program in Portland.

Emissions for 2005 would be greatest under the No Build Alternative. The No Build Alternative represents a 28% to 38% decrease in emissions over existing conditions. The TSM and LRT Alternatives would result in less than a 1% reduction in emissions when compared to the No Build Alternative, as commuters switch from individual automobiles to less-polluting mass transit.

5.5.2 Corridor Emissions

Carbon monoxide is the air pollutant of concern for transportation projects. CO concentrations at 16 receptors have been predicted using the CALINE3 computer model. Receptors were selected to compare local concentrations of CO (Figures 5.5-1a and 1b). At least one receptor site was selected next to each proposed park-and-ride facility, and two are adjacent to the Portland CBD, which is in a non-attainment area for CO. The remaining receptor sites are near intersections and highways that would experience traffic congestion.

Average concentrations of CO are determined for the peak one-hour and peak eight-hour periods (Tables 5.5-2 and 5.5-3) to measure compliance with the National Ambient Air Quality Standards (NAAQS). For CO, the second highest concentration of the calendar year determines whether a violation of either the one-hour or eight-hour average has occurred.

Table 5.5-1

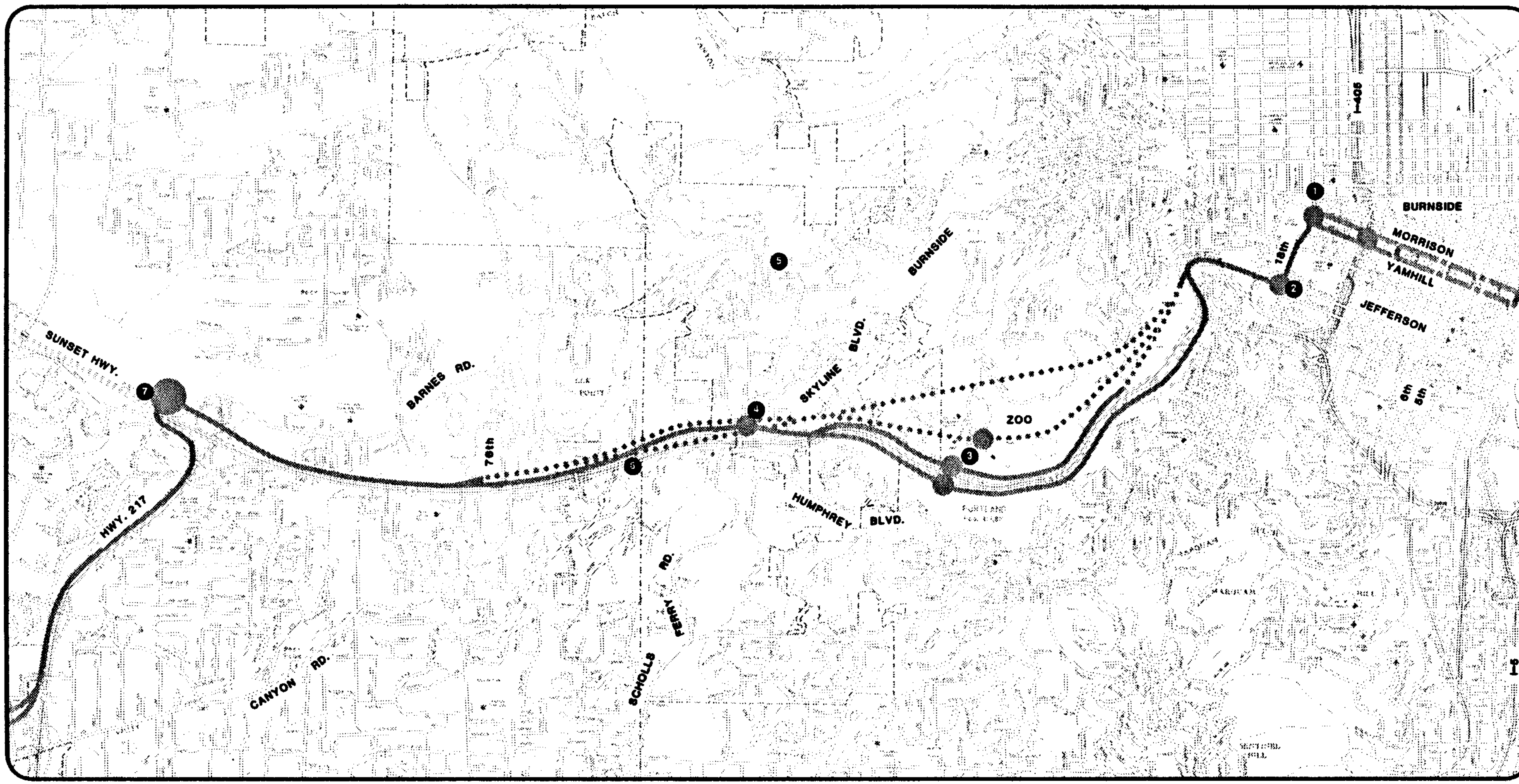
REGIONAL AIR QUALITY BURDEN ANALYSIS

		Emission Factor (g/mi) [2]			Total Emissions (kg/day)		
Alternative	Daily VMT [1]	CO	NOx	NMHC	CO	NOx	NMHC
Existing Conditions (1987)	18,878,000	20.48	2.49	5.1	386,621	47,006	96,278
No Build (2005)	25,572,000	10.21	1.14	2.71	261,090	29,152	69,300
TSM Alternative (2005)	25,462,000	10.21	1.14	2.71	259,967	29,027	69,002
LRT Surface to 185th	25,408,000	10.21	1.14	2.71	259,416	28,965	68,856
LRT Tunnel to 185th	25,419,000	10.21	1.14	2.71	259,528	28,978	68,885
LRT Surface to Murray	25,436,000	10.21	1.14	2.71	259,702	28,997	68,932
LRT Surface to Sunset	25,455,000	10.21	1.14	2.71	259,896	29,019	68,983

Notes: [1] VMT = Vehicle miles traveled in four-county area (METRO, 1989)
[2] Emissions factors in grams per mile (g/mi) from MOBILE4, based on Portland Area inputs (DEQ, 1989)

CO = Carbon Monoxide
NOx = Nitrogen Oxide
NMHC = Non-methane Hydrocarbons
kg/day = kilogram per day

Source: Shapiro and Associates, Inc.,1990.



LEGEND:

1 Air Quality Receptor Sites

Note: Refer to Table 5.5-1 and 5.5-2 for data pertaining to individual sites.

Source: Shapiro & Associates, Inc., 1990

N

SCALE-FEET

0 2000 4000

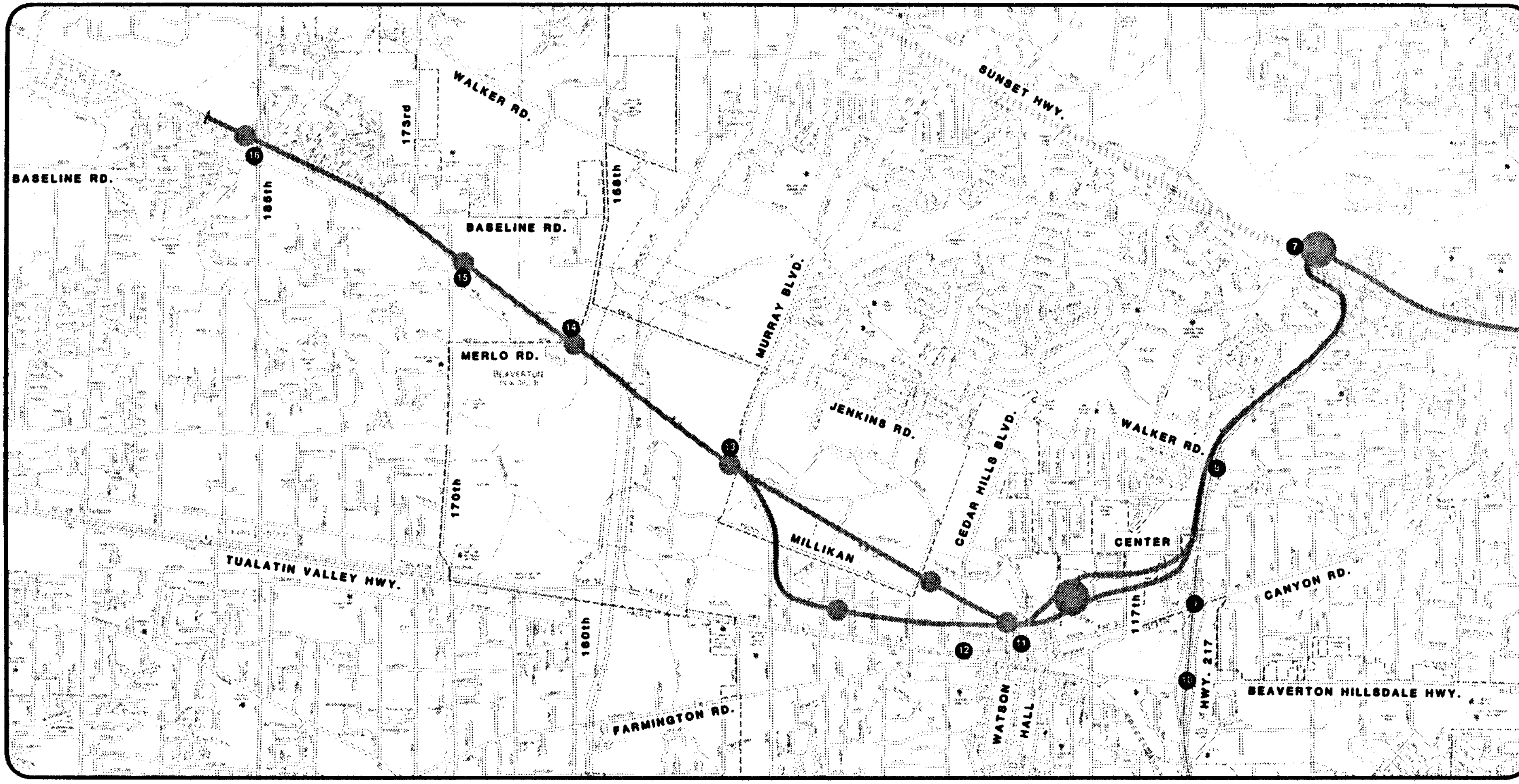
Westside Corridor Project

Air Quality Receptor Sites

The Oregon Department of Transportation

WESTSIDE LIGHT RAIL TRI-MET

Figure 5.5-1a
1 of 2



LEGEND:

1 Air Quality Receptor Sites

Note: Refer to Table 5.5-1 and 5.5-2 for data pertaining to individual sites.

Source: Shapiro & Associates, Inc., 1990

N

SCALE-FEET

0 2000 4000

Westside Corridor Project

Air Quality Receptor Sites

The Oregon Department of Transportation

WESTSIDE LIGHT RAIL TRI-MET

Figure 5.5-1b
2 of 2

Table 5.5-2

Carbon Monoxide Concentrations at Westside Corridor Receptors
PM Peak (1 Hour)

Receptor Number	Site/Location	---- CO Concentration (ppm) and Changes Relative To No Build Alternative-----							
		Existing	No Build	TSM 2005		LRT Surface 2005		LRT Tunnel 2005	
		1987	2005	Conc	Change	Conc.	Change	Conc.	Change
S.W. 11th Avenue to S.W. 18th Avenue/S.W. Jefferson Street									
1	Burnside Street and S.W.18th Avenue	8.8	7.0	6.0	-1.0	5.8	-1.2	5.8	-1.2
2	S.W. Jefferson Street and S.W.18th Avenue	7.4	5.1	5.3	+0.2	5.4	+0.3	5.3	+0.2
S.W. 18th Avenue/S.W. Jefferson Street to Sunset Transit Center									
3	Zoo	17.1	15.9	13.0	-2.9	12.1	-3.8	12.1	-3.8
4	Sylvan Park-and-Ride	15.6	11.0	10.9	-0.1	10.9	-0.1	10.9	-0.1
5	Skyline Boulevard and Burnside Street	10.8	7.9	6.9	-1.0	6.7	-1.2	6.9	-1.0
6	Canyon Road and Sunset Highway	12.9	8.8	8.8	0	7.9	-0.9	8.5	-0.3
7	Sunset Transit Center	13.6	11.5	11.6	+0.1	10.0	-1.5	11.1	-0.4
Sunset Transit Center to Cabot Street/Highway 217									
8	Walker Road and Highway 217	6.5	5.6	5.2	-0.4	5.4	-0.2	5.4	-0.2
East Beaverton-Cabot Street to Beaverton Transit Center									
9	Highway 217 and Canyon Road	6.3	5.7	5.3	-0.4	5.4	-0.3	5.4	-0.3
10	Highway 217 and Beaverton-Hillsdale Highway	6.3	6.3	6.2	-0.1	6.3	0	6.2	-0.1
East Beaverton-Beaverton Transit Center to Watson Avenue									
11	S.W. Hall Boulevard and S.W. Canyon Road	9.3	6.4	5.8	-0.6	5.7	-0.7	5.9	-0.5
Beaverton-Watson Avenue to S.W. Murray Boulevard									
12	Cedar Hills Boulevard and T.V. Highway	11.0	8.6	8.3	-0.3	8.4	-0.2	8.5	-0.1
13	S.W. Murray Boulevard Park-and-Ride	4.6	5.3	5.7	+0.4	5.7	+0.4	5.6	+0.3
Beaverton - S.W. Murray Boulevard to S.W.185th Avenue									
14	Merlo Road Park-and-Ride	4.4	4.4	4.4	0	4.4	0	4.4	0
15	S.W. 170th Avenue Park-and-Ride	4.6	5.0	5.8	+0.8	5.6	+0.6	5.7	+0.7
16	S.W. 185th Avenue Park-and-Ride	4.5	5.4	5.9	+0.5	5.8	+0.4	5.4	0

Note: See Figures 5.5-1a and 1b for location of receptors.

Source: Shapiro and Associates, Inc., 1990.

Table 5.5-3

Carbon Monoxide Concentrations at Westside Corridor Receptors
PM Peak (8 Hour)

Receptor Number	Site/Location	Existing 1987	No Build 2005	TSM 2005 Conc	TSM 2005 Change	LRT Surface 2005 Conc.	LRT Surface 2005 Change	LRT Tunnel 2005 Conc.	LRT Tunnel 2005 Change
		---- CO Concentration (ppm) and Changes Relative To No Build Alternative-----							
S.W. 11th Avenue to S.W. 18th Avenue/S.W. Jefferson Street									
1	Burnside Street and S.W.18th Avenue	6.2	4.9	4.2	-0.7	4.1	-0.8	4.1	-0.8
2	S.W. Jefferson Street and S.W.18th Avenue	5.2	3.6	3.7	+0.1	3.8	+0.2	3.7	+0.1
S.W. 18th Avenue/S.W. Jefferson Street to Sunset Transit Center									
3	Zoo	12.0	11.1	9.1	-2.0	8.5	-2.6	8.5	-2.6
4	Sylvan Park-and-Ride	10.9	7.7	7.6	-0.1	7.6	-0.1	7.6	-0.1
5	Skyline Boulevard and Burnside Street	7.6	5.5	4.8	-0.7	4.7	-0.8	4.8	-0.7
6	Canyon Road and Sunset Highway	9.0	6.2	6.2	0	5.5	-0.7	6.0	-0.2
7	Sunset Transit Center	9.5	8.1	8.1	0	7.0	-1.1	7.8	-0.9
Sunset Transit Center to Cabot Street/Highway 217									
8	Walker Road and Highway 217	4.6	3.9	3.6	-0.3	3.8	-0.1	3.8	-0.1
East Beaverton-Cabot Street to Beaverton Transit Center									
9	Highway 217 and Canyon Road	4.4	4.0	3.7	-0.3	3.8	-0.2	3.8	-0.2
10	Highway 217 and Beaverton-Hillsdale Highway	4.4	4.4	4.3	-0.1	4.4	0	4.3	-0.1
East Beaverton-Beaverton Transit Center to Watson Avenue									
11	S.W. Hall Boulevard and S.W. Canyon Road	6.5	4.5	4.1	-0.4	4.0	-0.5	4.1	-0.4
Beaverton-Watson Avenue to S.W. Murray Boulevard									
12	Cedar Hills Boulevard and T.V. Highway	7.7	6.0	5.8	-0.2	5.9	-0.1	6.0	0
13	S.W. Murray Boulevard Park-and-Ride	3.2	3.7	4.0	+0.3	4.0	+0.3	3.9	+0.2
Beaverton - S.W. Murray Boulevard to S.W.185th Avenue									
14	Merlo Road Park-and-Ride	3.1	3.1	3.1	0	3.1	0	3.1	0
15	S.W. 170th Avenue Park-and-Ride	3.2	3.5	4.1	+0.6	3.9	+0.4	4.0	+0.5
16	S.W. 185th Avenue Park-and-Ride	3.2	3.8	4.1	+0.3	4.1	+0.3	3.8	0

Note: See Figures 5.5-1a and 1b for location of receptors.

Source: Shapiro and Associates, Inc., 1990.

Under the No Build Alternative, none of the receptors would exceed the one-hour standard, and only the Zoo (Receptor Number 3) would exceed the eight-hour standard. CO concentrations under the No Build Alternative would decrease at 11 receptors when compared to the existing conditions, as the result of auto-mobile emission standards. Ambient concentrations of CO under the TSM Alternative would be lower than under the No Build Alternative at nine receptors, and increase or remain the same at seven. All concentrations would be at or below the NAAQS under the TSM Alternative.

Under the LRT Alternative (all options), all of the one-hour and eight-hour concentrations would be below the NAAQS. The ambient concentrations of CO would be lower than under the No Build Alternative at ten receptors, and would increase or remain the same at six receptors. The greatest increase for the surface alignment would be 0.4 ppm at the S.W. 170th Avenue park-and-ride (Receptor Number 15), and the greatest increase for the tunnel alignment would be 0.5 ppm at the same receptor. Compared with the TSM Alternative, the eight-hour CO concentrations under the LRT Alternative would be greater by no more than 0.2 ppm at five receptors, and less by 0.1 to 1.1 ppm at nine other locations.

5.5.3 Compliance with State Implementation Plan (SIP)

The Clean Air Act Amendments of 1990 affect Section 176(c) of the Clean Air Act which requires that a transportation project funded by a federal agency conform to any applicable state implementation plan (SIP). Conformity to a SIP is based on emission estimates. Until the SIP is revised as required by the 1990 amendments, conformity for a transportation project is demonstrated if the project comes from a conforming transportation plan and program, and if it reduces the severity and number of violations of the CO standard (Section 176(c)(3)).

The Westside Corridor Project is included in the Transportation Plan and Transportation Improvement Program for the Portland-Vancouver area. Metro has determined that the Plan and the Program are in conformance with the SIP.

The TSM and LRT Alternatives would reduce regional emissions of CO and ozone, compared with the No Build Alternative (Table 5.5-1). The decrease in emissions would reduce the severity and number of violations of the CO standards. Within the corridor, no violations of the CO standard are anticipated. The DEQ concurred in this finding (DEQ, 1991). Thus the project conforms with the SIP.

5.6 NOISE AND VIBRATION

Table 5.6-1 summarizes the number of sensitive receptors (residences, schools, parks, businesses, and churches) that would sustain noise and vibration impacts from the implementation of the project alternatives. The receptors in the Sunset Highway and Highway 217 corridors include those affected by both highway and LRT noise. However, the primary source of noise along Sunset Highway and Highway 217, regardless of alternative, is highway traffic.

5.6.1 Shared LRT/Highway Corridor Noise Impacts

The FHWA highway traffic noise prediction computer program, STAMINA 2.0/OPTIMA, was used to model existing and future noise levels. This model provides manageable and accurate noise level predictions, even in complicated topographic or roadway configurations. The noise level at a point adjacent to the roadway is a function of:

- the distance from the roadway
- the relative elevations of roadway and receptors
- traffic volume
- the percentage of light-duty (2 axles and 4 tires), medium-duty (2 axles and 6 tires), and heavy-duty (more than 3 axles) vehicles
- vehicle speed
- roadway grade
- topographic features
- the noise source height of the vehicles

Table 5.6-1

NOISE AND VIBRATION IMPACTS ON SENSITIVE RECEPTORS

	Without Mitigation		With Recommended Mitigation[1]	
	Noise	Vibration	Noise	Vibration
NO BUILD	128r,1s,2p,2c	0	NA	NA
TSM	141r,1s,2p,2c	0	120r,1s,2p,2c	0
LRT ADOPTED ALIGNMENT				
Sunset Transit Center Terminus	125r,1s,2p,2c	1r,6b	110r,1s,2p,2c	0
S.W. Murray Boulevard Terminus	119r,1s,2p,2c	4r,7b	109r,1s,2p,2c	1b
S.W. 185th Avenue Terminus	159r,1s,2p,2c	31r,7b	109r,1s,2p,2c	1b
LRT ALIGNMENT OPTIONS				
Canyon Segment:				
Southside	87r,1s,1c	1r,1b	77r,1s,1c	0
Long Tunnel	95r,1s,1c	4r,1b	89r,1s,1c	0
Northside	87r,1s,1c	0	77r,1s,1c	0
East Beaverton				
South (adopted)	0	2r	0	0
North	17r	17r	0	0
Central Beaverton				
BN (adopted)	0	1b	0	1b
Henry Street	17r,1b	11r	4r,1b	0
Segments Common To All Alignment Options [2]	72r,2p,1c	28r,5b	33r,2p,1c	0

r = residential s = school p = park b = business c = church

Note: Noise impacts are from highway traffic, LRT passby, LRT wheel squeal and ancillary facilities. No groundborne noise impacts are anticipated. Impacts were determined based on applicable criteria (see Section 3).

[1] Mitigation measures assumed were those recommended in Tables 5.6-2 and 5.6-4.

[2] To S.W. 185th Avenue terminus.

Source: HNTB/Wilson Ihrig and Associates, Inc., 1990.

Because projected traffic speeds are low during the afternoon peak hour, the worst-case conditions for noise analysis were assumed to be midday traffic volumes and speeds. A 10 dB increase in noise is equivalent to, or perceived by the human ear as a doubling of, loudness relative to present conditions. FHWA criteria regard a noise level increase of 10 dB or more as substantial, warranting a noise mitigation analysis. In addition, any residential receptor at or above the 67 dBA L_{eq} Noise Abatement Criteria (NAC, Category B) or any commercial or industrial receptor at or above the 72 dBA L_{eq} NAC (Category C) would be regarded as having an impact.

The No Build Alternative would locate the boundary of the 67 dBA L_{eq} residential NAC along the highway corridors approximately 150 to 330 feet from the centerline. This area of exposure to noise exceeding 67 dBA L_{eq} would expand in width until the roadway reaches capacity. Once the roadway reaches capacity, the area would remain constant, but the duration of the maximum noise levels would increase as the time period of congestion increases. With the projected traffic volumes for 2005, 133 receptors would be exposed to noise levels exceeding the NAC.

The projected peak hour traffic volumes along Sunset Highway and Highway 217 for the TSM Alternative vary less than 1% from the traffic projections for the LRT Alternative (all options). Therefore, the predicted noise levels and mitigation measures described for the TSM Alternative are the same as those for the LRT Alternative, with the TSM Alternative resulting in the following additional impacts:

- Three apartment buildings to the north of Sunset Highway between S.W. 66th Avenue and S.W. Canyon Road;
- Six residences to the north of Sunset Highway from S.W. 84th Avenue through S.W. 90th Avenue;
- Five residences to the west of Highway 217 between S.W. Walker Road and S.W. Canyon Road;
- Three residences to the west of Highway 217 between S.W. Winchester Court and S.W. Walker Road.

Bus volumes on the S.W. Jefferson Street and S.W. Columbia Street ramps are projected to increase with the TSM Alternative. These buses would produce noise levels in the Goose Hollow neighborhood that are 3 to 4 dBA L_{eq} higher than the noise levels projected with any LRT alignment option.

The boundary of the 67 dBA L_{eq} residential NAC along the highway corridors for the TSM Alternative would be approximately 150 to 330 feet from the existing edge of pavement. As with the No Build Alternative, this area of exposure to noise exceeding 67 dBA L_{eq} would expand in width until the roadway reaches capacity, after which the duration of the maximum noise levels would increase. With the projected traffic volumes for 2005, 146 receptors would be exposed to noise levels exceeding the NAC.

With the LRT Alternative, the projected traffic volumes along the Sunset Highway/Highway 217 corridors for the surface and tunnel options of the LRT Alternative vary less than 1% between options. Resulting variations in predicted sound levels would be minimal.

Traffic volumes would increase in the canyon segment of Sunset Highway because of highway improvements at, and east of, the Zoo Interchange. This increase in traffic would cause ambient noise levels in the adjacent canyon neighborhoods to increase by 1 to 2 dB. Eight homes in the Market Street Drive and S.W. Montgomery/S.W. Skyline Boulevard neighborhoods that are approaching or are at the 67 dBA L_{eq} NAC would be adversely affected.

One residential area between the Zoo and Sylvan Interchanges would be affected by the project. Along the south side of Sunset Highway, the projected noise levels at three residences along Humphrey

Boulevard would exceed the 67 dB L_{eq} NAC. Eleven residences along the north side of Sunset Highway, on Parkview Court and Elm Lane, would have impacts.

The residential areas adjacent to Sunset Highway west of the Sylvan Interchange would all exceed the 67 dBA L_{eq} NAC, primarily because of the short set-back distance between the residences and the edge of the highway pavement. Receptors north of Sunset Highway that would exceed the NAC include: 18 residences along S.W. Canyon Court west of Sylvan, a cemetery located between S.W. 66th Avenue and S.W. 84th Avenue, two residences off S.W. 76th Avenue, and 14 residences between S.W. 84th Avenue and S.W. 90th Avenue. The overall impact to the French/American School would be moderate, even with the proposed closure of S.W. Canyon Court and the resulting routing of traffic along S.W. 58th Avenue. Existing (60 dBA L_{eq}) and projected (66 dBA L_{eq}) noise levels at the school would be controlled by traffic on Sunset Highway. Interior noise levels at the school would be 56 dBA, with the windows open and 41 dBA with windows closed.

Receptors that would exceed the 67 dBA L_{eq} NAC on the south side of Sunset Highway include: nine residences just east of S.W. Canyon Road, ten residences from S.W. Camelot Court to S.W. Canyon Road, 12 residences from S.W. 79th Avenue to S.W. Camelot Court, and 16 residences and one church from S.W. 96th Avenue to S.W. 84th Avenues. The projected exterior noise level of 70 dBA would adversely affect the West Sylvan School. The interior noise level would be 60 dBA with the windows open and 45 dBA with the windows closed.

Two residential areas, one park, and one church along the west side of Highway 217 would exceed the 67 dBA L_{eq} NAC. Included in these areas are 20 residences between Sunset Highway and S.W. Walker Road; Roxbury Park, located just south of Berkshire Street; five residences located between S.W. Walker Road and S.W. Canyon Road; and Saint Bartholemew's Church north of S.W. Cabot Street. At S.W. Cabot Street, residential units adjacent to the highway right-of-way would be acquired to allow for the highway improvements. After the removal of this row of homes, two residences in the second row would be affected by this alternative.

Along the east side of Highway 217, two residential areas would be affected. They include six residences between S.W. Canyon Road and S.W. Walker Road, and seven residences and one park between S.W. Walker Road and Sunset Highway.

Within the Highway 217 corridor, the Sunset Transit Center terminus option would have the same noise impacts as the TSM Alternative. Because the LRT transitway would not be constructed along the west side of Highway 217, five residences between S.W. Walker Road and S.W. Canyon Road would experience noise levels from 67 to 71 dBA L_{eq} from projected traffic volume increases on Highway 217. These five residences are already experiencing noise levels exceeding 67 dBA L_{eq}. The S.W. Murray Boulevard terminus options would have the same impacts as the S.W. 185th Avenue terminus option within the Highway 217 corridor.

Noise-level reduction in the shared LRT/highway corridors could be accomplished with the use of noise barriers or traffic management techniques, such as reduced speed limits, time restrictions, or prohibition of trucks. Design changes that increase the distance between vehicles and receptors, wider rights-of-way, acoustical insulation, and landscaping are other methods of traffic noise attenuation. Projected speeds for the design year already are low because of high traffic volumes. The prohibition of trucks would be impractical because of the regional nature of the highway and the limited number of alternative routes. Physical limitations in the canyon and other locations preclude widening the right-of-way. Sound-proofing receptors along the highways would be effective only if all windows were permanently sealed, which would be objectionable to most local residents. Therefore, noise barriers are the only practical form of noise abatement considered for this project.

Modeled L_{eq} levels were used as a base for assessing the impact of noise level increases at sensitive receptors in the shared LRT/Highway corridors. Abatement measures have been recommended for affected receptors only if at least 5 dB of noise reduction could be achieved at one or more receptors with a barrier height not exceeding 16 feet and a $2,500 cost per unit per dBA reduction. Barrier costs were estimated at $14.50 per square foot for walls up to 16 feet high, and at $18.00 per square foot for walls between 16 and 21 feet high. Table 5.6-2 and Figures 5.6-1a and 5.6-1b present the Noise Abatement Summary of the barrier analysis for the shared LRT/Highway corridor. No noise walls would be constructed as part of this project without a consensus approval of adjacent property owners and the local government.

5.6.2 LRT Noise Impacts

Noise measurements of the maximum passby noise levels (L_{max}) along the Banfield Transitway were used to predict the noise that would be generated by the proposed LRT. These measurements, along with the operating headways of the LRT, were used to calculate the various descriptors of the acoustical environment of LRT throughout the project area. Table 5.6-3 tabulates the L_{eq} and L_{dn} as a function of train speed and distance from the track centerline for the proposed LRT transitway.

Existing LRT speeds in the downtown Portland area are 15 mph or less. LRT noise levels would be within criteria and would generally not have an impact.

Noise levels throughout the Sunset Highway and Highway 217 corridors are dominated by highway traffic noise. Typical highway traffic noise levels at the right-of-way are currently 72 to 73 dBA L_{eq}, and peak levels are 5 to 6 dB higher. The additional noise caused by the LRT operation would be negligible. Maximum passby sound levels from the proposed LRT in these areas would compare with the measured Banfield results at 45 mph (see Table 5.6-3). The calculated 80 dBA L_{max} noise contour would fall approximately 30 feet from the centerline of the track. In addition, the calculated L_{eq} of 63 dBA at 30 feet would increase noise levels less than 3 dB over the existing acoustical environment, an increase which UMTA generally considers not to be an impact. The calculated L_{dn} of 63 dBA at 30 feet is well within the 65 dBA APTA criteria. No sensitive receptors are located within 30 feet of the centerline of the proposed LRT transitway along the highway corridors except for one residence west of Highway 217, north of S.W. Walker Road. The LRT alignment at this location would be 20 feet below this receptor and projected noise levels would remain within UMTA and APTA criteria.

In east Beaverton, the North and South options would run within 75 feet of units of the Lynmarie Manor Apartments on S.W. 117th Avenue. Predicted L_{max} levels of 75 dBA at 75 feet would affect 17 residences, warranting consideration of mitigation according to UMTA's guidelines.

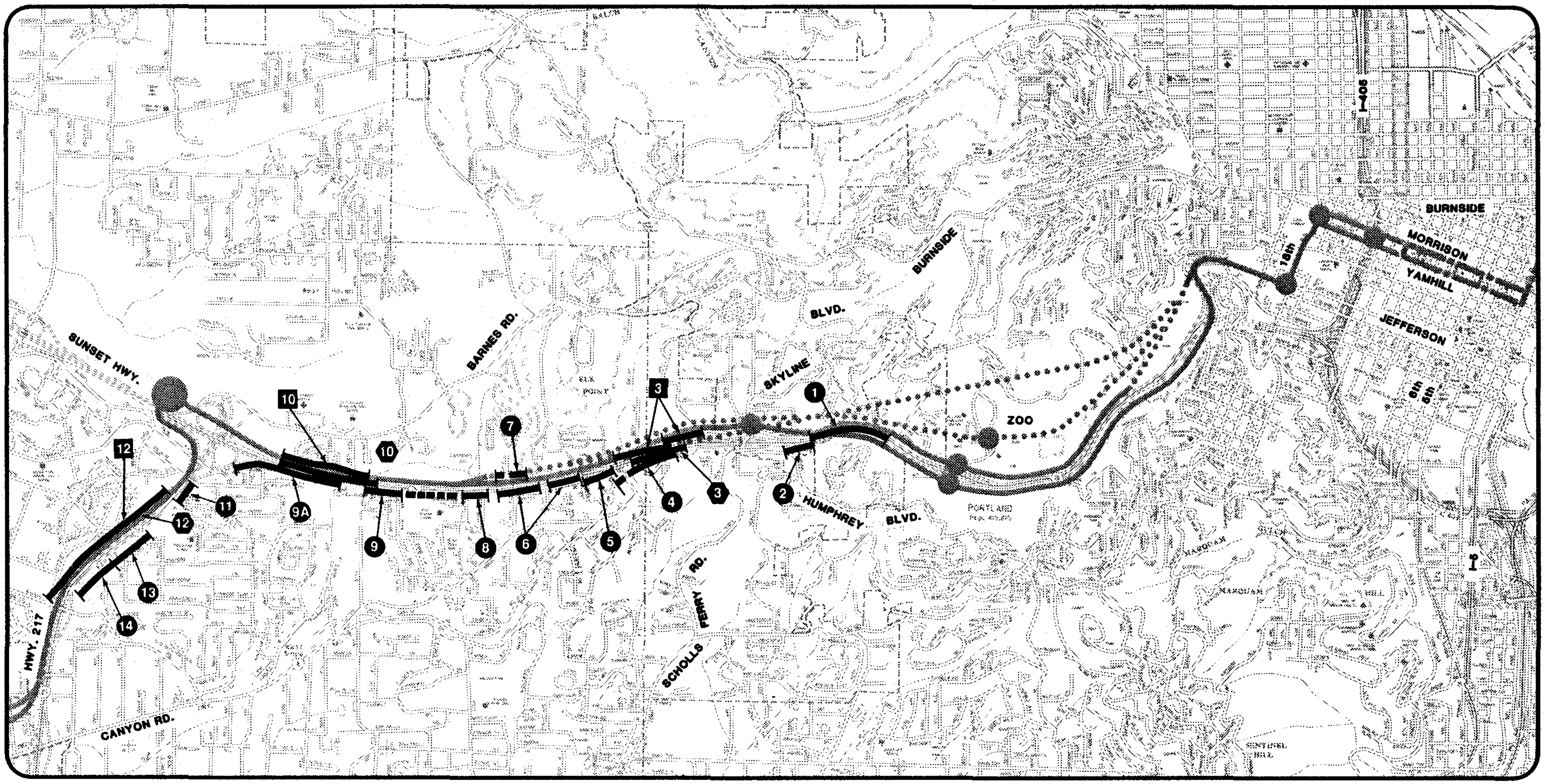
In central Beaverton, LRT noise impacts associated with the BN alignment option would be within APTA guidelines. The Henry Street option would expose 12 units of the Garden Court and Greystone Square Apartments, and three S.W. Tualaway Avenue and two S.W. 144th Avenue residences, to L_{max} noise levels of 77 dBA, which is 2dB greater than APTA guidelines, warranting consideration for mitigation. The L_{max} for Nendels Motel would be at the 80 dBA level recommended by APTA for commercial establishments and would exceed that for multifamily residential areas by 3 dB.

In west Beaverton and Washington County, 40 residences in the Heritage Village Trailer Park and Salix Place neighborhood would experience an LRT-induced L_{max} of 75 to 77 dBA and L_{dn} of 58 to 59 dBA. This would result in a noise impact for these residential areas, and consideration for noise mitigation.

Noise mitigation was considered for a number of residential areas along the proposed LRT transitway alignment through the Beaverton area (see Table 5.6-4 and Figure 5.6-1b). The recommended barriers would reduce project noise levels at the receptors to accepted criteria levels.

5.6.3 LRT Wheel Squeal Impacts

Wheel squeal noise is caused by the "stick and slip" of the wheel as it traverses a curve. Occurrence of squeal depends on the moisture at the the rail, the sharpness of the curve, the speed of operation, the profile of the wheel, and many other factors. Wheel squeal noise levels were measured at several locations on the existing Eastside MAX line. In general, the occurrence and magnitude of wheel squeal on the Eastside line was found to be similar to, or better than, other rail transit lines in North America.



LEGEND:

1 LRT

2 TSM

3 LRT & TSM

Source: Howard Needles Tammen & Bergendoff, 1990

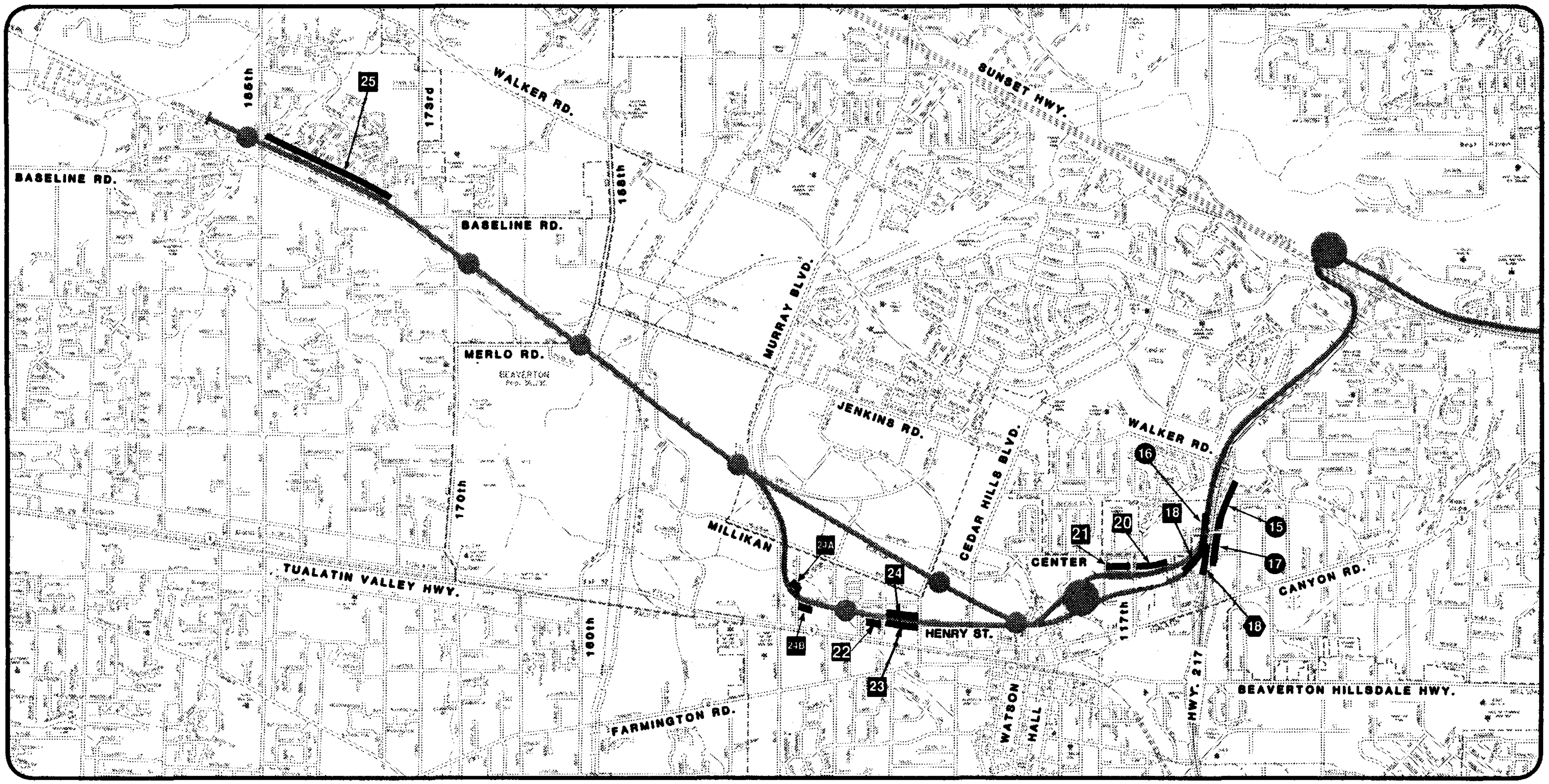
Westside Corridor Project

Potential Locations for Noise Mitigation

The Oregon Department of Transportation

WESTSIDE LIGHT RAIL TRI-MET

Figure 5.6-1a
1 of 2



LEGEND:

1 LRT

2 TSM

3 LRT & TSM

Source: Howard Needles Tammen & Bergendoff, 1990

Westside Corridor Project

Potential Locations for Noise Mitigation

The Oregon Department of Transportation

WESTSIDE LIGHT RAIL TRI-MET

Figure 5.6-1b
2 of 2

Table 5.6-2

HIGHWAY CORRIDOR NOISE ABATEMENT SUMMARY

No.	Segment	Noise Level without Barriers	Noise Level with Barriers	Barrier Length	Barrier Height	Barrier* Cost	# Units Attenuated	Cost/ Unit	dB Reduction	$/Unit/dB Reduction	Barrier Recommended
1	WB Sunset Highway	67-70	57-62	1800'	18'-21'	$611,550	11	$56,000	6-12	$6,000	No
	Parkview Court	67-70	61-64	1800'	15'	$391,500	11	$35,600	4-7	$5,600	No
	Elm Lane										
	Neighborhoods										
2	EB Sunset Highway	67-70	62-64	578'	18'	$187,280	3	$62,430	3-6	$11,020	No
	Humphrey Boulevard	67-70	62-64	578'	15'	$125,720	3	$41,910	3-8	$7,400	No
	Residences										
3-LRT	WB Sunset Highway	66-69	56-62	1620'	9-18'	$476,505	15	$31,770	6-10	$4,040	No
	66th Avenue and	66-69	57-64	1620'	9-15'	$331,500	15	$22,100	5-9	$3,500	No
	Canyon Road										
3-TSM	WB Sunset Highway	60-65	60-65	654'	9'-15'	$106,610	6	$17,770	5-8	$2,370	Yes
	66th Avenue and										
	Canyon Road										
4	EB Sunset Highway	67-70	59-64	979'	18'	$317,200	9	$35,250	4-9	$4,750	No
	E of Canyon Road	67-70	62-67	979'	15'	$212,950	9	$23,700	1-5	$5,350	No
5	EB Sunset Highway	63-67	58-66	720'	18'	$233,300	23	$10,150	1-9	$1,680	Yes
	W of Canyon Road	63-67	58-66	720'	15'	$156,600	23	$6,810	1-8	$1,200	Yes

* Based on $18.00 per square foot for 16'-21' height.
Based on $14.50 per square foot for up to 16' height.

Table 5.6-2 (continued)

HIGHWAY CORRIDOR NOISE ABATEMENT SUMMARY

No.	Segment	Noise Level without Barriers	Noise Level with Barriers	Barrier Length	Barrier Height	Barrier* Cost	# Units Attenuated	Cost/ Unit	dB Reduction	$/Unit/dB Reduction	Barrier Recommended
6	EB Sunset Highway 75th Avenue to Sylvan Interchange	67-74	60-67	1500'	15'	$326,250	13	$25,100	1-10	$4,660	No
7	WB Sunset Highway 76th Avenue	67-69	60	360'	18'	$116,650	2	$58,330	7-9	$7,290	No
		67-69	61-63	360'	15'	$78,300	2	$39,150	4-8	$6,525	No
8	EB Sunset Highway 79th & 78th Avenues	70	64	581'	15'	$126,370	3	$42,150	6	$7,020	No
9	EB Sunset Highway 84th Avenue thru 87th Avenue	64-70	58-62	1250'	18'	$405,000	10	$40,500	6-10	$4,600	No
		67-70	60-64	1250'	15'	$271,900	9	$30,250	6-7	$4,450	No
9A	EB Sunset Highway Highway 217 thru Wilshire Street	63-73	57-62	1994'	18'	$646,100	14	$46,150	6-12	$5,430	No
		63-73	61-64	1994'	15'	$433,700	13	$33,370	3-10	$5,000	No
10-LRT	WB Sunset Highway 84th Avenue thru 90th Avenue	65-70	58-63	1564'	18'	$506,750	11	$46,070	5-9	$6,420	No
		65-70	59-64	1564'	15'	$340,200	10	$34,020	5-7	$5,670	No
10-TSM	WB Sunset Highway 84th Avenue thru 90th Avenue	66-73	60-67	1813'	15'	$394,330	17	$23,200	4-11	$3,760	No

* Based on $18.00 per square foot for 16'-21' height.
Based on $14.50 per square foot for up to 16' height.

Table 5.6-2 (continued)

HIGHWAY CORRIDOR NOISE ABATEMENT SUMMARY

No.	Segment	Noise Level without Barriers	Noise Level with Barriers	Barrier Length	Barrier Height	Barrier* Cost	# Units Attenuated	Cost/ Unit	dB Reduction	$/Unit/dB Reduction	Barrier Recommended
11	NB Highway 217 S of Wilshire Street @ Ridgewood Park Neighborhood	69	61	421'	12'	$73,260	1	$73,260	8	$9,160	No
12 - LRT	SB Highway 217 Sunset Highway to Walker Road	65-70	58-62	3228'	15'-18'	$953,430	19	$50,180	5-11	$5,650	No
		67-70	60-64	3228'	12'-15'	$664,340	18	$36,910	4-9	$5,190	No
12- TSM	SB Highway 217 Sunset Highway to Walker Road	63-73	58-63	3332'	12'-15'	$687,090	24	$28,630	5-14	$3,660	No
13	NB Highway 217 106th Avenue and Woods Street	65-68	59-65	820'	18'	$265,700	6	$44,300	3-7	$7,600	No
		66-68	60-65	820'	15'	$178,350	5	$35,700	3-6	$7,150	No
14	NB Highway 217 107th Avenue N of Walker Road	68-70	65-67	797'	21'	$301,270	3	$100,430	3	$33,480	No
		68-70	66-68	797'	15'	$173,350	3	$57,790	2	$28,900	No
15	NB Highway 217 Cabot Street to S of Walker Road	66-70	58-62	1060'	15'	$230,550	5	$46,100	4-11	$5,250	No

* Based on $18.00 per square foot for 16'-21' height.
Based on $14.50 per square foot for up to 16' height.

Table 5.6-2 (continued)

HIGHWAY CORRIDOR NOISE ABATEMENT SUMMARY

No.	Segment	Noise Level without Barriers	Noise Level with Barriers	Barrier Length	Barrier Height	Barrier* Cost	# Units Attenuated	Cost/ Unit	dB Reduction	$/Unit/dB Reduction	Barrier Recommended
16	SB Highway 217 St. Bartholomews Church	70	56	315'	15'	$68,520	1	$68,520	14	$4,900	No
17	NB Highway 217 Canyon Road to Cabot Street	66-71	61	588'	15'	$127,900	3	$42,640	5-10	$5,120	No
18-LRT	SB Highway 217 113th Avenue and Cabot Street	64-67	55-61	640'	15'	$139,200	6	$23,200	5-12	$3,320	No
18-TSM	SB Highway 217 113th Avenue and Cabot Street	66-71	59-63	812'	9'-12'	$128,370	11	$11,670	5-8	$1,890	Yes

* Based on $18.00 per square foot for 16'-21' height.
Based on $14.50 per square foot for up to 16' height.

Source: HNTB, 1990.

In downtown Portland, the turnaround between S.W. Yamhill and S.W. Morrison Streets on S.W. 11th Street contains curves at both the entrance and exit. Wheel squeal at these curves would be reduced significantly because most trains would pass by, rather than enter, the turnaround. In the Goose Hollow neighborhood, a 100-foot radius curve would exist at the intersection of S.W. Jefferson Street and S.W. 18th Avenue. Two residences would be affected by wheel squeal noise at this curve. No other significant wheel squeal impacts would be expected within downtown Portland or Goose Hollow. Significant wheel squeal impacts should not occur in the Sunset Highway and Highway 217 corridors.

Table 5.6-3

CALCULATED LRT NOISE LEVEL DESCRIPTORS

Distance From track (ft)	Train Speed (mph)	L_{max} (dBA)	L_{eq} (dBA)	L_{dn} (dBA)
Sunset Highway/Highway 217				
50	35	75.0	60.0	60.0
50	45	77.0	61.0	60.5
100	35	69.5	55.5	55.0
100	45	72.0	57.0	56.5
150	35	66.5	53.0	53.0
150	45	68.5	54.0	54.0
200	35	63.5	51.0	50.5
200	45	66.0	52.5	52.0
Beaverton Area				
50	35	75.0	57.0	58.0
50	45	77.0	38.0	59.0
100	35	69.5	52.5	53.5
100	45	72.0	54.0	55.0
150	35	66.5	50.0	51.0
150	45	68.5	51.0	52.0
200	35	63.5	48.0	49.0
200	45	66.0	49.5	50.5

Note: Assumed one-way LRT headways

Portland to Beaverton TC	5 minutes
Beaverton/Washington County	10 minutes
Evening Hours	15 minutes
Night Hours	30 minutes

No transit operations from 1:30 a.m. to 5:00 a.m.

Source: Wilson, Ihrig and Associates, Inc./HNTB, 1990.

In East Beaverton, the North alignment option would have a 300-foot radius curve at the north end of the Beaverton Transit Center. Assuming that the track is on ballast-and-tie, the L_{max} sound level during curve negotiation would be about 82 dBA at a residential structure. This would be in excess of the APTA criterion for residential structures. The proposed track alignment plan and profile indicates that this residential structure and one immediately behind it would be located on an East-West Arterial proposed by the City of Beaverton. If this arterial is constructed, these structures would be removed. No significant wheel squeal impacts would be expected in the remainder of the corridor.

Table 5.6-4

LRT NOISE MITIGATION SUMMARY

Barrier No.	Location	Area Description	Barrier Length	Barrier Height	Barrier* Cost	# Units Attenuated	Cost/ Unit	dB Reduction	$/Unit/dB Reduction	Barrier Recommended
20	East Beaverton North Option	Lynn Marie Apts.	700'	5'	$50,750	8	$6,350	5	$1,270	Yes
21	East Beaverton North Option	Residential area west of S.W. 117th Street	630'	5	$45,700	9	$5,080	5	$1,020	Yes
22	Central Beaverton Henry St. Option	Tualaway Avenue Residences	410'	5'	$29,750	2	$14,875	5	$2,980	No
23	Central Beaverton Henry St. Option	Nendels Motel	450'	5'	$32,650	1	$32,650	5	$6,530	No
24	Central Beaverton Henry St. Option	Beaverton Garden Ct. Apts., Greystone Sq. Apts., and Tualaway Ave. Residences	690'	5'	$50,050	13	$3,850	5	$770	Yes
24A	Central Beaverton Henry St. Option	Residence west of S.W. 144th Avenue	225'	5'	$16,320	1	$16,320	5	$3,270	No
24B	Central Beaverton Henry St. Option	Residence east of S.W. 144th Avenue	300'	5'	$21,750	1	$21,750	5	$4,350	No
25	West Beaverton/ Washington County	Heritage Village Trailer Pk. Salix Pl. Neighborhood	2,795'	5'	$202,650	44	$4,610	5	$930	Yes

Note: Barrier cost based on $14.50 per square foot for up to 16' height.

Source: HNTB, 1990.

There are four general approaches that can be used to eliminate or reduce wheel squeal noise levels:

- damp the wheel or use resilient wheels
- lubricate the wheel surface that slides against the rail
- use articulated or steerable trucks to prevent crabbing through the curve
- use a barrier to block the sound energy before it reaches the receiver.

The first two options are already being used on the existing Eastside LRT. Light rail vehicles used on the Westside would be equipped with resilient wheels. The use of flange lubrication and/or rail lubrication would be analyzed on a site-specific basis. Use of articulated or steerable trucks to prevent crabbing and side-drag of wheels across the top of the rails while negotiating a curve would require retrofit of the existing fleet. This would involve considerable cost and engineering effort, and would not be feasible or practical. The use of a barrier for the single affected business in downtown Portland would be an impediment to vehicular and pedestrian traffic and is not recommended. Barriers would not be practical for mitigation of the two residences at the S.W. 18th Avenue/S.W. Jefferson Street intersection, because this track section would be imbedded in the street to allow for cross traffic. One form of mitigation would be to increase curve radii as much as possible.

5.6.4 Noise From Ancillary Facilities

An LRT storage yard and maintenance shop is proposed near the intersection of Baseline Road and S.W. 170th Avenue. Wheel squeal would be generated at curves in the storage track. No known noise sensitive receptors are located within 1,300 feet of the proposed storage yard and, therefore, no noise impacts to existing uses would be expected.

Vehicle maintenance that involves heavy equipment and automated tools, such as impact wrenches, would be performed within the maintenance building. Noise produced by shop tools would be limited to approximately 85 dBA within the building. Noise outside the building should not be significant.

Substations for the LRT transitway would be positioned in approximately 13 locations along the alignment. These substations would be of solid wall construction and designed to prevent tampering with, or vandalism of, the switching gear and transformers inside. Three residences, one church, and one business would be affected by LRT substation noise.

The Long Tunnel alignment options, both with and without the Zoo station, would have ventilation shafts in or near the Zoo parking lot, and to the west of S.W. Skyline Boulevard, north of Sunset Highway. APTA noise criteria for ancillary facilities would apply to fans and ventilation shafts. There are no sensitive receptors located near the Zoo parking lot, so there would be no impacts from ventilation shafts located there. If fans are incorporated into these shafts, the Long Tunnel with Zoo station alignment option would adversely affect four businesses at the Sylvan Interchange. The Long Tunnel without Zoo station alignment option would affect only one of these businesses.

Noise from substations could be mitigated by enhancing substation housings and designing ventilation systems to minimize sound. Near S.W. Skyline Boulevard, sound absorption treatment applied to the fan shaft walls and a silencer would eliminate the impact of ventilation fans.

5.6.5 LRT Vibration Impacts

Ground vibration from light rail systems is produced by wheel and rail roughness. The vibration energy is transmitted through the track support system to the soil. The vibration propagates through the soil into building foundations and causes walls, floors, and ceilings to vibrate.

In downtown Portland, vibration impacts would be avoided by restricting train speeds to 25 mph. If speeds approached or exceeded speeds of 30 mph, five buildings along S.W. Yamhill and S.W. Jefferson Streets could be exposed to levels slightly above the vibration criterion (see Table 3.6-3). Likewise, three multifamily residential buildings on S.W. 18th Avenue northeast of Collins Circle would experience vibration levels in excess of criterion if LRT speeds exceeded 25 mph. At both these locations, a ballast mat would mitigate vibration impacts on these receivers.

In the Sunset Highway corridor, LRT vibration impacts would vary with the alignment option selected. With the Southside or Northside alignment options, townhouses west of the Sylvan Interchange on S.W. Canyon Court at S.W. 66th Avenue would be affected by vibration. Ballast mats are recommended as mitigation at this location. No vibration impact is projected for any buildings that would be located above either Long Tunnel alignment. Along Highway 217, a multifamily residential unit located south of S.W. Eastridge Street would be impacted. A ballast mat would mitigate the vibration impact.

In east Beaverton, vibration impacts would vary with LRT alignment options. With the North alignment option, residential structures located in the vicinity of S.W. 114th and S.W. 117th Avenues would be affected by 45 mph trains. A ballast mat would sufficiently mitigate ground vibration impacts to structures between 35 and 60 feet from the LRT alignment. A floating slab track would mitigate vibration impacts on residences located within 30 feet of the LRT alignment. Both alignment options would affect residential buildings on S.W. Center Street in the vicinity of Highway 217. A ballast mat would provide sufficient vibration mitigation. These residences are in the path of the proposed East-West arterial, and, if the arterial is constructed, these buildings would be removed.

In central Beaverton, both the BN and Henry Street alignment options would have vibration impacts. With the BN alignment option, Tektronix, Inc. Building No. 02 is located about 45 feet from an existing BN spur track and the proposed LRT line. Operations on the BN line can produce vibrations comparable to or greater than the proposed LRT. Present use of this building is compatible with this location, and no adverse impact is anticipated from converting the BN line to LRT. Tektronix also has identified a potential impact from LRT vibration on future, vibration-sensitive manufacturing activities adjacent to the rail alignment. Specific sites of concern have not yet been established. If site-specific concerns are identified before construction, vibration mitigation may be required, depending on the extent of the problem.

The Henry Street alignment option would result in vibration impacts at several residential and motel buildings. A multifamily residence on S.W. Hocken Avenue, just north of the LRT alignment, would be slightly affected. Five multifamily residences located between S.W. Tualaway and S.W. Hocken Avenues, the Satellite and Nendels motels, and three multifamily residences on S.W. 144th Avenue would be affected by vibration from passing LRT trains. Ballast mats would provide sufficient vibration mitigation at all of these locations.

Between Baseline Road and Willow Creek (east of 185th Avenue) the construction of LRT would relocate the BN railroad alignment 40 to 50 feet south of its present location. The LRT track would be laid on the existing BN trackbed. Consequently, maximum vibration impacts at buildings along the existing track should decrease, because freight trains produce higher vibration levels than LRT vehicles. However, the occurrence rate of the lesser vibration from the LRT operations would be higher. Twenty-five residences in Heritage Village Trailer Park could be affected by LRT ground vibration. Ballast mat track would provide sufficient vibration mitigation at this location.

The planned use of continuous welded rail would reduce ground vibration. Wheel truing and rail grinding also would help control ground vibration from the LRT. Crossovers with movable switch frogs produce lower levels of ground vibration than do standard frogs. For all locations and existing land uses, the ballast mat system would reduce groundborne vibration to an acceptable level. Other site-specific mitigation measures include minor alignment adjustment, crossover relocation, and train speed reduction.

5.7 ECOSYSTEMS

This section summarizes the impact discussion included in Technical Memorandum 20g.

5.7.1 Fish and Wildlife

5.7.1.1 No Build Alternative

Under the No Build Alternative, existing upland and wetland habitats in the project area would not be affected. Secondary impacts from new roads and increased traffic in the vicinity of the proposed Sunset Transit Center, would affect the amount and quality of wildlife habitat in the project area.

5.7.1.2 TSM Alternative with Highway Improvements

Wetland and upland habitat would be reduced on both sides of Sunset Highway and Highway 217. The most significant wildlife habitat areas that would be affected by this alternative include coniferous and mixed forest on the south side of Sunset Highway between the Zoo and S.W. Skyline Boulevard, and wetlands and riparian areas associated with Sylvan and Golf Creeks. Wildlife that live in and frequent the affected habitat areas would be reduced or displaced. Common wildlife species that would be displaced include: woodpeckers, crows, chickadees, songbirds, small mammals, coyote, and deer.

With increased paved surface, water quality may be diminished in the Beaverton Creek and Fanno Creek Drainages. Decreased water quality could have a negative effect on resident fish and wildlife that use wetland and riparian habitats in, and downstream of, the project area.

5.7.1.3 LRT Alternative with Highway Improvements

S.W. 11th Avenue to S.W. 18th Avenue/S.W. Jefferson Street (Adopted)

No impacts on fish and wildlife are anticipated in this segment.

S.W. 18th Avenue/S.W. Jefferson Street to Sunset Transit Center

Wildlife habitat currently is subject to considerable noise and human disturbance in this segment. Added human intrusion and loss of habitat from clearing on both sides of Sunset Highway would result in out-migration or elimination of wildlife. Wildlife migrating from cleared areas could displace wildlife in other areas. Resident wildlife would be displaced and have to compete for reduced habitat resources elsewhere. Displaced wildlife species would include: small mammals, coyote, deer, woodpeckers, crows, chickadees, and songbirds. Fill or placement of structures in riparian areas, intermittent drainages, and upland forests adjacent to creeks; siltation of waterways; degradation of vegetation communities; and increased human intrusion would have a similar effect in riparian and wetland areas, particularly at the Zoo station, and in Sylvan and Golf Creeks.

By increasing the paved surface, this alternative could result in lower water quality within the Beaverton Creek and Fanno Creek Drainages. Decreased water quality could adversely affect fish and wildlife populations in wetland and riparian habitats in the project area. Anadromous and other game fish habitat downstream in the Tualatin River also could be adversely affected. However, compliance with water quality standards and implementation of mitigation measures to reduce water quality impacts (see Section 5.8.1) would reduce or eliminate the likelihood of this occurring.

Sunset Transit Center to S.W. Cabot Street/Highway 217 (Adopted)

Wildlife populations in cleared parkland, wetland, and mixed forest areas would be displaced to other habitats or perish. Because wildlife habitat currently is subject to considerable noise and human disturbance, increased human intrusion would not have an appreciable negative effect on resident wildlife populations. The most significant wildlife area that would be affected is Wetland Area 5 (See Figure 3.7-1 and section 5.7.3, Wetland and Riparian Areas).

East Beaverton/S.W. Cabot Street to Beaverton Transit Center

South (Adopted). Wildlife populations in this segment would be expected to consist of species that tolerate considerable disturbance, since the habitat is fragmented, and Highway 217 and other urban uses are nearby. Existing wetland and upland habitats between Highway 217 and S.W. 117th Avenue would be bisected by fill and by the alignment. Wildlife habitat would decrease and be degraded in this area. Wildlife populations able to tolerate such fragmented and disturbed habitat would be expected to exist in the area. Human-tolerant wildlife species such as American coots, mallards, starlings, house sparrows, and small mammals would populate these fragmented habitat areas.

North. Wildlife impacts would be similar to those for the South option.

East Beaverton/Beaverton Transit Center to S.W. Watson Avenue

South (Adopted). Wildlife that use the large black cottonwoods and snags along Beaverton Creek and southwest of the Beaverton Transit Center, would be displaced. Cavity nesting birds such as kestral and woodpeckers would be displaced. In addition, removal of large black cottonwoods and snags would reduce shade over Beaverton Creek, which would result in increased water temperatures.

North. No impacts on fish or wildlife are anticipated.

Beaverton/S.W. Watson Avenue to S.W. Murray Boulevard

BN (Adopted). Wildlife, primarily resident waterfowl that feed on grassy areas along Beaverton Creek, could be affected by increased train traffic. No significant impacts on fish or wildlife are anticipated, since the LRT would be placed on the existing BN railroad grade.

Henry Street. Because habitats within this segment of the project are primarily urban and tolerant of human disturbance, significant impacts on fish or wildlife are not anticipated. Wildlife in affected wetland areas would either adapt to the additional disturbance or be displaced.

Beaverton/S.W. Murray Boulevard to S.W. 185th Avenue

TEK Woods, a significant wildlife habitat area, would be reduced by about 5.4 acres in a corridor 12 feet wide along the existing BN railroad tracks. Increased traffic associated with the S.W. Murray Boulevard park-and-ride lot southeast of this area would interfere with movement of wildlife from this habitat area to Beaverton Creek, and to the corridor of mixed forest on the west side of Beaverton Creek. The removal of grassland habitat between Beaverton Creek and TEK Woods for the S.W. Murray Boulevard park-and-ride facility would decrease the population of small mammals, which in turn would result in lower diversity and number of predator species such as raptors.

Wildlife in the northern edge of Tualatin Hills Regional Nature Park would be adversely affected by the LRT and the S.W. Merlo Road park-and-ride facility. Increased traffic, human presence, and loss of habitat would displace wildlife species to other areas in the park. In addition, wildlife habitat on the north side of the BN railroad tracks in the wetlands associated with Cedar-Mill Creek (Wetland Area 14, Figure 3.7-1) would be reduced and degraded by increased traffic, LRT activities, and people. Wildlife diversity and abundance would be decreased, less-tolerant species such as green-backed herons, pileated woodpeckers, and migrating water fowl, would be displaced, and more human-tolerant species, such as mallards and starlings, probably would dominate the area.

5.7.1.4 LRT Terminus Options

Sunset Transit Center

Significant habitat areas that would be reduced include Sunset Canyon, Wetland Areas 1, 2, and 3 (Figure 3.7-1), and Golf Creek. This terminus would not affect significant wildlife habitat areas such as

TEK Woods and Tualatin Hills Regional Nature Park, or wetland habitats associated with Beaverton and Cedar-Mill Creeks.

<u>S.W. Murray Boulevard</u>

The same areas would be affected as for the Sunset Transit Center terminus option. In addition, Wetland Areas 4 through 11 would be affected (Figure 3.7-1). The quality of habitat provided near TEK Woods would decrease as a result of increased traffic and human activity associated with the LRT and park-and-ride facilities, even though the LRT line would end east of TEK Woods. Wetland areas at Cedar-Mill Creek and S.W. 170th Avenue would not be affected by this terminus option, nor would Tualatin Hills Regional Nature Park.

<u>S.W. 185th Avenue</u>

All of the wetland areas and significant wildlife areas identified in the project area, including Sunset Canyon, TEK Woods, and Tualatin Hills Regional Nature Park, would be affected by this terminus option.

5.7.2 Vegetation

This section discusses impacts on vegetation, such as mixed and coniferous forest, parkland, and residential landscaping. Impacts on wetland and riparian areas are discussed in Section 5.7.3.

5.7.2.1 No Build Alternative

In order to complete the proposed Sunset Transit Center and 600-space park-and-ride lot, 6.4 acres of urban/agricultural land would be removed. Under this alternative, no forested land would be cleared as a result of highway improvements or LRT construction in Sunset Canyon.

5.7.2.2 TSM Alternative with Highway Improvements

Vegetation would be cleared and the land graded to varying degrees on both sides of Sunset Highway and Highway 217. The greatest effect on vegetation would be in Sunset Canyon, on the south side of Sunset Highway between the Zoo and Sylvan Creek (see Table 5.7-1). About 14.1 acres of forested land would be cleared for highway improvements: 6.3 acres between the Zoo and Sylvan Interchanges and 7.8 acres between the Sylvan Interchange and the water tank at S.W. 76th Avenue. Between the Zoo and Sylvan Interchanges, the 6.3 acres cleared would include about 1.9 acres of mixed forest adjacent to Sylvan Creek, and about 2.3 acres of riparian and deciduous forest in ravines associated with the creek (see Table 5.7-1). On the north side of the highway, about 3.4 acres of parkland and residential landscaping would be cleared in a corridor ranging in width from 25 to 100 feet.

5.7.2.3 LRT Alternative with Highway Improvements

All habitat types identified within the project area would be affected by the LRT project. The extent and severity of the expected impacts differ depending on the alignment option. The following discussion describes impacts on vegetation for each alignment option within each of the seven segments of the project. Impacts on wetland and riparian areas are described in Section 5.7.3, Wetland and Riparian Areas.

<u>S.W. 11th Avenue to S.W. 18th Avenue/S.W. Jefferson Street (Adopted)</u>

No significant habitats exist within this segment. No impacts on vegetation other than removal of urban land are anticipated.

Table 5.7-1

ECOSYSTEMS IMPACT SUMMARY

Alternative	Acreage Affected Wetlands	Riparian Areas	Forests	Culverting (Linear Feet)
No Build	0.0	0.0	0.0	0.0
TSM	0.8	3.4	14.1	200.0
LRT Adopted Alignment				
Sunset Transit Center Terminus	0.8	3.4	32.5	295.0
S.W. Murray Boulevard Terminus	2.45	3.4	32.5	835.0
S.W. 185th Avenue Terminus	4.65	3.4	32.5	835.0
LRT ALIGNMENT OPTIONS				
Canyon Segment				
Southside (adopted)	0.8	3.4	32.5	295
Long Tunnel				
-With station	0.2	3.1	16.3	180
-Without station	0.2	3.1	16.3	180
Northside	0.4	3.4	23.1	295
East Beaverton				
South (adopted)	0.8	0.0	0.0	330
North	1.0	0.0	0.0	250
Beaverton				
BN (adopted)	0.0	0.0	0.0	0.0
Henry Street	0.6	0.0	0.0	380

Source: Shapiro and Associates, Inc., 1990.

S.W. 18th Avenue/S.W. Jefferson Street to Sunset Transit Center

Southside (Adopted). The greatest removal of vegetation would be in Sunset Canyon. As for the TSM Alternative, about 14.1 acres of forested land would be cleared for highway improvements. In addition, about 18.4 acres would be cleared for LRT construction: 9.1 acres between the Vista Ridge Tunnels and the Zoo Interchange, 5.1 acres between the Zoo and Sylvan Interchanges, 2.7 acres between the Sylvan Interchange and the water tank at S.W. 76th Avenue, and a possible 1.5 acres of tree removal adjacent to the construction zone. Between the Vista Ridge Tunnels and the Zoo Interchange, the 9.1 acres cleared would include about 1.0 acre of mixed forest adjacent to an intermittent creek (see Table 5.7-2). Between the Zoo and Sylvan Interchanges, the 5.1 acres cleared would include about 1.9 acres of mixed forest adjacent to Sylvan Creek, and about 2.3 acres of riparian and deciduous forest in ravines associated with the creek (see Table 5.7-2). Other vegetation impacts include clearing or grading about four acres of parkland and residential landscaping on the north side of the highway, in a corridor 25 to 100 feet wide. Between Sylvan Creek and the Sunset Highway/Highway 217 Interchange, agricultural land, parkland, and residential and urban development would be cleared on both sides of the highway in a corridor generally less than 100 feet wide.

Northside. Removal of vegetation in the steepest section of Sunset Canyon would be avoided with this alignment option. However, mixed forest, and urban and residential development would be removed east of the east tunnel portal, and about 23.1 acres of forested land would be cleared in Sunset Canyon as a result of highway improvements (14.1 acres) and LRT construction (9.0 acres). The forested land cleared between the Vista Ridge Tunnels and the Zoo Interchange would include about 0.3 acre of mixed forest adjacent to an intermittent creek at the west tunnel portal. Under the TSM Alternative, the forested land cleared between the Zoo and Sylvan Interchanges would include about 1.9 acres of mixed forest adjacent to Sylvan Creek, and about 2.3 acres of riparian and deciduous forest in ravines associated with the creek (see Table 5.7-2). West of the tunnel portal, on the north side of Sunset Highway, about four acres of parkland would be cleared and graded between the portal and the Zoo, and about 3.4 acres of parkland and residential development would be removed between the Zoo and S.W. Skyline Boulevard.

Long Tunnel with and without Zoo Station. In general, impacts on vegetation would be similar to those described for the TSM Alternative; about 14.1 acres of forested land in Sunset Canyon would be cleared for highway improvements. In addition, construction of the station at the Zoo would affect developed parkland. Only about 2.2 acres of forested land would be cleared in Sunset Canyon as a result of LRT construction: 0.8 acres between the Vista Ridge Tunnels and the Zoo Interchange, and 1.4 acres between the Sylvan Interchange and the water tank at S.W. 76th Avenue. As for the Southside and Northside alignment options, riparian and deciduous forest would be removed in ravines associated with Sylvan Creek in the vicinity of the Sylvan Interchange (see Table 5.7-2). Impacts from the west tunnel portal to Sunset Transit Center would be similar to those described for the Southside alignment option.

<u>Sunset Transit Center to S.W. Cabot Street/Highway 217 (Adopted)</u>

Mixed forest, coniferous forest, parkland, and urban and residential development would be cleared or graded for preparation of the proposed transit improvements.

<u>East Beaverton/S.W. Cabot Street to Beaverton Transit Center</u>

All Options. No significant impacts on vegetation are anticipated because only residential and urban development would be removed within this segment of the corridor.

<u>East Beaverton/Beaverton Transit Center to S.W. Watson Avenue</u>

All Options. No significant impacts on vegetation are anticipated, because only urban development would be removed within this segment of the corridor.

<u>Beaverton/S.W. Watson Avenue to S.W. Murray Boulevard</u>

BN (Adopted). No significant impacts on vegetation are anticipated if the LRT is placed on the existing BN railroad grade.

Henry Street. Residential and urban development and parkland would be cleared and graded; however, no significant impacts on vegetation are anticipated.

<u>Beaverton/S.W. Murray Boulevard to S.W. 185th Avenue</u>

Clearing and grading would occur in several areas, including about 7.5 acres of grassland for the LRT corridor and the S.W. Murray Boulevard park-and-ride lot. In addition, 5.4 acres (in a corridor 12 feet by 20,000 feet) of mixed oak/ponderosa pine forest on the north side of the existing BN railroad tracks (TEK Woods), and 0.4 acres of agricultural land, row crops, and nursery vegetation along the BN tracks would be cleared for the LRT, and about 1.8 acres of shrub land and barren ground would be cleared for the S.W. Merlo Avenue park-and-ride lot.

Table 5.7-2

WETLAND AND RIPARIAN AREA IMPACTS
UNDER THE WESTSIDE ALTERNATIVES

Alternatives and Segments	Action	Wetland (acres)	Riparian and Other Impacts	Culvert (feet)
No Build Alternative	0	0	0	0
TSM Alternative with Highway Improvements				
Riparian area east of Skyline Boulevard at LRT crossover; south side of Sunset Highway	Fill/culvert	0	Riparian; 0.3 acre	35
Wetland Area 2	Fill/culvert	0.2	Mixed forest adjacent to Sylvan Creek; 1.9 acres	0
Riparian area at Slyvan Creek; south side of Sunset Highway	Fill/culvert	0	Riparian and deciduous forest in ravines; 2.3 acres	40
Wetland Area 3	Fill	0.2	0	0
Riparian area at Golf Creek; south side of Sunset Highway	Fill/culvert	0	Riparian and deciduous forest; 0.8 acre	50
Wetland Area 4	Fill	0.3	0	0
Wetland Area 7	Fill/culvert	0.1	0	75
Subtotal		**0.8**		**200**
LRT Alternative with Highway Improvements				
S.W. 11th Avenue to S.W. 18th Avenue/ S.W. Jefferson Street (Adopted)	0	0	0	0
S.W. 18th Avenue/S.W. Jefferson Street to Sunset Transit Center	0	0	0	0
Southside (Adopted)				
-Wetland Area 1	Fill/culvert	0.4	0	30
-Intermittent Creek at the Zoo Station	Fill/culvert	0	Mixed forest adjacent to intermittent creek; 1 acre	50
-Riparian area east of Skyline Boulevard at LRT crossover; south side of Sunset Highway	Fill/culvert	0	Riparian; 0.3 acre	35
-Wetland Area 2	Fill	0.2	Mixed forest adjacent to Sylvan Creek; 1.9 acres	0
-Riparian area at Sylvan Creek; south side of Sunset Highway	Fill/culvert	0	Riparian and deciduous forest in ravines; 2.3 acres	40
-Wetland Area 3	Fill	0.25	0	0
-Riparian area at Golf Creek; north side of Sunset Highway	Fill and Toe-wall culvert	0	Coniferous forest adjacent to Golf Creek; 1 acre	90
-Riparian area at Golf Creek; south side of Sunset Highway	Fill/culvert	0	Riparian; 0.8 acre	50
Subtotal		**0.8**		**295**

Table 5.7-2 (continued)

WETLAND AND RIPARIAN AREA IMPACTS
UNDER THE WESTSIDE ALTERNATIVES

Alternatives and Segments	Action	Wetland (acres)	Riparian and Other Impacts	Culvert (feet)
Northside				
-Intermittent Creek at the West Tunnel Portal	Fill/culvert	0	Mixed forest adjacent to intermittent creek; 0.3 acre	80
-Riparian area east of Skyline Boulevard at LRT crossover; south side of Sunset Highway	Fill/culvert	0	Riparian; 0.3 acre	35
-Wetland Area 2	Fill	0.2	Mixed forest adjacent to Sylvan Creek; 1.9 acres	0
-Riparian area at Sylvan Creek; south side of Sunset Highway	Fill/culvert	0	Riparian and deciduous forest in ravines; 2.3 acres	40
-Wetland Area 3	Fill	0.2	0	0
-Riparian area at Golf Creek; north side of Sunset Highway	Fill and Toe-wall culvert	0	Coniferous forest adjacent to Golf Creek; 1 acre	90
-Riparian area at Golf Creek; south side of Sunset Highway	Fill/culvert	0	Riparian; 0.8 acre	50
Subtotal		**0.4**		**295**
Long Tunnel With Zoo Station				
-Riparian area at Sylvan Creek; south side of Sunset Highway	Fill/culvert	0	Riparian and deciduous forest in ravines; 2.3 acres	40
-Wetland Area 3	Fill	0.2	0	0
-Riparian area at Golf Creek; north side of Sunset Highway	Fill and Toe-wall culvert	0	Confierous forest adjacent to Golf Creek; 1 acre	90
-Riparian area at Golf Creek; south side of Sunset Highway	Fill/culvert	0	Riparian; 0.8 acre	50
Subtotal		**0.2**		**180**
Long Tunnel Without Zoo Station				
-Riparian area at Sylvan Creek; south side of Sunset Highway	Fill/culvert	0	Riparian and deciduous forest in ravines; 2.3 acres	40
-Wetland Area 3	Fill	0.2	0	0
-Riparian area at Golf Creek; north side of Sunset Highway	Fill and Toe-wall culvert	0	Coniferous forest adjacent to Golf Creek; 1 acre	90
-Riparian area at Golf Creek; south side of Sunset Highway	Fill/culvert	0	Riparian; 0.8 acre	50
Subtotal		**0.2**		**180**
Sunset Transit Center to S.W. Cabot Street/Highway 217 (Adopted)				
-Wetland Area 4	Fill	0.3	0	0
-Wetland Area 5	Fill/culvert	0.3	0	210
	Headwall/Fill	0.25	0	0
	Structure	0	0	0
-Wetland Area 6	No Action	0	0	0
Subtotal		**0.85**		**210**

Table 5.7-2 (continued)

WETLAND AND RIPARIAN AREA IMPACTS
UNDER THE WESTSIDE ALTERNATIVES

Alternatives and Segments	Action	Wetland (acres)	Riparian and Other Impacts	Culvert (feet)
East Beaverton/S.W. Cabot Street to Beaverton Transit Center				
•North				
-Wetland Area 7	Fill/culvewrt	0.1	0	75
-Wetland Area 8	Fill; headwall at bridges	0.2	0	40
-Wetland Area 9	Fill/culvert	0.4	0	75
Subtotal		**0.7**		**190**
•South (Adopted)				
-Wetland Area 7	Fill/culvert	0.1	0	75
-Wetland Area 8	Fill/culvert	0.1	Realign 350' of Hall Creek	50
-Wetland Area 9	Fill/culvert	0.5	Realign 400' of Beaverton Creek	125
Subtotal		**0.7**		**250**
East Beaverton/Beaverton Transit Center to S.W. Watson Avenue				
•North				
-Wetland Area 9	Fill, headwalls and culvert	0.3	0	60
Subtotal		**0.3**		**60**
•South (adopted)				
-Beaverton Creek	Fill/culvert	0.1	0	80
Subtotal		**0.1**		**80**
Beaverton/S.W. Watson Avenue to S.W. Murray Boulevard				
•BN (Adopted)	0	0	0	0
Subtotal		**0**		**0**
•Henry Street				
-Wetland Area 10	Fill/culvert	0.3	0	300
-Wetland Area 11	Fill/culvert	0.3	0	80
Subtotal		**0.6**		**380**
Beaverton/S.W. Murray Boulevard to S.W. 185th Avenue				
-Wetland Area 12	Avoid	0	0	0
-Wetland Area 13	Fill	0.3	0	0
-Wetland Area 14	Fill; retaining wall on north end	0.2	0	0
-Wetland Area 15	Fill	1.7	0	0
-Wetland Area 16	Bridge	0	0	0
Subtotal		**2.2**		**0**

Source: Shapiro and Associates, Inc., 1990.

5.7.2.4 LRT Terminus Options

Mixed deciduous and coniferous forest, agricultural land, and residential and urban development would be cleared by the LRT, if it ends at Sunset Transit Center or S.W. Murray Boulevard. All the upland and wetland habitat types would be affected by the LRT, if it ends at S.W. 185th Avenue.

5.7.3 <u>Wetland and Riparian Areas</u>

The identification and analysis of wetland impacts has been conducted in coordination with numerous federal, state and local agencies, including the U.S. Army Corps of Engineers (Corps), the U.S. Environmental Protection Agency (EPA), the Oregon Division of State Lands (DSL), local jurisdictions, and local interest groups. Representatives from the Corps, DSL, EPA, the City of Beaverton, and Washington County have visited many of the wetland and riparian areas within the project vicinity on one or more field trips. The objective of the field trips was to inspect the wetland delineation and discuss options that could avoid, minimize, and mitigate wetland impacts. In addition, a Section 404 Alternatives Analysis, which addresses the cost, logistics, and technology for each wetland impact between S.W. Cabot Street and S.W. Murray Boulevard, and cost and technology for impacts at other locations in the corridor, will be submitted to the Corps for review after selection of a preferred alternative. Until now, all discussions about wetland mitigation opportunities have been informal. Once a final alignment is selected, mitigation of wetland impacts will be addressed with the appropriate resource agencies. The final EIS will describe mitigation for wetland impacts.

Table 5.7-2 presents estimated wetland and riparian area impacts, alignment, and the amount of culvert that would be added under the alternatives and alignment options. The discussion in the following sections summarizes the impacts. Wetland areas are identified by the same numbering system used for describing and locating the wetland areas in Section 3.7.3.

5.7.3.1 No Build Alternative

No wetland or riparian areas would be affected and no culvert would be added under this alternative.

5.7.3.2 TSM Alternative with Highway Improvements

A total of 0.8 acres in Wetland Areas 2 (0.2 acres), 3 (0.2 acres), 4 (0.3 acres), and 7 (0.1 acres) would be filled under this alternative (see Figure 3.7-1). The riparian area at Golf Creek, on the south side of Sunset Highway, would be reduced, and about 350 feet of culvert would be added. In addition, several intermittent drainages on the southside of Sunset Highway, and Sylvan, Golf, and Hall Creeks would be filled.

5.7.3.3 LRT Alternative with Highway Improvements

All wetland and riparian areas identified within the project area would be affected by the LRT project. The extent and severity of the expected impacts differ depending on the alignment option. The following discussion describes impacts on wetland and riparian areas for each alignment option within the seven segments of the project.

<u>S.W. 11th Avenue to S.W. 18th Avenue/S.W. Jefferson Street (Adopted)</u>

No wetland areas, intermittent creeks or riparian areas would be affected and no culvert would be added within this segment.

<u>S.W. 18th Avenue/S.W. Jefferson Street to Sunset Transit Center</u>

Southside (Adopted). A total of 0.8 acres of emergent and scrub-shrub wetland would be filled in Wetland Areas 1 (0.4 acres), 2 (0.2 acres), and 3 (0.2 acres) (see Figure 3.7-1). One intermittent creek (at the Zoo station), three riparian areas on the south side of Sunset Highway (east of Skyline Boulevard at the LRT crossover, at Sylvan Creek, and at Golf Creek), and one riparian area on the north side of the highway (at Golf Creek) would be filled. About 295 feet of culvert would be added.

Northside. The impacts of this alignment option would be the same as for the Southside alignment option, except that Wetland Area 1 would not be affected, and the intermittent creek would be affected at the west tunnel portal, rather than the Zoo station.

Long Tunnel with and without Zoo Station. Wetland Areas 1 and 2 would not be affected with either Long Tunnel alignment option. However, 0.2 acres of emergent wetland in Wetland Area 3 would be filled. Two riparian areas on the south side of Sunset Highway (at Sylvan and Golf Creeks), and one riparian area on the north side of the highway (at Golf Creek), would be filled. A total of about 180 feet of culvert would be added.

<u>Sunset Transit Center to S.W. Cabot Street/Highway 217 (Adopted)</u>

A total of 0.85 acres of emergent, scrub-shrub, and forested wetland habitat types would be filled in Wetland Areas 4 (0.3 acres) and 5 (0.55 acres). A total of about 210 feet of culvert would be added at the north tributary to Hall Creek (Wetland Area 5).

<u>East Beaverton/S.W. Cabot Street to Beaverton Transit Center</u>

South (Adopted). A total of 0.7 acres of emergent, forested, and open-water wetland habitat types would be filled, the same as under the No Build Alternative. This includes Wetland Areas 7 (0.1 acres), 8 (0.1 acres), and 9 (0.5 acres). Other wetland and riparian impacts associated with realignment of Hall and Beaverton Creeks would include realignment of 350 feet of Hall Creek and installation of a 50-foot bridge structure, and realignment of 400 feet of Beaverton Creek. In addition, 250 feet of culvert would be added on Hall and Beaverton Creeks.

North. The same wetland areas would be affected as with the South alignment option, but the amount of acreage in Wetland Area 8 would be slightly more (0.2 acres) and in Wetland Area 9 would be slightly less (0.4 acres) (see Figure 3.7-1). A total of about 190 feet of culvert would be added in various locations on Hall Creek.

<u>East Beaverton/Beaverton Transit Center to Watson Avenue</u>

South (Adopted). Approximately 0.1 acre of open-water and emergent wetland along Beaverton Creek (Wetland Area 9) would be filled. About 80 feet of Beaverton Creek would be culverted. Several large cottonwoods and a snag lining Beaverton Creek west of the transit center access road would be removed.

North. About 0.3 acres of Wetland Area 9 would be filled, and a total of about 60 feet of culvert would be added.

<u>Beaverton/S.W. Watson Avenue to S.W. Murray Boulevard</u>

BN (Adopted). No wetland areas would be affected and no culvert would be added.

Henry Street. A total of 0.6 acres of emergent, forested, and open-water wetland habitat types would be filled in Wetland Areas 10 (0.3 acres) and 11 (0.3 acres) (see Figure 3.7-1). A total of about 380 feet of culvert would be added on Beaverton Creek.

<u>Beaverton/S.W. Murray Boulevard to S.W. 185th Avenue</u>

A total of 2.2 acres of open-water and emergent wetland habitat types would be filled in Wetland Areas 13 (0.3 acres), 14 (0.2 acres), and 15 (1.7 acres) (see Figure 3.7-1). The LRT alignment would cross Willow Creek east of S.W. 185th Avenue and north of Baseline Road on a 170-foot bridge structure; no filling or clearing of wetland or riparian vegetation is anticipated.

5.7.3.4 LRT Terminus Options

Sunset Transit Center

Wetland Areas 1, 2, and 3, which are located in this portion of the proposed LRT alignment, would be filled. This segment includes intermittent creeks at the Zoo station and at the west tunnel portal for the Northside alignment option, and riparian areas on the north and south side of Sunset Highway east of S.W. Skyline Boulevard at the LRT crossover, and at Sylvan and Golf Creeks. Between 180 and 295 feet of culvert would be added, depending on the alignment option.

S.W. Murray Boulevard

If the proposed LRT alignment ended at S.W. Murray Boulevard, affected areas would include those identified in that portion of the corridor east of Sunset Transit Center, as well as areas between the transit center and S.W. Murray Boulevard. Wetland Areas 4 through 11 are located in this portion of the corridor. Culvert would be added, with the amount depending on the alignment option.

S.W. 185th Avenue

With this terminus option, all areas identified with the S.W. Murray Boulevard option would be affected. In addition, Wetland Areas 12 through 15 would be affected. No additional culvert would be added.

5.7.4 Mitigation Measures

Mitigation for impacts on wetland and significant wildlife habitat in the Westside Corridor would be addressed on a project-wide basis. The first priority is to avoid or minimize impacts on wetlands and other significant natural areas. Where avoidance is not possible, other mitigation approaches, such as enhancement, restoration, or creation of similar habitat types, would be considered.

Mitigation discussions are preliminary, since a final project decision is still pending. Measures described in this section indicate only where mitigation for wetland impacts would occur within the LRT right-of-way. Wetland impacts that cannot be mitigated onsite would be mitigated by replacing the same wetland habitat type, at a one-to-one ratio, within the same or a nearby watershed. A complete discussion of mitigation for the final project alignment will be presented in the Final EIS, including buffering and other mechanisms to maintain the quality of wetland habitat.

5.7.4.1 No Build Alternative

No mitigation measures are proposed.

5.7.4.2 TSM Alternative with Highway Improvements

Impacts to Wetland Areas 2, 3, 4, and 7 cannot be mitigated onsite and would be mitigated by replacing the same wetland habitat type, at a one-to-one ratio, within the same or a nearby watershed. A complete discussion of mitigation for the final project alignment will be presented in the Final EIS, including buffering and other mechanisms to maintain the quality of wetland habitat.

5.7.4.3 LRT Alternative with Highway Improvements

S.W. 11th Avenue to S.W. 18th Avenue/S.W. Jefferson Street (Adopted)

No mitigation measures are proposed.

S.W. 18th Avenue/S.W. Jefferson Street to Sunset Transit Center

Mitigation for impacts on vegetation in Sunset Canyon is addressed in Section 5.4 (Aesthetics) and in the Technical Memorandum 20d.

Impacts to Wetland Areas 1, 2, and 3 cannot be mitigated onsite and would be mitigated by replacing the same wetland habitat type, at a one-to-one ratio, within the same or a nearby watershed. A complete discussion of mitigation for the final project alignment will be presented in the Final EIS, including buffering and other mechanisms to maintain the quality of wetland habitat.

At the Golf Creek crossing, on the north side of Sunset Highway, placement of fill with a toe wall is proposed to reduce the amount of fill required, and the effect on riparian habitat. Fill slopes at crossings of Sylvan and Golf Creeks could be revegetated with native species that would grow within the power line right-of-way.

Sunset Transit Center to S.W. Cabot Street/Highway 217 (Adopted)

Impacts to Wetland Area 4 cannot be mitigated onsite and would be mitigated by replacing the same wetland habitat type, at a one-to-one ratio, within the same or a nearby watershed. A complete discussion of mitigation for the final project alignment will be presented in the Final EIS, including buffering and other mechanisms to maintain the quality of wetland habitat.

Construction of a bridge-like structure 300 feet long at Wetland Area 5 could eliminate the need for 0.34 acres of proposed fill within the wetland. This is considered too expensive to be economically feasible. A ten-foot head wall at the top of the fill, and revegetation of the fill with native species are proposed. This wall would reduce the extent of the fill into the wetland by about 20 feet, avoiding about 0.1 acres of the wetland area. Revegetation would provide a buffer between the wetland and the LRT corridor.

East Beaverton/S.W. Cabot Street to Beaverton Transit Center

South (Adopted). Mitigation of impacts on Wetland Area 7 would include removing of about 0.2 acres of old fill on the Washington County drop box property, between Highway 217 and S.W. 114th Avenue, and replacing it with native wetland species. Box culverts with extended head walls would be used to reduce fill in Wetland Area 8. About 0.2 acres of fill west of S.W. 114th Avenue would be removed, and the existing wetland area enhanced with native wetland plantings to mitigate impacts on Wetland Area 8.

About 225 feet of the north tributary of Hall Creek north of Beaverton Transit Center and behind Canyon Place Shopping Center, which currently is in a culvert, would be opened. Existing Oregon white oak and Oregon ash trees would be maintained wherever possible.

North. Mitigation of impacts on Wetland Areas 7 and 8 would be the same as for the South alignment option.

To mitigate impacts on Wetland Area 9, about 0.3 acres of old fill, primarily on the southeast side of the Beaverton Transit Center, would be removed to create wetland, which would be planted with native species. As with the south alignment, existing Oregon white oak and Oregon ash trees would be maintained wherever possible.

East Beaverton/Beaverton Transit Center to S.W. Watson Avenue

Impacts to Wetland Area 9 cannot be mitigated onsite and would be mitigated by replacing the same wetland habitat type, at a one-to-one ratio, within the same or a nearby watershed. A complete discussion of mitigation for the final project alignment will be presented in the Final EIS, including buffering and other mechanisms to maintain the quality of wetland habitat.

Beaverton/S.W. Watson Avenue to S.W. Murray Boulevard

BN (Adopted). No mitigation measures are proposed at this time.

Henry Street. Approximately 400 feet of a tributary of Beaverton Creek, which currently flows in a culvert east of Willow Creek Park and S.W. 144th Avenue, would be opened, and about 0.6 acres of wetland would be created with native vegetation to mitigate impacts on Wetland Area 10.

Impacts to Wetland Area 11 cannot be mitigated onsite and would be mitigated by replacing the same wetland habitat type, at a one-to-one ratio, within the same or a nearby watershed. A complete discussion of mitigation for the final project alignment will be presented in the Final EIS, including buffering and other mechanisms to maintain the quality of wetland habitat.

Beaverton/S.W. Murray Boulevard to S.W. 185th Avenue

At Cedar-Mill Creek, an existing railroad spur would be removed, creating about 0.5 acres of wetland as mitigation for impacts on Wetland Area 14. The LRT would cross Cedar-Mill Creek on a box culvert with extended retaining walls on the north side of the corridor.

Impacts to Wetland Areas 13 and 15 cannot be mitigated onsite and would be mitigated by replacing the same wetland habitat type, at a one-to-one ratio, within the same or a nearby watershed. A complete discussion of mitigation for the final project alignment will be presented in the Final EIS, including buffering and other mechanisms to maintain the quality of wetland habitat.

5.7.4.4 LRT Terminus Options

Mitigation measures for the LRT terminus options would be the same as those identified in the preceding section for segments of the proposed alignment.

5.8 WATER QUALITY AND HYDROLOGY

5.8.1 Water Quality

The two major water quality concerns associated with the Westside Corridor Project are the addition of urban pollutants (oil, grease, heavy metals) and sediments to stormwater runoff, and the discharge of phosphorus into the Tualatin River.

Long-term impacts associated with the operation of the proposed project would primarily be related to runoff. The increase in impervious (sealed) surface area from the proposed highway improvements, park-and-ride lots, LRT stations, and LRT maintenance facility would increase stormwater runoff. Any associated contaminants would be discharged into stormwater systems and surface waters. The TSM and LRT Alternatives would add impervious surface area along existing freeway rights-of-way. In addition, at least two new transit centers, five new park-and-ride lots, and some highway improvements are associated with the TSM Alternative. The various LRT Alternatives would increase impervious surface area coverage in the drainage basins. New stormwater facilities would be needed to handle the runoff generated by these improvements. The Oregon Environmental Quality Commission's (EQC) requirements for phosphorus removal would be in effect; therefore, long-term effects of additional phosphorus are not expected to be significant.

In general, the placement of LRT tracks is not expected to produce additional runoff because the tracks would be laid either on existing surface streets or on a highly permeable bed of crushed rock. The highway improvements in the TSM and LRT Alternatives would create new impervious surface; however, because most of this area runs along existing freeway right-of-way. The increase in runoff would be distributed over such a large area that impacts would be minimized.

Some localized increases in runoff rates would occur, especially where there is construction of impervious surfaces. The potential for runoff pollutants from large paved areas, such as park-and-ride lots, could be reduced through the use of oil/water separators to trap oil, grease, and hydrocarbons, and wet ponds or grass-lined swales to trap phosphorous-enriched soil particles.

There is no evidence that the proposed project would produce significant changes in either the urban or suburban subbasin rainfall-runoff relationships. Because the project area is located primarily in a developed area, the additional impervious surface and any associated contaminants would be minor, when compared with the total drainage basin's discharge into the stormwater system and surface waters.

Tri-Met has adopted a policy of not allowing the project to significantly interfere with existing drainage patterns. Both the City of Portland and the Oregon Department of Environmental Quality (DEQ) recognize the need for regulating nonpoint source pollution of urban stormwater runoff, and preliminary regulations are being developed. A permitting program is expected to be in place for 1992. In addition, the Unified Sewer Agency (USA), the agency responsible for achieving phosphorus level reduction, has stated that the Westside Corridor Project would have to incorporate stormwater quality control facilities designed to meet phosphorus level reduction goals.

All new transit centers, park-and-ride lots, and maintenance facilities would be built and maintained in accordance with applicable requirements for stormwater runoff, phosphorus control, wetlands mitigation, flood hazard areas, and preservation of existing drainage patterns.

5.8.2 Groundwater

If a Tunnel option is selected, it is anticipated that groundwater would be encountered during construction. It is possible that the construction of the short tunnel may intersect a groundwater aquifer. In this case, the water would become a new source of surface water at the tunnel portal, requiring diversion to the nearest established drainage channel or stormwater sewer. Construction of the long tunnel (with or without a Zoo station) also could encounter groundwater. In both Long Tunnel alignment options, the vertical alignment would include grades that slope towards the east portal. Therefore, groundwater drainage would have an impact only on Portland's combined sanitary/stormwater sewage system, and not on the surface water.

5.8.3 Floodplain Encroachment

Within the urban subbasin, the project area does not traverse any 100-year floodplains. Extensive floodplain areas exist in the suburban subbasin, particularly in the vicinity of the Beaverton Transit Center and the Canyon Place Shopping Center. Highway improvements under the TSM Alternative would not affect any existing 100-year floodplains. Tri-Met has indicated that as a general design principal, the light rail tracks would be a minimum of one foot above the 100-year elevation in all designated flood hazard areas. Compliance with the Federal and County Flood Insurance Policies require that all fill operations in designated flood hazard areas be accomplished in a manner that would produce no net reduction in floodwater storage volume. Consequently, any encroachment on the 100-year floodplain would require mitigation at a one-to-one ratio.

The encroachment on floodplain areas resulting from implementation of the LRT Alternative would not be considered significant by criteria set forth in DOT Order No. 5650.2. Further, the natural and beneficial value of affected floodplain areas would be maintained through the application of mitigation measures. No impacts to floodplains would occur as a result of secondary development associated with the build alternatives. State of Oregon land use planning regulations require each county and local jurisdiction to identify natural resource and hazard areas, including the 100-year floodplain, in their comprehensive plans, and to establish land development controls to protect these resources from future development.

Rail segments of the North option in east Beaverton, and both the BN and Henry Street options in central Beaverton, which would be below the 100-year flood level if an on-grade alignment were used, could be elevated to meet the stated Tri-Met policy of one foot above the 100-year flood level. The South alignment option passes into the 100-year floodplain in the vicinity of S.W. 117th Avenue, and continues below flood elevation through Canyon Place Shopping Center and the Beaverton Transit Center to S.W. Hall Boulevard. The design of both the culvert through the shopping center and the roadway crossing this culvert at S.W. 117th Avenue allows flood waters to flow over S.W. 117th Avenue and over the shopping center parking lot during heavy flood conditions.

Since the rail line crosses S.W. 117th Avenue at grade at this location, and since the roadway cannot be raised without damming the floodway, the rail line cannot be raised above the floodplain on the south alignment. If this alignment is selected, and the track is not elevated to one foot of freeboard above the 100-year flood elevation, service disruptions from flooding are anticipated. Nuisance flooding, which typically occurs once or twice every two or three years, may halt service if water levels encroach on the track.

The best location for floodplain impact mitigation in the Tualatin River subbasin is at the Windolph rail spur near S.W. Merlo Road, near Station 465+00. Removal of this rail spur and its associated fill is under consideration as an element of this project. This would increase the capacity of the floodplain, and may represent sufficient mitigation for all other unavoidable encroachments within the subbasin.

The most significant unresolved floodplain mitigation issue concerns whether the project would incorporate the BN railroad track into the alignment. Since the BN already traverses most of the designated floodplain area in the suburban subbasin, its use as the project right-of-way would result in only minimal additional impacts on existing designated floodplain areas. If the BN track could not be used, and the LRT trackway were forced to parallel the existing BN track on new fill, additional floodplain mitigation could be required. Mitigation measures could include modifying the project design to avoid the initial impact to the extent possible, or creating new flood water storage adjacent to filled areas. A larger scale, regional mitigation opportunity would be the removal of the Windolph railroad spur adjacent to the S.W. Merlo Road station site. Final mitigation would be based on negotiations with local floodplain management agencies.

5.9 ENERGY

Direct energy impacts are those associated with operation of the transportation system. These include energy resources used by the LRT operation, energy used by buses, fuel used by motor vehicles traveling on roads, and energy used for maintenance of transit guideways and facilities. Indirect energy impacts are those associated with construction. An analysis of total energy consumption and construction payback periods for all alternatives revealed a payback period ranging from 47 years for the TSM Alternative to 16 to 55 years for the LRT Alternative (see Table 5.9-1). Payback for Surface LRT options ranged from 16 to 22 years with the S.W. 185th Avenue terminus option, from 20 to 29 years with the S.W. Murray Boulevard terminus option, and from 20 to 31 years with the Sunset Transit Center terminus option.

The impacts of growth and development on travel in the Portland region are reflected in estimates of daily vehicle miles traveled (VMT). By 2005, under the No Build Alternative, VMT in the Portland area would increase by about 36%, resulting in a 9% increase in energy use. This is the highest level of operating energy among the three project alternatives. Increased transit use under the TSM and LRT Alternatives would result in approximately a 1% decrease in VMT for the Portland region, compared with the No Build Alternative.

A comparison of the systemwide transit energy consumption (Table 5.9-2) among the transit alternatives reveals several consumption patterns. First, an increase in transit energy consumption generally reflects an increase in transit service. The overall transit energy consumption for the TSM and LRT Alternatives is about 60% higher than that for the No Build Alternative. Second, under all the alternatives, the energy consumption for buses accounts for 95% or more of the total transit energy consumption. Third, the total transit operations energy consumption for the LRT alignment options is slightly less than that for the TSM Alternative. However, shortening the LRT line to either Sunset Transit Center or S.W. Murray Boulevard adds energy consumption by buses, resulting in higher total transit energy consumption than the S.W. 185th Avenue terminus options. With respect to service level, the average energy consumption (in BTU) per vehicle mile of service for the LRT is about half of what it is for buses (24,000 BTU versus 45,000 BTU).

Table 5.9-1

SUMMARY OF ANNUAL ENERGY CONSUMPTION BY ALTERNATIVE
Westside Corridor Project
(BTU*10**9)

Alternative	Systemwide LRT Annual Energy Consumption	Systemwide Bus Annual Energy Consumption	Non-Transit Vehicle Annual Energy Consumption	Total Annual Maintenance Energy	Total Annual Energy	Annual Energy Savings	Total Construction Energy	Payback Period (years)
No Build Alternative	42	1,073	57,601	10,726	69,442	N/A	2	N/A
TSM Alternative	47	1,583	57,051	10,743	69,424	18	842	47
LRT Adopted Alignment:								
Sunset Transit Center Terminus	65	1,521	57,055	10,717	69,358	84	1,655	20
S.W. Murray Boulevard Terminus	86	1,507	57,014	10,728	69,335	106	2,159	20
S.W. 185th Avenue Terminus	93	1,490	56,978	10,728	69,289	153	2,403	16
LRT Alignment Options:								
Southside	93	1,490	56,978	10,728	69,289	153	2,428	16
Northside	93	1,490	56,978	10,728	69,289	153	3,358	22
Tunnel with Zoo Station	87	1,490	56,978	10,728	69,283	158	8,763	55
Tunnel w/out Zoo Station	86	1,490	56,978	10,728	69,232	159	8,755	55

Note: Assumes Annualization Factor of 290.
Includes region wide buses, autos, trucks, and motocycles.
Beaverton options make no difference in this comparison.

Source: Shapiro and Associates, Inc., 1990 and Tri-Met, 1990.

Table 5.9-2

TRANSIT OPERATIONS ENERGY CONSUMPTION
Regionwide, Average Daily, Year 2005
(BTU * 10**9)

				LRT					
	Existing (1990)	No Build	TSM	Southside to 185th	Northside to 185th	Tunnel w/ Zoo to 185th	Tunnel w/o Zoo to 185th	Northside to Murray	Northside to Sunset TC
Standard Articulated Buses	2.658	3.031	3.760	3.712	3.712	3.712	3.712	3.772	3.821
Articulated Buses	0.460	0.668	1.698	1.425	1.425	1.425	1.425	1.425	1.425
SUBTOTAL - BUSES	3.118	3.699	5.458	5.137	5.137	5.137	5.137	5.197	5.246
LRV Westside	N/A	N/A	N/A	0.158	0.158	0.153	0.148	0.136	0.063
LRV Eastside	0.093	0.145	0.161	0.161	0.161	0.161	0.161	0.161	0.161
SUBTOTAL - LRV	0.093	0.145	0.161	0.319	0.319	0.314	0.309	0.297	0.224
TOTAL TRANSIT ENERGY USEAGE	3.211	3.844	5.619	5.456	5.456	5.451	5.446	5.494	5.470

N/A - Not applicable.

Source: Shapiro and Associates, Inc., 1990 and Tri-Met, 1990.

5.10 GEOLOGY

In general, impacts to geology include changes to the topography, potential for slope failure (landslides), and to a lesser extent, soil erosion. Portions of the highway improvements and LRT surface alignments would cut into the side slopes along Sunset Canyon, creating a risk of slope failure. Construction activities and heavy rains could result in increased soil erosion.

Under the No Build Alternative, no major streets or highway improvements would be constructed, and associated impacts would be avoided.

Geologic impacts under the TSM Alternative would be mainly associated with improvements along Sunset Highway and Highway 217. Impacts would include changes in topography, potential impacts on slope stability in the Sunset Canyon and, to a lesser degree, erosion. These same types of impacts would result from the highway improvement component of the LRT Alternative.

Impacts associated with the LRT Alternative would be concentrated in the Canyon segment, and would vary depending on the alignment option selected. The Southside alignment option would follow the Tanner Creek Valley along Sunset Highway from Vista Ridge to Sylvan. Most of the south slope is covered by silt, which has a high potential for erosion and failure on steep slopes. This alignment crosses several drainage courses where fill sections are proposed.

This option includes a proposed bridge near the west portal of the Vista Ridge Tunnel. Cuts proposed along the steep south slope could exacerbate localized slope instability, with potential adverse impacts on residences located near the crests of slopes. Several local flow-slides and earth slumps have occurred along the south slope. These types of slides are generally unpredictable, and could affect LRT construction and operation.

The Northside alignment option includes construction of a short tunnel between S.W. Jefferson Street and Sunset Canyon, bypassing a very steep hillside north of Sunset Highway. Geologic impacts in the surface segments include changes to the topography, increased erosion and the potential for slope instability in historical landslide terrain and in steep, marginally stable slopes.

The LRT component of the tunnel options would avoid construction on slopes (except at portals), thereby avoiding potential landslide interfaces.

Impacts associated with the construction of the short tunnel would include vibrations from drill and blast excavation techniques, seepage of groundwater into the proposed excavation, the removal of excavated materials, and potential slope instability at the east portal.

Impacts associated with the Long Tunnel options would be similar, although more extensive, than those associated with the short tunnel. Some erosion potential also exists at the site of the western portal.

The geotechnical investigations conducted up to this stage of project development recommend several measures to mitigate potential slope instability and erosion impacts. These measures include specific retaining wall types and construction techniques, further subsurface exploration, completion of additional studies prior to final design, and monitoring during construction. Construction-related impacts and mitigation measures are discussed in Section 5.11.

Subsurface conditions have only been minimally explored along the Southside and Northside alignment options. The recommended additional geotechnical investigations should include borings along tunnel alignments and near critical bridge locations. These explorations should be a combination of soil and rock drilling, sampling, monitoring and testing.

Although faulting in the project vicinity is not considered a major issue, additional design studies should address earthquake hazards, especially for marginally stable slopes retained by major wall units. It is also recommended that additional slope-stability analysis be completed. This analysis should address the potential for local failure of marginally stable slopes, which could result from a combination of devegetation, heavy rainstorms, and changes caused by new construction.

5.11 CONSTRUCTION IMPACTS

The impacts of construction of highway and transit improvements on both the built and natural elements of the environment are identified in the following sections. Only those elements significantly affected by construction are discussed. For those elements not specifically addressed, the impacts would be similar regardless of the alternative chosen.

5.11.1 Transportation

Construction of the proposed highway and transit elements of the Westside Corridor Project would result in temporary impacts to local and regional traffic operations. The impacts identified are based on staging plans that would provide contractors reasonable access to construction areas. Highway and LRT construction could create airborne dust, which may affect the visibility of drivers on nearby freeway lanes, causing traffic to slow. Dust could affect businesses and residences adjacent to project construction sites. The construction impact analysis included the identification of potential lane closure requirements, alignment shifts, areas of construction activity adjacent to travel lanes, or other reductions in freeway or street capacity from LRT or highway construction activity.

5.11.1.1 Highway

Highway improvements are proposed within the Sunset Highway and Highway 217 corridors. Construction-related lane closures and restrictions would be the same whether the TSM or LRT Alternative is chosen. In the Sunset Corridor, improvements would be limited to the areas between the Vista Tunnels and the Highway 217 Interchange. Improvements within the Highway 217 corridor would be limited to the portion of the corridor between the Sunset Highway and S.W. Canyon Road Interchanges.

Specific impacts on highway capacity would depend on construction site access, equipment, and safety requirements. Replacement of overpasses and reconstruction of freeway ramps would result in significant impacts to surface street traffic. Reconstruction of freeway ramps would impact traffic circulation. The magnitude of capacity reductions will depend on the resulting geometry through the work zone, the nature of the work being done adjacent to the highway, and the amount of screening provided between moving traffic and construction activities.

The widening of Sunset Highway between the Zoo and Sylvan Interchanges would require lane closures. Impacts of peak-period closures would be severe. Significant queues would form upstream of the construction zones during substantial portions of the day; peak period delays could be on the order of 20 to 30 minutes per vehicle. Congestion on Sunset Highway could lead to an increase in traffic on alternate routes, including neighborhood streets. Elsewhere in the Sunset Highway and Highway 217 corridors, traffic impacts of highway-related construction would be minimal except during peak hour periods, when additional congestion resulting from capacity reductions, could occur. The volume of construction traffic, particularly dump trucks, could be large. Because of the magnitude of this traffic, direct access from Sunset Highway should be sought to minimize local traffic and neighborhood impacts.

Reconstruction of freeway interchanges in the Sunset and Highway 217 corridors would result in impacts to traffic circulation on surface streets. These impacts would result from lane reductions as overpasses are rebuilt, potential closures of freeway ramps, and detours around construction activities. The most significant impacts would occur at the Zoo, Sylvan, S.W. Camelot Court, and S.W. Wilshire/S.W. Park Way Interchanges.

In downtown Portland and the Goose Hollow area, LRT construction would, for the most part, occur within a right-of-way reserved for LRT. However, construction activity at any location along S.W. Morrison or S.W. Yamhill Streets would probably require full closure of the street at that location. From initial utility relocation through project finish activities, adjacent businesses and residences would be subjected to approximately one year of severe disruption of access, as well as noise and dust from construction activities. In addition, parking would temporarily be lost along S.W. 18th Avenue between S.W. Morrison and S.W. Jefferson Streets. As discussed in Section 4.2, parking would be removed permanently along S.W. Morrison and S.W. Yamhill Streets, from S.W. 11th Avenue to S.W. 18th Avenue.

Impacts of LRT construction would vary depending on the alignment option. From S.W. 18th Avenue to the Sylvan Interchange, the Southside alignment option would be more disruptive to traffic and take longer to construct than the Northside or Long Tunnel alignment options. East of the Zoo, total lane closure or lane-width restrictions with the Southside alignment option would reduce the ability to divert traffic off Sunset Highway if necessary. At the Vista Tunnels, peak period traffic demands are already at capacity. Delays during these closures could potentially be 20 to 30 minutes per vehicle, with significant queues upstream from the tunnels during most of the day.

West of the Zoo, construction of a retaining wall on the south side of the highway would result in a reduction of the capacity of Sunset Highway. Temporary access roads above the walls would be required. Long-term lane closures in both directions could be required at this location, creating severe traffic impacts.

Between the Sylvan and S.W. Camelot Court Interchanges on Sunset Highway, the Long Tunnel alignment options would have the fewest impacts. Both the Southside and Northside alignment options would have the same impacts in this segment. The construction of the cut-and-cover tunnel under S.W. Skyline Boulevard could disrupt surface street traffic. With the Long Tunnel alignment options, a temporary construction access road may be required. Acquisition of temporary access rights could be required if construction access is not available from public right-of-way. Construction activities could affect access to the Golf Creek Apartments, S.W. 76th Avenue, S.W. Camelot Court and Scholls Ferry Road.

All of the proposed LRT alignment options would be nearly identical between S.W. 76th Avenue and the Highway 217 Interchange on Sunset Highway. Construction of retaining walls for the LRT trackway, on the north side of the highway, could have impacts on westbound traffic. The most significant construction impacts in this section would occur during the construction of the proposed LRT and bus underpass under Sunset Highway on the west end of the interchange with Highway 217. S.W. Barnes Road, S.W. Marlow Avenue, and S.W. Park Way would experience construction-related traffic.

The Highway 217 corridor would experience some lane closures. In addition, detours on S.W. Wilshire Street and S.W. Park Way may be required during LRT construction. The proposed LRT cut-and-cover structure at S.W. Walker Road would require lane closures at the Highway 217 Interchange. This would affect local access to the freeway by removing turning lanes within the interchange area.

The primary impact of the LRT construction outside of the Sunset Highway and Highway 217 corridors would be attributable to the construction of grade crossings. Major streets probably would be reconstructed, with total closures possible during weekends. During all construction activities, attempts would be made to maintain access to businesses, residences, and driveways. Construction of grade crossings at S.W. 185th Avenue could have significant impacts on local traffic because of the distance between this street and parallel arterials, as well as the volume of traffic. A detour route probably would include S.W. Walker Road, S.W. 173rd Avenue, and Baseline Road. Construction of LRT on S.W. Henry Street would temporarily disrupt access to adjacent residences and businesses.

5.11.1.2 Transit

Transit impacts during construction could include substantial service delays, relocation of bus stops, street detours, and poor service reliability for bus lines using Sunset Highway (lines 57, 58, 59, 60, 88, and 89). Line 57 also could be subject to traffic delays because of reconstruction of Highway 217 at S.W. Canyon Road. Ridership could increase substantially as automobile commuters choose transit rather than driving in the congestion. The Tri-Met system, however, would have limited capacity to accommodate a major shift in travel mode.

5.11.1.3 Mitigation

Mitigation for transportation impacts during construction consists of three general categories: traffic handling options, transit management options, and public information. Detailed mitigation programs will be developed before construction, and will be coordinated with local jurisdictions and ODOT.

Traffic handling options would emphasize maintenance of peak-period, peak-direction traffic capacity on Sunset Highway and Highway 217 through techniques such as movable or portable traffic barriers, restrictions on local traffic use of Sunset Highway, and improved management of traffic incidents within construction zones. Coordination of highway and transit construction activities would be a key element in a construction impact mitigation plan.

Transit management options include providing supplemental bus service to alleviate congestion caused by lane closures, and providing temporary park-and-ride or shuttle bus options through highly constrained areas. TSM improvements would include temporary capacity improvements on other routes in the corridor, and increased transit service or provisions to encourage carpools and vanpools. Because transit, carpools, and vanpools (i.e., high occupancy vehicles (HOVs) would be forced to operate within mixed traffic, these measures would be of limited effectiveness unless provisions are made for HOV bypass lanes at ramp meters, queue-bypass lanes at intersections, or other preferential treatment. Mainline HOV lanes within the construction zones would be difficult to provide because of the limited space available for construction activities.

Public information tools such as newspaper and radio ads can be used to provide information regarding length of delays and availability of alternate transportation services. A second objective of public information programs would be to minimize access impacts to businesses and residences in construction zones through the use of community liaisons, who would coordinate mitigation measures with local businesses and residents.

Total earthwork includes both embankments and excavations. Suitable cut material will be used for embankment to the greatest extent possible. All options, particularly the Long Tunnel options, would require cut or fill materials to be trucked to or from the construction site. The Southside alignment option would require approximately 510,500 cubic yards, or 30%, more total earthwork than the Northside alignment option. While there would be more total earthwork with either the Northside or Southside alignment options, the Long Tunnel alignment options would result in excavation of approxiamtely 323,500 cubic yards (about twice as much as the Surface options), and would require the most trucking of excess material.

Initial soil borings along the proposed Long Tunnel alignments have identified rock material that would be excavated during tunnel construction. This material may be suitable for base, sub-ballast, or ballast. Tri-Met will investigate the possibility of processing the excavated rock for use on this project. The construction contractor would be responsible for locating suitable disposal sites for unusable or excess excavated materials. Disposal sites would be required to meet all applicable federal and state regulations.

Movement of excavated material from the Long Tunnel alignment options is expected to occur on a more regulated or cyclical manner than it would with either surface option. Tunnel excavation is generally performed in shifts that produce predictable quantities of excavated material, which can than be trucked out at the most opportune times. Standard haul routes would be established and predictable impacts would occur over the long-term construction phase. Earthwork on the surface would produce less predictable construction impacts. Hauling of cut and fill materials on much of the canyon surface segment would require close coordination among contractors and machine operators to avoid conflict in the limited working space.

Either existing highway sections, or new sections, constructed as part of the project, would be used for such haul trips. Trucks, rather than heavy earthmovers, would be used to haul excavated material, because haul loads will be restricted to legal load limits whenever hauling is done over portions of the new or existing roadway. Haul trips would be conducted on new, unopened portions of the highway when possible to reduce disruptions of freeway traffic.

Disruption of highway traffic flows, or limitation of highway capacity during construction, would be minimized to the extent possible by: (1) scheduling intense freeway construction activities (such as off-site haul trips, activities requiring use of existing freeway lanes) to coincide with non-peak hours; (2) using new, unopened freeway segments for haul trips; and (3) minimizing peak hour freeway lane closures. During peak hour construction activities that require lane closures, additional freeway capacity would be created when possible either by: (1) converting shoulders to temporary freeway lanes, or (2) reducing lane widths and establishing an additional lane within the existing freeway right-of-way where the total right-of-way width is sufficient.

Construction of highway and transit improvements would be coordinated to the extent possible to minimize the length of the total construction period and the loss of highway capacity. This could include phasing of LRT and highway improvements to maximize the opportunity to create additional highway capacity within the project right-of-way during construction.

Construction of LRT facilities along urban streets would follow standard street construction practices to minimize disruptions and inconveniences to the extent possible. Trackwork, electrification masts, and trolley wires would be installed using conventional construction equipment and techniques. At all locations, attempts would be made to maintain access to businesses, residences, and driveways.

The effects of construction-generated dust on nearby traffic and properties will be mitigated through the application of standard construction practices, such as wetting down project work sites at specified intervals, wetting down haul loads of excavated earth, and reducing speeds of trucks operating on the unimproved right-of-way.

5.11.2 Land Use and Economic Development

Construction-related impacts typically consist of short-term, temporary increases in construction employment and temporary disruptions to existing land use. Disruptions are generally caused by the acquisition of temporary construction easements and changes in access. Impacts, such as noise and dust, can be disruptive to residences and businesses located adjacent to construction or staging areas. Construction related impacts usually end when construction activity ends.

Construction-related employment impacts for all alternatives are discussed in Section 5.1.5, Employment Impacts.

The improvements along Sunset Highway, Highway 217, and the existing Eastside LRT as part of the TSM Alternative could require a four- to five-year construction period. Some of the construction would temporarily disrupt access to businesses in the Sylvan Interchange area, and residences in the Upper Highland area and along S.W. Raab Road. These disruptions would not be long-term, and therefore would not permanently affect the residences or the businesses. In some cases construction could require the temporary closure of access ramps, such as the Sunset Highway/Highway 217 Interchange ramp. Detour routes would be provided. Other disruptions would include temporary increases in noise and dust levels.

None of the impacts associated with the construction of any of the LRT Alternative options would be long-term or permanent. Most, if not all , of the impacts would include increased congestion, noise, and dust during the construction period; traffic detours for those streets temporarily closed during construction; and temporary loss of land for some property owners. Disruption impacts would be greatest along S.W. Morrison and S.W. Yamhill Streets, S.W. 18th Avenue and S.W. Jefferson Street in downtown Portland; in the Upper Highlands neighborhood at the Sylvan Interchange; in Cedar Hills at the Sunset Highway/ Highway 217 Interchange; S.W. Henry Street (under the Henry Street alignment option); and downtown Beaverton. LRT improvements would be coordinated with highway improvements to minimize the duration of construction activities in any one area. However, it is anticipated that the duration of construction activities could be six to twelve months in a particular segment.

Mitigation measures that would be implemented to minimize construction impacts to residences and businesses include maintaining access to existing uses wherever possible, and providing visual and acoustic screening to minimize dust and noise impacts. In the event that access or utility service to a residence or business would be temporarily disrupted, 24-hour notice would be provided to the property owner, and the length of the disruption would be minimized.

Pedestrian access to businesses located along the construction route would be maintained, and signs indicating the names of businesses located along these routes would be provided at intersections. Additional mitigation measures would be developed through coordination with affected businesses and residential property owners.

5.11.3 Neighborhoods

Short-term, temporary construction impacts include noise, dust, vibration, congestion, and increased truck traffic near residences, businesses, and institutions in construction areas; disruption of traffic along highways, at interchanges, and in locations where streets are being altered; temporary additional traffic from rerouting, detours, and lane closures; disruption of access to neighborhoods and businesses; and impacts on neighborhood cohesion from increased traffic during construction. In addition, construction impacts involve the displacement of existing uses (see Section 5.2 for more information on displacements). These impacts would be reduced by requiring the contractor to conform to all pertinent statutes, laws, ordinances, rules, and regulations of federal, state, and local governments.

The No Build Alternative would not result in construction impacts on neighborhoods.

Under the TSM Alternative, construction of highway improvements would result in substantial disruption in the Upper Highland neighborhood. Impacts would include noise, dust, and construction vehicle traffic. Neighborhood areas that would be subject to high construction impact with the TSM Alternative include West Highlands, Sylvan business district, Canyon Court west of Sylvan, Sunset Hills Cemetery, and S.W. 76th Avenue/Golf Creek Apartments. In addition, adjacent neighborhoods could be affected by cut-through traffic attempting to avoid delays on Sunset Highway. These include Washington Park, Sylvan, Arlington Heights, and Southside Hills.

Short-term traffic circulation problems associated with construction are expected to occur as a result of construction of highway and transit improvement, including:

- Partial street closures and traffic rerouting in the Central City (downtown Portland) and Goose Hollow neighborhoods;
- Traffic lane closures and temporary detours in the Goose Hollow neighborhood resulting from construction of the LRT trackway, relocation of major utility and water lines, and additional truck traffic and construction equipment in the neighborhood, and portal staging areas if a tunnel option is chosen;
- Disruption of access to the Sylvan area resulting from highway construction;
- Disruption of access and traffic along S.W. Henry Street if the Henry Street option is chosen through central Beaverton;
- Slowing of commuter traffic in Washington County and downtown Portland during construction of the highway improvements; and
- Slowing of intra-county traffic circulation resulting from construction on Highway 217.

The LRT Alternative would cause significant construction impacts in the areas of Goose Hollow, Market Street Drive, Washington Park Zoo, West Highlands, Sylvan business district, Canyon Court west of Sylvan, Sunset Hills Cemetery, and the S.W. 76th Avenue and Henry Street areas. In the Goose Hollow neighborhood, construction activities would be focused on S.W. Morrison, S.W. Yamhill, and S.W. Jefferson Streets, and S.W. 18th Avenue. Increased noise and dust would disrupt residences and businesses. Traffic detours and road closures would interfere with normal traffic patterns, and could result in increased vehicle volumes on residential streets. Adjacent neighborhoods, including King Hill and Garden Ridge, could experience spillover effects of construction, including cut-through traffic.

Construction of LRT and/or highway improvements through the Sunset Canyon segment is likely to take three or more years. The degree of construction impact would vary with the Canyon segment, depending on the alignment option. The Sylvan neighborhood would experience substantial disruption during construction of the highway improvements and LRT alignment under both Surface LRT options.

In east and central Beaverton, construction of LRT facilities would affect the East Beaverton, Central City, and Raleigh Hills-Garden Home Community neighborhoods. Increased noise, dust, and vehicular traffic would affect daily operations in these areas. The normal pattern of vehicular traffic would be disrupted. Cut-through traffic could affect portions of the Cedar Hills-Cedar Mill Community neighborhood.

Construction impacts of the LRT Alternative on neighborhoods would vary, depending on the terminus option chosen. With the Sunset Transit Center terminus option, disruption associated with highway improvements would occur in the Upper Highland neighborhood, disruption associated with LRT improvements would occur in downtown Portland and the Goose Hollow neighborhood, and extensive construction impacts could occur in the Washington Park and Southwest Hills neighborhoods. With the S.W. Murray Boulevard terminus option, impacts identified for the Sunset Transit Center terminus option would occur, as well, in the East Beaverton and Henry Street neighborhoods. All identified construction impacts related to neighborhoods would occur with the S.W. 185th Avenue terminus option.

For neighborhoods that would be directly affected by construction, the lead agency would work with representatives of the neighborhood to identify issues of concern and potential mitigation measures. Mitigation could include limiting construction hours to avoid times that are most sensitive to uses in a particular community, employing Best Management Practices to reduce dust (see Section 5.11.6), and the provision of fencing around construction and staging areas.

Mitigation incorporated into the final design of the chosen alignment would reduce, to the extent practicable, as many of the adverse impacts of construction as possible. These features would include fencing, landscaping, buffering, and facilities for pedestrian movement and safety, which would be incorporated into the final design of the alignment, transit stations, and park-and-ride lots.

5.11.4 Noise and Vibration

Construction under any of the alternatives would create temporary noise conditions. Noise levels vary greatly, and specific levels are difficult to predict accurately. Prediction is limited to a discussion of noise levels associated with the operation of common types of construction equipment. Such equipment includes bulldozers, back-up bells, conveyors, generators, compressors, and pile drivers. Noise levels for various types of construction equipment generally range between 70 and 100 dBA at 50 feet, with equipment such as impact pile drivers producing up to 110 dBA at 50 feet.

Measures to reduce construction-related noise associated would limit its impact. Construction noise from the proposed project would be subject to Section 18.10.060 of the City of Portland's Nuisance Abatement and Noise Control Ordinance within Portland city limits. This ordinance limits construction activities to between 7:00 a.m. and 6:00 p.m. on weekdays and Saturdays. These time constraints would be included as part of the project plans and specifications, and would apply to all construction activities, except by variance, reasons of emergency, or as directed by the project engineer. In addition to constraints imposed by the City, the following construction noise abatement measures would be included in the project construction specifications:

- Specifications for construction of the project would prohibit construction within 1,000 feet of an occupied dwelling on Sundays, legal holidays, and between the hours of 10:00 p.m. and 6:00 a.m. on other days. Exceptions to this general policy would require approval of the Project Engineer. These exceptions would be identified in later phases of the project, once final construction documents and construction sequencing plans have been prepared. Examples of construction activities that would require exceptions to this specification would include those activities that would be performed in high traffic areas, such as on or adjacent to Sunset Highway in the canyon, reconstruction of freeway interchanges, or construction of grade crossings on arterial streets.

- All equipment used would have sound control devices no less effective than those provided on the original equipment.

- All equipment would comply with pertinent equipment noise standards of the U.S. Environmental Protection Agency.

Should a noise complaint occur during construction, the contractor could be required to implement one or more of the following mitigation measures: locate stationary construction equipment as far from nearby noise-sensitive properties as possible; shut off idling equipment; reschedule construction operations to avoid the periods of noise annoyance identified in the complaint; notify nearby residents whenever extremely noisy work would be occurring; and install permanent or portable acoustic barriers around stationary construction noise sources.

Blasting and pile driving would occur during construction, causing high levels of groundborne vibration. Some types of heavy vehicles and excavation also could generate groundborne vibration noticeable in nearby buildings. Vibration from heavy equipment generally is of the same order of magnitude as the groundborne vibration created by heavy vehicles traveling on streets and highways. Blasting and drilling activities would produce vibration levels well below two inches/second peak-particle velocity, the intensity that would cause structural damage at nearby structures (those within 650 feet from the blast). At these levels vibrations associated with blasting and drilling activities, although unpleasant, would not be intolerable or damaging. Construction activities should not generate sufficient groundborne vibration to create a significant impact. Among the measures that would be implemented to reduce the impact from vibration are:

- No pile driving or blasting operations would be performed within 3,000 feet of an occupied dwelling unit on Sundays, legal holidays and between the hours of 8:00 p.m. and 8:00 a.m. on other days without the approval of the project engineer;

- Noise from rock crushing or screening operations performed within 3,000 feet of an occupied dwelling would be mitigated by strategic placement of material stock piles between the operation and the affected dwelling or by other means approved by the project engineer.

Construction impacts related to noise and vibration would vary depending on the terminus option chosen. With the Sunset Transit Center terminus option, impacts would occur between downtown Portland and the proposed transit center at the Sunset Highway/Highway 217 Interchange. The majority of impacts associated with blasting and drilling for the tunnel options would occur in this segment. The S.W. Murray Boulevard terminus option would result in impacts identified for the Sunset Transit Center terminus option, as well as from the proposed transit center through Beaverton to S.W. Murray Boulevard. All identified construction impacts related to noise and vibration would occur with the S.W. 185th Avenue terminus option.

5.11.5 Geology and Soils

Under the No Build Alternative, construction of the Sunset Transit Center bus maintenance facility would cause short-term construction impacts, including the potential for increased erosion at the construction site.

With the TSM and LRT Alternatives, portions of the highway improvements and/or LRT surface alignments would cut into the side slopes of Sunset Canyon. The Portland Hills soil in the canyon is easily eroded when exposed to heavy rains. The potential for erosion of these soils would depend on construction methods and the speed with which construction is completed after initial grading. Potential geologic impacts with these alternatives include risk of slope failure related to highway or surface LRT improvements and, to a lesser extent, increased erosion during construction activities. Areas where spring activity or seepage occur within the Portland Hills soils may require additional excavation, and soils may need to be replaced with gravel.

Under the LRT Alternative Surface alignment options, construction in areas of steep slope, local flow-slides, or earth slumps could result in slope movement, with potential adverse impacts on residences located near the crests of slopes. Removal of vegetation and excavation along the toes of slopes, particularly with the Southside alignment option, could increase the possibility of slides during and after construction. With the tunnel alignment options, construction impacts would include vibration from drill and blast excavation, groundwater within the proposed excavation, removal of excavation spoils, and potential slope instability at the tunnel portals.

Construction impacts related to geology and soils would vary depending on the terminus option chosen. Impacts in Sunset Canyon and between downtown Portland and the Sunset Highway/Highway 217 Interchange would occur under the Sunset Transit Center terminus option. The S.W. Murray Boulevard terminus option would result in impacts identified for the Sunset Transit Center terminus option, as well as from the proposed transit center through Beaverton to S.W. Murray Boulevard. All identified construction impacts related to geology and soils would occur with the S.W. 185th Avenue terminus option.

To mitigate impacts in areas of steep slope, local flow-slides, and/or earth slumps, most of the retaining walls would be designed as tie-back retaining walls. This type of wall is used as a preventive measure to support slopes during construction. In most cases, the walls would be designed to improve stability within marginal slopes and slopes in ancient landslide terrain. Inclinometers also would be placed adjacent to residences to monitor slope movement along the LRT alignment during construction.

In addition, erosion impacts would be mitigated using some or all of the following measures: silt fences, gravel berms, hay bales, filter fabric wrapped aggregate, ditches to disperse runoff into natural vegetation areas, and other techniques to slow and filter runoff.

5.11.6 Water Quality

Dust generated during construction of the Sunset Transit Center could enter surface waters; however, this effect is expected to be insignificant under the No Build Alternative.
Under the TSM and LRT Alternatives, short-term construction impacts on hydrology and water quality would occur. There could be short-term increases in erosion and sedimentation of adjacent waterways, and small, temporary increases in runoff rates caused by removal of vegetation. Short-term impacts on water quality would include release of oil and grease, fuel, hydraulic fluids, and sediment into stormwater runoff. Increased erosion and sedimentation also could be expected in areas where vegetation is removed.

Many Best Management Practices (BMPs) are available to control potential erosion and sedimentation problems associated with construction, including the use of hay bales, tarpaulins, barrier berms, silt fences, and temporary sediment detention basins. Special wet-weather rules to enhance sediment control may be adopted. These rules could include restricting excavation during critical weather, requiring dump trucks to be "diapered" to avoid spills, and prohibiting movement of heavy equipment off site before tires and tracks have been cleaned. As the cleared areas are revegetated, any temporary increases in runoff rates would disappear.

The use of BMPs would minimize the release of pollutants to stormwater runoff. Several other practices would mitigate adverse water quality effects. These include: confining equipment fueling and lubrication activities to bermed and membrane-lined containment areas at maintenance depots; requiring use of drip pans and portable membrane lines for maintenance and fueling at other locations; preparing and following a spill prevention, control, and countermeasure plan for all hazardous materials used at construction sites, including standard operating procedures for routine maintenance and refueling; and scheduling construction for times when high water is least likely to occur.

Construction impacts related to water would vary depending on the terminus option chosen. With the Sunset Transit Center terminus option, impacts would occur between downtown Portland and the proposed transit center at the Sunset Highway/Highway 217 Interchange. The S.W. Murray Boulevard terminus option would result in impacts identified for the Sunset Transit Center terminus option, as well as from the proposed transit center through Beaverton to S.W. Murray Boulevard. All identified construction impacts would occur with the S.W. 185th Avenue terminus option.

5.11.7 Energy

Estimates of construction-related energy impacts were based on the following factors: the energy used in mining and processing raw materials and manufacturing building materials; the energy used to transport materials to the construction site; and the energy used at the site during construction. Energy use for these activities was estimated using a technique developed for the U.S. Department of Energy (USDOE, 1979). Total construction energy for highway and LRT improvements is calculated using an input/output methodology based on either energy use per construction dollar or energy use per track mile.

For the No-Build Alternative, total energy input for construction of the Sunset Transit Center and bus maintenance facility would be 164.9 x 10^9 BTU. Under the TSM Alternative, construction of highway improvements would consume an estimated 842.40 x 10^9 BTU. About 43% of total construction energy would be for highway widening projects, while interchanges would account for about 51%; the remaining energy would be used for earthwork activities and illumination.

Energy consumed as a result of construction of highway improvements would be the same under the LRT Alternative and the TSM Alternative. LRT alignment construction would use additional energy; the amount would be dictated by the alignment option chosen. Analysis shows that the alignment options for the Sunset Highway segment would have the greatest effect on total construction energy. The Southside alignment option would require the least energy investment, and the tunnel alignment options, the greatest energy investments. Total energy consumption for the LRT improvements would range between 1,655 x 10^9 BTU and 8,755 x 10^9 BTU.

Energy consumption as a result of construction would vary depending on the terminus option chosen. The smallest energy consumption would be for construction of the Southside option to the Sunset Transit Center. The greatest energy consumption would occur with the Long Tunnel options to S.W. 185th Avenue. The S.W. Murray Boulevard terminus option would fall between the other two terminus options in this regard. It would result in all impacts identified for the Sunset Transit Center terminus option, as well as from the proposed transit center through Beaverton to S.W. Murray Boulevard. All identified construction impacts related to energy would occur with the S.W. 185th Avenue terminus option.

5.11.8 Hazardous Materials

The No Build Alternative would not involve significant construction impacts related to hazardous material. Construction of the proposed bus maintenance facility would result in little risk of adverse hazardous material impacts, provided appropriate safety precautions are taken before and during construction.

For the TSM and LRT Alternatives, construction impacts related to hazardous material could result from activities occurring in close proximity to generators of those materials, removal or excavation around underground storage tanks, and activities occurring in close proximity to spill sites. The risk of adverse impacts resulting from these sources would be low, provided that safe work practices are followed before and during construction. In addition, state regulations require that all underground storage tanks be removed by licensed specialists who follow state-approved procedures.

Construction impacts related to hazardous materials would vary depending on the terminus option chosen. The Sunset Transit Center terminus option would involve 21 sites and tanks between downtown Portland and the Sunset Highway/Highway 217 Interchange. The S.W. Murray Boulevard terminus option would involve between 36 and 53 sites and tanks, depending on the specific combination of alignment options selected. The S.W. 185th Avenue terminus option would involve sites and tanks identified for the two previous options, as well as additional sites and tanks, for a total of 46-63 sites and tanks, depending on the combination of alignment options.

Under the LRT Alternative, the BN alignment option between S.W. Watson Avenue and S.W. Murray Boulevard would pass through the Tektronix industrial campus, the largest generator and warehouser of hazardous materials in the proposed corridor. The Oregon Department of Environmental Quality (DEQ) regulates hazardous material generation, storage, treatment ,and disposal at Tektronix. Because the LRT would be placed at or above the existing land surface, any contaminants present in subsoils or groundwater would remain undisturbed, and the risk of impact is expected to be low.

Prior to construction, financial liability associated with acquiring land containing hazardous materials would be reduced by identifying parcels where these materials may be present along the selected LRT alignment. The DEQ would be contacted for the most up-to-date information, and to determine whether further DEQ investigation of the site(s) is warranted. The information would be provided to Tri-Met's legal counsel, so appropriate steps can be taken to decrease the liability risk.

A safety plan would be developed to guide construction activities. A qualified health and safety specialist would prepare the plan, based on the proposed construction activities and potential hazards that have been identified. The plan would prescribe safe work practices for all construction activities, including excavation of underground storage tanks and buried utility lines, cut-and-fill operations, vehicle fueling and maintenance, and handling and disposal of all hazardous materials. The plan also would address personal protective clothing, respiratory protection, emergency response procedures, and safety training requirements for construction workers. Procedures should be specified for monitoring construction sites to detect toxic or explosive conditions. Safety training and site monitoring would be performed by a qualified health and safety specialist. The safety plan should be reviewed by DEQ to ensure it is consistent with applicable regulations.

5.11.9 Public Services and Utilities

Negligible impacts on public services and utilities would occur during construction of improvements under the No Build Alternative.

For the TSM and LRT Alternatives, construction impacts on public services would result from street closures, and highway and interchange improvements. Response times for emergency vehicles could increase because of congestion around construction sites and street closures. Access to the St. Vincent Medical Center could be restricted during construction of highway improvements at the Sunset Highway/Highway 217 Interchange. To reduce impacts on public services and emergency vehicle response times, alternative routes for emergency vehicles should be developed along the Sunset Highway corridor to ensure optimal response times during construction.

Construction activities associated with improvements along Sunset Highway and the LRT alignment would affect the private French American school located near the Sylvan Interchange. Reconstruction of the Sylvan Interchange would restrict access to the school from the south. Noise from construction could disrupt school operations. No measures to reduce these impacts, other than those identified previously to maintain access and reduce noise, are proposed because the impacts would be temporary.

Most construction impacts on utilities would occur within dedicated public right-of-way as a result of one or more of the following conditions:

- disruption or intrusion into required utility clearance zones;
- the need to strengthen utilities where they are crossed by the alignment to prevent a collapse during LRT operation;
- the need to protect iron or steel pipeline against corrosion caused by stray electrical current when crossed by an LRT alignment; and
- the need to relocate utility facilities to allow maintenance access without interrupting highway or LRT operations.

Relocation of water and sewer lines could be necessary along the proposed LRT and highway alignments in several areas. These include S.W. Jefferson Street, S.W. Morrison Street, S.W. Yamhill Street, S.W. Canyon Court, Highway 217 between S.W. Walker Road and S.W. Cabot Street, and the Sunset Transit Center. Water and sewer service could be disrupted during construction, and some additional landscaping could be removed. To reduce this impact, residents and businesses would be provided 24-hours notice prior to interruptions of any utility service. Impacts on electric, stormwater and communications service also could occur. The affected locations would be determined during final design.

Impacts to public utilities during construction would be mitigated through agreements entered into by Tri-Met and the local utilities. These agreements would specify procedures for modification and relocation of utility lines, to ensure minimal disruption of service.

Under the LRT Alternative, construction impacts on railroad operations would be minor because there would be no at-grade crossings or track shared between the LRT and the BN Railroad. A reduction in the speed of freight trains using track adjacent to the LRT could occur because of increased activity at LRT stations. In addition, some disruption of BN service could occur during line relocation and construction between S.W. 153rd and S.W. 185th Avenues. Because this impact is expected to be negligible, the existing BN line could remain operational while the new line is installed between S.W. 185th and S.W. 153rd Avenues. The LRT line could be built after the BN line is relocated and operating, to allow the BN to provide continuous service.

Construction impacts related to public services and utilities would vary depending on the terminus option chosen. With the Sunset Transit Center terminus option, impacts would occur between downtown Portland and the proposed transit center at the Sunset Highway/Highway 217 Interchange, including impacts on the French/American School and the St. Vincent Medical Center, and relocation of utilities in several areas. The S.W. Murray Boulevard terminus option would result in impacts identified for the Sunset Transit Center terminus option, as well as from the proposed transit center through Beaverton to S.W. Murray Boulevard, including impacts related to railroad operations. All identified construction impacts related to public services and utilities would occur with the S.W. 185th Avenue terminus option.

CHAPTER 6

HISTORIC, ARCHAEOLOGICAL AND PARKLANDS RESOURCES

6.0 HISTORIC, ARCHAEOLOGICAL AND PARKLAND RESOURCES

This chapter presents an inventory and impact assessment of the Westside Corridor Project on historic, archaeological, and parkland resources in the Westside Corridor study area. The discussion of these resources is separated from the other environmental analysis in this document because this section is intended to address the specific requirements of Section 106 of the National Historic Preservation Act of 1966, and the Section 4(f) requirements of the 1966 Department of Transportation Act. This chapter summarizes Technical Memoranda 20j and 20k.

6.1 SUMMARY OF APPLICABLE FEDERAL LAWS

6.1.1 Section 106

Section 106 of the National Historic Preservation Act of 1966, as amended, and Executive Order 11593, Protection and Enhancement of the Cultural Environment, require that a federal agency consider the effect of a federally assisted project on any historic districts, sites, buildings, structures, objects or any archaeological sites listed on, or eligible for, the National Register of Historic Places. The criteria for determining effect and adverse effect as contained in 36 CFR 800.9 are:

(a) An undertaking has as effect on a historic property when the undertaking may alter characteristics of the property that may qualify the property for inclusion in the National Register. For the purpose of determining effect, alteration to features of the property's location, setting, or use may be relevant, depending on a property's significant characteristics, and should be considered.

(b) Any undertaking is considered to have an adverse effect when the effect on a historic property may diminish the integrity of the property's location, design, setting, materials, workmanship, feeling or association. Adverse effects on historic properties include, but are not limited to:

(1) Physical destruction, damage, or alteration of all or part of the property;

(2) Isolation of the property from or alteration of the character of the property's setting, when that character contributes to the property's qualification for the National Register;

(3) Introduction of visual, audible, or atmospheric elements that are out of character with the property or alter its setting;

(4) Neglect of a property resulting in its deterioration or destruction;

(5) Transfer, lease, or sale of the property.

(c) Effects of any undertaking that would otherwise be found to be adverse may be considered as not adverse for the purpose of these regulations when the historic property is of value only for its potential contribution to archaeological, historical or architectural research, and when such value can be substantially preserved through the conduct of appropriate research and such research is conducted in accordance with applicable professional standards and guidelines.

The finding of no adverse effect as a result of appropriate research, however, does not apply to the excavation of burial sites. Such excavation constitutes an adverse effect, and if required, would be carried out under the terms of a Burial Plan set forth in a Memorandum of Agreement (MOA), which would be prepared in coordination with the State Historic Preservation Office (SHPO) and the Advisory Council on Historic Preservation (ACHP).

The assessment of effects on historic and archaeological resources also provides a comparative evaluation to assist in the selection of the preferred alternative. When the preferred alternative is selected, the impact analysis and commitment to feasible mitigation measures would be completed in coordination with the ACHP. A MOA would be prepared for sites where an adverse effect is unavoidable.

6.1.2 Section 4(f)

Section 4(f) refers to regulations included in the 1966 Department of Transportation Act, as amended (23 CFR Part 771.135).

These regulations state:

> The Administration may not approve the use of land from a significant publicly owned public park, recreation area, or wildlife and waterfowl refuge, or any significant historic site unless a determination is made that:
>
> > (i) There is no feasible and prudent alternative to the use of land from the property; and,
> >
> > (ii) The action includes all possible planning to minimize harm to the property resulting from such use.

The regulations further state:

> (f) The Administration may determine that section 4(f) requirements do not apply to restoration rehabilitation, or maintenance of transportation facilities that are on or eligible for the National Register when:
>
> > (1) Such work will not adversely affect the historic qualities of the facility that caused it to be on or eligible for the National Register; and,
> >
> > (2) The SHPO and Advisory Council for Historic Preservation (ACHP) have been consulted and have not objected to the Administration finding in paragraph (f)(1) of this section.

After coordination with the SHPO and local park districts, the Section 4(f) evaluation is circulated for consultation and comment to the Department of Interior and to any federal, state, and local agencies with jurisdiction over affected resources. After consideration of all comments and appropriate changes in project plans, UMTA must be convinced, that based on all available data, a feasible and prudent alternative does not exist and that all possible mitigation measures are included. The Section 4(f) evaluation follows in a separate discussion in Section 6.4, to facilitate review.

6.2 HISTORIC AND ARCHAEOLOGICAL RESOURCES

6.2.1 Identification of Resources

6.2.1.1 Historic Resources

In consultation with the SHPO, it has been determined that 47 resources in the Westside Corridor study area meet the criteria for inclusion in the National Register of Historic Places as set forth in 36 CFR 60.6. Of these, eleven resources already are on the National Register. The 36 resources currently not included on the National Register have been added to the SHPO's inventory of eligible resources. Table 6.2-1 provides a listing of the 47 identified resources, including the National Register status of each. Figures 6.2-1a, 1b and 1c indicate the location of these 47 historic resources within the corridor. A detailed description of the identified historic resources in the Westside Corridor Project area that are on or eligible for inclusion in the National Register can be found in Technical Memorandum 20j.

Table 6.2-1

PRELIMINARY EVALUATION OF EFFECT
OF LRT ALTERNATIVE ON HISTORIC RESOURCES

Map Ref	Historic Resource*	National Register Status	No Effect	No Adverse Effect	Adverse Effect	Right-of-Way Required
a1	Central Building	On	X**			0
a3	Commercial Building	Eligible	X			0
a4	Professional Building	Eligible		X		0
a5	Arthur Hotel	Eligible		X		0
a7	Arminius Hotel	On		X		0
a10	Elks Temple	On	X			0
a15	First Baptist Church	Eligible	X			0
a17	Portland Women's Club	Eligible	X			0
a19	Terminal Sales Building	Eligible		X		0
a21	Danmoore Hotel	Eligible		X		0
a22	First Presbyterian Church	On	X			0
a23	Eglington Arms Hotel	Eligible	X			0
a27	Neighbors of Woodcraft	Eligible		X		0
a28	Hyland Apartment Building	On		X		0
a29	Scottish Rite Temple	Eligible		X		0
a30	Hotel Mallory	Eligible		X		0
a31	Masonic Annex	Eligible		X		0
a32	Concordia Club	Eligible		X		0
a33	The Lafayette Hotel Apts.	Eligible		X		0
a34	Hamiliton Arms Apartments	Eligible		X		0
a35	Commodore Hotel	On		X		0
a36	David Campbell Monument	Eligible	X			0
a37	Civic Stadium	Eligible		X		0
a39	Zion Lutheran Church	Eligible		X		0
a43	Haseltine Ensemble	Eligible	X			0
a44	Haseltine residence #2	Eligible	X			0
a45	Kamm House	On		X		0
a46	Chown House	On	X			0
a47	Gauld-Yeon Residence	Eligible	X			0
a48	Dole Residence	Eligible	X			0
a49	General Beebe Residence	Eligible		X		0
a50	Livingston Residence	Eligible		X		0
a51	Pattulio Residence	Eligible		X		0
a52	H.J.Russell Residence	Eligible	X			0
a53	Ransom Residence	Eligible	X			0
a54	2187 S.W.Market St. Res.	On	X			0
a57	Vista Bridge	On		234	1	0
a60	City Water Resvrs. #3,#4	Eligible		X		0
b67	Bert Smith Houses	Eligible	X			0
b68	Highland Racquet Club	Eligible	123	4		.18 ac
b71	French American School	Eligible	23	14		.09 ac.
c73	Polsky House	Eligible		X		
c75	J. Henry House	Eligible	6		5	.02 acres
c76	Burlington Northern RR	Eligible		56		2.9 miles

Table 6.2-1 (continued)

PRELIMINARY EVALUATION OF EFFECT
OF LRT ALTERNATIVE ON HISTORIC RESOURCES

Map Ref	Historic Resource*	National Register Status	No Effect	No Adverse Effect	Adverse Effect	Right-of-way Required
D2	Potential Morrison Street Historic District	Eligible		X		0
D4	King's Hill Historic District	Eligible		X		0
D6	Downtown Beaverton Historic District	On	X			0

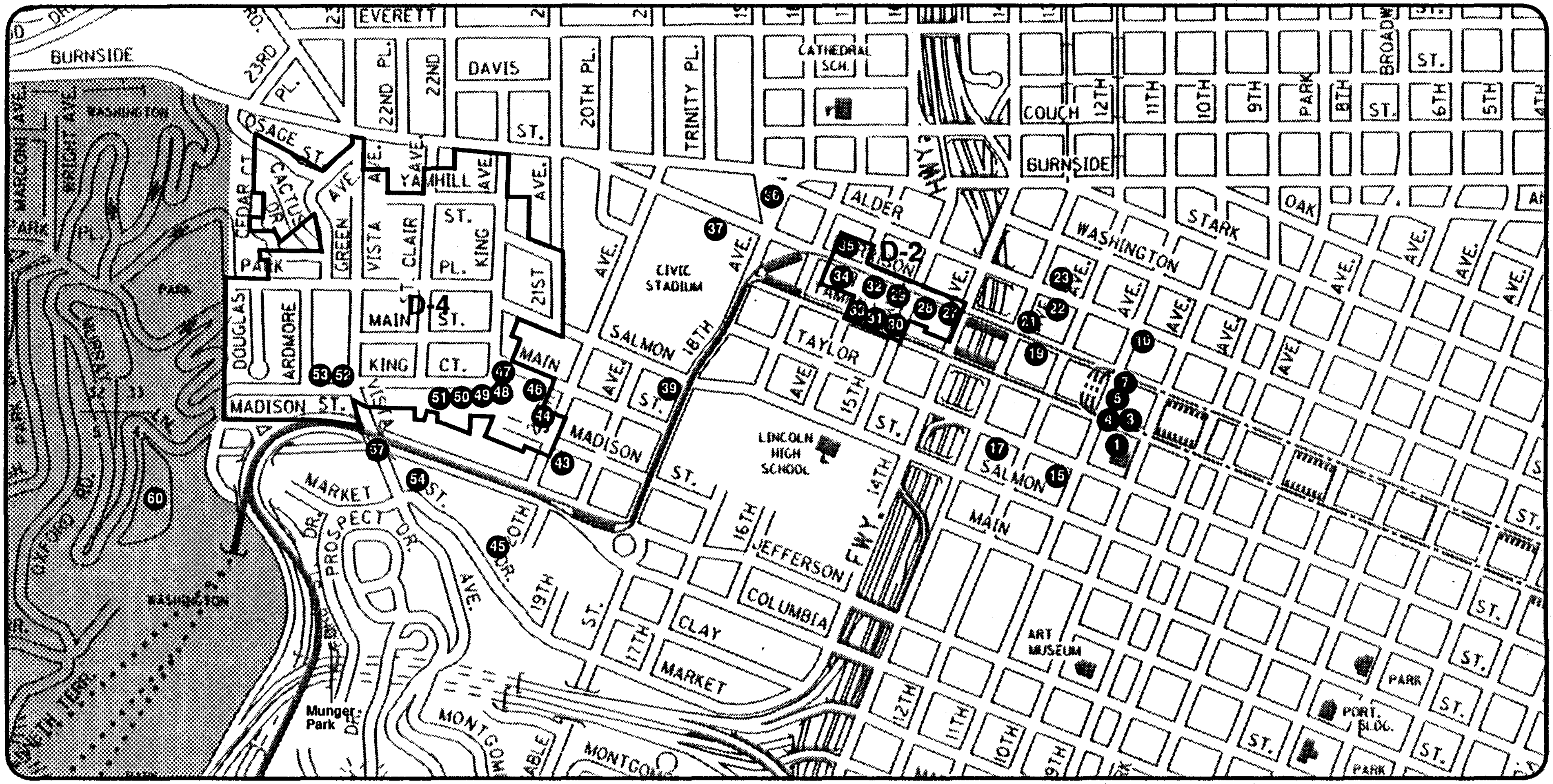
Note: These findings are preliminary and not yet concurred in the SHPO or ACHP.
The No Build and TSM Alternatives would not affect any historic properties or districts.

* Historic resources in, or eligible for inclusion in, the National Register of Historic Places.

** X refers to all LRT Options. Numeric entries refer to the Zoo segment or Beaverton segment options as follows:

1. Southside Surface Option
2. Long Tunnel with Zoo Station Option
3. Long Tunnel without Zoo Station Option
4. Northside Short Tunnel Option
5. Henry Street Option
6. BN Option

Source: Shapiro and Associates, Inc., 1990; Tri-Met, 1990.



LEGEND:

- On or eligible for inclusion in the National Register
- D-1 Existing or Potential District or Multiple Listing

Source: Shapiro & Associates, Inc., 1990

N

SCALE-FEET

0 500 1000

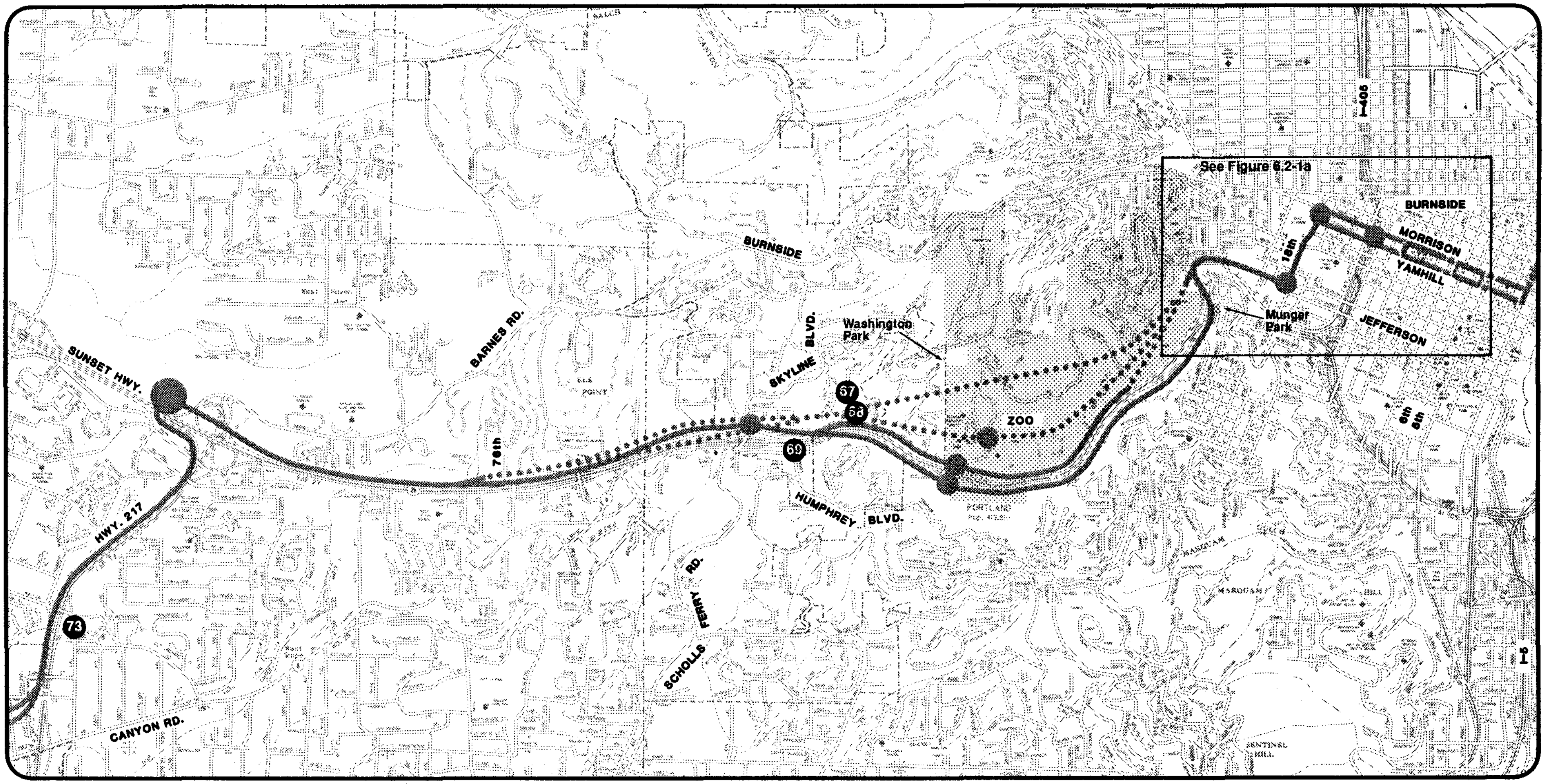
Westside Corridor Project

Historic and Parkland Resources

The Oregon Department of Transportation

WESTSIDE LIGHT RAIL TRI-MET

Figure 6.2-1a



LEGEND:

1 Existing or Potential Historic or Cultural Resource

SCALE-FEET

0 2000 4000

Westside Corridor Project

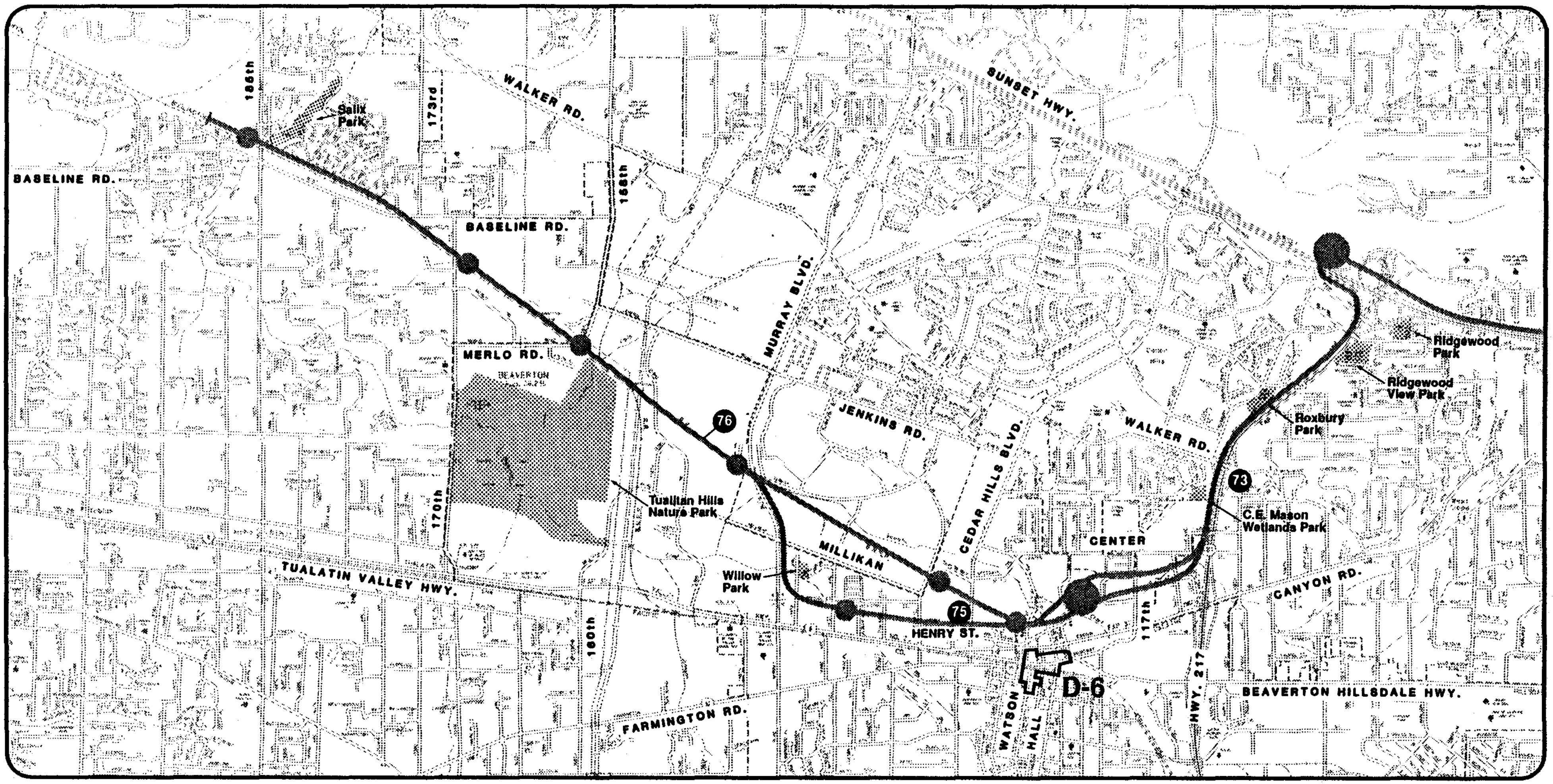
Historic and Parkland Resources

The Oregon Department of Transportation

WESTSIDE LIGHT RAIL TRI-MET

Figure 6.2-1b

Source: Shapiro & Associates, Inc., 1990



LEGEND:

1 Existing or Potential Historic or Cultural Resource

D-4 Existing or Potential District or Multiple Listing

N

SCALE-FEET

0 2000 4000

Westside Corridor Project

Historic and Parkland Resources

The Oregon Department of Transportation

WESTSIDE LIGHT RAIL TRI-MET

Figure 6.2-1c

Source: Shapiro & Associates, Inc., 1990

6.2.1.2 Archaeological Resources

A survey of archaeological resources identified two potential resources that could be affected by the Westside Corridor Project: a cemetery and a portion of an original plank road, both dating back to the 1850s. Several other areas appear to be archaeologically sensitive, meaning that while no archaeological materials have been confirmed in these areas, a reasonable possibility exists that they could be encountered during construction. Archaeologically sensitive areas include the shorelines of draws and creeks, the land around natural springs, wetland areas, floodplains, and small parcels of apparently undisturbed land. A detailed discussion of identified archaeological resources and archaeologically sensitive areas can be found in Appendix A of Technical Memorandum 20j.

6.2.2 Effects of Project Alternatives on Historic and Archaeological Resources

The assessment of potential effects on historic resources presents a comparative evaluation to assist in the selection of a preferred alternative. The preliminary application of the criteria of effect and adverse effect on historic resources is summarized below. The evaluation of effect analysis is preliminary. Coordination with the SHPO is in process. When the preferred alternative is selected, the final evaluation of effect and adverse effect will be completed, in coordination with the SHPO and ACHP. A Memorandum of Agreement would then be developed addressing all sites where an adverse effect is unavoidable, and would detail mitigation measures to be undertaken.

6.2.2.1 Historic Resources

A summary of the effects of the project alternatives on historic resources is presented in Table 6.2-1. A comparison of the effects by alternative and alignment option is included in Table 6.2-2.

Under the No Build Alternative, no highway improvements or LRT development would occur; therefore no historic resources would be affected. New construction under the TSM Alternative is limited to highway widening and construction of park-and-ride lots and bus maintenance facilities. The TSM Alternative improvements are not located in close proximity to any historic resources and, therefore, would not adversely affect any historic resources.

The LRT Alternative consists of various alignment options and three terminus options. All LRT alignment options include the same proposed highway improvements along Sunset Highway and Highway 217 as the TSM Alternative. In applying the criteria of effect, it was determined that 21 of the resources/districts identified in the Historic Resources Inventory would experience no effect from one or more of the LRT alignment options (see Table 6.2-1). Twenty-eight of the resources/districts would experience some effects from the LRT alignment options, however, the effects are not significant enough to alter the characteristics of these properties that qualify the properties for inclusion in the National Register. Therefore, a no adverse effect determination was made for these 28 properties/districts. Two of the properties (the Vista Bridge and the J. Henry House) would experience permanent adverse effects, each from different alignment options.

<u>Adverse Effect</u>

The Vista Bridge would experience an adverse visual effect from the elevated structure that would be constructed under the bridge for the LRT trackway under the Southside alignment option. The structure is required in order to raise the LRT guideway high enough to cross over Sunset Highway in the area of the west tunnel portals to the Vista Ridge Tunnels. This structure would diminish the Vista

Bridge's setting through introduction of a significant visual element that is out of character with the bridge's setting.

With the Henry Street alignment option in central Beaverton, the J. Henry House would experience an adverse effect because of the loss of the already small front yard. Additional right-of-way is required in

Table 6.2-2

IMPACTS ON ARCHAEOLOGICAL, HISTORIC, CULTURAL AND PARKLAND RESOURCES

	EFFECT ON ARCHAEOLOGICAL, HISTORIC AND CULTURAL RESOURCES								EFFECT ON PARKLAND RESOURCES	
				EFFECT			Right-of-Way Required		Right-of-Way Required	
	Total Number of	National Register		No	No Adverse	Adverse	Number of	Amount	Number of	Amount
ALTERNATIVE	Resources	On	Eligible	Effect	Effect	Effect	Properties	(acres)	Properties	(acres)
No Build	0	0	0	0	0	0	0	0	0	0
TSM	3H	0	3	2	1	0	1	0.09	0	0
LRT Adopted Alignment:										
Sunset Transit Center	2A	0	0	0	0	2	0	0	1	0.5
Terminus	38H	9	29	12	25	1	1	0.09		
	2D	0	2	0	2	0	0	0		
S.W. Murray Boulevard	2A	0	0	0	0	2	0	0	3	0.85
Terminus	40H	9	31	13	26	1	1	0.09 acres, 0.8 miles ROW		
	3D	1	2	1	2	0	0	0	0	
S.W. 185th Avenue	2A	0	0	0	0	2	0	0	4	0.86
Terminus	40H	9	31	13	26	1	1	0.09 acres, 3 miles ROW		
	3D	1	2	1	2	0	0	0		

A = Archaeologic H= Historic Building D= Historic District

* Historic resources are those identified as on, or eligible for inclusion in, the National Register of Historic Places.

** Preliminary evaluation of effect only.

Table 6.2-2 (Continued)
IMPACTS ON ARCHAEOLOGICAL, HISTORIC, CULTURAL AND PARKLAND RESOURCES

ALTERNATIVE	EFFECT ON ARCHAEOLOGICAL, HISTORIC AND CULTURAL RESOURCES: Total Number of Resources	National Register: On	National Register: Eligible	EFFECT: No Effect	EFFECT: No Adverse Effect	EFFECT: Adverse Effect	Right-of-Way Required: Number of Properties	Right-of-Way Required: Amount (acres)	EFFECT ON PARKLAND RESOURCES: Right-of-Way Required: Number of Properties	EFFECT ON PARKLAND RESOURCES: Right-of-Way Required: Amount (acres)
LRT ALIGNMENT OPTIONS										
Canyon Segment:										
Southside (adopted)	2A	0	0	0	0	2	0	0	1	0.5
	4H	1	3	2	1	1	1	.0.09		
	1D	0	0	0	1	0	0	0		
Long Tunnel with Station	2A	0	0	0	0	2	0	0	1	1.5
	7H	1	6	6	1	0	0	0		
	1D	0	0	0	1	0	0	0		
without Station	2A	0	0	0	0	2	0	0	1	1.3
	7H	1	6	6	1	0	0	0		
	1D	0	0	0	1	0	0	0		
Northside	2A	0	0	0	0	2	0	0	1	2.3
	6H	1	5	3	3	0	2	0.27		
	1D	0	0	0	1	0	0	0		

A = Archaeologic H= Historic Building D= Historic District

* Historic resources are those identified as on, or eligible for inclusion in, the National Register of Historic Places.

** Preliminary evaluation of effect only.

Table 6.2-2 (Continued)
IMPACTS ON ARCHAEOLOGICAL, HISTORIC, CULTURAL AND PARKLAND RESOURCES

ALTERNATIVE	EFFECT ON ARCHAEOLOGICAL, HISTORIC AND CULTURAL RESOURCES: Total Number of Resources	National Register: On	National Register: Eligible	EFFECT: No Effect	EFFECT: No Adverse Effect	EFFECT: Adverse Effect	Right-of-Way Required: Number of Properties	Right-of-Way Required: Amount (acres)	EFFECT ON PARKLAND RESOURCES: Right-of-Way Required: Number of Properties	EFFECT ON PARKLAND RESOURCES: Right-of-Way Required: Amount (acres)
East Beaverton:										
North	0	0	0	0	0	0	0	0	0	0
South (adopted)	1	1	0	1	0	0	0	0	0	0
Central Beaverton:										
BN (adopted)	1H	0	1	0	1	0	1	0.08	0	0
Henry Street	1H	0	1	0	0	1	1	0.02	0	0

A = Archaeologic H= Historic Building D= Historic District

* Historic resources are those identified as on, or eligible for inclusion in, the National Register of Historic Places.

** Preliminary evaluation of effect only.

Source: Shapiro and Associates, Inc., 1990; Tri-Met, 1990.

this area to accommodate the LRT trackway and retain access to the existing properties along Henry Street. The loss of the remaining front yard is considered an adverse effect because it will diminish the integrity of the property's location and feeling through altering the character of the property's setting. Noise and vibration criteria would not be exceeded.

<u>No Adverse Effect</u>

Twenty-eight historic resources have been determined to have effects from one or more of the LRT alignment options. However, these effects have not been determined to be adverse because they do not alter the characteristics of the properties that qualify them for inclusion in the National Register of Historic Places. This determination of no adverse effect is made in part because the majority of the resources included in this category are located in the area just west of the Portland CBD, generally within the Goose Hollow neighborhood. The development of this area occurred originally during the streetcar era and therefore, the reintroduction of LRT is not considered to be out of character with the historic setting of the area. Fixed facilities in this area (catenary poles, station, shelters) would be designed in consultation with the SHPO to be consistent with the historic setting.

The Highland Racquet Club and the French American School are outside the area of streetcar-era development, and would experience effects from the LRT canyon surface options in the canyon segment. The Highland Racquet Club would lose 0.18 acre of land for right-of-way if the Northside option is chosen. The required land is adjacent to S.W. Canyon Court and would not affect the racquet club's facilities or structures. A vegetated buffer would remain between S.W. Canyon Court and the Racquet Club's facilities.

The French American School would be affected through the loss of a small amount of land that would be used for right-of-way. The required land (0.09 acres) is adjacent to S.W. Canyon Court and is outside the school's fenced play area. The school structure would not be affected, nor would the character of its setting.

Two eligible historic districts have been determined to be not adversely affected by the proposed LRT improvements. These are the Morrison Street District and the Kings Hill District. The historic context of both of these districts is tied closely to the streetcar-era of development in Portland. The Morrison Street District consist primarily of structures used for fraternal organizations or social clubs that were built when streetcars originally served the area. The Kings Hill District was developed primarily because of access afforded by the early streetcars, and was bisected by the Vista Avenue line, which ran from Burnside Avenue through the neighborhood on Vista Avenue and then across the Vista Bridge. Here, too, the design of fixed rail facilities would be coordinated with the SHPO to be consistent with the historic character of areas.

The Burlington Northern (BN) Railroad right-of-way has been determined to be not adversely affected by the proposed LRT improvements. A portion of the BN right-of-way would be used for LRT improvements under all LRT alignment options (the Henry Street option would use about one mile less of the BN right-of-way than the BN option). The BN right-of-way (formerly the Oregon Electric Railway) was used as an early transportation corridor in the Tualatin Valley, and contributed significantly to the early development of the area. It also provided a vital link between the valley and the City of Portland and its docks for shipping agricultural products. The impact has been determined not to be an adverse impact, even though right-of-way will be required, because none of the original built features (i.e., the original railbed, rails, or stations) of the early railroad exist today. Again, the design of the facilities would be coordinated with the SHPO and would be consistent with the historic character of the rail corridor.

<u>No Effect</u>

Twenty-one of the resources identified in the Historic Resources Inventory have been determined to have no effect from the proposed LRT and highway improvements. These sites are either physically buffered from the proposed improvements or are significantly removed from one or more of the alignment options and therefore would not be affected by all alignment options (refer to Figures 6.2-1a-1c and Table 6.2-1).

6.2.2.2 Archaeological Resources

The two known potential archaeological resources (Carter's IOOF Cemetery and the Old Plank Road) identified in the archaeological reconnaissance would be affected by all LRT options. If significant resources are discovered after further investigation, there could be an adverse effect on both of these resources.

6.2.3 Proposed Mitigation

6.2.3.1 Historic Resources

Visual impacts would be mitigated through design. In downtown Portland, the design of street treatments would be similar to those used on the existing MAX line. Station and shelter design, construction materials, and street improvements would be chosen to contribute to and complement existing building and street settings. Because a large number of identified historic resources are located along the proposed LRT alignment in this area, these structures would be used to develop the character of LRT and street improvement design, as has been done in the Old Town Historic District and the Yamhill Historic District with the existing MAX line. In addition, wherever possible, overhead wiring would be attached to existing support structures. Design for surface improvements would incorporate features to enhance the recognition and visibility of the transit system. Design for project improvements adjacent to historic resources would be subject to review by the SHPO and appropriate local representatives (i.e. the Portland Historic Landmarks Commission) to ensure compatibility with all identified historic resources.

During preparation of the Final EIS, after selection of a locally preferred alternative, an agreement among the SHPO, UMTA and Tri-Met will be signed on how disagreements over design issues will be resolved. It is expected that the SHPO's non-concurrence in the design of any project element in a historic setting will reopen the Section 106 process.

The potential exists for construction-related groundborne vibration to affect historic resources, especially in the downtown area. This impact could be mitigated through construction practices. Ground vibration velocities should not exceed the maximum safe limit for historical monuments and sensitive structures recommended by the U.S. Bureau of Mines and the National Research Council (0.5 inches per second peak particle velocity, see Technical Memorandum 20j). During construction of the LRT improvements, identified historic structures and buildings adjacent to construction operations could be monitored for vibration velocities.

Four historic resources (the Racquet Club, the French-American School, the J. Henry House, and the BN Railroad) would be affected by property acquisition under the LRT Alternative. Alternatives for avoiding, and mitigation measures for, acquisition of these properties are detailed in the Section 4(f) Evaluation.

Final mitigation measures will be developed in consultation with the SHPO, ACHP, and executed in a formal Memorandum of Agreement before the Final EIS is issued for the Westside Corridor Project.

6.2.3.2 Archaeological Resources

To avoid altering or destroying remaining portions of Carter's IOOF Cemetery and the Old Canyon Road, if they exist, the areas that potentially contain these remnants could be inspected by a professional archaeologist after the present ground cover is removed. With the ground exposed, any archaeological remains, except those that may be buried deeply, would be visible and could be evaluated. Also, monitoring by an archaeologist during construction, and especially during excavation, could help identify any remnants of these resources that might lie below the current ground surface.

This procedure could also be used for areas identified as archaeologically sensitive (see Technical Memorandum 20j). As stated earlier, all final mitigation measures will be detailed in a formal MOA between UMTA, the SHPO, and the ACHP.

6.3 PARKLANDS

An inventory of public parks has been prepared for the Westside Corridor Project. This inventory was compiled from field surveys, literature review, and consultation with affected city, county, and regional agencies. Many of the public parks inventoried also serve as wildlife or waterfowl refuges; these are identified in the inventory below. Information for this section was obtained from Technical Memorandum 20k.

6.3.1 Affected Parklands

Nine public parks are located within the Westside Corridor project area. Information about these parks including the size and types of uses, is summarized in Table 6.3-1. The location of each park is shown in Figures 6.2-1a-1c.

6.3.2 Effect of Project Alternatives on Parklands

The following discussion describes how each of the identified parks would be affected by the proposed improvements. These parklands and impacts are described in greater detail in the section 4(f) evaluation (Section 6.4). Alternatives that would avoid using park property are examined and mitigation measures, where the use of parkland cannot be avoided, are described. No parks would be affected under either the No Build or TSM Alternative. Implementation of the LRT Alternative would affect the parks as summarized in Tables 6.2-2 and 6.3-1 and as described below.

6.3.2.1 Munger Park

With the Southside option, the LRT alignment would pass near this park, but would not require the use of any part of the park. All other alignment options through the canyon are far enough removed from the park so as to have no impact.

6.3.2.2 Washington Park

Washington Park will be affected by all LRT alignment options because all would require use of parkland. The Southside alignment option would require the use of approximately 0.5 acres of parkland in the area of the Zoo Interchange on the south side of Sunset Highway. This area would be used for a transit station, and related pedestrian and bus facilities that would provide connections to the Zoo. The Northside option would require the use of approximately 2.3 acres of parkland: 1.2 acres for the west portal of the short tunnel; approximately 0.1 acre for an air shaft in the park (near the archery range); and approximately 1.0 acre in the area south of the Zoo, adjacent to Sunset Highway, for the LRT trackway and station area. The Long Tunnel with a Zoo station option would require the use of 1.5 acres of parkland. With this option, 1.2 acres would be used for the west portal of the long tunnel, approximately 0.1 acre for an air shaft near the archery range and approximately 0.2 acres for the zoo station and a second air shaft. The Long Tunnel without a Zoo station option would require the use of 1.3 acres of parkland: 1.2 acres for the west portal of the long tunnel; and 0.1 acres for an air shaft in the area of the Viet Nam War Memorial parking lot.

6.3.2.3 Ridgewood Park

This small neighborhood park would not be adversely affected because the LRT improvements under all alignment options are on the opposite (west) side of Sunset Highway.

Table 6.3-1

IMPACTS ON PARKLANDS

Parkland	Acres	Type	Activities	Use Required	Amt. (Acres) by LRT Option*
Munger Park	11.6	Undeveloped	Wildlife habitat/open space	No	
Washington Park	500+	City/ Regional	Hoyt Arboretum, Washington Park Zoo, Zoo Railway, OMSI, Western Forestry Center, Japanese Gardens, TERA One, Rose Test Gardens, Shakespeare Garden, Metro Zoo, recreational facilities, wildlife habitat, open space	Yes	SS-0.5; NS-2.3 LT w/Zoo-1.5; LT w/o Zoo-1.3
Ridgewood Park	1.5	Neighborhood	Open playfield, play equipment, picnic tables	No	
Ridgewood View Park	1.5	Neighborhood	Open playfield, tennis court, small play structure, picnic tables	No	
Roxbury Park	6	Neighborhood	Tennis courts, volleyball court, open playfield, picnic tables, playground equipment	Yes	0.1
C.E. Mason Wetlands Park	3.07	Natural Area/ Wetlands	Wildlife and waterfowl habitat/open space	Yes	0.25
Willow Park	1	Neighborhood	Play equipment, picnic tables	No	
Tualatin Hills Regional Nature Park	180	Regional	Wildlife and waterfowl habitat/open space	No	
Salix Park	3.8	Natural Area/ Wetlands	Wildlife and waterfowl habitat/open space	Yes	0.01

Note: The No Build and TSM Alternatives would not affect any parkland.

*SS - Southside Option
NS - Northside/Short Tunnel Option
LT w/Zoo - Long Tunnel with Zoo Station Option
LT w/o Zoo - Long Tunnel without Zoo Station Option
Where no option is indicated, the impact would occur under all proposed LRT alignment options.

Source: City of Portland Parks Bureau, 1981; Tualatin Hills Park and Recreation District, 1989; Shapiro and Associates, Inc., 1990; Tri-Met. 1990.

6.3.2.4 Ridgewood View Park

In the area of this small neighborhood park, the LRT alignment would be located on the opposite side of Highway 217. Improvements to Highway 217 will occur adjacent to the park, but additional right-of-way is not needed.

6.3.2.5 Roxbury Park

The acquisition of approximately 0.1 acres of this park is needed with all LRT alignment options. This area will allow the LRT trackway to be constructed between the existing Highway 217 and the park.

6.3.2.6 C.E. Mason Wetlands Park

The acquisition of approximately a quarter-acre of this park would be required under all LRT alignment options. The additional right-of-way would allow the proposed LRT trackway to be located beyond the area needed for the future Highway 217 off-ramp. The off-ramp would be required for access to the proposed City of Beaverton East-West Arterial.

6.3.2.7 Willow Park

This small neighborhood park is located approximately 50 feet east of the proposed LRT trackway with the Henry Street alignment option. No use of the park would be required.

6.3.2.8 Tualatin Hills Regional Nature Park

No acquisition would be required from this regional park. It lies south of the proposed LRT alignment with all LRT options. The park would not be adversely affected, because the LRT would be either on or north of the existing BN railroad right-of-way, and the effects of LRT would not vary significantly from the existing BN impacts.

6.3.2.9 Salix Park

A very small portion (600 square feet or .01 acres) of this park would be used with all LRT alignment options if the LRT facilities cannot be located within the BN right-of-way.

6.4 SECTION 4(f) EVALUATION

As stated in section 6.1.2, Section 4(f) of the Department of Transportation Act of 1966 requires that federally funded programs or projects not use land from significant publicly owned parks or historic sites unless a determination is made that (1) there is no feasible and prudent alternative to using that land, and (2) such program or project includes all possible planning to minimize harm to the property resulting from such use. The word "use" in this case means property that is taken or acquired for construction of a permanent transportation facility, or, if not taken, has its intended use substantially impaired by the project.

For each park or historic site affected (except the BN railroad right-of-way), this section includes a description of the relevant portion of the current proposed action, a description of the property, a description of the expected impact, alternatives to avoid the potential effects, and measures to mitigate the anticipated effects when the resource cannot be avoided. For the BN railroad right-of-way, a 4(f) analysis is not included because the federal regulations specify an exemption to the 4(f) regulations when the project includes restoration, rehabilitation, or maintenance of a transportation facility when the work does not adversely affect the historic character of the facility (23 CFR 771.135 (f)(1)). Because the BN is identified as a historic resource for its contribution to the early development of the area as a transportation corridor, and not as a specific structure or district resource, an adverse effect determination is unlikely. (Refer to Section 6.4.9). If an adverse effect determination is made, then a section 4(f) evaluation would be necessary.

Throughout the development of the project design, alternatives have been evaluated and refined. A significant factor in the evaluation and elimination of alternatives has been the potential impacts to 4(f) resources. The options now being studied represent the previous efforts to avoid or minimize Section 4(f) impacts. Through this process, the number of Section 4(f) properties affected by the proposed options has been successfully reduced. The resources evaluated for 4(f) impacts discussed in this section include:

- Parklands: Washington Park, Roxbury Park, C.E. Mason Wetlands, Salix Park
- Historic Resources: Vista Bridge, Highland Racquet Club, French American School, J. Henry House, Burlington Northern Railroad
- Archaeological Resources: Carter's IOOF Cemetery, Old Plank Road

Selection of the No Build or TSM Alternatives would avoid all Section 4(f) impacts. With the LRT Alternative, one or more of the options under consideration would require use of each of these resources.

6.4.1 Washington Park

6.4.1.1 Proposed Action

In the area of Washington Park, the proposed improvements include the four LRT canyon options. These include the Southside alignment option, the two Long Tunnel alignment options (one with an underground Zoo station and one without), and the Northside alignment option.

6.4.1.2 Description of the 4(f) Resource

Washington Park is a large regional park of more than 500 acres. It is owned and maintained by the City of Portland Parks Bureau. The park has a variety of recreational, cultural, and educational facilities, including the International Rose Test Gardens, the Shakespeare Garden, the Japanese Garden, the Washington Park Zoo, the World Forestry Center, the Oregon Museum of Science and Industry (OMSI), the Viet Nam War Memorial, and the 214-acre Hoyt Arboretum, which has an extensive trail network. The Washington Park Master Plan, adopted in June of 1981, includes a policy to encourage the provision of light rail to adequately serve the needs of Washington Park.

6.4.1.3 Impact on the 4(f) Resource by the Proposed Action

Direct use of some portion of Washington Park would occur under all LRT alignment options. With the Southside alignment option, approximately 0.5 acres of Washington Park, south of Sunset Highway in the area of the Zoo Interchange, would be used. This area would be used for an LRT Zoo station and related pedestrian and bus facilities and connections to the Zoo. The Northside alignment option would require the use of 2.3 acres of parkland. With this option, 1.2 acres would be required for the west portal of the short tunnel, approximately 0.1 acre would be required for an air shaft in the park (in the area near the archery range), and approximately 1.0 acre would be needed in the area south of the Zoo, adjacent to Sunset Highway, for the LRT trackway and station area. The Long Tunnel with a Zoo station alignment option would require the use of 1.5 acres of parkland. With this option, 1.2 acres would be needed for the west portal of the long tunnel, approximately 0.1 acre for an air shaft near the archery range and approximately 0.2 acres for the Zoo station and a second air shaft in the Zoo parking lot. The Long Tunnel without a Zoo station alignment option would require the acquisition of 1.3 acres of parkland. With this option, 1.2 acres would be used for the west portal of the long tunnel and 0.1 acres would be used for an air shaft in the area of the Viet Nam War Memorial parking lot.

6.4.1.4 Avoidance Alternatives

Because of topographic constraints in the Sunset Canyon, and the location of park boundaries with relationship to the Westside Corridor, the alternatives to avoid use of this park are very limited. During the 1982 Alternatives Analysis for the Westside Corridor Project, alternatives using other major east-west corridors were examined and eliminated (a further description of the project history is included in Chapter 2 of this document). An alternative that would shift the alignment to the north, near N.W. Burnside, is not feasible because of excessive grades and the significant number of displacements that would be required. Moving the alignment further south in the Sunset Highway canyon is not feasible, again because of the excessive grades that would be required to cross the West Hills, and the significant number of displacements that would be required.

6.4.1.5 Mitigation Measures

The current design of the project for all options has included extensive planning to minimize the amount of land to be used from Washington Park. Replacement land in areas adjacent to the park is difficult to locate. Possibilities include a parcel of unused school district property located north of the Viet Nam War Memorial, and small parcels near the west and north boundaries of the park. The potential also exists for excess right-of-way (which is needed for construction, but may not be needed after construction) in the area of the east portal to be deeded to the park after construction is completed.

Depending on the option chosen as the preferred alternative, final design will include design treatments to minimize the visual impact of either surface alignment, such as special attention to protecting natural features in the park. Tunnel ventilation shafts would be located so as to minimize disruption to park activities, and would be screened with natural vegetation. Construction staging areas near the east portal would be sited to minimize impacts to the park.

6.4.2 Roxbury Park

6.4.2.1 Proposed Action

All alignment options are the same in the segment of the project adjacent to Roxbury Park. The proposed improvements include widening Highway 217 and building a segment of the LRT trackway adjacent to Roxbury Park. The majority of the improvements could be contained within the existing highway right-of-way; however, terrain between the highway and park includes a low drainage area. In order to build the LRT trackway, a portion of this area would need to be filled, and this fill area encroaches into the park.

6.4.2.2 Description of the 4(f) Resource

Roxbury Park is a six-acre neighborhood park located west of Highway 217, near the intersection of S.W. Roxbury Avenue and S.W. Berkshire Street. The park is owned and maintained by the Tualatin Hills Park and Recreation District (THPRD). According to its design as a neighborhood park, Roxbury Park provides basic recreational opportunities to the residents of the surrounding neighborhood. Because the park is within comfortable walking and bicycling distance of most residents, automobile access and parking are very limited. Roxbury Park contains two tennis courts, a volleyball court, an open play field, picnic tables, a drinking fountain, and playground equipment.

6.4.2.3 Impact on the 4(f) Resource by the Proposed Action

Approximately 0.1 acres of Roxbury Park adjacent to Highway 217 would be acquired for right-of-way under the LRT Alternative. This widening of the existing Highway 217 right-of-way would affect the park's irrigation system, but none of the other park facilities.

6.4.2.4 Avoidance Alternatives

Highway 217 is located along the eastern boundary of the park. In order to avoid use of the park, the entire highway would need to be shifted to the east in this area. This would be costly, and is complicated by the proximity to the S.W. Walker Road Interchange (i.e. the ramps to the interchange would need to be changed as well), and the relatively steep grades of the hill on the east side of Highway 217. Another alternative to taking land from the park could include regrading the area between the highway and the park. This would temporarily disrupt more area of the park than the 0.1 acre required for right-of-way, but could, with the use of some small retaining walls, eliminate the need to take any of the park.

6.4.2.5 Mitigation Measures

Replacement land in the area is very limited, but may be available to the north of the park near Winchester Court. A retaining wall adjacent to the park could reduce the amount of fill in the park, but may present an adverse visual feature to park users.

During construction, a safety fence installed along the construction zone would prevent park users from entering the construction area. Revegetation could be done after construction to provide a visual buffer between the park and the transitway.

6.4.3 C.E. Mason Wetlands

6.4.3.1 Proposed Action

All alignment options are the same in the segment of the project adjacent to the C.E. Mason Wetlands Park. The proposed improvements include widening of Highway 217 (including alterations to the Walker Road overpass and on- and off-ramps) and addition of a segment of the LRT trackway adjacent to the park. The design and location of the LRT trackway is influenced by the proposed location of Beaverton's East/West Arterial, which would include on- and off-ramps in the area of the C.E. Mason Wetlands Park. Although the Beaverton project is not proposed for construction at this time, the LRT facilities are designed to not preclude the project.

6.4.3.2 Description of the 4(f) Resource

The C.E. Mason Wetlands Park is classified as Natural Areas/Wetlands by THPRD, and has no developed recreation facilities. The 3.07-acre C.E. Mason Wetlands Park is part of a fairly expansive scrub- shrub/emergent wetland system supported by the north tributary of Hall Creek. Several creeks meander through the basin, with the most defined channel located on the north side. The park also has been evaluated for wetlands impacts. For more information on the wetlands analysis, refer to Section 5.7, Ecosystems.

6.4.3.3 Impact on the 4(f) Resource by the Proposed Action

Approximately a quarter-acre of the C.E. Mason Wetlands Park would be filled for preparation of the LRT transitway and highway improvements. The fill and related retaining walls would be located in the eastern portion of the park, adjacent to the existing fill and culverts associated with Highway 217. Currently in this area, the north tributary of Hall Creek, passes under Highway 217 in two culverts. The culverts would be extended by 70 feet, with a 10-foot head wall at the top of the fill. This wall would reduce the extent of the fill into the park/wetland by about 20 feet, preserving approximately 0.1 acres of wetland.

6.4.3.4 Avoidance Alternatives

Land use adjacent to the C.E. Mason Wetlands Park is residential to the north and west and undeveloped upland to the south. The eastern boundary of the park is defined by Highway 217. To avoid acquisition of land within this park, the proposed LRT alignment would have to be shifted to the east. This would require that Highway 217, the Highway 217/Walker Road Interchange, and the future East/West Arterial Interchange all be shifted to the east. Shifting the highway would result in a poor roadway alignment and would require the relocation of some businesses. The impacts associated with moving the alignment to the east make implementation of this alternative routing infeasible. Moving the alignment to the west to avoid the park would require the displacement of many residences, and would therefore not be feasible or prudent.

6.4.3.5 Mitigation Measures

The ten-foot head wall proposed for development of LRT improvements along the edge of this park reduces the park acreage required for LRT improvements from 0.35 to 0.25 acres. A higher retaining wall would reduce the amount of fill in the park, but would introduce an even greater built feature into this natural area and wetland. Replacement land in the vicinity is limited, but may be available to the south or west, and would be coordinated with the wetlands mitigation plan developed for the Westside Corridor Project. Wetland impacts would be mitigated at a one-to-one replacement ratio basis.

Construction in the park area would be managed to minimize disruption to the natural areas and wetlands of the park. The construction area would be fenced, and all natural areas would be revegetated with native species after construction.

6.4.4 Salix Park

6.4.4.1 Proposed Action

In the area of Salix Park, the proposed improvements include only the LRT trackway, which would be adjacent to and north of the existing BN railroad alignment, on a 180-foot bridge structure crossing over Willow Creek.

6.4.4.2 Description of the 4(f) Resource

Salix Park encompasses 3.8 acres along Willow Creek, generally located north of the BN railroad alignment and east of a small residential subdivision east of S.W. 185th Avenue. This park is owned and maintained by THPRD and has been retained in its natural condition to preserve wetlands, wildlife habitat, and scenic and recreation values. There are no developed recreation facilities in the park. Within Salix Park, Willow Creek is banked by forested and emergent wetland. Stormwater empties into the wetland from S.W. 185th Avenue via a culvert.

6.4.4.3 Impact on the 4(f) Resource by the Proposed Action

If the BN right-of-way is not utilized for the LRT improvements, the construction of the LRT Alternative would require the use of approximately 0.01 acres of the southern edge of Salix Park. This land would be below the 180-foot-long bridge constructed just north of the existing BN right-of-way and the existing BN trestle over Willow Creek.

6.4.4.4 Avoidance Alternatives

If the BN right-of-way is made available for the LRT improvements, then the use of a portion of Salix Park would be avoided. Moving the alignment to the south of the BN alignment would also avoid the use of this portion of Salix Park. However, there are two major factors which make the South option less desirable: a crossing of the LRT and BN rails would be required; and the LRT and BN crossings of S.W. 185th Avenue would be closer to the S.W. Baseline Road intersection. This would cause the intersection to work substantially less efficiently and require additional roadway improvements at the intersection. Another alternative to the use of Salix Park that has been evaluated includes moving the BN alignment to the south and locating the LRT in the existing BN right-of-way. This is not feasible because it would require the construction of two new structures across Willow Creek rather than one. Two new structures would be required because the LRT facilities include a double track configuration, which would not fit on the existing BN trestle. Also, with this option, the intersection of S.W.185th Avenue and Baseline Road would be adversely affected by moving the rail crossings closer to the intersection.

6.4.4.5 Mitigation Measures

Some opportunities exist for replacement lands to be acquired. A portion of the area to the east of Salix Park is owned by the Heritage Village Trailer Court and is an undeveloped wetland. Also, the possibility exists that excess right-of-way in this area could be deeded to THPRD after construction is complete. Because this area of the park is also a wetland, wetland mitigation would be accomplished on a one-to-one basis. Parkland replacement can be coordinated with the Wetland Mitigation Plan developed for the Westside Corridor Project.

During construction, the construction area would be fenced to minimize the impacts on the remainder of the park. After construction, the area would be revegetated with native species. Vegetation could be designed to buffer the wetlands and uplands to the north from the transitway along the southern boundary of the park.

6.4.5 Vista Bridge

6.4.5.1 Proposed Action

With the Southside alignment option, the proposed improvements in the area of the Vista Bridge include only the LRT transitway. The LRT tracks would be located in the center of S.W. Jefferson Street on a fill structure (with retaining walls on either side), approximately 10 feet above the grade of S.W. Jefferson Street. The three other canyon options are not evaluated here because they have been determined not to have an adverse effect on the Vista Bridge.

6.4.5.2 Description of the 4(f) Resource

The Vista Bridge, built in 1926, is a historic resource that is currently included in the National Register of Historic Places. The bridge is significant to the City of Portland as a delicately engineered and graceful intra-city structure that has played a vital part in the city's transportation network.

6.4.5.3 Impact on the 4(f) Resource by the Proposed Action

The Southside alignment option would have an adverse effect on the Vista Bridge because of the visual impact of the LRT structure that would be located below the bridge. This structure would diminish the integrity of the structure's location, setting, and feeling.

6.4.5.4 Avoidance Alternatives

Alternatives that would avoid this impact to the Vista Bridge include the Northside and the Long Tunnel alignment options. Also evaluated was an option to the Southside alignment option that would not require the structure under the Vista Bridge. This design routed the LRT facilities under Sunset Highway in a box-type structure in the area of the west Vista Ridge tunnel portals, rather than over the highway on a long aerial structure. With this design option, the grade of the LRT trackway in the Sunset Highway canyon would exceed the maximum grades of the design standards. Also, construction of a box structure under Sunset Highway would cause such significant disruption to traffic flow on the highway that it was determined not to be a feasible alternative.

6.4.5.5 Mitigation Measures

Measures to minimize the impacts to the Vista Bridge with the Southside option include enhanced design treatments. The design of the LRT structure has been developed to keep it as low as possible and still gain the elevation necessary to cross over the highway. The structure would be designed to be compatible with the character of the Vista Bridge to the extent possible. For example, a similar type of materials could be incorporated.

6.4.6 Highland Racquet Club

6.4.6.1 Proposed Action

The Highland Racquet Club would be affected by only the Northside alignment option. The proposed improvements in this area include improvements along Sunset Highway, the LRT transitway improvements, and the relocation of a portion of S.W. Canyon Court. The relocation of S.W. Canyon Court would require the use of 0.18 acres of land owned by the Racquet Club.

6.4.6.2 Description of the 4(f) Resource

The Highland Racquet Club is a historic resource that has been determined to be eligible for inclusion on the National Register of Historic Places. The property is located at 1853 S.W. Highland Drive, and is one of the first examples of a residential development that incorporated recreational facilities within the subdivision. The facilities were used as a marketing tool for upscale homesites during the depression, a practice that has become commonplace in large-scale housing projects today. The clubhouse was constructed in 1931 by developer and lumberman Lee Bruce Menefee. The club's tennis courts are located across the street to the north.

6.4.6.3 Impact on the 4(f) Resource by the Proposed Action

Implementation of the Northside LRT alignment option would require the acquisition of approximately 0.18 acres of Racquet Club property for the relocation of S.W Canyon Court. The clubhouse and the recreation facilities, which embody the historic elements of the property, would not be adversely affected, and would continue to be buffered from the highway and the LRT transitway by a stand of trees.

6.4.6.4 Avoidance Alternatives

The Southside and Long Tunnel alignment options would avoid an impact to the Highland Racquet Club. Closing a section of S.W. Canyon Court was evaluated and eliminated because it would limit access to the Highland neighborhood from the north.

Not providing a westbound lane on the ramp from the Zoo also was evaluated. This alternative was found to be infeasible because S.W. Canyon Court would be closed as a through street to the Sylvan Interchange, and there would be no direct route for the neighborhood residents or Washington Park/Zoo users to access the highway westbound.

Moving the entire corridor to the south (i.e., the highway, LRT and S.W. Canyon Court) also was evaluated. However, this was found to be infeasible because of the steep grades, the problems associated with changes in highway curvatures, and significant retaining wall construction that would be required.

6.4.6.5 Mitigation Measures

Because of the level of development in the area, replacement land adjacent to the Racquet Club would be very difficult to acquire without adverse impacts to other uses. During construction, extra efforts would be made to minimize the removal of existing vegetation in order to retain the existing buffer between the club and the highway. Areas cleared during construction would be revegetated.

6.4.7 French American School

6.4.7.1 Proposed Action

The proposed improvements in the area of the French American School would cause impacts from both Surface LRT alignment options, which are similar in this location. The proposed improvements in the area of the school include improvements to Sunset Highway, including the rebuilding of a portion of S.W. Canyon Court, and LRT transitway improvements.

6.4.7.2 Description of the 4(f) Resource

The French American School is a historic resource that has been determined to be eligible for inclusion in the National Register of Historic Places. It is significant as a historic resource because it is one of a small number of early schools that remain nearly unaltered through renovation. The French American School, constructed in 1937, is a one-story, wood-frame structure with a brick veneer. For most of its early history, the structure was known as the Sylvan School. During the 1970s, the school was incorporated into the Portland school system. Since 1979, it has been leased to the French American School.

6.4.7.3 Impact on the 4(f) Resource by the Proposed Action

Both Surface LRT alignment options would require approximately 0.1 acres of the school property for the relocation and reconstruction of S.W. Canyon Court. The acquisition would not affect any school structures or the fenced play area behind the school. The area needed for right-of-way currently is in natural vegetation and lies outside the fenced play area.

6.4.7.4 Avoidance Alternatives

The Long Tunnel alignment options would avoid this impact to the French American School. Another evaluated option that would avoid this impact to the school includes rerouting S.W. Canyon Court around the school (i.e., to the west and then north of the school). This option would require additional right-of-way and provide circuitous access to S.W. Skyline Boulevard for the neighborhood that uses S.W. Canyon Court. Also, several versions of narrowing the roadway and trackway improvements through this segment of the corridor have been evaluated, to reduce or eliminate the need for additional right-of-way. These options do not meet design or safety standards.

6.4.7.5 Mitigation Measures

Replacement land adjacent to the school property is difficult to acquire, but some might be available to the north or west. Steps would be taken to minimize impacts to the school land during construction. Property affected during construction would be revegetated.

6.4.8 J. Henry House

6.4.8.1 Proposed Action

In the area of the J. Henry House, the proposed improvements with the Henry Street alignment option include the LRT transitway on the south side of Henry Street and changing Henry Street from a two-way local street to a one-way, eastbound, local street.

6.4.8.2 Description of the 4(f) Resource

The J. Henry House is a historic resource that has been identified as being eligible for inclusion in the National Register of Historic Places. The property is located at 13075 S.W. Henry Street in Beaverton. The two-story, wood-frame building has gable roofs and a posts-and-beams foundation. The house has long, double-hung sash windows and shiplap siding. A front porch extends across the south (front) elevation. Alterations have been made to the west elevation, and the front door and porch railing have been replaced.

The J. Henry House is locally significant for its association with John Henry, a pioneer farmer in eastern Washington County. The house is also significant as one of only three intact nineteenth century farmhouses in the City of Beaverton. Henry is believed to have constructed the dwelling in 1886, and lived there until his death in 1908.

6.4.8.3 Impact on the 4(f) Resource by the Proposed Action

Implementation of the Henry Street alignment option would require the acquisition of approximately 0.02 acres of the J. Henry House property. Acquisition of this land would result in a total loss of an already narrow front yard setback between the historic structure and the bordering street and sidewalk.

This is considered to be an adverse effect because it would significantly alter the property's location and setting.

6.4.8.4 Avoidance Alternatives

The BN alignment option would avoid a negative impact to the J. Henry House. Another option that has been evaluated includes additional right-of-way acquisition from the south side of Henry Street. This would require the displacement of several businesses, because buildings adjacent to the existing right-of-way are not set back. Other alternatives, such as routing the LRT alignment either north or south of Henry Street, would require substantial displacement of residents and businesses.

6.4.8.5 Mitigation Measures

Replacement land in the vicinity of the J. Henry House could probably be located; however, the amount of the take is so small that replacing the take would not substantively mitigate the loss of the front yard. The house could be moved back on the lot to attempt to retain the setting; however, moving the house would likely compromise the structure's integrity. The design of the improvements in this area could be enhanced to emphasize the character of the structure. The portions of the property disturbed during construction would be revegetated.

6.4.9 Burlington Northern Railroad

6.4.9.1 Proposed Action

The BN alignment option through central Beaverton would follow the existing BN Railroad right-of-way from S.W. Watson Avenue to S.W. 185th Avenue. If negotiations with Burlington Northern officials are successful, the BN right-of-way would be acquired for the LRT transitway improvements. If the BN right-of-way cannot be acquired for all or part of this segment, then the LRT transitway would be located adjacent to the BN alignment, on right-of-way acquired from adjacent property owners.

6.4.9.2 Description of the 4(f) Resource

The BN Railroad right-of-way is a historic resource that has been identified to be eligible for inclusion in the National Register of Historic Places. The BN Railroad right-of-way is locally significant for its association with the Oregon Electric Railroad, which at one time was the largest interurban railroad in Oregon. It also is important for its major role in the growth and development of Washington County during the early decades of the twentieth century.

The steam-powered railroads provided commuter service between Portland and numerous towns throughout the greater Willamette Valley. In Washington County, the electric railroads fostered suburban development and opened the western half of the county to logging. This shaped the Washington County economy between 1910 and 1940, because previous logging efforts had been hampered by the limitations of transporting logs and logging equipment by horse power.

Competition from automobiles forced both commuter rail lines out of business in 1933. The right-of-way has been under BN Railroad management since sometime after World War II.

6.4.9.3 Exclusion of the BN Resource from Section 4(f) Requirements

The use of the BN Railroad right-of-way for the LRT facilities would not adversely affect the historic qualities of the facility, because it is the corridor itself that is eligible for the National Register. The original built facilities, such as the rail bed, the original tracks, and the original stations, no longer exist. Consequently, for purposes of the Westside Corridor Project, the BN Railroad right-of-way is exempt from the Section 4(f) requirements (23 CFR 771.135(f)(1)).

The SHPO and ACHP have been contacted with respect to exempting the BN from the Section 4(f) regulations. In both cases, the preliminary response has been that this exemption would be appropriate.

The actual documentation and responses from these agencies will be compiled after selection of the locally preferred alternative. If further engineering during preparation of the Final EIS reveals that adverse effects would occur, a separate Section 4(f) evaluation would be performed at that time.

6.4.10 Carter's International Order of Odd Fellows (IOOF) Cemetery

6.4.10.1 Proposed Action

The proposed improvements in the area of Carter's IOOF Cemetery include LRT trackway and associated improvements. The Southside alignment option includes guideway improvements in the center of S.W. Canyon Road and the associated road widening. The widening of the roadway would cause additional fill to be placed in the area where this pioneer cemetery is thought to have been located. The existing S.W. Canyon Road is constructed over the cemetery location.

With all three of the tunnel alignment options, the LRT guideway approach to the tunnel portal would be located over the area where the cemetery is thought to have been located.

6.4.10.2 Description of the 4(f) Resource

Carter's IOOF Cemetery is a potential archaeological resource. If a significant resource is discovered, it would be evaluated as a Section 106 resource and a Section 4(f) resource. Carter's IOOF Cemetery appears on an 1871 surveyor's map of the Carter Addition to the City of Portland. The cemetery site is thought to be located near the western terminus of S.W. Market Street, northwest of the intersection of S.W. Canyon Road and S.W. Jefferson Street. The surveyor's map indicates that the cemetery was adjacent to the east side of the original Canyon Road, a plank road built sometime during the 1850s. Research suggests that although the cemetery appears on the 1871 map, if used at all, it would have been used only during the 1850s. The rebuilding and paving of Canyon Road in the 1930s and again in the 1960s appears to have destroyed all traces of the cemetery. The new roadway was aligned directly through the area where the cemetery is believed to have been originally located. No record has been found of actual internments, or of graves having been moved prior to the road reconstruction. It is likely that at the time of the road reconstruction, grave sites, if any actually existed, were not marked. The possibility exists, however, that some trace of a cemetery may remain.

6.4.10.3 Impact on the Section 4(f) Resource by the Proposed Action

All of the LRT alignment options require the use of a portion of the area where the cemetery is believed to have been located. With the Southside option, construction in the center of the current S.W. Canyon Road for the footings of the LRT guideway columns could disturb previously undisturbed but filled portions of the cemetery. With the three tunnel options, construction in the area of the east tunnel portal and of the access structure, could disturb the area where the cemetery is thought to have been located.

6.4.10.4 Avoidance Alternatives

Avoidance alternatives that have been evaluated would locate the east portal of the tunnel in a different location. A number of other portal locations were evaluated in earlier phases of the preliminary engineering for the Westside Corridor Project, but were eliminated because of significant displacement impacts, poor ground conditions for tunneling, and the desire not to tunnel under areas of existing development. It is not possible to avoid this potential impact with a surface option, because of the narrowness of the canyon in this area.

6.4.10.5 Mitigation Measures

Measures taken to minimize harm to this potential resource would include review by a professional archaeologist after the site is cleared of vegetation, and monitoring during construction, especially during times of earth excavation. If cemetery remains were discovered, then reburial would be carried out under the terms of a reburial plan to be outlined in the MOA.

6.4.11 <u>Old Plank Road</u>

6.4.11.1 Proposed Action

The proposed action in the area where it is thought that remains of the Old Plank Road may be located are similar to those as described above for Carter's IOOF Cemetery. The Old Plank Road was adjacent to the cemetery.

6.4.11.2 Description of the 4(f) Resource

The Old Plank Road is a potential archaeological resource. If a significant resource is discovered, it would be evaluated as a Section 106 resource and a Section 4(f) resource. The original Canyon Road was a plank road constructed during the 1850s adjacent to the then Tanner Creek stream bed. The road linked the Portland waterfront with the agricultural lands and forests to the west, and contributed to Portland's economic success at that time. It is believed that most of the original plank road was destroyed in 1930, when Canyon Road was improved, and in the 1960s, when it was widened and improved again. Also, it is probable that portions of the plank road were destroyed around the turn of the century, when the city constructed its water reservoirs and built large water mains under S.W. Jefferson Street. Also, Tanner Creek was put in an underground culvert, and substantial fill was placed in the area. The construction of the water lines, the culverting of the creek, and the subsequent maintenance and repair work make it unlikely that much if any of the original plank road would remain intact. The possibility exists, however, that a small portion of the original road may remain below grade in the vicinity of Carter's IOOF cemetery.

6.4.11.3 Impact on the 4(f) Resource by the Proposed Action

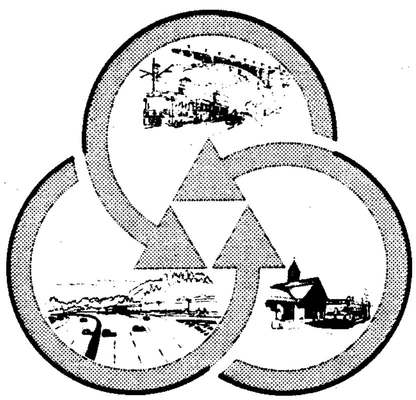
As described above for the cemetery site, construction related to all the LRT alignment options have the potential to impact this resource. The potential impacts are the same as described above.

6.4.11.4 Avoidance Alternatives

Avoidance alternatives evaluated are the same as described above under Carter's IOOF Cemetery.

6.4.11.5 Mitigation Measures

Measures taken to minimize harm to this potential resource would include review by a professional archaeologist after the site is cleared of vegetation, and on going monitoring during construction, especially during times of earth excavation. If a significant resource is discovered during construction, then recovery of data from the resource would be carried out under a recovery plan to be outlined in the MOA.



CHAPTER 7

FINANCIAL ANALYSIS AND EVALUATION OF ALTERNATIVES

7.0 FINANCIAL ANALYSIS AND EVALUATION OF ALTERNATIVES

This chapter presents the evaluation of the alternatives. Section 7.1: Financial Analysis provides information to judge the fiscal feasibility of building and operating each of the proposed alternatives. Section 7.2: Evaluation of Alternatives brings together the key conclusions of the other chapters to: (a) measure the effectiveness of each alternative in meeting the project's objectives (Section 7.2.2), (b) measure the cost-effectiveness of the project alternatives (Section 7.2.3), (c) examine equity considerations (Section 7.2.4), and (d) identify the major trade-offs between the alternatives (Section 7.2.5).

7.1 FINANCIAL ANALYSIS

This section addresses the feasibility and fiscal impacts of the financing scenarios for the project alternatives. The analysis consists of two elements:

Project Capital Cost Feasibility Analysis: focuses on whether there are adequate Project Capital resources to construct the preferred alternative and, if not, how the Project Capital shortfall will be resolved. It is important to note that Project Capital costs relate only to the implementation of the Westside Corridor Project. Between now and the year 2005, Tri-Met will have other capital costs that are not associated with the Westside Corridor Project. These are considered to be System capital costs, which are accounted for in the System analysis.

System Fiscal Feasibility Analysis: focuses on whether there are adequate resources to operate and maintain the entire transit System, including the operations of the preferred Westside alternative, between now and the year 2005 and, if not, how the System shortfall will be resolved. System costs include all transit capital expenditures to the year 2005, except the Westside Corridor Project Capital cost.

The feasibility analysis is conducted in two parts, one for Project Capital costs and one for System costs, because each element has different financing plans. This method of analysis can clearly differentiate between ongoing System fiscal problems, if they exist, and Project Capital shortfalls. Both the Project Capital and System fiscal analyses have been prepared on a cash-flow basis. The details of the cash-flow analyses are reported in the Updated Financial Analysis Results Report, November 1990.

In the detailed report, the Project Capital and System cash-flow projections were made under several economic scenarios. The results reported in Sections 7.1.1 - 7.1.5 use these "baseline" assumptions:

(a)	Operating Cost Inflation	5.6% per year
(b)	Capital Cost Inflation	6.9% per year
(c)	Annual Service Increase	1.0% per year
(d)	Payroll Tax Revenue Increase	6.6% per year

Baseline assumptions are based on the average growth rates of the last ten years for variables such as employment, consumer price index, construction inflation, durable goods inflation, and wages. As the last ten years in the Portland region have included a severe recession and three years of negative employment growth, the baseline assumptions are inherently conservative. The sensitivity of the baseline conclusions to other scenarios is discussed in Section 7.1.5.3, Risks and Uncertainties.

7.1.1 Costs

This section examines both Project Capital costs and System costs for each of the project alternatives. Project Capital costs are shown for both the transit and highway components. System costs include both a capital and an operations component. Costs are shown in 1990 dollars ($1990) and "Year of Expenditure" dollars.

Year of Expenditure dollars are calculated by inflating the year-by-year costs in $1990 by the appropriate inflation index for that cost component. These year-by-year inflated costs are then cumulatively summed into a total Year of Expenditure cost.

7.1.1.1 Project Capital Costs

Table 7.1-1 shows that transit Project Capital costs in Year of Expenditure dollars range from about $110 million for the TSM Alternative up to $703 million for the LRT Long Tunnel option. The costs shown in Table 7.1-1 are for the capital improvements and vehicles required by each project alternative, in excess of already committed capital costs associated with the No Build Alternative. These already committed capital costs are accounted for in the System component of the cash-flow analysis.

Table 7.1-1

WESTSIDE CORRIDOR PROJECT COST SUMMARY
($ Millions)

	TSM	Southside to 185th	Northside to 185th	Tunnel with Zoo to 185th	Tunnel without Zoo to 185th	Northside to Murray	Northside to Sunset TC
Project Capital Costs ($1990)							
Transit	$ 72.2	$445.8	$441.1	$491.2	$466.3	$390.6	$254.5
Highway	$ 87.7	$ 87.7	$ 87.7	$ 87.7	$ 87.7	$ 87.7	$ 87.7
Project Capital Costs ($YOE) (1)							
Transit	$109.9	$638.1	$631.5	$703.2	$667.6	$559.1	$364.4
Highway	$125.2	$125.2	$125.2	$125.2	$125.2	$125.2	$125.2
Year 2005 O&M Costs ($1990) (2)							
LRT	$ 0.0	$ 5.7	$ 5.7	$ 5.5	$ 5.3	$ 5.3	$ 3.1
Bus	$ 25.6	$ 16.5	$ 16.5	$ 16.6	$ 16.6	$ 17.3	$ 18.4
General Administration	$ 1.5	$ 1.6	$ 1.6	$ 1.6	$ 1.5	$ 1.5	$ 1.4
Total Year 2005 O&M Costs ($1990)	$ 27.1	$ 23.8	$23.8	$ 23.7	$ 23.4	$ 24.1	$ 22.9

Note: (1) Capital Costs, in Year of Expenditure dollars, include a 6.9% Capital Cost inflation index.
(2) Transit O&M costs shown are for the Westside Corridor only.

Source: Tri-Met, 1990.

Also included in the Project Capital costs shown in Table 7.1-1 are an additional $87.7 million ($1990) or $125.2 million (Year of Expenditure) dollars for the highway improvements that are common to all the alternatives. The fiscal feasibility of the highway project elements is assessed separately from the transit cash-flow analysis.

7.1.1.2 System Costs

System costs include all capital and operating and maintenance expenditures by Tri-Met over the next 15 years, except the Westside Corridor Project Capital cost. System operating costs include all annual transit operating and maintenance costs between FY 1989 and FY 2005 in Year of Expenditure dollars including: (a) a one-percent-per-year "customary" increase in transit service hours and (b) the added operation and maintenance costs that result from implementing a Westside Corridor Project. Table 7.1-2 shows that the cumulative total of System operating costs for the TSM Alternative is $29 to $62 million more than costs exhibited by the LRT options. This range results from the differences in operation and maintenance costs between the project alternatives shown in Table 7.1-1. The LRT options were projected to cost between $3.0 to $4.2 million ($1990) per year less to operate and maintain in FY 2005 than the TSM Alternative. The analysis accounted for the interim years by extrapolating the FY 2005 costs back to the opening year of the project. These year-by-year $1990 costs were converted to Year of Expenditure dollars by inflating the costs by 5.6% per year.

Table 7.1-2

TRANSIT SYSTEM COSTS
CUMULATIVE TOTAL FY1989-FY2005
($000s of Year of Expenditure)

	TSM	Surface to 185th	Tunnel with Zoo to 185th	Tunnel without Zoo to 185th	Surface to Murray	Surface to Sunset TC
System Operating Costs	$2,515,559	$2,485,249	$2,486,612	$2,484,403	$2,479,859	$2,454,202
System Capital Costs (1)	$552,822	$541,682	$541,685	$541,682	$541,920	$542,724
Total System Costs	$3,068,381	$3,026,931	$3,028,297	$3,026,085	$3,021,779	$2,996,926

Note: (1) System Capital Costs exclude Westside Corridor Project Capital Costs.

Source: Tri-Met, 1990.

System capital costs include all transit capital costs between FY 1989 and FY 2005 in Year of Expenditure dollars, including: (a) already committed capital projects that would be implemented by the No Build Alternative, (b) a regular schedule of vehicle replacement purchases, and (c) the purchase of additional vehicles necessitated by the one-percent-per-year customary service increases. The only capital cost between FY 1989 and FY 2005 not accounted for in the System capital cost is the Project Capital cost previously shown in Table 7.1-1. Table 7.1-2 shows that the cumulative total System capital cost associated with the TSM Alternative is $10 to $11 million more than those exhibited by the LRT options. This difference results from the reduced need for bus fleet expansion under the LRT options.

Total System costs is the total of System capital and System operating costs. Table 7.1-2 shows that the total System cost for the TSM Alternative is $40 to $71 million more than those for the LRT options.

7.1.2 Available Revenues

Three categories of available resources are examined: (a) those reserved for transit project capital costs, (b) those reserved for transit system operations and maintenance, and (c) those reserved for highway construction.

7.1.2.1 Available Transit Project Capital Revenues

Under the current plan, $87 million in capital revenues are currently available for a light rail project, while no capital revenue is available for the TSM. The light rail capital revenues include:

$80 Million From Light Rail Construction General Obligation Bonds: On November 6, 1990, the voters of the Tri-Met district approved a $125 million General Obligation bond to expand the regional light rail system, subject to a preferred alternative decision. Voter approval both authorized Tri-Met to issue the bonds and approved the use of ad valorem taxes to repay the debt.

A General Obligation bond pledges the "full faith and credit" of the district's property owners to fully repay the principal and interest on the bond. The "full faith and credit" pledge will provide the lowest interest rate possible when the bonds are issued. The bond measure provides flexibility in how proceeds can be used to further light rail. The basic legal restriction on the use of the funds is that they be used solely for light rail projects. A plan for their use has been developed in the "Regional Compact" approved by the regional transportation policy body, the Joint Policy Advisory Committee on Transportation (JPACT) of the Metropolitan Service District (Metro). In the compact, the intent of the bond proceeds is defined to: (a) provide matching funds to construct, subject to the preferred alternative decision, a light rail extension between downtown Portland and the Hillsboro Transit Center and (b) provide $15 million in engineering and right-of-way funding for an East Portland/Clackamas County light rail line.

The planned use for the Westside portion of the bond proceeds is to provide one-eighth of the total project costs, plus the entire Capital Reserve Account (CAPRA) for unanticipated project expenses. Since $15 million of the bond proceeds is reserved for an East Portland/Clackamas County line, and $30 million is planned, subject to the preferred alternative decision, for the light rail project between S.W. 185th Avenue and Hillsboro, $80 million is available for the LRT options to S.W. 185th Avenue plus a Capital Reserve Account (CAPRA). The Regional Compact provides the possibility of shifting funds from the East Portland/Clackamas Project to the Westside Corridor Project, if the necessity arose.

$7 Million in Local Government Contributions: The Regional Compact includes a provision for additional funding to be provided to a Westside light rail project, if light rail is selected as a preferred option, by governments representing areas or user groups directly served by the light rail. The local government funding includes:

(a) $7 million from the City of Portland, mostly anticipated from Urban Renewal Funds;

(b) $5 million from Washington County, anticipated to come in part from Traffic Impact Fees paid by developers;

(c) $2 million from Metro, anticipated from Zoo-related revenues;

(d) $7 million from Tri-Met, derived from working capital.

The Tri-Met Board of Directors voted to commit $7 million of Tri-Met funds to the project, subject to the preferred alternative decision, at its November 1990 meeting. It is anticipated that the other governmental approvals will be complete by the time the preferred alternative decision is approved. Accordingly, $7 million in local government contribution is shown as "available" in this analysis. The remaining $14 million is shown as a proposed "additional" resource.

7.1.2.2 Available Transit System Revenues

System revenues are derived from a series of sources, each with its own escalation rate. In total, between FY 1989 and FY 2005, these revenue sources are expected to provide between $3.038 to $3.052 billion, depending on the alternative (see Table 7.1-3). The difference between alternatives reflects differences in passenger revenues and interest earnings. The major sources of available System revenue shown in Table 7.1-3, and the baseline assumptions that are applied to them, include:

Table 7.1-3

SUMMARY OF AVAILABLE SYSTEM REVENUES
CUMULATIVE TOTAL - FY1989 THROUGH FY2005
($000s of Year of Expenditure)

	TSM	Surface to 185th	Tunnel with Zoo to 185th	Tunnel without Zoo to 185th	Surface to Murray	Surface to Sunset TC
Passenger Revenues	$596,764	$600,819	$601,229	$600,122	$597,227	$582,832
Employer Payroll Tax	$1,780,521	$1,780,521	$1,780,521	$1,780,521	$1,780,521	$1,780,521
Municipal Payroll Tax	$64,886	$64,886	$64,886	$64,886	$64,886	$64,886
Self-Employment Tax	$106,406	$106,406	$106,406	$106,406	$106,406	$106,406
State-in-Lieu	$36,680	$36,680	$36,680	$36,680	$36,680	$36,680
Federal Operating Subsidy	$50,119	$50,119	$50,119	$50,119	$50,119	$50,119
Cigarette Tax	$42,803	$42,803	$42,803	$42,803	$42,803	$42,803
Interest	$66,397	$72,995	$72,841	$73,166	$73,843	$77,604
Other	$22,981	$22,982	$22,980	$22,980	$22,980	$22,981
Subtotal (System Operations)	$2,767,557	$2,778,211	$2,778,465	$2,777,683	$2,775,465	$2,764,832
Federal Capital Funds (1)	$254,450	$254,450	$254,450	$254,450	$254,450	$254,450
Other Capital	$18,590	$18,590	$18,590	$18,590	$18,590	$18,590
Subtotal (System Capital)	$273,040	$273,040	$273,040	$273,040	$273,040	$273,040
Total System	$3,040,597	$3,051,251	$3,051,505	$3,050,723	$3,048,505	$3,037,872

Note: (1)Not including light rail construction funds.

Source: Tri-Met, 1990.

Payroll Tax Revenues: Payroll tax revenues accounted for about $60.5 million in FY 90. Based on existing conditions, payroll taxes are projected to increase by 9.5% this fiscal year (FY 1991), then 6.6% in all subsequent years to the year 2005. The long-term 6.6% growth rate is based on 2% regional employment growth and 4.6% wage inflation. This is a conservative estimate based on historical data. Between 1980 and 1990, payroll taxes increased 6.4% per year on average. During the same period, Tri-County employment increased 2.2% per year and wage inflation was 4.5%. This ten year period included the 1980-1982 recession, when employment fell in the Portland Metropolitan area for three consecutive years. It also included FY 1983, when Tri-Met reduced its boundaries and therefore its payroll tax base.

Self-Employment Tax Revenues and State In-Lieu Revenues: Self-employment tax revenues accounted for $4.6 million in FY90, and State "in-lieu" revenues accounted for $1.7 million. Self-employment revenue is projected to increase by 6% per year. State "in-lieu" revenues are projected to increase 4% per year.

The Municipal Payroll Tax: This is a new revenue source for Tri-Met, approved by the Legislature in 1989 to meet the needs of the Westside Corridor Project. Its tax rate is phased in over a five-year period beginning at 0.2% in FY91 and increasing to 0.6%. The payroll base that is taxed grows at a rate of 6.6% per year.

Passenger Revenues: In FY 90, passenger revenues provided $22.4 million. The baseline forecast assumes passenger revenues grow 4.5% on average. This assumes the equivalent of a 5% fare increase every two years beginning September 1992 and non-project-related ridership growth proportional to the estimated regional population growth. The projected passenger revenues for each alternative reflect ridership forecast differences for the Westside alternatives.

Federal Section 9 Formula Funds: In FY 90, Tri-Met received $4.1 million in federal operating assistance and $6.1 million in formula capital assistance. These funds are projected to decline in "real" terms. Operating assistance is projected to decrease by 5% per year in nominal dollars or 10.6% in Year in Expenditure dollars. Capital assistance is projected to remain a constant $6.1 million per year throughout the 15-year period, while the money's buying power declines at 6.9% per year. Local matching ratios are assumed to increase to 50% in FY 92 and remain constant thereafter.

7.1.2.3 Available Highway Construction Revenues

The Oregon Department of Transportation (ODOT) has programmed a portion of the funds needed for the highway projects, which are common to all transit alternatives, in the 1991-1996 Six Year Highway Improvement Program adopted in July 1990. ODOT programmed $450,000 of Federal Aid Primary (FAP) funds in FY 1994 for ramp-metering on Highway 217. The widening of Sunset Highway and related interchange improvements in the Sylvan area are programmed for $30 million of State Highway Funds in FY 1994. The Sunset Highway climbing lane and Zoo Interchange improvements have $8.95 million of State Highway Funds programmed in FY 1996. The Sunset Highway/Highway 217 Interchange and widening of Highway 217 are programmed for $2.1 million of FAP funding for right-of-way acquisition in FY 1994. Available highway revenues total approximately $41.5 million.

7.1.3 Existing Revenue Shortfalls

This section discusses the amount of additional Project Capital and System revenues that are needed to make each alternative fiscally feasible. As discussed above, the System financial analysis includes all capital and operating costs and revenues for the entire Tri-Met system, including the operating costs for the Westside Corridor alternatives, but not the Project Capital costs of the Westside Corridor alternatives. In this study, an option is fiscally feasible if it meets two conditions:

(a) Capital revenues are sufficient to meet the estimated Project Capital cost of the option plus, for the LRT options, a capital reserve account (CAPRA) equal to at least 10% of the high construction year total cost. At 10%, the CAPRA requirement for the Westside Corridor Project would range between $8 and $14 million. For purposes of this analysis, a flat $15 million of unused General Obligation Bond authority is defined as the minimum CAPRA requirement for all alternatives.

(b) Ongoing revenues must be sufficient to meet the estimated total System costs plus sufficient beginning-year working capital to meet two months of operating costs.

7.1.3.1 Existing Project Capital Revenue Shortfalls

Table 7.1-4 summarizes the capital funding shortfall (available capital revenues minus project costs) in year of expenditure dollars for the project options. As Table 7.1-4 illustrates, capital shortfalls occur for all transit alternatives, ranging from $110 million for the TSM Alternative to $616 million for the Long Tunnel with Zoo station option. In addition, the $15 million capital reserve account requirement is not met. An additional capital shortfall of $83.7 million occurs for the highway projects associated with all of the TSM and light rail alternatives.

Table 7.1-4

PROJECT CAPITAL REVENUE SHORTFALL
($000s of Year of Expenditure)

	Transit Project Capital Costs	Available Transit Project Capital Revenues	Transit Project Capital Funding Shortfall (1) (2)
TSM	$109,894	$0	$109,894
Southside Surface to 185th	$638,098	$87,000	$551,098
Northside Short Tunnel South BN to 185th	$631,509	$87,000	$544,509
Long Tunnel With Zoo to 185th	$703,162	$87,000	$616,162
Long Tunnel Without Zoo to 185th	$667,565	$87,000	$580,565
Northside Short Tunnel North BN to 185th	$629,120	$87,000	$542,120
Northside Short Tunnel South Henry to 185th	$646,387	$87,000	$559,387
Northside Short Tunnel North Henry to 185th	$642,537	$87,000	$555,537
Northside Short Tunnel to Murray	$559,105	$87,000	$472,105
Northside Short Tunnel to Sunset TC	$364,360	$87,000	$277,360

Note: (1) At a minimum, an additional $15 million is required in the Capital Reserve Account for the LRT options.
(2) An additional $83.7 million is required to meet the highway Project Capital costs associated with all build alternatives.

Source: Tri-Met, 1990.

7.1.3.2 Existing System Revenue Shortfalls

The System costs and revenues were projected over a 16-year period using the previously described assumptions. Lines "A" through "H" in Table 7.1-5 show a summarized version of the detailed System cash flow table for the LRT Surface option to S.W. 185th Avenue. The table shows how System revenues, costs, and working capital are projected on a year-by-year basis. Identical analyses were prepared for all alternatives.

Table 7.1-6 summarizes the cumulative total results of the cash flow analyses for each of the options. Table 7.1-7 shows the year-by-year "beginning working capital" results expressed in "dollars" and "months of operations". These analyses demonstrate that, for the LRT Alternative, available System revenues (a) meet the estimated System capital and operating costs and (b) meet the beginning working capital requirements. Accordingly, there is no System revenue shortfall for the LRT Alternative. The TSM Alternative does not meet these tests, and incurs a System revenue shortfall that must be met by additional revenue sources or management controls. These are discussed in Section 7.1.4.2.

TABLE 7.1-5
Summary Table of Detailed Cash Flow Analysis
Surface Light Rail to S.W. 185th
in Year of Expenditure Dollars
(000s)

	FY89 ACT	FY90 ACT	FY91 FRCST	FY92 FRCST	FY93 FRCST	FY94 FRCST	FY95 FRCST	FY96 FRCST	FY97 FRCST	FY98 FRCST	FY99 FRCST	FY2000 FRCST	FY2001 FRCST	FY2002 FRCST	FY2003 FRCST	FY2004 FRCST	FY2005 FRCST	TOTAL (1989-2005)
A. Operating Revenues																		
1. Federal	$5,934	$5,334	$3,904	$3,708	$3,523	$3,347	$3,179	$3,020	$2,869	$2,726	$2,590	$2,460	$2,337	$2,220	$2,109	$2,004	$1,904	$53,169
2. Tri-Met	$87,990	$96,737	$102,249	$111,603	$119,683	$127,952	$136,729	$144,066	$153,138	$166,435	$176,427	$186,953	$198,082	$209,850	$222,300	$235,463	$249,384	$2,725,041
3. Total	$93,924	$102,071	$106,153	$115,311	$123,206	$131,299	$139,908	$147,087	$156,008	$169,161	$179,017	$189,413	$200,419	$212,071	$224,41(	$237,466	$251,287	$2,778,210
B. Operating Expenditures	$84,285	$90,234	$96,272	$100,900	$106,900	$113,217	$120,546	$127,777	$135,503	$151,570	$161,103	$170,967	$181,454	$192,607	$204,451	$217,043	$230,419	$2,485,249
C. Operating Result (A-B)	$9,639	$11,837	$9,880	$14,411	$16,306	$18,082	$19,362	$19,310	$20,504	$17,591	$17,914	$18,446	$18,965	$19,464	$19,959	$20,423	$20,869	$292,962
D. System Capital Revenues (5)																		
1. Federal	$22,003	$50,077	$32,693	$19,269	$18,861	$25,359	$15,698	$11,601	$9,426	$6,763	$6,100	$6,100	$6,100	$6,100	$6,100	$6,100	$6,100	$254,450
2. Tri-Met (1)	$9,639	$11,837	$9,880	$14,411	$16,306	$18,082	$19,362	$19,310	$20,504	$17,591	$17,914	$18,446	$18,965	$19,464	$19,959	$20,423	$20,869	$292,962
3. Other	$5,117	$10,288	$1,880	$1,305	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$18,590
4. Total	$36,759	$72,202	$44,453	$34,985	$35,167	$43,441	$35,060	$30,911	$29,930	$24,353	$24,014	$24,546	$25,065	$25,564	$26,059	$26,523	$26,969	$566,001
E. System Capital Requirements (5)																		
1. Federal	$17,703	$48,517	$26,294	$16,238	$10,852	$15,761	$10,197	$8,275	$8,763	$9,280	$9,828	$10,408	$11,022	$11,672	$12,361	$13,090	$13,862	$254,122
2. Tri-Met (2)	$1,254	$5,217	$6,909	$5,774	$6,003	$12,825	$15,337	$13,718	$14,527	$17,617	$19,257	$20,753	$22,338	$23,943	$25,792	$27,674	$29,608	$268,546
3. Other	$5,477	$10,352	$1,880	$1,305	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$19,014
4. Total	$24,434	$64,086	$35,083	$23,317	$16,855	$28,586	$25,534	$21,993	$23,290	$26,897	$29,085	$31,161	$33,359	$35,615	$38,153	$40,764	$43,470	$541,683
F. Total System Result (3)	$8,385	$8,620	$2,971	$8,637	$10,303	$5,257	$4,025	$5,592	$5,977	($26)	($1,344)	($2,307)	($3,373)	($4,479)	($5,833)	($7,251)	($8,739)	$24,415
G. Beginning Working Capital (4)	$22,571	$30,956	$37,576	$35,547	$44,184	$54,487	$59,744	$56,769	$62,361	$68,338	$68,312	$66,968	$64,661	$61,288	$56,809	$50,976	$43,725	$885,279
H. Months of Operating Expense	3.2	3.9	4.4	4.0	4.7	5.2	5.3	4.8	5.0	4.9	4.6	4.3	3.9	3.5	3.0	2.6	2.1	69.3
I. Project Capital Revenues																		
1. Federal			$0	$19,102	$40,840	$87,316	$93,341	$99,781	$80,000	$39,909	$18,284	$0	$0	$0	$0	$0	$0	$478,573
2. Regional			$1,000	$18,293	$6,128	$6,080	$10,487	$35,503	$1,453	$622	$200	$0	$0	$0	$0	$0	$0	$79,766
3. State			$0	$36,445	$2,328	$2,015	$1,137	$35,563	$1,453	$621	$199	$0	$0	$0	$0	$0	$0	$79,761
4. Total			$1,000	$73,840	$49,296	$95,411	$104,965	$170,847	$82,906	$41,152	$18,683	$0	$0	$0	$0	$0	$0	$638,100
J. Project Capital Requirements			$0	$25,469	$54,453	$116,421	$124,455	$133,042	$106,666	$53,212	$24,379	$0	$0	$0	$0	$0	$0	$638,097
K. Total Project Capital Result			$1,000	$48,370	($5,157)	($21,010)	($19,489)	$37,806	($23,760)	($12,060)	($5,696)	$0	$0	$0	$0	$0	$0	$4
L. Cumulative Project Capital Balance			$1,000	$49,370	$44,213	$23,202	$3,713	$41,519	$17,759	$5,699	$3	$3	$3	$3	$4	$4	$4	

(1) Tri-Met Capital Revenues are equal to the Operating Result (A-B).

(2) If Federal Capital Revenues are LESS than Federal Capital Requirements, the difference is added to the Tri-Met Capital Requirements.

(3) Total System Results equals Tri-Met Capital Revenues minus Tri-Met Capital Requirements (D2-E2).

(4) Beginning Working Capital equals the sum of the Total System Result and Beginning Working Capital from the previous year (F+G).

(5) Includes all system wide capital costs exclusive of the Light Rail Projects. The Light Rail Capital Costs and Revenues are not co-mingled with the system capital costs and revenues and, therefore, are shown separately in lines "I" and "J".

Table 7.1-6

CUMULATIVE BALANCE OF SYSTEM REVENUES AND COSTS
FY1989 THROUGH FY2005
($000s of Year of Expenditure)

	TSM	Southside to 185th	Tunnel with Zoo to 185th	Tunnel without Zoo to 185th	Northside to Murray	Northside to Sunset TC
A. Operating Revenues (1)						
1. Federal	$53,169	$53,169	$53,169	$53,169	$53,169	$53,169
2. Tri-Met	$2,714,389	$2,725,041	$2,725,297	$2,724,515	$2,722,298	$2,711,663
3. Total	$2,767,559	$2,778,210	$2,778,466	$2,777,684	$2,775,467	$2,764,833
B. Operating Expenditures (2)	$2,515,446	$2,485,249	$2,486,612	$2,484,403	$2,479,859	$2,454,202
C. Operating Result (A-B)	$252,113	$292,961	$291,854	$293,281	$295,608	$310,631
D. System Capital Revenues (3)						
1. Federal	$254,450	$254,450	$254,450	$254,450	$254,450	$254,450
2. Tri-Met	$252,113	$292,961	$291,854	$293,281	$295,608	$310,631
3. Other	$18,590	$18,590	$18,590	$18,590	$18,590	$18,590
4. Total	$525,153	$566,001	$564,894	$566,321	$568,648	$583,671
E. System Capital Requirements (4)						
1. Federal	$254,122	$254,122	$254,122	$254,122	$254,122	$254,122
2. Tri-Met	$279,686	$268,546	$268,546	$268,546	$268,784	$269,588
3. Other	$19,014	$19,014	$19,014	$19,014	$19,014	$19,014
4.	4.	Total	$552,822	$541,682	$541,682	$541,682
$541,920	$542,724					
F. Total System Result (5)	($27,573)	$24,417	$23,308	$24,735	$26,824	$41,043

Note: (1) See Table 7.1-3.

(2) Includes all expenditures for the operation of existing and planned bus and rail service through 2005 including the Westside Corridor Project.

(3) Includes primarily federal Section 9 formula capital revenues, plus line 'C', Tri-Met revenues not needed for operations and, therefore, available for capital expenditures. Does not include any federal Section 3 light rail funds.

(4) Includes all capital maintenance and replacement costs, plus all capital costs associated with new services except for Westside Light Rail construction costs.

(5) The cumulative sum of system capital and operating costs and revenues between FY1989 and 2005.

Source: Tri-Met, 1990.

7.1.4 Proposed Additional Revenues

This section discusses additional revenues identified to meet Project Capital and System revenue shortfalls.

Table 7.1-7

SYSTEM FISCAL FEASIBILITY TEST:
BEGINNING WORKING CAPITAL FY1989 THROUGH FY2005
WITH EXISTING REVENUES
($000s of Year of Expenditure)

	TSM		Southside to 185th		Tunnel with Zoo Station		Tunnel without Zoo Station		Northside to Murray		Northside to Sunset TC	
	Beginning Working Capital	Months of Operating Expense	Beginning Working Capital	Months of Operating Expense	Beginning Working Capital	Months of Operating Expense	Beginning Working Capital	Months of Operating Expense	Beginning Working Capital	Months of Operating Expense	Beginning Working Capital	Months of Operating Expense
1989	22,571	3.2	22,571	3.2	22,571	3.2	22,571	3.2	22,571	3.2	22,571	3.2
1990	30,956	3.9	30,956	3.9	30,956	3.9	30,956	3.9	30,956	3.9	30,956	3.9
1991	37,576	4.4	37,576	4.4	37,576	4.4	37,576	4.4	37,576	4.4	37,576	4.4
1992	35,547	4.0	35,547	4.0	35,547	4.0	35,547	4.0	35,547	4.0	35,547	4.0
1993	44,184	4.7	44,184	4.7	44,184	4.7	44,184	4.7	44,184	4.7	44,184	4.7
1994	54,487	5.2	54,487	5.2	54,487	5.2	54,487	5.2	54,487	5.2	54,487	5.2
1995	59,744	5.3	59,744	5.3	59,744	5.3	59,744	5.3	59,744	5.3	59,744	5.3
1996	63,768	5.4	56,768	4.8	56,768	4.8	56,768	4.8	56,768	4.8	56,768	4.8
1997	69,907	5.6	62,361	5.0	62,361	5.0	62,361	5.0	62,361	5.0	62,361	5.0
1998	76,472	5.2	68,338	4.9	68,338	4.9	68,338	4.9	68,338	4.9	68,338	5.0
1999	68,263	4.6	68,312	4.6	68,312	4.6	68,421	4.7	68,780	4.7	70,352	4.9
2000	63,732	4.0	66,969	4.3	66,941	4.3	67,174	4.3	67,847	4.4	71,004	4.6
2001	57,047	3.4	64,662	3.9	64,576	3.9	64,951	3.9	65,920	4.0	70,748	4.4
2002	48,383	2.7	61,290	3.5	61,105	3.5	61,642	3.5	62,886	3.6	69,466	4.0
2003	37,637	2.0	56,810	3.0	56,484	3.0	57,204	3.1	58,697	3.2	67,114	3.7
2004	24,050	1.2	50,977	2.6	50,454	2.5	51,382	2.6	53,137	2.7	63,408	3.2
2005	8,476	0.4	43,727	2.1	42,948	2.0	44,109	2.1	46,086	2.2	58,274	2.8

Note: Two months of operating expense is adequate.

Source: Tri-Met, 1990.

7.1.4.1 Proposed Additional Transit Project Capital Revenues

Both the TSM and LRT Alternatives require currently unavailable capital revenues. The following have been identified as potential sources of additional capital revenues:

UMTA Section 3 Grants: UMTA Section 3 Grants are discretionary grants available for bus capital improvements, new fixed-guideway transit systems, and extensions to older fixed-guideway transit systems. The baseline funding scenario assumes that an UMTA Discretionary Section 3 Grant would provide 50% of the capital cost of the TSM Alternative's transit elements. The current Surface Transportation Act (STA), the authorization for federal transportation grants, allows federal grants to cover up to 75% of the capital cost of a transit project. The 50% federal share assumption used in this analysis presumes that, when Congress reauthorizes the UMTA program for federal FY 1992 (starting October 1991) and for subsequent years, it will allow a maximum federal share of 50% and that level will continue to the year 2005. Currently, it appears that the upcoming STA may authorize a slightly higher maximum federal share for bus projects, possibly 60%. In short, the maximum federal share in subsequent STAs is uncertain. At a flat 50%, the total federal grant would be approximately $55 million in Year of Expenditure dollars. These revenues are in excess of the already committed capital revenues, which are accounted for in the System analysis.

The baseline funding scenarios assume that an UMTA Section 3 New Start Grant will provide 75% of the cost of the LRT Alternative. This assumption is based on the congressional guidance in Conference Report 101-892 of the FY 1991 Transportation and Related Agencies Appropriations Bill which calls for 75% federal funding. Under this assumption, the federal grant, viewed in Year of Expenditure dollars, would be approximately $472 to $527 million for the LRT options to S.W. 185th Avenue. The assumed federal grant for the shorter LRT options would be in the $273 to $419 million range.

Recent Section 3 "New Start" funding has been at a level of about $400 million per year nationwide. More than 20 fixed guideway transit projects are in different stages of alternatives analysis and preliminary engineering, and could be competing for this limited source of funding. The current authorization for the Section 3 program expires in 1991, and the availability of Section 3 funds for any Westside alternative depends on reauthorization of the program. The features of the new UMTA authorizations, including the size of the discretionary program and the required local share, are not known at this time. Discussion of the sensitivity of the project's feasibility to the availability of federal funds is provided in Section 7.1.5.3.

Battery and Tire Fee: This revenue option is identified to fund the local share of the TSM Alternative. Under this scenario, a Battery and Tire Fee, or an equivalent source, would be proposed to the Legislature in either 1991 or 1993. The proposed Battery and Tire Fee would impose a $2 fee on new tires and a $3 fee on new automobile batteries, the proceeds going into a State Transit Capital Fund. Estimates are that the fund would collect more than $11 million ($1990) per biennium. Oregon Department of Transportation estimates that Tri-Met would receive, on average, 60% of the overall funds. In total, between 1993 and 2005, the State Transit Capital Fund would produce $56 million for Tri-Met -- sufficient revenue to meet the 50% local matching ratio for the TSM Alternative.

State Light Rail Construction Fund: This revenue source is anticipated to pay for one-eighth of the LRT Alternative Project Capital costs. The State Light Rail Construction Fund was established by the Legislature in 1989, although revenue was not appropriated. Its statute provides for the irrevocable commitment of revenue in the State Fund to a specific light rail construction project by the Director of the Oregon Department of Transportation. The ODOT Director has the authority to commit revenue in the Fund to a project to cover: (a) project costs on a cash basis, (b) debt service in the form of revenue bonds, certificates of participation, or any other form of indebtedness by the State or Tri-Met, or (c) a combination of cash and debt service requirements.

The Governor has submitted a bill (HB 2128) to the 1991 Legislative Assembly which appropriates $10 million per year to the State Light Rail Construction Fund. These revenues would be restricted to the Westside Corridor Project and would continue until such time as they were not required. The $10 million appropriation would come from the State's share of State Cigarette Tax proceeds. The

Governor's bill would appropriate the $10 million to the Light Rail Construction Fund each year before cigarette tax proceeds are appropriated to the State General Fund. This order of appropriations is important because it allows the full $10 million to be used for debt service without the need to reserve a portion of the funds for a contingency (so called "coverage") in case tax revenues are less than anticipated.

The baseline financing scenario assumes that the proceeds in the State Light Rail Construction Fund would be committed to Tri-Met to pay debt service on Tri-Met issued Certificates of Participation.

Local Government Contributions: The "Regional Compact" provision regarding funding to be provided to a light rail project, if selected, by local governments was previously explained in Section 7.1.2.1. Of the $21 million total, $7 million has been formally committed. Additional formal commitments that are required include: (a) $7 million from the City of Portland, (b) $5 million from Washington County, and (c) $2 million from Metro.

Formal action committing these funds to the project, subject to the preferred alternative decision, is anticipated by the governing bodies of these jurisdictions in the spring of 1991.

7.1.4.2 Proposed Additional Transit System Revenues

A System revenue shortfall is projected for the TSM Alternative by 2005. The deficit is of a magnitude that might be met by standard management techniques such as adjusting fares or the rate of service increase. Table 7.1-8 shows the sensitivity of System cash flow to prototypical management measures. A 5% fare increase in one year can produce almost $13 million more working capital in 2005. Delaying customary service expansion by just one year produces almost $4 million more working capital in 2005. Management activities to constrain the growth of operating cost escalation by two-tenths of one percentage point per year (5.4% instead of 5.6%) would produce about $33 million more working capital in 2005.

It is possible that management measures alone would not be sufficient and additional revenues would be required. If this is the case, it is noteworthy that regional policy seeks transit expansion in other corridors subsequent to the implementation of the Westside Corridor Project. Accordingly, if a new revenue source is sought to implement the TSM Alternative, it probably would be sized to provide for some additional service expansion. Tri-Met has determined that a new revenue source of at least $3.5 million ($1990) per year would be appropriate. For the TSM Alternative, the Battery and Tire Fee is proposed for capital match and, therefore, is not available for ongoing System expenses. Accordingly, an additional, yet to be identified, revenue source would be required. Additional System revenues are not required for the LRT Alternative presented in this SDEIS. However, regional policy is to seek additional revenues as necessary for transit expansion subsequent to the Westside Corridor Project.

7.1.4.3 Additional Highway Construction Revenues

ODOT programs its highway funding every two years through an updated State Six-Year Highway Improvement Program. Each program update (a) amends financial commitments to existing projects to account for more detailed engineering estimates and (b) makes financial commitments to new projects. As explained in Section 7.1.2.3, ODOT has programmed approximately $41.5 million in the 1991-1996 Six-Year Program for the highway projects associated with the Westside Corridor alternatives. This Program was based on engineering work-in-progress at the time, and did not account for right-of-way nor year-of-construction inflation. In total, ODOT must program about $83.7 million in additional revenue from Federal Aid Primary Funds or its successor federal formula grant program, or State Highway Funds in its 1992-1998 program update. Approximately $59.7 million of this total is required for the Highway 217 widening and interchange improvements, which are scheduled for FY 1997 and, therefore, not accounted for in the 1991-1996 program. The remaining $24 million is required to account for right-of-way and inflation costs on projects already programmed. The programming of new or additional highway funds requires Oregon Transportation Commission approval.

Table 7.1-8

IMPACTS OF PROTOTYPICAL MANAGEMENT MEASURES (1)
ON
SYSTEM FISCAL FEASIBILITY

Year	Baseline Scenario Fare Increase = 2.5%/YR Service Increase = 1.0%/YR Beginning Working Capital	Months of Operating Expense	Scenario 1 Add 5% to the Fare Increase in FY92 Beginning Working Capital	Months of Operating Expense	Scenario 2 No Service Increase in FY93 Beginning Working Capital	Months of Operating Expense	Scenario 3 Inflation of Operating Cost Reduced 0.2% (2) Beginning 1995 Beginning Working Capital	Months of Operating Expense
1989	22,571	3.2	22,571	3.2	22,571	3.2	22,571	3.2
1990	30,956	3.9	30,956	3.9	30,956	3.9	30,956	3.9
1991	37,576	4.4	37,576	4.4	37,576	4.4	37,576	4.4
1992	35,547	4.0	35,547	4.0	35,547	4.0	35,547	4.0
1993	44,184	4.7	45,081	4.8	44,184	4.8	44,184	4.8
1994	54,487	5.2	55,902	5.4	55,756	5.4	54,487	5.2
1995	59,744	5.3	61,774	5.5	61,558	5.5	59,744	5.3
1996	56,768	4.8	59,461	5.1	58,724	5.0	57,104	4.9
1997	62,361	5.0	65,783	5.3	64,469	5.2	63,434	5.2
1998	68,338	4.9	72,571	5.4	70,611	5.3	70,622	5.3
1999	68,312	4.6	73,447	5.2	70,762	5.0	72,371	5.2
2000	66,969	4.3	73,102	4.9	69,610	4.6	73,461	5.0
2001	64,662	3.9	71,901	4.5	67,509	4.2	74,352	4.7
2002	61,290	3.5	69,751	4.1	64,359	3.8	75,061	4.5
2003	56,810	3.0	66,620	3.7	60,119	3.4	75,680	4.3
2004	50,977	2.6	62,273	3.3	54,544	2.9	76,109	4.1
2005	43,727	2.1	56,661	2.8	47,572	2.4	76,454	3.9

Note: (1) Example shown is Surface LRT to S.W. 185th, the difference between the Baseline Scenarios and Management Measure scenarios is similar for all options.
(2) FY96 and beyond operating cost increases at 5.4% rather than 5.6% due to cost containment measures.

Source: Tri-Met, 1990.

7.1.5 Financial Feasibility Analysis and Conclusions

A 16-year cash flow analysis was prepared, in which transit revenues by source and transit expenditures by line item where projected on a year-by year basis using the economic assumptions described in Section 7.1. The analysis focused on whether or not the project options are fiscally feasible, using the feasibility standards identified in Section 7.1.3. The detailed results of the analysis are provided in the Updated Financial Analysis Results Report dated November 1990, which contains cash-flow tables for each option. Summary results are provided in Sections 7.1.5.1 through 7.1.5.3

7.1.5.1 Project Capital Feasibility Analysis and Conclusion

Lines "I" through "L" on Table 7.1-5 show a detailed project capital cash flow for the Surface LRT option to S.W. 185th Avenue. This table shows Project Capital costs and revenues on a year-by-year basis. A similar analysis was prepared for each of the LRT options.

Table 7.1-9 shows, for the TSM Alternative and nine representative light rail options, available and possible new Project Capital revenues and project costs in Year of Expenditure dollars. Note that interest earnings were constrained to meet all federal arbitrate and hedge bond laws.

Assuming 75% federal funding for the LRT Alternative and 50% for the TSM Alternative, Tri-Met is capable of providing sufficient capital revenues to meet capital cost and CAPRA requirements of all the project alternatives. Even under that circumstance, the CAPRA provided is greater than the minimum standard and, thus, provides an extra margin of contingency. Nonetheless, under the current Regional Compact, none of the LRT options would be financially feasible if federal funding were limited to 50%. The ability to meet unanticipated capital financing contingencies is discussed in Section 7.1.5.3.

7.1.5.2 System Fiscal Feasibility Analysis and Conclusions

Previously, in Section 7.1.3.2, it was shown that the LRT Alternative met the System fiscal feasibility test using only available resources. While the TSM Alternative did not meet the "Working Capital" requirement, it was shown in Section 7.1.4.2 that the deficit might be met through customary management measures such as adjusting fares or the rate of service increases. It is possible, however, that a new revenue source would be required.

Table 7.1-10 illustrates the System fiscal feasibility test for the alternatives with a new $3.5 million per year ($1990) source of operating revenue. This table shows that, under this scenario, TSM operating results would meet minimum working capital standards of two months each year between now and FY 2005. Table 7.1-10 also shows that, for the LRT Alternative, this financial scenario, while not needed to meet the feasibility test, would accommodate the Westside Project and other major service expansion well into the future.

7.1.5.3 Risks and Uncertainties

The fundamental risk associated with the funding concepts is the possibility that the new revenue sources would not be approved or not authorized at the levels assumed. Federal funds must be committed through a Full Funding Agreement before the funds are actually assured. In the interim, Conference Report 101-892 of the FY91 Appropriations Bill established a Congressional directive that 75% federal funding be provided.

State funding is not yet committed. While the state Legislature expressed its intent to financially participate in the Westside Project when it established the State Light Rail Construction Fund in 1989, it still must appropriate revenue to the fund during the 1991 legislative session.

If the combined total of federal grant and state appropriation is not at least equal to the total of the federal and state budget levels shown in Table 7.1-9 minus the CAPRA, then the project alternatives would not be feasible under the current plan. However, the Regional Compact provides for emergency transference of regional bond funds reserved for other projects to the Westside Corridor Project. This

Table 7.1-9

SUMMARY OF CAPITAL COST
FINANCIAL PLANS
($000s of Year of Expenditure)

	TSM	Southside Surface to 185th	Northside Short Tunnel South BN to 185th	Long Tunnel with Zoo to 185th	Long Tunnel without Zoo to 185th	Northside Short Tunnel North BN to 185th	Northside Short Tunnel South Henry to 185th	Northside Short Tunnel North Henry to 185th	Northside Short Tunnel to Murray	Northside Short Tunnel to Sunset TC
Project Costs	$109,894	$638,098	$631,509	$703,162	$667,565	$629,120	$646,387	$642,537	$559,105	$364,360
Project Resources (1)										
Federal Revenues (U)	$54,947	$478,574	$473,632	$527,371	$500,673	$471,840	$484,790	$481,903	$419,328	$273,270
State Bond Proceeds (U)	$0	$71,880	$71,137	$79,433	$75,111	$70,831	$72,777	$72,338	$62,956	$40,779
Interest Income From State Bonds (U)	$0	$7,882	$7,801	$8,463	$8,336	$7,813	$8,021	$7,982	$6,931	$4,769
Regional Bond Proceeds (A)	$0	$53,592	$52,796	$61,159	$56,977	$52,489	$54,672	$54,175	$44,670	$20,527
Local Government Contribution (U/A)	$0	$21,000	$21,000	$21,000	$21,000	$21,000	$21,000	$21,000	$21,000	$21,000
State Transit Capital Fund (U)	$54,947	$0	$0	$0	$0	$0	$0	$0	$0	$0
Interest Income From Regional Bonds (A)	$0	$5,171	$5,147	$5,739	$5,473	$5,157	$5,129	$5,151	$4,221	$4,029
Total Resources	$109,894	$638,099	$631,513	$703,165	$667,570	$629,130	$646,389	$642,549	$559,106	$364,374
CAPRA (2)	$1,578	$26,408	$27,204	$18,841	$23,023	$27,551	$25,328	$25,825	$26,279(3)	$26,079(4)

Note: (1) Resources will slightly exceed project costs due to interest earnings.

(2) CAPRA is the unused bond authority minus $45 million for the Hillsboro Project and East Portland/Clackamas County Project. These funds could be used for the Westside Corridor Project on an emergency basis.

(3) An additional $9.1 million in unused bond capacity is reserved for the Hillsboro Project to accommodate the segment between S.W. Murray and S.W. 185th.

(4) An additional $33.4 million in unused bond capacity is reserved for the Hillsboro Project to accommodate the segment between the Sunset Transit Center and S.W. 185th Avenue.

(U) Currently unavailable resource. $7,000,000 of local government contributions (Tri-Met portion) are officially available.

(A) Currently available resources.

Source: Tri-Met, 1990.

Table 7.1-10

SYSTEM FISCAL FEASIBILITY TEST:
BEGINNING WORKING CAPITAL FY1989 THROUGH FY2005 WITH
A NEW $3.5 MILLION PER YEAR REVENUE SOURCE
($000s of Year of Expenditure)

	TSM		Southside to 185th		Tunnel with Zoo Station		Tunnel without Zoo Station		Northside to Murray		Northside to Sunset TC	
	Beginning Working Capital	Months of Operating Expense	Beginning Working Capital	Months of Operating Expense	Beginning Working Capital	Months of Operating Expense	Beginning Working Capital	Months of Operating Expense	Beginning Working Capital	Months of Operating Expense	Beginning Working Capital	Months of Operating Expense
1989	22,571	3.2	22,571	3.2	22,571	3.2	22,571	3.2	22,571	3.2	22,571	3.2
1990	30,956	3.9	30,956	3.9	30,956	3.9	30,956	3.9	30,956	3.9	30,956	3.9
1991	37,576	4.4	37,576	4.4	37,576	4.4	37,576	4.4	37,576	4.4	37,576	4.4
1992	35,547	4.0	35,547	4.0	35,547	4.0	35,547	4.0	35,547	4.0	35,547	4.0
1993	44,184	4.7	44,184	4.7	44,184	4.7	44,184	4.7	44,184	4.7	44,184	4.7
1994	58,250	5.6	58,250	5.6	58,250	5.6	58,250	5.6	58,250	5.6	58,250	5.6
1995	67,637	6.0	67,637	6.0	67,637	6.0	67,637	6.0	67,637	6.0	67,637	6.0
1996	76,190	6.5	69,190	5.9	69,190	5.9	69,190	5.9	69,190	5.9	69,190	5.9
1997	87,287	7.0	79,741	6.4	79,741	6.4	79,741	6.4	79,741	6.4	79,741	6.4
1998	99,274	7.0	91,140	6.8	91,140	6.8	91,140	6.8	91,140	6.8	91,140	6.9
1999	96,991	6.7	97,039	6.8	97,039	6.8	97,148	6.8	97,507	6.9	99,079	7.0
2000	98,929	6.4	102,165	6.8	102,138	6.8	102,371	6.8	103,043	6.9	106,201	7.1
2001	99,301	6.1	106,916	6.7	106,829	6.7	107,205	6.7	108,173	6.8	113,001	7.1
2002	98,328	5.7	111,234	6.6	111,049	6.6	111,586	6.6	112,831	6.7	119,411	7.1
2003	95,959	5.2	115,133	6.4	114,806	6.4	115,527	6.5	117,019	6.5	125,436	7.1
2004	91,491	4.7	118,418	6.2	117,896	6.2	118,823	6.3	120,578	6.4	130,849	6.9
2005	85,837	4.2	121,088	6.0	120,309	6.0	121,470	6.0	123,447	6.1	135,635	6.8

Note: Two months of operating expense is adequate.

Source: Tri-Met, 1990.

could provide additional contingency, on top of the CAPRA, to cover even greater capital shortfalls if the necessity arose.

A second uncertainty associated with the analysis is the possibility that the capital costs or capital cost inflation is underestimated. Because (a) the capital cost estimates are based on Tri-Met's recent MAX construction experience, (b) the engineering specifications are well defined, and (c) engineering design and capital costs are based on conservative assumptions, the likelihood of a significant engineering miscalculation is less on the Westside Corridor Project than other similar projects. The projection of capital cost inflation rates is much more vulnerable to miscalculation.

The capital reserves and other contingencies built into the Project Capital financing plan can accommodate a significant range of underestimated costs or overestimated revenues. It is noteworthy that each of the light rail funding scenarios include CAPRA at a level considerably above the minimum standard. The emergency provision in the Regional Compact, explained above, provides additional insurance against shortfalls. Additional leveraging of the State Fund beyond that assumed in the base scenario is also possible by extending the term. In total, there are several contingencies that can be used in various combinations to avoid using working capital planned for System costs on the Project Capital costs. Thus, Project Capital deficits do not pose great risk to out-year System resources.

Even if federal funds are authorized at the assumed levels, timing may be uncertain. As a result, federal revenues may be insufficient to meet Project Capital costs in certain years. Local cost increases caused by delayed federal funding could be met by (a) the CAPRA, (b) emergency transfers of bond proceeds under the provisions of the Regional Compact, and (c) amending the use of the State Fund.

In addition to Project Capital uncertainties, there are uncertainties inherent in the System analysis. One such uncertainty is the possibility of weak regional growth and concurrent high inflation in transit labor costs. If inflation on transit operating costs were to outstrip increases in the Payroll Tax proceeds over the long term, none of the options would be fiscally feasible. This scenario is unlikely. While operating inflation may be greater than revenue increases for a period of time, the public and Tri-Met management would demand tighter budget controls if that were to continuously occur. Short-term System deficits caused by economic conditions of this nature could be managed through: (a) an additional fare increase, (b) an adjustment to the rate of customary service expansion, (c) other operating cost containment measures, or (d) enactment of an additional revenue source. The impacts of these measures was previously shown in Tables 7.1-8 and 7.1-10.

7.1.6 Implementation

The detailed Financing Plan for the preferred alternative will be adopted after this SDEIS is circulated and the local decision is made. Implementation of the financing plan will depend on the ability of Tri-Met and ODOT to successfully accomplish the following:

(a) If light rail is the preferred alternative, secure approval of the state cigarette tax or an equivalent revenue stream to fund the State Light Rail Construction Fund. Legislative approval must occur in 1991 if the implementation schedule is to be met.

(b) Execute Intergovernmental Agreements with local jurisdictions to transfer their committed funds into a Tri-Met project account.

c) Execute Tri-Met/ODOT Intergovernmental Agreement regarding the commitment of revenue from the State Light Rail Construction Fund.

(d) Execute a Full Funding Agreement with UMTA including a 75% Federal share.

(e) If the TSM Alternative is selected, secure approval of a continuous state source of transit capital revenue to fund vehicle replacement and customary expansion. The Battery and

Tire Tax or some equivalent would be needed by 1993. While desirable in 1993, such a revenue stream would not be required by the LRT Alternative.

(f) Program additional highway funds through Oregon Transportation Commission approval.

7.2 EVALUATION OF ALTERNATIVES

This section presents the effectiveness, cost-effectiveness, equity, and major trade-off evaluations of the alternatives under consideration for the Westside corridor. It draws on the background data and analysis of the previous six chapters.

7.2.1 Evaluation Methodology

"Effectiveness" is broadly measured on the basis of an alternative's ability to meet transportation, economic, and environmental objectives. Objectives for the Westside Corridor Project and associated evaluation measures are defined and applied in the effectiveness evaluation provided in Section 7.2.2.

The cost-effectiveness analysis compares the benefits of each alternative with the costs required to achieve these benefits. UMTA has established a quantitative cost-effectiveness measure in which the incremental benefits of fixed guideway alternatives (relative to the TSM Alternative) are compared with the incremental capital and operating costs. For the purposes of this measure, benefits are measured in terms of new riders and travel-time savings for existing riders. A definition of this measure and results of the analysis for several LRT options are provided in Section 7.2.3.1. The cost-effectiveness evaluation provides a series of locally identified operating cost-effectiveness indices in Section 7.2.3.2.

Section 7.2.4 evaluates the social equity associated with project alternatives. Three aspects of equity are assessed: (a) user benefits to low-income areas, (b) impacts on disadvantaged business enterprises, and (c) the relationship between who pays the costs and who receives the benefits.

The major modal and alignment choices are specified in Section 7.2.5. Therein, the significant trade-offs identified in the fiscal, effectiveness, cost-effectiveness, and equity assessments are described in a manner that cuts across the major decision choices.

7.2.2 Effectiveness In Meeting Local Goals and Objectives

This section reiterates the major objectives of the Westside Corridor Project as presented in Chapter 1, defines the specific measures of effectiveness in meeting these objectives, and evaluates the alternatives on the basis of the measures of effectiveness.

7.2.2.1 Goal Attainment: Measures of Effectiveness

The Westside Corridor Project Management Group, consisting of top transportation officials from each of the participating jurisdictions, established an overall goal for the project:

> "To build a transit and highway project designed to optimize the transportation system, be environmentally sensitive reflecting community values, while remaining fiscally responsive."

Based on this goal, as well as the transportation needs and policies identified in Chapter 1, five general objectives have been identified to evaluate the effectiveness of the Westside Corridor Project alternatives. Specific measures have also been defined for each of the objectives. Table 7.2-1 exhibits the objectives and their specific measures as used in this evaluation.

Table 7.2-1

MEASURES OF EFFECTIVENESS

Maintain a Balanced Road System	
Highway congestion	-miles of congested highway -miles of congested arterials -vehicles hours of delay
Sunset Highway Service	-volume to capacity ratio -level of service
Provide Transit Service that is a Reasonable Alternative to the Automobile	
Service Coverage	-% of population within 1/4 mile -% of employment within 1/4 mile
Reliability	-% of passenger miles on exclusive ROW -% of protected intersections -P.M. peak hour volume on transit Mall
Travel Times	-P.M. peak hour transit and auto travel times for selected trips
Corridor Ridership	-total transit trips -added transit trips
Meet Demands of Regional Growth with Transit	
Corridor Capacity	-place miles
Demand Requirement	-% new corridor trips on transit -% new radial trips on transit -P.M. peak hour transit ridership at peak-demand cutline
Provide Transportation Needed to Support Planned Development within the Urban Growth Boundary	
Impact on Downtown Portland minutes by transit and auto	-total number of corridor residents within 30/45 -total transit trips to CBD (work, non-work) -reduced downtown parking requirements
(commuter, short term)	
Impact on Central Beaverton	-work trips attracted to Beaverton
Impact on Sunset Corridor	-reverse commute travel times -work trips attracted to Sunset Corridor
Impact on Urban Growth Boundary	-qualitative
Provide an Environmentally Sensitive Transportation System	
Displacement	-residential units displaced -business units displaced
Noise	-number of impacted receptors
Aesthetics	-acres of removed vegetation -square feet of retaining wall
Wetlands/Parks	-acres of impacted wetlands -number of impacted parks
Historic/Cultural	-number of impacted sites

Source: Tri-Met, 1990.

7.2.2.2 Maintain a Balanced Road System

The relative effectiveness of the alternatives in providing a balanced highway system, one without stop-and-go traffic and unnecessary delay, is measured in terms of (a) miles of highway/arterial congestion and (b) hours of vehicle delay. In addition, the specific impacts of the project alternatives on the performance of the Sunset Highway is evaluated in terms of (a) volume-to-capacity ratios and (b) levels-of-service.

Highway Congestion

Table 7.2-2 illustrates the impact of the options on traffic congestion in the Westside Corridor. A highway or arterial is considered congested when it exhibits a level-of-service E (volume/capacity ratio is greater than 0.9) or worse. As shown, the TSM and LRT Alternatives would reduce the miles of peak period congestion on highways by almost seven miles (40%), compared with the No Build Alternative. Miles of arterial congestion exhibit almost a 30% reduction (21 miles) for the LRT Alternative and 25% (18 miles) for the TSM Alternative.

Vehicle hours of delay, shown in Table 7.2-2, provide another measure of highway performance. The LRT options to S.W. 185th Avenue provide more than a 25% reduction in delay in comparison to the No Build Alternative. The TSM Alternative is projected to result in 3% more vehicle delay than these LRT options.

Sunset Highway Service

The forecasted volume-to-capacity (V/C) ratios, and levels-of-Service (LOS) for the Sunset Highway are provided in Table 7.2-3 for the P.M. peak hour in the outbound direction. With the No Build Alternative, traffic congestion on all segments of Sunset Highway is expected to worsen in comparison with today. The Sunset Highway is projected to operate at a LOS F in all locations except just east of the Zoo, where traffic demands are forecasted at 97% of roadway capacity. Increased P.M. peak hour traffic demands and V/C ratios would cause drivers to seek alternative routes and lengthen the peak period during which congestion occurs.

Sunset Highway traffic operations would be similar for the TSM and LRT Alternatives. Highway capacity improvements west of the Zoo would make Sunset Highway more attractive under both alternatives. Thus demand between the S.W. Jefferson Street on-ramp and the Zoo would increase, compared with the No Build Alternative, resulting in a somewhat worse level of service in this segment. Under both alternatives, Sunset Highway congestion would improve slightly, to LOS E between the Zoo and Sylvan. Under both alternatives, conditions on the Sunset Highway segment west of Sylvan would improve to LOS E as compared with the No Build Alternative.

Table 7.2-2

HIGHWAY SYSTEM PERFORMANCE
Year 2005 Service Levels

	No Build	TSM	Surface to 185th	Tunnel w Zoo to 185th	Tunnel w/o Zoo to 185th	Surface to Murray	Surface to Sunset TC
Annual Vehicle Hours of Delay (4)	3,870,000	2,970,000	2,880,000	(1)	(1)	(3)	(2)
Freeway Miles with V/C > 0.9	18.0	11.0	11.0	(1)	(1)	(1)	(1)
Arterial Miles with V/C > 0.9	75.9	57.3	54.3	(1)	(1)	(3)	(2)

Notes: (1) Not specifically computed but would be virtually identical with the Surface LRT options to SW 185th Avenue.
(2) Not specifically computed but would be virtually identical with the TSM.
(3) Not specifically computed but would be mid-way between the SW 185th options and TSM.
(4) Assumes 3.6 peak hours per day and an annualization factor of 255.

Source: Metro, 1990.

Table 7.2-3

SUNSET HIGHWAY TRAFFIC PERFORMANCE
P.M. Peak Hour Outbound, Year 2005

Section of Sunset Highway	Characteristic	Existing (Year 1987)	No Build	TSM	LRT (1)
Vista Tunnels	V/C	1.00	1.13	1.05	1.05
	LOS	E/F	F	F	F
Jefferson on Ramp to Zoo	V/C	0.86	0.98	1.04	1.04
	LOS	E	E	F	F
Zoo to Sylvan	V/C	1.06	1.22	0.95	0.95
	LOS	F	F	E	E
Sylvan to Canyon	V/C	>1.0	>1.0	0.87	0.87
	LOS	F	F	E	E
Canyon to Highway 217	V/C	1.09	1.11	1.00	1.00
	LOS	F	F	E	E

Abbreviations: ">" means greater than;
"<" means less than;
"LOS"means "Level of Service";
"V/C" means "Ratio of Volume to Capacity".

Note: (1) Surface options to S.W. 185th. Other LRT options would show similar characteristics.

Source: Metro, 1990, and HNTB, 1990.

7.2.2.3 Provide Transit Service that is a Reasonable Alternative to the Automobile

The automobile provides the quality of service by which most people judge other transportation options. If transit is to be effective in reducing the region's reliance on the automobile, it must offer a competitive quality of service.

An automobile is usually within easy walking distance to a trip end (origin or destination). Transit may or may not be within reasonable walking distance. Thus the relative competitiveness of transit options to the automobile can be judged, in part, by walk access to residences and job locations. The automobile usually avoids the inconvenience of scheduling arrival or departure times, with reliability being determined by the level of congestion encountered on the road system. Traffic congestion has a compounding impact on transit reliability. Not only are in-vehicle travel times extended, but schedules are disrupted, excessive wait times are possible, and transfers may be missed. These effects can be mitigated by the use of transit priority measures such as reserved right-of-way (ROW) or gated intersection crossings. Thus, the relative competitiveness of transit options to the automobile can be judged, in part, by the relative use of transit priority measures.

The ability of transit options to provide travel times that are competitive with auto travel times is a major determinant of their effectiveness. In addition, because they account for many of these factors, transit ridership projections can be used as overall indicators of the relative competitiveness of transit options compared with the automobile. Accordingly, the relative effectiveness of the alternatives in providing high-quality, attractive transit service that is a reasonable alternative to the automobile is evaluated on the basis of (a) service coverage, (b) travel time savings, (c) corridor ridership, and (d) reliability .

Service Coverage

Service coverage is measured by the percent of corridor population and employment within a quarter-mile of a transit station or stop. Table 7.2-4 shows the TSM and LRT Alternatives exhibit significantly better service coverage than the No Build Alternative. About 40% more of the corridor's population is within a quarter mile of a transit stop with the TSM and LRT Alternatives as compared with the No Build Alternative. The TSM and LRT Alternatives also provide transit within a quarter-mile to about 80% more corridor employment than the No Build Alternative.

Travel Times

Table 7.2-4 shows P.M. peak hour total weighted travel times from downtown to major destinations in Washington County by auto and transit. Total weighted travel time is a measure that weights (i.e., multiplies by 2.1 times) the out-of-vehicle (access time, wait time, transfer time) component of total travel time to account for its greater onerousness to the average rider. Accordingly, weighted travel time is a measure of how long a trip feels, rather than the actual time a trip takes.

The TSM and LRT Alternatives, because of their common highway improvements, both would result in total peak-hour auto travel times between downtown Portland and major corridor destinations that are 2 to 4 minutes faster than the No Build Alternative. The impact of the alternatives on transit travel times is greater, as are the differences between alternatives. Total weighted, peak-hour transit travel times for the TSM Alternative would be one to 10 minutes (1% to 21%) faster between downtown Portland and major corridor destinations than the No Build Alternative except for trips to S.W. 185th Avenue and T.V. Highway, for which the TSM Alternative is seven minutes (10%) slower because it requires an extra transfer. The LRT Surface option to S.W. 185th Avenue provides between 16 and 29 minutes faster weighted travel times to Westside Corridor destinations than the No Build Alternative and 9 and 26 minutes faster weighted travel times than the TSM Alternative. The Tunnel LRT options to S.W. 185th Avenue are slightly (one to three minutes) faster than the Surface options. The shorter terminus LRT options result in longer times than the LRT options to S.W. 185th Avenue for destinations west of their termini. For the S.W. Murray Boulevard terminus option, weighted times for major destinations west of S.W. Murray Boulevard would be 5 to 16 minutes slower. For the Sunset Transit Center terminus option, weighted travel times for major destinations west of Highway 217 would be 1 to 24 minutes slower.

Corridor Transit Ridership

Transit ridership refers to the number of linked trips (transfers not counted) on the transit routes within the Westside Corridor. This measure of effectiveness is important because the major objective of improving the transit system is to increase the number of people using transit and decrease the number using individually-driven automobiles. A higher ridership indicates that transit is more attractive in relation to the automobile. Increased transit ridership is also a good indication of other potential benefits, such as reduced energy consumption, enhanced air quality, and support for community development programs.

Table 7.2-5 shows the projected Westside Corridor transit ridership for 2005. The TSM Alternative would attract 5,400 (20%) more daily riders in 2005 than the No Build Alternative. Year 2005 daily corridor ridership for the LRT Surface options to S.W. 185th Avenue would be 10,000 (36%) more than the No Build Alternative and 4,600 (14%) more than the TSM Alternative. The Tunnel options would attract the same total ridership (bus and light rail) as the Surface options. The LRT options to S.W. Murray Boulevard would attract about 10% less ridership than the longer LRT options. The Sunset Transit Center terminus option exhibits the lowest ridership among the "build" alternatives, and is even less effective than the TSM Alternative.

Table 7.2-4

WESTSIDE TRANSPORTATION SERVICE CRITERIA
Year 2005 Service Levels

	No Build	TSM	Surface to 185th	Tunnel w Zoo to 185th	Tunnel w/o Zoo to 185th	Surface to Murray	Surface to Sunset TC
Percent within 1/4 mile of Transit(1)							
Corridor Population	43%	60%	63%	63%	63%	63%	60%
Corridor Employment	46%	82%	83%	83%	83%	83%	82%
Miles of Reserved or Separated ROW	0.7	0.8	11.8	11.5	11.4	9.5	5.7
Percent of Corridor Passenger Miles on Reserved ROW(1)	2%	2%	65%	66%	65%	56%	39%
Percent of Intersections Preempted, Gated, or Grade Separated(1)	0%	0%	71%	70%	70%	67-69%	48-52%
PM Peak Hour Buses in Downtown Portland							
on S.W. Fifth Avenue	140	191	167	175	179	167	167
weighted on S.W. Fifth Ave.	152	233	197	206	210	197	197
PM Peak Hour Total Weighted Travel Time from CBD (minutes) to:							
Sunset Highway and Highway 217							
by Auto	25	23	23	23	23	23	23
by Transit	48	38	29	28	28	30	32
Beaverton							
by Auto	30	28	28	28	28	28	28
by Transit	60	51	33	32	32	34	46
S.W. 185th and Baseline							
by Auto	37	33	33	33	33	33	33
by Transit	69	67	48	47	47	58	57
S.W. 185th and TV Highway							
by Auto	39	36	36	36	36	36	36
by Transit	70	77	51	52	52	57	65
Hillsboro							
by Auto	49	46	46	46	46	46	46
by Transit	93	88	70	71	71	76	73
South Beaverton							
by Auto	32	30	30	30	30	30	30
by Transit	71	61	42	41	41	42	53
Rock Creek							
by Auto	37	33	33	33	33	33	33
by Transit	85	84	69	66	66	82	68

Notes. (1) Rounded to the nearest percent.

Source: Metro, 1990 and Tri-Met, 1990.

Table 7.2-5

WESTSIDE CORRIDOR TRANSIT SERVICE CRITERIA - RIDERSHIP
Average Weekday, Year 2005

	No Build	TSM	Surface to 185th	Tunnel to 185th	Surface to Murray	Surface to Sunset TC
Total Transit Trips	28,000	33,400	38,000	38,000	35,100	31,800
Total Additional Transit Trips compared to No Build	N/A	5,400	10,000	10,000	7,100	3,800

All numbers rounded to the nearest 100.

Source: Metro, 1990.

Reliability

Tri-Met has documented that light rail, because of its use of reserved or separated ROW, has historically exhibited a higher percent of on-time arrivals than buses. Table 7.2-4 shows the number of miles that transit operates on a reserved ROW for each alternative. The LRT options to S.W. 185th Avenue provide 20% more reserved ROW than the S.W. Murray Boulevard terminus option, and more than twice that offered by the Sunset Transit Center terminus option. The only reserved ROW for the TSM Alternative is the Transit Mall in downtown Portland, and its length is a fraction of the reserved ROW of the LRT options. Table 7.2-4 also shows the percent of corridor passenger miles that occur on a reserved ROW for each of the alternatives. The LRT options to S.W. 185th Avenue provide reserved ROW for about two-thirds of the corridor's passenger miles. This compares to 2% for the TSM and No Build Alternatives.

Another indication of the relative reliability of the alternatives is measured by the priority given to the transit trunk lines at intersections. Table 7.2-4 shows that 50% to 70% of all the intersections through which the light rail operates have traffic signals preempted by light rail, have gated crossings for light rail, or actually have the light rail separated from the other traffic. The bus alternatives have none. As a result, the LRT options are less likely to experience delay at intersections than the No Build or TSM Alternatives.

The downtown Portland Transit Mall was constructed to increase downtown service reliability and speeds. To date, the volume of buses on the Mall has not approached its theoretical capacity (180-200 buses per hour per direction) and, therefore, the Mall has operated reliably. Projected downtown Portland bus volumes for the future (Table 7.2-4), however, indicate the Mall will be at or over capacity for certain alternatives. The TSM bus volume equals the Mall capacity in absolute terms, and exceeds Mall capacity by 33 to 43 buses per hour when articulated buses are weighted to account for their longer length and poorer maneuverability (1 articulated bus = 1.5 standard buses). With the TSM Alternative, the time required to traverse the length of the Mall would increase by two minutes compared with the No Build Alternative. The LRT Alternative exhibits Mall volumes which, in absolute terms, are below the Mall capacity, but are at or slightly above when viewed in weighted terms. With the LRT Alternative, the time required to travel to the Mall would increase by one minute, compared with the No Build Alternative. The LRT options would be expected to operate more reliably in downtown than the TSM Alternative, if projected Mall bus volumes are realized.

7.2.2.4 Meet Demands of Regional Growth with Transit

The relative effectiveness of the alternatives in meeting the demands of projected population and employment growth with transit is measured in terms of: (a) the amount of service provided, (b) the ratio of added trips (due to growth) handled by transit, and (c) transit ridership on a cutline basis.

Amount of Service and Future Capacity

"Place Miles" is an indicator of how much travel the transit system can potentially accommodate. A "Place Mile" is defined as one seat or standing space traveling one mile. An option with the highest number of place miles provides the greatest overall amount of passenger travel capacity on a corridor basis. It does not necessarily indicate that the capacity is where it is needed to meet demand.

Table 7.2-6 shows the place miles of service provided in 2005 by each alternative. The TSM Alternative would provide 619,000 (41%) more place miles than the No Build Alternative. Year 2005 passenger carrying capacity for the Surface LRT option to S.W. 185th Avenue would be 761,000 (51%) more than the No Build Alternative and 143,000 (7%) more than the TSM Alternative. The LRT Tunnel options to the S.W. 185th Avenue and S.W. Murray Boulevard would provide slightly fewer (1 to 3%) place miles than the Surface options to S.W. 185th Avenue. The Sunset Transit Center terminus option would provide the fewest place miles among the "build" options.

Federal guidelines require that travel demand projections and analyses be performed for a design year approximately 15 years in the future. In response to this requirement, Chapter 4 and Tables 7.2-2 through 7.2-6 present the transportation impacts for a year 2005 time frame. However, an important local consideration in evaluation of alternatives is the effectiveness of the alternatives in responding to continued growth beyond 2005.

The ultimate capacity of the LRT Alternative is restricted by two-car trains to fit downtown Portland's blocks, and by the train signal system. The year 2005 LRT service levels on the Westside are based on five to six minutes headways east of Beaverton Transit Center, while the signal system is being designed to allow approximately a three-minute headway. Thus, the 2005 service levels for the LRT Alternative are roughly 50% to 60% of the ultimate capacity of the line.

Table 7.2-6

TRANSIT DEMAND CRITERIA

	No Build	TSM	Surface to 185th	Tunnel w Zoo to 185th	Tunnel w/o Zoo to 185th	Surface to Murray	Surface to Sunset TC
Total Corridor Weekday Place Miles	1,493,000	2,112,000	2,254,600	2,238,400	2,216,500	2,194,400	1,896,000
Percent of New Corridor Trips on Transit (1)	2%	3%	4%	4%	4%	4%	3%
Percent of New Corridor Trips on Transit to CBD	19%	59%	77%	80%	80%	62%	42%
Transit Demand at Peak Cutline (2)	2,945	4,060	4,548	4,413	4,315	4,180	3,372

Notes: (1)"New" trips are calculated as the difference between year 2005 levels and existing levels.
(2) PM Peak Hour, outbound direction total number of transit riders on Sunset Highway, West Burnside and Beaverton Hillsdale Highway at a cutline just east of the Zoo Interchange.

Source: Tri-Met, 1990.

New Trips Accommodated by Transit

Table 7.2-6 shows the new corridor transit trips (the difference between 2005 corridor levels and existing corridor levels) as a percent of total (highway and transit) new trips for all types of trips in the corridor. The No Build Alternative is projected to accommodate 2% of all new corridor trips. The TSM Alternative and the LRT options to Sunset Transit Center would accommodate about 3% of all new corridor trips on transit, or about one percentage point higher transit share than the No Build Alternative. The LRT options to S.W. Murray Boulevard and S.W. 185th Avenue would accommodate about 4%, or two percentage points higher than the No Build Alternative, and one percentage point greater than the TSM Alternative and LRT options to Sunset Transit Center.

Because total new corridor trips include trips for all purposes, in all directions, at all times of day, notable differences in the radial (corridor to Portland CBD) market are not evident in these results. Accordingly, Table 7.2-6 also shows the percent of new corridor trips accommodated by transit for radial trips only. The No Build Alternative would only accommodate 19% of all new trips to downtown on transit. The TSM Alternative would accommodate 59% of new radial trips, and similar results are exhibited by the LRT options to S.W. Murray Boulevard. Seventy-seven percent to 80% of new radial trips would use transit for the LRT options to S.W. 185th Avenue. In comparison, the LRT options to Sunset Transit Center would accommodate 42% of new radial trips.

Peak Cutline Ridership

Another measure of the effectiveness of the transit alternatives in meeting the demands of growth in the radial corridor is Peak Cutline transit ridership. Peak Cutline ridership is defined as the total of PM peak-hour, peak-direction (outbound) transit riders on Sunset Highway, West Burnside, and S.W. Beaverton-Hillsdale Highway at a cutline (an imaginary north-south line) just east of the Zoo interchange. The TSM Alternative would attract 1,115 (38%) more Peak Cutline riders than the No Build Alternative. Peak Cutline ridership for the LRT options to S.W. 185th Avenue would be 1,368 to 1,603 (46% to 54%) greater than the No Build and 255 to 488 (6% to 12%) greater than the TSM Alternative. The LRT options to Sunset Transit Center would attract 427 (14%) more Peak Cutline riders than the No Build Alternative, but 688 to 1,176 (17% to 26%) fewer than the other "build" options.

7.2.2.5 Provide Transportation Needed to Support Planned Development within the Urban Growth Boundary

The ability of the "build" alternatives to provide the transportation system necessary to support planned development is evaluated below in the context of four geographic areas: downtown Portland, Central Beaverton, Sunset Corridor, and the Urban Growth Boundary. Available empirical evidence does not suggest that transportation has any effect on the amount of net regional growth. Accessibility historically has not been a limiting factor to development in the Westside Corridor. However, recent experience has found the overall quality of the transportation system to be a factor to firms considering locating in the Portland region. The assumption underlying this SDEIS is that the alternatives will have no effect on the amount of development within the region and the corridor, but could have an effect on the distribution of development in the corridor.

Enhance Downtown Portland Development

Downtown Portland development is affected by many types of factors including market conditions; construction, purchase and lease costs relative to competitive sites; city policy and development procedures; and transportation access. The relative importance of these factors depends on the type of development in question and other particular circumstances. While generally transportation is not as important as market conditions and costs, downtown development potential could be affected by such factors as (a) transit and highway access to the labor pool and consumer pool in the Westside Corridor, (b) traffic and parking disincentives in downtown Portland, and (c) the number of workers and non-workers attracted to downtown Portland by transit.

The downtown Portland development market is affected by its accessibility to regional labor and consumer pools, including the Westside Corridor. Both auto and transit accessibility can be measured, as shown in Table 7.2-7, by the number of corridor residents within 30 and 45 minutes of downtown Portland by each mode.

The TSM Alternative would provide 30-minute auto access to downtown to 105,600 corridor residents, or 27,100 more than the No Build. The LRT Alternative to S.W. 185th Avenue is slightly better, providing 30-minute auto access to 38,800 (49%) more corridor residents than the No Build Alternative, and 11,700 (11%) more corridor residents than the TSM Alternative. A 45-minute auto trip is sufficient to serve all corridor residents for all alternatives, including the No Build. Accordingly, there are no differences in this measure between alternatives.

The TSM Alternative would provide 30-minute transit access to downtown to 9,500 corridor residents, or 2,400 (34%) more than the No Build. The number of corridor residents who would be provided 30-minute transit access to downtown with the LRT options to S.W. 185th Avenue is 11,100 (156%) more than the No Build Alternative and 8,700 (92%) more than the TSM Alternative. The differences are even greater for a 45-minute travel time to downtown Portland. In this time frame, the TSM Alternative would serve 52,600 corridor residents, 32,400 more than the No Build Alternative. In comparison, the LRT options to S.W. 185th Avenue would serve 104,300 (516%) more corridor residents than the No Build Alternative, and 71,900 (137%) more corridor residents than the TSM Alternative.

Downtown Portland development is shaped by many other factors. One such factor is the volume of pedestrian activity which, for purposes of this analysis, is measured by the number of people (workers and non-workers) traveling downtown. In accordance with UMTA procedures, this SDEIS assumes the same downtown trip volumes for all alternatives, although the apportionment between auto and transit differs. Accordingly, the projected total downtown trip volumes do not account for any development impact that could be caused by highway access or parking requirement differences. In Section 7.2.2.4., corridor transit ridership was used to measure the relative effectiveness of the alternatives to accommodate regional growth. In this section, downtown transit ridership is used in an analogous fashion to measure the relative ability of the alternatives to respond to auto access and parking constraints on downtown growth.

Table 7.2-7 shows the forecasted 2005 downtown transit ridership for Westside Corridor work and non-work trips for each alternative. In 2005, the TSM Alternative would attract 11,600 daily transit downtown work trips, or 3,100 (37%) more than the No Build Alternative. Year 2005 transit ridership to downtown for daily work trips would be 4,800 to 4,900 (56% to 58%) greater with the LRT options to S.W. 185th Avenue (Surface and Tunnel respectively) than the No Build Alternative, and 2,700 to 3,000 (79% to 88%) greater for non-work trips. In comparison to the TSM Alternative, the 2005 LRT options to S.W. 185th Avenue would attract 1,700 to 1,800 (15% to 16%) more transit work trips, and 700 to 1,000 (13% to 19%) more non-work trips. While the LRT options to the Sunset Transit Center would attract 2,700 (24%) more total (work plus non-work) daily transit trips than the No Build Alternative, it would attract 2,200 (8%) fewer than the TSM Alternative.

The City of Portland Parking and Circulation Policy limits the number of downtown (in the area between the I-405 freeway loop and the Willamette River) parking spaces allowed to about 45,000. Existing parking demand is approaching the supply permitted. While the project alternatives accommodate a large percentage of the new downtown trips on transit (Table 7.2-6), they also result in increased auto volumes to downtown and, as a consequence, increased parking demand. Assuming the parking limitation is maintained, this increased parking demand must be met through parking management measures. If this is not possible, parking supply deficiencies may begin to constrain development. Accordingly, the reduced need for additional parking spaces of the "build" alternatives, compared with the No Build Alternative, can be viewed as an indicator of their relative ability to minimize or accommodate parking constraints to downtown development.

Table 7.2-7

WESTSIDE CORRIDOR DEVELOPMENT IMPACTS ON PORTLAND CBD
Average Weekday, Year 2005

	No Build	TSM	Surface to 185th	Tunnel to 185th	Surface to Murray	Surface to Sunset TC
Corridor population within:						
30 minutes of CBD by transit	7,100	9,500	18,200	(3)	(3)	(3)
30 minutes of CBD by auto	78,500	105,600	117,300	(3)	(3)	(3)
45 minutes of CBD by transit	20,200	52,600	124,500	(3)	(3)	(3)
45 minutes of CBD by auto	282,200	282,200	282,200	(3)	(3)	(3)
Corridor Transit Work Trips to CBD	8,500	11,600	13,300	13,400	11,600	9,300
Additional Transit Work Trips to CBD compared to No Build	0	3,100	4,800	4,900	3,100	800
Corridor Transit Non-Work Trips to CBD	3,400	5,400	6,100	6,400	5,700	5,500
Additional Transit Non-Work Trips to CBD compared to No Build	0	2,000	2,700	3,000	2,300	1,900
Reduced (1) Downtown Commuter Parking requirements	N/A	1,300	2,000	2,000	1,300	300
Reduced (1) Downtown Short-Term Parking requirements	N/A	200	300	400	300	200
Total reduced (1) Downtown Parking requirements	N/A	1,500	2,300	2,400	1,600	500

Notes: (1) Relative to No-Build
(2) All numbers rounded to nearest 100
(3) Not calculated

Source: Metro, 1990 and Tri-Met, 1990.

Table 7.2-7 shows the reductions in needed downtown parking spaces, relative to the No Build Alternative, that result from the higher transit ridership projected for the "build" alternatives. It is important to note that the implementation of the "build" alternatives necessitates the removal of certain parking spaces within the area covered by the parking policy. The TSM and LRT Alternatives generally displace the same levels of parking (about 100 more spaces than the No Build) within the downtown area and, therefore, do not affect the relationships shown in Table 7.2-7.

The TSM Alternative would eliminate the demand for 1,500 downtown spaces by 2005, compared with the No Build Alternative. The LRT options to S.W. Murray Boulevard would produce similar results. The demand for parking would be 2,300 to 2,400 spaces less for the LRT options to S.W. 185th Avenue than the No Build Alternative, and would be 800 to 900 spaces less than the TSM Alternative. The LRT options to Sunset Transit Center would reduce parking demand by 500 spaces compared to the No Build Alternative.

The TSM Alternative is consistent with the transportation access levels needed to support downtown development goals. The LRT options to S.W. 185th Avenue provide better transit accessibility to downtown, attract more ridership to downtown, and reduce parking requirements more than the TSM Alternative and, therefore, are more supportive of downtown development goals.

Enhance Central Beaverton Development

The highway improvements associated with the "build" alternatives increase auto access to Beaverton and, by doing so, generally support Beaverton development.

The proposed downtown Beaverton Development Plan proposes a core area centered along the light rail axis between the Beaverton Transit Center and the proposed S.W. Watson Avenue LRT station. A Civic Center would be established at the west end of this axis, with a retail/commercial "esplanade" (a transit/pedestrian street with limited auto access) extending from the Civic Center to the Transit Center.

The development and operation of LRT, coupled with development policies could alter the distribution of economic activity which might have taken place in its absence. LRT would not trigger development on its own, but could reinforce the policy intent of Beaverton's redevelopment plans. There are approximately 195 acres of redevelopable land within 1,500 feet of the proposed LRT stations in Beaverton. By 2005, another 42 to 74 acres (depending on alignment options) of land will be deemed redevelopable. Development pressures and rising land values on these parcels are projected to support medium density office and retail development.

Table 7.2-8 shows the number of transit work trips attracted to Beaverton for each alternative. This measure provides an indication of the level of station area activity attributable to each alternative. The TSM Alternative would attract approximately 1,000 more daily work trips in 2005 to Beaverton, or 80 (9%) more than the No Build Alternative. Both the TSM and LRT Alternatives would be consistent with the transportation access needed to support Beaverton's development concept. The LRT options to S.W. 185th Avenue would result in 230 (26%) more daily work trips being attracted to Beaverton by transit than the No Build Alternative. In addition, the LRT options (except for the Sunset Transit Center terminus option) are physically integrated into the proposed development of the "esplanade".

Enhance Sunset Corridor Development

The Sunset Corridor is the state's major job growth center, in particular for high-tech manufacturing jobs. Metropolitan regions compete for high-tech manufacturing plants on a regional and, often times, national level. The private sector decision to site a plant at a particular location is the result of many factors including the accessibility of the labor pool to the site. Improving the highway and transit connection between east Portland residents and westside jobs will improve the labor supply connection to the Sunset Corridor. Because auto-ownership is relatively low for many residents of east Portland, transit access may, in a limited way, influence certain development decisions.

Reverse-direction commute weighted transit travel times for selected eastside-westside trips, shown in Table 7.2-8, demonstrate the transit travel time savings of the "build" alternatives. The TSM Alternative would be about 4 to 5 minutes faster to Beaverton, 9 to 12 minutes faster to Tektronix, and 45 to 57 minutes faster to Hillsboro than the No Build Alternative for residents of northeast Portland, depending on the location of their residence. In comparison, the same reverse commute trips would be respectively 11 to 24, 13 to 28 and 45 to 57 minutes faster with the LRT Alternative compared to the No Build Alternative.

Table 7.2-8

WESTSIDE CORRIDOR DEVELOPMENT IMPACTS
ON BEAVERTON AND THE SUNSET CORRIDOR

	No Build	TSM	Surface to 185th	Tunnel w Zoo to 185th	Tunnel w/o Zoo to 185th	Surface to Murray	Surface to Sunset TC
PM Peak Hour Total Transit Travel Time(1) From N.E. Broadway/21st to:							
Central Beaverton	70	66	49	48	47	49	59
Tektronix	74	65	50	49	48	50	61
Hillsboro	128	79	73	72	71	75	74
PM Peak Hour Total Transit Travel Time(1) From N. Vancouver/Prescott to:							
Central Beaverton	79	74	57	56	55	57	67
Tektronix	84	72	58	57	56	58	69
Hillsboro	128	86	81	80	79	83	82
Annual Transit Work Trips Attracted to:							
Beaverton	910	990	1,140	(2)	(2)	(2)	(2)
Sunset Corridor	1,130	1,340	1,450	(2)	(2)	(2)	(2)

Notes: (1) Total travel time is in minutes.
(2) Not calculated.

Source: Tri-Met, 1990.

Table 7.2-8 also shows the number of work trips attracted to the Sunset Corridor by transit in 2005. The transit travel time savings associated with the TSM Alternative would result in 210 (19%) more daily work trips being attracted to the Sunset Corridor in 2005 than the No Build Alternative. The LRT options to S.W. 185th Avenue would attract 320 (28%) more daily work trips than the No Build Alternative. Because they both improve access to the eastside labor pool, the TSM and LRT Alternatives are both supportive of Sunset Corridor development objectives. However, transit ridership to these suburban work sites is projected to be small due to such factors as ample free parking, lengthy walks, and lack of pedestrian amenities.

Support Urban Growth Boundary

Studies of the long-term land use effects of transportation improvements have concluded that such projects often continue the trend toward decentralization of households and some businesses by extending the reasonable commuting distance to the Central Business District. Without effective land use controls, these improvements could encourage urban sprawl.

In the Westside Corridor, the Urban Growth Boundary (UGB), and city and county comprehensive plans support urban containment and increased densities in the urban area. The transit overlay zones adopted by local jurisdictions demonstrate the commitment of local plans for higher-density development in areas with direct light rail access. These zones include the Transit Corridor Overlay District in Portland, LRT Overlay in Washington County, and the LRT Overlay in Beaverton. These zones permit higher density residential, commercial, and office development in areas along the LRT corridor.

In addition, the Portland region is currently developing policies that emphasize increased development densities. The draft Regional Urban Growth Goals and Objectives (Metro, 1990) emphasize a land use concept moving toward high-density, mixed-use centers at key locations on the regional light rail system. This is intended to increase densities in locations that can effectively be served by transit, thereby reinforcing the UGB policy to limit urbanization onto rural lands. Because an expansion to the UGB must, by statute, be based on the demonstrated "need" for more urban land, the region's policy to increase densities on existing urban land with light rail access may further help limit future expansion of the boundary.

If these local land use policies prove to be effective over time, the highway and transit improvements covered in this SDEIS are unlikely to contribute to the dispersion of households and jobs that might otherwise occur.

7.2.2.6 Provide an Environmentally Sensitive Transportation System

The ability of the alternatives to provide an environmentally sensitive transportation system is evaluated in Table 7.2-9. Notable results are discussed below.

<u>Displacement</u>

The LRT options to S.W. 185th Avenue would displace in the range of about 75 to 89 residential units and 10 to 39 businesses. In comparison, the TSM Alternative would displace 14 residential units and two businesses. The Surface LRT options would cause more business displacement than the Tunnel options, and the Henry Street option would cause more displacement than the BN option.

<u>Noise</u>

The No Build Alternative does not include construction of any new noise walls, and increased traffic levels will impact a total of 133 noise receptors.

The TSM and LRT Alternatives would affect approximately the same number of noise receptors, which is slightly less than the No Build Alternative because of noise walls that would be built as mitigation measures. In the Canyon and Highway 217 segments, noise impacts are primarily caused by the highway traffic; transit contributes very little. Overall, no significant noise problems have been identified throughout the corridor.

<u>Visual and Aesthetics</u>

The LRT Alternative would remove between 16 and 33 acres of trees from the Canyon Segment, and the TSM Alternative would remove about 14 acres. The LRT Alternative would require between one and two times the amount of retaining wall exposure compared to the TSM Alternative. Among the LRT options, the Southside option would cause the greatest impacts, the Northside would cause less impact, and Tunnel options would cause the least.

<u>Wetlands and Parks</u>

There are no major impacts with any of the alternatives, but all of the LRT options would have some minor impacts on wetlands and public parklands. Most affected wetlands are in Beaverton. All Canyon LRT options would require the use of some portion of Washington Park. The Northside option would require the largest amount of use of the park, and the Southside option the least. All other required use of parklands is similar for all options.

<u>Historic/Cultural</u>

No historic resources would be adversely affected by the No Build or TSM Alternatives. With the LRT Alternative, two historic resources could be adversely affected, one with the Southside option in the Canyon segment, and one with the Henry Street option in Beaverton.

Table 7.2-9

SUMMARY OF ENVIRONMENTAL IMPACTS

	Impact by Complete Alternative					Impact by Geographical Segment								
			LRT Adopted Alignment			LRT Alignment Options								
						Canyon Segment				East Beaverton		Beaverton		
	No Build	TSM	185th Terminus	Murray Terminus	Sunset Terminus	Southside Adopted	Northside	Long Tunnel with Station	Long Tunnel w/o Station	South Adopted	North	BN Adopted	Henry	Common to all Options to 185th
Displacements:														
Single Family	0	6	19	13	5	5	5	5	5	4	4	0	5	10
Multi Family	0	8	58	58	18	18	18	16	16	40	41	0	6	0
Business	0	2	30	26	20	17	17	2	2	6	1	0	9	7
Adversely Affected Noise Receptors Hwy and LRT with Recommended Mitigation	133	125	114	114	115	79	79	79	79	0	0	0	5	35
Retaining Wall Exposure (SF)	48,700	222,900	446,220	446,220	446,220	446,220	384,440	241,940	241,940	0	0	0	0	0
Acres of Tree Removal	0	14.1	32.5	32.5	32.5	32.5	23.1	16.3	16.3	0	0	0	0	0
Acres of Affected Wetland	0	0.8	4.7	2.5	0.8	0.8	0.4	0.2	0.2	0.8	1.0	0	0.6	3.05
Resources Adversely Affected														
Historic	0	0	1	1	1	1	1	1	1	0	0	0	1	0
Archaeological	0	0	2	2	2	2	2	2	2	0	0	0	0	0
Parks Affected														
Number	0	0	4	3	1	1	1	1	1	0	0	0	0	3
Acres	0	0	0.86	0.85	0.5	0.5	2.3	1.5	1.3	0	0	0	0	0.36

Source: Shapiro and Associates, Inc., 1990 and Tri-Met, 1990.

7.2.3 Cost-Effectiveness

This section presents a cost-effectiveness evaluation of project alternatives. It employs the UMTA cost-per-new-rider index and a series of locally defined operating cost-effectiveness measures.

7.2.3.1 UMTA Cost Per Added Rider Index

Cost-effectiveness analysis provides a means of comparing the benefits of each alternative with its costs. The cost-effectiveness analysis has become an important part of the UMTA procedures for review of major transit projects. UMTA has established the cost-effectiveness index as one measure for evaluating the relative merits of fixed guideway alternatives within a corridor.

The UMTA method for determining the cost-effectiveness measure is a formula described in "Procedures and Technical Methods for Transit Project Planning" published in September 1986, and updated by current UMTA practice. Specifically, the UMTA index is computed as follows:

$$\text{UMTA New Rider Index} = \frac{\Delta\$CAP + \Delta\$O\&M - \Delta\$TT}{\Delta\ \text{Riders}}$$

Where the Δ s represent changes in cost and benefits compared to the TSM Alternative, and

Δ \$CAP = change in equivalent annual capital cost;
Δ \$O&M = change in annual operating and maintenance costs;
Δ \$TT = change in value of travel time savings for existing riders; and
Δ RIDERS = change in annual transit ridership, measured in "linked" trips.

"Existing" riders are defined in this equation as the minimum number of transit patrons carried with either alternative. Values necessary to convert travel time into its monetary equivalent have been determined by UMTA to equal \$4.00 per hour for work trips and \$2.00 for non-work trips. These values are unchanged since 1984. Capital costs and O&M costs were annualized using UMTA approved assumptions about the discount rate and the economic life of cost components.

The output of the formula is an alternative's cost per new rider as compared to the TSM Alternative. The TSM Alternative is used as the baseline since it is designed to represent the most effective solution to transportation problems in the corridor, short of constructing major new facilities. Thus, the TSM Alternative provides a baseline, against which it is possible to isolate the added costs and added benefits resulting from a proposed major investment.

UMTA developed this index because it perceived a close relationship between the index and a project's ability to advance the essential goal of the federal transit program, which is to assist in providing a basic level of public mobility. The achievement of other goals and objectives of public transportation investments, such as the reduction of energy consumption and air pollutant emissions, and the promotion of economic development, are closely related to a project's ability to improve the level of transit service for existing transit riders, and to attract new riders. Thus, projects that provide substantial travel time savings and ridership increases are likely to not only satisfy the basic mobility objective, but may also meet transit's other objectives as well, such as energy, and air quality.

The cost-effectiveness index provides a measure of the costs, both capital and operating, for each new transit rider. Therefore, when two project alternatives are compared in terms of their cost-effectiveness indices, the one with the lower index represents the more cost-effective of the two. A project may be considered cost-effective so long as its index does not exceed the price that decision makers are willing to pay for each new rider.

Applying this index to the alternatives under consideration yields the results shown in Table 7.2-10. A range is provided for each LRT option, reflecting two different factors for converting daily transit trips to annual trips. The base forecast assumes a 315 days/year annualization factor. This reflects a continuation of trends for Tri-Met's Eastside line, where the number of weekend riders on the system has

Table 7.2-10

UMTA COST PER ADDED RIDER
INPUT VALUES AND INDICES
(Annual Value)

	TSM	SOUTHSIDE SURFACE to 185th via South BN	NORTHSIDE SHORT TUNNEL to 185th via South BN	LONG TUNNEL WITH ZOO to 185th via South BN	LONG TUNNEL W/O ZOO to 185th via South BN	NORTHSIDE SHORT TUNNEL to 185th via North BN	NORTHSIDE SHORT TUNNEL to 185th via South Henry	NORTHSIDE SHORT TUNNEL to 185th via North Henry	NORTHSIDE SHORT TUNNEL to Murray via South BN	NORTHSIDE SHORT TUNNEL to Sunset TC
Value of Travel Time Savings		($2.60)	($2.60)	($2.70)	$3.00	($2.60)	($2.60)	($2.60)	($2.60)	($0.80)
O&M Costs	$27.10	$23.80	$23.80	$23.70	$23.50	$23.80	$23.80	$23.80	$24.10	$22.90
Change in O&M Costs		($3.30)	($3.30)	($3.40)	($3.70)	($3.30)	($3.30)	($3.30)	($3.10)	($4.20)
Annualized Capital Costs	$9.30	$46.70	$46.20	$51.10	$48.80	$46.10	$47.30	$47.00	$41.10	$26.90
Change in Capital Costs		$37.40	$37.00	$42.20	$39.60	$36.80	$38.00	$37.70	$31.80	$17.60
Change in Riders		2.1	2.1	2.0	1.8	2.1	2.1	2.1	1.1	-0.1
UMTA Total Index		$15.23	$15.00	$17.81	$18.25	$14.91	$15.51	$15.38	$23.76	NA
UMTA Total Index - Modified		$13.23	$13.02	$15.57	$15.73	$12.95	$13.47	$13.36	$19.20	$69.39

Notes:

1. Change is relative to the TSM.
2. Annual values are in millions.
3. Equivalent annual cost or benefit in dollars are documented in technical memorandums.
4. UMTA cost per added rider indices are relative to TSM.
5. Modified indices assume a 327 rail annualization factor as opposed to 315 in the base index. The 327 factor is based on Tri-Met's experience with the Eastside line, while the 315 factor represents a continuation of declining weekend ridership trends over the first four years of Eastside operation.

Source: Tri-Met, 1990.

generally declined over the past four years. The modified forecast assumes a 327 annualization factor which is consistent with Tri-Met's current experience on the Eastside line.

The LRT options to S.W. 185th Avenue would cost the least per new transit rider and, therefore, rank higher on the UMTA cost-effectiveness index than the S.W. Murray Boulevard or Sunset Transit Center terminus options. The LRT options to S.W. 185th Avenue would cost between $14.91 and $15.51 per new rider, assuming the base forecast, and $12.95 to $13.47 per new rider, using the modified forecast. In comparison, the S.W. Murray Boulevard terminus option is estimated to cost $23.76 per new (base forecast) rider and $19.20 per new (modified-forecast) rider. Because it would attract less ridership than the TSM Alternative, the UMTA cost-effectiveness index can not be calculated for the Sunset Transit Center terminus option assuming the base forecast. The modified forecast cost per added rider for the Sunset Transit Center terminus option is $69.39.

In the Canyon segment, the Northside option ($15.00 per new rider) and the Southside option ($15.23) are similar in terms of their costs per new rider. The Long Tunnel with Zoo station option ($17.81) and the Long Tunnel without Zoo station option ($18.25) also exhibit similar degrees of cost effectiveness, but are less cost effective than either the Southside or Northside options. The additional costs of the Long Tunnel options do not result in additional new riders.

In Beaverton, the northern alignments are slightly more cost effective than the southern alignments. East of the S.W. Watson Avenue station, the North alignment option costs less per new rider than the South alignment option. West of the S.W Watson Avenue station, the BN option costs less per new rider than the Henry Street option.

These results can be displayed graphically in order to further illustrate the relative cost-effectiveness of the alternatives. Figure 7.2-1 plots the added costs of each alternative (annualized capital costs plus O&M costs minus the value of annual travel time benefits relative to the TSM Alternative) against the added benefits (increase in transit riders relative to the TSM Alternative). The slope of the line (Δriders/Δcosts) connecting an alternative with the origin is an indicator of the alternative's cost-effectiveness. The steeper the slope, the more cost-effective the alternative. (In fact, the slope of the line is the inverse of the alternative's cost-effectiveness index.) To identify the most cost-effective alternatives, the alternatives that lie highest and furthest to the left on the graph are connected. The resulting boundary, or "frontier," indicates the best that can be done with increasing levels of investment in the corridor. Those alternatives that are lower and to the right indicate less cost-effective investment opportunities for the corridor.

Referring to Figure 7.2-1, the options that define the cost-effectiveness frontier are the Surface options to S.W. 185th Avenue. These options overlap point A on Figure 7.2-1 at the scale provided. Therefore, they are shown as a generic single option for clarity purposes. The Long Tunnel options to S.W. 185th Avenue fall beneath the frontier, reflecting their higher capital costs. The shorter terminus options are even further from the cost-effectiveness frontier.

7.2.3.2 Operating Cost Efficiency Indices

The ability of the alternatives to provide a fiscally efficient operation is evaluated in this section. The cost-effectiveness of operations can be measured on a per rider basis, per unit of capacity basis or corridor-cost recovery basis. These measures do not take capital costs into account.

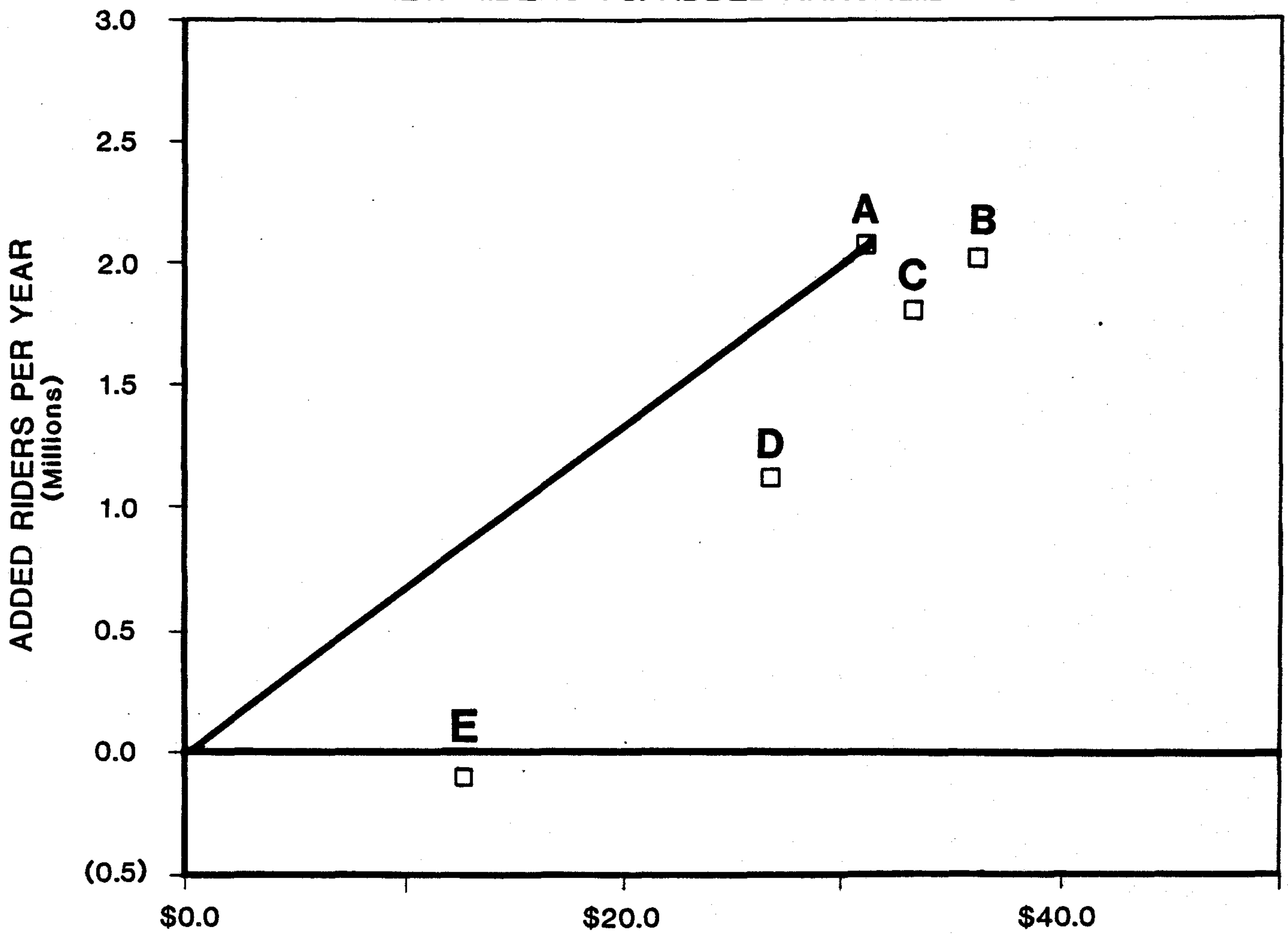
Operating Cost Per Rider

Table 7.2-11 shows the operating cost divided by total ridership for the alternatives. These statistics include the cost of all bus and light rail service in the corridor for each alternative. The TSM Alternative would cost $0.25 more per rider to operate and maintain than the No Build Alternative. In comparison, the corridor O&M cost per rider for the LRT Alternative is $0.29 to $0.64 less than the No Build Alternative and $0.54 to $0.89 less than the TSM Alternative. The LRT options to S.W. 185th Avenue cost $0.18 to $0.35 less per rider to operate and maintain than the shorter terminus options.

FIGURE 7.2-1

COST-EFFECTIVENESS "FRONTIER"

NEW RIDERS VS. ADDED ANNUALIZED COST



ANNUALIZED COST LESS TRAVEL TIME SAVING
(Millions)

A - SOUTHSIDE AND NORTHSIDE TO 185TH
B - TUNNEL WITH ZOO TO 185TH
C - TUNNEL NO ZOO TO 185TH
D - SURFACE TO MURRAY
E - SURFACE TO SUNSET (NEGATIVE VALUE)

Operating Cost Per Place Mile

This index, shown in Table 7.2-11, provides an indication of operating cost-effectiveness, in terms of cost per increment of passenger carrying capacity. The operating cost per 1,000 place miles for the TSM Alternative is $5.28 less than the No Build. In comparison the operating cost of 1,000 place miles for the LRT options to S.W. 185th Avenue is about $14.00 less than the No Build and about $9.00 less than the TSM Alternative.

Farebox Recovery

The farebox recovery ratio for each option is also shown in Table 7.2-11 as another measure of operating cost-effectiveness. A 30% farebox recovery ratio is expected for the LRT options to S.W. 185th Avenue, including all bus and rail operations in the corridor. These ratios are 50% better than the farebox recovery ratios for the No Build and TSM Alternatives.

Table 7.2-11

WESTSIDE CORRIDOR OPERATING EFFICIENCY INDICES
Year 2005 Service Levels
(FY 89 DOLLARS)

	No Build	TSM	Surface to 185th	Tunnel w Zoo to 185th	Tunnel w/o Zoo to 185th	Surface to Murray	Surface to Sunset TC
Corridor (1) O&M Cost per Originating Rider	$2.65	$2.80	$2.02	$2.01	$2.04	$2.22	$2.36
Corridor O&M Cost per 1000 Place Miles	$49.72	$44.44	$35.40	$35.46	$35.45	$36.83	$41.16
Corridor Percent Farebox Recovery (2)	21%	20%	31%	31%	30%	28%	26%
Annual Corridor Subsidy ($1989 in millions)	$17.0	$21.6	$16.5	$16.5	$16.3	$17.5	$17.0

Notes: (1) Corridor statistics for LRT options include LRT and Bus.
(2) Rounded to the nearest percent.

Source: Tri-Met, 1990.

7.2.4 Equity Considerations

The Westside Corridor has only a small percentage of the region's low-income residents. The Light Rail alignments would pass by a few low-income residences in downtown Portland with negligible impact. Overall, the project options do not disrupt any identifiable low-income neighborhoods nor any concentration of low-income residences or jobs.

7.2.4.1 Low-Income Transit User Benefits

While the Westside Corridor Project alternatives are not physically located in a low-income area, they do provide transportation service benefits to the low-income areas in eastside Portland. The electronic-equipment manufacturing jobs being created in the Westside Corridor represent major employment opportunities for the labor pool in north and northeast Portland. In fact, the Portland Development Commission (PDC) created and is operating an employment and training program, called Job Net, which is primarily aimed at assisting low-income eastside residents to secure Westside manufacturing jobs. The highway improvements associated with the "build" alternatives will generally benefit eastside-to-westside travelers. However, many members of this labor pool do not have regular access to a car, so transit access is another consideration. All of the "build" options result in a better eastside-westside transit connection in terms of employment coverage (as shown in Table 7.2-4). The LRT Alternative generally provides better reverse-direction transit commute travel times than the TSM Alternative (as shown in Table 7.2-8).

7.2.4.2 Disadvantaged Business Enterprises (DBE)

Each year, Tri-Met analyzes the availability of DBE's and their relation to upcoming contracting opportunities as a basis for establishing the agency's DBE goals for the next year. The goals established by the Tri-Met Board on September 6, 1990 are:

Type of Contract	DBE Goal
Construction	16%
Professional Services	12%
Supplies/Equipment	7%
Overall	14%

Goals of this nature will be established for expenditures on the Westside Corridor Project. ODOT will also establish DBE goals for the highway projects associated with the "build" options. Given the availability of DBE's in the Portland region, project options that have proportionately higher construction components, such as highway and light rail construction, will have proportionately higher DBE participation.

7.2.4.3 Financial Equity

The general financing plan for the Westside Corridor Project was defined as part of a Regional Compact agreed to by all major jurisdictions in the Tri-County region. The compact established a definition of regional financial equity. A regional General Obligation bond was agreed to as being the appropriate base for the regional share because of the metropolitan-wide travel and economic benefits of the project. The repayment of the bonds is a property-tax-based funding source and, therefore, relates to the general benefit. Because there are extra benefits to residents and businesses in downtown Portland and the Westside Corridor sector of Washington County, these jurisdictions will contribute funding beyond their share of the General Obligation bond. Furthermore, the extra benefits to the transit users and transit operator are reflected by supplemental financial participation by Tri-Met. Overall, the financing plan is viewed as being equitable, in that the regional non-federal funding sources generally relate to benefit.

7.2.5 Significant Trade-Offs Between Alternatives

This section draws upon the preceding sections and focuses on specific modal or alignment comparisons. As such, this section is organized into five main comparisons as follows:

- the basic comparison of Build and No Build
- the basic modal comparison of LRT and bus
- the comparison of LRT alignment options in the Canyon segment
- the comparison of LRT alignment options in Beaverton
- the comparison of LRT terminus options.

7.2.5.1 Build Versus No Build

As discussed in Chapter 2, the No Build Alternative includes certain systemwide transit and street improvements, but no major construction or expansion of capacity. The TSM and LRT Alternatives are both considered "build" alternatives, and both include, in varying degree, major construction and increases in transportation capacity in the Westside Corridor. Both the TSM and LRT Alternatives include highway widening and interchange improvements along Sunset Highway and Highway 217.

The consequences of a No Build scenario have been examined carefully throughout this SDEIS. Congestion and delay would increase and level-of-service decrease on most major highways and streets in the Westside Corridor. With one minor exception, demand would exceed capacity on Sunset Highway from the Vista Tunnels to west of Highway 217, and on Highway 217 south past S.W. Canyon Road.
Parking demand in downtown Portland would exceed the current established limitation. The frequency of bus service would improve, but buses would operate less reliably on a more-congested street network.

With the "build" alternatives, transit ridership in the corridor is projected to increase by approximately 5,400 to 10,000 more daily riders in 2005 than with the No Build Alternative; year 2005 daily transit ridership to/from the CBD is projected to increase by 5,100 to 7,500 riders; highway and intersection levels-of-service would improve in most locations; and parking demand would be reduced in downtown Portland by 1,500 to 2,400 spaces. These benefits are achieved at a substantial cost, both financial and otherwise. Specifically, the "build" alternatives (including highway and transit components) would cost roughly $160 million to $590 million ($1990) more to construct than the No Build Alternative, would displace 16 to 127 families and businesses, and would require tree removal and increased retaining wall exposure in the Canyon segment.

In summary, the increased capital costs and environmental impacts associated with construction of the "build" alternatives, and the resulting improvement in transportation access and mobility, must be considered in comparison to the lower capital cost, negligible construction impact, but increasingly congested transportation system associated with the No Build Alternative.

7.2.5.2 LRT Versus the TSM Alternative

The information previously presented shows that all LRT options would have a higher capital cost and greater environmental impact than the TSM Alternative. These costs and impacts must be viewed in light of the resulting improvement in transit service, higher transit ridership, lower operating costs, improved operating efficiency, reduced parking demand in downtown Portland, and greater support for development in the downtown and in the immediate vicinity of transit stations. Specifically the LRT options would cost from approximately $180 million to $420 million ($1990) more than the TSM Alternative, but result in annual operating cost savings of $3 to $4 million ($1990) compared to the TSM Alternative. The LRT options to S.W. 185th Avenue would attract about 4,600 more daily transit riders in 2005 than the TSM Alternative and have a cost-effectiveness index of $14.91 to $15.51 per additional rider, compared to the TSM Alternative.

Construction of a light rail line creates a new transportation facility in the region with capacity to meet demand beyond a 2005 time frame. The TSM Alternative provides the capacity for 2005, but on an increasingly congested highway system with little opportunity for expansion beyond this time-frame.

7.2.5.3 LRT Alignment Options in Canyon Segment

The Canyon segment extends from the LRT station at S.W. 20th Avenue and S.W. Jefferson Street to the intersection of Sunset Highway and Highway 217. As described above, there are four LRT alignment options in this segment, including the Southside (all surface), the Northside (Short Tunnel), the Long Tunnel with Zoo Station, and the Long Tunnel without Zoo Station. As currently configured, neither of the Long Tunnel options includes a station at Sylvan, while the two Surface options do. The Long Tunnel option can accommodate addition of a Sylvan Station, if that option is chosen as the preferred alternative.

There are three major tradeoffs to be considered among the alignment options in this segment. First, the higher capital costs of the Long Tunnel options must be weighed against the greater environmental impacts of the Surface (Southside or Northside) options. Depending on whether or not a Zoo Station is included, the Long Tunnel options are estimated to cost approximately $25 million to $50 million more than the Surface options. However, the Long Tunnel options result in about half the tree removal and retaining wall exposure of the Southside option and about two thirds of those of the Northside option. The Surface options are projected to cost $2.30 to $3.34 less per new rider (compared to the TSM Alternative) than the Long Tunnel options.

Second, for the Long Tunnel options, the capital cost of the Zoo station must be weighed against the importance of the station as a regional attraction and ridership generator. The underground Zoo station for the Long Tunnel option is estimated to cost approximately $20 million and carry at least 250,000 more riders a year than would be served by buses with the Long Tunnel without Zoo station option. Accordingly, the cost per new rider is lower ($0.44) with the Zoo station. LRT options which include a Zoo station would also reduce the need to provide additional parking capacity at the Zoo.

Third, the additional LRT ridership, broader development potential, and consistency with planning goals associated with a Sylvan station must be weighed against the absence of a station with the Long Tunnel options.

7.2.5.4 LRT Alignment Options in Beaverton

There are two alignment choices in Beaverton. In East and Central Beaverton, LRT could follow either the North or South options to the station at S.W. Watson Avenue. In West Central Beaverton, the choice lies between the BN Railroad option or the Henry Street option. Either of the North or South options could be combined with either the BN or Henry options.

In East Central Beaverton, the South option was the 1983 Adopted Alignment. However, the South option presents more difficulties in constructing an acceptable rail profile with regards to floodplain considerations. The North option is less costly, less disruptive to businesses, and causes the fewest traffic impacts.

In West Central Beaverton, the BN option was the 1983 Adopted Alignment, is the least costly, has the least right-of-way and displacement impact, and has the least traffic impact. Since the BN option would be located for the most part in an existing rail right-of-way, it will also pose the least risk of delay, cost overruns, or construction impacts on adjacent uses. The Henry Street option may act as a catalyst for redevelopment in the station area particularly at S.W. 141st Avenue if the City of Beaverton is able to enact supportive policies and redevelopment along the route. Thus the major trade-off in West Central Beaverton can also be summarized as lower costs and impacts for the BN option versus somewhat greater redevelopment potential for the Henry Street option.

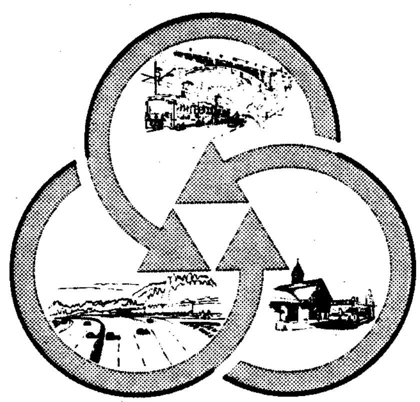
7.2.5.5 LRT Terminus Options

The previously Adopted Alignment terminated in the vicinity of S.W. 185th Avenue. At UMTA direction, two shorter terminus options, S.W. Murray Boulevard and the Sunset Transit Center, have been included in this document.

The higher capital costs associated with the S.W. 185th Avenue terminus option must be weighed against the improved operating efficiency, higher ridership, increased travel time savings, and generally improved transit service associated with extending the LRT line to S.W. 185th Avenue. The S.W. 185th Avenue terminus option would cost approximately $50 million ($1990) more than the S.W. Murray Boulevard terminus option and approximately $200 million ($1990) more than the Sunset Transit Center terminus option. However, the longer option would capture 2,900 to 6,200 more daily transit trips and reduce the O&M cost per rider by 10% and 20%, respectively. Additionally the S.W. 185th Avenue terminus option would capture 80% of all new trips to the CBD versus only 62% and 42% for the shorter terminus options. Therefore, the long terminus option would reduce traffic and the need for additional parking spaces in the downtown.

Furthermore, the shorter terminus options present operating and maintenance difficulties associated with maintenance facility location. There is no practical site available for a Westside LRT maintenance facility for the Sunset Transit Center terminus and all LRT operations and maintenance would have to be performed at the existing Ruby Junction facility in Gresham. Similarly, there are physical constraints associated with the proposed maintenance facility site for the S.W. Murray Boulevard terminus option.

The S.W. Murray Boulevard terminus option would be less cost effective than the options to S.W. 185th Avenue. While the S.W. Murray Boulevard terminus option has lower cost, it also attracts fewer riders leading to a higher cost per new transit rider. Because the ridership projected for the Sunset Transit Center option is less than that projected for the TSM Alternative, its UMTA cost-effectiveness index can not even be calculated. But while the shorter terminus options are less cost-effective than the S.W. 185th Avenue option, their lower costs may make them more financially feasible.



APPENDIX A

COMMUNITY PARTICIPATION

APPENDIX A
Community Participation

INTRODUCTION

Active public involvement is critical to the success of any large transportation project that has a significant impact on the surrounding community. The goal of the public involvement process is the selection of a preferred alternative by a well-informed community and local government. The process should ensure that community concerns and technical issues are identified early on and addressed in the engineering, environmental, economic, and financial analyses. Through this process, selection of a locally preferred alternative that most effectively responds to community needs and preferences, while satisfying local, state, and federal requirements, should be possible.

The Westside Corridor Project public involvement program began concurrently with the preliminary engineering process in early 1988. The two primary focuses of the public involvement program have been providing the public with information regarding the project while keeping them informed of project progress and decisions. The program also provides the public with the opportunity to express their concerns regarding the project and any additional ideas they might have to improve the project or mitigate its impacts. To these ends, a diverse public involvement program for the Westside Corridor Project Supplemental Draft Environmental Impact Statement (SDEIS) has been implemented. This program consists of several different elements, including:

- Local, State, and Federal Participation
- Community Participation
- Public Information Program
- Public Involvement Program

A description of each element follows.

LOCAL, STATE, AND FEDERAL PARTICIPATION

The Tri-County Metropolitan Transportation District of Oregon (Tri-Met) serves as the lead agency for the transit aspects of the Westside Corridor Project, and the Oregon Department of Transportation (ODOT) serves as the lead agency for the highway aspects. At the federal level, funding and approval for the study have come from the Urban Mass Transportation Administration (UMTA) and the Federal Highway Administration (FHWA). Coordination between affected jurisdictions occurred on several levels: a Technical Advisory Committee (TAC), made up of technical staff from all of the involved jurisdictions; the Project Management Group, made up of jurisdictional staff at the management level; and the project Steering Group, made up of agency heads and political leaders. The jurisdictions involved in the project are:

Tri-Met
Metropolitan Service District (Metro)
ODOT
City of Portland
City of Beaverton
City of Hillsboro
Multnomah County
Washington County

COMMUNITY PARTICIPATION

To facilitate community participation, a list of individuals, agencies, and organizations was developed. The list includes parties that indicated an interest in transportation planning during previous public information efforts, as well as individuals that have indicated an interest during the current study period. Project information, meeting notices, and newsletters have been mailed to these parties to keep them informed of project progress and public meetings, and to solicit public input.

The project has compiled a mailing list with more than 2,500 names and addresses of citizens interested in the project. Citizens included on this list receive monthly mailings of the CAC meeting agendas, as well as any other communication distributed to citizens in the project area.

PUBLIC INFORMATION PROGRAM

The purpose of the public information program is to educate the community regarding the project and transportation planning. It is distinguished form the rest of the public involvement program in that it is designed primarily to inform the public and not necessarily to elicit public input.

Several issues of the project newsletter, Westside MAX Facts, have been published to keep the public informed of project progress and key decision points. This newsletter has been distributed throughout the Westside Corridor Project area using zip code mailings, local area newspaper inserts, and the Westside Corridor Project mailing list. In addition, copies of the newsletter have been distributed to local jurisidictions for distribution and placed in public libraries throughout the project area. All publications have included mailing list information and telephone numbers so that interested citizens could request additional information.

Video simulation of light rail operations, particularly in areas where concerns regarding visual impacts have been raised, were developed to aid citizens and staff in understanding the visual impact of light rail. An informational slide show also was developed and transferred to videotape for interested groups and individuals. This slide show was included as part of an informational display that was used throughout the project area.

Tours of the Eastside MAX system have been held periodically throughout the preliminary engineering phase to provide interested citizens with an opportunity to see how the system works and how similar concerns were mitigated along the alignment.

Press releases announcing public meetings and key project decisions have been provided to local media.

PUBLIC INVOLVEMENT PROGRAM

Citizens Advisory Committee

The Citizens Advisory Committee (CAC) is made up of 24 members that were nominated by the eight jurisdictions involved in the Westside Corridor Project.

CAC meetings have been held once a month since November 1988. Each meeting includes a half-hour period for public comment. In addition, the CAC receives copies of letters from concerned citizens, copies of project information and decision documents, and any other information or documents that would affect project decisions. The purpose of the CAC is to serve as a forum for citizen concerns and to make recommendations regarding project decisions to the Westside Corridor Project Steering Group.

The CAC has been involved in several decisions and consideration since the beginning of the preliminary engineering phase. These have included making recommendations on selection of the alignment alternatives to be included in the SDEIS, selection of the route alignment west of Beaverton, recommending portals to be carried into the SDEIS for further study, reviewing the Technical Advisory

Committee Findings Reports for the Canyon and Beaverton segments of the alignment, reviewing the SDEIS and reviewing testimony and presentations from project staff, citizens, and local jurisdictions. .

Community Meetings

Since 1988, project Community Relations staff have held more than 200 community meetings. These meetings have fallen into several general categories, which are described below.

- Informational Meetings - These meetings are usually open to the general public and are used to provide project information and obtain public input. Several of these meetings were held at the beginning of the project to inform the public of the alternatives being considered and of the process for public involvement. These meetings have also been held at specific decision points in the process. In addition, a series of informational meetings were held prior to the public hearings on the Supplemental Draft Environmental Impact Statement (SDEIS) to explain the hearing and review process.

- Neighborhood Meetings - Community Relations staff met with neighborhood groups throughout the project area to obtain input about specific neighborhood concerns and develop possible design alternatives to mitigate those concerns.

- Meetings with Community Leaders - These meetings involved community leaders and were used to keep them informed of project progress and to ensure coordination of policy decisions that might affect the Westside Corridor Project. Examples of these groups include local city councils, the Portland Planning Commission, Transportation 2000, and the City of Beaverton Advisory Committee for the Downtown Plan.

- Civic Groups - Community Relations and technical staff made informational presentations to such civic groups as the Rotarians, the Association of University Women, and the League of Conservation Voters on request.

- Individual Property Owners - As requested, Community Relations staff met with individual property owners to explain project design and impacts. Community Relations staff then acted as a liaison between the property owners and technical staff to explain or mitigate impacts and design concerns.

- Public Hearing - A public hearing will be held in early 1991 to obtain public comment on the SDEIS. Comments received at the meeting as well as written comments received during the review period will be considered by local leaders in choosing the locally preferred alternative. Comments and concerns raised during the review process also will be addressed in more detail in the Final Environmental Impact Statement (FEIS) and in final design.

Documentation

A quarterly summary of public involvement activities has been submitted to the Urban Mass Transportation Administration (UMTA) throughout the preliminary engineering phase of the project. In addition, summaries of community meetings are bound into a single document on an annual basis and provided to neighborhood and community groups throughout the project area. This documentation is also available at local public libraries.

APPENDIX B

AGENCY COORDINATION

APPENDIX B
Agency Coordination

Agency coordination has played a major role throughout this study process. The agencies listed below were contacted during data collection and resource identification, determination of regulatory compliance requirements and development of methodology. Agencies also provided additional information and evaluation throughout the analysis process.

Federal Agencies	**Topic**
U.S. Army Corps of Engineers	Hydrology/Water Quality Wetlands
U.S. Department of Energy	Energy
U.S. Department of the Interior Geological Survey	Hydrology/Water Quality Visual Impact Assessment
U.S. Department of the Interior Park Service	Parkland Resources
U.S. Environmental Protection Agency	Hydrology/Water Quality Wetlands Air Quality Hazardous Materials
U.S. Fish and Wildlife Service	Threatened and Endangered Species
State of Oregon Agencies	
Division of State Lands	Hydrology/Water Quality Wetlands
Division of Fish and Wildlife	Wetlands Threatened and Endangered Species Wildlife
Department of Environmental Quality	Hydrology/Water Quality Wetlands Air Quality Energy Hazardous Materials Noise and Vibration
Division of Transportation	Hydrology/Water Quality Capital Cost Estimates Air Quality Energy Displacements/Relocations Highway Improvement Plans Historic Resources Noise and Vibration
State Historic Preservation Office	Historic Resources

Local Agencies	Topic
Association for Portland Progress	Land Use and Economic Development
Center for Population Research and Census	Demographics
City of Portland, Bureau of Buildings	Hydrology/Water Quality
City of Portland, Environmental Services	Hydrology/Water Quality Wetlands
City of Portland, Office of Neighborhoods	Neighborhood Boundaries
City of Portland, Planning Bureau	Land Use and Economic Dev. Displacements/Relocations Historic Resources
City of Portland Parks Bureau	Parklands
City of Portland, Bureau of Planning	Noise and Vibration
City of Portland, Traffic Engineering	Transportation Plans
City of Beaverton Neighborhood Association Committee	Neighborhood Boundaries
City of Beaverton, Public Works Department	Hydrology/Water Quality
City of Beaverton Planning Department	Hydrology/Water Quality Wetlands Land Use and Economic Development Displacements/Relocations Historic Resources
City of Beaverton, Traffic Engineering	Transportation Plans
City of Beaverton Fire Marshall	Hazardous Materials
City of Hillsboro Planning Department	Wetlands Land Use and Economic Development Historic Resources Displacements/Relocations Historic Resources
Metropolitan Service District (Metro)	Air Quality Energy Land Use and Economic Development Demographics Traffic Forecast Models
Multnomah County	Wetlands Land Use and Economic Development Displacements/Relocations Historic Resources

Local Agencies (continued)	**Topics**
Multnomah County Fire Marshall	Hazardous Materials
Pacific Northwest Utilities Conference Committee	Energy
Portland Development Commission	Land Use and Economic Development
Sunset Corridor Association	Land Use and Economic Development
Tualatin Hills Parks and Recreation District	Parklands
Washington County Department of Land Use and Transportation	Hydrology/Water Quality Wetlands Land Use and Economic Development Displacements/Relocations Transportation Plans Historic Resources
Washington County Citizen Participation Organizations	Neighborhood Issues
Washington County, Unified Sewerage Agency	Hydrology/Water Quality

7

DEPARTMENT OF THE ARMY
PORTLAND DISTRICT, CORPS OF ENGINEERS
P. O. BOX 2946
PORTLAND, OREGON 97208-2946

Reply to Attention of:

MAR 1 6 1990

Planning Division

SUBJECT: 8972 (Beaverton Creek & Tributaries -Light Rail/Fill)

Terry Ebersole
Urban Mass Transit Authority - Region X
Federal Building
915 2nd Avenue, Suite 3142
Seattle, Washington 98174

Dear Mr. Ebersole:

This is in response to a telephone discussion of March 6, 1990, between Jim Goudzwaard of our Regulatory and Resource Branch and Pat Levine of your office, about our participation as a cooperating agency for the proposed light rail construction in Washington and Multnomah Counties, Oregon.

We will be pleased to serve as cooperating agency on the environmental impact statement process for those portions of the project requiring Department of the Army authorization pursuant to Section 404 of the Clean Water Act. Our contact person will be Mr. Goudzwaard, telephone (503) 326-6995.

The project has been assigned application number 8972. Please refer to this application number in all future correspondence. We look forward to working with you.

Sincerely,

Charles E. Cowan
Colonel, Corps of Engineers
Commanding

Copies Furnished:

Oregon Div. of State Lands
Oregon Dept. of Transportation
TRIMET
Federal Highway Administration

DEPARTMENT OF THE ARMY
PORTLAND DISTRICT, CORPS OF ENGINEERS
P. O. BOX 2946
PORTLAND, OREGON 97208-2946

Reply to Attention of:

September 4, 1990

Planning Division

SUBJECT: Application No. 9321 (185th to Hillsboro - Light Rail/Fill)

Urban Mass Transit Authority - Region X
ATTN: Terry Ebersole, Regional Manager
Federal Building
915 2nd Ave., Suite 3142
Seattle, Washington 98174

Dear Mr. Ebersole:

This is in response to a telephone discussion of August 6, 1990, between Jim Goudzwaard of our Regulatory and Resource Branch and Pat Levine of your office. We will be pleased to serve as cooperating agency for the environmental impact statement, for the proposed light rail construction extension from 185th Avenue to downtown Hillsboro in Washington County, Oregon. Our involvement is based upon Section 404 of the Clean Water Act which requires Department of the Army authorization for the discharge of fill material in waters of the United States.

Mr. Goudzwaard has accepted another position within our Regulatory and Resource Branch, and this project has been reassigned to Richard Johnson, telephone (503) 326-6995. Please refer to the above application number in all future correspondence. We look forward to working with you.

Sincerely,

Lauren J. Aimonetto
Chief, Planning Division

Copy Furnished:

ODOT
TRIMET

Regulatory + Resource Branch

JAN -3

December 28, 1990

Planning Division

SUBJECT: Application No. 8972 (Westside Corridor Project- SDEIS)

Urban Mass Transit Authority - Region X
ATTN: Terry Ebersole, Regional Manager
Federal Building
915 2nd Ave., Suite 3142
Seattle, Washington 98174

Dear Mr. Ebersole:

We have completed review of portions of the Supplemental Draft Environmental Impact Statement (SDEIS) which considers various transportation alternatives, including light rail, between Portland and Southwest 185th Avenue. These portions are identified as follows:

Technical Memorandum, Ecosystems #20g,	dated September, 1990
2.0 Alternatives Considered	dated 12/12/90
3.0 Affected Environment	dated 11/28/90
5.0 Environmental Consequences	dated 11/27/90

Our authority in this project is Section 404 of the Clean Water Act, wherein the U.S. Army Corps of Engineers is designated the administrator of the regulatory permit process for the authorization of fills placed in waters of the United States. Because of our regulatory involvement, we are a cooperating agency for the preparation of the SEIS.

We have reviewed the revised documents in light of the comments made in our June 14, 1990, letter. Considering the information as revised, we have no further comments. We will, however, be reviewing each waterway and wetland fill for practicable alternatives that will reduce impacts in accordance with the Section 404(b)(1) guidelines. It is understood, as stated in Ecosystems #20g, page V-14, more information will be presented in the Final EIS regarding mitigation, buffering, mechanisms to maintain wetland habitat, and alternatives.

The project has been assigned application number 8972. Please use this number in all future correspondence. If you have any questions regarding our regulatory authority, please contact Richard Johnson at the above address, or telephone (503) 326-6995.

Sincerely,

W. B. Paynter
Chief, Regulatory and Resource Branch

Copy Furnished:

TRI-MET

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Portland Field Office
727 NE 24th Avenue
Portland, OR 97232

December 7, 1989

1-7-90-SP-30

Catherine A. Houck
Shapiro & Associates
The Smith Tower, Suite 1400
506 Second Avenue
Seattle, Washington 98104

Dear Ms. Houck:

This is in response to your letter dated November 7, 1989, and received by us on November 9, 1989, requesting information on listed and proposed endangered and threatened species which may be present within the area of the proposed Westside Light Rail Project in Washington and Multhnomah Counties, Oregon.

Your request and this response are made pursuant to Section 7(c) of the Endangered Species Act of 1973, as amended (15 USC 1531 et. seq.).

To the best of our present knowledge there are no listed or proposed species occurring within the area of the proposed project. Should a species become officially listed or proposed before completion of your project, Department of Transportation Urban Mass Transit will be required to reevaluate its responsibilities under the Act.

We appreciate your concern for endangered species.

Sincerely,

fr Russell D. Peterson
Field Supervisor

cc: PFO-ES
ODFW (Nongame)
ONHP

NEIL GOLDSCHMIDT
GOVERNOR

Department of Transportation
STATE HISTORIC PRESERVATION OFFICE
Parks and Recreation Division
525 TRADE STREET SE, SALEM, OREGON 97310

December 1, 1989

Sharon Kelly Meyer
Senior Planner
Tri-Met
4012 SE 17th Avenue
Portland OR 97202

RE: Westside Corridor Project
DOE & DOA Forms

Dear Ms. Kelly:

Thank you for forwarding copies of the draft forms that are being created for the Westside Corridor Project. The Determination of Eligibility form is based on the National Register form and is excellent.

In terms of the Determination of Affect form, I have a few questions. On the first page there are several check-offs regarding the DOE status. The agency (FHWA) must make the eligibility determination and seek the concurrence of the SHPO. Occasionally, there can be a difference of opinion as the whether or not the property meets the Criteria, which brings the Department of the Interior (National Park Service) into the picture. Your form seems to indicate a different procedure will be used and perhaps needs some revision.

On the last page, last check-off, the language seems to read that you are asking for "no effect" sign-off for historic resources again, after this has been already requested in the first check-off. Are you referring solely to prehistoric or historic archeological sites?

I would be glad to discuss any of this at your convenience. I will be the staff person reviewing the above-ground component of the review. Call me at 378-5001.

Sincerely,

James M. Hamrick
Preservation Specialist

JMH:sqh

cc: Jane Morrison
Craig Markham, ODOT

73410-807

Parks and Recreation Department
STATE HISTORIC PRESERVATION OFFICE
525 TRADE STREET SE, SALEM, OREGON 97310 PHONE (503) 378-5001 FAX (503) 378-6447

July 9, 1990

RECEIVED
JUL 09 1990
SHAPIRO AND ASSOCIATES

Catherine Wharton
Shapiro & Associates
The Smith Tower
500 Second Avenue, Suite 1400
Seattle WA 98104

RE: Westside Corridor Project

Dear Ms. Wharton:

Thank you for requesting our comments on the materials you forwarded on June 12th relating to Section 106 compliance for the project referenced above. I have also discussed the submittal with Sharon Meyer at Tri-Met.

Please be advised that it is our opinion that consultation on the Cultural Resource Determination of Eligibility and Archeological Reconnaissance is not complete. As previously noted in a letter to Susan Killen, our concurrence in your findings of non-eligibility must be sought and requires backup documentation that was not presented in the material provided. Additionally, Dr. Le Gilsen's review of the Archeological Report may also result in requests for more information.

The Evaluation of Effect Form looks fine, although I wonder if the spaces for comment under the Criteria of Adverse Effect are large enough.

Call me if you have any questions.

Sincerely,

James M. Hamrick
Acting Deputy State Historic Preservation Officer

JMH:sqh

cc: Sharon Kelly Meyer

73410 807

Parks and Recreation Department
STATE HISTORIC PRESERVATION OFFICE
525 TRADE STREET SE, SALEM, OREGON 97310 PHONE (503) 378-5001 FAX (503) 378-6447

July 10, 1990

RECEIVED
JUL 12 1990
SHAPIRO AND ASSOCIATES

Catherine Wharton
Shapiro & Associates
The Smith Tower
500 Second Avenue, Suite 1400
Seattle WA 98104

RE: Westside Corridor Project
Archeological Reconnaissance Report

Dear Ms. Wharton:

As a follow-up to my recent letter, I am writing in regard to Dr. Le Gilsen's review of the report.

He expressed a number of concerns about the report, the process used to get the information, and future actions relating to the construction.

I would suggest that Dr. Keeler contact Le at his earliest convenience, in order to determine if the report can meet the requirements of Section 106.

Call me or Dr. Gilsen if you have any questions.

Sincerely,

James M. Hamrick
Acting Deputy State Historic Preservation Officer

JMH:sqh

cc: Sharon Kelly Meyer

73410 807

Parks and Recreation Department
STATE HISTORIC PRESERVATION OFFICE
525 TRADE STREET SE, SALEM, OREGON 97310 PHONE (503) 378-5001 FAX (503) 378-6447

October 15, 1990

OCT 16 1990
TRI MET ENGINEERING

Sharon Kelly Meyer
Senior Planner
Engineering & Project Development
115 NW First, Suite 500
Portland OR 97209

RE: Westside Corridor Project

Dear Sharon:

Thank you for your letter outlining the various stages of the Section 106 work that has been completed to date for the Westside light rail project.

I would concur that the process to this point meets the requirements of 36 CFR Part 800. Call me if you have any questions.

Sincerely,

James

James M. Hamrick
Acting Deputy State Historic Preservation Officer

JMH:sqh

Parks and Recreation Department
STATE HISTORIC PRESERVATION OFFICE
525 TRADE STREET SE, SALEM, OREGON 97310 PHONE (503) 378-5001 FAX (503) 378-6447

November 27, 1990

1990
TRI MET ENGINEERING

Sharon Kelly Meyer
Tri-Met Engineering Services
115 NW First Avenue Suite 500
Portland OR 97209

RE: Westside Corridor Project

Dear Sharon:

Thank you for requesting our concurrence on the seven new Determinations of Eligibility for properties potentially affected by the light rail corridor extension.

We concur that the seven are "eligible," and the original forms are attached.

Thank you for your thorough attention to our concerns during this entire process. Call me if you have any questions.

Sincerely,

James Hamrick

James M. Hamrick
Acting Deputy State Historic Preservation Officer

JMH:sqh

Oregon Natural Heritage Data Base

1205 NW 25th Avenue
Portland Oregon 97210
503 229 5078

20 September 1989

Catherine Houck
Shapiro and Associates, Inc.
The Smith Tower, Suite 1400
506 Second Ave.
Seattle, WA 98104

Dear Ms. Houck,

We have checked our data base system for rare, threatened and endangered plants, animals and plant communities within the project area, West Side Light Rail, as designated on the maps given to us. We show no occurrences of rare elements in this area. Of course, the absence of information does not mean that no rare elements occur there.

Thank you for your interest in rare elements.

Sincerely,

Sue Vrilakas

Sue Vrilakas
Data Manager/Botanist

STATE OF OREGON

DEPARTMENT OF ENVIRONMENTAL QUALITY **INTEROFFICE MEMORANDUM**

DATE: July 14, 1989

TRI-MET ENGINEERING
JUL 17 1989

TO: Alonzo Wertz, Tri-Met

FROM: HWH Howard Harris, DEQ

SUBJECT: Indirect Source Permit Information/Noise Comments on FEIS Issues

I am attaching indirect source applications (short form and long form) plus a copy of the Rules and a writeup on the indirect source program. Also, I am including a memo from John Ruscigno on noise issues that should be addressed in the Westside Corridor FEIS. With respect to air quality, the FEIS should address only those areas where expected impacts would be significantly different from the DEIS analysis. Any new emissions analytical work should be done with the recently released EPA Mobile4 emission factor computer program. I have the Mobile4 program and would be happy to provide your consultant with a copy. I can also provide assistance with respect to input parameters to run Mobile4.

Attachments

STATE OF OREGON
DEPARTMENT OF ENVIRONMENTAL QUALITY

INTEROFFICE MEMORANDUM

DATE: January 5, 1989

TO: Howard Harris

FROM: John Ruscigno

SUBJECT: Westside Corridor Noise Impacts

Per your request for comments on the re-opening of the Westside Corridor EIS process, we supply the following comments:

1) In our last correspondence with MSD on the DEIS (copy attached), we expressed our concern that the noise impact from an individual vehicle passby was not being properly addressed. By utilizing the Leq noise metric for mitigation criteria, the project would not adequately address the communication disruption and sleep interference caused by each vehicle passby at impacted noise sensitive properties.

2) We have also found that the LRT wheel squeal on tight radius curves can be a problem and should be addressed using Banfield LRT experiences.

3) We also found that rail switches can be a problem when located near noise sensitive properties.

4) We would also re-emphasize that all noise impacts from the park & ride lots, stations, maintenance yards, car barns, etc. should be addressed.

METRO

May 25, 1982

Metropolitan Service District
527 S. W. Hall
Portland, OR 97201

Attention: Steve Siegal, Project Director

Re: Noise Comments - Westside Corridor Project

Gentlemen:

We have reviewed, as you requested, the Draft E.I.S. for the Westside Corridor Project dated March 1982.

Generally, the report adequately describes the noise impacts of this proposal. We did find a typographical error on page 3.8-8 under the "Downtown Portland" paragraph. The reference to "EPA" bus regulations is incorrect and should be replaced with "DEQ" as DEQ rules control noise emissions from new buses whereas EPA has no standards for buses.

We are very concerned about peak noise impacts at residential uses caused by bus or light rail pass-bys. DEQ standards designed to protect communication activities during the daytime and sleep at night will be threatened. Although these standards may not be applicable to all alternatives of this project, the impacts to the public would remain. Exterior peak levels above 60 dBA will disrupt communication and should be avoided. Noise walls and berms can normally be designed to provide a 10 dBA noise reduction.

Interior noise levels to protect sleep activities caused by short-term activities should not exceed 45 dBA. Standard construction normally provides a 10 dBA reduction with windows open. Acoustical treatment may be necessary for any residential structure that is exposed to exterior nighttime peak noise in excess of 55 dBA.

Thank you for this opportunity to comment. If you have any questions, please contact this office.

Sincerely,

John M. Hector
Program Manager
Noise Pollution Control

JMH:aho

Oregon

DEPARTMENT OF ENVIRONMENTAL QUALITY

RECEIVED
JAN 22 1991
SHAPIRO AND ASSOCIATES, INC.

January 16, 1991

Alonzo W. Wertz
Project Development Manager
Tri-Met, Engineering Services
115 NW First Ave., Suite 500
Portland, OR 97209

Re: Westside Corridor
Project Supplemental
DEIS, Air Quality

Dear Alonzo:

The Air Quality Division has reviewed the above referenced documentation for the Westside Corridor Project. We note that the analysis projects potential exceedances of the 8-hour carbon monoxide standard for existing conditions and the No Build scenario at the Zoo. No measurements of carbon monoxide have been made in the canyon, so we would characterize a projection of standard exceedance levels as having a great deal of uncertainty, due to the unique terrain and possible micro-meteorological effects.

With respect to Chapter 3.5, Air Quality, we are offering some alternative, replacement language (enclosed) to reflect circumstances that have changed in the last year. On an overall basis, we are comfortable with the writeups on air quality and look forward to reviewing the formally released Supplemental DEIS under the normal A-95, intergovernmental review process.

Sincerely,

Howard W. Harris, P.E.
Transportation Control
Program Coordinator
Air Quality Division

HWH:a
PLAN\AH11807
Enclosure
cc: Tim Krause, Shapiro & Associates
Carol Cooper, Shapiro & Associates

811 SW Sixth Avenue
Portland, OR 97204-1390
(503) 229-5696

Attachment

January 14, 1991

Recommended Replacement Paragraphs

The following paragraphs are recommended as replacements for the third paragraph under Section 3.5, Air Quality, page 49 (Chapter 3, Affected Environment). The information below reflects current circumstances, significantly changed in some respects from the situation that existed in early to mid-1990.

Geographic areas in which concentrations of a particular pollutant exceed the NAAQS are classified as nonattainment areas. The nonattainment areas within the Portland-Vancouver Air Quality Maintenance Area (AQMA) include the Portland CBD for CO and the entire Portland-Vancouver AQMA for ozone. Oregon adopted a CO control strategy and both Oregon and Washington adopted ozone control strategies for the Portland-Vancouver AQMA as part of the State Implementation Plans (SIPs) in 1982.

CO concentrations in the CBD and ozone concentrations in the AQMA generally improved as projected in the SIP and were in compliance with the NAAQS during 1987-89. However, recent air pollution monitoring indicates that the area has continuing CO and ozone problems: (1) CO violations were recorded outside of the CBD at 4th Plain/Fort Vancouver Way in Vancouver during 1988-90, and two exceedances were recorded at 82nd/Division in Portland during 1989; and (2) ozone exceedances were measured downwind of the AQMA during 1990.

Because of these recent CO and ozone exceedances, the 1990 Clean Air Act requires that the Oregon and Washington SIPs be revised by November 1992 to include new CO and ozone attainment strategies for the Portland-Vancouver AQMA. In preparation for revised SIPs, the Oregon Department of Environmental Quality (ODEQ) and the Washington Department of Ecology (WDOE) prepared updated emission inventories during 1989 and 1990 for ozone precursors and fall/winter CO.

October 5, 1989

Shapiro & Associates, Inc.
The Smith Tower, Suite 1400
506 Second Ave.
Seattle, WA 98104 Attn: Catherine A. Houck

Re: Westside Light Rail Corridor

The attached bird species list has been compiled by Donna Lusthoff, David Irons and myself. We have all birded in this particular area of Beaverton since the mid '70's, and have seen all of the birds listed in this or the close surrounding area.

Unfortunately, in the time allotted, we cannot give you accurate accounts on the abundance or population, however, I marked some of the species with the usual birder's marks for abundance. We hope this list will give you what you need.

As to the specific routing of the Light RailCorridor effecting the bird population, I can give you our assumptions, which could probably be backed up by further studies:

1. The routing from downtown Portland to Walker Road on Hwy 217 would cause minimal problems for bird populations as this area is already a heavily trafficked route, and no wetlands are along this route. I was amazed earlier this summer to have seen a Red-tailed Hawk flying within 150' of the west end of the Vista Ridge Tunnel as I would never have suspected a buteo in this habitat.

2. Once the route turns westward away from Hwy 217 below Walker Road, it apparently follows Wessenger Creek and Beaverton Creek wetlands, which would pretty well be wiped out with a 30' right of way.

3. The parking lot areas, of course, will be the most devestating effect on the westlands, particularly at the Beaverton Transit Station, Murray Blvd and 185th. I do not know the exact location of these parking areas because of the small scale maps I had, however, I assume the 185th (1000 car) lot will be located as the flat area just north of Baseline & east of 185th by a couple hundred yards. At least, I couldn't find any other spot to located it except in heavily wooded lots.

4. The St. Mary's Woods park area is where most of the bird species are found as well as the majority of the population. Unfortunately, part of the wooded area to the north along Jenkins Road will be lost to development - though not a part of the Rail Project - but certainly influenced by it.

In the past year, I have seen,alongside Murray Road near the Knowll Exit (West side), a deer and fawn, and one day a Red-tailed Hawk was feeding on a carcass in the median strip just off the north end of the overpass - as cars whizzed past on both sides.

We hope these ideas will help you with your planning.

Very truly yours,

John Biewener

John Biewener
2740 NW 144th Av
Beaverton, OR 97006

(503) 645-0368

attachment: bird list.

Bird Checklist for area in Beaverton Light Rail Corridor

Great Blue Heron
Great Egret
Green-backed Heron
Canada Goose
Wood Duck
Green-winged Teal
Mallard
Northern Pintail
Blue-winged Teal
Cinnamon Teal
Northern Shoveler
Gadwall
American Wigeon
Lesser Scaup
Bufflehead
Hooded Merganser
Turkey Vulture
Sharp-shinned Hawk
COoper's Hawk
Red-tailed Hawk
Rough-legged Hawk
American Kestrel
Merlin
Ring-necked Pheasant
California Quail
Virginia Rail
Sora
American Coot
Killdeer
Common Snipe
Mew Gull
Ring-billed Gull
California Gull
Thayer's Gull
Western Gull
Glaucous-winged Gull
Rock Dove
Mourning Dove
Common Barn Owl
Western Screech Owl
Great Horned Owl
Vaux's Swift
Anna's Hummingbird
Rufous Hummingbird
Belted Kingfisher
Red-breasted Sapsucker
Downy Woodpecker
Hairy Woodpecker
Northern Flicker
Olive-sided Flycatcher
Western Wood-Pewee
Willow Flycatcher
Hammond's Flycatcher
Western Flycatcher
Tree Swallow
Violet-green Swallow
Cliff Swallow
Barn Swallow
Scrub Jay
American Crow
Black-capped Chickadee
Chestnut-backed Chickadee
Bushtit
Red-breasted Nuthatch
White-breasted Nuthatch
Brown Creeper
Bewick's Wren
House Wren
Marsh Wren
Golden-crowned Kinglet
Ruby-crowned Kinglet
Swainson's Thrush
Hermit Thrush
American Robin
Varied Thrush
Cedar Waxwing
European Starling
Hutton's Vireo
Warbling Vireo
Orange-crowned Warbler
Yellow-Warbler
Yellow-rumped Warbler
Black-throated Gray Warbler
Townsend's Warbler
Common Yellowthroat
Wilson's Warbler
Black-headed Grosbeak
Rufous-sided Towhee
Savannah Sparrow
Fox Sparrow
Lincoln's Sparrow
White-throated Sparrow
Golden-crowned Sparrow
White-crowned Sparrow
Dark-eyed Junco
Red-winged Blackbird
Western Meadowlark
Brewer's Blackbird
Brown-headed Cowbird
Northern Oriole
House Finch
Pine Siskin
Lesser Goldfinch
American Goldfinch
Evening Grosbeak
House Sparrow

Catherine Houck, Biologist
Shapiro and Associates, Inc.
The Smith Tower, Suite 1400
506 Second Avenue
Seattle, WA 98104

November 2, 1989

Dear Catherine,

Enclosed is my compiled data on wildlife occurrence and abundance in the area of the proposed Sunset Transit Center. I wish I could provide you with information on wildlife along other parts of the proposed Westside Light Rail corridor, but I have spent little time walking and observing wildlife there.

Many of the important wildlife habitat areas near the route are already being disturbed by development, particularly the ponds near the corner of Miller and Barnes Road and all the way down the Golf Creek drainage to Sunset Highway. The notable exception is the J. Peterkort property which, as you know, was planned for development which has so far not occurred. In the current plans, about 30 acres that include the floodplain, stream corridors, steep slopes, and the artesian spring-fed pond near the ends of N.W. 112th and 114th Streets will be maintained as a natural area. It will provide absolutely minimal protection for these habitats, and simply may not maintain enough space for some of the most important species, in particular the breeding populations of Pileated Woodpeckers, Cooper's Hawks, Vaux's Swifts, Hutton's Vireos, Northwestern Salamanders, and Coyotes that make this area both noteworthy and highly liveable for the human residents of the older, wooded neighborhoods. Therefore, it is of the utmost importance that all phases of development of that area be scrutinized and planned carefully. Otherwise, while one step may not be too disruptive, the cumulative effects of several different types of development may cause unpredicted and unacceptable degradation.

Although the Sunset Transit Center is proposed to be located on the level cultivated lands just north of the Highway 217 interchange, there may be impacts to the adjacent forested slopes, the stream and riparian zone, and downstream to the floodplain and pond. Storm runoff will be vastly increased by the paving of large acreage for the Transit center and associated parking area. Increased erosion of steep hillsides, increased loading of chemicals and other substances into the stream system, and increased flooding which could be the catalyst for highly disruptive flood control measures are

CHARLOTTE C. CORKI
130 N. W. 114th Street Portland, Oregon 97229 (503)643

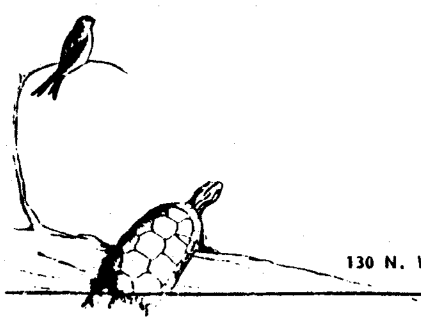
several major concerns which must be addressed. The potential for short-sighted planning to improve single passenger car traffic flow, even just to get to the Transit Center, is a major concern to residents of the surrounding neighborhoods, who are eager to help plan and build bicycle and pedestrian paths between their areas and the Transit Center, and who are interested in ensuring that the natural area is not chopped into separate islands of habitat by transecting roads.

Having not walked the areas, I personally know of no wetlands or other sensitive habitats that would be directly impacted by the Westside Light Rail in the adopted alignment or the alternative options. I would be happy to consult further, if additional information needs to be gathered, however, having just spent 3 solid days on the enclosed as a volunteer, I guess I'd have to resume my role as an independent wildlife consultant in a more businesslike manner! Thank you for the opportunity to participate in this planning effort.

Very sincerely,

Char

Charlotte C. Corkran



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ANNOTATED LIST OF NATIVE VERTEBRATE WILDLIFE SPECIES OBSERVED IN THE VICINITY OF THE PROPOSED SUNSET TRANSIT CENTER*
1972-1989
Charlotte C. Corkran

<u>FISH</u> (casual observations only)
Cutthroat Trout, Salmo clarki - Resident in most small streams
Sculpin, Cottus sp. - Unkn. sp., resident in most permanent water

<u>AMPHIBIANS</u> (casual observations only)
Northwestern (Brown) Salamander, Ambystoma gracile gracile - Breeds in the ponds and slow streams, forested areas. In late winter, terrestrial adults moving cross-country to breeding sites are vulnerable to traffic where habitat is broken up.
Western Long-toed Salamander, Ambystoma macrodactylum macrodactylum - Mostly subterranean, so rarely seen, but probably common in both forested and disturbed areas.
Oregon Ensatina, Ensatina eschscholtzi oregonensis - Very common in forested and open wooded areas.
Roughskin Newt, Taricha granulosa - Very common in forests, woods, and ponds.
Pacific Treefrog, Hyla regilla - Common near streams. Breeds in ponds and throughout the floodplain of Cedar Mill Creek.
Red-legged Frog, Rana aurora - Rare sightings. Needs study, particularly on competition with introduced Bullfrogs. Oregon Natural Heritage Data Base (ONHDB) Review List.

<u>REPTILES</u> (casual observations only)
[Painted Turtle, chrysemys picta - Reported from 2 ponds, species unconfirmed. Livetrapping in '86 unsuccessful. Needs study. ONHDB Threatened List.]
Northern Alligator Lizard, Elgaria coerulea - Regular sightings at one forest edge location. Status unknown.
Northwestern Garter Snake, Thamnophis ordinoides - Common in the upland areas, breeding in natural and man-made structures.
Red-spotted Garter Snake, Thamnophis sirtalis concinnus - Common along streams, the floodplain, and moist forested areas.

<u>BIRDS</u> (casual observations and informal surveys)
Great Blue Heron, Ardea herodias - Several residents. Breeding not known. Feeds along stream and in floodplain, roosts in mature forest edge.
Green-backed Heron, Butorides striatus - Occasional summer sightings near ponds and streams in the region.
Wood Duck, Aix sponsa - Regular breeder near the ponds and floodplain. Up to 104 seen on Xmas Bird Count at 2 ponds, during years when artificial feeding was occurring in winter.

* All of the information in this report pertains to private lands to the north of the Sunset Highway that are within a one mile radius of the site of the proposed Sunset Transit Center (referred to as "the Site"). For a few species, information is given from "the region" which also includes several ponds and open wooded areas which are within one and a half miles to the north of the site.

Green-winged Teal, Anas crecca - Occasional winter sightings on ponds in the region.
Mallard, Anas platyrhynchos - Breeds on ponds and in floodplain. Larger numbers in winter, especially when artificially fed.
Blue-winged Teal, Anas discors - Occasional fall/winter sightings on ponds in the region.
Cinnamon Teal, Anas cyanoptera - Occasional fall sightings on ponds in the region.
American Wigeon, Anas americana - Regular winter visitor to ponds in the region.
Bufflehead, Bucephala albeola - Regular sightings of 1 to 2 individuals at ponds in the region.
Hooded Merganser, Lophodytes cucullatus - Occasional fall and winter sightings at ponds in the region.
Sharp-shinned Hawk, Accipiter striatus - Regular winter resident in forested areas and neighborhoods with large trees (and bird feeders).
Cooper's Hawk, Accipiter cooperii - Rare year-round resident. Known to nest in mature forest adjacent to the Site. Hunts in forests and open wooded areas.
Red-tailed Hawk, Buteo jamaicensis - Regularly hunts over open fields of Site, and uses thermals from those fields for courtship displays. Immatures use same fields and thermals for learning flying and hunting skills. Large individual trees along edges of fields are favored perches. Probably nests along Tualatin Mtns (ie. ridge with Skyline Blvd. along top).
American Kestrel, Falco sparverius - Irregularly hunts and perches on the Site. Not known to nest there.
Ruffed Grouse, Bonasa umbellus - Irregular sightings in forested areas.
California Quail, Callipepla californica - Used to be a regular breeder in openings in woods, but recent increases in dogs, cats, opossums, etc. may be responsible for apparent decrease in numbers and apparently unsuccessful breeding.
Killdeer, Charadrius vociferus - Regular winter resident, foraging in cultivated fields. In spring, a few initiate nesting attempts in freshly plowed fields or gravel parking areas, and occasionally a nest is successful.
Common Snipe, Gallinago gallinago - Occasional fall and winter sightings in floodplain.
California Gull, Larus californicus - Flocks irregularly visit the area to forage in cultivated fields, especially in winter.
Glaucous-winged Gull, Larus glaucescens - Flocks irregularly visit the area to forage in cultivated fields, especially in winter.
Band-tailed Pigeon, Columba fasciata - Occasional sightings all year in wooded areas. Large flocks gather to forage on Blue Elderberries in July and August. Almost certainly breeds in woods near the Site.
Mourning Dove, Zenaida macroura - Year-round resident in open woods and nearby neighborhoods. Breeds in open woods.
Western Screech-Owl, Otus kennicottii - Breeds in riparian woods, hunts also in suburban neighborhoods with large trees. Not very vocal, perhaps because of plentiful Great Horned Owls, but probably quite common.

Great Horned Owl, Bubo virginianus - Large breeding population in forested areas, particularly on steep north slopes adjacent to the Site. Hunts also in floodplain, open woods, and residential areas with large trees (and small cats).
Northern Pygmy-Owl, Glaucidium gnoma - Heard in 1973, but not since, in forested area near the Site. Present status unknown.
Northern Saw-whet Owl, Aegolius acadicus - Occasionally heard in wooded areas near the Site. Status unknown.
Common Nighthawk, Chordeiles minor - Occasionally seen foraging over fields and floodplain, but probably does not breed near the Site.
Vaux's Swift, Chaetura vauxi - Since 1980 nests annually in large snags and occasional chimneys near the Site. Flocks of up to 100 gather in late summer, roosting apparently in snags in the mature forest adjacent to the Site. Forages for aerial insects over the floodplain and adjacent forested areas.
Anna's Hummingbird, Calypte anna - Winter resident since at least 1982, in open areas and edges where trees with berries and fruit are available. Known nesting 1984 through 1987 in blackberry thicket at edge of field near the Site. Cold period in February of 1989 appeared to eliminate local population. Present status unknown.
Rufous Hummingbird, Selasphorus rufus - Conspicuous in April, when Red currant is in bloom. Breeds in the area, probably along the riparian zone. Immatures frequent adjacent neighborhoods.
Belted Kingfisher, Ceryle alcyon - Irregular visitor, year-round, to fish in ponds and streams near the Site. Not known to breed there.
Red-breasted Sapsucker, Sphyrapicus ruber - Regularly seen in both coniferous and deciduous trees in forested and residential areas near the Site. Probably breeds, but status unknown.
Downy Woodpecker, Picoides pubescens - Quite common near the Site, especially in riparian areas. Nests in snags and dead branches.
Hairy Woodpecker, Picoides villosus - Infrequently seen in area since 1985, even though large snags are still available in some places near the Site.
Northern Flicker, Colaptes auratus - Still a fairly common breeder in forest and wooded residential areas near the site, even though introduced Starlings took over many cavities excavated by flickers and reduced their numbers during the 1970s. Starling numbers have dropped recently, and the flicker population seems to be recovering.
Pileated Woodpecker, Dryocopus pileatus - A relatively large number consistently breeds and forages in the large snags and abundant cedar trees in the mature forest areas adjacent to the Site. This is evidently the most reliable place around Portland for finding this species. It is on the ONHDB Review List, because large snags are maintained in so few places.
Olive-sided Flycatcher, Contopus borealis - Common summer resident, presumably breeding, along the riparian zone and wherever there are tall snags and snag tops in the forested areas adjacent to the Site and in nearby neighborhoods.
Western Wood Peewee, Contopus sordidulus - Common summer resident, presumably breeding, especially along the riparian zone.

Willow Flycatcher, Empidonax traillii - A few have summered and presumably have bred, annually since at least 1984, along the riparian zone and the floodplain edge.
Western Flycatcher, Empidonax difficilis - Common summer resident, breeding and foraging in forested and open wooded areas adjacent to the Site.
Violet-green Swallow, Tachycineta thalassina - A moderate number forage over the floodplain and forests, nesting in available cavities in snags adjacent to openings. Severe competition for nesting sites from introduced English Sparrows has reduced numbers of swallows, particularly in nearby residential areas.
Barn Swallow, Hirundo rustica - Moderate numbers forage throughout the area, nesting in and on natural and man-made structures in the more open areas.
Steller's Jay, Cyanocitta stelleri - Common year-round resident, foraging and nesting in forested and wooded residential areas adjacent to the Site. Mobbing jays regularly disclose whereabouts of Cooper's Hawks and Great Horned Owls.
Scrub Jay, Aphelocoma coerulescens - Common year-round resident, foraging and nesting in open wooded and residential areas adjacent to the site.
American Crow, Corvus brachyrynchos - Large flocks that roost in the Tualatin Mtns. forage in forests and cultivated fields near the Site. Probably some nest in the forests near the Site.
Black-capped Chickadee, Parus atricapillus - Common year-round resident in open wooded, riparian, and wooded residential areas around the Site. Nests in soft snags and dead branches, using an old woodpecker hole or excavating its own hole. Sometimes uses nest boxes. Forages mostly in deciduous tree branches.
Chestnut-backed Chickadee, Parus rufescens - Common year-round resident in forested areas adjacent to the Site. Nests in soft snags and dead branches, usually using an old woodpecker hole. Readily uses nest boxes. Forages in coniferous or deciduous trees, often high up in large trees.
Bushtit, Psaltriparus minimus - Common year-round resident in brushy, open wooded, and residential areas near the Site. Forages low in trees and in brush. Nests in woods and shrubby areas, seeming to favor the long, drooping branches of cedar trees for camouflaging the hanging nest.
Red-breasted Nuthatch, sitta canadensis - Common year-round resident in forested areas adjacent to the Site. Nests in soft snags and dead branches, usually using an old woodpecker hole. Rarely uses nest boxes. Forages in coniferous or deciduous trees, especially the rough bark of large, old trees.
Brown Creeper, Certhia americana - Common year-round resident in forested areas adjacent to the Site. Nests in crevices and under loose sections of bark of large, old trees. Forages on the trunks of coniferous or deciduous trees, especially the rough bark of large, old trees.
Bewick's Wren, Thryomanes bewickii - Common year-round resident, foraging in open wooded, shrubby, and residential areas near the Site. Nests in thick brush or branches, often in old woodpecker or other natural hole, occasionally in nest box.

Winter Wren, Troglodytes troglodytes - Common year-round resident in forested areas adjacent to the Site. Forages and nests in dense understory brush, particularly where dense forest comes close to streams and ponds.
American Dipper, Cinclus mexicanus - Occasionally found foraging along streams near the Site. Status unknown.
Golden-crowned Kinglet, Regulus satrapa - Common except during the breeding season. Flocks forage in forested and open wooded areas adjacent to the Site.
Ruby-crowned Kinglet, Regulus calendula - Fairly common except during the breeding season. Individuals often join flocks of other small birds, foraging in all areas with trees, but especially in the mature forest areas.
Swainson's Thrush, Catharus ustulatus - Regular, but not common, spring and fall migrant. A few may nest in the mature forest areas adjacent to the Site. Forages in forested and open wooded areas.
Hermit Thrush, Catharus guttatus - Moderately common spring and fall migrant. Occasional winter resident. Forages in forested and open wooded areas.
American Robin, Turdus migratorius - Common all year, abundant in winter and early spring. Nests mostly in open wooded and wooded residential areas. Forages in cultivated fields, berry-bearing trees (especially hawthorne and holly), lawns, etc.
Varied Thrush, Ixoreus naevius - Moderately common except during the breeding season. Very common in coldest winters. Forages in forested as well as open, cultivated areas. Roosts in mature forest areas adjacent to the Site.
Bohemian Waxwing, Bombycilla garrulus - Occasional winter flocks visit the area, feeding in berry-bearing trees and shrubs.
Cedar Waxwing, Bombycilla cedorum - Irregular year-round occurrence. Usually, large flocks arrive in May, as the Osoberries are ripening. Some nest in open forest areas near the Site. Large flocks with many immatures move around the area in fall, foraging in berry trees and shrubs, and occasionally using the tops of mature trees as perches while flycatching swarms of insects.
Solitary Vireo, Vireo solitarius - Occasionally seen in spring and fall. A very few may nest. Uses the open wooded areas.
Hutton's Vireo, Vireo huttoni - Probably present all year, as it is dependably heard from February through June. Known to nest in brushy forest understory not far from the Site. Uncommon but regular in forested and open wooded areas.
Warbling Vireo, Vireo gilvus - Moderately common in spring through fall. Nests and forages in riparian, open wooded, and wooded residential areas near the Site.
Tennessee Warbler, Vermivora peregrina - A rare migrant through the open wooded areas of the region.
Orange-crowned Warbler, Vermivora celata - Moderately common in spring through fall, in riparian and open wooded areas near the site. Probably nests in the area.
Nashville Warbler, Vermivora ruficapilla - An uncommon migrant through the area near the site.

Yellow Warbler, Dendroica petechia - Occasional late spring migrant, along riparian areas near the site. Probably does not breed in area.
Yellow-rumped Warbler, Dendroica coronata - The most common warbler at all seasons. Large flocks migrate through in spring and fall. Regularly seen in winter. Some nesting occurs. Uses a variety of wooded habitats. Both "Audubon's" and "Myrtle" forms occur, being about equally common.
Black-throated Gray Warbler, Dendroica nigrescens - Moderately common in spring through fall, in forested, open wooded, and wooded residential areas near the Site. Probably nests in the open wooded areas.
Townsend's Warbler, Dendroica townsendi - Moderately common spring and fall migrant. Occasionally seen in winter. A few may nest in the area near the Site. Forages high in the tallest conifers, and to a lesser extent elsewhere in the forested areas.
MacGillivray's Warbler, Oporornis tolmiei - Regular spring migrant, using brushy and riparian areas near the Site.
Common Yellowthroat, Geothlypis trichas - Moderately common in migration. In some years, a few remain to nest. Utilizes tall brush in the floodplain, brushy margins of cultivated fields, and particularly alfalfa.
Wilson's Warbler, Wilsonia pusilla - Common in migration. Some breeding in the area. Uses the riparian zone extensively, but also forages in brush and low in trees in wooded residential areas.
Western Tanager, Piranga ludoviciana - Moderately common in migration. A few may nest in some years. Usually forages in mature forest, but also uses other areas with trees.
Black-headed Grosbeak, Pheucticus melanocephalus - Common in spring through early fall. Nests in riparian zone and open woods. Forages also in residential areas.
Lazuli Bunting, Passerina amoena - A few utilize the brushy margins of cultivated fields at the Site in spring and summer, apparently nesting there.
Rufous-sided Towhee, Pipilo erythrophthalmus - Common all year, nesting in brushy understory of forested areas, and foraging in a variety of habitats in the area.
Chipping Sparrow, Spizella passerina - Rare spring sightings. Status unknown.
Savannah Sparrow, Passerculus sandwichensis - Irregular spring and summer occurrence. Moderately common in some years, apparently nesting. Uses the cultivated fields of the Site, and dense, weedy tangles at their margin.
Fox Sparrow, Passerella iliaca - Uncommon all year, but probably breeds in the area near the Site. Forages in leaf litter and dense understory of open wooded and riparian areas.
Song Sparrow, Melospiza melodia - Common year-round resident, nesting and foraging in a variety of brushy and weedy areas, especially along the riparian zone.
White-throated Sparrow, Zonotrichia albicollis - Uncommon in winter and spring, using dense underbrush in open woods and wooded residential areas near the Site.

Golden-crowned Sparrow, Zonotrichia atricapilla - Moderately common in fall through spring, using brushy edges of cultivated fields and residential areas near the Site.
White-crowned Sparrow, Zonotrichia leucophrys - Moderately common in spring through fall, presumably nesting. Rarely seen in winter. Uses edges of fields, and brushy or weedy areas near the Site.
Oregon Junco, Junco hyemalis oreganus - Very common in fall through spring, in all brushy and wooded areas. A few may remain to nest.
Red-winged Blackbird, Agelaius phoeniceus - Common breeder in the cattail marshes of the floodplain. Large flocks wander through the area in winter, foraging in cultivated fields.
Brewer's Blackbird, Euphagus cyanocephalus - Large flocks wander through the area in winter, foraging in cultivated fields. Probably breeds in open wooded areas.
Brown-headed Cowbird, Molothrus ater - Moderately common in spring through fall, utilizing a variety of habitats. Parasitizes nests of Song Sparrows, and probably other species.
Northern ("Bullock's) Oriole, Icterus galbula bullockii - Moderately common in spring through fall, foraging in a variety of wooded habitats, and nesting in the riparian zone.
Purple Finch, Carpodacus purpureus - Moderately common in spring through fall, although numbers vary considerably between years. Probably nests near the site. Uses forested, open wooded, and wooded residential areas.
House Finch, Carpodacus mexicanus - Very common all year, although at least many of the summer breeders are replaced in winter by other individuals. Utilizes all habitats with trees or brush.
Pine Siskin, Carduelis pinus - Common in winter and spring, abundant in some years. Large flocks wander through the area, descending on certain residential bird feeders, and using all wooded habitats. In some years, some stay to breed.
American Goldfinch, Carduelis tristis - Moderately common all year, although irregular in occurrence. Some nesting occurs in most years. Particularly favored habitat is the weedy thistle and teasel patches at the margins of cultivated fields of the Site.
Evening Grosbeak, Coccothraustes vespertinus - Irregular occurrence, but generally large flocks present from fall through late spring. Utilizes mature forests, but also takes over particular residential bird feeders.

<u>MAMMALS</u> (casual observations only)

Vagrant Shrew, Sorex vagrans - Probably common in wooded areas, especially riparian zones adjacent to the Site. Down logs used for nesting and hiding. Forages where dense grass, weeds, or underbrush are present.
Shrew-mole, Neurotrichus gibbsii - Probably common in wooded areas, especially riparian zones and moist, north slopes adjacent to the site. Down logs used for nesting and hiding. Forages under leaf litter, duff, and low underbrush.

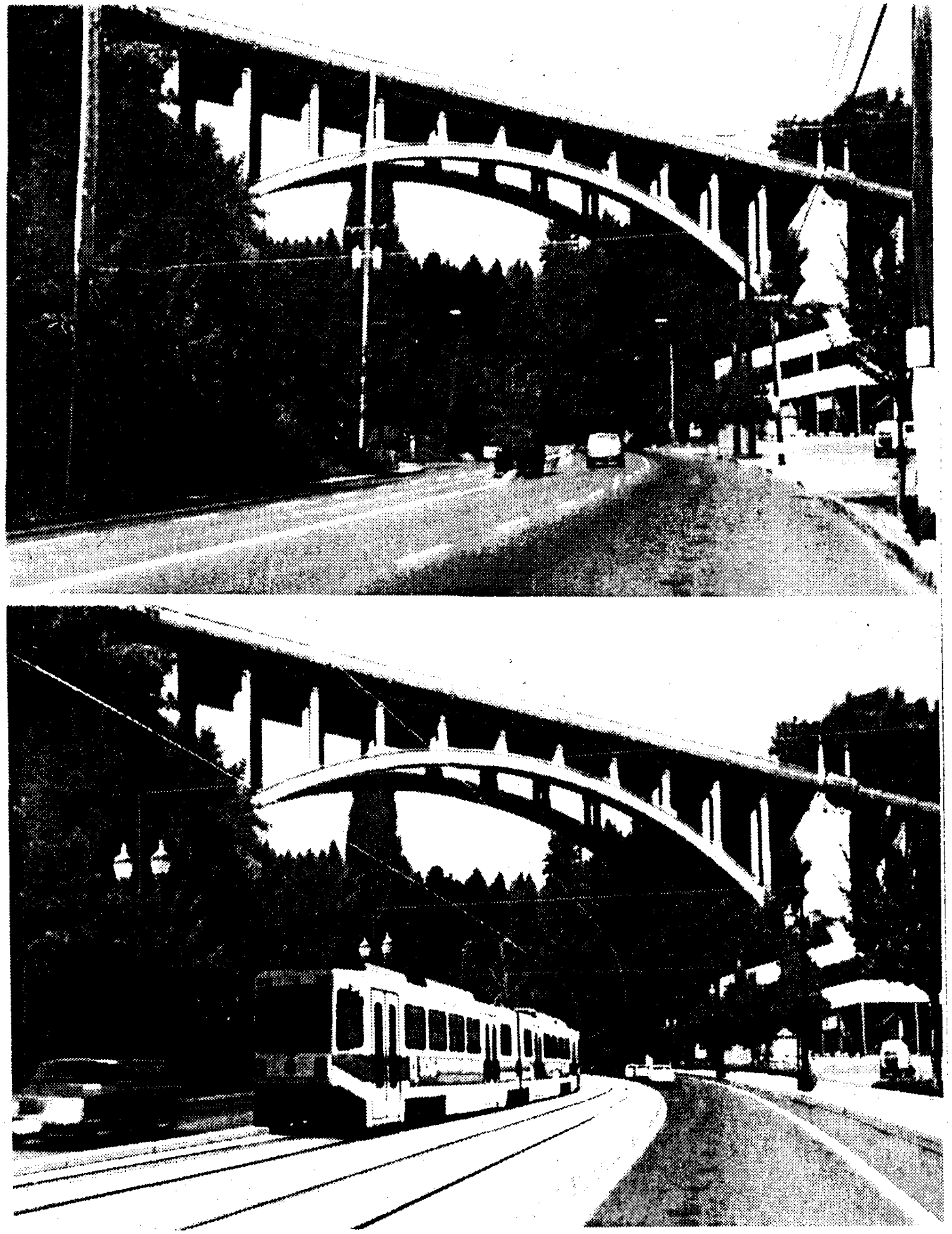
Townsend's Mole, Scapanus townsendii - Common in floodplain, moist forests, and cultivated areas. Any good soil will do.
Little Brown Myotis, Myotis lucifugus - Common in summer, foraging for insects throughout the area, but especially around the floodplain and riparian zone. Roosts and breeds in large snags in mature forests, and probably in some man-made structures.
[Other bat species are probably present but have not been identified.]
Brush Rabbit, Sylvilagus bachmani - Common in blackberry tangles, and weedy or brushy margins of cultivated areas near the Site. Breeds in and forages near these protected spots.
Townsend's Chipmunk, Tamias townsendii - Common in forest areas adjacent to the Site, although cats keep the numbers down near residential areas. Nests in rotten logs, bird nest boxes, and probably old woodpecker holes in snags. Forages in trees and shrubs.
Chickaree (Douglas' Squirrel), Tamiascurus douglasii - Moderately common in forests near the Site. Numbers kept low by cats and by competition with introduced Fox Squirrels which reached this area by the late 1980s. Mostly eats cones of Douglas fir and other conifers. Nests in dense conifer branches.
Northern Flying Squirrel, Glaucomys sabrinus - Probably moderately common in all forest areas near the Site. The relatively high numbers of Great Horned Owls may keep their numbers lower than normal. Forages in conifer and deciduous trees. Nests in woodpecker holes in snags, sometimes in dense tree branches, or in bird nest boxes.
Camas Pocket Gopher, Thomomys bulbivorus - Common subterranean resident throughout the area.
Beaver, Castor canadensis - Resident in the floodplain, but numbers severely reduced by trapping to eliminate damming of stream in floodplain. Probably occurs higher up streams, near the Site, but not as residents. Uses mostly willow, ash, and alder for dam and lodge building and for food.
Deer Mouse, Peromyscus maniculatus - Common throughout the area, especially in brushy parts.
Townsend's Vole, Microtus townsendii - Common in floodplain, small meadows, cultivated fields, other grassy places.
Muskrat, Ondatra zibethicus - Resident in ponds and slow parts of streams that have cattails and other marsh vegetation, but numbers remain low due to trapping pressure.
Coyote, Canis latrans - Uncommon resident. These individuals have apparently adapted to living close to residential areas by not vocalizing (except the young ones), and by nocturnal hunting for small cats, pet food, and un-cooped poultry, as well as more natural rodent and rabbit prey in the forest and open wooded areas near the Site, and voles and frogs in the floodplain.
Raccoon, Procyon lotor - Moderately common, especially around the ponds and floodplain. Uses snags for dens. Forages also in residential garbage and pet food.
Long-tailed Weasel, Mustela frenata - Rare resident, probably nearly eliminated by trapping, cats and dogs, etc. Dens in down logs and snags. Hunts especially in riparian areas.

Striped Skunk, Mephitis mephitis - Uncommon resident, numbers depressed by cars and trapping. Dens in down logs. Forages especially in riparian areas, but also in residential garbage, pet food, and bird seed.
Black-tailed Deer, Odocoileus hemionus - Occasional visitor, in the open wooded areas near the Site. Uncommon resident, foraging and breeding in open wooded areas of the region, at least prior to current development.

Compiled by Charlotte C. Corkran, November, 1989
130 N. W. 114th Street, Portland, Oregon 97229 (503)643-1349
All of the observations, as well as the assumptions of species abundance, distribution, and timing of occurrence, were made by the compiler, with the exception of one report of Painted Turtle.

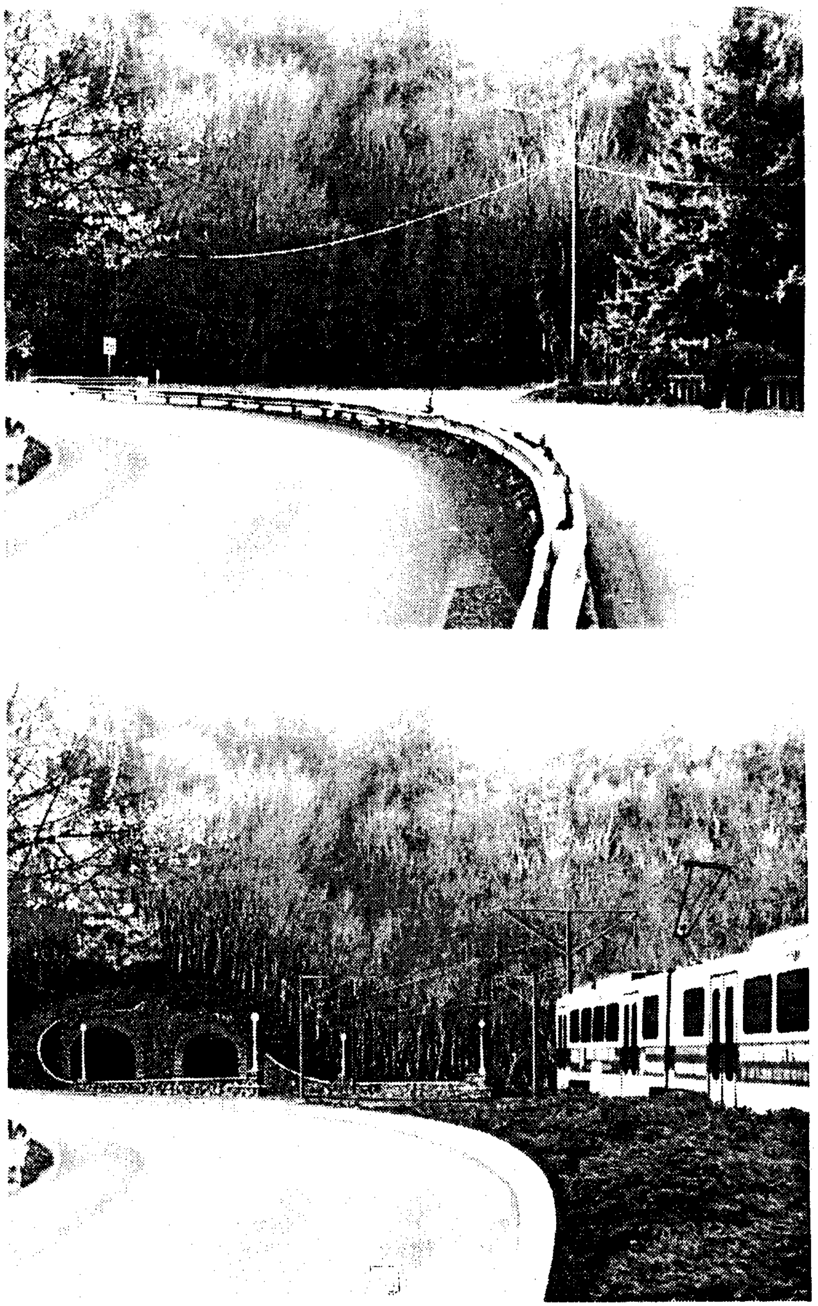
APPENDIX C

VISUAL SIMULATIONS

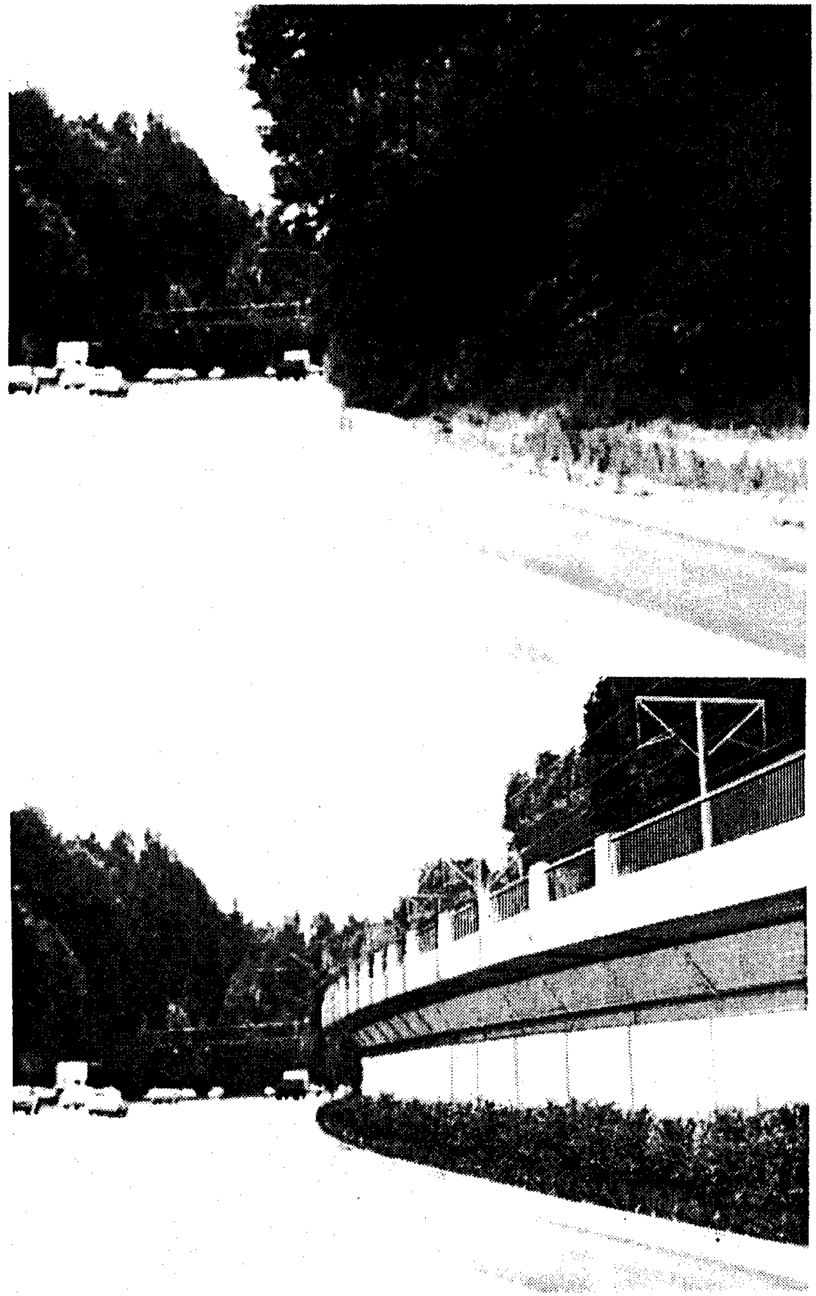


LOOKING WEST AT VISTA BRIDGE NORTHSIDE OR LONG TUNNEL OPTION

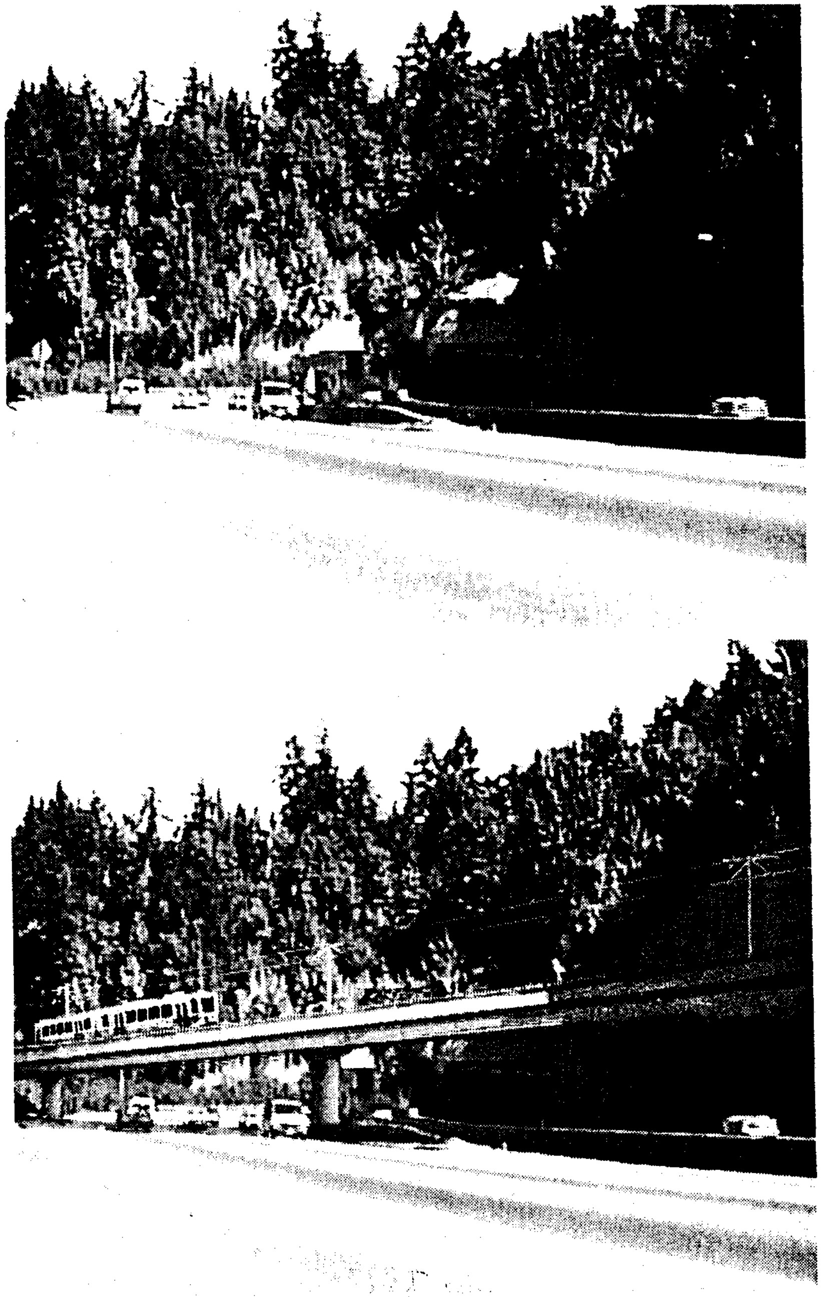
LOOKING WEST AT VISTA BRIDGE SOUTHSIDE OPTION



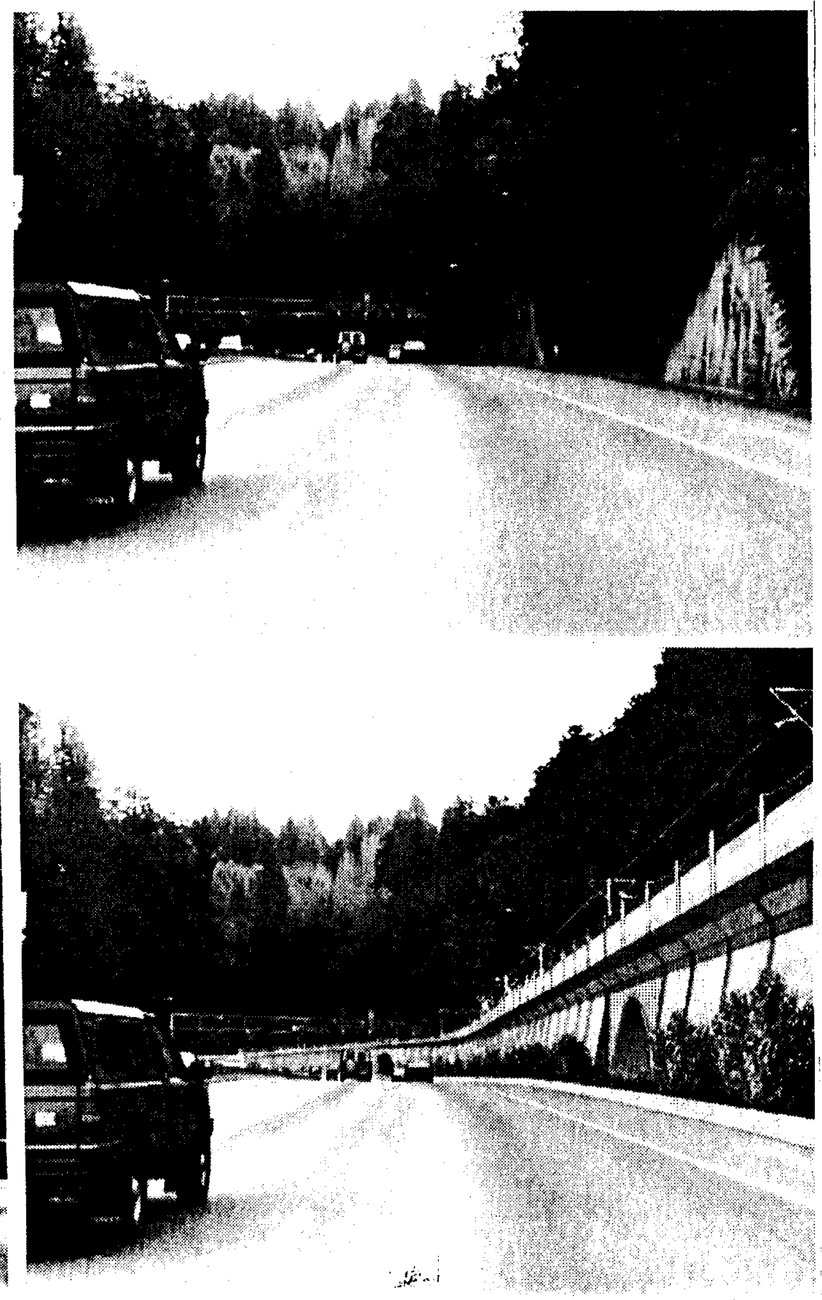
VIEW OF TUNNEL EAST PORTAL LOOKING SOUTHWESTERLY FROM
SW CANYON ROAD AND SW MURRAY STREET NORTHSIDE OR LONG TUNNEL OPTION



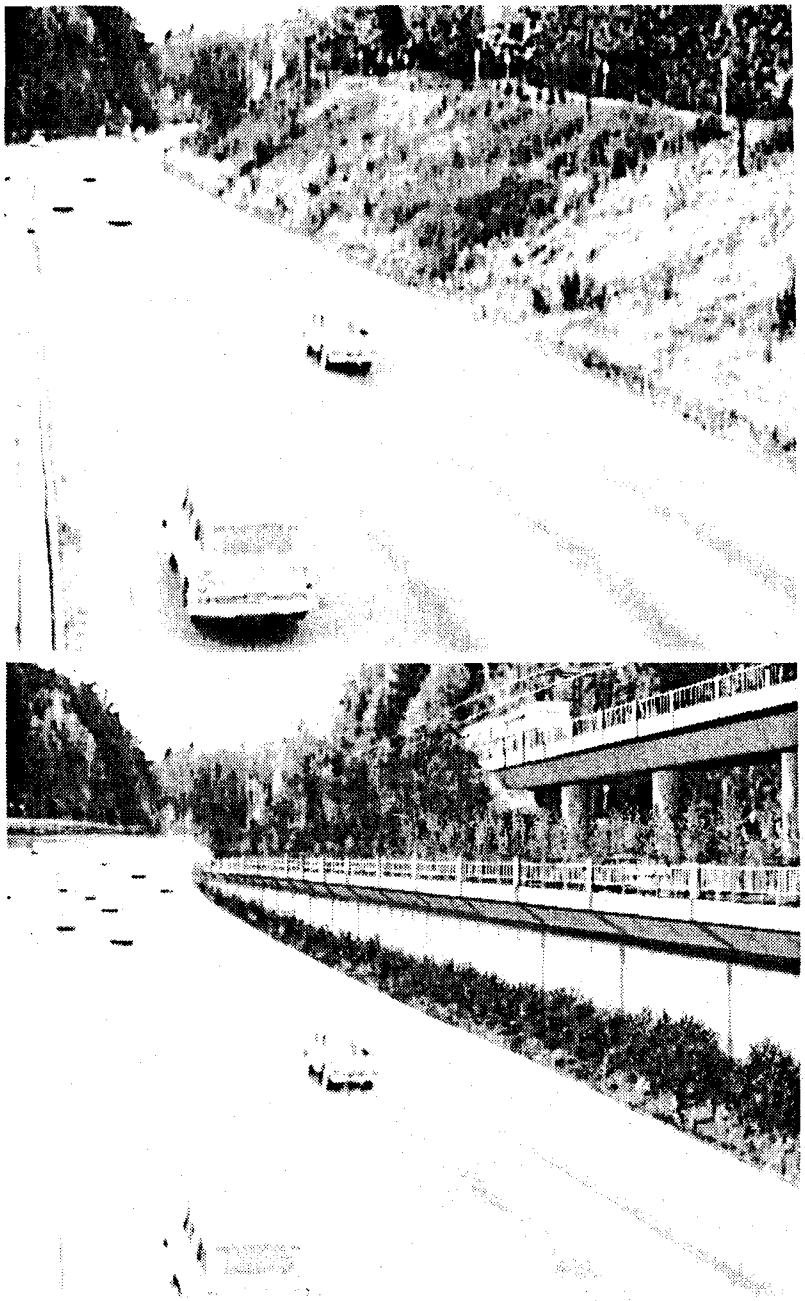
VIEW EAST OF ZOO ON SUNSET HIGHWAY
LOOKING WEST NORTHSIDE OPTION



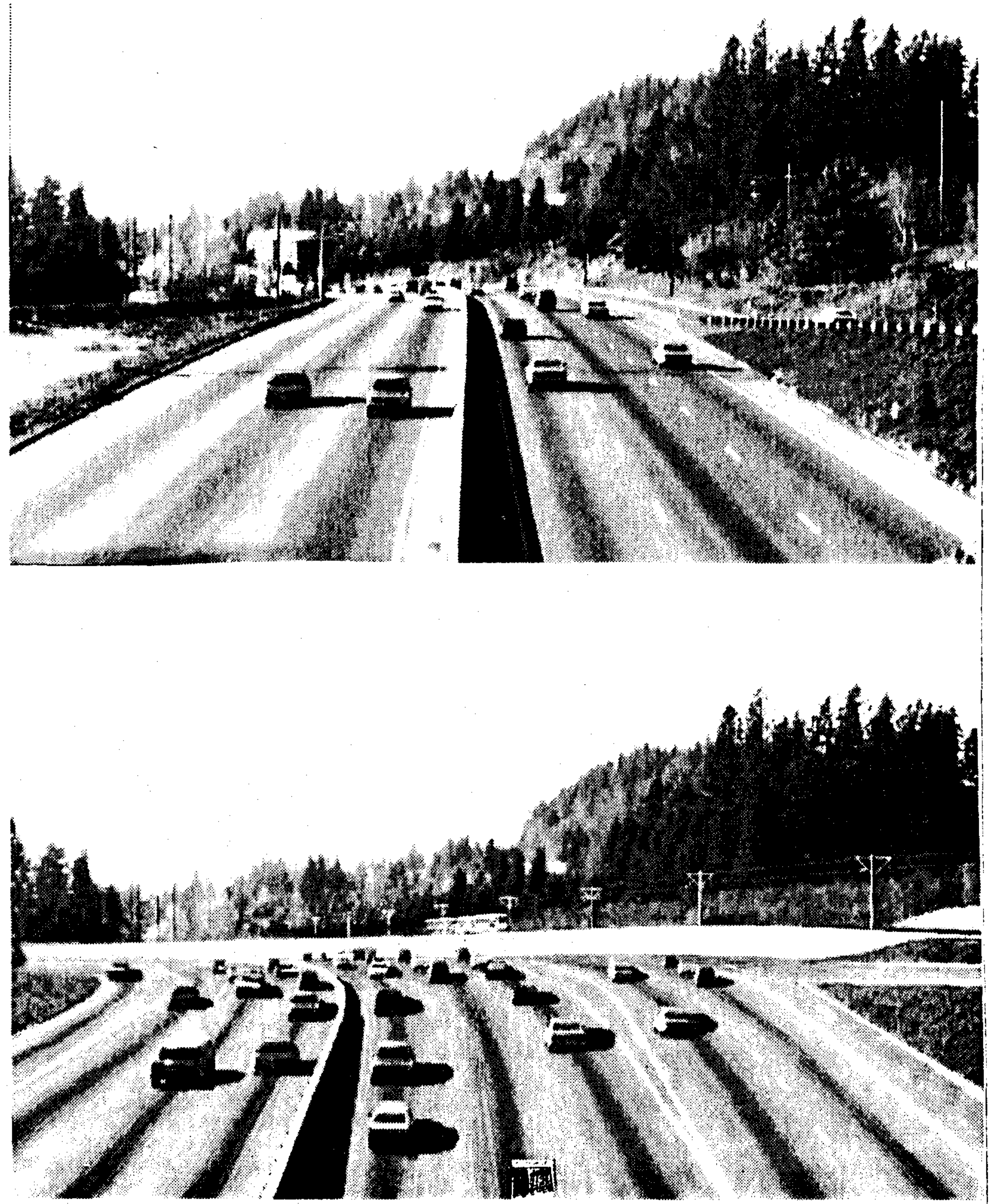
VIEW OF VISTA RIDGE HIGHWAY TUNNEL
LOOKING EAST SOUTHSIDE OPTION



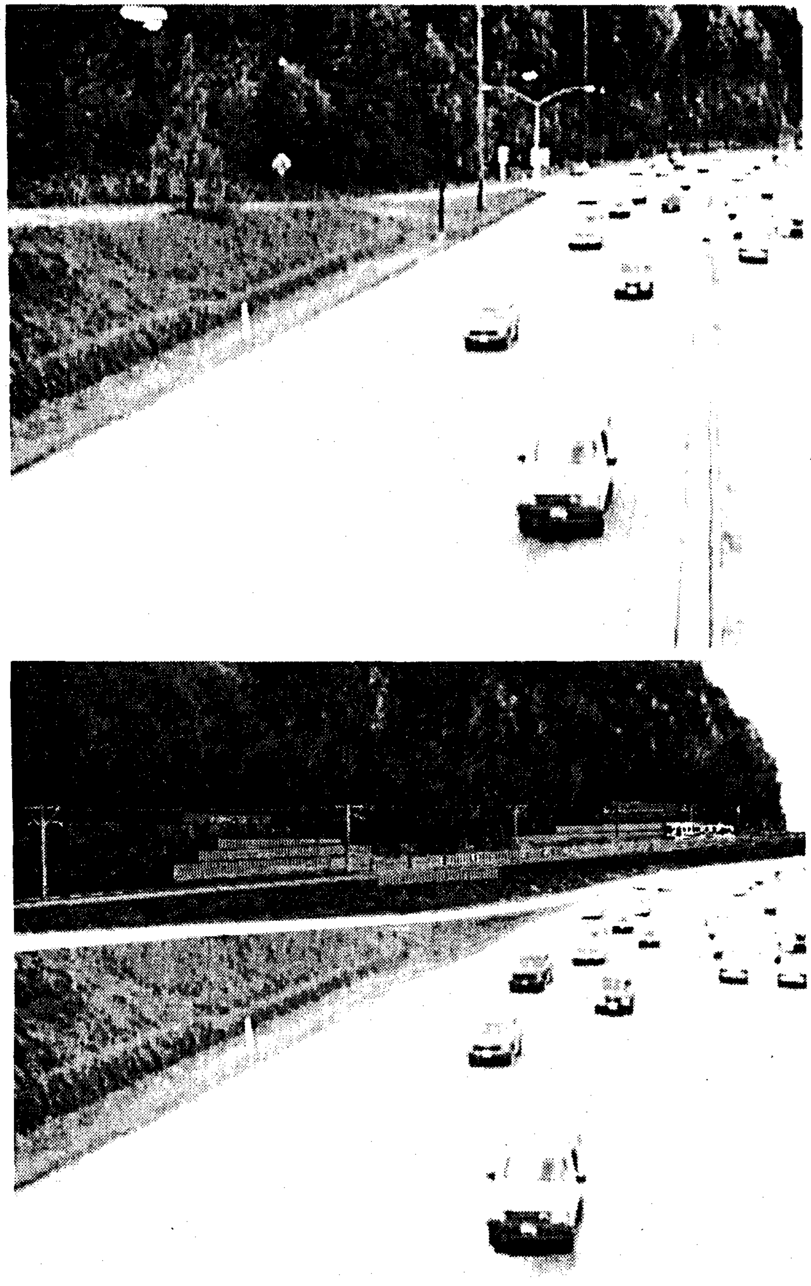
VIEW EAST OF ZOO ON SUNSET HIGHWAY LOOKING
EAST SOUTHSIDE OPTION ENHANCED



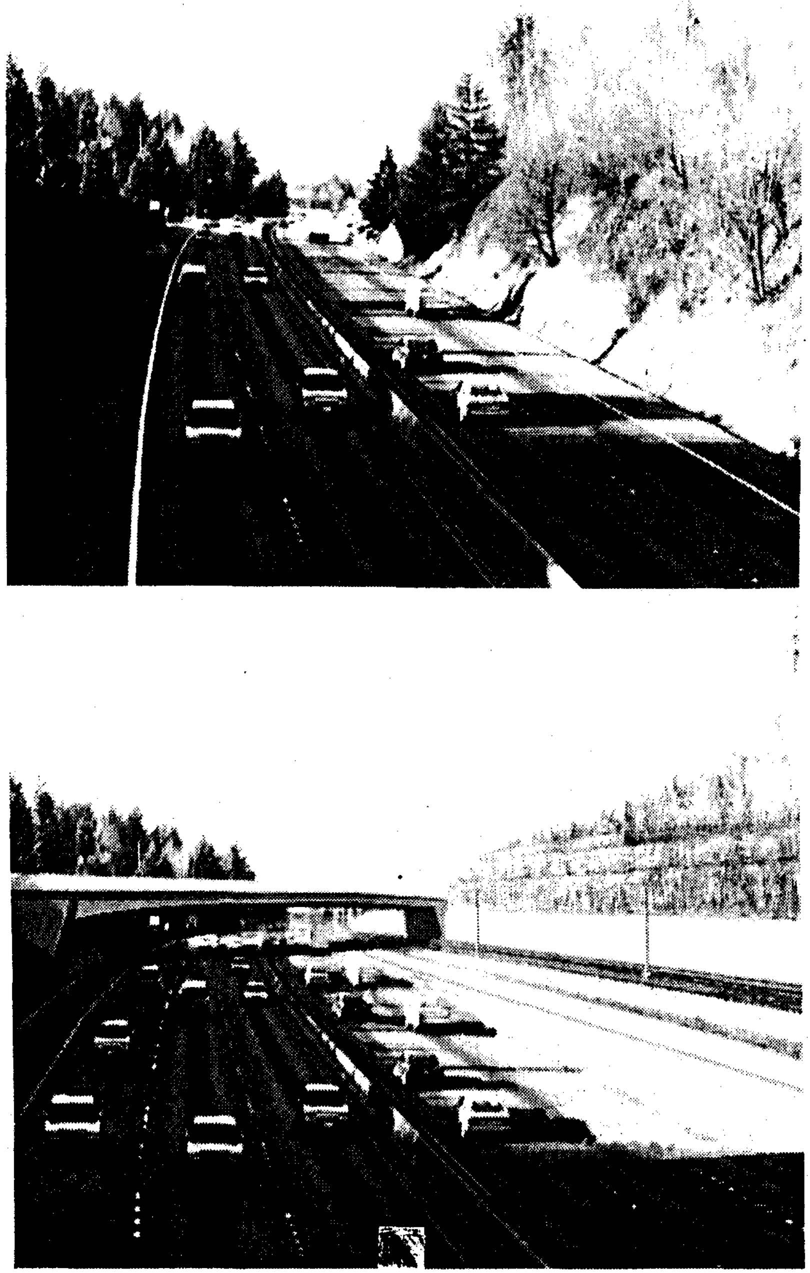
VIEW FROM ZOO OVERPASS LOOKING WEST NORTHSIDE OPTION



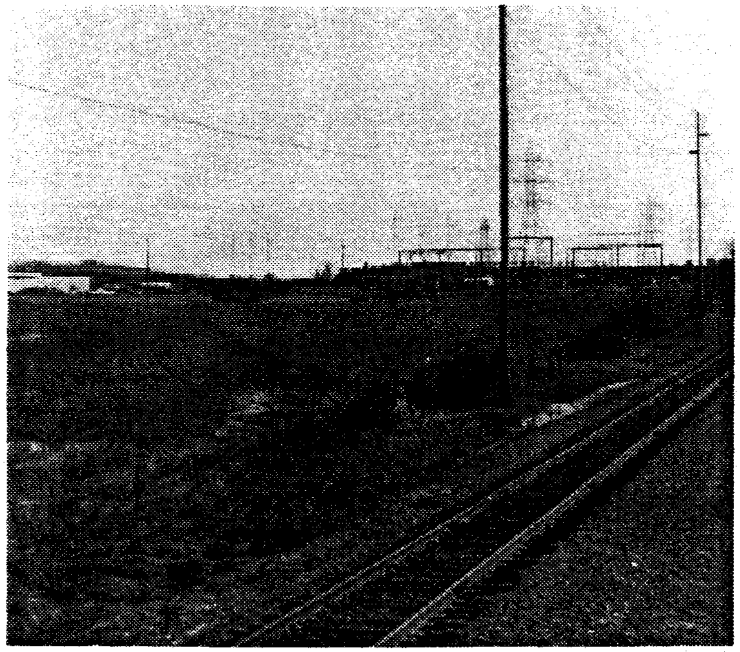
VIEW FROM SYLVAN OVERPASS LOOKING WEST NORTHSIDE AND SOUTHSIDE OPTIONS



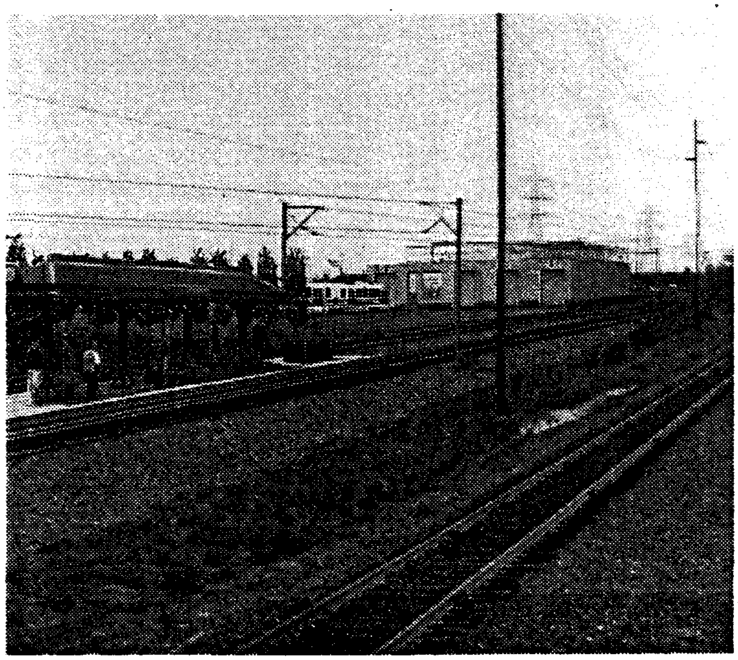
VIEW FROM ZOO OVERPASS LOOKING WEST SOUTHSIDE OPTION



VIEW FROM CAMELOT CT. OVERPASS LOOKING WEST
NORTHSIDE AND SOUTHSIDE OPTIONS



Existing



LRT- All Built Alternatives

GLOSSARY
REFERENCES
LIST OF PREPARERS
LIST OF RECIPIENTS

GLOSSARY

Access Time: The time required to walk or drive from the origin of the trip (for example, from home) to a (boarding) transit stop, plus the waiting time based on the frequency of transit service, the transfer time and the walking or driving time from the transit (deboarding) stop to the destination. For auto trips, it is the time required to walk to and from parking places, and delays within parking facilities, if any.

Air Pollutant (also, air contaminant): Smoke, dust, fumes, or odors in the ambient air that have potential for harmful effects.

Alignment: Horizontal and vertical geometric elements which define the location of a roadway or fixed-guideway transit facility.

Alluvium: An unconsolidated, terrestrial sediment composed of sorted or unsorted sand, gravel and clay that have been deposited by water.

Ambient Air: Surrounding air.

Annualized Capital Cost: A one time capital cost converted into an annual value which incorporates both the depreciation on the capital item and the foregone interest on the money invested in the project.

Annualized Energy: Total energy consumed annually for operations and construction of an energy system, expressed in British Thermal Units (Btu) per day.

AQMA: Air Quality Maintenance Area. An area having the potential to violate a federal or state ambient air quality standard, based on expected growth and development in the area.

Area Source: A general classification of the origin of an air pollutant (e.g., park-and-ride lots are area sources of CO emissions).

Arterial Roadway: A roadway with partial control of access, with some intersections at-grade and intended to move high volumes of traffic over long distances at high speed.

Articulated Vehicle: A vehicle which is jointed in a fashion which allows passenger access through the joint. Allows longer vehicles to turn at a shorter radius.

Artifacts: Any portable object used and/or modified by civilization (particularly during prehistoric times).

At-Grade Crossing: Any intersection of two or more flows of traffic at the same elevation (possibly involving more than one mode of transportation).

Atmospheric Stability: A measure of the capacity of the ambient air to disperse air pollutants, unstable air dispersing them more rapidly than stable air. (Pasquill stability designations A through F refer to increasingly stable air.)

Averaging Time (also, exposure time): The duration of exposure to a given concentration of an air contaminant, specified in ambient air quality standards, (e.g., the two national standards of 10mg/m3 and 40 mg/m3 specify averaging times of eight hours and one hour).

Average Daily Traffic (ADT): The total volume of traffic during a given time period divided by the number of days in that time period, representative of average traffic in a one-day time period.

Average Wait Time: Average time spent by passengers in the station (or stop) waiting for service.

Average Weekday (AWD): A measurement of average conditions during one weekday, i.e., Monday through Friday.

Background Concentration: The air pollutant level that would exist at a site in the absence of air pollution sources in the neighborhood of the site. (Different from Modeled Concentration).

Baseline Energy Consumption: Energy consumption, usually for a no build alternative, that is used as a reference against which energy consumption for a build alternative is compared.

Below-Grade: Placed below the ground surface as with a subway.

Boarding Trips: A trip on a transit line or group of lines, where each boarding of a transit vehicle is considered the start of a new trip. Number of trips boarding (entering) transit vehicles, regardless of whether the trip involved a transfer from another transit vehicle. Equivalent to unlinked trips. A fare may or may not be collected for each boarding trip, depending on whether a transfer is used.

Brushy Woodland Habitat: A habitat characterized by dense stands of deciduous trees and shrubs. Birds, small mammals and reptiles are common. This habitat type is often found in cleared areas that have not been maintained.

Btu: British Thermal Unit. An energy unit equal to the quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit. One therm equals 100,000 Btu.

Capital Costs: Nonrecurring costs required to construct transit systems, including costs of right-of-way, facilities, rolling stock, power distribution and the associated administrative and design costs, and financing charges during construction.

Car Pool: A group of passengers and drivers organized to utilize one automobile on a regular basis, riding together, for the same trip purpose (generally the work trip).

CBD (Central Business District): An area of major retail, financial and service activities concentrated in a downtown area. In Portland, the CBD constitutes census tracts 51,53,54,56 and 57. This is generally the area encompassed by the Willamette River and Interstate-405 freeway loop in the downtown area.

CO: Carbon Monoxide. A colorless, odorless, tasteless gas, and one of the criteria air pollutants released from automobile exhaust.

Concentration (also, level): A measure of the amount of an air pollutant in the ambient air, having the units of mass per volume.

Construction Energy: In transportation analysis, the energy used to build stations, terminals, roadbeds, trackbeds, tunnels, vehicles and other equipment and facilities. Construction energy includes the energy content of materials and the energy used to haul and place them.

CPO (Community Planning Organizations): Areas divided geographically charged with the responsibility of developing community plans which are a part of the overall Washington County comprehensive planning process.

Corridor: A route or restricted path connecting two locations such as Highway 26 between Washington County and downtown Portland.

Criteria Air Pollutants: Those air pollutants which have been recognized by the EPA as potentially harmful and for which standards have been set to protect the public health and welfare. The criteria air pollutants are carbon monoxide, sulfer dioxide, particulates, nitrogen dioxide, ozone, hydrocarbons and lead.

dBA: The sound level obtained through the use of A-weighting characteristics specified by the American National Standards Institute (ANSI) Standard S1.4-1971. The unit of measure is the decibel (dB), commonly referred to as dBA when A-weighting is used. The "A" weighting scale closely resembles human response to noise.

Disturbed Habitat: A habitat in which naturally occurring ecological processes and species interactions have been significantly disrupted by the direct or indirect results of human presence and activity.

Ecologically Sensitive Area: An area valued locally for its rare or sensitive habitat existing in a relatively undisturbed, natural state and supporting indigenous species.

Efficiency: In energy systems, the quotient of energy outputs to energy inputs, being in the range from zero to one (e.g., the energy efficiency of U.S. electric power generation plants is approximately 0.3). In transportation systems, the degree of goal attainment measured relative to cost, indicative of the productivity of a given level of investment.

Elasticity: In economic analysis, the sensitivity of the demand or supply of a commodity to changes in another variable, (e.g., the price elasticity of gasoline is the ratio of the percent change in consumption to percent change in price).

Elevated Guideway: A guideway which is positioned above the normal activity level (e.g., elevated over a street).

Emission Control: Method by which emissions are governed in an effort to minimize the amount of pollutants and/or noise emitted.

Emission Inventory: A listing by emission source of the amounts of air pollutants released into the atmosphere (generally, in tons or kilograms per day).

Emission Source: The origin of an air pollutant, (e.g., automobiles and trucks are sources of carbon monoxide, hydrocarbons and nitrogen oxides).

Emission Standard: A limitation on the release of an air contaminant into the ambient air (e.g., the federal government limits CO, HC and NOx emission per mile of travel in new automobiles).

Emissions: Particulate, gaseous, noise or electro-magnetic by products of the transit system or vehicle.

Endangered Species: According to the Federal Endangered Species Act of 1973, endangered species are any species in danger of extinction throughout all or a significant portion of its range, other than an insect determined by the Secretary of the Interior to constitute a pest whose protection under the provisions of this act would present an overwhelming and overriding risk to man.

Energy: The capability of doing work. Forms of energy include kinetic, potential, thermal, electromagnetic and nuclear. One form of energy may be converted to another (e.g., in hydroelectric plants, the conversion is from potential to kinetic to electromagnetic energy).

Energy Content of Materials: A total energy value equal to the sum of the latent energy of a material and the energy used in its manufacture.

Energy Factor: A number when multiplied by the appropriate usage units (e.g., vehicle miles, tons, dollars), yields a measure of energy consumption (e.g., 0.50 gallons per vehicle mile x 10 miles = 0.5 gallons consumed for propulsion).

Energy System: The network of major and minor routes, vehicles, facilities and other energy consuming entities that are considered in energy analysis.

Equity: The incidence of fairness and the distribution of costs and impacts among population subgroups.

Express Service: Transit service where a very limited number of stops are made en route.

Facilities Energy (also, station energy): A portion of the operational energy that includes the energy to operate parking lots, administration buildings and other facilities. It does not include propulsion or maintenance energy.

Fare: The authorized amount (cash or token) paid or valid transfer, pass, etc., presented for a transit ride.

Fare Box: A device that accepts and in some cases registers coins and tokens used by passengers as payment for rides.

Fare Structure: The methodology of determining the fare which a passenger pays for service.

Fareless Square: A fare-free area within the Portland Central Business District (CBD).

Feeder Bus Station: A station that provides lateral transportation service for riders to transfer to a transit mode.

Feeder Service: Local transit service which feeds some other (usually faster and at higher capacity) transit service.

Forest or Woodland Habitat: A habitat type generally dominated by Douglas fir, Western red cedar and Western hemlock, frequently with a hardwood understory. The ground cover is generally lush. Birds and small mammals abound and larger mammals are common in large stands.

Frequency, Vehicle: Time rate of vehicle arrivals at a station or stop or along a transit line.

Gaussian Model: A type of air dispersion model that is used to predict air pollutant concentrations based upon knowledge of the emissions source and of the meteorology in the area being studied.

Grade Separated: Parallel or crossing lines of traffic that are vertically separated from each other and do not share a common intersection.

Guideway: Specifically designed way traversed by transit vehicles constrained to the way.

HC: Hydrocarbons; specifically, non-methane hydrocarbons that contribute to the formation of photochemical oxidants (commonly known as smog), primarily ozone.

Headway: The time between transit vehicles at any particular point along the route.

HOV: High Occupancy Vehicle. Typically includes carpools with two or more people, vanpools and buses.

Impedance Value: A factor used to weight time spent waiting for transit. Often computed as 2.1 times the out-of-vehicle time.

Indirect Energy: A term used to denote all energy inputs for the construction, operation and maintenance of a system, exclusive of propulsion energy and parasitic loads within vehicles.

Indirect Source: An entity that does not directly emit pollutants but attracts emission sources such as automobiles and trucks. Shopping centers, stadiums and highways are examples.

Induced Trips: Trips generated because of the construction of a new (transportation) facility. (Different from Shifted Trips).

Intactness: The visual integrity of a landscape's natural and built features.

Integration with Other Modes: Method by which a transit system interfaces with other modes of transportation.

Interchange: The system of interconnecting ramps between two or more intersecting roadways or guideways which are grade separated.

Joint Development: Opportunities for the development or redevelopment of adjacent parcels (in station areas) in a manner which would support both the transit investment and the community objectives through the use of both public and private funds.

Kiss-and-Ride Station: A station that provides temporary loading and unloading facilities for autos and/or buses. The station may be combined with feeder bus stations.

KW: Kilowatt, a unit of electrical energy.

KWH: Kilowatt-hour; one Kilowatt of energy (measured over one hour).

L10: The sound level that is exceeded ten percent of the time (the 90th percentile) for the period under consideration. This value is an indicator of both the magnitude and frequency of occurrence of the loudest noise events.

L10(h): The hourly value of L10.

Land Development Pattern: The use, types and intensity of development. Land development patterns affect trip demand, average trip length and therefore, energy consumption.

Landscaped Habitat: A habitat in urban areas having limited native species. Vegetation generally consists of mowed lawns and exotic trees and bushes.

Ldn: The day/night average noise level.

Leq: The equivalent steady-state sound level which in a stated period of time would contain the same acoustic energy as the time-varying sound level during the same period.

Leq(h): The hourly value of Leq.

Level of Service (LOS): A qualitative measure that represents the collective factors of travel under a particular volume condition. A measure of traffic congestion.

Light Rail Transit (LRT): A mode of mass transportation comprised of light rail vehicles which travel on steel tracks and are powered by electricity from overhead wires. This mode is characterized by its ability to operate in both at-grade and/or grade-separated environment, and usually operating in combinations of 1,2, 3, or 4 vehicles.

Line Haul: A transit system which offers service along a line or corridor.

Line Source: A general classification of the origin of an air pollutant, (e.g., highways and other roads are line sources of CO emission).

Load Factor: The average ratio of passengers to seats during some specified period of operation of a public transit route.

Local Service: A type of operation involving frequent stops and consequent low speeds, the purpose of which is to deliver and pick up transit passengers as close to their destinations or origins as possible.

Loess: A wind deposited soil.

Maintenance Energy: A portion of operational energy that is applied to repair and maintenance of vehicles and buildings in the system. It does not include propulsion or facilities energy.

Microgram Per Cubic Meter (abbreviated g/m3 or mcg/m3): A unit of concentration equal to one thousandth of a gram per cubic meter.

Milligram Per Cubic Meter (abbreviated mg/m3): A unit of concentration equal to one millionth of a gram (or 1,000 micrograms) per cubic meter.

Minimum Turn Radius: Generally assumed to be the minimum horizontal turn radius.

Minority Groups: As defined by Metro, this includes blacks, hispanics and all racial/ethnic groups other than Caucasian.

Modeled Concentration: An air pollutant level, excluding the background level, predicted by a model (see Background Concentrations).

Mode: A particular form or method of travel.

Mode Split: Forecast of the proportion of total person-trips that would use each of the various modes of transportation that include transit and cars.

National Ambient Air Quality Standards (NAAQS): A federal limit on levels of atmospheric contamination necessary to protect the public from adverse effects on health (primary standards) and welfare (secondary standards).

National Historic Preservation Act of 1966: The Act which established the National Register and State Historic Preservation programs, and set forth guidelines and regulations for grants and environmental review of projects involving federal funding.

National Register of Historic Places: The official list of the nation's cultural resources worthy of preservation.

Network: A system of real or hypothetical interconnecting links that form the configuration of transit routes and stops which constitute the total system.

Nonattainment Area: An area designated by the EPA as presently violating the National Ambient Air Quality Standards, based on archival air quality data.

NOx: Oxides of nitrogen (nitrogen oxide and nitrogen dioxide). The pollutants released during high temperature combustion of fossil fuels such as diesel.

Off-Peak: Those periods of the day where demand for transit service is not at a maximum.

One Hundred Year Floodplain: An area of land susceptible to flooding during a storm which would historically occur only once every 100 years.

Operating Costs: Recurring costs incurred in operating transit systems, including wages and salaries, maintenance of facilities and equipment, fuel, supplies, employee benefits, insurance, taxes and other administrative costs. Amortization of facilities and equipment is not included.

Operating Revenue: The gross income from operation of the transit system including fares, charter income, concessions, advertising, etc. Does not include interest from securities, non-recurring income from sale of capital assets, etc.

Operational Energy: The energy used for vehicle propulsion, facilities and maintenance for a specified period, usually one year.

Open Field Habitat: A habitat characterized by various species of perennial and annual grasses, forbs, small and large birds, small mammals and snakes. This habitat is especially important in providing nesting sites and food for various song and predatory birds.

Originating Ride (or Trip): A one-way trip taken on a transit line or group of lines, where a transfer from one line to another is not considered to be the start of a new trip.

Ozone: A gas consisting of three oxygen atoms formed in reactions of non-methane hydrocarbons and nitrogen oxides in the presence of sunlight. One of the criteria air pollutants.

Park-and-Ride Lot: A lot that provides all day parking facilities for cars. Park-and-Ride lots are located near the fringe areas of a transit system where feeder bus service is sparse or nonexistent.

Particulate: See TSP, Total Suspended Particulates.

Passenger Mile: An amount of travel equivalent to one passenger traveling one mile.

Pasquill Stability Class: A category of atmospheric stability ranging from Class A (extremely unstable conditions) to Class F (moderately stable conditions).

Patronage: The number of person-trips carried by a transit system over a specified time period.

Payback Period (also, breakeven period): The period over which the initial cost of a project is recuperated. The period is calculated by dividing the construction energy consumption of a project by the forecast annual operational energy savings attributable to the project. Savings are measured against baseline energy consumption, and are the net of savings (losses) in propulsion, savings (losses) in maintenance and savings (losses) in facilities.

Pb: Lead. A component of total suspended particulates released in the combustion of gasoline containing lead.

Peak Hour: The hour of the day in which the maximum demand for service is experienced, accommodating the largest number of automobile or transit patrons.

Peak Period: A specified time period for which the volume of traffic is greater than that during other similar periods.

Person-Trip: A trip made by a person by any travel mode.

Photochemical Oxidants (Smog): Gaseous pollutants formed from reactions of HC and NOx in the presence of sunlight, (e.g., ozone).

Place Mile: A unit of carrying capacity that equals the capacity of a vehicle (including seats and standees for transit vehicles) multiplied by the miles the vehicle travels.

Platform Hours: Elapsed time from when a transit bus or train pulls out of the garage into service to when it returns to the garage after completing its service.

Point Source: A general classification of the origin of an air or water pollutant, usually characterized as smokestacks.

Power: The time rate of energy use.

Propulsion Energy (also, direct energy): In transportation analysis, a portion of operational energy that includes fuels and electricity to propel vehicles and provide lighting, heating and air conditioning within them.

Pulsing: The coordinated arrival and departure of buses on a number of different bus lines at a transit center to facilitate transferring of passengers among those bus lines. Usually, local feeder bus lines are scheduled to arrive at the transit center just ahead of the trunkline bus or train and then depart just after the trunkline bus or train.

Radial Line: A transit line with a terminus in the downtown area.

Radial System: A network of transit lines which meet in the downtown area.

Rare Species: A designation in the State of Oregon for species that are not presently threatened with extinction, but are limited to a restricted range or habitat or occur sparsely over a wider area. Listed species may be locally abundant but known at only a few sites, or occur in small number scattered over a wide range.

Right-of-Way: The corridor (horizontal and vertical space) occupied by the transportation way.

Riparian Habitat: A habitat type associated with stream and lake margins and characterized by dense vegetation consisting primarily of willow, alder and cottonwood species, supporting a wide variety of waterfowl, songbirds, amphibians and small mammals.

Route: The course followed by a transit vehicle as a part of the transit system.

Route Miles: The length of a route measured in miles between its end points.

Runoff: The rainwater which directly leaves an area in surface drainage, as opposed to the amount that seeps out as groundwater.

Seat Mile: An amount of potential travel equivalent to one transit seat traveling one mile.

Section 4(f) Land: Section 4(f) of the Department of Transportation Act applies to the following properties: any publically owned land from a public park, recreational area or wildlife and waterfowl refuge, or any land from an historic site used by the project.

Section 106: A portion of the National Historic Preservation Act of 1966 which establishes a review procedure of cultural resources which may be affected by projects receiving federal funds.

Sensitive Landscape Element: An individual object, landform, waterbody, structure, vegetation mass, or other visible form that is aesthetically important and is vulnerable (sensitive) to alteration of its character or views of it.

Sensitive Receptor: A local area or site which supports activities easily disrupted by audio or visual intrusions or distractions, such as a park, historic landmark or residential neighborhood.

Signal Preemption: Traffic signal options which may modify normal signal phasing for preferential treatment of transit vehicles.

SIP: State Implementation Plan. A plan required of each state by the Clean Air Act that describes how the state will attain and maintain the National Ambient Air Quality Standards.

Smog: See Photochemical Oxidants.

Social Interaction: Intra-neighborhood communication and circulation, utilizing street, sidewalk and bikeway connections between residential areas and community facilities, retail businesses, and employment centers. Also includes verbal interaction and telecommunications facilities.

Staging Area: A holding area where transit vehicles wait until they can depart the location in a specific scheduled sequence.

Station Area: For the purpose of this SDEIS, station areas have been defined as a 0.25-mile radius.

Terminal: The terminating point of transportation routes of one or more modes with transfer facilities and, often, amenities for passenger convenience.

Terminus: A transit station located at the end of a transit line.

Threatened Species: According to the Federal Endangered Species Act of 1973, any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Through-route: Interconnected transit lines in the downtown area, or at a transit center, which allows buses (or trains) entering downtown or the transit center on one line to pass straight through and exit on another line. This eliminates the need to turn transit vehicles around downtown or at the transit center.

Through-routing: Connecting together bus lines which otherwise would terminate in the downtown or at a transit center.

Total Suspended Particulate (TSP): Air pollutants which consist of solid particles (dust, lead, salts, etc.) suspended in the atmosphere. A criteria air pollutant.

Total Travel Time: The total elapsed time between trip beginning and end, including travel, terminal and waiting time.

Transfer: The portion of a trip between two connecting transit lines, both of which are used for completion of the trip.

Transfer Ratio: The number of boarding trips divided by originating trips.

Transfer Time: The elapsed trip time required to effect a change of mode or to transfer between routes of the same mode.

Transit: A transportation system principally for moving people in an urban area and made available to the public usually through paying a fare.

Transit Center: An off-street station with shelter where a large number of transit vehicles and passengers can be brought together with safety and convenience.

Transportation Accessibility: Both the ease of movement in a corridor and the proximity of residents to regional jobs.

Transportation Corridor (also, Corridor): The group of travel movements (or travel flows) between two or more locations. A corridor may have components, or sub corridors. A corridor includes all facilities, transit and highway, that may be used to accommodate the specified travel movement. In this analysis, the Westside Corridor is the transportation system under investigation.

Travel Time: The time required to travel between two points, not including terminal or waiting time.

Trip: The one-way movement of one person between his origin and his destination, including the walk to and from the means of transportation.

Trip Demand: The number and type (public or private origin and destination) of trips measured or calculated in a specified area having a given land development pattern. Trip demand also depends on prevailing economic, behavioral and attitudinal conditions.

Trip Length: The number of miles per trip. This is usually an average number for a specified trip type, area and analysis year.

Trunkline: A relatively high frequency, high capacity transit line which connects outlying activity centers and/or transit centers to the downtown area.

TSM: Transportation System Management. Strategies for improving the efficiency of existing roads and highways without major new capital investment.

Unity: The visual coherence and compositional harmony of the landscape.

Use of Section 4(f) Land: According to regulations of the U.S. Department of Transportation, use of Section 4(f) land is: 1) acquisition of title or easement to land, or 2) in unusual circumstances, serious indirect impacts, such as increase in noise, visual intrusion or access obstruction.

Vehicle Mile: An amount of travel equivalent to one vehicle traveling one mile.

Vehicle Occupancy: The number of persons per vehicle. Usually an average number for a specified trip type, area and analysis year.

View Opportunity Corridor: A visual corridor showing views of the surrounding landscape from the evaluated project or other significant viewpoints near the project.

Viewshed: An area from which a facility is generally visible from an array of points (individual viewpoints can be blocked by foreground obstructions, but still be within the general viewshed).

Visually Significant Areas: A local area that is found to be visually important to the community by virtue of its prominence, distinctive character, vulnerability to change, array of sensitive or high quality landscape elements (natural or built) or other appearance factors.

Vividness: The visual power or memorability of landscape components as they combine striking and distinctive visual patterns.

Walk-on Station: A station where the mode of arrival is by walking. This type of station will be targeted at high-density residential areas and employment concentrations.

Weaving: The crossing of two or more traffic streams traveling in the same direction along a significant length of highway, without the aid of traffic control devices. Weaving areas are formed when a merge area is closely followed by a diverge area.

Wetland Habitat: A habitat in lowland areas covered with water for all or part of the year. It is generally dominated by various grasses and sedges and is especially important to waterfowl wintering or resting habitat. Freshwater wetland areas in Oregon are limited.

Wetlands: Wetlands are areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, under normal conditions, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes and similar areas.

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