Southeast Portland Bus Rapid Transit Corridor Analysis

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Southeast Portland Bus Rapid Transit Corridor Analysis

prhg
Pahs - Rohden - Hampsten - Gallant
TRANSPORTATION SYSTEMS PLANNING & DESIGN
Southeast Portland Bus Rapid Transit Corridor Analysis

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Submitted in partial fulfillment of the Master of Urban and Regional Planning Degree
Portland State University

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Foreword
This project was completed in partial fulfillment of the Master of Urban and Regional Planning degree program at Portland State University. The Planning Workshop is the capstone course for the program, and is intended to give students practical planning experience. The course develops technical planning skills, by allowing students to gain exposure to the planning profession by completing a real-world planning project.

The client for this analysis was Tri-Met, Portland’s transit agency. The project team examined a potential corridor for future transportation enhancements. The objective of this project was to analyze alignment alternatives, and make recommendations to Tri-Met for a Bus Rapid Transit (BRT) system linking downtown Portland, Oregon, to developing areas in Southeast Portland.

The project team, PRHG Consulting, consisted of Matthew Pahs, Mark Rohden, David Hampsten and Seth Gallant. PRHG specializes in land use, transportation, urban design, and the interactions among each discipline. As a group, we identified a project based on our interests within the field of planning, and sought a client who could benefit from the outcome of our efforts. The project client, as well as a group of advisors selected by the project team, helped to guide our analysis strategy.

PRHG Consulting intends that this document will contribute to the client’s overall goal of providing transportation options to Portland metropolitan residents.
Southeast Portland Bus Rapid Transit Corridor Analysis

TABLE OF CONTENTS:

EXECUTIVE SUMMARY ................................................................................................................. 1

PART ONE: BACKGROUND ............................................................................................................. 1
  INTRODUCTION .......................................................................................................................... 1
  PURPOSE AND NEED ................................................................................................................... 2
  BUS RAPID TRANSIT CONCEPT .............................................................................................. 4
  SYSTEM GOALS .......................................................................................................................... 9
  PUBLIC INVOLVEMENT .............................................................................................................. 10

PART TWO: ANALYSIS .................................................................................................................. 12
  CRITERIA FOR CORRIDOR SELECTION ................................................................................... 12
  ALIGNMENT OPTIONS ............................................................................................................... 15
  CORRIDOR ANALYSIS: METHODOLOGY ................................................................................ 18
  CORRIDOR ANALYSIS: RESULTS ............................................................................................ 23
  STATION ANALYSIS: CRITERIA ............................................................................................... 40
  STATION ANALYSIS: RESULTS ................................................................................................ 42

PART THREE: CONCLUSIONS & RECOMMENDATIONS ............................................................. 47
  OPTIMAL ALIGNMENTS ............................................................................................................. 47
  MODEL LIMITATIONS ............................................................................................................... 48
  RECOMMENDATIONS ............................................................................................................... 49
  IMPLEMENTATION STRATEGY .................................................................................................. 51

APPENDICIES ............................................................................................................................... 53
  APPENDIX A: EXISTING PLANS AND POLICIES .................................................................... 53
  APPENDIX B: GLOSSARY OF TERMS ...................................................................................... 58

REFERENCES ................................................................................................................................. 61
Southeast Portland Bus Rapid Transit Corridor Analysis

LIST OF TABLES:

Table A: Results Matrix........................................................................................................... 23
Table B: Powell/205/Foster...................................................................................................... 24
Table C: Powell/205/Sunnyside.............................................................................................. 26
Table D: Powell/Foster............................................................................................................ 28
Table E: Powell/Division/182nd.............................................................................................. 30
Table F: Powell/Foster/205/Sunnyside.................................................................................. 32
Table G: McLoughlin/212........................................................................................................ 34
Table H: McLoughlin/Sunnyside............................................................................................ 36
Table I: Springwater.............................................................................................................. 38
Table J: Operations vs. Connectivity: The Tradeoff................................................................. 47

LIST OF FIGURES:

Figure A: Regional Context...................................................................................................... 3
Figure B: Alignment Alternatives............................................................................................ 15
Figure C: Typical Right-of-Way Cross-Section. ..................................................................... 20
Figure D: Powell/205/Foster Alignment................................................................................ 24
Figure E: Powell/205/Sunnyside Alignment.......................................................................... 26
Figure F: Powell/Foster Alignment......................................................................................... 28
Figure G: Powell/Division/182nd Alignment........................................................................ 30
Figure H: Powell/Foster/205/Sunnyside Alignment............................................................... 32
Figure I: McLoughlin/212 Alignment..................................................................................... 34
Figure J: McLoughlin/Sunnyside Alignment......................................................................... 36
Figure K: Springwater Alignment.......................................................................................... 38
Figure L: Typical Station Cross Section................................................................................ 40
EXECUTIVE SUMMARY

As metropolitan Portland continues to develop over the next 20 years, transit options will need to be expanded to meet the growing demands on the region's transportation system. Some outlying portions of Southeast Portland, specifically, the emerging communities of Pleasant Valley and Damascus, have been designated by Metro as areas that should be planned to accommodate future increases in population. Both Metro and Tri-Met have expressed a desire for Bus Rapid Transit (BRT) service to this area from downtown Portland, within a corridor roughly following SE Powell Boulevard and Foster Rd.

An extensive preliminary analysis of alternative BRT alignments was conducted for this study. After identifying eight alignment options (see map) linking downtown Portland with Pleasant Valley and Damascus Town Centers, a multivariate corridor analysis was applied to each of them. The criteria used for choosing the best alignment alternative include regional connectivity, local ridership, operational costs, trip duration, distance, right-of-way and political feasibility, environmental costs, and capital construction costs.

Alignments Considered
Regional connectivity is the measure of how effectively a given corridor connects to large commercial centers and institutions. Local ridership refers to the number of potential transit riders living within a quarter-mile of the corridor. Operational costs refer to the length, travel time and maintenance costs of an alignment option. Right-of-way represents the costs, both financial and political, of widening a given corridor enough for a BRT system without removing any existing travel lanes or sidewalks. Environmental factors include impacts to both natural and pedestrian environments. Finally, the relative capital construction costs include road building and other improvements.

These criteria were used to evaluate each of the eight alignment alternatives. After measuring, scoring, and weighting each variable, the alternatives were ranked in order of their overall performance. Results of the analysis are shown in the table below. For the two highest scoring alternatives, PRHG Consulting has made recommendations for possible station locations, as well as platform standards.

Results of the Analysis

<table>
<thead>
<tr>
<th>Southeast Portland Bus Rapid Transit Alignment Options</th>
<th>Connectivity</th>
<th>Ridership</th>
<th>Operations</th>
<th>Right-Of-Way</th>
<th>Environment</th>
<th>Construction</th>
<th>Total Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Powell/205/Foster</td>
<td>66%</td>
<td>54%</td>
<td>93%</td>
<td>83%</td>
<td>82%</td>
<td>82%</td>
<td></td>
</tr>
<tr>
<td>Powell/205/Sunnyside</td>
<td>100%</td>
<td>77%</td>
<td>53%</td>
<td>92%</td>
<td>92%</td>
<td>94%</td>
<td>80%</td>
</tr>
<tr>
<td>Powell/Foster</td>
<td>46%</td>
<td>88%</td>
<td>100%</td>
<td>60%</td>
<td>90%</td>
<td>83%</td>
<td>77%</td>
</tr>
<tr>
<td>Powell/205/Division/182nd</td>
<td>67%</td>
<td>100%</td>
<td>44%</td>
<td>94%</td>
<td>100%</td>
<td>92%</td>
<td>76%</td>
</tr>
<tr>
<td>Powell/Foster/205/Sunnyside</td>
<td>84%</td>
<td>79%</td>
<td>54%</td>
<td>73%</td>
<td>98%</td>
<td>96%</td>
<td>75%</td>
</tr>
<tr>
<td>South Corridor/212</td>
<td>91%</td>
<td>44%</td>
<td>57%</td>
<td>100%</td>
<td>86%</td>
<td>100%</td>
<td>73%</td>
</tr>
<tr>
<td>South Corridor/Sunnyside</td>
<td>84%</td>
<td>48%</td>
<td>60%</td>
<td>89%</td>
<td>91%</td>
<td>89%</td>
<td>71%</td>
</tr>
<tr>
<td>Springwater Corridor</td>
<td>38%</td>
<td>58%</td>
<td>60%</td>
<td>68%</td>
<td>35%</td>
<td>77%</td>
<td>54%</td>
</tr>
<tr>
<td>Maximum Possible Score</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

All corridors begin in Downtown Portland and end in Pleasant Valley/Damascus.

The Southeast Portland BRT Analysis is intended to assist Tri-Met with implementing a BRT system in this area. The results of the analysis suggest that a BRT system is feasible for the Powell/205/Foster alignment, which received 82% (see above chart). The outcome also suggests that BRT has the capacity to shape future land-uses, and could generate high transit ridership among. It is recommended that Tri-Met thoroughly evaluate the potential of BRT for this alignment.
PART ONE: BACKGROUND

Part One provides a background for this corridor study, including an introduction to the project, a statement of the project's purpose and need, a description of the Bus Rapid Transit (BRT) concept, a discussion of the project goals, and an overview of the public involvement component of the project.

Introduction

Relatively few system innovations have emerged in bus transit systems since their inception in the early 1900s. For this reason, bus transit fills a relatively small role in the expansion of transit opportunities, and has become a last resort transportation mode choice for many people. However, as traffic congestion increases, light-rail transit construction costs escalate and subsequent funding timelines lengthen, transit systems have begun to evolve with technological advances.

Bus Rapid Transit (BRT) is a relatively new concept that is being adopted by a number of communities internationally, and is now being researched further in the United States. BRT provides high-speed, high-capacity transit service as a more feasible alternative to light-rail transit (LRT). Bus Rapid Transit, also known as Rapid Bus, is defined by Metro as service that “…emulates LRT service in speed, frequency and comfort, serving major transit routes with limited stops.”

BRT offers many of the same qualities of rail transit, yet it has additional benefits in cost and flexibility. Because buses travel on urban roadways, infrastructure investments needed to support bus service can be substantially lower than the capital costs required for rail systems. As a result, bus service can be implemented cost-effectively on routes where rail-ridership may not be sufficient or where the capital investment may not be readily available to implement rail systems. BRT is more flexible than rail systems, and incorporates innovative vehicle designs and infrastructure, and new approaches to operations and station planning. The purpose of BRT is to provide transit service comparable to LRT, but at significantly lower costs.

Some BRT system designs integrate standard buses with intelligent transportation systems (ITS) to provide express service on standard streets and highways. In other cases, busways combined with ITS allow buses to operate more like a traditional rail system during all or part of each trip.

The end result is a rapid, reliable transit system that is comparable to light-rail service, but at a fraction of the cost. Rapid service combined with clean, quiet and smooth-riding vehicles can compete with automobiles, and may encourage higher transit usage. BRT is a transit concept that can serve special needs, incorporate new infrastructure and technological enhancements, and positively impact the quality of life and natural environment in communities.

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Purpose and Need

The Portland Metropolitan Region is delimited by the Urban Growth Boundary (UGB), which designates where urban development is allowed and where surrounding farm and forestland will be preserved, in accordance with the Metro 2040 Growth Concept. Oregon law requires that there be a twenty-year housing supply maintained within the boundary. Metro, Portland's regional government, also designates Urban Reserve areas just outside the UGB, which are selected based on several criteria, including the quality of the land for farming, the amount of land suitable for development, and the accessibility of the area to the greater metropolitan area.

Metro's Urban Reserve program earmarked the rural Pleasant Valley & Damascus areas for future urbanization (see map). Until a decision by the Land Conservation and Development Commission (LCDC) in January 2000, Metro was required to designate urban reserves. Those urban reserves were to contain a 30-year supply of land just outside the current urban growth boundary (UGB). The LCDC, under the Court of Appeals decision, has voted to allow Metro to proceed with UGB amendments without designating new urban reserves.²

Pleasant Valley was recently included in the UGB, and the Damascus area will be within the next few years. Combined, they comprise one of the largest areas in the metropolitan region that Metro plans to urbanize in the near future. Located fifteen miles southeast of Downtown Portland, Pleasant Valley and Damascus are adjacent to rapidly growing communities. Traffic on the few rural roads is already becoming congested, and residents are concerned about the changes that are projected.

Metro's 20-year Regional Transportation Plan (RTP) identifies several potential BRT corridors for future study and development. Among these is the Powell-Foster corridor, which extends from Portland's central business district (CBD) to the communities of Pleasant Valley and Damascus, on the border of the urban growth boundary (UGB) (see figure 1). The purpose of the SE Portland BRT Corridor Analysis is to develop, evaluate and prioritize BRT elements that are responsive to community needs and the expected travel demand in the SE corridor.

Population in the Portland metropolitan region is projected to increase by nearly 800,000 inhabitants from 1994 to 2020.³ In Pleasant Valley and Damascus alone, Metro projects an 800% population increase (from 13,000 to 125,000) during the same time period, with local employment increasing at a similar rate. Moreover, transportation infrastructure and services are quite limited in these communities. Currently, there is no transit service, and most of the roads have only two lanes. Additionally, portions of this study area are within Clackamas County, which is one of the fastest growing sections of the region. Between 1980 and 1998, the number of households in the county increased

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⁴ ibid.
by about 2.3% per year and the number of jobs increased by 3.8% per year. This growth will only add to the future traffic congestion that is likely to occur.

**Figure A: Regional Context**

Due to the environmentally sensitive nature of the Pleasant Valley and Damascus areas, where creeks and wetlands are abundant, development should be directed to Town Centers and along major transportation routes. Though much of the corridor from Portland’s CBD traverses the built environment, Pleasant Valley and Damascus are still rural communities. The expected residents are not yet there, which presents the opportunity to influence future growth patterns. If a BRT system is accepted in this district, future developments could be oriented to the transit corridor and overall accessibility to the system would be maximized.

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*bus rapid transit corridor analysis*
Bus Rapid Transit Concept
Slow travel time and poor on-time performance typically characterize conventional bus systems. The cumulative effects of traffic congestion, traffic signals and passenger boarding add to total travel time. When vehicles travel in traffic congestion, travel time is compromised, affecting system on-time performance and rider satisfaction.

Buses usually travel in mixed traffic on established roadways and therefore, the system lacks visibility and a sense of permanence. This contributes to public perceptions of unreliability and disorganization. Such negative perceptions of bus systems are changing worldwide with the increasing interest in BRT in places such as in Curitiba, Brazil and Ottawa, Canada.6

Bus rapid transit combines the high-quality attributes of rail transit with the flexibility of traditional bus systems. A BRT system may use exclusive lanes, cleaner and quieter vehicles, improved station amenities, and intelligent transportation systems (ITS) technology to enhance the performance of the system. By combining the attributes of rail and bus systems, BRT systems can achieve the benefits of both.

Intelligent Transportation Systems
Intelligent Transportation Systems represent the next step in the evolution of transportation systems planning. The application of electronics and information technologies in BRT systems aims to increase efficiency and reliability of the system. ITS technology includes signal prioritization, global positioning systems (GPS), and on-board diagnostics.

Signal prioritization allows a BRT vehicle to pass through a congested intersection with minimal delay. When a BRT vehicle is detected approaching an intersection in a busway or bus lane, the system can regulate the timing and/or duration of a green light. These changes in the traffic light cycle are limited by the demands of crossing traffic on the signal system, but even slight increases in the length of the green cycle can greatly reduce delays.

A BRT vehicle traveling in mixed traffic can bypass congestion at an intersection using a queue jump lane, which is a short stretch of bus lane that uses priority signalization. This will allow a BRT vehicle to proceed ahead of parallel traffic, thereby limiting delays.

Global positioning systems (GPS) can improve on-time performance by identifying the location of all transit vehicles in the system. This information can be used to alert a driver who is behind schedule, to adjust traffic signal timing, and to inform waiting passengers of when the bus will arrive.

On-board diagnostics leads to early detection of mechanical problems, and allows for preventative maintenance of vehicles. This improves system performance by minimizing vehicle downtime. Vehicle design life could be extended, lowering operating costs.

6 Henke. pp35-40
Exclusive Travel Lanes
The purpose of a BRT system is to provide rapid service, to reduce travel times and make the service more attractive to choice riders. Bus lanes or busways can be used to speed vehicles through congested intersections or entire roadways, thereby fulfilling the concept of BRT.

Bus lanes, with the physical separation of buses and other traffic, can be a viable mass transit option. When ROW capacity exists, such as in the Pleasant Valley/Damascus areas, the opportunity can be taken to provide a busway. It can be built to travel closer to houses, shops and employment centers than conventional public transit services, giving the BRT system an advantage over other private modes of transportation.7

Guideways
BRT systems can travel in a guideway, allowing the vehicle to pass through safely at high speeds, without increasing the width of the travel lane. Several guideway types are available, ranging from curbed to rail to magnetic or optical systems. A guideway is a permanent investment in infrastructure, providing a fixed route for the BRT. This permanency enables the system to influence land-uses and property values, and encourage transit-oriented developments. Guideways will also allow vehicles to dock at stations with more precision, which will increase the efficiency and safety for people who must use mobility devices.

The most common type of guideway system uses a vehicle with horizontally aligned guide-wheels that contact curbs on both sides of the vehicle. This type of guideway is being planned for the Eugene-Springfield BRT system.

A second type of guideway, currently in development stages, involves the use of a central rail system. The vehicle rides on rubber tires and the rail is used only as a guide and does not carry any of the vehicle’s weight. As opposed to a standard two-rail system, it does not need to bear the weight of the vehicle.

Another emerging technology is an optical, or electronic guide system that uses special striping or magnets embedded in the road to guide the vehicle.8 Although these systems function adequately, they lack the visual permanency of curbed and rail-guided systems.

Innovative Vehicles
Using the latest technology and alternative energy sources at the time of implementation, BRT vehicles will decrease noise and pollution emissions. They will also be lighter-weight to help minimize acceleration and braking noise. Clean and quiet vehicles will establish a positive image for BRT, and will set it apart from conventional city buses.

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8 Sneller, p50
The vehicle’s interior design will facilitate rapid loading and unloading of passengers. Wide doors allow for simultaneous boarding and exits, which will minimize vehicle dwell time. Low-floor vehicles provide superior access to all people, including those using wheelchairs and other mobility devices. Seating and standing areas in BRT vehicles are designed to ease passenger movement inside the vehicle. Bikes can be stored out of the way, on wall or ceiling mounted hooks.

Exterior design of vehicles promotes a highly desirable form of transit, and will distinguish the system from the local bus service. Using innovative materials and colors, the vehicles are designed to be attractive to choice riders.

**Integrated Stations**

Station design and amenities should address the unique character and history of the community they serve. Stations should be integrated into the community, and be developed as a community asset. Amenities may include neighborhood electric vehicles, providing connections to local residents. Bicycle and pedestrian access will be high priorities, as opportunities for these two modes will encourage ridership. Safety at stations will also be of primary concern, as ridership will depend largely on the accessibility and perception of safety. A major component of BRT is station stops that are designed to be safe and secure.

Tickets will be available for purchase from machines located at BRT stations, which is similar to current light-rail ticket systems. In addition, pre-paid fare collection systems will reduce vehicle dwell time at stations, and ease the boarding process. Fare systems that use smart cards are particularly convenient for riders, because of the electronic fare collection system the BRT stations will use. Real-time vehicle location at stations alert waiting passengers to the expected arrival time of the vehicle. Using GPS, the Automated Vehicle Location (AVL) system locates each vehicle on the route. Notification via real-time displays on overhead monitors will allow waiting passengers the opportunity to maximize their waiting time and also provide assurance that a vehicle is on the way. Weather protection, seating, lighting, and comfort are all important components to attract consistent ridership.

**Case Studies**

The Curitiba, Brazil transit system captures 70 percent of trips into and out of the city. The BRT system uses raised platforms for level boarding, and enclosed stations with turnstile-controlled access. The system performs similar to a subway with a 90-second headway, but it is above ground and visible.

Vancouver, British Columbia has implemented a BRT line and has three additional lines in the planning and construction phase. Ridership has increased by 12,000 riders since service began in 1996. Travel time on this line has been reduced by 5 to 15 minutes.

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compared to previous service. The frequency of service is every 4 minutes during the peak morning travel hours, 7 to 8 minutes mid-day, and 15 minutes in the evenings.\textsuperscript{11}

The South Dade Busway in Miami was built in an abandoned rail right-of-way. The 8-mile system parallels a major arterial and has 15 stations. Average weekly transit ridership increased 56\% since implementation. The success of this system results from the deployment of small, 20-seat minibuses and frequent service.\textsuperscript{12}

The premier example of a BRT system in North America is located in Ottawa, Canada. It includes 20 miles of exclusive busway, high-occupancy vehicle (HOV) lanes, and preferential treatment in mixed traffic. Ottawa officials estimate that the system has stimulated $1 billion dollars in new investment.\textsuperscript{13} Congestion has stabilized as development and jobs have continued to grow in the Central Business District.

**BRT in Portland’s Southeast Corridor**

Because the communities of Pleasant Valley and Damascus are expected to grow rapidly over the next 20 years, and transportation services are currently lacking, there is unlimited potential to shape future development patterns in the area. BRT could help create livable communities with a transit focus, and to encourage transit ridership concurrently with the growth.

Low-cost investments in infrastructure, equipment, and operational improvements can substantially increase bus system performance. If planned as an integrated system, BRT offers increased speed, comfort and capacity over a conventional bus route.\textsuperscript{14}

A BRT system in SE Portland would include some or all of the following features:

- **Bus lane**: A lane on an urban arterial street that is reserved for the exclusive use of buses.
- **Bus signal preference and preemption**: The extension of green light time or actuation of the green light at signalized intersections upon detection of an approaching bus.
- **Traffic management improvements**: Low-cost infrastructure elements to increase the speed and reliability of bus service.
- **Faster boarding**: Collecting fares upon entering a bus station or shelter area prior to bus arrival would allow passengers to board through all doors of a bus.
- **Integration of transit development with land use policy**: Bus Rapid Transit and compact, pedestrian-oriented development support each other. This consolidation of development also has the positive impact of using less land and encouraging the creation of neighborhood centers.

\textsuperscript{12} ibid.
\textsuperscript{13} Shen, At-Grade Busway Planning Guide, 1998, Section 2.0.
\textsuperscript{14} Shen, At-Grade Busway Planning Guide, 1998, Section 1.0.
- **Improved facilities and amenities:** The advantages of separating buses from traffic can be augmented with improved amenities such as bus shelters, stations, or real time schedule data.\(^{15}\)

Implementation of BRT in the SE Powell-Foster corridor poses a number of challenges, ranging from the need for adequate rights-of-way on arterial streets to provide exclusive lanes for buses, to maintaining the quality of general traffic flow and minimizing local pedestrian and air quality impacts. These challenges require detailed analysis in the context of specific locations to identify appropriate solutions, and to determine where BRT can have the greatest impact on future land uses.

System Goals
In the 2000 Regional Transportation Plan, Metro designates Powell Boulevard and Foster Road in Southeast Portland as a Rapid Bus corridor. Due to a proposed expansion of the Urban Growth Boundary and future population growth in the area, a high-capacity transit system will be needed to serve the Pleasant Valley and Damascus areas. Five major goals for reaching this objective have shaped this analysis:

System should serve as a connector between downtown Portland and both Pleasant Valley and Damascus Town Centers and should guide development. Town Centers are defined by Metro as concentrations of shops, services and housing, and may be ideal locations for offices, schools and government functions. The communities of Pleasant Valley and Damascus, located in the southeast region of Portland, will experience rapid growth over the next twenty years. This area is relatively lacking in transportation infrastructure.

Because Pleasant Valley and Damascus are newly urbanizing areas, there is a great opportunity for transit to influence the pattern of new growth. Therefore, the system should be permanent and visible in order to encourage and support transit-oriented development patterns.

System should minimize costs. The BRT concept is a means of providing high quality transit, similar to that offered by a light rail system, when funds are limited or ridership does not justify an investment in light rail. BRT can be implemented at a fraction of the cost of a light rail system.

System should provide service that is competitive with auto travel. Current bus service stops very frequently, making a trip between Downtown and outer suburbs extremely slow. In order to encourage people to choose transit, it must be comparable to autos in travel time and comfort to driving in congested rush hour transit.

The BRT must run frequently to limit passenger-waiting time to five minutes during peak-hours, and should also provide a high level of comfort including quiet and smooth vehicles, larger seats and preferred amenities at station stops.

System should be integrated with existing/future transit systems. In order to be a truly useful transit service, the BRT system must provide convenient transfers to other transit routes. This means that safe and accessible connections must be made between BRT stations and stops for connecting routes.

System should be environmentally sustainable and community supportive. The BRT system must not subject undue harm upon natural ecosystems. Wetlands and forested hillsides characterize Pleasant Valley and Damascus; these areas should be protected as much as possible. In addition, the system should support the goals of Metro's 2040 Regional Framework Plan and Regional Transportation Plan, including growth

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16 Metro, 2000 Regional Transportation Plan, August 2000.
management techniques, transportation mode balance, improved public transportation and energy efficiency. Local community planning efforts, such as those currently underway in Pleasant Valley should also be supported.

Public Involvement
Public involvement did not play a particularly significant role in this study, due to time constraints and the scope of the project. However, public input was gathered regarding the role of BRT in the communities of Pleasant Valley and Damascus, as well as the types of amenities local riders would likely desire.

Pleasant Valley Concept Plan Community Forums
A significant planning effort is currently underway for the Pleasant Valley area. Members of the community were invited to participate in three forums designed to guide future development. The forums allowed residents to participate in the planning process by addressing their concerns and by offering suggestions. Comments and suggestions that concern the development of a BRT system in the community are listed below.

- The existing street system is not adequate to serve future town center growth.
- Land uses should be carefully planned and controlled.
- Residents of the community desire high quality design standards for new developments.
- Additional connections and improvements to existing streets are needed to increase access from Pleasant Valley to other parts of the region. Many people also identified cut-through traffic on existing streets as an issue.
- No roads in the area are safe for walking and bicycling. A lack of facilities and high speeds and traffic volumes were repeatedly cited as obstacles.
- Concerns about funding for transportation improvements.
- Lack of enthusiasm about town center/transportation concepts among local farmers.

Planning Workshop Questionnaire
The Planning Workshop class participated in a field trip exercise involving the observations of existing transit vehicles and stations. Working in small groups, the students were asked to evaluate their experiences during a one-hour fieldtrip. These comments were intended to assist with the recommendations for vehicle and stations for the BRT line. Comments from this exercise are listed in the following bullet points.
Station Comments

- Design improvements include building orientation and site development standards at the pedestrian scale, improved accessibility for the elderly and wheelchairs, walls for station weatherproofing, and landscaped planting strips, along with art and cultural works to interest waiting passengers.
- Desired amenities include beverages and snacks, mist/heat devices, community bulletin board to display notices, entertainment such as television or newspaper, bike parking, and more and better seating. Amenities should be solar powered for sustainability.
- Information systems should include local phone numbers providing information regarding on-time performance, audio announcements for the sight-impaired, GPS/real-time displays, and maps and signs, particularly for transfers.

Vehicle Comments

- Vehicles should be quieter and cleaner, have a smoother ride, and have better climate control. Frequent service was desired, in addition to a possible business class upgrade.
- Larger seats and more legroom were desired, as well as footrests under seats, and a more comfortable standing area.
- On-board entertainment was desired, including music.
- Accessibility features were desired including bike improvements and overhead storage bins for luggage.

These comments, along with other data sources such as a user preference survey provided by Tri-Met, shaped this analysis and the subsequent recommendations made.
PART TWO: ANALYSIS
The analysis for this corridor study included eight possible alignments, and potential station locations. Part two of this report explains the steps taken to determine the best routes for the BRT system, and optimal station locations along the two highest scoring alternatives.

Criteria for Corridor Selection
Numerous alignment alternatives were considered for analysis in this study. Each one begins on the bus mall in downtown Portland and travels to the Pleasant Valley and Damascus Town Centers. According to the United States Federal Transit Administration (FTA), a BRT system should consider the following criteria: Bus travel-time savings and ridership increases; impacts on open spaces, wetlands, and historic resources; compatibility with land use policies and contribution to economic development; and the cost-effectiveness of the project. The end results of a BRT project should be reduced travel-time both relative to automobile travel-time and in absolute terms, greatly increased ridership, and improved air quality.\(^{17}\)

Based upon local data and conditions, the following criteria were developed for this study: Regional Connectivity; Local Ridership; Operations; Right-of-Way costs; Environmental Impacts; and Construction Costs. What follows in this section are basic explanations of each. The specific means of measuring each criterion is explained in greater detail in the Corridor Analysis: Methods section.

Regional Connectivity:
**Corridor must serve major activity centers.** Activity centers such as Town Centers and Regional Centers should be linked by the BRT system. These areas are expected to contain high densities of residential, retail and employment uses that are appropriate for transit. Other large trip generators, such as schools or major shopping destinations, should be served as well. Activity centers not only serve as focal points for local ridership, but are destinations for people in other parts of the region as well.

Local Ridership:
**Corridor must be in close proximity to potential riders to justify the investment.** The chosen corridor should pass through communities that are most likely to use the BRT line. It will run to the Pleasant Valley/Damascus area, where driving will become more difficult due to terrain constraints and lack of road infrastructure. High-speed service to downtown Portland and Regional Centers will be in demand.

Operations
**Corridor must allow for transit to move more rapidly than peak period traffic.** One of the primary objectives of this BRT system is to provide rapid service between an area of heavy growth and Downtown Portland. Travel time needs to be competitive with that

of the automobile in order to attract riders. Between stations, the BRT vehicle should be able to travel at the posted speed limits, even during peak travel hours.

**Corridor must allow for limited crossings and limited left turn access.** In order to offer rapid service, it is necessary to limit interference from other vehicles as much as possible. As a general guideline, major arterial roads should not cross the corridor more frequently than every half mile. Limiting cross-traffic is integral to rapid service. This will allow for the BRT vehicle to operate at speed (the posted speed limit) for larger sections of the route.

**Corridor must allow for signal prioritization.** Rapid service will require limiting vehicle delays. Traffic signals should give a green light to BRT vehicles wherever possible. Providing signal prioritization requires that existing signals have the necessary technology to do so, or can be upgraded affordably. It also requires that maintaining flow of cross traffic not be adversely affected.

**Corridor should minimize overall distance wherever possible.** The corridor must be as direct as possible, while remaining as affordable as possible. This means choosing corridor segments that will require as little reconstruction or property acquisition as possible without requiring indirect routes, which would increase operation costs and travel time.

**ROW Costs:**

**Corridor must have an adequate right-of-way (ROW).** If possible, the preferred corridor will not require any land acquisition in order to build the BRT line, and should maintain existing elements of the ROW. These elements include traffic lanes, parking lanes, bike lanes and sidewalks. It is not politically desirable to remove any of these elements. Though 12 feet is the minimum lane width for safe operation of a BRT system, a traffic lane can be 10 to 12 feet wide, depending on the type of road and speed of traffic. Parking lanes generally cannot be narrowed. However, where they exist it may be possible for the BRT vehicle to share the parking lane (if widened to 12 feet) by restricting parking during peak hours. Bike lanes can vary between 4 and 5 feet, and sidewalks can also be varied depending on the conditions of a given length of ROW.

If the existing ROW is not adequate, adjacent land uses must be low-intensity to allow for the expansion of the ROW (either through property acquisition or land easements). All alignments must be along either busy arterial streets or on wider ROWs, and no route must require the destruction of a pre-existing neighborhood. This will be important for gaining acceptance of adjacent property owners, and for reducing overall project costs. Low-intensity land use refers to lands that either do not have a structure on them, or have an abandoned or condemned structure. In general, this will mean parking lots. In order to provide adequate ROW, some narrow strips of parking lot may need to be acquired, or in other cases, easements will need to be secured.
Environmental Impacts:
Corridor must minimize adverse impacts on environmentally sensitive areas (ESAs), as defined by Metro. This BRT route may be located close to wetlands and a network of creeks, which are environmentally sensitive areas. The chosen corridor must either avoid these areas, or allow for proper mitigation measures to be conducted within a limited budget.

Corridor must allow for crossings and stations to be ADA compliant. Street crossings and transit stations must comply with the Americans with Disabilities Act. This means that the selected corridor must have enough ROW capacity to allow for stations that are large enough to provide at least three feet around any furniture, such as benches or ticket machines.

Corridor must insure that installation of BRT does not unduly degrade the local pedestrian environment. The optimal corridor must allow for the pedestrian environment to remain as it is, and possibly improved upon by widening a road. Sidewalks must remain as wide as they currently are. Any buffers between sidewalks and traffic lanes, such as trees, parking, or grass strips, should be retained whenever possible.

If the addition of BRT lanes requires significant widening of the roadway, pedestrian islands (refuges) should be provided for pedestrians crossing the BRT route or walking to stations to reduce danger from vehicles, as well as the perceived hostility of an automobile oriented street. Finally, the corridor must allow for pedestrian crossings to be located in high visibility areas.

Construction Costs
Alignment should minimize construction costs. Alignments should be chosen that require as little widening, reconstructing, or environmental mitigation as possible. One of the major objectives of BRT is to provide the highest possible quality of service at the lowest possible cost.

Corridor must allow for a permanent, highly visible system. Ridership will be encouraged if the system has an identity and is known to the community. It should run along heavily traveled roads, and provide a sense of permanency to residents and developers. If it follows a guide rail, it will be viewed as permanent infrastructure. This will encourage ridership because, as with a train, riders would know exactly where the route is and where it goes. Permanent infrastructure like a rail has the potential to increase adjacent land values, resulting in the encouragement of development along the corridor.
Alignment Options

Eight alignment options were selected for the analysis (see map below). All of the alignments are presented in this section, and the relative strengths and weaknesses of each one are examined.

Figure B: Alignment Alternatives

The original alignment for this analysis was the Powell/Foster route to Damascus, which was designated by Metro in the 2000 Regional Transportation Plan. All of the alignment options were generally based on the Powell/Foster route. The primary constraints associated with this option are two right-of-way bottlenecks, one on Foster between 50th and I-205 and another on Foster near 162nd and Jenne Road. These particular constraints led to the consideration of other options.

The second alignment was the Powell/205/Foster option. This option avoids the narrow section of Foster from 50th to the freeway. It takes advantage of the quite wide right-of-way provided by Powell Blvd between 50th and I-205. It then joins the freeway, using either a dedicated lane or an entire dedicated roadway, and heads south, meeting back up with Foster. The I-205 right-of-way was originally built to accommodate a transit corridor, and led to the selection of a corridor option that was ultimately removed from the analysis. This corridor would have taken advantage of the ROW and potential for...
high speed offered by I-205. It would originate at the Gateway Transit Center, travel south on a dedicated right-of-way, and continue east on Foster toward Pleasant Valley/Damascus. This option would operate as a MAX Light Rail feeder. Though it would offer high-speed service, it would necessitate a transfer, as well as have limited station opportunities. As a result, it was excluded from the analysis.

The next set of corridor possibilities makes use of the proposed South Corridor, which follows the same general alignment as the proposed South/North Light Rail line that was rejected by voters in 1998. Two alignment possibilities were examined that extend the South Corridor from Clackamas Regional Center to Pleasant Valley/Damascus. These would avoid the bottleneck on Foster Rd. at 162nd, and include the McLoughlin/Sunnyside route and the McLoughlin/212 route. Both would follow the South Corridor down McLoughlin Blvd. from Downtown Portland to Clackamas Regional Center.

From there, either Sunnyside Road or Highway 212 would be used to connect to the Pleasant Valley/Damascus area. Sunnyside Road has relatively dense residential areas along it, which could contribute to ridership. Highway 212 offers a very wide right-of-way for most of its length between Clackamas Regional Center and Damascus and would allow for rapid service.

Another pair of alignment options makes use of I-205's generous right-of-way. The two alternatives using this general route are Powell/205/Sunnyside and Powell/Foster/205/Sunnyside. They are nearly identical except that the former follows Powell all the way to the freeway, while the latter leaves Powell at 50th and follows Foster to the freeway. Despite appearing indirect, these were chosen because they avoided the environmentally sensitive areas in Pleasant Valley, and because they connect to Clackamas Regional Center.

Another alignment examined in this study was one that travels east into Gresham before turning south toward Pleasant Valley/Damascus. This option, called Powell/Division/182nd, would use Powell until I-205, head briefly north on I-205, and turn east on Division Street. An alternative that travels east on Powell from the freeway was considered, but excluded due to the narrow right of way on this segment. Division has a very wide right-of-way all the way into Gresham.

This option would then turn south on 182nd to Pleasant Valley/Damascus. Many of the future scenarios for this area connect 182nd in Gresham directly to 172nd in Pleasant Valley to form the primary north/south artery for the area. Though somewhat indirect, this alternative offers a relatively uniform and wide right-of-way.

A variation on this alternative was one that served MAX Light Rail at the 181st Ave. station, and ran due south from the station to Pleasant Valley/Damascus. As with the Gateway MAX feeder option, this alternative was abandoned early in the study because it did not provide a single-vehicle ride.
The final alignment option was the Springwater Corridor, a former railroad right-of-way that is now a paved recreational trail for bicyclists and pedestrians. It meanders through Southeast Portland, joining Foster Road near Lents Town Center. It is a popular trail, making its conversion to a transit line practically impossible. However, the entire corridor has a one hundred-foot right-of-way. Though it was not likely to be the ideal route to link downtown Portland with Pleasant Valley and Damascus, it was included in the study for comparison with other alignment alternatives.
Corridor Analysis: Methodology

The primary objective of the analysis is to determine the most feasible BRT route that would link Downtown Portland with the Pleasant Valley and Damascus Town Centers. A set of criteria was developed to assess the relative merits of each alignment, and each criterion was weighted based on its level of importance. The criteria were applied to each alignment option through a data modeling process described shortly.

Each criterion represents a grouping of several related factors. There are six criteria used, including Regional Connectivity, Local Ridership, Operations and Travel Time, Right-of-Way Costs, Environmental Impacts and Capital/Construction Costs.

Regional Connectivity

To analyze patterns of future transit usage, the most important criteria were Connectivity and Ridership. Because they determine the rationale of BRT for this corridor, the two criteria were collectively weighted above all the others. Individually, connectivity had a slightly higher weight of 25% because of the regional aspects of the system, while ridership was weighted at 23% because local transit service is vital for the system’s short-term functionality.

The connectivity score was determined by estimating the relative importance of activity centers and trip generators along each alignment. These include retail and employment centers, schools, colleges, and hospitals. Major activity centers were then located and geo-coded into a GIS. Trip generation capacity of each activity node was qualitatively estimated based upon field observation and interviews with public officials. Node scores were then compiled and divided by the entire length of the route, to generate a preliminary connectivity score for each corridor alignment. The final connectivity score was rated on a percent scale, 100% being given to the alignment with the highest number and size of activity centers per mile. In the overall tabulation, connectivity was weighted relative to the other criteria, and a final score was then calculated.

Local Ridership

Ridership is an estimate of the number of local transit users along any given route option. To find current ridership on each corridor, the current population for each segment was multiplied by corresponding ridership rates. Ridership rates were determined by a spatial sampling of estimated 1998 Census tract populations\(^{18}\) within one-quarter mile of each segment, divided by the total daily transit boardings, as measured by TriMet in 2000,\(^{19}\) for those segments. The ridership rates for remaining corridor segments were interpolated based upon density and Euclidean distance from Downtown Portland. Using Metro data projecting growth rates from 1990 to 2010,\(^{20}\) the projected 2020 population for each segment was estimated, with growth rates increasing as one goes further from central Portland. Projected ridership was based upon projected population and current ridership rates. The corridor ridership score was calculated by compiling the respective

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\(^{18}\) Metro. 2000. RLIS.


\(^{20}\) Gresham, City of. 1999. p.1
ridership populations for all segments, dividing this total by the route mileage, and then by rating the result on a percent scale, 100% being given to the alignment with the highest number of projected riders per mile. In the overall tabulation, ridership was weighted relative to the other criteria, and a final score was calculated. As indicated by feedback from Tri-Met, PRHG's ridership projections are likely to be conservative, as transfers from other lines or the perceived rider attractiveness of a new BRT line was not taken into account.

**Operations**

The next most important criterion for choosing the best route option was Operations. This variable is key to limiting costs and attracting riders. It includes estimated travel time for each option, which is derived from the distance, the number of sharp turns, the number of stations and the dwell time at each station.

The criterion also includes system operation costs. This is combined with travel time because ultimately, both are based on the length and directness of the corridor. As length increases, operating costs appear to grow exponentially. More staff and equipment are required, including vehicles, drivers, maintenance workers, and several other costs. This criterion was given a weight of 26%, because it was considered to be slightly more important than either ridership or connectivity.

Operation costs and travel time are functions of:

- Posted speed limits (a proxy for design speed).
- Distance of each corridor option.
- Costs of vehicles over expected life span of system (usually 40 to 50 years).
- Costs of vehicle and road maintenance over expected life span of system.
- Costs of drivers and mechanics over expected life span of system.
- Any reverse travel of non-direct routing was given a penalty of 1.5 minutes for every 1-minute of direct travel time.
- Any slowing for sharp turns (90 degrees or more) was penalized by 15 seconds.
- The slowing, acceleration, and dwell time at each station added 1 minute to the overall time, with all corridor options having one station per mile.

The operations score was based on the following formula, designed by PRHG:

\[ \text{Total weighted score} = \frac{10}{(T_t / T_{ts})} \]

with \( T_t = \text{Total time cost for each route} = (T - T_d)^2 + T_u + H + (S \times D) \)

and \( T_{ts} = \text{Total time cost for the shortest route.} \)

\( T = \text{the unadjusted linear time for each route, which} = \text{Summation} (D \times R); \)

\( T_d = \text{the unadjusted linear time for the shortest route}; \)

\( D = \text{linear distance for each alternative route segment}; \)

\( R = \text{the posted speed limit for each segment}; \)

\( T_u = \text{the total time penalty for each 90 degree turn on a route}; \)

\( H = \text{the total time penalty for non-direct travel on each route, and finally} \)

\( S = \text{the total time penalty for station stops on each route.} \)

The \((T - T_d)^2\) statement helps to account for the exponential growth in maintenance costs as a route length increases from the shortest possible route.

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*bus rapid transit corridor analysis*

June 2001

Page 19
In summary, each corridor option was given a trip time score, including actual minutes and penalty minutes for reverse travel and sharp turns. The difference between each corridor option’s trip time score, and that for the option with the shortest travel time, was squared. This was to account for exponential increases in operating costs due to increases in overall corridor length.

The Operations/Time score was calculated by compiling the respective time distances for all routes and then by rating the result on a percentage scale, 100% for lowest time per mile served by a given corridor option. In the overall tabulation, Operations/Time was weighted relative to the other criteria, and a final score was calculated.

Right of Way Costs
Right-of-way (ROW) refers to the publicly owned width of a given corridor. This means the entire route width, including the roadway, sidewalks, and any land between the sidewalk and property line. There is wide variation in right-of-way widths among the alignment options, as well as within given corridors. Typical residential streets have 50 to 60 foot ROWs, while major arterials, such as Powell, are generally about 90 feet wide, but also have limited portions as wide as 170 feet. According to officials at Tri-Met and at the City of Portland Office of Transportation, a legally safe BRT route needs at least a 106 foot ROW. Such a ROW will allow on each side of the street a 9 foot sidewalk with street trees, a five foot bike lane, two 12 foot auto travel lanes, and a 12 foot BRT lane, with two foot buffers from traffic (see Figure C). To find the ROW score, a 106 foot ROW was assumed to be necessary for all the routes, except for the Springwater route. The right-of-way score is based on an average of segment scores for an entire route option.

The scores represent two factors. One is the cost for purchasing land or obtaining easements from property owners in order to expand the right-of-way. This is greatly dependent on how much land is needed, which is why the existing width of a right-of-way is important. The second factor is the political cost. Asking residents to give up a portion of their land, even a small one, is always controversial. Of particular controversy

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is the tearing down of buildings to make way for transportation infrastructure. This project attempts to avoid situations like these as much as possible.

Land acquisition costs include:

- The amount of widening needed to use a given corridor.
- Land purchase or easement costs.

Political costs include:

- Resistance to growth, development, and loss of urban or rural aesthetics.
- Resistance to building demolition, specifically historic or community structures and parks.
- Need to maintain existing auto and bike lane capacity, and sidewalks.
- Need to minimize negative changes to traffic patterns.

The ROW score was calculated by compiling the qualitatively estimated costs of land and political feasibility for the routes, then rating the result on a percentage scale. 100% was given for the most affordable ROW costs in a given corridor option. In the overall tabulation, right-of-way was weighted relative to the other criteria, and a final score was calculated.

Environmental Impacts

This criterion refers not only to the natural environment, but also to pedestrian safety mitigation. The criterion requires that the chosen corridor enable any negative impacts on either to be mitigated at an affordable cost. Possible natural environment challenges for this project are limited primarily to creeks and wetlands in the Pleasant Valley/Damascus area, and hillside cuts on Foster. Possible negative pedestrian impacts tend to be located at major intersections, of which there are several on every corridor.

Since there is little variation in negative pedestrian impacts among corridor options, and the environmentally sensitive areas are located in only a few places, it was determined that this criteria did not require significant weighting. It was given a weight of 8%.

For each alignment, the analysis qualitatively assessed:

- Any possible harm to the natural environment that must be mitigated.
- Estimated costs of mitigation.
- Methods for minimizing negative impacts to the pedestrian environment include, but are not limited to, provision of wide sidewalks, allowing space for pedestrian islands to aid in crossing, and providing attractive and safe access to the system.

The environmental score was calculated by qualitatively estimating the costs of environmental and pedestrian mitigation for the routes, and then by rating the result on a percentage scale, 100% for the most affordable mitigation costs in a given corridor option. In the overall tabulation, the environmental score was weighted relative to the other criteria, and a final score was calculated.
Construction Costs
The final criterion refers to any costs that are not associated with right-of-way costs, primarily land acquisition. These vary depending on the amount of reconstruction a given corridor might need, from widening, to an entire reconstruction of the roadway and sidewalk. They also include stations, signaling and landscaping.

Infrastructure costs include:
- Paving, striping, sidewalks, stations, drainage, signaling, ITS enhancements, guideway if used, BRT lane pavement and/or landscaping.
- Costs associated with acquiring land for ROW expansion are not included.

Construction cost scores were calculated by compiling the respective scores of estimated costs for the routes, and then by rating the result on a percentage scale, 100% for the most affordable construction costs in a given corridor option. In the overall tabulation, construction was weighted relative to the other criteria, and a final score was calculated.

Overall these costs were not considered to vary significantly from one corridor to another, and therefore had a low weighting of only 4%.
Corridor Analysis: Results

The following table summarizes the analysis results.

Table A: Results Matrix

<table>
<thead>
<tr>
<th>Southeast Portland Bus Rapid Transit Alignment Options</th>
<th>Connectivity</th>
<th>Ridership</th>
<th>Operations</th>
<th>Right-Of-Way</th>
<th>Environment</th>
<th>Construction</th>
<th>Total Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Powell/205/Foster</td>
<td>68%</td>
<td>84%</td>
<td>93%</td>
<td>93%</td>
<td>82%</td>
<td>82%</td>
<td>100%</td>
</tr>
<tr>
<td>Powell/205/Sunnyside</td>
<td>100%</td>
<td>77%</td>
<td>53%</td>
<td>92%</td>
<td>92%</td>
<td>94%</td>
<td>80%</td>
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<tr>
<td>Powell/Foster</td>
<td>46%</td>
<td>88%</td>
<td>100%</td>
<td>60%</td>
<td>90%</td>
<td>83%</td>
<td>77%</td>
</tr>
<tr>
<td>Powell/205/Division/182nd</td>
<td>67%</td>
<td>100%</td>
<td>44%</td>
<td>94%</td>
<td>100%</td>
<td>92%</td>
<td>76%</td>
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<tr>
<td>Powell/Foster/205/Sunnyside</td>
<td>84%</td>
<td>79%</td>
<td>54%</td>
<td>73%</td>
<td>98%</td>
<td>96%</td>
<td>75%</td>
</tr>
<tr>
<td>South Corridor/212</td>
<td>91%</td>
<td>44%</td>
<td>57%</td>
<td>100%</td>
<td>86%</td>
<td>100%</td>
<td>73%</td>
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<td>South Corridor/Sunnyside</td>
<td>84%</td>
<td>48%</td>
<td>60%</td>
<td>89%</td>
<td>91%</td>
<td>89%</td>
<td>71%</td>
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<tr>
<td>Springwater Corridor</td>
<td>38%</td>
<td>58%</td>
<td>60%</td>
<td>68%</td>
<td>35%</td>
<td>77%</td>
<td>54%</td>
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</table>

Maximum Possible Score: 100% for all

Raw Scores

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<tr>
<th>Powell/205/Foster</th>
<th>170.0</th>
<th>193.2</th>
<th>241.8</th>
<th>116.2</th>
<th>65.6</th>
<th>32.8</th>
<th>819.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Powell/205/Sunnyside</td>
<td>250.0</td>
<td>177.1</td>
<td>137.8</td>
<td>128.8</td>
<td>73.6</td>
<td>37.6</td>
<td>804.9</td>
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<tr>
<td>Powell/Foster</td>
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<td>72.0</td>
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<td>Powell/205/Division/182nd</td>
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<td>230.0</td>
<td>114.4</td>
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<td>80.0</td>
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<td>760.3</td>
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<td>Powell/Foster/205/Sunnyside</td>
<td>210.0</td>
<td>181.7</td>
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<td>38.4</td>
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<td>South Corridor/212</td>
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<td>148.2</td>
<td>140.0</td>
<td>68.8</td>
<td>40.0</td>
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<td>156.0</td>
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<td>72.8</td>
<td>35.6</td>
<td>709.4</td>
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<tr>
<td>Springwater Corridor</td>
<td>95.0</td>
<td>133.4</td>
<td>156.0</td>
<td>95.2</td>
<td>28.0</td>
<td>30.8</td>
<td>538.4</td>
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</tbody>
</table>

Maximum Possible Score: 250.0 for Powell/205/Foster, 250.0 for Powell/205/Sunnyside, 250.0 for Powell/Foster, 250.0 for Powell/205/Division/182nd, 250.0 for Powell/Foster/205/Sunnyside, 250.0 for South Corridor/212, 250.0 for South Corridor/Sunnyside, 250.0 for Springwater Corridor

All corridors begin in Downtown Portland and end in Pleasant Valley/Damascus.
All totals are raw scores out of a possible 1000.

An in-depth analysis of each route will be given in the following sections.
Powell/205/Foster Alignment

In an analysis of eight separate routes within the study corridor, this route is the best alternative, with a final score of 82% of the maximum weighted score (100%). This 15.8-mile route will service the bus mall and Union Station in downtown Portland and cross the Willamette River on the Hawthorne Bridge. The route travels east on Powell Blvd. to Interstate 205, where it travels south to Foster Road and continues on Foster to the future Damascus Town Center. It is a relatively direct route to Pleasant Valley/Damascus, and traverses dense population areas and activity centers.

Figure D: Powell/205/Foster Alignment

Table B: Powell/205/Foster

<table>
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<tr>
<th>Criterion</th>
<th>Value</th>
<th>Weight</th>
<th>Score</th>
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<tr>
<td>Ridership</td>
<td>8.4</td>
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<td>84%</td>
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<td>Operations</td>
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<td>ROW Costs</td>
<td>8.3</td>
<td>14</td>
<td>116.2</td>
<td>83%</td>
</tr>
<tr>
<td>Environment</td>
<td>8.2</td>
<td>8</td>
<td>65.6</td>
<td>82%</td>
</tr>
<tr>
<td>Construction</td>
<td>8.2</td>
<td>4</td>
<td>32.8</td>
<td>82%</td>
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<tr>
<td><strong>TOTALS</strong></td>
<td><strong>100</strong></td>
<td><strong>819.6</strong></td>
<td><strong>82%</strong></td>
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<td>Distance (miles)</td>
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<td>Travel Time (min.)</td>
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<tr>
<td>Projected Daily Trips</td>
<td>6878</td>
<td>4/8</td>
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</tbody>
</table>

June 2001
Page 24
Strengths:
Overall, the Powell/205/Foster Alignment finished first in the analysis because of its directness and connectivity to regional and employment centers. Residential densities along Powell Blvd. provide adequate ridership to current bus routes that use this roadway, and projected population will further increase ridership. This route’s connections to activity centers are better than that of the Powell/Foster alternative, and its utilization of the I-205 ROW will allow the system to be more rapid. Its route along Powell will have a wide ROW and will not be constrained by the densely built-up areas on Foster Road between SE 50th and I-205.

Because of its advantages in ROW, construction and acquisition costs will be minimized. Interstate 205 was originally designed and built with the possibility for transit service in its median, and surface grading is present, thus reducing many of the engineering costs. Foster Road from I-205 to 136th has enough ROW to easily implement a BRT system.

Weaknesses:
Due to the imminent population and employment growth in the area, Foster Road will need to be expanded to create access for future residents. The entrance to Pleasant Valley is hindered by a natural bottleneck created by the surrounding topography located at the intersection of SE Foster and Jenne Road. Environmental damage could occur at this location as well as further into the valley itself, where a creek traverses the valley.
Powell/205/Sunnyside Alignment
This 18.8-mile route follows Powell Boulevard east from Downtown Portland, and then turns south on Interstate 205 to Clackamas Regional Center (CRC). From here, it follows Sunnyside Road east to Damascus. Upon reaching the Damascus Town Center, the corridor turns north on 172nd Avenue to Pleasant Valley. This corridor was considered in this model because it takes advantage of the extremely wide right-of-way provided by Interstate 205. It has the second highest overall score of the corridors analyzed, with 80%.

Figure E: Powell/205/Sunnyside Alignment

Table C: Powell/205/Sunnyside

<table>
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<tr>
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<th>Score</th>
<th>% Ranking</th>
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<td>25</td>
<td>250.0</td>
<td>100%</td>
</tr>
<tr>
<td>Ridership</td>
<td>7.7</td>
<td>23</td>
<td>177.1</td>
<td>77%</td>
</tr>
<tr>
<td>Operations</td>
<td>5.3</td>
<td>26</td>
<td>137.8</td>
<td>53%</td>
</tr>
<tr>
<td>ROW Costs</td>
<td>9.2</td>
<td>14</td>
<td>128.8</td>
<td>92%</td>
</tr>
<tr>
<td>Environment</td>
<td>9.2</td>
<td>8</td>
<td>73.6</td>
<td>92%</td>
</tr>
<tr>
<td>Construction</td>
<td>9.4</td>
<td>4</td>
<td>37.6</td>
<td>94%</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td><strong>100</strong></td>
<td><strong>804.9</strong></td>
<td><strong>80%</strong></td>
<td></td>
</tr>
</tbody>
</table>
Strengths:
On the surface, this alternative appears to be the least appealing route; however, it scored quite high among several criteria. In connectivity, the highest weighted criterion, it scored a 100%. Though the routing is indirect, this option serves the most, and the largest, activity centers. The major centers that are served by this corridor include Downtown Portland, 82nd and Powell, and Clackamas Regional Center. The CRC area has as many jobs and as much retail space as downtown Portland. This corridor also beat the top rated corridor in ridership (77%), meaning it passes through population centers with generally higher densities.

This corridor scored high on the right-of-way criterion (92%). It avoids some of the possible choke points such as on Foster between 50th and I-205, and similar situations on Foster between 136th and 172nd. Powell has a very wide ROW between 50th and I-205, requiring only minor land acquisition in some sections. The I-205 segment will not require any land acquisitions and has enough ROW to increase system speed. There are few ROW restrictions on Sunnyside Road. As growth increases in Pleasant Valley/Damascus, Sunnyside Road will likely be improved to suburban street standards.

This option also scored quite well on environment (92%) and construction costs (94%). Its environmental scores are good because it avoids many creeks and wetlands that several alternatives, which enter Pleasant Valley/Damascus from the north, will have to contend with. In terms of construction costs, the Powell/205/Sunnyside alternative is cost-effective because it utilizes the I-205 ROW, which is graded and ready for infrastructure.

Weaknesses:
The Powell/205/Sunnyside route is indirect. Despite scoring high in nearly every category, this corridor scored only 53% for operations and travel time. Operations include the cost of operating the system, which is heavily dependent on the length of the corridor. The length determines the number of vehicles needed and, consequently, the labor and maintenance costs for the entire system. Small increases in total distance can cause significant increases in operating costs.

This criterion also includes travel time for the entire corridor. It includes the total length, the number of 90 degree turns, the number of minutes spent traveling in the reverse direction (turning north from Damascus to Pleasant Valley, which is southeast of Downtown Portland), and the number of station stops. All the corridors were measured using a standard of one station per mile. With its greater length, this corridor has more stations, each of which add to the overall commute time.
Powell/Foster Alignment
This 14.9-mile route will start in Downtown Portland. Once on Powell Blvd., the route heads east until SE 50th, where it will turn southeast onto Foster Road to Damascus.

Figure F: Powell/Foster Alignment

Table D: Powell/Foster

<table>
<thead>
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<th>% Ranking</th>
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<td>4.6</td>
<td>25</td>
<td>115.0</td>
<td>46%</td>
</tr>
<tr>
<td>Ridership</td>
<td>8.8</td>
<td>23</td>
<td>202.4</td>
<td>88%</td>
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<tr>
<td>Operations</td>
<td>10.0</td>
<td>26</td>
<td>260.0</td>
<td>100%</td>
</tr>
<tr>
<td>ROW Costs</td>
<td>6.0</td>
<td>14</td>
<td>84.0</td>
<td>60%</td>
</tr>
<tr>
<td>Environment</td>
<td>9.0</td>
<td>8</td>
<td>72.0</td>
<td>90%</td>
</tr>
<tr>
<td>Construction</td>
<td>8.3</td>
<td>4</td>
<td>33.2</td>
<td>83%</td>
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<tr>
<td>TOTALS</td>
<td>100</td>
<td>766.6</td>
<td>77%</td>
<td></td>
</tr>
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Foster Road presents many opportunities and constraints between SE 50th and I-205, where residential densities are relatively high but the ROW is extremely narrow and has buildings next to the sidewalks. This segment is a good candidate to incorporate "Main Street" themes, enhance the pedestrian environment, and convert buildings into transit-oriented developments (TOD). Ridership in this segment is excellent due to the proximity of many residential developments.

June 2001
Page 28
At SE 82nd Ave., signal prioritization will be required to keep the buses moving because of the amount of auto and truck traffic on this major arterial. Mitigation near SE 82nd could provide ample opportunities to deal with the traffic congestion and increase pedestrian amenities, allowing access to a future station.

Beyond I-205, densities and developments decline markedly, as these areas of SE Portland less intensely developed. This segment presents some of the greatest challenges to the route, because of the sensitive nature of the physical environment. Foster will have to be widened at Jenne Road and environmental mitigation will be required at this location, as well as further into the valley itself, where several creeks traverse the valley.

**Strengths:**
Overall, this route is the most direct, which would allow for reduced operational costs. This alternative scored the best (100%) in terms of operations, as it is the shortest route. Redevelopment opportunities along this route are abundant, with some historic properties and under-utilized areas. Residential densities, particularly along Foster Road between SE 50th and SE 82nd, would contribute to very good ridership.

**Weaknesses:**
Foster’s severe ROW restrictions, primarily between SE 50th and I-205, were the primary reasons for this alternative’s lower outcome. Connectivity to activity centers is also very weak. Further, environmental concerns near Jenne Road will likely increase the costs of this route. Because of these important restrictions, the route finished third in the analysis, with a score of 77%.
Powell/Division/182\textsuperscript{nd} Alignment

This 18.7-mile route starts in Downtown Portland. Once on Powell, it heads east to I-205. It then turns north onto the interstate for a half-mile, then turns east on SE Division for approximately four miles. Turning south at 182\textsuperscript{nd} Avenue, the alignment will use a future roadway that will connect to 172\textsuperscript{nd} Avenue into Pleasant Valley and on to Damascus.

Figure G: Powell/Division/182\textsuperscript{nd} Alignment

Table E: Powell/Division/182\textsuperscript{nd}

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Value</th>
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<td>25</td>
<td>167.5</td>
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<tr>
<td>Ridership</td>
<td>10.0</td>
<td>23</td>
<td>230.0</td>
<td>100%</td>
</tr>
<tr>
<td>Operations</td>
<td>4.4</td>
<td>26</td>
<td>114.4</td>
<td>44%</td>
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<tr>
<td>ROW Costs</td>
<td>9.4</td>
<td>14</td>
<td>131.6</td>
<td>94%</td>
</tr>
<tr>
<td>Environment</td>
<td>10.0</td>
<td>8</td>
<td>80.0</td>
<td>100%</td>
</tr>
<tr>
<td>Construction</td>
<td>9.2</td>
<td>4</td>
<td>36.8</td>
<td>92%</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td><strong>100</strong></td>
<td><strong>760.3</strong></td>
<td><strong>76%</strong></td>
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<td>Travel Time (min.)</td>
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<td>8/8</td>
</tr>
<tr>
<td>Projected Daily Trips</td>
<td>9465</td>
<td>1/8</td>
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This alignment was considered because of its consistently wide ROW on SE Division, excellent connectivity to residential and commercial activity centers, the best projected ridership and the lowest environmental impacts. **Residential densities along Powell Blvd. and Division provide adequate ridership to current bus routes that use this roadway, and projected population will cause further increases in density, strengthening ridership.**

**Strengths**
The ridership this route is likely to generate almost compensates for its imperfect connectivity. While it may be a bit long and expensive to operate, it would be fairly easy to make this route cost-effective physically, environmentally and politically. While it might seem to parallel Eastside MAX, it is just far enough away to attract its own set of riders and transit-oriented development patterns. Coupled with one of the McLoughlin alignments or a South Corridor MAX, a perfect long-distance BRT loop could be created that would even connect with Clackamas Regional Center (CRC).

**Weaknesses**
Because of its overall length, operational costs are likely to be very high. Because it does not connect with Clackamas Regional Center and other important activity centers, this route finished fourth, with a score of 76%. 
Powell/Foster/205/Sunnyside Alignment
This 17.9-mile corridor option is nearly identical in routing to the Powell/205/Sunnyside Alignment, with the exception of its using SE Foster Road, rather than Powell, between SE 50th and I-205. This alternative is slightly shorter than the Powell/205/Sunnyside route. It ranked fifth out of eight in overall score, finishing with 75%.

Figure H: Powell/Foster/205/Sunnyside Alignment

Table F: Powell/Foster/205/Sunnyside

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<th>Criterion</th>
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<td>25</td>
<td>210.0</td>
<td>84%</td>
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<tr>
<td>Ridership</td>
<td>7.9</td>
<td>23</td>
<td>181.7</td>
<td>79%</td>
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<tr>
<td>Operations</td>
<td>5.4</td>
<td>26</td>
<td>140.4</td>
<td>54%</td>
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<tr>
<td>ROW Costs</td>
<td>7.3</td>
<td>14</td>
<td>102.2</td>
<td>73%</td>
</tr>
<tr>
<td>Environment</td>
<td>9.8</td>
<td>8</td>
<td>78.4</td>
<td>98%</td>
</tr>
<tr>
<td>Construction</td>
<td>9.6</td>
<td>4</td>
<td>38.4</td>
<td>96%</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td><strong>100</strong></td>
<td><strong>751.1</strong></td>
<td><strong>75%</strong></td>
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<tr>
<td>Travel Time (min.)</td>
<td>43</td>
<td>6/8</td>
</tr>
<tr>
<td>Projected Daily Trips</td>
<td>7212</td>
<td>3/8</td>
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</table>
Strengths:
This alignment option performed very well on both the environment and the construction criteria, scoring 98% and 96% respectively. The Powell/Foster/205/Sunnyside alignment enters the Pleasant Valley/Damascus area from the south, avoiding the environmentally sensitive lands at the north end of the valley. It also minimizes construction costs by making use of the Interstate 205 right-of-way.

It performed well on connectivity, rating 79% versus the 56% for the top choice corridor. This score falls very short, however, when compared to the Powell/205/Sunnyside corridor, which scored 100% on this criterion.

Weaknesses
Though a slight improvement over Powell/205/Sunnyside in operations, this is still far short of the 84% achieved by the top alternative, Powell/205/Foster. It is only slightly shorter than the Powell/205/Sunnyside alignment.

By using Foster to I-205 rather than taking Powell, this option’s appeal drops significantly. Though this shortcut appears to be quite logical, it reduces the scores for both connectivity and ROW by approximately 20%, compared to Powell/205/Sunnyside. The connectivity is reduced because Foster bypasses several significant trip generators around 82nd and Powell, and I-205 and Powell.

The section of Foster from 50th to I-205 has a very restricted ROW. The lanes are quite narrow and the buildings, many of which are historic, are built up to the lot lines. Consequently, there is little room for expansion in this segment without removing lanes, parking, pedestrian space, or structures.
McLoughlin/212 Alignment
This 19.6-mile route travels south from Downtown Portland along McLoughlin Boulevard. In Milwaukie, the route travels east along Highway 224 to the Clackamas Regional Center (CRC). At Interstate 205, the route heads south to Highway 212, then east to the future Damascus and Pleasant Valley Town Centers.

Figure I: McLoughlin/212 Alignment

Table G: McLoughlin/212

<table>
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<tr>
<th>Criterion</th>
<th>Value</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Connectivity</td>
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<td>25</td>
<td>227.5</td>
<td>91%</td>
</tr>
<tr>
<td>Ridership</td>
<td>4.4</td>
<td>23</td>
<td>101.2</td>
<td>44%</td>
</tr>
<tr>
<td>Operations</td>
<td>5.7</td>
<td>26</td>
<td>148.2</td>
<td>57%</td>
</tr>
<tr>
<td>ROW Costs</td>
<td>10.0</td>
<td>14</td>
<td>140.0</td>
<td>100%</td>
</tr>
<tr>
<td>Environment</td>
<td>8.6</td>
<td>8</td>
<td>68.8</td>
<td>86%</td>
</tr>
<tr>
<td>Construction</td>
<td>10.0</td>
<td>4</td>
<td>40.0</td>
<td>100%</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td>100</td>
<td></td>
<td>725.7</td>
<td>73%</td>
</tr>
</tbody>
</table>

Between Downtown Portland and CRC, this corridor was originally considered by Metro and Tri-Met for light-rail service. Since the defeat of the South-North alignment in 1998,
it has been under study for various other transportation options, and will most likely become a Rapid Bus line.

**Strengths:**
The McLoughlin/212 Alignment connects the two largest commercial activity centers in the region: Portland’s downtown and the Clackamas Regional Center. Because these two centers generate a large demand on the transportation system, serving them with transit would be likely to reduce single-occupant driving and traffic congestion. This alignment will also connect the Damascus and Pleasant Valley Town Centers, giving it a high score for connectivity.

This route takes advantage of the wide Union Pacific ROW adjacent to McLoughlin Boulevard, just east of the existing roadway, where ample room exists for a completely separate BRT busway. This would allow for rapid speeds with little or no disruption in service due to traffic congestion. As McLoughlin nears the City of Milwaukie, the route turns east as it follows Highway 224. Here, the ROW also allows for rapid speed. ROW capacity is great enough in this segment to allow for dedicated BRT lanes down the center of the roadway. A lack of cross traffic in these areas would also contribute to system speed. In addition, ROW costs would be minimal because relatively few acquisitions would be necessary. Sufficient ROW capacity currently exists along nearly all of the route.

Negative effects on the natural environment would be minimal, as the route does not enter environmentally sensitive areas. Additionally, because this route travels within main transportation corridors, the system would benefit from high-visibility.

**Weaknesses:**
Land uses from Portland to the Clackamas Regional Center (CRC) consist primarily of commercial and industrial uses and low residential density, which has potential negative effects on ridership along this section of the route. Also, because of the Union Pacific Railroad tracks along McLoughlin, pedestrian access would be blocked from the east without added footbridges. Although residential land exists along Highway 212 east of CRC, it is limited, as are commercial and office activity centers. This route had the lowest score for ridership of the alignments analyzed.

Because of the length of this route, operational costs will be high. More vehicles, drivers, and maintenance will be required to service this route, compared with some other alternatives. Also, this route suffers from a long reverse-directional hindrance, where it would head in the wrong direction. Because it will enter the valley at the south, it must travel north to serve the Pleasant Valley town center where the line will terminate.
McLoughlin/Sunnyside Alignment
This 19.1-mile route will service the bus mall in downtown Portland and cross the river on the Hawthorne Bridge, where it heads south along McLoughlin Boulevard. In the City of Milwaukie, the route travels east along Highway 224 to the Clackamas Regional Center (CRC). At Interstate-205, the route travels north to Sunnyside Road to the future Damascus and Pleasant Valley Town Centers.

Figure J: McLoughlin/Sunnyside Alignment

Table H: McLoughlin/Sunnyside

<table>
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<tr>
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<th>% Ranking</th>
</tr>
</thead>
<tbody>
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<td>25</td>
<td>210.0</td>
<td>84%</td>
</tr>
<tr>
<td>Ridership</td>
<td>4.8</td>
<td>23</td>
<td>110.4</td>
<td>48%</td>
</tr>
<tr>
<td>Operations</td>
<td>6.0</td>
<td>26</td>
<td>156.0</td>
<td>60%</td>
</tr>
<tr>
<td>ROW Costs</td>
<td>8.9</td>
<td>14</td>
<td>124.6</td>
<td>89%</td>
</tr>
<tr>
<td>Environment</td>
<td>9.1</td>
<td>8</td>
<td>72.8</td>
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<tr>
<td>Construction</td>
<td>8.9</td>
<td>4</td>
<td>35.6</td>
<td>89%</td>
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<tr>
<td><strong>TOTALS</strong></td>
<td><strong>100</strong></td>
<td><strong>709.4</strong></td>
<td><strong>71%</strong></td>
<td></td>
</tr>
</tbody>
</table>

This alignment is nearly identical to the McLoughlin/212 alignment, but travels east of Clackamas Regional Center on Sunnyside Road rather than Highway 212.
Strengths:
Sunnyside Road is much more residential than Highway 212, and also has office and retail activity. The McLoughlin/Sunnyside Alignment scores well on Connectivity, has minimal environmental impacts, and low construction costs. This Sunnyside Rd. is likely to be widened in the future to improve access to Pleasant Valley and Damascus, BRT infrastructure could be added as part of this project.

Weaknesses:
As with McLoughlin/212, land uses between Portland to the Clackamas Regional Center are mostly commercial and industrial, which would have potential negative effects on ridership along this section of the route. Though ridership on Sunnyside Rd. is higher than on Hwy. 212, overall ridership will be very low. Also, like McLoughlin/212, operational costs will be high.
Springwater Corridor Alignment
Starting from downtown Portland and the Hawthorne Bridge, this 18.6-mile corridor follows an old railroad alignment to the south, along the Willamette River to the Sellwood area, then east along Johnson Creek, continuing on to Powell Butte. At Powell Butte it joins Foster Road, and continues on into the Pleasant Valley/Damascus area.

Figure K: Springwater Alignment

Table I: Springwater

<table>
<thead>
<tr>
<th>Criterion</th>
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<tr>
<td>Ridership</td>
<td>5.8</td>
<td>23</td>
<td>133.4</td>
<td>58%</td>
</tr>
<tr>
<td>Operations</td>
<td>6.0</td>
<td>26</td>
<td>156.0</td>
<td>60%</td>
</tr>
<tr>
<td>ROW Costs</td>
<td>6.8</td>
<td>14</td>
<td>95.2</td>
<td>68%</td>
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<tr>
<td>Environment</td>
<td>3.5</td>
<td>8</td>
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<tr>
<td>Construction</td>
<td>7.7</td>
<td>4</td>
<td>30.8</td>
<td>77%</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td><strong>100</strong></td>
<td><strong>538.4</strong></td>
<td></td>
<td><strong>54%</strong></td>
</tr>
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</table>

The Springwater Corridor rail line has linked downtown Portland with the community of Boring since 1903. It roughly follows the path of Johnson Creek. It is currently a multi-use recreational path, popular with walkers, joggers, cyclists, wheelchairs and even the occasional equestrians.

southeast portland
This alignment was considered because of its previous use as a transit corridor, a consistently wide right-of-way (ROW) and frequent grade separation. It scored the lowest of the eight alignments analyzed, due to political and environmental conflicts and a lack of connectivity, with a final score of just 54%.

**Strengths**

There were several positive aspects of using the Springwater Corridor as a possible BRT alignment. While neither Multnomah nor Clackamas County officially lists the alignment as a right-of-way, parts of the ROW are owned by the City of Portland, City of Milwaukie, Portland Parks, or by Metro. This will likely reduce the costs and legal difficulties of land acquisition. In addition, because the route was once a commuter rail line, parts of the old railroad bed are grade-separated from many of the larger roadways.

Springwater would facilitate connectivity to a series of underdeveloped residential neighborhoods, allowing each to redevelop towards a transit orientation. In fact, Sellwood and Lents were built predominantly during the height of transit use in the early part of the 20th century. All along the route are 1000 foot by 300-foot station spacings approximately every mile, some of which still have station structures. Overall, Springwater is likely to be one of the faster alternative routes, given certain infrastructure improvements and political will.

**Weaknesses**

Political feasibility is Springwater's greatest weakness. It was converted to a recreational trail for pedestrians and bicyclists in the late 1980s and early 1990s. The Springwater Corridor trail is quite popular, for many of the same reasons BRT would work well here: there is little cross traffic, few dangerous crossings, good grade separation and good neighborhood connectivity. The trail was implemented as part of an overall plan to mitigate flooding on Johnson Creek. While the floodwaters have never directly threatened the railroad grades and bridges, they have damaged area homes and businesses nearby, making development especially difficult.

Converting the line into a BRT-exclusive line might be legally possible, but would be nearly impossible politically. A shared-use BRT/recreational trail may be more feasible, but technically impractical, with bicycle and pedestrian safety issues of primary concern. In this analysis, political costs were apportioned within the overall ROW costs. Springwater received a lower score on both the environmental and ROW costs, while its construction costs and ridership were about average. While this route has good residential connectivity and redevelopment potential, connectivity to commercial and activity centers is lacking, while its long overall length will likely increase its operational costs. Its connectivity score was the lowest of all alternatives, with a score of just 38%. Compared to all other routes analyzed, the Springwater Corridor was the least feasible.
Station Analysis: Criteria
The optimal locations for future BRT stations were decided based on the following criteria: Speed; Right-of-way; Environmental Impacts; Ridership; and Land Use.

**Speed**
Stations should be at intersections where speed will need to be reduced. In order to reduce delay as much as possible, the BRT vehicle should, when possible, only need to stop in sections of the corridor where it will already need to slow down for other reasons. These reasons can include major intersections, school zones, sections of narrow road, and tight curves.

Stations should be at least one mile apart. In order to maintain a short travel time, stations should be spaced approximately one mile apart. This will vary depending on conditions and other relevant criteria.

**Right-of-Way**
The ROW, with any additional easements, must be able to accommodate station platform while maintaining existing infrastructure. Stations should be located in areas where the ROW is not only wide enough to accommodate the BRT line without removing travel lanes or sidewalks, but also a station platform. This station platform will be a minimum of 11 feet wide and up to 80 feet long in order to provide adequate amenities such as seating, ticket machines, bike racks, and a shelter (see Figure L).

**Figure L: Typical Station Cross Section.**

Environmental and Pedestrian Impacts
Station conditions must allow for safe and convenient boarding. Conditions at a chosen station site should allow for safe and easy access to the station. For example, this may mean that a station should be located a half-block away from major intersections. This would reduce wide streets for pedestrians to cross due to turn lanes and where there is no threat from turning traffic.

**Ridership**
Stations should be located near intersections of major arterial roads. Where major arteries intersect, there tends to be more commercial activity, as well as density, than in other areas. This is due to the increased visibility and accessibility that a business has
when located on two major arterials rather than just one. This also means slightly higher densities because the increased accessibility can result in increased land value. Both commercial activities and increased density generate ridership.

In addition, major intersections have the most accessibility to pedestrians in areas with little street connectivity. Suburban areas tend to have road networks that concentrate travelers onto major arterials. Therefore, stations located at intersections with major arterials will provide the greatest convenience to potential riders, as well as help generate ridership for the BRT line.

**Stations must be at or near intersections with existing or projected transit corridors.** Other major transit lines that can feed into the BRT system would cross its path at the intersections of major roads. Stations located at major intersections would draw ridership from these easy transfer points. This will allow for broad areas to be relatively well served by the BRT line, and increase access of BRT passengers to more parts of the region.

**Land Use**

Stations should be located near high density, mixed-use areas, as defined by Metro. Areas with high densities provide a pool of potential riders. A mixed-use area generally consists of residential and commercial uses, including employment. Such an area becomes a draw for the neighborhood and can become a neighborhood center, and can further increase the number of potential riders.

**Land use around each station must be conducive to transit-oriented redevelopment.** Stations should be located where high-density, mixed-use land use patterns can be developed. This requires an area that has supportive zoning, a favorable political climate, and parcels that can be assembled into transit-oriented areas. Once a transit-oriented development is built, it will support the transit line with riders, and the transit line will support the development with increased land values.

**Outermost stations should be able to accommodate park & ride facilities.** In order to generate ridership in the areas furthest from downtown, park & ride facilities will be necessary. These areas will not have good access by feeder bus routes, as homes will likely be located further from the station, making walking to transit less feasible. These facilities should be designed in such a way so they can be upgraded to higher-level uses in the future, as growth warrants.
Station Analysis: Results
Based upon the station analysis criteria, optimal station locations were determined for the two highest scoring alignments.

Powell/I-205/Foster Road Alignment Stations

Downtown Portland Stations. Downtown Portland is a major regional destination, with some of the largest commercial, employment, and entertainment districts in the region. There is high population density, with existing mixed-use developments. Downtown has numerous intersections with major regional arterial and converging transit routes, including the bus-mall. There are few right-of-way restrictions and environmental impacts. The pedestrian environment in the CBD is currently excellent, making BRT accessible to everyone.

OMSI/Central Eastside Industrial District Station. This station will be located near the Oregon Museum of Science and Industry (OMSI), which is a major regional recreation destination. The station is also near major arterial roads, and near the proposed South Corridor transit line. Redevelopment potential is abundant in the district. Employment density is high in the vicinity, with industrial businesses nearby. There will be minimal environmental impacts and minimal pedestrian impacts as well. The pedestrian environment can be improved in many ways here, with wide sidewalks and possibly a footbridge connecting the route with surrounding neighborhoods.

11th/12th & Division/Clinton Station. This station will be located at the intersection of major arterial roads, which include several transit connections. There are minimal ROW restrictions, and minimal environmental impacts associated with this station location. Pedestrian impacts also will be minimal, as sidewalks will be widened to create greater access for local residents. Potential development and redevelopment opportunities are great, with many under-utilized properties. Currently, there is moderate population density and employment density.

26th & Powell Station. This station will be located at the intersection of a north/south collector street (26th), that does provide current transit routes and good neighborhood connections. There is moderate employment density, with a significant trip generator (high school) located nearby. Development opportunities include a potential transit-oriented-development at SE 32nd Avenue, where mixed-use developments would be a community asset. There are minimal environmental impacts associated with this location, and the pedestrian environment will be improved with wider sidewalks, and traffic calming measures.

39th & Powell Station. This station location is at a major arterial intersection with converging transit routes. There are minimal ROW restrictions and minimal environmental impacts associated with this location. Development opportunities include potential for mixed-use residential and commercial developments. Currently, there is moderate employment density, but high residential density in surrounding...
neighborhoods. The current pedestrian environment is in need of upgrades, so that local residents will be able to walk to the station.

50th/52nd & Powell Station. This station is at the intersection of three major arterial roadways, and several existing transit routes. Nearby commercial density along Foster Road creates an attractive activity center and Main Street possibilities. Opportunities for development include mixed-use housing and retail developments. There are moderate ROW challenges here, as Powell Blvd. has ample expansion capabilities to accommodate the BRT line. The pedestrian environment is currently not very welcoming, and will require significant upgrades to encourage local residents to use the system. There are minimal environmental impacts associated with this location considering the surrounding built-up areas. This station is also near a high school, which is a significant trip generator.

68th & Powell Station. This station location is near an intersection with a north/south collector street, with moderate residential density in the vicinity. There are no ROW restrictions associated with this location. There is great potential for transit-oriented developments in this area, and redevelopment opportunities are also present. There will be minimal environmental and pedestrian impacts. There are excellent neighborhood connections, and bicyclists and pedestrians alike will be able to access the system without safety concerns.

82nd & Powell Station. This station is located at an intense commercial activity center, with moderate residential density and mixed-use developments. 82nd Avenue is a state highway, designated as a major regional arterial, where current transit corridors merge. This area has significant pedestrian challenges, and many changes will be made in order to upgrade the environment for pedestrians and bicyclists. There are minimal environmental impacts in this area, and no ROW restrictions that otherwise would limit station amenities. There is great potential for redevelopment and possible placement of a Park & Ride structure.

I-205 & Powell Station. This station is located at the intersection of a major regional arterial road and an interstate highway. The greatest potential here is for a Park & Ride site, as the surrounding residential and commercial densities are lacking. There are no ROW restrictions, and minimal environmental impacts. The pedestrian environment is virtually non-existent here, and will need many improvements and upgrades including a possible footbridge to create access to the system. The potential for additional development and re-development is great.

I-205 & Foster Road Station. This station is located at the Metro designated Lents Town Center. There is potential for development and redevelopment in this area, with mixed-use retail and residential possibilities. The station is at the intersection of major regional arterial roads, where several transit routes converge. The opportunity for a Park & Ride is very good here, because of its location within the region. There are no ROW restrictions as Foster Road is more than adequate. High-density residential and commercial centers are in the immediate vicinity, which will support the BRT system.
Environmental impacts at this location would be minimal, however, the pedestrian environment would need major upgrades to encourage local residents to use the system. The location does allow for good neighborhood connections, whether driving, walking or bicycling.

122nd & Foster Station. This station is located at the intersection of major arterial roads and transit connections. The surrounding residential areas are characterized by moderate density, with opportunities for mixed-use development. Also, there is great potential for greenfield developments. There are minimal ROW restrictions, and minimal environmental impacts. The pedestrian environment will require upgrades, plus, this location is a good candidate for a Park & Ride facility.

136th & Foster Station. This station is located at the intersection of a minor arterial, and near the intersection of a primary access road to Happy Valley. The surrounding residential areas are characterized by low density, with significant potential for redevelopment, and greenfield development. ROW restrictions are moderate, which will be addressed during construction. The environmental and pedestrian impacts are minimal. This location is also a potential Park & Ride site, with good neighborhood connections.

172nd & Foster Station. This station is located at the Metro designated Town Center site in Pleasant Valley. There is significant potential for greenfield development, and high density and mixed use residential and retail developments. With population and employment growth projections around 400% over the next 20 years, many changes will occur in this area. Foster Road and 172nd will be undergoing expansion in the next 15 – 20 years, which eliminates most ROW restrictions. Negative environmental impacts are potentially great, and mitigation will play a major role in the future development of this area. The pedestrian environment will improve as the area grows, with moderate to high employment density and commercial activity in the surrounding areas. There is potential for a Park & Ride site, with good neighborhood connections.

172nd & Sager Station. This station is located between Pleasant Valley and Damascus, providing easy access to the system for future residents. There is significant potential for greenfield development, and future road expansion will deal with any current ROW restrictions. The environmental impacts could be significant, and mitigation will play a large role in the development of this area. The pedestrian environment will improve as the area grows, with moderate to high employment density and commercial activity in the surrounding areas. There is potential for a Park & Ride site, with good neighborhood connections.

172nd & Hagen Station. This station is located between Pleasant Valley and Damascus, providing easy access to the system. There is significant potential for development, and future road expansions will limit ROW restrictions. There could be considerable environmental impacts, and mitigation will be necessary. The pedestrian environment will improve as the area grows, with moderate to high employment density and
commercial activity in the surrounding areas. There is potential for a Park & Ride site here as well.

172nd and Sunnyside Road – Damascus Town Center Station. As a town center, this station location will have employment, commercial, mixed-use and residential development opportunities. In the coming years, residential densities will increase in support of transit-oriented communities. The natural environment may be negatively impacted, while the pedestrian environment will improve as the area grows, with moderate to high employment density and commercial activity in the surrounding areas. There is the potential for a Park & Ride site.

Powell/I-205/Sunnyside Alignment Stations
This alignment also begins in downtown Portland, and will utilize many of the same station stops as the best alternative alignment, Powell/I-205/Foster Road, with the exception of those detailed below. See the Powell/I-205/Foster Road alignment for a discussion of the following stations:

- Downtown Portland Stations.
- OMSI/Central Eastside Industrial District Station.
- 11th/12th & Division/Clinton Station.
- 26th & Powell Station.
- 39th & Powell Station.
- 50th/52nd & Powell Station.
- 68th & Powell Station.
- 82nd & Powell Station.
- I-205 & Powell Station.
- I-205 & Foster Road Station.

The stations within the Pleasant Valley and Damascus areas will also be the same as the previous alignment, but in reverse order:

- 172nd and Sunnyside Road – Damascus Town Center Station.
- 172nd & Hagen Station.
- 172nd & Sager Station.
- 172nd & Foster Station.

I-205 & Johnson Creek Station. This station is within the more than adequate right-of-way of Interstate 205, which merges with Johnson Creek Blvd., a major arterial traversing the southeastern portions of Multnomah County. Transit service on Johnson Creek will provide connections to and from the BRT line for those who live and work in the area. Residential density is moderate to low. However, commercial and retail densities are quite high due to the proximity to 82nd Avenue. This location has the potential for a Park & Ride lot, and there is potential for additional development and re-development. Environmental impacts will be virtually non-existent, but pedestrian amenities will need to be added. Wide sidewalks and traffic calming measures are just two examples of what could be done to improve the area for pedestrians.
Clackamas Regional Center and Sunnyside Road Station. This station will be located at the Clackamas Regional Center, which is comprised of the most retail space in the metropolitan area. Transit service on Sunnyside Road and 82nd Avenue converge at this location, where there currently is a transit center. Also, each of these are major arterial roads. Clackamas Regional Center is a focus of commercial and office activity, with smaller areas of industrial developments in the vicinity. Environmental impacts would be minimal, and the pedestrian environment will need improvements. There are no right-of-way restrictions at this location. Currently, there is a major pedestrian/bicycle path that follows I-205, and this will provide the foundation for a safe and adequate access for those who choose not to drive to the station.

122nd and Sunnyside Road Station. This station will be located at the intersection of 122nd and Sunnyside Road, where major arterial roads and transit routes converge, making this a necessary station location. This north/south route of 122nd is a main corridor from the community of Happy Valley and beyond. Sunnyside Road is currently being expanded in this location and further east, which will deal with any right-of-way restrictions that otherwise, would limit station amenities. Residential and commercial densities are moderate in this area, due to few activity centers in the immediate vicinity. The pedestrian environment is currently not inviting, and will be made more available not only to them but also to bicyclists who will commute to the station for a connection to downtown Portland, or further east of this location.

147th and Sunnyside Road Station. This station location is at a currently under-developed area, which over the next 15 – 20 years will expand dramatically. Sunnyside Road is a major arterial providing current transit access east and west, and 147th is a major north/south arterial. Sunnyside Road is currently being expanded in this location and further east, which will deal with any right-of-way restrictions that otherwise would limit station amenities. Residential and commercial densities are moderate at best, but given the growth that Sunnyside Road and this vicinity will experience in the coming years, a station location here is justified. Sunnyside Road is currently being expanded in this location and further east, which will deal with any right-of-way restrictions that, otherwise would limit station amenities. The pedestrian environment is currently not inviting, and needs major improvements to encourage transit ridership form the neighborhoods. Bicyclists will also benefit from the added bike lanes on Sunnyside Road. Considering the nature of the built environment here, which is limited, transit-oriented-developments will be possible here. With future expansion of Sunnyside Road, stations along this road will be large enough to include amenities such as bicycle parking and sheltered areas.
PART THREE: CONCLUSIONS & RECOMMENDATIONS
This section consists of a review of the two best alignments, a critique of the data model, a statement of recommendations, and a project implementation strategy.

Optimal Alignments
While the mean score for all eight alternatives examined was 73.5%, the Powell/205/Foster and the Powell/205/Sunnyside options scored 82% and 80%, respectively. Both performed well for entirely different reasons: Powell/205/Foster is a very direct route with good local ridership, while Powell/205/Sunnyside is long and indirect, but connects to more activity centers, in particular, Clackamas Regional Center.

Table J: Operations vs. Connectivity: The Tradeoff

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Powell/205/Foster Alignment
Although Powell/205/Foster did not score the highest on any single criterion, it did score very well on most. Many of the other alignments scored well on three or four criteria, but poorly on others. Powell/205/Foster scored best on Operations, with a score of 92%. This was the second best of all the options on that variable.

Expanding SE Foster Road at 162nd and Jenne Road to four travel lanes will be very expensive due to high costs of either cutting into the steep hillside to widen Foster, or tunneling underneath the ridge. Though plans to widen Foster at this section are presented in Metro's Regional Transportation Plan, the additional costs of widening this by two additional lanes for BRT are potentially prohibitive. A tunnel may be more affordable.

The lowest score for this alignment was 68% for connectivity. Although it is a short and direct route, and even has a high Ridership score, there are not as many important...
commercial centers and other activity locations as the next best option, Powell/205/Sunnyside.

**Powell/205/Sunnyside Alignment**
Because Powell/205/Sunnyside is very long and circuitous, it scored a 100% for Connectivity. Not only does it connect downtown Portland to Pleasant Valley and Damascus, it also goes near several high schools, many small shopping centers, Clackamas Regional Center, and many major intersections. While this alternative will likely have higher operating costs and only moderate local ridership, its regional connectivity is its strongest asset.

In addition, the expansion or acquisition costs for its right-of-way should be minimal, and further environmental impacts would be minimized. Similarly, construction costs will likely be lower for Powell/205/Sunnyside than on most other routes examined, allowing a BRT system to take advantage of the busway grading on I-205 and any subsequent improvements on Sunnyside.

**Model Limitations**
PRHG Consulting developed the model used for this analysis, and as with any model, it is not without its limitations.

The Connectivity and Ridership variables together made up nearly half of the combined weight of the six criteria. Individually, their weights were more comparable to the other variables. Using both criteria and making their weights cumulative may have skewed the results somewhat toward Connectivity and Ridership. Different weighting for these criteria may result in a very different final score for the Powell/205/Sunnyside corridor.

Ridership itself had some limitations. Since this was a preliminary analysis, only the most basic ridership statistics were included in the analysis. Due to data constraints and the limited availability of current census figures, the Ridership criterion only examined the projected ridership of those living within a quarter-mile of each alignment alternative. Unfortunately, this leaves out several important ridership factors. These include the positive influence of feeder bus routes bringing riders to the BRT corridor from beyond the quarter-mile buffer; park and ride lots, which can have an extensive coverage area; and riders who walk or bike to a BRT station from more than a quarter-mile away. In addition, the ridership numbers used were projected for a route using a conventional bus. There was no accounting for the possibility of increased ridership due to the greater attractiveness of such an enhanced transit system. This sort of projection would have been too complex to undertake within the scope of the project, considering the time constraints.

As a result, the ridership estimates are probably very conservative. Despite this, any underestimation of ridership would be consistent across all route alternatives. If the Connectivity and Ridership criteria were weighted too heavily, then the underestimation could, to some degree, moderate the extra weight given to these variables.
In the model, it was assumed that the costs of construction would be relatively uniform over all of the corridor options, with only minor variation among some corridors. The impact of any particular section of corridor may have been underestimated by the low weight of Construction Costs.

The section of SE Foster Road south of Powell Butte, near 162nd Avenue, is one location where construction costs could be extremely expensive. As Foster Rd. narrows to a two lane rural road, it skirts the edge of a very steep, wooded hill on one side, and passes an environmentally sensitive creek on the other. It was assumed that, since a project is included in the Regional Transportation Plan to widen this segment of Foster, any widening for the BRT line could be added onto this project at very little cost. The agency that widens the road would likely bear most of the high construction and environmental mitigation costs.

It was later discovered, however, that the steepness of this hillside was such that adding lanes to the roadway would sharply increase the amount of hillside that would need to be removed, potentially becoming a very expensive project. The possible underestimation of the weight of Construction Costs, and to some extent Environmental Costs, could have had a significant impact on the final ranking of the Powell/205/Foster corridor.

Despite this possible drawback, the flexibility of a BRT system allows operation in mixed traffic when necessary. There is no reason why a BRT vehicle cannot share general traffic lanes for a limited segment of this alignment. In fact, this is an excellent argument for Bus Rapid Transit in this corridor, since it does have greater flexibility to be run in mixed traffic than a rail system would.

Finally, this model has limits in its ability to account for variations in a given variable that may have been caused by one or more other variables. Given greater resources, a multi-linear regression would have been incorporated in the model to examine this covariance. Such an analysis isolates each variable by controlling for all other variables, which would have greatly assisted in the modeling process.

Recommendations

Despite these limitations, the two best performing alternatives are recommended, each for different reasons. If Tri-Met prefers a more direct route with good ridership, Powell/205/Foster would work best. If, however, Tri-Met prefers better connectivity, with less ridership, Powell/205/Sunnyside will be the optimal choice.

A full BRT system should include frequent buses, with maximum 10-minute headways, and 3-5 minute headways during peak periods. The system should have a full service day, from early morning commutes to late night service. Vehicles should be low-floor to allow for easy entry and exit for all passengers, including those who require extra time to board, such as elderly, disabled and sight-impaired users. Wide or double doors should be on both sides to allow quick and obstacle-free access. Wider seats are becoming a necessity, not an option. The buses and the station platforms should have audio and visual systems to alert passengers of bus arrivals, as well as a real-time schedule displays.

bus rapid transit corridor analysis
The stations should be fully enclosed when possible in a transparent glass shell or structure, to act as a shield from weather and traffic noise. Stations should be equipped with pre-board payment facilities, bulletin boards, benches, trash receptacles, and other amenities.

Due to the scope of this analysis, several factors should be further researched by TriMet, including a more detailed cost-benefit study of the various alignments and system options for the southeast Portland corridor. In addition, a more thorough examination of stakeholder views and policies will likely assist in future consensus-building processes and community planning for recommended routings. It is recommended that Tri-Met work with communities along the corridor to upgrade zoning codes and design standards to create more transit-supportive development strategies. Tri-Met should also participate in regional highway planning in this area to include BRT lanes into the overall planning projects.
Implementation Strategy

Assuming the Powel/205/Foster alignment is implemented, it would follow Powell Blvd. East from Portland, turning south on Interstate 205, and east on Foster Rd. to Pleasant Valley/Damascus.

The system should be built incrementally. This is one of the primary advantages of a BRT system. A rail system is a much larger investment and, as a result, a starter line must be built all at one time and be long enough to justify the investment. Rail systems are only incremental because additional spurs can later be built to connect with the original line.

Since BRT can utilize existing vehicles and roadways, it can be started with minor improvements, and others can be added as demand increases and funding becomes available. This particular line will serve an area, Pleasant Valley and Damascus, which will have a significantly larger population in twenty years. Since the area is currently rural, the demand for high-capacity transit does not yet exist. Incremental improvements should be made over the next two decades.

Initially, small steps should be taken. As growth begins to accelerate in Pleasant Valley and Damascus, and a new transit line is run into the area, work should begin on installing traffic signal prioritization technology along the corridor. This should include longer green signals when a bus is approaching an intersection, queue jump lanes at the most congested intersections, and global positioning systems to locate buses and adjust traffic signals to keep them on time.

The intersection of Powell and 82nd, for example, is extremely busy and becomes quite congested during peak travel times. In order to avoid delay here, the bus should be able to pass the lines of traffic waiting at a red light, likely using the existing right-turn lanes on Powell. As the bus approaches the intersection in this lane, it will be given a green signal prior to general traffic, and will pull ahead of other vehicles. The traffic light should be linked to an information network that tracks whether buses are on time and gives greater signal preference to vehicles that are behind schedule.

Either concurrent with or following these improvements, vehicle upgrades should be added. The buses will need to be made more comfortable and attractive. A fleet of vehicles that is distinct from other buses in the system should be purchased for the BRT line, helping give it its own identity. These vehicles should be quieter and smoother than existing buses. They should have relatively comfortable seating and roomy interior layouts. Vehicles with cleaner and quieter engines (electric, fuel cell, etc.) should be deployed either at this stage or in a future stage when guideway compatible vehicles are needed, and sustainable propulsion system technology is more advanced.

The following step should begin building the BRT infrastructure: This means dedicated lanes running in the middle of the roadway, possibly barrier-separated from other travel lanes. Sections of this should be added at the most heavily congested points in the corridor, as well as in the segments that offer the most speed advantage, such as Powell
between 50th and I-205 and I-205 between Powell and Foster. This will further increase the BRT’s ability to avoid traffic delays.

Stations will need to be constructed in sections where median bus lanes are added. Existing bus stops are always on the right-hand side of the street. Ultimately this system will use median lanes for the entire length of its route. Therefore, stations for this system will need to be located in the median, and should be built as segments of the median bus lanes are added.

The first sections of dedicated lanes will most likely be built in the middle of the route, around Powell and I-205. Outer sections will be developed later as demand increases in those areas, and as roadway capacity improvements are made. The inner-most sections are the most dense and present additional challenges, such as negotiating with railroads to share right-of-way; the construction of the South Corridor line, which will determine where parts of this BRT line will run and what bridge it will use; and increased need to acquire property to provide adequate right-of-way. In the meantime, however, even a separated, dedicated lane from 50th and Powell to 122nd and Foster could dramatically reduce travel time in this corridor.

Ultimately there should be a complete system of dedicated median bus lanes from the Hawthorne Bridge to Damascus Town Center by 2020. Due to right-of-way limitations, the completed infrastructure may necessitate single-lane operation or operation in mixed traffic lanes in limited sections. These include sections of Powell where there are parks or buildings at the edge of the right-of-way, and on Foster at the 162nd Ave. bottleneck.

Despite these limitations, a rapid, limited stop BRT service can be implemented on this corridor that can be competitive with peak-hour trips, as well as a pleasant way to get around the region. Installing a guidance system as well as using dedicated lanes can further enhance the service by making it more convenient and attractive. The combination of these upgrades holds great promise for improving bus service and making it an appealing alternative to the car at a very affordable price.
APPENDICIES

Appendix A: Existing Plans and Policies

The development of a BRT in the Pleasant Valley/Damascus communities supports by regional planning efforts. Several documents relating to BRT include:

2040 Regional Framework Plan
The Regional Framework Plan (RFP) contains policies that direct future growth, the plan provides specific guidelines that city and county governments will use to create and preserve livable communities. The following issues are addressed by the RFP:

- management and amendment of the Urban Growth Boundary
- protection of lands outside the Urban Growth Boundary for natural resource use and conservation, future urban expansion or other uses
- urban design and settlement patterns
- housing densities
- transportation and mass transit systems
- parks, open spaces and recreational facilities
- water sources and storage
- coordination with Clark County, Washington.
- planning responsibilities mandated by state law
- other issues of metropolitan concern.  

Specific land use/transportation policies within Metro’s Regional Framework Plan that support the development of a BRT system include:

1.2 Built Environment
Development in the region should occur in a coordinated and balanced fashion as evidenced by:

- a regional “fair-share” approach to meeting the housing needs of the urban population
- the provision of infrastructure and critical public services concurrent with the pace of urban growth and that supports the 2040 Growth Concept
- the continued growth of regional economic opportunity, balanced so as to provide an equitable distribution of jobs, income, investment and tax capacity throughout the region and to support other regional goals and objectives
- the coordination of public investment with local comprehensive and regional functional plans
- the creation of a balanced transportation system, less dependent on the private automobile, supported by both the use of emerging technology and the location of jobs, housing, commercial activity, parks and open space.  

1.10 Urban Design

22 RFP p. 2.
23 RFP p. 23.
The identity and functioning of communities in the region shall be supported through:

- the recognition and protection of critical open space features in the region
- public policies that encourage diversity and excellence in the design and development of settlement patterns, landscapes and structures
- ensuring that incentives and regulations guiding the development and redevelopment of the urban area promote a settlement pattern that:
  - link any public incentives to a commensurate public benefit received or expected and evidence of private needs
  - is pedestrian "friendly," encourages transit use and reduces auto dependence
  - provides access to neighborhood and community parks, trails and walkways, and other recreation and cultural areas and public facilities
  - reinforces nodal, mixed-use, neighborhood-oriented design
  - includes concentrated, high-density, mixed-use urban centers developed in relation to the region's transit system
  - is responsive to needs for privacy, community, sense of place and personal safety in an urban setting
  - facilitates the development and preservation of affordable mixed-income neighborhoods.

Pedestrian- and transit-supportive building patterns will be encouraged in order to minimize the need for auto trips and to create a development pattern conducive to face-to-face community interaction.24

2.6 Urban Form

2.6.1 Support and maintain a compact urban form with specific strategies that address mobility and accessibility needs and use transportation investments to leverage desired land use patterns.

2.6.2 Serve new development with interconnected public streets that provide safe and convenient pedestrian, bicycle and motor vehicle access.

2.6.3 Provide street, bicycle and pedestrian connections to transit routes within and between new and existing residential, commercial and employment areas and other activity centers.

2.6.4 Encourage development consistent with desired land use patterns that supports increased mobility and accessibility, particularly by transit, walking and bicycling.25

2.10 TRANSPORTATION BALANCE

Provide a multi-modal regional transportation system that reduces reliance on any single mode of travel and increases the use of alternative modes of travel.26

2.13 Public Transportation

Public transportation ridership is highly dependent on pedestrian access and adjacent land use. Therefore, the overarching goal of the public transportation system, within the

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24 RFP p. 31.
25 RFP p. 57.
26 RFP p. 58.
context of the 2040 Growth Concept, is to provide an appropriate level of access to regional activities for everyone residing within the Urban Growth Boundary (UGB). An important aspect of this goal is promoting public transportation amenities and connections to serve the region's major activity centers.

2.13.1 Develop a public transportation system that provides a primary transit level of service to central city, regional centers and a primary or secondary transit level of service to industrial areas, intermodal facilities and special regional destinations (such as major colleges or entertainment facilities).

2.13.2 Develop a public transportation system that provides a primary transit level of service to station communities, town centers, main streets, corridors and special community destinations (such as local colleges or entertainment facilities).

2.13.3 Develop a public transportation system that provides a secondary transit level of service to employment areas, outer neighborhoods and inner neighborhoods).

2.13.4 Continue to develop fixed-route service and complementary paratransit services that comply with the Americans with Disabilities Act of 1990 (ADA).

2.13.5 Continue efforts to maintain transit as the safest form of motorized transportation in the region.

2.13.6 Expand the amount of information available about public transportation to encourage more people to use the system.

2.13.7 Continue efforts to make public transportation an environmentally friendly form of motorized transportation.

2.13.8 Increase use of transit through making public transportation competitive with the private automobile.27

Regional Transportation Plan
Metro's 2000 Regional Transportation Plan (RTP) is a blueprint for creating a balanced transportation system for the Region. Its policies are designed to implement the 2040 Growth Concept. Below is a list of guidelines and policies from the RTP that support the creation of a BRT system.

Station communities
Station communities are located along light rail corridors and feature a high-quality pedestrian and bicycle environment. These communities are designed around the transportation system to best benefit from the public infrastructure. While they include some local services and employment, they are mostly residential developments that are oriented toward the central city, regional centers and other areas that can be accessed by rail for most services and employment.28

Town centers and main streets
Town centers function as local activity areas that provide close access to a full range of local retail and service offerings within a few miles of most residents. While town centers will not compete with regional centers in scale or economic diversity, they will offer

27 RFP pp. 59-60.
28 2000 RTP p.1-5
some specialty attractions of regional interest. Although the character of these centers varies greatly, each will function as strong business and civic communities with excellent multi-modal arterial street access and high-quality public transportation with strong connections to regional centers and other major destinations. Main streets feature mixed-use storefront style development that serves the same urban function as town centers, but are located in a linear pattern along a limited number of bus corridors. Main streets feature street designs that emphasize pedestrian, public transportation and bicycle travel.29

Policy 3.0. Urban Form
Facilitate implementation of the 2040 Growth Concept with specific strategies that address mobility and accessibility needs and use transportation investments to leverage the 2040 Growth Concept.

a. Objective: Serve new development with interconnected public streets that provide safe and convenient pedestrian, bicycle and motor vehicle access.
b. Objective: Provide street, bicycle and pedestrian connections to transit routes within and between new and existing residential, commercial and employment areas and other activity centers.
c. Objective: Encourage development that supports increased mobility and accessibility, particularly by transit, walking and bicycling.
d. Objective: Support mixed-use development to reduce travel demand. Locate housing, jobs, schools, parks and other destinations within walking distance of each other whenever possible.
e. Objective: Leverage the region's multi-modal transportation investment by supporting the development of innovative tools including transit-oriented development, the location efficient mortgage and others.30

Policy 4.0. Consistency Between Land-use and Transportation Planning
Ensure the identified function, design, capacity and level of service of transportation facilities are consistent with applicable regional land use and transportation policies as well as the adjacent land use patterns.

a. Objective: Provide adequate transportation facilities to support a land use plan that implements the 2040 Growth Concept.
b. Objective: Provide transportation facilities that enhance jobs and housing as well as the community identity of neighboring cities.31

Policy 10.0. Energy Efficiency
Design transportation systems that promote efficient use of energy.
a. Objective: Reduce the region’s transportation-related energy consumption through increased use of transit, telecommuting, zero-emissions vehicles, carpooling, vanpooling, bicycles and walking and through increasing efficiency of the transportation network to diminish delay and corresponding fuel consumption.32

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29 2000 RTP p. 1-6
Policy 14.0. Regional Public Transportation System
Provide an appropriate level, quality and range of public transportation options to serve this region and support implementation of the 2040 Growth Concept.

a. Objective: Serve this region with appropriate public transportation service.
b. Objective: Continue to work with local jurisdictions and Tri-Met to implement Tri-Met’s Transit Choices for Livability community transit plan.
c. Objective: Provide transit service that is accessible to the mobility impaired and provide paratransit to the portions of the region without adequate fixed-route service to comply with the Americans with Disabilities Act of 1990.
d. Objective: Develop a long-term strategy for potential use of freight railroad lines for passenger use and work with jurisdictions inside and outside of the Metro area to explore other commuter rail opportunities.\(^{33}\)

Pleasant Valley Neighborhood Plan

Comprehensive Plan Policy 7: Transportation
Promote the efficient use of the transportation system while reducing traffic and environmental impacts upon the residential areas of the neighborhood.

Objectives:
1. Ensure that roads are constructed, maintained, and reconstructed in a manner that assures the safety of persons on and near them, and to assure connectivity throughout the system.
2. Resolve traffic-related and/or safety problems in ways which will not compromise the character of Pleasant Valley.
3. Promote alternative modes of transportation.
   a. Improve the transit system to and within the neighborhood.
   b. Improve and make known bicycle-pedestrian access areas and routes.\(^{34}\)

\(^{34}\) Pleasant Valley Neighborhood Plan p. 50.
Appendix B: Glossary of Terms

**Above Grade** – The location of a structure or transit guideway above the surface of the ground (also known as elevated or aerial), in order to allow it to cross other roads or rail lines by passing over them.

**Accessibility** – (1) The extent to which facilities are barrier free and useable by disabled persons, including wheelchair users. (2) A measure of the ability or ease of all people to travel among various origins and destinations.

**Activity Center** – An area with high population and highly concentrated commercial activities that generate a large number of trips, also known as trip generator.

**Alignment** – The horizontal and vertical ground plan of a roadway, railroad, transit route or other facility.

**Alternative Fuel** – A liquid or gaseous non-petroleum fuel, used to power transit vehicles. Usually refers to alcohol fuels, mineral fuels, natural gas, and hydrogen.

**AM Peak** – The morning commute period, about two hours, in which the greatest movement of passengers occurs, generally from home to work.

**Americans with Disabilities Act of 1990 (ADA)** – The law passed by Congress in 1990 which makes it illegal to discriminate against people with disabilities in employment, services provided by state and local governments.

**At Grade** – The location of a structure or transit guideway at the same level as the ground surface.

**Bus Lane** – A lane of roadway reserved for exclusive use by buses, either all day or during specified periods.

**Busway** – A special roadway designed for exclusive use by buses. It may be constructed at, above, or below grade and may be located in separate rights-of-way or within highway corridors.

**Central Business District (CBD)** – The downtown area of a central city, serving an entire metropolitan area. A CBD includes major concentrations of retail businesses, offices, theaters, hotels and services. It is generally the largest single commercial area of a metropolitan area.

**Corridor** – A broad geographical band that follows a general directional flow or connects major activity centers. It may contain a number of streets and highways and many transit lines and routes.
Dwell Time – The time a vehicle spends stopped at a station, discharging and taking on passengers at a stop.

Environmentally Sensitive Area (ESA) – Areas where the landscape, wildlife or historic interest is of national importance.

Exclusive Right-of-Way – An access controlled right-of-way that is fully separated from general traffic roads and is used exclusively by transit.

Federal Transit Administration – A part of the U.S. Department of Transportation (DOT), which administers the federal program of financial assistance to public transit.

Grade Separated – A crossing of two forms of transportation paths (e.g., light rail tracks and a highway) at different levels to permit unconstrained operation.

Guideway – A length of exclusive bus lane that makes physical contact with a vehicle and guides it along the route. Typically these are curb-guided systems, using raised, concrete curbs that buses fitted with small horizontal guide wheels interface with. Other systems include rail and magnetic guideways. Guideways help buses move at higher speeds because they are protected from automobile traffic.

Headway – Time interval between transit vehicles moving in the same direction on a particular route.

HOV Lane – A traffic lane in a street or highway reserved for high occupancy vehicles, including buses and carpools. This allows those sharing rides to bypass congested areas.

Intelligent Transportation System (ITS) – ITS is a set of technologies designed to monitor traffic flows on major freeways and to inform motorists of problem areas. ITS technology also includes changeable message signs, cameras, video detectors, Global Positioning Systems (GPS), and traffic light prioritization.

Land Conservation and Development Commission (LCDC) – Oregon commission that adopts state land use goals, assures local plan compliance with the goals, coordinates state and local planning, and manages the coastal zone program.

Light Rail Transit (LRT) – An electric railway with a “light volume” traffic capacity compared with heavy rail.

Main Streets – Main streets serve the surrounding neighborhood's need for groceries, convenience shopping and other services.

Off-Peak – Non-rush periods of the day when travel activity is generally lower and less transit service is scheduled.
Operating Cost – The total costs to operate and maintain a transit system including drivers, mechanics, fuel, maintenance, etc.

Operating Speed – The rate of speed at which a vehicle is safely operated under prevailing traffic and environmental conditions.

Park-and-Ride – A parking area for automobile drivers who then board transit vehicles, shuttles or carpools from these locations.

Peak Hour/Peak Period – The period with the highest ridership during the entire service day, generally referring to the morning and evening rush hours.

Queue Jumper Lane – A bus has its own lane at an intersection, with a traffic signal that turns green a few seconds ahead of the other signals. This allows the bus to get a jump on traffic and make lane changes easily, avoiding long delays.

Rapid Transit – Rail or motorbus transit service operating completely separate from all other modes of transportation often on an exclusive right-of-way.

Regional Center – Regional centers are significant shopping, service, employment destinations. They serve the residents throughout the metropolitan area.

Regional Transportation Plan (RTP) – The RTP establishes transportation policies for all modes of travel, and describes priority projects for roads, freight movement, bicycling, walking and transit.

Ridership – The number of trips taken by people using a public transportation system in a given time period.

Right-of-Way (ROW) – The land over which a public road or rail line is built. An exclusive right-of-way is a road, lane, or other right-of-way designated exclusively for a specific purpose or for a particular group of users, such as light rail vehicles or buses.

Signal Prioritization – A means by which transit vehicles are given an advantage over other traffic, e.g., prioritization of traffic signals or transit priority lanes.

Town Center – These centers serve the immediate surrounding community, but on a larger scale than main streets, and contain additional jobs and housing.

UGB (Urban Growth Boundary) – A land-use planning tool that separates urban and developable land from rural land. It is required to contain a 20-year supply of housing within its borders.

Urban Reserve – Urban reserves are lands outside the present UGB, which are designated for future urban development.
REFERENCES


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