PORTLAND PLAN

Infrastructure Condition and Capacity

PORTLAND PLAN BACKGROUND REPORT
FALL 2009

PLANNING AND SUSTAINABILITY COMMISSION
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Planning and Sustainability
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OVERVIEW

The City of Portland provides and maintains infrastructure systems that supply water, sewer, transportation, parks and civic services and support affordable housing production. The City's infrastructure systems vary in service area, capacity to accommodate growth, replacement value and condition.

This report documents the condition and capacity of the City's primary infrastructure systems: sewer and stormwater, parks and recreation, transportation and water. The report documents key issues and attempts to identify areas of the city where additional growth may require changes in service levels or additional investment.

Portland partners with a wide variety of agencies and organizations to provide the City with infrastructure services. While generally not explicitly discussed in this report, the capacity of these partner agencies to provide necessary services affects the City of Portland's service capabilities and demands.

CITYWIDE INVENTORY

The City of Portland provides and maintains infrastructure systems that supply water, sewer, transportation, parks and civic services. These infrastructure systems represent a significant investment in the City and have a current replacement value of more than $22 billion.

Table E.1 Summary of Portland's Infrastructure Systems

Transportation	Environmental Services	Parks	Water
			
- 3,949 lane miles of roads - 157 bridges - 992 traffic signals - eight million square yards of sidewalks - 37,352 improved corners - 53,000 street lights	- 450 miles of separated storm sewers - 900 miles of sanitary sewers - 1,150 miles of combined sewers - 100 pumping stations - 2 wastewater treatment plants - green stormwater facilities	- 10,200 acres of parkland - 180 developed parks - 47 habitat parks - 5 golf courses - 7 botanical gardens - arboretum - raceway - stadiums - 13 pools - 12 community centers - 177 miles of trails - 142 playgrounds - over 300 sports fields - 31 community gardens - over 100 tennis courts	- Bull Run watershed - Columbia South Shore wellfield - 220 million gallons finished storage - 75 mi. of conduits - 43 mi. of mains - 2,200 mi. of pipes - 1,500 culverts - 2 dams - 33 wells - 180,000 service lines - 44,000 valves - 182,500 meters - 15,000 hydrants - 39 pump stations - 70 tanks

KEY INFRASTRUCTURE CHALLENGES AND OPPORTUNITIES

The City of Portland's infrastructure systems will face a variety of challenges and opportunities over the next 20 years – including accommodating new growth and density, effectively managing existing systems, serving current residents and meeting regulatory requirements.

Accommodating Growth and Increases in Density

The ability of the City's infrastructure to accommodate growth depends primarily on the City's ability to resolve current deficiencies—to serve underserved areas and to maintain the condition of existing infrastructure.

To better accommodate growth and reduce system loads, bureaus are actively researching and using a variety of demand management strategies. The ability of bureaus to innovate, reduce demand or increase efficiency through new technologies and practices will be instrumental in their ability to serve the city in the future.

Major redevelopment efforts can have significant implications on existing assets and the type and extent of new infrastructure needed to serve an area. Without careful planning, such projects can overstretch the ability of existing infrastructure to meet community needs, particularly in underserved areas. As redevelopment is planned, it will be important to consider the full implications of such efforts on infrastructure needs and financial resources and to coordinate planning with other bureaus whose infrastructure might be impacted.

Environmental Services

In general, the City's existing sewer and stormwater infrastructure can accommodate projected population growth. The Bureau of Environmental Services (BES) plans for its facilities based on build-out densities allowed within existing City of Portland Comprehensive Plan land use densities, which are higher than current projections for the 2030 population (as provided by Metro). BES expects to be able to maintain and improve the sewer systems to handle growth needs as long as growth does not exceed densities designated in the current Comprehensive Plan and sewer rates are sufficient to finance system maintenance and capacity upgrades. Additional densities may require modification of existing infrastructure or the construction of new facilities.

Water

The Portland Water Bureau's primary distribution system can reliably deliver water through 2030, mostly using existing facilities. The Water Bureau is planning water infrastructure improvements to address increasing retail demands within the city limits; demand is expected to increase from 61.5 million gallons per day in 2005 to 79 million gallons per day in 2030. The Water Bureau also supplies water to regional wholesale customers. Population in areas served through these wholesale contracts is expected to increase significantly, resulting in potentially large increases in water demand.

Transportation

The success of Portland's transportation system in meeting future local and regional mobility needs will depend on the City's—and its partners'—ability to maintain existing assets and make strategic investments. The City faces significant maintenance backlogs for existing assets; deficiencies in service provision; and challenges in providing complete, safe and accessible pedestrian, bicycle, and transit systems.

Parks & Recreation

To maintain Portland's quality of life while accommodating growth, it will be necessary to preserve access to high-quality park and recreation experiences by acquiring and protecting park lands, maintaining existing facilities and providing additional recreation facilities and services. The actual number of parks and facilities that will be needed will vary based on where and how growth occurs, the ability of existing facilities to serve additional users and what opportunities arise to locate and build additional parks and facilities. Growth may also place additional pressure on heavily used facilities, such as pools, and it may exacerbate needs in currently underserved areas. These pressures may be particularly acute in centers that currently lack sufficient park amenities, where both existing facilities and acquisition opportunities are scarce.

Effectively Managing the City's Infrastructure Systems

The 2009 replacement value of the City's physical infrastructure is estimated at $23.1 billion. The infrastructure bureaus have estimated that the City needs to reinvest approximately $183 million per year for each of the next 10 years to replace existing aging assets, maintain existing facilities, address regulatory requirements and/or meet service levels. That level of reinvestment would require spending at least 25 to 40 percent more than we currently do on major maintenance and capital projects.

We can assume that at current funding levels, some of Portland's infrastructure will continue to deteriorate. Although the City is still learning more about the condition of its infrastructure, it is estimated that significant numbers of our bridges, traffic signals, street lights, water reservoirs, natural resources and civic buildings currently are in poor condition or will be in 10 years.

Because city limits cannot expand significantly, the majority of new growth will be accommodated within the current footprint, meaning that the transportation, parks, water and sewer systems we have now will serve the majority of our current and new residents' needs over the coming decades. These systems also will be used more heavily, as new residents of Portland's suburbs come into the city to work, shop or play. To maintain a high level of infrastructure services, the City will need to reassess service standards, identify strategic investments, consider the full long-term costs of improvements, pursue innovative funding sources and partnerships and work with the community to make tough choices about funding priorities.

Asset management is a tool to identify the most cost-effective way to protect existing assets, provide community services and safeguard public health. The City currently is improving asset management practices, but continued improvement in processing, data management, monitoring and evaluation is needed to ensure that asset management practices accurately inform strategic decision making and effective infrastructure management.

Serving Currently Underserved Residents

Providing service in currently underserved areas is a significant challenge for both Portland Parks & Recreation and the Bureau of Transportation. Resolving these deficiencies and filling gaps in existing networks will aid the City in serving existing residents and accommodating new growth.

The Bureau of Transportation faces some significant deficiencies, based on level of service and design standards. These include street connectivity, pedestrian and bike access and facilities, safety improvements and substandard streets.

Portland Parks & Recreation bases its service on sufficiency and access to park and recreation facilities. Unfortunately, many areas of Portland lack sufficient park and recreation facilities, such as developed parks, community centers and trails and natural areas. Some areas, including parts of outer east, southwest and central northeast Portland, face multiple deficiencies. In addition, many areas – particularly in outer east and southwest – lack the supporting pedestrian infrastructure to allow safe pedestrian access to parks and recreation facilities.

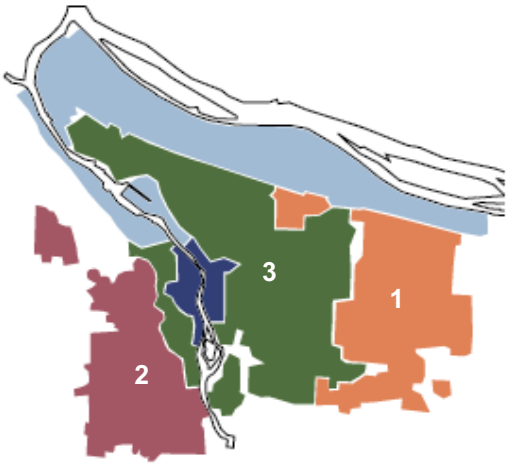
Complying with Regulatory Mandates

In addition to meeting maintenance and repair needs, the City also must comply with a variety of federal and state regulations, primarily related to service provision, public health and environmental quality. At the federal level, these mandates often are related to the Clean Water Act, Clean Air Act, Safe Drinking Water Act, Endangered Species Act or Americans with Disabilities Act. Complying with these mandates has a very significant impact on the City's capital priorities and represents a large component of infrastructure spending. These regulations often require involved and costly changes to the City's infrastructure but generally do not bring associated funding; this can mean that other maintenance, repair and improvement projects must be put on hold, or additional funding must be allocated.

Although the City can estimate the cost to comply with existing mandates, potential future regulations could require additional funding and/or further restrict the City's infrastructure priorities. Potential future mandates that would require significant capital expenditures include LT2 compliance (estimated at $50 million per year), new water quality requirements for stormwater and wastewater, and the Portland Harbor cleanup.

KEY FINDINGS: INFRASTRUCTURE DEFICIENCIES[1]

Key infrastructure deficiencies are presented below, by the following urban form pattern areas:



1. **Eastern Neighborhoods**: Primarily neighborhoods east of I-205, but also include some areas to the west of I-205 (notably the Cully neighborhood) that have similar development characteristics.

2. **Western Neighborhoods**: Primarily neighborhoods west of downtown, excluding streetcar-era neighborhoods adjacent to downtown.

3. **Inner Neighborhoods and Central City**: Primarily neighborhoods from I-205 west to the southwest hills. The central city is included because it has similar infrastructure deficiencies as the inner Portland neighborhoods.

Eastern Neighborhoods

Portland's eastern neighborhoods face a variety of infrastructure challenges that may impede the area's ability to serve existing residents and adequately accommodate additional infill development. These deficiencies include:

Transportation:

- Poor street connectivity requires vehicles to depend on a select number of arterials for through travel.
- A number of unimproved and substandard streets impede movement and connectivity.
- Eastern neighborhoods have the highest average vehicle miles traveled per capita.
- Five deficient bridges exist along the Johnson Creek corridor and are recommended for replacement.
- Pedestrian, cyclist and automobile passenger safety is also an issue. Twelve high-crash intersections occur in this area of Portland, primarily along 92nd, 102nd and 122nd avenues. Another six high-crash intersections are located on 82nd Avenue, just outside the area's boundary.
- Eastern neighborhoods lack sidewalks along most residential streets and many arterial streets. Existing sidewalks often are disconnected.

[1] Data on street performance and condition have not yet been included in this report. Thus, related issues are not included in this section.

- Although a significant portion of recommended bicycle lanes have been completed in eastern neighborhoods, primarily on major arterials, the area lacks a number of recommended bike boulevards and paths.

Sewer and Stormwater

- The sanitary sewer system is relatively new and in good condition, with few structural or hydraulic deficiencies.
- The Eastern Neighborhoods area encompasses land that primarily drains into the Johnson Creek Watershed and the Columbia Slough Watershed. Both of these waterways are key habitat for salmon and other native fish and wildlife but have significant water quality limitations. Improving water quality to meet regulatory requirements, protect public health and improve habitat conditions will continue to be a key concern in the coming decades, especially with increased development density.
- Flood management in the Johnson Creek watershed is a high priority for the bureau. Future investments include acquisition of parcels at high risk for flooding and expansion of the stream channel to accommodate variable and high flows.
- In the Johnson Creek Watershed, much of the stormwater runoff flows into Underground Injection Controls. Direct runoff and groundwater discharge into Johnson Creek causes frequent flooding and future increases in stormwater runoff from increased impervious area may increase the potential for flooding and stream habitat erosion. To address these impacts and protect existing investments, strategies will be required to retain and infiltrate stormwater as close as possible to its point of origin. However, onsite infiltration may be challenging in areas with topographic constraints or poor infiltration capabilities.
- The Bureau of Environmental Services currently uses Underground Injection Controls[2], or sumps, to infiltrate stormwater runoff in many areas of the eastern neighborhoods. New regulations require changes to the underground injection control system to protect groundwater quality. The full cost of compliance is included in the 5-year Capital Improvement Program.

Water

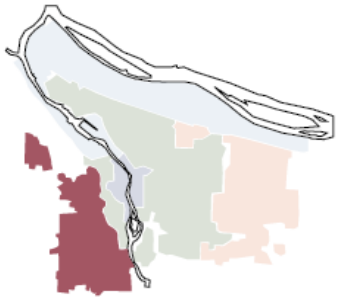
- Hydraulic deficiencies limit fire flow in direct pump areas surrounding Powell Butte. Capital improvement projects identified by the Portland Water Bureau will address these deficiencies.
- The City's backup water source, the Columbia South Shore Well Field, is located primarily in east Portland, as is the Powell Valley well system, which may be tied into the City's primary water system in the future.

[2] Underground Injection Controls are "any man-made design, structure or activity which discharges below the ground or subsurface. Common uses include: stormwater discharge, industrial/commercial and process waste water disposal, large domestic onsite systems and cesspools, sewage drill holes, aquifer remediation systems, motor vehicle waste disposal, agricultural drainage, geothermal systems and aquifer storage and recovery. Common designs include drywells, trench drains, sumps, perforated piping, floor drains, drainfields and drill holes." (definition from Oregon Department of Environmental Quality)

Parks

- Park distribution deficiencies exist in Cully, Gateway, Wilkes, Mill Park, Hazelwood, Powellhurst-Gilbert, Centennial, South Lents and Pleasant Valley. A total of 58 acres of parkland is desired to resolve these deficiencies.
- Sixteen of the 33 park properties (48 percent) in East Portland are currently undeveloped and provide limited or no park and recreation experience.
- Because of pedestrian facility and connectivity issues, many parks have poor pedestrian access.
- Although the East Portland Community Center was recently opened, the distribution of recreation facilities remains poor. Additional community centers are needed (in Cully and outer southeast), as are aquatic facilities (in outer northeast), basketball courts (in Cully and Parkrose), skatespots and play areas.
- Priority natural acquisition areas exist in outer southeast, along the Johnson Creek corridor and on Kelly Butte. The majority of outer northeast has no walkable access to natural habitat.
- Levels of existing tree canopy are relatively high when compared to the City as a whole. However, opportunities exist to increase the currently low level of street tree stocking and to reduce the loss of existing canopy on private property during infill development.

Western Neighborhoods



Much like the neighborhoods themselves, infrastructure in western neighborhoods often is shaped by the area's topography. Infrastructure deficiencies in western neighborhoods include:

Transportation

- There are a small number of major arterials, many of which follow natural topography. Residential streets are often curvilinear and do not meet connectivity standards.
- A significant number of streets in Southwest are either unimproved or substandard.
- Western neighborhoods have relatively high average vehicle miles traveled per capita.
- Most residential streets lack sidewalks, although off-street paths offer alternative pedestrian connections in limited cases.
- Less than one-third of southwest Portland's bikeways have been constructed. There are very few bike boulevards or off-street paths.

Sewer and Stormwater

- Sewers are generally in good condition. A major upgrade in the Fanno Basin will be complete in 2013.

- Pollutants from surface runoff enter the waters of Fanno and Tryon Creeks. These relatively small water bodies exceed temperature and pollutant load limits. Future compliance will require changes in the right of way as well as private land use changes.

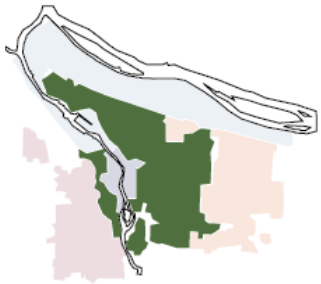
Water

- A number of pump station and supply improvements have been identified to improve fire flow in hilly water service areas throughout southwest and northwest Portland.

Parks

- Six park properties in the western neighborhoods currently are undeveloped and provide limited or no park and recreation experience.
- Although western neighborhoods have a number of protected open spaces, the area lacks sufficient developed parks and some recreation facilities, notably sports fields.
- Although the Western neighborhoods, as a whole, have a large number of trees and a high urban canopy rate, forest canopy has been lost in some areas as a result of development.

Inner Neighborhoods and Central City



With the exception of sewers, infrastructure deficiencies in inner neighborhoods and central Portland are less severe than those in other areas and in general should not impede development. However, some of these deficiencies may affect the quality of life of area residents. Key deficiencies in inner neighborhoods include:

Transportation

- The street network in inner neighborhoods and the central city generally meets the City's connectivity standards.
- This area has lower vehicle miles traveled per capita than other areas and than the city as a whole.
- Overall, inner neighborhoods and the central city have relatively high levels of sidewalk coverage. Approximately 20 to 26 percent of streets in the central city, northeast and southeast have no sidewalk coverage. A higher percentage of streets (36 percent) in north Portland lack sidewalks.
- A number of high-crash locations exist in the inner neighborhoods, including at multiple locations along 82nd Avenue, at the Broadway/Weidler and Vancouver/Williams intersections, at the intersections of MLK Boulevard with NE Fremont and NE Columbia, at NE 39th and Sandy, and downtown at SW Washington and 2nd Avenue.
- Sixteen bridges in this area are in poor condition and need major rehabilitation or replacement. All are currently weight restricted. This does not include the Willamette River bridges, which are not owned by the City of Portland.

- The condition of traffic signal hardware has declined substantially, which reflects a reduction in signal maintenance funds. The majority of traffic signals are located in the central city and inner neighborhoods. A number of priority signal optimization corridors have also been identified in this area.

Sewer and Stormwater

- Sewers in this area are generally the oldest pipes in the system and represent the greatest number of pipes in poor condition and/or with insufficient capacity. An estimated 10-15% of the parcels in this area are at risk of basement sewer backup during a 25-year storm (the agreed upon level of service). Addressing pipe condition and hydraulic capacity deficiencies is a high priority for the bureau.
- Significant reinvestment and improvements have been made to the combined sewer system to reduce the risk of combined sewer overflows into the Willamette River and Columbia Slough. This project will be completed in 2011.

Water

- Inner neighborhoods and the central city contain some of the oldest water infrastructure in the city. Maintenance, rehabilitation and/or replacement of these assets will be an ongoing need in the future.
- A new seismically hardened Willamette River transmission line crossing will be necessary within the next 20 years.
- Central eastside water systems, which were originally sized for industrial uses, are facing water quality issues because lower water demand has reduced the flushing of these pipes.

Parks

- Overall, there are few undeveloped park properties in inner neighborhoods; however there are key park development deficiencies in the River District, South Waterfront and north Portland (in Kenton, Portsmouth and St. Johns).
- The majority of inner neighborhoods and the central city are within a ½-mile walk of a park. However, some parkland acquisition deficiencies exist in inner neighborhoods, primarily in the Lloyd District, inner southeast, Hollywood, Interstate, Humboldt, the South Waterfront, downtown, inner northwest, and the northwest waterfront.
- Inner southeast currently is underserved by community centers; however, the planned redevelopment of the Washington-Monroe site in 2010 should resolve this deficiency.
- Improvements are needed to improve recreation facility distribution (particularly for pools) and to expand or improve existing facilities that are in poor condition or operating at capacity.
- Most inner neighborhoods have no walkable access to natural habitat.

RECOMMENDATIONS

In light of the overall condition and capacity of the City's infrastructure systems, the Bureau of Planning and Sustainability recommends six actions with the Portland Plan. Additional recommendations may surface as the Portland Plan begins to consider infrastructure needs in conjunction with growth, land use, economic development, housing and other community needs.

1. Update the City's Long-Range Infrastructure Plan

As required by the State, the City should complete a Citywide Systems Plan (CSP) to identify major public infrastructure needed over a 20-year period to support the land uses designated in the Portland Comprehensive Plan. The current Public Facilities Plan, adopted in 1989, is outdated, as is the list of significant capital projects intended to implement that plan. Only the transportation element of that plan has been fully updated and is able to guide major capital decisions.

A new Citywide Systems Plan will:

- Identify needed major infrastructure investments to provide core City services through 2030. Investments must address existing aging assets, regulatory requirements, deficiencies and new growth needs.
- Determine how the City can deliver those services in a more sustainable manner and facilitate larger community goals.
- Identify strategies to better manage City assets and interact with other service providers.
- Coordinate key cross-bureau issues, such as asset management, watershed health and urban form, within the context of the Portland Plan.

2. Set Appropriate Service Levels

To effectively plan for the future, the City must decide what services it will deliver, and at what level. Residents and businesses, in a sense, buy a bundle of services, including transportation, water, sewer and park service. With the Portland Plan, it is timely to adjust service and design standards to match updated community goals. As the City grows and evolves, standards may need to be revised to remain consistent with community needs and resources. Alternative service levels might allow the City to better respond to the various needs of different geographic areas.

For example, Portland Parks & Recreation is examining alternative standards and strategies that would improve the distribution of parks, open space and recreation facilities to better meet sufficiency and access goals. The Bureau of Transportation is exploring modifications to select classifications, levels of service and design standards to improve the City's transportation efficiency and its ability to provide alternative transportation options. Some service levels are set by external regulations, particularly for water and sewer.

3. Develop Geographically Sensitive Approaches

The Portland Plan offers a unique opportunity to examine infrastructure challenges and opportunities within the context of physical geography and to develop strategies, policies and priorities that reflect the unique needs and goals of different areas. Factors tied to an area's geography—its natural features, patterns of development and open space, and its community priorities—all affect where and how services are, or can be, delivered. Currently, some infrastructure standards set a goal of providing similar services citywide; however, meeting these standards may not be feasible in all areas because of topographic or environmental constraints. Developing geographically sensitive approaches would allow the City to apply alternative approaches to serve currently deficient areas, meet service levels and support underlying community goals within these constraints.

For example, the Portland Bureau of Transportation currently applies unique guidelines and standards to pedestrian districts, where policies and projects are designed to support walking. In other areas of the city, pedestrian standards often call for sidewalk improvements on both sides of the street—a goal that may not be feasible in environmentally or topographically constrained areas. Adjusting pedestrian service standards to promote alternative strategies in such areas may result in improved pedestrian connections and access while protecting environmentally sensitive areas.

The City could also further integrate its existing watershed-based planning approach with its parks and recreation and transportation systems. This could have implications for stormwater management, parks and natural areas, and even transportation systems. Such an approach could yield multiple benefits, such as reduced runoff, improved bike and pedestrian corridors, cooler and cleaner air and improved wildlife habitat.

4. Optimize Investment Decision Making

The City should review and update its methods of making capital decisions. A coordinated investment strategy would consider the full range of impacts and influences, including life cycle costs, risk, greenhouse gas and environmental impacts, economic development potential and health and equity outcomes.

Diverse challenges and opportunities—including global climate change, shifts in energy sources, population growth, shifting demographics and changes in the regional and global economy—will affect the City of Portland and its infrastructure systems over the next 20 years. The breadth of these challenges underscores the need to plan for adaptable and resilient infrastructure systems that help the City achieve its long-range goals of environmental and community health, economic development, equity, affordability and neighborhood livability. Through the Portland Plan and related planning processes, City infrastructure bureaus will review and potentially redefine service levels, implementation tools, roles and responsibilities in response to changes in service demands, growth, regulatory requirements and shifting community needs.

5. Develop Financially Constrained and Priority Capital Improvement Programs

To implement the Portland Plan in an adaptable and resilient way, the City should prepare a financially-constrained capital project list based on reasonably anticipated revenues, and identify additional priority projects. This approach will address capital, operations and maintenance needs for the City's infrastructure systems over 20 years and foster fiscal responsibility.

6. Continue to Improve and Integrate Asset Management Practice

The City should continue to build capacity to implement asset management best practices within infrastructure planning for capital bureaus and citywide. Such best practices will inform the City's investment decision making and improve its ability to do the following:

- Define and revise service levels to align service provision with system requirements, community needs and sustainable funding levels.
- Integrate growing portfolio of green infrastructure into asset management systems.
- Determine appropriate strategies to reduce maintenance liabilities.
- Set infrastructure investment priorities.
- Identify sustainable funding levels.

READER'S GUIDE

ABOUT THIS DOCUMENT

This report documents the condition and capacity of the City's primary infrastructure systems in the following chapters:

- Chapter 1: Bureau of Environmental Services (sewer and stormwater)
- Chapter 2: Portland Parks & Recreation
- Chapter 3: Bureau of Transportation
- Chapter 4: Portland Water Bureau

The report describes key issues and attempts to identify areas of the city where additional growth may require changes in service levels or additional investment. This report does not include information on civic facilities or affordable housing. However, information concerning the condition of these facilities is available in the Citywide Assets Report, which can be accessed at: http://www.portlandonline.com/bps/index.cfm?c=49854&a=233291.

Table A.1 (next page) provides a summary of Portland's infrastructure systems and major assets. Maps of the City's infrastructure referenced in this report can be found at the end of the document.

AN INTRODUCTION TO PORTLAND'S INFRASTRUCTURE

What is Infrastructure?

Infrastructure assets include physical systems that provide services to, and are maintained by, a community. Assets can include transportation networks, water storage and distribution, sewage collection and treatment, stormwater facilities, parks and recreation facilities, telecommunication networks, and other civic or community facilities.

Portland's Infrastructure Partners

Portland partners with a wide variety of agencies and organizations to provide the City with infrastructure services. While generally not explicitly discussed in this report, the capacity of these partner agencies to provide necessary services affects the City of Portland's service capabilities and demands. These partners include the following:

- Multnomah County, which manages and maintains six Willamette River bridges and more than 20 smaller bridges elsewhere in the county, and provides other services, including human and justice services
- Metro, the regional government, which manages regional parks and natural areas, the zoo, solid waste disposal contracts and regional planning services
- Special service districts for drainage and water
- State transportation department
- TriMet, which operates the regional transit system

- Five school districts
- The Port of Portland, a regional agency that operates several marine terminals and the Portland International Airport
- Two railroads and Amtrak, which move goods and people, respectively
- Portland General Electric, Pacific Power, and NW Natural, which provide electric and natural gas to Portland residents and businesses
- The telecommunications industry, which provides telephone and Internet services
- A variety of community organizations, including neighborhood, business and homeowner associations

Table A.1 Portland's Infrastructure: Inventory, Value, and Condition (2008)

		Replacement Value		Current Condition (in %)						
Capital Asset Class	**Description**	**$ million**	**Confidence**	**Very Good**	**Good**	**Fair**	**Poor**	**Very Poor**	**TBD**	**Confidence**
Transportation		**$7,880.1**								
Streets (by lane mile, improved)	3,949 lane miles	$5,497.8	Low[3]	0	0	0	0	0	100	tbd[4]
Sidewalk system										
Sidewalks	8,747,652 sq yds	$699.8	High	0	0	0	0	0	100	tbd
Curbs	3,247 centerline miles	$462.9	High	0	75	15	10	0	0	Moderate
Corners	37,606 corners	$117.3	High	0	75	15	10	0	0	Moderate
Structures (bridges only)	155 bridges	$420.5	Optimal	11	46	25	18	1	0	Optimal
Traffic signals (hardware only)	1,011 traffic signals	$114.5	Moderate	13	16	27	27	17	0	Moderate
Street lights	54,588 street lights	$88.1	Low	0	22	66	12	0	0	Low[5]
Support facilities	Various buildings	$6.5	None to Low	multiple facilities, mostly tbd / range from poor to very good at Sunderland facilities						tbd or moderate
Other transportation assets	Streetcar, aerial tram, signal controllers, traffic calming devices, street signs, pavement markings, meters, retaining walls, stairways, guardrails, harbor wall.	$472.7	Low to High	0	0	0	0	0	100	tbd[6]
Environmental Services		**$5,551.9**								
Combined sewers	1,216 miles of pipe & access structures	$2,175.3	Moderate	39	8	5	2	3	43	High
Sanitary sewers	1,303 miles of pipe & access structures	$1,044.1	Moderate	26	1	0	0	0	73	Moderate
Stormwater system	Includes channel, pipe, culverts, plus sumps, detention facilities. Full inventory being updated in the System Plan update.	To be determined.								
Wastewater treatment	2 treatment plants & 96 pump stations	$1,401.0	Moderate	33	30	20	10	7	0	High[7]

[3] Construction costs have been volatile over the past few years.
[4] PDOT is changing the way pavement condition is inspected and is implementing new software.
[5] Weighted average of Option B & C lights.
[6] A few of the other assets have condition assessments.
[7] Condition based on estimate of repairs for each process area. Updated facilities plan for CBWTP are being finalized; new information may be available in 2009.

Capital Asset Class	Description	Replacement Value $ million	Replacement Value Confidence	Current Condition (in %) Very Good	Good	Fair	Poor	Very Poor	TBD	Confidence
Water		**$5,472.0**[8]								
Supply	123 miles of roads; 1,500 culverts; 11 bridges; concrete dam; earth dam; 33 wells, pumps, motor; groundwater pump station	$649.0	Moderate	1	56	40	3	0	0	Moderate
Transmission	75 miles of large-diameter conduits, 28 conduit bridges or trestles or river crossing, 43 miles of large-diameter transmission mains	$717.0	Moderate	1	47	41	11	0	0	Moderate
Terminal storage	220 million gallons finished water storage	$314.0	Moderate	0	7	24	56	13	0	High
Distribution	2,200 miles of pipes, 180,000 service lines, 44,000 valves, 7,500 large meters, 175,000 small meters, 15,000 hydrants, 24,000 backflow devices, 39 pump stations, 70 storage tanks	$3,672	High	14	45	33	6	2	0	High
Support facilities	7 primary support buildings, SCADA, vehicles and computers	$120.0	High	10	23	16	42	9	0	Moderate
Parks and Recreation		**$816.0**[9]								
Buildings (includes support facilities)	Over 1 mi. ft^2 including arts (7), aquatic (13), community centers (12); stadiums (3), clubhouses; visitor services; restrooms, shelters; gazebos; admin./maint. facilities	$218.9	Moderate	35	22	28	10	5	0	Moderate[10]
Amenities	Furnishings (benches, tables, drinking fountains, etc.), recreation facilities (courts, fields, play areas, boat ramps, etc.), trails, water features	$193.1	Moderate	10	26	50	10	4	0	Low[12]
Infrastructure (partial data only)	Roads and utilities	$48.2[11]	Low	0	0	0	0	0	100	tbd
Landscapes	Green/living elements in developed parks (187 parks at 3,272 acres) that require frequent regular maintenance, including turf, trees, planting beds and swales	$205.4	Low	10	34	45	7	4	0	Low[12]
Natural resources	Green/living elements of an ecological system, generally self-sustaining and managed as natural areas (7,263 acres), including veg. units, landforms and natural water features.	$150.4	High	2	35	40	18	5	0	Low[12]

[8] 2008 values increased from 2007 values by using the ENR-CCI increase of 4.2%
[9] Parks used a 4.2% inflation factor, based on ENR-CCI data.
[10] Parks is in the process of updating inspection schedules and methods. Current information is based on last year's estimates.
[11] Infrastructure value is based on partial information.

		Replacement Value		Current Condition (in %)						
Capital Asset Class	**Description**	**$ million**	**Confidence**	**Very Good**	**Good**	**Fair**	**Poor**	**Very Poor**	**TBD**	**Confidence**
Civic		**$1,016.9**								
Facilities (buildings, structures)										
Police facilities	Four precincts, Justice Center, property warehouse, equestrian division and vehicle storage lot	$60.9	High	0	53	47	0	0	0	High
Office buildings	Portland Building, 1900 Building, City Hall	$117.1	High	0	100	0	0	0	0	High
Other buildings	Records Center, Kerby Garage and Portland Communications Center	$28.3	High	0	94	6	0	0	0	High
Union Station	Train station and related buildings	$26.5	High	0	0	0	100	0	0	High
Parking garages	Seven parking garages	$112.9	High	0	59	41	0	0	0	High
Spectator facilities	Memorial Coliseum, Rose Quarter parking garages and PGE Park	$360.4	High	0	37	63	0	0	0	High
PCPA	Portland Center for the Performing Arts	$75.8	Low	0	0	0	0	0	100	tbd
Fire facilities	30 stations, administration building and support facility	$67.6	High	0	97	0	3	0	0	High
Technology Services										
800 MHz radio	Towers, communication devices and backbone infrastructure	$49.3	Low	0	100	0	0	0	0	Moderate
Telecommunication	Telephone system	$14.6	Low	0	100	0	0	0	0	Moderate
IT operations	E-mail system, data networks; storage and core servers	$4.1	Low	0	64	26	10	0	0	Moderate
Strategic tech.	Large corporate applications such as TRACS, CAD, PPDS, Cayenta and EBS	$99.4	Low	0	74	26	0	0	0	Moderate

EXPLANATION OF TERMS

Alternative transportation mode: This term refers to all passenger modes of travel except for single-occupancy vehicle, including bicycling, walking, public transportation, carpooling and vanpooling.

Asset: A physical component of infrastructure or a facility which has value and has an expected useful life of more than one year, that would be replaced if destroyed, and is not surplus to needs.

Asset Management: The continuous cycle of asset inventory, condition, and performance assessment that has as its goal the cost-effective provision of a desired level of service for physical assets. Investment decisions consider planning, design, construction, maintenance, operation, rehabilitation, and replacing assets on a sustainable basis that considers social, economic, and environmental impacts.

Backlog: The sum of deferred activities, such as maintenance, operations, and rehabilitation, needed to achieve the lowest life-cycle cost for an asset. Backlog results from lack of money, materials, or staff to perform the needed work. (See Funding Gap.)

Basement Sewer Backup: High rainfall intensities can cause sewer backups, or basement flooding, in low-lying homes and businesses. (Also see pipe surcharge)

Combined Sewer Overflow: In older Portland neighborhoods, the sewer system mixes untreated sewage and stormwater runoff in a single pipe. On rainy days, runoff from buildings, streets, and other hard surfaces can fill these combined sewers to capacity, causing them to overflow into the Willamette River and/or the Columbia Slough. Overflows are regulated by permits.

Confidence Level: The expression of accuracy and reliability in the areas of information (source and reliability), process (ad hoc or repeatable) and documentation (documented or not documented).

Condition Assessment: The method used to quantify the deterioration rate and remaining useful life of an asset. Methods of condition assessment vary by asset classification and range from use of industry estimates for deterioration rates up to documented physical inspection regimens on established cycles that ensure optimum economic life of an asset.

Condition Measure /Rating: A means of classification using information from periodic inspections or measurements to indicate the ability of an asset to deliver a particular level of service.

Current Replacement Value (CRV): The CRV is the total cost to replace the entire asset to meet current accepted standards and codes.

Design Storm: A selected storm event, described in terms of the probability of occurring once within a given number of years, for which stormwater management improvements are designed and built.

Funding Gap (or Unmet Need): The difference between the funding needed to address infrastructure needs of an asset at a defined condition or level of service and the funding that is currently available. The funding gap varies with the funding level and affects the level of service. The

funding gap is the amount of money needed to eliminate the backlog and/or maintain the asset to achieve its useful life. Given a certain funding level, the resulting level of service can be forecast; if a certain level of service is desired, the funds needed to achieve it can be estimated.

Green Infrastructure (or Green Stormwater Facilities): Infrastructure that uses natural processes, systems, or features to provide traditional infrastructure services. There are two types of green infrastructure:

- Natural networks of streams, rivers, and open spaces that naturally manage stormwater, provide habitat, improve air and water quality, reduce flooding risk, and provide areas for human recreation and respite; and
- Engineered facilities, such as green street treatments or eco-roofs, which use natural processes in an infrastructure setting.

Impervious surfaces: This term refers to hard surfaces that do not allow water to soak into the ground and increase the amount of stormwater running off into the stormwater drainage system. The majority of total impervious surfaces is from roofs, roads, sidewalks, parking lots and driveways. Stormwater runoff from these impervious surfaces reduces the amount of recharge of water to ground water and increases the capacity requirements of the storm water drainage system.

Infiltration: Passage or movement of water into the soil.

Infrastructure: Consists of assets in two general networks that serve whole communities—transportation modalities (roads, rail, etc.) and utilities. These are necessary municipal or public services, provided by the government or by private companies and defined as long-lived capital assets that normally are stationary in nature and can be preserved for a significant number of years. Examples are streets, bridges, tunnels, drainage systems, water and sewer lines, pump stations and treatment plants and dams.

Intermodal facility: A transportation element that accommodates and interconnects different modes of transportation and serves the intra-state, interstate and international movement of people and goods.

Inventory: A list of assets and their principal components.

Level of Service: A defined standard against which the quality and quantity of service can be measured. A level of service can include reliability, responsiveness, environmental acceptability, customer values and cost.

Maintenance: Activities that keep an asset operating as designed or prevent it from deteriorating prematurely, excluding rehabilitation or renewal which may extend asset life. Maintenance can be planned or unplanned.

Pipe Surcharge: When the hydraulic grade line (i.e. the water surface elevation) in a pipe exceeds the crown (top) of the pipe (in other words, the pipe is flowing full). When this occurs, pressure in the pipe increases in proportion to the increase in the hydraulic grade line. Excess flow may escape through outlets, including cracks in the pipe, manholes or drains, potentially causing flooding.

Rehabilitation / Renewal: Capital investment performed on an asset to restore it to its original level of service or capacity and achieve its useful life, which may result in an extension of the asset's service life.

Right-of-way (ROW): This term refers to publicly-owned land, property or interest therein, usually in a strip, within which the entire road facility (including travel lanes, medians, sidewalks, shoulders, planting areas, bikeways and utility easements) must reside. The right-of-way is usually defined in feet and is acquired for multi-modal transportation purposes including bicycle, pedestrian, public transportation and vehicular travel.

Single-occupancy vehicle (SOV): This term refers to vehicles that are carrying one person.

Triple Bottom Line: A method to categorize the benefits and impacts an organization can expect from investing in its assets. The benefits are categorized into Social, Economic, and Environmental benefits to ensure a comprehensive evaluation in the decision-making process.

Underground Injection Control: In this report, any man-made design, structure or activity (including sumps) which discharges stormwater below the ground or subsurface.

Useful Life: The period of time over which an asset is expected to deliver efficient service with normal or appropriate maintenance (defined as accepted industry standard or documented local experience).

Vehicle miles of travel (VMT): Automobile vehicle miles of travel for the movement of people. The definition does not include buses, heavy trucks and trips that involve commercial movement of goods.

Watershed: The land area drained by a river, stream, or creek.

Water Quality Limited Waterway: A body of water that does not meet water quality standards set by the Oregon Department of Environmental Quality (DEQ), limiting whether beneficial uses (such as domestic water supply, irrigation, fishing, swimming, and boating) are permitted. A water quality limited water body will be listed on DEQ's 303(d) list and is subject to Total Maximum Daily Load (TMDL) requirements, which set limits on the amount of pollutants allowed to enter the water body.

CHAPTER 1: BUREAU OF ENVIRONMENTAL SERVICES

OVERVIEW

The Bureau of Environmental Services (BES) serves the Portland community by protecting public health, water quality and the environment. It provides sewage and stormwater collection and treatment services to accommodate Portland's current and future needs. The bureau protects the quality of surface and ground waters and conducts activities that promote healthy ecosystems in our watersheds.

The Bureau serves Portland residents, numerous commercial and industrial facilities, and six wholesale contract customers. It operates and manages three systems: a combined sewer system, a separated sanitary sewer system, and a separated stormwater system, which provide stormwater and wastewater management services to the City of Portland. These systems are supplemented by pumping stations and two wastewater treatment plants. In 2009, the city's storm- and wastewater systems have a combined value of nearly $6 billion.

The Bureau of Environmental Services contracts with the Portland Bureau of Transportation to maintain the City's sewers. The Bureau has completed recent condition inspections for approximately 55-60% of its combined sewer system and approximately 25-30% of its sanitary system. Of inspected pipes, the vast majority are in good or very good condition, see Table 1.1. Knowledge of the system is expected to improve as inspections continue and work on the System Plan is completed. In general, the condition of the city's sewer systems is expected to improve over the next ten years, as completion of the CSO program allows capital resources to shift to rehabilitation and system improvements.

The City's combined sewer system provides sanitary and stormwater service to approximately 30% of the City's area, and the majority of its population, through over 1,140 miles of pipes. The combined sewer system carries both sanitary sewage and stormwater runoff in the same pipes. Of the pipes that have been inspected, nearly all (83%) are in good to very good condition. An estimated $130 million is needed to address the condition backlog.

Separate sanitary and storm sewer systems serve the remaining 70% (by area) of the City, primarily in the western and outer eastern areas. The sanitary sewer system includes a network of over 900 miles of sanitary lines and access structures. All of the sanitary sewer pipes that have been inspected are in good to very good condition. The separated stormwater system

collects and conveys stormwater for discharge to local receiving waters and includes pipes, culverts, ponds, sumps, and detention facilities.[12]

Table 1.1 Bureau of Environmental Services Inventory[13]

Asset Group	Number	Unit	Replacement Value	Condition (in %)					
				Very Good	Good	Fair	Poor	Very Poor	TBD
Combined Sewer System									
Pipes (Total)[1,3]	1147	miles	tbd	40%	8%	5%	2%	3%	41%
8" or Less	409	miles	tbd	44%	9%	7%	3%	4%	33%
> 8" and < 24"	508	miles	tbd	43%	11%	5%	2%	2%	36%
≥ 24 and < 36"	92	miles	tbd	42%	5%	2%	1%	1%	49%
36" and Larger	137	miles	tbd	17%	1%	1%	2%	1%	78%
Sanitary Sewer System									
Pipes (Total)[2,3]	901	miles	tbd	37%	1%	0%	0%	0%	61%
8" or Less	746	miles	tbd	39%	1%	0%	0%	0%	59%
> 8" and < 24"	114	miles	tbd	31%	2%	1%	0%	0%	67%
≥ 24 and < 36"	25	miles	tbd	26%	0%	0%	0%	0%	74%
36" and Larger	17	miles	tbd	2%	0%	0%	1%	1%	97%
Stormwater System									
Inventory information for the Stormwater System is being collected through the Bureau's System Plan Update, and is not currently available. This section will be updated prior to final Stormwater facilities include: pipes, stormwater inlets, ditches, underground injection controls (sumps), detention facilities, pollution reduction facilities (manufactured and green), and wet ponds.									
Wastewater Treatment									
Treatment Plants	2	each							
Pump Stations	96	each							

[1] Combined totals include the following pipe types: Combined, Sanitary, Pressure, Storm/Combined Overflow

[2] Sanitary totals include the following pipe types: Combined, Sanitary, Pressure

[3] 27 miles of pipes were unassigned to either system.

The City also owns and operates ninety-six pumping stations, which move wastewater uphill as needed, and two wastewater treatment plants, which use a series of processes to clean wastewater through removal of solids and organic materials and disinfection.

Each of these systems, including their condition and capacity, is discussed in greater detail in the following pages.

CAPITAL IMPROVEMENT PROGRAM (CIP) STRATEGY

The work of BES is focused on strategic and comprehensive program delivery; protecting public health and restoring the environment; within a prescribed, but negotiated, regulatory framework. Using asset management principles, the Bureau budgets to maintain infrastructure and natural

[12] The Bureau is currently updating inventory and condition data for the separated stormwater system as part of its System Plan update. Information will be available prior to completion of the Citywide Systems Plan.

[13] Bureau of Environmental Service, May 2009; the inventory values presented in this report include assets owned by the City of Portland within its urban service boundary (USB) as well as assets outside the USB, but within its service area.

systems to meet regulatory requirements and enhance the health of watersheds. Asset management addresses life-cycle costs, trade-offs between capital and operating expenditures, and prioritization of projects based on risk and consequence of failure, to achieve long-term system sustainability and acceptable levels of service. The Bureau recognizes the enhanced benefits of an integrated approach rather than one that addresses only single subject permit requirements. This integrated approach improves watershed conditions – hydrology, water quality, habitat – as it solves urban problems.

In January 2005, the Bureau adopted "Our Clean River Guide" as the strategic framework for both the operating and capital budgets. It identifies a number of key challenges and issues, many of which are described further in this report:

- Meeting all regulatory requirements within BES' financial constraints;
- Maintaining the aging infrastructure with limited financial resources;
- Improving watershed health and improving water quality;
- Managing stormwater to reduce sewer overflows and basement flooding;
- Creating innovative ways to use stormwater and wastewater as a resource;
- Ensuring BES has the technical expertise and knowledge to adapt to changing regulations; and,
- Managing the Bureau's work to meet goals and minimize rate increases.

The Bureau focuses efforts on comprehensive, multi-purpose solutions in the highest priority areas for work in all five program areas of the CIP. These program areas include: combined sewer overflow, sewage pumping and treatment systems, collection system maintenance and reliability, surface water management, and systems development.

KEY ISSUES & CONCERNS

Maintaining Existing Infrastructure

For 2009, BES estimates an annual maintenance funding gap of $28 million, including $16 million in combined sewers, $4 million in sanitary sewers, $2 million for stormwater and $6 million for wastewater treatment. The long-term financial forecast anticipates significant increases in the capital maintenance budget after completion of the CSO program in 2011. BES is applying new technologies and collecting improved data on its assets, which are allowing enhanced analysis, planning, and correction of problems in its systems.

Maintenance of Surface Stormwater Facilities

In 2008, the City's stormwater system included approximately 475 greet street facilities and had plans to construct nearly 1,000 more by 2013. The construction of surface stormwater facilities will have long term maintenance and operations impacts. Unlike pipe, which requires only limited maintenance, vegetated facilities require regular maintenance to be effective.

Serving Existing Residents

Both Portland's combined sewer system and its sanitary sewer system have hydraulic and condition deficiencies that impact these systems' abilities to serve existing residents at designated service levels. These deficiencies can result in higher risks for sewer backups.

Combined System Deficiencies

Pipe segments with insufficient hydraulic capacity to adequately convey the design storm are widely distributed throughout the combined sewer service area. The greatest concentration of pipe segments with capacity problems is located within the inner city, relatively close to the Willamette River. These capacity problems lead to the risk of the combined sewer backing up into basements during intense storm events. The highest risk of basement sewer backups on the east side of the Willamette River are in an area roughly bounded by NE Prescott Street to the north, SE Holgate Blvd to the south and SE 20th Avenue to the east. On the west side of the river, the highest predicted risk of basement sewer backups is in NW Portland in an area roughly bounded by NW Yeon Avenue to the north, West Burnside Street to the south and NW 23rd Avenue to the west. Pipe segments that are in poor structural condition are widely distributed throughout the combined sewer service area.

Sanitary Sewer System Deficiencies

Overall the sanitary sewer system has adequate capacity to convey the 5-year winter design (or, modeled) storm with no sewage releases to basements, streets and ground surface. Less that 0.2 % of all basements are at risk for sewer back ups due to capacity. Capacity deficiencies are concentrated in the southwest (Fanno, Burlingame, Clean Water Services South), and the Peninsular-Rivergate D basin in the north.

Pipe segments inspected within the last 10 years are in good structural condition. However approximately 60% of sewers in the sanitary service area have either no inspection records or inspection records over 10 years old. This is of most concern in the west side basins where the pipes are older. There is a focused effort currently underway to inspect west side sewers.

Stormwater Management

In areas not served by the combined sewer system, where stormwater is channeled through pipes or ditches into streams and rivers or detention facilities, or allowed to infiltrate in natural areas, Portland continues to face challenges to improve water quality and watershed health. This includes meeting regulatory requirements under the Clean Water Act and Safe Drinking Water Act, as well as improving habitat for native fish and wildlife populations. Flooding also continues to be a key issue in the Johnson Creek area, where the City is working with partners to restore more natural conditions.

Meeting Regulatory Requirements

Meeting current regulatory requirements presents additional challenges. Satisfying regulatory requirements now accounts for the majority of investment made by the Bureau. Existing and potential mandates will continue to drive the priorities of the Bureau in the future. Major mandates currently affecting the City's waste and stormwater systems include the Federal Clean Water Act, the Endangered Species Act, Safe Drinking Water Act, and Comprehensive

Environmental Response, Compensation and Liability Act. More information on these and other significant mandates can be found in the next section.

Accommodating Growth

The Bureau of Environmental Services plans for its facilities based on build-out densities allowed within existing comprehensive plan land use densities, which are higher than current 2030 population projections as provided by Metro. The bureau expects to be able to maintain and improve the sewer systems to handle growth needs as long as growth does not exceed densities designated in the current Comprehensive Plan. Additional densities may require modifications of existing infrastructure or the construction of new pipe or green infrastructure to accommodate.

REGULATORY COMPLIANCE

Management of watershed health now guides BES' coordinated response to its regulatory responsibilities. The watershed approach provides a framework to coordinate and integrate these regulatory responses in order to achieve efficiencies and address the City's larger goals for clean and healthy rivers. An important theme of the Portland Plan is to improve watershed health through repair and maintenance of existing infrastructure, installation of new stormwater infrastructure, and watershed-friendly development.

The dominant regulatory mandates are described in the following sections.

Clean Water Act

National Pollutant Discharge Elimination System Permits

The National Pollutant Discharge Elimination System (NPDES) permitting program was developed to control the discharge of point and certain non-point sources of pollution to the nation's waters. The NPDES program is administered in Oregon by the Department of Environmental Quality (DEQ). There are several different types of NPDES permits.

- Wastewater Program. Portland has NPDES Water Pollution Control Facility permits for treated municipal wastewater discharges from the Columbia Boulevard Wastewater Treatment Plant (WWTP) and the Tryon Creek WWTP. The permits include water quality-based effluent limits.
- Stormwater Program. Portland has a Phase I NPDES permit for stormwater discharges from the municipal separate storm sewer system (MS4). The City's response includes the following elements: development standards; industrial and commercial controls; illicit discharge controls; structural controls; operations and maintenance requirements; preservation and restoration of natural areas; and public education and outreach.
- Industrial Stormwater Program. Portland has been delegated responsibility for administration of an industrial stormwater permit system within its jurisdiction. Some types of industrial permits, such as for large construction sites, are administered directly by DEQ.

Capacity, Management, Operations, and Maintenance (CMOM) Regulations

CMOM is a new provision of the Clean Water Act requiring municipalities to improve the performance and reliability of sanitary and combined sewer systems. In 2008, BES submitted a Draft CMOM Program Report to DEQ for review. The strategies and activities outlined in the program are consistent with the City's asset management approach for managing, operating, and maintaining the wastewater collection system. Although the program will require the City to modify certain practices, many of the practices and activities have already been adopted.

Water Quality Standards and Total Maximum Daily Load Programs

The Clean Water Act established programs to develop and implement water quality standards and limits for pollutants received by water bodies. DEQ is responsible for developing water quality standards and total maximum daily loads in Oregon. DEQ's program specifies maximum amounts of certain pollutants that a particular body of water is allowed to receive based on its assimilative capacity. The goal is to protect beneficial uses such as recreation, cold water fisheries, municipal and industrial water supplies and navigation.

Portland is responsible for addressing total maximum daily loads established by DEQ for the Lower Willamette mainstem as well as small west-side tributaries, Tryon, Fanno, and Johnson Creeks, and the Columbia Slough.

Amended Stipulated Final Order (CSO Program)

In 1994, BES entered into a final legal agreement with the Oregon Environmental Quality Commission concerning the City of Portland's CSO-abatement program. Overflows from Portland's Combined Sewer Overflow (CSO) system violated water quality standards for the Willamette River and the Columbia Slough, subject to the Clean Water Act. The City's $1.4 billion CSO program, due to be completed in December 2011, includes separation of some parts of the combined sewer system, diversion of west-side streams from the sewer system, installation of UICs in the right-of-way, and disconnection of downspouts. It also includes three major tunnel projects. The biggest of the tunnel projects, the East Side Tunnel Project, will be completed in 2011.

Underground Injection Control (UIC) Program

The National UIC Program was enacted in 1974 under the Safe Drinking Water Act. In Oregon the program is administered by DEQ. In 2005, DEQ issued a Water Pollution Control Facility (WPCF) permit for stormwater discharges to approximately 9,000 City-owned underground injection controls (UICs). The ten-year WPCF permit regulates the construction, operation, and maintenance of all city-owned UICs. The permit also requires the development and implementation of a UIC Management Plan. The management plan includes a Systemwide Assessment and Corrective Action Plan (completed in December 2006) to identify and correct non-compliant UICs.

In association with Corrective Action Plan, the Decision Making Framework for Groundwater Protectiveness Demonstrations (GWPD framework, completed in 2008) provides a consistent, streamlined decision making framework for evaluating the potential impacts to groundwater associated with the discharge of urban rights-of-way stormwater into permitted city-owned UICs. The GWPD framework was applied to city-owned UICs with inadequate separation distance

(less than 10 feet) between the bottom of the UIC and seasonal high groundwater in public rights-of-way and parks; approximately 140 UICs were shown to be protective of groundwater and received a no further action from DEQ. 219 UICs with inadequate separation distance (with less than 5 feet of separation) will receive structural corrective action to be completed by 2015. This work is funded in the bureau's CIP.

Endangered Species Act (ESA) Requirements

Eight species[14] of salmon and five species of steelhead use or migrate through watercourses in the Portland area, including the Columbia River, Columbia Slough, Willamette River, Johnson Creek, Tryon Creek, Fanno Creek and several other smaller westside streams. Four salmon and steelhead species actually call these rivers home (Coho, Chinook, Chum and Winter Steelhead), and all 13 are listed as threatened or endangered under the Endangered Species Act (ESA).

The basic requirement of the ESA is to avoid harming or harassing the listed species or adversely modifying their critical habitat, including physical, chemical, and biological modifications. Portland's waterways are designated as protected critical habitat, which triggers requirements when a City project involves federal actions such as funding or permitting. The requirements are enforced through an individual permit.

The City is currently working with the State of Oregon to develop a regional recovery plan that will be reviewed and hopefully approved by NOAA Fisheries and the US Fish and Wildlife Service. Based in part on the City's Framework for Watershed Health and the Watershed Management Plan, the recovery plan identifies limiting factors for fish, establishes delisting and broader recovery goals, and identifies actions to move towards these joint goals.

The recovery plan incorporates existing efforts by the City to meet the goals of the ESA. Those efforts include a dedicated Science, Fish and Wildlife program, the Watershed Management Plan, TMDL implementation plans, Superfund activities, streamlining of the permitting process, Section 4(d) permits for routine road maintenance, the Integrated Pest Management system, stormwater management requirements, restoration activities such as culvert replacement, stream bank restoration and riparian protections, erosion control and revegetation, BES fish studies and continued monitoring, as well as efforts undertaken by other City bureaus (for instance, concerning zoning and climate change).

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA – Superfund) Portland Harbor Cleanup

In December 2000, the USEPA listed a portion of the Lower Willamette River, known as Portland Harbor, as a Superfund site under the federal National Priorities Listing process. The Portland Harbor Superfund investigation is currently focused on a stretch of the Willamette River from River Mile 2 to River Mile 11.8. The City operates stormwater or combined sewer overflow outfalls within the Portland Harbor area. The outfalls serve as conduits for stormwater draining from City owned rights-of-way and from industrial, commercial, residential, and vacant lands.

[14] For Pacific salmon, National Marine Fisheries Service (NOAA Fisheries) considers an Evolutionarily Significant Unit (ESU) a "species" under the ESA. For Pacific steelhead, NOAA Fisheries has delineated Distinct Population Segments (DPSs) for consideration as "species" under the ESA.

When it rains, stormwater can transport contaminated soils to the river. These materials may impair Willamette River water quality and sediments.

Under an Intergovernmental Agreement, the City and Oregon DEQ are working to identify sources that discharge significant contamination to the municipal conveyance system and to control these sources to reduce contaminant loads. The City is working closely with the Oregon DEQ and the EPA to develop a comprehensive plan to address future stormwater discharges under state and municipal programs to prevent recontamination of the harbor.

PORTLAND'S WATERSHED APPROACH

The requirements of the individual regulations described in the preceding sections are complex and address specific public health and environmental concerns. In the past the City generally responded individually to different regulations. The resulting programs were independent, single focus efforts that didn't completely acknowledge overlapping issues. Trying to satisfy these requirements one at a time often meant lost opportunities to serve multiple objectives at the same time.

Using watershed health as a goal and guide, BES is moving away from responding individually to different regulations. The new approach considers the whole watershed system and recognizes the interconnection through the hydrologic cycle. Solutions which promote healthy watersheds while addressing other infrastructure objectives are often the most cost-effective and publicly acceptable.

This holistic approach integrates the work of various city bureaus, private citizens, businesses and local non-profit organizations to improve watershed health. It has the greatest potential to protect and improve water quality while meeting state and federal regulatory requirements in the process. Rather than only responding to regulatory requirements, ecological principles and watershed conditions will help set the course. The result will be net environmental improvements.

Portland Watershed Management Plan

Portland's Watershed Management Plan (PWMP) was adopted in 2006. The Framework for Integrated Management of Watershed Health, which sets out the scientific basis for the plan, was adopted with the plan. The PWMP focuses efforts to protect and restore the natural systems within the city's boundaries, and lays out an integrated, system-wide approach. Since its adoption, the PWMP has been instrumental in assisting bureaus' consideration of watershed health as projects are designed and implemented.

Rather than focusing separately on single issues such as flooding, combined sewer overflows, or contaminated sediments, the PWMP considers all activities that affect watershed conditions including issues like transportation, redevelopment and open space needs. Features like trees, ecoroofs and swales integrated into the urban environment can capture and filter precipitation that would otherwise drain through outfall pipes directly into rivers and streams, or drain to the waste water treatment plant.

While the PWMP builds on previous efforts, it is unique because it is the first plan to present the shared goals, objectives, strategies and actions of the city's five watersheds. It is a first step toward documenting all of the City's watershed work, as well as the functional and organizational relationships between the work elements.

Portland's Five Watersheds

The City of Portland is located at the confluence of the Willamette River and the Columbia River – occupying an important ecological crossroads. Similarities as well as differences exist in the five watersheds within the City's boundaries which influence the effectiveness of various stormwater management tools.

The **Portland Willamette River Watershed** occupies about 0.5 percent of the Willamette River's total drainage basin, which covers more than 11,000 square miles in Western Oregon. Within the city's boundaries, the watershed encompasses 69 square miles. The river flows north through the downtown core to the Columbia River and serves industrial, residential, commercial and recreational uses.

The Willamette River is water quality limited with approximately 35% of the watershed within Portland covered in impervious surfaces. The largest acreage of open space and parks in the City exist here with Forest Park being a significant contributor to this total. Although UIC's are used to manage stormwater in the far eastern section, the majority of stormwater is managed through the separated and combined systems and sustainable stormwater systems. Significant projects have been undertaken to address stormwater related issues such as basement backups and CSO's. By 2011, 94% of CSO's will be controlled.

The **Columbia Slough Watershed** extends along the Columbia River shoreline north of Portland and drains approximately 51 square miles. The watershed is defined by the 19-mile long main channel (the slough) and includes approximately 30 miles of secondary waterways. The Columbia Slough is a highly managed system, with piped surface water, dikes and levees, and a system of pumps that provide watershed drainage and flood control. The watershed continues to serve industrial uses, but is also home to commercial enterprises and thousands of residents.

The Slough is water quality limited and has been impacted by activities in its watershed, although the 99% reduction in combined sewer overflows has improved conditions. Approximately 54 percent of the watershed is covered with impervious surfaces, such as roads, parking lots, sidewalks, and rooftops which lead to large volumes of stormwater. Stormwater is directed into UIC's, the separated system, the combined system, and sustainable stormwater facilities. A few of the UIC's, located within the Columbia South Shore wellfield have been targeted for improvements.

The **Johnson Creek Watershed** encompasses approximately 54 square miles, over half of which lies outside the City of Portland. Johnson Creek originates in Clackamas County east of Boring, Oregon, and flows west approximately 25 miles to its confluence with the Willamette River.

Johnson Creek is water quality limited with approximately 28% of the watershed covered in impervious services. The majority of stormwater runoff is directed into UIC's with separated, combined systems, and sustainable stormwater facilities also being used to manage runoff. Many of the UIC's located east of I-205 and west of Powell Butte have been identified for improvements due to the high water table in this area.

The **Tryon Creek Watershed** in southwest Portland covers an area of approximately 6 square miles. About 21 percent of the watershed is outside the City of Portland's boundary and within the jurisdictions of Multnomah County, Clackamas County, and the City of Lake Oswego.

Tryon Creek is water quality limited with approximately 22% of the watershed covered in impervious surfaces – the smallest percentage of all watersheds in the city. The majority of stormwater in this watershed flows quickly across soils that are slow to infiltrate and down steep slopes into stream channels that flow into Tryon Creek. Some stormwater is handled by the separated system and sustainable stormwater facilities.

The Fanno Creek Watershed covers an area of approximately 32 square miles. Approximately 7 square miles are within the City of Portland. The remaining watershed area is mainly within the jurisdiction of Washington County.

Fanno Creek is water quality limited with approximately 25% of the watershed covered in impervious surfaces. Like Tryon Creek, the majority of stormwater flows into stream channels and into Fanno Creek. Some stormwater is handled by the separated system and sustainable stormwater facilities.

Additional information on Portland's watersheds can be found in the Watershed Health Report completed for the Portland Plan.

COMBINED SEWER SYSTEM

The combined sewer system includes the network of pipelines and pump stations that collect and convey combined stormwater and wastewater. The combined sewer system area is located in the central portion of the City along the Willamette River and the Columbia Slough and is divided into 41 basins[15], which lie within all five watersheds, see Map 1.2. This area is approximately 27,084 acres in size and is bounded on the north by the Columbia Slough, on the south by Johnson Creek, on the west by the Portland West Hills, and on the east by 82nd Avenue (approximately). It includes most of downtown Portland and many older residential areas.

Inventory

In 2008, the combined sewer system was valued at nearly $2.4 billion. It includes 1,147 miles of pipe and 37 outfalls. (see Table 1.2 and Map 1-3). The system also includes a variety of supporting components, including valves and access structures, which due to their extensive number, are not included in the mapped inventory.

Table 1.2 Combined Sewer System Inventory[16]

Asset Group	Total (miles)
Pipes (Total)	1147
8" or Less	409
> 8" and < 24"	508
≥ 24 and < 36"	92
36" and Larger	137
Outfalls	37

Desired Levels of Service

The level of service of the combined sewer system should be adequate to prevent basement sewer backup during a 25-year design storm. The combined sewer system must also meet a

[15] BES has defined multiple basins for the combined sewer, sanitary sewer, and stormwater systems. Basin boundaries are based on the routing of flows to downstream discharge locations. The basins are delineated separately for each type of sewer – combined, sanitary, and stormwater. Within one watershed, there may be combined sewer basins, sanitary sewer basins, stormwater basins, or a combination of each.
[16] Bureau of Environmental Service, May 2009

variety of water quality standards as mandated by federal and state regulation (see Regulatory Compliance).

Current Structural Condition (2008)

Of the portions of the combined sewer pipe network with recent assessment, the majority is in good to very good condition, see Table 1.3. Less than one-tenth of the system is in poor or very poor condition. Knowledge of existing conditions is used to analyze and rank problems so that effective rehabilitation plans and schedules can be developed.

Table 1.3 Current Condition (2008) - Combined Sewer System[17]

Asset Group	Very Good	Good	Fair	Poor	Very Poor	TBD
Pipes (Total)	40%	8%	5%	2%	3%	41%
8" or Less	44%	9%	7%	3%	4%	33%
> 8" and < 24"	43%	11%	5%	2%	2%	36%
≥ 24 and < 36"	42%	5%	2%	1%	1%	49%
36" and Larger	17%	1%	1%	2%	1%	78%

Incorporating preliminary pipe condition assessment information from the BES System Plan Update, Figure 1.1 shows the pipes within the combined sewer system that have either hydraulic or structural problems[18], or both. Less than 13% of pipes in the combined sewer system currently have hydraulic deficiencies, over 7% have structural deficiencies, and nearly 2% have both. Hydraulic deficiencies affect a greater percentage of pipes in the eastside system, while the westside system has a higher percentage of structural problems than the city average. Hydraulic deficiencies are discussed further in the Capacity section.

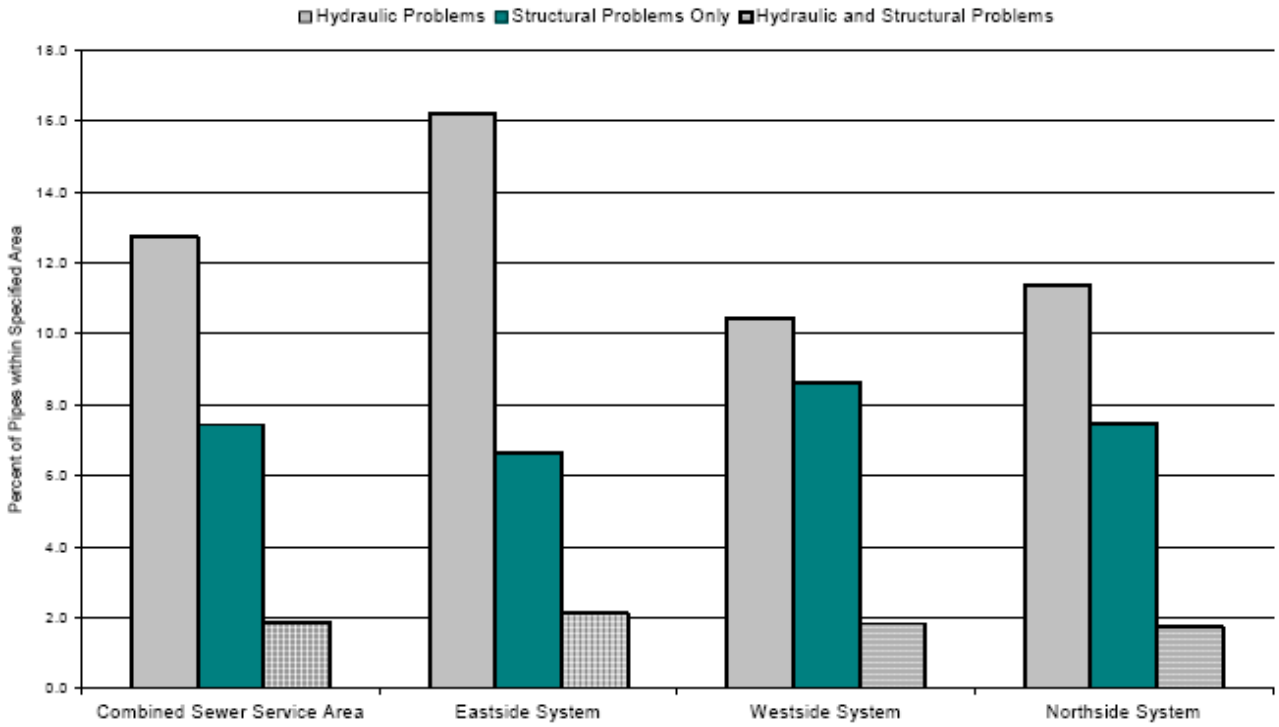
Structural deficiencies in the City's combined sewer pipes can be found, at some level, in all of the city's combined sewer system sub-basins, see Map 1-4. However, certain sewer basins have a higher incidence of structural problems, including the Taggart D, NE 13th, Balch, and Beech-Essex.

Pipe inspections generally occur on a 7-year rotation, and BES has inspected approximately 60-70% of combined sewer pipes to date. To estimate the condition of un-inspected pipes, the Bureau correlates the condition and useful life of nearby pipes. In some basins, a significant percentage of pipes have not undergone inspections since 1980. These include large portions of the St. Johns A and B, Chautauqua, and Sellwood basins, as well as some areas of the Lents, Fiske, Mill/Jefferson, Tanner A, and Sullivan basins. In these areas there is a reduced level of knowledge about current and projected condition.

[17] Bureau of Environmental Services, May 2009.

[18] Structural (or Condition) Pipe Deficiency: Structural deficiencies are generally caused by the deterioration of concrete pipes installed in the 1950s; variations in soil conditions, pipe material, and construction method and quality; and intrusions. Pipe condition is monitored as it is a key factor in the pipes ability to meet service standards. Replacement or rehabilitation of a deficient pipe depends on its functional ability and relative risk.

Figure 1.1 Summary of Existing and Projected Hydraulic and Structural Pipe Problem Estimates[19]



Projected Condition (2018)

In general, the current condition of the combined sewer system is expected to improve slightly in the next ten years. Completion of the Combined Sewer Overflow Program, expected in 2011, will allow the Bureau to increase capital investment in existing assets.

Existing and Projected Capacity

The Bureau of Environmental Services conducted hydraulic modeling of the combined sewer system to characterize and evaluate system performance. This was done as part of the Combined Sewer System Characterization Study, which is part of the larger BES System Plan Update.

The hydraulic characterization of the combined sewer system was performed using a highly detailed modeling technique called explicit modeling. With this technique, all of the pipes, manholes, diversion structures, sumps, and pump stations in the basins were simulated as individual objects. The following conditions were simulated:

- Existing conditions (2006) during the 2-year design storm: identifies the highest priority areas.
- Existing conditions (2006) during the 5-year design storm: identifies high priority areas.
- Existing conditions (2006) during the 25-year design storm: identifies areas that potentially are not currently meeting the BES combined sewer system service levels.[20]

[19] Bureau of Environmental Services, "Combined Sewer System Plan Characterization Plan," October 2006.

- Future conditions (2040) during the 25-year design storm: identifies areas that potentially will not meet the BES combined sewer system service levels and therefore require planning to accommodate future growth.

The percentages of the system estimated to not meet key hydraulic performance criteria under these conditions are graphed in Figure 1.2 for the combined sewer service area as a whole and for its three component systems: Eastside, Westside, and Northside. The criteria include an evaluation of deficient pipe capacity[21] where the modeled peak flow to design flow ratio is greater than 1.2, and basement sewer backup risk where the maximum hydraulic grade line elevation is within 8 feet of the estimated finish floor elevation. As shown in Figure 1.2, approximately 14%, or 179 miles, of the combined sewer service area does not have sufficient pipe capacity to meet the BES combined sewer service levels and 10.3% does not currently meet the service levels for basement sewer backup risk (equivalent to over 12,000 affected parcels). These deficiencies will require rehabilitation or replacement to resolve. Pipe improvements made to resolve hydraulic deficiencies within the combined sewer system are generally intended to reduce the risk of basement sewer backup.

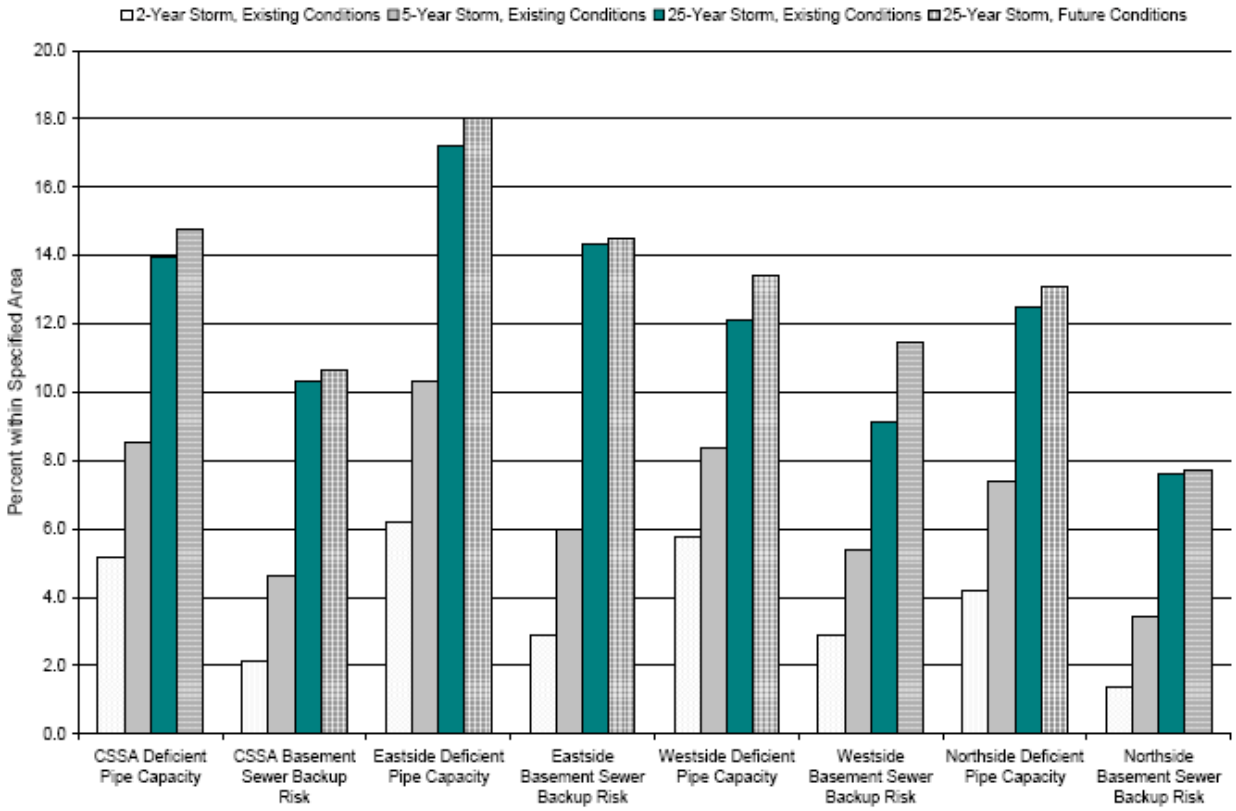
Maps 1-5 and 1-6 show that areas throughout the City will likely not meet system service levels for pipe capacity or sewer backup risk in 2040 and will require planning to accommodate growth.

Areas with the highest relative levels of pipe capacity deficiency include portions of the Alder, Division, Oak, and Taggart A basins (central eastside); the Wheeler, and Beech-Essex basins (inner northeast, centered on NE M.L.K. Boulevard); the Linnton basin; and the Tanner B and Balch basins (northwest), see Table 1.4. In general, risk increases as the size of the storm increases, with similar current and projected back-up risk for a 25-year storm. Areas with the lowest relative pipe capacity deficiency include the Lents, Westside Streams, Bayard, Fiske, Holladay, Stark, Sullivan, and Kenton basins.

[20] BES combined sewer system service levels are currently under development as part of the BES System Plan Update. The standards used in this report are preliminary. Service standards are expected to be established by December 2006.

[21] *Hydraulic (or Capacity) Pipe Deficiency*: Pipe capacity is expressed as the ratio of design storm peak flow to the maximum design flow of the pipe segment, which is called the pipe flow ratio. Pipe segments are considered deficient when the pipe flow ratio is greater than 1.2 for the 25-year design storm. If a pipe exceeds this ratio, it is carrying more flow than it is designed for and surcharging is likely occurring in the pipe segment. In addition, surcharging may be occurring to a significant enough depth to cause a risk of basement sewer backups and street flooding in adjacent, and possibly upstream, properties.

Figure 1.2 Summary of Combined Sewer System Hydraulic Performance Estimates[22]



[22] Bureau of Environmental Services, "Combined Sewer System Plan Characterization Plan," October 2006.

Figure 1.3 Combined and Sanitary Sewer Basins

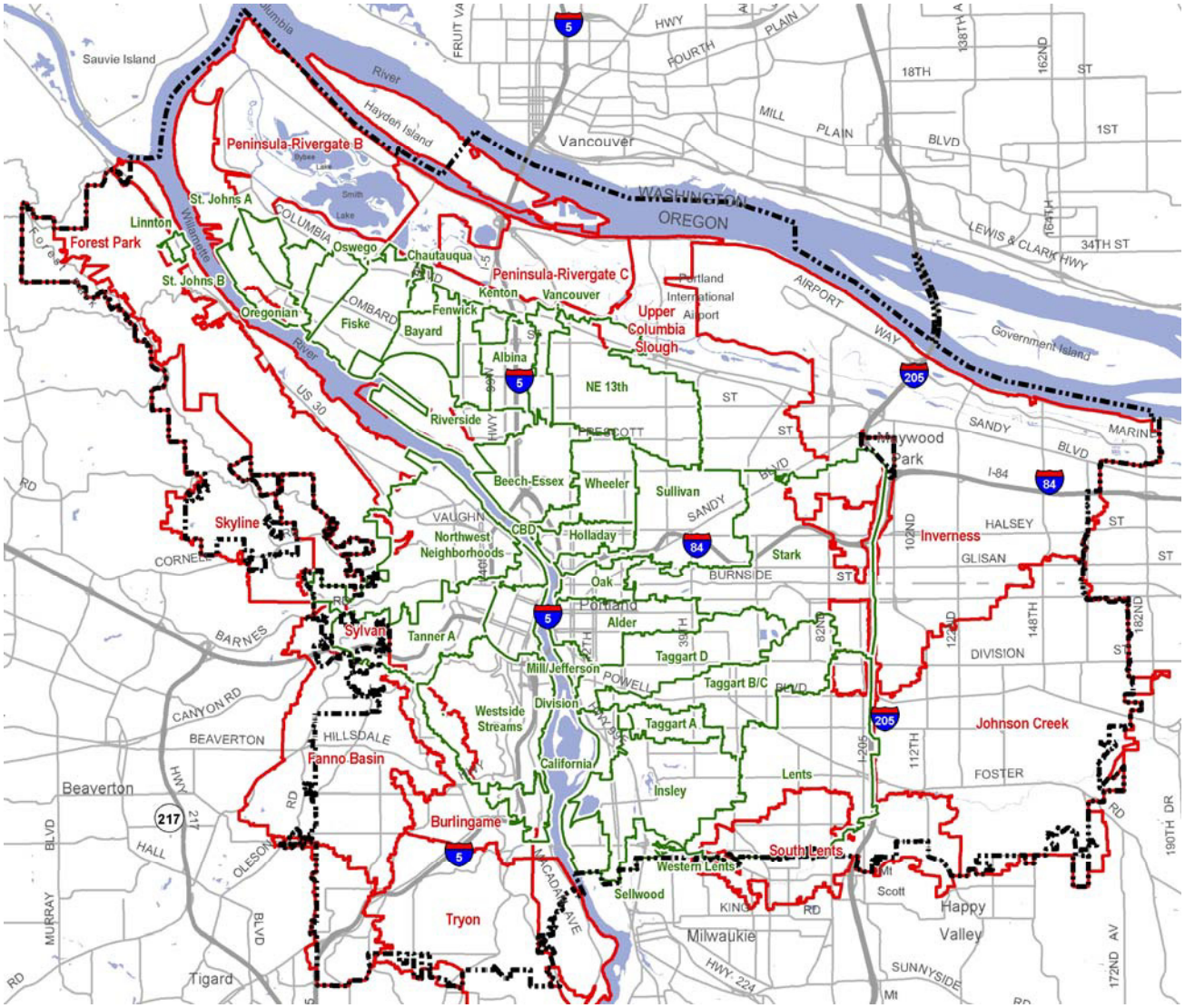


Table 1.4 Combined Sewer Pipe Capacity Deficiencies[23]

Basin Name	Total (miles) Length	Future 25-Year Storm Length	%	Basin Name	Total (miles) Length	Future 25-Year Storm Length	%
Eastside Basins	392.0	70.6	18.0%	Northside Basins	576.7	75.5	13.1%
Alder*	43.4	14.5	33.4%	Albina, Fenwick & Vancouver	40.2	5.3	13.2%
Division*	4.9	1.6	32.7%	Bayard	20.2	0.9	4.5%
Lents	113.1	4.9	4.3%	Beech-Essex*	39.3	12.2	31.0%
Oak*	15.3	5.7	37.3%	Chatauqua	5.3	0.3	5.7%
Sellwood, Insley & Western Lents	78.4	8.2	10.5%	Fiske	30.5	1.9	6.2%
Taggart A*	24.3	7.7	31.7%	Holladay, Stark & Sullivan	207.1	35.1	16.9%
Taggart B/C	56.0	12	21.4%	Kenton	15.9	0.7	4.4%
Taggart D	56.6	16	28.3%	Linnton*	2.9	0.9	31.0%
Westside Basins	243.2	32.6	13.4%	NE 13th	88.3	3.7	4.2%
California	13.1	0.9	6.9%	Oregonian	20.8	0.8	3.8%
Central Business District*	8.3	3	36.1%	Oswego	17.4	0.6	3.4%
Mill/Jefferson	31.1	4	12.9%	Riverside	21.7	2.9	13.4%
Northwest Neighborhoods	85.1	13.4	15.7%	St. Johns A & B	33.5	3.6	10.7%
Tanner A	39.0	3.7	9.5%	Wheeler	33.6	6.6	19.6%
Westside Streams	66.6	7.6	11.4%				
Total - All Basins	**1,212**	**179**	**14.7%**				

* Combined Sewer basins whose percentage of deficient pipe is in the top 75% of all basins.

Areas with the highest basement sewer backup risk include portions of the Alder, Oak, and Taggart D basins (central eastside); the Holladay, Wheeler, and Beech-Essex basins (inner northeast, centered on NE M.L.K. Boulevard); and the Tanner B and Balch basins (northwest), see Table 1.5. In general, risk increases as the size of the storm increases.

Areas with the lowest relative sewer back-up risk include the Albina, Fenwick, Vancouver, and Kenton basins in North Portland, and the Westside Streams basin.

[23] Bureau of Environmental Services, May 2009.

Table 1.5 Combined Sewer Backup Risk[24]

Basin Name	Total Parcels	Future 25-Year Storm Parcels	Future 25-Year Storm %	Basin Name	Total Parcels	Future 25-Year Storm Parcels	Future 25-Year Storm %
Eastside Basins	45,941	6,653	14.5%	Northside Basins	62,985	4,870	7.7%
Alder*	4,261	1,488	34.9%	Albina, Fenwick & Vancouver	4,542	188	4.1%
Division*	184	74	40.2%	Bayard	2,551	17	0.7%
Lents	14,814	170	1.1%	Beech-Essex*	3,934	1,305	33.2%
Oak*	1,123	702	62.5%	Chatauqua	407	2	0.5%
Sellwood, Insley & Western Lents	8,238	397	4.8%	Fiske	3,449	28	0.8%
Taggart A*	2,460	714	29.0%	Holladay, Stark & Sullivan	23,843	2,368	9.9%
Taggart B/C	7,282	854	11.7%	Kenton	2,077	19	0.9%
Taggart D	7,579	2,254	29.7%	Linnton	309	12	3.9%
Westside Basins	13,083	1,496	11.4%	NE 13th	10,330	167	1.6%
California	873	38	4.4%	Oregonian	1,780	28	1.6%
Central Business District**	341	82	24.0%	Oswego	1,412	18	1.3%
Mill/Jefferson	847	76	9.0%	Riverside	1,620	38	2.3%
Northwest Neighborhoods	4,452	958	21.5%	St. Johns A & B	2,091	190	9.1%
Tanner A	2,092	113	5.4%	Wheeler	4,640	490	10.6%
Westside Streams	4,478	229	5.1%				
Total - All Basins	**122,009**	**13,019**	**10.7%**				

* Combined Sewer basins whose percentage of parcels with back-up risk is in the top 75% of all basins.
** The Central Business District basin's percentage of parcels with back-up risk is in the top 75% of all basins for the future 25-year storm condition

Combined Sewer Overflows

During dry weather and very light precipitation, combined sanitary and stormwater sewage is transported to the Columbia Boulevard Wastewater Treatment Plant for treatment. During light to heavy precipitation, combined sewage flows can exceed system capacity, and excess untreated flows can be released through outfalls to the Willamette River or the Columbia Slough. The resulting combined sewer overflows, or CSOs, exceed water quality standards in the receiving water and are regulated by the Clean Water Act.

To address this problem, the City undertook a twenty year, $2 billion program to control CSOs by 2011. The CSO program involves the construction of three “Big Pipes” along the Columbia Slough and the east and west sides of the Willamette River; the Swan Island Pump Station, a new pump station; and the Portsmouth Force Main, which will carry sewage from the Swan Island Pump Station to the Columbia Boulevard Wastewater Treatment Plant. The Columbia Slough Big Pipe, completed in 2000, reduced combined sewer overflows by 99% by preventing about 300 million gallons of combined sewage from overflowing into the Columbia Slough each year. The West Side Big Pipe was completed and operational in December 2006. The East Side pipe is under construction, with a planned completion in 2011. Once the Combined Sewer Overflow project is complete, combined sewer overflow volume to the Willamette River will be reduced by over 94%.

[24] Bureau of Environmental Services, May 2009.

Green Stormwater Facilities

BES has been implementing programs, such as Tabor to the River – Brooklyn Creek Basin Program, that combine traditional engineering approaches, such as repairing and replacing sewer pipes, with green infrastructure approaches, such as green street facilities and street trees, to address stormwater management and watershed health issues. The goal of these programs and facilities is to capture and detain stormwater runoff as close to the source as possible; reduce the volume of stormwater entering the combined sewer system and the resulting risk of basement sewer backups and combined sewer overflows; filter stormwater to remove pollutants before the runoff enters groundwater, streams, or wetlands; and achieve multiple environmental benefits.

SANITARY SEWER SYSTEM

The sanitary sewer system includes the network of pipelines and pump stations that collect and convey wastewater only. The areas served by sanitary sewers are divided into 15 basins, totaling 66,726 acres, and covering most of outer east and southwest Portland, see Map 1-2. The sanitary flow from these basins is treated at either the Columbia Boulevard or the Tryon Creek Wastewater Treatment Plan, or through contract arrangement at facilities operated by the Unified Sewerage Agency or the City of Gresham.

The information presented in this section is based on preliminary system characterization efforts, conducted as part of the Bureau's System Plan update. More complete information will be added prior to the completion of the Citywide Systems Plan.

Inventory

The sanitary sewer system includes 900 miles of sanitary sewer pipes and access structures, see Table 1.6 and Map 1-7.

Table 1.6 Sanitary Sewer System Inventory[25]

Asset Group	Total (miles)
Pipes (Total)	901
8" or Less	746
> 8" and < 24"	114
≥ 24 and < 36"	25
36" and Larger	17

[25] Bureau of Environmental Services, May 2009.

Desired Levels of Service

Sanitary sewer systems must have adequate capacity to collect and transport the base sanitary flow and the infiltration/inflow associated with a 5-year storm without producing sanitary sewer overflows. New or replacement sanitary sewer pipe must have adequate capacity to convey 100 percent of the future (year 2040) peak 1-hour wet-weather flow associated with a 5-year storm.

Current Structural Condition

Approximately one-third of the sanitary pipe system has been assessed as part of BES System Plan update. All of these pipes were found to be in good to very good condition, see Table 1.6. However, known structural deficiencies exist in a small percentage of the system, primarily in the Council Crest, Fanno, Dunthorpe-Riverdale, and Cleanwater Services South basins of southwest Portland, see Map 1-8 and Table 1.7. Current structural condition data was not available for significant areas of the Fanno and Tryon basins. The age of these sewers suggest that additional defects will be found in these areas. The bureau has committed to repairing structurally deficient portions of the sewer system through the sewer rehabilitation program.

Table 1.6 Current 2008 Condition: Sanitary Sewer System[26]

	Very Good	Good	Fair	Poor	Very Poor	TBD
Pipes (Total)	37%	1%	0%	0%	0%	61%
8" or Less	39%	1%	0%	0%	0%	59%
> 8" and < 24"	31%	2%	1%	0%	0%	67%
≥ 24 and < 36"	26%	0%	0%	0%	0%	74%
36" and Larger	2%	0%	0%	1%	1%	97%

[26] Bureau of Environmental Services, *Sanitary Sewer System Plan Characterization*, May 2009.

Table 1.7 Current 2008 Condition: Sanitary Sewer System, by basin[27]

		Condition					
Basin	Total Miles	Very Good	Good	Fair	Poor	Very Poor	TBD
Eastside	233.8	31%	0%	0%	0%	0%	69%
Clackamas	0.3	--	--	--	--	--	100%
Johnson Creek	177.4	39%	0%	0%	--	--	61%
South Lents	56.1	4%	--	--	0%	--	96%
Northside	376.4	46%	1%	0%	0%	0%	52%
Altamead	9.0	11%	--	1%	--	--	88%
NE Broadway	13.3	26%	--	--	--	--	74%
Brooklyn	5.6	85%	1%	--	--	--	14%
Forest Park	0.1	--	--	--	--	--	100%
Gregory Heights	12.3	86%	6%	2%	1%	1%	4%
Guilds Lake	13.3	8%	--	1%	--	1%	91%
Inverness	184.6	42%	0%	0%	0%	0%	57%
North Linnton	0.0	--	--	--	--	100%	0%
Peninsula-Rivergate A	7.0	46%	1%	1%	--	1%	51%
Peninsula-Rivergate B	8.1	23%	--	--	--	--	77%
Peninsula-Rivergate C	14.0	8%	--	--	--	--	92%
Peninsula-Rivergate D	4.4	--	--	--	--	--	100%
Royal Highlands	1.6	--	--	--	--	--	100%
Skyline	33.8	57%	0%	0%	1%	0%	41%
St Johns C	2.0	18%	--	--	--	2%	81%
Swan Island	8.8	44%	10%	4%	2%	2%	38%
Upper Columbia Slough	58.6	76%	2%	1%	0%	0%	21%
Westside	291.3	29%	2%	1%	0%	0%	67%
Burlingame	42.7	19%	2%	1%	0%	--	77%
Council Crest	9.0	13%	2%	0%	1%	1%	84%
Cleanwater Services South	31.6	85%	6%	2%	0%	2%	6%
Dunthorpe Riverdale	15.2	9%	1%	--	--	--	91%
Fanno Basin	112.4	40%	3%	1%	0%	0%	55%
Lake Oswego	2.3	2%	--	--	--	--	98%
Sylvan	8.6	2%	--	--	--	1%	97%
Tryon	69.5	4%	0%	0%	--	0%	96%
Total	**901.5**	**37%**	**1%**	**0%**	**0%**	**0%**	**61%**

[27] Bureau of Environmental Services, *Sanitary Sewer System Plan Characterization*, May 2009.

Existing Capacity

A limited number of sanitary sewer pipes fail to meet the City's service level for pipe surcharge risk. These pipes are primarily located in the Fanno Basin in Southwest Portland, see Map 1-9 and Table 1.8. Parcels adjacent to these pipes have associated elevated levels of sewer backup risk, see Map 1-10.

Table 1.8 Sanitary System Basement Sewer Backup Risk, 5-year Design Storm[28]

		At-Risk Parcels			
		Existing Conditions		Future Conditions	
Basin Name	Total Parcels	#	%	#	%
Eastside	27,964	0	0.0%	20	0.1%
Johnson Creek	20,032	0	0.0%	6	0.0%
South Lents	7,932	0	0.0%	14	0.2%
Northside	34,737	3	0.0%	73	0.2%
Altamead	1,337	0	0.0%	0	0.0%
NE Broadway	1,588	0	0.0%	0	0.0%
Brooklyn	667	0	0.0%	0	0.0%
Gregory Heights	1,502	0	0.0%	0	0.0%
Guilds Lake	395	0	0.0%	0	0.0%
Inverness	17,739	0	0.0%	17	0.1%
Peninsula-Rivergate A	295	0	0.0%	0	0.0%
Peninsula-Rivergate D	91	1	1.1%	26	28.6%
Peninsula-Rivergate B	232	0	0.0%	16	6.9%
Peninsula-Rivergate C	1,104	0	0.0%	0	0.0%
Royal Highlands	26	0	0.0%	0	0.0%
Skyline	3,127	0	0.0%	0	0.0%
St Johns C	84	0	0.0%	0	0.0%
Swan Island	163	0	0.0%	0	0.0%
Upper Columbia Slough	6,387	2	0.0%	14	0.2%
Westside	22,415	117	0.5%	156	0.7%
Burlingame	2,951	17	0.6%	24	0.8%
Cleanwater Services South	2,980	1	0.0%	1	0.0%
Council Crest	781	0	0.0%	0	0.0%
Fanno Basin	8,779	99	1.1%	129	1.5%
Sylvan	519	0	0.0%	0	0.0%
Tryon	6,405	0	0.0%	2	0.0%
Sanitary System Service Area	**85,116**	**120**	**0.14%**	**249**	**0.3%**

[28] Bureau of Environmental Services, *Sanitary Sewer System Plan Characterization*, May 2009.

STORMWATER SYSTEM

The City of Portland manages stormwater through both piped systems and natural networks of streams, rivers, and open spaces. The stormwater system includes the swales, ponds, channels, creeks, sloughs, culverts, and pipe systems that convey and treat stormwater runoff from the land. The stormwater system is designed and operated to collect and safely convey stormwater flow for discharge to local receiving waters. The stormwater system consists of 15 piped and separated basins, see Map 1.11, each with its own independent network of conduits (pipelines and culverts), ponds, and stream channels. In addition to conveyance facilities, the stormwater system includes facilities that detain stormwater runoff to reduce high flows and remove pollutants.

Inventory, Condition, and Capacity

Accurate inventory, condition, and capacity information is currently not available for the stormwater system. The Bureau of Environmental Services will be undertaking a detailed analysis of the stormwater system beginning in 2009. As available, the results of this work will be integrated into this section prior to completion of the Citywide Systems Plan.

Desired Levels of Service

In order to meet the desired level of service, stormwater pipes must be capable of conveying the peak hour of a 10-year storm without surcharge, and of passing a 25-year storm without damage to property. Stormwater flows must stay within the banks of open channels and ditches during a 25-year storm, and must not cause significant damage during a 100-year storm. In addition, to prevent significant streambank erosion, peak velocities in open channels during a 2-year storm must not exceed 7 feet per second.

Green Stormwater Facilities

Green stormwater facilities are an important part of the City's response to environmental regulations, and are central to the City's over-arching goal of improving watershed health. These stormwater management facilities can help reduce stormwater runoff peaks and volumes, combined sewer overflows (CSOs) and stormwater pollution. They reduce the impact of development on natural resources, help control temperatures and pollutant loadings in streams, alter the physical structure of waterways for the benefit of threatened fish, and protect existing wetlands, all of which help the City meet its various regulatory obligations in an integrated way.

Green stormwater facilities are designed to infiltrate, detain and improve the quality of stormwater using vegetation and soil. Facilities in the right of way are public assets maintained by BES. On-site facilities manage stormwater within the tax-lot, and are privately owned and maintained. Although facilities on private property are not a BES asset, they are critical for meeting regulatory goals. The 1999 Stormwater Management Manual (SWMM) introduced the full range of green stormwater facilities. The SWMM was updated in 2004 and 2008.

Inventory

The following inventories are from various sources including the Hansen Asset Management Database as well as databases maintained by the Downspout Disconnect Program, the Sustainable Stormwater Management Program, and the Maintenance Inspection Program. The numbers included below are current as of May 2009. Mapped locations of green stormwater facilities on shown on Map 1.12.

Right of Way (Public) Facilities

- Green Streets: A green street facility is typically a single curb extension, planter or, vegetated basin. Development of a green streets program began in 2005. Currently, approximately 700 Green Street facilities are in service.[29]
- Tree canopy: Canopy includes both trees within the right-of-way and those on private property. Trees can reduce stormwater loads by intercepting rainfall.

On-site (Private) Facilities

- Ecoroofs: An ecoroof is a roof designed to support a layer of soil and plants that will absorb precipitation. 154 ecoroofs currently exist within the City boundaries. The size of the ecoroofs range from 50 square feet to 25,000 square feet and cover a total of 9.3 acres.[30]
- Downspout disconnections: Disconnections direct roof runoff to lawns and vegetated areas. The Bureau provides incentives to property owners in the combined sewer service areas to disconnect their downspouts. Broad-based downspout disconnection got underway in 1995. To date, 25,144 properties have participated in the Downspout Disconnection Program, totaling 51,791 downspouts that have been disconnected or were approved for disconnection. In addition, more than 34,000 surveyed homes have been found to have one or more downspouts already disconnected or other onsite stormwater management.[31]
- Vegetated Facilities: Vegetated facilities include swales, infiltration planters, lined flow-through planters, vegetated basins, and rain gardens. Vegetated facilities meet multiple objectives by absorbing, treating, storing, and gradually releasing stormwater. Over 4,000 properties with vegetated surface facilities are being tracked and inspected by the BES Maintenance Inspection Program (MIP). These properties are part of a total of 9,000 vegetated facilities. The MIP database tracks the required Operation and Maintenance (O&M) Plan as well as inspection notes. An Operations and Maintenance Plan is required and is recorded with the County.[32]
- Tree canopy: Canopy includes both trees within the right-of-way and those on private property. Trees can reduce stormwater loads by intercepting rainfall.

Maintenance

[29] Bureau of Environmental Services, Hansen Asset Management System, May 2009.
[30] Bureau of Environmental Services, Sustainable Stormwater Management Program, May 2009.
[31] Bureau of Environmental Services, DISCO database, May 2009.
[32] Bureau of Environmental Services, Maintenance Inspection Program, May 2009.

The construction of surface stormwater facilities will have a long term impact on the Bureau's operating expenses. Unlike pipe, which requires only limited maintenance, vegetated facilities require regular maintenance to be effective.

Monitoring

Information on how well green stormwater facilities perform is critical to in order to quantify their benefits, keep maintenance costs low, ensure public safety, and improve overall design and function. The Sustainable Stormwater Management Program has an ongoing monitoring program. Information is collected and evaluated on how well the facilities reduce peak flows and total flow volume, which has implications for watershed health and regulatory compliance in the combined sewer system. Green streets, lined flow-through planters and ecoroofs are regularly monitored. Water quality monitoring is limited but will increase as budget allows. Sampling of facility soils has also begun, with the objective of determining if there are any long-term issues with pollutant accumulation within the facilities.

On-Site Storage Requirements[33]

New development must follow guidelines for controlling stormwater runoff, as established in the City of Portland Stormwater Management Manual, which requires on-site management of stormwater runoff attributable to the development.[34] However, some areas of the City, particularly in western neighborhoods and surrounding the East Buttes, have steep topography and other constraints that limit infiltration potential. Development in these areas will inevitably cause hydrologic changes, which can increase the risks of flooding and landslides and increase City permitting and inspection costs.

Given the lack of stormwater infrastructure, poor infiltration, and the current zoning and development expectations, there are few technically feasible options for meeting stormwater management and drainage requirements in the East Buttes area. Stormwater runoff from existing developments in and upslope of hazard areas can overwhelm drainage ways, flood roads, and inundate streams and rivers. Mitigating current problems, cleaning-up damage from erosion and flooding, and developing permitting guidelines to address these problems will require significant effort on the part of the Bureau of Environmental Services. Since new development in this area presents significant stormwater-management challenges, and given the high quality and unique attributes of the area's natural resources, the City and Metro identified this as a promising area for land acquisition to protect natural resources.

WASTEWATER TREATMENT SYSTEM

Inventory

The City of Portland owns and operates two municipal wastewater treatments plants, where wastewater goes through a series of processes to clean wastewater through removal of solids and organic materials and to provide disinfection. The Columbia Boulevard Wastewater Treatment Plan, located in north Portland, serves most of the City. The Tryon Creek Wastewater Treatment Plan,

[33] EcoNorthwest, "Economic Arguments for Protecting the Natural Resources of the East Buttes Area in Southeast Portland", May 2009.
[34] City of Portland Bureau of Environmental Services. 2008. City of Portland Stormwater Management Manual.

located south of Portland in the City of Lake Oswego, serves Lake Oswego and a small portion of southwest Portland, see Map 1.12. Whenever possible, the City uses gravity to carry wastewater from drainage basins to the treatment plants. However, sometimes pump stations are needed to move wastewater uphill. Environmental Services has 96 pump stations throughout the Portland area, also shown in Map 1-12.

Desired Levels of Service

Pump stations should have adequate firm capacity (i.e. capacity of the pump station with the largest pump out of service) to pump the peak hourly and peak instantaneous flows associated with the 5-year, 24-hour storm intensity of its tributary area, without overflows.

Treatment plants must have sufficient secondary treatment and wet weather treatment capacity. Effluent must comply with standards set by the federal Clean Water Act.

Condition & Capacity

Columbia Boulevard Wastewater Treatment Plant

The Columbia Boulevard Wastewater Treatment Plant, located in north Portland, is an activated-sludge, secondary treatment plant with a designed average dry weather flow (ADWF) of 100 million gallons per day (mgd) for secondary treatment. The headworks and the primary treatment process have a design capacity of 450 mgd. The gravity interceptor system has an estimated peak delivery rate of 450 mgd. In 2009, the plant received an ADWF of approximately 60-70 mgd.

The current hydraulic capacity of the Columbia Boulevard Wastewater Treatment Plant is sufficient to meet the projected CSO flow estimates and to accommodate future twenty-year growth. The Bureau is currently increasing the plant's capacity to treat solids by constructing two additional anaerobic digesters; planning to upgrade secondary treatment capacity; and constructing a Wet Weather Screening Facility to enhance wet weather treatment capability to better meet CSO needs (see CBWTP Facilities Plan Update, 2010).

Tryon Creek Wastewater Treatment Plant[35]

The Tryon Creek Wastewater Treatment Plan is located in north Lake Oswego and receives sanitary flow from sanitary basins in southwest Portland and the City of Lake Oswego. It has an ADWF design capacity of 8.3 mgd and a peak wet weather flow capacity of 35 mgd. The plant currently has an ADWF of 4-6 mgd, with Lake Oswego contributing approximately half the flow volume. Treated wastewater is discharged to the Willamette River via an outfall system.

The Tryon Creek Wastewater Treatment Plant Facilities Plan Update was completed in 1999. According to this plan, the Tryon Creek Wastewater Treatment Plant does not have capacity problems in terms of meeting future growth needs, particularly for wet weather capacity.

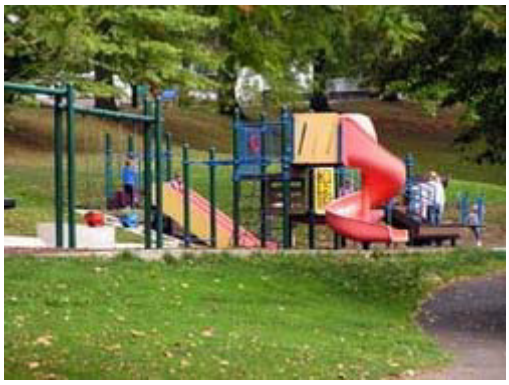
Improvements at the plant are primarily process improvements for reliability, energy conservation and treatment efficiency, and odor control.

Pump Stations

[35] Bureau of Environmental Services, 1999 Public Facilities Plan.

The Bureau's 96 pump stations undergo regular condition and performance assessments to ensure proper operation. Improvements are underway to upgrade pump station capacity to accommodate wet weather loads, due in part to the CSO program. These improvements are on schedule for completion in 2011 and should provide sufficient capacity to meet 2040 growth needs.

In addition to the pump station upgrades and operations changes required for the CSO program, the Bureau regularly updates a facilities plan for its pump stations. Per this plan, each pump station is scheduled for capital renewal on an average of every twenty years. Minor upgrades most often involve electrical and control systems More major upgrades involve replacement of the pumps themselves. This program is regularly funded through the Bureau's capital improvement program.



CHAPTER 2: PORTLAND PARKS & RECREATION

OVERVIEW

The bureau's mission is sustaining a healthy park system to make Portland a great place to live, work, and play. In pursuit of this mission, Portland Parks & Recreation contributes to the City's vitality by:

- Establishing and safeguarding the parks, natural resources and urban forest that are the soul of the city; ensuring that green spaces are accessible to all;
- Developing and maintaining excellent facilities and places for public recreation; building community through play and relaxation, gathering and solitude; and
- Providing and coordinating recreation services and programs that contribute to the health and well being of residents of all ages and abilities.

Inventory

Portland Parks & Recreation (PP&R) manages over 7,000 acres of natural areas and over 3,200 acres of developed parks - about 10 percent of Portland's land base. There are 180 developed parks, 47 habitat parks, five golf courses, seven botanical gardens, an arboretum and a raceway. PP&R also manages over a million square feet of buildings including 13 swimming pools, 12 community centers, numerous picnic shelters, restrooms and stadiums and one historic mansion. Recreation facilities include 177 miles of trails, 142 playgrounds, over 300 sports fields, 30 community gardens and more than 100 tennis courts. PP&R serves residents of Portland and surrounding areas as well as visitors to the City through its parks and recreation programs. PP&R also oversees the City's urban forestry program, which is responsible for managing the urban forest on City-owned or managed land, and which coordinates implementation of the City's Urban Forest Management Plan.

The Park & Recreation system is currently valued at over $816 million, see Table 2.1. This multitude of parklands, recreation facilities, support facilities, trees, and natural areas contribute to access to nature, recreational opportunity, environmental quality, and livability within the city.

A variety of other agencies and organizations provide park and recreation services to Portland residents, either independently or in partnership with PP&R. These include Metro and neighboring

jurisdictions, the state of Oregon, public and private schools, non-profit agencies, homeowners' associations, churches, and private social, athletic, and fitness clubs.

Besides PP&R, Metro is the largest park and natural area provider in the city. Metro's inventory includes significant natural habitat areas, including the over 2,000 acre Smith & Bybee Wetlands and the 20 acre Beggars-Tick Wetlands; as well as Glendoveer Golf Course; the M. James Gleason Memorial Boat Ramp on the Columbia River; and fourteen pioneer cemeteries. Metro also owns and operates the Oregon Zoo, the Oregon Convention Center, the Portland Center for the Performing Arts, and the Portland Metropolitan Exposition Center.

Table 2.1 Parks & Recreation Asset Groups and Replacement Values[36]

Inventory by Asset Group	Value ($ millions)	Description
Entire System	$816	
Buildings and Support Facilities	$218.9	Over 1,000,000 square feet including Arts (7), Aquatic (13 pools), and Community Centers (12); Stadiums (3), Clubhouses and Visitor Services; Restrooms, Shelters and Gazebos; Administration and Maintenance Facilities.
Amenities	$193.1	The built elements within a park or property (excluding buildings) that enrich and directly support park visitor experiences, including: furnishings (benches, tables, drinking fountains, etc.); recreation facilities (courts, fields, play areas, boat ramps, etc.); trails; and water features
Infrastructure*	$48.2	Roads and utilities
Landscapes	$205.4	Green/living elements in developed parks (187 parks at 3,272 acres) that require frequent regular maintenance, including turf, trees, planting beds, and swales.
Natural Resources	$150.4	Green/living elements that are part of an ecological system, generally self-sustaining and managed as natural areas (7,263 acres), including vegetation units, landforms, and natural water features.

Inventory by Facility Type			
Parks	3,272 acres	Skateparks	5 facilities
Natural Areas	7,263 acres	Community Gardens	30 gardens
Trails	177 miles	Arts Facilities	7 facilities
Community Centers	12 facilities	Play Areas	142 areas
Aquatic Facilities	13 pools	Stadiums	3 facilities
Tennis Facilities	>100 courts	Botanical Gardens	7 gardens
Athletic Fields	>300 fields	Administrative Facilities	14 facilities
Golf Courses	5 courses	Maintenance Facilities	39 facilities

* Infrastructure inventory is based on partial information

Overall Condition

Approximately 37% to 57% of assets in each of PP&R asset groups are in good to very good condition, see Table 2.2. Another 30-50% of these assets are in fair condition. The condition and capacity of the City's parks, recreational facility, support facilities, trails, natural areas, and tree canopy, is discussed in greater detail in the following pages.

Condition is primarily determined by visual inspections conducted by trained evaluators unless the asset is hidden from view. In those cases, remaining life is the default method. In some cases, additional testing is needed. Since last year, Parks had completed additional inventory and

[36] City of Portland, *2008 City of Portland Asset Status and Condition Report*, December 2008.

condition assessments for Buildings, and the health and inventory of Natural Resources are well documented. Playgrounds and Furnishings in all developed parks were inventoried and assessed in summer 2007. Roads and parking lots have been inventoried but not yet assessed. Inventories for other asset groups are planned or underway. PP&R is updating its annual asset inspection program to determine the condition of all assets and will inspect 20% of all assets each year. All assets will be inspected at least once every five years and more often in the cases of pools and play equipment.

Table 2.2 Current Condition: Parks and Recreation System (2008)[37]

Asset Group	Very Good	Good	Fair	Poor	Very Poor	Confidence level
Buildings	35%	22%	28%	10%	5%	Moderate
Amenities	10%	26%	50%	10%	4%	Low
Infrastructure*	n/a	n/a	n/a	n/a	n/a	n/a
Landscapes	10%	34%	45%	7%	4%	Low
Natural Resources	2%	35%	40%	18%	5%	High

*Infrastructure Condition information is not available at this time.

KEY ISSUES & CONCERNS

Providing Services in Underserved Areas

Unfortunately, not everyone has equal access the benefits of parks and recreation. Virtually every sector of the city has at least one parkland deficiency. In Northeast Portland, residents have little habitat parkland or access to natural resource areas. In Outer East and Southwest Portland, where there are few developed neighborhood and community parks, residents get little benefit from the social and recreational programs that parks provide. Since little land appropriate for neighborhood and community parks is available in the city, remedying park deficiencies presents a formidable challenge.

Although community centers provide the recreational programs and community gathering places that give appeal to urban living, those benefits are unavailable to some residents. Certain areas of the city have no community centers, and others have centers that are housed in old, ill-adapted buildings that lack fundamental elements. Sellwood Community Center (SCC), for example, was built in 1909 as a rooming house. It does not have adequate security surveillance, ADA accessibility, or storage, and many rooms lack basic equipment for classes and programs. Yet, the neighborhood depends on SCC to fulfill its recreation needs. Since recreation programs and facilities are inextricably intertwined, the shortage of quality community centers limits the availability, breadth, and quality of recreation programs. Besides parkland and community centers, Portland's park system lacks sufficient aquatic facilities and sports fields. Both are heavily used, highly programmed, and in short supply. Of the 35 community garden sites, only two have room for new gardeners — more than 1,000 people are waiting for garden plots. As more people crowd into existing parks and facilities, user conflicts are increasing and the quality of park resources is declining.

[37] City of Portland, *2008 City Asset Status and Conditions Report*, December 2008.

Lack of access to parks and few connections between parks limits the benefits of the system. Highways, heavy traffic, and industrial properties prevent many Portland residents from accessing river recreation on the Columbia and Willamette Rivers. Fragmentation reduces optimal conditions and forfeits the immense benefits of a holistic system.

To resolve these deficiencies and to meet goals established in Parks 2020 Vision, Portland Parks & Recreation has identified a need for:

- Approximately 150 acres of new parkland throughout the City, and the development existing park properties, to meet the goal of providing a park within ½ mile of all city residents;
- 75 miles of multi-use trails within the City to connect people and places;
- Civic spaces in dense urban centers;
- Community centers to serve recreation needs in inner southeast, central and outer northeast and distant southeast.
- Additional pools, particularly in outer northeast Portland.
- Play areas, particularly in central northeast and outer east;
- Additional facilities, including skateparks, courts, fields, and community gardens in areas throughout the city.

Maintaining Existing Infrastructure

Portland's extensive park and recreation system has a current replacement value of over $816 million, excluding the underlying land. The condition of the system directly influences its ability to provide users with quality recreation experiences. Currently, 23% of natural areas and 15% of the rest of the system are in poor or very poor condition.

Preserving and improving the condition of a park, facility or natural area requires regular maintenance, which in turn requires sufficient funding. However, PP&R is currently only able to reinvest 1-2% of an assets value annually, half of the industry standard of 2-4%. This is not sufficient to maintain the city's facilities and provide the services that the residents of Portland expect. With the downturn in the current economy, even one percent may be difficult to achieve.

While the Bureau has identified specific maintenance needs and is currently addressing the most serious needs, PP&R continues to lack sufficient funds to maintain its assets properly. Improving the level of maintenance and repair of the system to sustainable levels would require nearly $10 million more in resources each year.

Portland Parks & Recreation has instituted an asset management program to ensure the provision of high-quality facilities, provide for long-range capital planning, and develop best management practices. Asset Management enables Parks to better determine acquisition and capital improvement needs, develop appropriate levels of maintenance, and determine which assets to acquire and dispose of in order to develop a stable asset portfolio that meets service needs.

Accommodating Growth

Parks and recreation facilities are an important contributor to quality of life in the City of Portland. They provide not only a place to recreate and find respite, but also improve the environmental, social, and physical health of the community. Maintaining Portland's quality of life will require preserving access to high quality park and recreation experiences by acquiring and protecting park lands, maintaining existing facilities, and providing additional recreation facilities and services. The actual number of parks and facilities necessary will vary based on where and how growth occurs, the ability of existing facilities to serve additional users, and opportunities to locate and build additional parks and facilities.

Growth and increasing density will provide other challenges as well. Increased development will make acquiring new parks more difficult, as development reduces the number of parcels available for parks and natural areas. Heightened competition for a fixed amount of land drives up prices. Growth may also place additional pressure on heavily utilized facilities, such as pools, and exacerbate needs in currently underserved areas. These pressures may be particularly acute in dense urban centers that currently lack sufficient park amenities, where both existing facilities and acquisition opportunities are scarce.

Currently, the City assesses a Park Systems Development Charge (SDC) on new residential and non-residential construction to partially offset the costs associated with providing park services to new development. SDC funds are restricted to land acquisition and capital improvements in areas of population growth and new development. SDC funds cannot be used to correct existing parkland deficiencies, nor can they be used to meet the equally vital operations or maintenance needs. At a rate that is 75% of the legal maximum, the SDC assessment does not fully offset the true costs of park development in Portland.

Meeting Increasingly Diverse Community Needs

Portland's diverse park and recreation system includes a wide variety of facilities and programs, including those unlikely to have been part of park systems just fifteen years ago. These facilities, including off-leash dog areas, community gardens, spray parks, skateparks, and disc golf courses – to name a few – provide valuable recreation opportunities to a wide variety of users. However, providing for these facilities, and other emerging activities, requires space and resources within a constrained park system.

Portland Parks & Recreation looks at the demand for, and provision of, these types of facilities at the citywide scale to maximize their ability to serve community needs. The bureau considers such factors as existing distribution, service areas, and capacity; current and projected demand; available locations; and resources when planning for and siting new facilities.

The city is currently unable to satisfy rapidly growing public demand for skate boarding and off-leash areas. Demands for traditional recreation are also increasing — there are not enough soccer fields in any part of the city. Decisions about resource allocations must balance current demands with projected park system needs. Although the City must plan now to invest for the future, accurate predictions are difficult in this evolving environment. The public's strong desire for nature recreation will continue to grow and intensify. Heavy media coverage of population growth trends has raised

Oregonians' awareness of environmental and livability issues. As population density increases, our yearning for connections to nature, for refuge from the built environment, will intensify.

Protecting Portland's Natural Resources

Portland's natural areas and urban forest provide innumerable environmental, economic, and health related benefits to the city. Natural area settings in Portland include forests, meadows, wetlands, streams, and riverbanks. PP&R currently protects more than 7,500 acres of natural areas. Protecting natural resources is very important to most residents who look to parks to maintain the quality of life and the quality of environment. As existing open space is developed, more people will seek and use park system resources — crowding into existing parks and facilities, escalating user conflicts, and degrading resource quality.

The City's Natural Area Acquisition Strategy, adopted in 2006, focuses future acquisitions on protecting large, sustainable tracts of land and examples of exceptional value for habitat and watershed health. Of primary importance is protecting a large forested site on Portland's east side, including additional land at Kelly, Powell, and Clatsop Buttes. These, and other "last, best places" in Portland must be protected, as once developed they can never be returned to their natural state.

Portland's street and park trees form a sustainable resource vital to the city's environmental, social, and economic health. Portland's publicly-owned trees cost approximately $6.5 million annually to maintain – costs borne by adjacent property owners -- yet provide nearly $27 million worth of environmental and aesthetic benefits. In fact, the Urban Forest Master Plan calls for expanding the urban forest canopy to cover 33 percent of the city and increasing street tree stocking levels, especially in underserved neighborhoods. Although these public trees provide a large return for the investment, opportunities exist to further improve the structure and management of the urban forest on public and privately owned property. To maximize benefits, PP&R and its partners are focusing efforts on retaining and expanding existing canopy, planting the right tree in the right place, planting large-growing species where appropriate, and keeping trees healthy.

Managing Park, Recreation, and Natural Resources

PP&R is developing a System Plan that will provide a holistic and comprehensive approach to park acquisition, management, programming, and resource protection. PP&R is also developing master plans to guide development, management and funding decisions to optimize resources and meet needs.

Parks is developing accurate inventory and assessment information for all assets. Without valid, reliable information on which to base management decisions, it is difficult to effectively anticipate and prepare for new park uses, or manage resources like the urban forest. Basic information such as canopy cover, species diversity and distribution is needed for proactive management.

Funding the City's Park, Recreation, and Natural Area System

In fiscal year 2008/09, PP&R will spend just under $111M to operate, maintain, and expand Portland's park system. About half of PP&R's financial support comes from the city's General Fund (i.e., discretionary resources that the Council allocates). In addition to the discretionary General Fund monies, PP&R receives revenue from user fees, interagency agreements, and a variety of other sources. A small (and unpredictable) fraction of PP&R's budget — one half of one percent —

comes from grants and donations. Over the last 10 years, fees have been constantly raised to provide the variety and scope of programs that the public needs and wants. This effect is felt most keenly by those on fixed incomes or with lower incomes.

PP&R operating expenses have risen steadily in recent years due to increasing use, annexation, utility costs and an aging park infrastructure, as well as construction of new facilities to accommodate a growing population and demand for different recreation activities. Unfortunately, over many decades, park system funding has not kept up with needs. Numerous parks need major renovation and many recreation facilities are in poor condition. There is a backlog of park maintenance projects that will take an additional $9.8 million per year to resolve. Additional funding will be needed to respond to new growth and existing deficiencies.

Insufficient funding for public schools also has budget impacts on parks and recreation. As public schools cut youth programs, PP&R's role as the state's second-largest provider of youth programs becomes even more vital. PP&R now provides many of the arts, athletics and recreation programs that schools cannot.

PARKLAND

The following section discusses the City of Portland's parkland. Parks vary greatly in their level of development to provide a variety of recreational experiences.

Nature|People|Experience Approach

The Nature|People|Experience approach creates an over-arching framework for integrating PP&R's three-mission areas – recreation programs, developed parks, and natural resource protection. These three components can operate independently, but they also need to be understood and treated as components of one integrated park system. In its simplest terms the approach can be summarized as: people + activities + settings = experiences. This report includes descriptions of the three primary settings, more information on activities and experiences, as well as the overall approach, can be found in the PP&R Parks System Plan, May 2009.

The Three Primary Settings

A recreation setting is simply a space that has specific physical characteristics, both naturally occurring and constructed, which offer recreation opportunities for people to enjoy. A park site, depending on its size and design, may have a few or many different types of settings. Each setting has unique qualities that make it suitable for different types and intensity of recreational use. In addition settings can be modified or programmed to create opportunities people want, depending upon the type and quality of the natural features and resources in the setting.

Nature

These settings are intended primarily to protect the city's ecological health, and diversity of wildlife and native plants. They provide valuable ecosystem services, such as improved air and water quality, and protection from flooding through managing stormwater. In these settings ecosystems are the primary focus of attention. Some natural areas are zoned to allow nature-based recreation, such as hiking, and people can have access through volunteering to restore habitat, or using the

site to learn about nature. In other areas there is no visitor access, temporary or permanent, due to resource sensitivity. They also can be enjoyed by viewing from afar.

Nature | People

These settings are important for linking people with the natural environment in contrast to the surrounding urban environment. Vegetation is dominant, creating opportunities to see wildlife, smell fragrant flowers, hear leaves rustling and mark the natural progression of the seasons. The traditional pastoral park is a main example, but this type of setting also includes examples like Crystal Springs Rhododendron Garden and the Park Blocks, along with recreational trails. Parks have decreased in size as property values have increased, so sometimes the Nature|People setting can be part of a larger park with more facilities. Such areas may be compromised because there is not enough buffer from the more people-oriented parts of the park.

Most parks include a combination of Nature|People and People settings and the ratio of each varies considerably. Over the years, as the size of parks has decreased, facilities are taking up a larger percentage of space in a developed park, often at the expense of the Nature|People setting. It is very difficult to determine precisely how much land should be acquired since these are settings for informal recreation activities and thus have less specific land and facility requirements. There also is not a clear constituency such as the interest groups supporting sports activities or natural resource protection. However, activities that Nature|People support, such as walking or informal play, are very popular and the demand is increasing.

One benefit of improving the quality of this setting type is to create places where people can have rich experiences of nature without going to sensitive natural areas. Many people enjoy this urban type of nature experience and prefer it to Nature settings in part because of security concerns, but also because there is a variety of vegetation and open areas.

People

These are highly developed “urban” settings, where recreation is primarily social and the main motivation is interaction with others. People come to these settings either with friends or family or as part of a group such as a team or club. Examples include community centers, pools, stadiums, event venues and fields for competitive sports. People settings are in high demand – Portlanders are particularly interested in more swimming pools and recreation centers.

From a park provider standpoint, these are the most expensive of all setting types to develop and maintain, although some have the potential to generate revenue. Often they require specialized recreation facilities and typically there is a high expectation of comfort and cleanliness. They need to be designed for durability, safety, easy maintenance and resistance to vandalism. Facilities such as courts or fields are located in “people” areas of parks. Some parks, like Pioneer Courthouse Square, are completely people oriented. These settings are asset-dependent, and can support intense use. Maintenance costs are generally high.

Inventory

PP&R’s inventory of parkland includes a variety of People, People|Nature, and Nature settings, see Table 2.3. Total parkland is nearly 10,700 acres and is primarily composed of Nature type settings.

Map 2.1 displays the location of PP&R land. This is due primarily to the 5,500-acre Forest Park and 600-acre Powell Valley Nature Park.

In addition to Portland Parks & Recreation, Metro's inventory includes significant natural habitat areas, including the over 2,000 acre Smith & Bybee Wetlands and the 20 acre Beggars-Tick Wetlands; as well as Glendoveer Golf Course; the M. James Gleason Memorial Boat Ramp on the Columbia River; and fourteen pioneer cemeteries within Portland's city limits. Oregon State Parks also owns and operates Tryon Creek State Park, an approximately 650-acre natural area in Southwest Portland.

A note on school facilities: While PP&R relies on school grounds and facilities to provide services (primarily playgrounds, sports fields and sports courts) in areas where it is difficult or impossible to provide public park space, they are not counted as park infrastructure in the inventory since PP&R does not own or manage these sites, and they are subject to change beyond Parks' control.

Table 2.3 Parkland Inventory[38]

Type	Acreage
Total Parkland	10,685
People	1,012
People|Nature	1,780
Nature	7,084
Other (areas not available to the public or not assigned to a category above)	989

Desired Levels of Service

It is the goal of Portland Parks & Recreation to provide a recreational opportunity – such as a developed park, trail, or access to a natural area – within ½ mile (approximately a ten minute walk) of all residents. This goal requires both physical proximity and physical access to recreational opportunities; however it may not be feasible to meet this goal in areas with severe geographical constraints. Projected parkland needs are therefore established based on level of service and access standards. PP&R may expand this goal to commercial and industrial areas in the future.

Parks vary in their level of development and the number and types of facilities they contain. In general, parks of at least four acres in size are desired, to allow greater flexibility in design and programming and to provide space for active and passive recreation as well as recreation facilities. The Facilities section provides additional detail on major park amenities.

Current Capacity

In setting park system development charge rates, PP&R determines applied level of service standards (see Table 2.4) and facility needs (see Table 2.5) to resolve existing deficiencies and accommodate new growth. According to the 2008 rate update, approximately 235-240 acres of new parks, trails, and natural areas are needed to serve new growth by 2020.

[38] Portland Parks & Recreation, February 2009.

Table 2.4 Current & Applied Levels of Service (LOS)[39]

Facility Type	Area	Type	Current Inventory (acres)	Current & Applied LOS (acres/1,000 persons)
Local Access Park	Central City	Acquired	57	0.72
		Developed	50	0.72
	Non-Central Areas	Acquired	1,254	2.21
		Developed	1,092	2.21
Trailways	Citywide	Acquired & Developed	333	0.54
Habitat and Natural Areas	Citywide	Acquired	7,003	11.32
		Restored		(12.11)*
Citywide Access Park Land	Citywide	Acquired	945	1.54
		Developed	942	1.54
Total	**Citywide**	**Acquired**	**9,592**	**n/a**
		Developed	**2,417**	

* The Applied LOS standard for Habitat and Natural Areas, 12.11 acres per 1,000 people, is based on the City's adopted Natural Area Acquisition Strategy.

Table 2.5 Park, Trail, and Natural Area Needs Based on Maintaining Current Levels of Service[40]

			Needed based on Standards (2007-2020)			Recommended (2007-2020)		
Facility Type	Area	Type	Deficiency Repair	Growth-Required (acres)	Total	Deficiency Repair	Growth-Required (acres)	Total
Local Access Park	Central City	Acquired	0	14	14	0	8	8
		Developed	0	21	21	0	11	11
	Non-Central Areas	Acquired	49	70	272	49	60	110
		Developed	202	45	45	151	53	204
Trailways	Citywide	Acquired & Developed	0	45	45	0	45	45
Habitat and Natural Areas	Citywide	Acquired	410	1,011	1,421	287	707	995
		Restored				0	100	100
Citywide Access Park Land	Citywide	Acquired	0	126	126	0	126	126
		Developed	0	128	128	0	126	126
Total	**Citywide**	**Acquired**	**612**	**1,266**	**1,878**	**336**	**948**	**1,284**
		Developed	**0**	**241**	**241**	**151**	**235**	**386**

[39] Portland Parks & Recreation, "Park System Development Charge Methodology Update Report", for Council Hearing March 5, 2008. Tables 3-7 through 3-9.
[40] Portland Parks & Recreation, "Park System Development Charge Methodology Update Report", for Council Hearing March 5, 2008. Tables 3-7 through 3-9.

Parkland Proximity

Approximately 76% of Portland's population lives within ½ mile radius of a developed park or a natural area. When the "walkability" of the street network is taken into account, half of all residents live within a ¼ mile walk of a developed park or natural area.[41]

Current park service area mapping examines the distribution and access of parks to residential areas. However, PP&R recognizes the potential need for parks in commercial and industrial areas to provide recreational opportunities and visual relief.

Significant gaps in park distribution exist in areas throughout the city, see Table 2.6 and Map 2.2. Resolving priority gaps will require approximately 150 additional park acres. Additionally, a number of existing park properties in outer east Portland are currently undeveloped and provide more limited recreational opportunities.

Establishing equitable parkland access throughout the city will require significant coordination with the Bureau of Transportation. In many areas, particularly in outer east and southwest Portland, parkland access is constrained by incomplete pedestrian networks.

Table 2.6 Park Priority Acquisition Areas, 2008-2020[42]

Area	Acquisition Target Size	Area	Acquisition Target Size	Area	Acquisition Target Size
North		**Northeast**		**Outer Northeast**	
Interstate Corridor	4 acres	Cully	4 acres	Cascade Station	6 acres
St John's	4 acres	Hollywood	4 acres	Gateway	7 acres
		Humbolt	4 acres	Wilkes	4 acres
Total	8 acres	Total	12 acres	Total	17 acres
Northwest		**Inner Southeast**		**Southwest**	
Forest Park	12 acres	Brooklyn/Creston-Kenilworth	6 acres	Southwest	10 acres
Linnton	8 acres			John's Landing	2 acres
NW Waterfront	8 acres	South Tabor	5 acres	Hillsdale	4 acres
Total	28 acres	Total	11 acres	Total	16 acres
Outer Southeast		**Central City**		**Citywide Totals**	
Centennial	14 acres	Lloyd District	3 acres	North	8 acres
Hazelwood	4 acres	Inner Southeast	6 acres	Northeast	12 acres
Mill Park	4 acres	S. Waterfront	4 acres	Outer Northeast	17 acres
Pleasant Valley	2 acres	Downtown	2 acres	Outer Southeast	28 acres
Powellhurst-Gilbert	4 acres	Inner Northwest	2 acres	Inner Southeast	11 acres
South Lents	15 acres	Total	17 acres	Southwest	16 acres
Total	43 acres			Northwest	43 acres
				Central City	17 acres
				Total	152 acres

[41] Coalition for a Livable Future, *Regional Equity Atlas*, 2007.
[42] Portland Parks & Recreation, "Park System Development Charge Methodology Update Report", for Council Hearing March 5, 2008. Tables 3-7 through 3-9.

Current In-Park Capacity

With the exception of parks in South Waterfront and the River District, very few parks face capacity problems and could not accommodate additional users. Where additional parkland is desired, it is generally to improve distribution and access to parks in underserved neighborhoods.

Current Condition

In general, park landscapes and amenities are in fair or better condition, with approximately 11-14% in poor or very poor condition. However, confidence in these estimates is relatively low, pending completion of ongoing condition assessments, including assessments of turf areas.

FACILITIES

Park and recreation facilities include community centers, aquatic centers, play areas, sports courts, sport fields, skate parks, and community gardens.

Community Centers[43]

Community centers provide health and recreation benefits to Portland residents of all ages, helping to make Portland a family-friendly and a livable city. Community centers are places where community members interact in social events, classes, play, sport, and general fitness, or in specialty programs for seniors, teens, preschoolers and special interest groups.

Inventory

The City of Portland currently has twelve community centers of varying sizes and capacities; see Table 2.7 and Map 2.3. PP&R Community Centers fall into two categories: those with pools and those without, and come in three basic sizes: small (under 15,000 sq. ft.), medium (from 15,000 sq. ft. to 32,000 sq. ft.) and large (over 32,000 sq. ft.). Large centers offer the widest range of programming and recreation activities. Except for University Park, all of the large centers have indoor aquatics facilities. Medium centers offer a moderate amount of programming. However, current demand challenges their capacity and building size and site constraints limit their ability to respond to new recreation trends and accommodate more users. All except St. Johns have aquatics facilities. Montavilla and Peninsula have outdoor pools. The smallest centers are also among the oldest. Their size seriously limits their programming capacity. Their service areas are small (a mile or less) and attendance is modest. These centers are challenged by maintenance costs due to age and condition. None have aquatic facilities and there are accessibility problems.

In addition to PP&R, a variety of other institutions provide recreation and community facilities, including community centers owned and operated by neighboring jurisdictions, YM and YWCAs, Boys and Girls Clubs, public schools, churches, as well as private social, athletic, and fitness clubs.

[43] Excerpted from: Portland Parks & Recreation, Draft Community Centers Technical Paper, June 2008

Table 2.7 Inventory and Condition of Portland Parks & Recreation's Community Centers

Location	Size	Type	Condition	Suitability	Registered Users*	Key Services
Large (>32,000 sf)						
East Portland	45,198 sf	CC & 2 pools	Very good	Sufficient	3,763 (w/o pool)	Senior; Gym; Fitness
Matt Dishman	43,345 sf	CC & pool	Very good	Sufficient	1,795	Gym; Boxing; Fitness
Mt. Scott	60,744 sf	CC & 2 pools	Very good	Sufficient	3,544	Fitness; Gym; Auditorium; Preschool
Southwest	48,347 sf	CC & 2 pools	Very good	Sufficient	3,406	Full Services
University Park	43,652 sf	CC only	Very good	Sufficient	1,051	Fitness ; Gym; Senior
Medium (>15,000 sf)						
East Portland	15, 125 sf	CC Outdoor Pool	Good	Limited	1,805	Gym; Classes
Peninsula	26,190 sf	CC Outdoor Pool	Very good	Sufficient	1,470	Teen Outreach
St. John's	15,817 sf	CC	Very good	Sufficient	862	Classes; Events
Small (<15,000 sf)						
Fulton	9,500 sf	CC only	Good	Limited	525	Preschool; Classes; Gym
Hillside	11,075 sf	CC only	Very good	Limited	710	Classes; Pre-school
Sellwood	10,524 sf	CC only	Fair	Limited	1,811	Small gym; Classes
Woodstock	3,120 sf	CC only	Good	Limited	376	Meetings

* Attendance numbers shown are for registered patrons and do not account for drop-in users or pass holders.

Major Issues

Providing community center services is complex and requires an understanding of customer needs, facility management, asset distribution, demographics, services, and programming. Among the issues to be considered are:

- Service distribution: Facilities and services should be located to allow equitable access. Adequate access is also dependent on adjacent transportation networks to allow walking, biking, and transit access.
- Economic, physical, and social barriers to service: Even if there are adequate facilities available, some people cannot or do not use the centers due to economic, physical or social barriers.
- Age and condition of existing facilities: The majority of centers were built over 50 years ago and although some have been updated, service may be limited due to limited space, lack of modern conveniences, and poor accessibility. Many were built for other purposes, such as schools or fire stations, and are ill-suited to their current uses.
- Unmet current and future need: Many areas have unmet needs and distribution of PP&R community centers is uneven within the city. Northeast and parts of Outer Southeast do not have access to a center or a pool. Service in Central City, Northwest, and Inner Southeast is not adequate, although that will change if Washington-Monroe is built in the Buckman Neighborhood.
- Maintaining community centers: Community centers are expensive to maintain due to their size, complexity and heavy use.
- Trends and preferences: Research on nationwide recreation trends strongly points to the increasing popularity of fitness and recreation among all age groups.
- Building Trends: Nationwide trends are to build large recreation centers (>75,000 sq.ft.) with indoor pools. This approach allows cities to build fewer centers, increase the target service area, consolidate staff, contain operating and maintenance costs, and increase programming offerings.
- Funding needed for capital improvements: Providing community center facilities is expensive. Cost recovery does not and is not intended to equal the expense of providing the services.

Desired Levels of Service

Parks 2020 Vision, adopted in 2001, has an objective of providing "a full-service community center – that is, a center with a pool, arts facilities, classrooms and active recreation facilities – within three miles of every resident." Portland Parks & Recreation has the following additional goals for community centers:

- A broad range of recreation experiences and opportunities with basic levels of service available to all.
- High quality, well-maintained facilities that support intensive use.
- Facilities and programs are well managed and affordable.
- Equitable distribution of centers throughout the city.

Current Levels of Service

Determining if PP&R provides the desired level of service requires looking at the community center system as a whole, and determining where there is and is not sufficient service.

Current Capacity and Condition

Table 2.7 provides an overview of the condition of the City's community centers. More detailed information on the history and physical condition of PP&R's community centers can be found in the 2005 Community Center Asset Register Report which is available on the bureau's web site: http://www.portlandonline.com/parks/

PP&R has three centers that meet the 2020 Vision definition of a full-service center: East Portland (pool completed in March 2009), Mt. Scott and Southwest. A pool may be added at UPCC but this has not been determined at this time. A fifth center is planned for the Washington–Monroe site in Inner Southeast Portland. At around 75,000 sq. ft., it will be the largest center in the system. Economic factors will determine when this center is built.

The remaining PP&R community centers provide some capacity, but the number and kind of activities that can be provided are limited by the size and age of the facility. Generally speaking, the four medium-size centers serve residents in a two-mile radius. Their capacity can be improved in some cases.

The four smallest community centers have very little capacity and no way to increase it. While they are charming and much loved in their immediate neighborhoods, they provide very limited service. Their size and limited spaces prevents them from being programmed for multiple activities, making them much less suitable for families and groups with multiple interests.

As noted earlier, there are numerous public and private organizations that provide additional capacity. At this point, there are no firm numbers on the amount of capacity that they provide. Using these facilities does not preclude people from using community center facilities and people may use both private and public facilities depending on the type of activities they are seeking.

Notable condition concerns include seismic structural needs for older buildings and the condition and accessibility of restrooms.

Distribution

Map 2-3 shows the location of existing facilities and their approximate service areas. Large facilities have service areas of about three miles; medium size facilities serve an area with a two-mile radius and small facilities serve an area with a one-mile radius.

- Location and access are keys to providing sufficient service.
- Currently, there is sufficient service in central Southwest, along a broad swath on either side of I-205 and parts of North and Northeast Portland. Construction of a new combined center at the Washington-Monroe site in the Buckman Neighborhood will provide sufficient service for inner Southeast and Downtown.
- The largest gaps in service occur in inner Southeast, outer Northeast (Cully) and distant Southeast (SE 122nd and beyond).
- Growth and Need for Future Service: Increasing population will drive the need for additional capacity in community centers. Most of this growth is happening in currently underserved areas. This will only worsen over time. Closing the current gap will help fill the future gap.

Facility Needs

Combined centers – those with aquatic facilities and multiple recreation amenities - are the most effective model for service. Although smaller centers can be successful, even without pools, and efficient, they can't serve large numbers of people or offer a sufficient variety of programming. Existing small and medium centers are important elements of the community center system but it is unlikely that PP&R would add any more of this size, certainly not the smallest ones. Key system-wide concepts for the future provision of community centers include:

- Provide sufficient full-service community center facilities to serve the whole city.
- Use the large, combined recreation center with pool as the model. It demonstrates a better return on investment, provides more activities, and serves more people.
- Expand or rebuild selected existing facilities to improve recreation opportunities in various neighborhoods where there is little room for a large site.
- Remain flexible to accommodate population changes, demographic shifts, real estate fluctuations, and changes in recreation preferences.

Aquatic Facilities[44]

Aquatic programs, facilities and activities are important to Portland residents. They provide health and recreation benefits to residents of all ages, helping to make Portland a family-friendly and livable city. Community members interact in play, sport and general fitness, residents learn water safety – an important life skill in a state with hundreds of miles of ocean beaches and a multitude of lakes and rivers – and therapeutic pools provide comfort and healing to many. A wide variety of beaches, indoor and outdoor swimming pools, spray features and fountains provide aquatic experiences in Portland - PP&R owns, programs and manages many of them.

[44] Portland Parks & Recreation, *Draft Aquatic Facilities Technical Paper*, June 2008

Inventory

The City of Portland currently owns or manages seven outdoor pools and six indoor pools, one of which is owned by Portland Public Schools, see Table 2.8, Map 2.4 and Map 2.5. Outdoor pools are only open for the summer season, from mid-June through Labor Day, and generally see between 12,000 and 90,000 visitors each for the 11-week season. Indoor pools are open year-round and range in attendance from just over 10,000 to over 200,000 visitors each annually. Size, location, and condition of each facility determine the number of visitors.

While swimming pools accommodate most aquatic activities in Portland, additional access to water is provided by beaches, wading pools, spray pools and some fountains.

- Beaches - Water pollution continues to make swimming in rivers hazardous as do cold temperatures, sudden drop-offs and strong currents. Water quality in the Willamette River may improve as pollution control projects like “the Big Pipe” are built, but swimming in the Willamette will always be somewhat risky.
- Wading Pools – The City owns 35 wading pools, which must be retrofitted, renovated, or removed by the end of 2009, due to changes in state health requirements. Some pools are being replaced with spray features that provide potable water on demand that drains immediately.
- Spray Parks - The City current owns and operates seven spray parks, located at Essex, Grant, Holladay, Raymond, Ventura, Washington, and Woodlawn parks. These water features provide opportunities for play and cooling in the summer with no standing water.
- Interactive and Decorative Fountains – PP&R also manages four decorative fountains located in Downtown and Inner Northeast: Ira Keller, Jamison Square, Lovejoy, and Salmon Street Springs. These fountains are maintained and operated by the Portland Water Bureau.

Table 2.8 Inventory and Condition of Portland Parks & Recreation's Aquatic Facilities

Location	Size	Type	Capacity	Condition	2006 Attendance
Outdoor Pools					
Creston	25 x 25 yd	Lap & Leisure	313	Very good	59,317
Grant	25 x 25 yd	Lap & Leisure	308	Very good	113,749
Montavilla	25 x 25 yd	Lap & Leisure	308	Good	50,833
Peninsula	33 ⅓ yd oval	Leisure	188	Very good	12,261
Pier	25 x 25 yd	Lap & Leisure	308	Very good	11,977
Sellwood	Oval (120' x 81')	Lap & Leisure	409	Very good	58,605
Wilson	69' x 42' 80' x 80' approx	Lap Leisure	160 295	Very good	57,605
Indoor Pools					
Buckman (PPS)	4 lane 4 x 20 yd	Lap	40	NA	22,213*
Columbia	25 x 25 yd	Lap & Leisure	234	Very good	61,392
Dishman CC	6 lane x 25 yd + shallow 9' x 14'	Lap & Leisure Spa	180	Very good	104,283
Mt Scott CC	6 lane x 25 yd 75' x 48' 10' x 14'	Lap Leisure Spa	143 114	Very good	190,116
Southwest CC	6 lane x 25 yd 79' x 46' 11' x 15'	Lap Leisure Spa	114 143	Very good	214,366
East Portland CC	4 lane x 25 yd 75' x 67' 21' x 18'	Lap Leisure Spa	95 180 25	Very good	Opened 2009

* 2005 figure

Major Issues

Providing aquatics services is complex and requires an understanding of customer needs, facility management, asset distribution, services, and programming. Among the issues to be considered are:

- Service distribution: Facilities and services should be located to allow equitable access to pools and other aquatic facilities.
- Economic, physical, and social barriers to service: Even if there are adequate facilities available, some people cannot or do not use the facilities due to economic, physical or social barriers.
- Age and condition of existing facilities: Many of Portland's pools were built 70 to 80 years ago and although they have been updated, service may be limited due to limited space, lack of modern conveniences, and poor accessibility.
- Unmet current and future demand: Many areas have unmet needs and distribution of PP&R aquatic facilities is uneven within the city. Residents in Northeast and parts of Outer Southeast do not have access to a pool. Service in Central City, Northwest, and Inner

Southeast is not adequate, although that will change if the Washington-Monroe Community Center and Pool is built. Additional specific challenges include meeting demand at peak times, increasing demand for play and therapy, lack of new facility sites, and the high cost of replacing existing facilities or building new centers.

- Maintaining aquatic facilities: Pools are expensive to build and difficult to maintain due to their size, complexity and heavy use.
- Funding to provide needed services: Full-service aquatic facilities are expensive to build and operate. Cost recovery does not, and is not intended to, equal the expense of providing the services. Financial sustainability for aquatic facilities needs to be balanced with affordability of services for all citizens.

Desired Levels of Service

Parks 2020 Vision, adopted in 2001, has an objective of providing "a full-service community center – that is, a center with a pool, arts facilities, classrooms and active recreation facilities – within three miles of every resident." PP&R has the following additional goals for aquatic facilities:

- Sufficient full-service year-round public aquatic facilities to serve the whole city.
- Opportunities to meet summer demand for outdoor water recreation.
- High quality facilities that support intensive use and are environmentally responsible.
- Programs that are well managed and meet cost recovery goals.

Distribution

For the purposes of this report, pools with a capacity of 100 people or less have a one-mile service area. Pools with a capacity of between 100 and 250 have a two-mile service area and pools over 250 have a three-mile service area. Spray pools provide limited but important water recreation capacity, especially in areas without pools. Spray pools have a service area of about one-half mile.

Capacity

A generally accepted standard of sufficient public swimming pool capacity is to be able to accommodate 1% the total population in the pools at any one time. Using this standard, the City of Portland needs to accommodate about 5,800 people at a time. Currently, 3,700 people can be accommodated. Construction of a pool at the Washington-Monroe site would add capacity for an additional 400 people, bringing the total capacity to 4,100 people.

Accessibility

Aquatic facilities need to be accessible to all people, regardless of physical capabilities.

Current Levels of Service

Determining if PP&R provides the desired level of service requires looking at the community center system as a whole, and determining where there is sufficient service and where there is not.

Current Capacity and Condition

Table 2.8 provides an overview of the condition of the City's outdoor and indoor pools. More detailed information about the condition of PP&R pools is found in the 2006 Aquatics Asset Register Report, available at www.portlandparks.org

- Currently, Southwest, Mt. Scott, Matt Dishman and the East Portland Community Center provide a full-service community center with a pool. A center with a pool is planned at the Washington – Monroe site in Inner Southeast in the next few years.
- Currently, PP&R can accommodate about 3,300 people in the summer at any one time if all the pools are at capacity. This is about 60% of what is needed. Indoor pools can accommodate about 1,000 people and seasonal outdoor pools can accommodate 2,300.
- Most PP&R aquatic facilities are operating at capacity and use is anticipated to increase.
- The level of service currently provided depends on the size, configuration and condition of the pools and features. Facilities with large pools or multiple pools can be programmed to meet a variety of needs. It is much more difficult to program small pools for concurrent activities or for uses that require different water temperatures,
- Wilson and Sellwood Pools have sufficient capacity and are in very good condition. Buckman (Portland Public School pool) has very limited capacity, serves a very small population and is not ADA accessible. Peninsula pool is limited in its ability to serve children and families. Pier pool will soon need major maintenance and is poorly located to serve the area. See Table 2.8 for a summary of all pools.

Distribution

Map 2.4 and 2.5 show the location of existing facilities and their approximate service areas. Large facilities have service areas of about three miles; medium size facilities serve an area with a two-mile radius and small facilities serve an area with a one-mile radius.

- Location and access are keys to providing sufficient service.
- In general, Southwest, Inner Northeast, North and parts of Southeast are fairly well served. No PP&R outdoor pools are located east of I-205. Areas in Outer East and Northeast have few indoor pool facilities.

Accessibility

All pools except Buckman are ADA accessible. Buckman cannot be retrofitted to provide access.

Facility Needs

The goal of these recommendations is to increase PP&R pool capacity from 3,300 pool users to 5,500 pool users at any one time by developing new facilities and expanding existing facilities. In general, new aquatics facilities should include a large leisure pool with play features and an eight-lane lap pool, if possible. These should be able to accommodate a wide variety of needs with an appropriate ratio of 'leisure' water to 'exercise' water. "Larger multi-tank pools with high level of user amenities and varying opportunities are much more attractive, much more popular and much more economical to operate (from both a financial and environmental point of view.)" Key system-wide concepts for the future provision of aquatic facilities include:

- Provide sufficient, full-service, year-round, indoor aquatic facilities to serve the whole city. Build new aquatic facilities with other recreational facilities like community centers to achieve economies of scale in staffing and programming, higher use and better rates of cost recovery.
- Expand and rebuild selected existing facilities to improve recreation opportunities in the neighborhoods. Add amenities and play features to existing outdoor pools to improve their appeal and amount of use.
- Provide interactive spray parks to help meet summer demand for aquatic recreation in areas where it is difficult to build full-size pools.

Play Areas[45]

Inventory

Portland's developed parks have 121 play areas at 109 sites ranging from scattered stand-alone play equipment to accessible curbed areas with drainage and safety surfacing. They vary in size and include a few special destination play areas.

Elementary schools in the Portland area provide play areas on a fairly consistent basis, but many public schools are unable to maintain their play equipment. Many school play areas have limited

[45] Excerpted from: Portland Parks & Recreation, Draft Play Area Technical Paper, June 2008

challenge levels for the equipment they provide. School play areas can and do contribute to the citywide resources, but need to be evaluated on an individual basis.

Major Issues

Among the issues to be considered are:

- Many play areas are not adequate in size and condition.
- Not all play areas meet Americans with Disabilities Act (ADA) standards.
- Distribution of play areas is uneven and many parts of Portland do not have access to any public play areas.
- Funding is not sufficient to meet major maintenance needs. Currently, the total estimated cost to eliminate deferred maintenance is $3.98 million. This includes eliminating safety problems and maintenance issues, and addressing ADA requirements.
- Vandalism degrades many play areas and impacts the frequency and cost of periodic and major maintenance. Structural vandalism accounts for about 90% of the maintenance costs related to vandalism.
- Additional and/or appropriate play areas are needed to meet the needs of pre-teens.
- The biggest safety challenges in Portland's play areas are due to aging equipment, especially wood play structures. Additionally, some play equipment does not meet today's safety guidelines. Examples are slides without platforms and canopies, or with head entrapment potential, and swing-sets with inadequate safety zones.

Desired Levels of Service

PP&R strives to provide play areas that are evenly distributed, safe, accessible, and designed to meet the needs of urban children and their families. Play areas are an essential facility for public recreation, and one of the most common components of a developed park. While not every developed park needs a playground, every child in the City should be able to walk safely to a play area designed to allow children to play together in groups or individually. PP&R's goals include providing:

- Provide a neighborhood-scale play area within a 10-minute (half-mile) walk of every residence in Portland.
- Play areas should be well-designed, imaginative, and be able to support intensive use.
- The play area system should be diverse and include, as appropriate, opportunities for young children and pre-teens, "destination play areas" with more specialized offerings, and opportunities for creative and nature-based play.

PP&R strives to assess the condition of all play areas on a regular cycle, and constantly update capital needs; fund safety and deferred maintenance problems; and bring all existing play areas up to a standard level of quality in terms of safety, durability, accessibility, and play opportunities.

Distribution

Parks 2020 Vision outlined a goal of providing developed neighborhood parks within a safe 10-minute (approximately half-mile) walk of every resident. Play areas should be provided within parks based on the following levels of service as possible, depending on the conditions and opportunities:

- A small play area within walking distance (10 minutes or ½ mile) of every resident with as much variety as can be accommodated and provided.
- Larger play areas in larger parks that can accommodate more children with separate areas for bigger and smaller kids and provide more extensive creative play settings.
- Special destination play areas with adventure play, water play, and nature play themes.

Accessibility

All play areas must meet ADA requirements and include a variety of interesting, enjoyable and challenging equipment and play opportunities.

Current Levels of Service

Outdoor play is essential in the lives of children, and Portland has great places to play outdoors. In urban areas, parks provide the best opportunity for outdoor play and may be the only contact urban children have with nature. Unfortunately, not everyone has access to a playground, and many existing ones are inadequate.

Distribution and Gaps in Service

Play areas are provided mainly in parks and elementary schools, but there are numerous gaps in service. Map 2-6 shows park locations with play areas and ½ mile (ten-minute) walking distance around each one, as well as ½ mile service area around public school play areas. The map clearly shows the gaps in service, and the location of park lands that could fill those needs. School play areas are taken into account in areas where there are none in parks. (These service areas are modeled using the street network, so dead-ends do not model as access. Roads with four lanes or more are considered to be barriers to safe access for children.)

- In locations where school play areas can fill gaps in play area distribution (see Table 2.9), school play areas need to be evaluated for their ability to meet children's needs. Parks in these areas may still need to include play areas.

Table 2.9 Schools currently filling play area gaps

Abernethy ES	Faubion ES	Markham ES	Prescott ES	Smith ES
Alameda ES	Irvington ES	Lynchwood ES	Richmond ES	Stephenson ES
Alder ES	Gilbert Heights ES	Margret Scott ES	Rigler ES	West Powellhurst ES
Arthur Academy	Glenfair ES	Menlo Park ES	Sacajawea Center	Wilcox ES
Cherry Park ES	Lynch Meadows ES	Mill Park ES	Shaver ES	Wilkes ES

- Many gaps in distribution occur in growth areas where park acquisition and improvements can be funded through Parks Systems Development Charges. However, SDC funding cannot be used to address existing service gaps.

- A few play areas such as Jamison Square and Washington Park provide exciting, unusual facilities and draw families from all over the City, but they are concentrated in or near downtown.
- There are few play areas for pre-teens aged 10 to 12.

Quality

Quality of play areas varies substantially, and many are inadequate. They may contain very little play equipment, have equipment in very poor condition, or simply have equipment that provides very little challenge. Some still contain hazardous wooden elements that decay over a relatively short amount of time and are not safety compliant. Drainage issues are a problem in some areas.

Accessibility

Currently, over 30 percent of play areas do not meet ADA standards.

Creative and Destination Play

There are insufficient settings for creative and nature-based play in neighborhood parks. Portland would also benefit from a wider range of options for adventure play, environmental play, creative play, and special play areas. These facilities should be distributed equitably around the city.

Facility Needs

Table 2.10 Play Area Facility Recommendations

Park	Improvement
Various	Address safety issues in existing play areas such as safety surfaces at whirls, etc.
Various	Bring play areas that do not meet ADA guidelines up to standards
Various	Improve existing playgrounds that do not meet current quality expectations, for drainage, inadequate equipment, inadequate scale for the park, etc
Cathedral Park, East Holladay, Hillsdale, Errol Heights, Senn's Dairy	Complete play area improvement projects at existing parks.
Various	Nature-based or creative play opportunities at 34 sites
Clatsop Butte, Cully, Dickinson, Floyd Light, Gates, Gilbert Heights, Glenfair, Kingsley Bundy, Mill, North Powellhurst, Richmond, Spring Garden, Terrace Trails, The Fields, Thomas, South Waterfront	Develop and include play areas where appropriate
Beech, Cherry, West Powellhurst, Gilbert Heights, Lynchwood, Sacajawea, Thompson	Assess adjacent school play areas during PP&R master planning process and develop with appropriate play areas
Various	Build play areas on school grounds in areas with inadequate park and school playgrounds. Assess school play areas first.
Various	Acquire land and develop approximately 22 parks with small play areas in areas with no park land
Potential sites are: Fernhill, Thomas Cully, Brentwood and Normandale	Provide a minimum of two special destination play areas: one in east or southeast Portland, and one in north or northeast Portland.

Skateparks[46]

Skateboarding and freestyle BMX riding are popular, healthy recreational activities, but historically there have been few safe places in Portland for them to occur. In July 2005, Portland's City Council adopted the recommendation of the Skatepark Leadership Advisory Team (SPLAT) to create a comprehensive citywide skatepark system. This skatepark system establishes a network of legal, public skateparks of various sizes throughout Portland.

Inventory

There are five public skateparks in Portland, the Pier Park (north), Glenhaven (northeast), Gabriel Park (southwest), and Ed Benedict (outer southeast) skateparks, which are considered district parks, and the smaller Holly Farm skatespot in southwest Portland, see Map 2.7. These parks are uncovered, unlit, and open from dawn to dusk. In addition to these public facilities, the Burnside skatepark, built and managed by users, is located under the east end of the Burnside Bridge.

Major Issues

Skateparks, like all recreational facilities, require extensive planning and thoughtful design to ensure their continued success. There is a range of design and operational issues which, when considered and dealt with early, contribute to more successful outcomes.

- Siting affects the overall success, or failure, of a given skatepark. Suitable locations for skatepark facilities consider visibility, distance from residences, and potential neighborhood impacts, including noise and parking demand.
- Maintenance is done through a combination of routine inspections, work orders and capital projects. Based on estimates from other sites, an area of about 20,000 sf (nearly double that of any current facility) requires about $24,000/year for upkeep and maintenance, though needs can vary based on park design.
- Vandalism and graffiti affect skateparks, as they do all park facilities. It is unclear at this time the frequency or types of such damage at the skatepark facilities.
- PP&R has made a policy decision to allow all action sports users to use its public skatepark facilities. Use of the facilities will be monitored and may be modified over time based on confirmed reports of injuries or excessive damage.
- With the variety of skatepark users (skateboarders, freestyle BMX bike riders and in-line skaters) come desires for different kinds of terrain. PP&R intends to provide a variety of features and elements throughout its system.

Estimate of Current and Future Need

According to the 2004 Superstudy of Sports Participation, action sports (including skateboarding, in-line skating, and BMX bicycling) are becoming increasingly popular. This study indicated that participation in these three sports (30.6 million) is greater than participation in all other sports

[46] Excerpted from: Portland Parks & Recreation, *Skatepark System Plan*, June 2008

except recreational bicycling and basketball.[47] Participants in these sports tend to participate actively, with more average annual days of participation for BMX bicycling (59 days per year) and skateboarding (48) than for baseball (44), basketball (44) and soccer (39). Finally, this study demonstrates that skateboarding has a low average participant age, between 7 and 16 years of age, many of whom may not be able to easily get to facilities far from their homes.

There are no national standards or methods for determining the need for skateparks or their space requirements as there are for other, more regulated sports. Therefore, PP&R sought recommendations from other jurisdictions regarding their approach to this issue.

Based on 2005 estimates of the skateboarding population (not including BMX riders or inline skaters) and understanding that use and demand will grow over time, PP&R is initially planning for a system of 150-350,000 square feet with 9-16 park locations to meet the current demand.

Desired Levels of Service

Parks 2020 Vision acknowledged the need for skateparks, stating "Emerging recreational activities place new demands on an already strained park system. The city is unable to satisfy rapidly growing public demand for skateboarding." Portland's skateparks are and will be great places for Portlanders to stay active while providing safe, legal, publicly sanctioned places for participants to develop skills and abilities. Together, PP&R and SPLAT developed goals for a comprehensive skatepark system that would:

- Provide easily accessible, safe, supportive environments;
- Be open to the public and equitably distributed around the city;
- Provide a range of opportunities for people of all skill levels, with facilities of varying sizes and elements to meet the needs for different terrain.
- Provide access to a legal, publicly sanctioned skateboarding facility within a one-mile radius of every Portlander.

SPLAT recommended a three-tiered system consisting of one regional skatepark, several district skateparks, and many small neighborhood skatespots as follows:

- The largest facility, a 40,000+ square foot regional skatepark, could accommodate 200-500 users and host local and regional competitions. This is estimated to cost from $2 to 3 million, plus the additional costs of lights, parking, and other amenities.
- Four to five mid-size district skateparks (10,000+ sq ft) that could accommodate 40-100 users, and could be covered and lit for extended use throughout the year. Each of these facilities could cost from $700,000 – $1 million or more depending on added amenities.

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[47] *The Superstudy of Sports Participation, Volume II, Recreational Sports (2004). American Sports Data, Inc. Hartsdale, N.Y.* The Superstudy does not differentiate between those who in-line skate or BMX bike ride in skateparks vs. those who practice their sport on the street or other places. Therefore, this data does not necessarily indicate the relative popularity of use of future skateparks by in-line skater or BMX bike riders.

- Five to ten smaller neighborhood skatespots (1,500-8,000 sq ft) designed to offer neighborhood users a closer location to learn basic skating / BMX techniques in a safe environment. They could cost from $75,000 to $500,000 each.

PP&R and SPLAT also agreed on a set of goals for a successful selection process of potential sites, which included criteria related to usability and safety, potential impacts, stakeholder involvement, current and future demand, and education

Facility Needs

SPLAT identified a total of 19 sites that met the criteria for skatepark development and are included in Portland's citywide skatepark plan, including thirteen skatespots, five district skateparks, and one regional skatepark, see Table 2.11. They proposed the exact location within the park and the size for each skatepark. They also recommended that additional sites on undeveloped park property be considered for potential skatepark sites during their master planning process. Estimates for the total cost to develop recommended facilities range from $4.7 million to $13 million.

Table 2.11 Summary of Skatepark Site Recommendations[48]

Park Location	Area	Size	Type	Status
North	North	26,000 sf	--	--
Kenton	North	6,000 - 8,000 sf	Skatespot	Proposed
Pier Park	North	11,000 sf	District	Built
University Park	North	8,000 - 10,000 sf	Skatespot	Proposed
Northeast	Northeast	30,000 sf	--	--
Alberta Park	Northeast	5,000 - 6,000 sf	Skatespot	Proposed
Fernhill Park	Northeast	10,000 -12,000 sf		Proposed
Glenhaven Park	Northeast	11,000 sf	District	Built
Parkrose High	Northeast	10,000 -12,000 sf		Proposed
Southeast	Southeast	21,000 sf	--	--
Brentwood Park	Southeast	4,000 - 6,000 sf	Skatespot	Proposed
Lents Park	Southeast	5,000 - 6,000 sf	Skatespot	Proposed
Powell Park	Southeast	2,000 - 3,000 sf	Skatespot	Proposed
Westmoreland	Southeast	8,000 - 10,000 sf	Skatespot	Proposed
Woodstock Park	Southeast	4,000 - 5,000 sf	Skatespot	Proposed
Total Southwest	Southwest	14,000 sf	--	--
Holly Farm	Southwest	2,800 sf	Skatespot	Built
Gabriel	Southwest	10,000 -12,000 sf	District	Built
Total Outer East	Outer East	20,000 sf	--	--
Berrydale Park	Outer East	5,000 sf	Skatespot	Proposed
Ed Benedict	Outer East	8,000 -12,000 sf	Skatespot	Built
Ventura Park	Outer East	7,000 - 9,000 sf	Skatespot	Proposed
Total City Center	City Center	40,000 sf	--	--
ODOT Steel Bridge	City Center	30,000 - 35,000 sf	Regional	Proposed
ODOT I-405	City Center	10,000 - 12,000 sf	District	Proposed
Total Citywide	**Citywide**	**151,000 sf**	**--**	**--**

[48] Portland Parks & Recreation, *Skatepark System Plan*, June 2008

Sport Courts[49]

Basketball and tennis are popular recreation activities provided in public schools, on school grounds, in community centers and parks, as well as in private gyms and clubs. These courts have been an integral part of PP&R's portfolio of services for many years. This section addresses the distribution of these facilities in the public realm. Although basketball and tennis facilities share many characteristics, this section addresses them separately as they have different distribution and serve different clienteles.

Basketball Courts

Inventory

There are 340 basketball courts distributed throughout the city of Portland in parks, public and private schools, community centers and gymnasiums, see Map 2-7. Of this total, the majority (233) are provided by public schools. PP&R provides 70 basketball courts and private schools provide 37.

The distribution of basketball courts in the city varies by size (full or half-court) and whether they are indoors or outdoors. Some of these variables also affect use levels and the kinds of players that visit these courts. The distribution of basketball courts can be summarized as follows:

- Portland Parks & Recreation: PP&R's 70 courts represent approximately one-fifth of the City's basketball courts. These courts are found in 49 parks and 10 community centers.
- Most of PP&R's courts are full courts (80%). The ratio of full to half courts at PP&R facilities is about 16:5.
- With the exception of 11 full courts at community centers, all are outdoor courts.
- Five parks include multi-court complexes. Irving Park has three courts and Clinton, Alberta, Unthank, and Lents Park each have two courts. Nine parks have half-court facilities and about half of these sites include two half courts. In many cases, these courts are in older parks that have not been renovated.
- Public Schools: Courts at public schools account for almost 70% of all courts in the city. Public schools have slightly more half courts than full courts. The ratio of full to half courts at public schools is about 6:5. Most indoor courts are provided by public schools, followed by PP&R and then by private schools.

Current Use

Most information on the existing use of basketball courts – especially unprogrammed use is informal, derived from years of observation by PP&R sports staff. Quantitative information is available on a national and state level and can augment local knowledge. Use of the city's basketball courts appears to be divided into a few basic groups. Younger children (about 6 – 12 years old) tend to visit schoolyards for informal play or enroll in leagues that use indoor gyms. "Serious" competitive players, tend to concentrate their use at a handful of PP&R's courts or indoor gyms. Other noncompetitive and informal adult use occurs at a variety of parks throughout the city.

[49] Excerpted from: Portland Parks & Recreation, *Draft Sport Courts Technical Paper*, June 2008

Future Demand

Based on a review of participation trends and discussions with PP&R staff, participation is expected to continue at least at current levels. Participation tends to be relatively constant because basketball is one of a handful of sports that have few barriers for new and experienced players. Furthermore, the wide distribution of courts and portable hoops make it available to almost everyone.

Desired Levels of Service

The Parks 2020 Vision document outlined a goal of providing developed neighborhood parks within a half-mile of every resident. Sports courts are an essential facility for public recreation, and a common component of a developed park. While not every developed park needs a sports court, every one in the city should be able to walk safely to a sports court for recreation, exercise and social gathering.

- Distribution: Distribute basketball courts equitably throughout the city in terms of need and population density.
- Covered basketball courts should be located at a one-mile radius whenever possible. Many of these courts are on school grounds or in school gyms and should be included in the review of basketball court distribution. Wherever possible, full courts should constitute the basic service level. Half courts should be considered only where site conditions do not allow a full court.
- Integrate outdoor basketball courts on school grounds as part of the overall citywide distribution. While this may not be possible at all locations, the use of school courts offers a cost-effective way of providing basketball opportunities.
- Quality: Provide a consistent level of quality in terms of playing surface, standards, and other features that affect the use of basketball courts.
- Design: Develop and maintain a set of design and siting standards for basketball courts. These standards should define the number of courts to be provided, size, number of hoops, distance from adjacent residences, clear zones, and other aspects that affect the use of basketball courts.

Existing Level of Service

Basketball courts owned by PP&R are in excellent condition because almost all of the outdoor courts were resurfaced by Nike in 2004. Indoor courts in gyms are also in excellent condition. There are 10 older courts that are in fair to poor condition since they were not resurfaced in the Nike initiative.

Recommendations

Table 2.12 Summary of Basketball Court Capital Recommendations[50]

Parks	Action
Northeast: Cully and Parkrose Neighborhoods and Northeast Portland	Develop new basketball courts to improve the distribution of high-quality courts and provide access to a PP&R or school court within one mile of every resident.
North: Eastern St. John's neighborhood	Develop new basketball courts to improve the distribution of high-quality courts and provide access to a PP&R or school court within one mile of every resident.
North - Northeast Portland 8 – 10 schools Outer East (east of I-205) 12 – 15 schools Southeast (south of I-84) 17 – 20 schools Southwest Portland 11 – 15 schools	Explore the renovation of school basketball courts in areas where there is a shortage of PP&R basketball courts. Specific locations should be studied in more detail. If school sites cannot be utilized, new courts should be built in city parks.

Tennis Courts[51]

Inventory

Approximately 170 tennis courts in parks and at public schools are scattered throughout the city, though there is a general deficiency in number in the outer east area, east of I-205, see Map 2.8. Approximately 69% of all tennis courts in the city are provided by PP&R. The remaining courts are provided by several public school districts and a variety of private schools. Of the 171 courts in the city, 155 or 91% are outdoor courts. Of these, about half (47%) are lighted, with most found in PP&R parks. There are only 12 indoor facilities in the city – PP&R provides seven of them at its two indoor tennis centers. Five private tennis clubs also provide tennis court facilities within the City of Portland.

Current Use

Surveys for PP&R between 1986 and 2004 show a low level of participation in Portland. Of 13 facilities and activities queried, tennis ranked last in demand, with 19.0% of population expressing a need for more courts. Half said there were an adequate number of courts. This low level of participation needs to be viewed with caution because it may be attributed to the small number of indoor courts, which limits year-round participation. Also, PP&R tennis staff note that in the spring, when outdoor tennis begins to increase, almost all city courts are being used by public schools.

Future Demand

Participation in tennis in Portland is difficult to predict and will depend mainly on the kinds of facilities and programs that are developed. As noted earlier, there is a shortage of indoor facilities, which are key to greater tennis participation in the Pacific Northwest. Based on information with local tennis professionals, it appears that participation in tennis will increase if PP&R's tennis facilities are improved and additional programs are offered.

Desired Level of Service

[50] Portland Parks & Recreation, Draft Sport Courts Technical Paper, June 2008

[51] Excerpted from: Portland Parks & Recreation, *Draft Sport Courts Technical Paper*, June 2008

The Parks 2020 Vision outlined a goal of providing developed neighborhood parks within a half-mile of every resident. Sports courts are an essential facility for public recreation, and a common component of a developed park. While not every developed park needs a sports court, every one in the city should be able to walk safely to a sports court for recreation, exercise and social gathering. Other goals for the capital development and management of tennis courts include:

- Establish a system of well-maintained tennis facilities throughout the city that are anchored by the Portland Tennis Center.
- Establish new tennis facilities in areas where there is demonstrated demand, where there is capacity to provide services, and where a minimum of two courts can be provided.
- Redevelop the Portland Tennis Center to provide a minimum of 10 covered courts, two outdoor courts, and additional parking.
- Initiate a program to cover some of PP&R's outdoor tennis courts.
- Initiate a program to renovate courts that are in poor condition.
- Decommission courts where there is insufficient demand, where alternative sites are available, and where courts do not meet design guidelines.
- When feasible, group tennis courts into clusters to achieve economies of scale.

Existing Level of Service

In the case of tennis courts, PP&R provides most of the public facilities. An assessment of tennis court condition was conducted by Mike Stone, Portland Tennis Center Director in April, 2002. According to this review (see chart below), approximately 27% of PP&R's tennis courts are in poor condition; another 24% are in fair condition; and about half of the courts are in good (39%) or excellent (10%) condition. Courts that are in poor condition are, for all purposes, unplayable. These courts exhibit a variety of deficiencies but the most common are poor surface condition and worn nets. Year-round participation is limited by the small number of indoor courts.

Facility Needs

Table 2.13 Summary of Tennis Court Capital Recommendations[52]

Parks	Action
Portland Tennis Center	Redevelop to provide a minimum of 10 covered courts, two outdoor courts, and additional parking.
St. John's Tennis Center	Assess continued operation in terms of service mix, economics, and the area's long-term development.
Gabriel Park and Grant Park	Initiate a program to cover some of PP&R's outdoor tennis courts based on public consultation.
System-wide	Establish new tennis facilities in areas where there is demonstrated demand, where there is capacity to provide services, and where a minimum of two courts can be provided.
Argay, Glenhaven, Grant, Irving, Arbor Lodge, Mt. Tabor, Washington, Clinton, Gabriel	Designate specific parks as Community Tennis Centers. These parks would feature enhanced levels of programs, events, and maintenance. Include additional amenities such as covered benches, more benches, water fountains, lights, and a higher level of maintenance.
Various	Initiate a program to renovate courts that are in poor condition, especially those with two courts. Priority 1: Portland Tennis Center, Argay, Col. Summers, Clinton, Wallace, Hillside, Willamette, Sellwood, Washington, Glenwood Priority 2: Arbor Lodge, Laurelhurst , Kenilworth, Woodstock, Berkeley, Brentwood, Essex, Hamilton, Burlingame, Fernhill, Westmoreland
Montavilla, Rose City, King School, Alberta, Lair Hill, Northgate, Creston, Mt. Scott, Lents	After public consultation, consider decommissioning courts where there is insufficient demand (with a threshold of use to be established as a criterion), where alternative sites are available, and where courts do not meet design guidelines.

Community Gardens[53]

Community gardens have been an integral part of PP&R's portfolio of services since 1975. The program has grown from three garden sites in 1974 to 35 sites in 2010, see Map 2.9. Over the last three decades, the program has broadened its educational services to include several kinds of demonstration gardens, along with a children's gardening program. In addition, a friends group provides political support and some financial assistance.

Inventory

PP&R maintains 35 community gardens with about 1,000 plots (usually 400 sq. ft. in size for the full-size plots) throughout the City, serving approximately 3,000 gardeners, see Map 2.9. Most of the gardens are located in inner Southeast, Northeast and North and Southwest Portland. Three gardens are located east of I-205.

The number of plots/gardens varies with the smallest gardens (Patton) having eight to ten plots and the largest garden (Fulton) comprising 102 plots. Improvements at the garden sites include fencing, locked gates, water lines, signs, and raised accessible beds. In addition to regular plots, the system

[52] Portland Parks & Recreation, *Draft Sport Courts Technical Paper*, June 2008
[53] Portland Parks & Recreation, Draft Community Gardens Technical Paper, June 2008

includes half plots and raised beds, which are used for education programs and for gardeners who are disabled. Some gardens have sheds for tool storage, paved paths, and other amenities.

Major Issues

There are a number of issues around providing community gardens in a fair and equitable manner.

- Capacity: There are not enough garden plots to meet demand in some areas. Waiting lists are growing. Providing additional capacity within the current system is difficult.
- Demand for public land: Demand for all park land for various recreational activities is growing. While most recreation on public land allows for other uses when it is not being reserved by a particular group for a specific time, community gardening provides exclusive use of public land to private individuals as long as they garden responsibly. While this is understandable to prevent theft, it is also reasonable to discuss how to increase use of these areas to more people.
- Capital Costs: There is no consistent source of funds for capital projects at the community gardens. Revenues for the program are limited to what is generated through plot fees, which usually averages $45,000/year. Improvements are typically funded through grants and non-PP&R sources. The total development cost of a “typical” community garden site, with 30 to 50 plots and typical amenities, ranges from $40 – 60,000.

Desired Levels of Service

Because there is no standard method to determine demand for community gardens, estimates are based on an analysis of current distribution within the city, comparisons with comparable cities, and a review of broad citywide trends that affect the interest in community gardening.

The overall goal for community gardens is to provide a network of community gardens that are distributed equitably throughout the city. Locations should be chosen based on demand, appropriate land, and where adverse impacts are minimal. While community gardens should be located on publicly owned properties whenever possible, they should be sited carefully taking into account other desirable uses. Private sites should not be used unless there are no other options and there is a legal agreement so that the garden can remain on the site for at least 15 to 20 years.

Given these goals, and coupling the particular requirements of community gardens, i.e. flat land, good soil, access to water, good sun exposure, and sufficient size for at least 18 full-size plots, with the geographic differences of the city, it is difficult to provide a uniform level of service in all areas. There is also a wide variety in demand across the city. Some areas have high demand as evidenced by the large number of people waiting for plots while others have relatively low demand with few people on the waiting list. See Recommendations for suggestions on how to provide sufficient service.

Existing Level of Service - Distribution

As shown in Map 2.9, the distribution of community gardens is uneven within the city. Because the gardens have been developed based on expressed demand and development opportunities, the distribution of gardens has not evolved in a systematic way. Community garden plots are generally located throughout the city west of I-205. Larger gardens are found in the southwest and southeast

Portland while smaller sites tend to be concentrated in older, established neighborhoods. Areas without gardens are the eastern-most areas of the city, Hollywood, Rose City, Central, Downtown, Northwest and the Lloyd District.

There is ongoing demand for new community gardens from neighborhoods in inner and central northeast, inner southeast, downtown, and the River District. Acquisition of garden sites is possible in some of these neighborhoods while it will be very difficult in areas such as inner southeast and downtown.

Another index of demand – at least for existing sites – is provided by the waiting lists. The gardens in inner southeast have the longest waiting list, with over 350 people. Interestingly, the four gardens with the highest numbers (Col. Summers, Clinton, Everett, and Sewallcrest) are in neighborhoods that include a large proportion of multi-family residential units. As of 2010, the waiting list for community gardens was over 1,000 people.

Facility Needs

A list of recommended capital improvements for community gardens can be found in Table 2.14. In addition to capital improvements and given the large waiting list for garden plots and the limited opportunities for expansion, PP&R should employ appropriate demand management strategies to meet current and future demand. These strategies could include variable pricing, educational outreach, and increasing the number of plots by dividing larger plots into smaller plots where appropriate. Additionally, gardens may be placed in non-traditional locations such as roofs or raised beds.

Table 2.14 Summary of Community Garden Capital Recommendations[54]

Parks	Action
Acquire and develop sites for new community gardens.	Acquire and develop 12 new garden sites. High priority acquisition locations: (1) The area of the existing Boise-Eliot garden because that site is now privately owned and is expected to be developed; (2) Replacement site for the Reed Garden. (3) Replacement site for the Blair garden. Additional acquisition is needed for new garden sites in the downtown, inner southeast (two sites), Linnton, Mt. Tabor, outer east (three sites), Pearl District, Rose City, and Sellwood. However, many of these areas are land scarce and alternative solutions such as roof tops will need to be explored. Develop new community garden sites first in undeserved areas or in areas where demand currently exceeds supply.
Expand existing community garden sites where appropriate.	Some of the existing gardens have consistently had long waiting lists. As a result, expanding these sites should be considered. Sites include Lents, Col. Summers, Everett, Sabin, and Sellwood.

[54] Portland Parks & Recreation, *Draft Community Gardens Technical Paper*, June 2008

Support Facilities: Maintenance & Administration[55]

Although not seen by the general public, well-located and functional maintenance and administration facilities are critical to PP&R's ability to provide timely and effective service.

Inventory

PP&R's primary maintenance facility is the Yard at Mt Tabor. This centrally located 5-acre facility is at SE 64th and Division and houses over 100 permanent and about 40 seasonal employees. District maintenance facilities are located at Gabriel Park, SE 136th, Washington Park, East Delta Park, Northeast 21st and Pacific, McLoughlin Blvd. and Tabor Park. The golf courses also have maintenance facilities. Small maintenance buildings, storage sheds and utility buildings are located throughout the park system.

Desired Level of Service

Plans were recently completed and accepted by City Council to redesign and rehabilitate the crumbling central facility at Mt Tabor. Plans are being developed to address maintenance needs at the other facilities. In some cases they will be relocated and in others, they will be expanded and renovated.

Existing Condition

Most maintenance facilities are functionally outdated, inadequately sized, and some have serious deferred maintenance issues. Some parts of the central yard are over 90 years old, and little of it was designed for its current use.

Major Issues/Concerns

Providing adequate facilities for maintenance and operations staff frequently takes a back seat to providing better facilities for the public. Unfortunately, this often means that services are not delivered as efficiently as they could or should be. City Council recognizes that employees need safe, well-located facilities, but funding these improvements is difficult.

TRAILS[56]

PP&R and its partners provide many types of trails so that residents and visitors can circulate both within and between parks and natural areas. The network of park sidewalks, hiking trails, pathways, multi-use trails, and greenways connect to city sidewalks, bikeways, and transit. They serve both recreational and transportation needs, and many of the regional trails extend or connect to other trails beyond the city limits.

Inventory

Regional Trails

[55] Portland Parks & Recreation, *Development of Service Zone Facilities*, October 2006, and *Mt Tabor Central Yard and Nursery Planning Group Final Report*, Amendment to Mt Tabor Park Master Plan, December 2008.

[56] Excerpted from: Portland Parks & Recreation, *Recreational Trails Strategy: A 20-Year Vision for Portland's Regional Trail System*, June 2006

Regional trails connect Portland to adjacent communities or to regionally significant rivers, streams, and natural areas. Portland has 21 individually named land trails and two water trails, see Table 2.15. Map 2-11 shows the existing and proposed regional trails, including trail connectors, existing gaps and trails in need of upgrades. A regional trail can have a 2'-wide soil surface like the 30-mile-long Wildwood Trail or 14'-wide concrete like the one-mile-long Eastbank Esplanade. Trails with this designation are included in the Metropolitan Regional Trails Map.

Table 2.15 Regional Trails & Greenways[57]

Land Trails	
Columbia Slough Cross-Levee	Peninsula Canal
East Buttes Loop	Peninsula Crossing Bikeway
East Buttes Power Line Corridor	Scouter Mountain
Hillsdale to Lake Oswego	Springwater Corridor
I-205 Corridor	Sullivan's Gulch
I-5 Bridge Trail Crossing	Terwilliger Trail & Parkway
I-84 Corridor	Wildwood
Lewis & Clark Discovery Greenway	Willamette Blvd Bikeway
Mt. Scott	Willamette Shoreline Trolley Rail-with-Trail
North Willamette River Greenway	
Regional Trails outside of, but connecting to, Portland	
Bronson Creek Greenway	Beaverton Powerline
Water Trails	
Columbia Slough	Lower Columbia River

Community Connectors

Community connectors link important land uses and areas of interest, often within a neighborhood, typically using street rights-of-way. PP&R maintains relatively few of these: the sidewalks in the Park Blocks and the boardwalk in the Pearl District.

Local Access Trails

Local access trails connect local features such as parks, community centers, and schools. PP&R has a substantial amount of local access trails: approximately 80 miles of paths in developed parks and nearly 60 miles of trail in natural areas.

PP&R trails complement sidewalks, bike lanes, bikeways and boulevards, rails-with-trails, hiking trails, shared use trails, and transit. In addition to the City of Portland – PP&R, the Portland Bureau of Transportation (PBOT), the Bureau of Environmental Services (BES), and the Water Bureau – many other agencies provide facilities used as trails. Substantial portions of trails, such as the Willamette Greenway Trail and Columbia Slough Trail, are located on private land and maintained by the landowners. In some cases, railroads allow trails to be built over or along their rail beds.

PP&R is responsible for the review and approval of public recreational trails built on private property. PBOT reviews improvements to street rights-of-way and has pedestrian and bike classifications in the Transportation System Plan. Both bureaus work together to integrate sidewalks, bike lanes, and off-street trails; they also collaborate on trail construction when funding is available.

[57] Recreational Trails Strategy: A 20-Year Vision for Portland's Regional Trail System, June 2006

A wide variety of individuals and groups support trails in Portland. Neighborhood associations, non-profit organizations, and volunteer groups help expand the trail system by fundraising, assisting with funding applications, reviewing designs, commenting on land use applications, providing work parties, and hosting trail events.

System Goal

PP&R has an adopted regional trail vision of 220 miles of regional trails connecting people to each other and to the natural beauty of our city.

Current Use

A survey commissioned by PP&R, in 2004, found that 77% of Portlanders used trails each year; over 50% at least monthly. Seventy-four percent of the respondents were satisfied with the quality and quantity of trails – most likely due to the diverse types of trails.

Existing Condition

The 40-Mile Loop: In the 1980s, the 1903 Olmsted plan inspired staff and citizens to envision a trail loop connecting parks and natural areas. Featuring routes along the Columbia and Willamette Rivers, Columbia Slough, and Johnson Creek, it was christened the "40-Mile Loop" for the estimated length of Olmsted's original concept. However, the name is now a source of some confusion since there will actually be about 102 miles of trail once the Loop is complete. Substantial progress has been made in completing the Loop and 70% of the trails are now complete, however significant gaps still exist (see Table 2.16). The Loop will eventually extend out to the Sandy River, however, neighboring jurisdictions may need regional assistance in completing the loop.

Table 2.16 Regional Trails & Greenways[58]

Willamette Greenway	**Columbia Slough**
South Waterfront	Rivergate to Chimney Park
Willamette Shoreline Trolley with Trail	Landfill to Peninsula Crossing
Burnside thru BES	N Denver to NE Vancouver
Swan Island, South and North	Peninsula Canal
St. Johns	NE Vancouver to NE Elrod
Bluff-top Trail	Cross-Levee
Swan Island Waud Bluff Trail	Kenton Connection
Swan Island Landfill Trail	Multnomah County Drainage District to I-205
Marquam to SE Ivon	East of I-205
SE by Sellwood Bridge	
Springwater Corridor	**Marine Drive**
Sellwood Gap	East of I-205
Rugg Road to Boring	Bridgeton
Brooklyn Connection	
Other	
Sullivans Gulch	Delta Park Trail
Hillsdale to Lake Oswego - Marshall Park segments	Red Electric

[58] Portland Parks & Recreation, *Recreational Trails Strategy: A 20-Year Vision for Portland's Regional Trail System*, June 2006

Major System Concerns

Trail projects often involve multiple stakeholders and land owners and require resources for acquisition, design, construction, and maintenance. To date, trails have been built incrementally as development occurred or funding could be secured, creating gaps within the trail network that reduce its usability.

Currently, 146 miles (66%) of the proposed 220 miles of trails in or owned by Portland are complete. Closing the trail gaps on nearly complete trails would result in greater connectivity and opportunities for extensive trail trips. Longer trails connect more neighborhoods to transit, shopping, schools, and employment areas which benefit those communities as well as trail users. Most of the remaining trails are either much less complete or not yet started. Support facilities such as trailheads, restrooms, neighborhood connections, and signage are also lacking, while some trails need redevelopment due to increased use.

Building key regional connectors to access the more complete trails may improve trail usage more immediately than building new or less complete long trails. Also, most of the connector projects involve relatively short stretches and are less expensive.

NATURAL AREAS[59]

The Parks 2020 Vision outlines the goal "The city and region have an interconnected system of trails, parks, natural areas, streams, and rivers that are well protected and ecologically healthy," and identifies a need for additional natural area acquisition.

To maintain Portlanders' current quality of life, including access to open space, clean water, and breaks from urban density, natural lands must be protected from impacts of development both on-site and upstream of natural areas. Additional population will inevitably increase pressure on parks and open spaces. As use increases, larger spaces are needed to provide opportunities for both people and wildlife in the city.

Open space is scarce, but the demand is high. Oregon State Parks' Statewide Comprehensive Outdoor Recreation Plan (SCORP) evaluates demand for recreational facilities. Of the top ten outdoor recreation activities listed in the 2008-2012 report, the top four are all associated with parks and natural areas: walking for exercise and pleasure, day hiking, bird watching, and nature and wildlife observation. In a 2004 survey for PP&R, residents in Portland were asked which of a long list of park elements were adequate and which needed additional facilities. Natural wildlife areas topped the list in percentage of respondents desiring additional facilities.

Inventory

Natural area settings in Portland include forests, meadows, wetlands, streams, and riverbanks. The 7,000 acres currently managed by PP&R as natural area are primarily forest (85%) and represent the range of forest types naturally occurring in the region including upland Douglas fir stands, ash and cottonwood riparian forests, and younger deciduous forest types. Open woodlands, such as those dominated by Oregon white oak, account for another eight percent of the system. Shrublands

[59] Excerpted from: Portland Parks & Recreation, *Natural Areas Acquisition Strategy*, November 2006.

and grasslands, including wetland marshes and scrubs, and upland sites occur less frequently but offer unique habitat features.

Particularly significant natural areas include Forest Park, Powell Butte, Oaks Bottom, Columbia Slough, and Smith and Bybee Wetlands. Map 2.12 displays the City of Portland's natural area inventory.

Benefits of Natural Areas

Natural areas provide a variety of habitats for our native plants and animals, helping to preserve the biodiversity of the region. Native wildlife living within Portland include Great Blue Herons, Bald Eagles, Ospreys, Red-legged Frogs, and Western Painted Turtles. Natural areas provide essential wildlife corridors for animal migration between the Coast Range and the Cascades. Natural areas help define our Pacific Northwest quality of life by providing wildlife habitat and access to nature. Natural areas help cool streams by providing shade and help clean our air. Natural landscapes also serve to infiltrate and hold water from rain events, improving water quality and habitat for native salmon. And natural areas help cool the air and capture carbon dioxide, thereby reducing urban heat island effect and greenhouse gas emissions.

Hiking and nature watching are some of the most popular outdoor recreational activities in Portland. For many residents, urban natural areas are the only access to nature. These park sites provide an opportunity to learn about the natural world and to become stewards of the land. Natural area parkland serves as a laboratory for ecological research and a classroom for service learning. And as the metropolitan area becomes increasingly dense, natural areas protection will become essential for the habitat they provide for residential and migrating birds and wildlife.

Partnerships

PP&R manages most of the protected natural areas within the City of Portland (7,000 acres). Other large natural area sites include Metro's Smith and Bybee Wetlands Wildlife Area and Oregon State Parks' Tryon Creek State Natural Area. Additional natural areas are held by Portland's Bureau of Environmental Services (BES), organizations such the Port of Portland, Three Rivers Land Conservancy, and private neighborhood associations. Acquisition, as well as management, will continue to be a shared responsibility.

PP&R's mission to protect and manage natural areas blends with the utility and watershed health responsibilities of BES. Responsible for water quality and stormwater management within the city, BES relies on the green infrastructure of park natural areas and has been a key partner in previous acquisition projects. Portland's Bureau of Planning and Sustainability (BPS) has joined PP&R and BES in the identification of natural area acquisition target areas through its inventory of riparian resources and upland habitat within the city. Additional support for natural area acquisition priorities can be found in the Framework for Integrated Management of Watershed Health and the 2005 Portland Watershed Management Plan, both developed by BES. Watershed Councils, park friends groups, and local land trusts also serve as key partners in identification and acquisition of natural area land.

System Goals & Priorities

Conservation planning at the state, regional, and local levels has converged in the last few years, defining a clear path for Portland to follow. The Oregon Conservation Strategy, published by the Oregon Department of Fish and Wildlife in 2006, highlights two actions for the Willamette Basin ecoregion: 1.) Maintaining and restoring fish and wildlife habitats in urban environments and 2.) Conserving, restoring, and reconnecting high value habitats. Resource conservation principles for Portland were adapted from the Willamette Valley principles listed by the Oregon Watershed Enhancement Board in a 2004 report on Land Acquisition priorities.

System goals for natural areas focus on preserving a regional system of natural areas to protect large, intact habitat areas and areas with exceptional biodiversity or priority species habitat. As such, the desired system is not based on a level of service standard but on analysis of existing and potential natural areas.

In the last five years, PP&R has refined the elements of protecting a healthy connected system of natural areas within the city. This natural area acquisition strategy outlines a general approach and highlights priority actions to achieve the vision. Implementation will rely on a number of partners. This strategy offers a vision developed with both city and regional partners. PP&R's focus will be on protection priorities outlined below, building on our present system. Map 2-12 identifies priority natural area acquisition locations.

- Protecting Large, Intact Areas: Larger areas offer more protected interior habitat and are shown to be required breeding habitat for many species. Forest Park is the city's largest habitat area; to maintain a citywide system, an eastside area is also needed. Powell Butte is the second largest protected natural area maintained by the City. Acquisition of existing undeveloped land south of Powell Butte would provide a second large forested park and provide eastside residents with a closer forested park. This butte natural area would protect the headwaters and steep ravines of Johnson Creek tributaries.
- Protecting Sites With Exceptional Biodiversity Values: Examples include the now uncommon oak madrone habitat remnants on the escarpment that continues along the east side of the Willamette, the unique habitat islands of the East Buttes, and the riparian cottonwood and Oregon ash forests once common along the Willamette banks. Habitat for individual species of concern will also be given priority.
- Improving Connectivity within a Regional System of Natural Areas: Connections between our sites in Portland and those outside of the city are important, as are connections within the city between natural areas and from natural areas to trails. An example is the undeveloped land along Johnson Creek between Johnson Creek Park and the Metro-owned Springwater Trail. The acquisition of this land, under option currently, will make the connection to the new Johnson Creek Bridge and offer habitat restoration opportunities. Additional connectivity needs include a westside wildlife corridor connecting Forest Park to the north with Tryon Creek State Natural Area.
- Buffering Current Natural Areas: Interior habitat is rare in Portland's natural areas. Edges are more subject to weed invasion and other urban influences and support different wildlife than does interior habitat. De facto buffers of undeveloped or lightly developed land have

protected some natural areas. As infill and increased density change the landscape, intense development will occur up to the edges of our protected land. Adding land adjacent to our existing natural areas helps protect the existing sites and offer more efficient management.

- Priority Habitats and Species: Led by BES, a Terrestrial Ecology Enhancement Strategy is being developed with an interbureau team and outside advisory group which will further refine acquisition priorities to protect Portland's biodiversity. Preliminary lists of habitats and species of concern used for acquisition priorities were taken from listings by federal and state agencies and the Oregon Natural Heritage Information Center.

The identified acquisition zone identified comprises over 11,000 acres in the city. This large area highlights the acquisition target areas and more specific refinement will identify parcels and phasing. Acquisition is always opportunistic, especially as PP&R employs a willing seller approach. A phased plan has been developed which will guide acquisition planning. The intersection of available funds and available land will determine specific parcel acquisitions.

Major Issues

- Need for Landbanking: A landbanking program must be established to stabilize and hold new acquisitions. These areas may not be open for formal public use for the foreseeable future and the entire system may exceed our capacity to restore all habitat land immediately. It can be a challenge to obtain resources to maintain these areas over time. However, the choice is to leave a protected, but somewhat degraded, system to future generations or lose the opportunity to build the system.
- Equity: The acquisition strategy for natural areas is focused on protection of existing functioning habitat. However, due to past development patterns, remaining natural areas are not distributed equally throughout the city and all residents do not have equal proximity to natural area parkland. Since all city residents benefit from access to natural areas, programs to restore small patches of natural landscapes in developed parks and schools, to create green corridors between natural areas, or to provide neighborhood trail connections to existing natural areas will improve access for all Portlanders.
- Maintaining and increasing species diversity: The continued habitat fragmentation and increase in development adjacent to our natural area parks impacts wildlife movement and creates an environment for non-native and common species to thrive. The loss of interior habitat spaces reduces the biodiversity in our region.

URBAN FOREST[60]

The urban forest, which includes all the trees and shrubs in the city, provides environmental, social and economic benefits to Portland's residents in the form of increased biodiversity, improved neighborhoods and increased property values, and many others. Management of this important resource is shared among many city bureaus that have an interest in its improvement and well-being. These bureaus have developed an action plan to realize the goals of the 2004 Urban Forest

[60] Excerpted from: Portland Parks & Recreation, *Portland's Urban Forest Canopy Assessment and Public Tree Evaluation*, October 2007

Management Plan. The action plan calls for diverse activities to meet Urban Forest Management Plan goals and outcomes; activities such as education and stewardship, research and monitoring, planting and maintenance, and policy and regulatory improvements.

Inventory

Forest Structure – Trees on Public Land

Portland's public streets, parks, and natural areas host a diverse array of tree types. Nearly 1.5 million trees grow in these public spaces, see Map 2-13. The street tree population is estimated at 236,000 trees of 171 different types, and over 1.2 million trees of 41 types are found in developed parks (39,000) and natural areas (1.2 million).

Even though Portland's streets host a diversity of trees, ten types (6%) comprise nearly half (45%) of the resource, leaving the vast majority of tree types (94%) relatively poorly represented. Similarly in parks, over half (54%) of all trees belong to one of three types (7%).

The dominant tree types growing along Portland's streets vary by area of town. While Norway maple (Acer platanus) is the most abundant street tree species citywide, bigleaf maple (Acer macrophyllium) and arborvitae (Thuja occidentalis) are the most prevalent in northwest and southwest Portland, respectively. Of the city's five most abundant species, only red maple (Acer rubrum) is widespread enough to make it into the top five species for all five areas of town.

Maples are ubiquitous in Portland. The native bigleaf maple (Acer macrophyllum) is the most abundant tree in natural areas; Norway maple, red maple, and bigleaf maple are among the five most common street tree types.

Broadleaf deciduous trees dominate the landscape, accounting for 85% of street trees and 77% of park trees. Tree size designations (small, medium, and large) are determined by both the functional type and mature tree size of the tree. Parks contain more large-at-maturity trees (64%) and more conifers (23%) than do street rights-of-way. Streets host four times the diversity of tree types than parks, one-third of which are small when mature.

The City does not have an inventory of private trees, but recognizes that more than half of the tree canopy of the urban forest is located on privately owned land.

Mature Tree Size

The amount of environmental and aesthetic benefits a tree may provide over its lifetime is a function of mature tree size and longevity, so the larger the mature size of the tree and the longer the tree lives, the greater the potential environmental and aesthetic benefits the tree will provide.

Tree Height

In general, park trees overtop street trees. The majority of street trees are shorter than 30 feet, and the majority of park trees are taller than 30 feet. Tree height is a function of species, location, and maintenance history.

Leaf Area, Canopy Coverage, and Importance Values

Leaf surface area is the tree's fundamental unit of production. Generally speaking, the greater the leaf surface area, the greater the photosynthetic capacity of the tree and the greater the benefits the tree provides. Canopy coverage is the amount of ground surface covered by tree canopy. Along with the total number of trees, leaf area and canopy coverage combine to show the amount of biomass present in the population for each tree type. In ecological terms, the greater the biomass, the greater the ecological importance of the tree type.

Of Portland's ten most important street tree types, Norway maple is the most important and is more than twice as important as the next tree type. The ten most important street tree types account for roughly one-third of the population. In parks, roughly one-third of the trees are either Douglas-fir or bigleaf maple, and the ten most important park trees account for 90% of the population.

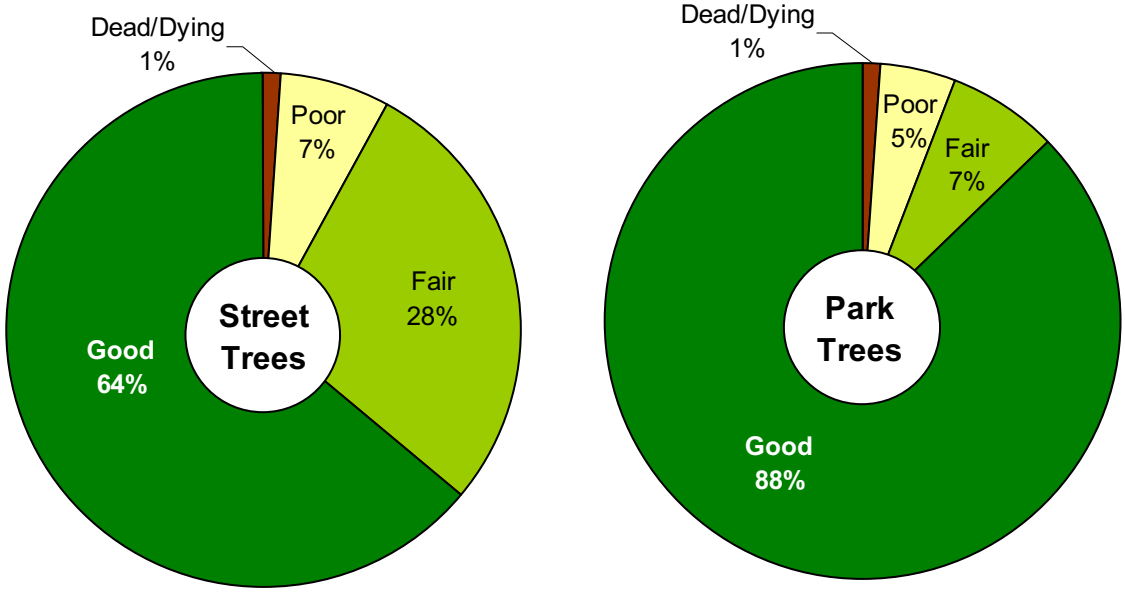
Native Origin

The majority of Portland's street trees (60%) are native to places outside of the United States, mainly Europe and Asia, with only 13% native to the Portland area. Conversely, the majority of park trees (84%) have genetic origins in the Willamette Valley. Non-native species can reduce the quality and quantity of habitat for native species.

Condition

Tree condition is the health of the tree as manifest in the condition of its bark and leaves. The condition of urban trees reflects species hardiness, site conditions, and maintenance history. Trees that are well suited to Portland's climate, that can adapt to the challenges of growing in an urban environment, and that have been maintained using proper arboricultural techniques are generally the most successful.

Figure 2.1 General Condition of Portland's Street and Park Trees



Portland's park trees are in generally better health than its street trees. While roughly the same proportion of park (94%) and street (91%) trees are in fair to good condition, 24% more park trees

are classified in good condition. Compared with parks and natural spaces, the street environment – where growing space is limited, soils are generally poor, and automobile exhaust reduces local air quality – is far less hospitable to trees.

While street trees are an important public asset, maintenance of these trees is generally the responsibility of adjacent property owners. The City has recently sponsored a preliminary study to consider the costs of increasing City responsibility for maintaining street trees in Portland (Davey Resource Group, 2009).

Capacity

Citywide Forest Canopy Coverage

Total forest canopy coverage for the City of Portland exceeds 24,000 acres or 26% of the city's land cover. Just over half (54%) of the property in Portland is privately owned, and 53% of the city's tree canopy shades private property. While public property hosts less canopy cover (47%) overall, canopy density is slightly greater on public (27%) than private (26%) property, see Table 2.17.

Portland's Urban Forestry Management Plan (2004) contains forest canopy coverage goals for four major Urban Land Environments (ULEs) within the urban forest: residential, commercial/industrial, developed parks/open space, and rights-of-way (see Table 2.18). Based on the acreage of each ULE, citywide forest canopy coverage must increase by one-fourth – covering additional 7% of the city – to fulfill these goals.

Table 2.17 Citywide Land Cover and Forest Canopy Coverage (2002)[61]

Canopy Extent	Public Property	Private Property	Citywide	Target Canopy
Total Landcover (acres)	42,785	49,845	92,630	92,630
Total Canopy Coverage (acres)	11,404	12,714	24,118	30,566
Canopy % of Landcover	27	26	26	33

Table 2.18 Existing (2002) and Target Forest Canopy by ULE[62]

Urban Land Environment (ULE)	Existing Canopy	Target Canopy*
Residential	30%	35-40%
Commercial/Industrial	7%	15%
Developed Parks/Open Space	28%	30%
Rights-of-Way	17%	35%

* Targets established in the Portland Urban Forest Management Plan, 2004.

[61] Portland Parks & Recreation, *Portland's Urban Forest Canopy: Assessment and Public Tree Evaluation*, October 2007.
[62] Ibid.

Street Tree Stocking Level

Street tree stocking level reflects the percentage of potential planting spaces within the street rights-of-way that are currently occupied by trees. Stocking levels range from 37% in southeast Portland to 64% in northwest Portland, averaging 45% citywide, see Table 2.19. The total number of street trees varies from roughly 19,000 in northwest Portland to more than 69,000 in northeast Portland. Differences in the stocking potential in each zone reflect differences in the zone size. Because the east side zone are larger than the west side zones, east side stocking levels are lowest ever though east side street tree populations are highest.

Table 2.19 Distribution of Street Trees and Rights-of-Way Planting Spaces by Region[63]

	North	Northeast	Northwest	Southeast	Southwest	Citywide
Trees	39,900	69,800	19,300	64,200	43,400	236,500
ROW Planting Spaces	88,900	168,300	30,300	173,300	70,400	531,100
Stocking Rate	45%	41%	64%	37%	62%	45%
Land Area (mi2)	27	37	19	37	21	141
Planting Spaces/mi2	3,352	4,535	1,606	4,632	3,305	3,762
Trees/mi2	1,504	1,880	1,024	1,717	2,036	1,675

Southeast and northeast Portland have the lowest stocking levels (37% and 41%) but the largest numbers of right-of-way planting spaces in the city. Although northwest Portland has the highest stocking rate of all zones (64%), it houses only 6% of the city's right-of-way planting spaces and has the fewest street trees per square mile. By comparison, north Portland has twice the number of planting spaces per square mile, one and a half times the number of trees per square mile, and a stocking level equal to that of the city as a whole. Southwest Portland has the second highest stocking level (62%) and the greatest density of street trees.

Major Issues

The city's urban forest faces a number of challenges. First, canopy cover is being lost to development, particularly in areas of southwest and outer east Portland. Traditional development patterns often involve significant losses of tree canopy cover and increases in impervious surfaces which limits areas for replanting, particularly large tree species. These changes can result in increased stormwater volumes and air temperatures, and heighten pressures placed on hillsides and streams. The urban forest is also threatened by the rise in invasive plants and animals. These invasive species can stress the ability of natural species to survive. Invasive pests and diseases can have sudden and devastating effects on the urban forest especially in areas that lack age and species diversity. Additional information on urban forest related issues is contained in a separate background report, entitled "Portland's Urban Forest and the Portland Plan".

[63] Ibid.

CHAPTER 3: PORTLAND BUREAU OF TRANSPORTATION

OVERVIEW

Portland's transportation system serves an area of approximately 147 square miles and a population of 586,000 people. The $8.1 billion dollars the public has invested in this system allow individuals to get to work, school, recreation activities and sustain their household needs. Collectively, the City's transportation system does much more. It creates the foundation for a variety of activities essential to our lives: livable and safe neighborhoods, land uses and managing growth, commerce and job creation, environmental protection, freight mobility, and revitalization.

Portland's transportation system, provided by the City and a variety of other jurisdictions and agencies, includes not only the networks of roads and highways, but also right-of-way, sidewalks and paths, bikeways, bridges and other structures, transit (light rail, bus, streetcar, and tram), and thousands of supporting assets (lights, signals, signs, etc.). This transportation system is a fundamental component of regional access and mobility – serving residents, businesses, and travelers and providing essential connections to local, regional, interstate, and even international destinations.

INVENTORY

Portland's investment in transportation facilities totals $8.1 billion. The network of 3,949 lane miles of paved streets represents the largest replacement value, $5.4 billion, or 66% of the value of the transportation system. The next most valuable inventory is the sidewalk system, representing an investment of $1.6 billion or 20%. The City's bridges, retaining walls, guardrails, stairs and the harbor wall account for $728 million or 9% of the system. Traffic signals have a replacement value of $122 million or 2% of the system. All other inventories, including traffic calming devices, street lights, street signs, pavement markings, streetcars, aerial tram, building facilities, and parking meters account for $232 million or 3% of the transportation system's replacement value.

The City of Portland also owns over 2,000 lane miles of public right-of-way, see Map 3-1, with an estimated 2007 value of over $7.5 billion. The right-of-way includes the land area of the streets, sidewalks, and planting strips. The value of the right-of-way is not included in the facilities total.[64]

The City of Portland's inventory does not include transit facilities owned by Tri-Met, the region's transit provider. Regionally, these assets include a 44-mile regional MAX light rail system, with 104 MAX vehicles and 64 stations; 892 miles of bus service, served by 603 buses along 93 routes; 18 transit centers, 26 park-and-ride lots, and 269 LIFT vehicles, providing door-to-door service.

Table 3.1 shows the overall condition of major types of transportation facilities. Based on 2007 ratings, the majority of curbs, improved corners, parking meters, streetcar system, aerial tram, stop signs, and retaining walls are in good or very good condition. The majority of streetlights,

[64] Portland Office of Transportation, *City of Portland Transportation System: Status and Condition Report*, 2007.

buildings, and bridges are in fair to good condition. Condition information is not available for a number of major transportation asset groups, including improved streets, sidewalks, bikeways, most signs, pavement markings, traffic controllers and equipment, stairways, and guardrails. The total value of assets with unknown condition is over $5.5 billion, or nearly 70% of the City's total transportation asset value. The Bureau of Transportation is currently updating its pavement management system, which once complete, will provide condition information for improved streets. Improved street pavement makes up the vast majority (app. 98%) of assets with unknown condition.

Other jurisdictions and agencies also provide key transportation assets within the City of Portland. These include:

- Oregon Department of Transportation: Owns and maintains interstate facilities including Interstates 5, 84, 205, and 405; the Glenn Jackson, Marquam, Fremont, and Interstate 5 – Columbia River bridges; and supporting infrastructure including smaller bridges, retaining walls, lane markings, and signage. Also owns and in some cases maintains district highways and supporting assets including US Routes 26 and 30; State Routes 10, 43, 99, 99W and 213; and the Ross Island and St. Johns bridges.
- Multnomah County: Owns and maintains the Sellwood, Hawthorne, Broadway, Burnside, and Morrison, and Sauvie Island bridges;
- Union Pacific Railroad: Primary owner of the Steel Bridge, the Union Pacific Railroad bridge, and rail lines and yards.
- TriMet: TriMet is the primary transit service provider for the City of Portland, and provides bus and light rail service.
- Neighboring Jurisdictions: Transit agencies serving come neighboring counties, including Clark County (C-Tran) and Columbia County (Columbia County Rider), also provide limited connector service to locations in Portland.
- Port of Portland: The Port of Portland operates the Port of Portland and the Portland International Airport, which is served by domestic and international carriers.
- Private Companies: A variety of private and for-hire companies offer taxi, limousine, bus, and pedi-cab transportation. Zipcar operates a membership based car sharing program.

Table 3.1 Portland Bureau of Transportation Inventory, Condition, and Replacement Value[65]

Facility	Inventory	Replacement Value ($ millions)	Condition (in %)						Total Unmet Need ($ millions)
			VG	G	F	P	VP	TBD	
Pavement	**4,074 lane mi**	**$5,371**							**tbd**
Improved Streets	3,949 lane mi	$5,371	0	0	0	0	0	100	tbd
Unimproved Streets	125 lane mi	n/a	0	0	0	0	100	0	n/a
Parking Meters	**1,697**	**$14.9**							**$0**
Double	275	$0.34	0	95	5	0	0	0	$0
Single	118	$0.07	0	95	5	0	0	0	$0
SmartMeter	1,304	$14.5	13	87	0	0	0	0	$0
Traffic Signals		**$122.1+**							**$45.5+**
Hardware	1,003	$110.2	14	16	29	27	14	0	$45.5
Controllers	1,003	$9.03	0	0	0	0	0	100	tbd
Other Equipment	386	$2.90	0	0	0	0	0	100	tbd
ITS Equipment	tbd	tbd	0	0	0	0	0	100	tbd
Street Lights	**54,238**	**$103.6**							**$16.2**
Option B	44,103	$31	0	15	75	10	0	0	$3.1
Option C	10,135	$72.6	0	52	30	18	0	0	$13.1
Street Signs	**245,609**	**$15.1**							**$0.7+**
Street Name	41,010	$2.3	0	0	0	0	0	100	tbd
Parking	49,406	$0.78	0	0	0	0	0	100	tbd
Traffic Control	47,909	$4.6	0	0	0	0	0	100	tbd
Stop Signs	14,205	n/a	44	41	10	5	0	0	$0.1
Guide Signs	5,124	$0.5	0	0	0	0	0	100	tbd
Sign Mounts	**87,955**	**$6.9**	**0**	**0**	**0**	**0**	**0**	**100**	**$0.6**
Lines	1,601 mi.	$1.4	0	0	0	0	0	100	tbd
Markings	21,943	$3.8	0	0	0	0	0	100	tbd
Structures	**n/a**	**$728.3**							**$136.9+**
Bridges	157	$398.7	8	50	22	19	1	0	$136.9
Retaining Walls	519	$99.3	94	5	1	0	0	0	tbd
Stairways	185	$4.4	0	0	0	0	0	100	tbd
Guardrails	26 mi.	$13.0	0	0	0	0	0	100	tbd
Harbor Wall	5,133 ft.	$212.8	0	100	0	0	0	0	$0
Buildings	**183,478 ft^2**	**$5.4+**							**tbd**
Albina Yard	17,652 ft^2	$0.7	0	15	45	40	0	0	tbd
Sunderland Yard	14,248 ft^2	$0.3	50	0	17	33	0	0	$0
Kerby Building	54,318 ft^2	$4.1	0	50	50	0	0	0	tbd
Kerby – Storage	6,000 ft^2	$0.3	0	0	100	0	0	0	tbd
Stanton Yard	91,260 ft^2	tbd	0	0	30	70	0	0	tbd

[65] City of Portland Transportation System: Status and Condition Report, 2007

Table 3.1 Portland Bureau of Transportation Inventory, Condition, and Replacement Value, cont.

Facility	Inventory	Replacement Value ($ millions)	Condition (in %) VG	G	F	P	VP	TBD	Total Unmet Need ($ millions)
Sidewalk System	**n/a**	**$1,624**							**$138.6**
Sidewalks	8.7 mil. yd^2	$860.6	0	0	0	0	0	100	n/a
Curbs	3,239 mi.	$649.9	0	75	15	10	0	0	$65.0
Corners	55,764	--	--	--	--	--	--	--	--
Improved	37,567	$113.5	0	80	15	5	0	0	$73.7
w/ Ramps	13,195	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Unimproved	5,002	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Bicycle Network	**204 mi.**	**inc. in pavement**	**0**	**0**	**0**	**0**	**0**	**100**	**tbd**
Streetcar		**$29.0**							**$0+**
Streetcars	10	$26.4	30	70	0	0	0	0	$0
Tracks	tbd	tbd	0	0	0	0	0	100	tbd
Maintenance Fac.	7,830 ft2	$2.6	100	0	0	0	0	0	$0
Aerial Tram	**1**	**$48.5**	**0**	**100**	**0**	**0**	**0**	**0**	**$0**
Facilities Total		**$8,078+**							
Right-of-Way	**2,001 centerline miles**	**$7,529**							
TOTAL		**$15,608+**							

KEY ISSUES & CONCERNS

Maintaining Existing Infrastructure

The Portland Bureau of Transportation is the steward of $8.1 billion in transportation assets. Inventories have increased dramatically over the last 20 years due to annexation and development. Many City streets and facilities are reaching the end of their useful life, and maintenance has been deferred due to inadequate funding.

To keep pace with the demands of the system, the Portland Bureau of Transportation has a goal to bring all assets up to standard or good condition. As of July 2007, the unmet need is $338 million excluding pavement needs, see Table 3.1. The sidewalk system has one of the greatest unmet needs at $139 million. Of the $139 million, $73.6 million consists of improved corners needing curb ramps installed to meet American with Disabilities Act requirements. The other $64.9 million is the cost to replace curbs that are currently in poor condition. The City's transportation structures have an unmet need of $137 million followed by traffic signals at $45 million. The City has seven bridges considered structurally deficient and 29 bridges considered to be in poor or very poor condition. The vast majority of these bridges are weight-restricted. Traffic signal hardware has experienced substantial declines in condition. The recent decline in condition reflects a reduction in signal maintenance funds that began a few years ago. Even facilities in fair condition, such as street lights, face serious decline if adequate funding is not found. Over the next 10 years, pavement and signals will have more assets in poor than good condition if the level of current funding continues.

The city's street system is aging and facing ever-increasing use. The transportation system, vital to the City and its citizens, is deteriorating. Without increased revenue, the costs required to bring the system back to good condition will grow four to five times if routine maintenance is not completed in a timely manner.

Service Levels

Service levels for transportation can be measured a number of different ways. One is level of service (LOS) of an intersection or link of a road. Current LOS standards at the city and regional level are unable to adequately access pedestrian and bicycle service levels. The city and region needs to determine if lower levels of service (i.e. more motor vehicle congestion) are an acceptable reality in a growing region. Another way to measure service levels is in the presence or adequacy of transportation facilities. How many streets are paved? How many City Walkways have sidewalks? How many City Bikeways have bike facilities? These service levels may also need to change in order to accommodate topography, environmental concerns and fiscal restraints.

Accommodating Growth

A majority of the city's transportation infrastructure is developed at the time of construction, by private developers. Major infrastructure improvements as streetcar, arterial street reconstruction or bridge repair, are done by the city as a capitol project. A difficult aspect of accommodating growth for transportation is the lack of existing transportation infrastructure especially in East Portland and SW Portland. Not only do the areas lack infrastructure for current growth projections, and any additional density proposed, but there are also environmental and topographic restraints. The city's transportation plan (TSP) and project lists that support that plan, must also comply with the regional transportation plan's projections for growth and infrastructure improvements. The RTP is being updating and will have new growth and infrastructure targets in Fall 2009.

Safety

Improving transportation system safety is an integral part of the City's planning efforts. Portland has had an increasing focus on understanding the causes and cost of traffic crashes. Over the last few years, Portland has done extensive analysis regarding the locations and causes of traffic crashes within the City of Portland.

In general, traffic safety has improved in Portland. Fewer total traffic fatalities occurred in 2008 than in any other year on record. However, even though the City has implemented a number of improvements and enhanced educational and enforcement efforts, far too many Portlanders continue to be injured and killed in crashes. Over the last 10 years, 342 Portlanders were killed on Portland streets. Sixty-five percent of fatal crash victims were motor vehicle occupants, 6% were bicyclists, and 29% pedestrians. In addition, traffic safety improvement is not consistent across the entire city. In particular, East Portland could benefit from safety improvements. This area, which has experienced intense development, has a number of large, high speed arterial roads and lower levels of neighborhood connectivity resulting in higher frequency of and severity of crashes.

Collisions are responsible for a significant number of fatalities and injuries, lost work time, family trauma, and property damage. Children, senior citizens, and people with disabilities are especially vulnerable. For these reasons, it is an important City goal to decrease collisions between all modes through safety improvements and education.

During a recent transportation funding effort, public concern for traffic safety was identified as a top neighborhood and business concern. The community expressed strong concerns that a failure to avoid crashes has the potential to dramatically increase congestion and lack of reliability for the transportation network. This concern is validated by findings that a significant amount of traffic congestion is caused by crash events. Using multipliers provided by the National Safety Council, Portland estimates that the direct annual cost of traffic injuries and fatalities is over $144 million per year. In addition to concern over personal and economic loss, the overall effect on neighborhood livability and access to local business has driven a wide spectrum of support to improve overall traffic safety.

Multi-Modal Transportation

Portland is recognized nationwide for its approach to transportation planning and for making significant investments in bicycle, transit and pedestrian infrastructure. The Transportation System Plan, PBOT's long-range plan to guide transportation investments and policies, acknowledges that people will not use alternatives to driving unless they have viable choices. While providing transportation choices is important for achieving regional 'mode split' targets (the percentage of trips taken by each of the possible modes of travel: auto, transit, bicycle, and walking) transportation choices are even more important for people who cannot or choose not to drive. PBOT also recognizes the environmental, economic and community benefits of investing in a multi-modal system.

PBOT has laid a solid foundation for increasing transportation choices for Portlanders. Several plans including the Bicycle Master Plan and the Pedestrian Master Plan have been instrumental in laying this foundation. Portland has seen significant changes to the physical infrastructure as well as changes in the mode splits. Since the first Bicycle Master Plan was adopted in 1996, PBOT has more than doubled the bikeway network to 300+ miles. As measured during summer months over Portland's four "bike friendly" bridges (Hawthorne, Burnside, Broadway, and Steel), the number of daily bike trips more than doubled since 1996. The number of transit riders has also increased. According to the 2006 Accomplishment Report, bus ridership increased by 7 percent since FY 1996-97, and Portland Streetcar ridership increased about 15 percent per year since opening. MAX ridership more than tripled since FY 1996-97. Several new plans and multi-modal projects are in progress. For instance, PBOT is currently updating the Bicycle Master Plan, the downtown transit mall was recently opened, and the Streetcar Concept Plan is in its final stages.

Three key multi-modal issues need to be addressed:

- Bicycling, walking and transit are increasing as viable transportation modes. Funding for these projects needs to increase in order for the system to be built to its full potential.
- Another critical issue is the lack of right of way to accommodate multiple modes onto a single street. The City may have to consider other measures such as reducing on-street parking, removing travel lanes and prioritizing pedestrians, bicycles and transit.
- Currently, unless in a 'modal district" or with specific guidelines, the TSP does not give modal preference, therefore there is no policy direction to design streets in an order of priority. For example, Policy 6.4, Objective C does not allow improvements for one mode that will prevent improvements for another mode and states, "All of a street's classifications must be considered in designing street improvements and allocating funding. While a proposed project may serve only one classification, improvements should not preclude future modifications to accommodate other classifications on the street." The Street Design Classification policy gives some direction on what elements the street should have, but there is still no full direction if there is a policy difference. For example, if a street is classified at the highest level for Traffic, Transit and Bicycle, all elements need to be addressed within a usually limited right of way.

REGULATORY REQUIREMENTS

Federal

Federal mandates or regulations guiding PBOT's services or assets include:

- The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), signed into law in 2005. With guaranteed funding for highways, highway safety, and public transportation totaling $244.1 billion, SAFETEA-LU represents the largest surface transportation investment in our Nation's history. The two landmark bills that brought surface transportation into the 21st century—the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) and the Transportation Equity Act for the 21st Century (TEA-21)—shaped the highway program to meet the Nation's changing transportation needs. SAFETEA-LU builds on this firm foundation, supplying the funds and refining the programmatic framework for investments needed to maintain and grow our vital transportation infrastructure.
- National Bridge Inspection Standards is the national standard for all publicly owned highway bridges longer than twenty feet located on public roads. Inspection is to locate and evaluate existing bridge deficiencies to ensure the safety of the traveling public. The standards require bridge inspection every 2 years for established criteria.
- The Manual on Uniform Traffic Control Devices (MUTCD) contains standards for traffic control devices that regulate, warn, and guide road users along highways and roads in all 50 states;
- The American with Disabilities Act (ADA) sets guidelines for accessibility to places of public accommodation and commercial facilities by individuals with disabilities. These

guidelines are to be applied during the design, construction, and alteration of such buildings and facilities to the extent required by regulations issued by Federal agencies, including the Department of Justice, under the Americans with Disabilities Act of 1990.

- The Government Accounting Standards Board Statement 34 (GASB34) requires governmental financial statements to reflect the value of all infrastructure, in Portland, using the depreciation method
- National Environmental Policy Act - Environmental Impact Statements (EIS) required for any federally (ODOT) funded projects.
- NPDES Permit (MS4 Permit) Stormwater- NPDES Requirements- Water Quality/ Erosion and Sediment Control; PDOT coordinates on-site construction management and green streets project design and evaluation with BES.

State[66]

The Oregon Transportation Plan (OTP), adopted in September 2006, is the state's guide for transportation policy and long-range, comprehensive planning for the multimodal transportation system. Developed by the Oregon Department of Transportation (ODOT), the plan emphasizes maintaining the assets in place, optimizing the existing system performance through technology and better system integration, creating sustainable funding and investing in strategic capacity enhancements.

The OTP has many profound effects on regional transportation planning, in no small part because the state's Transportation Planning Rule (TPR) requires consistency between state, metropolitan and local plans. The main policy features of the OTP center around the emerging trend of demand/supply management of the roadway system, which is captured in the second goal. As noted above in the trend section, transportation agencies are increasingly attentive to the strategies they can use to make existing infrastructure work better.

The Land Conservation and Development Commission adopted the Transportation Planning Rule (TPR) (OAR 660-012) in 1991 to implement Statewide Planning Goal 12. The rule requires the state, the four metropolitan areas (Medford, Eugene, Salem and Portland), and all other cities and counties to adopt Transportation System Plans (TSPs). Each TSP is required to determine transportation needs and plans for roadway, transit, bicycle, pedestrian, air, rail, water, and pipeline facilities. TSPs in larger jurisdictions also are required to address transportation system management, demand management, parking, and finance. The TPR requires the development of modal system plans, including those for road, rail, and aviation systems.

The Oregon Highway Plan (OHP), adopted in 1999, focuses specifically on Oregon's state highway system. The plan emphasizes efficient system management, partnerships with regional and local agencies, connecting land use and transportation, access management, connectivity between modes, and environmental and scenic resources.

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[66] Excerpted from: Metro, *2035 Regional Transportation Plan Update: A Profile of the Regional Street and Throughway System in the Portland Metropolitan Region*, April 2007.

Regional[67]

In 1979, the voters in this region created Metro, the only directly elected regional government in the nation. In 1991, Metro adopted **Regional Urban Growth Goals and Objectives (RUGGOs)** in response to state planning requirements. In 1992, the voters of the Portland metropolitan area approved a home-rule charter for Metro. The charter identifies specific responsibilities of Metro and gives the agency broad powers to regulate land-use planning throughout the three-county region and to address what the charter identifies as "issues of regional concern." Among these responsibilities, the charter directs Metro to provide transportation and land-use planning services.

The charter also directed Metro to develop the 1997 **Regional Framework Plan** that integrates land-use, transportation and other regional planning mandates. The Regional Framework Plan is a comprehensive set of policies that integrate land-use, transportation, water, parks and open spaces and other important regional issues consistent with the 2040 Growth Concept. The Framework Plan is the regional policy basis for Metro's planning to accommodate future population and employment growth and achieve the 2040 Growth Concept.

The **2040 Growth Concept** text and map identify the desired outcome for the compact urban form to be achieved in 2040. It envisions more efficient land use and a diverse and balanced transportation system closely coordinate with land use plans. Bicycling is an important element of the transportation concept envisioned in Region 2040. The 2040 Growth Concept has been acknowledged to comply with statewide land use goals by the Land Conservation and Development Commission (LCDC). It is the foundation of Metro's 1997 Regional Framework Plan.

The **Regional Transportation Plan** implements the goals and policies in 1995 RUGGOs and the 1997 Regional Framework Plan, including the 2040 Growth Concept. The region's planning and investment in the regional public transportation system are directed by current RTP policies and objectives for the regional public transportation system.

STREET SYSTEM

Overview

Portland's arterial street system is substantially complete, although not necessarily improved to City standards. Major expansions to capacity are not anticipated, with a few exceptions. A few parts of the City, notably South Waterfront, do not have a network of streets to support future growth. Other areas, such as Southwest and Far Southeast, have a network of arterials, but lack local street connectivity. A well-connected street system relieves congestion on arterials and improves access for alternatives to motor vehicles, such as walking and bicycling.

Jurisdiction

The Oregon Department of Transportation (ODOT), Multnomah County, and the City of Portland are the primary transportation jurisdictions within the City. The Port of Portland, railroads, and

[67] Excerpted from: Metro, *2035 Regional Transportation Plan Update: A Profile of the Regional Street and Throughway System in the Portland Metropolitan Region*, April 2007.

private owners are also involved in transportation infrastructure. There are two primary considerations with respect to roadway jurisdiction: right-of-way (ROW) jurisdiction and route jurisdiction. In Portland, most roadways are either City streets on City ROW, ODOT routes on City ROW, or ODOT routes on ODOT ROW.

Map 3-1 Right-of-Way and Route Jurisdiction shows which government entity controls the right-of-way and which controlled the route on all roadways in Portland. Maintenance jurisdiction, see Map 3-2, is somewhat more complex than ROW or route jurisdiction, and depends on particular agreements between the City, ODOT, Multnomah County, and adjacent property owners. The City's Pavement Management System (PMS) maintains information about maintenance responsibility for City routes.

Inventory

The City of Portland owns 2,001 centerline miles of right of way, with a median width of 50 feet. This right-of-way currently accommodates 3,949 lane miles of improved streets and 125 lane miles of unimproved streets, see Map 3-3. The replacement value of the City's right-of-way and pavement is estimated at nearly $13 billion.

Table 3.2 Street System Inventory, Condition, and Replacement Value[68]

Facility	Inventory	Replacement Value ($ millions)	Condition						Total Unmet Need ($ millions)
			VG	G	F	P	VP	TBD	
Pavement	**4,074 lane mi**	**$5,371**							**tbd**
Improved Streets	3,949 lane mi	$5,371	0%	0%	0%	0%	0%	100%	tbd
Unimproved Streets	125 lane mi	n/a	0%	0%	0%	0%	100%	0%	n/a
Right-of-Way	**2,001 mi**	**$7,529***							
North	253 mi	$548							
Northwest	117 mi	$420							
Northeast	583 mi	$1,728							
Core	32 mi	$1,090							
Southwest	331 mi	$1,257							
Southeast	685 mi	$2,484							

* The replacement value of street right-of-way varies based on the average land cost in each district.

Portland's street system of arterials, collectors, local streets, and other important non-collector street connections is summarized below.

Classification Descriptions

Traffic Classification Descriptions

The City of Portland's Transportation System Plan includes six classifications for traffic streets: Regional Trafficways, Major City Traffic Streets, Traffic Access Streets, District Collectors, Neighborhood Collectors, and Local Service Traffic Streets. Table 3.3 and Map 3-4 provide more information on street traffic classifications. Each classification describes how a traffic

[68] City of Portland Transportation System: Status and Condition Report – 2007

street should function including what kinds of traffic and what kinds of trips are expected, and what types of land uses the street should serve.

Table 3.3 Traffic Classification Descriptions

Regional Trafficways	Regional Trafficways are intended to serve interregional district movement that has only one trip end in a transportation district or to serve trips that bypass a district completely.
Major City Traffic Streets	Major City Traffic Streets are intended to serve as the principal routes for traffic that has at least one trip end within a transportation district.
Traffic Access Streets	Traffic Access Streets are intended to provide access to Central City destinations, distribute traffic within a Central City district, provide connections between Central City districts, and distribute traffic from Regional Trafficways and Major City Traffic Streets for access within the district. Traffic Access Streets are not intended for through-traffic with no trip ends in the district.
District Collectors	District Collectors are intended to serve as distributors of traffic from Major City Traffic Streets to streets of the same or lower classification. District Collectors serve trips that both start and end within a district.
Neighborhood Collectors	Neighborhood Collectors are intended to serve as distributors of traffic from Major City Traffic Streets or District Collectors to Local Service Streets and to serve trips that both start and end within areas bounded by Major City Traffic Streets and District Collectors.
Local Service Traffic Streets	Local Service Traffic Streets are intended to distribute local traffic and provide access to local residences or commercial uses.

Emergency Response Classification Descriptions

The City of Portland's Transportation System Plan also includes two classifications for emergency response routes: Major and Minor Emergency Response Streets. Table 3.4 and Map 3-5 provide more information on emergency route classifications. Emergency Response Streets are intended to provide a network of streets to facilitate prompt emergency response. The Emergency Response Street classification descriptions were developed as part of the Emergency Response Study adopted by City Council resolution in 1998.

Table 3.4 Emergency Response Classification Descriptions

Major Emergency Response	Major Emergency Response Streets are intended to serve primarily the longer, most direct legs of emergency response trips.
Minor Emergency Response	Minor Emergency Response Streets are intended to serve primarily the shorter legs of emergency response trips.

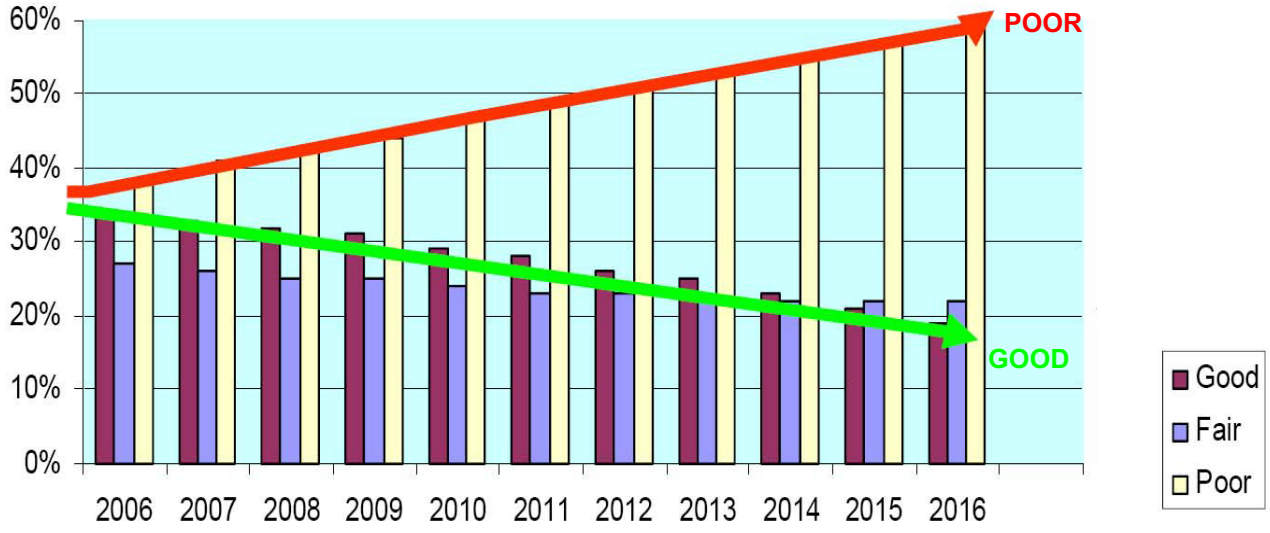
Chapter 2: Transportation Element of the TSP contains a detailed explanation of the functional classification of streets in Portland and eight maps showing traffic classifications for each of the seven transportation districts and the Central City. The modal plans in Chapter 5: Modal Plans and Management Plans, contain equivalency tables that compare the street classification schemes used in Portland's TSP with those used in Metro's Regional Transportation Plan (RTP). Classifications for pedestrian, bicycle, transit and freight networks are discussed in their respective sections of this document.

Pavement Condition

The Bureau of Transportation initiated a Pavement Management System in 1983 to identify and track the condition of all streets within the City. In 2007, the Bureau began implementing major changes to pavement management practices to comply with audit recommendations. New pavement condition rating methods, replacement of 25-year old software and changes to street preservation activities are in progress. Due to this update, current information on pavement condition is not available at this time. However, Map 3-6 displays priority pavement improvement areas, as determined by the Safe, Sound, and Green Streets Project.

The percentage of Portland's streets in fair or better condition declined from 86% in 1991 to 62% fifteen years later (2006). Without additional investment above projected levels, it is anticipated that the percentage of pavement in fair or better condition will decline even further, to approximately 40% by 2016, see Figure 3.1.

Figure 3.1 Projection of Pavement Condition, 2006 to 2016



Unmet Pavement Need

The ability to keep the road system in good repair is an important indicator of transportation system health. The level of unmet pavement need tracks success in reducing Portland's

backlog of streets needing maintenance. Large backlogs indicate a growing pool of streets that are deteriorating and will need increasingly costly repairs over time.

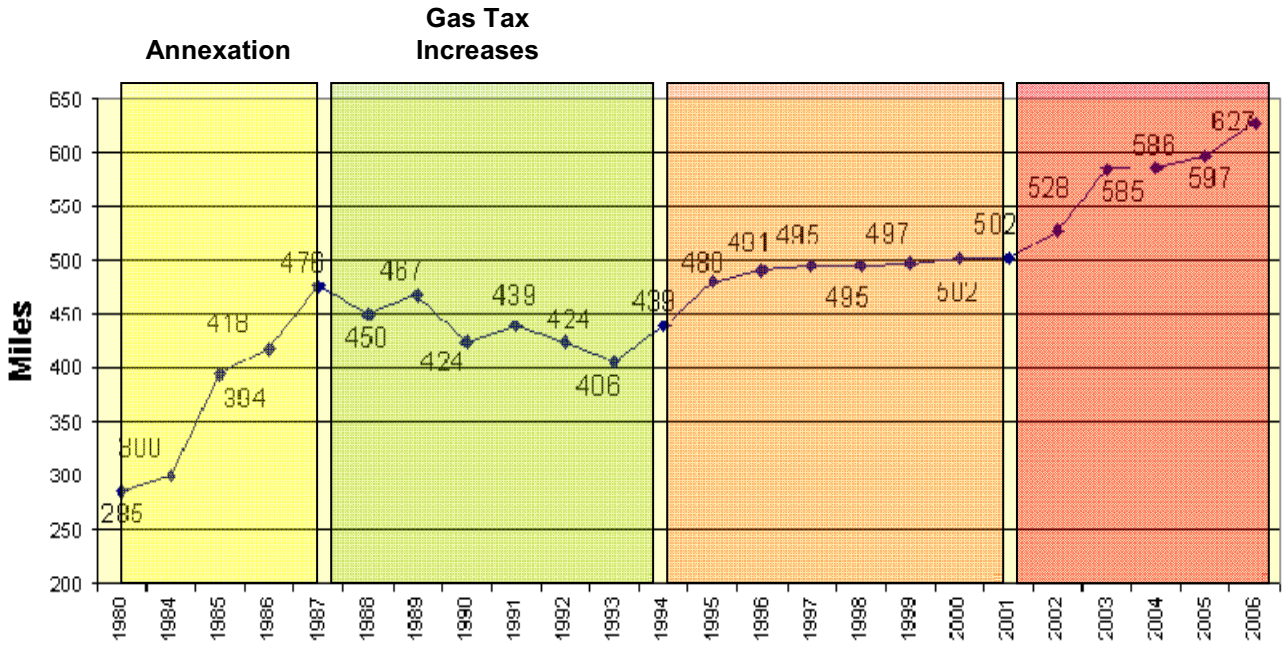
The Bureau of Transportation is currently updating condition assessments, the Pavement Management System software, performance measures, and unmet need estimates. Updated information on pavement unmet need should be available during fiscal year 2009-10. Table 3.5 lists unmet pavement needs for 1996 to 2005. Unmet need estimates may change once updates are completed. Figure 3.2 shows the growth of unmet pavement need from 1980 to 2006.

Table 3.5 Unmet Pavement Need (in lane miles)[69]

Type	2001	2002	2003	2004	2005	5-Year Average
Total	502	528	585	586	597	560

Type	1996	1997	1998	1999	2000	5-Year Average
Total	491	495	495	497	502	496
Major Rehabilitation/ Reconstruction	67	68	80	72	72	72
Structural Overlay	150	154	134	110	106	131
Preservation Overlay	128	131	127	144	155	137
Slurry Seal	146	142	154	171	168	156

Figure 3.2 Change in Unmet Pavement Need, 1980-2006



[69] City of Portland Bureau of Transportation, *Portland Transportation System Plan*, Chapter 15, Table 15-9, 2007. and City of Portland Bureau of Maintenance, *Status & Condition Report* , 1999.

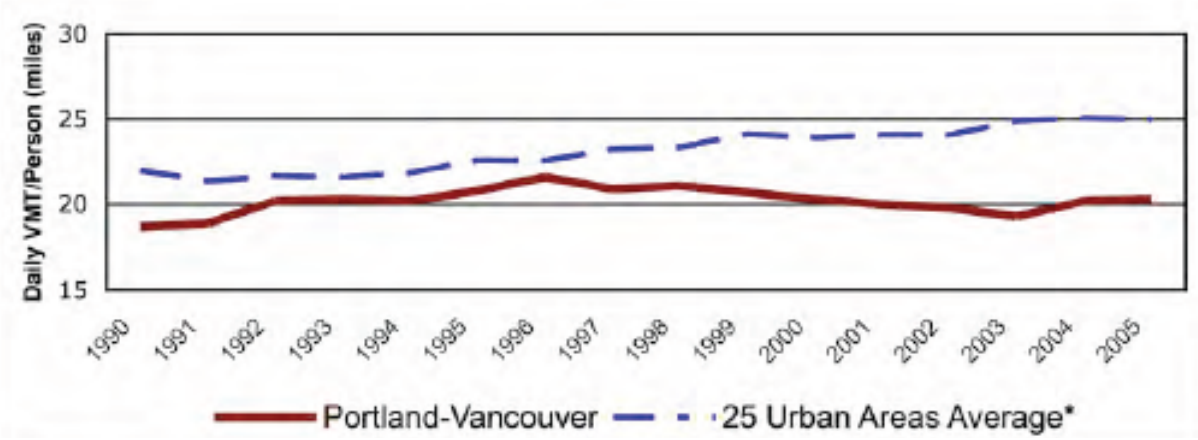
System Performance

Vehicle Miles Traveled per Capita

Vehicle miles traveled (VMT) is a measure used to describe total automobile use on a daily or annual basis. It is an important descriptor of changes in travel demand in an urban area and is a good indicator of the reliance on autos for urban mobility. VMT is more comprehensive than other indices used to measure travel by automobile because it incorporates both the number of vehicle trips and the length of those trips.

The City relies on Metro's regional model to estimate travel within the region. VMT estimates documented here use a trip-based approach, which multiplies average vehicle trip length (derived from the model) by the number of vehicle trips to establish VMT. A more detailed discussion of VMT calculation methodology is available in Appendix E-1 of the 2007 Transportation System Plan, available from the Portland Bureau of Transportation.

Figure 3.3 Daily Vehicle Miles Traveled Per Person, (1990–2005): Portland-Vancouver Region Compared with 25 Large Urban Areas in the U.S. 2070



[70] Metro, "Draft Federal Regional Transportation Plan", 2007. 2006 data for Portland, OR, and Vancouver, WA were received from the respective DOT HPMS's offices, via email, in July 2007. National data will be available in December 2007.Sources: Portland, OR only and Portland-Vancouver, OR-WA data are both from the FHWA in Washington, DC and from ODOT's Highway Performance Monitoring System (HPMS)program in Salem, Oregon - 1990 through 2005. National DVMT/ Person data is from the FHWA booklet "Highway Statistics," 1990-2005; Table HM-72, 'Urbanized Areas – Selected Characteristics', Publication No. FHWA-PL-03-013 (for 2004 booklet). The national average of DVMT/ Person is calculated from 'Total DVMT' divided by 'Estimated Population,' as it appears on Sheet 9 of Table HM-72; which lists all the Federal-Aid Urbanized Areas in the U.S. "A 'Federal-Aid Urbanized Area' is an area with 50,000 or more persons that at a minimum encompasses the land area delineated as the urbanized area by the Bureau of the Census" (from Roadway Footnotes for HM-72, page V-85 of 'Highway Statistics 2004').

Table 3.6 presents the VMT per capita for the City of Portland, including each transportation district, and the region as a whole. Overall, the City's VMT per capita is lower than the region as a whole for residential trips. The Central City generally has lower than average residential and employment VMT production. The highest VMT levels are generally found in outer northeast and in southwest.

Table 3.6 1994 and 2020 VMT per Capita[71]

	VMT Productions[1]				VMT Attractions[2]	
	Residential Trips[3]		Employment Trips[4]		Employment Trips	
District	1994	2020	1994	2020	1994	2020
Central City						
Downtown	3.47	2.18	3.15	2.95	13.73	9.00
Lower Albina	5.17	2.79	4.29	3.42	18.25	9.73
Lloyd	7.86	2.81	6.36	4.85	25.26	15.60
Central Eastside Ind.	5.19	3.81	3.81	3.87	17.05	16.24
N. Macadam	8.74	5.55	4.84	4.58	17.66	15.90
Goose Hollow	4.43	2.52	3.62	4.07	20.40	13.44
North	8.82	7.34	6.90	6.79	27.68	26.94
Northeast	8.55	7.83	7.67	8.78	33.26	35.70
Southeast	8.31	7.23	5.97	6.32	27.36	27.90
Far Northeast	11.95	10.68	6.59	6.86	29.60	28.27
Far Southwest	11.89	11.08	7.18	6.57	33.02	27.03
Southwest	10.92	10.64	5.83	5.82	28.13	30.09
Northwest	8.01	8.96	4.78	4.68	22.85	22.14
City	9.35	8.53	5.44	5.49	24.19	22.24
Region (for comparison) [5]	12.25	12.23	5.89	5.88	25.96	23.68

1 VMT Productions – All weekday vehicle miles traveled for trips produced in a district, regardless of destination.
2 VMT Attractions - All weekday vehicle miles traveled for trips attracted to the district, regardless of origin.
3 Residential VMT – Includes all home-based trip purposes and the residential component of the non-home-based, non-work purposes.
4 Employment VMT – Includes all non-home-based trip purposes except the residential component of the non-home-based, non-work purposes.
5 The regional VMT shown here includes the entire four county area. In the RTP, VMT was calculated excluding both Clark County and the area out side of the urban growth boundary (UGB).

[71] City of Portland Bureau of Transportation, *Portland Transportation System Plan*, Table 15-2, 2007.

Interim Benchmarks[72]

Table 3.7 lists the City's interim benchmarks for reduction of VMT per capita. The TPR calls for a 10 percent reduction in VMT per capita in the Portland metropolitan region over 20 years. The 2020 regional model output estimates a decline in the City's VMT per capita of 9 percent for residential production trips, 8 percent for employment attraction trips, and an increase of 1 percent for employment production trips.

Table 3.7 VMT per Capita Reduction Benchmarks[73]

	VMT per Capita Reduction Targets			
VMT Type	**5-year**	**10-year**	**15-year**	**20-year**
Residential Production				
Employment Production	2.5%	5%	7.5%	10%
Employment Attraction				

Non-Single-Occupancy Vehicle (SOV) Mode Split

The objective of this performance indicator is to increase the percentage of daily non-SOV person trips within Portland. Non-SOV person trips include transit, bicycling, walking, or shared rides (two or more to a vehicle) as modes of transportation. This indicator represents all of the factors leading to increases in non-SOV mode share, including land use changes and system improvements such as increased transit service, TDM programs, bike lanes, and sidewalks.

Metro's 2000 Regional Transportation Plan requires local jurisdictions to establish non-single-occupant vehicle (non-SOV) mode split targets for each 2040 design type, consistent with the targets as identified in Table 3.8.

Table 3.8 RTP Non-SOV Modal Targets[74]

2040 Design Type	Target	2040 Design Type	Target	2040 Design Type	Target
Central City	60-70%	Regional Centers Town Centers Main Streets Station Communities Corridors	45-55%	Industrial Areas Intermodal Facilities Employment Areas Inner Neighborhoods Outer Neighborhoods	40-45%

[72] The Transportation Planning Rule requires jurisdictions to set five-year interim benchmarks to ensure progress toward meeting these objectives. If benchmarks are not met, the TPR stipulates that the TSP must be amended to include new or additional efforts to meet the requirements.
[73] City of Portland Bureau of Transportation, *Portland Transportation System Plan*, Chapter 15, Table 15-3, 2007.
[74] City of Portland Bureau of Transportation, *Portland Transportation System Plan*, Chapter 15, Table 15-1, 2007.

Table 3.9 shows changes in non-SOV mode split for each transportation district and 2040 center. The 1994 base year and 2020 future year mode split are derived from the RTP preferred scenario (round one) regional model run. Factors from travel behavior surveys applied to auto person trips are used to calculate SOV use. These factors include auto ownership, age and income, transit accessibility, parking costs, trips distance, trips purpose, and relative travel time.

Table 3.9 Non-SOV Mode Split by Transportation District and 2040 Center[75]

District	1994	2020	2040 Center[1]	1994	2020
Central City			Gateway Regional Center	37%	39%
Central Business Dist.	46.28%	63.91%	Hollywood Town Center	39%	45%
Lower Albina	31.29%	46.54%	Lents Town Center	43%	43%
Lloyd	35.19%	46.34%	St. Johns Town Center	42%	40%
Central Eastside Ind.	34.13%	42.42%	West Portland Town Center	38%	37%
N. Macadam	25.88%	41.55%	60th Station Community	42%	44%
Goose Hollow	45.47%	65.85%	82nd Station Community	42%	44%
North	35.81%	37.13%	122nd Station Community	40%	41%
Northeast	37.55%	39.09%	148th Station Community	43%	48%
Southeast	39.27%	42.06%			
Far Northeast	35.33%	37.18%			
Far Southwest	37.58%	39.18%			
Southwest	35.25%	37.52%	**City**	**37.99%**	**42.97%**
Northwest	34.80%	41.83%	**Region**	**38.04%**	**39.44%**

Interim Benchmarks

TPR Section 660-012-0035 requires that jurisdictions increase the modal share of non-automobile vehicle trips (transit, bicycle, pedestrian).

The interim benchmarks listed in Table 3.10 are set citywide and for key 2040 design types, including the Central City. The 20-year benchmarks are consistent with the RTP's 2040 regional non-SOV mode split targets.

[75] City of Portland Bureau of Transportation, *Portland Transportation System Plan*, Chapter 15, 2007.

Table 3.10 Non-SOV Interim Benchmarks[76]

	Benchmarks			
Type	**5-year**	**10-year**	**15-year**	**20-year**
Citywide	38%	38.5%	39%	40%
Central City[1]	45%	50%	55%	60%
Regional Centers, Town Centers, Station Communities[2]	40%	41%	43%	45%

[1] Derived from the RTP's 2040 target mode split and Policy 3 of the Central City Transportation Management Plan (CCTMP).
[2] From the non-SOV mode split goals recommended in the 2040 Centers Transportation Strategies and Mode Split Targets Project.

Auto Occupancy per Capita

Increasing the number of people per vehicle, particularly for trips during normal commuting times when there is the greatest constraint on capacity, reduces congestion and improves the overall efficiency of the transportation system. Increasing the average auto occupancy also reduces total vehicle miles traveled per capita, helping to minimize air pollution and mitigate parking problems.

Table 3.11 shows the average number of persons per vehicle by transportation district. The City average is 1.20 persons per vehicle in 1994, dropping slightly to 1.19 in 2020. There are no significant differences between districts or horizon years. There is a slight decrease for most City districts over the planning horizon. The TPR (Section 660-012-0035) requires that jurisdictions increase average automobile occupancy (persons per vehicle).

Table 3.11 Average Auto Occupancy by Transportation District (persons)[77]

District	**1994**	**2020**	**District**	**1994**	**2020**
Central City			Northeast	1.20	1.19
Central Business Dist.	1.19	1.19	Southeast	1.21	1.20
Lower Albina	1.16	1.16	Far Northeast	1.20	1.18
Lloyd	1.19	1.18	Far Southwest	1.21	1.20
Central Eastside Ind.	1.16	1.17	Southwest	1.19	1.18
N. Macadam	1.14	1.17	Northwest	1.17	1.17
Goose Hollow	1.19	1.21	North	1.19	1.18
City	**1.20**	**1.19**	**Region (for comparison)**	**1.20**	**1.19**

Data are derived from Metro's regional travel forecast model, and represent Metro's 2020 strategic scenario of the RTP (round 3). The base year is 1994.

[76] City of Portland Bureau of Transportation, *Portland Transportation System Plan*, Chapter 15, Table 15-6, 2007.
[77] City of Portland Bureau of Transportation, *Portland Transportation System Plan*, Chapter 15, Table 15-7, 2007.

Interim Benchmarks

Benchmarks are not set for this measure. Metro has proposed a TPR revision that limits jurisdictional responsibility for benchmarking auto occupancy. Metro reasons that the information from the regional travel demand model is not useful to set objectives, since vehicle occupancy appears to be driven more by demographics, family size, and school-age versus aging populations than by transportation policy.

Street Connectivity

The state's Transportation Planning Rule requires local jurisdictions to develop standards for local street layouts that improve pedestrian and bicycle access. The RTP requires the development of street master plans for emerging areas greater than five acres and the application of street spacing standards to both existing areas and emerging areas when new development occurs. This performance indicator tracks Portland's progress toward improving street connectivity over time.

Metro defines a block spacing standard of 530 feet for auto connectivity and 330 feet for bike/pedestrian connectivity. However, for this performance measure, the block spacing standard has been increased to 570 feet to account for intersection street width between blocks. City blocks are contiguous tax lots defined on all sides by full street connections. City blocks with their centers within IG1, IG2, IH, OS, or p overlay zones were excluded from analysis because increased connectivity within designated protected and industrial sanctuary areas conflicts with other City goals. Table 3.12 lists the number and percentage of blocks meeting the 570-foot connectivity standard.

Table 3.12 Percentage of Street Connectivity by TE District[78]

TE District	Blocks less than or equal to 570'	Blocks greater than 570'	Total Blocks in District	% of Blocks that meet Metro Standard
Central City	545	33	578	94%
North	664	440	1,104	60%
Northeast	1,690	684	2,374	71%
Far Northeast	79	341	420	19%
Southeast	2,163	1,163	3,326	65%
Far Southeast	157	447	604	26%
Northwest	285	153	438	65%
Southwest	713	615	1,328	54%

Many of the older areas of Portland already meet the connectivity standards. Connectivity should be preserved in those areas. Maps 11.11.1 through 11.11.8 of the Transportation System Plan show areas of the City where new street and pedestrian/bicycle connections have been identified. Maps 11.11.9 through 11.11.16 show areas of the City where street connectivity standards are met and areas that are exempt from street connectivity standards. Maps should be used together with the applicable City codes that address connectivity. Street and

[78] City of Portland Bureau of Transportation, *Portland Transportation System Plan*, Chapter 15, Table 15-14, 2007.

pedestrian/bicycle connections should be considered for any site, regardless of whether it falls within an area that meets street connectivity standards. Additional connections may be warranted by its location within a 2040 land use type such as a center, or because of prevailing block size in an area.

Master Street Plans

Metro's Regional Transportation Plan requires master street plans for local jurisdictions covered by Metro. These master street plans are intended to promote a logical, direct, and connected street system. Conceptual street plans have been developed for areas of the City that have significant amounts of vacant or underdeveloped land and where the street network does not meet City and Metro connectivity guidelines. Master Street Plans have been completed for the areas listed in Table 3.13 and can be found in Chapters 2, Section 9 of the Transportation System Plan.

Table 3.13 Master Street Plan Areas[79]

South Waterfront District	Far Southeast District
Bridgeton Neighborhood (western half)	Ross Island Bridge (west end)
Gateway Regional Center	St. Johns town center
Airport Way vicinity	Northwest District
River District	Multnomah County Unincorporated Urban Pockets
Southwest District	

Traffic Volume and Level of Service

The City of Portland collects ongoing traffic data. The Bureau of Traffic Management combines this actual count data with the City's transportation model (EMME2) to produce an average daily traffic flow map that shows generalized traffic volumes for all arterial streets, see Map 3-7.

Level of service (LOS) defined either as the ratio of volume to capacity or as average vehicle delay, has historically been used as the sole measure of a transportation system's performance. The City is broadening this traditional congestion-based measure to incorporate the following factors:

- District Accessibility: Measures the ability of people in motorized vehicles to gain access to defined geographic areas called access districts. It provides a picture of the level of service for a district as a whole, rather than for specific intersections within it.
- Street Use Characteristics: Looks at the origin and destination of trips using a specific facility and the consistency of those trip types with the street's classification as defined in the TE.
- Travel Time: Measures the time it takes for a motor vehicle to go from point A to point B.
- Traffic Flow: Defined as the movement of traffic along a street. Performance is based on vehicle speed profiles and the number of stops made.

[79] City of Portland Bureau of Transportation, *Portland Transportation System Plan*, Chapter 2, Section 9, 2007.

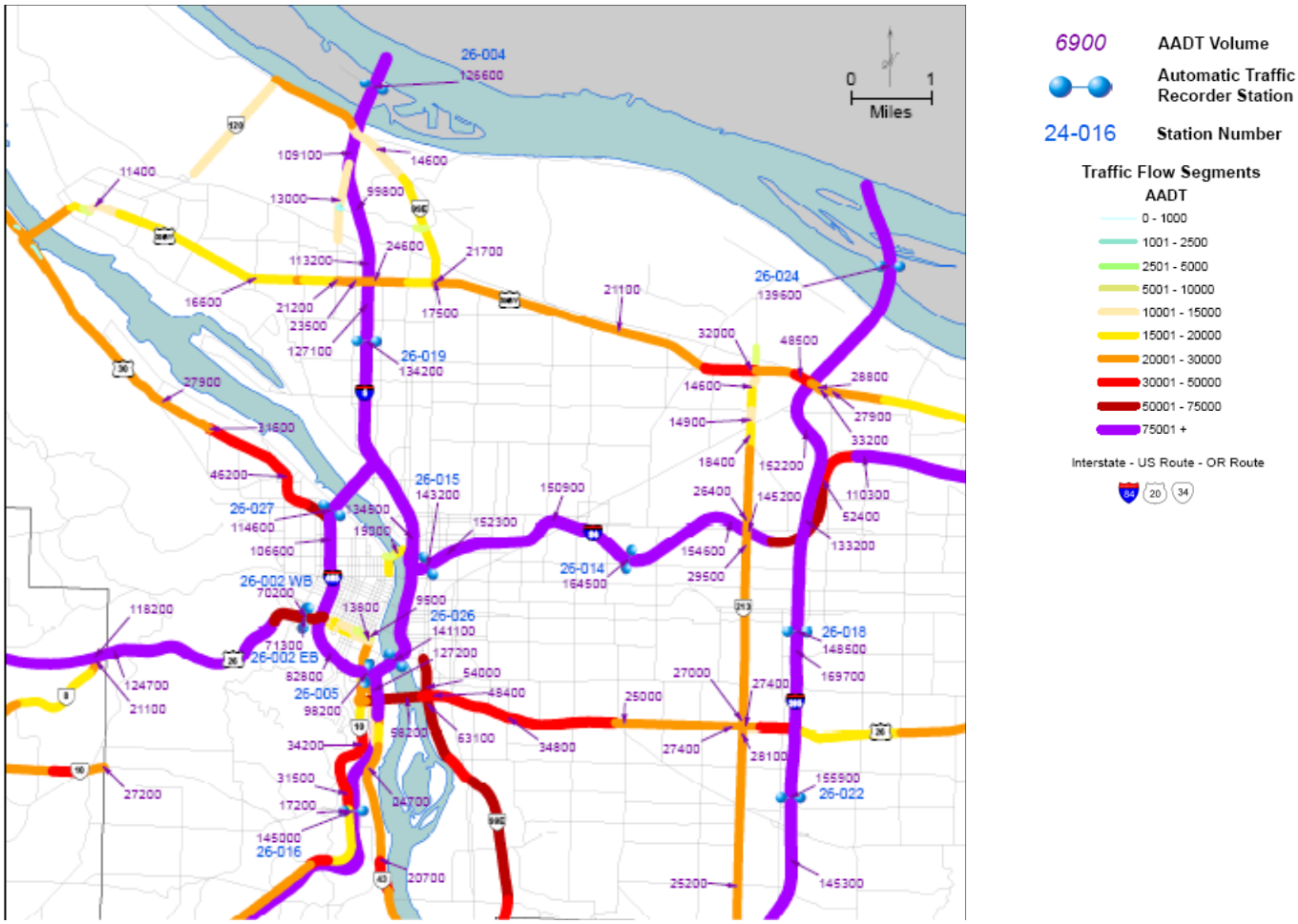
- Multimodal Service Level: The above four measures apply only to motor vehicle traffic. This measure incorporates non-motorized modes (bicycling and walking). Its emphasis is on the person-carrying capacity of the corridor, rather than the vehicle carrying capacity, to arrive at an averaged service level for all modes.

Congestion[80]

According to the Regional Transportation Plan, congestion is currently "assessed using average travel speeds and travel times drawing from an archive of real-time traffic monitors generated by the Oregon Department of Transportation and maintained by Portland State University (PSU). Currently this data are available only for the region's limited-access freeways. Efforts are underway to expand current data collection to include the regional arterial network."

Traffic Flow

Figure 3.4 Average Daily Traffic, Oregon State Highway System, 2007[81]



[80] Addiional information regarding current and projected levels of service and congestion on Portland's roadways will be available in the summer/fall 2009.

[81] Oregon Department of Transportation, Traffic Counts. "Traffic Flow Map, 2007, Portland Area". Online: http://www.oregon.gov/ODOT/TD/TDATA/tsm/tvt.shtml#Traffic_Volume_Tables. Accessed June 2009.

Major Highway Bottlenecks

In the Portland area, freeways and the interstate highway system suffer from the highest levels of congestion. Major bottlenecks in the highway system occur throughout the Portland metropolitan area, see Table 3.14. Significant bottlenecks within the City of Portland occur near the I-84 and I-5 interchange, the I-84 and I-205 interchange, along I-5 near the Interstate 5/Columbia River Bridge, and along I-26 near the Vista Ridge Tunnel.

Table 3.14 Major Highway Bottlenecks [82]

Reg. Rank	Road/Direction	Segment/ Interchange	Average Congested: Length (miles)	Hours / Day	Speed (mph)
Road Segments Located within the Portland City Limits					
1	I-5 Northbound	Marine Dr/Exit 307	0.76	23	14.8
2	I-5 Northbound	Victory Blvd/Exit 306	0.51	20	15.9
3	I-5 Southbound	N. Broadway/Exit 302	0.56	21	15.8
4	I-5 Northbound	Columbia Blvd/Exit 306	0.76	19	16.2
5	I-84 Westbound	Grand Ave/Hwy 99E/Pacific Hwy	0.20	20	15.6
6	I-5 Northbound	N Tomahawk Island Dr/Exit 308	0.53	23	20.0
7	I-5 Northbound	Alberta St/Exit 303	0.73	15	14.0
8	I-5 Northbound	Killingsworth St/Exit 303	1.12	16	15.3
9	I-5 Southbound	Victory Blvd/Exit 306	0.60	21	20.2
10	I-5 Northbound	US 30 Byp/Lombard St/Exit 305	0.32	15	16.5
11	Sunset Hwy/US 26 EB	Skyline Blvd/Exit 71	0.57	18	20.7
12	I-5 Northbound	Portland Blvd/Exit 304	0.93	14	17.0
13	Sunset Hwy/US 26 EB	I-405/Market St	0.60	20	20.0
14	I-5 Southbound	Weidler St/Exit 302	0.28	16	20.6
16	I-5 Southbound	Marine Dr/Exit 307	0.65	13	20.9
17	I-84 Eastbound	Lloyd Blvd/NE 1st Ave/Exit 1	0.68	14	21.5
19	I-5 Northbound	I-405	0.62	12	18.6
22	I-405 Southbound	I-5 (Portland) (South)	0.15	8	14.5
24	I-5 Northbound	I-405/US 30/Exit 302	0.80	10	18.9
Road Segments Located Outside the Portland City Limits, but within the Metropolitan Area					
15	Sunset Hwy/US 26 EB	Hwy 8	0.31	14	20.2
18	Beaverton-Tigard Fwy/ Hwy 217 SB	Walker Rd/Exit 1	0.92	11	19.2
20	Sunset Hwy/US 26 EB	Canyon Rd/Exit 72	0.79	14	23.8
21	Sunset Hwy/US 26 EB	Canyon Rd/Exit 73	1.14	14	23.6
23	Pacific Hwy/ I-5 SB	Mill Plain Blvd/Exit 1	0.64	10	19.2
25	Sunset Hwy/US 26 EB	Cornell Rd/Exit 65	0.94	11	22.6

Bottleneck "congestion" is defined as times when average hourly speed is half or less than the uncongested speed for that road segment. Additional information on the methodologies used in this report is available at http://scorecard.inrix.com.

Congestion Management Strategies

"Consistent with federal planning regulations, Metro maintains a Congestion Management Process (CMP) for the Portland metropolitan region. The CMP includes a performance

[82] Inrix National Traffic Scorecard, 2008 Annual Report. Online: http://scorecard.inrix.com/scorecard/MetropolitanDetails.asp?ID=23

monitoring program that informs needed capital investments, such as new or improved road capacity as well as demand and system management strategies to improve performance of the existing infrastructure. In addition to traditional congestion management strategies, transportation practitioners in the region have developed non-traditional approaches to managing congestion to reduce the number of vehicles on roads and highways, improve traffic flow and improve travel-time reliability."[83] Congestion management strategies in practice in Portland include high occupancy vehicle (HOV) lanes, incident management practices, transit-oriented development, and promotion of alternative transportation options through infrastructure improvements and education programs.

Intelligent Transportation System (ITS) Corridor Travel Time

Given the cost and livability impacts of expanding capacity of the motor vehicle network, it is increasingly important to maximize the efficiency of traffic movement on existing arterials, without adding new lanes. The aim of intelligent transportation systems (ITS) is to address peak-period travel to help manage unusual high volume traffic incidents (for example, public events and collisions on parallel highway and arterial routes) and reduce bottlenecks to provide efficient, consistent traffic flow through a travel corridor.

Travel time is the proxy measure for the efficiency of vehicle movement along significant radial and circumferential routes. Measurements performed every five years provide an indication of travel time change in a given corridor, and give planners and traffic engineers information about where to target land use and transportation projects (including ITS projects) to better balance travel patterns in the identified corridors. Degradation of travel time in a given corridor can trigger prioritization of ITS projects such as better signal timing.

Table 3.15 lists the ITS corridors and the 2001 baseline travel time, measured in minutes and fractions of minutes.

[83] Metro RTP

Table 3.15 Travel Time in ITS Corridors (minutes)[84]

Corridor	AM Peak	Mid-Day	PM Peak
SW Macadam			
(NB) SE 15th to SW Lincoln	12.68	8.66	9.52
(SB) SW Jackson to SE 15th	11.16	10.99	13.73
SW Barbur			
(NB) SW 68th Avenue to SW Lincoln	13.55	13.38	17.05
(SB) SW Jackson to SW 68th Ave	14.02	12.80	15.40
Burnside			
(EB) NW Skyline to NE 14th Ave.	11.24	13.93	19.58
(WB) NE 14th Ave to NW Skyline	13.80	14.52	17.51
NW Yeon/S t. Helens Rd.			
(NB) SW 14th and Washington to Lombard x-Walk E	14.03	12.55	13.57
(SB) Lombard x-Walk E to SW 14th and Washington	14.90	13.68	12.73
NE MLK/Grand			
(NB) Market to Kilpatrick	14.66	14.38	16.14
(SB) Kilpatrick to Market	12.50	13.19	18.71
NE Sandy Blvd			
(EB) E 9th Ave. to NE 105th	13.94	13.94	17.61
(WB) NE 105th to E 9th Ave.	13.59	14.06	16.01
SE Powell Blvd.			
(EB) SW Jackson to E/174th	23.55	25.10	30.72
(WB) E/174th to SW Jackson	27.77	23.89	25.48
SE McLouglin			
(NB) SE Ochoco St to SE Taylor	7.79	6.06	6.28
(SB) SE Taylor to SE Ochoco St.	5.96	5.99	7.92
N/NE Lombard			
(EB) N Alta Ave. to NE 104th	19.85	22.25	24.39
(WB) NE 104th to N Alta Ave.	20.63	22.01	23.85
NE/SE 82nd			
(NB) SE Clackamas St. to Pacific Equipment D/W	15.59	16.90	19.60
(SB) Pacific Equipment D/W to SE Clackamas St.	15.25	18.28	21.35

Note: Values are averages of between 5-8 runs completed for each corridor/direction/time of day combination.
NB= northbound; SB=southbound; EB=eastbound; WB=westbound

[84] City of Portland Bureau of Transportation, *Portland Transportation System Plan*, Chapter 15, Table 15-12, 2007.

System Safety

Improving transportation system safety is an integral part of the City's planning efforts. In addition to causing property damage, collisions are responsible for a significant number of fatalities and injuries, lost work time, and family trauma. Children are especially vulnerable in collisions. For these reasons, it is an important City goal to decrease collisions between all modes through safety improvements and education.

High-Crash Locations

High crash locations, or intersections with high numbers and high severity crashes, persist along a number of major arterials in the City - most notably 82nd Ave, 122nd Ave, Glisan St, Stark St, Foster Rd, and the Broadway/Weidler/Vancouver/Williams area (see Map 3.9 and Table 3.16).[85]

Table 3.16 High Auto Crash Intersections[86]

SE 39th at Powell	SE Duke St at 82nd Ave	NE Glisan St at 102nd Ave
NE Sandy at 82nd Ave	SE Stark St at 102nd Ave	NE Marine Dr at 33rd Ave
SE Powell at 122nd Ave	N Weidler St at Vancouver Ave	N Broadway at Williams Ave
SE Powell at 92nd Ave	NE Fremont St at MLK Blvd	E Burnside at 82nd Ave
NE Halsey at 122nd Ave	SE Foster Rd at 96th Ave (I-205)	SE Foster Rd at 122nd Ave
SE Stark St at 122nd Ave	SE Division St at 162nd Ave	W Burnside St at 23rd Ave
NE Columbia Blvd at MLK Blvd	SE Stark St at 148th Ave	NE Glisan St at 82nd Ave
NE Glisan St at 122nd Ave	SE Washington St at 96th Ave	SE Washington St at 102nd Ave
SE Holgate Blvd at 82nd Ave	N Broadway at Vancouver Ave	NE Sandy Blvd at 39th Ave
SW Washington St at 2nd Ave	SW Jefferson Rd at Canyon Rd	
SE Foster Rd at 82nd Ave	SE Foster Rd at 92nd Ave	

Intersections with more than six crashes over a four-year period are termed 'major intersections.' Major intersections typically carry through-moving traffic on non-local streets. At the time of the 1996 inventory, Portland had 1,327 major intersections.

Traffic Fatalities and Injuries

Table 3.17 includes fatal and injury crash data for the years 1996 – 2007. The table demonstrates a reduction in serious traffic incidents, involving autos, pedestrians, or cyclists, in the City over the past ten years.

[85] City of Portland Bureau of Transportation, Safe Sound and Green Streets, 2007.
[86] City of Portland Bureau of Transportation, Safe Sound and Green Streets, 2007.

Table 3.17 Fatal and Injury Crashes per Thousand Capita (1996-2007)[87]

		Fatal Crashes		Injury Crashes	
Year	Population	Number	Crashes/1,000	Number	Crashes/1,000
1996	503,000	55	0.11	6,271	12.47
1997	508,500	45	0.09	5,938	11.68
1998	509,600	44	0.09	4,981	9.77
1999	512,395	37	0.07	4,439	8.65
2000	531,600	35	0.07	5,107	9.61
2001	536,240	36	0.07	5,582	10.41
2002	538,180	40	0.07	6,001	11.15
2003	545,140	47	0.09	5,905	10.83
2004	550,560	37	0.07	5,480	9.95
2005	556,370	34	0.06	5,250	9.44
2006	562,690	31	0.06	5,816	10.34
2007	568,380	36	0.06	4,691	8.25

PEDESTRIAN NETWORK

The City of Portland is committed to providing the benefits of walking to all residents by supporting pedestrian travel as a safe, efficient, desirable, and accessible mode throughout the City's neighborhoods. Walking is considered an essential component in efforts to develop a multimodal transportation system and reduce reliance on the automobile.[88]

Inventory

Portland's pedestrian system includes not only the sidewalk system, but also off-street paths, crosswalks, signals, signage, and other amenities. The City has 8,692,461 square yards of sidewalk, 37,567 improved street corners, and 3,239 lineal miles of curbs. The replacement value of sidewalks is estimated at $860.5 million, curbs at $649.8 million, and improved street corners $113.5 million. (see Table 3.1 and Map 3-10) Other important components of the pedestrian system are discussed in detail in other sections of this report, including off-street paths (see Trails, page 85), signals (see Signals, page 146), crosswalks (see Pavement Markings, page 149), and signage (see Signs, page 149).

Sidewalks

The sidewalk system is comprised of sidewalks, corners and curbs. The City of Portland has regulatory responsibility of all designated pedestrianways, except for State-owned streets within City limits and the Willamette River bridges (see Map 3-10). Adjacent property owners are responsible for maintaining sidewalks on pedestrianways, as well as sidewalks on other streets. The two exceptions are street corners and public stairways, which the City of Portland maintains.

[87] City of Portland Bureau of Transportation, *Portland Transportation System Plan*, Chapter 15, Table 15-14, 2007.
[88] City of Portland Bureau of Transportation, *Transportation System Plan*

The 1996 Inventory analyzed sidewalk inventory data for arterial streets and local streets in each of the eight Transportation Districts defined in the Transportation Element of the Comprehensive Plan (Chapter 2 of the TSP). Table 3.18 summarizes the inventory results, organized by Transportation District. The data are grouped by total sidewalk miles, total miles on arterial streets, and total miles on local service streets. (Figure 10 in the 1996 Inventory depicts these results in bar chart form. Figure 11 in the 1996 Inventory shows the geographic distribution of the blocks with full sidewalks on at least one side.)

As might be expected, the inventory results show that older, inner neighborhoods (such as Southeast and Northeast) are much more likely to have completed sidewalk systems on at least one side of the street than the more recently annexed areas of the City (such as Southwest or outer east neighborhoods).

Table 3.18 Sidewalk Inventory by District for City Streets[89]

District	Total Miles	Total with Sidewalks on Both Sides		Total with Sidewalk on One Side		Total with Incomplete or No Sidewalk	
		Miles	%	Miles	%	Miles	%
All Streets							
North	255	134	53%	28	11%	93	36%
Northeast	426	295	69%	20	5%	110	26%
Far Northeast	153	46	30%	15	10%	92	60%
Far Southeast	200	42	21%	20	10%	138	69%
Southeast	524	385	74%	35	7%	104	20%
Southwest	322	36	11%	23	7%	263	82%
Northwest	116	39	34%	15	13%	62	54%
Central City	107	76	71%	11	10%	21	20%
Whole City	2,102	1,054	50%	166	8%	883	42%
Arterial Streets							
North	47	21	46	8	18	17	37%
Northeast	87	20	57%	6	6%	32	37%
Far Northeast	53	15	29%	10	20%	27	52%
Far Southeast	46	12	26%	6	14%	28	61%
Southeast	90	73	81%	5	6%	12	38%
Southwest	78	8	11%	9	12%	60	78%
Northwest	31	12	39%	7	23%	12	38%
Central City	34	18	53%	10	29%	6	19%
Whole City	465	210	45%	62	13%	194	42%
Local Streets							
North	208	113	54%	19	9%	76	36%
Northeast	338	245	73%	15	4%	78	23%
Far Northeast	101	31	31%	5	5%	65	64%
Far Southeast	154	30	20%	14	9%	110	72%
Southeast	434	312	72%	29	7%	92	21%
Southwest	244	28	11%	14	6%	203	83%
Northwest	85	27	32%	8	9%	50	59%
Central City	73	58	79%	1	1%	15	20%
Whole City	1,637	844	52%	104	6%	689	42%

Note: The sidewalk inventory methodology does not take into account the discontinuity of the sidewalk between blocks. In the category of street segments with 100 percent sidewalk on one side, for example, a sidewalk that jumps from one side of the street to the other is counted no differently than a sidewalk that continues on the same side.

[89] City of Portland Bureau of Transportation, *Transportation System Plan*, Table 9.9, 9.10, and 9.1, 2007. Original Source: Pedestrian Program Inventory 1996

Figure 3.5 Sidewalk Coverage on Arterial Streets, 1996 Inventory

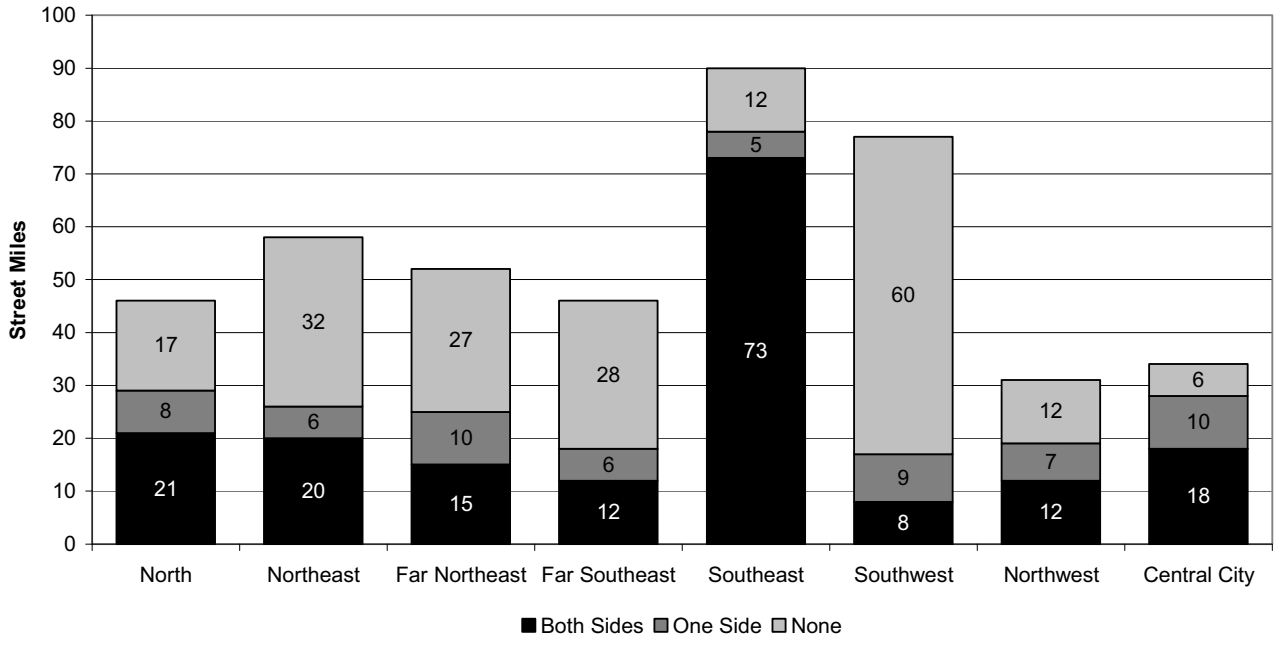
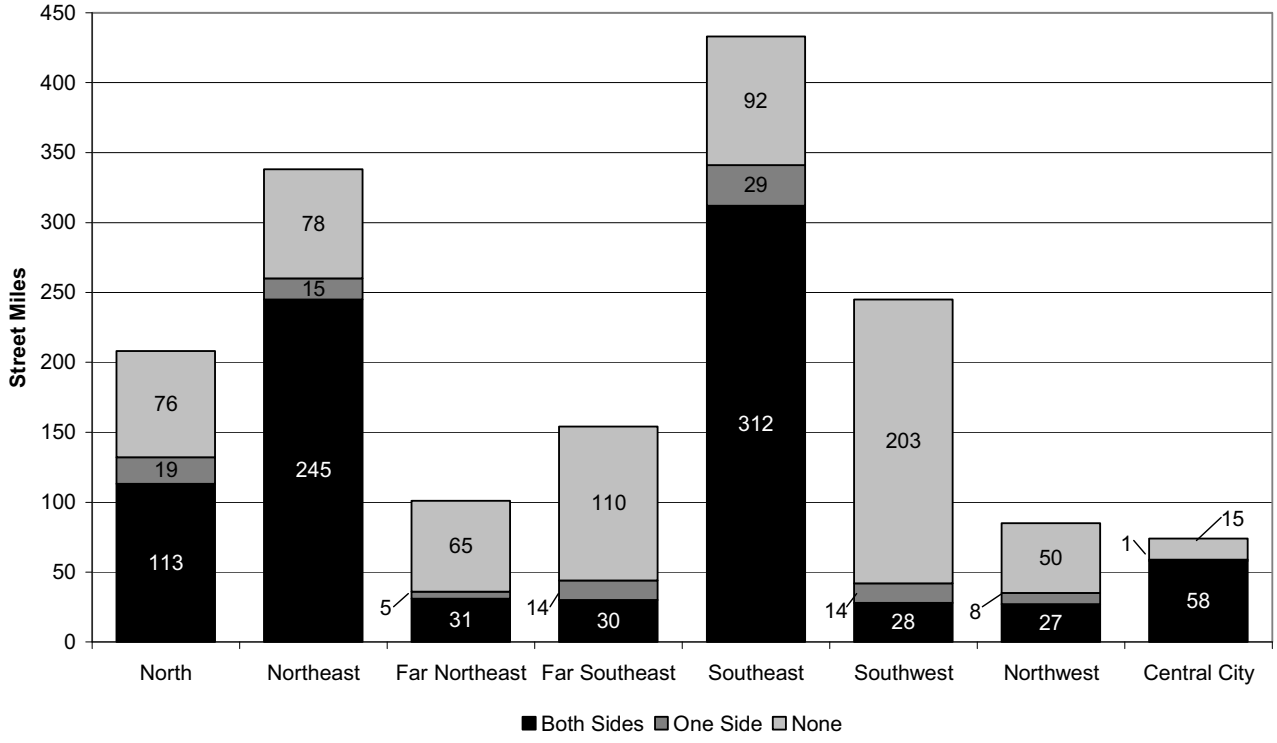


Figure 3.6 Sidewalk Coverage on Local Streets, 1996 Inventory



Curb Ramps

The 1996 Inventory analyzed curb ramp data for regular corners and for 'T' intersections.

Corners were classified by the existence or lack of curb ramps. For corners with a single ramp, the data do not identify whether it is a diagonal ramp serving both travel paths or a straight ramp serving only one path. A "T" intersection generally has two legal crosswalks that extend between corners on one side of the intersection to a straight curb on the other side. Ramps on the straight curb were designated as a single entry.

Table 3.19 shows the 1996 Inventory distribution of corners and "T" intersections across the eight districts. The Maintenance and Operations Group has an ongoing program to install curb ramps throughout the City, with priority given to business districts and transit streets. The number of curb ramps installed each year varies, and can be as many as 400 to 600. (Figure 12 in the 1996 Inventory illustrates the distribution of corners and T intersections across the City, and Figure 13 shows all the existing curb ramps in the City at the time of the inventory.)

Table 3.19 Curb Ramp Inventory by Transportation District [90]

		Corners with at least One Ramp	
District	Total Corners	#	%
North	5,812	1,900	33%
Northeast	11,430	2,967	26%
Far Northeast	3,324	569	17%
Far Southeast	4,478	722	16%
Southeast	16,186	5,010	31%
Southwest	7,384	775	10%
Northwest	2,248	920	41%
Central City	3,712	2,086	56%
Whole City	54,574	14,949	27%

Desired Levels of Service

The City of Portland's goal is to provide pedestrian connections at approximately 330-foot intervals on public easements or rights-of-way when full street connections are not possible, except where prevented by barriers such as topography, railroads, freeways, or environmental constraints. Pedestrian connections that cross protected water features should have an average spacing of no more than 530 feet, unless exceptional habitat quality or length of crossing prevents a connection. The City also aims to provide accessible pedestrian access throughout the system to achieve compliance with the Americans with Disabilities Act.

Current Condition

There is no condition inventory for the sidewalk system. Condition assessments on curbs and corners are based on professional judgments of Public Works Supervisors. The percent in poor condition is based on the estimated backlog of curbs and corners.

[90] City of Portland Bureau of Transportation, *Transportation System Plan*, Table 9.12, 2007. Original Source: Pedestrian Program Inventory 1996.

Table 3.20 Portland Bureau of Transportation Inventory, Condition, and Replacement Value[91]

Facility	Inventory	Replacement Value ($ millions)	Condition						Total Unmet Need ($ millions)
			VG	G	F	P	VP	TBD	
Sidewalk System	**n/a**	**$1,624**							**$138.6**
Sidewalks	8.7 mil. yd^2	$860.6	0%	0%	0%	0%	0%	100	n/a
Curbs	3,239 mi.	$649.9	0%	75%	15%	10%	0%	0%	$65.0
Corners	55,764	--	--	--	--	--	--	--	--
Improved	37,567	$113.5	0%	80%	15%	5%	0%	0%	$73.7
w/ Ramps	13,195	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Unimproved	5,002	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Sidewalks

The repair of sidewalks is the responsibility of the adjacent property owner. Sidewalk inspection occurs on a 25-year cycle for residential neighborhoods and a 5-year cycle for the Central Business District. If inspection determines that a section of sidewalk requires repair, the City notifies the adjacent property owner. The property owner has the option to repair the sidewalk. If repairs are not made within a specified period of time, the City performs the repairs and bills the property owner for the cost of repairs.

Corners

Corners are inspected on the same cycle as sidewalks. Unlike sidewalks, the corners are the responsibility of the City. The City is working to modify curbs in corner areas where they form a barrier to access as required by the Americans with Disabilities Act (ADA). According to the City's inventory, 65% or 24,372 corners need ramps to comply with ADA standards. The cost of improving curb ramps is $73.6 million, including the cost of installing curb ramps at all crossings where curbs form a barrier.

Curbs

Responsibility for curb repair is divided between the property owner and the City, depending on the type of curb. Curbs constructed in combination with the adjacent sidewalk are the responsibility of the property owner. Curbs separated from the sidewalk are the responsibility of the City and are repaired as funds are available. The average life expectancy of curbs is 60 years. The U.S. Environmental Protection Agency considers curbs a part of the drainage systems. Deteriorated curbs allow water to collect under the street pavement causing damage to the street. Curb height is noted when pavement condition is inspected; however, curb condition is not currently assessed on a system-wide basis.

Pedestrian Classification Descriptions

The City of Portland's Transportation System Plan includes five classifications for pedestrianways: Pedestrian Districts, Pedestrian-Transit Streets, City Walkways, Off-Street Paths, and Local Service Walkways. Table 3.21 and Maps 3-11 provide more information on pedestrianway classifications. The classifications are intended to maintain a system of pedestrianways to serve all types of pedestrian trips, particularly those with a transportation

[91] City of Portland Transportation System: Status and Condition Report - 2007

function. Chapter 2: Transportation Element of the TSP contains more detailed explanations of the functional classification of pedestrianways in Portland and eight maps showing traffic classifications for each of the seven transportation districts and the Central City.

Table 3.21 Pedestrian Classification Descriptions

Pedestrian Districts	Pedestrian Districts are intended to give priority to pedestrian access in areas where high levels of pedestrian activity exist or are planned, including the Central City, Gateway regional center, town centers, and station communities.
Pedestrian-Transit Streets	Pedestrian-Transit Streets are intended to create a strong and visible relationship between pedestrians and transit within the Central City.
City Walkways	City Walkways are intended to provide safe, convenient, and attractive pedestrian access to activities along major streets and to recreation and institutions; provide connections between neighborhoods; and provide access to transit.
Off-Street Paths	Off-Street Paths are intended to serve recreational and other walking trips.
Local Service Walkways	Local Service Walkways are intended to serve local circulation needs for pedestrians and provide safe and convenient access to local destinations, including safe routes to schools.

Major System Concerns

Network Connectivity

The sidewalk system has a relatively high level of connectivity in inner neighborhoods and the central city. However, a significant portion (greater than 60%) of streets in outer east and southwest Portland lack sidewalks. In outer southeast and southwest Portland, greater than 60% of arterials have no sidewalks, severely limiting safe, accessible pedestrian options for residents. In many cases, completing the sidewalk network in these areas is complicated by financial and topographic constraints.

Pedestrian Safety

Apart from increases in 2005 and 2006, pedestrian injuries have been declining since 1999, see Table 3.22. Intersections with high numbers of crashes involving pedestrian injuries can also be found in all areas of the city. Concentrations of high pedestrian crash intersections can be found on SE 82nd Ave, SE Division, SW Barbur, SW Beaverton-Hillsdale Highway, NW Highway 30, NE Sandy, NE Halsey, NE 102nd Ave, and N Willamette Blvd. A full list of high pedestrian crash intersections can be found in Table 3.23 and displayed on Map 3-12. Many of these roads are considered major arterials or state routes, with higher traffic volumes and speeds.

Table 3.22 Pedestrian Injuries and Fatalities, 1999-2007[92]

		Pedestrian Injuries		Pedestrian Fatalities	
Year	Population	Total Incidents	Rate per 100,000 people	Total Incidents	Rate per 100,000 people
1999	512,395	238	46	15	2.9
2000	531,600	202	38	10	1.9
2001	536,240	198	37	10	1.9
2002	538,180	189	35	11	2.0
2003	545,140	192	35	15	2.8
2004	550,560	149	27	10	1.8
2005	556,370	162	29	8	1.4
2006	562,690	191	34	6	1.1
2007	568,380	123	22	10	1.8

Table 3.23 High Pedestrian Crash Intersections[93]

Northeast	Northwest	Southwest
NE Broadway at 26th Ave	NW Burnside at Uptown Ter	SW Barbur at Troy St
NE Broadway at 35th Ave	NW Burnside at Maywood Dr	SW Barbur at Luradel St
NE Killingsworth at 57th Ave	NW Hwy 30 at Harbor Blvd	SW Barbur at SW 30th Ave
NE Sandy at 59th Ave	NW Hwy 30 at 56th Ave	SW Barbur at 11240
NE Sandy at 85th Ave	NW Hwy 30 at 112th Ave	SW Beav.-Hills Hwy at 35th Ave
NE Sandy at 64th Ave	**Southeast**	SW Beav.-Hills Hwy at 42nd Ave
NE Halsey Ave at 114th Ave	SE 82nd Ave at Ash St	SW Beav.-Hills Hwy at 50th Ave
NE Halsey at 126th Ave	SE 82nd Ave at Cooper St	**North**
NE Halsey at 140th Ave	SE 82nd Ave at Main St	N Lombard at Chase Ave
NE 82nd at Thompson	SE 82nd Ave at Lambert St	N Lombard at Russet St
NE 102nd Ave at Davis St	SE 82nd Ave at Pacific St	N Rosa Parks at Newcastle
NE 102nd Ave at Oregon St	SE 82nd at Francis St	N Willamette at Harvard
NE 102nd Ave at Hancock St	SE Foster Rd at 107th Ave	N Willamette at Woolsey
NE 102nd Ave at Shaver St	SE Foster at 116th Ave	N Willamette at Washburne
NE 122nd at Stanton	SE Division at 45th Ave	
NE 122nd Ave at Holladay St	SE Division at 66th Ave	
	SE Division at 87th Ave	
	SE Division at 105th Ave	

[92] City of Portland Bureau of Transportation, *Transportation System Plan*, 2007.
[93] Portland Bureau of Transportation, Safe, Sound, and Green Streets, 2008.

According to the 2007 City of Portland Citizen Survey, perceptions of pedestrian safety vary widely by neighborhood. In 2007, just over half of residents rated their neighborhood streets as good or very good for pedestrian safety citywide. In general, residents in inner neighborhoods rate their local streets as safer for pedestrians than do those in southwest, outer southeast, and central northeast. Pedestrian safety ratings are particularly low in the Markham, Arnold Creek-Marshall Park, and Maplewood neighborhoods of southwest Portland.

Accessibility

Pedestrian accessibility guidelines have been established by the federal Americans with Disabilities Act and by the City of Portland's Pedestrian Design Guidelines. Curb cuts, right-of-way barriers, slope, sidewalk buckling, and non-accessible signals represent the most significant barriers to fully accessible pedestrian access on Portland's sidewalks.

Approximately 65% of corners do not have curb cuts necessary to comply with ADA requirements and provide equitable access to meet all pedestrian needs. However, the City is improving corners on an annual basis – approximately 1400-1500 were improved each year from 2003 to 2006. This level currently exceeds goals established in the City's ADA Transition Plan. Curb improvements are also installed by city and private contractors as part of capital improvements and permit projects for private development. The City has also established a request-based curb cut program to address urgent needs.

Since FY 2006-07, the budget for all curb repair and replacement has been eliminated. Portland's current curb service level would need to be increased to 54 lineal miles per year to correspond with the expected life of curbs.

The unmet need for curbs is $64.9 million (10% of total replacement value). This is the cost to replace curbs that are currently in poor condition. The unmet need for improved street corners is $73.6 million, based on an estimate that 65% of the improved corners need curb ramps installed to meet ADA standards. Adjacent property owners are financially responsible for repairing sidewalks; therefore, the City does not have any unmet sidewalk repair need.

BICYCLE NETWORK[94]

Inventory

The City of Portland's bicycle network currently includes approximately 270 miles of bikeways, including approximately 170 miles of bicycle lanes, 30 mile of bicycle boulevards, and 69 miles of off-street paths, see Table 3.25 and Map 3-13.

Classification

The City's Transportation System Plan identifies only two bicycle classifications: "City Bikeway," for bikeways within the public right-of-way, and "Off-Street Paths," for shared, multi-use paths that are not open to motorized vehicles and are generally, though not exclusively, outside the boundaries of the public right-of-way. However, the City's Bicycle Master Plan identifies four

[94] Excerpted from: Portland Bureau of Transportation, *Platinum Bicycle Master Plan Existing Conditions Report,* September 2007.

separate types of facilities for Portland's City Bikeways: Bicycle Lanes, Bicycle Boulevards, Signed Connections, and Off-Street Paths. These facilities reflect different criteria for their development, different treatments to develop them, different locations in the private and public realm, and different functions. Table 3.25 lists the existing, funded, and planned extent of each type of bikeway for areas throughout the City.

Jurisdiction

Portland's Bureau of Transportation is the "road authority" for the City of Portland. While this means that PBOT owns and manages (and constructed) the majority of roads, and thus bikeways in the city, it is by no means the only agency involved in developing and managing the city's bikeways. The Oregon Department of Transportation owns a number of roadways in Portland, and is thus directly responsible for the existing and future bikeways on their roads. Multnomah County also owns and operates significant bikeways in the city—most significant among their holdings are a number of the bridges across the Willamette River, including the Hawthorne, Morrison, Burnside, Broadway, and Sellwood bridges. Portland Parks and Recreation also plays an important role in the city's bikeway system as they are the principal owner and manager of several significant off-street paths. Other jurisdictions and agencies with ownership and management responsibility for city bikeways include Metro, the Port of Portland, and the Multnomah County Drainage District.

Bicycle Classification Descriptions

The City of Portland's Transportation System Plan includes three classifications for bikeways: City Bikeways, Off-Street Paths, and Local-Service Bikeways. Table 3.24 and Maps 3-14 provide more information on bikeway classifications. The classifications are intended to maintain a system of bikeways to serve all bicycle users and all types of bicycle trips. Chapter 2: Transportation Element of the TSP contains more detailed explanations of the functional classification of bikeways in Portland and eight maps showing traffic classifications for each of the seven transportation districts and the Central City.

Table 3.24 Bicycle Classification Descriptions

City Bikeways	City Bikeways are intended to serve the Central City, regional and town centers, station communities, and other employment, commercial, institutional, and recreational destinations.
Off-Street Paths	Off-Street Paths are intended to serve as transportation corridors and recreational routes for bicycling, walking, and other non-motorized modes.
Local Service Bikeways	Local Service Bikeways are intended to serve local circulation needs for bicyclists and provide access to adjacent properties.

Bikeway Treatments

Bicycle Lanes

Bicycle lanes are the most frequently used bikeway treatment on Portland's streets. Portland currently has 167 miles of roadway striped with bicycle lanes. Portland's roadways are typically striped with bicycle lanes only when the average daily traffic on the street (ADT) exceeds 3,000 vehicles per day (vpd). In limited circumstances Portland has striped bicycle lanes on roadways carrying lower volumes for a number of reasons.

Most of Portland's bicycle lanes are the traditional "right-running" bicycle lane. They run either against the right curb or adjacent to parking on the right side of the roadway. Occasionally bicycle lanes are provided on only one-side of a two-way roadway when insufficient width exists to stripe both directions.

Five feet is the standard width for bicycle lanes in Portland. However, there are bicycle lanes of width ranging from as narrow as 3-feet—used only in exceptionally unusual circumstances, to four-feet, the more typical 4.5 feet, 5.5 feet, 6.0 feet, and 6.5 feet. Four-foot bicycle lanes are rarely used, despite being the minimum acceptable standard width according to the American Association of State Highway and Transportation Officials (AASHTO).[95] Portland has many bicycle lanes measuring 4.5-feet as this width is recommended on bicycle lane retrofits of 36-foot wide roadways, which Portland has in abundance. Similarly, as five feet has been the standard for bicycle lanes in Portland, all streets, where width exists, are generally striped as such. Five-and-a-half-foot bicycle lanes are typically used on streets with gutter pans. Six foot bicycle lanes are used on higher volume roadways or on roadways where sufficient width exists.

Bicycle Boulevards

Bicycle boulevards are those City Bikeways with fewer than 3,000 vehicles per day. These are generally Local Service Streets, but can also be Neighborhood Collector Streets. Portland currently has approximately 30 miles of developed bicycle boulevards. These are streets that generally work well for bicycling because of low vehicle volumes. To improve conditions for cyclists, PBOT works to address four principal issues on these bikeways: motor vehicle volumes and speeds; free-flow for cyclists; ease of crossing arterials; and way-finding. The sum of PBOT's efforts in creating a bicycle boulevard is to create a supremely family-friendly bikeway on which bicyclists are given priority both by design and operation.

Improvements can include vehicle diversion devices, traffic calming devices, stop sign alignment, crossing improvements (curb extensions, median refuges, and specialized traffic signals); and wayfinding signs, including pavement markings and signage.

Shared Use Paths

Shared use paths are restricted to bicycles, pedestrians, and other non-motorized users. They are among our most popular places in the city to bicycle, and range from paths across the Willamette River on the Hawthorne, Steel and Broadway bridges, to the Springwater Corridor Trail, the I-205 Bike Path, the Eastbank Esplanade, and the extensive trail system in North

[95] The AASHTO manual is the primary guide and standards document for roadway design. The AASHTO *Guide for Development of Bicycle Facilities*. published in 1999, provides guidelines and standards for bikeway designs.

Portland, including the Marine Drive Trail. Portland has 70 miles of shared, off street paths. The width of shared use paths varies from four- to five-foot sidewalks on the St. Johns Bridge, Ross Island Bridge, Sellwood Bridge, and the upper deck of the Steel Bridge, to 14-feet on portions of the Springwater Corridor Trail and Eastbank Esplanade. Planned shared use paths through South Waterfront and south of the Morrison Bridge will be wider, from 15 to 30 feet.

Signed Connections

Portland's Bicycle Master Plan calls for approximately 26 miles of signed connections. In the Transportation System Plan these streets are simply identified as City Bikeways, the same as every other on-street bikeway. Signed connections are intended to be on local, low-traffic streets where bicycle lanes or boulevard treatments are not needed. They are intended to connect two developed bikeways or to provide a connection to major attractions. Since the only recommended treatment for Signed Connections is signing, these facilities were considered incomplete until the city began to comprehensively sign the city's bikeway network in 2005. Now, most of the designed signed connections have bikeway signing directing people to the appropriate destinations.

Secondary Facilities

There are a number of bikeway network design treatments that help create, augment, or in some cases, substitute for the Primary Bikeway Facilities, described above. These include shared lane pavement markings, arterial crossing treatments, traffic calming treatments, traffic diversion, signing and marking, blue bicycle lanes, and bicycle-specific signalization.

Table 3.25 Bikeway Facilities by City District

District	Facility Type	Existing (miles)	Funded (miles)	Recom-mended (miles)	Total (miles)	Existing & Funded by Type	Total by Type	% of Total Existing or Funded
North		**42.6**	**3.5**	**40.1**	**86.2**	**100%**	**100%**	**53%**
Area:	Bicycle Lanes	26.0	3.3	24.2	53.5	64%	62%	55%
20.2 mi^2	Bicycle Boulevard	1.2	0.0	4.4	5.6	3%	6%	21%
Bikeway Density:	Off-Street Paths	15.4	0.1	5.5	21.1	34%	24%	74%
2.1 miles/mi^2	Signed Connections	0.0	0.0	6.0	6.0	0%	7%	0%
Northeast		**39.3**	**1.5**	**86.3**	**127.2**	**100%**	**100%**	**32%**
Area:	Bicycle Lanes	23.6	0.6	51.0	75.2	59%	59%	32%
29.5 mi^2	Bicycle Boulevard	9.2	0.6	19.0	28.7	24%	23%	34%
Bikeway Density:	Off-Street Paths	6.6	0.4	12.7	19.7	17%	15%	35%
1.3 miles/mi^2	Signed Connections	0.0	0.0	3.6	3.6	0%	3%	0%
Southeast		**46.8**	**0.7**	**53.3**	**100.8**	**100%**	**100%**	**47%**
Area:	Bicycle Lanes	20.6	0.7	29.3	50.6	45%	50%	42%
22.4 mi^2	Bicycle Boulevard	13.4	0.0	19.8	33.2	28%	33%	40%
Bikeway Density:	Off-Street Paths	12.8	0.0	1.0	13.8	27%	14%	93%
2.1 miles/mi^2	Signed Connections	0.0	0.0	3.2	3.2	0%	3%	0%
Outer East		**59.0**	**1.5**	**57.2**	**117.7**	**100%**	**100%**	**51%**
Area:	Bicycle Lanes	44.3	1.5	43.9	89.8	76%	76%	51%
27.4 mi^2	Bicycle Boulevard	0.0	0.0	5.5	5.5	0%	5%	0%
Bikeway Density:	Off-Street Paths	14.7	0.0	7.3	22.0	24%	19%	67%
2.2 miles/mi^2	Signed Connections	0.0	0.0	0.4	0.4	0%	0%	0%
Northwest		**23.2**	**0.2**	**29.9**	**53.4**	**100%**	**100%**	**44%**
Area:	Bicycle Lanes	10.1	0.2	25.4	35.8	44%	67%	29%
20.2 mi^2	Bicycle Boulevard	3.7	0.0	0.7	4.5	16%	8%	84%
Bikeway Density:	Off-Street Paths	9.3	0.0	1.3	10.6	40%	20%	88%
1.1 miles/mi^2	Signed Connections	0.0	0.0	2.5	2.5	0%	5%	0%
Southwest		**28.8**	**0.7**	**76.9**	**106.4**	**100%**	**100%**	**28%**
Area:	Bicycle Lanes	24.2	0.7	63.9	88.9	84%	84%	28%
18.2 mi^2	Bicycle Boulevard	0.0	0.0	1.9	1.9	0%	2%	0%
Bikeway Density:	Off-Street Paths	4.6	0.0	1.7	6.2	16%	6%	73%
1.6 miles/mi^2	Signed Connections	0.0	0.0	9.4	9.4	0%	9%	0%
Central		29.7	2.8	24.0	56.6	100%	100%	58%
Area:	Bicycle Lanes	21.8	1.7	18.0	41.5	72%	73%	57%
4.6 mi^2	Bicycle Boulevard	2.2	0.0	2.8	5.0	7%	9%	44%
Bikeway Density:	Off-Street Paths	5.7	1.1	1.3	8.1	21%	14%	84%
6.5 miles/mi^2	Signed Connections	0.0	0.0	1.9	1.9	0%	3%	0%
Citywide		**269.5**	**11.0**	**367.7**	**648.2**	**100%**	**100%**	**43%**
Area:	Bicycle Lanes	170.6	8.8	255.9	435.3	64%	67%	41%
142.6 mi^2	Bicycle Boulevard	29.7	0.6	54.1	84.4	11%	13%	36%
Bikeway Density:	Off-Street Paths	69.2	1.6	30.8	101.6	25%	16%	70%
1.9 miles/mi^2	Signed Connections	0.0	0.0	26.9	26.9	0%	4%	0%

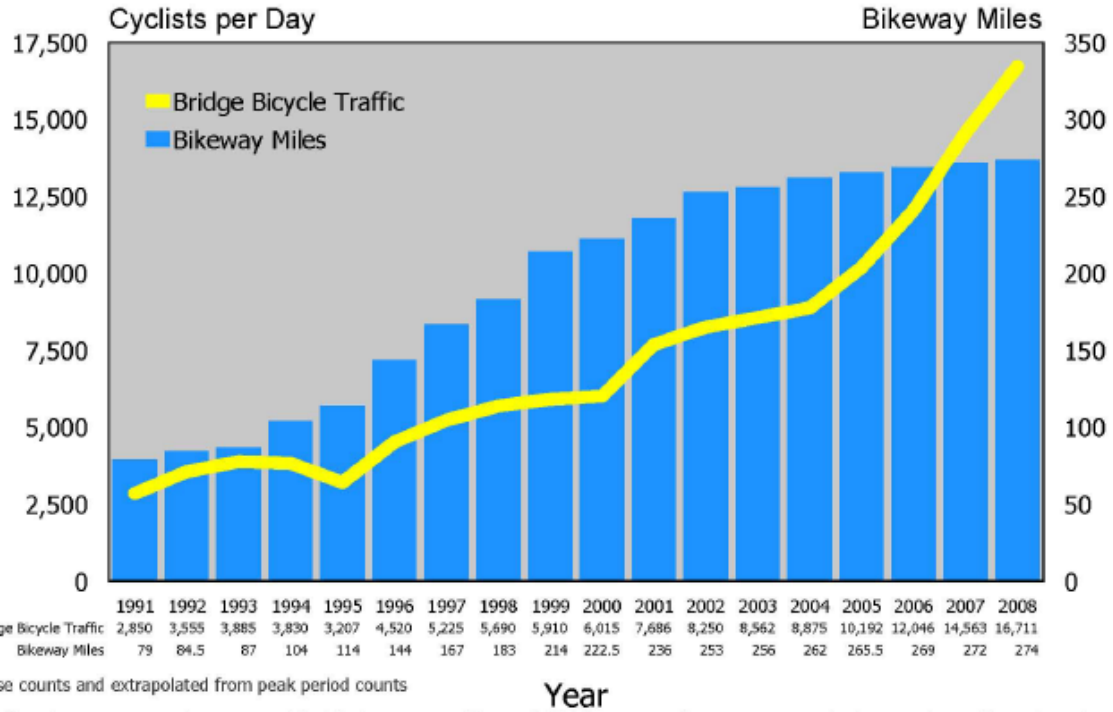
Condition and Capacity

Growth in Network

Since 1990, Portland's bikeways have grown from 78 miles of roadway to more than 274 miles today. Much of this growth occurred in the years between 1994 and 2002. During this period the city built 166 miles of bikeways, representing 60% of today's existing network. These 166 miles included 20.5 miles of bicycle boulevards (68% of today's total of 30 miles), 111 miles of bike lanes (66% of today's total of 167 miles), and 34 miles of off-street paths (49% of today's total of 69 miles).

Portland has seen bicycle traffic—across the now four truly bicycle-friendly Central City bridges—increase from 4,500 daily trips in 1996 to over 14,600 daily trips in 2008. This correlation is not coincidental; it is the result of focused improvements on City Bikeways that prioritized connections, the filling in of important gaps, with a focus on projects that could generally be readily and realistically achieved. Bicycles now represent 10% of all vehicle trips on those bridges, up from approximately 2% in 1991. Figure 3.7 shows this correlation between overall network growth and increases in ridership across the four bicycle-friendly Willamette River bridges.

Figure 3.7 Combined Bicycle Traffic over Four Main Portland Bicycle Bridges Juxtaposed with Bikeway Miles



Portland's Bikeway Network increased 250% between 1991 and 2008. During that same period, the number of bicycle riders daily crossing the four main bicycle bridges in Portland increased 490%. This increase was especially noticeable on the Broadway, Hawthorne, and Steel Bridges, where combined daily ridership went from 2,115 in 1991 to 14,676 in 2008. During this period, the bikeway network feeding these bridges was greatly improved, as were facilities on the bridges themselves.

Percentage of City Bikeway Network Completed

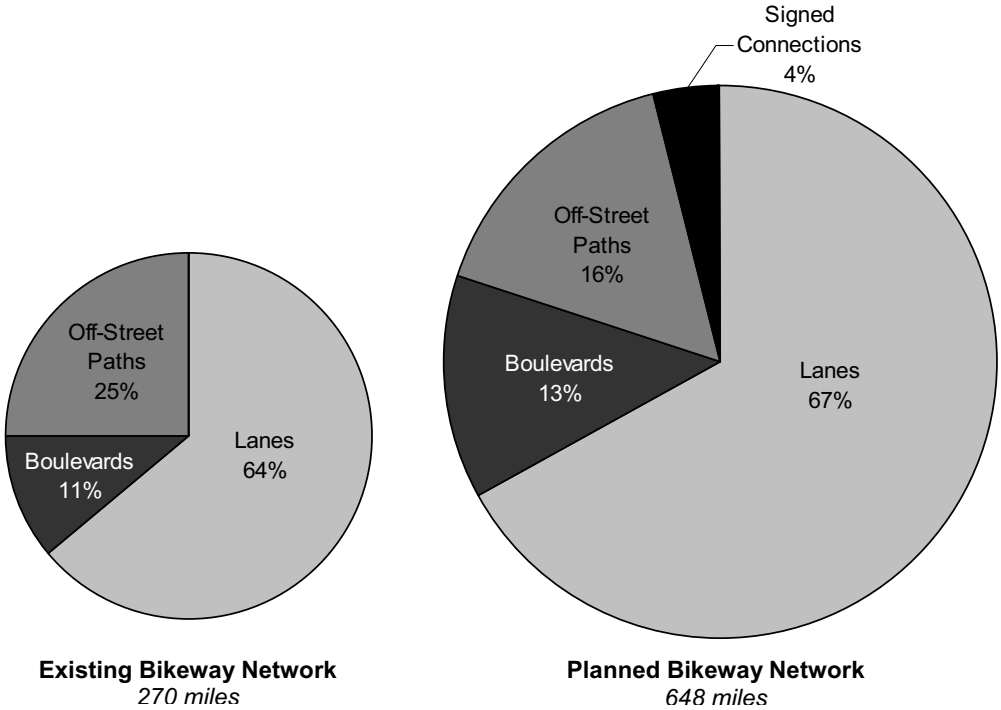
Portland's Bikeway Network is approximately 45% complete. Under the existing plan, when complete it will comprise 431 miles of bicycle lanes, 84 miles of bicycle boulevards, 101 miles of off-street paths, and 27 miles of signed connections. Not including signed connections, those facilities are 41%, 36%, and 70% complete, respectively. Table 3.25 shows the relative completeness of bikeways by area of the city.

There are notable differences between different areas of the city both in terms of what has been developed and what is slated for development. As shown in Table 3.25, city-wide, 45% of the network is complete. There is significant variation in percent completeness in the seven transportation districts in Portland, ranging from a low of 28% in Southwest Portland, to a high of 53% and 58% in North Portland and the Central City, respectively.

Of the 280 miles that have been developed (includes 9 miles of funded, but not yet constructed projects), 64% have been developed as bicycle lanes, 26% have been developed as off-street paths, and 11% have been developed as bicycle boulevards. As bicycle boulevards are the most "family-friendly" of bikeways in the public right-of-way it is worthwhile to consider how these facilities have been developed in the different sectors of Portland.

Inner Northeast and Inner Southeast Portland have the highest percentage (24% and 28%, respectively) of their existing network comprised of boulevards. Northwest Portland is next highest, with 16% of their developed bikeways consisting of boulevards. Outer East and Southwest Portland have no boulevards. North Portland and the Central City also contain relatively few miles of boulevards, with only 3% and 7%, respectively.

Figure 3.8 Existing and Planned Bikeway Networks, by Type



Bikeway Quality

Poor bikeway quality can reduce the quality of a cycling experience and can expose riders to additional accident risk, particularly if high automobile volumes or speeds are present, there are difficult transitions along the route, or the roadway condition is hazardous. Since the original Bicycle Master Plan was adopted in 1996, the City has increased its on-street bikeway mileage from slightly over 100 miles of roadway to more than 220 miles today. Portland has seen impressive growth in the quantity of bikeways; however, this trend alone does not fully address the desire for Portlanders to feel comfortable and safe while riding. As a result, the City has not contented itself with simply increasing bikeway miles but is placing more emphasis on the quality of those bikeways.

In order to evaluate the qualities and deficiencies of City Bikeways, staff divided existing, planned, and proposed bike lanes and boulevards into bikeway segments ranging in length from 250 feet to over 6,000 feet. Bikeway segments were identified to include major intersections in order to capture the quality of the associated intersections. The GIS-based methodology developed for determining the quality of each bikeway segment is referred to as the Bikeway Quality Index (BQI).

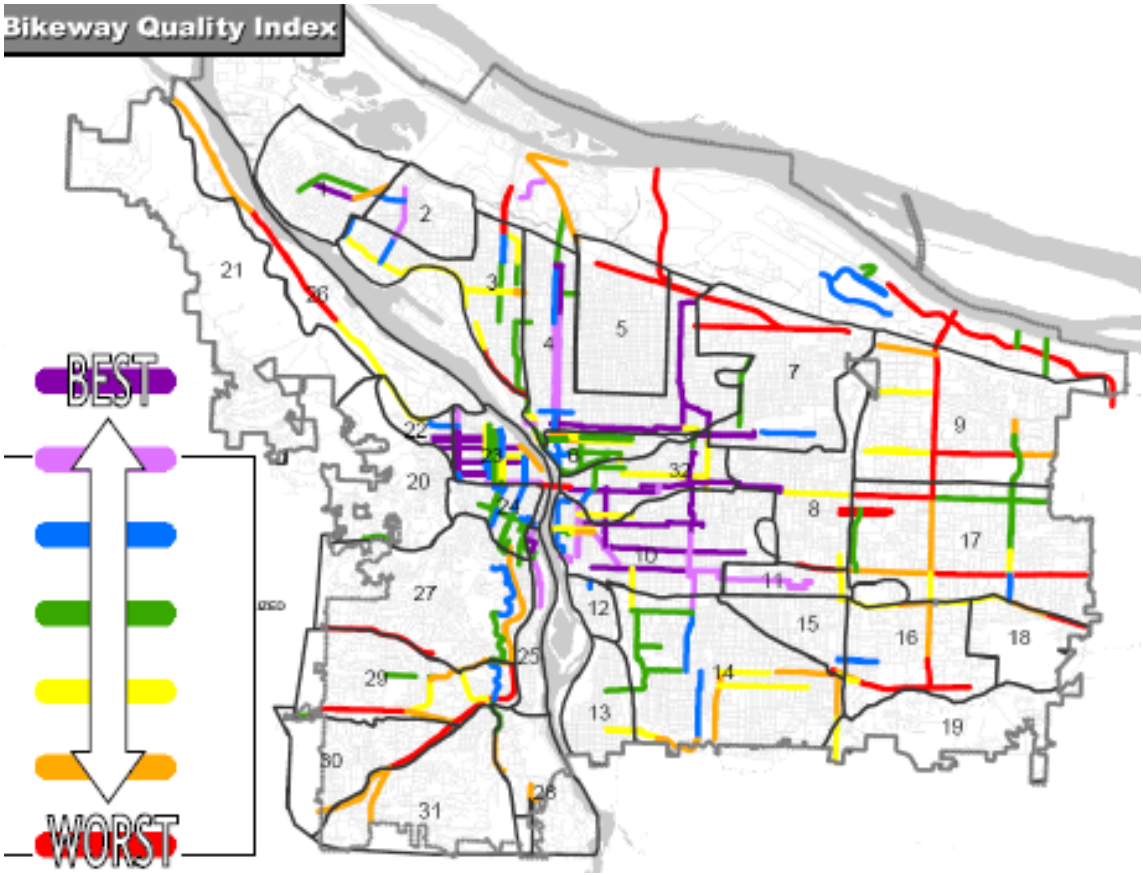
Table 3.26 Factors Used in Bikeway Quality Index Analysis

Factor	Blvd	Lane
Auto Speed	✓	✓
Auto Volume	✓	✓
Number of Auto Lanes	✓	✓
Bike Lane Drop		✓
Difficult Transition	✓	
Bike Lane Width		✓
Jogs	✓	
Pavement Quality	✓	✓
Intersection Crossing Quality	✓	✓
Stops	✓	

Separate methodologies were developed and applied to bike boulevards and bike lanes. Table 3.26 shows the final list of factors analyzed. Staff then combined the findings of both methods using a normalized scoring system to compare the quality of the bike lanes with boulevards. The score for each segment was calculated as the percentage of the ideal condition for a given segment. Each of these factors was assigned a weighting based on its importance relative to the other factors analyzed.

Figure 3.9 illustrates the results of the Bikeway Quality assessment. In general, bike boulevards are of higher quality than bicycle lanes. Outer east, north, northwest, and southwest Portland tended to have bikeways of lower quality. However, bikeways of very high and very low quality can be found in virtually all areas of the city. Inner northeast, inner southeast, and downtown tend to have bikeways of higher quality than areas in outer east, north, and southwest Portland.

Figure 3.9 Bikeway Quality Index



Major System Concerns

Barriers to Cycling and Cycling Potential

In 2007, the Portland Bureau of Transportation conducted a Cycle Zone Analysis to examine the existing and potential conditions for cycling within the City. One goal of this exercise was learn which areas of the City are already great places to cycle and which areas have the potential to become great places to cycle. Another is to determine which zones may have less potential due to constraints like steep terrain and a lack of destinations. This exercise was also intended to inform financial investment strategies for the Bicycle Master Plan. This tool can help to pinpoint areas where the cycling experience will improve significantly with small investments and areas that may require a large fiscal investment and create only mediocre improvements to the quality of the cycling experience.

A cycle zone is a geographic area of the City that possesses similar characteristics for cycling. Generally, they are defined by features that represent significant barriers or crossing difficulties, like I-205 and the Willamette River. They are also partially defined by neighborhoods and areas that contain places that are desirable destinations for cyclists like parks or neighborhood centers.

The Cycle Zone Analysis integrated the Bikeway Quality Index analysis with an assessment of a variety of other factors which pertain to the cycling environment, such as slope, road network density, and connectivity. Table 3.27 lists the measure that were used for the Cycle Zone Analysis.

Table 3.27 Factors Used in Bikeway Quality Index Analysis

Factor	Definition	Reasoning
Bikeway Quality	See explanation in Table 3.26	
Total Road Network Density	The density in linear feet per square acre of all roads in the cycling zone. This includes roads of all types, including local streets, arterials, highways and freeways.	A zone with a greater density of roads will facilitate a better cycling experience. Riders will be able to go more places and have greater route choice.
Bike Network Density	The density in linear feet per square acre of all the City of Portland's bicycle facilities within a specific cycling zone. The facilities used for this analysis include planned, funded and existing bicycle boulevards and existing bike lanes.	The presence of facilities designed for cyclists increases their comfort and safety. A greater presence of cycle facilities will improve the cycling experience.
Barrier	Permeability or ease of passage from one zone to the next. If there is no barrier, a perfect score of six (best) a one (worst) is given to areas that are impassable.	Areas that allow easy passage and access between zones will create a better cycling experience.
Connected Node Ratio (4-way)	A measure of network connectivity, this number represents the ratio of cul-de-sacs and three way intersections to 4 or more way intersections. The closer to one, the more grid-like the street pattern. An overall average score was calculated for each zone.	A zone with a greater connectivity of roads will facilitate a better cycling experience. Riders will be able to easily go more places and have greater route choice.
Average Road Segment Slope	The average slope for all road segments, measured in degrees, for each cycling zone.	Topography can decrease the ease of cycling. Generally a great cycle zone will be relatively flat. Topography is an issue that is difficult or impossible to change and is very important to consider when evaluating the bikability of a zone.
Average Network Distance to Commercial Establishments	The average network distance, measured in linear feet, from a residential tax lot to the nearest tax lot zoned for commercial use.	This is a proxy measure for land use mix. People are more likely to cycle in areas with many available activities. Generally, the shorter the distance from residential to commercial uses, the greater the land-use diversity.

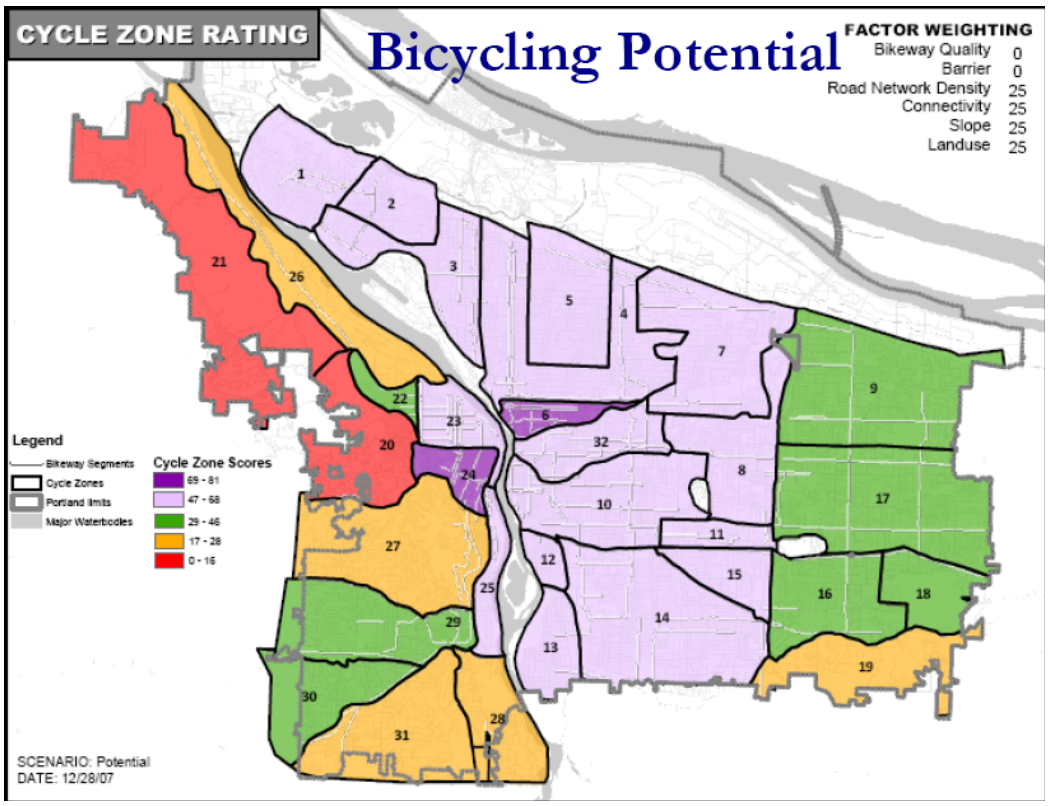
The cycle zone analysis found that conditions for bicycling are best in those areas of Portland where the quality of the bikeway network is the highest, where street connectivity is the best, where the roadway network is the most dense, where physical barriers to bicycling are moderate to minimal, where land use is most integrated, and where slopes are minimal. Those areas comprise, or are adjacent to the central city. In contrast, those areas with the worst conditions for bicycling are the furthest from the Central City. It is in these areas, where topography (in the case of the west side), limited roadway network, poor street connectivity, limited commercial and retail destinations, significant physical barriers, and, perhaps most importantly, poor bikeway quality, all conspire against the quality of the cycling environment. In between the best and the worst, in a circular band ranging from Sellwood, along the western edge of I-205 and up through St. Johns, are areas where the cycling experience is intermediate in quality.

However, it is important to recognize that this analysis produces only relative ratings as it compares areas within Portland to each other. A rating of “poor” does not necessarily mean that conditions for cycling are objectively poor. Cycling in areas of Portland that rate poorly in this analysis are still comfortable and pleasurable for many cyclists. Similarly, areas that are rated among the best in Portland could be considered unpleasant to some Portlanders because of conditions they subjectively perceive as uncomfortable or unsafe.

In addition to describing existing conditions, the Cycle Zones Analysis lends itself to identifying those areas in the city with the most potential for advancing bicycle transportation. Removing consideration of “bikeway quality” and “barriers” from the analysis of cycle zones, leads to a map of “Cycle Zone Potential,” displayed in Figure 3.10. These two elements—bikeway quality and barriers—are both within the ability of the City of Portland to address, given sufficient funding, adequate designs, and clear policy direction. Slope generally cannot be addressed; neither can the density of the roadway network nor street connectivity. Although Portland is working to create a dense, mixed-use urban form, correcting street connectivity issues may take much longer than addressing other barriers and the quality of the bikeway network.

The best potential for achieving the mode splits for bicycling is found in the Central City, and in areas lying between the Willamette River and I-205, particularly in the Lloyd District and Downtown. East Portland and much of SW Portland show moderate potential for making the bicycle a more important means of daily transportation, while other areas of SW Portland, and outer NW Portland have the least potential.

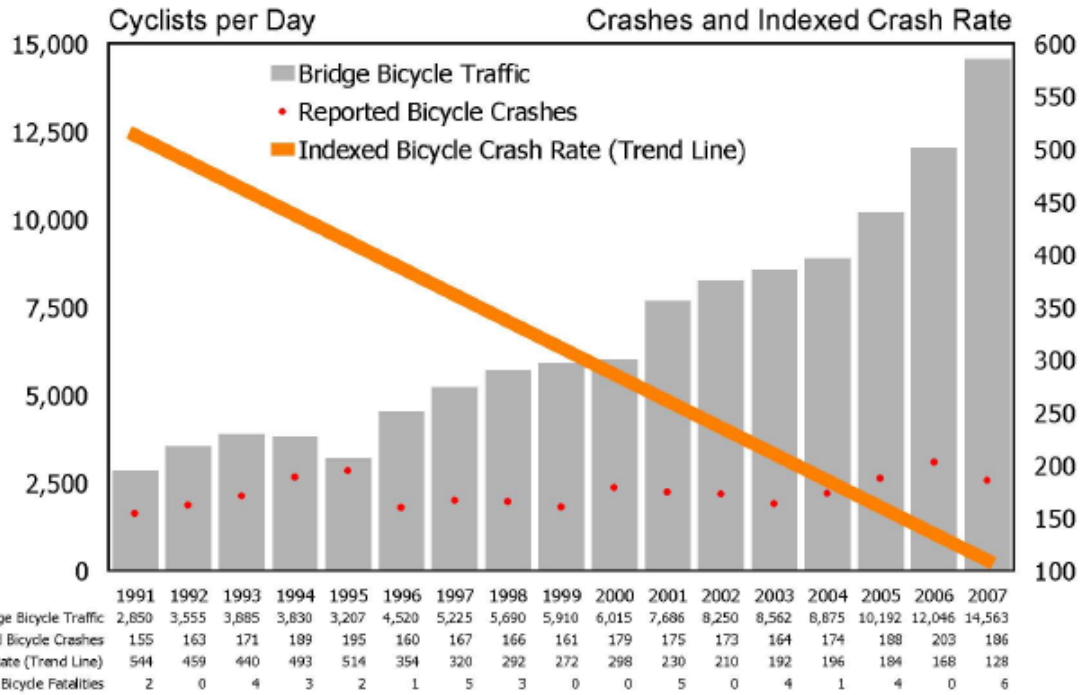
Figure 3.10 Bicycle Potential Based on Cycle Zone Rating



Cyclist Safety

The City has focused on improving cycling conditions by providing cycling facilities such as bike lanes and bike boulevards; cycling safety improvements, like signage and signals; and through educational campaigns. Due to this investment, the city's bike system has grown from 83 miles of bikeways in 1992 to 271 miles in 2008. Portland has seen a continuous increase in the number of cyclists over the past decade, from just over 2,500 daily trips over the Willamette River bridges in 1991, to over 14,500 daily trips in 2008. Per capita cyclist injury rates have remained relatively constant, with the exception of a large drop in 2008. However, the percentage of people cycling has increased dramatically over the same period, resulting in significant declines in the crash rate among cyclists, see Figure 3.11.

Figure 3.11 Bicyclist Crash Rates[96]



	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Bridge Bicycle Traffic	2,850	3,555	3,885	3,830	3,207	4,520	5,225	5,690	5,910	6,015	7,686	8,250	8,562	8,875	10,192	12,046	14,563
Reported Bicycle Crashes	155	163	171	189	195	160	167	166	161	179	175	173	164	174	188	203	186
Indexed Bicycle Crash Rate (Trend Line)	544	459	440	493	514	354	320	292	272	298	230	210	192	196	184	168	128
Bicycle Fatalities	2	0	4	3	2	1	5	3	0	0	5	0	4	1	4	0	6

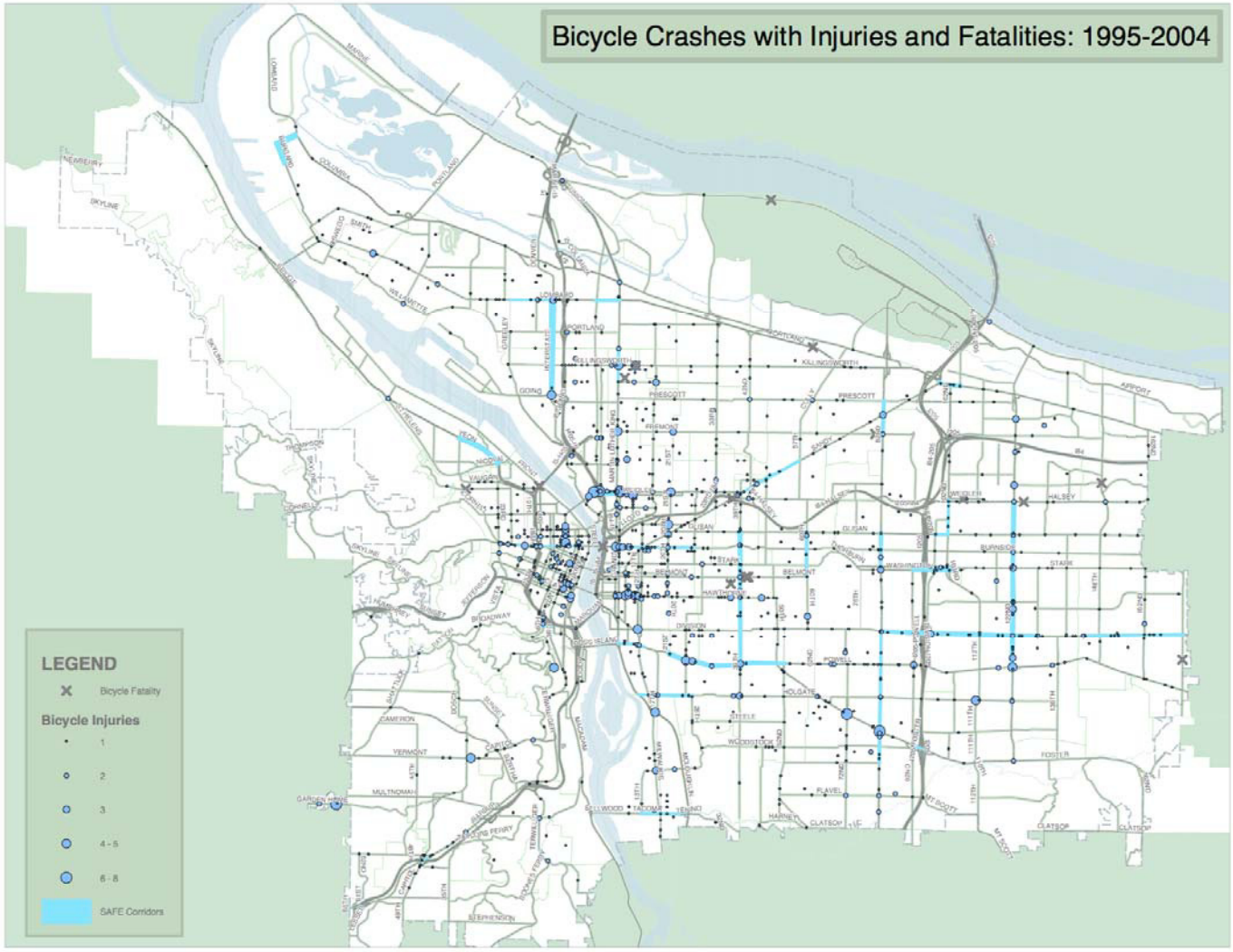
Extrapolated from peak period counts

"Crash Rate" represents an indexing of annual reported crashes to daily bicycle trips across the four main bicycle bridges.

[96] Portland Cycle Zone Analysis Presentation

Figure 3.12 shows the location of reported bicycle crashes occurring between 1994 and 2004. There is a concentration of crashes in inner northeast, southeast, and downtown Portland, where there are also higher numbers of riders. High numbers of crashes also occurred along outer east and southwest Portland arterials and in more geographically dispersed areas of the rest of the city. The most frequent bicycle crashes involve a vehicle making a right or left hand turn (15.5%) or the bicyclist or motorist running a stop sign or signal (25%).[97, 98]

Figure 3.12 Bicycle Crashes with Injuries and Fatalities: 1995 to 2004



[97] Data for 2002-2006.
[98] City of Portland Bureau of Transportation. "Improving Bicycle Safety in Portland". Online: http://www.portlandonline.com/transportation/index.cfm?&c=46717&a=185776. October, 2007.

Citywide, 44% of residents rated their neighborhood streets as good or very good for bicyclist safety. However, significantly fewer residents rated cyclist safety as good in many outer east and southwest neighborhoods.[99]

Supporting Transportation Assets

Parking Meters

Inventory

The City of Portland owns 1,697 parking meters, of which approximately one-quarter are coin-operated single or double meters and about 75% are SmartMeters, see Table 3.28. SmartMeters operate a full block of parking spaces from a single location and, in addition to accepting coins, provide the ability to use credit, debit, and 'Smart Cards' for payment. SmartMeters come equipped with wireless 2-way communication that allows the unit to tell PBOT when service or maintenance is needed or coins need to be collected. The City's parking meters have a total replacement value of nearly $15 million.

In January of 2002, PBOT signed a contract with Parkeon to provide SmartMeter pay station technology to replace most of the single-space meters in the Central Business District.

A small inventory of single-space parking meters remains in the downtown and Lloyd districts. These single-space meters serve block fronts with less than three spaces. SmartMeter receipts are also valid for these spaces. A small inventory of parts was purchased for these older meters to keep them in service over the next few years. After testing in the Lloyd District, the City signed a contract with Cale to provide pay stations for Lloyd and South Waterfront Districts. Approximately half of the single space meters in the Lloyd District have been replaced with SmartMeters. In December 2006, the first Cale machines were placed in the South Waterfront District. Further installations are anticipated as this new district develops.

Current Condition

Currently, the vast majority (95-100%) of single, double, and SmartMeter parking meters are in good or very good condition, see Table 3.28. There is no unmet need reported for parking meters.

Table 3.28 Parking Meter Inventory, Condition, and Replacement Value[100]

Facility	Inventory	Replacement Value ($ millions)	Condition						Total Unmet Need ($ millions)
			VG	G	F	P	VP	TBD	
Parking Meters	1,697	$14.9							$0
Double	275	$0.34	0%	95%	5%	0%	0%	0%	$0
Single	118	$0.07	0%	95%	5%	0%	0%	0%	$0
SmartMeter	1,304	$14.5	13%	87%	0%	0%	0%	0%	$0

[99] City of Portland 2007 Resident Survey
[100] City of Portland Transportation System: Status and Condition Report - 2007

Signals

Inventory

PBOT is responsible for 1,003 signalized intersections (see Map 3-15) and maintains all traffic signals except those on state highways in annexed areas. A "signalized intersection" includes multiple components such as signal heads, mast arms, suspension wires, and wiring. The current replacement value of the traffic signal system is $122 million, which includes hardware, controllers, and other equipment, see Table 3.29.

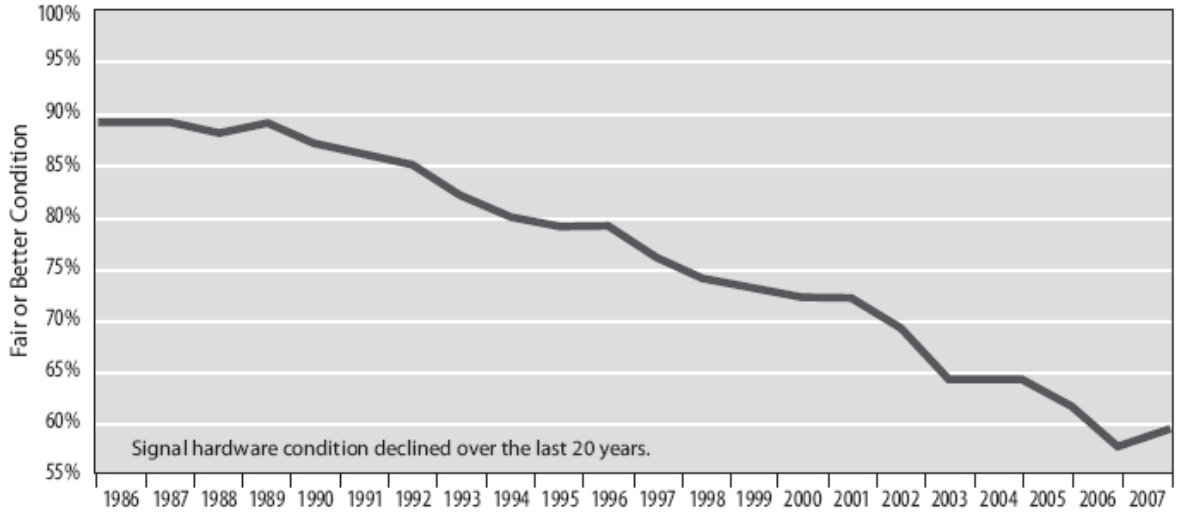
Current Condition

The traffic signal hardware condition has deteriorated over the past two decades. Without additional resources, the condition will continue to decline. Hardware has deteriorated from 72% in fair or better condition in 2001 to 59% in 2007. The number of maintenance calls and the average repair costs increase dramatically for hardware 25 years and older. The cost per hardware replacement is $110,000.

Table 3.29 Traffic Signal Inventory, Condition, and Replacement Value[101]

Facility	Inventory	Replacement Value ($ millions)	Condition						Total Unmet Need ($ millions)
			VG	G	F	P	VP	TBD	
Traffic Signals		$122.1+							$45.5+
Hardware	1,003	$110.2	14%	16%	29%	27%	14%	0%	$45.5
Controllers	1,003	$9.03	0%	0%	0%	0%	0%	100%	tbd
Other Equipment	386	$2.90	0%	0%	0%	0%	0%	100%	tbd
ITS Equipment	tbd	tbd	0%	0%	0%	0%	0%	100%	tbd

Figure 3.13 Signal Hardware Condition, 1986-2007[102]



[101] City of Portland Transportation System: Status and Condition Report - 2007
[102] Signal Inventory Database, Portland Office of Transportation, July 2007.

Intelligent Transportation System (ITS): In addition to standard signalized intersections, the City has 386 electrical warning devices such as flashing beacons, overhead crosswalk signs and island lights. A system-wide assessment of the condition of these devices has not been done, although many of these devices are old and nearing the end of their useful life of 15 years. Further study to determine the exact unmet need for these devices is needed. The replacement value for ITS equipment has also not been determined.

The City is transitioning to an Intelligent Transportation System (ITS), leading to the installation of advanced surveillance and control systems. This system currently has an estimated 90 miles of interconnected cable, which is being expanded annually. New fiber optic links are being installed to support closed circuit TV and variable message signs. Although in good condition now, these assets will need to be replaced in the future to keep pace with technological advances. More study to determine realistic useful lives for the various types of devices (i.e. cameras, electronic signs, special detectors, fiber cable, etc.) is needed.

Unmet Need

The current hardware replacement rate is 5 signals per year, and controller replacement is 20 per year, both of which are not sufficient to meet the need ($45 million unmet need).

Streetlights

Inventory

The City of Portland owns 54,238 street lights. Portland General Electric (PGE) contractually provides electricity for all city-owned street lights, and maintenance to 81% of city-owned street lights ("Option B" lights). PBOT employees maintain the remaining 19% of the system ("Option C"). The inventory count is based on the PGE utility bill, and is not actually inventoried by the Office of Transportation.

Transportation must stock parts and lamps for approximately 60 different types of fixtures and poles the city maintains. Efforts to reduce the types of street light designs to simplify maintenance and reduce costs are underway.

Today's replacement value of the street light system is approximately $103.6 million, based on the cost of replacement parts and the number of components needing replacement, such as wiring, poles and luminaires. This estimate reflects the total replacement, both above and below ground.

Table 3.30 Street Lights Status, Condition and Value (July 2007)[103]

Facility	Inventory	Replacement Value ($ millions)	Condition						Total Unmet Need ($ millions)
			VG	G	F	P	VP	TBD	
Street Lights	54,238	$103.6							$16.2
Option B	44,103	$31	0%	15%	75%	10%	0%	0%	$3.1
Option C	10,135	$72.6	0%	52%	30%	18%	0%	0%	$13.1

[103] PGE Utility Bill, Portland Bureau of Transportation, July 2007

Desired Level of Service

Lighting standards based on traffic safety and street classification, similar to those adopted by the Illuminating Engineering Society, are used to operate Portland's street lights.

Current Condition

During 2002 and 2003, the City conducted an evaluation of the Option C lights (City owned and maintained), which gave the City a much better assessment of the condition and expected maintenance needs of these lights. Today, 52% of Option C lights are in good condition. Condition assessments are based on professional judgment of Street Lighting Manager. The percent of the condition is based on the estimated age of the components, the type of luminaire, and the type of system (underground vs. above ground).

The Option B lights were also evaluated during fiscal year 2002-03. The condition was based on a sample review, mainly on the major streets and arterials. The City assumed responsibility for Option B lights in the late 1970s and early 1980s. These lights have an estimated lifespan of twenty years. Today, 15% of Option B street lights are in good condition. The City can expect a substantial capital replacement need as they reach the end of their life span.

The contract with PGE only requires PGE to repair and replace parts as needed, with no preventive maintenance other than a five-year relamping cycle. Therefore, degradation of condition continues over the lifetime of the fixture.

Street light cable that runs under much of the central business district is direct-burial lead-encased cable. This cable is over seventy years old, rapidly deteriorating and located at depths varying from 6 inches to 4 feet. Approximately 4 miles of cable need to be replaced with a maintainable conduit system.

Unmet Need

The current unmet need for street lights is $16.2 million.

Signs and Markings

Inventory - Signs

Within the City, there are over 143,000 street name, parking, traffic and guide signs and nearly 88,000 sign mounts. Street name and guide signs are installed at street corners to aid in identifying their location and direction. Parking signs help manage parking availability for businesses and residents. Traffic signs are installed to control and guide the flow of traffic on the street system. The sign inventory includes signs and mounts that are on State Highways within the City limits. The Oregon Department of Transportation is responsible for maintenance of these signs in most cases. Exceptions include parking signs on State Highways that are routed over City rights-of-way. Today's replacement value of the street sign system is approximately $15.1 million.

Inventory - Pavement Markings

Pavement Markings include all longitudinal lines (parallel to traffic), transverse lines (across traffic lanes), words ("ONLY", "BUS", "BIKE", etc.) and symbols (arrows, railroad) used as

exclusive or supplemental direction to the road user. As of July 2007, there were over 1,600 pass-miles of longitudinal lines, over 4,000 crosswalks and over 13,000 symbols and words on the City's streets. In total, Portland's pavement markings cover almost 80 acres. Pavement markings inventory is not available for curb markings, delineators and raised pavement markings. New inventory data is in the process of being collected on the bike loop markings and truncated domes (tactile markings located at sidewalk ramps).

The $5.2 million replacement value is the cost to apply all of these pavement markings features one time, including labor, equipment, materials, supervision and indirect costs. Unmet need has not been defined.

Table 3.31 Signs and Pavement Markings Status and Replacement Value July 2007[104]

Facility	Inventory	Replacement Value ($ millions)	Condition						Total Unmet Need ($ millions)
			VG	G	F	P	VP	TBD	
Street Signs	245,609	$15.1							$0.7+
Street Name	41,010	$2.3	0%	0%	0%	0%	0%	100%	tbd
Parking	49,406	$0.78	0%	0%	0%	0%	0%	100%	tbd
Traffic Control	47,909	$4.6	0%	0%	0%	0%	0%	100%	tbd
Stop Signs	14,205	n/a	44%	41%	10%	5%	0%	0%	$0.1
Guide Signs	5,124	$0.5	0%	0%	0%	0%	0%	100%	tbd
Sign Mounts	87,955	$6.9	0%	0%	0%	0%	0%	100%	$0.6
Pavement Markings	n/a	$5.2							tbd
Lines (pass mile)	1,601 mi.	$1.4	0%	0%	0%	0%	0%	100%	tbd
Markings	21,943	$3.8	0%	0%	0%	0%	0%	100%	tbd

As used in the table, a "pass-mile" is a continuous 4-inch wide line, one mile in length. Lines are applied in various widths and patterns - the pass-mile provides a single equivalent measure of the amount of striping on the road surface.

Current Condition - Signs

General work practices insure that most traffic control signs receive regular maintenance, with stop signs having a higher priority. Sign condition data for other regulatory signs and all warning signs is unavailable.

No condition assessment for guide signs has been estimated. A pending Federal Highway Administration (FHWA) ruling would place a condition assessment process into the Manual on Uniform Traffic Control Devices (MUTCD) within two years. A comprehensive pilot inspection program for stop signs was completed in FY 02/03. That study showed that 85% of the 11,600 signs inspected were in very good or good condition. Other non-guide signs are probably in better condition than previously assumed. However, with stop signs receiving a higher maintenance priority, the same condition for all traffic signs should not be assumed. Therefore, prior condition estimates were used along with the Traffic Control (Regulatory & Warning) sign conditions to arrive at an estimated moderate condition for the Traffic Control Signs category. All signs continue to be inspected for graffiti and damage annually and are replaced as needed.

[104] Asset Management Systems (Maximo, SWAMI), Portland Bureau of Transportation, July 2007

Current Condition - Pavement Markings

Condition ratings are, at this point, impractical since paint lasts an average of six months, and is replaced routinely about twice per year. Inventory tracking and asset management processes will need to address pavement marking conditions over the next few years as more durable markings are used system-wide.

Projected Condition - Signs

The Bureau does not currently have projected condition information for signs.

Projected Condition - Pavement Markings

The Bureau of Transportation expects to convert 80% of existing pavement markings from paint to thermoplastic over the next five years. This switch will dramatically increase the replacement value, condition, and expected useful life for affected markings. Thermoplastic markings, while costing approximately five times as much as painted markings (15¢ to 18¢ per foot versus 3.5¢ per foot, respectively), have an average useful life that is about 9 times longer (4.5 years vs. 6 months) and an average annual cost of about 40% less. Due to reduced paint-striping operations, an annual savings of over $100,000 is expected.

Unmet Need

The unmet need for street signs is $717,236. This includes $132,533 to replace all the stop signs in poor condition and $584,703 to replace all non-standard mounts with standard pipe-post mounts. In addition, the Bureau will need to assess and update signage to meet new retroreflectivity standards by 2012. There are no cost estimates for compliance at this time.

Structures

Inventory

The City of Portland owns 157 bridges, 519 retaining walls, 26 miles of guardrails, 185 stairways, and the harbor wall along the Willamette River, see Table 3.32.

Since 1985, Portland's bridge inventory has grown by approximately 51% due to City annexation, Oregon Department of Transportation construction projects and new local construction. The total replacement value of the City's 157 bridges is approximately $398 million. The replacement value of other structures, including retaining walls, stairways, guardrails, and the harbor wall account for $330 million.

In addition to City-maintained bridges, there are over 250 additional bridges and over-crossings owned by ODOT, Burlington Northern Railroad, Union Pacific Railroad and Multnomah County in the local area including 3 railroad bridges and 5 Willamette River bridges.

Table 3.32 Portland Bureau of Transportation Inventory, Condition, and Replacement Value[105]

Facility	Inventory	Replacement Value ($ millions)	Condition						Total Unmet Need ($ millions)
			VG	G	F	P	VP	TBD	
Structures	n/a	$728.3							$136.9+
Bridges	157	$398.7	8%	50%	22%	19%	1%	0%	$136.9
Retaining Walls	519	$99.3	94%	5%	1%	0%	0%	0%	tbd
Stairways	185	$4.4	0%	0%	0%	0%	0%	100%	tbd
Guardrails	26 mi.	$13.0	0%	0%	0%	0%	0%	100%	tbd
Harbor Wall	5,133 ft.	$212.8	0%	100%	0%	0%	0%	0%	$0

Current Condition

The City of Portland rates its bridges in a five tier system from very good to very poor as outlined below. The rating is derived from the inspected condition rating of the critical bridge items (deck, superstructure, and substructure) in accordance with the criteria of the National Bridge Inspection guidelines, see Table 3.33. Bridges can also be classified as structurally deficient or functionally obsolete, depending on the type and severity of deficiencies, and based on guidelines set by the Federal Highway Administration.

Table 3.33 Bridge Rating System[106]

Condition	Description	NBI Condition Rating	# of Bridges
Very Good	No problems noted.	8-9	17
Good	Some minor problems.	7	71
Fair	Primary structural elements are sound but may have minor cracking or spalling.	5-6	38
Poor	Deterioration of structural elements and/or weight restricted.	4	28
Very Poor	Serious deterioration of primary structural elements. Local failures are possible.	0-3	1

Structurally Deficient Bridge

This reported Federal Highway Administration bridge designation is based on the structural condition of the bridge. For this evaluation the critical bridge inspection items are Deck (NBI Item 58), Superstructure (NBI Item 59) and Substructure (NBI Item 60). The lowest condition rating for any of these critical inspection items indicates the rating for the entire bridge. The ratings range from 0 to 9, with 0 indicating a failed condition and 9 indicating an excellent condition. A rating of 4 or less indicates a structurally deficient bridge.

Functionally Obsolete Bridge

This reported Federal Highway Administration bridge designation is derived from the present day deficiencies in the functionality of a bridge. For example, among other things, it considers how traffic conditions change over the lifetime of a bridge, often requiring more lanes to carry a certain volume of traffic than the bridge was originally designed for.

[105] City of Portland Transportation System: Status and Condition Report - 2007
[106] City of Portland Transportation System: Status and Condition Report - 2007

Based on condition assessments, thirty of the City's bridges are in poor or very poor condition and are in need of rehabilitation or replacement, see Table 3.34. These bridges are located throughout the city, were built at various times, and feature a variety of material types. All but three of these bridges currently have weight restrictions. Another twenty bridges are in fair or better condition, but are functionally obsolete and in need of rehabilitation – generally seismic improvements. The locations of deficient bridges are mapped in Map 3-16.

Table 3.34 Deficient Bridges[107]

COP #	Location	Year Built	Material	PBOT Rating	NIB Deficiency	Weight Limited	Improvement Needed
Bridges in Poor or Very Poor Condition, in need of Rehabilitation or Replacement							
006	N. Vancouver Ave.	1929	Concrete	Poor	Structural	Yes	Replace
007	N. Willamette Blvd. Semi-viaduct	1941	Concrete	Poor	Structural	Yes	Replace
008	NE 21st Ave – Columbia Slough	1974	PS Concrete	Very Poor	Structural	Yes	Replace
012	N. Going – Swan Island	1930	Concrete	Poor	None	Yes	Seismic Rehab
014	NW Alexandra	1922	Concrete	Poor	Functional	Yes	Rehab
015	NW Thurman at Balch Creek	1905	Steel Truss	Poor	Functional	Yes	Rehab ($)
017/ 018	NW Maywood Semi-Viaducts	1934	Concrete	Poor	None	Yes	Replace
027	NE 28th Ave – UPRR	1908	Concrete	Poor	None	Yes	Replace
033	NE Glisan – MHRR at 90th Ave	1911	Concrete	Poor	Functional	Yes	Replace
035	SW Osage Semi-Viaduct	1930	Concrete	Poor	None	Yes	Replace
041	SW Vista Semi-Viaduct	1914	Concrete	Poor	None	Yes	Replace
042	SW Greenway at SW Talbot	1926	Concrete	Poor	Functional	Yes	Replace
075	NE 42nd – UPRR						
079	N Columbia Blvd at Columbia	1968	Concrete	Poor	Structural	No	Replace
080	SE Foster at Johnson Creek	1915	Concrete	Poor	Structural	Yes	Replace ($)
081	SW Capitol at SW Bertha	1915	Concrete	Poor	Functional	Yes	Replace
082	SW Capitol at SW Multnomah	1927	Concrete	Poor	Functional	Yes	Replace
087	SE Tacoma at Springwater Tr	1970	Steel	Poor	None	Yes	Replace
088	SE Tacoma Semi-Viaduct	1915	Concrete	Poor	None	Yes	Replace
089	SE 112th at Johnson Creek	1947	Steel	Poor	Functional	Yes	Replace
094	NE Sunderland	1970	Steel	Poor	None	Yes	Replace
097	SE 110th at Johnson Creek	1947	Steel	Poor	Functional	Yes	Replace
098	SE Lambert at Johnson Creek	1947	Steel	Poor	Functional	Yes	Replace
099	SE 122nd at Johnson Creek	1959	Timber	Poor	Functional	Yes	Replace
117	N Vancouver at Col. Slough	1935	Steel	Poor	Structural	Yes	Replace ($)
145	Steel Bridge – E Ramp (LRT)	1952	Concrete	Poor	Structural	No	Rehab ($)
146	Steel Bridge – E Ramp	1952	Concrete	Poor	Functional	Yes	Rehab ($)
152	N Interstate Semi-Viaduct	1950	Concrete	Poor	None	Yes	Replace
153	N Interstate Ramp to Broadway Bridge	1950	Concrete	Poor	Functional	No	Replace

[107] City of Portland Bureau of Transportation, Bridge Inventory, 2006-2007.

Bridges in Fair or Better Condition, but Functionally Obsolete and in Need of Rehabilitation							
009	NE 33rd Ave – NE Lombard	1929	Steel	Fair	Functional	No	Seismic Rehab
010	NW Kittridge Ave	1968	PS Concrete	Fair	Functional	No	Seismic Rehab
016	NE 33rd – UPRR/LRT Tracks	1924	Concrete	Good	Functional	No	Seismic Rehab
021	NE Halsey – I-84	1985	PS Concrete	Good	Functional	No	Seismic Rehab
025	NE 12th – I-84	1910	Steel	Fair	Functional	No	Seismic Rehab
026A	NE 21st – I-84	1986	PS Concrete	Good	Functional	No	Seismic Rehab
027A	NE 28th – I-84	1985	PS Concrete	Fair	Functional	No	Seismic Rehab
028	NE 39th – I-84	1985	PS Concrete	Good	Functional	No	Seismic Rehab
029	NE 47th – I-84	1985	PS Concrete	Fair	Functional	No	Seismic Rehab
030A	NE 53rd – I-84	1985	PS Concrete	Very Good	Functional	No	Seismic Rehab
031A	NE 60th – I-84	1985	PS Concrete	Good	Functional	No	Seismic Rehab
036	SW Vista	1926	Concrete	Fair	Functional	No	Rehab
044	SE Holgate	1982	PS Concrete	Good	Functional	No	Seismic Rehab
051	SE 142nd at Johnson Creek	1973	PS Concrete	Good	Functional	No	Seismic Rehab
057	SE Harney at Johnson Creek	1948	Steel	Good	Functional	No	Seismic Rehab
078A	N Columbia – BNRR	1968	Steel	Fair	Functional	No	Seismic Rehab
122	NW Cornell	1986	Steel	Good	Functional	No	Seismic Rehab
128	NW Everett (various)	1986	Various	Good	Functional	No	Seismic Rehab
139	SW Capitol – Barbur Blvd	1959	Steel	Fair	Functional	No	Seismic Rehab
140	SW Capitol Semi-Viaduct 6.62	1959	Concrete	Good	Functional	No	Seismic Rehab
Bridges considered Functionally Obsolete based on NBI Rating, but with no capital improvement need							
013	N Greeley – N Going	1976	PS Concrete	Good	Functional	No	None
022A	NE 74th – I-84	1984	PS Concrete	Very Good	Functional	No	None
058	SE Ochoco at Johnson Creek	1947	Concrete	Fair	Functional	No	None
080A	SE Foster at Johnson Creek	1971	Steel	Good	Functional	No	None
113	NE Alderwood at Col. Slough	1989	PS Concrete	Good	Functional	No	None
141	SW Capitol Semi-Viaduct 6.55	1959	Concrete	Good	Functional	No	None
142	SW Capitol Semi-Viaduct 6.47	1959	Concrete	Fair	Functional	No	None

Other Structures

The number of retaining walls continues to increase due to new construction. Overall, the condition of retaining walls is very good or good. Stairways and guardrails are replaced as required due to vandalism and wear. The harbor wall, located on the west bank of the Willamette River in downtown Portland, was built in 1929. The harbor wall is inspected every other year and, if funds are available, after the departure of the Rose Festival Fleet. The condition of the Harbor Wall is rated as good based on a minimal rate of settlement and movement since its construction.

Major System Concerns

Seismic Retrofit of Bridges

The City undertook a Seismic Retrofit Prioritization Study of its bridge inventory in 1994. That study indicated that the City had 89 seismic deficient bridges out of a total inventory of 133 at that time. Seismic Deficiency of a bridge is not taken as an indicator of its condition, consistent with ODOT practice.

The total requirement can be sorted into two groups: Phase 1 (life safety – collapse prevention) and Phase 2 (upgrades to meet current seismic design standards). Funding for seismic retrofits is a City responsibility. No funding has been available for this work since 1997 and none is included in the 5-year Financial Forecast.

Unmet Need

The unmet need for bridges is $50 million. This includes $16.6 million for the ten-year Capital Improvement Program based on the Structural capital improvement section and $38.9 million for seismic retrofitting identified by the Bridge Seismic Retrofit Prioritization Project. The 2000-2009 capital improvement program includes all bridges in very poor condition, three bridges in poor condition, and provisions for seismic retrofitting.

PUBLIC TRANSPORTATION

Overview

The City of Portland's public transit network includes the city's transit network of bus, light rail, and streetcar; the aerial tram; special transit services; intercity bus and rail networks; and an international airport. Providing transit services to Portland residents and visitors is dependent on the work and coordination of a wide variety of providers and partners.

TriMet is the primary transit provider for the region. However, the City of Portland has in the past and will continue to have a large role in the development of an effective transit system. The city actively promotes transit to the community, advocates for better transit service to TriMet, develops transit-supportive infrastructure, implements transit-preferential measures, and facilitates and helps fund the development of streetcar lines, river taxi stops, and light rail.

The Transportation System Plan's (TSP) public transit policy supports a transit system that serves City residents and workers 24 hours a day, seven days a week. The City believes that light rail is the foundation for the transit system, linking the Central City to regional centers and major destinations such as the airport. Streetcars serve Portland neighborhoods, employment centers, shopping, educational institutions, and recreation destinations on both sides of the Willamette River. Buses provide the principal means of transit for access and mobility needs for the City, helping to relieve congestion and support economic activities.

Jurisdiction

A variety of agencies and municipalities are responsible for the ownership, construction, maintenance, and operation of the City's transit system.

- City of Portland: The City of Portland owns the Streetcar system, which is managed by Portland Streetcar Inc. The City also owns and maintains the aerial tram, which is operated by the Oregon Health and Science University (OHSU).
- TriMet: TriMet is the primary transit service provider for the City of Portland, and provides bus and light rail service.
- Port of Portland: The Port of Portland operates the Port of Portland and the Portland International Airport, which is served by domestic and international carriers.
- Neighboring Jurisdictions: Transit agencies serving some neighboring counties, including Clark County (C-TRAN) and Columbia County (Columbia County Rider), also provide limited connector service to locations in Portland.
- The City is also served by Amtrak rail and Greyhound bus lines which provide passenger rail and bus connections to other destinations in North America.

Transit Classification Descriptions

The City of Portland's Transportation System Plan includes five classifications for transitways: regional transitways, major transit priority streets, transit access streets, community transit streets, and local service transit streets. Table 3.35 and Map 3-17 provide more information on transit classifications. The classifications are intended to maintain a system of transit streets that supports the movement of transit vehicles for regional, interregional, interdistrict, and local trips. Chapter 2: Transportation Element of the TSP contains more detailed explanations of the functional classification of transitways in Portland and eight maps showing traffic classifications for each of the seven transportation districts and the Central City.

Table 3.35 Transit Classification Descriptions

Regional Transitways	Regional Transitways are intended to provide for interregional and interdistrict transit trips with frequent, high-speed, high-capacity, express, or limited service, and to connect the Central City with all regional centers.
Major Transit Priority Streets	Major Transit Priority Streets are intended to provide for high-quality transit service that connects the Central City and other regional and town centers and main streets.
Transit Access Streets	Transit Access Streets are intended for district-oriented transit service serving main streets, neighborhoods, and commercial, industrial, and employment areas.
Community Transit Streets.	Community Transit Streets are intended to serve neighborhoods and industrial areas and connect to citywide transit service.
Local Service Transit Streets	Local Service Transit Streets are intended to provide transit service to nearby residents and adjacent commercial areas.
Transit Stations	Transit stations are locations where light rail vehicles or other high-capacity transit vehicles stop to board and unload passengers.
Intercity Passenger Rail	Intercity Passenger Rail provides commuter and other rail passenger service.
Passenger Intermodal Facilities	Passenger Intermodal Facilities serve as the hub for various passenger modes and the transfer point between modes.

Transit Network[108]

TriMet was created in 1969 as a special district of the state of Oregon and is governed by a seven-member Board of Directors appointed by the Governor. TriMet's 575 square mile district serves approximately 1.3 million people in the urban portions of Clackamas, Multnomah and Washington Counties. TriMet provides a viable transportation option for hundreds of thousands of Portland-area residents every day.

Over one-half of the district's population lives within half a mile of TriMet service that arrives every 15 minutes or better. TriMet's network of fixed-route bus and rail lines attracts riders making trips at a variety of times and locations. The system is based upon a grid of north-south and east-west transit routes on arterial streets serving the Central City as well as crosstown trips.

This grid serves the more densely populated parts of the region with weekday service on most lines operating at least every 15 minutes. Less frequent service connects lower density areas to transit centers (located in Regional Centers and some Town Centers). Though many of the routes serve downtown Portland or Regional Centers because they have the highest travel demand, the system design allows travel from any point in the system to any other point, without necessarily passing through downtown. Park & Ride lots, bicycle lockers, sidewalks and shuttles help provide access to transit from areas without fixed-route service. Overall, 90 percent of people within the TriMet district live within one-half mile of TriMet service.

Table 3.36 Fixed Route Service Summary[109]

	Max Light Rail	Frequent Service Bus	Standard Bus Service
Routes	3	16	77
Length	44 miles	164 miles	728 miles
Vehicles at Peak Service	76	206	322

Fixed-Route Bus

The TriMet fleet of 608 buses serves 93 bus lines and seasonal shuttles with 7,280 bus stops and 1,140 bus shelters, see Map 3.18. Buses serve 18 major transit centers in the Portland region and connect with the MAX and Streetcar.

TriMet's 16 Frequent Service bus lines operate every 15 minutes or better, every day along key corridors throughout the region. These lines offer low-floor, air-conditioned vehicles, new shelters and schedule information in addition to increased service frequency. The 164-mile Frequent Service network carries 57% of all bus trips, with 46% of weekly bus-service hours.

Light Rail Service

The 79-station, MAX Light Rail system, including the new Green Line, is 52 miles long and operates at least every 15 minutes. The system currently connects four of the seven Regional

[108] TriMet, Transit Investment Plan, Fiscal Year 2009
[109] TriMet, 2009 Transit Investment Plan, Figure 2.1

Centers in the TriMet district with the Portland Central City. With the opening of the Green Line in Fall 2009, MAX service operates in the following way:

- Blue Line average headways: 15-minute base, 7.3-minute peak hour and direction, all 24 trains are two-car trains;
- Red Line average headways: 15-minute all day, eight of 10 trains are two-car trains;
- Yellow Line is routed on the Portland Mall from the Steel Bridge to Portland State University. Average headways: 15-minute base, 10-minute peak hour and direction, four of eight trains in the afternoon peak will be two car trains starting in September 2008;
- Green Line service, 10-minute peak hour and direction and 15-minute base service between Clackamas Town Center and Portland State University via Gateway TC, Rose Quarter TC and the Portland Mall with 10 peak trains and eight base trains;

Average peak hour, peak direction headways in segments with multiple lines:

- Eastside—3.3 minutes (between Gateway TC and Rose Quarter TC)
- Westside and Downtown Portland—5 minutes (between Merlo Road/SW 158th Ave and Steel Bridge)
- Mall—4.3 minutes (between Union Station and Portland State University)
- Steel Bridge—2.5 minutes

It is proposed that MAX Red Line service be extended to Willow Creek/SW 185th Ave Transit Center, in September 2011, which would add the Elmonica/SW 170th Ave and Willow Creek/SW 185th Ave stations to Red Line service.

Table 3.37 MAX Light Rail Summary[110]

Line	Segment*	Open	Length (miles)	Annual Ridership, Opening Year	Annual Ridership FY2008	Stations	Park & Ride Spaces
Blue Hillsboro to Gresham	Eastside Portland to Gresham	September 1986	15	6,600,000		30	2,898
	Westside Hillsboro to Portland	September 1998	18	5,900,000		20	3,613
Red Beaverton to Airport	Airport Gateway to Airport	September 2001	5.5	571,484	35,100,000	4	193
Yellow City Center to Expo	Interstate Rose Quarter to Expo	May 2004	5.8	3,900,000		10	600
Green Clackamas to PSU	Clackamas to Gateway; Rose Quarter to PSU	September 2009	8.3	n/a		15	2,200

* Data for each construction segment.

[110] TriMet, 2009 Transit Investment Plan, Figure 2.2

Transit Centers, Stops, and Park-and-Rides

There are currently seven transit centers within the City of Portland. In general, bus stops are located at two-block intervals along each route. TriMet operates 60 park-and-ride lots in the tri-county region (10,400 spaces), 18 of which are located within Portland's City limits (3,300 spaces).

Streetcar

The Portland Streetcar is owned and operated by the City of Portland. Portland's fleet of ten streetcars run in mixed traffic and, except at platform stops, accommodates existing curbside parking and loading. The Portland Streetcar was designed to fit the scale and traffic patterns of the neighborhoods through which it travels. The Streetcar is intended to link neighborhoods with a convenient and attractive transportation alternative to reduce short inner-city auto trips, parking demand, traffic congestion and air pollution.

Streetcars run on a 8.0-mile continuous loop (4.0-mile in each direction) from Legacy Good Samaritan Hospital at NW 23rd Avenue, on Lovejoy and Northrup, through the Pearl District and on 10th and 11th Avenues, Portland State University, SW River Parkway & Moody (RiverPlace), SW Moody and Gibbs in the South Waterfront District where it connects with the Portland Aerial Tram to a terminus at SW Lowell and Bond. A total of 46 stops are located along the alignment located about every 3-4 blocks.

Aerial Tram

The Portland Aerial Tram is part of Portland's public transportation system, and is owned by the City of Portland. OHSU oversees operation of the Tram, while the city is responsible for the maintenance of the upper and lower stations and tower, and provides regulatory oversight. The Tram was opened in December 2006 and carried approximately 1.4 million passengers in 2007.

The Tram cabins travel 3,300 linear feet between the South Waterfront terminal adjacent to the OHSU Center for Health & Healing, and the upper terminal at the Kohler Pavilion on OHSU's main campus. Traveling at 22 miles per hour, the Tram cabins rise 500 feet for the three-minute trip over I-5, the Lair Hill neighborhood and the Southwest Terwilliger Parkway.

Door-To-Door Paratransit

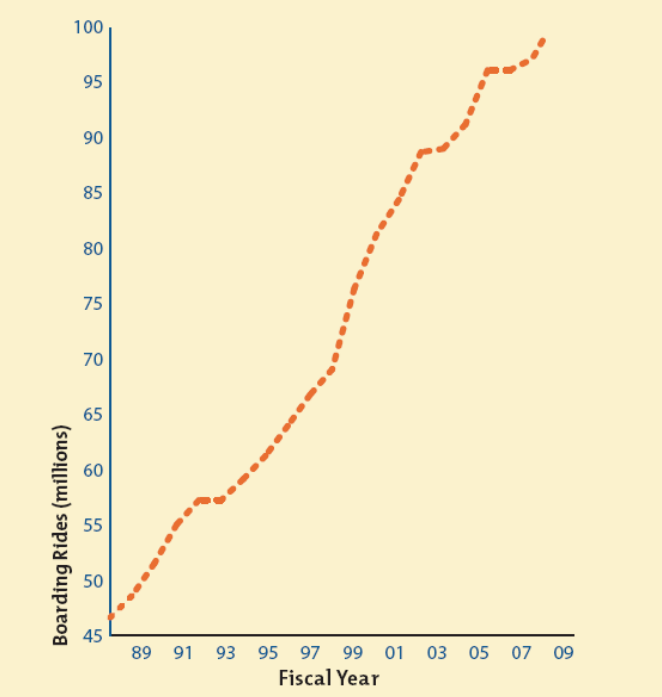
In addition to fixed-route bus and MAX service, TriMet meets the needs of eligible elderly and disabled individuals with the LIFT and Medical Transportation Programs (see Chapter 8). TriMet operates 258 LIFT vehicles, providing door-to-door service for people with special needs. The LIFT service area is three-quarters of a mile from a regular TriMet route; both the origin and destination of a trip must be within this boundary. TriMet provides over 10 million rides annually to seniors and people with disabilities on the fixed-route system and an additional 1.12 million rides on LIFT.

Ridership

TriMet's annual ridership has increased every year since FY1988 but one (FY2006), see Figure 3.14. Passengers are expected to board a TriMet bus or MAX train 99.1 million times in FY2008 (up from 96.9 million in FY2007). Ridership growth reflects the investments TriMet has made in

improving service, especially on Sundays. The portion of weekday riders served by Frequent Service increased from 17 percent in 1998 to 57 percent (for FY2008). All of the net bus system ridership growth since FY1999 has been on Frequent Service lines. Overall, TriMet ridership is increasing faster than other indicators of regional growth, including population and automobile vehicle miles traveled. Map 3.19 shows the number of boardings and de-boardings at TriMet stops.

Figure 3.14 Annual TriMet Ridership Growth, MAX and Bus[111]



Transit Underserved Areas

An area is considered to be a 'major underserved area' if it includes one or more of Metro's regional traffic zones in which less than 25 percent of the population is within one-quarter mile of existing transit service. The major underserved areas in Portland identified in the 1996 TSP inventory were Arnold/Stephenson, Front Avenue, Hart/Bany, and Johnson Creek/92nd. Since the inventory, weekday peak-hour service has been instituted on Front Avenue, between St. Johns and the Central City.

Intercity Bus and Rail

Policy 6.19 of the Transportation Element of the Comprehensive Plan states: Union Station is the hub of the multimodal Transportation Center located in the North Downtown area and should serve as the primary passenger rail and intercity bus terminal in the Portland metropolitan area, providing direct connections between passenger rail, light rail, vintage trolleys, intracity buses, taxis and airport bus shuttles. Portland's Greyhound terminal is located

[111] TriMet, "Facts about TriMet". October 2008.

next to Union Station and provides bus service to cities and towns throughout the United States. (See Greyhound System Timetable available at www.greyhound.com)

Nine Amtrak trains serve the City of Portland each day, connecting the city by rail to cities throughout the U.S. and Canada. Five trains serve Portland daily along the Pacific Northwest Corridor from Vancouver to Eugene; two provide daily service from Seattle to Los Angeles; and two provide daily service from Seattle to Chicago.[112]

Air Travel[113]

Portland International Airport (PDX), owned and operated by the Port of Portland, is the primary commercial air transportation facility in the region. The airport is located on approximately 3,200 acres of land about 5 miles northeast of downtown Portland and primarily serves the surrounding Washington, Yamhill, Clackamas, Multnomah, and Clark Counties. PDX also serves the counties beyond this primary area, depending on the range and character of airline service provided in nearby cities such as Boise, Seattle, and Spokane. The PDX airfield consists of three active runways and supporting taxiways.

The Federal Aviation Administration (FAA) classifies Portland as a medium air traffic hub. The FAA defines a medium hub as a metropolitan region enplaning 0.5 to 1.0 percent of the total passengers enplaned on certified route air carriers in scheduled service in the 50 states and the District of Columbia; Portland accounted for 0.95 percent in 2007.

As of December 2008, PDX was served by 15 scheduled passenger airlines, including 9 major airlines, see Table 3.38. These airlines serve 44 domestic destinations and six international destinations (Vancouver, Amsterdam, Frankfurt, Tokyo, Guadalajara, and Mexico City). The airport served approximately 253,000 flights and nearly 14.3 million passengers in 2008. The majority (84%) of these flights were commercial, with a smaller number of general aviation (14%) and military (2%) flights. The vast majority of commercial flights were domestic flights by major or regional carriers.

As of 2008, 11 all-cargo airlines provided service at the airport. In addition, 98 general aviation aircraft were based at the airport.

[112] Based on Route Schedules available from Amtrak (www.amtrak.com) on March 10, 2009.
[113] Portland International Airport, Online: http://www.flypdx.com

Table 3.38 Airlines Serving Portland International Airport[114]

Cargo		
ABX	Ameriflight	MartinAire Aviation, LLC
Air China	Empire	UPS
Air Transport International	Evergreen	Western
Airpac	FedEx	
Passenger		
Major	**National**	**Regional**
Alaska Airlines	Frontier Airlines	Air Canada Jazz
American Airlines	Hawaiian Airlines	Horizon Air
Continental Airlines		JetBlue Airways
Delta Air Lines		SkyWest Airlines
Lufthansa German Airlines		
Northwest Airlines		
Southwest Airlines		
United Airlines		
US Airways		

FREIGHT SYSTEM[115]

A combination of geography and multimodal freight infrastructure assures Portland's role as a center for goods distribution to and from the Pacific Northwest and throughout the world. Portland is a "trans-shipment" center, where freight is handled on the way to somewhere else. In fact, more goods move through its transportation network to national and international destinations than are consumed here in the region. The economy of the Portland metropolitan region relies on the movements of goods, ideas and people. The ability to move these goods efficiently is critical to regional competitiveness and affordability, not only for businesses but also for all citizens.

Inventory

The Portland/Vancouver region is the fourth largest freight hub on the West Coast behind Los Angeles/Long Beach, Seattle/Tacoma and San Francisco/Oakland. Portland also serves as Oregon's freight hub. Portland's freight system is comprised of waterborne, rail, air, pipeline, and truck transportation networks, see Table 3.39, Table 3.40 and Map 3-20.

- Water: The city lies at the confluence of the navigable waters of the Columbia and Willamette rivers. The Port of Portland operates several deep-water marine terminal facilities along the Columbia and Willamette rivers.
- Rail: Two Class I railroads, the Burlington Northern & Santa Fe Railroad (BNSF) and the Union Pacific Railroad, connect Portland with national rail services and markets along the west coast and to major Midwest and Eastern United States markets. The city is also

[114] Portland International Airport, 2008 Calendar Year Aviation Statistics, Passenger Airlines include only those carrying more than 300 passengers in 2008.
[115] City of Portland Office of Transportation, *Freight Master Plan*, July 2006.

served by several branch rail lines, which distribute freight to and from the Class I railroads, as well as between local customers.

- Air: Portland International Airport, located entirely within the city of Portland, provides passenger and air cargo service for the Portland metropolitan area, including southwest Washington. Many air carriers provide domestic and international cargo transport in and out of the region.
- Pipes: Without local petroleum refineries, all of the Portland/Vancouver metropolitan region's fuel must be imported from Puget Sound refineries. The Olympic pipeline is the primary mode for transporting gasoline, diesel, and jet fuel to the region. This 400-mile common carrier pipeline transports approximately 12.3 million gallons of fuel per day – the daily equivalent of 1,500 tanker trucks traveling Interstate 5. Portland is also the terminus for the Kinder Morgan pipeline, which distributes fuel products from Portland into the Willamette Valley. Portland also has 20 pipeline distribution centers located along the Willamette River: 17 in Northwest Portland and 3 in North Portland. (Figure 17 in the 1996 Inventory shows the locations of these centers.)
- Roads: The link to all these modes is the network of freeways, highways, streets that connect the City's various modes of freight transport to their destinations. Two interstate freeways intersect in the heart of Portland. I-5 is the primary West Coast truck freight route linking urban centers between Canada and Mexico. Portland is the terminus for I-84, a primary freight route between the Pacific Northwest and Salt Lake City, where it merges with I-80 to the East Coast. I-205, I-405, US 26, US 30, and McLoughlin Blvd (OR 99E) are highways that facilitate intra-regional truck freight movement. Portland's streets are the first and last mile connections for trucks moving freight to and from marine terminals, rail yards, the airport, and industrial businesses. Trucks also use city streets to deliver goods and services to local businesses and residents.

Table 3.39 Mainline Facilities in the Portland Region[116]

Categories	Facilities
Navigable Waterways	Willamette and Columbia Rivers
Railroad Main Lines	Union Pacific, Southern Pacific, and Burlington Northern Main routes
Main Roadway Routes	I-84, I-5, I-205, I-405, US 26, Hwy 99E, Hwy 99W, Hwy 212/224

[116] Port of Portland

Table 3.40 Freight Facilities in the Portland Region[117]

Facility	Number of Facilities
Marine Facility	
General Cargo Terminal	8
Bulk Terminal	22
Forest Products Terminal	2
Grain Elevator Terminal	9
Auto Terminal	3
Container Terminal	1
Rail Facility	
Rail Passenger Station	1
Intermodal Yard	5
Switching Yard	3
Airport	
Air Passenger Terminal	1
Air Cargo Facility	14
Reload Facility	
General Rail/Truck Reload	31
Petroleum Rail/Truck Reload	1
Truck/Truck Reload	102
Grain rail/Truck Reload	0
Other	
Truck Terminal	30
Distribution Facility	35
Carrier (no on-site freight handling capabilities)	31
Freight forwarder and Customs Broker (no on-site freight handling capabilities)	7

Map 3-20 shows how the State's most vital highway, railroad and marine freight routes converge in Portland.

Freight Classification Descriptions

The City of Portland's Transportation System Plan includes nine classifications for freight: freight districts, regional truckways, priority truck streets, major truck streets, truck access streets, local service truck streets, railroad main lines, railroad branch lines, and freight facilities. Table 3.40 and Map 3-21 provide more information on freight classifications. The classifications are intended to maintain a system of truck streets, railroad lines, and intermodal freight facilities that support local, national, and international distribution of goods and services. Chapter 2: Transportation Element of the TSP contains more detailed explanations of the functional classification of pedestrianways in Portland and eight maps showing traffic classifications for each of the seven transportation districts and the Central City.

[117] RTP Freight Element, Freight Facilities, Port of Portland

Table 3.41 Freight Classification Descriptions

Freight Districts	Freight Districts are intended to provide safe and convenient truck mobility and access in industrial and employment areas serving high levels of truck traffic and to accommodate the needs of intermodal freight movement.
Regional Truckways	Regional Truckways are intended to facilitate interregional and movement of freight.
Priority Truck Streets	Priority Truck Streets are intended to serve as the primary route for access and circulation in Freight Districts, and between Freight Districts and Regional Truckways.
Major Truck Streets	Major Truck Streets are intended to serve as principal routes for trucks in a Transportation District.
Truck Access Streets	Truck Access Streets are intended to serve as access and circulation routes for delivery of goods and services to neighborhood-serving commercial and employment uses.
Local Service Truck Streets	Local Service Truck Streets are intended to serve local truck circulation and access.
Railroad Main Lines	Railroad Main Lines transport freight cargo and passengers over long distances as part of a railway network.
Railroad Branch Lines	Railroad Branch Lines transport freight cargo over short distances on local rail lines that are not part of a rail network and distribute cargo to and from mail line railroads.
Freight Facilities	Freight Facilities include the major shipping and marine, air, rail, and pipeline terminals that facilitate the local, national, and international movement of freight.

Major System Concerns

Growth and Congestion in the Freight System

The region's travel forecast model estimates that between 2000 (base year) and 2020 (future year), the number of medium and heavy truck trips nearly double. Not surprisingly, arterials that serve the Portland's industrial areas have the highest volume of medium and heavy truck trips today and in the future. Along with the growth in truck movement, traffic congestion is also increasing on Portland's street system. Analysis of the travel forecast model data indicates that locations that experience peak hour vehicle congestion today will have increased levels of congestion in the future. The locations that demonstrate the greatest increases in travel delay for freight movement occur on roads approaching the Portland International Airport and surrounding industrial area, along the US 30 industrial corridor, and on all of the freeway corridors in the city.

Growth challenges are not confined to Portland's street system. The projected growth in freight moved by water, rail, and air is significant.[118]

- Air cargo is anticipated to increase at a rate of 5 to 9 percent per year over the next 15 years.
- Marine traffic is expected to grow by 7 percent per year between 2000 and 2020.
- Freight rail traffic increases by 3.5 to 4 percent per year. According to recent technical studies, the Portland region's rail infrastructure contains critical bottlenecks along several main line segments and rail yards operated by Burlington Northern-Santa Fe and

[118] *Commodity Flow Forecast Update and Lower Columbia River Cargo Forecast Final Report*, prepared for the Port of Portland, Metro, Oregon Department of Transportation, Port of Vancouver, Regional Transportation Council, prepared by DRI-WEFA, BST Associates, and Cambridge Systematics, Inc, June 30, 2002.

Union Pacific. The delays experienced on the local freight network are equivalent to those experienced in the nation's largest rail hub – Chicago – which has 3.7 times the freight train traffic and 42 times the passenger train traffic of Portland.[119] In addition, branch line rail operations to and from rail yards and intermodal terminals are also highly congested. Rail capacity and service is also impacted by the need to expand and redesign some rail yards in the region.

Freight Mobility – Truck Delay

Freight mobility within and through Portland is key to the region's economic vitality. Delay in goods shipment incurs significant costs for businesses and consumers and detracts from the City's commercial competitiveness. The intent of this measure is to track progress toward accommodating the freight movement needs of commerce and industry. The goal is to minimize hours of delay to trucks on Major Truck Streets during both peak and off-peak times.

Freight delay is defined as the increased travel time attributable to congestion. This is the time increment accrued on road links above a 90 percent volume/capacity ratio. Only the positive differences are summed. Roads within the City are compared to all roads in the region.

Freight delay is measured for both the 2-hour p.m. peak and the 1-hour mid-day off-peak periods. The results are presented in Table 3.42. Mid-day (off-peak) delay in the 1994 model base year is quite small. Trucks encounter very few delays as a result of congested facilities in this time period. In the scenario representing the 2020 constrained RTP conditions, hours of truck delay are expected to increase significantly because of a rise in congestion.

Table 3.42 Truck Delay (hours)[120]

	1994 Mid-Day 1 Hour	2020 Mid-Day 1 Hour	1994 PM 2-Hour	2020 PM 2-Hour
City Street System	1.8	29.3	82.0	344.5
Region	6.5	82.2	129.9	809.2

Infrastructure Barriers to Freight Mobility

Congestion is not the only challenge facing freight mobility in Portland. Physical barriers due to inadequate infrastructure also hamper the efficient and reliable movement of freight in the city. Some of the more significant obstacles include:

- Weight-Restricted Bridges: A number of bridges on truck routes in Portland are weight-restricted to a single-unit truck weight of 50,000 pounds and 80,000 pounds for a combination truck, and in some instances less than 80,000 pounds. Industry efficiencies have led to an increase in the size of trucks since these bridges were constructed. Modern-day truck weights routinely exceed the design weight of these aging facilities. The result is that over-weight trucks are detoured from direct routes, increasing fuel

[119] I-5 Rail Capacity Study, prepared by HDR Engineering, Inc, February 2003, page 2-5. Bertha Blvd underpass at Capitol Hwy. Truck detour at weight-limited MLK Jr. Blvd. Viaduct.
[120] City of Portland Bureau of Transportation, *Portland Transportation System Plan*, Chapter 15, Table 15-11, 2007.

consumption and operating costs. There is also the potential for diversion of trucks to streets that are not intended for frequent truck trips.

- Bridges with Low Vertical Clearance: Bridges with sub-standard clearance are also an issue for trucks passing under them. The legal height for trucks operating on highways and city streets is 14 feet but many trucks operating by permit exceed this standard height. As many as 24 bridges in Portland have clearance between 14 feet and 17 feet, with most located on highways or priority truck routes. Like weight-restricted bridges, this barrier also results in detours from direct routes.
- At-Grade Railroad Crossings: With the predictions of substantial increases in train traffic in the Pacific Northwest over the next twenty years, conflicts between train and truck traffic will likely rise. Safety at locations where roads and rails intersect has long been a concern. More recently, the concern has focused on longer delays. Crossings near intermodal facilities, ports, major rail yards, and classification and switching areas will experience higher volumes of train and truck traffic due to growth in domestic and foreign trade.[121] In Portland, most at-grade crossings are located in industrial areas. At some crossings, trucks and other traffic may be stopped for up to a total of four hours in a 24-hour period creating congestion and increasing operating costs.
- Pavement Condition: Portland is facing a growing pavement maintenance backlog. Declining revenues and increasing costs have reduced the miles of city streets maintained on a regular basis. Between 1980 and 2004, the backlog has grown from 285 miles to 586 miles. Regular maintenance of pavement increases its longevity, extending the time before major reconstruction is needed. Large trucks accelerate the deterioration of paved surfaces. With forecasts of increasing truck volumes, the pavement on Portland's streets will certainly be subjected to increased wear and tear. The result of poor pavement conditions is decreased fuel economy, increased vehicle operation and maintenance costs, and the potential for damaged cargo.[122]
- Lift and Swing Spans over the Columbia River: A more unique freight barrier in the region is the misalignment of two adjacent bridge spans. Travel by river tow boats and barge vessels is complicated during high water periods by the indirect alignment of the high span of the Interstate Bridge and the swing span of the BNSF rail bridge over the Columbia river. Captains maneuver their vessels under the mid-section of the I-5 bridge to avoid I-5 bridge lifts that delay interstate traffic. Once clear of this bridge, captains maneuver their vessel to the northern river channel to clear the swing span of the rail bridge. During periods of high water, about six months of the year, this maneuver becomes far more difficult, increasing the potential for an accident.
- Road Design: Most of Portland has a mature arterial street system, designed to accommodate vehicle traffic of a former era. Today, many of the trucks that use these older streets to deliver goods and services to the community are much larger than the street design is intended to support. At times, the needs for efficient truck movement are

[121] *Status of Nation's Highways, Bridges and Transit:2002 Conditions and Performance Report to Congress*, U.S. Department of Transportation, Federal Highway Administration, Pg. 26-1.
[122] Source: www.transportationca.com, Transportation California, April 28, 2004.

in conflict with other desired design features on the same street such as median islands or curb extensions. In other cases, trucks benefit from a design feature such as bike lanes that provide more space for turns. Balancing the needs of the different truck types using the streets with the needs of other users presents a challenge, especially in mixed-use centers and along main streets.

- Parking and Loading: A critical element of the supply chain is the ability to efficiently transfer goods and materials between shippers, trucks, and customers. Portland provides commercial on-street loading zones along many of its streets. The zones are assigned by request from individuals who receive and/or make truck deliveries. Portland's zoning code has requirements for off-street loading spaces in commercial, employment and larger residential developments. Anecdotal evidence suggests that the existing supply of and demand for loading spaces is mismatched. The result is that drivers either double-park in travel lanes, blocking traffic, or park illegally. Currently, there is no comprehensive method to ensure that on- and off-street loading is adequate to meet business needs.
- Over-Dimensional Truckloads: Some loads carried by trucks are not practically divisible, meaning that they can not be reduced to meet legal limits for weight, height, length, and/or width set by the State of Oregon. The State requires that trucks exceeding legal dimensions obtain a permit when traveling on public roadways. Portland also regulates over-dimensional loads and writes permits based on criteria established in Title 16 of the City Code. The most common type of over-dimensional load in Portland is construction equipment such as cranes and excavators but other manufactured items such as steel slabs and bridge girders require over-dimensional moves. These are an infrequent but an important type of freight movement in the city. There is a need to identify and maintain a primary network of over-dimensional routes, with a focus on connections in and between Freight Districts.

CHAPTER 4: PORTLAND WATER BUREAU

OVERVIEW

The mission of the Portland Water Bureau is to provide reliable water service to customers in the quantities they desire and at a quality level that meets or exceeds both customer and regulatory standards; to provide the highest value to customers through excellent business, management, and operational practices, and appropriate application of innovation and technology; to be responsible stewards of the public's water infrastructure, fiscal and natural resources; and to provide the citizens and the City Council with a water system that supports their community objectives and overall vision for the City of Portland.

The City of Portland is the largest supplier of domestic water in Oregon, serving over 800,000 people and providing about 100 million gallons of water per day, or about 36 billion gallons per year. About 60 percent of the water is delivered to customers within City limits. The remaining 40 percent is sold to customers in 19 surrounding cities and special water districts. Water is supplied from the Bull Run watershed and the Columbia South Shore wellfield through over 2,000 miles of pipes within the City's boundaries. The water system is currently valued at about $5.3 billion.

The City's water system includes four main systems:

- a supply system, which collects water from the Bull Run watershed and Columbia South Shore wellfield;
- a transmission system of conduits, which moves water to a number of reservoirs;
- a terminal storage system of reservoirs; and
- a distribution system of mains, service lines, pumps and tanks, which distribute water to residences and businesses.

These systems are described in more detail in Table 4.1. Figure 4.1 illustrates the main components of Portland's water system, while Map 4.1 shows the water system within the City's limits in greater detail.

Figure 4.1 Portland's Water System

Table 4.1 Portland Water System Status and Condition, 2007

Asset Group	Number	Units	Total Value ($ millions)	Very Good	Good	Fair	Poor	Very Poor
Distribution System				**14.2**	**45.7**	**33.1**	**5.5**	**1.6**
Distribution Mains	2163	miles	$1,807	12	50	34	4	1
Distribution Mains - Cast Iron	1407	miles	$1,122	0	46	52	2	0
Distribution Mains - Ductile Iron	630	miles	$529	39	59	0	2	0
Distribution Mains - Steel	38.2	miles	$62	0	37	11	46	6
Pump Mains	31	miles	$66	10	60	15	10	5
Other Distribution Mains	31	miles	$15	4	60	23	7	6
Service Lines	183,020	miles	$760	14	22	45	6	1
Service Lines (<2 in)	172,100	miles	$620	15	25	53	7	1
Service Lines (≥ 2 in to < 4 in)	5060	miles	$52	30	30	25	10	5
Service Lines (≥ 4 in)	2760	miles	$43	27	45	18	5	5
Service Lines (Firelines)	3100	miles	45	38	37	16	5	4
Appurtenances			$585	16	52	16	11	5
System Valves	43,800	each	$377	20	59	10	8	2
Meters	179,908	each	$35	39	23	16	4	19
Hydrants	14,400	each	$147	5	42	28	15	10
Fountains	149	each	$11	0	67	14	18	0
Backflow Prevention Devices	24,000	each	n/a	0	0	100	0	0
Regulator Stations	261	each	$15	0	33	33	34	0

Table 4.1 Portland Water System Status and Condition, 2007, cont.

Asset Group	Number	Units	Total Value ($ millions)	Very Good	Good	Fair	Poor	Very Poor
Pump Stations And Tanks			$372	14	5	30	16	0
Pump Stations	39	each	$102	37	38	22	4	0
Storage Tanks	71	each	$270	6	60	32	1	1
Supply System			**$623**	**1**	**56**	**40**	**3**	**0**
Supply - Bull Run			$485	1	57	39	3	0
Road System	123 mi. roads, 1500 culverts, 11 bridges		$146	1%	41	55	3	0
Bull Run Lake	1	each	$16	0	90	5	5	0
Dams	2	each	$290	0	63	36	1	0
Headworks	1	each	$24	2	67	19	12	0
Lusted Hill Treatment	1	each	$9	0	70	30	0	0
Watershed	103	mi^2	n/a					
Supply - Groundwater			$138	3	51	43	3	0
Well Sites	33	each	$65	0	42	53	5	0
Collection Mains	12	miles	$29	13	85	0	2	0
Pump Stations	1	each	$35	0	28	69	3	0
Treatment Facility	1	each	$10	0	100	0	0	0
Transmission			**$688**	**1**	**47**	**41**	**11**	**0**
Conduits (all components)	75.2	miles	$442	1	39	50	9	0
Sandy River Crossings	2	each	$27	0	0	50	50	0
Willamette River Crossings	7	each	$44	0	40	20	40	0
Washington County Supply Line	14.2	miles	$75	0	90	10	0	0
GWPS to Powell Butte	6.3	miles	$36	0	90	10	0	0
Tabor to Washington Park	22.2	miles	$64	0	50	40	10	0
Terminal Storage			**$301**	**0**	**7**	**24**	**56**	**13**
Powell Butte (Res. #1)	50	mi. gal.	$63	0	0	100	0	0
Mt. Tabor (Res. #1, 5, 6)	136	mi. gal.	155	0	0	0	80	20
Washington Pk (Res. #3, 4)	34	mi. gal.	43	0	0	0	80	20
Terminal Storage Treatment	1	each	$10	0	0	0	100	0
Other Improvements	n/a		$30	0	67	33	0	0
Support Facilities			**$115**	**10**	**23**	**17**	**42**	**9**
Buildings	11	locations	$81	2	32	12	53	1
Vehicles/Heavy Equipment	n/a		$18	37	3	4	20	36
Other Equipment	n/a		$16	16	3	50	13	18
Water System Total			**$5,252**	**10**	**44**	**34**	**10**	**2**

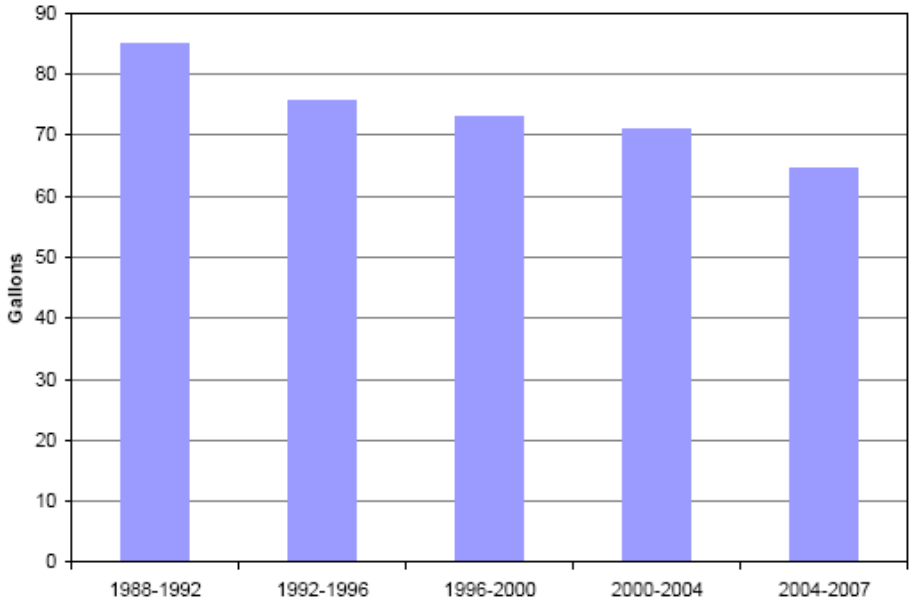
Some assets are not owned by Bureau, but the PWB maintains or ensures proper operation.
Water System summary now includes most PVRWD assets (all that are in GIS plus pump stations and tanks)

KEY ISSUES & CONCERNS

Declining Water Demand

Total water demand for the Portland system has fallen over the last few years, as retail and wholesale customers buy less water. Per capita water use for retail single-family residential customers has gone down significantly since 1992. The average consumption for retail single-family customers between 1987 and 1992 was 87 gallons per person per day (GPC), is now down to about 66 GPC, and has been as low as 62 GPC. Variables such as the water shortage of 1992, updated state and national plumbing codes, the change from flat rates to consumption-based rates for wastewater (in 1994), and behavioral changes from conservation education have helped to reduce each household's overall consumption. Figure 4.2 shows the average annual GPC from 1988–2007.

Figure 4.2 Average Residential Per Capita Daily Water Use[123,124]



Water demand forecasts developed by the Water Bureau anticipate that while per capita water demands will continue to decline somewhat over time, the overall demands on the Portland water system will increase. The status of continued wholesale water sales is not known at this time, but the Bureau anticipates continuing to sell surplus supplies while requiring conservation and curtailment plans by wholesale customers.

Maintaining Existing Infrastructure

Many water system facilities are nearing the end of their useful lives. Half of the 2,000 miles of distribution mains are older than 50 years. Open reservoirs are 79 to 100 years old. Transmission conduits are 50 to 92 years old. Dams and reservoirs are 42 to 75 years old. The Water Bureau faces new costs to maintain and replace aging infrastructure, respond to security and vulnerability

[123] Each bar is an average of the gallons-per capita for the three or four-year period.

[124] Portland Water Bureau, *Draft Water Management and Conservation Plan*, March 2008. Original Data Source: Water Bureau system billing data

issues, and comply with regulatory requirements. In the meantime, there is pressure to hold down rate increases. For 2007, the Water Bureau estimates a $15 million annual funding gap, primarily in the replacement of assets in poor condition, including distribution system components, transmission conduits and the Interstate maintenance facility. Over the next 5 years, the Water Bureau expects to invest over $264 million on water-related capital improvements, primarily on the Distribution Program (57 percent).

Regulatory Compliance

Following a recent court decision, the Water Bureau has new unfunded requirements related to replacing terminal storage reservoirs and treating the water supply system. It may cost an additional $20 million to $50 million per year for ten years to fulfill these requirements. Obligations resulting from this ruling may include replacing uncovered finished storage reservoirs at Mt. Tabor and Washington Park, and treatment of the Bull Run supply.

Vulnerability and Security

The City of Portland Water Bureau is dedicated to protecting public health and safety by ensuring that key components of the water system will withstand most human-caused or natural disasters. The Water Bureau has completed a number of studies looking into vulnerabilities within our system. Significant funding will be required to increase protection of more than 80 critical facilities, including dams, reservoirs, water supply pipelines, pump stations, and operations yards.

Accommodating Growth

The City of Portland provides water to customers within the city limits, i.e. retail customers, as well as a significant number of large wholesale customers. Approximately 60% of water delivered by the Water Bureau is to retail customers. Average daily demand for these customers in 2005 was 61.5 million gallons per day (MGD). This is expected to grow to 79 MGD by 2030. While this is not a huge growth rate within the City, it is something that needs to be addressed in the planning of infrastructure.

A larger issue is the impact of regional growth, which is happening at a much faster pace. Population in areas served through wholesale contracts is expected to increase significantly. However, as wholesale customers make decisions on future supply sources which may or may not include supply from the City of Portland, it is unknown just how this growth will impact the Water Bureau.

Climate Change

In January 2002, in conjunction with the University of Washington, the Water Bureau completed a report on the impacts of climate change on the Portland water system. The Bureau is continuing to study the issue of climate change and to establish both adaptation and mitigation strategies to deal with this issue. The ability of Portland's two water systems to meet future demands, as well as the need for conservation and efficiency programs, will be important considerations as climate change impacts become clearer.

The City of Portland has kept detailed climate records for the past 66 years and continues to research and model climate patterns and their effect in the Bull Run watershed. The city also

monitors current global and regional climate change information. The Water Bureau hired the University of Washington staff to develop a climate change study for the Bull Run watershed. This study was completed in 2002 and showed that winter precipitation would increase on average, but that snowmelt would provide less flow in spring. Although the length of the longest drawdown period was not predicted to increase, the average length of drawdown for all years was expected to increase. The study also showed that the storage in the Bull Run system would still be filled each year, because overall winter flows in the watershed are still much greater than the amount stored.

Although global climate change models vary in predictions of precipitation amounts and patterns, predictions of increased temperatures in the future show a more consistent trend. The University of Washington Climate Impacts Group's (CIG) review of newer global climate models for the 2007 Intergovernmental Panel on Climate Change reports show that, for the Pacific Northwest, the precipitation changes in the summer are still fairly unpredictable, and temperature increases are 10-20 years further in the future than predicted in studies conducted in 2002.

The City is preparing for climate change through research and monitoring, revising long-term planning models, working with other west coast cities on adaptation and mitigation strategies, developing its rights in the Columbia South Shore Wellfield to provide summer supply and emergency backup capacity, and supporting water conservation and sustainable use practices.

DESIRED LEVELS OF SERVICE

The Portland Water Bureau's Strategic Plan lists the following infrastructure related service levels:

- 100% compliance with state and federal water quality regulations.
- No more than 5% of customers out of water for more than 8 hours a year.
- No customer out of water more than 3 times per year.
- At least one working hydrant within 500 feet of service connection.
- Maintain minimum pressure of 20 pounds per square inch (psi) during normal demands.
- The Bureau also maintains a variety of other customer service, financial health, infrastructure management, workforce, and sustainability service levels.

SYSTEM SERVICE AREA

Approximately 860,000 people living within a 225-square-mile service area around Portland are served by the Water Bureau's retail and wholesale water sales, see Figures 4.3 and 4.4.[125] The Portland Water Bureau has supplied domestic water to residents of the Portland area for more than 100 years and is the largest supplier of domestic water in Oregon. The Water Bureau delivered 36 billion gallons (BG) to customers during fiscal year (FY) 2006-2007. The 19 wholesale water customers are contiguous to the Water Bureau's retail service area, in Multnomah County and serve parts of neighboring Clackamas and Washington counties.

[125] This number reflects the average daily population served regularly; the total population number has been adjusted to reflect use of alternative water sources by wholesale customers. For more information, see the Demand Forecast Methodology subsection of Section 5.4 in Water Supply.

Figure 4.3 Drinking Water Supply System Retail and Wholesale Service Areas

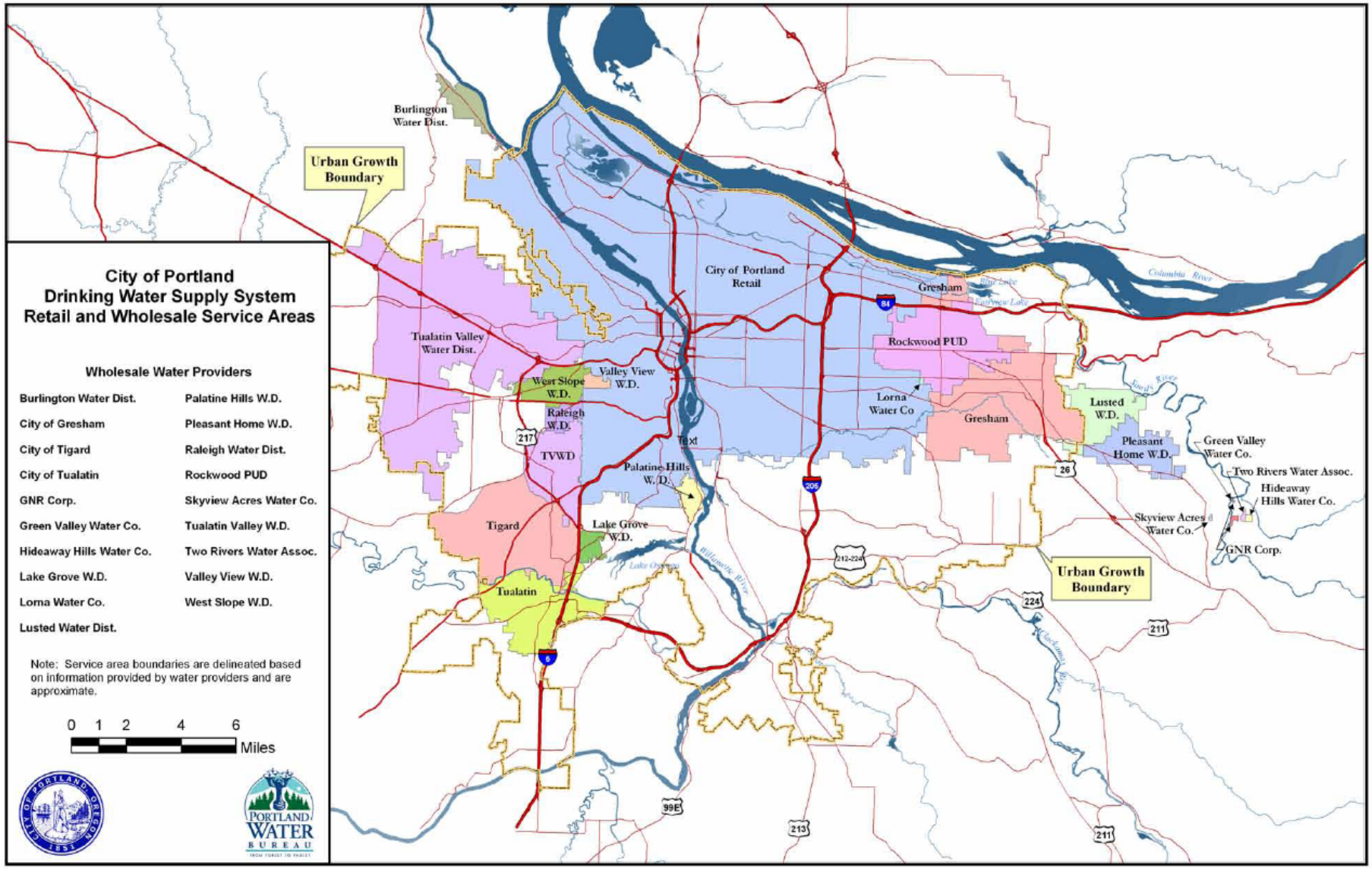
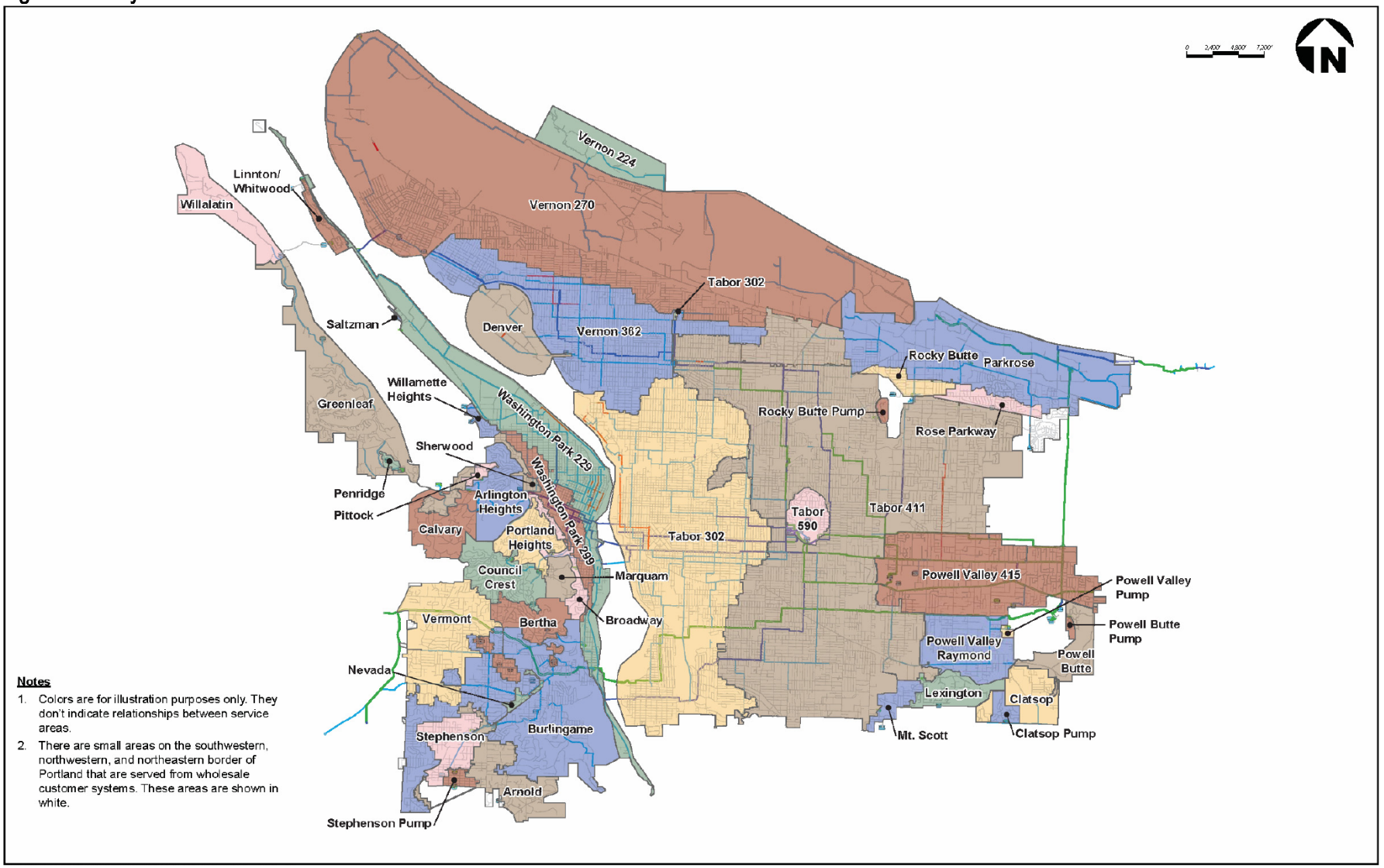


Figure 4.4 City of Portland Retail Service Areas



REGULATORY REQUIREMENTS

Federal Mandates

Safe Drinking Water Act (SDWA)[126]

Under the Safe Drinking Water Act, which is implemented through Oregon Revised Statutes and Administrative Rules, the Portland Water Bureau is required to conduct sampling and submit results to Oregon Department of Human Services, in order to demonstrate compliance with maximum contaminant levels, participate in on-site inspections (sanitary surveys) of treatment and distribution facilities by State Drinking Water Program personnel every three years and participate in annual inspections of the watershed. The Portland Water Bureau is also required to submit a Water System Master Plan every 20 years, submit a list of completed projects annually, produce and distribute annual Consumer Confidence Reports, meet operator certification requirements, and submit annual cross-connection reports.

Unregulated Contaminant Monitoring Rule (UCMR[127])

The UCMR is administered under direct authority of the U.S. EPA and requires monitoring for 25 unregulated contaminants using five analytical methods during 2008-2010. The U.S. EPA uses the data generated by the UCMR to evaluate and prioritize contaminants on the Drinking Water Contaminants Candidate List, a list of contaminants EPA is considering for possible new drinking water standards.

Stage 2 Disinfection Byproducts Rule[128]

The Stage 2 Disinfection Rule is administered under direct authority of the U.S. EPA and requires the Portland Water Bureau to submit a sample plan and conduct sampling for disinfection byproducts.

Enhanced Surface Water Treatment Rule, LT2[129]

The Long Term 2 Enhanced Surface Water Treatment Rule (LT2) is administered under direct authority of the U.S. EPA. Published in December 2005, LT2 applies to surface water or groundwater under direct influence of surface water (GWUDI) systems, increasing the regulation of Cryptosporidium. LT2 also addresses the regulation of Cryptosporidium, Giardia and viruses in open reservoirs.

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[126] of 1974, 1986, 1996 as administered under the U.S. EPA Primacy Agreement by the Oregon Department of Human Services (ODHS) under Oregon Revised Statutes (ORS) 448 and Oregon Administrative Rules (OAR) 333-061

[127] U.S. EPA 1996 Safe Drinking Water Act Amendments – UCMR 2 40 CFR Parts 9, 141 and 142 - Federal Register: January 4, 2007 (Volume 72, Number 2 - , Rules and Regulations Page 367-398.

[128] U.S. EPA Safe Drinking Water Act of 1974, 1986, 1996 - 40 CFR Parts 9, 141, and 142 - Federal Register: January 4, 2006 (Volume 71, Number 2), Rules and Regulations Page 387-493.

[129] U.S. EPA Safe Drinking Water Act of 1974, 1986, 1996 - 40 CFR Parts 9, 141, and 142 - Federal Register: January 5, 2006 (Volume 71, Number 3) - Rules and Regulations Page 703-752

Compliance with the LT2 would have impacts on two separate parts of Portland's water system. First, the rule requires the city to provide additional treatment to its Bull Run supply to either remove or inactivate Cryptosporidium. The treatment options available to the city for this include filtration (either traditional or newer micro-membrane technology to remove the parasites), ozonation (the introduction of ozone to water to destroy the Cryptosporidium oocysts) or ultraviolet radiation (ultraviolet lights irradiate the Cryptosporidium oocysts to prevent them from reproducing which is commonly referred to as inactivation).

Secondly, the rule would require changes to how open finished drinking water reservoirs are managed and operated. The rule requires that water systems with uncovered finished water reservoirs, like those at Mt.Tabor and Washington Parks, either cover the reservoirs or provide treatment at the outlets of the reservoirs to inactive Cryptosporidium and other viruses.

In 2002 new treatment facilities were estimated to cost from $55 to $204 million to construct and millions more to operate on an annual basis. The city estimated at that time that it would cost an additional $77 million to come into compliance with the open reservoir requirements of the rule.

Americans with Disabilities Act[130]

The Americans with Disabilities Act requires new facilities and in some instances existing facilities to be brought up to ADA accessibility standards.

Bull Run-Related Mandates

A variety of federal mandates and agreements relate to the protection, management, and operation of the Bull Run Watershed. These include the:

- Federal Bull Run Trespass Act of 1904 - Public Law 206, which set aside the Bull Run watershed to protect it from settlement and entry.
- 1994 Northwest Forest Plan – USDA Forest Service, which set a coordinated management direction for the lands within the range of the northern spotted owl to meet the need for forest habitat and the need for forest products.
- Bull Run Watershed Management Act "Bull Run Act", P.L. 95-200, as amended by the Oregon Conservation Resources Act in 1996 - USDA – Forest Service, directs the Forest Service to consult and coordinate with the City of Portland to ensure management programs, practices, and standards on watershed lands are protective of drinking water quality. The City of Portland and USDA Forest Service have also established a 30-year agreement, the Bull Run Watershed Management Unit Agreement (2007) to adhere to the terms of the Bull Run Watershed Management Act and the Northwest Forest Plan. Under this agreement, the city develops and maintains Security and Access Management Plans, an Emergency Response Coordination Protocol, a Road Decommissioning Plan, and a Fire Protection Plan; and participates in meetings and collaborative efforts to maintain and manage various aspects of the watershed. This Agreement must be reviewed and updated every 5 years.

[130] 1990, administered through Oregon Structural Specialty Code Oregon Administrative Rules 918-460

- Federal Oregon Resource Conservation Act (ORCA) of 1996: Requires the Secretary of Agriculture to prohibit timber cutting within the hydrographic boundary of the Bull Run River Drainage, except as necessary to protect or enhance water quality or for the construction, expansion, protection, or maintenance of water supply, energy transmission, or approved hydroelectric facilities.
- Bull Run Water Supply Habitat Conservation Plan (2007) - NOAA/USFW: outlines how the City will meet its responsibility to address the environmental impacts of the existence and operation of the water system.
- The Endangered Species Act of 1973, 1988 and associated City of Portland - Bull Run Fish Restoration Program.
- Bull Run Planning Unit Land Management Plan, Final E.I.S. (USDA-FS-FES (Adm)-76-16, January 24, 1979)
- US Forest Service Administrative Closure Order for the Bull Run Management Unit (July 27, 1984)
- Water Quality Standards for Bull Run Watershed Management Unit (1984, Rev. 1991)
- Little Sandy Protection Act (PL 107-30, August 20, 2001), which extended the boundaries of the Bull Run Management Unit.

State and Regional Mandates

Oregon Revised Statutes and Administrative Rules

Statewide Planning Goals and Guidelines[131]

Requires the PWB to participate in the City's efforts to update the Public Facilities Plan (the Citywide Systems Plan) and submit to the Oregon Department of Land Conservation and Development (DLCD) for acknowledgment as consistent with Statewide Goals.

Water Rights[132]

To maintain water rights, the Portland Water Bureau (PWB) has developed a Water Management and Conservation Plan, which was approved by the State in 2010, and reports water use on an annual basis.

Oregon Structural (OSSC), Mechanical (OMSC) and Electrical (OESC) Specialty Codes[133]

Requires new facilities and in some instances existing facilities to be brought up to new building code standards.

[131] SB 100, Statewide Planning Goals and Guidelines (OAR 660-011), Compliance procedures (ORS 197, and) Goal 11-Public Facilities and Services
[132] ORS 436 and 437 and OAR 690-086, 690-410, and 690-315 Water Rights - Oregon Water Resources Department (OWRD) Oregon Revised Statutes 436, 537 Oregon Administrative Rules 690-086, 690-410, 690-315
[133] 2007 OSSC – OAR 918-460, 2007 OMSC – OAR 918-440, 2005 OESC – OAR 918-305

2003 Oregon Natural Heritage Plan

The mission of the Oregon Natural Heritage Program is to conserve the full range of Oregon's native plants, animals and ecosystems through voluntary and cooperative action.

Regional Water Supply Plan

The Regional Water Supply Plan (RWSP) was adopted in 1996 (updated in 2004) by most of the region's individual water providers and is coordinated by the Regional Water Providers Consortium. The RWSP provides a comprehensive, integrated framework of technical information, resource strategies and implementing actions to meet the water supply needs of the Portland Metropolitan Area to the year 2050.

Metro Regional Plans

1997 Metro Regional Framework Plan (Amended in 2005) - METRO

In 1992, the region's voters adopted a Metro charter for Metro which gave Metro jurisdiction over matters of metropolitan concern and required the adoption of a Regional Framework Plan. The Regional Framework Plan unites all of Metro's adopted land use planning policies and requirements. The Charter directs Metro to address the water sources and storage in the Plan. The Regional Framework Plan, originally adopted in 1997, was amended in 2005 and includes the Metro 2040 Growth Concept.

The Metro 2040 Growth Concept defines regional growth and development in the Portland metropolitan region. The Water Bureau will need to provide the water infrastructure to meet demands associated with projected population densities.

Urban Growth Management Functional Plan - Title 6 (Metro Code Sections 3.07.610 - 3.07.650) - Central City, Regional Centers, Town Centers and Station Communities - METRO

The Urban Growth Management Functional Plan was adopted by the Metro Council and codified in Section 3.07 of the Metro Code. The purpose of this functional plan is to implement regional goals and objectives adopted by the Metro Council as the Regional Urban Growth Goals and Objectives (RUGGO).

The intention of Title 6 is to enhance the Centers designated on 2040 Growth Concept Map by encouraging development in these Centers. Metro will work with cities and counties to implement development strategies which will include an analysis of the barriers to development, an accelerated review process for preferred types of development, an analysis of incentives to encourage development and a program to adopt the incentives. Cities and counties are encouraged to site government offices in Centers and are required to report on the progress made in their Centers to Metro every two years. PWB is expected to complete infrastructure improvements as needed in order to support activities related to development of these urban environments.

SUPPLY SYSTEM[134]

The primary drinking water source for Portland is the Bull Run watershed, supplemented by a groundwater supply from the Columbia South Shore Well Field (CSSWF) and the wells in the former Powell Valley Road Water District. The Bull Run watershed is located east of Portland and just north of the western foothills of Mt. Hood; the CSSWF is south of the Columbia River and east of the Portland International Airport, see Figure 4.5. The former Powell Valley Road Water District is located in southeast Portland, near Powell Butte.

Since 1895, Portland has relied on the Bull Run watershed as its principal source of supply. Rainfall runoff and snowmelt from within the watershed are captured in the Bull Run storage system, which is comprised of Bull Run Lake, and Reservoir 1 and 2, all located on the Bull Run River. At Reservoir 2, water enters the Headworks, the beginning of the three conduits that convey water from the Bull Run System to Powell Butte Reservoir. From Powell Butte, water is supplied to Mt. Tabor and Washington Park Reservoirs. These reservoirs serve as terminal storage for the water supply transmission system, and as central points for distributing water into the retail water system.

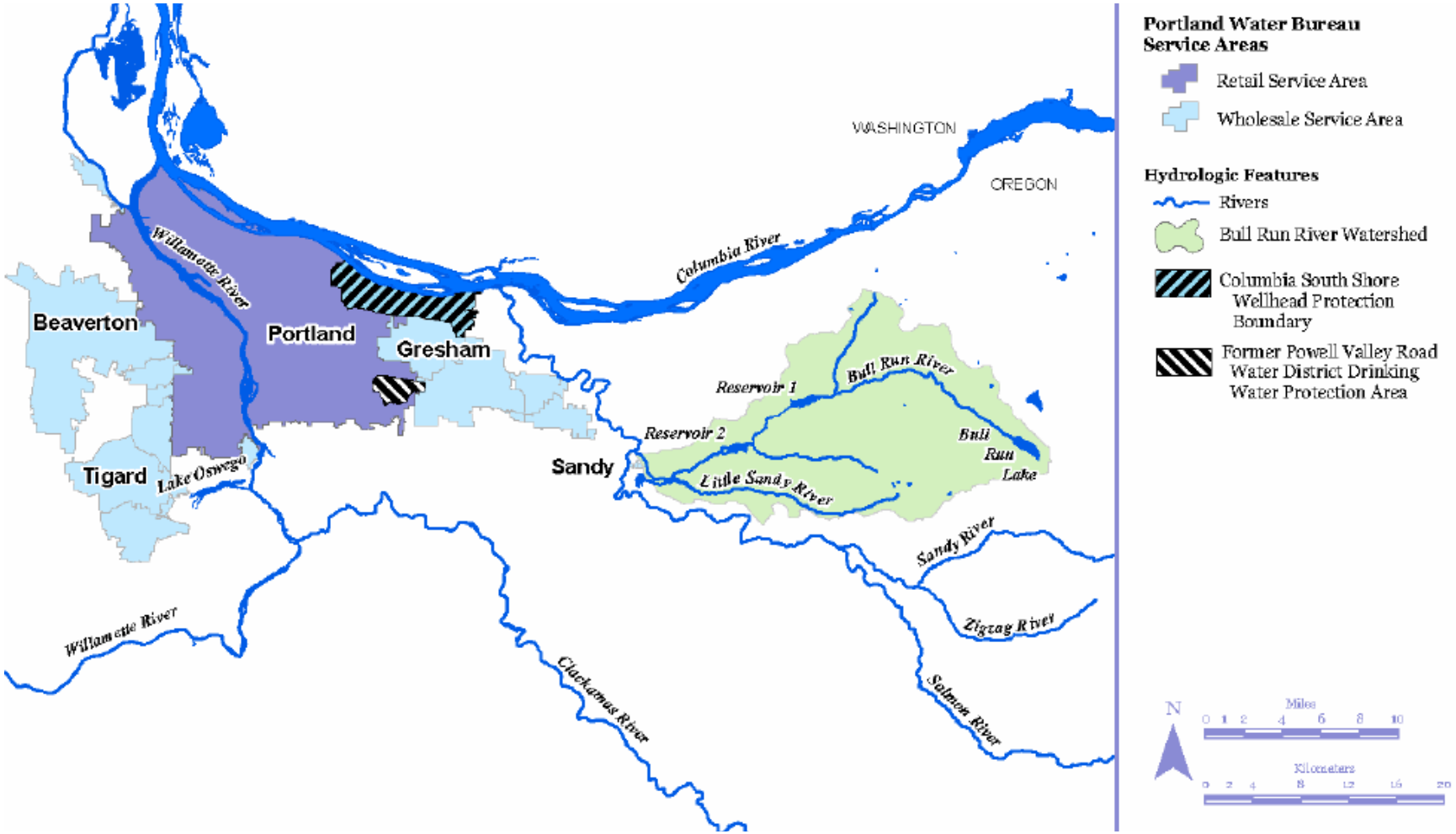
The Federal Safe Drinking Water Act, which regulates public drinking water supplies, typically requires surface water supplies to be filtered to meet federal drinking water standards. Because the Bull Run source water quality is very high and Portland implements source water protection measures, Portland is currently exempted from filtration requirements. Portland's water supply is disinfected using chloramines. Water is chlorinated at the Headworks at Reservoir 2. Ammonia and caustic soda are added at a second treatment facility, Lusted Hill.

Since 1985, Portland has used groundwater from the Columbia River South Shore Well Field, as an emergency seasonal supply, and as a backup supply when winter storms cause high turbidity in the Bull Run watershed. The groundwater supply comes from four aquifers along the south shore of the Columbia River. The system includes 27 wells, one storage tank, a groundwater booster pump station, and a treatment facility.

Several other wells throughout the city supply non-potable water to PP&R for irrigation of public parks, golf courses, and other recreation facilities. These wells fall under the jurisdiction of PP&R but are reported in this section.

[134] Portland Water Bureau, Distribution System Master Plan and Portland Water Bureau, Water Management and Conservation Plan

Figure 4.5 Drinking Water Supply System Water Sources



Wholesale Customers

The Water Bureau supplies water to its wholesale customers; the City of Portland does not receive water from any sources owned or operated by its wholesale customers. The city's water supply system is interconnected with other water suppliers including the City of Lake Oswego, the City of Milwaukie, and Clackamas River Water. Portland is able to receive water from these other sources on a limited basis for an emergency.

Bull Run Watershed

Inventory

The Bull Run watershed provides the majority of Portland's total water supply—an average of 180 billion gallons (BG) a year. [135] The water of the Bull Run River is primarily impounded in two reservoirs: Reservoir 1, completed in 1929, and Reservoir 2, completed in 1962. Periodically, the Water Bureau relies on storage capacity in Bull Run Lake, a natural lake that is upstream of the headwaters of the Bull Run River, to enhance the supply of the two reservoirs.

At the Headworks facility below Dam 2, the raw water is disinfected. The water then flows to the Lusted Hill facility for further treatment, and is fed by gravity to the "in-town" transmission and distribution system. The Bull Run water system includes facilities for hydropower and water treatment. The Portland Hydroelectric Project comprises hydropower facilities at two dams that generate electricity that the city sells to Portland General Electric (PGE).

The Water Bureau's facilities in the Bull Run Supply system are served by a network of 123 miles of roads and 11 bridges. In total, infrastructure assets in the Bull Run supply system have a 2007 replacement value of $485 million.

Current Condition

The vast majority of assets in the Bull Run Watershed are in Fair to Good condition, see Table 4.1. Twelve percent of assets at the Headworks facility are in poor condition – the highest level of any asset group.

Adequacy and Reliability of Supply

The Bull Run watershed is the city's primary water source. The approximate median annual water yield from the Bull Run watershed (measured at Headworks, RM 6.5) is 180 billion gallons. The median annual diversion for water supply over the same period was about 36 billion gallons, or approximately 20 percent of the total median yield. The reservoirs in the Bull Run are recharged during the fall, winter, and spring when rainfall is abundant. During the dry summer months (starting in June or July), the reservoirs are drawn down. This drawdown period typically lasts until early October but can sometimes last until November or December. During this period, the water flowing out of the reservoirs exceeds the infill from rainfall and tributary flow.

[135] Measured at Headworks, river mile (RM) 5.9

Water demand varies annually, driven primarily by weather. In warm, dry summers when demand is high, the yield from the Bull Run watershed is at its lowest. In cool wet summers, water demand is often lower and yield from the Bull Run tends to be higher.

The duration of the dry season is also important because it determines the time period during which the city will rely on the limited storage in the watershed's reservoirs. Long dry seasons increase the proportion of groundwater that the city uses to meet demand before fall rains return.

The two Bull Run reservoirs are relatively small in comparison to the amount of precipitation and stream discharge in the basin. The reservoirs are not large enough to provide a multi-year water supply. Refill each winter is necessary to ensure supply for the following summer.

An analysis of seasonal (June-October) reservoir supply data from 1946-2004 shows a declining trend for total reservoir inflow for these months (City of Portland 2007). The city is monitoring inflow data to determine whether the trend will continue.

Over the last 20 years, the city has examined a number of options for increasing water storage in the Bull Run system. In the future, the city will continue to explore these and other options to meet long-term water supply needs.

Columbia South Shore Well Field

The Columbia South Shore Well Field (CSSWF) is the second-largest developed water source in the state, and the largest developed groundwater source. Located on the floodplain of the Columbia River northeast of downtown Portland, this eleven-square-mile area spans the boundaries of three cities: Portland, Fairview, and Gresham. The wells in the well field provide water when the Bull Run supply is shut down due to emergency conditions such as turbidity events, landslides, fires, or human-caused disruptions. The groundwater system is a supplemental supply when the Bull Run supply cannot provide enough water to meet demands during the summer peak season.

Inventory

As of December 2007, there are 26 active wells in the CSSWF.[136] The wells draw on three aquifers: the Sand and Gravel Aquifer (SGA); the Troutdale Sandstone Aquifer (TSA), and the Blue Lake Aquifer (BLA). The sum of the nominal instantaneous pumping capacity for all of the active wells is approximately 103 to 118 million gallons a day (MGD), based on the maximum pumping rates of the individual wells. In use, the well field has an empirically determined initial 30-day operating capacity of approximately 102 MGD. A 112-MGD pump station moves water to the city's Powell Butte Reservoir, where it is mixed with Bull Run water (unless the Bull Run supply is off-line).

Current Condition

Roughly half of the wells in the CSWWF are in either fair condition (53%) or good condition (41%). Collection mains are primarily in good to very good condition (85% and 13%,

[136] A map of the Columbia South Shore Well Field can be found in Figure 2-3 of the *Water Management and Conservation Plan*, 2008.

respectively). The treatment facility is in good condition and the pump station is in fair to good condition. Additional condition information can be found in Table 4.1.

Supplemental and Emergency Use of the CSSWF

According to the Seasonal Water Supply Augmentation and Contingency Plan—also referred to as the Summer Supply Plan (SSP), the CSSWF is used for supplemental and emergency supply under the following conditions:

- Supply Augmentation: During seasonal warm dry periods, groundwater may be used to augment the Bull Run supply to meet demand when the Bull Run water supply is not sufficient to meet the needs of the bureau's retail and wholesale customers; to maintain in-stream flows for fish habitat; or if water demand exceeds the conduit capacity long enough to deplete in-town storage below safe levels.[137]
- Turbidity Event Augmentation: Groundwater may be needed to augment or replace the Bull Run surface supply to avoid violating state and federal drinking water standards for turbidity. Turbidity in the surface water supply is typically caused by storm events in the Bull Run watershed.
- Emergency Use: Groundwater may be needed during catastrophic events (in addition to turbidity events) that would cause a loss of part or all of the Bull Run surface water supply. Catastrophic events include, but are not limited to, severe or extended drought, fire in the watershed, flood, landslides, volcanic activity, earthquakes, and acts of vandalism or terrorism. Any of these events could cause significant water quality problems or result in damage to, or shutdown of, the conduits or other critical infrastructure used to transfer Bull Run water to the Bureau's in-town reservoirs. An example of a catastrophic event in the watershed was a landslide in 1995 that damaged two conduits. Groundwater was used for 27 days and provided an average of 25.4 MGD to the distribution system.[138]

Contamination and Remediation

Anthropogenic, or human-related, contamination was first discovered in shallow groundwater aquifers near the well field in the 1980s. Since the early 1990s, the city has worked closely with the Oregon Department of Environmental Quality (ODEQ) to expedite the discovery, assessment, and remediation of contaminant sources and plumes, and to keep the well field operational. Remediation technologies used to remove contaminants from soil and groundwater include pump-and-treat, soil vapor extraction, electro-resistive heating, air sparging, and chemical and biological treatment. An extensive multi-aquifer monitoring well network is used by the bureau to track changes in groundwater levels and groundwater quality over time. Data from city groundwater quality monitoring indicate that the primary deep confined aquifers are free of contamination within the capture zones of active wells.

[137] Conduit capacity may be exceeded if demand is exceptionally high or if one or more of the conduits is out of service.
[138] Although the average is 25.4 MGD, the actual amounts per day varied widely.

Groundwater Protection Program

The Groundwater Protection Program adopted in July 2003 replaced existing programs in Portland and Fairview and initiated requirements for groundwater protection in Gresham. The Groundwater Protection Program requires businesses that use, store, or transport hazardous material above a certain threshold amount to implement best management practices to prevent spills on the ground.

The Water Bureau relies on the well field for summer supply augmentation and as an emergency backup supply when the Bull Run surface water supply is unavoidably limited or unavailable. The well field infrastructure represents supply capacity already in place and ready to use. Other water supply options of similar capacities will not be available until demand (as moderated by conservation programs) grows enough to enable financing and construction of new storage or supply. Given uncertainties about future per capita demand, the pace of urban growth, future wholesale water customer behavior, requirements to provide instream flows for fish, and changes in weather or climate patterns, the city anticipates a continuing need for the groundwater system to meet its responsibilities to customers.

Adequacy and Reliability of Supply

The Portland Water Bureau has not experienced any major supply deficiencies in the last 10 years. Portland is fortunate in that it has a high-quality secondary source of drinking water in the Columbia South Shore Well Field (CSSWF) to use should there be a supply shortage in the Bull Run watershed. In the past ten years, water from the CSSWF was used to augment Bull Run supply due to turbidity (4 times) and for summer supply augmentation (5 times). Since the groundwater system was installed in the mid-1980s, it has been used a total of 19 times—6 times for turbidity events in Bull Run, once for a landslide that took the conduits out of service, and 12 times for summer supply augmentation.

Although current well field capacity is sufficient to meet short-term (less than 30 days) emergency needs during the non-peak-season, there is no additional reliable capacity. As such, the current capacity of the well field system is not sufficient to meet demand during a full shutdown of the Bull Run system due to emergencies or catastrophic events, for events longer than 30 to 90 days. In addition, groundwater may be limited in the future due to increased withdrawal from the aquifer by full-time and growing municipal users in Oregon and Clark County, Washington.

High-manganese concentrations in two wells have limited the ability of the Water Bureau to utilize these wells. Manganese can cause water discoloration which can affect laundry businesses served by the Water Bureau. The Water Bureau avoids using the high-manganese wells unless no Bull Run supplies are available and the full capacity of the well field is needed.

The city has evaluated several options for maintaining and improving the adequacy and reliability of supplies the Bull Run watershed, CSSWF, and other sources. The results of these studies indicate that developing supplies in the CSSWF is the most cost-effective option.

Former Powell Valley Road Water District Wells

On July 1, 2005, the city annexed areas served by the Powell Valley Road Water District (PVRWD) in southeast Portland, northwest of Powell Butte. Residents of this former water district are now served by the Portland Water Bureau's retail system. The city took over all of the district's assets, including six active wells under an intergovernmental agreement.[139] The PVRWD assets included water rights and water infrastructure. The installed capacity of the Powell Valley wells can be as much as 8.6 MGD, however less than half of this capacity is currently available.[140] Several capital improvement projects are planned to repair various facilities and fully integrate the wells into the Water Bureau system. These projects may be completed in three to ten years.

The former Powell Valley Road Water Districts' wells are in good condition, are well-producing, and do not have significant water quality issues. In the future, the Water Bureau intends to upgrade these facilities to allow connection of these wells to the Powell Butte system. This integration would allow the Bureau to increase capacity if needed and to blend well water with water from the Bull Run Watershed and/or CSSWF before it enters the distribution system.

Current and Projected Water Demands

Table 4.2 summarizes existing and 2030 retail demands for the distribution system by service area. 2005 average daily demand was 61.5 mgd.[141] Average daily distribution system demand for 2030 is projected to increase to 79 mgd. The Water Bureau develops its demand forecasts using historical water use data, along with population and employment forecasts developed by the regional metropolitan services district, Metro. Historically, per capita demand in the retail area has shown a steady downward trend since 1993. However, current demand forecasts project relatively steady total demand through 2015, with an upward trend thereafter. Average and peak demand for the total service area is anticipated to increase 23% between 2005 and 2030.

[139] A map of the former Powell Valley Road Water District can be found in Figure 2-4 of the *Water Management and Conservation Plan*, 2008.
[140] Additional information on these wells, including size, depth, and capacity can be found in Table 2-2 of the Portland Water Bureau's Water Management and Conservation Plan.
[141] A 2005 demand of 64 mgd was used in capacity evaluations, projected from 2002 demand data at the outset of the study.

Table 4.2 Existing and Projected Retail Water Demands[142]

Service Area	2005 - Daily Demand Avg (mgd)	2005 - Daily Demand Peak (mgd)	2030 – Daily Demand Avg (mgd)	2030 – Daily Demand Peak (mgd)	Service Area	2005 - Daily Demand Avg (mgd)	2005 - Daily Demand Peak (mgd)	2030 – Daily Demand Avg (mgd)	2030 – Daily Demand Peak (mgd)
Arlington Heights	0.7	1	0.9	1.3	Powell Butte Pump	0.02	0.03	0.03	0.05
Arnold	0.5	1	0.6	1.2	Powell Butte	0.2	0.4	0.4	0.7
Bertha	0.5	1.1	0.6	1.3	PV Pump	0.03	0.05	0.03	0.1
Broadway	0.2	0.4	0.3	0.5	PV Raymond	1	1.8	1.3	2.3
Burlingame	1.9	3.3	2.1	3.7	PV 415	2.9	5.1	3.6	6.5
Calvary	0.6	1	0.8	1.3	Rocky Butte Pump	0.02	0.03	0.02	0.04
Council Crest	0.3	0.8	0.4	1.1	Rocky Butte	0.2	0.3	0.2	0.4
Clatsop Pump	0.1	0.2	0.1	0.2	Rose Parkway	0.3	0.6	0.3	0.7
Clatsop	0.2	0.3	0.2	0.4	Saltzman	0.001	0.003	0.002	0.004
Denver	0.9	1.6	1	1.7	Sherwood[1]	0.5	0.9	0.6	1.2
Greenleaf	1	1.6	2.1	3.5	Stephenson	0.4	0.7	0.4	0.7
Lexington	0.2	0.4	0.3	0.5	Stephenson Pump	0.1	0.1	0.1	2
Linnton/Whitwood	0.1	0.2	0.2	0.3	Tabor 302	10.6	15.6	12.7	18.7
Marquam	0.7	1.2	0.9	1.6	Tabor 4112	15.1	22.7	16.9	25.4
Mt Scott	0.2	0.4	0.3	0.5	Tabor 590	0.3	0.5	0.3	0.5
Nevada	0.1	0.2	0.1	0.2	Vermont	1.6	2.5	1.8	2.7
Parkrose	1.9	3.6	2	3.9	Vernon[3]	10	15.2	12.1	18.2
Penridge	0.04	0.1	0.1	0.2	Willalatin	0.1	0.3	0.3	0.8
Pittock	0.04	0.1	0.1	0.1	Washington Park 229	6.2	9.8	8.9	14
Portland Heights	0.6	1	0.8	1.3	Washington Park 299	3.7	5.8	5.2	8.2
Totals[4]	**64.2**	**102.6**	**79.2**	**126.6**					

1 Willamette Heights service area demands are included in Sherwood service area total.
2 The demands for Tabor 411 include Tabor 338.
3 The demands for Vernon include Vernon 224, Vernon 270 and Vernon 362.
4 The area served via Rockwood WD is not included in the total. The average daily demand for this area is estimated to be 0.3 mgd with a peak demand of 0.5 mgd. In the future the average daily demand will remain the same and the peak demand will rise to 0.6 mgd.

Wholesale Water Agreements

The PWB has wholesale contracts with 19 water purveyors in the Portland, Oregon metropolitan area, including cities, water districts, and private water companies. Portland can potentially sell water to a wholesale population of 385,000 and routinely provides wholesale service to over 260,000 people. Annual wholesale water sales account for 19 percent of annual water sales and 39 percent of annual water demand. These agreements require the PWB to meet levels of service outlined in each of the wholesale contracts.

[142] Portland Water Bureau, Distribution System Mater Plan, June 2007 (Table 2-4)

Table 4.3 Portland Water Bureau Wholesale Agreements[143]

5-Year Contract	10-Year Contract	20-Year Contract
GNR Water Company	Pleasant Home Water District	Burlington Water District
Green Valley Water Company	Lake Grove Water District	City of Gresham
Hideaway Hills Water Company	City of Tigard	Lusted Water District
Lorna Water Company	City of Tualatin	Raleigh Water District
Skyview Acres Water Company	Tualatin Valley Water District	Rockwood Water PUD
Two Rivers Water Association		Valley View
		West Slope Water District

The Pallatine Hill Water District remains a wholesale customer under a previous agreement.

TRANSMISSION SYSTEM

Inventory

Three large diameter conduits carry the water from the Bull Run watershed to the Water Bureau's in-town storage and distribution system. The conduits have interconnections in three places to ensure reliability, should one or two conduits fail. The water flows downhill from an elevation of 735 feet above mean sea level (MSL) then through the Lusted Treatment facility to Portland's easternmost storage reservoir on Powell Butte, at 530 feet above MSL. Alternatively, groundwater can be pumped to Powell Butte from the Columbia South Shore Well Field through the Groundwater Pump Main when the Bull Run Supply is not available or limited. When the municipal water supply is from both Bull Run and the Columbia South Shore Well Field, the water is blended at Powell Butte. See Figure 4.6 for a schematic diagram of the City's water transmission system.

Current Condition

The transmission system's 75 miles of conduits is in primarily in fair to good condition, though about 10% is in poor condition. The Washington County Supply Line and Groundwater Pump Main are primarily in good condition (90%), while the Mt. Tabor to Washington Park system is in fair to good condition. The Bureau's Sandy River and Willamette River crossings have a significant percentage of components in poor condition (50% and 40%, respectively).

Capacity

The conduits have a combined maximum capacity of approximately 212 MGD. The average annual demand is approximately 100 MGD. Peak day demand is approximately 170 MGD. At this time, transmission capacity is available to meet demands when all facilities are in operation. However, transmission system outages and vulnerability remains a concern.

Key Issues

Gaining better information on the condition of the conduits and providing the necessary maintenance is of great importance to the Bureau. Funding will need to be provided over the next few years to help accomplish this. The new Sandy River crossing, currently under

[143] Portland Water Bureau, 2007.

construction, will help reduce vulnerability and replace sections of the conduit that are considered in poor condition. A new seismically hardened Willamette River crossing is also planned, and should be in place within the next 20 years.

DISTRIBUTION SYSTEM[144]

The retail distribution system within the City of Portland comprises 2,100 miles of mains connected to 67 active storage tanks and reservoirs and 39 pump stations, located in 42 service areas. Table 4.4 lists the retail distribution service areas and the number of service connections (according to Water Bureau maps as of August 2006). The distribution systems for wholesale water customers are owned and managed by other water service providers and are not included in this report.

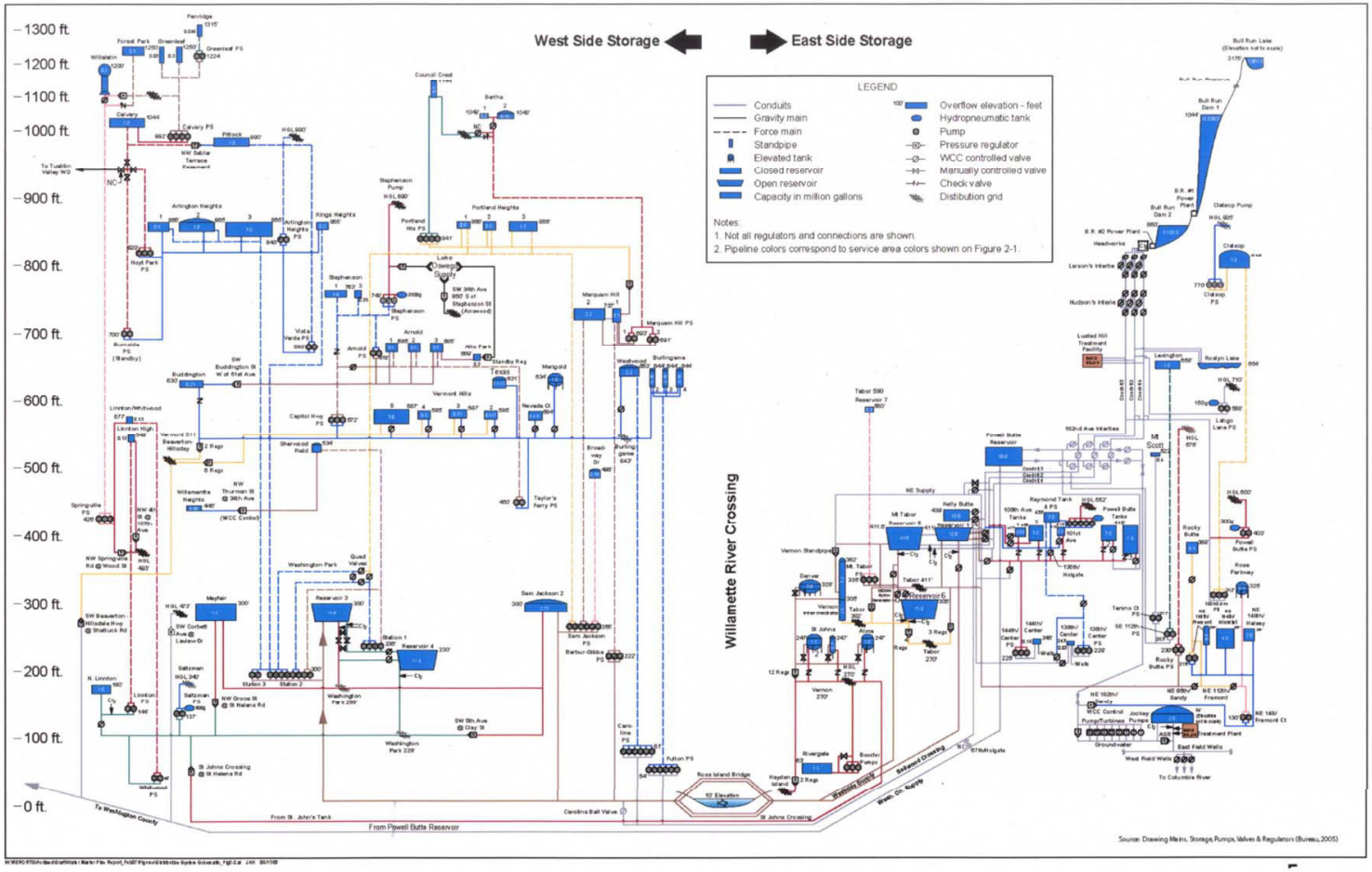
Table 4.4 Service Connections by Service Area

Service Area	# of Connections	Service Area	# of Connections
Arlington Heights	825	Powell Butte Pump	50
Arnold	1,548	Powell Valley Road 415	3,782
Bertha	1,730	Powell Valley Road Pump	15
Broadway	604	Powell Valley Road Raymond	2,000
Burlingame	7,816	Rocky Butte	892
Calvary	643	Rocky Butte Pump	46
Clatsop	438	Rose Parkway	766
Clatsop Pump	277	Saltzman	8
Council Crest	1,334	Sherwood	679
Denver	225	Stephenson	1,383
Greenleaf	2,414	Stephenson Pump	379
Lexington	526	Tabor 302	32,362
Linnton/Whitwood	192	Tabor 411	59,070
Marquam	170	Tabor 590	888
Mt Scott	699	Vermont	3,650
Nevada	144	Vernon 224 & 270	15,932
Parkrose	4,167	Vernon 362	18,545
Penridge	37	Washington Park 229	5,223
Pittock	78	Washington Park 299	4,297
Portland Heights	1,323	Willalatin	213
Powell Butte	431	Willamette Heights	292
Total Service Connections	**176,093**		

Portland's retail water distribution system includes storage reservoirs, pump stations, and pipelines in 42 service areas. Figure 4.4 presents a map showing the locations of the service areas. Figure 4.6 is a schematic of the City's system, showing key Bull Run and Groundwater supply and transmission facilities, and key distribution system pipelines, pump stations and storage reservoirs. The schematic represents a profile view of the system, looking north. Colors used for the service area pipe connections shown on the schematic correspond to the colored service areas shown on Figure 4.4.

[144] Portland Water Bureau, Distribution System Master Plan, 2007

Figure 4.6 City of Portland Water Supply Schematic[145]



[145] Portland Water Bureau, Water Management and Conservation Plan, 2008.

Service areas east of the Willamette River are shown on the right side of Figure 4.6. Most of the areas east of the Willamette are supplied by gravity (without pumping) from Powell Butte and Mount Tabor Reservoirs, which are fed from the supply and transmission system. Exceptions are small areas in southeast Portland, in and around Powell Butte, the Tabor 590 Service Area, which is located on Mount Tabor, and some areas of northeast Portland, shown on the far right hand side of the schematic.

Service areas west of the Willamette River are shown schematically on the left side of Figure 4.6. Areas west of the Willamette are served from several key pump stations (Carolina, Fulton, Sam Jackson, and Washington Park) that draw from major transmission lines that run from Mt. Tabor Reservoir complex to Washington Park Reservoir.

The distribution system configuration has evolved over the past 100+ years, in response to changing requirements and regulations. Many parts of the system originated as small, independent water districts that have been incorporated into the system over the years.

Inventory

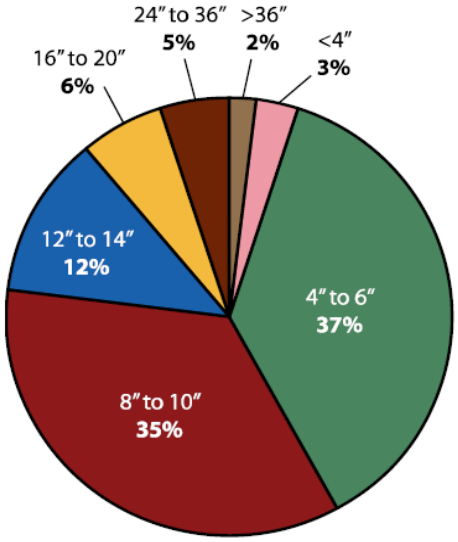
Portland's retail water distribution system is composed of vast networks of distribution mains, service lines, pump stations, and tanks, as well as hydrants, meters, valves, and fountains.

Mains

Portland's retail distribution system comprises more than 2,160 miles of pipeline. Figure 4.7 summarizes pipeline diameters in the distribution system. Distribution piping includes a number of materials, including unlined and lined cast iron (65%), ductile iron (29%), galvanized steel (2%), and a small percentage of other materials. The City's distribution mains have a combined replacement value of over $1.8 billion.

Figure 4.7 Pipeline Diameters in the Distribution System[146]

[146] Water Bureau field data



Service Lines

The retail distribution system also includes over 183,000 miles of service lines. The vast majority of these lines (94%) are smaller than 2" in diameter, although larger lines do exist in some areas. The network of service lines has a replacement value of $760 million.

Tanks

The retail water system is served by 67 active storage tanks with a total storage capacity of approximately 270 million gallons. Table 4.5 lists the tank, its service area, capacity information, and whether the condition of the tank was assessed in 2006 as a part of the Distribution System Master Plan. Portland's storage tanks have a replacement value of $270 million.

Pump Stations

The distribution system includes 239 pump stations, valued at $102 million. Table 4.5 lists the capacity of each pump station, and whether a condition assessment was performed in 2006 as a part of the Distribution System Master Plan.

Meters

The Portland Water Bureau has nearly 180,000 meters worth approximately $35 million. Small meters are replaced every 20 years while large meters are tested and replaced based on condition and criticality.

Valves

The water distribution system contains approximately 43,800 system valves, with a replacement value of $377 million.

Hydrants

The distribution system includes about 14,400 hydrants, with a combined replacement value of $147 million.

Table 4.5 Distribution System Service Areas, Storage Reservoirs and Pump Stations[147]

Service Area and # of Connections		Reservoirs/ Tanks	Capacity (mg)	Condition Assessed	Pump Stations	Capacity1 (mgd)	Condition Assessed
Arlington Heights	825	Arlington 1	0.5	✓	Arlington Heights	NA	✓
		Arlington 2	1	✓	Sam Jackson	1700	✓
		Arlington 3	3	✓	Wash. Park 1	3200	✓
		Kings Heights	0.2	✓	Wash. Park 2	7500	✓
					Wash. Park 3	1300	✓
Arnold	1,548	Alto Park	0.2	✓	Capitol Hwy	2500	✓
		Arnold 1	0.5	✓	Taylors Ferry	2000	✓
		Arnold 2	0.5	✓			
		Arnold 3	0.6	✓			
Bertha	1,730	Bertha 1	0.2	✓	Marquam Hill 1 & 2	2410	~
		Bertha 2	0.9	✓			
Broadway	604	Broadway Drive	0.4	✓	Sam Jackson	800	✓
Burlingame	7,816	Buddington	0.3	✓			
		Burlingame 2	1.6	~	Carolina	10800	~
		Burlingame 3	0.4	~			
		Burlingame 4	0.9	~			
		Marigold	1	✓	Fulton	6400	✓
		Texas	0.7	✓			
		Westwood	1	~			
Calvary	643	Calvary	1	✓	Burnside	470	✓
					Hoyt Park	2800	✓
Clatsop	438	Clatsop	3	✓	162nd Avenue	880	✓
Clats. Pump	277				Clatsop	775	✓
Council Crest	1,334	Council Crest	0.5	✓	Portland Heights	4300	✓
Denver	225	Denver	3	✓			
Greenleaf	2,414	Forest Park	0.5	X			
		Greenleaf 1	0.03	✓	Calvary	1900	✓
		Greenleaf 2	0.3	✓			
Lexington	526	Lexington	1	✓	112th Avenue	1100	✓
Linwit	192	Whitwood	0.1	~	Linnton	130	✓
					Whitwood	640	✓
Marquam	170	Marquam Hill 1	0.3	✓	Barbur Gibbs	1300	✓
		Marquam Hill 2	2.3	✓	Sam Jackson	2100	✓
Mt. Scott	699	Mt. Scott	0.4	✓	Tenino Ct.	320	✓
Nevada	144	Nevada Ct	0.6	✓			
Parkrose	4,167	104th/Klickitat	4	✓			
		148th/Halsey	2	✓			
Penridge	37	Penridge	0.1	✓	Greenleaf	130	✓
Pittock	78	Pittock	1	✓	Verde Vista	1000	✓
Portland Heights	1,323	Portland Heights 1	0.6	✓			
		Portland Heights 2	0.5	✓			
		Portland Heights 3	1.9	✓			
Powell Butte	431	Powell Butte N/S	50	X	1st & Kane	N.A.	✓
PB Pump	50				PB Heights	1480	✓

[147] *Portland Water Bureau, Water Management and Conservation Plan, 2008 (Tables 2-21 and 2-22)*

Powell Valley Road 415	3,782	101st Ave	0.5	✓			
		109th Ave 1	3	✓			
		109th Ave 2	0.7	X			
		160th Ave 1	7	✓			
		160th Ave 2	3	✓			
		PV 144th/Center	0.2	✓			
PV Rd Pump	15				PV Raymond St	440	✓
PV Road Raymond	2,000	PV 138th/Center	0	✓	PV 138th / Center	1100	✓
		Raymond	2	✓			
Rocky Butte	892	Rocky Butte	0.5	✓			
RB Pump	46				Rocky Butte	200	✓
Rose Pkwy	766	Rose Parkway	0.5	✓			
Saltzman	8				Saltzman	75	X
Sherwood	679	Sherwood	0.4	✓	Washington Park 2	1400	✓
Stephenson	1,383	Stephenson 1	1.3	✓	Arnold	1000	✓
		Stephenson 3	0.3	✓			
Steph. Pump	379				Stephenson	500	X2
Tabor 302	32,362	Mt. Tabor 6	37.8	X			
		Vernon 2	2.5	✓			
Tabor 4113	59,070	Kelly Butte	10	✓			
		Mt. Tabor 1	12	X			
		Mt. Tabor 5	49	X			
Tabor 590	888	Mt. Tabor 7	0.2	✓	Mt. Tabor	1200	✓
Vermont	3,650	Vermont Hills 2	0.6	✓			
		Vermont Hills 3	0.9	✓			
		Vermont Hills 4	0.5	✓			
		Vermont Hills 5	2.8	✓			
Vernon 224 & 270	15,932	Alma	1	✓			
		St Johns 2	1.5	✓			
Vernon 362	18,545	Vernon 3	3.2	✓			
Washington Park 229	5,223	North Linnton	1	✓			
		Washington Park 3	16	X			
		Washington Park 4	17.6	X			
Washington Park 299	4,297	Sam Jackson 2	2.8	✓			
		Mayfair	5.6	✓			
Willalatin	213	Willalatin	0.2	✓	Springville	630	✓
Willamette Heights	292	Willamette Heights	0.1	~			

1 Pump station firm capacity is the pump station capacity with the largest unit in the pump station out of service.
2 Stephenson Pump Station was recently constructed and was not included in the condition assessment
3 The estimate for Tabor 411 includes Tabor 338
✓ indicates condition was assessed during the DSMP process.
~ indicates condition was assessed in other studies. Results and improvements incorporated into the DSMP.
X indicates condition has not been assessed recently. N.A. indicates information is not available.

Current Condition

In general, the majority of the Water Bureau's distribution system asset groups are fair to very good condition. However, over half of the bureau's steel distribution mains (52%) are in poor to very poor condition, as are over one-fifth of the meters (23%), and hydrants (25%) (by value). Half of the 2,000 miles of distribution mains are older than 50 years. More information on the condition of major asset groups can be found in Table 4.1. The Water Bureau evaluates asset condition as one factor in asset management decisions.

Service Area Assessment

In 2005, with the assistance of an outside consultant, the Portland Water Bureau completed a series of hydraulic evaluations of the backbone distribution system to assess its ability to meet demands under both existing (i.e., 2005) peak day conditions and 2030 peak day conditions.[148] The evaluation found that both a strong backbone delivery system and Portland's proactive planning have resulted in a system that will reliably deliver water through 2030. A key observation was that the backbone system can deliver water to the majority of the system through 2030 with existing facilities. Of the 42 service areas evaluated representing the retail system, 20 service areas, accounting for 86 percent of the 2030 peak day demand, have no deficiencies.

Table 4.6 summarizes the results of the preliminary screening.

Of the remaining 22 service areas, accounting for 14% of 2030 peak day demand:

- Six (6) service areas (Clatsop Pump, Powell Butte Pump, PV Raymond Pump, Rocky Butte Pump, Saltzman Pump, Stephenson Pump) are direct pump service areas with no storage, and deficiencies are based on providing sufficient capacity to meet fire flows. In some instances, pump stations were designed for lower fire flow requirements, in place at the time of pump station design. In other instances, the Bureau has designed pumps to meet fire flow requirements with all units in service. If all units are used in the screening, three (3) service areas show no deficiencies (Powell Butte Pump, PV Raymond Pump, Stephenson Pump).
- Eight (8) service areas have recognized deficiencies and are being evaluated by the Bureau in other studies. These are: Calvary, Council Crest, Greenleaf, Linnton/Whitwood, Penridge, PV Raymond, Willalatin, and Willamette Heights.
- Five (5) service areas were flagged for further assessment in the hydraulic evaluation. These are: Broadway; Mt Scott; Sherwood; Stephenson; Tabor 590 Although the preliminary screening did not identify deficiencies in the Burlingame service area for the planning scenarios evaluated, the Bureau has recently completed a Master Plan for the service area that includes several capital projects to remedy previously identified deficiencies.
- The remaining three (3) service areas have mitigating circumstances which relieve some of their identified deficiencies. The Lexington service area was deemed deficient in the outage screening, but the Bureau has purchased a generator to supply the service area in a power

[148] Options to integrate the former Powell Valley Road 415 service area with the Tabor 411 service area, and supply capacity through Washington Park were also assessed. More information can be found in the Portland Water Bureau's Distribution System Plan, 2008.

outage situation. However, the generator would not address a service outage of the pump main, so the service area was still deemed deficient. The second, Bertha, was deficient for both storage and outage. However, the service area has additional regulated supply from other service areas. The third, the Vernon 362 service area, has a large number of regulators that supply the zone, which addresses the storage deficiencies.

Table 4.6 Results of Preliminary Screening of Service Areas[149]

Service Areas that Passed Preliminary Screening for Pumping, Fire, Storage and Outage Service Goals; or Are Being Addressed in Other Studies*

Arlington/Portland Heights **	Arnold	Burlingame
Clatsop	Denver	Marquam Hill
Nevada	Parkrose	Pittock
Powell Butte	PVRWD 415	Rocky Butte Tank
Rose Parkway	Tabor 302	Tabor 411
Vermont	Vernon 270	Washington Park 229
Washington Park 299		

Service Areas that were Deficient for One of More Screening Service Goals

Service Area	Pumping	Fire	Storage	Outage	Notes
Bertha	✓	✓	X	X	Additional regulated supply available
Broadway	X	X	X	X	Additional regulated supply available
Calvary	X	X	X	N/A	Being evaluated in NW Hills study
Clatsop Pump	X	X	N/A	X	
Council Crest	✓	✓	X	X	Being evaluated by Bureau
Greenleaf	✓	✓	X	X	Being evaluated in NW Hills study
Lexington	✓	✓	✓	X	The Bureau has purchased a generator with an automatic transfer switch for 112th St Pump Station. The generator would not address outages due to a pump main break
Linnton / Whitwood	X	X	X	X	In Upper Linnton Tank Analysis
Mt. Scott	X	X	X	X	Additional regulated supply available
Penridge	X	X	X	✓	Being evaluated in NW Hills study
Powell Butte Pump	X	X	N/A	✓	Not deficient if all pumps used
PV Raymond Pump	X	X	N/A	✓	Not deficient if all pumps used
PV Raymond	X	X	X	X	Being evaluated by Bureau
Rocky Butte Pump	X	X	N/A	✓	
Saltzman	X	X	N/A	✓	
Sherwood	X	X	X	X	Additional regulated supply available
Stephenson	X	X	X	✓	
Stephenson Pump	X	X	N/A	✓	Not deficient if all pumps used
Tabor 590	✓	X	X	X	
Vernon 362	N/A	X	X	N/A	Large regulated supplies available
Willalatin	X	X	X	X	Being evaluated in NW Hills study
Willamette Heights	N/A	X	X	X	Being evaluated in Willamette Heights Tank study

[149] Portland Water Bureau, *Distribution System Master Plan*, 2008

* Passed all screening criteria (Arnold, Clatsop, Denver, Marquam Hill, Nevada, Rocky Butte Tank, Vermont), were only deficient in storage screening (Parkrose, Rose Parkway), or passed pumping, storage, and fire screening goals, but were not screened for outages, since these are being addressed by other studies, or are large service areas with adequate redundancy (Arlington/Portland Heights, Burlingame, Powell Butte, PVRWD 415, Tabor 302, Tabor 411, Washington Park 229, Washington Park 299).

** Arlington Heights and Portland Heights service areas are hydraulically interconnected and were evaluated together.

N/A = Not applicable, or not evaluated in DSMP ✓ = Passed screening X = Failed screening

Backbone Hydraulic Evaluation

The backbone evaluation assessed system operation, taking into account system hydraulics, to see if further deficiencies were identified that were not evident in the preliminary screening. The model simulated a 24-hour period on the peak demand day for 2005 and 2030 demand conditions. Results of the hydraulic evaluation were consistent with the preliminary screening. No additional deficiencies were identified in the hydraulic modeling evaluation.

Three service areas, however, which had deficiencies in the screening evaluation showed no deficiencies in the hydraulic evaluation. All three (Broadway, Sherwood Field, and Stephenson) have adequate pumping capacity to meet normal demand, but insufficient capacity to meet peak day demand plus re-fill of storage following a fire within the service area.

In selecting improvements, service areas were reviewed to identify constraints and/or issues that would affect selection and/or siting of improvements. For example, Tabor 590 service area has a small amount of storage relative to demand. New storage would provide greater flexibility to meet fires and outages, but was judged to not be feasible because new storage would be sited within Mt. Tabor Park, a visually scenic area, with strict limitations on new development, based on the City of Portland planning policies.

For direct pumped service areas, the improvements were developed based on a criterion of meeting peak hour demands plus fire flows with one pumping unit out of service, rather than peak day plus fire flows, since direct pumped areas have no storage and pumps must be able to meet both normal and fire demands. In some instances, the Bureau has designed pump stations to meet fire flows with all units in service. In Powell Butte Pump, Powell Valley Road Water District Pump and Stephenson Pump service areas, pump stations can provide adequate fire flow if all units are used. Policy input will be needed from the Bureau to determine whether these pump stations built to then current standards should be upgraded based on the Distribution System Master Plan criteria.

Table 4.7 Summary of Improvements Identified in the Hydraulic Backbone Evaluation[150]

Service Area/Improvement Description	Needed To:
Broadway Service Area Replace small diameter mains in northern part of zone with 4,500 feet of 12-inch main	Provide fire flow for higher density residential area in northern part of zone during normal operations and with an outage of the main from Broadway Tank
Sherwood Field Service Area Install new regulator station adjacent to Washington Park Reservoir No. 4 Install 1,200 feet of 16-inch main running north from Washington Park Pump Station	Provide fire flow to high-density residential area in southern part of service area during normal operations and with an outage at the Washington Park Pump Station No. 2
Stephenson (Tank) Service Area Add new 40 HP pump at Arnold Pump Station Install 3,300 feet of 16-insh main from Stephenson Tanks to service area	Provide fire flow to commercial area in central part of service area during normal operations
Tabor 590 Service Area Install new 170 HP Pump Station Install 1,200 feet of 12-inch diameter main	Provide second supply to service area to meet fire needs and outages within the service area
Vernon 270 Service Area Remove St. Johns and Alma Tanks from service	Decommission tanks which have a history of water quality problems due to poor turnover
Direct Pump Areas Install capacity upgrades in Clatsop Pump, Powell Butte Pump, Powell Valley Road Pump, Rocky Butte Pump, Saltzman and Stephenson Pump service areas	Provide fire flow with one large pump out of service. Powell Butte Pump, Powell Valley Road Pump, and Stephenson Pump service areas can meet fire flows with all units in service

[150] Portland Water Bureau, *Distribution System Master Plan*, 2007

Assessment of Pump Stations and Tanks[151]

Condition assessments have been conducted for 35 pump stations and 66 tanks in the distribution system. The pump station assessment found that, in general, the pump stations originally constructed by the Bureau were in good condition. With the exception of the recently acquired Powell Valley system pump stations, pump stations acquired from other formerly independent water system had more deficiencies.

- 15 pump stations are in good condition with only minor corrective maintenance needed;
- 20 pump stations are operationally and functionally sound, but exhibiting some signs of wear, with some need for corrective action;
- Deficiencies were identified in the Fulton, Linnton, Portland Heights, Sam Jackson, and Taylors Ferry service areas.

All of the pump station projects generated from the pump station condition assessment would be performed as part of ongoing capital and maintenance programs, or as part of larger planned pump station rehabilitation projects.

Of the 66 tanks assessed,

- 4 tanks are in conditions that substantially diminish performance
- 55 tanks are operationally and functionally sound, but exhibiting some signs of wear, with some need for corrective action, and
- 7 tanks are in good condition with only minor corrective maintenance needed.

The tank assessments found that coating and painting for tanks has not been performed routinely in recent years, and a strategic coating and painting program should be implemented. The analysis also found seven tanks that require further evaluation to address extensive cracks observed during inspections. Fifty-two tanks also had minor repair or maintenance recommendations, and several tanks require anchoring and/or flexible piping connections to reinforce tanks during earthquakes. All work would be performed as part of ongoing capital and maintenance programs.

Seismic Assessment

A qualitative seismic assessment was provided for 32 tanks, to identify conceptual-level seismic improvements for tanks. The analysis used condition information collected in the tank inspections, along with probabilistic ground-motion data from U.S. Geological Survey, to assess which tanks would be most vulnerable in a large-scale earthquake in the Portland area (100- year to 500-year frequency). For tanks identified to be the highest risk, conceptual-level improvements were identified to reinforce the tanks.

Tables 4.8 and 4.9 summarize identified deficiencies and capital projects recommended for repairs and retrofits. The most common retrofit recommended is anchorage of steel tanks and/or provision of flexible inlet/outlet connections to prevent loss of contents due to pipe failure due to rocking or sliding.

[151] Portland Water Bureau, *Distribution System Master Plan*, 2007

Table 4.8 Recommendations for Tank Improvement Projects from Condition Assessment

Tanks	Deficiencies/Maintenance Needed	Capital Improvement Improvements
Burlingame Tanks 2, 3 and 4	Replace roof structures -Tanks 2 & 3 Recoat Tank 4 roof interior/exterior; Remove interior tank platforms	Burlingame Tank Improvements
Portland Heights Tank 1	Corrosion of trusses; Polyethylene liner needs replacement	Portland Heights Tank # 1 Internal Corrosion
PV 109th Avenue Tank 2	Column deformation; Broken vent screen	PV-109 Tank Internal Support Integrity
Alma, Arlington Heights No. 2, Arlington Heights No. 3, Arnold No. 1, Arnold No. 3, Bertha No. 1, Bertha No. 2, Broadway Drive, Calvary, Council Crest, Denver, Greenleaf No. 1, Kelly Butte, Kings Heights, Mayfair, Mt Scott, Reservoir No. 7, Portland Heights No. 2, PV 101st, PV 138th & Center, PV Powell Butte No. 2, PV Raymond, Sherwood Field, St. Johns No. 1, St Johns No. 2, Vermont Hills No. 2, Vermont Hills, No. 3, Vermont Hill No. 4, Vernon Intermediate (low combo) and Vernon Standpipe (upper combo)	Clean and recoat exteriors, roofs, interiors, columns, piping, screens, and vents as needed; Repair and patch concrete as needed; Repair railings, ladders, etc. as needed.	Storage Tank Maintenance and Repair Program
Texas, Sam Jackson No. 2, Arlington Heights No. 1 and Portland Heights 1	Extensive cracks seen on the exterior; Perform interior inspection and possible structural analysis	Storage Tank Structural Review and Analysis Project
Texas Tank, Sam Jackson Tank 2, Arlington Tank 1	Internal investigation to determine extent of wall cracks; Investigate roof cracks at Arlington Tank #1	Tank Horizontal Crack Maintenance Program

Table 4.9 Recommendations for Tank Improvement Projects from Seismic Assessment

Tanks	Improvements Needed	Project
Arlington Heights No. 1, Arlington Heights No. 2, Calvary, Clatsop, Council Crest, Denver, Greenleaf No. 1, Greenleaf No. 2, Groundwater, Kelly Butte, Lexington, Mayfair, Mt Scott, North Linnton Tank, Penridge, Pittock, Portland Heights No. 1, Portland Heights No. 2, PV 101st, PV 138th & Center, PV 144th & Center, Rivergate, Rocky Butte, St. Johns No. 1, St. Johns No. 2, Vermont Hills, No. 3	Provide anchorage, flexible pipe connections and replace bolts as needed	Storage Tank Maintenance and Repair Program
Arlington Heights No. 1, Kelly Butte, Marquam Hill No. 1, Marquam Hill No. 2, Portland Heights No. 1, Portland Heights No. 2, Portland Heights No. 3, Sam Jackson No. 2, Vermont Hills No. 2, Vermont Hills, No. 3, Vermont Hill No. 4, Vermont Hills No. 5 and Westwood	Investigate potential slope movement	Storage Tank Maintenance Slope Movement Investigation Project

TERMINAL STORAGE

Inventory

The Water Bureau maintains water storage, or reservoirs, to provide for daily fluctuation of water use, to fight fires, and to provide time to bring on emergency sources of supply when primary sources are unavailable .Terminal storage in Portland's water system consists primarily of Powell Butte Reservoir #1, Mount Tabor Reservoirs #1, 5 and 6, and Washington Park Reservoirs #3 and #4. It also includes storage at Kelly Butte, Sam Jackson and Mayfair, see Figure 4.6.

Condition

Terminal storage located at Mount Tabor and Washington Park are classified as open reservoirs, and therefore must be decommissioned or covered as part of the Federal LT2 regulations. Therefore, they are ranked in the condition assessment as "poor". As a result of the LT2 regulations, plans are currently underway to build replacement terminal storage at Powell Butte (Reservoir #2) and Kelly Butte. Additional west side storage to replace the open reservoirs at Washington Park is also being investigated.

Capacity

Total storage capacity of the terminal storage reservoirs is approximately 195 million gallons (MG). Minimum recommended capacity as identified by the Bureau and outlined in its LT2 response plan is 148 MG.

Key Issues

Replacement of terminal storage is expensive - significant funding is needed to complete the new storage within the timelines negotiated with the Environmental Protection Agency (EPA). Additional transmission improvements will also be required as part of this work.

CHAPTER 5: MANAGED FLOOD PLAINS[152]

OVERVIEW

The Multnomah County Drainage Districts (Districts) play a public service role in the Portland community by protecting public health and safety from the threat of flooding. North and northeast Portland sit at the confluence of two great rivers, the Columbia and Willamette Rivers. The low-lying areas of north and northeast Portland were inundated regularly until levees were completed in about 1921, to prevent flooding and allow year-round farming. In addition to flood protection, the Districts serve the public through careful environmental stewardship of the resources under their management. Lands along the Willamette River through central Portland are protected from flooding by a seawall, which is owned and maintained by the Portland Bureau of Transportation.

The Districts serve an 8,832 acre area of which 5,912 acres lie within the City of Portland. The area protected by the Districts contains both public and private facilities of statewide importance, and significant natural resources. The estimated real estate value of development within the District boundaries is twenty billion dollars. Protecting the Portland well fields and the Columbia Corridor, the state's largest industrial sanctuary and employment center, are important responsibilities. The Drainage Districts provide flood protection for numerous industrial, commercial, resource and recreation facilities, including the Portland International Airport, Portland Delta Park and five golf courses, among others. The Districts also provide flood protection for numerous Portland neighborhoods, including all or parts of the Bridgeton, East Columbia, Kenton, Parkrose, Argay, Wilkes, Cully, Sumner, Maywood Park, Sunderland, Concordia, Piedmont and Woodlawn neighborhoods, and parts of I-5 and I-205.

The Districts' flood management program protects these areas from flooding, as would otherwise naturally occur. This flood prevention requires a series of levees, sloughs, drainage ditches, culverts and pump stations, which manage the flow of water into and out of the system. The District manages 30 miles of levees and 35 miles of open waterways. All rainfall within the Columbia Slough Watershed Basin has to be removed via pumping stations. The benefits afforded the District properties extend to all city residents by providing a stormwater system for

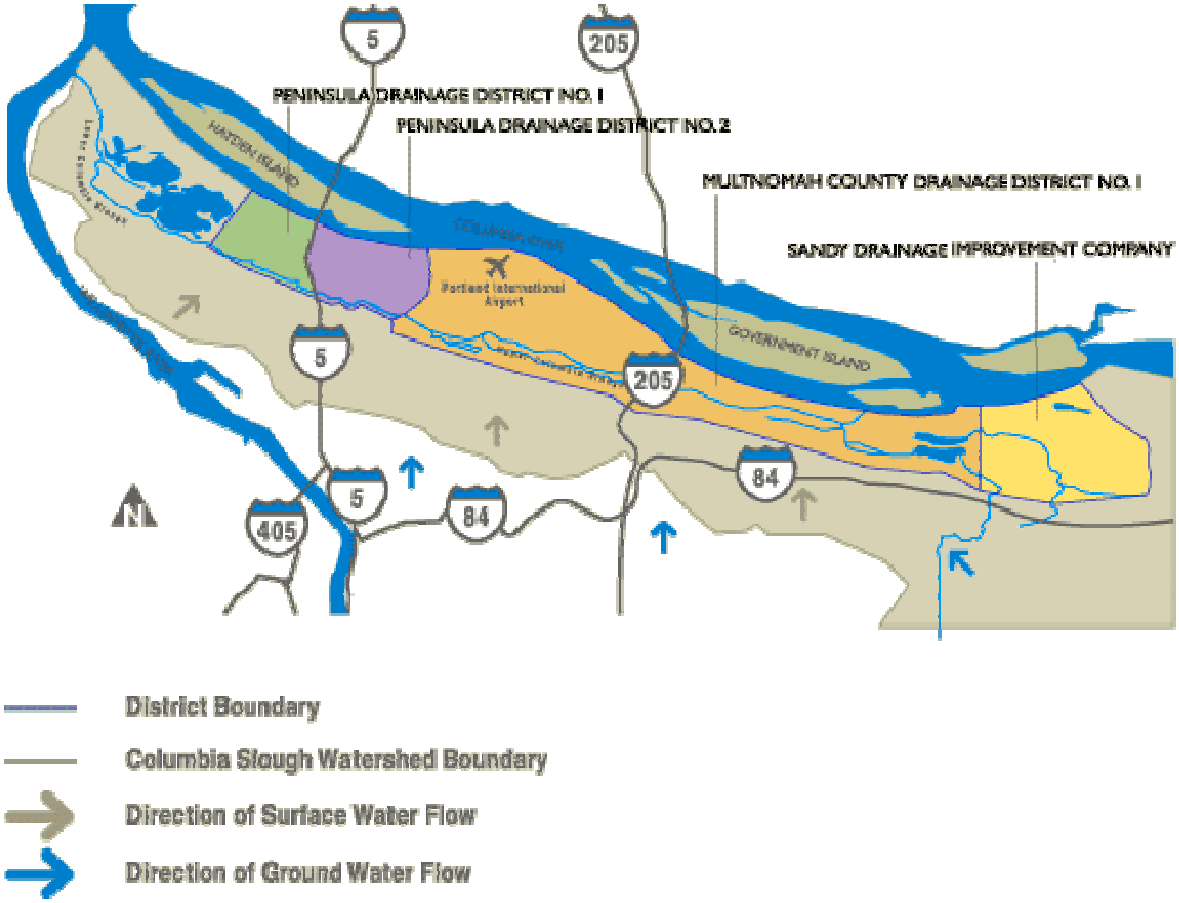
[152] Information contained in this report was prepared by the Multnomah Drainage District #1, dated September 2010.

the City to discharge to, without the cost of developing and managing a separate system for the properties and roads within the Columbia Slough Watershed.

ROLE OF DRAINAGE DISTRICTS

Four Drainage Districts keep the Columbia Corridor dry, from Heron Lakes Golf Course in Portland, to the Sandy River in Troutdale. Multnomah County Drainage District #1 is the largest of the four and manages the other three: the Peninsula Drainage District #1 (PEN 1), Peninsula Drainage District #2 (PEN 2) and the Sandy Drainage Improvement Company (SDIC). SDIC lies outside the City of Portland and serves Troutdale and Fairview. This chapter provides information on the three Districts within the City of Portland: PEN 1 and PEN 2, and the portions of MCDD within the City of Portland limits, see Figure 5.1.

Figure 5.1 Drainage Districts in the City of Portland



The Districts serve the public much as City bureaus do, and are public entities regulated and empowered by the Oregon Revised Statutes (ORS 547). The Districts were formed in 1917 by landowners who began building levees to stop the Columbia River from inundating property during the spring freshets. Soon the US Army Corps of Engineers (Corps) and the City of Portland became involved in completing the levees, which were completed in about 1921. The

Districts' mission of flood control is state and federally mandated and regulated. It is the mission of the Districts to:

"…protect lives, property and the environment through innovative, proactive leadership assuring a reliable, well-managed floodplain."

Each District has a Board of Directors elected by the landowners of the District. Each Board sets its own budget for assessing the landowners based on the cost of the flood control and drainage services. Multnomah County tax department collects the assessments with the November taxes.

KEY ISSUES & CONCERNS

The Drainage Districts will face multiple opportunities and challenges over the next twenty years. A few of the larger issues are highlighted below.

Local Coordination

One challenge facing the City and the Districts is a need for greater early planning coordination and improved partnering. This section on the Managed Flood Plain, a first for inclusion in the Portland Plan background documents, is a step in the right direction, and provides valuable information for a better understanding of the Districts' role and purpose. It is anticipated this will be followed by other steps to establish collaborative planning on emergency plans, long range plans, infrastructure needs and funding, international treaties, global warming and other common issues. The City and Districts need to develop an overall formalized inner governmental agreement, which addresses their approach and cooperation on the above topics. It is the Districts' goal that this chapter will promote a better understanding of the value of the Drainage Districts to all of Portland, not just the areas encompassed within the District boundaries.

City Regulations

From time to time the City may consider adopting regulations with which the Districts cannot comply, as they will put the Districts in conflict with mandatory federal and state regulations. Thus, it is important for the City to partner with the Districts whenever considering a change in regulations having to do with:

- flood plains,
- storm water management,
- natural resources,
- environmental protection,
- landscaping requirements,
- sustainability requirements,
- recreation access or improvements,
- tree placement,
- water coming into the Districts and/or water leaving the Districts,

- or anything that affects the geographic area within the managed floods plain as defined by District boundaries (see Figure 5.1).

Likewise, the Districts will partner with the City to develop policy and regulations to achieve City goals and objectives in a way that does not threaten the integrity of the managed flood plain flood control system, does not violate federal nor state regulations, and does not put the public health and safety at risk.

An example, the Districts work with the City of Portland, Metro and Multnomah County to encourage bike and pedestrian trails on levees. This achieves public objectives for connections to nature, completion of the 40 mile loop trail, and to encourage use and enjoyment of the natural resources of the Columbia Slough and its environs. The District is also leading a pilot project to provide more trees and shaded habitat along the Columbia River, without adversely affecting the levee system.

Equity in Assessing the Costs

Multnomah County Drainage District # 1 manages a significant amount of stormwater that comes into the District from outside the District. Proper coordination between the District and the City is critical to keep the District flood control system from not having the required conveyance or pumping capacity to meet federal and state requirements. The need for City and District coordination, and cost sharing, is imperative as we plan for growth in this region. The anticipated increase in population density will increase the amount of stormwater the District is managing. Property owners within the District will be paying for management of more and more stormwater for those outside the District “taxing” boundary. This equity issue needs to be addressed.

The Districts work with the City of Portland, Metro and Multnomah County to encourage bike and pedestrian trails on levees. This achieves public objectives for connections to nature, to complete this section of the 40 mile loop trail around Portland, and to encourage use and enjoyment of the natural resources of the Columbia Slough and adjacent areas.

Federal Coordination

Another concern lies in the possibility that the Corps/FEMA could upgrade the levee standards in response to flooding disasters in other parts of the country, leaving the Districts to fund such levee changes. Following Hurricane Katrina, the Districts are responsible for funding annual levee inspections. This new requirement for recertification of all federal levees amounts to a new additional annual cost. The Corps does not have funding for new mandates, thus they fall to the local Districts. From this we can see it is prudent to plan for actions like this, non-funded mandates, or to position ourselves to better present a case against unnecessary changes, by demonstrating how our systems exceeds known threats and meets or exceeds standards. The Multnomah County Drainage Districts are held up as a model operation, and thus we are in a good position to make such a case.

International Coordination

US/Canada Columbia River Water Treaty

Other of the most significant challenges are beyond the Districts' scope to influence individually, and rather must be addressed collaboratively in cooperation with the City and State at the Federal level. One of these is the US/Canada Columbia River Water Treaty. The treaty is up for renewal in 2017, and negotiations on a new treaty began in 2009, leaving seven years to resolve issues such as how much Columbia River water Canada will continue to hold back. If the amount of Canadian water storage is decreased and more is released to flow downstream to help salmon runs, irrigation and/or hydroelectricity, this could increase the Columbia River water level downstream and change the levee profile needed to provide flood protection in Portland. If this were to happen, the question of who bares the cost to do the necessary levee work would need to be addressed. Ultimately the Districts are responsible for doing the work, with or without additional federal funding.

Global Warming

An emerging area of concern is the impact of global warming on the Columbia and Willamette River levels. If with global warming the water levels go up, the Districts would have to react to the change and perform levee improvement work. Scientists are not yet in agreement on the rise in water level predictions, thus we can not yet plan, nor engineer, for best and worst case outcomes.

REGULATORY REQUIREMENTS AND DESIRED LEVELS OF SERVICE

Federal Levee Standards

The Districts are responsible for the levee system along the Columbia River and Lower Columbia Slough, and the pumping systems. The Districts are required by the Corps to construct and maintain levees and pump stations in accordance with Federal Levee Standards. The Federal Levee Standards have been designed by the Corps to insure the levees can withstand a 100-year high water event of the Columbia and Willamette Rivers.

Federal Flood Insurance

The Federal Emergency Management Agency (FEMA) provides standards the Districts must achieve in order for landowners in the floodplain to qualify for federal flood insurance. If the Districts did not manage to keep the flood plain dry, property owners would be unable to obtain affordable flood insurance. It is important to property owners, the City, businesses and homeowners alike, to be insured against flood loss. Banks will not lend on properties or businesses within flood plains, unless they are flood insured

In order for the City of Portland and its residents and businesses to have flood insurance, the levees must be certified by the Corps and accredited by FEMA. In order to be certified and accredited, the flood control structures and facilities have to meet Corps and FEMA standards. These standards are stringent and if not complied with, the managed flood plains would forgo federal flood insurance. Not only would this geographic area within the managed flood plains be flood uninsurable, there would be a rate increase that would affect the entire City.

CARRYING OUT THE DISTRICTS' MISSION: MANAGING HIGH WATER, STORMWATER AND THE INFRASTRUCTURE OF MANAGED FLOOD PLAINS

The Districts encompass the part of Portland geographically located between the Columbia River on the North; Columbia/Sandy Boulevard generally on the south; the BNSF Railroad on the West and 185th Avenue on the east. The Districts keep this area dry with a series of levees that prevent the high water events of the Columbia and Willamette River from flooding the low lands behind the levees. And they accomplish this by pumping stormwater out of the levee ringed areas. This is known as a managed flood plain, where natural water conveyance systems have been replaced or modified and are now managed by a man-made system of barriers to flood water, and pumping out of stormwater.

Stormwater

There are two sources of stormwater, surface water and groundwater. The primary source of stormwater handled by the Districts is surface water coming from rain and snow.

As the amount of impervious area increases through development, so does the impact of stormwater on the District facilities, which in turn impacts the cost of operation. With increased amounts of impervious area, an increasing amount of stormwater does not percolate into the soil. Rather, it hits rooftops, parking lots and streets. More of the stormwater which used to be naturally absorbed by the soil, now runs quickly to the nearest ditch. Runoff which used to take three days to reach the slough ditch system, now takes hours. This has a major affect on the pumping capacity and operation costs of the District.

The second run-off source is groundwater. Groundwater, which rises to the surface, has to be drained off with the other water sources from this low-lying area, through a system made up of the slough, ditches and culverts. This is called the stormwater conveyance system and it has to be designed and maintained for capacity to convey a 100-year stormwater event without flooding the adjacent properties.

Pump Stations

Pump stations pump the water from the stormwater conveyance system to maintain dry land according to FEMA standards of water level management. The pump stations are built and maintained by the Districts. These stations vary in size and pumping capacity. Some were built nearly seventy years ago, while others were upgraded in the late 1990's. Each is designed with a pumping capacity linked to the engineered hydrology of that District. The pump stations are automatically operated by computers, which have been programmed by the District. There are ten pump stations with a total pumping capacity of one million gallons/minute.

Levees

The levees function as a "wall" to keep out the flood waters of the two rivers. All the Districts levees are built to withstand a 100-year high water event on the Willamette and Columbia Rivers. This region experienced 100-year high water events in 1964, and again in 1996, and the levees did as they were engineered to do, they kept out the flood waters. Most of MCDD's levees along the Columbia are built to about 44 feet in height. PEN 1 and PEN 2 have levees that are built to about 35 feet in height. The 100-year high water event in the Columbia River at

the Vancouver gauge is 29.6 feet and the 500 year event would be about 33 feet, thus we have 5 to 14 feed of freeboard built into the system. The critical levee height for the Columbia River and Lower Columbia Slough levees is determined by the Corps and is the minimum size levee that will withhold a 100-year high water event.

OVERVIEW OF DRAINAGE DISTRICTS IN THE CITY OF PORTLAND

Peninsula Drainage District #1 (PEN 1)

Service Area

The geographic boundaries of PEN 1 are the Columbia River Levee to the north, the Lower Columbia Slough Levee to the south, North Portland Road to the west and Interstate 5 to the east. The major landowners in PEN 1 are the City of Portland with Heron Lakes Golf Course and Portland International Raceway, Metro with the Portland Metropolitan Exposition Center, the Port of Portland with Vanport Wetlands, and Graphic Packing and several other commercial businesses.

Stormwater

PEN 1 is an enclosed system, thus only surface stormwater from within this District is captured, channeled and pumped out, with the exception of surface runoff from Interstate 5.

Levees

The PEN 1 levee on the Columbia River is buttressed by a seven foot tall concrete flood wall engineered and installed on top of the levee to withstand the 100 year event. During high flood events, the City is responsible for installing stop logs in the two open sections of the flood wall, one across Marine Drive and the other across the entry into the south entrance to Graphics Packaging. The flood wall is maintained by PEN 1.

Peninsula Drainage District #2 (PEN 2)

Service Area

The geographic boundaries of PEN 2 are the Columbia River Levee to the north, the Lower Columbia Slough Levee to the south, the Interstate 5 to the west and Peninsula Canal to the east. The major landowners in PEN 2 are Columbia Edgewater Golf Course, City of Portland Parks, Portland Meadows Race Track and several industrial, commercial and trucking industries.

Stormwater

PEN 2 is an enclosed system, thus only surface stormwater from within the District is captured, channeled and pumped out, with the exception of surface runoff from Interstate 5.

Levees

The PEN 2 levees have been designed and constructed at the minimum height and width requirements to withstand the 100-year high water event. The PEN 2 Drainage District Board has worked to add width to the levee, whenever possible.

Multnomah County Drainage District #1 (MCDD)

The geographic boundaries of MCDD are the Columbia River Levee to the north, the Lower Columbia Slough Levee and Columbia Boulevard to the south, the Peninsula Canal to the west and NE 223rd Avenue to the east. Major landowners in MCDD are the Port of Portland with Portland International Airport, Cascade Station, City of Portland well fields, and many other industrial and commercial developments.

Stormwater

Unlike Pen 1 and Pen 2, MCDD is not self-contained and a large percentage of the water it handles comes from outside the District. The hydrology of the Multnomah County Drainage District #1 watershed has been modeled. The modeling shows 60% of the water handled by this District is generated from outside the District boundaries, from the Cities of Fairview, Gresham and Portland. Runoff from I-205 and other city streets and state highways, add to the surface water it handles.

Figure 5.2 NE Marine Drive Levee

Levees

The MCDD levees are built from 35 feet to a maximum of 44 feet in height. The width varies from 200 feet to 400 feet. The Marine Drive Levee has been significantly overbuilt, to accommodate Marine Drive on top of the levee and allow for bike paths and pedestrian walk ways along side the levee.

INVENTORY & CONDITION

Table 5.1 provides composite data on MCDD infrastructure.

Table 5.1 MCDD Infrastructure

District Category	PEN 1	PEN 2	MCDD
Stormwater Conveyance (miles)	3.1	5.9	26.1
Levees (miles)	4.9	5.9	12.2
Height of Levees (average NGVD29)	35 with a floodwall	35’	42’
Width of Levees (average feet)	250-300	150-200	250-400
Pump Stations (number)	2	2	7
Benching (miles)	0	2	0
Natural Areas (acres)			
Parks and Public Areas (number)	5	3	6
Storm Event Capacity	100-year	100-year	100-year
Measuring Devices (number)	1	2	14

Table 5.2 includes inventory of critical infrastructure, and its condition, in the three drainage districts. Some infrastructure is not critical so has not been included here. The term ‘acceptable’ is used by the Corps in their inspection and is the highest rating available.

Table 5.2 MCDD Infrastructure Value and Condition

Infrastructure Category	Construction Value	Condition
Penninsula Drainage District #1 (PEN 1)		
PIR Pump Station	$1,335,000	Acceptable
Railroad Levee	N/A	Needs about 40 trees removed
Columbia Slough Levee	N/A	Acceptable
Columbia River Levee	N/A	Acceptable
Schmeer Pump Station	$1,385,000	Acceptable
13th Pump Station	$1,185,000	Acceptable
Columbia Slough Levee	N/A	Acceptable
Penninsula Drainage District #2 (PEN 2)		
Columbia River Levee	N/A	Acceptable, but needs repairs
Gantenbien Weir	$85,000	Acceptable
Multnomah County Drainage District #1		
Pump Station #1	$3,735,000	Acceptable
Pump Station #2	$760,000	Acceptable
Broadmoor Pump Station	$935,000	Acceptable
Pump Station #4	$3,385,000	Acceptable
181st Pump Station	$510,000	Acceptable
Columbia River Levee	N/A	Acceptable
18th Cross Levee	N/A	Acceptable
142nd Cross Levee	N/A	Acceptable
Gravity Flow System	N/A	Acceptable
142nd Cross Levee Culverts	N/A	Acceptable

DEFERRED MAINTENANCE

Penninsula Drainage District #1 (PEN1)

PEN 1 is less complicated than the other districts, but its two pump stations will ultimately need to be rebuilt, and there is a significant amount of ditch maintenance work, primarily dredging and culvert replacement, deferred for several decades, that is becoming critical. In addition, much of the stormwater run-off from the proposed Columbia River Crossing Bridge will come into PEN 1. It will be necessary to expand the pumping capacity at both the Vanport Wetlands and Portland International Raceway pump stations. The District needs help from the City to insure these costs are addressed in the I-5 bridge budget, and funded from sources other than the District.

Penninsula Drainage District #2 (PEN2)

Other challenges are more local in nature. Over six years, PEN 2 has established a $650,000 reserve fund to match federal funds, which will be used to correct a small percentage of the deficiencies identified. The work estimate is $5 to $8 million will be needed, and there is a $3 to $5 million dollar funding shortfall. To put this in context, PEN 2 has a $600,000 annual budget and limited opportunity to raise millions more. The District has already delayed major maintenance on levees, ditches, culverts and pump station systems. The District needs an estimated $20 million.

Multnomah County Drainage District #1 (MCDD)

MCDD has the benefit of having upgraded its facilities in the late 90's. However, there are capital projects like levee resurfacing, tree removal, ditch benching to provide more stormwater storage during high water events, habitat improvements and replacement of old culverts with bridges.

ENVIRONMENTAL STEWARDSHIP

Today the Districts face the challenge of integrating the public's need for flood protection, stormwater drainage and economic activity with improving the environmental quality of the Upper Columbia Slough and adjacent lands. The Districts take their responsibility as stewards of the environmental seriously and work collaboratively with community and government organizations to seek innovative solutions to problems facing our natural environment. By working together with many different groups the Districts are able to make significant strides in environmental protection without compromising the other needs of the areas they serve.

Levee Vegetation

Levees are safety structures and as such are subject to federal landscape standards. In briefest form, this means trees are not allowed on the levee and but grasses are. Trees can blow over in wind storms leaving a rootball hole that could lead to a levee breech. In addition, tree roots, under the immense pressure of a high water event, act as undesirable water conduits within the levee. Both of these are risks the Districts seek to avoid.

Grasses form a protective coating of interwoven roots that keep the surface soil together and control erosion from rains and snow melts. The Districts have experimented with various grass

types to develop a seed mix that is drought resistant, hardy and low growing. Ground covers form a barrier to visual inspections, so are not allowed.

In-Water Maintenance

Sloughs and ditches throughout the Districts carry water to pump stations for discharge out of the system. For this reason they are designed using computer models to carry the appropriate amount of water. This is called the hydraulic cross-section and it is reached through channel design and maintenance dredging.

Figure 5.3 In-Water Maintenance

In the past, the Districts performed maintenance work from the top of the channel banks using a dragline excavator to remove debris and silt blocking water flow, and this practice damaged vegetation. Technology created by the District, using a small barge-mounted backhoe, allows dredging of the conveyance channels to be done from water-based equipment rather than from the slough banks. This allows trees and other vegetation to remain on the banks to provide shade and habitat. This technique also creates emerging wetlands, and the Districts have won awards for their innovative approach to solving an engineering problem with an eco-friendly solution. In the coming years, the goal is to expand this practice to improve the habitat on all ditch banks. This technique also helps enhance the habitat of species making homes on the banks of the Columbia Slough, including a variety of turtles and water fowl.

Habitat Restoration

The Districts also use a technique called “meandering channels” to enhance the natural environment of the slough and drainage ways. Several channels have been changed from very straight, linear ditches, to meandering channels with gentle side slopes that are replanted with native vegetation to keep water temperatures cooler and improve fish and wildlife habitat. A method known as wetland benching widens the steep ditches to create wetlands next to the water channels and creates new land for native plants. Revegetation of parts of the slough banks with native species enhances wildlife habitat, provides natural water filtration, shades the slough for water temperature and creates an attractive waterway.

Figure 5.4 West Bridgeton Slough Before and After Habitat Restoration

The Districts have implemented a low flow program during the summer for improving in-channel water quality. The upper and middle Columbia Slough experience high water temperatures in the summer. Using the Districts pumps, the water level is kept lower and confined in the meandering channel sections. This helps to bring in greater quantities of cooler groundwater, which are confined to a shaded channel that is deeper and narrower, keeping water temperatures cooler than wide flat channels.

Whenever possible the Districts are also replacing culverts with bridges to allow passage over the slough while improving the flow of water. Removing culverts improves water quality, facilitates wildlife passage and improves access for recreational users of the Slough.