35452

Columbia Boulevard
Wastewater Treatment Plant
PORTLAND, OREGON

FACILITIES PLAN

Executive Summary

SEPTEMBER 1995

CH2M HILL
BROWN AND CALDWELL
and Associated Firms

In partnership with the Columbia Boulevard Wastewater Treatment Plant Facilities Plan
Citizens Advisory Committee
Members Pam Arden, William Benz, Tom Kelly, Patricia Merkle, Barry Messer, Barbara Novak, Lee Poe, and Ted White

ENVIRONMENTAL SERVICES
CITY OF PORTLAND

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Chapter 1
Executive Summary

Need for the Facilities Plan

This facilities plan for the Columbia Boulevard Wastewater Treatment Plant (CBWTP) was prepared to address updated flow and load projections, necessary facilities improvements, correlation with the combined sewer overflow (CSO) pollution abatement program, recent regulatory changes, current and expected National Pollutant Discharge Elimination System (NPDES) permit requirements, possible integration and use of methane gas, land use planning requirements, encroachment of development from the surrounding community, and the plant's role as a good neighbor

The plan is a road map for expansion of the treatment plant to meet the future needs of the various stakeholders, including the plant's neighbors, city residents, plant staff, and regulatory agencies The plan presents an assessment of the adequacy of the existing facilities through the year 2040 and identifies capital improvements that may be necessary

Development Process

The City of Portland Environmental Services staff developed the CBWTP facilities plan in partnership with the Columbia Boulevard Citizens Advisory Committee (CAC) From the beginning, CAC members worked collaboratively with Environmental Services staff and the technical and consulting team CAC members participated in reviewing and building the information base for the plan, analyzing information, making group decisions, and establishing and conducting a community outreach program

The CAC refined, approved, and adopted a vision statement for the facilities plan that became the standard by which the various planning alternatives were evaluated The general objectives of the vision statement are as follows

- Protecting the public health
- Practicing environmental stewardship
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- Incorporating flexibility to meet changing regulatory and operational requirements
- Serving as a center for water resource education and training
- Not adversely affecting the community
- Providing a pleasing setting that supports neighborhood livability
- Providing a recognized positive and equitable asset to the community
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- Linking to and enhancing the ecosystem in which it is situated
- Maintaining an open dialogue with the community
- Continuing to apply new and innovative ideas
- Providing accountability during implementation of the plan

From October 1994 to July 1995, CAC members contributed to development of the facilities plan through a series of 13 meetings on issues such as CSO coordination, site planning, and biosolids utilization They also participated in special workshops on methane utilization and workshops on odor and air emissions The CAC's involvement in development of the facilities plan promoted a proper balance of technical, environmental, and neighborhood issues and helped reframe many aspects of the technical problems under discussion

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Recommended Plan

The recommended plan addresses treatment of projected increases in sanitary sewer flow from the service area, new sanitary sewer flows from the Inverness area of Portland, and CSOs from the Columbia Slough Basin and Willamette River Basin

Implementation phases for the recommended plan were developed for planning periods ending in 2001, 2011, 2020, and 2040 These periods were selected because of the regulatory and growth impacts that will be occurring at these times Figure 1-1 illustrates the new and modified facilities prescribed by the plan and their implementation phases

In the phase ending in the year 2001, actions will be taken to ensure that a wet-weather treatment facility is operational and able to handle Columbia Slough Basin CSOs by December 31, 2000, and that facilities are in place to treat sewage flows from the Mid-County service area.

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In the phase ending in the year 2020, actions will be taken to meet the treatment requirements for the projected increases in domestic sewage flows

In the phase ending in the year 2040, actions will be taken to meet a potential nitrification requirement and to implement the extensive secondary treatment expansion needed to meet the projected population growth and increased wastewater flows The year 2040 marks the end of the overall planning period for the Portland metropolitan area and is the estimated year of ultimate build-out for the service area

In collaboration with the CAC, Environmental Services staff, and the technical and consulting team developed five potential environmental enhancement areas to complement the recommended plan

- Plant entrance
- Public link to Columbia Slough
- Triangle Lake
- Columbia Slough screening to the west secondary expansion site
- North Portland Road screening

These concepts are illustrated in Figure 1-2

Existing Conditions

The base year for the planning was 1995 The current average dry-weather flow is 60 million gallons per day (mgd), and the current average wet-weather flow is 80 mgd The plant has a peak hydraulic flow of 278 mgd, which is limited by the interceptor sewer

The new headworks and the primary treatment process have a design capacity of 300 mgd The secondary treatment process has an average dry-weather capacity of 100 mgd, a maximum-day capacity of 130 mgd, and a peak hydraulic capacity of 160 mgd The outfall to the Columbia River has a peak hydraulic capacity of 240 mgd Flows in excess of 240 mgd bypass the system and are sent to the Oregon Slough

All flows that exceed the collection system capacity overflow through 55 outfalls 13 into the Columbia Slough and 42 into the Willamette River A stipulation and final order (SFO) has been issued by the Oregon Department of Environmental Quality (DEQ) for elimination of the overflows The *City of Portland Combined Sewer Overflow (CSO) Management Plan*

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The overflows to the Willamette River will be collected and treated adjacent to the Willamette River or at the CBWTP Site selection for the Willamette River Wet-Weather Treatment Facility (WRWWTF) has not yet been finalized Therefore, planning of the facilities has included placement of the WRWWTF at the CBWTP One-third of the overflows to the Willamette River must be reduced by 2006, and the remaining overflows must be contained by 2011

Planning Period 1995 to 2001

The average dry-weather flow is projected to increase to 78 mgd, and the average wet-weather flow is projected to increase to 97 mgd by the year 2001 The peak hydraulic flow from the interceptor, Inverness, and Columbia Slough consolidation conduit (CSCC) will be 365 mgd by the year 2000

Treatment facilities for flows from the CSCC must be in operation by 2001 The new Inverness force main will be completed, and additional flows will be brought from currently unsewered areas These projects will include odor control facilities to capture odors from the treatment processes identified as high odor producers

The treatment facilities for flows from the CSCC will require construction of a 75-mgd influent pump station and headworks The existing primary clarifiers will be used for wet-weather treatment The wet-weather primaries will need to be covered for odor control A new effluent pump station and outfall will need to be constructed to handle the increase in peak hydraulic flows A dechlorination system will need to be constructed on Hayden Island to dechlorinate wet-weather flows

New dry-weather primary clarifiers will need to be constructed Three of the four dry-weather primaries will need to be constructed by 2001

Nonprocess improvements planned for completion by the year 2001 are the addition of a new fueling station, relocation and upgrading of the process control laboratory, and a portion of the seismic improvements identified in the *Seismic Vulnerability Assessment Report* (Dames and Moore, 1995)

Environmental enhancements to be performed in conjunction with these projects will include construction of the portion of the 40-mile-loop trail on the north side of the slough, the slough bridge, and a system of paths, on the east side of the plant, that connect the 40-mile-loop trail with a neighborhood access at North Portsmouth Avenue

Solids handling improvements will consist of modifications to the existing dewatering equipment The resulting increased dryness of the cake solids will reduce the costs of hauling biosolids to the arid lands application site Recuperative thickening will be added to the digestion process to increase digester capacity

The capacity of the new headworks (under construction in 1995) will need to be increased from 300 to 319 mgd This increase can be accomplished through increased pump speeds

Planning Period 2001 to 2011

The average dry-weather flow is projected to increase to 87 mgd, and the average wet-weather flow is projected to increase to 109 mgd by the year 2011 The peak hydraulic flow from the interceptor, Inverness, and CSCC will be 374 mgd by the year 2010 The WRWWTF will need to be fully operational to handle a peak hydraulic flow of 336 mgd

If the WRWWTF will be located at the CBWTP, it will require construction of an influent pump station, headworks, primary clarifiers, an effluent pump station, and an outfall with a peak hydraulic capacity of 336 mgd The location of the new effluent pump station will depend on the selected outfall alignment Construction of the WRWWTF at the CBWTP site will also require expansion of the existing chlorination facility, that is, addition of three railcar bays and the necessary feed equipment and emergency scrubber system The dechlorination facility on Hayden Island will also need to be expanded

During this planning period, the dry weather flows to the treatment plant will have increased enough to necessitate construction of the fourth dry-weather primary The secondary system will have reached capacity under dry-season, maximum-month conditions, the limitation will be the secondary clarification capacity This will require construction of two new secondary clarifiers on the west side of North Portland Road, with installation of piping and galleries under the railroad tracks and North Portland Road, as well as an access road for light vehicles along the south side of the Columbia Slough

Nonprocess improvements planned for completion by the year 2011 are construction of a new centralized monitoring and control building, addition of improved access to the plant's tunnel system, and completion of the seismic improvements identified in the *Seismic Vulnerability Assessment Report* (Dames and Moore, 1995)

Environmental enhancements will continue to be implemented in conjunction with the various projects The enhancements will include restoration of the wetlands at Triangle Lake, improvements along the Columbia Slough, and creation of a buffer between the Columbia Slough and the new secondary facilities on the west side of North Portland Road

Solids handling improvements will consist of compartmentalization and lining of Triangle Lake and construction of an odor-free compost storage facility The location of the compost storage facility will depend on an evaluation of the market, it may, for instance, be beneficial to locate it offsite The most cost-effective biosolids utilization program will continue to be land application on arid lands, with a composting program similar to the one currently operated

Planning Period 2011 to 2020

The average dry-weather flow is projected to increase to 97 mgd, and the average wet-weather flow is projected to increase to 120 mgd by the year 2020 The peak hydraulic flow from the interceptor, Inverness, and CSCC will be 380 mgd by the year 2020

The dry-weather flows will have increased enough to make it necessary to add two more secondary clarifiers west of North Portland Road Environmental enhancements will continue to be implemented in conjunction with the various projects

Solids handling improvements will require the addition of two anaerobic digesters and upgrading of the existing dewatering facility Biosolids will continue to be land applied on arid lands

Planning Period 2020 to 2040

The average dry-weather flow is projected to increase to 115 mgd, and the average wet-weather flow is projected to increase to 143 mgd by the year 2040 The peak hydraulic flow from the interceptor, Inverness, and CSCC will be 394 mgd by the year 2040

It is assumed that nitrification will be required by 2040 The existing secondary clarifiers will need to be converted to activated sludge basins, and another 10 secondary clarifiers will need to be constructed west of North Portland Road Environmental enhancements will continue to be implemented in conjunction with the various projects

Solids handling improvements will require the addition of another two anaerobic digesters, another dewatering unit, and a third gravity belt thickener for waste activated sludge thickening Biosolids will continue to be land applied to arid lands

Project Cost Estimates

The capital costs, annual operation and maintenance costs, and present worth analysis for the recommended west secondary expansion alternative are presented in Table 1-1 In this analysis, the capital construction was assumed to occur in four phases over a 45-year period, from 1995 through 2040 The four construction phases are 1995 to 2001, 2001 to 2011, 2011 to 2020, and 2020 to 2040 The costs are shown in Table 1-1 by phases for each major facility

The total cost for the recommended alternative, including the wet-weather flows for the Columbia Slough Basin, is estimated to be $361,808,000 for the 45-year period in 1995 dollars The annual operation and maintenance cost is estimated to be $6,297 for the new facilities, therefore, the present worth for the project is $165,126,000

As shown in Table 1-2, the total cost for the recommended alternative, including the wet-weather flows for both the Columbia Slough Basin and the Willamette River Basin, is estimated to be $491,877,000 for the 45-year period in 1995 dollars The annual operation and maintenance cost is estimated to be $6,873 for the new facilities, therefore, the present worth for the project is $261,679,000

The annual operation and maintenance costs were based primarily on the cost of labor and power, but do include equipment and other costs as appropriate For the present worth calculations, it was assumed that all capital costs would be incurred in the first year of a construction period, the facility would be operated for 20 years, with an annual operation and maintenance cost, and the facility would have a salvage value that would be applied in the 21st year All facility structures were assumed to have a 50-year service life, and all equipment was assumed to have a 20-year service life A discount rate of 8 percent was used in the analyses, all cost estimates, including the phased costs, were in 1995 dollars

Table 1-1
Summary of Estimated Costs
Recommended Plan Including Columbia Slough CSO Facility
Columbia Boulevard Wastewater Treatment Plant

Cost Item	Capital Costs ($1,000)* Years 1995-2001	Years 2001-2011	Years 2011-2020	Years 2020-2040	Grand Total	Annual O&M Cost ($1,000) (Year 1995)	Present Worth in 95 Dollars ($1,000)
Liquid Treatment							
Influent pumping	3,479				3,479	10	3,184
Headworks	14,123				14,123	27	12,439
Primary treatment - basins	27,789	6,413			34,202	336	30,325
Secondary treatment		11,608	9,200	64,000	84,808	1,644	20,112
Filtration				77,680	77,680	1,560	11,864
Disinfection - CL2/DCL2	3,232				3,232	307	5,712
Subtotal	48,623	18,021	9,200	141,680	217,524	3,884	83,636
Effluent Discharge							
Effluent pumping	9,860				9,860	31	9,049
Outfall	23,927				23,927	0	20,394
Subtotal	33,787	0	0	0	33,787	31	29,443
Solids Management							
Digestion	870		18,560	18,560	37,990	248	7,500
Dewatering	550		17,250	750	18,550	1,120	8,042
Thickening				1,000	1,000	400	657
Liquid biosolids storage		6,822			6,822	150	4,571
Access to west of Portland Road		5,835			5,835	0	3,134
Subtotal	1,420	12,657	35,810	20,310	70,197	1,918	23,904
Odor Control Facilities							
Conduit/PS/headworks	517				517	12	555
Primary treatment - covers	6,747				6,747	66	6,425
Solids management	2,266	7,000			9,266	137	6,662
Compost storage building		6,934			6,934	89	4,283
Subtotal	9,530	13,934	0	0	23,464	304	17,925
Support Facilities							
Land purchase	776	1,999			2,775	NA	NA
Access/egress		4,699			4,699	0	2,524
Fueling station	220				220	0	201
Centralized control		2,286			2,286	0	1,281
Process control laboratory	167				167	0	145
Tunnel access		189			189	0	102
Slough bridge	0				0	0	0
Seismic improvements	1,150	1,150			2,300	0	1,598
Environmental enhancements	2,400	1,800			4,200	160	4,366
Subtotal	4,713	12,123	0	0	16,836	160	10,217
Total Cost	98,073	56,735	45,010	161,990	361,808	6,297	165,126

*Costs are in 1995 dollars
Capital costs include categories for planning, engineering, administration, and contingencies at 45 percent
Capital costs include categories for mobilization/demobilization, bonds/insurance, and interface at 18 percent.
Capital costs include Columbia Slough combined sewer overflows

Abbreviations
CSO = combined sewer overflow
O&M = operation and maintenance
NA = not applicable
PS = primary sludge

Table 1-2 Summary of Estimated Costs Recommended Plan Including Willamette River CSO Facility Columbia Boulevard Wastewater Treatment Plant							
	Capital Costs ($1,000)*					Annual O&M Cost ($1,000) (Year 1995)	Present Worth in 95 Dollars ($1,000)
Cost Item	Years 1995-2001	Years 2001-2011	Years 2011-2020	Years 2020-2040	Grand Total		
Liquid Treatment							
Influent pumping	3,479	4,395			7,874	142	8,292
Headworks	14,123	20,591			34,714	55	30,471
Primary treatment - basins	27,789	48,973			76,762	657	55,201
Secondary treatment		11,608	9,200	64,000	84,808	1,644	20,112
Filtration				77,680	77,680	1,560	11,864
Disinfection - CL2/DCL2	3,232	7,079			10,311	369	6,120
Subtotal	48,623	92,646	9,200	141,680	292,149	4,427	132,060
Effluent Discharge							
Effluent pumping	9,860	15,515			25,375	64	23,144
Outfall	23,927	39,929			63,856	0	54,428
Subtotal	33,787	55,444	0	0	89,231	64	77,571
Solids Management							
Digestion	870		18,560	18,560	37,990	248	7,500
Dewatering	550		17,250	750	18,550	1,120	8,042
Thickening				1,000	1,000	400	657
Liquid biosolids storage		6,822			6,822	150	4,571
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Subtotal	1,420	12,657	35,810	20,310	70,197	1,918	23,904
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Primary treatment - covers	6,747				6,747	66	6,425
Solids management	2,266	7,000			9,266	137	6,662
Compost storage building		6,934			6,934	89	4,283
Subtotal	9,530	13,934	0	0	23,464	304	17,925
Support Facilities							
Land purchase	776	1,999			2,775	NA	NA
Access/egress		4,699			4,699	0	2,524
Fueling station	220				220	0	201
Centralized control		2,286			2,286	0	1,281
Process control laboratory	167				167	0	145
Tunnel access		189			189	0	102
Slough bridge	0				0	0	0
Seismic improvements	1,150	1,150			2,300	0	1,598
Environmental enhancements	2,400	1,800			4,200	160	4,366
Subtotal	4,713	12,123	0	0	16,836	160	10,217
Total Cost	98,073	186,804	45,010	161,990	491,877	6,873	261,679

*Costs are in 1995 dollars

Capital costs include categories for planning, engineering, administration, and contingencies at 45 percent

Capital costs include categories for mobilization/demobilization, bonds/insurance, and interface at 18 percent

Capital costs include Columbia Slough and Willamette combined sewer overflows

Abbreviations

CSO	=	combined sewer overflow	O&M	=	operation and maintenance
NA	=	not applicable	PS	=	primary sludge

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Acknowledgments

An intrinsic part of this treatment plant expansion project is the work of the Columbia Boulevard Citizens Advisory Committee (CAC) CAC members have helped provide a road map for expansion that will meet future needs of stakeholders, including the plant's neighbors and all Portland residents They adopted the vision values and project objectives needed to implement the facilities plan, and they reviewed and made recommendations on all aspects of the facilities plan Their names are listed below

- Pam Arden
- William Benz
- Tom Kelly
- Patricia Merkle
- Barry Messer
- Barbara Novak
- Lee Poe
- Ted White

Environmental Services Director Dean Marriott sent appointment letters to the nine community and city residents of the CAC and established the decision process that brought them together with Environmental Services and consulting staff in a series of monthly meetings

The CAC initiated several outreach efforts to ensure that residents would have opportunities to ask questions, state their views and concerns, and contribute insights (see Chapter 12 for a list of residents attending the outreach meetings)

Environmental Services also established a team to serve as a vision resource for the CAC Participants included John Filbert, Gary Krahmer, Linda Dobson, William Benz, Pat Merkle, Darrell Simms, Michael Read, and Gene Appel Their meetings were facilitated by Bruce Wiley of HDR Engineering

Others who have contributed to this effort are the City of Portland Environmental Services communications manager, Columbia Boulevard Wastewater Treatment Plant facilities plan project manager, Columbia Boulevard Wastewater Treatment Plant task leaders, and other Clean River Works staff

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Tables

Figures

Flow Definitions and Abbreviations

The various flow parameters used in treatment system planning and design are defined and abbreviated below (all flows are to be given in volume per day)

Periods

Dry weather–Year-round in both seasons, excluding rainfall flows and flows on day after rainfall

Dry season–May 1 through October 31 (including rainfall)

Wet season–November 1 through April 30 (including rainfall)

Flows

Dry Weather

Average-day dry-weather (ADDW) flow–Total flow, excluding rainfall, in a specific 24-hour period

Average-month dry-weather (AMDW) flow–Total flow, excluding rainfall, in a specific dry-weather calendar month, divided by number of days in that month

Maximum-month dry-weather (MMDW) flow–Highest average-month dry-weather flow

Peak-hour dry-weather (PHDW) flow–Highest 1-hour flow, excluding rainfall, at any hour in a specific reporting period

Dry Season

Average-day dry-season (ADDS) flow–Total flow in a specific 24-hour period during dry-season months

Maximum-month dry-season (MMDS) flow–Highest average daily flow for any dry-season month

Peak-hour dry-season (PHDS) flow–Highest 1-hour flow at any hour in a specific reporting period during dry-season months

Wet Season

Average-day wet-season (ADWS) flow–Total flow in a specific 24-hour period during wet-season months

Average-month wet-season (AMWS) flow–Total flow, including rainfall, in a specific wet-season calendar month, divided by number of days in that month

Maximum-month wet-season (MMWS) flow–Highest average-month wet-season flow during wet-season months

Peak-hour wet-season (PHWS) flow–Highest 1-hour flow, including rainfall, at any hour in a specific reporting period during wet-season months

Other Flows

Average annual flow (AAF)–Total flow during a calendar year, divided by 365 days

Maximum 10-year storm (MTYS) flow–The magnitude of the flow is measured in terms of probability of occurrence The probability of occurrence is designated as a return interval of once every 10 years or a frequency with a 10 percent change of recurrence The return interval is the average number of years within which a given flow is equaled or exceeded once A 10-year return flow is exceeded, on the average, only once every 10 years

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Treatment facilities for flows from the CSCC must be in operation by 2001 The new Inverness force main will be completed, and additional flows will be brought from currently unsewered areas These projects will include odor control facilities to capture odors from the treatment processes identified as high odor producers

The treatment facilities for flows from the CSCC will require construction of a 75-mgd influent pump station and headworks The existing primary clarifiers will be used for wet-weather treatment The wet-weather primaries will need to be covered for odor control A new effluent pump station and outfall will need to be constructed to handle the increase in peak hydraulic flows A dechlorination system will need to be constructed on Hayden Island to dechlorinate wet-weather flows

New dry-weather primary clarifiers will need to be constructed Three of the four dry-weather primaries will need to be constructed by 2001

Nonprocess improvements planned for completion by the year 2001 are the addition of a new fueling station, relocation and upgrading of the process control laboratory, and a portion of the seismic improvements identified in the *Seismic Vulnerability Assessment Report* (Dames and Moore, 1995)

Environmental enhancements to be performed in conjunction with these projects will include construction of the portion of the 40-mile-loop trail on the north side of the slough, the slough bridge, and a system of paths, on the east side of the plant, that connect the 40-mile-loop trail with a neighborhood access at North Portsmouth Avenue

Solids handling improvements will consist of modifications to the existing dewatering equipment The resulting increased dryness of the cake solids will reduce the costs of hauling biosolids to the arid lands application site Recuperative thickening will be added to the digestion process to increase digester capacity

The capacity of the new headworks (under construction in 1995) will need to be increased from 300 to 319 mgd This increase can be accomplished through increased pump speeds

Planning Period 2001 to 2011

The average dry-weather flow is projected to increase to 87 mgd, and the average wet-weather flow is projected to increase to 109 mgd by the year 2011 The peak hydraulic flow from the interceptor, Inverness, and CSCC will be 374 mgd by the year 2010 The WRWWTF will need to be fully operational to handle a peak hydraulic flow of 336 mgd

If the WRWWTF will be located at the CBWTP, it will require construction of an influent pump station, headworks, primary clarifiers, an effluent pump station, and an outfall with a peak hydraulic capacity of 336 mgd The location of the new effluent pump station will depend on the selected outfall alignment Construction of the WRWWTF at the CBWTP site will also require expansion of the existing chlorination facility, that is, addition of three railcar bays and the necessary feed equipment and emergency scrubber system The dechlorination facility on Hayden Island will also need to be expanded

During this planning period, the dry weather flows to the treatment plant will have increased enough to necessitate construction of the fourth dry-weather primary The secondary system will have reached capacity under dry-season, maximum-month conditions, the limitation will be the secondary clarification capacity This will require construction of two new secondary clarifiers on the west side of North Portland Road, with installation of piping and galleries under the railroad tracks and North Portland Road, as well as an access road for light vehicles along the south side of the Columbia Slough

Nonprocess improvements planned for completion by the year 2011 are construction of a new centralized monitoring and control building, addition of improved access to the plant's tunnel system, and completion of the seismic improvements identified in the *Seismic Vulnerability Assessment Report* (Dames and Moore, 1995)

Environmental enhancements will continue to be implemented in conjunction with the various projects The enhancements will include restoration of the wetlands at Triangle Lake, improvements along the Columbia Slough, and creation of a buffer between the Columbia Slough and the new secondary facilities on the west side of North Portland Road

Solids handling improvements will consist of compartmentalization and lining of Triangle Lake and construction of an odor-free compost storage facility The location of the compost storage facility will depend on an evaluation of the market, it may, for instance, be beneficial to locate it offsite The most cost-effective biosolids utilization program will continue to be land application on arid lands, with a composting program similar to the one currently operated

Planning Period 2011 to 2020

The average dry-weather flow is projected to increase to 97 mgd, and the average wet-weather flow is projected to increase to 120 mgd by the year 2020 The peak hydraulic flow from the interceptor, Inverness, and CSCC will be 380 mgd by the year 2020

The dry-weather flows will have increased enough to make it necessary to add two more secondary clarifiers west of North Portland Road Environmental enhancements will continue to be implemented in conjunction with the various projects

Solids handling improvements will require the addition of two anaerobic digesters and upgrading of the existing dewatering facility Biosolids will continue to be land applied on arid lands

Planning Period 2020 to 2040

The average dry-weather flow is projected to increase to 115 mgd, and the average wet-weather flow is projected to increase to 143 mgd by the year 2040 The peak hydraulic flow from the interceptor, Inverness, and CSCC will be 394 mgd by the year 2040

It is assumed that nitrification will be required by 2040 The existing secondary clarifiers will need to be converted to activated sludge basins, and another 10 secondary clarifiers will need to be constructed west of North Portland Road Environmental enhancements will continue to be implemented in conjunction with the various projects

Solids handling improvements will require the addition of another two anaerobic digesters, another dewatering unit, and a third gravity belt thickener for waste activated sludge thickening Biosolids will continue to be land applied to arid lands

Project Cost Estimates

The capital costs, annual operation and maintenance costs, and present worth analysis for the recommended west secondary expansion alternative are presented in Table 1-1 In this analysis, the capital construction was assumed to occur in four phases over a 45-year period, from 1995 through 2040 The four construction phases are 1995 to 2001, 2001 to 2011, 2011 to 2020, and 2020 to 2040 The costs are shown in Table 1-1 by phases for each major facility

The total cost for the recommended alternative, including the wet-weather flows for the Columbia Slough Basin, is estimated to be $361,808,000 for the 45-year period in 1995 dollars The annual operation and maintenance cost is estimated to be $6,297 for the new facilities, therefore, the present worth for the project is $165,126,000

As shown in Table 1-2, the total cost for the recommended alternative, including the wet-weather flows for both the Columbia Slough Basin and the Willamette River Basin, is estimated to be $491,877,000 for the 45-year period in 1995 dollars The annual operation and maintenance cost is estimated to be $6,873 for the new facilities, therefore, the present worth for the project is $261,679,000

The annual operation and maintenance costs were based primarily on the cost of labor and power, but do include equipment and other costs as appropriate For the present worth calculations, it was assumed that all capital costs would be incurred in the first year of a construction period, the facility would be operated for 20 years, with an annual operation and maintenance cost, and the facility would have a salvage value that would be applied in the 21st year All facility structures were assumed to have a 50-year service life, and all equipment was assumed to have a 20-year service life A discount rate of 8 percent was used in the analyses, all cost estimates, including the phased costs, were in 1995 dollars

Table 1-1
Summary of Estimated Costs
Recommended Plan Including Columbia Slough CSO Facility
Columbia Boulevard Wastewater Treatment Plant

Cost Item	Capital Costs ($1,000)* Years 1995-2001	Years 2001-2011	Years 2011-2020	Years 2020-2040	Grand Total	Annual O&M Cost ($1,000) (Year 1995)	Present Worth in 95 Dollars ($1,000)
Liquid Treatment							
Influent pumping	3,479				3,479	10	3,184
Headworks	14,123				14,123	27	12,439
Primary treatment - basins	27,789	6,413			34,202	336	30,325
Secondary treatment		11,608	9,200	64,000	84,808	1,644	20,112
Filtration				77,680	77,680	1,560	11,864
Disinfection - Cl_2/DCl_2	3,232				3,232	307	5,712
Subtotal	48,623	18,021	9,200	141,680	217,524	3,884	83,636
Effluent Discharge							
Effluent pumping	9,860				9,860	31	9,049
Outfall	23,927				23,927	0	20,394
Subtotal	33,787	0	0	0	33,787	31	29,443
Solids Management							
Digestion	870		18,560	18,560	37,990	248	7,500
Dewatering	550		17,250	750	18,550	1,120	8 042
Thickening				1,000	1,000	400	657
Liquid biosolids storage		6,822			6,822	150	4,571
Access to west of Portland Road		5,835			5,835	0	3,134
Subtotal	1,420	12,657	35,810	20,310	70,197	1,918	23,904
Odor Control Facilities							
Conduit/PS/headworks	517				517	12	555
Primary treatment - covers	6,747				6,747	66	6,425
Solids management	2,266	7,000			9,266	137	6,662
Compost storage building		6,934			6,934	89	4,283
Subtotal	9,530	13,934	0	0	23,464	304	17,925
Support Facilities							
Land purchase	776	1,999			2,775	NA	NA
Access/egress		4,699			4,699	0	2,524
Fueling station	220				220	0	201
Centralized control		2,286			2,286	0	1,281
Process control laboratory	167				167	0	145
Tunnel access		189			189	0	102
Slough bridge	0				0	0	0
Seismic improvements	1,150	1,150			2,300	0	1,598
Environmental enhancements	2,400	1,800			4,200	160	4,366
Subtotal	4,713	12,123	0	0	16,836	160	10,217
Total Cost	98,073	56,735	45,010	161,990	361,808	6,297	165,126

*Costs are in 1995 dollars
Capital costs include categories for planning, engineering, administration, and contingencies at 45 percent
Capital costs include categories for mobilization/demobilization, bonds/insurance, and interface at 18 percent
Capital costs include Columbia Slough combined sewer overflows

Abbreviations

CSO =	combined sewer overflow	O&M =	operation and maintenance
NA =	not applicable	PS =	primary sludge

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Table 1-2
Summary of Estimated Costs
Recommended Plan Including Willamette River CSO Facility
Columbia Boulevard Wastewater Treatment Plant

Cost Item	Capital Costs ($1,000)* Years 1995-2001	Years 2001-2011	Years 2011-2020	Years 2020-2040	Grand Total	Annual O&M Cost ($1,000) (Year 1995)	Present Worth in 95 Dollars ($1,000)
Liquid Treatment							
Influent pumping	3,479	4,395			7,874	142	8,292
Headworks	14,123	20,591			34,714	55	30,471
Primary treatment - basins	27,789	48,973			76,762	657	55,201
Secondary treatment		11,608	9,200	64,000	84,808	1,644	20,112
Filtration				77,680	77,680	1,560	11,864
Disinfection - Cl_2/DCl_2	3,232	7,079			10,311	369	6,120
Subtotal	48,623	92,646	9,200	141,680	292,149	4,427	132,060
Effluent Discharge							
Effluent pumping	9,860	15,515			25,375	64	23,144
Outfall	23,927	39,929			63,856	0	54,428
Subtotal	33,787	55,444	0	0	89,231	64	77,571
Solids Management							
Digestion	870		18 560	18,560	37,990	248	7,500
Dewatering	550		17,250	750	18,550	1,120	8,042
Thickening				1,000	1,000	400	657
Liquid biosolids storage		6,822			6,822	150	4,571
Access to west of Portland Road		5,835			5,835	0	3,134
Subtotal	1,420	12,657	35,810	20,310	70,197	1,918	23,904
Odor Control Facilities							
Conduit/PS/headworks	517				517	12	555
Primary treatment - covers	6,747				6,747	66	6,425
Solids management	2,266	7,000			9,266	137	6,662
Compost storage building		6,934			6,934	89	4,283
Subtotal	9,530	13,934	0	0	23,464	304	17,925
Support Facilities							
Land purchase	776	1,999			2,775	NA	NA
Access/egress		4,699			4,699	0	2,524
Fueling station	220				220	0	201
Centralized control		2,286			2,286	0	1,281
Process control laboratory	167				167	0	145
Tunnel access		189			189	0	102
Slough bridge	0				0	0	0
Seismic improvements	1,150	1,150			2,300	0	1,598
Environmental enhancements	2,400	1,800			4,200	160	4,366
Subtotal	4,713	12,123	0	0	16,836	160	10,217
Total Cost	98,073	186,804	45,010	161,990	491,877	6,873	261,679

*Costs are in 1995 dollars
Capital costs include categories for planning, engineering, administration, and contingencies at 45 percent
Capital costs include categories for mobilization/demobilization, bonds/insurance, and interface at 18 percent.
Capital costs include Columbia Slough and Willamette combined sewer overflows

Abbreviations
CSO = combined sewer overflow   O&M = operation and maintenance
NA = not applicable   PS = primary sludge

Chapter 2

Facilities Plan Vision

Chapter 2
Facilities Plan Vision

Need for the Facilities Plan

The previous Columbia Boulevard wastewater treatment plant (CBWTP) facilities plan was prepared in 1987 Potential modifications to the plan were identified in 1992 as part of the headworks replacement project The current update was prompted by the need of City of Portland Environmental Services to reflect the following updated flow and load projections, necessary facilities improvements, correlation with the combined sewer overflow (CSO) pollution abatement program, recent regulatory changes, current and anticipated future National Pollutant Discharge Elimination System (NPDES) permit requirements, possible integration and use of methane gas, land use planning requirements, encroachment of development from the surrounding community, and the plant as a better neighbor

Purpose of the Facilities Plan

The purpose of this project is to provide a road map for expansion of the treatment plant that will meet future needs of the various stakeholders, including the plant's neighbors, all city residents, plant staff, and regulatory agencies This plan assesses the adequacy of the existing facilities through the year 2040 and identifies capital improvements that may be necessary because of decisions and regulatory requirements The scope of work for this project includes the following aspects of the treatment plant

- Sanitary wastewater liquid treatment processes
- CSO and wet-weather liquid treatment processes
- Solids processing, solids handling, and ultimate reuse or disposal of biosolids
- Support facilities
- Seismic vulnerability of existing structures
- Methane utilization
- Odor and air emissions
- Site layout and mitigation opportunities
- Plant hydraulics
- Effluent outfalls

Addressing these topics included coordination with Environmental Services Clean River Works Program staff, an input and partnership arrangement with the Columbia Boulevard Citizens Advisory Committee (CAC), and guidance from the Oregon Department of Environmental Quality (DEQ) on the proper scope and content of facilities plans (DEQ, 1994b) The Environmental Services project management plan objectives, Environmental Services guiding principles, and CAC facilities plan vision statement, which also provided guidance, are described in this chapter

Project Management Plan Objectives

Environmental Services identified the following objectives in its project management plan at the outset of the project

- Manage the project by consensus
- Plan for facilities that will meet the projected demands on the sewerage system and that will meet the projected regulatory requirements
- Plan for cost-effective facilities and incorporation of public values, needs, and benefits to optimize the community's investment
- Plan for "good neighbor" facilities by prioritizing odor, noise, and visual mitigation
- Plan for effective operation and maintenance, including safety and risk minimization for operation and maintenance staff, best utilization of staff resources, and optimum automation
- Plan for process reliability and flexibility, energy efficiency and optimization of plant energy resources, and conservation of other resources, including maximization of recycling and reuse when practical
- Plan for minimum disruption to existing facilities, activities, and development and address encroachment of development in the surrounding community
- Develop and implement a meaningful and effective citizen involvement program
- Develop the plan in close coordination with staff working on other Environmental Services programs and other citywide and area programs
- Ensure input and review by CBWTP operation and maintenance staff, CSO program and project staff, and design and construction teams for the Columbia Slough consolidation conduit, pump stations, and outfall
- Provide socioeconomic job opportunities in the form of employment, education, and opportunities for minority-owned and emerging businesses
- Provide a document suitable for submission to the Portland Bureau of Planning as a master plan and suitable for inclusion in an update of the public facilities plan

Environmental Services Guiding Principles

A meeting was held with Environmental Services staff on September 8, 1994, to develop guiding principles and objectives for the project The majority of the guiding principles agreed to by the staff were drawn from the Environmental Services project management plan The principles were modified and enhanced in the consensus-building process as follows

1 Manage project by consensus, to include the following

(a) Environmental Services engineering staff

(i) Project staff (Environmental Services task leaders)
(ii) Decision team

(b) Plant staff

(c) Local community

(d) Regulators

2 Develop and encourage neighborhood and total community participation in facility planning, with interaction between plant staff and citizens

3 Incorporate public values, needs, and benefits to "optimize the community's investment"

4 Commit to a "good neighbor" facility, including the following

(a) Odor mitigation–minimize odors within the plant and make them nondetectable beyond the property line

(b) Noise mitigation–meet or exceed the Occupational Safety and Health Administration (OSHA) requirements within the plant and the low-but-achievable limit at the property line

(c) Visual mitigation–achieve "best appearance of the neighborhood" and "urban park-like development in an aquatic setting"

(d) Light mitigation–make the lighting nonintrusive to neighbors, yet provide light necessary for plant operation, maintenance, and security

(e) Traffic mitigation–achieve a net improvement over the base condition

(f) Community facilities–provide joint-use amenities such as parkland, river access, trails, recreational facilities (that is, softball diamonds and tennis courts), meeting space, and training and educational facilities, develop the available area between the plant and neighborhoods for community joint uses

5 Provide socioeconomic opportunities for minority-owned, women-owned, and emerging businesses

6 Provide for conservation, recycle, and reuse to the extent practical, including the following

(a) Water (in-plant, landscaping, industrial, and agricultural uses)
(b) Residuals (compost for horticulture and cake for agriculture)
(c) Gas
(d) Electricity

7 Achieve close coordination of all activities with other Environmental Services and citywide programs

8 Ensure input review by the following

(a) CBWTP plant staff

(b) CSO program and project staff

(c) Design and construction teams for the Columbia Slough consolidation conduit, pump stations, and outfall

The majority of the project objectives were also drawn from the Environmental Services project management plan They were modified, enhanced, and supplemented through consensus building, as follows

- A facility that meets the projected sewerage system demands
- A facility that meets the projected regulatory requirements
- A facility that is cost-effective
- A facility that is energy-efficient
- A facility with both process reliability and flexibility
- A facility having effective operation and maintenance provisions and optimal automation
- A facility with minimum safety risks and associated risks to plant staff
- A motivating and professional growth environment for plant staff
- A plan for facilities additions or modifications that minimizes disruption to existing works

- A plan for addition of technologies and automation that takes into account available plant staff skills and training needs

- A plan that gives Environmental Services staff flexibility in responding to the demands of environmental stewardship and regulatory requirements

- A plan that is implementable and practical and that features low-maintenance solutions

- An awareness of the updated CBWTP public facilities plan and its guiding principles

- An improved public understanding of the CBWTP and its service to the community

- A planning document that is suitable for the following

  - Use as a master plan for the City of Portland Bureau of Planning
  - Inclusion in the updated CBWTP public facilities plan

- A planning document that receives council approval

Facilities Plan Vision Statement

To effectively develop a meaningful and farsighted facilities plan, Environmental Services established a vision resource team composed of knowledgeable individuals and representatives from Environmental Services, City Commissioner Mike Lindberg's office, and the CAC The team's mission was to be a resource for the CAC At the outset of the project, the team held workshops with Environmental Services staff and CAC members to brainstorm and identify the concepts and concerns that must be reflected and addressed in the plan and to formulate guiding principles for the plan On the basis of these workshops, the team prepared a draft vision statement that was reviewed and modified by the CAC The CAC approved the vision statement on March 29, 1995 Chapter 12 (Public Participation) provides more information about the CAC and its involvement in developing this plan

The vision statement process was more than just an exercise in visionary thinking or a means of communicating what wastewater practitioners expected It was a fundamental aspect of the project's decisionmaking and was designed to create a truly shared vision As a consequence, the vision statement process challenged all participants to learn and to work in partnership The CAC further emphasized the need for a continued partnership and requested, in the adopted vision statement, that its involvement continue until appointment of a successor citizens' oversight committee with the power to set priorities and resolve conflicts among vision statement objectives A copy of the vision statement is provided on the pages that follow

CLEAN RIVER WORKS

Columbia Boulevard Wastewater Treatment Plant Facilities Plan

VISION STATEMENT

March 29, 1995

ENVIRONMENTAL SERVICES
CITY OF PORTLAND

In partnership with the Columbia Boulevard Wastewater Treatment Plant Facilities Plan
Citizens Advisory Committee.
Members Pam Arden, William Benz, Tom Kelly, Patricia Trow-Merkle, Barry Messer, Barbara Novak, Lee Poe, Ted White

CH2M HILL
BROWN AND CALDWELL
and Associated Firms

CLEAN RIVER WORKS

The vision statement for the Columbia Boulevard Wastewater Treatment Plant (CBWTP) Facilities Plan was prepared through the collaborative efforts of the following individuals and groups Each of the participants shares a commitment to open discussion, water quality, and setting the groundwork for the CBWTP to become an asset to the community and the city

Vision Resource Team
William Benz
Linda Dobson
John Filbert
Gary Krahmer
Michael Read
Darrell Simms
Steve Simonson
Patricia Trow-Merkle
Bruce Willey/HDR facilitator

Columbia Boulevard Wastewater Treatment Plant Citizens Advisory Committee
Pam Arden
William Benz
Tom Kelly
Barry Messer
Barbara Novak
Lee Poe
Patricia Trow Merkle
Ted White
Linda Macpherson/CH2M HILL facilitator

BES and Consulting Team Participants
Gene Appel/BES
John Filbert/CH2M HILL
Kim Isaacson/Murasse & Associates
Linda Macpherson/CH2M HILL
Michael Read/BES
Dale Richwine/CH2M HILL
Joan Saroka/BES
Steve Simonson/BES

Columbia Boulevard Wastewater Treatment Plant

Vision Statement
for the

Columbia Boulevard Wastewater Treatment Plant Facilities Plan

(Approved by the Citizens Advisory Committee on March 29, 1995)

The Citizens Advisory Committee ("CAC") has adopted this Vision Statement to govern the operational strategies for, and the long-term growth and development of, the Columbia Boulevard Wastewater Treatment Plant The intent of the Vision Statement is to guide the development of a wastewater treatment system that enhances the environment of which it is a part, while protecting the health, welfare, and water quality for all Portland residents

The Vision Statement is divided into a section titled "GENERAL OBJECTIVES" and a statement of "SUPPORTING DETAIL" that repeats elements of the general objectives and sets forth specific directives related to the general objectives The Vision Statement contains a directive for providing accountability during the implementation of the Columbia Boulevard Wastewater Treatment Plant Facilities Plan (the "Plan"), including the maintenance of a citizen oversight committee with the power to set priorities and resolve conflicts among Vision Statement objectives

The Vision Statement should be consulted by all planners, decisionmakers, citizen review boards, and oversight committees involved with any phase of the planning and implementation process All phases should be designed to minimize conflict among the various elements of the Vision Statement When considering developmental alternatives that support some, but not all, of the Vision Statement's objectives and directives, decisionmakers should pursue those alternatives that support Vision Statement priorities as determined by the CAC or other oversight body Any planning decision that is inconsistent with the Vision Statement should be reconsidered The CAC intends the Vision Statement to evolve as necessary to respond to new technologies and environmental concerns and to accommodate future development of the service area

General Objectives

The Columbia Boulevard Wastewater Treatment Plant shall be a model of excellence where environmental and community objectives are accomplished by

- Protecting public health
- Practicing environmental stewardship
- Achieving outstanding operational performance by promoting employee excellence
- Providing cost-effective service

- Conserving, recovering, and reusing resources
- Advocating pollution control at the source
- Incorporating flexibility to meet changing regulatory and operational requirements
- Serving as a center for water resources education and training
- Not adversely impact the community
- Providing a pleasing setting that supports neighborhood livability
- Providing a recognized positive and equitable asset to the community
- Providing social and economic benefits to the community
- Linking to and enhancing the ecosystem in which it is situated
- Maintaining an open dialogue with the community
- Continuing to apply new and innovative ideas
- Providing accountability during implementation of the plan

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Vision Statement

for the

Columbia Boulevard Wastewater Treatment Plant

Facilities Plan

Supporting Detail

The following statements illustrate, clarify, and support the concepts incorporated in the General Objectives section of the Vision Statement They represent the detailed ideals developed during the visioning process Some individual ideals support several of the general objectives and are repeated

Protecting Public Health and Practicing Environmental Stewardship

- Leave it cleaner than we found it
- When selecting ways to meet water quality and regulatory requirements, select solutions that address the pollutants rather than use indirect approaches such as dilution Choose solutions that are in the best interest of the environment

Achieving Outstanding Operational Performance by Promoting Employee Excellence

- Achieve excellence in the maintenance, operations, and cleanliness of the internal operations of the treatment facility
- Encourage development of employee excellence at specific tasks so that the operation of the facility will be optimized
- Create a facility that is sensibly automated
- Look for opportunities to control operation of the facility from remote locations
- Design facilities to minimize the need for operations and maintenance staff
- Minimize the use of paint to improve aesthetics and reduce maintenance

Providing Cost-Effective Service

- Be cost-efficient in the operation of the facility–be consistent with the cost spent by other communities
- Be energy-efficient at all levels of design and operation

- Consider costs in a way that does not adversely affect the benefits to the community

Conserving, Recovering, and Reusing Resources

- Become known as a water reclamation facility rather than a wastewater treatment plant
- Create an example facility that conserves and recovers all resources–water, energy, etc
- Look for opportunities to recover and refine reusable products of resources from the raw wastewater–move toward zero discharge, emphasize reuse
- Design facilities for recycling and waste reduction–dedicate, educate, label
- Be energy-efficient at all levels of design and operation
- Consider use of upstream reclamation plants to provide a source of water for reuse, thus conserving available potable water supplies

Advocating Pollution Control at the Source

- Use the treatment facility as the last resort for pollution control, not the one that is used simply because of its convenience, i e , emphasize source controls and best management practices upstream of the collection system and treatment plant
- Emphasize pollution control at the source–provide "cradle to grave" pollution control
- Be an active agent for industrial pretreatment and source controls in order to meet the goals for reuse of water and by-products
- Develop a cost-of-service program that encourages waste reduction and source control
- Designate areas in the plant for recycling, source control, gray water use and management, etc
- Using plant staff and city employees, educate the public about resource management and the best use of the facilities
- Educate about the potential use of composting toilets
- Use technologies that prevent release of toxics and minimize the use of hazardous chemicals

- Design facilities for recycling and waste reduction–dedicate, educate, label

Incorporating Flexibility to Meet Changing Regulatory and Operational Requirements

- Build in flexibility to address future water quality and regulatory requirements, such as nutrient removal, virus control, reduction of air emissions, etc
- Maintain flexibility for operational changes and expansion
- Be prepared for "cross media" permits that combine the regulation of air, water, and solid waste
- Create a facility that demonstrates leadership in the application of innovative, appropriate technologies to achieve current and anticipated water quality requirements

Serving as a Center for Water Resources Education and Training

- Create a laboratory for education in partnership with schools at all levels
- Create a water resources education facility and training center at the plant
- Ensure that the entire public understands the function of the facility and the role that it plays in the community
- Using plant staff and city employees, educate the public about resource management and the best use of the facilities
- Create an informational kiosk to demonstrative innovative, worldwide developments in water quality technology and management programs
- Educate about the potential use of composting toilets

Not Adversely Impacting the Community

- Never emit offensive odors that can be detected off the site
- Minimize all adverse impacts to the neighboring communities–odor, air quality, noise, lights, vibration, traffic, etc
- Minimize the impact of construction on the local community
- Select and design processes that avoid problems such as odors, neighborhood traffic, etc Use innovative approaches, be proactive, eliminate the problem, don't treat the symptoms

- Develop a mechanism to log odor events and to identify what caused the odors Generate this information "from the inside" and make it available to and accessible by the public Use the information to develop solutions to odor generation

Providing a Pleasing Setting that Supports Neighborhood Livability

- Improve the aesthetics of the facility to the point where BES receives positive feedback from the surrounding neighborhood

- Develop a setting that is visually pleasing, one that resembles a campus setting at a high-tech industrial park (an example is the Nike facility)

- Establish a buffer between the plant and the neighboring community, look for opportunities for joint use/public facilities within the buffer

- Design a facility so well that you don't need buffers between the plant and neighboring uses

- Design facilities that have a low visual profile (no skyscrapers)

- Make optimum use of the site (footprint), gain public support for the uses and layout of the site

Providing a Recognized Positive and Equitable Asset to the Community

- Develop the facility in such a manner that the public will think of the site first as a public resource, and second as a treatment plant

- Create a facility that the neighborhood is proud to have in its community so that the staff and management of the City of Portland Bureau of Environmental Services would want to live nearby

- Create a facility that becomes a recognized, positive destination for the community and for visitors to the city

- Be inviting to the community, be an available resource

- Link the facility with recreational programs, facilities, activities, and sites along the Columbia Slough

- Through the process of creating this facility, yield an equitable economic and social impact to all of the community

- Develop a facility that provides leadership in the area for industrial development, redevelopment, and improvements Set a positive standard for others to follow

- Protect (and possibly improve) local property values

Providing Social and Economic Benefits to the Community

- Provide an employment resource for North Portland, where students/youth in the area have the first opportunity to work at the facilities
- Involve youth in any positive fashion that can be identified
- Maximize the use of local resources, building materials, contractors, etc

Linking to and Enhancing the Ecosystem in which it is Situated

- Enhance and contribute to the restoration of the Columbia Slough–habitat, natural systems, water quality, etc
- Be an active agent in wetland remediation and a benefit to aquatic wild-life/habitat

Maintaining an Open Dialogue with the Community

- Maintain an ongoing dialogue between the plant staff and the neighborhood to facilitate understanding
- Implement an open book policy that provides public access to information Develop effective mechanisms to keep the neighborhood informed
- Develop a public information network system specific to activities at the plant

Continuing to Apply New and Innovative Ideas

- Continue to experiment with new ideas throughout the life of the facility
- Provide an international model of excellence

Providing Accountability During Implementation of the Plan

- A citizens oversight committee should be maintained during all phases of the facilities plan to determine whether the design and implementation of the Plan furthers the achievement of the objectives set forth in the Vision Statement Upon request of the oversight committee, decisionmakers should report the facts and findings that are the basis for planning decisions The citizens oversight committee should be prepared to (1) review and recommend those alternatives that are most consistent with the Vision Statement to determine, as between conflicting objectives, those that rise to the level of priority considerations, (2) request action on the part of decisionmakers consistent with the achievement of benchmark accomplishments consistent with the Vision Statement, and (3) propose new ideas for the furtherance or acceleration of the achievement of the objectives of the Vision Statement

- The community at large should be informed of, and involved in, the development and implementation of the Plan Decisionmakers and the citizens oversight committee should cooperate in this responsibility The community should be given ample opportunities to comment on alternatives prior to their final adoption or implementation

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Chapter 3

Existing Capabilities

Chapter 3
Existing Capabilities

Site Description

The Columbia Boulevard Wastewater Treatment Plant (CBWTP) is located on North Columbia Boulevard, near the intersection with North Portsmouth Avenue, in the northern part of the City of Portland The plant site is bounded on the west by main-line railroad tracks and by North Portland Road Immediately to the east of the existing plant are about 20 acres of City-owned, industrially zoned land, that site is bounded on the east by another railroad track Most of the plant site is bounded on the north by the Columbia Slough The Triangle Lake sludge lagoon, however, is located north of the slough and east of North Portland Road Figure 3-1 provides an aerial photo of the plant site, and Figure 3-2 shows the site plan for the current facilities

History

The first major wastewater treatment plant constructed for the City of Portland was completed at the present plant site, 5001 North Columbia Boulevard, in 1952 The original plant provided only preliminary and primary treatment, with no disinfection, for an average dry-season capacity (ADSC) of 60 million gallons per day (mgd) and peak wet-season capacity (PWSC) of 155 mgd Sludge was treated by anaerobic digestion Disinfection of the plant effluent by chlorination was added in 1961 The various plant modifications that have taken place since then are described below

The first major plant expansion, completed in 1969, increased the ADSC of the primary treatment units to 100 mgd and the PWSC of these units to 300 mgd Parshall flumes replaced venturi flumes as flow-measuring devices, and cyclonic grit separators replaced mechanically raked grit channels The primary clarifier tankage was doubled, and two gravity primary sludge thickeners were added The facultative sludge lagoon (Triangle Lake) on the north side of the Columbia Slough was also constructed at this time to store solids after anaerobic digestion

Secondary treatment with activated sludge was added in 1974 The ADSC, primary PWSC, and secondary PWSC design capacities of the plant after completion of the 1974 expansion were identified as 100 mgd, 300 mgd, and 200 mgd, respectively Major changes to the sludge handling system were also added in 1974 These included disk centrifuges for waste activated sludge (WAS) thickening, heat treatment for sludge conditioning, vacuum filters for dewatering, side-stream treatment systems for odors and high-strength wastes, and chemical feed systems for sludge conditioning

A coarse-grit removal system was added to the headworks in 1975 This modification included a septage dumping station Heat treatment of sludge and vacuum filtration were discontinued in 1975, and WAS was stabilized by aerobic digestion in Aeration Basins 7 and 8 until 1982 The sludge lagoon was modified in 1979 to increase its holding capacity

Sludge system modifications in 1981 included restarting the vacuum filters and adding a dredge to the sludge lagoons to allow harvesting of stored digested sludge for vacuum filtration Sludge cake was hauled to a landfill

Construction of four additional anaerobic digesters and an additional gravity thickener was completed in 1982 Aerobic digestion of WAS was discontinued when the digesters were placed in service Thickened primary sludge and WAS were separated and anaerobically digested in dedicated batteries of tanks

Belt filter presses replaced the vacuum filters in 1983, and disk centrifuging of WAS was discontinued at the same time WAS was thickened by gravity after the addition of polymer Composting of all sludges in the Taulman-Weiss enclosed-vessel composting units began in 1985, and disposal of compost was contracted to the North American Soils Company

In 1993, gravity belt thickening replaced gravity thickening of the WAS before anaerobic digestion

Triangle Lake, the digested sludge storage lagoon, reached its capacity of 62,900 dry tons in 1991 At that time, a program to transport biosolids to the Madison Ranch in eastern Oregon near Hermiston for application to arid lands was initiated This program, combined with the composting of biosolids, will provide for the removal of solids from Triangle Lake by the year 2000

New chlorination facilities were constructed in 1991 to meet the revised *Uniform Fire Code (UFC)* requirements for containment and emergency scrubbers A new maintenance building (now known as the Dodd Center) was constructed in 1991 near the present administration building

In 1994, modifications to the secondary treatment system were completed These modifications included reconfiguring the aeration tanks to incorporate plug flow selector technology, converting the remaining aeration tanks to use fine-bubble diffusion, performed in conjunction with the aeration tank reconfiguration, adding more intermediate blower capacity to take advantage of the energy savings of the new diffusers, and modifying the secondary clarifiers to improve performance and hydraulic capacity

For safety reasons, a new headworks is currently being constructed to replace the existing headworks/screenings building The existing headworks configuration, with its numerous conveyors, made maintenance operations unsafe, and the antiquated bar screens that required manual cleaning needed to be replaced with automatic screens The new headworks will correct these deficiencies, it will have a PWSC of 300 mgd It is expected to be completed in 1996

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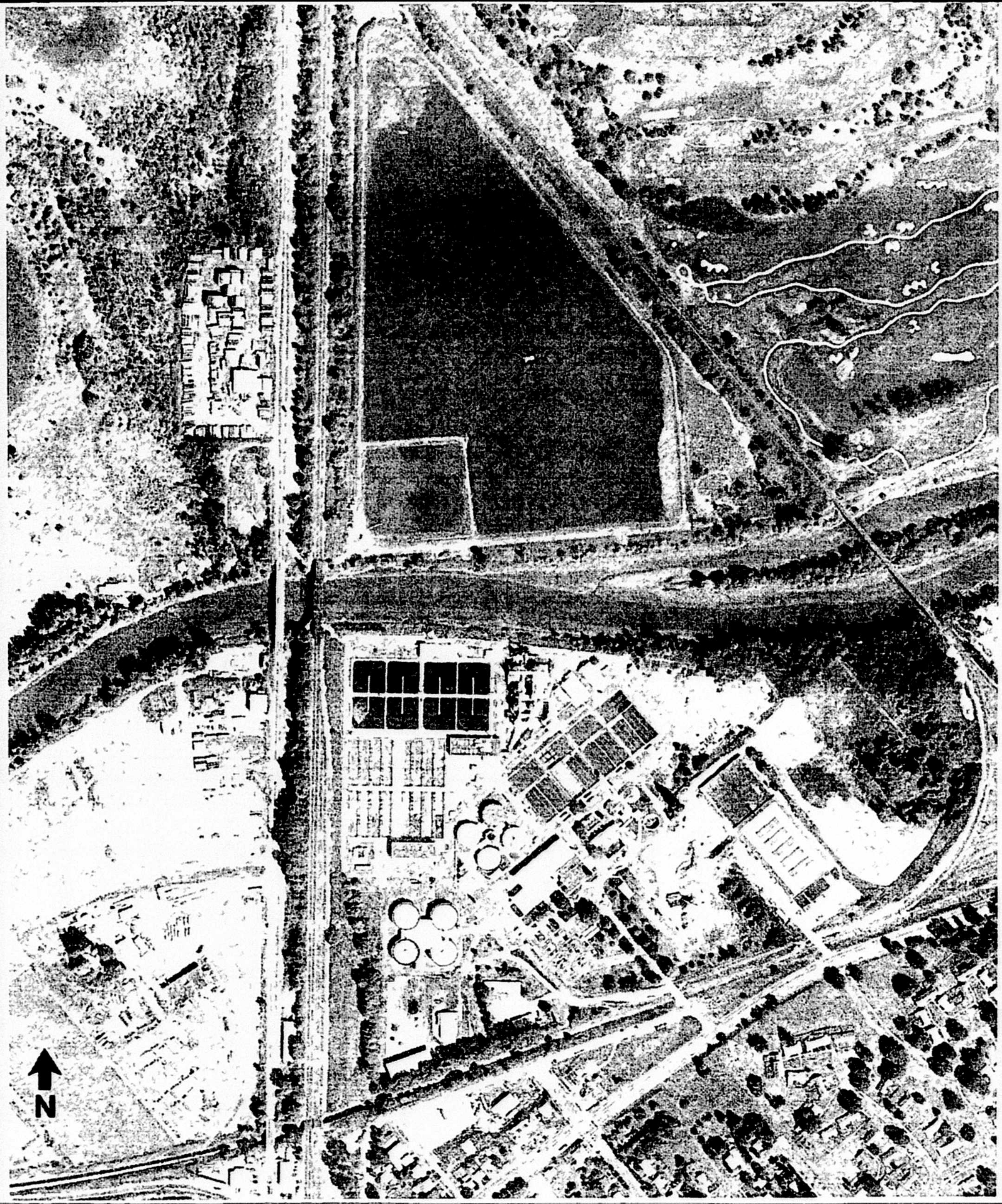

CBWTP Facilities Plan

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Aerial Photograph of Columbia Boulevard Wastewater Treatment Plant

FIGURE 3-1

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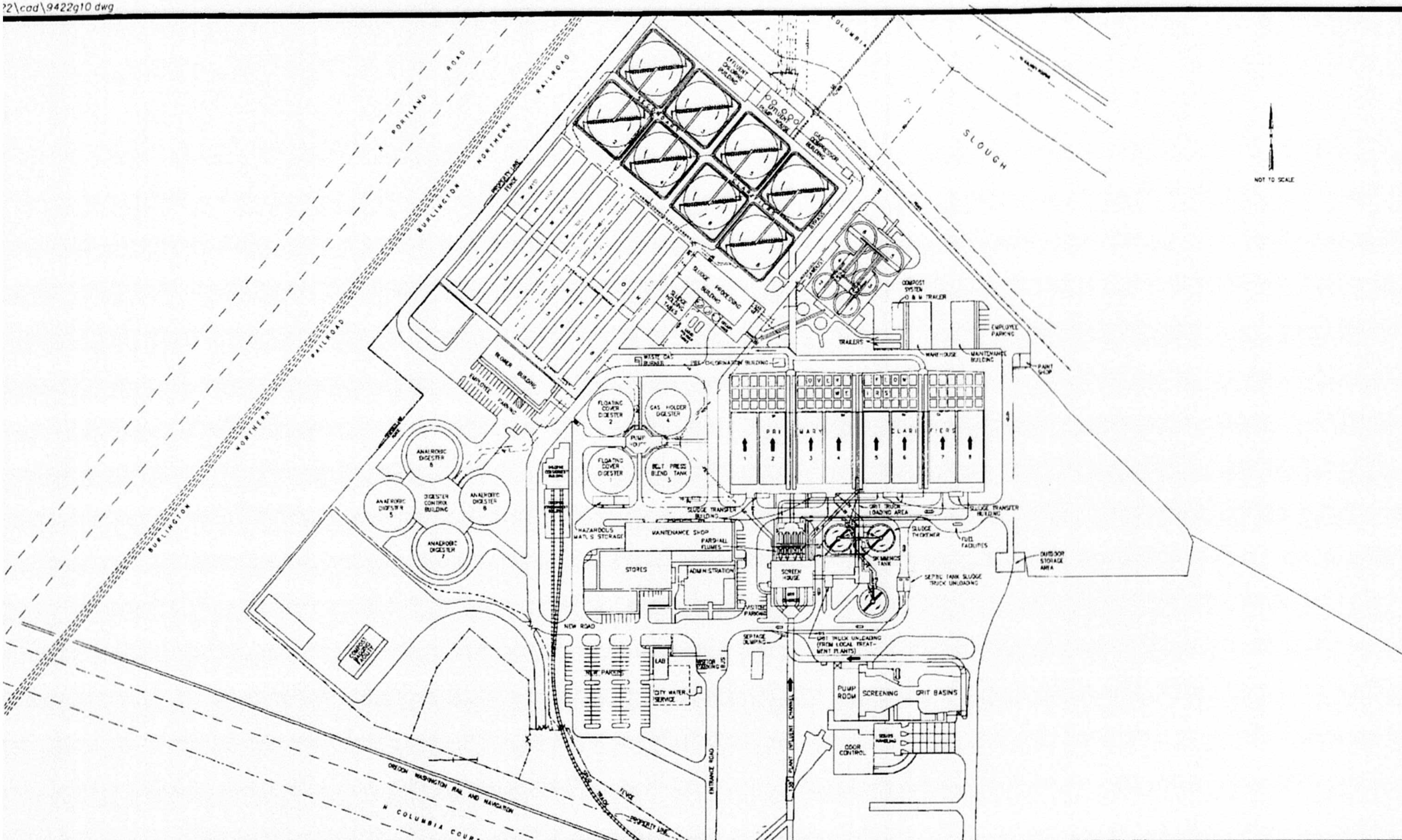

Plan

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Site Plan of Current Facilities Columbia Boulevard Wastewater Treatment Plant

FIGURE 3-2

Existing Liquid Processes

The design criteria and capacities of the existing liquid processes are summarized in Table 3-1 Figure 3-3 is a schematic of the liquid processes

Preliminary/Primary Treatment

After the 1969 plant expansion, the preliminary/primary treatment unit processes were designed to treat a PWSC of 300 mgd Treatment consists of flow splitting, coarse-grit removal, mechanically cleaned screening, flow measurement, and primary sedimentation

Flow enters the plant through a box-section-shaped influent line and is split into four equal portions just upstream of the screening house The split was designed to be accomplished through simple channel geometry without head loss, however, unequal splits led to the installation of flow-directing vanes at the point of splitting

In the screening house, the four influent flow streams pass through coarse-grit removal channels and mechanically cleaned screens The coarse-grit removal system is operated intermittently during normal flows and continuously during stormwater flows to remove rocks The bar screens remove objects more than 1 inch in diameter, including much of the stringy material Conveyors carry both the coarse grit and the screenings from the screenings house to dumpsters for eventual disposal

Parshall flumes measure flow in each of the four channels exiting the screening house The total flow of the four channels is considered to represent the plant influent flow, despite contributions from some in-plant return streams that enter upstream of the screening house The flow measurements in the four channels are used to adjust the flow-directing vanes that split the influent flow Remaining in-plant return streams enter the flow path just downstream of the Parshall flumes

The new headworks will include influent pumping, bar screens with screening presses, grit basins with grit washer-separators, a new septage receiving station, and an emergency bypass to the primary clarifiers After passing through the grit system, the wastewater will flow through the existing headworks structure to the flow-monitoring area with the existing Parshall flumes, and then to the primary clarifiers The peak capacity of the new headworks will be 300 mgd

The flow from the four influent channels is split among eight rectangular primary clarifiers The splitting method for the original four clarifiers is different from the splitting method for the four clarifiers added during the 1969 expansion The original clarifiers depend on distribution control at the tank inlets for splitting, the newer clarifiers have individual conduits to each tank The split for the newer tanks is accomplished through sluice gates at the ends of the influent channels downstream of the Parshall flumes

All eight 10-foot-deep primary clarifiers are 225 feet long by 58 feet wide, with longitudinal chain and flight collectors and cross collectors at the inlet ends Thin sludge is continuously pumped from the tanks for degritting in cyclone separators All eight tanks are designed for a surface overflow rate of 960 gallons per day per square foot (gpd/ft^2) at an ADSC of 100 mgd The PWSC design flow is 300 mgd

Primary effluent from the four original tanks is collected in a common effluent channel and approaches the bypass divider gate through a short conduit Primary effluent from the four newer tanks is collected in another common effluent channel and flows to the bypass divider gate through a long box channel The bypass divider gate was designed to modulate at high flow rates and thus limit the secondary treatment influent flow to 200 mgd, but because of hydraulic constrictions that limit flow to the secondary treatment process to approximately 160 mgd, the gate has been used to bypass flows greater than 160 mgd Operational experience has shown that secondary treatment can sustain flows of only 130 mgd at sludge volume indexes (SVIs) of 100 to 130 milliliters per gram (mL/g) Therefore, the current practice at the plant is to bypass flows greater than 130 mgd around the secondary treatment system Primary effluent flows in excess of the secondary system capacity (130-mgd) are bypassed to the outfall system

Secondary Treatment

Processes for the original secondary treatment activated sludge system were designed for an ADSC of 100 mgd and a PWSC of 200 mgd As described in the preceding subsection, the primary treatment portion of the plant was designed for a PWSC of 300 mgd The plant was designed so that any primary effluent flows greater than 200 mgd would bypass the secondary treatment and blend with secondary effluent for subsequent chlorination and discharge However, before the 1994 modifications, the actual peak capacity of the secondary system was limited to 80 to 100 mgd With the 1994 modifications, the secondary treatment capacity was increased to a 160-mgd sustained peak (6- to 8-hour) flow and a 130-mgd maximum-day flow There is currently no accurate way to measure the flow actually undergoing secondary treatment

The primary effluent receiving secondary treatment is divided among eight aeration basins Each basin is 381 feet long by 40 feet wide and operates with about 17 feet of water depth When the system is operating in the plug flow mode, secondary influent enters the basins with the return activated sludge (RAS) at the influent end of the basin RAS can be directed either to the secondary influent channel or to the head of each basin Secondary influent, under the step-feed mode of operation, is directed in the channel down the length of the basin and into the basin through any of eight gates per basin The RAS enters at the head of each basin in step-feed mode

The effluent launders run fully across the end of each basin Aeration is provided by fine-bubble diffusers that cover the floor of the basin Aeration air is supplied by four large centrifugal blowers installed before the most recent 1993/1994 modifications and two small blowers installed in 1993/1994

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Table 3-1
Design Criteria and Capacities of Existing Liquid Unit Processes
Columbia Boulevard Wastewater Treatment Plant

Flow	
ADSC	100 mgd
PWSC	300 mgd
Design BOD_5 Load	
Average dry-season month	159,294 lb/day
Maximum dry-season month	241,860 lb/day
Design Effluent Requirements	
Maximum monthly average TSS	30 mg/L
Maximum monthly average BOD_5	30 mg/L
Influent Pumps (New Headworks)	
Number	6
Type	Centrifugal
Speed	Variable speed rpm
Capacity	4 pumps at 75 mgd each and 2 pumps at 40 mgd each
Horsepower	4 at 450 hp and 2 at 250 hp
Preliminary Treatment	
Bar racks	
Number	4
Size	Clearance, 6-inch
Bar screens	
Number	5
Spacing	Clearance, 5/8-inch
Grit basins	
Number	6
Type	Mechanically induced vortex
Size	24-foot diameter
Efficiency	85 percent of 100 mesh at 130 mgd
Primary Treatment primary clarifiers	
Number	8
Size	225 by 58 by 10 feet
Overflow rates (1 unit out of service)	3,284 gpd/ft^2 at peak flow
	960 gpd/ft^2 at 100 mgd
	2,880 gpd/ft^2 at 300 mgd
Aeration Basins	
Number	8
Size	381 by 40 by 17 feet
Volume (each)	1 8225 million gallons
Capacity (each)	20 0 mgd at an SVI of 80 mL/g
Design organic loadings	
Instantaneous peak	120,000 BOD_5 and 17,800 NH_3 lb/day
Diurnal peak	90,000 BOD_5 and 13,350 NH_3 lb/day
Minimum	20,000 BOD_5 and 3,000 NH_3 lb/day
Detention time	2 2 hours at 100 mgd and 60 mgd for RAS

Table 3-1
Design Criteria and Capacities of Existing Liquid Unit Processes
Columbia Boulevard Wastewater Treatment Plant

Aeration Equipment Type	Fine-bubble diffusers
Mixer Type	Submerged mixer/aerator
Clarifier	
Number	8
Type	Square, peripheral-feed
Size	125 feet by 125 feet
Sidewater depth	10 feet
Surface overflow rate	800 gpd/ft^2 at ADSC of 100 mgd
Solids loading rate	32 4 lb/day/ft^2
Detention time	2 79 hours at 100 mgd
Sludge removal	Revolving suction arm
Sludge Recirculation	
Number of pumps, each clarifier	2
Type	1 variable-speed and 1 constant-speed
Combined capacity	62 5 mgd
Chlorination	
Type	V-notch chlorinator
Control	Residually paced
Reactor	Chlorine contact pipe
Detention time	22 minutes at 300 mgd
Effluent Pumping	
Number of low-head pumps	3
Speed	1 variable-speed and 2 constant-speed
Rated head	17 feet
Rated capacity (each)	78 mgd
Number of high-head pumps	2
Rated head	32 feet
Rated capacity (each)	72 mgd

Abbreviations

ADSC	=	average dry-season capacity
BOD_5	=	5-day biochemical oxygen demand
ft^2	=	square feet
gpd/ft^2	=	gallons per day per square foot
hp	=	horsepower
lb/day	=	pounds per day
mgd	=	million gallons per day
mg/L	=	milligrams per liter
mL/g	=	milliliters per gram
NH_3	=	ammonia
PWSC	=	peak wet-season capacity
RAS	=	return activated sludge
rpm	=	revolutions per minute
SVI	=	sludge volume index
TSS	=	total suspended solids

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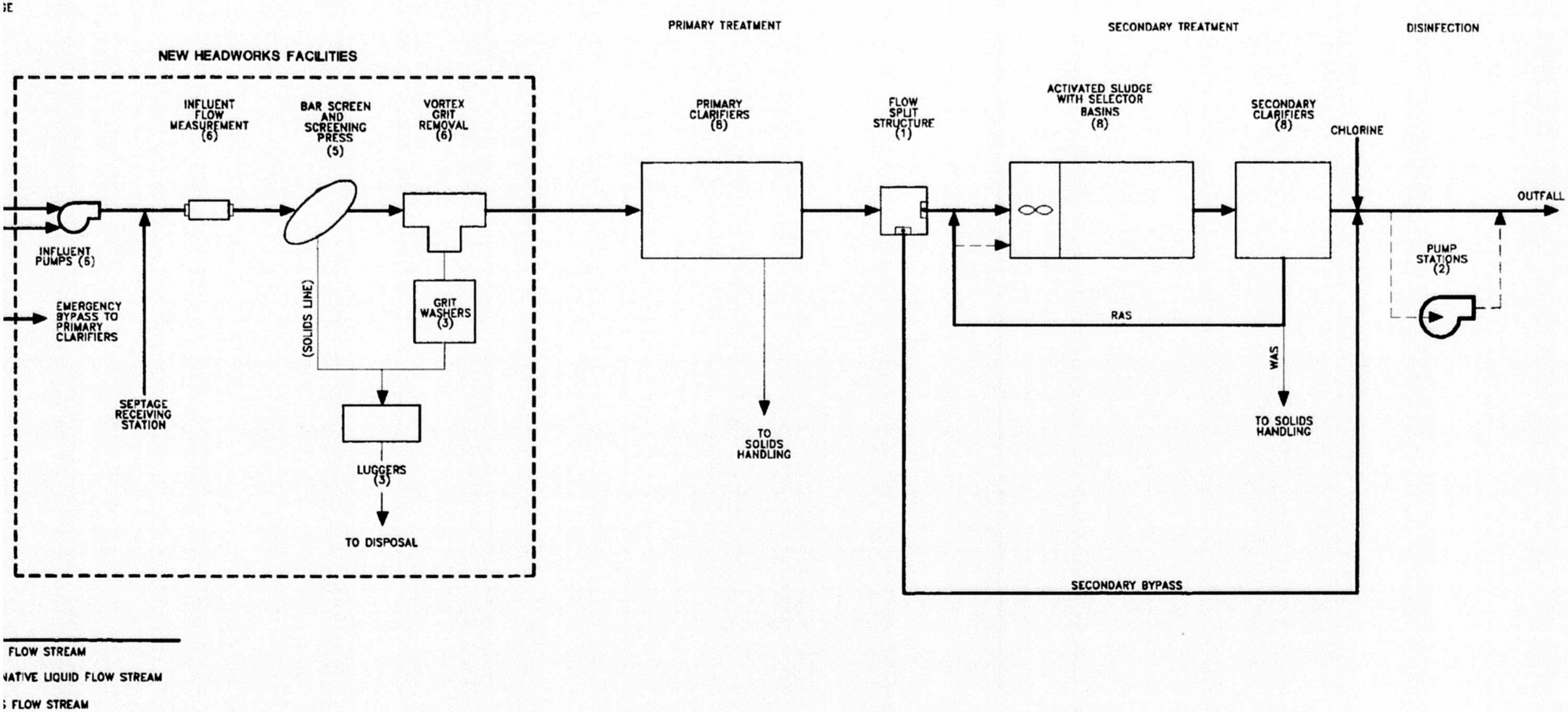

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Schematic of Existing Liquid Processes Columbia Boulevard Wastewater Treatment Plant

FIGURE 3-3

The aeration basins must be operated in pairs Except for Basins 7 and 8, the basin pairs cannot be drained separately Structural limitations of the center common walls in Basins 1 through 6 preclude the differential head that would result from independent draining of the basins

For each aeration basin, there is a dedicated secondary clarifier The eight secondary clarifiers are 125-foot-square tanks with 10 feet of sidewater depth and flat bottoms The clarifiers employ peripheral feed and peripheral overflow Sludge is withdrawn by direct pumping through articulated sludge collector arms The clarifiers are designed for a surface overflow rate of 800 gpd/ft^2 at 100 mgd and a peak overflow rate of 1,600 gpd/ft^2 at 200 mgd Before the most recent modifications, operational experience established that the peak overflow rate was actually 640 gpd/ft^2 The 1994 modifications increased the overflow rate A stress test of the clarifiers is scheduled to verify that when the SVI is near 100 mL/g, the peak overflow rate can be increased to 1,300 gpd/ft^2 for 6 to 8 hours, the length of time depends on conditions of the wastewater and sludge in the clarifier before the peak flow event

Two RAS pumps–one constant speed and one variable speed–are directly connected to each clarifier Both pumps discharge into a common line containing a flowmeter and flow control valve Under the original design, RAS was returned only to the aeration basin associated with the clarifier from which it was drawn, the result was eight independent, activated sludge plants, operating side by side A modification to the system permits combining RAS from all eight clarifiers and returning the combined flow to the secondary influent channel upstream of the aeration basins This modification limits the RAS capacity and increases hydraulic head losses in the secondary influent channel, but it permits the plant to operate as a single system and this is now the normal flow path

Effluent Pumping and Chlorination

One outfall line carries treated effluent from the plant to the Columbia River by gravity under most operating conditions The discharge point is at Columbia River Mile 105 5 just west of the Burlington Northern Railroad (BNRR) bridge that connects Hayden Island to Vancouver, Washington Under certain conditions–when the Columbia River water stage is high and plant flow is high–effluent pumping is required Operational experience has shown that the main outfall and pumps are limited to a capacity of 240 mgd An alternative outfall to the Oregon Slough must be opened to pass flows greater than 240 mgd

At normal river stages, the 102-inch-diameter main outfall line carries up to 130 mgd by gravity from the plant to the Columbia River Two pipes from the plant discharge their contents into the 102-inch pipe one 72 inches and one 54 inches in diameter With the effluent pumps in use, the main outfall line will carry up to 240 mgd at high river stages

The alternative outfall to the Oregon Slough is another 72-inch-diameter line All flow through it is pumped at the plant, the peak capacity of the line is 145 mgd

The effluent pumping station at the plant includes three low-head pumps and two high-head pumps The low-head pumps discharge into the 102-inch main outfall line, and the high-head pumps discharge into the alternative 72-inch line The configuration of the wet well and control gates at the pumping station permits only secondary effluent to be pumped by the high-head pumps, the low-head pumps can pump secondary effluent, primary effluent, or a combination of the two Thus, if use of the high-head pumping system is required, the more highly treated effluent is discharged to the more sensitive receiving waters of the Oregon Slough Low-head pumping is required less than 3 percent of the time Although high-head pumping has never been required, the high-head pumps have been operated in a backup capacity when the 102-inch line has been shut down for maintenance

To meet disinfection requirements, chlorine solution is injected into the upstream end of the outfall lines Chlorine, delivered to the plant site in 90-ton railcars, is metered through two evaporators and two 10,000-pound-per-day (lb/day) chlorinators into the outfall lines There are two 8,000-lb/day chlorine injectors at the effluent pump station An outfall diffuser was constructed just upstream of the existing Columbia River outfall to prevent potential chlorine toxicity problems The 102-inch outfall line to the Columbia River provides sufficient detention time to meet chlorine contact requirements when flow rates are within the design limits

Existing Processes for Handling Solids

The unit processes currently used for solids handling at the CBWTP include degritting, gravity thickening of primary sludge, gravity belt thickening of the WAS, anaerobic digestion, seasonal lagoon storage for secondary sludge, and belt press dewatering and composting of anaerobically digested biosolids Table 3-2 summarizes information about the existing CBWTP processes for handling solids (see Figure 3-4 for a schematic of the existing solids processes)

Primary sludge is pumped to cyclone degritters in the screening house The degritted sludge is then thickened to about 5 percent solids in three 55-foot-diameter gravity thickeners The thickened sludge is passed through in-line grinders and pumped to anaerobic digesters The WAS is chemically conditioned with polymer and thickened on gravity belt thickeners The thickened sludge, at 3 to 4 percent solids, is pumped to anaerobic digesters

Seven anaerobic digesters are used to stabilize both the primary and the secondary sludges Two are used for first-stage digestion of primary sludge, and two are used for first-stage digestion of secondary sludge Of the remaining three, one is used for primary sludge settling and gas storage, one is used for digested WAS cooling, and one is used as a second-stage digester for WAS settling An eighth digester has been converted to a sludge-blending tank Digested sludge and harvested lagoon sludge (biosolids) are mixed and held in the blend tank before dewatering Biosolids are dewatered on four belt filter presses yielding an 18 to 25 percent solids cake

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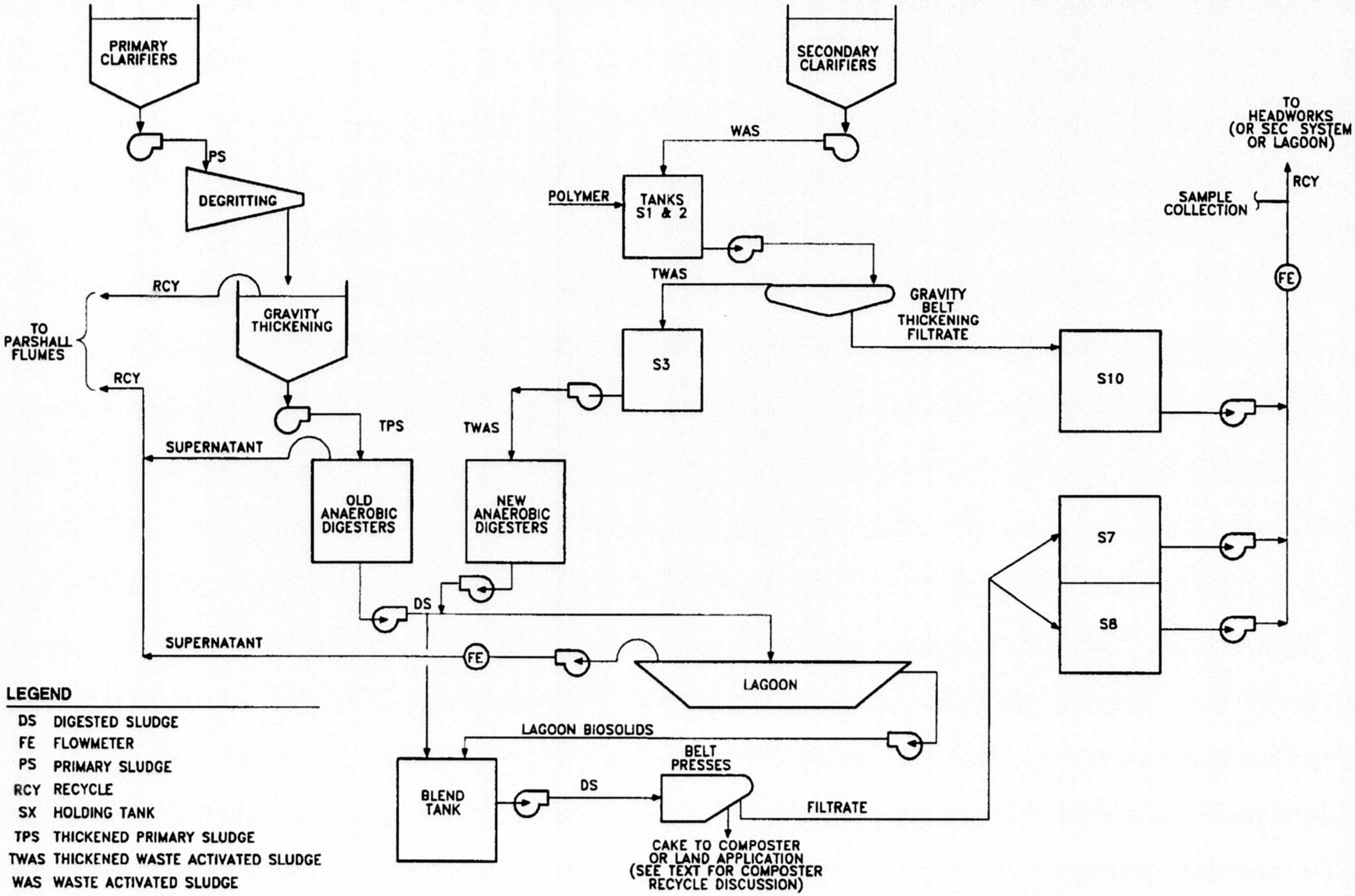

CBWTP Facilities Plan

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Schematic of
Existing Solids Processes
Columbia Boulevard
Wastewater Treatment Plant

FIGURE
3-4

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Table 3-2 Existing Solids Processes Columbia Boulevard Wastewater Treatment Plant	
Item	**Value**
Gravity Thickening of Primary Sludge Thickeners	
Number	3
Diameter, each (feet)	55
Sidewater depth (feet)	10
Gravity Belt Thickening of Secondary Sludge Thickeners	
Number	3
Width, each (meters)	3
Feed flow rate, each (gallons/minute)	900
Anaerobic Digesters*	
Number	8
Diameter (feet)	4 at 90 4 at 105
Sidewater depth (feet)	4 t 25 3 4 at 37
Effective volume, each (cubic feet)	4 at 160,000 4 at 320,000
Triangle Lake Sludge Lagoon	
Area (acres)	36
Effective sidewater depth (feet)	14
Dredge capacity (gallons/minute)	1,000 to 2,000
Mechanical Dewatering	
Belt filter presses	
Number	4
Belt width (meters)	2
Solids loading rate (pounds/hour/meter)	750 to 1,000
Composter	
Rated capacity (dry tons/day)	60
Practical capacity (dry tons/day)	30

*Including one of the 160,000-cubic-foot digesters, which is used as a blend tank before dewatering

The CBWTP generates approximately 13,000 dry tons of biosolids annually Approximately 5,000 dry tons per year of the biosolids are fed to a Taulman-Weiss enclosed-vessel compost system The composting system can handle 30 dry tons of digested biosolids a day The solids not composted at the CBWTP, in the form of dewatered cake, are transported in trucks to the Madison Ranch near Hermiston, Oregon, for direct land application

In addition to new solids from the CBWTP, lagoon solids from the associated Triangle Lake storage facility are dredged and dewatered for transport to the Madison Ranch Removal of solids from Triangle Lake is part of a renovation project that will eventually increase the treatment and storage capacity of the lagoon and provide future operational flexibility for management of biosolids

Both the compost distribution program and the land application at the Madison Ranch provide beneficial reuse of biosolids Operations are conducted under authorization from the Oregon Department of Environmental Quality (DEQ) and are performed in compliance with all applicable regulatory requirements, including U S Environmental Protection Agency (EPA) biosolids regulations in 40 *Code of Federal Regulations (CFR)* Part 503 Details regarding management of the biosolids programs are available in the February 1995 *CBWTP Biosolids Management Plan*

Existing Hydraulic Conditions

Hydraulic conditions for the CBWTP were investigated with the PROFILE software model The following assumptions were made for the modeling

- All treatment units are in service
- The effluent pump station is operated to keep the secondary clarifier effluent weir from being submerged
- Aeration tanks are operated in a plug-flow activated sludge mode

The plant flow conditions that were investigated are summarized in Table 3-3 The plant cannot currently achieve maximum hydraulic flow without overflowing plant structures in the primary treatment area The existing treatment units experience premature flooding of effluent structures while having difficulty obtaining acceptable flow splitting to multiple units The problem is difficult to solve because eliminating typically premature flooding requires a reduction in plant head loss, and flow-splitting improvements may require additional plant head loss Figure 3-5 shows the hydraulic profile developed from the modeling

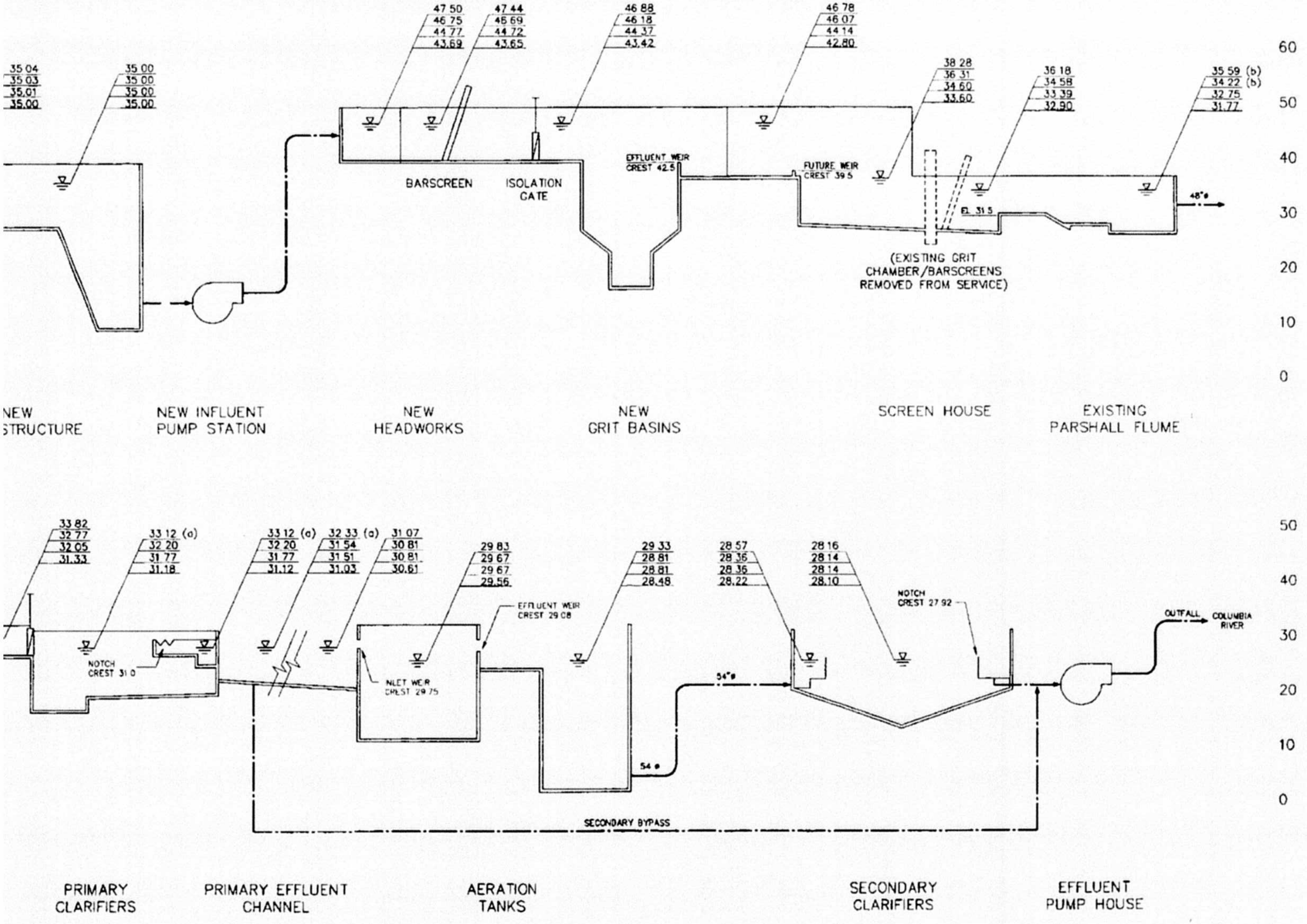
Table 3-3
Modeled Hydraulic Flow Conditions
Columbia Boulevard Wastewater Treatment Plant

	Flow (million gallons/day)			
Flow Condition	**Primary**	**Secondary**	**Bypass**	**Return Activated Sludge***
Maximum hydraulic	300	200	100	100
Maximum secondary	260	160	100	60
Maximum month	160	160	0	60
Average dry weather	100	100	0	60

*The return activated sludge is introduced to the primary effluent channel downstream of the secondary bypass gate

LEGEND

MAX HYDRAULIC
MAX SECONDARY
MAX MONTH
AVERAGE DRY



MAX HYDRAULIC
- 300-MGD PRIMARY TREATMENT
- 200-MGD SECONDARY TREATMENT (PEAK 1-HR CAPACITY)
- 100-MGD SECONDARY BYPASS
- 100-MGD RAS

MAX SECONDARY
- 260-MGD PRIMARY TREATMENT
- 160-MGD SECONDARY TREATMENT (PEAK 4-HR CAPACITY)
- 100-MGD SECONDARY BYPASS
- 60-MGD RAS

MAX MONTH
- 160-MGD PRIMARY TREATMENT
- 160-MGD SECONDARY TREATMENT (PEAK 4-HR CAPACITY)
- 0-MGD SECONDARY BYPASS
- 60-MGD RAS

AVERAGE DRY
- 100-MGD PRIMARY TREATMENT
- 100-MGD SECONDARY TREATMENT
- 0-MGD SECONDARY BYPASS
- 60-MGD RAS

(a) STRUCTURE OVERFLOW

(b) PARSHALL FLUME SUBMERGED

ASSUMPTIONS

1. ALL UNITS IN SERVICE
2. EFFLUENT PUMP STATION OPERATED TO MAINTAIN SECONDARY EFFLUENT WEIR NONSUBMERGENCE
3. AERATION TANKS IN PLUG FLOW MODE
4. RETURN ACTIVATED SLUDGE (RAS) INTRODUCED IN PRIMARY EFFLUENT CHANNEL DIRECTLY DOWNSTREAM OF SECONDARY BYPASS GATE

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Hydraulic Profile
Columbia Boulevard
Wastewater Treatment Plant

FIGURE
3-5

Environmental Services staff identified the most important hydraulic considerations as follows

- The Columbia River outfall is limited to 240 mgd
- Secondary treatment is limited to a 100-mgd average dry-season flow
- Secondary treatment theoretically is limited to a 160-mgd peak flow for 6 hours at an SVI of 100 mL/g
- Secondary treatment is limited to a 130-mgd maximum-day flow at an SVI of 100 to 200 mL/g (on the basis of operational experience)
- Flows greater than 240 mgd must be bypassed to the Oregon Slough outfall
- There are no working flowmeters to measure flows through the secondary system

Methane Utilization

As the anaerobic digesters at the CBWTP stabilize wastewater solids, they produce a gas that contains methane Methane is a primary constituent of natural gas The CBWTP currently uses its digester gas to fuel its boilers for heating the digesters and for space heating The CBWTP also sells digester gas to the Malarkey Roofing Company The excess gas is burned in onsite flares Figures 3-6 and 3-7 illustrate the amount of digester gas that was produced at the plant from 1990 through 1994 and how the gas was used As digester gas production increased at the plant, digester gas use gradually decreased from 61 percent in 1990 to 53 percent in 1994

The CBWTP burns digester gas in low-pressure steam boilers The steam from the boilers at the digester control building is condensed in steam-to-water converters The heated water is circulated to the digesters for heating Boilers in the solids treatment area use digester gas to produce steam for space heating Digester gas use is metered, but the metering has malfunctioned in the past few years Plant staff have upgraded the metering system for accurate tracking of gas production, onsite gas use, and sale of gas to the Malarkey Roofing Company

The Malarkey Roofing Company operates a manufacturing plant for roofing material, primarily asphalt shingles The plant uses both digester gas from the CBWTP and natural gas purchased from Northwest Natural Gas A contract was executed between the CBWTP and Malarkey in 1983 for delivery of up to 370,000 therms per year of digester gas to Malarkey The contracted amount was later expanded to 600,000 therms per year (300,000 cubic feet per day of digester gas) maximum and 370,000 therms minimum Malarkey's gas use fluctuates seasonally with variations in production demands

The yearly revenues and savings obtained by selling digester gas to Malarkey and using the gas onsite for heating are presented in Table 3-4

Table 3-4 Digester Gas Revenues and Savings Columbia Boulevard Wastewater Treatment Plant		
Year	Onsite Heating Natural Gas Savings ($)	Sales to Industry ($)
1990	345,233	73,629
1991	348,346	74,292
1992	351,487	74,962
1993	354,656	75,638
1994	357,854	76,320

Existing Structural Conditions

The various structures at the plant currently appear to be sound and capable of continuing to support their intended loads The oldest structures onsite are almost 50 years old, which is commonly considered a useful design life for concrete sanitary structures Continued use of the older structures will probably require increased maintenance and the use of coatings to protect the concrete and reinforcement With proper care, however, they should last virtually indefinitely

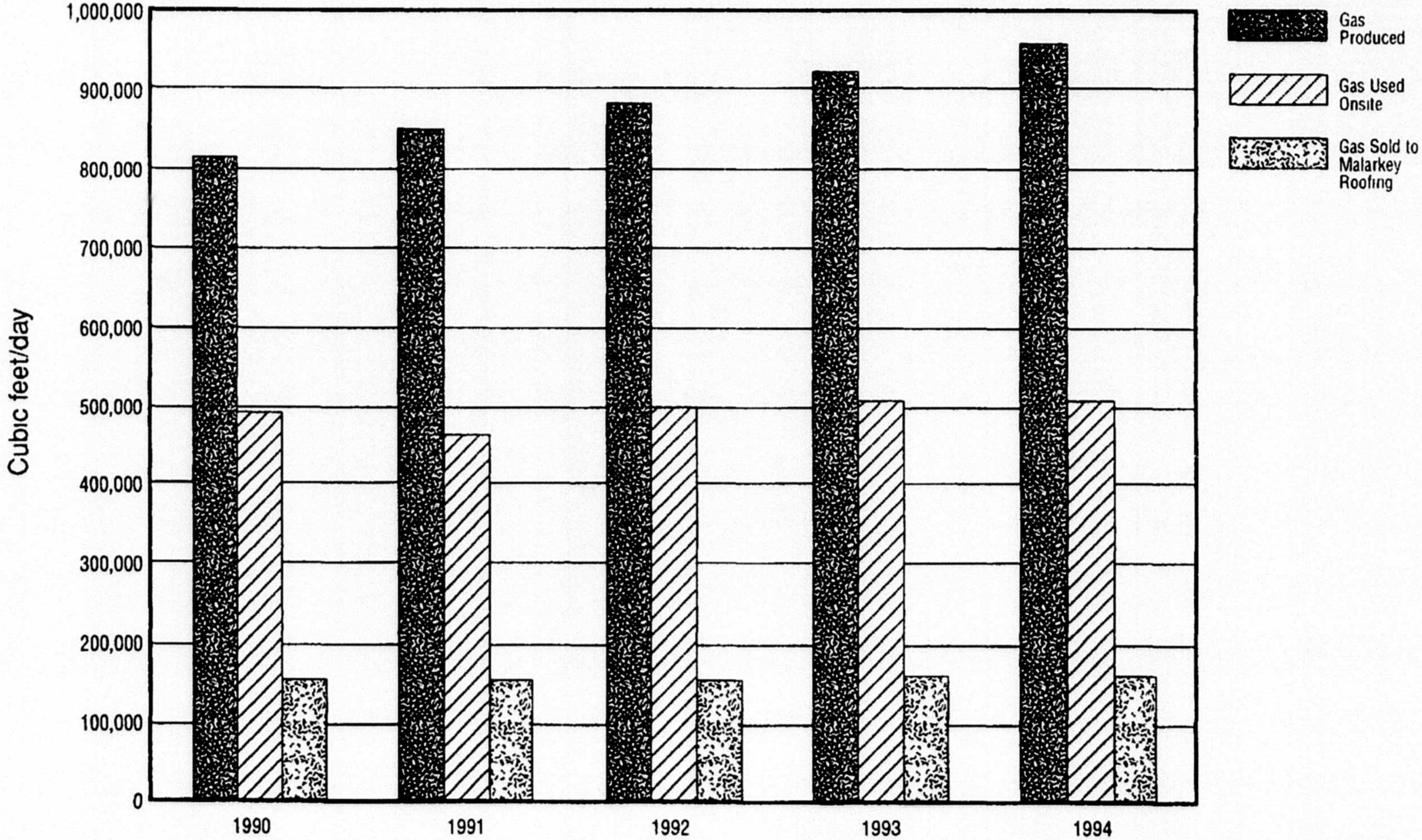
Most of the structures at the CBWTP were designed and built before the January 1, 1993, effective date of the *Oregon Structural Specialty Code (OSSC)* that upgraded Portland and Multnomah County to *Uniform Building Code (UBC)* Seismic Zone 3 Previously, this same vicinity had been designated Zone 2 or 2B, with code seismic forces two-thirds as large as those associated with Zone 3 and with much less stringent regulations for connections The Seismic Vulnerability Assessment section that follows provides recommendations for earthquake-related facility upgrades

Seismic Vulnerability Assessment

Earthquake Hazards

Earthquake hazards were assessed for the CBWTP for two levels of earthquake

- An operating-basis earthquake (OBE) defined to have a 50 percent probability of exceedance in 50 years (equivalent to a 72-year average return interval)



CBWTP Facilities Plan

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Digester Gas Production and Use
Columbia Boulevard
Wastewater Treatment Plant

FIGURE
3-6

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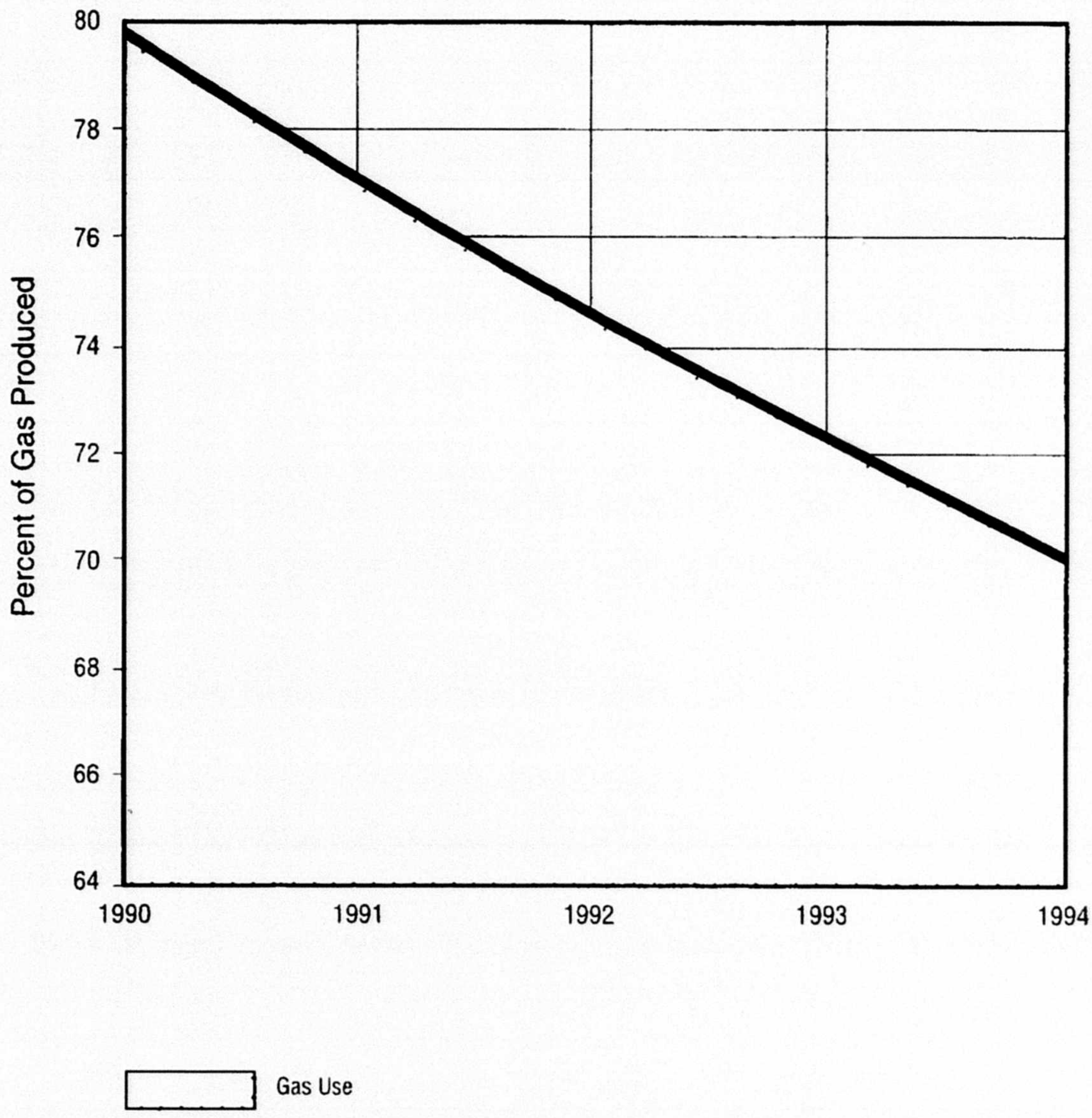

CBWTP Facilities Plan

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Digester Gas Use
Columbia Boulevard
Wastewater Treatment Plant

FIGURE
3-7

- A design-basis earthquake (DBE) defined to have a 10 percent probability of exceedance in 50 years (equivalent to a 475-year average return interval)

The three most significant types of earthquake that threaten the CBWTP are listed below

- Interplate subduction zone earthquake that would occur near the coast of the Pacific Northwest at the interface where the Juan de Fuca tectonic plate is being subducted by the North American tectonic plate

- Intraplate subduction zone earthquakes that would occur in the upper part of the subducted Juan de Fuca tectonic plate, 40 to 60 kilometers directly below Portland

- A Portland-area earthquake in the North American crustal plate (Portland fold belt)

Ground-shaking attenuation models were used to estimate peak ground accelerations for the OBE and DBE earthquake scenarios hypothesized for these source zones For OBE events, a peak ground acceleration of 15 percent of gravity is estimated for the CBWTP The peak ground acceleration for a DBE may reach 30 percent of gravity

Permanent ground deformation hazards from landslide, fault rupture, subsidence, uplift, and lurching are not expected Tsunamic or seiche hazards are not considered to be credible Liquefaction and lateral spread at the CBWTP are possible for OBE and DBE events Liquefaction and lateral spread are expected to be most severe for a DBE interplate subduction earthquake Significant liquefaction may also occur for other DBE events For OBE events, some liquefaction may occur, but the areal extent and severity (for instance, settlement and lateral spread displacements) are expected to be much less than those for DBE events

Settlements on the order of approximately 8 to 15 inches are estimated for liquefied soil in an interplate subduction DBE event Settlement of up to approximately 20 inches is possible in localized areas For OBE events, liquefied soil settlements are estimated to be approximately 6 to 8 inches In nonliquefied areas, soil settlement may range from approximately zero to 2 inches

Performance Objectives

Performance objectives for the CBWTP were established for the OBE and DBE events These objectives were expressed in terms of wastewater system performance categories, in order of recommended importance, as follows

1 Life safety
2 Public health
3 Property damage
4 Business interruption
5 Environmental damage

For existing wastewater collection and treatment systems, the recommended performance objectives are shown in Table 3-5

Table 3-5
Recommended Earthquake Performance Objectives
Columbia Boulevard Wastewater Treatment Plant

Performance Category/Earthquake Scenario	Life Safety	Public Health	Property Damage and Business Interruption	Environmental Damage
Operating-basis earthquake (50% in 50 years)	Minimal	Minimal	Low	Moderate
Design-basis earthquake (10% in 50 years)	Minimal	Low to moderate	Moderate	High

Ideally, the CBWTP systems and components should be seismically upgraded to meet these objectives If necessary because of budgetary constraints, upgrades should be ranked by priority in accordance with the importance of the adverse consequences

Identification of Seismic Deficiencies

The seismic vulnerability assessments of the CBWTP facilities were based on brief drawing reviews (when the drawings were available) and walkthroughs of the plant Seismic vulnerability was estimated by comparison of seismic responses for the CBWTP and similar facilities Detailed calculations were not performed

Widespread liquefaction at the plant site could severely damage many facilities Liquefaction-caused damage will probably affect CBWTP functionality and public health more than life safety Pile-supported facilities are probably the least vulnerable Mitigation of liquefaction hazards is typically very expensive and usually cost-effective only for critical facilities Liquefaction-related mitigation should concentrate on the piping system and at least ensure that raw sewage can be transported to the Columbia River if an earthquake causes widespread liquefaction Earthquake emergency planning should also be used to mitigate the losses from widespread liquefaction

The total order-of-magnitude cost estimates for recommended facility upgrades are summarized in Table 3-6 The *Seismic Vulnerability Assessment Report* (Dames & Moore, 1995) provides details

Table 3-6 Order-of-Magnitude Cost Estimates for Recommended Seismic-Hazard-Related Facility Upgrades Columbia Boulevard Wastewater Treatment Plant	
Facility	**Order-of-Magnitude Cost Estimate ($)**
Building structures	1,200,000
Nonbuilding structures	700,000
Nonstructural elements	300,000
Emergency power	20,000
Gallery piping	50,000
Shutoff valves	75,000
Total	2,300,000

Recommendations

On the basis of the findings of the seismic vulnerability assessment, a seismic mitigation program can be developed for the CBWTP To provide a reasonable level of loss mitigation at a low cost, the CBWTP seismic mitigation program should include the following elements

- Design and construct all new buildings and facilities to meet current codes and standards It may be appropriate for the CBWTP to develop a document that lists the appropriate standards for the different types of facilities For example, the Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) guidelines would be used for piping and for heating, ventilation, and air conditioning (HVAC) equipment The construction inspection process for new facilities should ensure that the appropriate standards have been met

- Using seismic vulnerability and the performance expectations (life safety, process interruption, and repair cost) developed in Section 3 of the *Seismic Vulnerability Assessment Report* (Dames & Moore, 1995), rank the mitigation recommendations presented in that report by priority Upgrade deficiencies that are life-safety threats In order of priority, perform upgrades necessary to achieve the performance objectives

- Develop an emergency response and preparedness program specific to earthquake hazards This program should address known vulnerabilities and provide a means to mitigate and respond to the possible effects of these vulnerabilities

Effluent Quality

The current requirements of the National Pollutant Discharge Elimination System permit issued for the facility by DEQ are summarized in Table 3-7 Until recently, the chlorine residual limit was 1 5 milligrams per liter (mg/L), but is changing to 1 0 mg/L because of the mixing capability of the new diffuser that is being installed on the Columbia River outfall

Table 3-7
Current NPDES Discharge Limitations and Monitoring Requirements
Columbia Boulevard Wastewater Treatment Plant

	Average Effluent Concentration (mg/L)[a]					Monitoring and Reporting Requirements[a]	
Year-round Parameters	Monthly	Weekly	Monthly Average (lb/day)[a]	Weekly Average (lb/day)[a,b]	Daily Maximum (lb)[a]	Minimum Frequency	Sample Type
BOD_5	30	45	25,000	37,500	50 000	Daily	Composite
TSS	30	45	25,000	37,500	50,000	Daily	Composite
Fecal coliform/100 mL	200	400	--	--	--	Daily	Grab
Other parameters	Range percentage of concentration						
pH	Range within 6 0 to 9 0					Daily	Grab
BOD_5 and TSS removal efficiency	No less than 85 percent of the monthly average for the period May 1 through October 31					Monthly	Calculated
Chlorine residual	Concentration no more than 1 0 mg/L[c]					Daily	Grab

[a]Notwithstanding the effluent limitations established by the permit no wastes shall be discharged and no activities shall be conducted that violate water quality standards adopted in *OAR* 340-41-445, except in the defined mixing zones each mixing zone shall have a 100-foot radius from its point of discharge

[b]Based on average dry-season design flow of 100 mgd When because of excessive stormwater inflows, the monthly, weekly, or daily average flow entering the treatment facility exceeds 100 mgd, the pounds discharged may exceed the established limits During those periods, the amount of BOD_5 and suspended solids discharged shall not exceed a monthly average of 50,000 lb/day each when the monthly average flow exceeds 100 mgd, or a daily maximum of 100 000 pounds each when the daily flow exceeds 100 mgd

[c]This draft permit limit was proposed by the Oregon Department of Environmental Quality on May 16, 1995

Abbreviations

BOD_5	=	5-day biochemical oxygen demand
lb	=	pounds
lb/day	=	pounds per day
mgd	=	million gallons per day
mg/L	=	milligrams per liter
mL	=	milliliters
NPDES	=	National Pollutant Discharge Elimination System
OAR	=	*Oregon Administrative Rule*
TSS	=	total suspended solids

The future environmental and regulatory issues that may need to be addressed are discussed in Chapter 5

Chapter 4

Planning Projections

Chapter 4

Planning Projections

Service Area

The Columbia Boulevard Wastewater Treatment Plant (CBWTP) service area, which encompasses approximately 81,000 acres, is shown in Figure 4-1 Areas with combined sewers that overflow into the Columbia Slough and the Willamette River are identified in the figure The remainder of the service area is served by separate sanitary and storm sewer systems The CBWTP service area includes the Mid-County area, where onsite sewage disposal systems are being replaced with a sanitary sewer system that will be connected to the CBWTP

Population Projections

Population forecasts recently prepared for the year 2040 by the Metropolitan Service District (Metro, 1994) were compared with those developed in the *City of Portland Combined Sewer Overflow (CSO) Management Plan Facilities Plan,* Technical Memorandum 2 4 (CH2M HILL and Brown and Caldwell, 1994) Table 4-1 summarizes these population projections and their differences The Metro population forecast for the combined sewer areas was 4 percent less than the population forecasted in the CSO facilities plan When the Metro population projections and the flow projection techniques from the CSO facilities plan were used, the flow from the separately sewered areas was projected to be 17 percent less than the previous estimate

Table 4-1
Population Estimates for the Year 2040

Area	Existing Population (Year 1993)	Metro 2040 Plan	Service Area Buildout*	Difference (Metro minus buildout)
Combined sewer areas	288,000	331,000	346,000	-15,000
Separated sewer areas	132,000	207,000	242,000	-35,000
Total	420,000	538,000	588,000	-50,000

*Buildout at current zoning densities

The differences in projections were caused mainly by differences in assumptions For the CSO facilities plan, complete buildout at allowable densities with current zoning was assumed For the Metro projections, it was assumed that buildout occurs in the core area (combined sewer area), that less than full buildout occurs in the outer areas within Portland's urban growth boundary (UGB), and that increased growth occurs in satellite cities For the

Metro projections, it was also assumed that household sizes would decrease from 2 7 to 2 3 persons The CSO facilities plan projections were used in this facilities plan instead of the Metro projections because they are more conservative and allow this plan to be consistent with other wastewater system planning by the City of Portland Environmental Services

Recent Flows, Loadings, and Production of Solids

Existing plant data from November 1991 to April 1994 were reviewed to determine current flows and loads to the CBWTP The data were evaluated for seasonal, average annual, and dry-weather periods This information is summarized in Table 4-2 Monthly influent flows and loads are shown in Table 4-3

The current flows were checked against longer period averages for 1981 through 1993 to confirm seasonal peaking factors With this approach, a peaking factor of 1 2 was derived for estimating the maximum-month flow from the average-day flow for either dry or wet seasons

The seasonal information includes all recorded data for the dry season (May through October) and wet season (November though April) This information was used to determine the recent seasonal loads to the treatment plant The dry-season loads for May 1993 through October 1993 were 120,000 pounds per day (ppd) for biochemical oxygen demand (BOD_5) at a concentration of 233 milligrams per liter (mg/L) and 118,000 ppd for total suspended solids (TSS) at a concentration of 230 mg/L The maximum-month loads were 1 06 times the average BOD_5 loads and 1 14 times the average TSS loads The wet-season loads for November 1993 through April 1994 were 110,000 ppd for BOD_5 at a concentration of 179 mg/L and 114,000 ppd for TSS at a concentration of 185 mg/L The maximum-month loads were 1 10 times the average BOD_5 loads and 1 30 times the average TSS loads The average 1993 annual loads were approximately 113,000 ppd for BOD_5 at a concentration of 197 mg/L and 117,000 ppd for TSS at a concentration of 204 mg/L

The recent quantities of solids handled by the CBWTP, as represented by 1993 data, are summarized in Table 4-4 Maximum-month and maximum-week values are provided because processes for handling solids must be able to cope with the actual peak quantities that are produced, with only limited equalization possible in the upstream processes Table 4-5 compares the available solids-handling capacity with the recent solids quantities, criteria, and required capacities

Projected Sanitary Sewer Flows and Loads

The year 2040 sanitary sewer flow and load projections for the CBWTP are summarized in Table 4-6 The method for obtaining these projections follows

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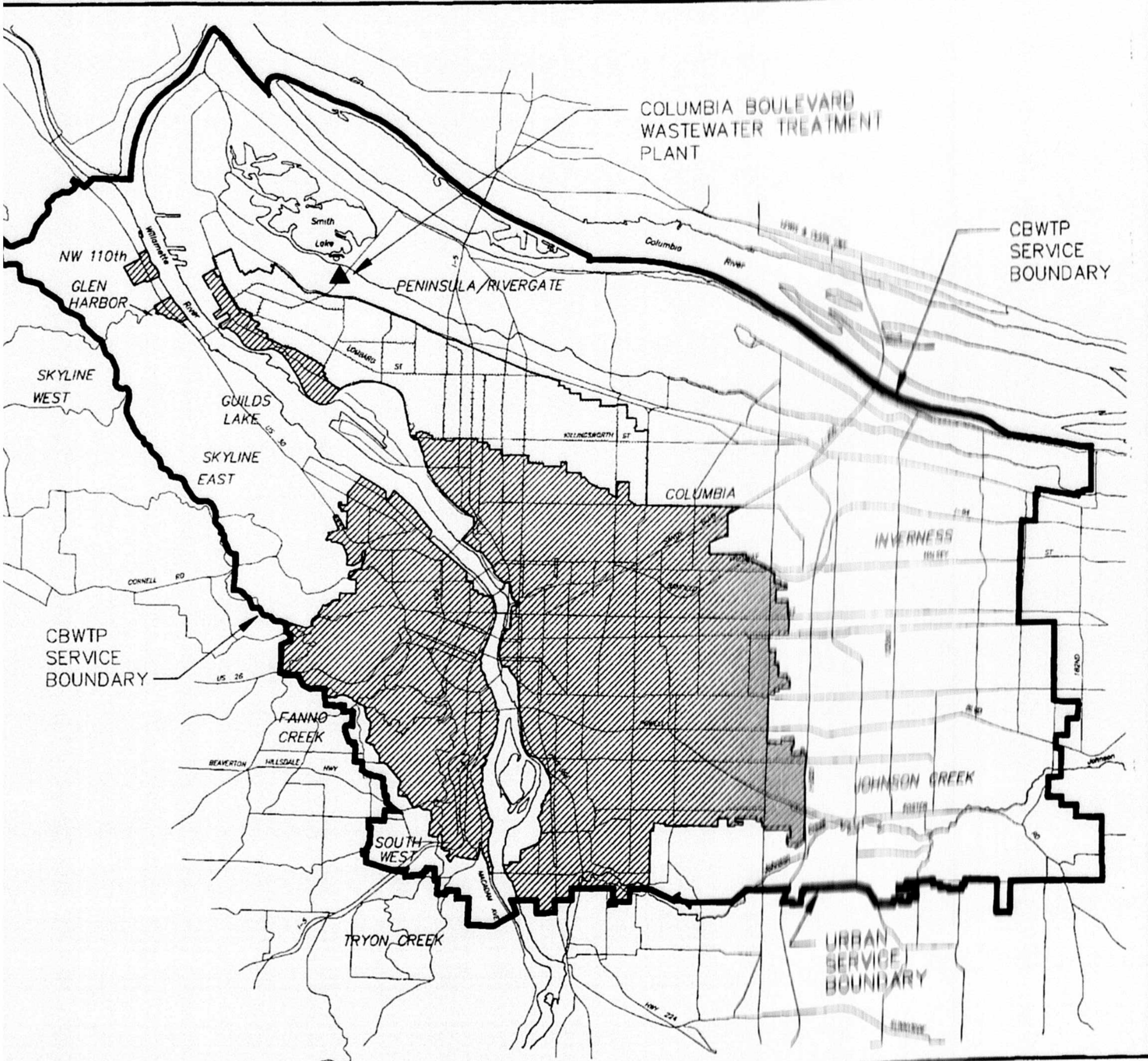

CBWTP Facilities Plan

Service Area
Columbia Boulevard
Wastewater Treatment Plant

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FIGURE
4-1

Table 4-2
Recent Influent Flows and Loads
Columbia Boulevard Wastewater Treatment Plant

Description	Flow (mgd)	Peaking Factor[a]	BOD_5 (mg/L)	BOD_5 (ppd)	TSS (mg/L)	TSS (ppd)
Dry-Season Flows and Loads (May through October)						
Average-Day Dry Season (ADDS)						
1992	58 6		233	113 741	244	119,166
1993	61 6		233	119,764	230	118,398
1981 through 1993	63 6					
Maximum-Month Dry Season (MMDS) Flows						
1992	61 6	1 05				
1993	73 9	1 20				
1981 through 1993	77 0	1 21				
MMDS Loads						
1992			246	118,966	260	133,342
1993			273	127,033	284	135 130
Wet-Season Flows and Loads (November through April)						
Average-Day Wet Season (ADWS)						
1991 to 1992	81 8		162	110,768	175	119,104
1 992 to 1993	80 2		168	112,271	189	126,457
1993 to 1994	73 7		179	110,022	189	113,708
1981 through 1993	79 6					
Maximum-Month Wet Season (MMWS)		[b]				
1991 to 1992	87 7	1 07				
1992 to 1993	93 1	1 16				
1993 to 1994	83 3	1 13				
1981 through 1993	104 7	1 32				
MMWS Loads						
1991 to 1992			177	122,989	198	124 600
1992 to 1993			216	116,659	217	142,089
1993 to 1994			204	120 755	242	147 404
Peak-Hour Wet Season (PHWS)	[c]					
Average Annual Flows and Loads						
1992	69 4		192	111,073	206	118,944
1993	69 0		197	113,353	204	117 161
1981 through 1993	71 6					
Dry-Weather Flows[d]						
May 1993 to October 1993						
Average-Day Dry Weather (ADDW)	57 3					
Maximum-Month Dry Weather (MMDW)	62 3	1 09				
Average Peak-Hour Dry Weather (PHDW)	74 1	1 29				
November 1993 to April 1994						
ADDW	58 6					
MMDW	62 0	1 06				
PHDW	73 4	1 25				
Annual (May 1993 to April 1994)						
ADDW[e]	57 9					
MMDW	62 3	1 08				
PHDW	73 8	1 27				

[a] Maximum-month or peak-hour flow divided by average daily flow
[b] Additional data for years 1981 to present show peaking factor of 1 2
[c] Flow measurement not accurate because of submerged flume
[d] Dry-weather flow values exclude days with recorded rainfall and the subsequent day after the rainfall
[e] For the combined sewer overflow facilities plan, average daily dry-weather flow was determined for June to September from 1981 to 1992 as 58 5 million gallons per day

Abbreviations

BOD_5 = 5-day biochemical oxygen demand
mgd = million gallons per day
mg/L = milligrams per liter
ppd = pounds per day
TSS = total suspended solids

Table 4-3
Recent Monthly Influent Flows and Loads
Columbia Boulevard Wastewater Treatment Plant

Month	Flow (mgd)	BOD_5 (mg/L)	BOD_5 (ppd)	TSS (mg/L)	TSS (ppd)	Peak-Day Flow (mgd)[a]	Peak-Hour Flow (mgd)[b]
Nov 91	85.6	163	116,568	166	118,503	135.0	249.1
Dec 91	86.0	171	122,989	171	122,348	170.1	222.0
Jan 92	85.0	155	110,077	176	124,600	149.0	185.0
Feb 92	87.7	146	106,846	161	117,638	157.3	199.9
Mar 92	71.3	177	105,386	198	117,617	161.7	187.2
Apr 92	75.3	164	102,740	181	113,916	126.9	185.0
May 92	58.1	226	109,419	235	113,653	66.0	81.0
Jun 92	58.0	246	118,966	252	121,670	110.7	190.0
Jul 92	58.2	236	114,528	245	118,919	80.5	146.0
Aug 92	57.1	237	113,009	215	102,468	77.6	120.0
Sep 92	58.7	242	118,287	255	124,944	114.2	205.0
Oct 92	61.6	211	108,236	260	133,342	110.5	194.0
Nov 92	76.3	182	115,688	186	118,339	171.0	202.0
Dec 92	84.9	155	109,690	170	120,218	163.9	210.0
Jan 93	81.4	159	107,708	194	131,577	159.7	197.0
Feb 93	64.9	216	116,659	217	177,613	113.1	177.0
Mar 93	80.8	166	112,009	191	128,907	141.2	190.0
Apr 93	93.1	144	111,871	183	142,089	147.0	197.0
May 93	73.9	186	114,504	219	135,130	123.3	192.0
Jun 93	65.5	219	119,690	240	131,219	105.4	170.0
Jul 93	58.7	254	124,328	260	127,382	87.2	170.0
Aug 93	55.7	273	127,033	284	131,877	63.1	109.0
Sep 93	55.6	[c]	[c]	[c]	[c]	60.0	75.0
Oct 93	60.2	226	113,266	132	66,384	101.4	213.0
Nov 93	61.3	181	92,410	128	65,501	120.2	265.0
Dec 93	77.2	167	107,400	173	111,091	148.0	310.0
Jan 94	78.9	166	109,482	177	116,555	142.6	212.0
Feb 94	83.3	263	113,448	176	122,204	188.0	282.0
Mar 94	73.1	198	120,755	242	147,404	104.0	
Apr 94	68.4	204	116,636	209	119,492	150.4	220.0
May 94	57.2	223	106,252	241	115,162	77.0	157.0
Jun 94	57.9	247	119,422	263	127,221	78.1	162.0
Jul 94	55.5	267	123,474	259	120,040	62.5	72.0

[a]Peak-day flow refers to maximum 24-hour flow that occurred during the month
[b]Peak-hour flow refers to maximum instantaneous flow noted during the month This is actually based on visual checking of flowmeter every 2 hours
[c]Data deleted because of abnormally high readings

Abbreviations
BOD_5 = 5-day biochemical oxygen demand
mgd = million gallons per day
mg/L = milligrams per liter
ppd = pounds per day
TSS = total suspended solids

Table 4-4 Recent Quantities of Solids Columbia Boulevard Wastewater Treatment Plant (pounds per day)					
Condition	Primary Sludge	Waste Activated Sludge	Thickened Sludge	Digested Sludge	Dewatered Biosolids
1993 Dry Season					
Average	84,104	63,603	132,937	83,439	75,095
Maximum month	92,514	69,963	146,231	91,782	82,605
Maximum week	109,335	82,684	172,818	108,471	97,264
1993 Wet Season					
Average	87,313	54,273	127,428	80,014	72,013
Maximum month	104,776	65,128	152,914	96,017	86,416
Maximum week	113,507	70,555	165,656	104,018	93,617

Table 4-5 Evaluation of Current Solids-Handling Capacity Columbia Boulevard Wastewater Treatment Plant					
Process	1993 Condition	Solids Quantity (lb/day)	Criteria	Required Capacity	Available Capacity (all units in service/largest unit out of service)
PS thickening	Wet season Peak week	113,507	25 lb/ft²/day	4,540 ft²	7,127/4,751 ft²
WAS thickening	Dry season Peak week	82,684	250 gpm/meter at 6,000 mg/L	1,147 gpm	2,250/1,500 gpm
Anaerobic digester	Wet season Maximum month	152,914	20 days at 4% TS	9 2 MG	12 0/9 6 MG[a]
Lagoon	Annual average	81,727	1 year at 6%	59 6 MG	182 5 MG[b]
Dewatering	Wet season Maximum month	96,017	825 lb/meter-hour at 22 hr/day	96,017	145,200/108,900 lb/day
Reuse	Annual average	73,554	—	—	Per arid lands and compost contracts

[a]Available digestion capacity equals primary digester (active digestion) volume and excludes secondary digestion volume
[b]Lagoon capacity for storage only

Abbreviations

ft²	=	square feet	lb/ ft²/day	=	pounds per square foot per day
gpm	=	gallons per minute	MG	=	million gallons
gpm/meter	=	gallons per minute per meter	mg/L	=	milligrams per liter
hr/day	=	hours per day	PS	=	primary sludge
lb/day	=	pounds per day	TS	=	total solids
lb/meter-hour	=	pounds per meter-hour	WAS	=	waste activated sludge

Table 4-6 Projected Flows and Loads for the Year 2040 Columbia Boulevard Wastewater Treatment Plant						
Description	Flow (mgd)[a]	Peaking Factor[b]	BOD_5 (mg/L)	BOD_5 (ppd)[c]	TSS (mg/L)	TSS (ppd)[c]
Dry Weather						
Average-day dry weather (ADDW)	110	---	---	---	---	---
Maximum-month dry weather (MMDW)	121	1 1	---	---	---	---
Average peak-hour dry weather (PHDW)	143	1 3	---	---	---	---
Peak hydraulic[d]	160	---	---	---	---	---
Dry Season (May to October)						
Average-day dry season (ADDS)	115	---	235	225,000	233	223,000
Maximum-month dry season (MMDS)	138	1 2	208	239,000	221	254,000
Wet Season (November to April)						
Average-day wet season (ADWS)	143	---	174	207,000	179	214,000
Maximum-month wet season (MMWS)	169	1 2	161	227,000	197	277,000

[a]Based on projections of plant data
[b]Maximum-month or peak-hour flow divided by average daily flow
[c]Projected from existing loads on the basis of the ratio of future flow divided by present flow
[d]Conservative continuous hydraulic flow rate for secondary system

Abbreviations
BOD_5 = 5-day biochemical oxygen demand
mgd = million gallons per day
mg/L = milligrams per liter
ppd = pounds per day
TSS = total suspended solids

Average-Day Dry-Weather Flow for the Year 2040

Dry-weather flows, which occur year-round, do not include flows from rainfall days and flows from days after a rainfall day Influent flow records from the CBWTP were evaluated to obtain historical dry-weather flow data The historical plant data and CSO management plan population forecasts were used to project the year 2040 dry-weather flows

These projections were compared with the dry-weather flows previously projected for the CBWTP in the *City of Portland CSO Management Plan Facilities Plan,* Technical Memorandum 2 4 (CH2M HILL and Brown and Caldwell, 1994) The average dry-weather flow predicted in the CSO management plan appeared to be conservatively high–higher infiltration rates were predicted than the plant records suggested To produce a reasonable estimate of average-day dry-weather (ADDW) flow, a value midway between that predicted by plant records and that projected in the *CSO Management Plan* was selected Thus, the ADDW flow for the year 2040 was projected to be 110 million gallons per day (mgd)

Dry-Weather Flow Peaking Factors

CBWTP flow and load data were evaluated for seasonal and dry-weather periods Peaking factors were developed for maximum-month flows and loads and average peak-hour flows These factors are based on the original population and flow information presented in the *City of Portland CSO Management Plan Facilities Plan,* Technical Memorandum 2 4 (CH2M HILL and Brown and Caldwell, 1994)

The peaking factor for maximum-month dry-weather (MMDW) flow was determined to be 1 1, and the peaking factor for average peak-hour dry-weather (PHDW) flow was determined to be 1 3 Plant records show that some PHDW flows significantly exceed the average 1 3 peaking factor These flows are probably due to the effect of rainfall within the collection system Rainfall, however, was not recorded at the treatment plant To account for this effect and provide a conservative value that would ensure a continuous hydraulic flow rate for the secondary treatment system, an additional 10 percent was added to the average PHDW flow, for a peak hydraulic dry-weather flow of 157 mgd A peak hydraulic dry-weather flow of 160 mgd will be used for planning purposes

Dry-Season Flows

Dry-season flows occur from May 1 through October 31 and include rainfall These flows were projected by multiplication of the existing flows obtained from plant records by the ratio of future flow to present flow derived from information provided in the *City of Portland CSO Management Plan Facilities Plan,* Technical Memorandum 2 4 (CH2M HILL and Brown and Caldwell, 1994) Average and maximum-month loads were estimated in a similar manner

Wet-Season Flows

Wet-season flows occur from November 1 through April 30 and include rainfall They were projected with the XP-SWMM software model developed for the CSO facilities planning project The model predicted that the average-day wet-season (ADWS) flow for the year 2040 would be 143 mgd, and the maximum-month wet-season (MMWS) flow would be 169 mgd

Dry-Season and Wet-Season Peaking Factors

Existing plant data from November 1991 to April 1994 were reviewed to determine current flows and loads to the CBWTP These flows were checked against longer period averages for 1981 through 1993 With this approach, a peaking factor of 1 2 was developed for estimating the maximum-month flow from the average-day flow for either dry or wet seasons

Rate of Flow Increases from 1990 to 2040

Because of the sewer connections that will be made with the Mid-County sewer project until the year 2000, sewer flows are projected to increase initially at a higher rate, as shown in Figure 4-2 The Mid-County interceptor project summary reports were reviewed to determine the schedule for adding equivalent dwelling units (EDUs) to the sanitary sewer flow for the CBWTP This information was used to estimate the additional dry-weather flow to the CBWTP Figure 4-2 compares the rate of flow increases with a straight linear interpolation of present flows to the year 2040 Table 4-7 summarizes the CBWTP sanitary sewer flow projections for the years 1994, 2000, 2005, 2010, 2020, and 2040

Table 4-7
Sanitary Sewer Flow Projections
Columbia Boulevard Wastewater Treatment Plant
(million gallons per day)

Description	1994	2000	2005	2010	2020	2040
Average-day dry weather	59	75	79	83	92	110
Maximum-month dry weather	64	82	87	92	102	121
Average-day dry season	62	78	82 5	87	97	115
Maximum-month dry season	74	94	99 5	105	116	138
Average-day wet season	80	97	103	109	120	143
Maximum-month wet season	96	115	121 5	128	142	169

Projected CSO Flows

In 1994, during preparation of the CSO facilities plan for the City of Portland, an intense modeling effort was conducted (1) to gain a better understanding of the CSO problem in Portland and (2) to estimate the size of CSO storage and treatment facilities required to solve the CSO problem In this modeling effort, the effects of various "cornerstone" project scenarios to reduce inflow to the combined system were reviewed, as were a range of CSO storage and treatment alternatives

The recommended cornerstone projects are the CSO management projects that provide cost-effective inflow reduction, have generally systemwide application, can be implemented early, and would be common to all storage and treatment options The cornerstone projects consist of installation of stormwater infiltration sumps, disconnection of directly connected residential roof drains or downspouts, diversion of west-side streams, and local sewer separation It is estimated that the cornerstone projects will reduce the total annual CSO discharged to the Columbia Slough and Willamette River by approximately 40 to 50 percent

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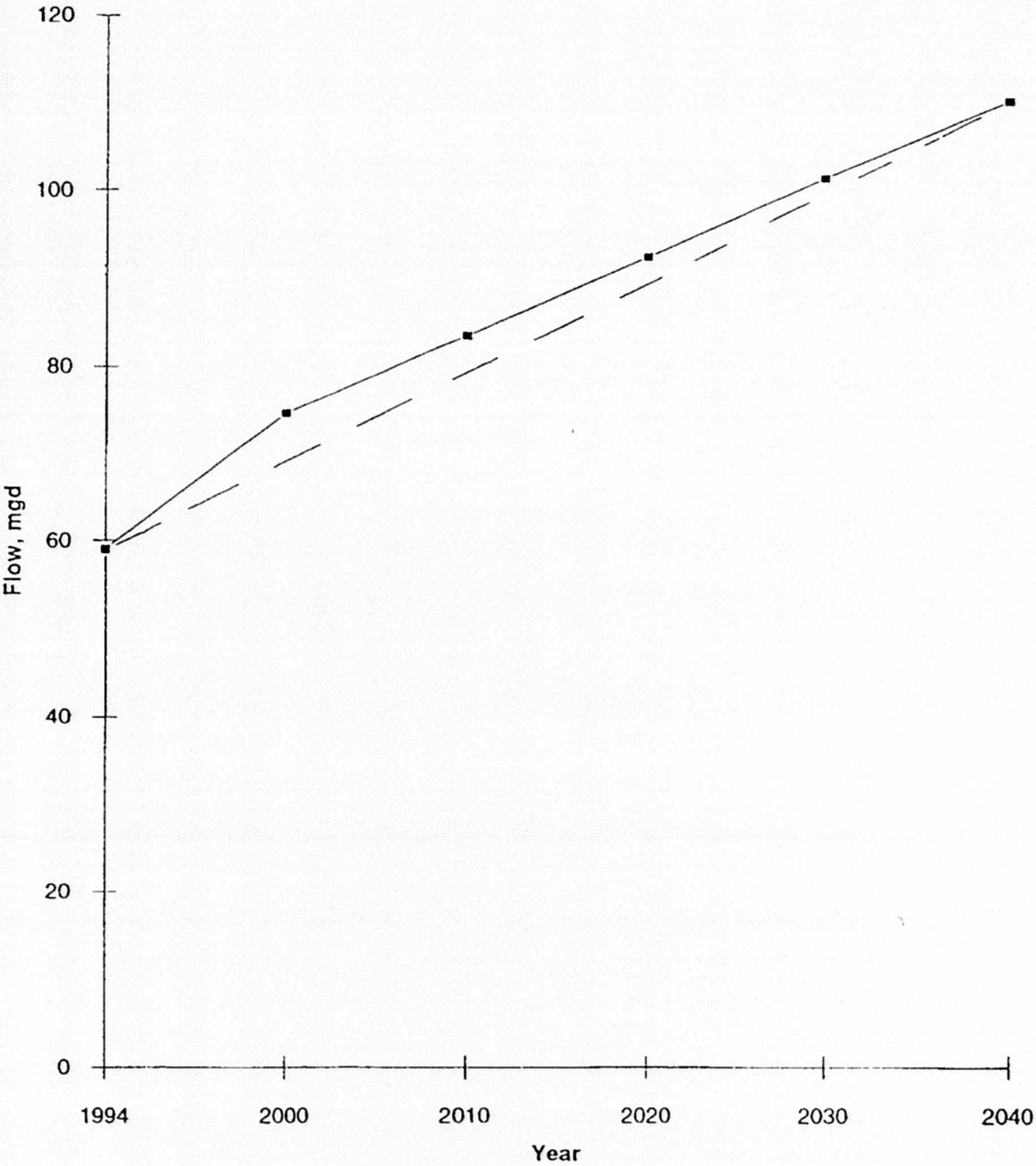

CBWTP Facilities Plan

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Projected Dry-Weather Flows
Columbia Boulevard
Wastewater Treatment Plant

FIGURE
4-2

The major storage treatment options reviewed during preparation of the CSO facilities plan included construction of separate inline storage tunnel systems for the Columbia Slough combined sewer basins and for the Willamette River combined sewer basins The wet-weather treatment facility (WWTF) for CSOs captured from the Columbia Slough Basin would be located at the existing CBWTP The WWTFs for the CSOs captured from the Willamette River Basin would be located at one of the following

- A single treatment facility on the Willamette River (Option 1)
- Multiple treatment facilities on the Willamette River (Option 2)
- An expanded single treatment facility at the CBWTP (Option 3)

Option 1 was the recommended alternative presented in the CSO facilities plan However, for planning purposes, the layout of the new Columbia Boulevard Wet-Weather Treatment Facility (CBWWTF) will also incorporate the possibility that Option 3 will be implemented

Year 2040 Hydraulic Capacity Requirements

Because the Columbia Slough was designated a water-quality-limited stream, it was determined that the storage and treatment facilities for Columbia Slough CSOs must be able to handle the peak overflow rates generated by a 10-year summer storm For the Willamette River CSOs, it was determined that the facilities must be able to handle the overflow rates generated by the 3-year summer storm and the fourth largest annual winter storm These requirements were set forth in the amended stipulation and final order issued by the Oregon Department of Environmental Quality (DEQ) in 1994

Information from the CSO facilities plan modeling was used to calculate peak flows in order to determine the hydraulic capacities that the WWTF would need for the year 2040 75 mgd for Columbia Slough CSOs and 336 mgd for Willamette River CSOs In the same way, it was calculated that the peak interceptor (sanitary sewer system) flows during the 10-year storm would be 278 mgd, including flows from the existing Inverness force main In the future, an additional peak of 41 mgd can be expected from the new Inverness force main Thus, the hydraulic capacity that the CBWTP will need to handle peak sanitary sewer flows in the year 2040 is 319 mgd This is equal to the sum of the maximum capacity of the existing interceptor (278 mgd) and the maximum capacity of the new Inverness force main (41 mgd) The year 2040 hydraulic capacity requirements are summarized in Table 4-8

Annual Storm and Overflow Statistics

Flow statistics for a statistically constructed 1-year series of storm events were prepared to assist in the sizing and planning of appropriate treatment facilities These statistics are summarized in Table 4-9

Annual storm and overflow statistics for Columbia Slough CSOs plus interceptor flows were compared with the same statistics for Columbia Slough CSOs plus Willamette River CSOs plus interceptor flows

Table 4-8 Year 2040 Hydraulic Capacity Requirements Columbia Boulevard Wastewater Treatment Plant	
Flow	**Hydraulic Capacity Required (million gallons per day)**
Interceptor flows (CBWTP sanitary flows)	319
Columbia Slough CSOs	75
Willamette River CSOs	336
Interceptor flows plus Columbia Slough CSOs	394
Interceptor flows plus Columbia Slough and Willamette River CSOs	730

Abbreviations
CBWTP = Columbia Boulevard Wastewater Treatment Plant
CSOs = combined sewer overflows

Flow volumes, on an average annual basis, for the interceptor CSO consolidation conduits are presented in Table 4-10

Representative storms were developed statistically The Columbia Slough Basin and interceptor flow alternative and the Columbia Slough Basin and Willamette River Basin and interceptor flow alternative show the typical winter storm pattern of a long period of rainfall with minor and major peaks occurring at various times during the event The representative summer storms show the typical pattern of one large peak occurring over a relatively short time

The representative storms for the Columbia Slough Basin and interceptor flow alternative and for the Columbia Slough Basin and Willamette River Basin and interceptor flow alternative have the following points of interest

- The representative winter and summer storms have similar shapes for both alternatives, they vary only in the quantity of flow

- The majority of the plant inflow receives primary and secondary treatment during both representative storm events for both alternatives

- The amount of Columbia Slough and Willamette River consolidation conduit flow that can receive secondary treatment during the storm events is minimal, on the basis of a review of the excess secondary treatment capacity available during overflow events However, on the basis of this same review of the excess secondary capacity during and after overflow events and an assumed dewatering capacity of 10 mgd, a greater portion of the flow receiving wet-weather primary treatment can receive secondary treatment after the storm is over, by dewatering in the wet-weather primaries to the secondary treatment system

Table 4-9
Annual Storm and Overflow Statistics
Columbia Boulevard Wastewater Treatment Plant

Period	Number of Events*	Average Flow During Events (mgd)	Peak Hourly Flow (mgd)	Average Event Length (hours)	Average Dry Period Length (hours)	Total Days of WWTF Operation	Average Days/Event of WWTF Operation
Interceptor Flows Only							
Wet season	29	29 7	115 3	50	95	78	2 7
Dry season	17	28 8	102 5	13	248	20	1 2
Annual	46	29 5	115 3	36	153	98	2 1
Columbia Slough Basin Flows Only							
Wet season	30	7 8	75 0	27	114	52	1 7
Dry season	17	5 7	74 6	10	252	19	1 1
Annual	47	7 3	75 0	21	165	71	1 5
Willamette River Basin Flows Only							
Wet season	26	60 9	403 3	31	140	48	1 8
Dry season	16	45 0	403 3	13	265	18	1 1
Annual	42	56 4	403 3	24	189	66	1 6
Interceptor Flows plus Columbia Slough Basin Flows							
Wet season	28	34 2	184 0	53	97	78	2 8
Dry season	17	79 3	158 9	13	248	20	1 2
Annual	45	42 3	184 0	38	154	98	2 2
Interceptor Flows plus Columbia Slough Basin Flows plus Willamette River Basin Flows							
Wet season	28	65 3	587 3	53	95	78	2 8
Dry season	17	75 8	548 4	14	247	20	1 2
Annual	45	67 2	587 3	38	154	98	2 2

*Events are separated by a minimum of 24 hours of dry time Events are counted as part of the month in which they end Generation of the annual statistics involved the use of rainfall during a representative year and detailed hydraulic models from the CSO facilities plan

Abbreviations

mgd = million gallons per day WWTF = wet-weather treatment facility

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Table 4-10 Flow Volumes–Average Annual Basis Columbia Boulevard Wastewater Treatment Plant (million gallons)		
Item	**Columbia Slough Basins plus Interceptor Flows**	**Columbia Slough Basin plus Willamette River Basin plus Interceptor Flows**
Inflow from interceptor	44,900	44,900
Inflow from Columbia Slough consolidation conduit (CSCC)	410	410
Inflow from Willamette River consolidation conduit (WRCC)	Not applicable	2,600
Total inflow	45,300	47,900
Interceptor flow to dry-weather plant	42,800	42,800
Interceptor flow to wet-weather plant	2,100	2,100
CSCC or WRCC flow to secondary treatment	60	80
Wet-weather primary dewatering to secondary plant	530	550

Projected Solids Received from Other Sources

The Tryon Creek Wastewater Treatment Plant (TCWTP) undigested solids are currently being hauled to the CBWTP for processing at an average rate of 7,687 pounds per day Although the TCWTP can digest its solids, this transfer of solids to the CBWTP may continue The projected amount of solids that CBWTP could receive from the TCWTP in the year 2040 is 27,800 pounds per day

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Chapter 5

Environmental and Regulatory Issues

Chapter 5

Environmental and Regulatory Issues

Water Quality

Regulations

Federal Regulations

The federal Water Pollution Control Act of 1972, as amended by the Clean Water Act (CWA) of 1977 and the Water Quality Act of 1987, designates the objectives of restoring and maintaining the physical, chemical, and biological integrity of the nation's waters The CWA provides broad authority to the U S Environmental Protection Agency (EPA) to do the following

- Establish the National Pollutant Discharge Elimination System (NPDES) Program and the National Pretreatment Program
- Define acceptable pollution control technologies
- Establish effluent limitations
- Obtain information through reports and compliance inspections
- Take enforcement actions, both civil and criminal, when violations of the CWA occur

The NPDES Program, mandated by Section 402 of the CWA, regulates discharge of pollutants from point sources such as municipal treatment plants To discharge pollutants, each municipal treatment plant is required to obtain an NPDES permit that specifies effluent limits, monitoring and reporting requirements, and any other terms and conditions required to protect water quality

State Regulations

The Oregon Department of Environmental Quality (DEQ) manages water quality within the state under the applicable regulations of the Oregon Environmental Quality Commission Water quality standards have been developed as part of the *Oregon Administrative Rules* (*OARs*), Chapter 340, Division 41 These standards were last updated in January 1992 The portion of the Columbia River into which the Columbia Boulevard Wastewater Treatment Plant (CBWTP) discharges water is considered part of the Willamette Basin by DEQ (*OARs* 340-41-442 through 470)

The CWA directs each state to adopt water quality standards as necessary to protect beneficial uses of the state's public waters

DEQ reviews its water quality standards every 3 years, this process is commonly called the triennial review The purpose of the triennial review is to keep water quality standards current with respect to evolving scientific information and changing needs of the state

As a separate review process, DEQ is required by the CWA to prepare a water quality assessment report every 2 years to assess the designation of beneficial uses, identify water-quality-limited bodies of water, and determine total maximum daily loads on the water-quality-limited bodies of water

The *OAR* water quality standards designate indicators, such as the dissolved oxygen (DO) content, as either numeric or narrative standards for monitoring water quality Potential water quality standard revisions were evaluated for this facilities plan by use of issue papers developed by DEQ

Lower Columbia River Bi-State Water Quality Program

The Lower Columbia River Bi-State Water Quality Program is a cooperative effort between the states of Oregon and Washington, citizen organizations, and business groups The program was initiated in 1990 to assess the water quality of the lower Columbia River between the river's mouth and the Bonneville Dam and to formulate a management plan The program is a 5-year effort scheduled for completion in July 1996

The program is managed by DEQ and the Washington State Department of Ecology (Ecology), with the assistance of a 20-member steering committee

The program consists of four phases Phase 1 involved research and collection of data from historical and current studies of the river to determine the water, biological, and sediment quality status Phase 2 consisted of a reconnaissance survey completed in 1991 and a backwater areas survey completed in 1993

Phase 3 of the program, currently under way, is an evaluation of the data collected during the screening surveys It provides a follow-up on specific areas of concern raised during Phase 1 and Phase 2 Phase 3 includes an assessment of effects of pollutants on human, fish, and wildlife health A report on various polluted areas, including hot spots, problem confirmation, and source identification, is expected in early 1995

Phase 4 will involve final data analyses, a final report, identification and prioritization of future study and action needs, and public involvement and a transition to a new structure beyond the bi-state program The report findings may be used for developing and implementing a management plan for the lower Columbia River Oregon and Washington have applied to EPA to be included in the National Estuaries Program (NEP) as ongoing participants in the Lower Columbia River Bi-State Water Quality Program The NEP was considered twice before (1989 and 1992), but concerns over a lack of information, possible increased regulatory stringency, and uncertainty about federal involvement kept such a step from being taken The NEP not only will provide additional funding but also will involve the substantial resources of the federal government, including national information and expertise

Standards

Dissolved Oxygen

DO is an important indicator of the ability of a receiving water to support a healthy ecosystem

A statewide DO criterion of 6 0 milligrams per liter (mg/L) was originally implemented by the Oregon State Sanitary Authority (OSSA), which was the predecessor to DEQ In 1972, the basin criteria appeared as management plans in the *OARs*

The current standard for the Columbia River is 90 percent of saturation This DO criterion was based on the assumption that all sections of the Columbia River support spawning or rearing of various important commercial and sport fish (in particular, salmonids)

The DEQ Technical Advisory Committee and Policy Advisory Committee have recommended the use of numerical DO concentration standards related to stream use and level of protection (Table 2-1, DEQ Water Quality Division, *Issue Paper Dissolved Oxygen*, 1994a) On the basis of this recommendation, the Columbia River would be classified a coldwater body with the following DO limits

- 30-day mean DO concentration of 8 mg/L
- 7-day minimum DO concentration of 6 5 mg/L
- Instantaneous minimum DO concentration of 6 mg/L

Data from the Lower Columbia River Bi-State Water Quality Program for sampling stations in the vicinity of the CBWTP indicated a DO concentration around 9 1 mg/L (September and November 1991) Although the current DO standards were not met at a number of stations, of the 11 stations reporting less than 90 percent saturation, 8 measured levels greater than 85 percent The proposed revision of the DO criterion from the 90 percent saturation standard to specific in-stream concentration criteria will lessen the frequency of standard violations

The addition of a minimum DO standard to the CBWTP NPDES permit is not expected because of the large amount of dilution available in the Columbia River and the enhanced diffusion associated with the new outfall The new CBWTP outfall diffuser will increase the permitted mixing zone and dilution potential, and thus will allow diffusion to mitigate short-term impacts such as the CBWTP effluent DO concentration while having no effect on long-term DO exertion in the Columbia River

Temperature

Water temperature affects physiological processes and the ability of aquatic organisms to survive and reproduce effectively Temperature also plays a major role in other aspects of water quality such as DO, organic degradation, and bacteria survival The purpose of the existing temperature standard for Oregon waters is to protect the beneficial uses that are sensitive to temperature These uses include anadromous fish passage, salmonid fish rearing and spawning, protection of resident fish, aquatic life, and wildlife, and fishing Nearly all native Oregon fish species are classified as coldwater or coolwater species

In 1967, OSSA adopted the temperature standard for the Willamette River, primarily to protect anadromous fish In 1969, an exception clause for limited-duration activity was added to the standard In 1979, the exception clause was modified to the present form to incorporate the mixing zone and measurement relative to an upstream control point For Columbia River water temperatures of 68°F or higher, no measurable increase is permitted For Columbia River water temperatures between 67 5°F and 66°F, an increase of 0 5°F is permitted For Columbia River water temperatures at or below 66°F, an increase of 2°F is permitted DEQ has generally quantified "measurable" as 0 25°F

Future revisions to the water quality standards are currently under review Although these have not yet been promulgated, DEQ has indicated that it may establish a maximum temperature limit of 68°F for the Columbia River Data from the Lower Columbia River Bi-State Water Quality Program for sampling stations in the vicinity of the CBWTP indicated a river temperature of around 66°F During the backwaters survey, the range of measured temperatures was 17 3°C to 21 9°C (63 14°F to 71 42°F) If the proposed temperature criterion is established, the Columbia River might be designated water-quality-limited for temperature

The impact of the temperature criterion on the CBWTP is unclear As with other water quality criteria, the available dilution and mixing-zone implications might play a major role in application of the temperature criterion to the CBWTP NPDES permit It is not likely that a new process or technology will be required to address the issues Instead, the CBWTP might have to perform a temperature audit and institute a temperature control and reduction plan to ensure that its operation does not cause a net thermal load to the Columbia River

Bacteria

Oregon has historically applied the bacterial standard to keep all waters of the state "swimmable" at all times EPA has recommended that the "swimmable" criteria be defined as an acceptable risk of developing gastroenteritis of as many as 8 in 1,000 swimmers in fresh water The basis for the use of bacteria as indicators of water quality is that the presence of these organisms should correlate with the presence of human pathogens and, therefore, the risk of disease Pathogens can cause infection and illness when in contact with human beings engaged in swimming or other recreation or consuming fish, shellfish, or wildlife

The current standard for the Columbia River was adopted in 1976 as a part of the statewide bacteria standard The current standard for fresh water is a log mean of 200 fecal coliform colonies per 100 milliliters (mL) on the basis of a minimum of five samples in a 30-day period with no more than 10 percent of the samples in the 30-day period exceeding 400 fecal coliform colonies per 100 mL

During the late 1970s and early 1980s, EPA investigated the usefulness of fecal coliform, enterococcus, and *Escherichia coli* (*E coli*) as indicator organisms These studies were the basis of EPA's technical guidance in 1986, which recommended adoption of enterococcus or *E coli* for freshwater criteria Oregon adopted the enterococcus standard for fresh waters in 1991 The existing phased-in rule adopted in 1992 postponed the enterococcus standard for 3 years (until July 1995), pending a triennial review The enterococcus standard for fresh waters as currently written states that enterococcus bacteria shall not exceed a geometric mean of 33 enterococcus colonies per 100 mL on the basis of no fewer than five samples, representative of seasonal conditions, collected over a period of at least 30 days No single sample should exceed 61 enterococcus colonies per 100 mL

At present, the DEQ Technical Advisory Committee and Policy Advisory Committee are recommending adoption of the alternative *E coli* standard The recommended *E coli* standards would be 126 *E coli* colonies per 100 mL as a 30-day log mean and a single exceedance value of 406 *E coli* colonies as an action limit and instream standard The action limit would be triggered by a single sample exceeding 406 *E coli* colonies, and five additional samples would have to be taken at 4-hour intervals upon receipt of the results of the first test The geometric mean of the five follow-up samples would need to meet the monthly geometric mean of 126 *E coli* colonies per 100 mL

Turbidity

Turbidity is a general criterion that measures the ability of a water column to transmit light Turbidity can be caused by many different sources, including both dissolved and suspended solids Excessive turbidity can inhibit naturally occurring functions by limiting or eliminating sunlight available for photosynthesis or obstructing the sight path available to aquatic life The current standard for the Columbia River is no more than a 10 percent increase in natural turbidity as measured against a control point immediately upstream

Discussions in earlier issue papers indicated that DEQ is considering a new standard of a 5-day value of 25 nephelometric turbidity units (NTUs) and an instantaneous value of 50 NTUs Data from the Lower Columbia River Bi-State Water Quality Program reconnaissance survey for sampling stations in the vicinity of the CBWTP indicated turbidity levels in the range of 4 5 to 4 8 NTUs and total suspended solids (TSS) concentrations in the range of 6 5 to 7 8 Backwater survey turbidity was in a similar range, 5 7 to 30 NTUs There is no current initiative to modify this criterion as a part of the current triennial review

pH

The water quality criterion pH is a measurement of the hydrogen ion concentration in the receiving water Sharp deviations in pH can hamper or eliminate less tolerant animal and plant species and have a considerable effect on the toxicity of some compounds The current standard for the Columbia River is 7 0 to 8 5, the current NPDES permit range for the CBWTP is 6 0 to 9 0

The CBWTP has not historically experienced extreme pH depression, with effluent pH typically in the range of 7 0 to 7 5 However, recent effluent data indicate that the pH has dropped below 6 5, with significant periods in which values are less than 7 0 This change is the result of nitrification in the activated sludge process

Future CBWTP expansion planning has taken into account advanced treatment technologies such as biological nutrient removal, which can place additional demands on wastewater alkalinity, which in turn can drop the effluent pH below 7 0 Future plant expansion may require nitrification to reduce ammonia-nitrogen effluent concentrations The need to employ nitrification at CBWTP could be related either to Columbia River DO criteria or to the first step in biological nitrogen removal related to nuisance algal growth The CBWTP may have to provide additional alkalinity via chemical addition or use selector technology to maintain a stable process

Although pH was recently addressed in a draft issue paper issued September 1, 1994, the recommendation of the DEQ Technical Advisory Committee and Policy Advisory Committee was to essentially maintain the existing standards with minor changes that should not affect the CBWTP

Nutrients and Chlorophyll a

Phosphorus and nitrogen compounds are essential nutrients for algal growth When present in a sufficient amount, they can result in noxious amounts of algal biomass Chlorophyll *a* is a surrogate measure of algal and phytoplankton biomass Although moderate amounts of algae provide food to other organisms, high levels can degrade water quality by depleting DO concentrations

No criteria have been established for nutrients, with the exception of a 10-mg/L drinking water standard for nitrate Total ammonia-nitrogen criteria established by EPA in 1986 and adopted by DEQ are based on the toxic effects of un-ionized ammonia at certain pH and temperature levels

There are no standards for algal biomass or chlorophyll *a* Oregon has established a chlorophyll *a* action level of an average of 15 mg/L for reservoirs, rivers, estuaries, and natural lakes in which water does not thermally stratify The average concentration is based on a minimum of three samples collected over any 3 consecutive months at representative locations

The concentration of chlorophyll *a* measured at the 15 backwater sampling stations ranged from 6 7 to 35 mg/L, with a median concentration of 14 mg/L The chlorophyll *a* concentration exceeded Oregon's 15-mg/L action level at 5 of the 15 stations sampled

Nutrient and chlorophyll *a* data for the Columbia River may cause DEQ to take action with respect to nutrients If the Columbia River is designated water-quality-limited for nutrients, the CBWTP may be required to employ advanced treatment options such as biological nutrient removal for phosphorus, nitrogen, or both Preliminary data indicate that nitrogen may be the limiting nutrient requiring biological nitrogen removal Phosphorus may also be identified for control, if it is, phosphorus would be removed either biologically or chemically The choice of technology would depend on the effluent limits Each of these options can reduce the effluent pH, which is another water quality criterion under discussion

Dissolved Gases

Under certain conditions, a gas can become dissolved in a liquid and then subsequently be released into the atmosphere Once a gas is solubilized, it can be released into the atmosphere after being discharged to the receiving water The release of objectionable gases such as hydrogen sulfide can become a nuisance or even a hazardous situation

The current standard for the Columbia River prohibits the liberation of dissolved gases such as carbon dioxide and hydrogen sulfide, or of other gases, in sufficient quantities to cause objectionable odors or to be deleterious to fish or other aquatic life, navigation, recreation, or other reasonable uses Currently, there are no perceived concerns regarding the CBWTP and the water quality criterion for dissolved gases

Radioisotopes

Radioisotopes are radioactive elements or compounds that, if touched or ingested, may be harmful to human beings, aquatic life, and wildlife The current standard for the Columbia River limits the maximum permissible concentrations of radioisotopes to levels below those that pose an external radiation hazard There currently are no perceived concerns regarding the CBWTP and the water quality criterion for radioisotopes

Total Dissolved Solids

Total dissolved solids (TDS) are the minute organic and inorganic matter, colored particles, salts, and other material not removed by a filter Dissolved solids occur naturally from degradation and run-off in the drainage basin The current standard for the Columbia River is 500 mg/L of TDS unless background levels are higher, then the background level becomes the standard

The existing CBWTP NPDES permit does not require monitoring of the primary dissolved solids of concern, sulfates and chlorides Discussions during the initial portion of the latest triennial review indicated that the EPA criterion of 250 mg/L for sulfates and chlorides may be pursued

Data from the Lower Columbia River Bi-State Water Quality Program for sampling stations in the vicinity of the CBWTP indicated chloride levels less than 2 5 mg/L and sulfate levels less than 11 mg/L Discussions regarding TDS have not been pursued, nor is the CBWTP expected to be affected by these standards

Toxic Substances

Toxic substances, by definition, are harmful to water-quality-related beneficial uses The effects of a toxic substance on the biota and vegetation can sometimes be sudden or can build up over time (bioaccumulation) The current standards for the Columbia River are listed in Table 20 of the *OAR*s The Columbia River is currently designated water-quality-limited for dioxin

The potential for toxic compounds in the effluent is recognized in the CBWTP NPDES permit by the requirement to conduct periodic whole-effluent toxicity tests For the CBWTP effluent, these whole-effluent toxicity tests have shown that the current effluent can be described as sporadically acutely toxic and consistently chronically toxic A summary of recent testing is presented in Table 5-1

Table 5-1
Whole-Effluent Toxicity Test Results
Columbia Boulevard Wastewater Treatment Plant

	Survival of Organism					
	***Pimephale* (Fathead Minnow)**			***Ceriodaphnia dubia***		
Sample Month	**Acute LC_{50} (%)**	**Chronic IC_{25}* (%)**	**Chronic NOEC (%)**	**Acute LC_{50} (%)**	**Chronic IC_{25}* (%)**	**Chronic NOEC (%)**
10/94	>100	NA	>100	98	NA	25
9/94	>100	NA	>100	>100	NA	50
8/94	>100	91 1	25	>100	71 6	50
7/94	77 56	44 98	25	>100	93 18	>100
6/94	>100	53 24	25	57 44	38 69	50
3/94	>100	38 2	25	>100	33 2	50

*The U S Environmental Protection Agency has indicated that IC_{25} is the approximate analogue of the NOEC (*Technical Support Document for Water Quality Based Toxics Control*, EPA/505/2-90-001, March 1991)

Abbreviations
IC_{25} = concentration of effluent causing 25 percent reduction in biological growth
LC_{50} = lethal concentration with 50 percent mortality
NA = not available, not reported by laboratory currently performing analyses
NOEC = no-observable-effects concentration

The recent increase in no-observable-effects concentrations for fathead minnows is related to nitrification at the CBWTP, which significantly reduced the ammonia-nitrogen concentration in the effluent In the Lower Columbia River Bi-State Water Quality Program's backwater survey, copper and lead were identified as metals warranting further study because they were detected at concentrations that exceeded the available chronic criteria

It is expected that some requirements for monitoring and toxicity control will be added to the revised NPDES permit for the CBWTP.

Aesthetics

Fungi, tastes, odors, bottom sludges, floating materials, and aesthetic criteria are narrative standards for the overall protection of water quality, for the protection of public health and the environment, and for public perception These standards are general in nature and target grossly objectionable criteria such as odors There are currently no aesthetic concerns about the CBWTP because of the level of treatment being provided and the mixing occurring at the outfall diffusers